Bruce A. Cole
EVP & President Industrial/
Recycling Americas & APAC
13000 Deerfield Parkway
Milton, Georgia 30004 USA

678-566-9631 tel
bruce.cole@exide.com

VIA FEDERAL EXPRESS

May 22, 2014

Richard A. Hyde, P.E.
Executive Director
Texas Commission on Environmental Quality
P.O. Box 13087
Austin, TX 78753

Sunita Singhvi, Chief
Compliance Enforcement Section (6EN-HE)
Compliance Assurance and Enforcement Division
U.S. EPA, Region 6
1445 Ross Avenue, Suite 1200
Dallas, TX 75202-2733
Attn: Paul James

Order Compliance Team
Enforcement Division, MC 149A
Texas Commission on Environmental Quality
P.O. Box 13087
Austin, TX 78711-3087

Attn: Mr. Gary Beyer
Mr. Bill Shafford

Subject: Revised Affected Property Assessment Report and
Tier 2 Screening Level Ecological Risk Assessment
Exide Technologies Frisco Recycling Center; Frisco, Texas
TCEQ Agreed Order Docket No. 2011-1712-IHW-E; IHW Permit No. HW-50206;
TCEQ SWR No. 30516; Customer No. CN600129779; Regulated Entity No. RN100218643;
EPA ID No. TXD 006451090; EPA Administrative Order on Consent RCRA 06-2012-0966

Dear Mr. Hyde and Ms. Singhvi,

Exide Technologies ("Exide") has completed additional actions at the Frisco Recycling Center in Frisco, Texas to comply with the ordering provisions of TCEQ Agreed Order Docket No. 2011-1712-IHW-E ("AO"), and the EPA Order on Consent RCRA 06-2012-0966 ("EPA AOC"). Specifically, Exide has completed those activities specified in Exide's letter dated October 8, 2013 responding to TCEQ and EPA comments (dated October 8, 2013) regarding the Affected Property Assessment Report and Tier 2 Screening Level Ecological Risk Assessment submitted by Exide on July 9, 2013. These activities have

also been completed in compliance with the conditional approval for Exide's response to comments issued by the TCEQ on November 19, 2013. Enclosed is the revised Affected Property Assessment Report and Tier 2 Screening Level Ecological Risk Assessment incorporating that additional work.

Sincerely,

EXIDE TECHNOLOGIES

Bruce Cole
EVP & President, Industrial/Recycling Americas & Asia Pacific

Enclosure

cc: Mr. Gary Beyer – TCEQ – 5 copies
Dr. Troy H. Stuckey – EPA
Ms Melissa Smith – EPA
Mr. Mack Borchardt – City of Frisco
Mr. Matthew Love – Exide Technologies
Ms. Aileen Hooks – Baker Botts
Waste Section Manager, Dallas/Fort Work Regional Office, Texas Commission on Environmental Quality, 2309 Gravel Drive, Fort Worth, Texas 77118-6951
Mr. Eric Pastor – Pastor Behling & Wheeler

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that quality personnel gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fines and imprisonment for knowing violations.

I certify that this document and all attachments were prepared under my direction or supervision. I certify that the information contained in or accompanying this submittal is true, accurate, and complete. I certify that this submittal and all attachments were prepared in compliance with the RCRA § 3013 Administrative Order on Consent entered into between EPA and Exide Technologies; docket number RCRA 06-2012-0966. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

Bruce Cole

Bruce Cole, Exide Technologies

State of Georgia
County of Fulton

The foregoing instrument was subscribed and sworn before me this 21st day of May, 2014 by Bruce Cole.

CANDACE CAMPRINI
DAWSON
SEAL
COUNTY GA
NOTARY PUBLIC

Candace Camprini

Notary Public, State of Georgia
My commission expires: 3 March 2015

May 2014

TABLE OF CONTENTS

		Check If Included
Cover Page		X
Professional Signatures and Seals		X
Abbreviations and Acronyms		X
Executive Summary		X
Conclusions and Recommendations		X
Chronology		X
Specialized Submittals Checklist		X
List of Acronyms		X
Figure A	Affected Property and PCLE Zone Map	See Figures 1B.1 and 1B.2
Section 1 Property Information		
Site operations, release sources, and geology/hydrogeology		X
Table 1A	Sources of Release	X
Table 1B	Potential Off-Site Sources	NA
Table 1C	Historical Document Summary	X
Table 1D	Summary of Documented Historical Releases	X
Figure 1A.1	On-Site Property Map	X
Figure 1A.2	On-Site Property Map with Flood Zones	X
Figure 1B.1	Affected Property Map - On-Site	X
Figure 1B.2	Affected Property Map - Off-Site Stewart Creek	X
Figure 1C	Regional Geologic Map	X
Figure 1D	Regional Geologic Cross Section	X
Section 2 Exposure Pathways and Groundwater Resource Classification		
Potential receptors, groundwater classification, and exposure pathways		X
Table 2A	Water Well Summary	X
Table 2B	Threatened and Affected Water Well Summary	NA
Table 2C	Complete or Reasonably Anticipated to be Complete Exposure Pathways	X
Figure 2A	Potential Receptors Map	X
Figure 2B.1	2012/2013 Field Survey Photographs	X
Figure 2B.2	2014 Field Survey Photographs	X
Figure 2C	Water Well Map	X
Attachment 2A	Tier 1 Ecological Exclusion Criteria Checklist and Supporting Documentation	See Section 9
Section 3 Assessment Strategy		
Assessment strategies		X
Table 3A	Underground Utilities	X
Table 3B	Constituent of Concern Evaluation	X
Figure 3A	Thickness of Fill Zones in Which Slag Was Observed	X
Section 4 Soil Assessment		
Nature and extent of COCs in soil		X
Table 4A	Surface Soil Residential Assessment Levels with No Ecological Component	X
Table 4B	Surface Soil Residential Assessment Levels with Eco Component	See Section 9
Table 4C	Subsurface Soil Residential Assessment Levels with No Ecological Component	X
Table 4D.1	Soil Data Summary - Cadmium and Lead (2012/2013)	X
Table 4D.2A	Soil Data Summary - Lead, Cadmium, and Additional Metal (2012/2013)	X
Table 4D.2B	Soil Data Summary - Lead, Cadmium, and Additional Metals (2014)	X

May 2014

TABLE OF CONTENTS

		Check If Included
Table 4D.2C	Soil Data Summary - Lead, Cadmium, and Additional Metals (2014 Cap Samples)	
Table 4D.3A	Soil Data Summary - Total Petroleum Hydrocarbons - TX1005 (2012/2013)	X
Table 4D.3B	Soil Data Summary - Total Petroleum Hydrocarbons - TX1005 (2014)	X
Table 4D.4	Soil Data Summary: Total Petroleum Hydrocarbons (TX1006)	X
Table 4D.5A	Soil Data Summary - Volatile Organic Compounds and Semivolatile Organic Compounds (2012/2013)	X
Table 4D.5B	Soil Data Summary - Volatile Organic Compounds and Semivolatile Organic Compounds (2014)	X
Table 4D.6	Soil Data Summary – Perfluorinated Compounds (PFCs), Polychlorinated Biphenyls (PCBs), and Sulfate	X
Table 4E	Soil Boring Water Samples	X
Table 4F	Soil Geochemical Data	
Figure 4A	Soil COC Concentration Map - Lead	X
Figure 4B	Subsurface Soil COC Concentration Map	Included on Figure 4A
Figure 4C.1	Cross Section Location Map	X
Figure 4C.2	Geologic Cross Sections (1 of 2)	X
Figure 4C.3	Geologic Cross Sections (2 of 2)	X
Section 5 Groundwater Assessment		
Nature and extent of COCs in groundwater		X
Table 5A	Groundwater Residential Assessment Levels	X
Table 5B.1	Groundwater Data Summary: Cadmium and Lead	X
Table 5B.2	Groundwater Data Summary: Arsenic and Selenium	X
Table 5B.3	Groundwater Data Summary: Total Petroleum Hydrocarbons and Polycyclic Aromatic Hydrocarbons	X
Table 5B.4A	Groundwater Data Summary: Metals (2014)	X
Table 5B.4B	Groundwater Data Summary: VOCs, SVOCs, and THP (2014)	X
Table 5B.5	Groundwater Data Summary – Perfluorinated Compounds (PFCs) (2014)	
Table 5C	Groundwater Geochemical Data Summary	X
Table 5D	Groundwater Measurements	X
Figure 5A.1	Groundwater Potentiometric Surface Map: March 11, 2013	X
Figure 5A.2	Groundwater Potentiometric Surface Map: April 5, 2013	X
Figure 5A.3	Groundwater Potentiometric Surface Map: April 29, 2013	X
Figure 5A.4	Groundwater Potentiometric Surface Map: January 21, 2014	X
Figure 5B	Groundwater COC Concentration Map	NA
Figure 5C	Groundwater Hydrographs	See Table 5D for Variability of GW Levels
Figure 5D	Cross Section Groundwater-to-Surface Water Pathway	See Figure 4C.2 and 4C.3
Section 6 Surface Water Assessment and Critical PCL Development		
Nature and extent of COCs in surface water		X
Table 6A	Surface Water Critical PCLs	X
Table 6B.1	Surface Water Data Summary (2012/2013)	X
Table 6B.2	Surface Water Data Summary (2014)	X
		X
Figure 6A.1	On-Site and Upstream Surface Water Sample Locations	X

May 2014

TABLE OF CONTENTS

		Check If Included
Figure 6A.2	Downstream Surface Water Sample Locations	X
Figure 6B	Photographs	See Figures 2B.1 and 2B.2
Section 7 Sediment Assessment and Critical PCL Development		
Nature and extent of COCs in sediment		X
Table 7A	Sediment Critical PCLs	X
Table 7B.1	Sediment Data Summary (2012)	X
Table 7B.2	Sediment Data Summary (2014)	X
Figure 7A.1	On-Site and Upstream Sediment Sample Locations	X
Figure 7A.2	Downstream Sediment Sample Locations	X
Section 8 Air Assessment and Critical PCL Development		
Nature and extent of COCs in outdoor air		NA
Table 8A	Outdoor Air Data Summary	NA
Figure 8A	Outdoor Air COC Concentration Maps	NA
Section 9 Ecological Risk Assessment		
Ecological risk assessment, expedited stream evaluation, and/or reasoned justification. Copies of SLERA or SSERA.		X
Section 10 COC Screening		
COC screening process and results		X
Table 10A	COC Screening Summary Table	X
Section 11 Soil Critical PCL Development		
Soil critical PCL evaluation		X
Table 11A	Surface Soil Critical PCLs	X
Table 11B	Subsurface Soil Critical PCLs	X
Figure 11A	Soil PCLE Zone Map	See Figure 4C.2 and 4C.3
Figure 11B	Subsurface Soil PCLE Zone Map	See Figure 4C.2 and 4C.3
Figure 11C	Cross Sections of the PCLE Zone	X
Section 12 Groundwater Critical PCL Development		
Groundwater critical PCL evaluation		X
Table 12A	Groundwater Critical PCLs:	X
Table 12B	Groundwater-to-Surface Water PCLs	NA
Table 12C	Groundwater-to-Sediment PCLs	NA
Table 12D	Groundwater Critical PCL Evaluation: Surface Water/Sediment Discharge POE	NA
Figure 12A	Groundwater PCLE Zone Map	NA
Section 13 Notifications		
Notifications conducted		X
Table 13A	Notification Summary	X
Figure 13A	Notification Map	X
Appendices		
Appendix 1	Notifications	X
Appendix 2	Boring Logs and Monitoring Well Completion Details	X
Appendix 3	Monitoring Well Development and Purging Data	X
Appendix 4	Registration and Institutional Controls	X
Appendix 5	Water Well Records	X
Appendix 6	Monitoring Well Records	X
Appendix 7	Groundwater Resource Classification Evaluation	NA
Appendix 8	Statistics Data Tables and Calculations	X
Appendix 9	Development of Non-Default RBELs and PCLs	X
Appendix 10	Laboratory Data Packages and Data Usability Summary	X

May 2014

TABLE OF CONTENTS

		Check If Included
Appendix 11	Miscellaneous Assessments – Interim Action Reports	X
Appendix 12	Waste Characterization and Disposition Documentation	X
Appendix 13	Photographic Documentation	X
Appendix 14	Standard Operating Procedures	NA
Appendix 15	OSHA Health and Safety Plan (§350.74(b)(1))	NA
Appendix 16	Reference List	X
Appendix 17	Historical Data	X
Appendix 18	W&M Slag and Battery Case Chip Survey Reports	X
Appendix 19	Previous Studies by SWG of Stewart Creek Downstream of the FOP	X
Appendix 20	Storm Water Retention Pond and Solar Evaporation Pond Inspection Reports	X
Appendix 21	Documentation from Former FRC Personnel Regarding Fill Material below the Battery Receiving/Storage Building	X
Appendix 22	Historical Aerial Photographs	X
Appendix 23	FRC Feed Documentation	X
Appendix 24	SPLP Data Summary	X
Appendix 25	SIR and APAR Sample Coordinates	X

Notes:
1. X – Included in APAR.
2. NA – Not Applicable.

May 2014

PROFESSIONAL SIGNATURES AND SEALS

Program ID No. (primary): **RN100218643** Report date: **May 22, 2014**
TCEQ Region No.: **4** MSD Certificate No.: ____
Additional Program ID Numbers: SWR/Facility ID No.: **30516** PST Facility ID No.: ____
DCRP ID No.: ____ VCP ID No.: ____ LPST ID No.: ____
MSW Tracking No.: ____ HW Permit/CP No.: **HW-50206** Enforcement ID No.: ____
Other ID Nos.: **Agreed Order Docket No. 2011-1712-IHW-E; CN600129787**

Reason for submittal (check all that apply):
- ☐ Initial submittal
- ☒ Revision
- ☐ Notice of Deficiency Letter
- ☒ Permit/Compliance Plan
- ☐ Voluntary response
- ☒ Enforcement/Agreed order
- ☐ Directive/NOV letter
- ☐ Other: ____

On-Site Property Information

On-Site Property Information: **Frisco Recycling Center, Former Operating Plant**
On-Site Property (Facility) Name: **Frisco Recycling Center, Former Operating Plant**
Street no. **7471** Pre dir: **South** Street name: **5th** Street type: **Street** Post dir: ____
City: **Frisco** County: **Collin** County Code **43** Zip **75034**
Nearest street intersection and location description: **On-site property located at intersection of Eagan Dr. and Parkwood Dr.**

Latitude: ~~Degrees, Minutes, Seconds~~ OR Decimal Degrees (indicate one) **33.140287**
Longitude: ~~Degrees, Minutes, Seconds~~ OR Decimal Degrees (indicate one) **-96.828218**

Contact Person for On-Site Property Information and Acknowledgment

Company Name or Person: **Exide Technologies**
Contact Name: **Matthew A. Love** Title: **Director, Global Environmental Remediation**
Mailing Address: **3000 Montrose Avenue**
City: **Reading** State: **PA** Zip: **19605** Phone: **(610) 921-4054**
e-mail: **Matt.Love@exide.com** Fax: **(610) 921-4063**
Person is: __property owner __property manager ___potential purchaser ___tenant ___operator
Other **property owner's representative**

By my signature below, I acknowledge the requirement of §350.2(a) that no person shall submit information to the executive director or to parties who are required to be provided information under this chapter which they know or reasonably should have known to be false or intentionally misleading, or fail to submit available information which is critical to the understanding of the matter at hand or to the basis of critical decisions which reasonably would have been influenced by that information. Violation of this rule may subject a person to the imposition of administrative, civil, or criminal penalties.

Signature of Person	Name (print):	Date:
Matthew A. Love	MATTHEW A. LOVE	MAY 22, 2014

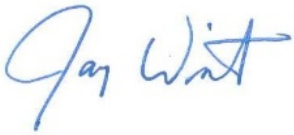
May 2014

PROFESSIONAL SIGNATURES AND SEALS

Consultant Contact Person

Consultant Company Name: **Golder Associates Inc.**
Contact Person: **Anne Faeth-Boyd** Title: **Senior Project Engineer**
Mailing Address: **820 South Main Street, Suite 100**
City: **St. Charles** State: **Missouri** Zip: **63301**
Phone: **636-724-9191** Fax: **636-724-9323** E-mail address **afaeth@golder.com**

Professional Geoscientists

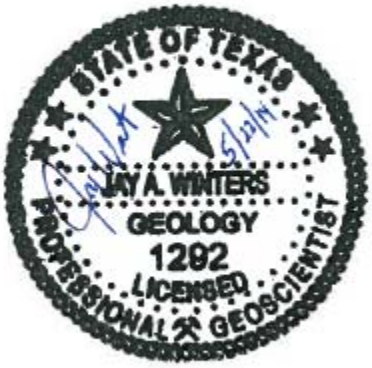
Jay Winters	**1292**	**3-31-2015**
Professional Geoscientist	Geoscientist License Number	Expiration date
		
Signature	Date **5/22/14**	
(281) 821-6868	**(281) 821 6870**	**jwinters@golder.com**
Telephone number	FAX number	E-mail

Firm Registrations

Golder Associates Inc.	50369	June 30, 2014
Firm Geoscience Registration Number	Geoscience Registration No.	Expiration date

PROFESSIONAL SIGNATURES AND SEALS

Seals, as applicable:



GOLDER ASSOCIATES INC.
Geoscience Firm Registration
Certificate Number 50369

May 2014

EXECUTIVE SUMMARY

Environmental Media	Actual or Probable Exposures On-Site?		Actual or Probable Exposures Off-Site?		Have notifications for actual or probable exposures been completed? (§350.55(e))		
	Yes	No	Yes	No	Yes	No	N/A
Soil		x (1)		x			x
Groundwater		x		x			x
Sediment		x	x		x		
Surface Water		x		x			x

(1) Site access onsite is controlled by Exide and is limited to onsite personnel and contractors. Potential exposures are managed through Exide's comprehensive health and safety program.

Is there, or has there been, an affected or potentially affected water well? ___ Yes _x_ No
If yes, what is the well used for? _____

Actual land use: On-site: ___ Res _x_ C/I Off-site affected property: _x_ Res ___ C/I ___ N/A
Land use for critical PCL determination: On-site: ___ Res _x_ C/I Off-site affected property: _x_ Res ___ C/I ___ N/A
Did the affected property pass the Tier 1 ecological exclusion criteria checklist? ___ Yes _x_ No

Affected groundwater-bearing unit(s) (in order from depth below ground surface), or uppermost groundwater-bearing unit if none affected

Unit No.	Name	Depth below ground surface (ft)	Resource Classification (1, 2, or 3)
1	Uppermost Groundwater Bearing Unit	Depth to Water = approximately 0.5-20	2 (see Section 2.5)

Assessment

Environmental Media		Assessment Levels Exceeded? On-Site? Yes	On-Site? No	On-Site? Not sampled	Off-Site? Yes	Off-Site? No	Off-Site? Not sampled	Affected property defined to RAL? Yes	Affected property defined to RAL? No	Affected property defined to RAL? N/A	Is COC extent stable or expanding?	General classes of COCs (VOCs SVOCs, metals, etc.)
Soil	*Surface*	x			x[1]			x			**Stable**	**Metals, TPH, VOCs, SVOCs**
Soil	*Subsurface*	x					x	x			**Stable**	**Metals, TPH, VOCs, SVOCs**
Groundwater		x					x	x			**Stable**	**Metals (selenium)**
Sediment			x		x			x			**Stable**	**Metals (lead, cadmium, and arsenic)**
Surface Water		x				x		x			**Stable**	**Metals (lead and cadmium)**

Notes:
[1] – Surface soil samples were collected from the Frisco Recycling Center Undeveloped Buffer Property as part of the on-going Voluntary Cleanup Program investigation for that property (VCP No. 2541). Lead concentrations in surface soil samples collected on the Undeveloped Buffer Property during the VCP investigation exceeded the soil RAL for lead (275 mg/kg).

EXECUTIVE SUMMARY

NAPL Occurrence Matrix

	NAPL Occurrence		Description
NAPL in vadose zone	x	No NAPL in vadose zone	There is no direct or indirect evidence of NAPL in the vadose zone
		NAPL in/on soil	NAPL detected in or on unsaturated, unconsolidated clay-, silt-, sand-, and/or gravel-dominated soils
		NAPL in fractured clay	NAPL detected in fractures of unsaturated fine-grained soils
		NAPL in fractured or porous rock	NAPL detected in unsaturated lithologic material
		NAPL in karst	NAPL detected in karst environment
NAPL at capillary fringe	x	No NAPL at capillary fringe	There is no direct or indirect evidence of NAPL at the capillary fringe
		NAPL at capillary fringe	NAPL detected at vadose-saturated zone transition, capillary fringe (in contact with water table)
NAPL in saturated zone	x	No NAPL in saturated zone	There is no direct or indirect evidence of NAPL in the saturated zone
		NAPL in soil	NAPL detected in saturated unconsolidated clay-, silt-, sand-, and/or gravel-dominated soils
		NAPL in fractured clay	NAPL detected in fractures of saturated fine-grained soil or other double-porosity sediments
		NAPL in saturated fractured or porous rock	NAPL detected in saturated lithologic material
		NAPL in saturated karst	NAPL detected in karst environment within the saturated zone
NAPL in surface water or sediment	x	No NAPL in surface water or sediment	There is no direct or indirect evidence of NAPL in surface water or sediments
		NAPL in surface water	NAPL detected in surface water at exceedance concentration levels or visual observation
		NAPL in sediments	NAPL detected in sediments at exceedance concentration levels or visual observation via migration pathway or a direct release

EXECUTIVE SUMMARY

Remedy Decision

Environmental Media		Critical PCL exceeded on-site?			Critical PCL exceeded off-site?			PCLE zones defined?			General class (VOCs, SVOCs, metals, etc.) of COCs requiring remedy
		Yes	No	N/A	Yes	No	N/A	Yes	No	N/A	
Soil	*Surface*	x			x[1]			x			**Metals (on-site: Pb, Cd, As, Sb, and Se; off-site: Pb and Cd)**
	Subsurface	x					x	x			**Metals (As, Cd, Pb only)**
Groundwater		x[2]					x			x	
Sediment			x		x			x			**Metals (on-site: Pb and Cd; off-site: Pb, Cd, and As)**
Surface Water		x[3]				x				x	**Metals (onsite: Pb and Cd)**

Notes:
[1] – Surface soil samples were collected from the Frisco Recycling Center Undeveloped Buffer Property as part of the on-going Voluntary Cleanup Program investigation for that property (VCP No. 2541). Lead concentrations in surface soil samples collected on the Undeveloped Buffer Property during the VCP investigation exceeded the soil RAL for lead (275 mg/kg).
[2] – Critical PCL exceedences for Pb and Cd in groundwater were not confirmed by subsequent sampling events.
[3] –Three samples from Stewart Creek collected in 2012 exceeded the critical PCLs for dissolved cadmium and/or lead in surface water; however, no samples collected from Stewart Creek in 2014 (including samples collected in the near vicinity of the 2012 samples) had dissolved arsenic, cadmium, or lead concentrations that exceeded their respective critical PCLs.

EXECUTIVE SUMMARY

NAPL Triggers

NAPL Response Action Triggers		Description of Triggers
x	No NAPL response action triggers	No NAPL triggers have been observed in any assessment zones (vadose, capillary fringe and saturated), nor in surface water or sediments
	NAPL vapor accumulation is explosive	NAPL vapors accumulate in buildings, utility and other conduits, other existing structures, or within anticipated construction areas at levels that are potentially explosive (≥ 25% LEL)
	NAPL zone expanding	NAPL zone is observed to be expanding using time-series data
	Mobile NAPL in vadose zone	NAPL zone is observably mobile, or is theoretically mobile based on COC concentrations and residual saturation
	NAPL creating an aesthetic impact or causing nuisance condition	NAPL is responsible for objectionable characteristics (e.g., taste, odor, color, etc.) resulting in making a natural resource or soil unfit for intended use
	NAPL in contact with Class 1 groundwater	NAPL has come in actual contact with saturated zone or capillary fringe of a Class 1 GWBU
	NAPL in contact with Class 2 or 3 groundwater	NAPL has come in actual contact with saturated zone or capillary fringe of a Class 2 or Class 3 GWBU
	NAPL in contact with surface water	Liquid containing COC concentrations that exceed the aqueous solubility in contact with surface water via various migration pathways or direct release to surface water
	NAPL in or on sediments	Liquid containing COC concentrations that exceed the aqueous solubility impact surface water sediments via migration pathway or a direct release

ABBREVIATIONS AND ACRONYMS

AOC – Administrative Order on Consent
APAR – Affected Property Assessment Report
Banks – Banks Environmental Data
BEG - Bureau of Economic Geology
bgs – below ground surface
BNSF – Burlington Northern Santa Fe Railroad
BSB – Battery Storage Building
CAB – Cellulose Acetate Butyrate
cm/sec – centimeters per second
CMS – Corrective Measures Study
COC – Chemical of Concern
CRA – Conestoga Rovers & Associates
DPT – Direct Push Technology
DUS – Data Usability Summary
EP Toxicity – Extraction Procedure Toxicity
EPA – United States Environmental Protection Agency
Exide – Exide Technologies
FEMA – Federal Emergency Management Agency
FOP – Former Operating Plant
FRC – Frisco Recycling Center
FSCWWTP – Former Stewart Creek Waste Water Treatment Plant
ft – feet
GNB – Gould National Batteries
GPS – Global Positioning System
GW -- Groundwater
GWBU – Groundwater Bearing Unit
HDPE – High Density Polyethylene
HHERA – Human Health and Ecological Risk Assessment
HMCRI - Hazardous Materials Control Resources Institute
HW – Hazardous Waste
IAWP – Interim Action Work Plan
IDW – Investigation-Derived Waste
K_d – Water/Soil Partition Coefficient
LCS – Laboratory Control Spike
LDR – Land Disposal Restrictions
LPST – Leaking Petroleum Storage Tank
MCL – Maximum Contaminant Level
MQL – Method Quantitation Limit
MSD – Municipal Setting Designation
MSDS – Material Safety Data Sheet
NA – Not Applicable
NAD 83 – North American Datum of 1983
NAICS – North American Industry Classification System
NAPL – Non-Aqueous Phase Liquid
NAVD 88 – North American Vertical Datum of 1988
NDA – North Disposal Area
NELAC – National Environmental Laboratory Accreditation Conference
NFA – No Further Action
NFG – National Function Guidelines
NOR – Notice of Registration
NS – Not Selected
NTMWD – North Texas Municipal Water District
NTU – Nephelometric Turbidity Units
O&M - Operation and Maintenance
ORP – Oxidation Reduction Potential
PAH – Polycyclic Aromatic Hydrocarbons
PBW – Pastor, Behling & Wheeler, LLC
PCL – protective concentration level
PCLE – Critical Protective Concentration Level Exceedance
PFC - Perfluorinated Compounds

ABBREVIATIONS AND ACRONYMS

PID – Photo Ionization Detector
POE – Point of Exposure
PPM – Parts per Million
PVC – Polyvinyl Chloride
QAPP – Quality Assurance Project Plan
QA – Quality Assurance
QC – Quality Control
RAP - Remedial/Response Action Plan
RAL – Residential Assessment Level
RAP – Response Action Plan
RBEL – Risk-Based Exposure Limit
RCRA – Resource Conservation and Recovery Act
RCI – Resource Consultants Inc.
RFA – RCRA Facility Assessment
RFI – RCRA Facility Investigation
RMSA - Raw Materials Storage Area
RMSB - Raw Materials Storage Building
RPD – Relative Percent Difference
RSI - Remediation Services, Inc.
SDA – South Disposal Area
SIR – Site Investigation Report
SDL – Sample Detection Limit
SLERA – Screening Level Ecological Risk Assessment
SPLP – Synthetic Precipitation Leaching Procedure
SQL – Sample Quantitation Limit
SVOC – Semivolatile Organic Compound
SWG – Southwest Geoscience
SWL – Southwestern Laboratories
SWMU – Solid Waste Management Unit
TAC – Texas Administrative Code
TCEQ – Texas Commission on Environmental Quality
TCLP – Toxicity Characteristic Leaching Procedure
TDS – Total Dissolved Solids
TNRCC – Texas Natural Resource Conservation Commission
TDPES - Texas Pollutant Discharge Elimination System
TPH – Total Petroleum Hydrocarbons
TRRP – Texas Risk Reduction Program
TWC – Texas Water Commission
TWDB – Texas Water Development Board
USACE – United States Army Corps of Engineers
USCS – Unified Soil Classification System
USGS – United States Geological Survey
UTS-N – EPA Universal Treatment Standards-Non-Wastewater
VCP – TCEQ Voluntary Cleanup Program
VOC – Volatile Organic Compound
WMA – Waste Management Area
WMU – Waste Management Unit
W&M – W&M Environmental
XRF – X-Ray Fluorescence

CONCLUSIONS AND RECOMMENDATIONS

Project Background

This Affected Property Assessment Report (APAR) serves as Revision No. 1 to the initial APAR for the Exide Technologies (Exide) Frisco Recycling Center (FRC) Former Operating Plant (FOP or the Site) submitted to the Texas Commission on Environmental Quality (TCEQ) and United States Environmental Protection Agency (EPA) on July 9, 2013. This report was prepared by Golder Associates Inc. (Golder) and represents an update to the 2013 APAR for the FOP prepared by PBW (PBW, 2013a). This APAR describes the methods, findings, and results of investigation activities performed at the Site and upstream and downstream areas of Stewart Creek

Investigation activities were performed in accordance with an Administrative Order on Consent (AOC) entered into by Exide and the EPA effective May 2, 2012 (original Docket No. RCRA 06-2011-0966; re-designated by EPA as Docket No. RCRA 06-2012-0966) and with a TCEQ Agreed Order effective February 10, 2013 (Docket No. 2011-1712-IHW-E). The Agreed Order incorporates outstanding requirements of Exide under the AOC, namely the requirements regarding (i) finalization of the implementation of the requirements of the revised Sampling and Analysis Work Plan (Work Plan) prepared by Conestoga Rovers & Associates (CRA) and approved by the EPA on December 2, 2011 and (ii) revision and finalization of the Site Investigation Report (SIR) covering a portion of the Site, which was prepared by PBW and submitted to the EPA on July 12, 2012. The SIR addressed requirements and goals outlined in the Work Plan and included a summary of actions taken to comply with the AOC and an evaluation/comparison of sample data to appropriate Texas Risk Reduction Program (TRRP) protective concentration levels (PCLs) or risk-based exposure limits (RBELs), as applicable. Data and findings presented in the SIR have been incorporated into this APAR.

As noted above, the initial APAR for the FOP was submitted to the TCEQ and EPA on July 9, 2013. The TCEQ and EPA provided comments to Exide on the initial APAR in a letter from the TCEQ dated October 8, 2013, which required that additional assessment activities be conducted on the FOP property and in Stewart Creek downstream of the FOP. Exide provided a comment response letter to the TCEQ and EPA dated October 29, 2013 that described in detail proposed future assessment activities to be conducted to address TCEQ and EPA comments on the initial FOP APAR. The TCEQ issued conditional approval of Exide's responses to TCEQ and EPA comments in a letter dated November 19, 2013.

Scope of Work

Bers Metals constructed the FRC facility and began operations in approximately 1964 to produce lead oxide (Lake, 1991). In approximately 1969, battery recycling operations began at the facility. Spent lead-acid batteries and other lead-bearing scrap materials were recycled to produce lead, lead alloys, and lead oxide. Exide purchased the FRC in 2000 from Gould National Batteries, Inc. (GNB) and operated the plant until its closure in November 2012.

The FOP property consists of the FRC's former production area, two closed pre-RCRA landfills (North Disposal Area and South Disposal Area), one closed Class 2 landfill (the Slag Landfill), one active Class 2 landfill (the Class 2 Landfill), and ancillary facilities (Figure 1A.1). Two creeks cross the property from east to west, including Stewart Creek, which runs along the south side of the former production area, and a tributary to Stewart Creek (the "North Tributary"), which runs north of the North Disposal Area and the Slag Landfill. The North Tributary converges with Stewart Creek on-site, northwest of the former production area.

The affected property assessment strategy was guided by knowledge of historical Site operations, data from previous RCRA Facility Investigations (RFIs) and other assessment activities, and the physical setting of the Site. Since 1983, numerous investigations have been

conducted to evaluate COCs (primarily lead and cadmium) in soil, groundwater, surface water, and sediment at or in the near vicinity of the Site (see Section 1.2.3). Available historical data from reports and documents completed prior to the SIR are included in Appendix 17. These data were used to develop assessment strategies for the SIR and APAR investigations, but were not used to delineate residential assessment level (RAL) or PCL exceedance zones at the Site.

The initial assessment strategy for the SIR activities, discussed in Section 3 of this APAR, was described in the EPA-approved Work Plan (CRA, 2011). Subsequent steps involved a review of previous Site investigations and identification of data gaps or uncompleted agency recommendations on those previous investigations (including EPA comments on the SIR and EPA and TCEQ comments on the initial APAR).

The nature and extent of Chemicals of Concern (COCs) in environmental media were evaluated primarily using data collected during the SIR and APAR investigations. As part of these investigations, approximately 570 soil samples, 31 surface water and 25 sediment samples (from Stewart Creek and the North Tributary), and groundwater samples from 48 monitoring wells, and perched water from 5 monitoring wells were collected from the Site or adjacent vicinity and were analyzed for the primary COCs (i.e., lead and cadmium). From off-Site areas of Stewart Creek, there were 10 upstream and 8 downstream surface water samples; and 10 upstream and 53 downstream sediment samples collected (collected by Golder). In addition, 5 surface water samples and 5 sediment samples were collected upstream in tributaries to Stewart Creek that intersect the creek downstream from the FOP. Additional COCs such as other metals (including antimony, arsenic, and selenium at the request of TCEQ), total petroleum hydrocarbons (TPH), volatile organic compounds (VOCs), and semivolatile organic compounds (SVOCs) were analyzed in samples from process areas or other locations associated with specific COCs (e.g., TPH in the Former Diesel Fuel Tank release area). The extent of COCs in environmental media at the Site and in off-site portions of Stewart Creek was evaluated through comparisons to TRRP PCLs or RBELs, as applicable.

In addition to the sampling assessment activities described above, W&M Environmental performed multiple inspections of the FOP property on behalf of Exide over the period from 2009 to 2013 to locate and identify exposed slag, battery case chips, and other debris on-site. Reports prepared by W&M that summarize the inspection findings (W&M, 2011a; W&M, 2013a) are provided in Appendix 18.

On behalf of Exide, Golder began conducting an ongoing visual survey of Stewart Creek from the western FOP property boundary to Lake Lewisville in January 2014. During the survey, potential slag and battery case chips were identified within and along the banks of the creek. SWG also identified potential slag and/or battery case chips during previous downstream studies (SWG, 2013a; SWG, 2013b) conducted on behalf of the City of Frisco. Details of the downstream evaluation conducted for this APAR are provided in Sections 6, 7, and 9 and the SWG downstream study reports are provided in Appendix 19.

In 2008, W&M performed a survey and soil liner characterization analysis for the on-site storm water retention pond to document the as-installed condition of the pond (W&M, 2011b). Additional inspections of the storm water retention pond and the Class 2 Landfill solar evaporation pond were conducted by Golder in 2014. Golder concluded that the pond liners appear to be in excellent condition based on visual observations. Summary reports for the pond inspections are provided in Appendix 20.

CONCLUSIONS AND RECOMMENDATIONS

Affected Property Assessment Results

Applicable Exposure Pathways and TRRP Assessment Levels

Potentially complete human health exposure pathways identified as applicable for this affected property assessment are listed in the following table:

Potentially Complete Exposure Pathway	Environmental Media Assessed
${}^{Tot}Soil_{Comb}$	Surface Soil
${}^{GW}Soil_{Ing}$	Surface Soil; Subsurface Soil
${}^{Air}Soil_{Inh\text{-}V}$	Surface Soil (included in ${}^{Tot}Soil_{Comb}$ assessment); Subsurface Soil
${}^{GW}GW_{Ing}$	Groundwater
${}^{Air}GW_{Inh\text{-}V}$	Groundwater
${}^{SW}GW$	Groundwater
${}^{Sed}Sed$	Sediment
${}^{SW}SW$	Surface Water

As specified in TRRP [30 TAC §350.51(c)], evaluation of COCs for the potentially complete exposure pathways and environmental media listed in the table above was initially performed using assessment levels for residential land use (RALs) or Risk Based Exposure Limits (RBELs), as applicable. Soil RALs are based on a 30-acre source area for inorganics, and a 0.5 acre source area for organics. Groundwater RALs are based on a Class 2 groundwater resource. Based on the current and anticipated future land use of the Site, and planned restrictive covenants specifying commercial-industrial land use, critical PCLs were developed using assessment levels established for commercial-industrial land use or RBELs, as applicable, to evaluate the extent of critical PCL exceedance (PCLE) zones at the Site.

Affected Property Areas and PCL Exceedances

Sample data collected during the SIR and APAR indicate that soil is the primary affected medium at the Site, and that lead and cadmium are the primary COCs. Eight soil affected property areas, one sediment affected property area, and two potential soil affected property areas were identified at the Site. Each affected property area was delineated using RALs established for Site COCs (Figure 1B). As discussed in Sections 10 and 11, all COCs other than lead, cadmium, antimony, selenium, arsenic, benzene, methylene chloride, and bis(2-chloroethyl)ether in surface soil, and arsenic, cadmium and lead in subsurface soil were screened from critical PCL development. Lead, cadmium, arsenic, antimony, and selenium exceeded critical PCLs in soil samples from the Site. Two surface soil locations exhibited localized exceedences of benzene, methylene chloride (duplicate sample only), and/or bis(2-chloroethyl)ether. In most locations, lead exceedances were co-located with exceedances of the other COC metals. All areas where slag or battery case chips were observed outside of the designated on-site disposal areas (i.e., the North Disposal Area, South Disposal Area, Slag Landfill, and Class 2 Landfill), including downstream portions of Stewart Creek, are also included within the PCL exceedance (PCLE) zones.

With the following exceptions, all groundwater data collected as part of the SIR and APAR investigation activities were below applicable RALs and RBELs:

CONCLUSIONS AND RECOMMENDATIONS

- Total concentrations of lead at B4R exceeded the RAL for lead in 2012, but did not exceed the RAL in 2013 or 2014.
- At MW-46, installed adjacent to the perched water well MW-32, between the Wastewater Treatment Plant and Stewart Creek, samples (primary and duplicate) exceeded the PCL (^{SW}GW) for lead and cadmium in January 2014. The well was purged further and resampled in February and March 2014, including a duplicate sample in March 2014, and results were below the applicable PCL (^{SW}GW).
- At LMW-9, total and dissolved selenium concentrations exceeded the RAL in March and April 2013. The Eagle Ford Shale is known to contain gypsum. Selenium commonly is an impurity in gypsum, where selenium replaces calcium in the crystal matrix, potentially serving as a natural source of selenium. In addition, LMW-9 is not located at a potential point of discharge of groundwater to surface water. An attenuation evaluation (Appendix 11) for potential migration of selenium to the nearest stream (the North Tributary) demonstrates that potential migration will not result in an exceedance at the POE. Selenium in LMW-9 is defined to RALs at downgradient wells LMW-17 and LMW-8.

Based on these results, no affected property areas were identified for groundwater. Samples of perched water in the FOP area did exceed critical PCLs, but these are not considered representative of groundwater at the Site and should not be compared to RALs/critical PCLs.

Three samples from Stewart Creek collected in 2012 exceeded the critical PCLs for dissolved cadmium and/or lead in surface water; however, no samples collected from Stewart Creek in 2014 (including samples collected in the near vicinity of the 2012 samples) had dissolved arsenic, cadmium, or lead concentrations that exceeded their respective critical PCLs. Sulfate exceeded the Texas Surface Water Quality Standard at three locations in 2014, but is not believed to be attributable to the Site. Based on these results, no affected property areas were identified for surface water.

Sediment samples collected in Stewart Creek did, in some cases, exceed the critical PCLs. These areas comprise an affected property for sediment. Locations were slag or battery case fragments have been identified are also included in this affected area for sediment.

NAPL Discussion

Non-aqueous phase liquids (NAPL) were not encountered during SIR or APAR investigation activities.

Response Actions and Recommendations

In compliance with the TCEQ Agreed Order, and upon approval of this APAR, a Response Action Plan (RAP) will be prepared to describe proposed response actions for the Site. Specific response actions will be detailed in the RAP; however, it is anticipated that critical PCL exceedance (PCLE) zones will likely be addressed by a combination of Remedy Standard A (removal) and Remedy Standard B (institutional controls) response actions.

Soil

The Site will be deed restricted to commercial-industrial land use. Based on this future land use, soil critical PCLs were developed based on commercial-industrial PCLs. Additional actions are required to address areas where COC concentrations (primarily lead) exceed critical PCLs and where fill containing some slag material was observed in soils under the Battery Receiving/Storage Building. In compliance with the TCEQ Agreed Order, and upon approval of this APAR, a RAP will be prepared to describe proposed response actions for those areas.

Although specific response actions will be detailed in the RAP, it is anticipated that soils in the critical PCLE zone areas will likely be addressed by a combination of surface soil excavation where vertical impacts are shallow and/or localized, capping of other impacted areas, particularly within and near the previously closed landfills and FOP, and repair or upgrades of the closed landfill caps, as necessary. Proposed response actions will likely also include excavation/removal and verification sampling of areas of exposed slag and battery chips identified by W&M (2011a; 2013a). Predesign investigations and confirmation sampling will be used to complete or refine delineation of soil impacts in any areas where delineation is incomplete.

Groundwater

Future groundwater monitoring is recommended to evaluate possible future effects on groundwater from Site waste management units. This recommendation includes annual monitoring of groundwater in the vicinity of the Class 2 Landfill in accordance with the previously submitted Class 2 Landfill Groundwater Monitoring Plan (PBW, 2013a) which was approved on April 4, 2014.

Stewart Creek Sediments

As noted above, North Tributary sediment sample data collected from the Site as part of the SIR and APAR investigations were below applicable PCLs for lead and cadmium. These findings are consistent with previous creek sediment remediation activities conducted at the Site (see Chronology table and discussion in Section 1.2.3). However, previous investigations described therein, other studies of Stewart Creek (SWG, 2013a; SWG, 2013b), and downstream sediment samples collected as part of the revised APAR investigation have identified localized lead and cadmium hot spots within Stewart Creek sediment downstream of the Site, including adjacent to the Former Stewart Creek Wastewater Treatment Plant (FSCWWTP) immediately downstream of the Site, approximately near the Dallas North Tollway, and farther downstream. These hot spots are usually associated with battery case chips or slag. An ongoing interim action is addressing these areas and other remedial actions to address sediment will be determined at the time of RAP preparation. Arsenic concentrations in sediment although above the critical PCL are within the range of background concentrations and not attributed to Site operations.

Surface Water

No specific surface water actions are proposed.

Interim Actions

Prior to completion and approval of this APAR, Exide has performed several interim actions, which are summarized below. Specific interim action reports are provided in Appendix 11.

French Drain System

Water seepage along the exterior of the flood wall/retaining wall (designated as the “Flood Wall”) located on the south side of the former production area has been observed over time in the area between the Slag Treatment Building and the Battery Receiving/Storage Building. Exide periodically completed repairs and sealed the exterior face of the Flood Wall in a number of locations; however, seepage continued in some areas, resulting in spalling and deterioration of the exterior wall face and localized areas of wet soil and/or standing water at the exterior base of the wall. The French drain system was proposed in the EPA-approved November 2011 Sampling and Analysis Work Plan (CRA, 2011) as an interim remediation system. Installation of the French drain was completed in the Fall of 2012. W&M, who designed and oversaw construction of the system, prepared a summary report detailing the specifications of the system and procedures

used in the construction of the system. The W&M French drain construction report (W&M, 2013b) is provided in Appendix 11.

Prior to construction of the French drain, a subsurface investigation consisting of soil borings and groundwater observation wells was completed in the proposed French drain area to evaluate the levels of static groundwater in relation to the elevations of observed seepage. W&M concluded that source(s) of artificial recharge were resulting in saturation of the shallow fill soils on the facility side of the Flood Wall, presumably caused by storm water and wash water from operation areas infiltrating into the fill material through cracks, joints, and areas of deteriorated concrete and/or leaks from subsurface drains or sumps located within the plant. The French drain system was designed to collect and convey water from the zone of saturated fill behind the Flood Wall to a sump, where it is collected and pumped to the storm water retention pond.

W&M visited the wall on three occasions (un-specified date in November 2012; March 28, 2013; and June 6, 2013) after the French drain was completed to observe the condition of the wall. On each occasion, the entire perimeter of the wall was walked and observed for evidence of ongoing seepage. W&M has indicated that no evidence of recent seepage was observed during these site visits. Photographs of the Flood Wall were taken by W&M during the March 28, 2013 site visit. These photographs are included with the French drain construction report in Appendix 11.

A flood wall inspection was performed by Golder on January 7th and 8th, 2014 to observe the condition of the wall. The French Drain was not being pumped at the time of the inspection due to maintenance issues and the French Drain system was full of water. Moisture and “white crystalline material” were observed in several locations on the exterior of the Flood Wall, but no standing water was observed. There was no visible flow through the wall. Golder visited the Flood Wall on March 18, 2014 observe the condition of the wall once the French Drain had been operating for several weeks but at the time of the Site visit, Golder noted that the system had recently shut down again due to a power outage from severe weather. The “white crystalline material” and moisture were observed in similar locations to those observed during the January 2014 inspection. However, no visible flow through the wall or standing water were observed.

Based on the information described above, when the French Drain is in operation, it appears to be effective in preventing seepage through the wall and effective in collecting and conveying the shallow perched water from the zone of saturated, shallow fill behind the Flood Wall to the collection sump. During the time the French Drain was not in operation and water was accumulated behind the Flood Wall, conditions similar to those noted before the French Drain was installed were observed. Since the time of the Golder inspections, a significant amount of work has been done to improve the French Drain system, including installation of a new pump with a float activated switch and raising the manhole access. Golder prepared a French Drain Operation and Maintenance (O&M) Plan for the facility which prescribes regularly scheduled maintenance, record keeping and responsible parties for long term operation of the French Drain.

South Disposal Area Cap Repairs

During an inspection of the Site in 2011, the TCEQ observed that the cap cover of the South Disposal Area on the south side had been eroded, exposing battery chips in various areas along the slope (TCEQ, 2011a). On June 3, 2013, representatives of W&M, PBW, and Remediation Services, Inc. (RSI) met with representatives of the TCEQ at the Site. The South Disposal Area was walked, typical areas requiring repair were identified, and repair procedures were discussed. The repairs to the South Disposal Area cap were conducted on June 5, 2013 and June 27, 2013. A report documenting the cap repair activities (W&M, 2013c) is provided in Appendix 11.

CONCLUSIONS AND RECOMMENDATIONS

Cap Inspections

Golder conducted inspections of the caps at the North Disposal Area, Slag Landfill, Class 2 Landfill, and South Disposal area in 2013. Permeability samples were also collected for each cap except the Class 2 Landfill cap, where a geomembrane forms part of the liner system. All four caps were observed to appear generally firm and well drained, with no cracking, erosion, or rilling. Vegetative cover in most areas was generally well established across the cover, although localized areas of potentially sparse vegetation were observed, and part of the Class 2 Landfill is still undergoing establishment of vegetative cover. Minor undulations and equipment tracking were observed on the cover and in the vegetation, although neither appeared to impact the integrity of the cover. It was noted that, because the inspection was performed in December, the overall health of the vegetation could not be assessed as it was dormant or partially dormant at the time of inspection. Permeabilities of the cap systems were in the 10^{-7} cm/sec range or lower.

On-Site Exposed Slag and Battery Case Chips Interim Action

In 2009 and 2011, W&M conducted visual inspections of the Site to identify exposed slag, battery case chips, and other debris within and along the banks of the on-site portion of Stewart Creek west of the former production area (W&M, 2011a) and in the vicinity of the North Disposal Area and South Disposal Area (W&M, 2011c). In November 2009, representative samples of suspected slag were collected from twelve specimens located within or along the banks of the on-site portion of Stewart Creek west of the former production area. The analytical results for the suspected slag samples were presented in a report prepared by W&M in 2011 (W&M, 2011a), which is provided in Appendix 18. In 2013, W&M completed additional inspections on the remaining areas of the FOP. W&M summarized the results of the 2013 inspection and previous inspections in a report dated March 28, 2013 (W&M, 2013a), which is also provided in Appendix 18. W&M identified exposed slag and/or battery case fragments in several areas of the Site, including the South Disposal Area, the south wooded area east of the South Disposal Area, the North Disposal Area/Slag Landfill area, the north wooded area, the Class 2 Landfill area, and within and along the banks of Stewart Creek west of the former production area. Locations of the slag and/or battery case chips identified during the inspections are shown on Figures 4 through 7 in the 2013 W&M report (W&M, 2013a) provided in Appendix 18.

Based on the visual inspections conducted by W&M, an interim action was performed in July-August 2013 to identify and remove exposed slag and battery case fragments using hand shoveling and other manual methods from the ground surface in areas where these items had previously been identified. Information was also collected regarding lead concentrations in areas where these materials were removed to evaluate whether future larger scale response actions may be necessary in these areas. The scope of work for the interim action activities was submitted to the TCEQ as an Interim Action Work Plan (IAWP) dated April 29, 2013 prior to the start of work. The IAWP was approved by the TCEQ in correspondence dated July 1, 2013. After completion of the interim action, W&M prepared a summary report (W&M, 2013d) of the results dated October 14, 2013, which was submitted to the TCEQ. The W&M interim action report was approved by the TCEQ in a letter dated January 10, 2014 (TCEQ, 2014). The W&M interim action report and TCEQ approval letter are provided in Appendix 11.

Shooting Range Berm

In conjunction with this APAR and in accordance with the aforementioned TCEQ Agreed Order, soil and debris associated with a former shooting range berm located adjacent to the South Disposal Area were removed and disposed off-site in 2013. The report summarizing the shooting range berm removal activities (PBW, 2013b) is provided in Appendix 11.

CONCLUSIONS AND RECOMMENDATIONS

Downstream Stewart Creek Interim Action

The evaluation of Stewart Creek conducted for this APAR included a visual survey of the creek from the FOP property to Lake Lewisville. During the evaluation, potential slag and battery case chips were identified within and along the banks of the creek. During previous investigations conducted on behalf of the City of Frisco, SWG also identified potential slag and/or battery case chips in downstream portions of Stewart Creek (SWG, 2013a; SWG, 2013b) Details of the downstream evaluation conducted for this APAR are provided in Sections 6, 7, and 9 and the SWG downstream study reports are provided in Appendix 19. On behalf of Exide, Golder submitted an IAWP to the TCEQ dated November 7, 2013 for removal of slag and battery case chips identified in downstream portions of Stewart Creek during the APAR investigation for which the TCEQ issued a conditional approval letter dated December 17, 2013 for this IAWP. This interim action is ongoing.

CONCLUSIONS AND RECOMMENDATIONS

____ Check here if no specialized submittals in this report

	If included, specify section or appendix
Ecological Risk Assessment	
Reasoned justification, expedited stream evaluation, Tier 2 or 3 ecological risk assessment, and/or proposal for ecological services analysis	Tier 2 SLERA; Section 9
Statistics	
Calculated site-specific background concentrations	Appendix 8
Used alternate statistical methods to determine proxy values for non-detected results (§350.51(n))	
Calculated representative concentrations (§350.79(2)) for remedy decision	
Analytical Issues	
Used SQL for assessment or critical PCL instead of the MQL (§350.51(d)(1)) or PCL (§350.79)	
The MQL of the analytical method exceeds assessment levels/critical PCLs (§350.54(e)(3))	Section 10
Human Health/Toxicology	
Variance to exposure factors approved by TCEQ Executive Director (§350.74(j)(2))	
Developed PCLs based on alternate exposure areas	
Evaluated non-standard exposure pathway (e.g., agricultural, contact recreation, etc)	contact recreation; Appendix 9
Combined exposure pathways across media for simultaneously exposed populations (§350.71(j))	
Adjusted PCLs due to residual saturation, cumulative risk, hazard index, aesthetic concerns, or theoretical soil vapor	
Utilized non-default human health RBELs to calculate PCLs (includes use of non-default parameters, toxicity factors not published in rule, etc.) (§350.51(l), §350.73, §350.74)	
Calculated Tier 2 or 3 RBELs/PCLs or TSCA levels for polychlorinated biphenyls, or calculated Tier 2 or 3 RBELS/PCLs for cadmium, lead, dibenzo-p-dioxins, dibenzofurans, and/or polycyclic aromatic hydrocarbons	
Calculated Tier 1, 2, or 3 total petroleum hydrocarbon (TPH) PCLs	Appendix 9
Developed sediment/surface water human health RBELs and PCLs	Appendix 9
Fate and Transport	
Used or developed groundwater to surface water dilution factors	Appendix 9
Calculated Tier 2 PCL	Appendix 9
Calculated Tier 3 PCL	
Groundwater Issues	
Conducted aquifer test, classified Class 3 groundwater, or determined non-groundwater bearing unit (saturated soil)	

Chronology

Date of Report or Event(s)	*Title of Report* / Assessment Activities	Author/Assessor	Summary of Environmental Assessment and/or Correspondence
1964-2012	Plant in operation	GNB/Exide Technologies	Lead oxide production (1964-2012) and secondary lead smelting activities (1969-2012).
August 29, 1983	Groundwater Investigation; Frisco, Texas Plant	Dames & Moore	Seven borings were advanced in the vicinity of the North Disposal Area and South Disposal Area. Cores collected from the borings were evaluated for geotechnical properties. Seven monitoring wells were installed within the borings, groundwater was sampled and aquifer testing performed at each well. The study concluded that groundwater was flowing towards and discharging into Stewart Creek at a low flow rate (e.g. $3.1x10^{-5}$ to $1.0x10^{-8}$ cm/s). Slight exceedances of the standards for cadmium (0.01 mg/L) and/or lead (0.13) were noted in three wells. Additional groundwater monitoring was recommended in the report.
1986	Stewart Creek sediment remediation	Southwest Laboratories	A Stewart Creek surface water and sediment investigation in 1984 and 1986 indicated elevated concentrations of lead and cadmium in sediment samples. Subsequently, sediments in Stewart Creek were removed by dredging along the portion that lies between the former 5th Street and the BNSF railroad. Three dredging events were performed and the sediments were sampled following each event and evaluated for EP Toxicity for lead and cadmium. The final sampling event data indicated that sediments in the cleanup area were below the cleanup standards of 5.0 mg/L for lead EP Toxicity and 1.0 mg/L for cadmium EP Toxicity.
November 16, 1987	RCRA Facility Assessment	Texas Water Commission	A RCRA Facility Assessment was issued by the Texas Water Commission (TWC) November 16, 1987. In the assessment, nine SWMUs were identified: (1) Battery Storage Area; (2) Raw Material Storage Area; (3) Slag Landfill; (4) North Disposal Area; (5) South Disposal Area; (6) Stewart Creek; (7) Old Drum Storage Area; (8) Stewart Creek Sediment Dredging Waste Pile; and (9) Product Waste Pile.
May 8, 1991	Phase I RCRA Facility Investigation	Lake Engineering, Inc.	The Phase I RCRA Facility Investigation (RFI) was initiated in 1990 and consisted of investigation of several Waste Management Areas (WMAs). Waste Management Areas were designated for the purpose of designing a groundwater monitoring system. Investigative activities included soil and groundwater investigations of WMA 1 (North Disposal Area and Slag Landfill), WMA 2 (Battery Storage Area, Raw Material Storage Area, Old Drum Storage Area, Product Waste Pile and Oil Leak) and WMA 3 (South Disposal Area); an investigation of WMA 4 (Stewart Creek); and delineation of the North Disposal Area and South Disposal Area. The limits of the North Disposal Area and South Disposal Areas were delineated during the Phase I RFI by borings around the perimeter and within the units. The Phase I RFI report, dated May 8, 1991 (Lake, 1991), and the Addendum to the Phase I RFI Report dated December 10, 1993 (Lake, 1993) identified lead as the primary COC at the Site, and soil as the primary environmental media of concern. The Phase I RFI also concluded that cadmium is present in soils, but at very low concentrations.
1991-1992	Stream Investigations of Stewart Creek	Resource Consultants, Inc.	A study conducted by Resource Consultants in 1991 (RCI, 1991) investigated sediments at one location upstream of the Site and two locations downstream relative to the Site. Cadmium hotspots were indicated in the two samples collected downstream. Resource Consultants conducted an additional study in 1992 (RCI, 1992) that investigated the biotic community in order to classify the stream. Three sample locations were chosen, with one upstream of the Site and two locations downstream of the Site. Based on the biotic community observed during the study, the stream was classified as an intermittent stream.
August 26, 1993	RCRA Facility Investigation Report Notice of Deficiency	Texas Water Commission	Following review of the RCRA Facility Investigation Report (Lake, 1991), the Texas Water Commission (TWC) issued a Notice of Deficiency letter dated August 26, 1993. In the Notice of Deficiency, TWC requested additional information and changes to the sampling and statistical methods for groundwater and soil background value calculations and comparisons to RFI sample values. The TWC also requested that Stewart Creek be addressed as a separate RFI project from the rest of the facility. In addition, TWC requested pH analysis for all future groundwater samples and additional information regarding the soil properties encountered during the delineations of the South Disposal Area and North Disposal Area. Various other miscellaneous details regarding the investigation were also requested.
December 10, 1993	Addendum to the RCRA Facility Investigation for GNB Incorporated, Frisco, Texas	Lake Engineering, Inc.	The RFI addendum was submitted in response to the TWC Notice of Deficiency letter dated August 26, 1993 (TWC, 1993). The addendum provided additional information as requested by TWC, including a rationale of using MCLs and the Superfund cleanup guidelines in lieu of background values; additional information regarding the soil properties encountered during the North Disposal Area and South Disposal Area delineations, and other investigation details as requested by the TWC.
June 3, 1994	Phase I RFI Report and Addendum Approval	Texas Natural Resource Conservation Commission	The Texas Natural Resource Conservation Commission (TNRCC) approved the Phase I RFI report and Addendum in correspondence dated June 3, 1994, and requested a Phase II RFI to conduct additional investigation at the former railroad culvert down-gradient of the Slag Landfill; along the railroad spur south of the North Disposal Area; at the closed battery storage area; in the vicinity of the acid sump located in the Battery Breaker Building; in the vicinity of the South Disposal Area; and in the Truck Staging Area. In addition, TNRCC requested that the soil cap over the North Disposal Area be evaluated for integrity.
August 30, 1995	Notification of On-Site Class II Industrial Waste Landfill	RMT/Jones & Neuse, Inc.	Prior to construction of the on-Site Class II landfill, a notification was prepared and submitted during 1995 by RMT/JN that included specifications of the landfill design, waste composition, site geology, a groundwater monitoring plan, and a closure and post closure care plan. To characterize the site geology, eighteen soil borings were collected and lithologically described by a geologist. Monitoring wells were installed within nine of the soil borings. Slug tests were performed in four wells and a pump test was performed in LMW-17. One groundwater elevation gauging event was conducted. The geologic assessment indicated the presence of limited sand and gravel lenses in the south to southwest portion of the landfill area. The groundwater elevation gauging event indicated a hydrogeologic gradient to the southwest towards the North Tributary.
May 1996	Stewart Creek Final Phase II RFI Report, GNB Technologies, Frisco, Texas	RMT/Jones & Neuse, Inc.	The Stewart Creek Phase II investigation was performed in accordance with a work plan approved by TNRCC on January 29, 1996. Eighty sediment samples were collected and analyzed for lead and cadmium during 1995. In addition, 20 background sediment samples were collected upstream of the former 5th Street on Stewart Creek and Cottonwood Creek, which is a creek that feeds into Stewart Creek. Twenty-six sediment samples were collected in areas of accumulated sediment along Stewart Creek during February 1996. Sixteen sediment sample results reported in the Phase I RFI report (Lake, 1991) were also included in the Stewart Creek Final Phase II Report. Sediment sample locations ranged from the main plant area to the Stewart Creek West WWTP, which is located downstream of the Site. Based on sampling results, the report recommended further study of the Stewart Creek segment between the former 5th Street and the 7700-foot marker.

Chronology

Date of Report or Event(s)	*Title of Report* / Assessment Activities	Author/Assessor	Summary of Environmental Assessment and/or Correspondence
August 1998	Phase II RFI	JD Consulting, Inc.	A Phase II RFI was conducted by JD Consulting, Inc. (JDC) in June 1998, pursuant to a work plan prepared by RMT/Jones and Neuse (RMT/JN. 1994), modified by letter dated September 24, 1995 (GNB, 1995), and approved, with modifications, by the TNRCC on February 27, 1998. The Phase II RFI addressed the areas referenced in the TNRCC's June 3, 1994 correspondence, which approved and noted deficiencies in the Phase I and Phase I RFI Addendum that were to be addressed in the Phase II RFI. Investigative activities included soil sampling at the truck staging area, the railroad spur, and the area adjacent to monitoring well B7R (Figure 1B). Further delineation of the lateral extent of soil COC concentrations above applicable regulatory standards at the South Disposal Area and development of a Corrective Measures Study were also addressed in the Phase II RFI for the South Disposal Area. Several exceedances of the lead investigation limit of 500 mg/kg were encountered in surface soil samples, including in the area adjacent to B7R, at the railroad spur area, and the South Disposal Area. Subsurface soil exceedances for lead were noted in the railroad spur area and the South Disposal Area.
August 1998	Human Health and Ecological Risk Assessment	JD Consulting, Inc.	Stewart Creek was addressed as a separate project from the Phase II RFI pursuant to a TNRCC request dated September 6, 1993. The Human Health and Ecological Risk Assessment (HHERA) and Corrective Measures Study for Stewart Creek (JDC, 1998b) were submitted to the TNRCC on August 5, 1998. This study included an evaluation of Stewart Creek sediment and surface water data from several investigations, including the Phase I RFI (Lake, 1991), the Phase II RFI (JDC, 1998a), additional sediment sampling performed by RMT/JN in 1995 and 1996 and the Stewart Creek Final Phase II (RMT/JN, 1996). The study area for the HHERA included portions of Stewart Creek at the facility area and areas downstream of the facility. The study concluded that the levels of cadmium and lead in surface water do not pose a risk to ecological or human receptors. The sediments within the facility boundaries, however, pose a potential risk to human and ecological receptors. In addition, the study noted that cadmium and lead levels at four locations downstream of the facility boundary (6,500 ft, 7,000 ft, 7,200 ft, and 7,600 feet downstream of the former 5th Street) may also pose an ecological risk and warranted further investigation. A Corrective Measures Study was recommended for the on-Site sediments.
January 13, 2000	Acceptance Closure for Four Solid Waste Management Units	Texas Natural Resource Conservation Commission	The TNRCC issued a letter dated January 13, 2000, that approved closure for the following SWMUs: the former Battery Storage Area, Old Drum Storage Area, Stewart Creek Dredging Waste Pile and the Product Waste Pile. The letter stated that each SWMU was closed according to the closure plans approved by the TNRCC.
July 2000	Stewart Creek Corrective Measures Implementation Report	JD Consulting, Inc.	As a result of the HHERA described above, an approximate 2,800-foot stretch of the creek sediments was remediated to standards for lead and cadmium approved by the TNRCC (91 milligrams per kilogram [mg/kg] for lead and 4.23 mg/kg for cadmium). The remediation was carried out by first removing visible slag "buttons" from the creek bed and banks, then excavating the soils at an average depth of 1ft. Soils were excavated to deeper depths as needed based on the extent of slag presence in the soil. Excavated soil was screened for recoverable slag fragments, which were recycled in the blast furnace at the facility. Remaining soil was stockpiled and sampled for TCLP analysis for lead and cadmium. Most samples passed the criteria for Class II waste; the samples that did not pass the criteria were treated until they passed. Some stockpiled material was tested for SPLP lead and cadmium for potential re-use as intermediate fill in the active Class 2 landfill at the facility. The TNRCC approved the reuse proposal on November 8, 1999. The material that met the re-use criteria were stored in the Class 2 landfill, while the material that did not meet the re-use criteria but met or was treated to meet the Class 2 waste criteria was disposed of off-site in an appropriate landfill.
July 15, 2003	Leaking Petroleum Storage Tank (LPST) Case Closure of Subsurface Release of Hydrocarbons at G.N.B. Technologies Facility	Texas Commission on Environmental Quality (TCEQ)	A diesel oil release residue was discovered in April 1988 during the construction of the retaining wall adjacent to Stewart Creek. Details of the discovery and subsequent remedial actions are provided in a letter by Lake Engineering to the Texas Water Commission (Lake, 1988). Following discovery of the residue, a pump and mobile storage tank were immediately installed. Three test holes were advanced to determine the extent of residue; residue was not detected in any of the holes. To enhance collection of residue, an oil recovery sump and intercept trenches were constructed. TCEQ issued a letter dated July 15, 2003, certifying that the former diesel fuel release (LPST ID No. 106075) had met site closure requirements and that no further action was necessary.
2009-2011	TCEQ and EPA Inspections	TCEQ and and United States Environmental Protection Agency (EPA)	TCEQ and EPA performed multiple inspections of the Site. Key investigations are listed in Table 1C.
March 29, 2011	Suspect Slag Sampling Report; Stewart Creek - West Segment	W&M Environmental	W&M Environmental conducted a visual survey of the western reach of Stewart Creek from the Battery Receiving/Storage Building to the BNSF railroad. Suspected slag samples collected from the banks of the creek were photographed and evaluated for Pb, Ca, and Fe to develop a visual criteria for identifying suspected slag in the field. Ca and Fe were evaluated to differentiate between Pb slag and limestone fragments. Based on analytical results and the resultant visual criteria, slag occurrences were observed along the majority of the study area on both sides of the creek but were noted to occur more frequently along the central portion and eastern portions of the study area.
August 1, 2011	RCRA Section 3013(a) Administrative Order	EPA	The Administrative Order was issued on August 1, 2011 (Docket No. RCRA 06-2011-0966; re-designated by EPA as Docket No. RCRA 06-2012-0966), following an EPA inspection on December 14-18 2009 and March 29, 2010 and review of historical documents. EPA concluded that there was potential soil, groundwater, sediment and surface water contamination resulting from the activities at the facility and issued the Administrative Order. The Administrative Order ordered Exide to submit to EPA a workplan that proposed sampling and analysis. A sampling and analysis workplan was prepared by Conestoga-Rovers and submitted November 2011. The Site Investigation (PBW, 2012), detailed below, addressed areas noted as potential areas of concern in the Administrative Order. Additional details of the Administrative Order are provided in Table 1C.
October 7, 2011	Geotechnical Engineering Report	Rone Engineering	A geotechnical study was performed in 2011 in the general area of WMA 1 (North Disposal Area and Slag Landfill) to support the engineering design for a series of buildings and upgrades to existing facility structures proposed at the time of the report. The lithologic information obtained from the borings drilled for this investigation was used in support of Site hydrogeologic evaluation and for the development of geologic cross-sections in this APAR.
December 28, 2011	North and South Disposal Areas Evaluation	W&M Environmental	W&M conducted a visual inspection of the North Disposal Area and the South Disposal Area to assess the condition of the soil caps and to inspect for suspected slag on the ground surface within each area. The study identified limited areas of exposed slag and/or battery chips in the South Disposal Area as well as isolated occurrences of slag on the ground surface to the north and east of the area. The study also noted cracks in the soil above the South Disposal Area, but no slag or battery chips were identified in the areas of cracking. In the North Disposal Area, exposed slag was noted within materials storage areas and areas of heavy vehicular traffic in the southern portion of the area. In addition, isolated occurrences of slag were noted along the North Tributary, the railroad spur, and in the north wooded area.

Chronology

Date of Report or Event(s)	*Title of Report* / Assessment Activities	Author/Assessor	Summary of Environmental Assessment and/or Correspondence
July 12, 2012	Site Investigation Report	Pastor, Behling & Wheeler, LLC	The SIR investigation was performed in accordance with a Sampling and Analysis Work Plan prepared by Conestoga-Rover Associates, submitted November 2011, and approved by the EPA by email on December 2, 2011, and pursuant to Paragraph 33 of the AOC for the Site, dated May 2, 2012. An investigation of soil, groundwater, surface water, and sediment was conducted to evaluate the nature, location, extent, direction, and rate of movement of any hazardous wastes and/or hazardous constituents which are present at or have been released at the facility. Soil samples were collected from the North Disposal Area, Slag Landfill, the Raw Material Storage Area, South Disposal Area, Boneyard, Bale Stabilization Area, Crystallization Unit Frac Tank area, Stewart Creek Corridor, and the Shooting Range Berm. Sediments were sampled in Stewart Creek and the North Tributary, and surface water was sampled in Stewart Creek. Two surface water gauging stations were installed along Stewart Creek and three monthly gauging events of the surface water and groundwater wells were performed. A groundwater investigation was also conducted during the SIR investigation, which included the installation of two background wells to the east of the Site and sampling of eleven existing wells in order to evaluate groundwater conditions downgradient of WMA 1 (the closed North Disposal Area and Slag Landfill), WMA 2 (the closed Battery Storage Area, Raw Material Storage Area, the closed Old Drum Storage Area, the closed Product Waste Pile and the Former Diesel Fuel Tank leak area) and WMA 3 (South Disposal Area). The report recommended additional investigation at the Raw Material Storage Area and the Stewart Creek Flood Wall at a creek-side sample location adjacent to the Battery Storage/Receiving Building.
Effective February 10, 2013	Agreed Order; Docket No. 2011-1712-IHW-E	TCEQ	The TCEQ Agreed Order was entered effective February 10, 2013, between TCEQ and Exide. The Agreed Order ordered Exide to prevent disposal of waste in the active Class 2 landfill that exceeds LDR Treatment Standards; to submit a groundwater monitoring plan for the active landfill; to submit an APAR to address areas of concern identified in the May 6, 2011 TCEQ inspection; to submit an APAR for the RCRA Facility Investigation units listed in RCRA HW Permit No. 50206, PS IX.C. and any new areas identified by previous EPA and TCEQ investigations; to dispose of the berm material near the west side of the South Disposal Area; to prevent release of untreated slag and refractory brick from the Slag Treatment Building; and to ensure integrity of and maintain the cover of the South Disposal Area.
May 2013	Wall Seepage Project; Retaining Wall at Stewart Creek	W&M Environmental	W&M prepared a report detailing the procedures used to install the French drain along the facililty side of the Flood Wall. The French drain was installed as an interim measure to address seepage along the creek side of the Flood Wall.
July 5, 2013	South Disposal Area Cap Repair Report	W&M Environmental	This letter report summarizes interim measures conducted to identify and repair discrete areas of the South Disposal Area cap.
July 9, 2013	FRC Former Shooting Range Berm Removal Action	Pastor, Behling & Wheeler, LLC	This letter report summarizes interim action measures conducted to remove and dispose of the Former Shooting Range Berm as required by Ordering Provision 3.c.iii of the TCEQ Agreed Order effective February 10, 2013. The letter report also summarizes the removal of bermed material near the south side of the South Disposal Area, which was not explicitly required by the Agreed Order.
July 9, 2013	Affected Property Assessment Report (APAR)	Pastor, Behling & Wheeler, LLC	Pursuant to the Agreed Order effective February 10, 2013, PBW conducted an affected property assessment of potentially affected media at the Site during January - May 2013. Media that were investigated included soil, groundwater, and Stewart Creek and North Tributary surface water and sediments.
October 8, 2013	Comments on the APAR and the Tier 2 Screening Level Ecological Risk Assessment (SLERA) for the FOP, dated July 9, 2013, Request for Revised APAR	TCEQ and EPA	TCEQ and EPA comments on the July 9, 2013 APAR, which required that additional assessments of the FOP and downstream portions of Stewart Creek be conducted. Required that a revised APAR be prepared by Exide.
October 14, 2013	Implementation of Interim Actions, Slag and Battery Case Fragment Removal and Disposal, Exide Frisco Recycling Facility, Frisco, Texas	W&M Environmental	This letter report describes interim measures completed on the Former Operating Plant (FOP) property to remove slag and battery case fragments exposed on the ground surface within the former production area, the designated disposal areas (i.e., the South Disposal Area, North Disposal Area, and Slag Landfill), areas around the Class 2 Landfill, along the banks of on-site portion of Stewart Creek west of the former production area, in the wooded area east of the South Disposal Area, and in the wooded area adjacent to the on-site portion of the North Tributary. The W&M interim action report was approved by the TCEQ in a letter dated January 10, 2014.
October 29, 2013	Response to TCEQ and EPA Comments on APAR and SLERA for the FOP	Exide	Response letter to the TCEQ and EPA proposing additional assessment activities for the FOP and downstream portions of Stewart Creek. The response letter indicated that a revised APAR would be prepared.
Nobember 7, 2013	Interim Action Work Plan (IAWP), Slag and Battery Case Fragment Removal and Disposal	Golder	IAWP addressing slag and battery case chip removal from Stewart Creek downstream of the FOP.
November 19, 2013	Conditional Approval of Response to TCEQ and EPA Comments on APAR and SLERA for the FOP, dated October 29, 2013	TCEQ	The [TCEQ] has reviewed the…response to comments dated October 29, 2013, and generally concurs with the response provided. Please see the enclosed comments and ensure you consider these items as you proceed with the additional assessment."
December 17, 2013	Conditional Approval of IAWP, Slag and Battery Case Fragment Removal and Disposal, dated November 7, 2013	TCEQ	Conditional approval of IAWP dated November 7, 2013 regarding slag and battery case chip removal from Stewart Creek downstream of the FOP.

AFFECTED PROPERTY ASSESSMENT REPORT

AFFECTED PROPERTY ASSESSMENT REPORT

Exide Frisco Recycling Facility
7471 South 5th Street, Frisco, Texas 75034-5047
TCEQ SWR No. 30516
TCEQ Hazardous Waste Permit No. HW-50206
TCEQ Agreed Order Docket No. 2011-1712-IHW-E
EPA Administrative Order on Consent RCRA 06-2012-0966
Customer No. CN600129779
Regulated Entity No. RN100218643

May 2014 1302086

Table of Contents

1.0 PROPERTY INFORMATION 1
1.1 Physical Location 1
1.1.1 Property Location and Land Use 1
1.1.2 Topography 2
1.1.3 Weather 3
1.2 Affected Property and Sources of Release 3
1.2.1 History and Operations 3
1.2.1.1 Agricultural Use 3
1.2.1.2 Industrial Use 4
1.2.2 Project Overview 7
1.2.3 Previous Investigations 7
1.2.3.1 Groundwater Investigation, Frisco, Texas Plant, Dames and Moore, 1983 (D&M, 1983) ... 7
1.2.3.2 Water and Sediment Tests, GNB Lead Plant, Southwestern Laboratories, 1986a (SWL, 1986a), Stream Sediment Tests; GNB, Inc. Plant, Southwestern Laboratories, 1986b (SWL, 1986b), Stream Sediment Test; GNB, Inc. Plant, Southwestern Laboratories, 1986c (SWL, 1986c); Stream Sediment Tests, GNB, Inc. Plant, Southwestern Laboratories, 1986d (SWL, 1986d) 8
1.2.3.3 RCRA Facility Assessment, Texas Water Commission, 1987 (TWC, 1987) 8
1.2.3.4 Phase I RCRA Facility Investigation, Lake Engineering, 1991 (Lake, 1991) 8
1.2.3.5 Stream Investigation; Stewart Creek; Collin County, Texas, Resource Consultants, Inc. , 1991 (RCI, 1991), Stream Investigation; Stewart Creek; Collin County, Texas, Resource Consultants, Inc., 1992 (RCI, 1992) 9
1.2.3.6 RCRA Facility Investigation (RFI) Report Notice of Deficiency, Texas Water Commission, 1993 (TWC, 1993) 9
1.2.3.7 Addendum to the RCRA Facility Investigation for GNB Incorporated, Frisco, Texas, Lake Engineering, Inc. (Lake, 1993) 10
1.2.3.8 Notification of On-site Class 2 Industrial Waste Landfill, RMT/Jones & Neuse, Inc., 1995 (RMT/JN, 1995) 10
1.2.3.9 Stewart Creek Final Phase II RFI Report; GNB Technologies; Frisco, Texas, RMT/Jones & Neuse, Inc., 1996 (RMT/JN, 1996) 10
1.2.3.10 Human Health and Ecological Risk Assessment, JD Consulting, Inc., 1998 (JDC, 1998b) 10
1.2.3.11 Phase II RFI, JD Consulting, Inc., 1998 (JDC, 1998a) 11
1.2.3.12 Acceptance of Closure Certification for Four Solid Waste Management Units, Texas Natural Resource Conservation Commission, 2000 (TNRCC, 2000) 11
1.2.3.13 Corrective Measures Implementation Report, JD Consulting, Inc., 2000 (JDC, 2000) 12
1.2.3.14 Leaking Petroleum Storage Tank (LPST) Case Closure of Subsurface Release of Hydrocarbons at G.N.B Technologies Facility, Texas Commission on Environmental Quality, 2003 (TCEQ, 2003) 12

1.2.3.15 Report of RCRA Sampling Inspection, 2010 (EPA, 2010a); EPA RCRA Corrective Action Report, 2011 (EPA, 2011a) ... 12
1.2.3.16 TCEQ Inspection Report, TCEQ, 2011 (TCEQ, 2011a) ... 13
1.2.3.17 Suspect Slag Sampling Report; Stewart Creek – West Segment, W&M Environmental, 2011 (W&M, 2011a) ... 14
1.2.3.18 North and South Disposal Areas Evaluation, W&M Environmental, 2011 (W&M 2011b) 14
1.2.3.19 Geotechnical Engineering Report, Rone Engineering, 2011 (Rone, 2011) ... 14
1.2.3.20 RCRA Section 3013(a) Administrative Order, United States Environmental Protection Agency, 2011 (EPA, 2011b) ... 15
1.2.3.21 Laboratory analytical report from the EPA Region 6 Laboratory for EPA samples collected January 11-18, 2012. (EPA, 2012) ... 15
1.2.3.22 Site Investigation Report, Pastor, Behling & Wheeler, LLC, 2012 (PBW, 2012a) ... 15
1.2.3.23 Agreed Order; Docket No. 2011-1712-IHW-E, Texas Commission on Environmental Quality, 2013 (TCEQ, 2013b) ... 16
1.2.3.24 Wall Seepage Project; Retaining Wall at Stewart Creek, W&M Environmental, 2013 (W&M, 2013b) ... 16
1.2.4 Potential Sources of Release ... 17
1.2.4.1 Potential Sources of Release Identified in the Phase I RFI ... 17
1.2.4.2 Potential Sources Identified in the 2011 Sampling and Analysis Work Plan ... 20
1.2.4.3 Notice of Registration Waste Management Units ... 23
1.2.4.4 Other Potential Source Areas ... 24
1.2.5 Affected Property Description ... 29
1.2.5.1 Affected Property No. 1 (North Area) ... 31
1.2.5.2 Affected Property No. 2 (Production Area) ... 32
1.2.5.3 Affected Property No. 3 (South Area) ... 33
1.2.5.4 Affected Property No. 4 (Crystallizer Way) ... 34
1.2.5.5 Affected Property No. 5 (West and Southwest of Class 2 Landfill) ... 35
1.2.5.6 Affected Property No. 6 (Lake Parcel North) ... 35
1.2.5.7 Affected Property No. 7 (North Tributary at Boundary) ... 35
1.2.5.8 Affected Property No. 8 (Stewart Creek Sediments) ... 36
1.2.5.9 Possible Affected Property No. 9 and 10 ... 36
1.3 Geology, Hydrogeology, and Surface Water Hydrology ... 37
1.3.1 Geology ... 37
1.3.2 Hydrogeology ... 38
1.3.3 Surface Water Hydrology ... 39
2.0 EXPOSURE PATHWAYS AND GROUNDWATER RESOURCE CLASSIFICATION ... 1
2.1 Source(s) of Potable Water for On-site Property and Affected Off-Site Properties ... 1
2.2 Field Receptor Survey ... 1
2.3 Records Survey ... 1

2.4 Receptor Survey Results 2
2.5 Groundwater Resource Classification 4
2.6 Exposure Pathways 4
2.6.1 Chemical/Physical Properties Governing Transport of Lead, Antimony, Arsenic, Cadmium, and Selenium 6
2.6.2 Transport of COCs in Surface Soil Via Surface Runoff 6
2.6.3 Transport of COCs in Groundwater to Surface Water and Sediments 8
3.0 ASSESSMENT STRATEGY 1
3.1 General Assessment Issues 1
3.1.1 Environmental Media Assessed 1
3.1.2 Target COCs 1
3.1.2.1 Step 1 – Evaluate Permit, Order, or Program Requirements 2
3.1.2.2 Step 2 – Evaluate Project Objectives 5
3.1.2.3 Step 3 – Collect Information That Will Help Determine the Target COC List 5
3.1.2.4 Step 4 – Review the Information Using Professional Judgment 6
3.1.2.5 Step 5 – Select Options When Information Is Insufficient 7
3.1.2.6 Step 6 – Designate the Target COCs 7
3.1.3 Background 8
3.2 Assessment Strategy 8
3.2.1 Soil Assessment Strategy 9
3.2.2 Groundwater Assessment Strategy 10
3.2.3 Flood Wall, Structural Sub-base and Perched Water Assessment Strategy 12
3.2.4 Surface Water and Sediment Assessment Strategy 14
3.2.5 Reconnaissance Slag and Battery Case Chip Assessment 15
3.2.6 Storm Water Retention Pond and Solar Evaporation Pond Evaluations 16
3.2.7 Utilities/Preferential Pathways 18
3.2.7.1 Utilities 18
3.2.7.2 Historical Stewart Creek and North Tributary Stream Channels 21
3.2.7.3 Use of Slag as Fill Material 21
3.2.7.4 Potential of Slag in Fill as Preferential Pathway 23
3.2.8 Landfill/Disposal Area Caps 23
3.2.8.1 Cap Inspections and Permeability Sampling/Analyses 23
3.2.8.2 COC Sampling of Disposal Areas 24
3.3 Assessment Methods 25
3.3.1 Soil Assessment Methods 25
3.3.2 Groundwater Assessment Methods 26
3.3.3 Surface Water Assessment Methods 27
3.3.4 Sediment Assessment Methods 28

3.4 Investigation-Derived Waste 29
3.5 Data Quality 29
3.5.1 SIR Investigation Data Validation Summary 29
3.5.2 APAR Phase I Investigation Data Validation Summary 31
3.5.3 Data Quality Issues Regarding Sample MW-31 (0.9-2') 33
3.5.4 APAR Phase II Data Validation Summary 34
4.0 SOIL ASSESSMENT 1
4.1 Derivation of Assessment Levels 1
4.2 Nature and Extent of COCs and NAPL in Soil 2
4.2.1 Battery Receiving/Storage Building (RCRA HW Permit Unit No. 001; NOR WMU No. 11) 3
4.2.2 Raw Material Storage Building (RCRA HW Permit Unit No. 002; NOR WMU No. 5) 5
4.2.3 Slag Treatment Building (NOR WMU No. 8) 7
4.2.4 Stewart Creek Flood Wall 10
4.2.4.1 Flood Wall Facility Side 10
4.2.4.2 Flood Wall Creek Side 11
4.2.5 Additional NOR WMUs within the Former Production Area (NOR WMU Nos. 6, 9, 14, and 16) 12
4.2.6 North Disposal Area (NOR WMU No. 3) 15
4.2.7 Slag Landfill (NOR WMU No. 7) and Former Stewart Creek and North Tributary Railroad Outfall 18
4.2.8 Boneyard and NOR WMU No. 17 21
4.2.9 Class 2 Landfill (NOR WMU No. 12) 22
4.2.10 Bale Stabilization Area 24
4.2.11 Truck Staging Area, Administrative Building Area, and Maintenance Building 25
4.2.12 South Disposal Area (NOR WMU No. 4) 27
4.2.13 Crystallization Unit Frac Tank (NOR WMU No. 15) 30
4.2.14 Former Shooting Range Berm and the South Berm 32
4.2.15 Potential Ecological Habitat Areas 33
4.2.16 Lake Parcel 34
4.2.17 Firefighter Training Area 34
4.2.18 Former Burn Pile Area 35
4.2.19 Western Part of North Tributary 35
5.0 GROUNDWATER ASSESSMENT 1
5.1 Derivation of Assessment Levels 2
5.2 Nature and Extent of COCs in Groundwater 3
5.3 Nature and Extent of NAPL in Groundwater 8
6.0 SURFACE WATER ASSESSMENT AND CRITICAL PCL DEVELOPMENT 1
6.1 Type of Surface Water and Applicable Water Quality Criteria 1

6.2 Surface Water Risk-Based Exposure Levels (RBELs) for Human Health and Aquatic Life Protection 1
6.3 Nature and Extent of COCs in Surface Water 2
6.4 Critical PCL for Surface Water 3
7.0 SEDIMENT ASSESSMENT AND CRITICAL PCL DEVELOPMENT 1
7.1 Type of Sediment and Applicable Criteria 1
7.2 Sediment Risk-Based Exposure Levels (RBELs) 2
7.3 Nature and Extent of COCs in Sediment 3
8.0 AIR ASSESSMENT AND CRITICAL PCL DEVELOPMENT 1
9.0 ECOLOGICAL RISK ASSESSMENT 1
10.0 COC SCREENING 1
10.1 Frequency of Detection 1
10.2 Lab Contaminant or Blank Contaminant 1
10.3 COC Not Sourced On-site 1
10.4 Appropriate Sample Quantitation Limits 2
10.5 Screened COCs Expected to be Present Dropped from Future Sampling 2
11.0 SOIL CRITICAL PCL DEVELOPMENT 1
11.1 Tier 2 or 3 PCL Development and Non-Default Parameters 1
11.2 Soil PCL Adjustments 1
11.3 Soil Critical PCLs 1
12.0 GROUNDWATER CRITICAL PCL DEVELOPMENT 1
12.1 Tier 2 or 3 PCL Development and Non-Default Parameters 1
12.2 Groundwater PCL Adjustments 1
12.3 Groundwater Critical PCLs 1
13.0 NOTIFICATIONS 1
13.1 Section 13.1 Notification of Actual or Probable Exposure 1
13.2 Section 13.2 Other Notifications 1

1.0 PROPERTY INFORMATION

1.1 Physical Location

1.1.1 Property Location and Land Use

The Exide Technologies (Exide) Frisco Recycling Center (FRC) is a former oxide manufacturing, battery recycling and secondary lead smelting facility located at 7471 South 5th Street in Frisco, Collin County, Texas. The FRC encompasses approximately 257 acres consisting of the 87-acre Former Operating Plant (FOP) and the surrounding 170-acre Undeveloped Buffer Property. This Affected Property Assessment Report (APAR) addresses assessment activities conducted at the FOP (the Site), which includes the FRC's former operational areas, two closed pre-RCRA landfills (North Disposal Area and South Disposal Area), one closed Class 2 landfill (the Slag Landfill), one active Class 2 landfill, and other ancillary facilities (Figure 1A.1). Based on discussions with Exide, The current and anticipated future land use of the FOP is commercial-industrial.

Stewart Creek is approximately 8 miles long running from east of the Site to the west of the Site, ultimately flowing into Lake Lewisville. The TCEQ has classified Stewart Creek as perennial. A portion of Stewart Creek runs through the central portion of the Site from east to west along the south side of the former production area. This APAR also addresses assessment activities conducted in on-site and off-site segments of Stewart Creek, including upstream of the FOP on the Undeveloped Buffer Property and downstream of the FOP from the BNSF railroad bridge, located at the western boundary of the FOP, to Lake Lewisville.

Land immediately adjacent to the FOP primarily consists of undeveloped portions of the Undeveloped Buffer Property (Figure 1A.1). An affected property assessment of the Undeveloped Buffer Property was conducted concurrently with the FOP investigation, and the APAR for the Undeveloped Buffer Property was submitted to The Texas Commission on Environmental Quality (TCEQ) on April 1, 2014 (PBW, 2014). Land immediately adjacent to the FOP includes the following properties:

- West: Undeveloped Buffer Property, the St. Louis-San Francisco Railroad (owned by BNSF) and an aggregate distribution facility;
- North: Undeveloped Buffer Property, an automotive repair facility, an equipment/automotive yard, a batting cage facility, a heating and air conditioning facility, other commercial properties, and residential properties;
- Northeast: An automotive repair facility and a plumbing supply facility;
- East: Undeveloped Buffer Property; and
- South: Undeveloped Buffer Property.

Land surrounding the properties immediately adjacent to the FOP includes both residential and commercial-industrial properties. Properties immediately surrounding Stewart Creek between the Site and Lake Lewisville primarily include residential, undeveloped, agricultural, or commercial-industrial properties. Stewart Creek flows through the planned Grand Park area to the west of Dallas North Tollway. Grand Park is a 320 acre property currently owned by the City of Frisco which is currently unused pasture or wooded floodplain (CJI, 2014).

1.1.2 Topography

The Site is located within a shallow valley created by the drainages of two streams that flow in a general east to west direction through the Site. The on-site streams include Stewart Creek, which runs along the south side of the former production area, and an unnamed tributary of Stewart Creek (the "North Tributary"), which runs north of the North Disposal Area and the Slag Landfill (Figure 1A.1). The confluence of these streams occurs northwest of the FOP's former production area.

In general, the ground surface at the Site slopes toward Stewart Creek or the North Tributary. Based on survey data from the Site, ground surface elevations range from approximately 685 feet above mean sea level (msl) in the southeastern portion of the Site at an outcrop of the Austin Group (the "Austin Chalk") to approximately 610 feet msl at Stewart Creek near the western boundary of the Site. Stewart Creek flows to the southwest and eventually flows into Lake Lewisville. The elevation of the water on Lake Lewisville is approximately 515 ft.

According to the 2009 Federal Emergency Management Agency (FEMA) Flood Insurance Rate Map for Collin County, Texas, areas of the Site along Stewart Creek and the North Tributary are located within the 100-year flood plain (FEMA, 2009) (Figure 1A.2). A barrier wall (designated as the "Flood Wall") was constructed between the former production area and Stewart Creek in 1988 to reduce the potential for flooding in the former production area from Stewart Creek and to serve as a runoff control feature that captures storm water and wash water in the former production area (Lake, 1991). However, the FEMA flood zone demarcated along Stewart Creek and the North Tributary near the former operating area do not appear to consider the flood wall or other Site improvements. Based on review of mapped flood plain elevations near the former production area (approx. 635 feet msl) and the elevation of the Flood Wall (approx. 637 feet msl), it appears the Flood Wall would prevent, as designed, flooding in this area. A revised FEMA flood zone demarcation can either be addressed by a Letter of Map Revision (LOMR) or a Letter of Map Amendment (LOMA). The LOMR process essentially consists of a demonstration that the flood elevation along drainages (in this case Stewart Creek and the North Tributary) is not negatively affected by the structures. The LOMA entails mapping of the flood elevations along the drainages with the existing structures (e.g. Flood Wall) which are then input into a model (such as HEC) to evaluate impacts of the structures.

1.1.3 Weather

The average annual rainfall in the Dallas area is highly variable, ranging from less than 20 inches per year to more than 50 inches per year, with the largest amount of monthly precipitation occurring in May and October. Periods of rainy weather typically last for one to two days. Thunderstorms occur throughout the year, but are most common during the spring. During the summer, daily high temperatures frequently exceed 100 degrees Fahrenheit (^{o}F) and daily lows are generally less than 80°F. Summer hot spells are typically 3 to 5 days in duration, broken up by periods of thunderstorm activity. Winters are mild, with short periods of extreme cold (NOAA, 2013).

TCEQ has published wind rose diagrams for the Dallas-Fort Worth area using wind data obtained from the EPA for the years 1984-1992 (TCEQ, 2013a). The TCEQ wind rose diagrams indicate that the prevailing wind direction in the area is toward the north during each month of the year. Southerly (south to north) winds are particularly dominant during spring, summer, and fall months. Northerly winds are common in winter, but still occur less frequently than southerly winds during that period.

1.2 Affected Property and Sources of Release

1.2.1 History and Operations

1.2.1.1 Agricultural Use

The Site and surrounding areas (including areas surrounding Stewart Creek from upstream of the FRC to Lake Lewisville) were historically used for agricultural purposes likely dating to prior to the early 1900s (City of Frisco, 2014). The 1929 topographic map for the area depicts structures and roads consistent with agricultural development at that time (USGS, 1929). Based on a review of historical aerial photos for the Site, portions of the FRC were used for agricultural purposes as early as 1951 (the earliest aerial photograph reviewed for the Site) through as late as 1984 (Appendix 22). Specifically, the area of the FRC north of the FOP was used for agricultural purposes prior to construction of the Class 2 Landfill. Aerial photos for the area including and surrounding the planned Grand Park area (downstream Stewart Creek between Dallas North Tollway and just south of Stonebrook Parkway) show agricultural land use as early as 1942 (the earliest aerial photograph reviewed for the Grand Park area) with some areas remaining as unused pasture in 2014 (CJI, 2014).

The University of Texas at Austin Bureau of Economic Geology (BEG) prepared a report in 2005 that evaluated arsenic contamination in Texas (BEG, 2005). Based on information included in this report, over the past 100 years, agricultural uses of arsenic compounds have included use of arsenic as a component of animal feed, herbicides and pesticides. Documented uses include:

- Arsenic was used as a defoliant until 1992.

- Inorganic arsenical products were used as herbicides and insecticides in the first half of the 20th century until banned in 1988.
- Calcium arsenate was specifically used to fight a cotton pest, the boll weevil.
- Sodium arsenite was used in sheep and cattle dips.
- Another inorganic arsenical product, arsenic acid, was massively used as a cotton desiccant in Texas from approximately 1965 to 1992, when it was banned by EPA.

Although specific records are not available regarding the exact type of agricultural activities performed at the Site and surrounding areas, many of the agricultural tracts were likely used for cotton farming given: 1) cotton was historically identified as the main cash crop in Collin County (USDA, 1969) and 2) the development of the City of Frisco as a hub for area cotton farmers providing cotton gins and grain elevators (CCHC, 2014).

1.2.1.2 Industrial Use

The FOP was developed for industrial purposes in approximately 1964 when Bers Metals constructed the FRC facility and began operations to produce lead oxide (Lake, 1991). In approximately 1969, battery recycling operations began at the facility. Since 1969, the FRC has recycled spent automobile and industrial batteries and other lead-bearing scrap materials to produce lead, lead alloys, and lead oxide. Exide acquired GNB Technologies in 2000 (including the facility) and operated the plant until its closure in November 2012. The FRC is currently classified under North American Industry Classification System (NAICS) codes 331492 (Secondary Smelting); however, smelting activities have ceased and will not be resumed at the facility. Demolition of the on-site buildings began in the spring of 2013 in accordance with the Decontamination and Demolition Work Plan (PBW/RSI, 2013a), the last revision of which was submitted to the TCEQ on January 25, 2013. The only buildings currently remaining at the facility are the Administrative Building, the on-site Wastewater Treatment Facility, the Crystallization Unit, and a former City of Frisco firefighter training facility (Figure 1A.1).

A RCRA Hazardous Waste Permit for the FRC (RCRA HW Permit No. 50206) was originally issued to GNB on May 24, 1988 (Exide, 2001). The RCRA HW Permit was reissued to Exide on March 30, 2001. The permit authorized the FRC to store and process lead-acid batteries and other lead-bearing materials in two permitted units: The Battery Receiving/Storage Building (RCRA HW Permit Unit No. 001) and the Raw Material Storage Building (RCRA HW Permit Unit No. 002). Both permitted units are located within the former production area at the Site (Figure 1A.1). Closure activities for the two permitted units are ongoing in conformance with closure requirements in the RCRA Permit, discussions with TCEQ personnel, and procedures detailed in the Decontamination and Demolition Work Plan (PBW/RSI, 2013a). As indicated previously, the structures for both units have been demolished, and all that remains are the concrete foundations and floors.

Additional structures that are or were previously located within the former production area include the Battery Breaker Building, Slag Treatment Building, Maintenance Building, the Furnace Building (which housed the blast furnace and reverberatory furnace), an oxide production facility (Oxide Building), the refining/casting and finished goods storage facility (Refines and Shipping), a wastewater treatment facility, an administrative/health and safety building (the Administrative Building), and other ancillary facilities (Figure 1A.1). Site facilities located outside of the former production area include a storm water retention pond, Crystallization Unit (used in wastewater treatment process), two closed pre-RCRA landfills (North Disposal Area and South Disposal Area), one closed Class 2 landfill (the Slag Landfill), an active Class 2 landfill (the Class 2 Landfill)/with solar evaporation pond, a former City of Frisco firefighter training facility, and a former shooting range berm (removed in 2013).

The demolition of the buildings on-site was conducted in accordance with the Decontamination and Demolition Work Plan (PBW/RSI, 2013a), the last revision of which was submitted to the TCEQ on January 25, 2013. Demolition of most on-site buildings has been completed. As indicated previously, the only buildings that currently remain at the facility are the Administrative Building, the on-site Wastewater Treatment Facility, the Crystallization Unit, and a former City of Frisco firefighter training facility.

Battery recycling operations at the FRC were typical of the secondary lead recycling industry (Lake, 1991; RMT/JN, 1995; Exide, 2001; TCEQ, 2011a). Batteries and other lead-bearing scrap received by the FRC were initially stored in the Battery Receiving/Storage Building. The batteries were transferred to the Battery Breaker Building, where they were shredded or crushed. Lead-bearing materials were separated from the polypropylene and hard rubber components of the batteries using a vibrating table and water baths located in the Battery Breaker Building. The lead-bearing components of the batteries were rinsed, drained, and transferred to the Raw Material Storage Building where they were stored and mixed with other lead-bearing materials. This material was then placed on a feed table with a front end loader and automatically placed into a rotary-drier before being fed to the reverberatory furnace via a system of screw auger delivery systems. The reverberatory furnace produced lead bullion and slag (i.e., masses of solid, rock-like impurities that separate from the bullion in the furnace). Slag from the reverbatory furnace and drosses (i.e., masses of solid impurities floating on the bullion) from refining operations were used as feed for the blast furnace. The lead bullion produced by the furnaces was processed in refining kettles, yielding refined lead and various lead alloys that were cast into ingots and shipped to battery manufacturing plants and other industries. Flue dust from the furnaces was captured and recycled back through the furnaces. The slag from the blast furnace was periodically taken by front end loader to the Slag Treatment Building, where it was crushed, screened, and mixed with water and a stabilization agent to chemically fix the remaining lead content. During the period that Exide operated the FRC (2000-2012), the treated slag was disposed on-site in the Class 2 Landfill. Prior to Exide purchasing the facility, slag

was disposed in the pre-RCRA landfills (South Disposal Area and North Disposal Area) and post-RCRA landfills (Slag Landfill and Class 2 Landfill) located on-site.

Process wastewater generated when the Site was operating was treated in the on-site Wastewater Treatment Facility (to remove metals) and then through the Crystallization Unit (to remove salts), producing condensate that was then discharged to the North Texas Municipal Water District (NTMWD) sanitary sewer. Prior to construction of the on-site waste water treatment plant in approximately 1988, wastewater from the Site was pre-treated and then discharged to the Former Stewart Creek Waste Water Treatment Plant located adjacent to the west side of the Site for off-Site treatment (Figure 1A.1).

Current storm water control features within the former production area include a concrete slab cover located throughout the former production area, the Flood Wall located between the former production area and Stewart Creek (acts as a flood wall/retaining wall), and a French drain system located on the facility side of the Flood Wall that was constructed as an interim measure to address seepage of perched water in the former operations area through the Flood Wall. The perched water is believed to be stormwater that has migrated between cracks and joints of the concrete in the former operations area. These storm water control features route storm water to a conduit near the western end of the Flood Wall that directs the water to a storm water retention pond located on the south side of Stewart Creek (Figure 1A.1). According to former FRC personnel, the storm water retention pond was constructed in approximately 1987-1988, which corresponds to the timing of the construction of the Flood Wall. Water within the retention pond historically was either treated and discharged to Stewart Creek or was used as make-up water in the plant's process streams. Discharge of water to Stewart Creek is regulated by the TCEQ under Texas Pollutant Discharge Elimination System (TPDES) Permit No. WQ0002964000. The areas of the Site outside of the former production area generally have moderate relief that is stabilized with vegetation. Runoff from these areas flows into either Stewart Creek or the North Tributary. All surface water features within the City of Frisco, including Stewart Creek, are included in the City's MS4 permit.

There are currently no planned future operations at the Site other than maintaining the current buildings and systems until they are no longer needed (the Administrative Building, the on-site Wastewater Treatment Facility, Storm Water Pond, Solar Evaporation Pond, and the Crystallization Unit), which are included, including demolition as applicable, in the final remediation and maintenance design to be developed in the Remedial Action Plan (RAP) for the Site. Pending evaluation in the RAP for the Site, waste disposal area caps will be managed and maintained or otherwise addressed in compliance with applicable TCEQ requirements. These buildings and systems will be decommissioned and removed when they are no longer needed. The ultimate storm water management plan will be designed in

conjunction with the final remediation and maintenance design to be developed in the RAP for the Site. Future use of the Site will be restricted to commercial-industrial use only.

1.2.2 Project Overview

This APAR describes the methods, findings, and results of investigation activities performed at Exide's FRC FOP in accordance with the TCEQ Agreed Order effective February 10, 2013 (Docket No. 2011-1712-IHW-E). This APAR constitutes a revision of the SIR (PBW, 2012a) prepared by PBW and submitted to the EPA on July 12, 2012, and incorporates the outstanding requirements of Exide under the Administrative Order on Consent (AOC) entered into by Exide and the EPA effective May 2, 2012 (original Docket No. RCRA 06-2011-0966; re-designated by EPA as Docket No. RCRA 06-2012-0966) that were incorporated into the Agreed Order, namely the requirements regarding (i) finalization of the implementation of the requirements of the revised Sampling and Analysis Work Plan (Work Plan) prepared by Conestoga Rovers & Associates (CRA) and approved by the EPA on December 2, 2011 and (ii) revision and finalization of the SIR. The SIR addressed requirements and goals outlined in the Work Plan and included a summary of actions taken to comply with the AOC and an evaluation/comparison of sample data to appropriate Texas Risk Reduction Program (TRRP) protective concentration levels (PCLs) or risk-based exposure limits (RBELs), as applicable. Per the TCEQ Agreed Order, data and findings presented in the SIR have been incorporated into this APAR.

1.2.3 Previous Investigations

Since 1983, numerous investigations have been conducted to characterize the Site soil, groundwater, surface water, and sediments, and evaluate the presence of Chemicals of Concern (COCs) in these media. Available historical data from these investigations are included in Appendix 17. Where historical data indicated PCL exceedances, additional investigation was conducted in those areas. However, historical data were not used to delineate PCL exceedances. PCL exceedances were delineated through sampling activities conducted in connection with the SIR or the APAR investigation of the Site. A summary of key historical documents is described below, with additional documents and information provided in Table 1C.

1.2.3.1 Groundwater Investigation, Frisco, Texas Plant, Dames and Moore, 1983 (D&M, 1983)

D&M conducted a groundwater investigation in the vicinity of the North Disposal Area and South Disposal Area in 1983. For the investigation, seven cores were completed for geotechnical testing. The core holes were converted to monitoring wells upon completion of the cores. Groundwater samples were collected from the monitoring wells and in-situ permeability tests were performed. The study concluded that groundwater was flowing toward Stewart Creek and its tributaries at rates of approximately 3.1×10^{-5} to 1.0×10^{-8} cm/sec (calculated linear velocities).

1.2.3.2 Water and Sediment Tests, GNB Lead Plant, Southwestern Laboratories, 1986a (SWL, 1986a), Stream Sediment Tests; GNB, Inc. Plant, Southwestern Laboratories, 1986b (SWL, 1986b), Stream Sediment Test; GNB, Inc. Plant, Southwestern Laboratories, 1986c (SWL, 1986c); Stream Sediment Tests, GNB, Inc. Plant, Southwestern Laboratories, 1986d (SWL, 1986d)

Water and stream sediment tests were performed in early 1986 by Southwestern Laboratories at twenty-eight locations along the North Tributary and Stewart Creek from the former 5th Street (now Eagan Drive) to the BNSF railroad (SWL, 1986a). These tests were designed as a follow-up sampling event to sediment and surface water tests performed by Southwestern Laboratories during 1984 that indicated elevated concentrations of lead and cadmium in four sediment samples. The surface water and sediment sampling results of the 1986 sampling event indicated that four stream sediment samples exceeded the criteria then for characteristically hazardous waste of 5 mg/L for leachable lead and/or 1 mg/L for leachable cadmium (SWL, 1986a).

These sediment samples were analyzed using the EP (Extraction Procedure) Toxicity method, which was the required laboratory method for evaluating leachability at the time these samples were collected. In 1990, the EPA replaced the EP Toxicity method with the Toxic Characteristic Leaching Procedure (TCLP) (EPA, 1992). The classification of materials as hazardous waste is dependent on the time such material was placed (i.e., pre- or post-RCRA); whether, if the material was placed pre-RCRA, it will be excavated; and the results of TCLP testing.

Dredging of Stewart Creek sediments was performed in 1986 along the segment from the plant area to the BNSF railroad. Three dredging events were performed and sediments were sampled following each event and evaluated for EP Toxicity for lead and cadmium. The final sediment sampling event data (SWL, 1986d) indicated that sediments in the cleanup area were below EP Toxicity concentrations of 5.0 mg/L for lead and 1.0 mg/L for cadmium (the cleanup standards adopted for this work).

1.2.3.3 RCRA Facility Assessment, Texas Water Commission, 1987 (TWC, 1987)

A RCRA Facility Assessment Report was issued by the Texas Water Commission (TWC) on November 16, 1987. In the assessment, nine Waste Management Units (WMUs) were identified: (1) Battery Storage Area; (2) Raw Material Storage Area; (3) Slag Landfill; (4) North Disposal Area; (5) South Disposal Area; (6) Stewart Creek; (7) Old Drum Storage Area; (8) Stewart Creek Sediment Dredging Waste Pile; and (9) Product Waste Pile.

1.2.3.4 Phase I RCRA Facility Investigation, Lake Engineering, 1991 (Lake, 1991)

The Phase I RCRA Facility Investigation (RFI) was initiated in 1990 and consisted of the investigation of several Waste Management Areas (WMAs). WMAs were designated for the purpose of designing a groundwater monitoring system. Investigative activities included soil and groundwater investigations of

WMA 1 (North Disposal Area and Slag Landfill), WMA 2 (Battery Storage Area, Raw Material Storage Area, Old Drum Storage Area, Product Waste Pile, and Oil Leak) and WMA 3 (South Disposal Area); an investigation of WMA 4 (Stewart Creek); and delineation of the North Disposal Area and South Disposal Area. The limits of the North Disposal Area and South Disposal Area were determined during the Phase I RFI by borings around the perimeter of and within these areas. The Phase I RFI report, dated May 8, 1991 (Lake, 1991), and the Addendum to the Phase I RFI Report dated December 10, 1993 (Lake, 1993) identified lead as the primary COC at the Site, and soil as the primary environmental medium of concern. The Phase I RFI also concluded that cadmium is present in soils, but at very low concentrations.

The Texas Natural Resource Conservation Commission (TNRCC) approved the Phase I RFI report and Addendum in correspondence dated June 3, 1994, and requested a Phase II RFI to conduct additional investigation at the former railroad culvert down-gradient of the Slag Landfill; along the railroad spur south of the North Disposal Area; at the closed battery storage area; in the vicinity of the acid sump located in the Battery Breaker Building; in the vicinity of the South Disposal Area; and in the Truck Staging Area. The TNRCC also requested that the Phase II workplan propose remediation of the areas of thinned cover at the North Disposal Area.

1.2.3.5 Stream Investigation; Stewart Creek; Collin County, Texas, Resource Consultants, Inc. , 1991 (RCI, 1991), Stream Investigation; Stewart Creek; Collin County, Texas, Resource Consultants, Inc., 1992 (RCI, 1992)

A study conducted by Resource Consultants in 1991 (RCI, 1991) investigated sediments and surface water at one location upstream of the Site and two locations downstream of the Site. Cadmium hotspots were indicated in the two sediment samples collected downstream. Resource Consultants conducted an additional study in 1992 (RCI, 1992) that investigated the biotic community in order to classify the stream. Three sample locations were chosen, with one upstream of the Site and two locations downstream of the Site. Based on the biotic community observed during the study, the stream was classified as an intermittent stream.

1.2.3.6 RCRA Facility Investigation (RFI) Report Notice of Deficiency, Texas Water Commission, 1993 (TWC, 1993)

Following review of the RCRA Facility Investigation Report (Lake, 1991), the TWC issued a Notice of Deficiency letter dated August 26, 1993. In the Notice of Deficiency, TWC requested additional information and changes to the sampling and statistical methods for groundwater and soil background value calculations and comparisons to RFI sample values. The TWC also requested that Stewart Creek be addressed as a separate RFI project from the rest of the facility. The TWC also requested pH and sulfate analysis for future groundwater samples and additional information regarding the soil properties encountered during the delineations of the South Disposal Area and North Disposal Area. Various other details regarding the investigation were also requested.

1.2.3.7 Addendum to the RCRA Facility Investigation for GNB Incorporated, Frisco, Texas, Lake Engineering, Inc. (Lake, 1993)

The RFI addendum was submitted in response to the TWC Notice of Deficiency letter dated August 26, 1993 (TWC, 1993). The addendum provided additional information as requested by TWC, including a rationale for using MCLs and the Superfund cleanup guidelines in lieu of background values, additional information regarding the soil properties encountered during the North Disposal Area and South Disposal Area delineations, and other investigation details as requested by the TWC.

1.2.3.8 Notification of On-site Class 2 Industrial Waste Landfill, RMT/Jones & Neuse, Inc., 1995 (RMT/JN, 1995)

Prior to construction of the on-site Class 2 Landfill located near the northern boundary of the FOP, a notification was prepared and submitted during 1995 by RMT/JN that included specifications of the landfill design, waste composition, landfill-area geology, a groundwater monitoring plan, and a closure and post-closure care plan. To characterize the landfill-area geology, eighteen soil borings were completed and lithologically described by a geologist. Monitoring wells were installed within nine of the soil borings. Slug tests were performed in four wells and a pumping test was performed in LMW-17. One groundwater elevation gauging event also was conducted. The geologic assessment indicated the presence of limited sand and gravel lenses in the south to southwest portion of the landfill area. The groundwater elevation gauging event indicated a hydrogeologic gradient to the southwest toward the North Tributary.

1.2.3.9 Stewart Creek Final Phase II RFI Report; GNB Technologies; Frisco, Texas, RMT/Jones & Neuse, Inc., 1996 (RMT/JN, 1996)

The Stewart Creek Phase II investigation was performed in accordance with a work plan approved by TNRCC on January 29, 1996. Ninety-eight sediment samples had been previously collected and analyzed for lead and cadmium during 1995. Twenty background sediment samples were also collected and analyzed for lead and cadmium upstream of the former 5th Street on Stewart Creek and Cottonwood Creek, which is a creek that feeds into Stewart Creek. Twenty-six sediment samples were collected in areas of accumulated sediment along Stewart Creek during February 1996. Sixteen sediment sample results reported in the Phase I RFI report (Lake, 1991) were also included in the Stewart Creek Final Phase II Report. Sediment sample locations ranged from the main plant area to the Stewart Creek West Wastewater Treatment Plant, which is located downstream of the Site. Based on sampling results, the report recommended further study of the Stewart Creek segment between the former 5th Street and the 7700-foot marker.

1.2.3.10 Human Health and Ecological Risk Assessment, JD Consulting, Inc., 1998 (JDC, 1998b)

Stewart Creek was addressed as a separate project from the Phase II RFI pursuant to a TNRCC request dated September 16, 1993. The Human Health and Ecological Risk Assessment (HHERA) and

Corrective Measures Study for Stewart Creek (JDC, 1998b) were submitted to the TNRCC on August 5, 1998. This study included an evaluation of Stewart Creek sediment and surface water data from several investigations, including the Phase I RFI (Lake, 1991), the Phase II RFI (JDC, 1998a), additional sediment sampling performed by RMT/JN in 1995 and 1996 and the Stewart Creek Final Phase II (RMT/JN, 1996). The study area for the HHERA included portions of Stewart Creek at the facility area and areas downstream of the facility. The study concluded that the levels of cadmium and lead in surface water did not pose a risk to ecological or human receptors, but that the sediments within the facility boundaries posed a potential risk to human and ecological receptors. In addition, the study noted that cadmium and lead levels at four locations downstream of the facility boundary (6,500 ft, 7,000 ft, 7,200 ft, and 7,600 feet downstream of the former 5th Street) may also pose an ecological risk and warranted further investigation. A Corrective Measures Study for on-site sediments was included in the report as a separate section. Implementation was carried out in accordance with the Corrective Measures Study and a report dated July 13, 2000 was submitted to the TNRCC (See JDC, 2000 below for further details).

1.2.3.11 Phase II RFI, JD Consulting, Inc., 1998 (JDC, 1998a)

A Phase II RFI was conducted by JDC in June 1998 and submitted to the TNRCC in August 1998 pursuant to a work plan prepared by RMT/Jones and Neuse (RMT/JN. 1994), modified by letter dated September 24, 1995 (GNB, 1995a), and approved, with modifications, by the TNRCC on February 27, 1998. The Phase II RFI addressed the areas referenced in the TNRCC's June 3, 1994 correspondence, which approved and noted deficiencies in the Phase I and Phase I RFI Addendum that were to be addressed in the Phase II RFI. Investigative activities included soil sampling at the railroad spur and in the vicinity of the Truck Staging Area (Figure 1B.1). Further delineation of the lateral extent of soil COC concentrations above applicable regulatory standards at the South Disposal Area and development of a Corrective Measures Study were also addressed in the Phase II RFI for the South Disposal Area. Several exceedances of the lead investigation limit of 500 mg/kg were encountered in soil samples from the railroad spur area, north of the Truck Staging Area at sample location NTS-1, and the South Disposal Area.

1.2.3.12 Acceptance of Closure Certification for Four Solid Waste Management Units, Texas Natural Resource Conservation Commission, 2000 (TNRCC, 2000)

The TNRCC issued a letter dated January 13, 2000, that approved closure for the following WMUs: The former Battery Storage Area, Old Drum Storage Area, Stewart Creek Sediment Dredging Waste Pile, and the Product Waste Pile. The letter stated that each WMU was closed according to the closure plans approved by the TNRCC.

1.2.3.13 Corrective Measures Implementation Report, JD Consulting, Inc., 2000 (JDC, 2000)

As a result of the HHERA described above, an approximate 2,800-foot stretch of Stewart Creek sediment was remediated to standards for lead and cadmium approved by the TNRCC (91 mg/kg for lead and 4.23 mg/kg for cadmium). The remediation was carried out by first removing visible slag "buttons" (disc-like pieces of slag formed at the base of refining kettles) from the creek bed and banks, then excavating the soil/sediment to an average depth of 1 foot. Soil/sediment was excavated to deeper depths as needed based on the extent of slag present. Excavated soil/sediment was screened for recoverable slag fragments, which were recycled in the blast furnace at the facility. Remaining soil/sediment was stockpiled and sampled using the TCLP for lead and cadmium. Most samples passed the criteria for Class 2 waste; the samples that did not pass the criteria were treated until they passed. Some stockpiled material was tested for SPLP lead and cadmium for potential re-use as intermediate fill in the active Class 2 Landfill at the facility. The TNRCC approved the re-use proposal on November 8, 1999.

1.2.3.14 Leaking Petroleum Storage Tank (LPST) Case Closure of Subsurface Release of Hydrocarbons at G.N.B Technologies Facility, Texas Commission on Environmental Quality, 2003 (TCEQ, 2003)

Residue associated with a diesel fuel release was discovered in April 1988 during the construction of the Flood Wall adjacent to Stewart Creek. Details of the discovery and subsequent remedial actions are provided in a letter by Lake Engineering to the TWC (Lake, 1988). Following discovery of the residue, a pump and mobile storage tank were immediately installed. Three test holes were advanced to determine the extent of residue; residue was not detected in any of the holes. To enhance collection of residue, an oil recovery sump and intercept trenches were constructed. TCEQ issued a letter dated July 15, 2003 certifying that the former diesel fuel release (LPST ID No. 106075) had met site closure requirements and that no further action was necessary.

1.2.3.15 Report of RCRA Sampling Inspection, 2010 (EPA, 2010a); EPA RCRA Corrective Action Report, 2011 (EPA, 2011a)

EPA (2010a) summarized inspections of the FOP conducted by the EPA during April 2010. During these inspections, the EPA collected samples of leachate from the leachate collection tank for the Class 2 Landfill, untreated slag from the Slag Treatment Building, and treated slag material from the Class 2 Landfill as it was being offloaded from the slag mixer truck. TCLP extracts of the samples were analyzed for thirteen inorganic constituents, including lead, cadmium, antimony, arsenic, barium, beryllium, chromium, nickel, selenium, silver, thallium, vanadium, and zinc. The EPA inspection report (EPA, 2010a) indicated that samples from the leachate tank exceeded Universal Treatment Standards – Non-Wastewater (UTS-N) for antimony, arsenic, and vanadium, while samples of the untreated slag exceeded the UTS-N for barium. The results for all other constituents, including for lead and cadmium, were below the UTS-N for all samples. Although not indicated in the EPA inspection report (2010a), the leachate

samples from the leachate collection tank for the Class 2 Landfill detected arsenic and selenium above the standards for characteristic hazardous wastes.

EPA (2011a) summarized inspections of the FOP conducted by the EPA during December 14-18, 2009, March 15-16, 2010, and March 29, 2010. During these inspections, the EPA identified several areas of concern on-site, including the area between the Battery Receiving/Storage Building, the Slag Treatment Building, the Crystallizer and the creek side of the Stewart Creek Flood Wall. On March 29, 2010, the EPA collected five soil samples and one sample of white crystalline material along the exterior of the Flood Wall from areas where "visibly impacted soil (i.e., wet soil with crystalline substance and dead vegetation)" was observed (EPA, 2011a). The samples were analyzed for total lead, total cadmium, pH, ammonia, phosphorus, and sulfate. Lab results provided by the EPA (2011a) indicate that three of the samples (EX-SS-002, EX-SS-003, and EX-SS-004) exceeded soil RALs for lead and that two of the samples (EX-SS-002 and EX-SS-004) exceeded soil PCLs for cadmium. A sample location map was not provided in the EPA inspection report; therefore, the precise locations of these samples are not known.

On March 15-16, 2010, the EPA collected X-ray fluorescence (XRF) measurements and composite soil samples from the 0 to 1-inch below ground surface (bgs) depth interval in thirteen publicly accessible areas within approximately one mile of the Exide facility, as well as one location farther away (EPA, 2011a). The soil samples as a whole and the screened fine fraction of the soil samples (< 250 micron fraction) were both analyzed for total lead and cadmium. Since EPA screening levels are based on whole-sample soil concentrations, only the whole-sample concentrations were used for comparison with EPA screening levels. The EPA indicated in the report that the fine fraction concentrations were only used in determining locations for further evaluation. The report indicated that all laboratory whole-sample lead and cadmium results for all soil samples collected off-site were below EPA screening levels for these constituents and that the XRF results were comparable to the soil sample results.

1.2.3.16 TCEQ Inspection Report, TCEQ, 2011 (TCEQ, 2011a)

The TCEQ performed an inspection of the facility during several visits to the Site during the period from May 6, 2011 to June 29, 2011. The inspections identified several areas of concern, including areas around the Slag Treatment Building, the South Disposal Area, the Shooting Range Berm, the drainage swale west of the Crystallizer and the creek side of the Stewart Creek Flood Wall. The TCEQ inspection report (TCEQ, 2011a) indicated that samples of treated slag and sediments collected from the Class 2 Landfill during the inspections tested hazardous for TCLP lead and cadmium. Additional soilsamples collected from the storm water conduit where it exits the Flood Wall, along the exterior of the Flood Wall near the Slag Treatment Building, in the drainage swell west of the Crystallizer, and between the Slag Treatment Building and the Flood Wall consisting of soil or crystalline material with entrained soil exceeded soil PCLs for total lead and/or cadmium and/or tested hazardous for TCLP lead and cadmium.

One sample of potential slag with entrained soil from the north side of the Slag Treatment Building near the entrance to the building exceeded soil PCLs for total lead and cadmium and tested hazardous for TCLP lead and cadmium.

1.2.3.17 Suspect Slag Sampling Report; Stewart Creek – West Segment, W&M Environmental, 2011 (W&M, 2011a)

W&M Environmental (W&M) conducted a visual survey of the western reach of Stewart Creek from the Battery Receiving/Storage Building to the BNSF railroad. Suspected slag samples collected from the banks of the creek were photographed and evaluated for lead, cadmium, and iron to develop a visual criteria for identifying suspected slag in the field. Based on analytical results and the resultant visual criteria, occasional slag occurrences were observed along the majority of the study area on both sides of the creek but were noted to occur more frequently along the central portion and eastern portions of the study area. A copy of the W&M (2011a) report is included in Appendix 18.

1.2.3.18 North and South Disposal Areas Evaluation, W&M Environmental, 2011 (W&M 2011b)

W&M conducted a visual inspection of the North Disposal Area and the South Disposal Area to assess the condition of the soil caps and to inspect for suspected slag on the ground surface within each area. The study identified limited areas of exposed slag and/or battery case fragments in the South Disposal Area as well as isolated occurrences of slag on the ground surface to the north and east of the area. The study also noted cracks in the soil above the South Disposal Area, but no slag or battery case fragments were identified in the areas of cracking. In the North Disposal Area, exposed slag was noted within materials storage areas and areas of heavy vehicular traffic in the southern portion of the area. In addition, isolated occurrences of slag were noted along the North Tributary, the railroad spur, and in the wooded area on the north side of the North Disposal Area. The findings of this inspection were incorporated into a later inspection report by W&M (W&M, 2013a) that encompassed a broader area of the FOP. A copy of the W&M (2013a) inspection report is included in Appendix 18.

1.2.3.19 Geotechnical Engineering Report, Rone Engineering, 2011 (Rone, 2011)

A geotechnical study was performed in 2011 in the general area of WMA 1 (North Disposal Area and Slag Landfill) to support the engineering design for a series of buildings and upgrades to existing facility structures proposed at the time of the report. The lithologic information obtained from the borings drilled for this investigation was used in support of Site hydrogeologic evaluation and for the development of geologic cross sections in this APAR.

1.2.3.20 RCRA Section 3013(a) Administrative Order, United States Environmental Protection Agency, 2011 (EPA, 2011b)

The Administrative Order was issued on August 1, 2011 (Docket No. RCRA 06-2011-0966; re-designated by EPA as Docket No. RCRA 06-2012-0966), following an EPA inspection on December 14-18, 2009 and March 29, 2010 and review of historical documents, and was replaced by an Administrative Order on Consent effective May 2, 2012. EPA concluded that there was potential soil, groundwater, sediment, and surface water contamination resulting from the activities at the facility and issued the Administrative Order. The Administrative Order ordered Exide to submit to EPA a workplan that proposed sampling and analysis. A sampling and analysis workplan was prepared by Conestoga-Rovers and submitted to the EPA in November 2011 (CRA, 2011). The SIR (PBW, 2012a) addressed areas noted as potential areas of concern in the Administrative Order. Additional details of the Administrative Order are provided in Table 1C.

1.2.3.21 Laboratory analytical report from the EPA Region 6 Laboratory for EPA samples collected January 11-18, 2012. (EPA, 2012)

The EPA has informed Exide that one sample (Floodwall Comp-01) collected by the EPA in January 2012 (EPA, 2012) from the exterior side of the Flood Wall tested characteristically hazardous for lead (sample TCLP lead concentration = 10.5 mg/L). The EPA has indicated that this sample was a composite of several samples collected from locations along the exterior of the Flood Wall that consisted of white crystalline material with entrained soil. The precise locations (e.g., GPS coordinates) of the composited samples were not provided by the EPA. The lab report is included in Appendix 11.

1.2.3.22 Site Investigation Report, Pastor, Behling & Wheeler, LLC, 2012 (PBW, 2012a)

The SIR investigation was performed in accordance with a Sampling and Analysis Work Plan prepared by Conestoga-Rover Associates, submitted November 2011, and approved by the EPA by email on December 2, 2011, and pursuant to Paragraph 33 of the AOC for the Site, dated May 2, 2012. An investigation of soil, groundwater, surface water, and sediment was conducted to evaluate the nature, location, extent, direction, and rate of movement of any hazardous wastes and/or hazardous constituents which are present at or have been released at the facility. Soil samples were collected from the vicinity of the North Disposal Area, the Slag Landfill, the Raw Material Storage Area, South Disposal Area, Boneyard, Bale Stabilization Area, Crystallization Unit Frac Tank Area, Stewart Creek Corridor, and the Shooting Range Berm area. Sediments were sampled in Stewart Creek and the North Tributary, and surface water was sampled in Stewart Creek. Two surface water gauging stations were installed along Stewart Creek and three gauging events of the surface water and groundwater wells were performed. A groundwater investigation was also conducted during the SIR investigation, which included the installation of two background wells to the east of the Site and sampling of eleven existing wells in order to evaluate groundwater conditions downgradient of WMA 1 (the closed North Disposal Area and Slag Landfill), WMA

2 (the closed Battery Storage Area, Raw Material Storage Area, the closed Old Drum Storage Area, the closed Product Waste Pile and the Former Diesel Fuel Tank release area), and WMA 3 (South Disposal Area). The report recommended additional soil investigations at the Raw Material Storage Area and the Stewart Creek Flood Wall at a creek side sample location adjacent to the Battery Receiving/Storage Building.

1.2.3.23 Agreed Order; Docket No. 2011-1712-IHW-E, Texas Commission on Environmental Quality, 2013 (TCEQ, 2013b)

The TCEQ Agreed Order was entered into between TCEQ and Exide, effective February 10, 2013. The Agreed Order ordered Exide to prevent disposal of waste in the active landfill that exceeds LDR Treatment Standards; to submit a groundwater monitoring plan for the active landfill; to submit an APAR to address areas of concern identified in the May 6, 2011 TCEQ inspection; to submit an APAR for the RCRA Facility Investigation units listed in RCRA HW Permit No. 50206, PS IX.C. and any new areas identified by previous EPA and TCEQ investigations; to dispose of the berm material near the west side of the South Disposal Area; to prevent release of untreated slag and refractory brick from the Slag Treatment Building; and to ensure integrity of and maintain the cover of the South Disposal Area.

1.2.3.24 Wall Seepage Project; Retaining Wall at Stewart Creek, W&M Environmental, 2013 (W&M, 2013b)

W&M previously prepared a report detailing the construction of the French drain along the facility side of the Flood Wall in 2012. A copy of the report is provided in Appendix 11. According to the W&M report, water seepage along the exterior of the Flood Wall was observed by the EPA (EPA, 2011a) and TCEQ (TCEQ, 2011a) during Site inspections conducted from 2009 to 2011 in the area between the Slag Treatment Building and the Battery Receiving/Storage Building (see Figure 1A.1). Exide periodically sealed cracks on the exterior face of the Flood Wall in a number of locations; however, seepage continued in some areas, resulting in spalling and deterioration of the exterior wall face and localized areas of wet soil and/or standing water at the exterior base of the wall. The French Drain was proposed to mitigate seepage of water through the Flood Wall.

Prior to construction of the French Drain, a subsurface investigation consisting of soil borings and groundwater observation wells was completed on the facility side of the Flood Wall to evaluate groundwater elevations in relation to the elevations of observed seepage. W&M concluded that source(s) of artificial recharge were resulting in saturation of the shallow fill soils on the facility side of the Flood Wall, presumably caused by storm water and wash water from operation areas infiltrating into the fill material through cracks, joints, and areas of deteriorated concrete, and/or leaks from subsurface drains or sumps located within the plant. The French drain system was designed to collect and convey water from the zone of saturated, shallow fill behind the Flood Wall to a sump, where it is collected and pumped to

the storm water retention pond. As-built drawings of the French Drain system are provided in the W&M French drain construction report provided in Appendix 11.

W&M visited the wall on three occasions (un-specified date in November 2012; March 28, 2013; and June 6, 2013) after the drain was completed to observe the condition of the wall. On each occasion, the entire perimeter of the wall was walked and observed for evidence of ongoing seepage. W&M indicated that no evidence of recent seepage was observed during the site visits. Photographs of the Flood Wall were taken by W&M during the March 28, 2013 site visit, which are included directly after the Wall Seepage Report in Appendix 11.

1.2.4 Potential Sources of Release

Potential source areas were identified based on historical knowledge of operations at the Site, including waste storage, processing, handling, and disposal activities. As described in the following sections, potential source areas evaluated during the SIR and APAR investigations include WMUs identified in the Phase I RFI (Lake, 1991; Lake, 1993; and JDC, 1998a), areas identified in the EPA-approved Work Plan (CRA, 2011), WMUs identified on the TCEQ Solid Waste Notice of Registration for the FRC (NOR No. 30516), and potential source areas documented in other previous investigations of the Site. Table 1A lists the potential sources of releases that have been identified at the Site.

A list of documented historical releases at the Site is provided in Table 1D. The list of documented historical releases includes releases identified prior to the start of the SIR investigation--the findings of that investigation and subsequent investigations are detailed in this APAR--as identified in EPA and TCEQ Site inspection reports and other site assessment reports prepared on Exide's behalf. As indicated on Table 1D, historical releases have been documented in the former production area (battery management system, Former Diesel Tank Area, Old Drum Storage Area, Raw Material Storage Building, and Slag Treatment Building), within or adjacent to Site disposal areas (Boneyard, North Disposal Area, South Disposal Area), and within or adjacent to Stewart Creek. The historical releases generally have been associated with exposed slag, battery case fragments, or other process waste materials (e.g., white crystalline precipitate material identified on the exterior side of the Flood Wall during EPA and TCEQ site inspections). Exceptions to this include a historical diesel fuel release identified in the Former Diesel Tank Area (Lake, 1988), liquid observed leaking from the Crystallization Unit Frac Tank (EPA, 2011a), and a hydraulic fluid leak observed in the Boneyard (EPA, 2011a).

1.2.4.1 Potential Sources of Release Identified in the Phase I RFI

The Phase I RFI (Lake, 1991) evaluated nine WMUs that were identified in the RCRA HW Permit as units requiring investigation:

1.2.4.1.1 Battery Storage Area

The former Battery Storage Area was located on a concrete slab within the former production area and was used to store palletized whole spent lead-acid batteries (Lake, 1991). The unit was closed in 1989. Closure information and the closure certification for this unit were included in the Phase I RFI Report. According to Exide personnel, the Battery Receiving/Storage Building (RCRA HW Permit Unit No. 001) was constructed in approximately 1988-1989 to replace the Battery Storage Area.

1.2.4.1.2 Raw Material Storage Area

The Raw Material Storage Area was a steel and concrete building with a concrete slab floor located within the former production area. It was used to temporarily store lead-bearing raw materials and other process materials (Lake, 1991). The unit is registered on the 2001 RCRA Permit as the "Raw Material Storage Building" (RCRA HW Permit Unit No. 002). According to Exide personnel, the unit was constructed in approximately 1979-1980.

1.2.4.1.3 Slag Landfill

The Slag Landfill is a closed landfill, listed as inactive on the NOR, that was used for the disposal of non-hazardous, Class 2, slag-containing material. It is located northwest of the former production area and is bound by the North Tributary to the north, the North Disposal Area to the southeast, and the railroad spur to the southwest.

1.2.4.1.4 North Disposal Area

The North Disposal Area is a pre-RCRA closed landfill located immediately north of the former production area. It is bound by the Slag Landfill to the west and the Bale Stabilization Area to the east. The landfill was capped and closed in 1978. Closure documentation was included in the Phase I RFI Report (Lake, 1991). The lateral and vertical extents of the North Disposal Area were determined as part of the Phase I RFI, documented in the 1993 Addendum to the Phase I RFI (Lake, 1993). The locations of the delineation borings are shown on Figure 1B.1 and boring description tables from the Phase I RFI Addendum are reproduced in Appendix 2. Boring locations with the "NL" designation were bored through clay soils to a minimum depth of ten feet bgs. During the Phase I RFI "several pockets of slag, construction debris, and normal household and industrial trash" were encountered within the North Disposal Area (Lake, 1993). A portion of the NDA was reportedly used by the City of Frisco and local residents for disposal of municipal waste.

1.2.4.1.5 South Disposal Area

The South Disposal Area is a closed pre-RCRA landfill located on the south side of the FOP property used for the disposal of battery case fragments and slag (Lake, 1991). According to a memorandum provided by Larry Eagan (Eagan, 2013a), former plant manager at the FRC, soil was quarried from a

borrow pit at the location of the South Disposal Area during the period from 1960 to 1964 (prior to construction of the landfill) to serve as fill for the foundation of the Oxide Building. The South Disposal Area landfill was capped and closed in 1974. Closure documentation was included in the Phase I RFI Report (Lake, 1991). The lateral and vertical extents of the South Disposal Area were determined as part of the Phase I RFI, documented in the 1993 Addendum to the Phase I RFI (Lake, 1993). The locations of the delineation borings are shown on Figure 1B.1 and boring description tables from the Phase I RFI Addendum are reproduced in Appendix 2. Boring locations with the "SL" designation were bored through clay soils to a minimum depth of eight feet bgs. During the Phase I RFI "blast furnace slag and rubber chips" were encountered within the South Disposal Area (Lake, 1993).

During a site inspection in 2011, the TCEQ observed that the cap cover of the South Disposal Area on the south side had been eroded, exposing battery case fragments in various areas along the slope (TCEQ, 2011a). On June 3, 2013, representatives of W&M, PBW, and Remediation Services, Inc. (RSI) met with representatives of the TCEQ at the Site. The South Disposal Area was walked, typical areas requiring repair were identified, and repair procedures were discussed. The repairs to the South Disposal Area cap were conducted on June 5, 2013 and June 27, 2013. A report documenting the cap repair activities (W&M, 2013c) is provided in Appendix 11.

1.2.4.1.6 Stewart Creek

As described above, Stewart Creek is a creek running from east of the Site to the west of the Site, ultimately flowing approximately 8 miles downstream from the Site into Lake Lewisville. A portion of Stewart Creek runs through the central portion of the Site from east to west along the south side of the former production area. Several remediation actions have been implemented within Stewart Creek, including dredging activities that removed impacted sediment and slag from the channel and banks in 1986 and 1999. JDC submitted a report (JDC, 2000) to the TNRCC documenting remediation activities conducted in the creek in 1999. Completion of the closure/remediation actions was approved by the TNRCC in a letter dated July 25, 2000.

In 1988, GNB constructed a Flood Wall between the former production area and Stewart Creek to act as both a retaining wall to contain surface runoff within the former production area and as a flood wall to protect against flooding from Stewart Creek (Lake, 1991).

1.2.4.1.7 Old Drum Storage Area

The Old Drum Storage Area was formerly located on the south side of the Raw Material Storage Building. GNB removed lead and cadmium-impacted soil during the closure of the Old Drum Storage Area in 1987 and deed recorded the area in accordance with the closure plan. The closure certification and related information on the closure were included in the Phase I RFI Report (Lake, 1991).

1.2.4.1.8 Stewart Creek Sediment Dredging Waste Pile

A pile of sediment dredged from Stewart Creek in 1986 was disposed on-site overlying the western portion of the North Disposal Area. The dredged sediment pile was capped and closed in 1989. The closure report and related information were provided in the Phase I RFI Report (Lake, 1991).

1.2.4.1.9 Product Waste Pile

The Product Waste Pile area was formerly located adjacent to the Battery Breaker Building. It included two waste piles that served as collection points for rubber battery case case fragments stored on top of the concrete slab in the former production area. The closure certification completed in 1988 and related closure information were provided in the Phase I RFI Report (Lake, 1991).

As previously noted in Section 1.2.3, the nine WMUs listed above were initially identified by the TWC in an RFA dated November 16, 1987 (TWC, 1987). Closure of the former Battery Storage Area, Old Drum Storage Area, Stewart Creek Sediment Dredging Waste Pile, and Product Waste Pile was approved by the TNRCC in a letter dated January 13, 2000 (TNRCC, 2000). As noted previously, completion of the closure/remediation actions associated with Stewart Creek in 1999 was approved by the TNRCC in a letter dated July 25, 2000.

A tenth WMU, residue from a diesel release at the Former Diesel Tank Area (Figure 1B.1), was identified during construction of the Flood Wall in 1988, and after the initial TWC RFA for the Site was completed. The release was subsequently remediated and closed within the TCEQ LPST Program (LPST ID No. 106075). As noted previously, the TCEQ approved completion of the corrective action requirements for the release incident in a letter dated July 15, 2003 (TCEQ, 2003).

Additional investigative activities were conducted in these and other areas of the Site during the Phase II RFI (JDC, 1998a; JDC, 1998b). As noted in Section 1.2.3, several exceedances of the RAL for lead were detected during this study in soil samples at the railroad spur near the Battery Breaker Building, in the vicinity of the Truck Staging Area, and in the vicinity of the South Disposal Area.

1.2.4.2 Potential Sources Identified in the 2011 Sampling and Analysis Work Plan

The EPA-approved Work Plan (CRA, 2011) identified eight potential source areas requiring investigation, including several areas identified in the Phase I RFI (the North Disposal Area, Slag Landfill, Raw Material Storage Area, and South Disposal Area), and the following additional areas:

1.2.4.2.1 Boneyard

The Boneyard was located on the southwest side of the Slag Landfill within the boundary of the Slag Landfill. Unused equipment was formerly stored in this area (CRA, 2011). During an inspection in

December 2009, the EPA noted that several pieces of equipment in this area contained process materials/wastes and that one piece of hydraulic equipment was leaking.

1.2.4.2.2 Bale Stabilization Area

The Bale Stabilization Area is located along the eastern edge of the North Disposal Area and adjacent to the Truck Staging Area. Bales of shrink wrap and cardboard materials used as packaging for batteries delivered to the Site were placed in roll-off boxes located in this area and treated with a stabilization agent prior to off-site disposal (CRA, 2011; TCEQ, 2011a).

1.2.4.2.3 Crystallization Unit Frac Tank

The Crystallization Unit, located on the south side of the property, is used to remove sodium sulfate from wastewater after it is treated in the Wastewater Treatment Facility and before it is discharged to the NTMWD sanitary sewer (CRA, 2011). Approximately once per month, a “boil out” of the Crystallization Unit is performed to clean the unit. The liquid from the boil out is collected in the Crystallization Unit Frac Tank, sampled, and then sent off-site for solidification and disposal. The Crystallization Unit Frac Tank sits on top of the Crystallization Unit’s concrete slab foundation. The AOC states that EPA inspectors observed liquid leaking from the frac tank, as well as visible drainage pathways leading from the frac tank to the edge of the concrete slab. Following the EPA’s inspection of this area, the frac tank seals were repaired and inspected, and curbing was enhanced such that runoff or spillage in the area is collected in a sump, treated as necessary, and returned to the storm water process stream (CRA, 2011).

1.2.4.2.4 Stewart Creek Flood Wall

The Flood Wall acts as both a retaining wall to contain surface runoff within the former production area and as a flood wall to protect against flooding from Stewart Creek. Seepage and white crystalline material has been noted on the exterior of the Flood Wall during inspections of the Flood Wall area by the EPA and TCEQ (EPA, 2011a; TCEQ, 2011a).

As noted previously, the EPA collected five soil samples and one sample of white crystalline material on March 29, 2010 along the exterior of the Flood Wall from areas where “visibly impacted soil (i.e., wet soil with crystalline substance and dead vegetation)” was observed (EPA, 2011a). The samples were analyzed for total lead, total cadmium, pH, ammonia, phosphorus, and sulfate. Lab results provided by the EPA (2011a) indicate that three of the samples (EX-SS-002, EX-SS-003, and EX-SS-004 with lead concentrations of 1,370 mg/kg, 1,040 mg/kg, and 5,610 mg/kg, respectively) exceeded soil PCLs for lead and that two of the samples (EX-SS-002 and EX-SS-004 with cadmium concentrations of 74.1 mg/kg and 220 mg/kg, respectively) exceeded soil PCLs for cadmium. A sample location map was not provided in the EPA inspection report; therefore, the precise locations of these samples are not known.

The EPA has informed Exide that one sample (Floodwall Comp-01) collected by the EPA in January 2012 (EPA, 2012) from the exterior side of the Flood Wall tested characteristically hazardous for lead (sample TCLP lead concentration = 10.5 mg/L). The EPA has indicated that this sample was a composite of several samples collected from locations along the exterior of the Flood Wall that consisted of white crystalline waste material with entrained soil. The precise locations (e.g., GPS coordinates) of the composited samples were not provided by the EPA. The analytical report is included in Appendix 11.

The TCEQ collected two soil samples along the exterior of the Flood Wall during inspections of the Site in May-June 2011 (TCEQ, 2011a). One sample was collected south of the Slag Treatment Building in an area of dead vegetation where the TCEQ observed indications of seepage through the wall. The sample (total lead = 3,560 mg/kg; TCLP lead = 2.86 mg/L) exceeded soil PCLs for total lead, but did not test hazardous for TCLP lead. A second soil sample was collected consisting of "soil and rock" (TCEQ, 2011a) in the area where the storm water conduit exits the Flood Wall. The inspection report stated that, "the pipe appeared to be leaking due to worn out gaskets." The second sample (total lead = 39,800 mg/kg; TCLP lead = 127 mg/L; total cadmium = 894 mg/kg; TCLP cadmium = 12.2 mg/L) exceeded soil PCLs for total lead and cadmium and tested hazardous for TCLP lead and cadmium.

A French drain system was installed along the facility side of the Flood Wall in 2012 as an interim measure to address seepage through the Flood Wall. The French drain construction activities are documented in a report prepared by W&M (W&M, 2013b), which is provided in Appendix 11.

1.2.4.2.5 Former Shooting Range Berm

A shooting range formerly operated in the vicinity of the South Disposal Area. A soil pile behind the former target area was located west of the South Disposal Area (Figure 1A.1). Battery casings and slag were noted during the TCEQ inspection on the easternmost surface of the pile (TCEQ, 2011a). During the SIR investigation, the Former Shooting Range Berm was evaluated by means of three test trenches excavated perpendicular (east-west) to the long axis (north-south) of the berm. These test trenches were visually inspected for bullets, clay pigeon fragments, battery casing fragments, and slag or other foreign materials. No soil samples were collected at that time. The test trench observations indicated that foreign materials were generally absent in the westernmost portions of the berm and were generally limited to near or just below the berm surface (i.e., not in the berm interior) in the easternmost portions of the berm. Pursuant to Ordering Provision 3.c.iii of the TCEQ Agreed Order, the former Shooting Range Berm was removed in April 2013. Residual soil samples were collected after removal of the berm, the results of which are provided in Section 4.

Bermed material identified by the TCEQ east-adjacent to the former Shooting Range Berm (the South Berm) was also removed as required by the TCEQ in June 2013. Residual soil samples were collected from the footprint of the South Berm after it was removed (see Section 4).

Removal activities for the Former Shooting Range Berm and the South Berm are detailed in the FRC Former Shooting Range Berm Removal Action Report (PBW, 2013b) provided in Appendix 11.

1.2.4.3 Notice of Registration Waste Management Units

Nineteen WMUs are listed on the TCEQ NOR for the FRC (NOR No. 30516), which is provided in Appendix 4. The following table summarizes each of the WMUs listed on the NOR for the FRC.

WMU ID No.	NOR Description	Status on NOR	Additional Information
1	*No description provided in NOR*	Inactive	According to plant personnel, this unit corresponds to the Former Product Waste Pile that was removed in 1988 (see item 9 in Section 1.2.4.1); closure of this unit was approved by the TCEQ in 2000, but the status on the NOR has not been updated.
3	North Disposal Area, pre- RCRA	Closed	Closed in 1978.
4	South Disposal Area, pre- RCRA	Closed	Closed in 1974.
5	Raw material storage building (capacity 4150 tons)	Active	RCRA Permit Unit 002. Closure procedures provided in RCRA Permit.
6	3-yard dump hoppers for storage of rubber chips. Unit is inactive.	Inactive	According to plant personnel these were staged on west side of Battery Breaker Building on the concrete slab in the former production area.
7	North Landfill, treated blast slag, inactive 1996, Non-Haz, class II, monofill.	Inactive	The Slag Landfill (located west of North Disposal Area).
8	Treatment tank for blast furnace slag located south of breaker building.	Active	Slag Treatment Building (<90-day unit). Closure procedures provided in Decontamination and Demolition Plan (PBW/RSI, 2013a).
9	Wastewater / Grey Treatment facility.	Active	Wastewater Treatment Facility; will remain in operation at least until decon/demo is complete.
10	Accumulation area for Storage prior to shipment.	Inactive	According to a letter from GNB to the TNRCC dated January 24, 1996, Unit 010 never existed at the FRC and was inadvertently added to the NOR.
11	Battery Receiving / Storage building. Storage of batteries prior to processing.	Active	RCRA Permit Unit 001. Closure procedures provided in RCRA Permit.
12	Landfill, North Property, 1996	Active	Closed and open cells of Class 2 Landfill that contain treated slag.
13	Stewart Creek dredged sediments pile. 4/89 Closed 8/89. Waste code 149620.	Closed	Dredged sediment pile overlying the western side of North Disposal Area; closed in 1989.

14	Roll-off container/box	Active	These are rental units that are picked up for disposal when full and replaced with empty containers. According to FRC personnel, the roll-off boxes are or were previously located on south side of Oxide Building, on west side of Raw Material Storage Building, at the Battery Receiving/ Storage Building loading dock, between the Slag Treatment Building and Wastewater Treatment Facility, and in the Bale Stabilization Area.
15	Frac tank used to store purge water	Active	Crystallization Unit Frac Tank.
16	Drums	Active	Temporary drum staging area located on south side of Refines and Shipping building. Used to store drums containing dust and oxide collected during decontamination. No drums are currently located in this area.
17	Debris Piles	Active	Previously located in the Boneyard within Slag Landfill. These were stockpiles of assorted debris (wood, fiberglass, etc.) collected and stockpiled during plant cleanup and demolition. The piles were removed in April 2013.
18	Miscellaneous Storage Containers	Active	Roll-offs that contain treated slag located within the permitted boundaries of the on-site landfill.
19	Slag in Lower Fill Material at Battery Receiving Building, pre-RCRA	Active	Two distinct zones of non-native material, or fill zones, were typically encountered below the concrete slab in borings completed below the Battery Receiving/ Storage Building. The upper fill zone, directly below the building, generally consisted of select fill material (reddish-yellow clayey sand) within the upper 4 to 8 feet bgs. No slag material was observed in the upper fill zone. The lower fill zone generally consisted of silty clay or sandy clay to a depth of 10.5 feet bgs or less. Slag material was observed within the lower fill zone.

1.2.4.4 Other Potential Source Areas

1.2.4.4.1 Slag and/or Battery Case Fragments in Areas Outside of Designated Disposal Areas

Several occurrences of fill material containing slag and/or battery case fragments were observed outside of the designated disposal areas at the Site (i.e., the North Disposal Area, South Disposal Area, Slag Landfill, and Class 2 Landfill) in borings completed during the SIR and APAR investigations. The primary area with fill containing slag and/or battery case fragments observed during these investigations was located beneath and immediately adjacent to the Battery Receiving/Storage Building. Additional borings were completed during the January 2014 investigation to further delineate slag extent. Beneath the Battery Receiving/Storage Building, the zone containing slag and/or battery case fragments was generally encountered at 4 to 10.5 feet bgs (e.g., in borings 2013-BSB-1, 2013-BSB-2, 2013-BSB-5, 2013-BSB-6, 2013-BSB-7, 2013-BSB-8, 2013-BSB-10, and MW-31), while immediately adjacent but outside of the footprint of the building the zone containing slag and/or battery case fragments was generally encountered in the upper 3 feet bgs (e.g., in borings 2012-FWCS-1, 2012-FWCS-1A, 2013- RRS-2A and

2013-WMU-14-1). In one instance (2013-FWCS-12A) slag was encountered at a depth of approximately seven feet adjacent, but outside the BSB building footprint. According to former plant personnel, the timing of the placement of this material was pre-RCRA (Appendix 21).

During the SIR and APAR investigations slag and/or battery case fragments were also observed in borings completed at 2013-CUFT-10 (ditch northwest of the Crystallization Unit), 2013-RMSB-4 (Raw Material Storage Building), 2013-RRS-4A (Battery Breaker Building), and SCC-3 (south of Flood Wall near Truck Washing Station). Slag and/or battery case fragments were generally encountered within the upper 2 feet bgs in these borings. Slag was also observed in boring MW-30 at 28 feet bgs, near the base of fill in this boring. MW-30 is located on the south side of the North Disposal Area in the apparent infilled former stream channel of Stewart Creek. Based on the timing of the relocation of Stewart Creek (prior to 1972, as shown in the aerial photographs in Appendix 22), the slag identified within the infilled former stream channel of Stewart Creek is assumed to have been placed at this location pre-RCRA (i.e., prior to July 26, 1982). Information provided by a long-time Site employee confirmed in the Affidavit dated February 21, 2014 (included in Appendix 21), indicated that no hazardous waste was disposed of, other than instances of treatment failure associated with the Class 2 Landfill, after November 1980. No hazardous waste was disposed or otherwise used as fill on-site, or was used as fill when the Battery Receiving/Storage Building was constructed in the late 1980s. The timing of the placement of the surficial slag and/or battery case fragments in the ditch northwest of the Crystallization Unit and in the area south of the Flood Wall near the Truck Washing Station is undetermined and is assumed to have been placed pre-RCRA (i.e., before July 26, 1982). Figure 3A depicts slag extent and thickness based on investigation boring logs.

In 2009 and 2011, W&M conducted visual inspections of the Site to identify exposed slag, battery case fragments, and other debris within and along the banks of the on-site portion of Stewart Creek west of the former production area (W&M, 2011a) and in the vicinity of the North Disposal Area and South Disposal Area (W&M, 2011c). In November 2009, representative samples of suspected slag were collected from twelve specimens located within or along the banks of the on-site portion of Stewart Creek west of the former production area. The analytical results for the suspected slag samples were presented in a report prepared by W&M in 2011 (W&M, 2011a), which is provided in Appendix 18. In 2013, W&M completed additional inspections on the remaining areas of the FOP. W&M summarized the results of the 2013 inspection and previous inspections in a report dated March 28, 2013 (W&M, 2013a), which is also provided in Appendix 18. W&M identified exposed slag and/or battery case fragments in several areas of the Site, including the South Disposal Area, the south wooded area east of the South Disposal Area, the North Disposal Area/Slag Landfill area, the north wooded area, the Class 2 Landfill area, and within and along the banks of Stewart Creek west of the former production area. Locations of the slag and/or battery

case fragments identified during the inspections are shown on Figures 4 through 7 in the 2013 W&M report (W&M, 2013a) provided in Appendix 18.

Based on the visual inspections conducted by W&M, an interim action was performed in July-August 2013 to identify and remove exposed slag and battery case fragments using hand shoveling and other manual methods from the ground surface in areas where these items had previously been identified. W&M also collected information regarding lead concentrations in areas where these materials were removed to evaluate whether future larger scale response actions may be necessary in these areas. The scope of work for the interim action activities was submitted to the TCEQ as an Interim Action Work Plan (IAWP) dated April 29, 2013 prior to the start of work, which was approved by the TCEQ in correspondence dated July 1, 2013. After completion of the interim action, W&M prepared a summary report (W&M, 2013d) of the results dated October 14, 2013, which was approved by the TCEQ in a letter dated January 10, 2014 (TCEQ, 2014). The W&M interim action report and TCEQ approval letter are provided in Appendix 11.

An evaluation of Stewart Creek downstream of the FOP was conducted by Exide as part of this APAR. During the evaluation, which included a visual survey of the creek from the FOP property to Lake Lewisville, potential slag and battery case fragments were identified in downstream sections of the creek. Southwest Geoscience (SWG) also identified potential slag and battery case fragments during previous downstream studies (SWG, 2013a; SWG, 2013b) conducted on behalf of the City of Frisco. Details of the downstream evaluation conducted for this APAR are provided in Sections 6, 7, and 9 and the SWG downstream study reports are provided in Appendix 19. On behalf of Exide, Golder submitted an IAWP to the TCEQ dated November 7, 2013 for removal of slag and battery case fragments identified in downstream sections of Stewart Creek during the APAR investigation. The TCEQ issued a conditional approval letter for the IAWP dated December 17, 2013. Initial inspection activities were initiated in January 2014 during sampling of Stewart Creek and were performed on various downstream parcels as access became available. Access for removal activities was granted by the City of Frisco and other parties in April 2014 and removal activities were on-going at the time of preparation of this report. Based on the initial inspection activities conducted to date, battery case fragments were observed on downstream parcels from the FOP to the property owned by the United States Army Corps of Engineers (USACE), but no battery case fragments were observed on USACE property. Potential slag materials were only observed immediately downstream from the FOP property.

1.2.4.4.2 Aerial Deposition

Other potential source areas include areas where stack-generated and/or fugitive dust particulates have been aerially deposited. Since operations at the FRC stopped in November 2012, air emissions and aerial deposition of COCs within the confines of the Site, proximate to known COC-generating activities,

have ceased other than what may be entrained from surface soils as fugitive dust during windy periods. During decontamination and demolition activities at the Site, dust suppression measures were implemented to reduce the potential for particulate emissions associated with these activities. Details of the dust suppression and air monitoring procedures performed during decontamination and demolition activities are provided in the Dust Control Plan (PBW/RSI, 2013b) and Perimeter Air Monitoring Plan (PBW/RSI 2013c), respectively, the last revisions of which were submitted to the TCEQ on February 20, 2013.

In order to address the potential for fugitive dust emissions from the landfill and existing slag piles, Exide has employed several temporary measures. These have included application of a dust control agent to the landfill (applied November 22, 2013) and the purchase and installation of custom covers to cover two slag piles (installed on November 21, 2013). Subsequent to implementation of these measures, mulching of the landfill and piles was performed (April 15 and 16, 2014 and May 14, 2014). Stockpile cover repair was performed on May 13 and 14, 2014. Exide contractors visit the area on a weekly basis and any issues identified during those visits are addressed as needed.

A network of ambient lead monitors currently operates around the Exide Frisco facility. Three monitoring stations are operated by the Texas Commission on Environmental Quality (TCEQ): the “North” monitor located at the facility fenceline just west of the on-site slag landfill, the “Ash Street” monitor located in the nearest residential neighborhood just north of the facility fenceline, and the “East” monitor located on plant property near the main entrance. In addition to operating its own monitors co-located with the above-mentioned North and East TCEQ monitors, the facility operates a monitor called the “South” monitor at a location well inside the south fenceline. TCEQ provided sampling data from ambient air for the period January 4, 2013 through April 11, 2014. The data represents sampling events that generally occurred every 6 days. The individual readings are reduced to monthly averages and then again to 3-month rolling averages. The National Ambient Air Quality Standard (NAAQS) for lead is 0.15 micrograms per cubic meter (ug/m3) based on a 3-month rolling average. This standard is sometimes referred to as the design value. None of the four monitors exceeded the NAAQS of 0.15 ug/m3 based on a 3-month rolling average from the period January 4, 2013 through April 11, 2014. As such, the sampling data collected at the monitoring stations indicated compliance with the NAAQS.

1.2.4.4.3 City of Frisco Firefighter Training Facility

The Firefighter Training Facility, located on the north side of the Truck Staging Area (Figure 1A.1), was formerly used by the City of Frisco Fire Department to conduct training exercises. The City has advised Exide that records for the Firefighter Training Facility are available back to 1988 and that use of the facility has been discontinued. According to City representatives, chemicals used at the facility by the City Fire Department included diesel and propane (as accelerants) and Class “A” and “B” foams. The

City indicated that no formal measures were used to control runoff during operation of the facility and that no environmental assessment or cleanup activities, other than general housekeeping after each training session, were conducted. The City indicated that the parking lots immediately adjacent to the training tower were used for simulated "emergency response" activities, and that an area of at least 200-feet around the burn building may have been used at various times. The City also indicated that the area east to "old" 5th Street (Eagan Way) was also used as a work area.

1.2.4.4.4 Former Burn Pile Area

Mr. Larry Eagan, a former plant manager at the FRC, indicated in an interview conducted on January 8, 2014 that a burn pile area associated with the Firefighter Training Facility was formerly located approximately 200 feet west-northwest of the Firefighter Training Facility (Figure 1A.1). According to Mr. Eagan, materials historically burned in the burn area included scrap wood from blocking stacks of lead bars that were shipped into the plant by rail or "dunnage", and other materials such as brush from the Site and from areas throughout the City of Frisco, such as trees and brush from City landscaping/drainage cleanout that were brought by the City of Frisco to the Site. Materials burned also included partially burned materials that remained after Frisco's Fire Department Firefighter training exercises. The former burn pile was used from approximately the early 1960s to the 1990sFirefighter. During the interview, Mr. Eagan indicated that the former burn pile area corresponded to an area of stressed vegetation approximately 200 feet north-northwest of the Firefighter Training Facility, as shown in the 1995 aerial photograph of the Site, which is provided in Appendix 22. Additional assessment activities for the Firefighter Training Facility and former burn pile area were conducted as part of the second phase of the APAR investigation (see Section 3.2.1).

1.2.4.4.5 Storm Water Retention Pond and Solar Evaporation Pond

The storm water retention pond is located on the south side of Stewart Creek at the Site and is used to store storm water and wash water collected from the former production area. Storm water control features within the former production area route the water to the storm water retention pond via a conduit (with integrated secondary containment) that passes over Stewart Creek (Figure 1A.1). Water within the retention pond historically was either treated and discharged to Stewart Creek or was used as make-up water in the plant's process streams. Discharge of water to Stewart Creek is regulated by the TCEQ under TPDES Permit No. WQ0002964000. Larry Eagan, former plant manager at the FRC, indicated that the storm water retention pond was pumped dry (or nearly so) and accumulated sediment was removed from the pond on an approximate annual basis as part of routine maintenance activities performed on the pond when the plant was in operation.

In 2008, W&M performed an assessment of the storm water retention pond that included a survey of the pond and characterization of the liner to document the as-installed condition of the pond. W&M

completed a summary report of the 2008 assessment activities in 2011, which is provided in Appendix 20. W&M indicated that the storm water retention pond is lined with at least two layers of 40-mil HDPE liner separated by fill sand. Due to storm damage in the 1990s, a 60-mil HDPE liner was placed over the original liner system. Underlying the HDPE liners is a compacted clay soil liner at least 2.5 feet thick. The W&M report concluded that the estimated leakage rates met the design criteria for the pond.

The solar evaporation pond, located on the western side of the Class 2 Landfill, is used to store rainwater that falls on the active cells of the Class 2 Landfill. Contact water from the Class 2 Landfill is pumped to the solar evaporation pond via a hard-piped system. The solar evaporation pond has a high-density polyethylene (HDPE) liner and a capacity of approximately 900,000 gallons (TCEQ, 2011a). Sediments that accumulate in the solar evaporation pond are or were previously recycled in the reverberatory furnace or disposed at DFW Recycling and Disposal in Lewisville, Texas (TCEQ, 2011a). Larry Eagan, former plant manager at the FRC, indicated that the solar evaporation pond was pumped dry (or nearly so) and accumulated sediment was removed from the pond on an approximate annual basis as part of the routine maintenance activities performed on the pond. The pond appears to be lined with a 60-mil HDPE liner. The Class 2 Landfill is equipped with two leachate collection sumps located at the bottom of the landfill (TCEQ, 2011a). The leachate sumps are hard piped to a leachate collection tank (capacity = 2,000 gallons) located on the north side of the solar evaporation pond inside a concrete secondary containment system. Leachate from the tank is processed in the on-site Wastewater Treatment Facility.

Additional assessment activities for the storm water retention pond and solar evaporation pond were conducted as part of the second phase of the APAR investigation (see Section 3.2.6).

1.2.5 Affected Property Description

An affected property is defined as the entire area which contains releases of COCs at concentrations equal to or greater than the assessment level applicable for groundwater classification and residential land use (30 TAC §350.4(a)(1)). Assessment levels for the potentially complete pathways, which are discussed in Section 2 of this APAR, were used for comparison with Site sample data results to determine the extent of the affected property for each potentially affected environmental media, as applicable. The primary COCs evaluated for this affected property assessment are lead and cadmium, based on historical operations, process knowledge, previous investigations, and guidance, direction, and/or approval given by EPA and TCEQ as part of permits, orders, and program requirements (see Section 3.1.2 for a detailed discussion of Site COCs).

Additional analytes, including antimony, arsenic, selenium, VOCs, SVOCs, and TPH were also evaluated, typically in association with specific process areas, as identified and discussed in Section 3 of this APAR and as requested by TCEQ.

During the second phase of the APAR investigations, many of the samples collected addressed the need for additional vertical or horizontal delineation due to a change in groundwater classification. In addition, at the request of TCEQ, during the second Phase of the APAR investigation, samples were collected to assess the distribution of arsenic, selenium, and antimony throughout the Site. The original schedule proposed by Exide included three phases of investigation to complete the delineation for the new RALs and expanded list of COC metals. Because of the alternate schedule required by TCEQ, not all areas have been fully delineated laterally and vertically within the TCEQ-required timeframe for submission of this APAR. However, although it is acknowledged that delineation is not 100% complete in all areas of the Site for all metals, based on the amount of information collected for the Site to date, there is sufficient data to prepare a RAP for the Site with the understanding that additional sampling will be done as part of a pre-design investigation or as part of confirmation sampling, following remedial activities.

Based on the new dataset of select samples that were collected to further evaluate the distribution of arsenic, antimony and selenium horizontally and vertically, in almost all cases, wherever one of these metals was present in exceedance of the RALs, lead was also present in exceedance of the RAL at the same location. Only two general exceptions were noted:

- Concentration of antimony at SRB-VS-11B (3.10 mg/kg) exceeded the RAL (2.7 mg/kg) for the 0.5 to 2 foot bgs sample, collected in the shooting range/south berm area. The sample concentration is considered anomalous.
- Concentrations of arsenic in several locations exceeded the RAL where lead exceedances were not observed to be present. However, exceedances, were within the expected range of background concentrations for historical agricultural use based on published documents (BEG, 2005).

This report is being submitted as required by the TCEQ schedule without additional phases of investigation. Areas not delineated at the time of submission of this APAR revision will be further assessed during a pre-design investigation (PDI) or during confirmation sampling (including all five COC metals) following remedial actions. Because lead and cadmium are the primary COC, areas already planned to be remediated to address known impacts of lead and cadmium will also address RAL exceedances for antimony, arsenic, and selenium except as specifically noted above.

During the SIR and APAR Site investigations (excluding duplicate samples), approximately 570 soil samples, 31 surface water and 25 sediment samples (from on-site areas of Stewart Creek and the North Tributary), groundwater samples from 48 monitoring wells, and perched water from 5 monitoring wells were collected from the FOP and analyzed for one or more COCs. From off-Site areas of Stewart Creek, there were 10 upstream and 8 downstream surface water samples; and 10 upstream and 53 downstream sediment samples collected (collected by Golder). In addition, 5 surface water samples and 5 sediment samples were collected upstream in tributaries to Stewart Creek that intersect the creek downstream from

the FOP. Based on these data, ten affected property areas were identified at the Site, each of which has been delineated except where noted. Historical sample data from previous investigations conducted at the Site, including from the Phase I and Phase II RFIs, were reviewed and were used to develop sampling strategies; however, these data were not used to delineate affected property boundaries at the Site.

SIR and APAR sample data, as well as historical data from the Site, indicate that soil and sediment are the primary affected media at the Site. The majority of groundwater and surface water sample data collected during the SIR and APAR investigations were below applicable residential assessment levels (RALs) and RBELs. No affected property areas were identified for these media.

Detailed discussions of soil, groundwater, surface water, and sediment sample data from the SIR and APAR investigations are provided in Sections 4, 5, 6, and 7, respectively. A brief description of each of the affected property areas identified during the SIR and APAR investigations, based on RAL exceedances, is provided below.

1.2.5.1 Affected Property No. 1 (North Area)

Affected Property No. 1 (North Area) is located north of the North Tributary and south of the Class 2 Landfill (Figure 1B.1). Exceedances of the soil RAL for lead were detected in several soil samples from this area. The maximum soil sample concentration of lead detected in this area was 11,200 mg/kg in sample E-11C (0-0.5'). The RALs for arsenic, cadmium, selenium, and antimony were also exceeded at this point. The affected property was laterally delineated within the FOP site boundary by soil samples collected to the east, north, and west of the affected property, and by sediment samples collected from the North Tributary to the south that were below the applicable assessment levels for sediment and soil (see Section 7). The affected property is also bounded farther to the west on the Undeveloped Buffer Property, which is being addressed separately (PBW, 2014), Lateral delineation is complete with the exception of the following (Figures 4A.1 through 4A.5):

- The area northeast of P-1 where the PCLE zone extends to the property boundary and utilities prevented additional borings in this area. The area to the east of 5th Street/Parkwood Drive is within the PCLE Zone for the Undeveloped Buffer Property (PBW, 2014).
- The affected property boundary is assumed to extend all the way to the edge of the North Tributary south of sample location 2013-NT-02 where the southern extent of the affected property was not delineated by soil samples collected between the affected property and the North Tributary (i.e., where sediment samples were used to delineate the affected property).
- Arsenic detections above the RAL near Affected Property No. 1 that are not co-located with lead are within the range of background values (BEG, 2004) and are believed to be

attributable to other anthropogenic sources. These locations are not included within Affected Property No. 1.

- Antimony and selenium were detected in exceedance of the RAL at one location co-located with the highest lead exceedance and were not detected above the RAL in other locations.

Affected Property No. 1 was vertically delineated to below RALs at several sample locations within the affected property boundary. Consistent with 30 TAC §350.51(d)(2), RALs were used for vertical delineation purposes within Affected Property No. 2 since a groundwater assessment was performed in this area Groundwater sampling included downgradient wells MW-41 and MW-42. RALs were not exceeded in these wells. In addition, surface water and sediment sampling results in the North Tributary did not exceed Critical PCLs, suggesting that delineation is complete in this area. Atmospheric deposition from FOP emissions is believed to be the source of metals concentrations above the RAL in soils in this area.

1.2.5.2 Affected Property No. 2 (Production Area)

Affected Property No. 2 (Production Area) encompasses the majority of the former production area, the Slag Landfill, and the North Disposal Area (Figure 1B.1). The Undeveloped Buffer Property is located east of Affected Property No. 2 (PBW, 2014) where the affected property and PCLE Zone for the FOP extend to the Site boundary. Based on their historical use, the entire Slag Landfill and North Disposal Area were included within the affected property zone.

Exceedances of the soil RALs for lead and cadmium were detected in samples within the affected property zone, with a maximum lead concentration of 95,000 mg/kg in soil sample 2013-WMU14-1 (0.9-2'), collected from the Battery Receiving/Storage Building loading dock, and a maximum cadmium concentration of 984 mg/kg in soil sample 2012-FWFS-9 (Floor), collected from the excavation for the French drain along the north side of the Flood Wall near the Slag Treatment Building. Maximum concentrations of antimony (32.4 mg/kg) and arsenic (36.7 mg/kg) were detected in soil sample 2013-MW-17B, in the Battery Storage Building area. One VOC exceedance, benzene at 2013-STB-6 (0.0406 mg/kg compared to a RAL of 0.0257 mg/kg) was detected. Benzene did not exceed its RAL in any other samples.

The soil RAL exceedance zone for metals in Affected Property No. 2 was laterally delineated within the FOP site boundary with the exception of the east side of the Site where the affected property boundary extends to the Site boundary (Figure 4A). The Undeveloped Buffer Property is located farther to the east and as noted above, is being addressed separately (PBW, 2014). Affected Property No. 2 was also delineated between the former production area and Stewart Creek in most locations by numerous soil samples collected along the north side of the creek. The affected property boundary extends to Stewart

Creek near MW-27E, 2013-MW-17A, 2013-MW-17B, SCC-8, and SCC-10. The Flood Wall is included within the affected property boundary due to observations related to white crystalline material (as discussed above and below).

Consistent with 30 TAC §350.51(d)(2), RALs were used for vertical delineation purposes within Affected Property No. 2 since a groundwater assessment was performed in this area by sampling multiple groundwater monitoring wells within and downgradient of the affected property. Vertical delineation to RALs was generally completed at depths of less than 5 feet bgs in each sampling area, typically at locations where the highest sample concentrations were observed; however, at several locations within the former production area, including within the Battery Receiving/Storage Building and Raw Material Storage Building, the affected property was vertically delineated at depths deeper than 5 feet bgs or was not vertically delineated before reaching the saturated zone (where soil delineation would terminate and groundwater assessment would be performed). Soil samples at two locations within the Battery Receiving/Storage Building (2013-BSB-2 and 2013-BSB-9) and one location within the Raw Material Storage Building (2013-RMSB-4) from the approximate depth of observed saturation at these locations exceeded the applicable RAL for lead. Consistent with 30 TAC §350.51(d)(3), groundwater samples were collected from monitoring wells:

- MW-16 and MW-17, downgradient from the slag landfill/boneyard area;
- MW-26, downgradient from the Wastewater Treatment Building;
- MW-29, located downgradient of the Raw Material Storage Building;
- MW-31, within the Battery Receiving/Storage Building;
- MW-39 and MW-40, between the slag landfill area and the North Tributary;
- MW-44, in the truck wash area, to assess groundwater in this area; and
- MW-46, in the Wastewater Treatment Building area.

As shown on Table 5B.1, metals were not detected above RALs in the groundwater samples from these wells with the exception of the first sample collected from MW-46. Subsequent resampling, including a duplicate sample did not exceed RALs.

The depth of fill material within the North Disposal Area was assessed as part of the 1993 Addendum to the Phase I RFI (Lake, 1993). The reported maximum depth of fill material was 20 feet bgs, observed in test pits and soil borings completed in the North Disposal Area during the study.

1.2.5.3 Affected Property No. 3 (South Area)

Affected Property No. 3 (South Area) is located on the south side of the FOP property, south of Stewart Creek (Figure 1B.1). Exceedances of the soil RAL for lead were detected in soil samples from the vicinity of the South Disposal Area, the wooded area east of the South Disposal Area, and the former Shooting

Range Berm and South Berm. Arsenic and antimony also exceeded their respective RALs in two locations. Based on its historical use, the entire South Disposal Area was included within the affected property boundary. The maximum soil sample concentration of lead in this area was 6,150 mg/kg in sample 2014-SDA-7 (0-0.5'), located near the southeast corner of the South Disposal Area. The maximum RAL exceedances for antimony (102 mg/kg) and arsenic (96.6 mg/kg) were also detected in this location. The soil RAL exceedance zone (i.e., the affected property) was laterally delineated as follows:

- To the north by ECO-5, SCC-4, 2013-SDA-4B.
- To the west, south, and east of the Site to the Undeveloped Buffer Property which is being addressed separately (PBW, 2014) as well as select soil sample locations (ECO-4A, ECO-4B and SRB-VS-9E).

Consistent with 30 TAC §350.51(d)(2), RALs were used for vertical delineation purposes within Affected Property No. 3 since a groundwater assessment was performed in this area. The affected property was generally vertically delineated to the RAL at a maximum sample depth of 2 feet bgs in the vicinity (but outside the boundary) of the South Disposal Area and 0.5 feet bgs in both the wooded area east of the South Disposal Area. One location to the northwest (B3RA) and three locations along Stewart Creek (SDA-3B, SCC-5 and ECO-8B) were not delineated horizontally for lead and will be addressed during future work at the Site. In the location of highest lead, antimony and arsenic concentrations (2014-SDA-7), arsenic was delineated vertically to RALs, but lead and antimony were not vertically delineated at the maximum sample depth, 2 feet bgs (antimony was not delineated due to data quality issues in the deeper sample). Vertical delineation will be completed during future work at the Site. Groundwater samples at B4R did not exceed the RALs for metals.

The reported maximum depth of fill material observed within the South Disposal Area was 8 feet bgs during the investigation completed in this area as part of the 1993 Addendum to the RFI (Lake, 1993).

1.2.5.4 Affected Property No. 4 (Crystallizer Way)

Affected Property No. 4 (Crystallizer Way) is a portion of the road (Crystallizer Way) and adjacent ditch. Crystallizer Way is a road extending west from Eagan Drive, past the storm water retention pond to the west boundary of the Site. Affected Property No. 4 includes an approximately 500 foot long section of the Site generally to the north of Crystallizer Way, including 2014-CUFT-5B-A at the east end and 2014-CUFT-16 at the west end. Several soil samples were found to exceed the RAL for lead, and further delineation samples were collected. The central portion of the impact (the 2013-CUFT-7 and 2013-CUFT-10 areas, with their respective step-out samples) has been laterally delineated for lead. The western area will be delineated to the north and west during future investigations and/or remedial activities. In general, areas to the south are included within the Undeveloped Buffer Property PCLE Zone (Figure 4A). At the location of maximum concentration, 2014-SDA-16 (1,530 mg/kg), lead was vertically

delineated to the RAL at a depth of 0.5 feet bgs (117 mg/kg), but not to background. Similar results were achieved at most sampling locations, with the maximum depth of RAL exceedance at 0.5 feet bgs. Additional evaluation at 2014-SDA-16 will be completed in the future to vertically delineate COCs to below background concentrations in accordance with 30 TAC §350.51(d)(1) since groundwater assessment was not performed in this area.

1.2.5.5 Affected Property No. 5 (West and Southwest of Class 2 Landfill)

Affected Property No. 5 (West and Southwest of Class 2 Landfill) includes an area extending approximately 80 feet west and 100 feet south of the Class 2 Landfill. Several samples in this location exceeded RALs for lead, antimony, selenium, and/or arsenic. Impacts were laterally delineated within the Site boundary to the north, west and south (south area is also within the approximate limits of the Class 2 Landfill disposal area) and to the east by Class 2 Landfill cap samples (except for arsenic at a concentration of 19.2 mg/kg in 2014-C2L-C01B, which is likely related to background arsenic concentrations at the Site). At the location of maximum concentration for all four of these metals, 2014-C2L-6C (lead at 2,970 mg/kg, antimony at 7.99 mg/kg, selenium at 7.09 mg/kg, and arsenic at 28.0 mg/kg), lead, arsenic, and selenium were vertically delineated to below the RAL; and antimony was vertically delineated to background.. Consistent with 30 TAC §350.51(d)(2), RALs were used for vertical delineation since a groundwater assessment was performed in this area. Groundwater samples collected at LMW-5 and LMW-21, adjacent to and downgradient from Affected Property No. 5, did not exceed RALs for arsenic, selenium, lead, or cadmium, ..

1.2.5.6 Affected Property No. 6 (Lake Parcel North)

Affected Property No. 6 (Lake Parcel North) includes one sample location (F-5) in the north part of the Lake Parcel. The lead concentration at this location (367 mg/kg) exceeded the RAL in the 0 to 3-inch bgs depth interval (Figure 4A). Delineation samples were subsequently collected surrounding F-5, and none were found to exceed the RAL. Consistent with 30 TAC §350.51(d)(1), background was used for vertical delineation purposes for lead, for Affected Property No. 6 since a groundwater assessment was not performed in this area. The sample at the 1 foot bgs interval also did not exceed background. This area is considered to be delineated vertically and horizontally.

1.2.5.7 Affected Property No. 7 (North Tributary at Boundary)

Affected Property No. 7 (North Tributary at Boundary) includes one soil sample location exceeding the lead RAL (2014-NT-3) located between the North Tributary and the M Tract of the Undeveloped Buffer Property. The concentration of lead in the 0 to 0.5 foot bgs sample at 2014-NT-3 (353 mg/kg) exceeded the RAL. The area is bounded to the east and west by samples that do not exceed the RAL; to the north by the Undeveloped Buffer Property (areas to the north are within the Undeveloped Buffer Property PCLE Zone) and to the south by the North Tributary, including sediment samples in the North Tributary.

Consistent with 30 TAC §350.51(d)(1), background was used for vertical delineation purposes within Affected Property No. 7 since a groundwater assessment was not performed in this area. The soil sample is vertically delineated on the Site to the RAL but not to background at 0.5 feet. However, areas immediately adjacent to the north on the Undeveloped Buffer Property with higher concentrations of lead have been vertically delineated to background (PBW, 2014).

1.2.5.8 Affected Property No. 8 (Stewart Creek Sediments)

Affected Property No. 8 (Stewart Creek Sediments) includes on-site and downstream areas of Stewart Creek from just east of the Battery Receiving/Storage Building to the upstream end of the USACE property (Figure 1B.2).

During the APAR and other investigations, numerous sediment samples were collected from the North Tributary on the Site and from Stewart Creek, from upgradient of the Site to the confluence with Lake Lewisville downgradient to the southwest. No exceedances of critical PCLs were detected in the North Tributary. For Stewart Creek samples, lead concentrations did not exceed the critical PCL in any of the sediment samples collected during the APAR investigation (although critical PCL exceedances were detected in other studies as discussed in Section 7.3). Arsenic was detected upstream and downstream of the FOP and exceeded the critical PCL. Arsenic exceedances upgradient and downgradient from the Site are believed to be associated with other anthropogenic sources. Cadmium concentrations slightly exceeded the critical PCL at three downstream locations (Figure 7A.2):

- 2014-SED-025, downstream from the Dallas North Tollway bridge
- 2014-SED-021, between the Dallas North Tollway bridge and the Legacy Drive bridge
- 2014-SED-046, downstream from the Legacy Drive bridge

Surveys of potential slag and battery case materials have also been conducted downstream from the Site, and an interim action to remove these materials was ongoing at the time of this APAR preparation. This downstream portion of Stewart Creek is included as Affected Property No. 8 due to the presence of slag and battery case fragments observed in this area.

1.2.5.9 Possible Affected Property No. 9 and 10

These areas are each defined by a single XRF sample collected during the 2013 W&M Interim Actions (W&M, 2013d). A confirmation sample will be collected in this location during future investigations. These locations include the following:

- South of Stewart Creek to the south of the Waste Water Treatment Building.
- On the southern portion of the Lake Parcel near Crystallizer Road Way.

1.3 Geology, Hydrogeology, and Surface Water Hydrology

1.3.1 Geology

The Site is situated in southwestern Collin County along the north-south trending contacts between the Cretaceous-aged Austin Chalk, the Cretaceous-aged Eagle Ford Formation ("Eagle Ford Shale"), and Quaternary-aged undivided surficial deposits (Figure 1C). Regional dip is to the east and southeast such that outcropping rock formations become relatively younger from west to east, with the exception of Quaternary deposits, which are generally controlled by variations in topography. Regional geologic units encountered at the surface or in the shallow subsurface at the Site are as follows (from youngest to oldest):

- Quaternary Undivided Surficial Deposits: Sand, clay, silt, and gravel; mostly colluvium and minor alluvium (McGowen et al., 1991). At the FOP, this unit generally consists of clay or silty clay with minor occurrences of gravelly clay (gravel suspended in a clay matrix), sand, and clayey gravel lenses.
- Austin Chalk: Upper and lower parts consist of light gray massive chalk (limestone primarily composed of the calcareous skeletons of micro-organisms) with some calcareous clay interbeds and partings; middle part mainly light gray bedded marl with massive chalk interbeds (McGowen et al., 1991).
- Eagle Ford Shale: Medium to dark gray shale (fine-grained, fissile, sedimentary rock composed of clay-sized and silt-sized particles); commonly selenitic (contains gypsum) and bituminous with thin platy beds of sandstone and sandy limestone in middle and upper parts (McGowen et al., 1991).

A regional geologic map is provided as Figure 1C and a generalized regional geologic cross section is provided as Figure 1D. A geologic cross section location map for cross sections constructed using soil boring data from the Site is provided as Figure 4C.1 and the cross sections are provided on Figure 4C.2.

The Austin Chalk forms steep hillsides to the north, east, and south of the Site. Within the FRC property boundary, the drainages of Stewart Creek and the North Tributary have eroded the Austin Chalk such that the Quaternary surficial deposits typically lie directly on top of the Eagle Ford Shale. The surface of the Eagle Ford Shale has also been eroded in the vicinity of the Site such that it and the overlying Quaternary surficial deposits generally slope toward Stewart Creek and the North Tributary, and to the west in the downstream direction of these drainages (see Figure 4C.2).

The geology encountered at the Site generally consisted of approximately 10 to 30 feet of moist to wet, clay-rich, colluvial soils (Quaternary undivided surficial deposits) overlying the Eagle Ford Shale Formation. Colluvium is a general term used to define soil material and rock debris that accumulates at the base of slopes due to erosional forces such as slides, slumps, sheetfloods, or debris flows (USGS, 2013). It is typically characterized by heterogeneous and poorly sorted material. As noted previously and as depicted on Geologic Cross Sections A-A' through G-G (Figures 4C.2 and 4C.3), the colluvial soils at

the Site typically consist of clay or silty clay with minor occurrences of gravelly clay (gravel suspended in a clay matrix), sand, and clayey gravel lenses.

1.3.2 Hydrogeology

The uppermost groundwater-bearing unit (GWBU) at the Site is comprised of the clay-rich colluvial soils that lie on top of the Eagle Ford Shale. The Eagle Ford Shale acts as an aquiclude unit at the base of the uppermost GWBU. During the SIR and APAR investigations, a total of seven groundwater gauging events (three gauging events during the SIR investigation in 2012, three gauging events during the APAR investigation in 2013, and one gauging event during the APAR investigation in 2014) were conducted using monitoring wells completed in the upper GWBU at the Site (Table 5D). During these gauging events, depth to water measurements ranged from less than 0.5 feet bgs in well MW-18, located on the bank of the North Tributary north of the Slag Landfill, to approximately 30 feet bgs in well VCP MW-12, located on the Undeveloped Buffer Property east of the Class 2 Landfill. Groundwater potentiometric surface maps for the four APAR investigation water level gauging events (conducted on March 11, 2013; April 5, 2013; April 29, 2013; and January 21, 2014) are provided as Figures 5A.1 through 5A.4. The potentiometric surfaces depicted on each of these figures slope toward Stewart Creek and/or the North Tributary, suggesting that groundwater flow within the upper GWBU at the Site is strongly controlled by topography and that groundwater discharges to the on-site creeks. Discussions regarding potential preferential pathways and perched water above the uppermost GWBU are provided in Section 3.2.7.

The Texas Water Development Board (TWBD) does not consider the Austin Chalk, the Eagle Ford Shale, or the Quaternary undivided surficial deposits in the vicinity of the Site to be major or minor water producing formations of Texas (George et al., 2011). A water well records search performed within an approximate 0.5-mile radius of the Site identified five potential wells completed in the Woodbine, Paluxy, or Twin Mountain Formations (see Section 2). These formations all lie stratigraphically below the Eagle Ford Shale (Figure 1D).

The Woodbine Formation, which lies directly below the Eagle Ford Shale, is considered by the TWDB to be a minor aquifer of Texas (George et al., 2011). The Paluxy and Twin Mountains Formations lie at deeper depths, and comprise the upper and lower portions, respectively, of the Trinity Aquifer, which is considered by the TWDB to be a major aquifer of Texas (George et al., 2011). The Paluxy Formation is separated from the Woodbine Formation by the Washita and Fredericksburg Groups, which are not considered by the TWDB to be major or minor aquifers of Texas (George et al., 2011). According to Nordstrom (1982), both the Washita and Fredericksburg Groups consist predominantly of limestone, shale, clay, and marl and yield only small amounts of water to localized areas. The Paluxy and Twin Mountains Formations are separated by the relatively impermeable Glen Rose Formation, which is composed primarily of argillaceous limestone. Based on a regional cross section constructed by

Nordstrom (1982) (Figure 1D), the approximate depths of these formations in the vicinity of the Site are as follows:

- Eagle Ford Shale: Near surface to 550 feet bgs;
- Woodbine Formation: 550 to 850 feet bgs;
- Washita Group: 850 to 1,325 feet bgs;
- Fredericksburg Group: 1,325 to 1,400 feet bgs;
- Paluxy Formation: 1,400 to 1,650 feet bgs;
- Glen Rose Formation: 1,650 to 2,100 feet bgs; and
- Twin Mountains Formation: 2,100 to 2,650 feet bgs.

1.3.3 Surface Water Hydrology

As stated previously, Stewart Creek and a tributary of Stewart Creek, the North Tributary, flow in an approximate east to west direction through the central portion of the Site. Stewart Creek is a small first order stream within the Trinity River Basin that drains a watershed of approximately 3 square miles upstream of the FOP. It flows into Lewisville Lake (Classified Segment 0823), located approximately 8 miles downstream of the FOP. The on-site portions of Stewart Creek and the North Tributary receive surface water flow from five distinct creeks that collect water from east of the Site. These creeks have been incorporated into parks as water features, run along roadways and/or run through neighborhoods and other developments, and are part of the surface water features within the Frisco city limits, which are contained within the City's MS4 storm water management permit. Upstream of the FOP a portion of Stewart Creek is a neighborhood fountain that effectively provides a near constant supply of water to the creek. Upstream of that fountain, the creek has been observed dry. It is anticipated that the on-site portion of Stewart Creek would potentially be dry on some occasions during the year if it were not for the fountain and other artificial sources of runoff upstream of the FOP, such as irrigation/sprinkler systems. Anecdotal reports from long-time Exide employees indicate that historically the creek did go dry for periods of time. A study of biological communities within Stewart Creek in 1991 (RCI, 1991) concluded that at that time (prior to much of the current upstream urban development) the biological community upstream of the former City of Frisco's Stewart Creek Wastewater Treatment Plant "is representative of a stream with only limited periods of flow." A subsequent study by RCI (1992) concluded "Stewart Creek is an intermittent stream based on the structure of the biological community and the flow regime." The Water Quality Assessment Section of the TCEQ has previously classified Stewart Creek as an intermittent stream (TCEQ, 2011b). However, in a memorandum dated September 23, 2013 (TCEQ, 2013c), the TCEQ reclassified Stewart Creek as a perennial stream; therefore, Stewart Creek is considered a perennial stream for this APAR.

The North Tributary has been observed dry on several occasions during the SIR and APAR investigations and is shown dry on the 2008 historical aerial photograph provided in Appendix 22. It should be noted that upstream of the FOP, the North Tributary is dammed to form a pond in Oak Creek Park, and the source of that water appears to be surface runoff from rainwater, sprinkler systems, and other landscaping features. In an email provided to Exide dated October 18, 2013 (TCEQ, 2013g), the TCEQ indicated that Exide should evaluate the North Tributary as an intermittent stream.

During the SIR investigation, two staff gauges were installed in Stewart Creek to measure water level elevations in the creek. As shown on Figures 5A.1 through 5A.4, Staff Gauge #1 is located in the eastern portion of the Site (near the upstream end of the on-site reach of Stewart Creek) and Staff Gauge #2 is located in the western portion of the Site (near the downstream end of the on-site reach of Stewart Creek). Creek water levels at the staff gauges were measured concurrent with groundwater gauging events twice during the SIR investigation (January 17, 2012 and February 13, 2012) and three times during the APAR investigation (April 5, 2013, April 29, 2013 and January 21, 2014). During the January 21, 2014 gauging event, only Staff Gauge #2 was measured because Staff Gauge #1 was damaged. As shown on the groundwater potentiometric surface maps on Figures 5A.2 through 5A.4 (representing the April 5, 2013, April 29, 2013 and January 21, 2014 gauging events, respectively), the creek water level elevations at the staff gauge locations on those dates were generally lower than the projected potentiometric surface contours in their immediate vicinity, suggesting that the creek is a gaining stream (i.e., groundwater discharges to the creek). Although staff gauges were not installed in the North Tributary, the groundwater potentiometric contours in the vicinity of the North Tributary on Figures 5A.1 through 5A.4 suggest that it is also a gaining stream.

The current stream channels of Stewart Creek and the North Tributary have been altered from their historical flow paths, as evident in historical photographs of the Site (Appendix 22). Prior to approximately 1968, Stewart Creek flowed in a northwestward direction through the former production area (which consisted only of the Oxide Building at that time) and the North Disposal Area and Slag Landfill (prior to their construction). During this period, the confluence of Stewart Creek and the North Tributary was located near the current boundary of the North Disposal Area and Slag Landfill. Prior to 1956, Stewart Creek ran in a southward direction from this point to a small lake upstream of the BNSF rail line west of the FRC (the lake was created by a small dam in the vicinity of the railroad bridge). By 1956, the lake was drained and the western reach of Stewart Creek was in its approximate current position. During the period from approximately 1968 to 1971, the section of the former Stewart Creek channel that ran through the former production area was filled with on-site soil to expand the general plant area, and the stream was rerouted to its current configuration (Eagan, 2013a). According to former plant personnel, the North Tributary was rerouted to its current position in approximately 1993 (Eagan, 2013b). The

projected paths of the former Stewart Creek and North Tributary creek channels are shown on Figure 1B.1.

During the APAR investigation, several monitoring wells (MW-21, MW-22, MW-24, and MW-30) were completed within or immediately adjacent to the projected former Stewart Creek and North Tributary creek channels as indicated on historical aerial photographs to evaluate these features as potential preferential pathways for migration of Site COCs. Fill material associated with the projected former infilled creek paths was observed at MW-24, located south of the Slag Landfill, and MW-30, located near the northwest corner of the Battery Breaker Building. At MW-24 the well was screened across the clayey fill and native materials which consist of silty clay with interbedded sand, clayey silt, gravelly clay and clayey sand, and terminated in shale. At MW-30, the well was screened within clayey fill and terminated in shale. Fill material was not observed at MW-21 or MW-22, located within the projected former paths of the North Tributary east of the Slag Landfill. The groundwater results for each of the wells for cadmium and lead were either non-detect or between the method detection limit and quantitation limit. In all cases, RALs were not exceeded. Based on the analytical data from the samples taken in MW-21, MW-22, MW-24, and MW-30, the former creek channels are not considered a pathway for contaminant migration originating at the facility. Boring logs for these monitoring wells are provided in Appendix 2. Soil and groundwater data for the former creek channel monitoring wells are presented in Sections 4 and 5, respectively.

Table 1A
Sources of Release

Affected Property Name/Number	Name of Potential Source	Type of Potential Source	NOR unit or SWMU Number, if Applicable	Substances of Potential Concern	Size of Source (capacity, area, or volume)[1]	Status of Source		Was a Release from This Source Confirmed?			
						Status	If closed or other, list date closed or explain	No	Yes[2]	Discovery method	Date
No. 1	Former Operating Plant Emissions	Aerial deposition	NA	Lead and cadmium	30 acres (assumed; TCEQ default)	Operations stopped	November 2012		X	Site assessment	2012-2013
No. 2	Battery Storage Building	HW container storage area	RCRA SWMU No. 1/NOR WMU No. 11	Lead and cadmium	< 0.5 acres	Inactive			X	Site assessment	2012-2013
No. 2	Raw Material Storage Building	HW Containment Building	RCRA SWMU No. 2/NOR WMU No. 5	Lead and cadmium, RCRA 8 metals, SVOCs, VOCs*	< 0.5 acres	Inactive			X	Site assessment	2012-2013
No. 2	Slag Treatment Building	Waste treatment unit	NOR WMU No. 8	Lead and cadmium, petroleum hydrocarbons*	< 0.5 acres	Inactive			X	Site assessment	2012-2013
No. 2	Slag Landfill	Landfill	RCRA SWMU No. 3/NOR WMU No. 7	Lead and cadmium	~ 3.5 acres	Closed	1996		X	Site assessment	2012-2013
No. 2	North Disposal Area	Landfill	RCRA SWMU No. 4/NOR WMU No. 3	Lead and cadmium	~ 5.5 acres	Closed	1978		X	Site assessment	2012-2013
No. 2	Stewart Creek Sediment Dredging Waste Pile (overlying west side of North Disposal Area)	Capped waste pile	RCRA SWMU No. 8/NOR WMU No. 13	Lead and cadmium	~ 1 acre	Closed	1989		X	Site assessment	2012-2013
No. 2	Product Waste Pile (adjacent to Battery Breaker Building	Former waste pile	RCRA SWMU No. 9/NOR WMU No. 1	Lead and cadmium	< 0.5 acres	Removed and Closed	2000		X	Site assessment	2012-2013
No. 2	3-yard dump hoppers (west side of Battery Breaker Building)	Container	NOR WMU No. 6	Lead and cadmium	< 0.5 acres	Inactive			X	Site assessment	2012-2013
No. 2	Boneyard	Equipment storage area	NA	Lead and cadmium	~ 0.5 acres	Inactive			X	Site assessment	2012-2013

Table 1A
Sources of Release

Affected Property Name/Number	Name of Potential Source	Type of Potential Source	NOR unit or SWMU Number, if Applicable	Substances of Potential Concern	Size of Source (capacity, area, or volume)[1]	Status of Source		Was a Release from This Source Confirmed?			
						Status	If closed or other, list date closed or explain	No	Yes[2]	Discovery method	Date
No. 2	Roll-off boxes (several locations in former production area and in Bale Stabilization Area)	Roll-off boxes used to store treated HW	NOR WMU No. 14	Lead and cadmium	< 0.5 acres	Inactive			X	Site assessment	2012-2013
No. 2	Stewart Creek Flood Wall	Spills	NA	Lead and cadmium, petroleum hydrocarbons*	< 0.5 acres	Active			X	TCEQ Inspection	May-June 2011
No. 2	Wastewater Treatment Facility	Wastewater treatment unit	NOR WMU No. 9	Lead and cadmium, petroleum hydrocarbons*	< 0.5 acres	Active			X	Site assessment	2012-2013
No. 2	Boneyard debris piles	Debris piles	NOR WMU No. 17	Lead and cadmium	< 0.5 acres	Removed	2013		X	Site assessment	2012-2013
No. 3	South Disposal Area	Landfill	RCRA SWMU No. 5/NOR WMU No. 4	Lead and cadmium	~ 1 acre	Closed	1974		X	Site assessment	2012-2013
No. 3	Former Shooting Range Berm	Soil pile adjacent to South Disposal Area	NA	Lead and cadmium	< 0.5 acres	Removed	2013		X	Site assessment	2012-2013
No. 3	Former Operating Plant Emissions	Aerial deposition	NA	Lead and cadmium	30 acres (assumed; TCEQ default)	Operations stopped	November 2012		X	Site assessment	2012-2013
No. 3	Crystallization Unit drainage ditch (at sample location 2013-CUFT-7A)	Unknown	NA	Lead and cadmium	< 0.5 acres	Not removed			X	Site assessment	2012-2013
Various	Exposed Battery Chips/Slag	Battery Chips/Slag	NA	Lead and cadmium	< 0.5 acres (each)	Not removed			X	Site assessment	2012-2013
NA	Class 2 Landfill	Landfill	NOR WMU No. 12	Lead and cadmium	~ 7 acres	Active		X			

Sources of Release

Affected Property Name / Number	Name of Potential Source	Type of Potential Source	NOR unit or SWMU Number, if Applicable	Substances of Potential Concern	Size of Source (capacity, area, or volume)[1]	Status of Source		Was a Release from This Source Confirmed?			
						Status	If closed or other, list date closed or explain	No	Yes[2]	Discovery method	Date

1. [1] A 30-acre source area was assumed for establishing PCLs for areas of the Site where inorganics were of potential concern (lead, cadmium); a 0.5-acre source area was assumed for establishing PCLs where organics were of potential concern (VOCs, SVOCs, TPH).
2. [2] Indicates that COCs were detected in vicinity of potential source above Residential Assessment Levels (RALs). Actual source of release may not be clearly identified.
3. RAL exceedances at Site were detected in soil only.
4. * - Lead and cadmium are the primary COCs; however, process area-specific COCs were additionally analyzed in these areas.
5. NA - Not applicable.
6. HW - Hazardous waste.

Table 1C
Historical Document Summary

Author	Date	Title	Contents	Outstanding issues / recommendations	Comments
Dames and Moore	8/29/1983	Groundwater Investigation; Frisco, Texas Plant	Dames and Moore conducted a groundwater investigation in the vicinity of the North Disposal Area and the South Disposal Area in 1983. For the investigation, seven core holes were completed for geotechnical testing, which were converted to monitoring wells. Groundwater samples were collected from the monitoring wells and in-situ permeability tests were at the monitoring wells during the study. The study concluded that groundwater was flowing toward and discharging into Stewart Creek and its tributaries at approximately 3.1x10-5 to 1.0x10-8 cm/sec.	"...the groundwater levels in several wells have not recovered to static levels. Therefore, water level readings should be made in all the site monitoring wells for a period of 6 months to a year." ..."the potentiometric surface should be revised to determine if there are significant changes in flow direction as a result of the new data."	The following wells were plugged and abandoned during the Phase I RCRA Facility Investigation (Lake, 1991): B-1, B-1S, B-2, B-2N. B-3, B-4, B-4N, B-5, B-6, B-7, B-8, and B-9 (B-8 and B-9 installed in 1987 by Southwest Laboratories). The wells were plugged and abandoned at the request of the TWC due to potential surface completion issues.
				Once static water levels are reached"...the positioning and depths of the present wells should be examined critically at that time and modifications made to the system to assure representative monitoring of the disposal facilities. In particular, once static water level conditions are reached in wells B-1, B-3 and B-4, shallower wells intercepting the groundwater table should be installed adjacent to each of these wells to provide water quality data representative of the upper ground water flow system"	
				"...additional groundwater samples should be collected from all wells except B-1, B-3 and B-4 to evaluate chemical variations with time. Monitoring wells B-1, B-3 and B-4 should not be sampled so that these wells can recover to static water levels."	
Southwest Laboratories	2/21/1986	Water and Sediment Tests	28 creek water samples, 28 stream sediment samples and 4 creek bank samples were collected and analyzed for lead and cadmium. The soil and sediment samples were analyzed using EP toxicity procedure.	"...we recommend sediments be excavated from the stream bed from current sample location 7, westward to sample location 19; this is a distance of approximately 1700 feet on Stewart Creek. The north branch appears to be relatively "clean" as indicated by our current analytical test results."	Stewart Creek was remediated during 1986 and again during 2000. Remedial activities conducted during 2000 approved by TNRCC letter dated 7/25/2000. Improvements were made to the stormwater system, including construction of Flood Wall, in 1987-1988.
				"At this time is appears that only stream sediment samples need to be analyzed in the future as water sample test results by SWL to date have not shown unacceptable concentrations of lead and/or cadmium. Sampling and testing of sediments will occur if recommended by the soil engineer before, during and after the excavation work."	Sediments tested as recommended following remediation activities in 1986.
	5/21/1986	Stream Sediment Samples	Following an initial dredge of Stewart Creek sediments, 12 stream sediment samples were collected and evaluated for lead and cadmium using the EP toxicity procedure.	"We suggest redredging the Stewart Creek from about 50 feet east of sample location 1 to approximately 50 feet west of sample location 2. This is a distance of about 250 feet."	Stewart Creek was remediated during 1986 and again during 2000. Remedial activities conducted during 2000 approved by TNRCC letter dated 7/25/2000. Improvements were made to the stormwater system, including construction of Flood Wall, in 1987-1988.
	6/13/1986	Stream Sediment Test	Following a second dredge of Stewart Creek sediment, 23 stream sediment samples were collected from a stockpile of stream sediments (19 samples) and Stewart Creek (4 samples) and evaluated for lead and cadmium using the EP toxicity procedure.	None noted. Two of the four stream sediment samples were above the 5 mg/L EPA limit of leachable lead.	Stewart Creek was remediated during 1986 and again during 2000. Remedial activities conducted during 2000 approved by TNRCC letter dated 7/25/2000. Improvements were made to the stormwater system, including construction of Flood Wall, in 1987-1988.
	7/29/1986	Stream Sediment Tests	Following a third dredge of Stewart Creek sediments (approximately 300 feet), four Stewart Creek sediment samples were collected and evaluated for lead and cadmium using the EP toxicity procedure.	"The four sediment sample tests indicated that the current EPA specifications for lead (5 mg/L) and cadmium (1 mg/L) were not exceeded."	Stewart Creek was remediated during 1986 and again during 2000. Remedial activities conducted during 2000 approved by TNRCC letter dated 7/25/2000. Improvements were made to the stormwater system, including construction of Flood Wall, in 1987-1988.
	9/10/1987	Three Monitor Wells	Two new monitoring wells were installed (B-8 and B-9) and B-3 drilled out and replaced due to damaged casing.	Report detailing the installation of two new monitoring wells (B-8 and B-9) and the replacement of well B-3 by drilling out and replacing the well. B-3 was replaced due to damaged casing.	None noted.

Table 1C
Historical Document Summary

Author	Date	Title	Contents	Outstanding issues / recommendations	Comments
Texas Water Commission	11/16/1987	RCRA Facility Assessment	A RCRA Facility Assessment was issued by the Texas Water Commission (TWC) November 16, 1987. In the assessment, nine SWMUs were identified: (1) Battery Storage Area; (2) Raw Material Storage Area; (3) Slag Landfill; (4) North Disposal Area; (5) South Disposal Area; (6) Stewart Creek; (7) Old Drum Storage Area; (8) Stewart Creek Sediment Dredging Waste Pile; and (9) Product Waste Pile.		
Lake Engineering, Inc.	9/8/1989	RCRA Facility Investigation Workplan for GNB Incorporated, Frisco, TX	Proposed investigation of several Waste Management Areas (WMAs). Third revision approved by TWC letter dated February 6, 1990	The "location of the boundaries of the landfills (will be delineated)…and information regarding the construction and condition of the cover of each landfill" will be gathered. The landfills will be delineated horizontally by examining historical aerial photography and conducting interviews with employees…to determine the approximate outline of the landfills…"The exact location of the boundaries will be determined using a hammer drill as a pneumatic soil problem…the probing will begin on 100' centers and become more closely spaced as required…The depth of the disposal areas will be determined by trenching in the center of the North (2 trenches) and South (1 trench) areas. The depth of the active slag fill can be determined from pre-existing ground level contours v versus current elevations.…During the determination of the boundaries of the landfills, an inspection will be made to ascertain the construction of the covers on the landfills and their conditions. This determination will include visual inspections of the holes and the trenches."	Addressed during Phase I RFI (Lake, 1991)
				"The possibility of contamination under the controlled surface slab, such as under the raw material pile and the old rubber chip pile, has been raised by the stipulations of the permit. In order to investigate this possibility, the slab would have to be breached, thus increasing the possibility of future migration pathways. To place holes through the controlled surface would weaken the integrity of the system. Any hole, even though grouted to the surface will expand and contract at a different rate than the slab itself…If contamination does exist under the slab it is immobile, unless it is in contact with liquid. If it is in contact with liquid and is being moved downgradient, it will be detected by the proposed facility monitor wells which border the production area."	An official closure approval letter was requested of the TWC by letter dated December 22, 1999. Closure was approved by TNRCC by letter dated January 13, 2000.
				"To address the (the extent of the) diesel oil plume, a series of four hand or power auger samples will be taken outside of the containment wall…and will be sampled to a depth of eight feet, the depth equivalent to the level of the diesel skim found in the recovery sump… (and) analyzed for Total Petroleum Hydrocarbons (TPH)."	Addressed during Phase I RFI (Lake, 1991)
				"…the well installation borings will be (visually and geotechnically) logged to provide additional knowledge of the subsurface…Continuous recovery soil borings will be made at all well installations. Samples of this material will be used to determine permeability, lead and cadmium concentrations (and total petroleum hydrocarbons, where applicable), grain size and composition. In general, these samples for analysis will be taken at the start of each hole (0 to 6"), at the 6 to 12" interval, at 12 to 18", at the 5' level and at five foot intervals thereafter, until the water table is encountered…The samples taken from proposed monitor wells MW-10, B-1N, B-7N, and the eastern piezometer locations (P1 and P2)…will be used to establish soil background parameters…A total of 217 soil samples are currently proposed for analyses. These will be collected from the borings at the monitor well and piezometer locations, along the containment wall (diesel oil plume investigation), and adjacent to existing well B-3."	Addressed during Phase I RFI (Lake, 1991)
				"To determine whether or not surface contamination could have been a contributing factor to the elevated lead level existing at B-3, a series of surface soil samples will be collected immediately uphill of this well. The samples will be analyzed (for total lead and total cadmium)."	Addressed during Phase I RFI (Lake, 1991)

Table 1C
Historical Document Summary

Author	Date	Title	Contents	Outstanding issues / recommendations	Comments
Lake Engineering, Inc.	9/8/1989	RCRA Facility Investigation Workplan for GNB Incorporated, Frisco, TX (Continued)	Proposed investigation of several Waste Management Areas (WMAs). Third revision approved by TWC letter dated February	"The hydrogeologic investigation will involve the removal of the ten existing monitor wells and the installation of eighteen new monitor wells and three piezometers. The combined data collected from the replacement and new monitor wells will be used to assess the present hydrogeologic conditions at the facility. In addition, the visual and geotechnical logging of the wells will allow geologic cross sections of the site to be developed…The hydrogeologic activities are designed to address the following…to confirm the direction of groundwater flow; to further define the local groundwater flow pattern; to determine the uppermost aquifer beneath the solid waste management areas; to develop geologic sections of the facility areal to determine the vertical and horizontal extent of any contamination at any of the WMA's; to determine the hydraulic conductivity of the aquifer system; to determine the background groundwater contaminant concentrations; and to determine whether any releases to the soil and groundwater have occurred from any of the units listed in the permit."	Addressed during Phase I RFI (Lake, 1991)
				"…the degree of contamination which may be encountered along Stewart Creek…will be accomplished by taking (9) sediment samples along Stewart Creek and the unnamed tributary…In addition to sediment samples, (9) water samples will be taken at the same locations, if water is present. Also, water level elevations will be surveyed, if possible, to determine the relationship of the stream levels to the water table."	Addressed during Phase I RFI (Lake, 1991)
				Potential contamination by fine lead contaminated particulate material from the Raw Material Storage Area (RMSA) is proposed to be addressed by way of the proposed investigation of the North Disposal Area, since this is likely the receiving area of any releases and it would be impossible to differentiate particulate contamination from other sources of contamination.	Addressed during Phase I RFI (Lake, 1991)
Resource Consultants, Inc.	2/1/1991	Stream Investigation; Stewart Creek; Collin County, Texas	A study conducted by Resource Consultants in 1991 investigated sediments at one location upstream of the Site and two locations downstream relative to the Site. Cadmium hotspots were indicated in the two samples collected downstream.		
Lake Engineering, Inc.	5/8/1991	RCRA Facility Investigation for GNB Incorporated; Frisco, TX	RCRA Facility Investigation that included investigation of four Waste Management Areas (WMA)	WMA1 (Slag Landfill, North Disposal Area, Sediment Waste Pile): "Evaluation of the groundwater data collected indicates that WMA 1 is not contributing lead or cadmium contamination to the substrate. However, the monitor wells for the area should continue to be monitored as specified in the operating permit in order to ensure the proper ongoing management of these units."	
				Slag landfill (SL): "A permit application has been made for fixating and stabilizing the slag prior to disposal. No further action is recommended in relation to this unit."	
				North Disposal Area (NDA): "In general the cover is in good condition, but has thinned in some areas. The cover of the landfill should be repaired in areas of thinning by emplacing compacted native soil to achieve a total cover depth of two feet." Native soil discussed as having good properties (e.g. low permeability and tests run for other landfill) for landfill cover application.	NDA cover in need of additional soil placement, see W&M, Mar 2011 and PBW, 2012.
				Stewart Creek Sediment Dredging Waste Pile: closed in 1989 in accordance with TWC approved plan. "The cover of the unit is in good repair and well vegetated. No further action beyond continued periodic inspection of the cover and limiting access to the unit is recommended."	An official closure approval letter was requested of the TWC for this area by letter dated December 22, 1999. Closure was approved by TNRCC by letter dated January 13, 2000.

Table 1C
Historical Document Summary

Author	Date	Title	Contents	Outstanding issues / recommendations	Comments
Lake Engineering, Inc.	5/8/1991	RCRA Facility Investigation for GNB Incorporated; Frisco, TX (Continued)	RCRA Facility Investigation that included investigation of four Waste Management Areas (WMA)	WMA 2 (Bale Stabilization Area, Raw Material Storage Area, Old Drum Storage Area, Battery Storage Area, Product Waste Pile, Diesel Oil Spill): "Interpretation of the data gathered in relation to WMA 2 indicates that the area is not contributing Pb or Cd contamination to the substrate. The information gathered in relation to the diesel spill indicates that the spill is not migrating beyond the original area of discovery. It is recommended that monitoring be continued on wells surrounding this area."	NFA for diesel spill area issued by TCEQ on July 15, 2003. See below for details regarding other areas.
				Battery Storage Area (BSA): "The battery storage area referred to in the permit was closed under TWC approval. The unit was cleaned, contaminated soil removed, and the area was paved and deed recorded. No further action is recommended in relation to this unit."	Following closure of this area, the blast furnace slag stabilization unit was built over the area. TWC comments indicate additional investigation was needed below the concrete slab of this area to confirm additional contamination had not occurred due to eroded concrete covering the area. The former Battery Storage Area was closed in accordance with a TWC-approved closure plan dated March 1988 and a certification letter was subsequently submitted to TWC on January 24, 1989. An official approval letter was requested of the TWC by letter dated December 22, 1999. Closure was approved by TNRCC by letter dated January 13, 2000.
				Raw Material Storage Area (RMSA): "(The RMSA) is a covered building and materials are protected from precipitation. Further, the building is located within a runoff controlled area. No further action is recommended for this unit."	No further action requested by TWC in Notice of Deficiency letter (TWC, 1993).
				Old Drum Storage Area: "The old drum storage area referred to in the permit was closed under TWC approval. The unit was cleaned, contaminated soil was removed, and the area was paved and deed recorded. No further action is recommended in regard to this unit."	Closed according to an agreed order issued on March 17, 1987. Official approval letter requested from TWC by letter dated December 22, 1999. Closure was approved by TNRCC by letter dated January 13, 2000.
				Product (rubber chip) Waste Pile: "The product waste pile was closed according to a closure plan approved by the TWC. No further action is recommended in regard to this unit."	Closed in accordance with a closure plan approved by TWC on January 22, 1988 and as required by an Agreed Order issued March 17, 1987. The waste piles were certified as closed in March 1988. An official approval letter was requested from the TWC (TNRCC) by letter dated December 22, 1999. Closure was approved by TNRCC by letter dated January 13, 2000.
				Diesel Oil Leak: "The retrieval sump should continue to be monitored and the oil should be removed as required. For the following reasons, no additional action is recommended for this unit: 1) only moderately low levels of TPH have been detected in groundwater and soils in the immediate area of the original leak; 2) the surface overlying the spill is now entirely paved; 3) only small quantities of free product accumulate between pumping intervals indicating the majority of the oil has been retrieved."	NFA for diesel spill area issued by TCEQ on July 15, 2003.
				WMA 3 (South Disposal Area, "SDA"): The horizontal and vertical extent of the landfill have been identified... In general the cover is in good condition, but has thinned in some areas...and should be rehabilitated...traffic in the area should be restricted... ...lead concentrations in B-1N ranged from 0.03 to 0.15 mg/L...the three wells immediately downgradient (B2R, B3R and B4R) have shown no Pb or Cd concentrations exceedances of the Primary Drinking Water standards. ...MW-12 and MW-13 indicated elevated Pb readings, near or above the MCL, on two and one sampling events, respectively. ...these readings are not statistically significant. ...it is recommended that groundwater monitoring of all wells around this management area be continued."	SDA soil cover in need of additional soil placement. See W&M, Mar 2011 and TCEQ, 2011. Groundwater monitoring data provided in Phase II (JDC, 1998a). Additional groundwater monitoring described in Section 5 of the APAR.
				WMA 4 (Stewart Creek): ...in the areas of Stewart Creek, where observed levels exceed the action level for lead (1000 mg/kg)... be resampled on a tighter sampling pattern..."	Stewart Creek was remediated on-site during 1986 and again during 2000. Remedial activities conducted during 2000 approved by TNRCC letter dated 7/25/2000. Improvements were made to the stormwater system, including construction of Flood Wall, in 1987-1988.
				"...the soil sampling in the general grounds area indicated several locations where lead in soil exceeds the cleanup level of 1000 mg/kg... These locations are 1) east of the entrance to the truck staging area and 2) west of the battery storage building...	

Table 1C
Historical Document Summary

Author	Date	Title	Contents	Outstanding issues / recommendations	Comments
Lake Engineering, Inc.	5/8/1991	RCRA Facility Investigation for GNB Incorporated; Frisco, TX (Continued)	RCRA Facility Investigation that included investigation of four Waste Management Areas (WMA)	Monitoring of all wells in this area should be continued.	Groundwater monitoring data reported in Phase II RFI (JDC, 1998a)
				"The elevated concentration of lead [greater than MCL of 0.05 mg/L] at the culvert on 5th Street could be indicative of road runoff...Since surface water samples at the 5th Street culvert suggest a possible impact from runoff, additional investigation of the drainage channels along the road is recommended."	Stewart Creek was remediated on-site during 1986 and again during 2000. Remedial activities conducted during 2000 approved by TNRCC letter dated 7/25/2000. Improvements were made to the stormwater system, including construction of Flood Wall, in 1987-1988.
Resource Consultants, Inc.	12/1/1992	Stream Investigation; Stewart Creek; Collin County, Texas	Resource Consultants conducted an additional study in 1992 that investigated the biotic community in order to classify the stream. Three sample locations were chosen, with one upstream of the Site and two locations downstream of the Site. Based on the biotic community observed during the study, the stream was classified as an intermittent stream.		
TWC	8/26/1993	Notice of Deficiency	TWC Comments on 1991 RCRA Facility Investigation	Requested clarification of various technical aspects of the Phase I RFI, including why groundwater background levels were not established. Soil background levels also need to be determined.	
				"TWC is in agreement that groundwater monitoring for Pb and Cd should continue on a quarterly basis. Analysis for pH and sulfates must also be included."	Pb, Cd, pH and sulfates analyzed in groundwater samples for Site Investigation (PBW, 2012) and the APAR investigation (Section 5).
				Requested statistical methods for comparison to background soil concentrations to be specified.	Background soil samples were collected for the Site Investigation (PBW, 2012). A statistical analysis of the samples is included in the APAR (Appendix 8).
				"The results of the surface water and sediment sampling for the RFI indicate that an adverse impact on Stewart Creek from this facility appears to be continuing... In addition, TWC stream monitoring data collected in 1989-1991 from stations downstream of the GNB facility show dissolved lead levels which exceed the State Water Quality standard for lead. Statistically significant contamination by lead and cadmium is shown in the stream sediments, indicating an ongoing problem with releases from this facility...the investigation and remediation of Stewart Creek will be addressed in a separate letter, and will be handled as a separate RFI project."	Stewart Creek was remediated on-site during 1986 and again during 2000. Remedial activities conducted during 2000 approved by TNRCC letter dated 7/25/2000. Improvements were made to the stormwater system, including construction of Flood Wall, in 1987-1988.
				"The TWC has some concern about pH values in the range of 3.0 to 6.0 from calcareous formations.... Any additional groundwater analyses should include an analysis for pH. Background groundwater pH values for comparison purposes must also be established."	The wells that indicated pH ranges between 3.0-6.0 during the 1991 RFI investigation were B-3R, B-8N, MW-10, MW-12, and MW-13. During the 2012 Site Investigation, B-8N was discovered to have been damaged beyond repair and B-3R was dry during the Site Investigation and APAR investigation: these two wells were not sampled. MW-10 was not sampled during the 2012 Site Investigation in accordance with the November 2011 EPA-approved workplan for Site Investigation activities but was sampled during the APAR investigation and had a pH value of 7.38. MW-12 and MW-13 had pH values above 6.0 and ranged from 6.78-7.40 for groundwater sampling events for the Site Investigation (PBW, 2012) and APAR investigation. Because B-8N was damaged beyond repair, MW-18, located nearby B-8N, was sampled as a replacement with prior EPA approval. MW-18 had pH values above 6.0 and ranged from 7.14-7.38 for the Site Investigation and APAR investigation groundwater sampling events. All wells had a pH value above 6.0 during the Site Investigation and first Phse of the APAR investigation groundwater sampling events except for the following wells sampled during the APAR investigation: MW-27 (5.82), MW-29 (5.82) and B9N (5.62). During the second Phase of the APAR investigation the following wells had a pH below 6.0: MW-37 (5.97), MW-43 (4.85), MW-46 (4.38 to 5.68).
				"Please provide correspondence documenting TWC approval of the certified closure of the battery storage area"	In their Phase I RFI Report approval letter dated June 3, 1994,TNRCC acknowledged that a Texas registered P.E. certified the closure of the battery storage area according to the Closure Plan. GNB requested official approval of closure from TNRCC by letter dated December 22, 1999. Closure was approved by TNRCC by letter dated January 13, 2000.

Table 1C
Historical Document Summary

Author	Date	Title	Contents	Outstanding issues / recommendations	Comments
TWC	8/26/1993	Notice of Deficiency (Continued)	TWC Comments on 1991 RCRA Facility Investigation	"The report does not indicate the type and thickness of soil or rock underlying the waste in the North Landfill...(and)...South Landfill. Please provide a description of the underlying soil/rock."	Descriptions provided in Phase I Addendum (Lake, 1993).
TNRCC	9/16/1993	TNRCC Letter: RCRA Facility Investigation Report/Stewart Creek Phase II RFI	Letter designed to specifically address investigation and remediation of Stewart Creek separately from other WMAs.	Required GNB to conduct a separate investigation on Stewart Creek apart from the RFI/CMI program from the rest of the facility.	Addressed separately as requested by 1994 Workplan.
				A surface water value exceeded State Water Quality Standards for dissolved Pb. Additional samples collected by TNRCC at stations downstream of the site during 1989-1991 showed elevated lead levels in surface water.	Stewart Creek was remediated on-site during 2000 and remedial activities approved by letter dated 7/25/2000.
				"GNB is to sample sediments downstream from the facility until the lead levels are shown statistically to be at background, using acceptable sampling and analytical methods, sampling points and an acceptable statistical method to determine the point that the stream is no longer impacted by the facility. Sediment samples must be analyzed for total Pb and total Cd."	Stewart Creek was remediated on-site during 2000 and remedial activities approved by letter TNRCC dated 7/25/2000. Downstream sediment sampling results reported in Final Phase II Stewart Creek RFI (RMT/JN, 1996).
				"High levels of Pb (in sediments) were found near the large conduits installed through the closed NDA, which routes the unnamed tributary to Stewart Creek... In the Phase II RFI Workplan, please detail how potential contamination via this conduit can be investigated."	Stewart Creek was remediated on-site during 2000 and remedial activities approved by TNRCC letter dated 7/25/2000. The north tributary was re-routed after the Phase I sampling and the conduits plugged in 2000 (See Remediation Services, Inc., 2000 report detailed in this table).
GNB	12/9/1993	GNB letter: RCRA Facility Investigation Notice of Deficiency response		Groundwater background levels were not determined, therefore sample values were not compared to background concentrations. MCLs were used for comparison instead. A new background monitor well is proposed to the east of the facility to determine background water concentrations (e.g. total and dissolved Cd and Pb, pH).	A background monitoring well east of the facility was not installed during the Phase II investigation. Two background wells (MW-19 and MW-20) were installed during the Site Investigation (PBW, 2012).
				Four new background soil sample locations are proposed east of the facility in order to compare to soil sample values. The background samples will be collected in 6-inch intervals at 0-6, 6-12 and 12-18 inches and analyzed for "indicator parameters as specified in the permit." Soil samples will be compared to background concentrations as determined from the 4 samples east of the facility.	Background soil samples were collected for the Site Investigation (PBW, 2012) and the APAR investigation. A statistical analysis of the samples is included in the APAR (Appendix 8).
				"A certification of closure (for the battery storage area) has been located and will be submitted to the Agency."	The TNRCC acknowledged possession of the certification of closure in their letter dated 6/3/1994. GNB requested official approval of closure from TNRCC by letter dated December 22, 1999. Closure was approved by TNRCC by letter dated January 13, 2000.
Lake Engineering, Inc.	12/10/1993	Addendum to the RCRA Facility Investigation for GNB Incorporated; Frisco, TX	Addendum submitted to address concerns of 8/26/1993 TWC letter	Same recommendations as 1991 report. TNRCC comments addressed in Dec 9, 1993 letter and by edits throughout the report.	
				"The installation of a background monitor well east of the facility to determine background groundwater concentrations for the indicator constituents listed in the facility's operating permit is recommended. Four groundwater sampling events spaced at two month intervals should be conducted from the well and analyzed for total Cd and Pb; dissolved Cd and Pb; and pH. Statistical analyses should be performed on the RFI groundwater data and the new background concentrations to determine what impact, if any, the operations at the facility have had on the groundwater beneath the Site."	A background monitoring well east of the facility was not installed during the Phase II investigation. Two background wells (MW-19 and MW-20) were installed during the Site Investigation (PBW, 2012). Groundwater data collected for the APAR are presented in Section 5.
	1/21/1994	Stewart Creek Phase II Workplan	Approved by letter June 1, 1994 and modified August 3, 1994, modification approved August 8, 1994		

Table 1C
Historical Document Summary

Author	Date	Title	Contents	Outstanding issues / recommendations	Comments
TNRCC	6/1/1994	Stewart Creek Phase II Workplan Approval	Conditional approval	Tighter sampling intervals of Stewart Creek sediments than workplan proposes: 100-ft intervals for first quarter mile from property boundary, continue at quarter mile increments until delineated	Sediment sampling results reported in Final Phase II Stewart Creek RFI (RMT/JN, 1996). Stewart Creek was remediated during 2000 and remedial activities approved by letter dated 7/25/2000.
				Background samples and statistical method: collect 8 background sediment samples upstream from 5th Street and collect 8 background soil samples from the east side buffer zone of plant at 12-18 inches bgs. On the background data sets, perform outlier test, test of normal distribution (or use non-parametric methods), then perform UTL statistical method.	Stewart Creek was remediated during 2000 and remedial activities approved by letter dated 7/25/2000. Surface water sampling was performed during the Site Investigation (PBW, 2012) and APAR investigation. Background soil samples were collected for the Site Investigation (PBW, 2012) and the APAR investigation. A statistical analysis of the background soil samples is included in Appendix 8 of the APAR.
				Downstream sediment samples: Collect as large a core of sediment as possible, do not composite, and analyze each sample separately. Background sediment samples should be collected in the same manner.	Downstream sediment sampling results reported in Final Phase II Stewart Creek RFI (RMT/JN, 1996). Stewart Creek was remediated during 2000 and remedial activities approved by letter dated 7/25/2000. Additional downstream sediment samples are discussed in Section 7 and Appendix 19.
				"The workplan states that collection of surface water samples will be dependent upon stream flow. Surface water samples should be collected regardless of flow. If the stream is at low flow conditions, then samples must be collected up to the farthest upstream location as practical, provided the locations are adjacent to or downstream from the facility."	Stewart Creek was remediated during 2000 and remedial activities approved by TNRCC letter dated 7/25/2000. Surface water sampling was performed during the Site Investigation (PBW, 2012) and the APAR investigation (Section 6).
				Analyze three samples of blast furnace slag located in the creek and three samples of blast furnace slag from the plant directly for total and TCLP lead and cadmium.	W&M (W&M, 2011a) sampled suspected slag from Stewart Creek and analyzed the samples for total Pb and Cd (Appendix 18). The samples were also analyzed for Fe and Ca to differentiate slag from limestone fragments.
Delta	1994	Stewart Creek Phase II RFI	20 sediment samples collected and analyzed for Cd and Pb	Remedial activities should focus on stream segment between GNB and 7700 feet downstream of Stewart Creek at 5th Street	Stewart Creek was remediated on-site during 2000 and remedial activities approved by TNRCC letter dated 7/25/2000.
				Develop corrective measures study	See JDC, 1998a.
				Develop Tier 1 eco risk assessment	See JDC, 1998b.
TNRCC	6/3/1994	TNRCC Approval of Phase I and Phase I Addendum	Required several areas of concern to be addressed in Phase II	Background wells: TNRCC requires GNB to install one monitor well for SWMUs 3 (SL), 4 (NDA), 5 (SDA) and 8 (Stewart Creek Sediment Dredging Waste Pile). Also recommended are additional background wells to provide an adequate sample population for statistical calculations to determine if background values have been exceeded. It is unclear if well B1-R has been impacted by the South Disposal Area, so an additional well may need to be installed up-gradient of the SDA to be used as background.	A background monitoring well east of the facility was not installed during the Phase II investigation. Two background wells (MW-19 and MW-20) were installed during the Site Investigation (PBW, 2012).
				Groundwater monitoring: "...TNRCC is requesting that groundwater samples be analyzed for sulfates.." in addition to the parameters proposed in the Phase I Addendum (i.e. total and dissolved Pb and Cd, pH)	Quarterly groundwater monitoring results were presented for total lead in the Phase II Investigation report (JDC, 1998). Total and dissolved Pb and Cd, pH and sulfates were analyzed in groundwater samples collected for the Site Investigation (PBW, 2012) and the APAR investigation (Section 5).
				Background soil: "...background soil samples must correspond to the same soil type, or soil horizon as the down-gradient samples."	A background soil study was conducted in 1993, however, TNRCC did not agree with the values. Background samples were not collected during the Phase II investigation. Background soil samples were collected during the Site Investigation (PBW, 2012) and the APAR investigation (Appendix 8).

Table 1C
Historical Document Summary

Author	Date	Title	Contents	Outstanding issues / recommendations	Comments
TNRCC	6/3/1994	TNRCC Approval of Phase I and Phase I Addendum (Continued)	Required several areas of concern to be addressed in Phase II	WMA 1: "Additional soil samples should be collected around the outfall of the old railroad culvert down-gradient of the active slag landfill to determine whether this area could be a "hot spot" due to historical runoff from the slag landfill or north disposal area. Soil samples should also be collected south of the north disposal area along the railroad tracks." Samples to be collected from 0-6, 6-12, 12-18, 18-24 inches and at 3 feet. Samples are not to be composited. If sample results indicate hazardous constituents are present at deeper than 4 feet, the collection of deeper samples may be necessary.	Soil samples collected during the APAR investigation in the vicinity of the former railroad culvert outfall are discussed in Section 4.
				North Landfill: to address the thinned cover in some areas, the Phase II workplan should propose the necessary remediation, including whether placement of additional cap material is necessary during the Phase II RFI.	
				WMA 2: Closed battery storage area: "...photographs of the Battery Storage Area taken after closure was completed show pitted, eroded and cracked concrete, indicating a potential release pathway to the soil beneath this unit. Since the closure, a building has been constructed over the site. The TNRCC cannot conclude at this time that the subsurface soil in this area was not impacted by the previous battery storage practices. Please propose a method to investigate the subsurface soils in this area to document that a release did not occur.	Following closure of this area, the blast furnace slag stabilization unit was built over the area. TWC comments indicate additional investigation was needed below the concrete slab of this area to confirm additional contamination has not occurred due to eroded concrete covering the area. The former Battery Storage Area was closed in accordance with a TWC-approved closure plan dated March 1988 and a certification letter was subsequently submitted to TWC on January 24, 1989. GNB request official approval of closure from TNRCC by letter dated December 22, 1999. Closure was approved by TNRCC by letter dated January 13, 2000.
				WMA 2: Battery Acid Management System: "The acid sump, located at the battery breaker, is a SWMU, with a conduit leading to the on-site wastewater treatment plant. The WWTP includes subsurface treatment tanks. Groundwater samples from MW-12 and 13 showed a pH of 3.9, 5.0 and 4.9, which is lower than the expected range for ground water in this area. It is our understanding that the acid sump has been recently checked for integrity and that the conduit leading from the sump to the WWTP has been replaced. Please provide documentation of the physical integrity of the sump and the conduit, and removal of the previous conduit. Also, please provide information on repairs and/or changes to the sump or the conduit. In the Phase II workplan, please propose a method to sample soils in the proximity of the sump and conduit. Provide information, if available, pertaining to integrity testing conducted on the subsurface WWTP tanks. If these tanks have not been integrity tested by an independent Texas registered PE, then integrity testing, and possibly subsurface soil sampling, will be necessary as part of the Phase II RFI.	GNB proposed to provide documentation of the integrity of the battery acid management system (i.e. sump, current conduit, and removal or previous piping); available information compiled on repairs and/or changes to the sump and conduit; and information complied on integrity of subsurface tanks at the on-site WWTP. Further investigation was not requested by TNRCC. Groundwater pH measurements collected during the Site Investigation (PBW, 2012) and APAR investigation are discussed in Section 5.
				WMA 2: Stored Raw Materials: "In the area immediately adjacent to the battery breaker, liquid materials collect on the floor prior to draining into the acid sump. This appears to be management of a solid waste...and meets the definition of a SWMU. The integrity of the concrete receiving this material is questionable, due to the appearance of eroded and cracked concrete and the nature of the liquid. This area must be cleared of the liquid, and the integrity of the concrete and possibly the underlying soils must be investigated as part of the Phase II."	Soil and groundwater samples were collected in this area during the APAR investigation.
				WMA 2: "Soil borings must be completed at approximately every 100 feet around WMA 2."	Soil borings were proposed in the Phase II workplan south of WMA 2 along Stewart Creek. Samples were not proposed along the northern border of WMA 2 due to this area being up-gradient of potential source areas. Many borings have been completed and sampled subslab within WMA2, including in the Battery Receiving/Storage Building, the Slag Treatment Building and outside vicinity, the Raw Material Storage Building and outside vicinity, as well as various other areas. Further discussion is provided in Section 4 of the APAR.
				WMA 3: South Disposal Area: "During the Phase I RFI, it appears that some sample points showing high lead results were not sampled at greater depths. Additional borings are needed in the area to further delineate lateral and vertical extent of contamination. An additional well should be installed near B1-R and screened in a deeper zone, since B-1R appears to be screened in the vadose zone and seldom supplies a water sample. Monitoring well B-4R appears to need replacing for the same reason."	The Phase II investigation further delineated SDA lead exceedances. B-1R and B-4R are both completed to the top of the shale bedrock and are fully penetrating of the uppermost groundwater bearing unit.

Table 1C
Historical Document Summary

Author	Date	Title	Contents	Outstanding issues / recommendations	Comments
TNRCC	6/3/1994	TNRCC Approval of Phase I and Phase I Addendum (Continued)	Required several areas of concern to be addressed in Phase II	WMA 3: "Further interpretation of the WMA 3 subsurface is necessary. A revised groundwater contour map and more detailed cross sections of the SDA should be included in the final Phase II report, incorporating the additional information collected during the RFI."	Completed in Phase II RFI (JDC, 1998a) and Site Investigation (PBW, 2012).
				Truck Staging Area (TSA): Exceedances indicated at MW-10 at upper 6 inches. "...These lead levels may have been caused by historical runoff from the TSA. Aerial photos from 1979 and 1981 show that this area was not paved and curbed at that time. ...bundles of spent batteries...may have leaked onto the ground while the trucks were/are parked in the TSA... the TNRCC is requiring additional soil borings along the periphery of the staging area and along the 5th Street drainage ditch. Each soil boring should be sampled for lead and cadmium every 6 inches to a min depth of 3 feet."	TSA sampled during Phase II RFI (JDC, 1998) and lead exceedances delineated during the Phase II and the Site Investigation (PBW, 2012). Additional soil samples in this area were collected during the APAR investigation.
				Hydrogeology: "The cross sections and lithologic logs show some gravel layers...Please use the additional information gathered during the Phase II RFI to further interpret the stratigraphy immediately below the facility...and provide more detailed cross sections in the Phase II report."	Additional information provided in Phase II RFI (JDC, 1998a), SIR (PBW, 2012), and APAR.
RMT/Jones and Neuse, Inc.	10/1/1994	Workplan for Phase II RCRA Facility Investigation; GNB Facility, Frisco, Texas	Conditionally approved by TNRCC letter dated February 27, 1998	Background monitor wells: "The following four background wells are recommended to adequately define groundwater concentrations at the site: 1) two new wells east of 5th street; 2) one new well south/southeast of WMA3 (SDA); and 3) one new well northeast of WMA1 (Slag Landfill, North Disposal Area, Sediment Waste Pile)...(also), the surficial water-bearing zone penetrated in soil borings proximal to Stewart Creek is not present at well B-1R (SDA). The location of the well on the bluff, which is capped by the relatively impermeable Austin Chalk Formation, may account for the absence of the surficial water in this area. A well located near the topographic saddle south/southwest of the south disposal area may provide hydraulically up-gradient (background) groundwater samples for WMA3."	Background monitor wells not installed during Phase II investigation due to on-site construction activities and dry weather. Two background wells (MW-19 and MW-20) were installed east of the facility and reported in the SIR (PBW, 2012).
				"...three soil borings will be drilled in the area of WMA 3 to determine the surface geology adjacent to the SDA. The primary emphasis of these soil borings is to determine the extent of the sand and gravel layers noted in previous investigations. "	Addressed in Phase II RFI (JDC, 1998a).
				"Well B4R will be plugged and decommissioned, and a replacement well installed slightly northwest of the location of this well. The new monitor well will be completed to a depth of approximately 40 feet."	Well not replaced due to dry conditions at the site during the time of the Phase II investigation. Well B4R is completed to the top of the shale bedrock and produced groundwater samples for Site Investigation and APAR investigations (Section 5).
				Background soil: "Surface soils not impacted from lead emissions of vehicular traffic as well as subsurface soil will be evaluated from a minimum of six locations along the perimeter of the property. Only locations upwind (south or west) of the plant are recommended. Samples will be collected from the 0 to 6" and 6 to 12" depths and analyzed for both lead and cadmium as well as pH. In addition to this data, soil lead concentrations are also being evaluated by Delta from analytical data generated during the Stewart Creek Phase II RFI activities."	Background soil samples were collected for the Site Investigation (PBW, 2012) and APAR investigation (Appendix 8).
				WMA1: (NDA, Stewart Creek Dredged Sediment Pile, SL) former railroad culvert "...three soil sampling locations are proposed south of the north disposal area along the railroad tracks..."	Sampling completed during Phase II RFI (JDC, 1998a) between WMA1 and WMA2 along railroad tracks.

Table 1C
Historical Document Summary

Author	Date	Title	Contents	Outstanding issues / recommendations	Comments
RMT/Jones and Neuse, Inc.	10/1/1994	Workplan for Phase II RCRA Facility Investigation; GNB Facility, Frisco, Texas (Continued)	Conditionally approved by TNRCC letter dated February 27, 1998	NDA recommendations: "...1) a visual inspection be conducted to determine all areas of the north disposal area in which the cap has deteriorated; 2) a permeable geotextile fabric be installed in these areas prior to the addition of native fill; 3) the cover material be tested for lead cadmium, pH and texture; 4) re-seed cover material with suitable grass mixture and 5) limit future access in this area."	
				WMA 2: Former battery storage area: "...the integrity of the concrete floor will be determined by an independent Texas registered professional engineer during the Phase II RFI. Soil sampling from beneath the existing paved surface is not recommended at this time. Such sampling (i.e. drilling through concrete) may provide a conduit for future contamination and should be evaluated following the inspection process."	An official closure approval letter was requested of the TWC for this area by letter dated December 22, 1999. Closure was approved by TNRCC by letter dated January 13, 2000.
				Battery acid management system: "During the Phase II RFI, the following activities will be conducted related to the battery acid management system: 1) documentation provided of physical integrity of sump, current conduit, and removal of previous piping; 2) available information compiled on repairs and/or changes to sump and conduit; and 3) information compiled in integrity of subsurface tanks at on-site WWTP."	
				Soil borings around WMA 2: "Ten soil borings will be completed along Stewart Creek on the south side of WMA 2 to evaluate potential contamination. Of particular concern is the release of acidic materials which would impact soil and groundwater pH. Soil borings are proposed along the south and west sides of the process area just outside of the paved area. These locations are hydraulically downgradient of the battery breaker sump and conduit. No soil borings are proposed along the north perimeter of the WMA2 since these locations are hydraulically upgradient of the potential source areas."	Addressed in the Human Health and Ecological Risk Assessment and Corrective Measures Study (JDC, 1998b).
				WMA 3 (SDA): "A grid layout for soil sampling is proposed for the SDA to determine the lateral and vertical extent of soil contamination. The spacing of the grid lines will be 50 by 50 feet with soil samples collected to a depth of six feet at every grid node. Samples will initially be only analyzed from the 100 by 100 foot interval at grid points outside of the boundaries of the SDA. All other soil samples will be held at the laboratory for later analysis, if necessary. The data from the sampling results will be evaluated with a geostatistical program to generate isopleths of soil lead and cadmium concentrations. The program can also be utilized to determine where additional data is required to refine the isopleths. This evaluation will help to determine if soil samples should then be analyzed. Following the review of the analytical data, one or more samples may then be analyzed for leachable concentrations of lead and/or cadmium utilizing the SPLP."	Addressed during Phase II RFI (JDC, 1998a)
				Additional monitor well (re-stated from background monitor wells section above regarding B-1R.)	Background monitor wells not installed during Phase II RFI due to on-site construction activities and dry weather. Two background wells (MW-19 and MW-20) were installed east of the facility and reported in the SIR (PBW, 2012).
				Truck staging area (TSA): "A total of eight soil borings are proposed for installation along the periphery of the truck staging area and along 5th street. Soil borings will be located approximately 100 feet apart around the staging area and along the west side of 5th street from the staging area to Stewart Creek. The soil borings will be drilled to a minimum depth of six feet. Soil samples will be collected from each six inch interval to a depth of three feet. Below three feet, samples will be collected every 12 inches. All samples from the 0 to 3 foot depth interval will be analyzed for total lead and cadmium as well as pH. Samples collected from below the three foot depth will be initially held at the laboratory...Soil borings are not recommended within the truck staging area, rather around the perimeter and north of Stewart Creek."	TSA sampling conducted during Phase II investigation (JDC, 1998a) and APAR investigation.

Table 1C
Historical Document Summary

Author	Date	Title	Contents	Outstanding issues / recommendations	Comments
RMT/Jones and Neuse, Inc.	10/1/1994	Workplan for Phase II RCRA Facility Investigation; GNB Facility, Frisco, Texas (Continued)	Conditionally approved by TNRCC letter dated February 27, 1998	Site geology: "Three geotechnical borings will be installed during the Phase II RFI to further evaluate site geology. Of primary concern is the presence of discontinuous gravel layers."	
				"Water levels from available wells will be measured during a one-day time period to determine groundwater flow and for development of a groundwater contour map."	Not addressed in Phase II investigation. Water level measurements presented in SIR (PBW, 2012) and APAR (Section 5).
GNB	10/12/1994	Miscellaneous Stained Soil Samples	Letter from GNB to TNRCC presenting results of Delta sampling of stained soils near the retaining wall and Stewart Creek walking bridge. Suggested staining may have originated from water coming from under the footing of the flood wall. The conduit seal appeared sound, so it appeared that the seeps may have been caused by hydraulic pressure from the interior and underside of the flood wall.	Actions taken include: "A small area of black top North of the conduit sump was removed and the new concrete poured and sealed against the battery building and flood wall, etc."	
				"The stained soil has been scraped up and drummed and will be handled appropriately."	
				"Confirmation samples were collected on October 12, 1994 by Delta."	See stabilization approval letter (TNRCC, 1997).
Delta	10/16/1994	Miscellaneous Stained Soil Samples	Four surface soil samples were collected near the GNB Stewart Creek walking bridge adjacent to the retaining wall. Three of the samples were collected from stained soils, while one was collected nearby and adjacent to the retaining wall from an area that was not stained.		
Delta	10/20/1994	Miscellaneous Stained Soil Samples	Three soil samples were collected on the creek side of the retaining wall at locations where water seepage through the retaining wall had been observed. One surface soil sample was collected from a similar unaffected area of soil.		See stabilization approval letter (TNRCC, 1997).
GNB	3/20/1995	Stewart Creek Phase II Implementation Notice		Modifies sampling frequency of Stewart Creek to less frequent intervals due to low concentrations of Pb and Cd found in certain areas of the creek and to refine additional samples based on results	
RMT/Jones and Neuse, Inc.	8/30/1995	Notification of On-Site Class II Industrial Waste Landfill	Prior to construction of the on-Site Class II landfill, a notification was prepared and submitted during 1995 by RMT/JN that included specifications of the landfill design, waste composition, site geology, a groundwater monitoring plan, and a closure and post closure care plan. To characterize the site geology, eighteen soil borings were collected and lithologically described by a geologist. Monitoring wells were installed within nine of the soil borings. Slug tests were performed in four wells and a pump test was performed in LMW-17. One groundwater elevation gauging event was conducted. The geologic assessment indicated the presence of limited sand and gravel lenses in the south to southwest portion of the landfill area. The groundwater elevation gauging event indicated a hydrogeologic gradient to the southwest towards the North Tributary.		
GNB	9/24/1995	Revisions to Stewart Creek Phase II RFI Work Plan		Sediment sample locations to be selected based on sediment accumulations identified (6 total) in aerial photos. Within each sediment accumulation area, 3 to 5 sediment grab samples will be collected.	Sediment samples were collected in this manner and reported in the Stewart Creek Final Phase II Report (RMT/JN, 1996) Stewart Creek was remediated during 2000 and remedial activities approved by TNRCC letter dated 7/25/2000.

Table 1C
Historical Document Summary

Author	Date	Title	Contents	Outstanding issues / recommendations	Comments
RMT/Jones and Neuse, Inc.	5/1/1996	Stewart Creek Final Phase II RFI Report	The Stewart Creek Phase II investigation was performed in accordance with a work plan approved by TNRCC. Eighty sediment samples were collected and analyzed for lead and cadmium during 1994. In addition, 20 background sediment samples were collected upstream of the former 5th Street on Stewart Creek and Cottonwood Creek, which is a creek that feeds into Stewart Creek. Twenty-six sediment samples were collected in areas of accumulated sediment along Stewart Creek during February 1996. Sixteen sediment sample results reported in the Phase I RFI report (Lake, 1991) were also included in the Stewart Creek Final Phase II Report. Sediment sample locations ranged from the main plant area to the Stewart Creek West WWTP (located approx. 2.5 miles downstream of the site), which is located downstream of the site. Based on sampling results, the report recommended further study of the Stewart Creek segment between the former 5th Street and the 7700-foot marker.	"It can be concluded from this investigation and previous investigations that remedial activities and stabilization should focus on the stream segment between GNB and approximately 7700 feet downstream of Stewart Creek at 5th Street."	Stewart Creek was remediated on-site during 2000 and remedial activities approved by TNRCC letter dated 7/25/2000. Additional evaluation was conducted during the APAR investigation.
				"A Corrective Measures Study for the stream sediment between 5th Street and the 7700 foot marker and a Tier I qualitative ecological risk assessment will be submitted."	A corrective measures study for this stream segment was submitted 8/1/1998 (JDC, 1998a). Stewart Creek was remediated on-Site during 2000 and remedial activities approved by letter dated 7/25/2000.
TNRCC	3/26/1997	Miscellaneous Stained Soil Samples - Stabilization Approval		"This letter approves the sampling and excavation of contaminated soil as a stabilization measure."	
				"It is understood that further investigation of this area will be included in the Phase II RFI for the facility upon TNRCC review and approval of the Phase II RFI workplan submitted January 1, 1994 and revised October 5, 1994."	This area was investigated during the Site Investigation (PBW, 2012) and the APAR investigation (Section 4).
	2/27/1998	Conditional approval of Phase II RCRA Facility Investigation Workplan		Background soil concentration: GNB conducted a background soil study in 1993 (results presented in Phase II Workplan) to determine background concentration of Pb and Cd. TNRCC does not agree with values as representative of background and also required that background samples be taken at similar intervals as proposed soil samples to be collected.	Background soil sampling performed for Site Investigation (PBW, 2012) and APAR investigation. Statistical analysis of the samples is provided in the APAR (Appendix 8).
				WMA 1: "...the TNRCC is requiring soil samples to be collected at the railroad spur unloading area located on the southern side of the NDA."	Railroad spur samples were collected during the Phase II investigation (RRS-1, RRS-2, RRS-3 and RRS-4).
				"Modification of sampling procedures at the railroad culvert outfall requested: instead of sampling the first two inches, sample at intervals similar to that stated in the June 3, 1994 TNRCC letter. Samples are not to be composited."	Soil investigation in the vicinity of the former railroad culvert addressed in APAR investigation. Three soil borings completed and sampled to evaluate lead and cadmium in this area (Section 4).
				"...the soil and groundwater samples collected from boring B-7N...showed levels of lead which appear to be elevated. The lateral and vertical extent of contamination must be determined for all areas around WMA1."	The Phase II investigation (JDC, 1998) and Site Investigation (PBW, 2012) established lateral delineation around boring B-7N. Vertical delineation of soil at this boring was achieved during the Phase I RFI.
				WMA 2: "Even if/when GNB submits integrity check documentation, TNRCC stated that GNB will have to sample underneath WMA 2. "...the TNRCC strongly suspects that the soils underlying WMA 2 have been impacted...as evidenced by seepage from underneath the battery storage area along Stewart Creek...documented by Misc. Stained Soil samples report dated October 6, 1994... TNRCC will assume a release beneath WMA 2 (if borings not advanced through concrete at WMA2). "	Multiple soil borings were advanced through concrete throughout WMA2 during the Site Investigation (PBW, 2012) and APAR investigation. In addition, samples were collected along the Stewart Creek floodwall following concrete removal from the area during French drain construction activities. An official closure approval letter was requested for this area of the TWC by letter dated December 22, 1999. Closure was approved by TNRCC by letter dated January 13, 2000.
				WMA 3: SDA: "Groundwater delineation is not addressed adequately. The TNRCC suspects that the acidic conditions, lead and cadmium detected in MW-12 may be associated with the SDA."	During the groundwater sampling events for the Site Investigation (PBW, 2012) and APAR investigation, MW-12 had pH ranging from 6.48-7.17. Pb and Cd levels were below Residential Assessment Levels for both sampling events (Section 5).
				Truck Staging Area: "Soil samples should be collected around and in (the truck staging area) and sampled at the same depths as the proposed samples during the Phase II RFI."	TSA samples collected from non-paved areas during Phase II investigation.

Table 1C
Historical Document Summary

Author	Date	Title	Contents	Outstanding issues / recommendations	Comments
GNB	3/31/1998	Letter response to Phase II Workplan conditional approval	Confirms TNRCC comments will be integrated into new workplan	In lieu of the Phase II soil borings between WMA 1 and WMA 2, a BLRA and CMS will be submitted for Stewart Creek and submitted by Aug 1, 1998	Borings proposed for this area are specified in the Phase II workplan as being located along Stewart Creek only: boundaries north of WMA 2 are upgradient of potential areas of contamination. See also Human Health and Ecological Risk Assessment and Corrective Measures Study (JDC, 1998b).
				"GNB will perform the appropriate aspects of the Phase II investigation at the WMA 3 to determine the lateral extent of lead contamination in the shallow soil and to evaluate risk and develop the CMS for this area. In addition, GNB will determine the extent of lead in groundwater in the area of MWs B1N, BR3, MW12 and MW13."	Quarterly groundwater monitoring results (including those for B-1R, B-3R, MW-12 and MW-13) were presented for total lead in the Phase II Investigation report (JDC, 1998a). In addition, groundwater sampling was performed during the Site Investigation (PBW, 2012) and the APAR investigation (Section 5). Soil sampling of WMA 3 addressed in the Phase II investigation as described in the workplan (RMT/JN, 1994)
GNB	3/31/1998	Letter response to Phase II Workplan conditional approval (continued)	Confirms TNRCC comments will be integrated into new workplan	Additional samples will be collected from non-paved areas of the truck staging area, the area around B7N and samples will be collected from the RR spur unloading area between WMA1 and WMA2. The purpose of the soil sampling is to determine the lateral extent of lead contamination in shallow soil and to gather the appropriate information to evaluate risk and to develop the CMS for these areas.	All three areas were addressed during the Phase II investigation (JDC, 1998a).
JDC	8/1/1998	Human Health and Ecological Risk Assessment and Corrective Measures Study Report for Stewart Creek	Stewart Creek was addressed as a separate project from the Phase II RFI pursuant to a TNRCC request dated September 16, 1993. The Human Health and Ecological Risk Assessment (HHERA) and Corrective Measures Study for Stewart Creek (JDC, 1998b) were submitted to the TNRCC on August 5, 1998. This study included an evaluation of Stewart Creek sediment and surface water data from several investigations, including the Phase I RFI (Lake, 1991), the Phase II RFI (JDC, 1998a), additional sediment sampling performed by RMT/JN in 1995 and 1996 and the Stewart Creek Final Phase II (RMT/JN, 1996). The study area for the HHERA included portions of Stewart Creek at the facility area and areas downstream of the facility.	HHERA: Surface water concentrations of Cd and Pb do not pose a risk to human or ecological receptors. Cd and Pb in creek sediments within GNB's facility boundaries may pose a risk to on site workers. Corrective measures are recommended for the 2050 foot section of Stewart Creek within the GNB facility from a location 750 feet downstream from the former South 5th Street to the northwest facility boundary (approximately 2800 feet downstream from the former south 5th street) because the sediments in this portion of the creek consistently exceed the ecological screening levels for lead (218 mg/kg) and for cadmium (10 mg/kg). The 4 locations downstream of the northwest facility boundary (6500 feet, 7000 feet, 7200 feet and 7600 feet downstream of the former South 5th Street) that exceeded for sediment screening levels should also be evaluated.	Stewart Creek was remediated during 2000 and remedial activities approved by TNRCC letter dated 7/25/2000. Additional evaluation of Stewart Creek downstream of the facility was conducted during the APAR investigation.
				CMS: Additional sampling and statistical evaluation of downstream sediment samples that exceeded screening values for Pb and Cd. At least five samples at each area should be collected and analyzed for total lead and cadmium to characterize the lateral and vertical extent of sediments that exceed the screening levels. The sampling results will be used to estimate the volumes of contaminated sediments to be addressed by evaluation of corrective measures, if necessary.	A CMS of on-site sediments was included in the HHERA; following implementation of the CMS, a Corrective Measures Implementation Report (CMI) dated July 13, 2000, was submitted to TNRCC. Additional evaluation of Stewart Creek downstream of the facility was conducted during the APAR investigation.
JDC Consulting	8/1/1998	Phase II RFI Report	A Phase II RFI was conducted by JD Consulting, Inc. (JDC) in June 1998, pursuant to a work plan prepared by RMT/Jones and Neuse (RMT/JN. 1994), modified by letter dated September 24, 1995 (GNB, 1995), and approved, with modifications, by the TNRCC on February 27, 1998. The Phase II RFI addressed the areas referenced in the TNRCC's June 3, 1994 correspondence, which approved and noted deficiencies in the Phase I and Phase I RFI Addendum that were to be addressed in the Phase II RFI. Investigative activities included soil sampling at the truck staging area, the railroad spur, and the area in the vicinity of the Truck Staging Area (Figure 1B). Further delineation of the lateral extent of soil COC concentrations above applicable regulatory standards at the South Disposal Area and development of a Corrective Measures Study were also addressed in the Phase II RFI for the South Disposal Area.	Truck Staging Area: "The Phase II RFI shallow surface soil sample result of 11800 mg/kg lead from NTS2 exceeds the proposed investigation limit....the subsurface soil samples collected from NTSB1 (same location as NTS2) had lead concentrations that were all below the proposed investigation limit (500 mg/kg)…vertical extent determined... It is recommended that stabilization measures be evaluated, and additional investigation conducted, to determine the extent of lead at concentrations above the proposed investigation limit...at this area."	NTS2/NTSB1 has been delineated by soil sample 2012-NDA-3, collected during the Site Investigation (PBW, 2012) (Section 4).

Table 1C
Historical Document Summary

Author	Date	Title	Contents	Outstanding issues / recommendations	Comments
JDC Consulting	8/1/1998	Phase II RFI Report (Continued)	A Phase II RFI was conducted by JD Consulting, Inc. (JDC) in June 1998, pursuant to a work plan prepared by RMT/Jones and Neuse (RMT/JN. 1994), modified by letter dated September 24, 1995 (GNB, 1995), and approved, with modifications, by the TNRCC on February 27, 1998. The Phase II RFI addressed the areas referenced in the TNRCC's June 3, 1994 correspondence, which approved and noted deficiencies in the Phase I and Phase I RFI Addendum that were to be addressed in the Phase II RFI. Investigative activities included soil sampling at the truck staging area, the railroad spur, and the area in the vicinity of the Truck Staging Area (Figure 1B). Further delineation of the lateral extent of soil COC concentrations above applicable regulatory standards at the South Disposal Area and development of a Corrective Measures Study were also addressed in the Phase II RFI for the South Disposal Area.	Railroad Spur: "Surface soil samples...had lead concentrations that exceeded the proposed investigation limit.... Only one soil sample (collected deeper than 24") (RRS4e 24-42") had a lead concentration that exceeded the proposed investigation limit...(42-48" in same sample was below investigative limit). Therefore, the vertical extent of lead in soil, relative to the proposed investigation limit, has been determined at the railroad spur. Access to this area is limited because of the boundaries of WMA1 and WMA2, therefore an investigation to determine the lateral extend of lead concentrations in surface and subsurface soils is not recommended or feasible. The lead concentrations reported for the surface soil samples collected from boring RRS 1 appear anomalous because they increase with depth, therefore, it is recommended that this area be resampled."	Addressed in APAR investigation. Soil samples collected and analyzed to evaluate lead and cadmium in this area (Section 4).
				South Disposal Area: The following surface soil samples exceeded the proposed investigation limit: SDA2, SDA3, SDA4, SDA5, SDA9-1, SDA9-2. "Most of the impact was limited to the upper 12 inches of soil. Only two soil samples exceeded the proposed soil investigation limit in the 12-18 and 18-24" intervals (SDA9-2c and SDA9-2d) and only one sample collected from the 12-18" depth interval exceeded the proposed surface soil cleanup level (1000 mg/kg). ...Two subsurface soil samples collected from the 24-30" and 30-36" depth intervals in boring SDA8 exceeded the proposed investigation limit. Deeper intervals at this sample did not exceed the proposed investigation limit. Thus, the vertical extent of lead concentrations in soil, relative to the proposed investigation limit of 500 mg/kg, has been determined at the SDA. It is recommended that an investigation to determine the lateral extent of lead concentrations in surface soil be implemented at the areas north of the SDA where lead concentrations in the Phase II surface soil samples exceeded the proposed investigation limit of 500 mg/kg."	Surface soils near the SDA were further delineated in the Site Investigation (PBW, 2012) and APAR (Section 4).
				Groundwater: the pH anomaly (at MW-12 and MW-13) was not investigated due to dry weather conditions and construction, but a corrective measure will be proposed once the investigation is conducted.	MW-12 and MW-13 showed pH values greater than 6.0 during the January 2012 Site Investigation (PBW, 2012) and the APAR groundwater sampling events.
TNRCC	7/29/1999	Corrective Measures Implementation Workplan Conditional Approval	Approval with modifications	"The report states that the ecological screening level for lead is 218 ppm, equivalent to the Effects Range Median (ERM) for marine sediments. Since the creek is located in an area unaffected by tidal influences, please used the Threshold Effects Level (TEL) for sediment, which is 35 ppm for lead. "	Stewart Creek was remediated on-site during 2000 and remedial activities approved by letter dated 7/25/2000.
				"The report states that the ecological screening level for cadmium is 10 ppm, equivalent to the ERM for marine sediments. Since the creek is located in an area unaffected by tidal influences, please use the TEL for cadmium, which is 6 ppm. Please remember that site-specific background concentrations may be substituted for the previously mentioned screening levels."	Stewart Creek was remediated on-site during 2000 and remedial activities approved by TNRCC letter dated 7/25/2000.
	1/13/2000	Acceptance of Closure Certification for 4 Solid Waste Management Units	Approval of four SWMUs	Closure approval for the former Battery Storage Area, Old Drum Storage Area, Stewart Creek Sediment Dredging Waste Pile and the Product Waste Pile.	
Remediation Services, Inc.	2/15/2000	Culvert Plugging	Details the plugging of the former railroad culvert. Plugging completed during February 2000.		

Table 1C
Historical Document Summary

Author	Date	Title	Contents	Outstanding issues / recommendations	Comments
JDC Consulting	7/13/2000	Stewart Creek Corrective Measures Implementation Report	As a result of the HHERA conducted by JDC in 1998, an approximate 2,800-foot stretch of the creek sediments was remediated to standards for lead and cadmium approved by the TNRCC (91 milligrams per kilogram [mg/kg] for lead and 4.23 mg/kg for cadmium). The remediation was carried out by first removing visible slag "buttons" (formed at the bottom of kettle bottoms and approx. 12-18 inches in diamater) from the creek bed and banks, then excavating the soils at an average depth of 1ft. Soils were excavated to deeper depths as needed based on the extent of slag presence in the soil. Excavated sedimen/soil was screened for recoverable slag fragments, which were recycled in the blast furnace at the facility. Remaining sediment/soil was stockpiled and sampled for TCLP analysis for lead and cadmium. Most samples passed the criteria for Class II waste; the samples that did not pass the criteria were treated until they passed. Some stockpiled material was tested for SPLP lead and cadmium for potential re-use as intermediate fill in the active Class 2 landfill at the facility. The TNRCC approved the reuse proposal on November 8, 1999.	Soil/sediments were mechanically removed to one foot from the channel and banks of Stewart Creek. Deeper depths were removed if slag material was present at deeper depths.	
TNRCC	7/25/2000	Stewart Creek Corrective Measures Implementation Report Response	Acknowledges attainment of cleanup standards	"Based on the information contained in the Final Report and other information available to staff, it appears that cleanup at Stewart Creek has attained RRS No. 1. GNB Technologies, Inc. is released from deed recordation and post-closure care requirements.	
TCEQ	7/15/2003	Leaking Petroleum Storage Tank (LPST) Case Closure of Subsurface Release of Hydrocarbons at G.N.B Technologies Facility	A diesel oil release residue was discovered in April 1988 during the construction of the Flood Wall adjacent to Stewart Creek. Details of the discovery and subsequent remedial actions are provided in a letter by Lake Engineering to the Texas Water Commission (Lake, 1988). Following discovery of the residue, a pump and mobile storage tank were immediately installed. Three test holes were advanced to determine the extent of residue; residue was not detected in any of the holes. To enhance collection of residue, an oil recovery sump and intercept trenches were constructed. TCEQ issued a letter dated July 15, 2003, certifying that the former diesel fuel release (LPST ID No. 106075) had met site closure requirements and that no further action was necessary.	The letter stated that no further action was necessary.	
EPA	8/25/2010	Report of RCRA Sampling Inspection	EPA visited the site on April 1 and April 15, 2010 and collected samples from the Class 2 Landfill and Slag Treatment Building that were analyzed for TCLP lead, cadmium, antimony, arsenic, barium, beryllium, chromium, nickel, selenium, silver, thallium, vanadium, and zinc.	Samples of leachate from the leachate collection tank for the Class 2 Landfill tested hazardous for arsenic and selenium and exceeded the UTS-N standards for antimony, arsenic, and vanadium. Samples of treated slag from the Class 2 Landfill did not test hazardous and did not exceed UTS-N standards. Samples of untreated slag from the Slag Treatment Building exceeded the UTS-N standard for barium.	
EPA	1/12/2011	Corrective Action Inspection	Details of compliance inspection coducted 12/14/09-12/18/08, 3/15/10-3/16/10 and 3/29/10.	Bale Stabilization Area - Inspectors observed pieces of cardboard used for packaging of batteries on the ground in the stabilization area	
				Boneyard - "During the inspection, numerous pieces of equipment were observed which still had process materials/wastes present. Wastes observed included a roller belt with battery chips, a kettle with refining drosses, and a "grizzly screen" with pieces of slag, a bail of cardboard and shrink wrap, and several "supersacks" containing what appeared to be building insulation. Also observed was a piece of hydraulic equipment which had two full hydraulic tanks that were leaking fluid onto the ground."	
				Crystallizer - "During the inspection, the inspectors observed liquid leaking from the frac tank as well as visible drainage pathways leading from the frac tank to the edge of the concrete ramp."	

Table 1C
Historical Document Summary

Author	Date	Title	Contents	Outstanding issues / recommendations	Comments
EPA	1/12/2011	Corrective Action Inspection (continued)	Details of compliance inspection coducted 12/14/09-12/18/08, 3/15/10-3/16/10 and 3/29/10.	Flood Wall - Along the wall, inspectors observed what appeared to be liquid seeping from beneath the wall resulting in standing water and white crystalline substance on the ground. During the inspection, Mr. Messer stated that the liquid is presumed to be groundwater seeping up along the edge of the wall.	The flood wall area was investigated during the Site Investigation and APAR investigation.
				Flood Wall - Three samples of material (one of white crystalline material and two of soil) collected on the creek side of the Flood Wall exceeded the EPA Region 6 screening level for lead concentration in industrial soil (800 ppm).	The referenced samples exceed the current PCL for lead.
				North Disposal Area - "Battery chips were observed on the gravel road running adjacent to the disposal area. Again, these are not removed due to the concern that the facility would be "actively managing" the disposal unit. Brick was observed in the wooded area along the north side of the disposal area. The source of the brick is unknown."	
				South Disposal Area - "Inspectors observed several pieces of slag and battery chips in the vegetation around the perimeter of the disposal area. Mr. Messer explained that nothing is removed from the area to avoid "actively managing" the unit which would result into he unit being regulated under RCRA. Instead, as slag and/or battery chips are uncovered due to erosion, additional soil is added to the cap."	
				Stewart Creek - Although the creek had been previously remediated, according to the facility representative, additional slag was discovered recently due to the erosion of the creek bed and is currently under investigation by the facility	
				On March 15-16, 2010, the EPA collected X-ray fluorescence (XRF) measurements and composite soil samples from the 0 to 1-inch below ground surface (bgs) depth interval in thirteen publicly accessible areas within approximately one mile of the Exide facility, as well as one location farther away (EPA, 2011a). The soil samples as a whole and the screened fine fraction of the soil samples (< 250 micron fraction) were both analyzed for total lead and cadmium. Since EPA screening levels are based on whole-sample soil concentrations, only the whole-sample concentrations were used for comparison with EPA screening levels. The EPA indicated in the report that the fine fraction concentrations were only used in determining locations for further evaluation. The report indicated that all laboratory whole-sample lead and cadmium results for all soil samples collected off-site were below EPA screening levels for these constituents and that the XRF results were comparable to the soil sample results.	
W&M Environmental	3/28/2011	Suspect Slag Sampling Report	W&M Environmental conducted a visual survey of the western reach of Stewart Creek from the Battery Receiving/Storage Building to the BNSF railroad. Suspected slag samples collected from the banks of the creek were photographed and evaluated for Pb, Ca, and Fe to develop a visual criteria for identifying suspected slag in the field.	"Probable slag materials have been identified in the western reach of Stewart Creek at the Site...The location of materials identified as probable slag based on laboratory results suggests that slag materials are concentrated near the middle of the Site, but are also present to the eastern boundary of the study Site. When the analytical data are considered in combination with the distribution of probable slag, the slag may not extend to the western boundary of the Site."	W&M conducted additional evaluation of suspected slag material site-wide. The report is included as an appendix to the APAR (Appendix 18).
TCEQ	5/6/2011	Investigation Report	Results from TCEQ inspection conducted May 6, 2011	"...TCEQ staff observed that the floor (in the slag treatment building) of the <90 day tank was covered by free liquids. The free liquids were identified by Exide personnel as equipment wash down water and dust suppression water. TCEQ staff observed these waters contacting the untreated piles of slag and refractory brick in the tank. TCEQ staff also noted that this water contacts loose fragments of wastes on the crusher when the crusher is washed down. A sump is used to collect these waters until it can be used in the slag treatment process...TCEQ staff observed...overflow."	Soil sampling has been performed sub-slab in this building for the APAR investigation (Section 4). All liquids and water have been removed and the building has been decontaminated and demolished.

Table 1C
Historical Document Summary

Author	Date	Title	Contents	Outstanding issues / recommendations	Comments
TCEQ	5/6/2011	Investigation Report (continued)	Results from TCEQ inspection conducted May 6, 2011	"...Ms. Lewis collected a sample of a material resembling blast furnace slag from the north side of the (slag treatment) building. The sample was collected beneath the opening used to transfer untreated refractory brick and untreated blast furnace slag into the building...Sample results...indicated that the sample contained elevated concentrations of lead (total: 47,100 mg/kg, TCLP 59.3 mg/L) and cadmium (total: 574 mg/kg, TCLP: 1.74 mg/L)."	Addressed during APAR investigation. Nine soil samples collected and analyzed to evaluate lead and cadmium in the area (Section 4). All liquids and water have been removed and the building has been decontaminated and demolished.
				"...TCEQ staff viewed the on-site active industrial non-hazardous Class 2 landfill. Two of the landfill cells were capped but a third cell was active. TCEQ staff collected two samples of the treated slag and one sample of a material resembling mud that consisted of contact water and sediments. The analytical sample results indicate that slag containing hazardous concentrations of lead (total 36,200 mg/kg, TCLP 44.8 mg/L) and cadmium (total 433 mg/kg, TCLP 1.43 mg/L)were present in the nonhazardous class 2 landfill."	Being addressed per Response Action Workplan (RAWP).
				"TCEQ staff observed large amounts of untreated slag and battery chips in the (shooting range) berm which appeared to have originated from the South Disposal Area."	Removal of Shooting Range Berm completed. Verification soil samples are included in the APAR (Section 4).
				"...TCEQ staff observed a white solid and several battery chips in a drainage swale west of the Crystallizer. TCEQ also observed dead vegetation and a white solid along a drainage pathway that began at the Crystallizer and ended at the culvert. ...staff collected a sample of the soil at the opening of the culvert which contained the white solid. The sample's analytical results indicated that the soil contained elevated concentrations of lead (total 694 mg/kg, TCLP 3.92 mg/L) and sulfates (total 6040 mg/kg)."	Addressed during APAR investigation. Thirteen soil samples collected and analyzed to evaluate lead, cadmium and sulfate in the area (Section 4).
				"...TCEQ staff inspected the barrier wall and the Stewart Creek embankment. TCEQ staff observed dead vegetation near a crack in the barrier wall where a liquid was discharging (slag treatment building on other side of wall). TCEQ collected a soil sample from the embankment where the dead vegetation was observed and sample analysis results indicated an elevated concentration of lead (total 3560 mg/kg, TCLP 12.2 mg/L)."	Addressed during APAR investigation. Soil samples collected and analyzed to evaluate lead and cadmium in the area (Section 4).
				"...TCEQ staff observed a dark rust-colored stain along the wall where the stormwater pipe exited the wall. The pipe appeared to be leaking due to worn out gaskets. TCEQ staff collected a sample of the soil and rock along the embankment beneath the pipe. Sample analysis results indicated elevated concentrations of lead (total 39800 mg/kg, TCLP 127 mg/L) and cadmium (total 894 mg/kg, TCLP 12.2 mg/L)."	Addressed during APAR investigation. Soil samples collected and analyzed to evaluate lead and cadmium in the area (Section 4).
				"Review of sample results indicated elevated concentrations of lead and cadmium along the barrier wall that could potentially impact the waters of Stewart Creek. However, according to the analytical sample results of the water samples collected from Stewart Creek, it does not appear that the lead and cadmium discharges from the facility have contaminated the Stewart Creek water. Analytical sample results indicate there are no detectable concentrations of lead or cadmium in water. Elevated concentrations of lead and cadmium were also detected in the treated slag disposed in the landfill. Elevated concentrations of lead were also detected in soils near a culvert that discharges to the City of Frisco. Elevated concentrations of lead and cadmium were also detected around the outside of the Slag Treatment Building."	Addressed during APAR investigation. Soil samples collected and analyzed to evaluate for lead and cadmium in the area (Section 4).
EPA	5/10/2011	Multimedia Areas of Concern		"Exide failed to maintain the fugitive dust wet suppression system in its blast furnace area resulting in the uncontrolled release of lead-containing dust to the atmosphere from the facility's blast furnace feed storage piles."	

Table 1C
Historical Document Summary

Author	Date	Title	Contents	Outstanding issues / recommendations	Comments
EPA	8/1/2011	RCRA Section 3013(a) Administrative Order Docket No. RCRA 06-2011-0966; Re-designated by EPA as Docket No. 06-2012-0966	The Administrative Order (AO) was issued following an EPA inspection on December 14-18 2009 and March 29, 2010 and review of historical documents. EPA concluded that there was potential soil, groundwater, sediment and surface water contamination resulting from activities at the facility and issued the AO. The AO ordered Exide to submit to EPA a workplan that proposed sampling and analysis. The requirements are detailed in the following column.	"A preliminary facility-specific Site Conceptual Model (CSM)..."	CSM provided in workplan submitted November 2011 (CRA, 2011) and refined in SIR (PBW, 2012). CSM elements (exposure pathways) provided in Section 2 of APAR.
				"A plan and timetable for sampling and analysis of soil to characterize the nature and extent of horizontal and vertical contamination, and to identify source areas and potential source areas, including but not limited to, areas in the vicinity of the NDA, SDA, RMSA, inactive SL, Boneyard (BY), Bale Stabilization Area (BSA), Crystallization Unit Frac Tank (CUFT), and seepage along the flood wall. The soil sampling program shall include the collection of background soil samples (not impacted by facility operations) to account for any natural background metal concentrations. The plan shall include the locations and depths of the soil samples, collection and analytical methods, and the parameters for analysis."	A workplan submitted in November 2011 (CRA, 2011) to address each of these requirements.
				"A plan and timetable for the collection and analysis of surface water and sediment samples associated with Stewart Creek (March 29, 2010 EPA samples of soil between flood wall and Stewart Creek showed elevated levels of lead). Surface water and sediment sampling shall focus on the upstream side of the facility, within the facility at or immediately downstream of source/potential source areas, on the downstream side of the facility at the property boundary, and any off site sampling that may be needed to determine the nature and extent of contamination. In the event that the creek is dry, soil samples shall be collected for analysis in lieu of surface water and sediment samples, in similar locations. The plan shall include the locations of the surface water and sediment (or soil) samples, collection and analytical methods, and the parameters for analysis.	A workplan submitted in November 2011 (CRA, 2011) to address each of these requirements.
				"A plan and timetable for characterizing the groundwater flow direction and groundwater quality. The plan shall focus on the collection of groundwater samples upgradient of, within and downgradient of source areas/potential source areas (including but not limited to....i.e. NDA, SDA, SL, BY, BSA, CUFT, flood wall. The plan shall include the location and depths of monitoring wells, well construction methods, well sampling methods, analytical methods, and the parameters for analysis."	A workplan submitted in November 2011 (CRA, 2011) to address each of these requirements.
Rone Engineering	10/7/2011	Geotechnical Engineering Report	A geotechnical study was performed in 2011 in the general area of WMA 1 (North Disposal Area and Slag Landfill) to support the engineering design for a series of buildings and upgrades to existing facility structures proposed at the time of the report. The lithologic information obtained from the borings drilled for this investigation was used in support of Site hydrogeologic evaluation and for the development of geologic cross-sections in the APAR.	None	
W&M Environmental	12/28/2011	North and South Disposal Areas Evaluation	W&M conducted a visual inspection of the North Disposal Area and the South Disposal Area to assess the condition of the soil caps and to inspect for suspected slag on the ground surface within each area. The study identified limited areas of exposed slag and/or battery chips in the South Disposal Area as well as isolated occurrences of slag on the ground surface to the north and east of the area. The study also noted cracks in the soil above the South Disposal Area, but no slag or battery chips were identified in the areas of cracking. In the North Disposal Area, exposed slag was noted within materials storage areas and areas of heavy vehicular traffic in the southern portion of the area. In addition, isolated occurrences of slag were noted along the North Tributary, the railroad spur, and in the north wooded area.	"Areas to the south and east of the designated SDA contain exposed materials, as does the gun range berm located immediately to the west. Intermittent and isolated observations of chips and small slag fragments were noted in areas to the north of the SDA, and within wooded and overgrown areas east of the SDA...It is possible that many observations of surficial material represented isolated conditions that can be managed with minimal effort; other areas will warrant some additional intrusive investigations to define the depth and lateral extent of material to be managed."	W&M conducted additional evaluation of suspected slag material site-wide. The report is included as an appendix to the APAR (Appendix 18).

Table 1C
Historical Document Summary

Author	Date	Title	Contents	Outstanding issues / recommendations	Comments
PBW	7/12/2012	Site Investigation Report		North Disposal Area: "Lead concentrations in the 2 to 4 foot interval below ground surface (bgs) depth interval sample from location 2012-NDA-1 and in the 0 to 2 foot depth interval sample from location 2012-NDA-3, both north of the previously identified NDA boundary, exceeded the lead critical PCL. Soil sample data from the current and previous investigations were combined to evaluate the lateral extent of soil PCL exceedances in the NDA vicinity. Based on this information, the northern extent of PCL exceedances is delineated by sample locations 2012-NDA-4, 2012-NDA-2 and 2012-NDA-6. The eastern extent of the PCL exceedances is bound by previous sample locations NTS-1, TS-2, and TS-1. Soil PCL exceedances were not bound to the south and west due to the presence of the Slag Landfill to the west and process buildings to the south. In light of the noted surface soil exceedances and apparent boundary extension further north from the previously identified NDA boundary, and in conjunction with the findings noted below for the Bale Stabilization Area, which is located over part of the NDA surface, it is recommended that the PCL exceedances in this area be addressed by a combination of surface soil excavation where vertical impacts are shallow, extension of the existing NDA cap in areas outside of the previously defined cap boundaries where impacts are not limited to shallow depths, and repair of the existing cap as necessary.	Soils in NDA vicinity evaluated in Section 4 of APAR. Additional sampling was conducted at TS-1 and TS-2. Soil samples were also collected east of NTS-1 in the vicinity of these locations.
				Slag Landfill: "The lead concentration in the 2 to 4 foot bgs depth interval sample from location 2012-SL-1, west of the previously identified Slag Landfill boundary, exceeded the lead critical PCL. Slag fragments were noted in this boring suggesting that the landfill may extend to this location. Subsequent interviews with long-time Facility personnel indicate this is likely the case. The lateral extent of the lead exceedance is bound to the north by sample locations 2012-SL-2 and 2012-SL-3, and to the west and south by previous sample locations B8N, MW-16 and MW-16S, and the railroad spur in that area, which is believed to precede the construction of the landfill. Soil PCL exceedances were not bound to the southeast due to the presence of the NDA in this direction. In light of the apparent extension of the landfill boundary further to the west from the previously identified boundary and in conjunction with the findings noted below for the Boneyard area, which is located over part of the Slag Landfill surface, it is recommended that PCL exceedances in this area be addressed by a combination of surface soil excavation where vertical impacts are shallow, extension of the existing Slag Landfill cap in areas outside of the previously defined cap boundaries where impacts are not limited to shallow depths, and repair of the existing cap as necessary."	Soils in vicinity of Slag Landfill evaluated in Section 4 of APAR.
				Raw Material Storage Area: The lead concentration in the 0.5 to 2.5 foot bgs depth interval sample from location 2012-RMSA-2, in the southeastern part of the RMSA, exceeded the lead critical PCL. Cadmium and lead concentrations in all three other soil borings from this area were below their critical PCLs and total petroleum hydrocarbons (TPH) was not detected in any of the four soil samples from the RMSA. It is recommended that the extent of this PCL exceedance and the appropriate remedial action to address this area be evaluated following the planned decontamination and dismantling of the RMSA in conjunction with Facility closure activities.	Addressed during APAR investigation. Fifty-two soil samples collected and analyzed to evaluate cadmium and/or lead in this area (Section 4).
				South Disposal Area: No PCL exceedances were noted in any of the ten SDA soil samples collected and, therefore, these samples serve to generally bound the extent of PCL exceedances noted in previous soil samples from this area. Elevated lead concentrations limited to surface samples from previous soil samples in the northeastern part of this area are consistent with reported sporadic surface accumulations of battery cases and slag in the area. As noted in the Work Plan (CRA, 2011) and previously discussed with EPA, Exide has been performing a comprehensive inspection of the SDA with the objective of identifying and addressing battery case and slag accumulations in this vicinity. To the extent that areas where soils with COC concentrations exceeding PCLs do not coincide with locations where incidental battery cases and/or slag will be addressed, these soils could be addressed via focused excavation or additional capping.	Soils in vicinity of SDA evaluated in Section 4 of APAR. W&M conducted additional evaluation of suspected slag site-wide, including in SDA vicinity. The report is included as an appendix to the APAR (Appendix 18).

Table 1C
Historical Document Summary

Author	Date	Title	Contents	Outstanding issues / recommendations	Comments
PBW	7/12/2012	Site Investigation Report (Continued)		Boneyard:"The lead concentration in the 0 to 2 foot bgs depth interval sample from location 2012-BY-4 in the southwestern part of the Boneyard exceeded the critical PCL for lead. Cadmium and lead concentrations in the four other soil borings from this area were below their critical PCLs. Slag was encountered at the base of boring 2012-BY-4 at a depth of 2 feet bgs, likely indicating that the Slag Landfill extends to this area. The extension of the Slag Landfill to this location is consistent with the observation of slag in boring 2012-SL-1 to the northwest as the two borings suggest the Slag Landfill extends further west than had been previously indicated. Subsequent interviews with long-time Facility personnel indicate this is likely the case. The western and southern extent of the landfill is bound by data from previous sample locations B8N, MW-16 and MW-16S, if not by the railroad spur in that area, which is believed to precede the construction of the landfill. In light of the apparent extension of the Slag Landfill boundary further to the west from the previously identified boundary and in conjunction with the findings noted above for the landfill, it is recommended that PCL exceedances in this area be addressed by a combination of surface soil excavation where vertical impacts are shallow, extension of the existing Slag Landfill cap in areas outside of the previously defined cap boundaries where impacts are not limited to shallow depths, and repair of the existing cap as necessary."	Soils in vicinity of Boneyard evaluated in Section 4 of APAR.
				Bale Stabilization Area: "The lead concentrations in the 0 to 2 foot bgs depth interval sample from location 2012-BSA-2, and the 0 to 1 foot bgs depth interval samples from 2012-BSA-4c and 2012-BSA-4d exceeded the lead critical PCL. The cadmium concentration in the 0 to 2 foot bgs depth interval sample from 2012-BSA-3A exceeded the cadmium critical PCL. Cadmium and lead concentrations in all other soil samples from this area were below their critical PCLs. The northern extent of PCL exceedances in the bale Stabilization Area surface soils is delineated by NDA sample locations 2012-NDA-3 (for cadmium) and 2012-NDA-6 (for lead). In light of these results and in conjunction with the findings noted above for the NDA, it is recommended that PCL exceedances in this area be addressed by a combination of surface soil excavation where vertical impacts are shallow, extension of the existing NDA cap in areas outside of the previously defined cap boundaries where impacts are not limited to shallow depths, and repair of the existing cap as necessary."	Soils in vicinity of Bale Stabilization Area evaluated in Section 4 of APAR.
				Crystallization Unit Frac Tank: "Two soil samples were collected from two locations in the vicinity of the former Crystallization Unit Frac Tank and analyzed for antimony, arsenic, barium, beryllium, cadmium, chromium, lead, nickel, selenium, silver, zinc, and sulfate. All sample concentrations were below their respective critical PCLs. No further action is recommended in this area."	Soils in vicinity of Crystallizer Unit evaluated in Section 4 of APAR.
				Stewart Creek Flood Wall Creek Side: "Nine soil samples were collected from the 0 to 2 foot bgs depth interval from nine borings advanced along the creek side of the Stewart Creek flood wall. These samples were analyzed for cadmium, lead and TPH. The sole PCL exceedance noted in these samples was a lead concentration of 2,240 mg/kg in sample 2012-FWCS-1 (0-2) near the western end of the flood wall. Additional sampling is proposed in this vicinity to define the lateral and vertical extent of this exceedance. The additional sampling will be performed concurrent with the collection/analyses of soil samples during construction of a French drain system (including an impermeable barrier liner) between the flood wall and the Facility process area."	Soil samples were collected during construction of the French drain during September-October 2012 and additional samples collected during the APAR investigation. Area in the vicinity of 2012-FWCS-1 addressed during APAR investigation. Additional soil samples collected and analyzed during APAR investigation to further evaluate lead in this area. Additional soils on creek side of Flood Wall evaluated in Section 4 of APAR.

Table 1C
Historical Document Summary

Author	Date	Title	Contents	Outstanding issues / recommendations	Comments
PBW	7/12/2014	Site Investigation Report (Continued)		Shooting Range Berm: "The eastern face of the former shooting range berm was investigated by means of three test trenches excavated perpendicular (east–west) to the long axis (north-south) of the berm. These test trenches were visually inspected for bullets, clay pigeon fragments, battery casing fragments, slag or other foreign materials, but no soil samples were collected. The test trench observations indicate that foreign material was generally absent in the upper, westernmost portions of the berm and that, within the lower, eastern portions of the berm, this material was generally limited to near or just below the berm surface (e.g., not in the berm interior). Thus, although no data were collected from this area for comparison to TRRP PCLs, the test trench observations suggest that slag and battery cases are limited to the eastern face of the berm and are not distributed throughout the berm. It is recommended that the berm soils containing slag and/or battery cases be removed to a maximum depth of bedrock and post-excavation samples be collected for comparison to lead and cadmium PCLs."	Shooting Range Berm removed. Removal activities documented in summary report provided in Appendix 11.
				Stewart Creek Sediment: "Sediment ecological PCLs derived for cadmium and lead were lower than the human health PCLs for those metals and were therefore, the critical PCLs for sediment. The ecological PCL was derived to be protective of benthic and aquatic organisms, and is the mid-point of the ecological benchmark and the second effects level. None of the 25 sediment samples collected from Stewart Creek or the North Tributary contained cadmium or lead at concentrations in excess of the critical PCL."	Site Stewart Creek and North Tributary sediment samples evaluated in Section 7 of APAR.
				Surface Water: "Surface water ecological PCLs derived for cadmium and lead were lower than the human health PCLs for those metals and were therefore, the critical PCLs for surface water. The ecological PCLs were derived to be protective of chronic aquatic life. Dissolved cadmium and lead concentrations in 15 Stewart Creek surface water samples were compared to these critical surface water PCLs. The only concentrations exceeding their respective critical PCLs were dissolved cadmium and lead concentrations in surface water samples 2012-SW-1 and 2012-SW-2, near the downstream boundary of the Site, and the dissolved cadmium concentration in sample 2012-SW-11, upstream of the plant operational area. These were the only samples with detectable dissolved concentrations and all of these results were estimated (J-flag) values very near the limits of detection. None of the measured concentrations exceeded acute aquatic life screening values and all were far below human health based PCLs and even below drinking water standards (if surface water were a drinking water resource). In light of these considerations, the isolated and inconsistent nature of the few surface water PCL exceedances, and most significantly, the absence of any detectable dissolved cadmium or lead concentrations in surface water samples collected in the near vicinity of potential source areas near Stewart Creek, such as the RMSA, the SDA, or near the flood wall, no further investigation of surface water is recommended."	
				Groundwater: "The uppermost GWBU at the Site consists of the clay-rich alluvial soils situated above the Eagle Ford Formation. Groundwater within this unit generally occurs under unconfined conditions. The potentiometric surface for this GWBU (based on water level elevations measured in Site monitoring wells on February 13, 2012) generally slopes toward the southwest at a gradient of approximately 0.018 ft./ft. except near the bluff at the southern boundary of the Site where it slopes steeply toward the north and Stewart Creek. Although localized transmissive zones are present within the uppermost GWBU, the lateral extents of these more transmissive zones within the overall clay-rich soils of the GWBU are limited and, thus, significant groundwater transmissivity within the GWBU as a whole is not expected. Since there is no current or future drinking water pathway, the critical PCL for groundwater was not based on drinking water exposure, but rather was based on a groundwater to surface water PCL. The critical PCL for cadmium and lead in groundwater was compared to dissolved concentrations of these metals. None of the dissolved cadmium and lead concentrations exceed the critical PCL. Based on these results, no further groundwater investigation or remediation is recommended."	

Table 1C
Historical Document Summary

Author	Date	Title	Contents	Outstanding issues / recommendations	Comments
EPA	9/12/2012	Comments on SIR		"Please note under 350.51(d)(1), one shall delineate to vertical limit of COCs in soil exceeding background concentrations, including the soil-to-GW pathway"	Delineated to RALs in conjunction with groundwater investigation. 351.51(d)(1) states that delineation to background is not needed if an adequate groundwater assessment has been conducted (e.g. COC concentrations in the groundwater have been measured from appropriate locations)
				Since the MSD agreement has not been established at this time, all soil results must be re-evaluated under correct assessment PCLs	MSD- based conclusions have been removed in the APAR.
				"All nine soil results from the Stewart Creek Flood Wall Creek Side exceed background concentrations and $^{GW}Soil_{Ing}$"	
				"Was there a door-to-door water well inventory to identify unregistered water wells in area, which EPA believes are present; What is the status of well 18-50-8C drilled by Frisco Concrete"	A water well field survey was conducted by Larry Eagan during October and November 2012. During this survey it was concluded that the Frisco Concrete well is believed destroyed.
				"Include findings from W&M inspection reports and discuss implications"	Reports included as appendix in the APAR (Appendix 18). Implications discussed therein.
				"Due to abundance of small to large animal burrows around the facility, may need data for deeper subsurface since soil burrow terrestrial receptors may exist at the site."	SLERA (Section 9) prepared to evaluate potential ecological receptors/exposures.
				"Eco assessment is in order due to COC, the creek, and the surrounding environment ecosystems"	SLERA (Section 9) conducted in accordance with approved SLERA workplan.
				"Where do we stand at this facility regarding GW classification"	
				"Please explain why so many J flagged soil data for Pb and Cd and how does it affect outcome of report"	Clarified in APAR (see Section 3.5).
				"Pb and Cd concentrations are flagged as estimates and may not represent actual concentrations. Cd is also flagged as out of normal QA ranges"	Clarified in APAR (see Section 3.5).
				"What are Exide's plans to remediate area of contamination in Slag Landfill"	Will be addressed in Response Action Plan to be prepared after final APAR approval by TCEQ.
				"Pb and Cd exceedances in reconnaissance GW samples"	Data for reconnaissance water samples collected from soil borings discussed by area in Section 4 of APAR.
				"Do not agree with statement at this time "no further investigation of surface water is recommended"	Re-evaluated in SLERA and APAR based on TCEQ classification of Stewart Creek as an intermittent stream.
				"For soils, different PCLs should be considered based on area of current and future land use...e.g., soil samples at the flood wall should be compared to eco PCL or background"	Additional soil samples were collected along the flood wall in support of the SLERA. Data evaluated in SLERA (Section 9).
				"Since hazardous wastes have been disposed of in Crystallization Unit Frac Tank, must delineate to background levels"	Per TRRP requirements, soils were evaluated relative to Residential Assessment Levels (See Section 4).
				"Due to the change in depositional energy environments from on-site (channelized creek with coarser grain sediments) to off-site (meandering creek with finer grain sediment) confirmation sampling downstream is necessary"	Downstream sediment samples were collected from the segment of Stewart Creek that runs alongside the Former Stewart Creek Wastewater Treatment Plant and in other downstream areas as part of other investigations. Further evaluation of sediment hot spots in these down stream areas is recommended (see Section 7).
				"Due to exceedances in surface water, off-site surface water confirmation sampling (down stream) is essential"	Re-evaluated in APAR and SLERA based on TCEQ classification of Stewart Creek as an intermittent stream.

Table 1C
Historical Document Summary

Author	Date	Title	Contents	Outstanding issues / recommendations	Comments
EPA	12/18/2012	Consent Agreement and Final Order		Compliance: "...the respondent shall continue with the implementation of the sampling plan approved by EPA pursuant to such agreed order, including use of the procedures set forth in "Test Methods for Evaluating Solid Waste, Physical/Chemical Methods," EPA Publication SW-846 and the corresponding method detection limits, for the delineation of any lead contamination to applicable TRRP standards in the affected media in area bounded by the south side of the flood wall near the Battery Storage Area and Stewart Creek ("Flood Wall Area").	Evaluation of soils data in Battery Storage area and Flood Wall area relative to TRRP RALs provided in Section 4.
				"Within thirty days of the effective date of this CAFO, Exide will submit a work completion implementation of the sampling plan approved by EPA and delineation of any lead contamination of the Flood Wall Area to applicable TRRP standards in the affected media; and (ii) to develop and implement a Response Action Plan to be approved by the TCEQ for the defined area of contamination requiring remediation, in accordance with 30 TAC 335.174 (40 CFR 264 Subpart G and 264.310) and 30 TAC 350 (TRRP)."	Work completion plan submitted to EPA on January 17, 2013.
TCEQ	2/10/2013	Agreed Order		"Within 150 days after the effective date of this Agreed Order: Submit an APAR for the unauthorized discharges located on the southwest corner, south side, and below the opening on the north face of the Slag Treatment Building, the east side of the South Disposal Area, at the drainage swale west of the Crystallizer, and the on-site portion of the Stewart Creek embankment, sediments, and surface water...The Site Investigation Report will be incorporated into the APAR...	Soils evaluation provided in Section 4. Sediment evaluation provided in Section 7. Surface water evaluation provided in Section 6.
				"...Submit an APAR for the RCRA Facility Investigation units listed in IHW Permit No. 50206, PS IX.C. and also for any and all solid waste management units and areas identified by previous TCEQ and EPA investigations and any new releases discovered subsequent to issuance of the permit in October 1986, as required by IHW Permit No. 50206, PS IS.A...The APAR required by (order above) may be satisfied by submittal of a single APAR covering both requirements."	APAR submitted to address this requirement.
TCEQ	2/7/2013	Handout at 2/8/2013 Meeting		"Affected Property Assessment Report (APAR) - General Discussion: The APAR should be an all-inclusive, stand-alone document. Please include the information presented in the July 12, 2012 Site Investigation Report (SIR) in the APAR. The APAR should satisfy all requirements of the pending TCEQ order...the Permit, the EPA requirements and comments to the July 12 SIR."	APAR submitted to address requested elements.
				"The results of past studies and past data can be used for historical reference, but may need to be revisited in order to accurately describe current conditions. New data will be required to verify current conditions since site conditions may have changed due to the fact that it has been an active facility, and relatively newer contamination may have been deposited in areas that were considered "clean" in the past. Confirmation sampling should be conducted on previously closed sites to verify whether or not releases have occurred, and that the configuration of the site boundaries has not changed."	Past data evaluated in context of individual data points/closed areas. New data provided in APAR Sections 4,5,6,7, and 9 were used for affected property assessment and evaluation of previously closed areas. Historical data provided in Appendix 17.
				"A visual and/or instrumental (XRF?) recon of the entire site for slag and battery chips should be conducted."	W&M conducted a visual inspection of the western reach of Stewart Creek (west of the Battery Storage Building). W&M tested several samples of suspected slag to develop a visual criteria for identifying suspected slag (W&M, March 2011). In a separate event, W&M conducted a visual inspection of the NDA (including the Slag Landfill and the areas immediately north of the Slag landfill and the wooded area north of the NDA and south of the north tributary of Stewart Creek (W&M, December 2011). The SDA was evaluated from the northeastern most reach of the SDA to the property line to the west and south. The inspection report by W&M are included in the APAR in Appendix 18.

Table 1C
Historical Document Summary

Author	Date	Title	Contents	Outstanding issues / recommendations	Comments
TCEQ	2/7/2013	Handout at 2/8/2013 Meeting (Continued)		"TCEQ Ordering Provisions 3.b.i.i. - Within 60 days (due and submitted by April 11, 2013) of the date of the Agreed Order Issuance, submit to the Executive Director for approval a groundwater monitoring program at the active landfill to be implemented following receipt of written approval from the executive director."	A groundwater monitoring plan for the Class 2 landfill was submitted on April 11, 2013.
				"TCEQ Ordering Provisions 3.c.i - Within 150 days (due July 10, 2013) of the date of the Agreed order, submit an APAR for the unauthorized discharges located on the southwest corner, south side and below the opening on the north face of the Slag Treatment Building, the east side of the South Disposal Area, at the drainage swale west of the Crystallizer, and the on-site portion of the Stewart Creek embankment, obligations specified in IHW Permit No. 50206, PS IX, to the Executive Director for approval. The Site Investigation Report will be incorporated into the APAR under this provision and ordering provision number 3.c.ii, below. If response actions are necessary comply with all provisions of the TRRP, Institutional Controls and corrective actions obligation specified in IHW Permit No. 50206, PS IX."	APAR submitted to address requested elements. RAP to be submitted after final APAR approval by TCEQ.
				"TCEQ Ordering Provisions 3.c.ii - Within 150 days (due date July 10, 2013) of the date of the Agreed Order submit an APAR for the RCRA Facility Investigation units listed in IHW Permit No. 50206, PS IX.C and also for any and all solid waste management units and areas identified by previous TCEQ and EPA investigations and any new releases discovered subsequent to issuance of the permit in October 1986, as required by IHW Permit No. 50206, PS IXA. If response actions are necessary, comply with all applicable provisions of TRRP. If the Response Action Plan does not propose a permanent remedy, then it shall be submitted as part of a new Compliance Plan application as specified in PS IX.B.6. The RAP shall contain detailed final engineering design and monitoring plans and schedules necessary to implement the selected remedy. Implementation of the corrective measures shall be addressed through a new CP as specified in PS IX.B.6; The APAR required by ordering provision no. 3.c.i. above may be satisfied by submittal of a single APAR covering both requirements."	APAR submitted to address requested elements. RAP to be submitted after final APAR approval by TCEQ.
				"TCEQ Ordering Provisions 3.c.ii - Dispose of the berm material (within 150 days of issue of Agreed Order) located near the west side of the South Disposal Area at an authorized facility."	Removal of Shooting Range Berm completed. Verification soil samples are evaluated in Section 4.
				"TCEQ Permit Provisions requiring Closure according to Permit Provision VII.C and D. Specifically VII.D.2.a. – Within 120 days of the determination that closure to Remedy Standard A cannot be attained, the permittee shall submit to the TNRCC a response action plan (RAP) and an affected property assessment report (APAR) in accordance with procedures described in the approved closure plans for Container Storage Area (Battery Receiving/Storage Area) and Containment Building (Raw Materials Storage Building) referenced by Provision VII.A.1. and the requirements of 30 TAC Sections 350.94 and 350.91 for review and approval by the Executive Director. These provisions will require coordination with TCEQ IHW Permits staff."	A RAP will be submitted after final APAR approved by TCEQ. Exide has been coordinating with TCEQ IHW permits staff.
				"A further discussion of the overlapping portions of the Order and Permit are presented in the discussion of the Raw Materials Storage Area below."	
				"TCEQ Permit Section IX – Corrective Action for Solid Waste Management Units (SWMUs) The Order refers to this portion of the Permit and is meant to be all inclusive not only for the RFI units, but also any new SWMUs."	No specific new SWMUs identified during APAR investigation. Two monitoring wells installed in former North Tributary infill and soil samples collected. No waste was encountered during soil sampling and well installation in this area.
				"APAR data gaps: PG Seal Geologic cross sections were not PG sealed. Please submit a new APAR in which all appropriate documents are PG sealed."	All geologic cross sections in the APAR are sealed by a PG.

Table 1C
Historical Document Summary

Author	Date	Title	Contents	Outstanding issues / recommendations	Comments
TCEQ	2/7/2013	Handout at 2/8/2013 Meeting (Continued)		"Interim Actions at Stewart Creek Flood Wall – As a result of investigations performed as part of the EPA Order, discharges of contaminated surface runoff water were identified in the vicinity of the Stewart Creek Flood Wall adjacent to the Slag and Wastewater Treatment Buildings. An interim action was taken by the facility to intercept this contaminated water to prevent discharge to Stewart Creek. In the APAR, include a full discussion of activities, chronology of events, sample results, engineered drawings, a discussion of contaminated water origin, transport, sampling, classification, handling, and disposal. If this is to be a permanent remedy, it should be included in a RAP. If the discharges are from the RCRA permitted units (and) have resulted in soil contamination that cannot be remediated to non-hazardous concentrations, the soils will have to be closed as a RCRA landfill subject to 30 years of detection monitoring, or if groundwater contamination is present, a modification to the permit for a compliance plan for corrective action/compliance monitoring will be required."	Detailed information of the French Drain is included Appendix 11 of the APAR. Permanent remedy to be determined and will be presented in RAP.
				"COC screening Lead and Cadmium are the presumptive COCs. However, a complete historical review should be conducted of all products, waste management activities, and past COC occurrences and investigations, such as arsenic and selenium as measured in a landfill leachate sample by a 2009 EPA investigation, PST removals and final closure documentation, spills around the above ground diesel tank, corrosive liquids from battery acid at Battery Breaking area, herbicides, pesticide storage etc. and justification as to why/why not these constituents are being screened according to TRRP-10 and TRRP-14. Include documentation such as maps, interviews with former employees and any other documentation."	COCs were discussed during the February 15, 2013, meeting between TCEQ and Exide. A COC screening/selection discussion based on TRRP guidance is provided in the APAR (Sections 3.1.2 and 10).
				"Sampling Procedures As part of the sampling process at the lab, during the soil screening process, are chunks of slag ground up and included in the sample results, or are they excluded by screening?"	The lab homogenizes samples for analysis and includes the entire sample as collected, in accordance with SW-846, 6010b.
				"In addition to sampling for total metals, TCLP sampling should be conducted on any areas where waste was deposited after July 26, 1982 and compared to 40 CFR 264.24, Toxicity Characteristics to determine if the waste is characteristically hazardous."	No specific areas for TCLP sampling were identified during APAR investigation.
				"Complete GW Investigation The groundwater investigation only examined the groundwater/surface water interface, from wells located along the banks of Stewart Creek. Groundwater PCLs were not delineated due to a possible MSD promised by the City of Frisco. MSDs are not allowed on RCRA Permitted facilities. A more definitive delineation of subsurface transmissive zones and the extent of groundwater contamination is required to the appropriate PCL."	MSD- based conclusions have been removed in the APAR. Groundwater investigation and PCL development documented in APAR (Section 5).
				"A complete understanding of the possible exposure pathways of soil to groundwater, soil to surface water/sediment, groundwater to surface water/sediment, and the potential for groundwater migration off-site is required."	PCLs, including potential exposure pathways, were discussed in the February 15, 2013 meeting between TCEQ and Exide. A complete PCL discussion is provided in the APAR (Sections 4,5,6 and 7).

Table 1C
Historical Document Summary

Author	Date	Title	Contents	Outstanding issues / recommendations	Comments
TCEQ	2/7/2013	Handout at 2/8/2013 Meeting (Continued)		"Regarding groundwater classification, our joint determination that the eastern portion of the site can be classified as saturate soils and the western portion of the site can be classified as Class 3 based upon the limited aerial extent and storativity of the alluvial lobe. The groundwater classification evaluation according to TRRP-8 should be presented in the APAR. A discussion of high sulfate levels should also be included. The limited groundwater data presented as part of the July 12, Site Investigation Report suggests that all groundwater migrates toward and discharges into Stewart Creek. Please provide a complete evaluation of groundwater at the site, including a delineation of the groundwater/saturated soils boundary, groundwater conditions at the Class 2 landfill and between the landfill and the surface water discharge points, and groundwater conditions beneath each SWMU. An examination of groundwater in the infill of the former Relocated Tributary should be conducted. The existence of a preferred permeability pathway in the infill should be assessed, and determine the point of discharge, into Stewart Creek or back into the Relocated Tributary."	Site groundwater is evaluated in Section 2.5 and Section 5 of the APAR.
				"If any new evidence to the contrary of the "limited extent" of the alluvial aquifer is revealed as a result of a more extensive assessment of groundwater conditions (i.e.. groundwater migration off-site in the western portion of the facility) as part of the APAR, a re-evaluation of the Class 3 designation will be required. Please include the water well survey as presented in the SIR in the APAR"	For this APAR, a Class 2 groundwater resource classification is assumed for the uppermost groundwater bearing unit at the Site (see Section 2.5).
				"Complete Surface Water Investigation- Exceedances of surface water for Stewart Creek exist at SW-1 and SW-2 locations for Lead and Cadmium at downstream edge of facility with J flagged results. An exceedance of surface water SW-11 for Cadmium located upstream, also J flagged. These locations should be resampled to confirm their existence. Use the TRRP Guidance 24 –Determining PCLs for Surface Water and Sediment and provide a complete assessment of this exposure pathway. Since it is anticipated that Grand Park will be constructed downstream of the facility, conduct a comparison of Stewart Creek surface water to contact recreation PCLs as well as other considerations as examined using TRRP Guidance No. 24. Potential for impacts to Stewart Creek along the industrial portion of the facility should be fully examined. If it is determined that the industrial area is to be closed as a RCRA unit, provisions should be made for a regular surface water sampling program to monitor contaminant levels through time to determine potential current and future impacts."	Additional surface water evaluation conducted for APAR (see Section 6).
				"Surface water and sediment in the relocated North Tributary should be sampled."	Sediment was sampled in the North Tributary during the 2012 Site Investigation and evaluated in Section 7 of APAR. Surface water sampled in the North Tributary evaluated in Section 6 of APAR.
				"Tier II SLERA – The facility must conduct a Tier II SLERA, which is currently underway."	SLERA was conducted in accordance with TCEQ/EPA-approved Work Plan (See Section 9).
				"EPA Comments – The APARs should address all the comments provided by EPA to the July 12, Site Investigation Report."	EPA comments addressed in APAR (see comment-by-comment description provided previously in this table).
				"Soil Investigation – The soil investigation report should re-evaluate the extent of contamination using the proper PCL. Soil to Surface Water and Soil to dust inhalation should be considered in addition to Soil to GW ingestion. If the Class 3 groundwater is affected, a soil PCL is 150 ppm lead for greater than 30 acre exposure area. Soil sample depth and sampling interval should be determined by the depositional environment. 0-6 inches for aerial deposition, 0-2 ft. intervals can be used for other areas as long as the absence or presence of slag/battery chips is noted in the boring log and as a column a table which summarizes the sampling results."	The referenced exposure pathways are discussed in Section 3 of the APAR. Soil samples were collected from 0-6" to evaluate for aerial deposition. The APAR soil assessment is discussed in Section 4.

Table 1C
Historical Document Summary

Author	Date	Title	Contents	Outstanding issues / recommendations	Comments
TCEQ	2/7/2013	Handout at 2/8/2013 Meeting (Continued)		"Soil Background Sampling, page 32 - The use of background sample results is permitted if the Soil to GW Ing number is lower than background. Some of the sample results in Table 5 appear to be outliers. Also, you can default to Texas Specific Soil Background numbers as per TRRP. Please complete the site specific background determinations and compare them to the Texas Specific Soil Background numbers."	The background soil samples collected during the Site Investigation have been statistically evaluated. The statistical evaluation is presented in the APAR (Appendix 8).
				"As mentioned in the initial general discussion, determine the extent of slag/battery chips throughout the facility. This will require a robust sampling plan to determine if the slag is concentrated in certain areas, or does it exist throughout the facility"	W&M inspection reports for exposed slag/battery chips provided in Appendix 18.
				"In areas where battery acid may have been present, measure the pH of the soils and determine corrosivity (Battery Receiving/Storage Building and Bale Stabilization Areas)."	Soil pH included in the analysis of soils collected in the vicinity of these areas. Fifty-three soil samples were collected and analyzed to evaluate pH in these areas (Section 4).
				"Interim measures (vegetative cover, artificial cover, hydro-mulch) may be necessary to prevent fugitive dust emissions from occurring from disturbed or exposed soils where such emissions are occurring (wind-blown dust) until such time a final remedy has been put in place."	A dust control plan was implemented for dust control during decontamination and demolition.
				"North Disposal Area (NDA) – Black, gravel sized slag fragments were noted in sample NDA-1 boring log, from 2-2.5 ft. This indicates the necessity to determine the northern most extent of slag in the subsurface. Also, the boring was noted as infilling with water. This boring appears to be in the infilled portion of the Relocated North Tributary and a ground water sample should be analyzed to determine the presence of COCs. NDA-2 has fill from 0-4ft, with the northern boundary not determined. Additional sampling to the north required to determine the extent of fill. NDA-3 has fill from 0-4.5 ft. NDA-5 slag blocked the sampling barrel at 6 inch depth and precluded deeper sampling. More sampling to determine the extent of the slag and landfill should be undertaken. If the NDA is to be capped, any contamination outside the landfill boundaries should be consolidated into the landfill, or properly disposed at an off-site facility."	Groundwater monitoring wells installed in the former North Tributary. The well borings were continuously sampled for lithologic purposes and selected soil samples collected for laboratory analyses (Section 4). Groundwater samples were also collected from the monitoring wells (Section 5). Extent of NDA has been delineated by borings 2012-NDA-4, 2012-NDA-6, B7N, MW-21 and MW-22.
				"Slag Landfill – Depending upon the critical PCL (groundwater to surface water PCL,etc.) the extent of contamination in the Slag Landfill may or may not have been determined. The erosion of contaminated soil directly to and potential for leaching to the infilled areas of the Relocated North Tributary should be examined."	The selection of the groundwater RAL to be used for delineation purposes is described in Section 5. Monitoring well installed in the former North Tributary infill in the vicinity of the Slag Landfill. Two monitoring wells and soil samples collected and analyzed to evaluate lead and cadmium in this area (Sections 4 and 5).

Table 1C
Historical Document Summary

Author	Date	Title	Contents	Outstanding issues / recommendations	Comments
TCEQ	2/7/2013	Handout at 2/8/2013 Meeting (Continued)		"Raw Materials Storage Area – Regulatory overlap exists between closure requirements for the Raw Materials Storage Building, which shall be closed according to IHW Permit Provision VII.D., Permit RFI requirements Provisions IX. C-G., and Ordering Provisions 3.c.i and ii. These areas overlap and require compliance with different regulations with different timeframes for the same area. Permit Provision VII.D. 2.a. stipulates "within 120 days of the determination that closure to Remedy Standard A cannot be obtained, the permittee shall submit to the TNRCC a RAP and APAR for Raw Materials Storage Bldg and Battery Receiving/Storage Area. Order stipulates submission of an APAR within 150 days of the date of issuance of the Agreed Order (7/10/2013). Permit Provision IX. E. requires the submission of a schedule. What is the anticipated timing for the closure of the two permitted units? In the Response Action Work Plan, Appendix A. Waste Stabilization Plan, page 5, it states "At the completion of the work, the sediments (from the decontamination area) will be removed and transferred to the existing Slag Treatment Building (not a permitted unit) at the facility for treatment or transferred to a less than 90 day container for characterization, storage and disposal in accordance with local, state, and federal requirements." The requirements for the APARs as stipulated in the order are meant to be all inclusive and should include the APAR for the Raw Materials Storage Area. However, if waste management activities are conducted during the remediation phase after the APAR has been completed, another APAR or some form of closure documentation for the area will be necessary to determine if any contamination has occurred due to the remediation activities."	As described in Section 4, soil samples collected below the Battery Receiving/Storage Building and Raw Material Storage Building exceed critical soil PCLs for lead and cadmium. A Response Action Plan to address these areas will be submitted after TCEQ approval of the final APAR. Closure of permitted units is being performed as required by the permit.
				"The Decontamination and Demolition Plan, Revision 1, dated January 25, 2013, Section 6.1.6 Soils Verification Sampling discusses soils sampling for the soils immediately beneath Raw Materials Storage Bldg. but not the Battery Receiving/Storage Area."	Subslab soil samples were collected in the Battery Storage/Receiving Area in areas identified with cracking or pitting based on an examination of the concrete floor. Fifty-one subslab soil samples were collected in areas of cracking and/or pitting of the slab and analyzed to evaluate lead, cadmium and pH (Section 4).
				"According to TCEQ Ordering Provisions 3.c.i - Within 150 days (due July 10) of the (effective) date of the Agreed Order, submit an APAR for the unauthorized discharges located on the southwest corner, south side, and below the opening on the north face of the Slag Treatment Building."	This area addressed in APAR. Soil samples collected and analyzed to evaluate lead and cadmium in the area (Section 4).
				"South Disposal Area – Discharges noted in the TCEQ inspection for the east side of the South Disposal Area must be delineated according to Ordering Provision 3.C.i. Groundwater monitoring wells need to be installed between the South Disposal Area and Stewart Creek to determine possible impact. Surface water quality standards need to be met in monitoring wells adjacent to Stewart Creek according to TRRP-24. Additional soil sampling to the east and west to define the eastern and western boundaries is required. 0-6 inch aerial deposition samples are necessary. The existence of high levels of contamination at the surface in the landfill interior will require remediation/capping."	Additional soil sampling to the east of the SDA performed to further delineate lead exceedances. Surface soil samples (0-6") have been collected in this area for the SLERA evaluated for lead and cadmium. Additional samples were collected north of SDA-4 and SDA-3 and were evaluated for COCs from 0-6". Samples collected for the SLERA in the wooded area to the east of the SDA were collected from the 0-6" interval. Additional soil samples collected and analyzed to evaluate lead and cadmium in this area during the APAR investigation. The groundwater to surface water PCL was considered a pathway for wells located adjacent to Stewart Creek, the groundwater to surface water point of exposure. Water levels were evaluated in monitoring wells between the South Disposal Area and Stewart Creek. B-4R was sampled as part of the investigation. An attempt was made to sample B-3R but the well provided an insufficient volume for sampling.
				"Site Specific Recommendations – Non-RFI SWMUs Boneyard – Additional groundwater monitoring wells may need to be installed between the Boneyard and Stewart Creek to determine possible impact to the west and east of MW-16. Determine if any additional slag fragments are in this area to determine if either capping or spot excavation is necessary."	Additional soil samples were collected in the vicinity of MW-16 to determine the extent of lead and/or cadmium contamination in the vicinity (Section 4). An additional monitoring well (MW-24) was installed to the east of MW-16 (Section 5). W&M performed a Site-wide survey for slag; the report is included in an appendix to the APAR (Appendix 8).
				"Bale Stabilization Area – How were the bales treated and stabilized in this area? Additional soil and groundwater samples should be gathered from this area. Identification of exposed battery chips and slag during a 2010 inspection performed by the EPA should necessitate a higher frequency of confirmation sampling to ensure additional exceedances outside the landfill boundaries are not present."	The requested information is included in the APAR (Section 1). Per a separate comment, a monitoring well (with soil sampling) was installed and sampled to evaluate for total and dissolved lead and cadmium, pH and sulfate. A substantial number of soil samples were previously collected in this area for the Site Investigation (PBW, 2012). These are described in Section 4.

Table 1C
Historical Document Summary

Author	Date	Title	Contents	Outstanding issues / recommendations	Comments
TCEQ	2/7/2013	Handout at 2/8/2014 Meeting (Contineud)		"Crystallization Unit Frac Tank – The discharge at the drainage swale west of the Crystallization Unit should be sampled and the extent of contamination determined."	Soil samples were collected in the vicinity of the drainage swale west of the Crystallization Unit Frac Tank. Ten soil samples collected and analyzed to evaluate lead, cadmium and sulfate in the area (Section 4).
				"Stewart Creek Floodwall – Additional sampling in the vicinity of FWCS-1 should be conducted and the extent of contamination defined. Discharges of groundwater/perched water/wash water should be sampled and discussed. Groundwater monitoring should be conducted to determine if groundwater is affected. Provide engineered drawings of the French drain system and a discussion of its function in relation to present and future uses to intercept discharges that could impact Stewart Creek."	Additional soil samples were collected to address lead and/or cadmium exceedances in soil samples collected along the Stewart Creek Floodwall (Section 4). A groundwater investigation was conducted to determine if groundwater is affected. Four soil samples collected and analyzed to evaluate lead and cadmium in this area. Wells MW-17 and B5N were also sampled in this area. A report for the French Drain (W&M, 2013) is provided in Appendix 11.
				"Berm Material – Ordering Provision 3.c.iii require proper disposal of the Berm Material. Conduct confirmation sampling to determine that all contaminated berm material has been excavated."	Removal of Shooting Range Berm has been completed. A report summarizing removal activities is provided in Appendix 11.
W&M Environmental	5/10/2013	Wall Seepage Project; Retaining Wall at Stewart Creek; Exide Frisco Recycling Facility	W&M prepared a report detailing the procedures of the French drain installation along the flood wall. The French drain was installed to prevent seepage along the creek side of the flood wall, which had been previously observed. In the fall of 2012, W&M installed a French drain from the eastern edge of the Slag Treatment Building to the southeast corner of the Battery Storage/Receiving Building. The installation was completed in roughly 100-foot sections. First, the concrete was broken and the soil excavated. The soil was stockpiled on polyethylene sheeting and covered nightly with additional sheeting. Next, the wall footing was sealed with asphaltic sealer and a 40 ml HDPE liner. Then, a 4-inch PVC underdrain was installed and surrounded by crushed stone and the concrete replaced. In addition, collection sumps were installed at the west end of the wall: one to collect liquids from the new underdrain system and another to collect surface runoff. The excavated soil was sampled and characterized for disposal off-site, by manifest, in an appropriate landfill.		Included in Appendix 11 of APAR.

Table 1D

Summary of Documented Historical Releases

Area	Document Author	Document Date	Document Title/Description	Description of Study/Activities	Description of Release/Findings	Comments
Battery Acid Management System	TNRCC	2/27/1998	Conditional approval of Phase II RCRA Facility Investigation Workplan	Comments RE: Phase II Investigation workplan.	"...the TNRCC strongly suspects that the soils underlying WMA 2 have been impacted...as evidenced by seepage from underneath the battery storage area along Stewart Creek...documented by Misc. Stained Soil samples report dated October 6, 1994... TNRCC will assume a release beneath WMA 2 (if borings not advanced through concrete at WMA 2)."	
Boneyard	EPA	1/12/2011	Corrective Action Inspection	Details of compliance evaluation inspection conducted 12/14/09-12/18/09, 3/15/10-3/16/10 and 3/29/10.	Boneyard - "During the inspection, numerous pieces of equipment were observed which still had process materials/wastes present. Wastes observed included a roller belt with battery chips, a kettle with refining drosses, and a "grizzly screen" with pieces of slag, a bail of cardboard and shrink wrap, and several "supersacks" containing what appeared to be building insulation. Also observed was a piece of hydraulic equipment which had two full hydraulic tanks that were leaking fluid onto the ground."	
Crystallizer	EPA	1/12/2011	Corrective Action Inspection	Details of compliance evaluation inspection conducted 12/14/09-12/18-09, 3/15/10-3/16/10, and 3/29/10.	Crystallizer - "During the inspection, the inspectors observed liquid leaking from the frac tank as well as visible drainage pathways leading from the frac tank to the edge of the concrete ramp."	
	TCEQ	8/29/2011	Investigation Report	Results from TCEQ inspection conducted May-June 2011.	"…TCEQ staff observed a white solid and several battery chips in a drainage swale west of the Crystallizer. TCEQ also observed dead vegetation and a white solid along a drainage pathway that began at the Crystallizer and ended at the culvert. …staff collected a sample of the soil at the opening of the culvert which contained the white solid. The sample's analytical results indicated that the soil contained elevated concentrations of lead (total 694 mg/kg, TCLP 3.92 mg/L) and sulfates (total 6040 mg/kg)."	
Diesel Release	Lake Engineering, Inc.	4/29/1988	Letter to TWC RE: Diesel Product Discovery	Details discovery of diesel product during activities related to Flood Wall installation. Letter stated that it likely originated from a leak discovered and remediated approximately 5 years prior to the letter date.	Historical diesel release from former diesel fuel tank.	
	Lake Engineering, Inc.	August 1989	Appendix F of RCRA Facility Investigation for GNB Incorporated, Frisco, TX dated May 8, 1991	Document indicates that an oil spill recovery system was completed as detailed in the document. Approximately 687 gallons had been recovered since the report date.		
	Lake Engineering, Inc.	5/8/1991	RCRA Facility Investigation for GNB Incorporated; Frisco, TX	WMA 2 (Diesel Oil Spill): "The information gathered in relation to the diesel spill indicates that the spill is not migrating beyond the original area of discovery. It is recommended that monitoring be continued on wells surrounding this area."		
				Diesel Oil Leak: "The retrieval sump should continue to be monitored and the oil should be removed as required. For the following reasons, no additional action is recommended for this unit: 1) only moderately low levels of TPH have been detected in groundwater and soils in the immediate area of the original leak; 2) the surface overlying the spill is now entirely paved; 3) only small quantities of free product accumulate between pumping intervals indicating the majority of the oil has been retrieved."		
	TCEQ	7/15/2003	Leaking Petroleum Storage Tank (LPST) Case Closure of Subsurface Release of Hydrocarbons at G.N.B Technologies Facility	This letter stated that no further action was required regarding the diesel release.		
Flood Wall Creek Side	GNB	10/12/1994-10/20/1994	Miscellaneous Stained Soil Samples	Summary report and lab reports detailing the sampling and analysis of soils located near the Stewart Creek walking bridge on the creek side of the Flood Wall.	Water seepage was observed through the Flood Wall in this area. The Flood Wall was repaired at the area where the seepage was observed. The visibly stained soil was removed and confirmation samples were collected.	Remediation measures approved by TNRCC letter dated 3/26/1997.
	TNRCC	3/26/1997	Miscellaneous Stained Soil Samples - Stabilization Approval	"This letter approves the sampling and excavation of contaminated soil as a stabilization measure."		
	EPA	1/12/2011	Corrective Action Inspection	Details of compliance evaluation inspection conducted 12/14/09-12/18-09, 3/15/10-3/16/10, and 3/29/10.	Flood Wall - Along the wall, inspectors observed what appeared to be liquid seeping from beneath the wall resulting in standing water and white crystalline substance on the ground. The EPA collected five soil samples and one sample of white crystalline waste material along the exterior of the Flood Wall from areas where "visibly impacted soil (i.e., wet soil with crystalline substance and dead vegetation)" was observed. Three of the samples (EX-SS-002, EX-SS-003, and EX-SS-004) indicated elevated concentrations of lead (1370 mg/kg, 1040 mg/kg, and 5610 mg/kg, respectively) and two of the samples (EX-SS-002 and EX-SS-004) indicated elevated concentrations of cadmium (74.1 mg/kg and 220 mg/kg, respectively).	
	TCEQ	8/29/2011	Investigation Report	Results from TCEQ inspection conducted May-June 2011.	"…TCEQ staff inspected the barrier wall and the Stewart Creek embankment. TCEQ staff observed dead vegetation near a crack in the barrier wall where a liquid was discharging (slag treatment building on other side of wall). TCEQ collected a soil sample from the embankment where the dead vegetation was observed and sample analysis results indicated an elevated concentration of lead (total 3560 mg/kg, TCLP 12.2 mg/L)."	
					"…TCEQ staff observed a dark rust-colored stain along the wall where the stormwater pipe exited the wall. The pipe appeared to be leaking due to worn out gaskets. TCEQ staff collected a sample of the soil and rock along the embankment beneath the pipe. Sample analysis results indicated elevated concentrations of lead (total 39800 mg/kg, TCLP 127 mg/L) and cadmium (total 894 mg/kg, TCLP 12.2 mg/L)."	

Table 1D

Summary of Documented Historical Releases

Area	Document Author	Document Date	Document Title/Description	Description of Study/Activities	Description of Release/Findings	Comments
North Disposal Area	EPA	1/12/2011	Corrective Action Inspection	Details of compliance evaluation inspection conducted 12/14/09-12/18-09, 3/15/10-3/16/10, and 3/29/10.	North Disposal Area - "Battery chips were observed on the gravel road running adjacent to the disposal area. Again, these are not removed due to the concern that the facility would be "actively managing" the disposal unit. Brick was observed in the wooded area along the north side of the disposal area. The source of the brick is unknown."	
Old Drum Storage Area	Southwest Laboratories	4/29/1987	Soil Cleanup of Old Drum Storage Area	Details soil sampling and cleanup of impacted soil in the Old Drum Storage Area.	Soil samples from the Old Drum Storage Area exhibited elevated concentrations of EP Toxicity lead and cadmium.	
	GNB	6/16/1987	Letter to TWC RE: Closure Activities for Old Drum Storage Area	Details soil cleanup activities, including excavation, disposal, and soil confirmation sample activities.		Approximately 470.41 tons of soil were removed over a series of excavations from the Old Drum Storage Area.
	TWC	10/8/1987	Interoffice Memo RE: Old Drum Storage Area Cleanup	States additional remedial action needed at one sample location.		
	Lake Engineering, Inc.	5/8/1991	RCRA Facility Investigation for GNB Incorporated; Frisco, TX	Old Drum Storage Area: "The old drum storage area referred to in the permit was closed under TWC approval. The unit was cleaned, contaminated soil was removed, and the area was paved and deed recorded. No further action is recommended in regard to this unit."		Official closure approval letter requested from TWC by letter dated December 22, 1999.
	TNRCC	1/13/2000	Acceptance of Closure Certification for 4 Solid Waste Management Units	Closure approval for the former Battery Storage Area, Old Drum Storage Area, Stewart Creek Sediment Dredging Waste Pile and the Product Waste Pile.		
Raw Material Storage Building	EPA	5/10/2011	Multimedia Areas of Concern		"Exide failed to maintain the fugitive dust wet suppression system in its blast furnace area resulting in the uncontrolled release of lead-containing dust to the atmosphere from the facility's blast furnace feed storage piles."	
Shooting Range Berm	TCEQ	8/29/2011	Investigation Report	Results from TCEQ inspection conducted May-June 2011.	"TCEQ staff observed large amounts of untreated slag and battery chips in the [shooting range] berm which appeared to have originated from the South Disposal Area."	Removal of Shooting Range Berm completed in 2013 (see removal report in Appendix 11 of APAR).
Slag Treatment Building	TCEQ	8/29/2011	Investigation Report	Results from TCEQ inspection conducted May-June 2011.	"…TCEQ staff observed that the floor [in the slag treatment building] of the <90 day tank was covered by free liquids. The free liquids were identified by Exide personnel as equipment wash down water and dust suppression water. TCEQ staff observed these waters contacting the untreated piles of slag and refractory brick in the tank. TCEQ staff also noted that this water contacts loose fragments of wastes on the crusher when the crusher is washed down. A sump is used to collect these waters until it can be used in the slag treatment process…TCEQ staff observed…overflow."	
					"…Ms. Lewis collected a sample of a material resembling blast furnace slag from the north side of the (slag treatment) building. The sample was collected beneath the opening used to transfer untreated refractory brick and untreated blast furnace slag into the building…Sample results…indicated that the sample contained elevated concentrations of lead (total: 47,100 mg/kg, TCLP 59.3 mg/L) and cadmium (total: 574 mg/kg, TCLP: 1.74 mg/L)."	
South Disposal Area	EPA	1/12/2011	Corrective Action Inspection	Details of compliance evaluation inspection conducted 12/14/09-12/18-09, 3/15/10-3/16/10, and 3/29/10.	South Disposal Area - "Inspectors observed several pieces of slag and battery chips in the vegetation around the perimeter of the disposal area. Mr. Messer explained that nothing is removed from the area to avoid "actively managing" the unit which would result into the unit being regulated under RCRA. Instead, as slag and/or battery chips are uncovered due to erosion, additional soil is added to the cap."	Repairs to the South Disposal Area cap were conducted on June 5, 2013 and June 27, 2013, as documented in a summary report prepared by W&M (2013c), which is included in Appendix 11 of the APAR.
	TCEQ	8/29/2011	Investigation Report	Results from TCEQ inspection conducted May-June 2011.	"…staff observed that the cover of the South Disposal Area on the south side had significantly eroded exposing battery chips in various areas along the slope…"	

Table 1D

Summary of Documented Historical Releases

Area	Document Author	Document Date	Document Title/Description	Description of Study/Activities	Description of Release/Findings	Comments
Stewart Creek	Southwest Laboratories	2/21/1986	Water and Sediment Tests	28 creek water samples, 28 stream sediment samples and 4 creek bank (soil) samples were collected on-site in Stewart Creek and the North Tributary and analyzed for lead and cadmium. The soil and sediment samples were analyzed using EP toxicity procedure.	Several sediment samples from Stewart Creek analyzed for EP Toxicity exceeded 5.0 mg/L leachable lead. "...we recommend sediments be excavated from the stream bed from current sample location 7, westward to sample location 19; this is a distance of approximately 1700 feet on Stewart Creek. The north branch appears to be relatively clean" as indicated by our current analytical test results."	Stewart Creek was remediated during 1986 and again during 2000. Remedial activities conducted during 2000 approved by TNRCC letter dated 7/25/2000. Improvements were made to the stormwater system, including construction of the Flood Wall in 1988.
	Southwest Laboratories	5/21/1986	Stream Sediment Samples	Following an initial dredge of Stewart Creek sediments, 12 stream sediment samples were collected and evaluated for lead and cadmium using the EP toxicity procedure.	"We suggest redredging the Stewart Creek from about 50 feet east of sample location 1 to approximately 50 feet west of sample location 2. This is a distance of about 250 feet."	
	Southwest Laboratories	6/13/1986	Stream Sediment Test	Following a second dredge of Stewart Creek sediment, 23 stream sediment samples were collected from a stockpile of stream sediments (19 samples) and Stewart Creek (4 samples) and evaluated for lead and cadmium using the EP toxicity procedure.	Two of the four stream sediment samples were above the 5 mg/L EPA limit of leachable lead.	
	Southwest Laboratories	7/29/1986	Stream Sediment Tests	Following a third dredge of Stewart Creek sediments (approximately 300 feet), four Stewart Creek sediment samples were collected and evaluated for lead and cadmium using the EP toxicity procedure.	"The four sediment sample tests indicated that the current EPA specifications for [leachable] lead (5 mg/L) and cadmium (1 mg/L) were not exceeded."	
	TWC	9/30/1986	Letter RE: Notice of Solid Waste Violations	Notified GNB of violations noted during a 9/6/1986 inspection of the facility.	Notified GNB that runoff from waste management areas (i.e. the main plant area) had been allowed to discharge into Stewart Creek.	
	GNB	11/10/1986	Letter RE: Facts Meeting of 10/21/1986 with TWC Personnel	Meeting notes from 10/21/1986 meeting regarding notice of violation of 9/30/1986.	Discussed runoff of water from waste management area. GNB stated improvements were being made in the form of a rainwater runoff system and an effluent treatment system. In addition, a roof over and wall curbing around the "Outside Raw Material Storage Building" was to be installed to control process and rainwater runoff.	
	TWC	8/29/1993	Notice of Deficiency	TWC Comments on 1991 RCRA Facility Investigation.	"The results of the surface water and sediment sampling for the RFI indicate that an adverse impact on Stewart Creek from this facility appears to be continuing... In addition, TWC stream monitoring data collected in 1989-1991 from stations downstream of the GNB facility show dissolved lead levels which exceed the State Water Quality standard for lead. Statistically significant contamination by lead and cadmium is shown in the stream sediments, indicating an ongoing problem with releases from this facility..."	
	JDC Consulting	7/13/2000	Stewart Creek Corrective Measures Implementation Report	As a result of the HHERA conducted by JDC in 1998, an approximate 2,800-foot stretch of the Stewart Creek sediments was remediated to standards for lead and cadmium approved by the TNRCC (91 milligrams per kilogram [mg/kg] for lead and 4.23 mg/kg for cadmium). The remediation was carried out by first removing visible slag "buttons" (approx. 12-18 inch diameter slag formed in kettle bottoms) from the creek bed and banks, then excavating the sediments/soils at an average depth of 1ft. Sediments/soils were excavated to deeper depths as needed based on the extent of slag presence in the sediment/soil. Excavated sediment/soil was screened for recoverable slag fragments, which were recycled in the blast furnace at the facility. Remaining sediment/soil was stockpiled and sampled for TCLP analysis for lead and cadmium. Most samples passed the criteria for Class II waste; the samples that did not pass the criteria were treated until they passed. Some stockpiled material was tested for SPLP lead and cadmium for potential re-use as intermediate fill in the active Class 2 landfill at the facility. The TNRCC approved the reuse proposal on November 8, 1999.		
	TNRCC	7/25/2000	Stewart Creek Corrective Measures Implementation Report Response	Letter acknowledges attainment of cleanup standards.	"Based on the information contained in the Final Report and other information available to staff, it appears that cleanup at Stewart Creek has attained RRS No. 1. GNB Technologies, Inc. is released from deed recordation and post-closure care requirements."	
	EPA	1/12/2011	Corrective Action Inspection	Details of compliance evaluation inspection conducted 12/14/09-12/18-09, 3/15/10-3/16/10, and 3/29/10.	Stewart Creek - Although the creek had been previously remediated, according to the facility representative, additional slag was discovered recently due to the erosion of the creek bed and is currently under investigation by the facility.	

EXPLANATION

- On-Site Property Boundary
- FRC Property Boundary
- Flood Wall Location

Note:
1. Original figure prepared by PBW as part of the APAR dated July 9, 2013. Modified by Golder in May 2014.

N

Scale in Feet
0 75 150

Source of photo:
Imagery from NCTCOG, 2009 photography.

FORMER OPERATING PLANT
FRISCO RECYCLING CENTER
FRISCO, TEXAS

Figure 1A.1

ON-SITE PROPERTY MAP

PROJECT: 13-02086	BY: BCL	REVISIONS
DATE: MARCH, 2014	CHECKED: JWT	

GOLDER ASSOCIATES, INC.

EXPLANATION

- On-Site Property Boundary
- FRC Property Boundary
- Special Flood Hazard Areas Subject to Inundation by the 1% Annual Chance Flood (100-year Flood) (FEMA, 2009)
- Areas of 0.2% Annual Chance Flood, Areas of 1% Chance Flood with Average Depths of Less that 1 foot or with Drainage Areas Less than 1 Square Mile, or Areas Protected by Levees from 1% Annual Chance Flood (FEMA, 2009)
- Flood Wall Location

Note:
1. Original figure prepared by PBW as part of the APAR dated July 9, 2013. Modified by Golder in May 2014.
2. The FEMA Flood Zone demarcated in the former operating area along Stewart Creek does not consider the flood wall.

N

Scale in Feet
0 75 150

Source of photo:
Imagery from NCTCOG, 2009 photography.

FORMER OPERATING PLANT
FRISCO RECYCLING CENTER
FRISCO, TEXAS

Figure 1A.2

ON-SITE PROPERTY MAP WITH FLOOD ZONES

PROJECT: 13-02086	BY: BCL	REVISIONS
DATE: MARCH, 2014	CHECKED: JWT	

GOLDER ASSOCIATES, INC.

EXPLANATION

- On-Site Property Boundary
- FRC Property Boundary
- Former Path of North Tributary (1951 Aerial Photo)
- Former Path of North Tributary (1972 Aerial Photo)
- Former Path of Stewart Creek (1951 Aerial Photo)
- Stewart Creek (Approximate Creek Centerline)
- North Tributary (Approximate Creek Centerline)
- Monitoring Well Location
- Soil Boring Location (2012 - 2014)
- Soil Sample Location (2012 - 2014)
- Phase II RFI Soil Sample Location (1998)
- Phase I RFI Soil Sample Location (1991)
- Disposal Area Delineation Boring Location (1993)
- Dredged Sediment Stockpile Sample Location (1986)
- Dredged Sediment Stockpile Sample Location (1987)
- Old Drum Storage Area Sample Location (1987)
- Geotech Boring Location (2011)
- Class 2 Landfill Notification Boring (1995)
- Critical PCL Exceedance Zone (PCLE Zone)
- J-Parcel PCL Exceedance Zone (PCLE Zone)
- Surface Drainage Direction
- Water Line
- Fire Hydrant
- Sanitary Sewer Line
- Sanitary Sewer Manhole
- Stormwater Line
- Stormwater Manhole
- Stormwater Inlet/Basin
- GAS — Gas Line
- Fiber Optic Line
- Flood Wall Location

Note:
1. Locations of utilities shown are approximate. Additional underground utilities are present throughout the former production area, commonly within concrete trenches.
2. Original figure prepared by PBW as part of the APAR dated July 9, 2013. Modified by Golder in May 2014.

Source of photo:
Imagery from NCTCOG, 2009 photography.
Source of utilities:
City of Frisco, GIS Department

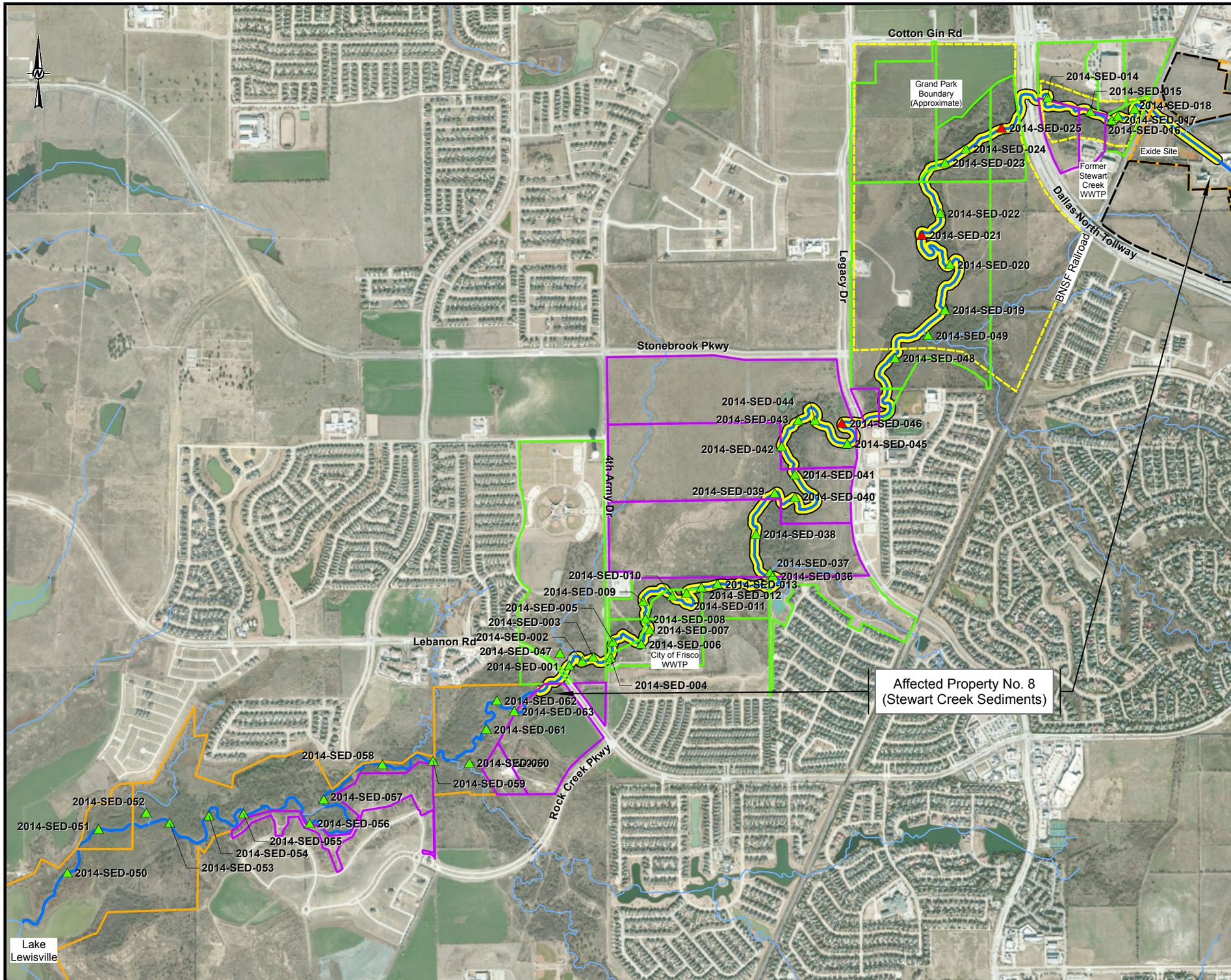
FORMER OPERATING PLANT
FRISCO RECYCLING CENTER
FRISCO, TEXAS

Figure 1B.1

AFFECTED PROPERTY MAP ON-SITE

PROJECT: 13-02086	BY: BCL	REVISIONS
DATE: MARCH, 2014	CHECKED: JWT	

GOLDER ASSOCIATES, INC.



Legend

- Sediment Sample Location
- Exceedence of Pb or Cd RAL/Critical PCL for Surface Water
- No Exceedence of Pb or Cd RAL/Critical PCL for Surface Water
- Stewart Creek (Appoximate Creek Centerline)
- Creek Tributary (Appoximate Creek Centerline)
- Stewart Creek PCLE Zone
- Grand Park Boundary (Approximate)
- Former Operating Plant
- Undeveloped Buffer Property
- Private Owner Property
- City of Frisco or City of Frisco Entity Property
- USACE Property

Notes:
1. Screening Values:
Pb: 81.9 mg/kg
Cd: 3.0 mg/kg
2. PCLE Zone Boundary is based on sediment data and/or visual observations of slag or battery case fragments.

Source:
1. Locations - PBW and Golder, 2012 - 2014
2. Basemap by PBW Figure 1B, as part of the APAR dated July 9, 2013.
3. Aerial Imagery: Source: Esri, DigitalGlobe, GeoEye, i-cubed, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, and the GIS User Community

1,500 750 0 1,500 Feet

Scale: AS SHOWN
File No. 1302086-B023 FIG 1B2.mxd

FORMER OPERATING PLANT
FRISCO RECYCLING CENTER
FRISCO, TEXAS

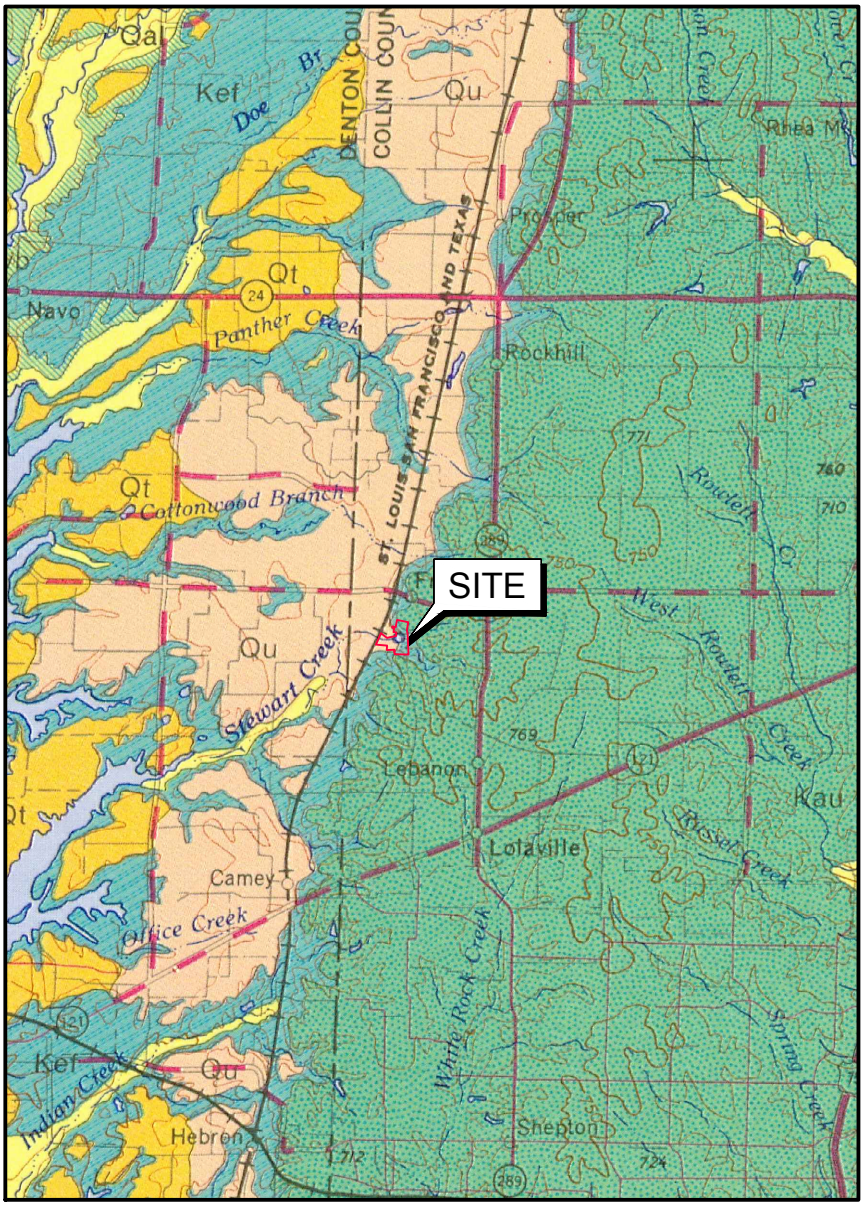
FIGURE 1B.2

AFFECTED PROPERTY MAP
OFF-SITE STEWART CREEK

PROJECT NO. 13-02086	BY: JWT	REVISIONS
DATE: 5/20/2014	CHECKED: - - -	

GOLDER ASSOCIATES INC.

Map Document: N:\File\2013\13-02086 Exide Frisco\B - APAR Phase II\map documents\1302086-B023 FIG 1B2.mxd / Modified 5/20/2014 8:27:13 AM by jthomas / Exported 5/20/2014 8:27:26 AM by jthomas



EXPLANATION

Holocene, Pleistocene	Qal, Qt, Qu — Alluvium (Qal), fluviatile terrace deposits (Qt), surficial deposits undivided (Qu)	QUATERNARY
Upper Cretaceous	Kau — Austin Group	CRETACEOUS
Upper Cretaceous	Kef — Eagle Ford Formation	CRETACEOUS
Upper Cretaceous	Kwb — Woodbine Formation	CRETACEOUS

N

Scale 1:250,000

0 3

Statute Miles

Source: Geologic Atlas of Texas, Sherman Sheet (McGowen et al., 1991).

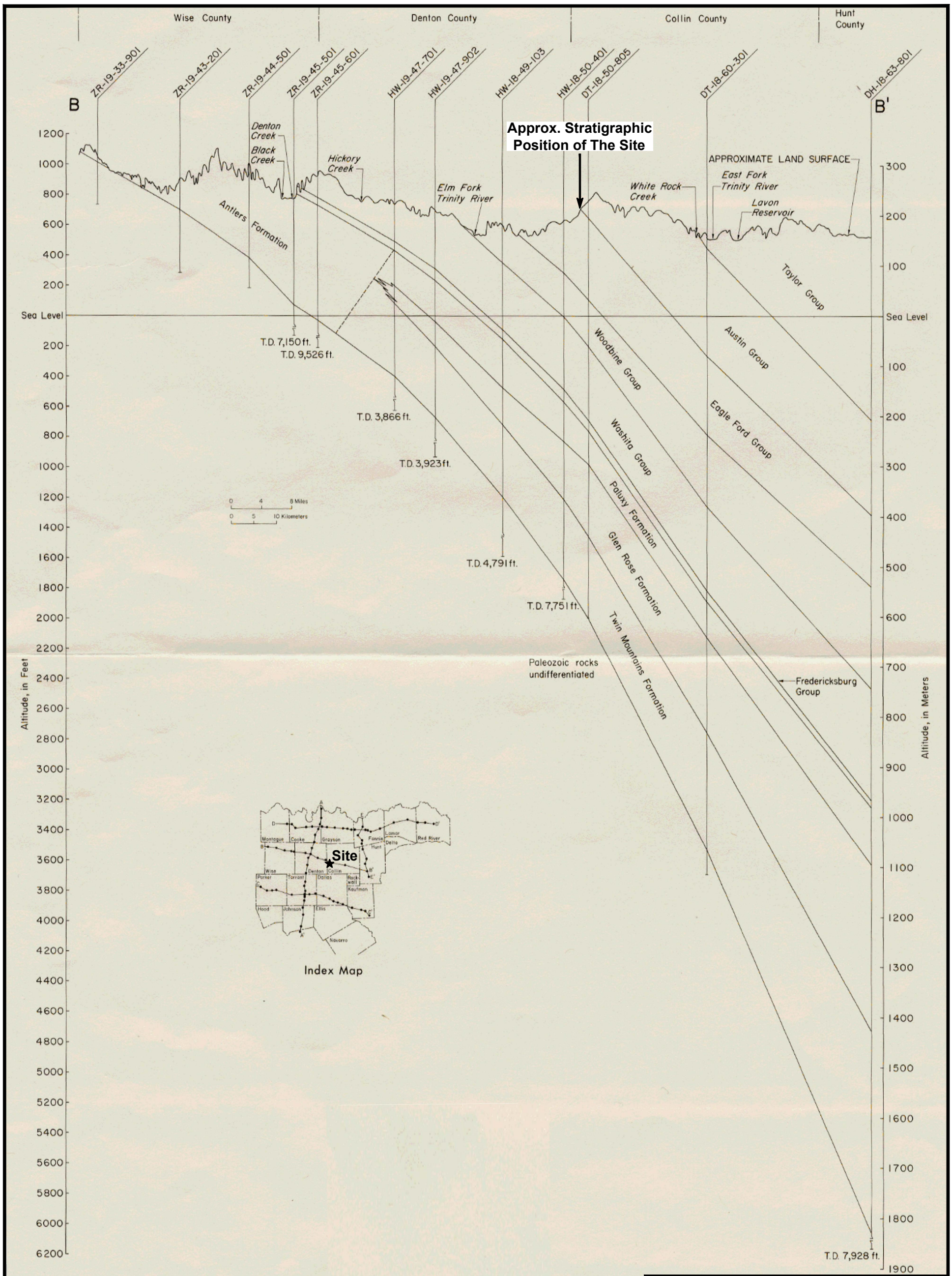
FORMER OPERATING PLANT
FRISCO RECYCLING CENTER
FRISCO, TEXAS

Figure 1C

REGIONAL GEOLOGIC MAP

PROJECT: 1755	BY: AJD	REVISIONS
DATE: JUNE, 2013	CHECKED: WFV	

PASTOR, BEHLING & WHEELER, LLC
CONSULTING ENGINEERS AND SCIENTISTS



FORMER OPERATING PLANT
FRISCO RECYCLING CENTER
FRISCO, TEXAS

Figure 1D

REGIONAL GEOLOGIC CROSS SECTION

PROJECT: 1755	BY: AJD	REVISIONS
DATE: JUNE, 2013	CHECKED: WFV	

PASTOR, BEHLING & WHEELER, LLC
CONSULTING ENGINEERS AND SCIENTISTS

Source:
After Nordstrom (1982).

2.0 EXPOSURE PATHWAYS AND GROUNDWATER RESOURCE CLASSIFICATION

This section addresses TRRP requirements, but also includes additional information regarding potential receptors previously provided in (and updated from) the SIR (PBW, 2012a).

2.1 Source(s) of Potable Water for On-site Property and Affected Off-Site Properties

Potable water for the Site and properties within the vicinity of the Site is provided by the City of Frisco, which purchases treated surface water from the NTMWD. The primary source for the NTMWD water supply is Lavon Lake, which is located approximately 16 miles east of the Site (City of Frisco, 2013).

2.2 Field Receptor Survey

As required by TRRP, a survey of potential receptors within at least 500 feet of the affected property areas has been completed. The 500-foot radius boundary is depicted on Figure 2A. Land within 500 feet of the affected property areas is mostly within the boundaries of the FOP or the Exide-owned Undeveloped Buffer Property, which is being investigated separately as a TCEQ Voluntary Cleanup Program (VCP) site (PBW, 2014). Field receptor surveys of the area within the TRRP-required 500-foot affected property radius and the Site vicinity beyond the 500-foot radius was conducted February 22, 2012 and October 22, 2012 by Kirby Tyndall of PBW and on May 9, 2014 by David Poe of Golder. Trip reports for the field receptor surveys are included with the receptor survey photographs in Figure 2B.1 and Figure 2B.2. In addition to the field receptor survey conducted by PBW, a supplemental field water well survey was conducted by Larry Eagan on behalf of Exide in October-November 2012 within approximately 0.5 miles of the FRC property. The findings of the field receptor surveys and supplemental water well survey are discussed in Section 2.4.

2.3 Records Survey

A water well records search was performed by Banks Environmental Data (Banks) on June 5, 2013 as part of the SIR investigation to identify water wells located within approximately 0.5 miles of the FRC. As noted in the Banks report (Appendix 5), the following databases were accessed during the water well search:

- TWDB databases: Groundwater Data, Submitted Drillers Reports;
- TCEQ databases: Water Utility Database, Public Water Systems Database, Central Records;
- Local Groundwater Conservation District and Subsidence District Records; and
- USGS databases: National Water Information System.

2.4 Receptor Survey Results

The first receptor survey, conducted in February of 2012, focused primarily on developed properties in the vicinity of the FRC. Developed land near the facility includes residential, industrial, and commercial properties. Several schools and parks with playgrounds are located within nearby residential neighborhoods: Grand Park is located approximately 5,000 feet southwest of the FRC, First Street Park, which contains a community garden, is located approximately 4,000 feet due north of the FRC, and Oakbrook and Hickory Parks are located in neighborhoods across 5th Street, east of the FRC.

The second receptor survey, conducted in October of 2012, focused primarily on Stewart Creek, the North Tributary, and potential ecological habitat. Receptors of potential concern previously identified during the February 2012 survey were confirmed and/or further evaluated during the second receptor survey. On-site and downstream portions of Stewart Creek and the North Tributary are considered potential surface water receptors. During the February 2012 receptor survey, no additional potential surface water receptors were identified. During the survey, the upstream segments of both Stewart Creek and the North Tributary, which run through developed neighborhoods east of the FRC, were observed. Much of the base flow of Stewart Creek and the North Tributary is attributed to surface runoff from upstream irrigation systems. Surface water in the vicinity of the FRC is not used for domestic or agricultural purposes. The ground surface within the survey area generally slopes toward the drainages of Stewart Creek and the North Tributary, and in the downstream direction of these creeks to the west.

The third receptor survey was conducted to address the expansion of the 500-foot radius area (survey area) to properties off of the Exide property to the north and west due to the change in the PCLE zone configuration in 2014. An updated receptor survey was completed by Mr. David Poe of Golder on May 9, 2014. As with the previous 500 foot survey area, most of the area is within the boundaries of the FOP or the Exide-owned Undeveloped Buffer Property. Observations of adjacent properties within the expanded survey areas are noted below:

- The area immediately west of the Site within the 500-foot survey area is developed with a railway, and farther to the west are commercial properties. The railway is owned by the Burlington Northern Santa Fe Railroad.
- The survey area located at the northwest corner of the Exide property is commercial property currently operated by Martin Marietta Materials as a sand and aggregate processing and distribution facility. The direction of surface water flow could not be determined from field observations but is likely to the southwest based on topography. The eastern and southern boundaries of the Martin Marietta property have a surface water diversion berm constructed, that would limit the flow of surface waters between the two properties. The property was observed from the fence line bordering the Exide and Martin Marietta properties.

- The survey area located along the eastern Exide property boundary (crossing Parkwood Boulevard onto the property east of the Exide property) includes several utilities (water, fiber optic, and electrical). Four (4) curb and gutter stormwater drains were observed in the section of roadway within the survey area-.
- Finally, the northern end of the survey area, east of Parkwood Boulevard, contains a parking lot for an adjacent commercial building.
- Potential receptors beyond those previously identified were not observed during the updated receptor survey,

The records survey and supplemental field water well survey identified five potential water wells within approximately 0.5 miles of the Site (Table 2A). The reported locations of the wells are shown on Figure 2C. Mr. Eagan presented the findings of the supplemental water well field survey in a memorandum dated December 18, 2012 (included in Appendix 5). As described therein, the memorandum also included the evaluation of a possible well location that was observed during the field survey. A summary of the findings for the records survey and the water well field survey is provided below:

- Based on State well records, Figure 2C well location No. 1 (TWDB State Well No. 18-50-8C) consists of one domestic well screened from 600 to 620 feet bgs. The reported location of the well is approximately 0.25 miles northwest of the Site, in the vicinity of the intersection of Page Street and John W. Elliot Drive. Well records indicate that the well is owned by Frisco Concrete, which is no longer in operation at this location. Donnie Mayfield, a City of Frisco employee who oversaw the demolition of three home sites located in the vicinity of the reported well location, was interviewed by Mr. Eagan on October 19, 2012. Mr. Mayfield indicated that the Frisco Concrete cement plant was formerly located in the vicinity of the demolished home sites. Lynn Floyd, of Floyd Architectural Millwork at 8734 John W. Elliot Drive, the only current business owner and operator in the vicinity of the reported well, was interviewed by Mr. Eagan on October 22, 2012. Mr. Floyd, who has operated a business at this address for 15 years, indicated that he was not aware of any active wells in the area. Evidence of an active well in the area was not observed during a walking survey performed by Mr. Eagan on October 22, 2012. Based on this evaluation, the well is believed to be destroyed.
- Based on State well records, Figure 2C well location No. 2 is a cluster of four public supply wells (TWDB State Well Nos. 18-50-802, 18-50-803,18-50-804, and Public Water System ID G0430005A) owned by the City of Frisco. Well records indicate that the four wells are completed in the Paluxy and/or Twin Mountains Formations with total depths ranging from approximately 1600 to 2800 feet bgs. The reported wells are located approximately 0.25 miles northeast of the Site, in the vicinity of Elm Street and 7thStreet. Mr. Eagan interviewed Mr. Mayfield of the City of Frisco on October 19, 2012 in regards to the wells. Mr. Mayfield indicated that two of the wells are capped and not currently in use by the City of Frisco, but could be utilized in an emergency. According to Mr. Mayfield, the other two wells have been plugged and abandoned.
- A possible well location was preliminarily identified during the February 2012 receptor survey by PBW and again by Mr. Eagan during the supplemental field water well survey. Specifically, a small concrete structure, possibly associated with a well, was observed at 8661 7th Street, located approximately 0.20 miles northeast of the Site (see Appendix 5).

> The owner of the property, Janet Lovelady, was interviewed over the phone by Mr. Eagan on November 7, 2012. Ms. Lovelady indicated that there is no active well currently located on the property, but that there had been a well on the property in the distant past that was believed to have caved in. As noted previously, the records search did not indicate a well at this location. Based on this evaluation, the observed concrete structure was determined to not be an active well.

There were no active water wells identified in the upper GWBU within 0.5 miles of the Site.

Potential ecological receptors are discussed in the Screening Level Ecological Risk Assessment (SLERA) presented in Section 9.

2.5 Groundwater Resource Classification

An assessment of the groundwater classification for the uppermost GWBU at the Site was completed for the initial FOP APAR dated July 9, 2013 in accordance with the procedures described in TCEQ regulatory guidance document RG-366/TRRP-8 (TCEQ, 2010a). PBW summarized initial groundwater classification assessment activities performed at the Site in a memorandum dated November 29, 2012, in which the uppermost GWBU was classified as a Class 3 groundwater resource. This memorandum was submitted to and discussed with TCEQ and EPA representatives in a meeting on December 7, 2012, and TCEQ concurrence with the Class 3 classification was documented by a TCEQ Interoffice Memorandum that summarized the meeting discussion (TCEQ, 2013d). Based on information obtained subsequent to the November 29, 2012 memorandum, PBW prepared an updated report entitled *Updated Groundwater Resource Classification Evaluation*, which was provided in Appendix 7 of the July 9, 2013 APAR. The updated evaluation also concluded that the uppermost GWBU at the Site is a Class 3 groundwater resource. However, comments provided by the TCEQ and EPA (TCEQ, 2013e; EPA, 2013) on the July 9, 2013 APAR revisited the earlier TCEQ concurrence regarding groundwater classification and questioned whether a Class 3 groundwater designation was appropriate. Although Exide believes a Class 3 groundwater designation is appropriate, Exide as agreed to apply Class 2 criteria for this APAR.

2.6 Exposure Pathways

Based on the Site history and current and anticipated future land use of the Site, the following human health exposure pathways were identified for evaluation in the APAR in accordance with 30 TAC §350.71(c):

- 1) COCs in Class 2 groundwater;
- 2) Combination of:
  - inhalation of volatile emissions and particulates from surface soil containing COCs,
  - dermal contact with COCs in surface soil, and

- ingestion of COCs in surface soil for commercial-industrial workers;
- 3) Leaching of COCs in surface or subsurface soils to groundwater; and
- 4) Contact with surface water or sediment containing COCs originating from a source area (Table 2C).

In addition, shallow fill soils present as base material below paved areas in the former production area and infilled areas of former on-site creek channels could potentially serve as pathways for COC migration to soil, groundwater, and surface water, and thus were identified as pathways for evaluation in this APAR.

Tier 1 PCLs were used to evaluate the potential impacts of the first two exposure pathways, as they are considered complete for the affected property areas, while Tier 1 or Tier 2 PCLs were used to evaluate the third pathway. The fourth pathway is evaluated in Sections 2.6.2 and 2.6.3 to assess whether PCLs are applicable for possible impacts to surface water and sediment in Stewart Creek and the North Tributary from groundwater discharge and/or overland surface runoff. Direct contact with surface water and sediment, also relating to pathway four listed above, was evaluated by comparing Site data to human health and ecological PCLs.

The primary release mechanism at the affected properties was historic releases from former operations and waste units, as well as fugitive dust sources and permitted historical air emissions. The air emissions from the facility could have subsequently settled and deposited on surfaces nearby. The complete exposure pathways associated with potential contact with Site-related COCs include direct exposure to soil, leaching to groundwater, and potential surface runoff into Stewart Creek and the North Tributary.

Since the plant stopped operating at the end of November 2012, continued air emissions and deposition of COCs onto surface soil has ceased other than what may be entrained from surface soils through fugitive dust emissions during windy periods. As noted previously, the inhalation of particulates from surface soil containing COCs was considered a potential exposure pathway. Fugitive dust exposure is considered in the $^{Total}Soil_{Comb}$ PCL; therefore, the $^{Total}Soil_{Comb}$ PCL is protective of this pathway. As noted in Section 1.2.4.4, during the decontamination and demolition activities at the Site, dust suppression measures were implemented to control particulate emissions associated with these activities.

In order to address the potential for fugitive dust emissions from the landfill and existing slag piles, Exide has employed several temporary measures. These have included application of a dust control agent to the landfill (applied November 22, 2013) and the purchase and installation of custom covers to cover two slag piles (installed on November 21, 2013). Subsequent to implementation of these measures, mulching of the landfill and piles was performed (April 15 and 16, 2014 and May 14, 2014). Stockpile cover repair was performed on May 13 and 14, 2014. Exide contractors visit the area on a weekly basis and any issues identified during those visits are addressed as needed.

As stated above, a network of ambient lead monitors currently operates around the Exide Frisco facility. None of the four monitors exceeded the NAAQS of 0.15 ug/m3 based on a 3-month rolling average from the period January 4, 2013 through April 11, 2014. As such, the sampling data collected at the monitoring stations indicated compliance with the NAAQS.

2.6.1 Chemical/Physical Properties Governing Transport of Lead, Antimony, Arsenic, Cadmium, and Selenium

Lead, antimony, arsenic, cadmium, and selenium, like all compounds, have the potential to move within environmental media (e.g., soil) to some degree. The ability for a compound to be transported within a medium or between media is based on the chemical and physical characteristics of the compound(s) and the source medium as well as the receiving medium. Physical characteristics include parameters such as grain size and moisture content for surface soil particles. Chemical characteristics include parameters such as soil/water distribution coefficients, adsorption potential, and degradation characteristics for potential contaminants. These chemical characteristics are specific to each chemical present, and may be affected by the physical characteristics of the media in which the chemical is present. In surface water, physical and chemical characteristics are both important because transport may occur in solution or in association with suspended sediment. Dissolved-phase transport is the dominant contaminant migration mechanism in groundwater; therefore, chemical characteristics are often important with respect to that medium as well.

Lead, antimony, arsenic, cadmium, and selenium generally tend to remain bound to organic matter, minerals, clays, and silts in soil and, as such, they are relatively immobile. If present in the dissolved phase, these metals can migrate in groundwater, although that migration can be significantly attenuated through sorption to the groundwater matrix, particularly in clay-rich soils such as those that comprise the uppermost GWBU at the Site.

2.6.2 Transport of COCs in Surface Soil Via Surface Runoff

The potential for soil releases to surface water and sediment via runoff was evaluated per TRRP regulatory guidance document RG-366/TRRP-24 (TCEQ, 2007). Section 7.4 of TRRP-24 describes the general approach for characterizing dissolved and particulate COC releases to surface water and sediment from erodible soils and the development of PCLs for this pathway. If PCLs are necessary, they only apply to the area and thickness of soils likely to be eroded based on a property-specific evaluation. To determine if this pathway is complete, TRRP-24 indicates that the following factors can be used to determine whether the transport of affected soil and COCs is relevant:

- Proximity of surface waters;

- Extent of exposed or erodible soils;
- Extent of erodible impacts;
- Transport or erosion potential based on soil types, compaction, vegetation density, and slope; and
- Presence of metals and/or persistent bioaccumulative organic COCs in soil.

Overland surface runoff from surface soil to Stewart Creek and the North Tributary has the potential to result in the transport of slag, battery case fragments, and COCs bound to soil particles to these surface water bodies during/after rainfall events. Overland flow during runoff events would be expected to occur in the direction of topographic slope and would more likely occur with significant rainfall events when soils are fully saturated and/or precipitation rates are greater than infiltration rates. The possibility of a reduced vegetative cover during drought conditions could allow for increased run-off relative runoff during more normal weather periods.

W&M (2011a) identified slag within and along the banks of the western reach of Stewart Creek on-site during a survey of this area in 2011 (W&M, 2011a). A summary report for this survey event is provided in Appendix 18. It is documented that the facility historically used slag as an erosion control material in the creek. All slag in the creek that could be found was removed when the creek sediments were remediated. The slag that is now visible is believed to be remnants that were missed during the remediation and that has been exposed through erosion. As noted previously, all areas where slag or battery case fragments were observed outside of the designated on-site disposal areas (i.e., the North Disposal Area, South Disposal Area, Slag Landfill, and Class 2 Landfill), including within and along the banks of the western reach of Stewart Creek on-site, have been included within the PCL exceedance (PCLE) zone.

There is limited physical evidence of erodible impacts other than the slag observed within Stewart Creek noted above. Other areas where erodible impacts were observed include a small area of wash-out on the south side of the railroad spur on the western-most portion of the former production area and areas of preferential surface water flow in the South Wooded Area, which are stabilized by natural vegetation. The majority of the Site where runoff is not controlled by the storm water collection system (discussed in detail in Section 1.2.1) is vegetated. The soils at the Site are predominantly clay, and clay soils generally have a relatively low erosive potential. Furthermore, an extensive erosion control system (rock gabion system) is currently in place along Stewart Creek in the vicinity of the former production area that appears to be effective based on the low concentrations of COCs detected in sediment samples in this area.

Dissolved lead, antimony, arsenic, cadmium, and selenium associated with surface runoff from the Site are expected to be generally low due to the relatively low solubilities of these metals. These metals will preferentially partition to organic matter in soil and sediment. Once bound to organic matter, these metals

may migrate as part of the sediment matrix, if sediment is suspended during storm events. The relatively low measured concentrations of COCs in the on-site and off-Site sediment samples collected from Stewart Creek and North Tributary during the SIR and APAR investigations support that there is little evidence that overland erosion and transport of soil COCs is a significant migration pathway. Based on the evaluation of TRRP-24 factors described herein, PCLs were not developed for Site surface soil to evaluate this pathway. It should be noted, however, that potential impacts to human and ecological receptors potentially contacting COCs in surface water and sediment are evaluated in this APAR (see Sections 6, 7, and 9).

2.6.3 Transport of COCs in Groundwater to Surface Water and Sediments

Leaching and infiltration of COCs from surface and subsurface soils into groundwater may occur; however, groundwater data from the Site suggest that none of the COCs has leached from soils to the uppermost GWBU to an appreciable extent. Based on the groundwater potentiometric surface maps presented as Figures 5A.1 through 5A.4, Stewart Creek and the North Tributary appear to be gaining streams, but none of the Site data suggest that impacted groundwater is or has discharged to surface water.

The transport of constituents in groundwater is typically characterized as a mass balance governed by the partitioning of each constituent between the mobile aqueous phase and the immobile solid phase. It should be noted, however, that the transport of inorganic colloids, generally defined as particulate matter with an upper size limit of 10 microns (EPA, 1989), through sand and gravel-type aquifers may be significant under certain hydrogeologic conditions. As detailed in Section 3.3, particulates in the colloid-sized fraction (< 10 microns) were not filtered from groundwater or surface water samples analyzed for total constituents (as opposed to dissolved-phase constituents) during the SIR or APAR investigations. Therefore, the groundwater and surface water assessments performed during the SIR and APAR investigations include an evaluation of potential COCs adsorbed onto colloidal particulates in surface water and groundwater.

Groundwater data from Site wells nearest Stewart Creek and the North Tributary were evaluated by assuming they represent groundwater discharge to surface water in these creeks per 30 TAC §350.37(i) and 30 TAC §350.51(f). None of the groundwater samples collected during the SIR and first phase of the APAR investigations at wells that would be considered potential groundwater to surface water Point of Exposure (POE) wells (MW-B5N, MW-B7N, MW-9N, MW-11, MW-12, MW-13, MW-14, MW-16S, MW-17, MW-21, MW-22, MW-24, MW-26, MW-27, and MW-29) contained COC concentrations that exceeded the applicable groundwater to surface water PCL (^{SW}GW) ambient water quality criteria for these constituents (Table 5B.1).

Additional groundwater samples were collected in 2014from the existing POE wells MW-11, MW-14, MW-16S, MW-17, MW-26, MW-27, and MW-29; and MW-16 to aid in development of applicable groundwater to surface water PCLs.

New wells were installed in the Upper GWBU, including new groundwater to surface water POE wells (MW-37, MW-38, MW-44, and MW-46) along Stewart Creek; wells to provide further data for the Slag Landfill (MW-39 and MW-40); wells to provide further data near the North Tributary (MW-41 and MW-42). None of the samples from these wells contained COC concentrations that exceeded the applicable groundwater –PCLs, with the exception of the initial groundwater sample collected from MW-46, which exceeded the applicable groundwater PCLs for lead and cadmium. Confirmation groundwater samples collected from MW-46 during two subsequent sampling events all contained lead and cadmium concentrations below applicable groundwater PCLs -

In addition to the groundwater monitoring wells, five wells were installed to investigate potential perched water above the uppermost GWBU in the former production area (MW-32, MW-33, MW-34, MW-35, and MW-36).

Cadmium and lead measured in surface water and sediment samples (Tables 6B.1/6B.2 and 7B.1/7B.2, respectively) were below surface water ambient water quality criteria and sediment PCLs in most locations. Arsenic measured in sediment exceeded sediment PCLs in several locations, but is believed to be attributable to other anthropogenic sources (i.e. runoff from cotton farming operations within the Stewart Creek watershed) based on historical agricultural use of the area. Measured arsenic surface water concentrations did not exceed ambient water quality criteria. Consistent with TRRP-24 guidance, a ^{GW}Sed PCL was not developed for this pathway since it is not likely to be complete. This evaluation suggests that the groundwater to surface water and groundwater to sediment pathways are incomplete or insignificant exposure pathways. The potential impact of groundwater to surface water is also discussed in the Groundwater Assessment section of this APAR (Section 5).

Additionally, to evaluate whether variable levels of sulfate detected in groundwater monitoring wells have the potential to impact surface water quality, a generalized mass balance calculation for sulfate was performed and is discussed in Section 5.2. The evaluation further supports the conclusion of limited contaminant transport from groundwater to surface water.

Table 2A
Water Well Summary

Well ID on Figure 2C	Source Well ID	Owner of Record	Approximate Distance from Site (miles)	Screened Interval (feet bgs)	Casing Interval (feet bgs)	Cemented Interval (feet bgs)	Surface Completion Type	Total Depth (feet bgs)	Completion Date	Producing Formation	Current Water Use	Current Status	Data Source
1	18-50-8C	Frisco Concrete	0.25	600-620	0-600	--	--	620	2/14/1980	Woodbine	NA	Destroyed	TWDB, field survey and interviews
2	18-50-802	City of Frisco	0.25	1440-1632	0-1440	--	--	1632	1/1/1940	Paluxy	Unused	inactive (possibly plugged and abandoned)[1]	TWDB, interview with City employee
2	18-50-803	City of Frisco	0.25	1440-2796	0-1440	0-1440	--	2796	3/22/1950	Paluxy and Twin Mountains	Unused	inactive (possibly plugged and abandoned)[1]	TWDB, interview with City employee
2	18-50-804	City of Frisco	0.25	--	--	--	--	1680	1/1/1924	Paluxy	Unused	Plugged and abandoned	TWDB, interview with City employee
2	G0430005A	City of Frisco	0.25	--	--	--	--	2796	3/22/1950	Paluxy and/or Twin Mountains	Unused	inactive (possibly plugged and abandoned)[1]	TCEQ, interview with City employee

NOTES

1. [1] - Donny Mayfield, City of Frisco employee, indicated that two of the four City of Frisco-owned wells have been plugged and abandoned and that the remaining two wells are capped and unused (see Section 2.4 for additional details).
2. "--" - information not available.
3. NA - not applicable.
4. bgs - below ground surface.
5. TWDB - Texas Water Development Board.

Table 2C

Complete or Reasonably Anticipated to be Complete Exposure Pathways

Exposure Pathway	Surface Soil[1]	Subsurface Soil[2]	Groundwater	Surface Water / Sediment
${}^{Tot}Soil_{Comb}$ [3]	X	NA	NA	NA
${}^{Air}Soil_{Inh\text{-}V}$	NA	X		
${}^{GW}Soil_{Ing}$ or ${}^{GW}Soil_{Class3}$	X	X		
${}^{GW}GW_{Ing}$ or ${}^{GW}GW_{Class3}$	NA	NA	X	
${}^{Air}GW_{Inh\text{-}V}$			X	
${}^{SW}GW$			X*	
${}^{Sed}GW$				
${}^{SW}SW$ or ${}^{Sed}Sed$			NA	X
Other (specify)				

Notes:

1. [1] Residential: soils from 0-15 feet deep, or to bedrock or groundwater-bearing unit if shallower. Commercial/industrial: soils from 0-5 feet deep, or to bedrock or groundwater-bearing unit if shallower.
2. [2] The vadose zone beneath the surface soil extending to the groundwater-bearing unit, and including unsaturated zones between stratified groundwater-bearing units.
3. [3] Residential: ${}^{Air}Soil_{Inh\text{-}VP} + {}^{Soil}Soil_{Ing} + {}^{Soil}Soil_{Derm} + {}^{Veg}Soil_{Ing}$
   Commercial/industrial: ${}^{Air}Soil_{Inh\text{-}VP} + {}^{Soil}Soil_{Ing} + {}^{Soil}Soil_{Derm}$
4. **X** - complete or reasonably complete exposure pathway.
5. * - The ${}^{SW}GW$ exposure pathway only applies in areas where there is a potential point of discharge of groundwater to surface water (i.e., in the near vicinity of Stewart Creek or the North Tributary).
6. NA - Not applicable.

EXPLANATION

- On-Site Property Boundary
- FRC Property Boundary
- Former Path of North Tributary (1951 Aerial Photo)
- Former Path of North Tributary (1972 Aerial Photo)
- Former Path of Stewart Creek (1951 Aerial Photo)
- Monitoring Well Location
- Critical PCL Exceedance Zone (PCLE Zone)
- J-Parcel PCL Exceedance Zone (PCLE Zone)
- Flood Wall Location
- Surface Drainage Direction
- Approximate 500-Foot Radius of Affected Property

Note:
1. Original figure prepared by PBW as part of the APAR dated July 9, 2013. Modified by Golder in May 2014.

N

Scale in Feet
0 80 160

Source of photo:
Imagery from NCTCOG, 2009 photography.

FORMER OPERATING PLANT
FRISCO RECYCLING CENTER
FRISCO, TEXAS

FIGURE 2A

POTENTIAL RECEPTORS MAP

PROJECT: 13-02086	BY: BCL	REVISIONS
DATE: MARCH, 2014	CHECKED: JWT	

GOLDER ASSOCIATES, INC.

Photo 1 At apartment complex on E. Hickory, west of Preston Rd. looking toward North Tributary. This landscaping feature drains into Stewart Creek.

Photo 2 Looking upstream at North Tributary from bridge at apartment complex on E. Hickory St. Irrigation system is visible (associated with apartment complex landscaping).

Photo 3 Looking downstream at North Tributary from bridge at apartment complex on E. Hickory St. Stream bed is paved until it reaches Oak Creek Park.

Photo 4 North Tributary of Stewart Creek at Oak Creek Park at E. Hickory St. and Woodstream Drive.

Photo 5 Standing on bridge on Woodstream Dr. looking downstream at the North Tributary.

Photo 6 Looking downstream at the North Tributary in Oak Creek Park.

Photo 7 Looking downstream at the North Tributary in Oak Creek Park.

Photo 8 On-site on bridge on Eagan Dr. looking upstream at Stewart Creek.

Photo 9 On-site on bridge on Eagan Dr. looking downstream at Stewart Creek as it enters the Site.

Photo 10. Standing on Eagan Dr. just south of Crystallizer Rd. Way looking at dense shrubs and trees.

Photo 11 Standing on Crystallizer Rd. Way southeast of South Disposal Area, view looking south.

Photo 12 Standing on Crystallizer Rd. Way looking south toward the South Disposal Area.

Photo 13 Standing on Crystallizer Rd. Way looking southwest. The former Shooting Range Berm is visible in the background.

Photo 14 Stewart Creek adjacent to former production area at Site.

Photo 15 Standing near the western side of the hayfield on the Lake Parcel, looking toward the storm water retention pond.

Photo 16 Looking upstream of the North Tributary of Stewart Creek on-site on the road leading from the FRC plant to the Class 2 Landfill.

Photo 17 Looking downstream at the relocated North Tributary on-site on the road leading from the FRC plant to the Class 2 Landfill.

Site Visit Forms:

GENERAL RECEPTOR SURVEY SITE VISIT

Date: February 22, 2012

Project No: 1732

Project Name: Exide Frisco Facility located at 7471 S. Fifth St. Frisco, TX Collin County

Page 1 of: 2

Site Visit by Kirby Tyndall and Eric Pastor

Arrival Time: about 9:30 am

Weather (@ arrival): 70 degrees, partial cloud cover, 7 mph SSE

Weather (past 48 hrs.) mild, no precipitation

General Survey Location (i.d., description) Secondary Lead Smelter, Lead Metal Recycling

Air Temperature @ arrival:

Departure Time: 2:30 pm

Is Access to the Site restricted? Yes

If so, how (eg., fencing, security, etc.): fencing, security, active operations

GENERAL SITE INFORMATION

Current Site Conditions and Operations and general notes:

Approximate Site Area: approx. 87 acres

Operating facility with health and safety program in place. Runoff from operating area contained and treated per SWPPP. Little evidence of overland flow from areas outside of SWPPP control.

Land Use On Site:

% Urban:
% Rural:
% Residential:
% Industrial: 75% Heavy Industrial
% Ag (describe crops): 10% hayfield (crop not sold)
% Recreational (describe):
% Undisturbed: 15% overgrowth of trees
% Other:

Latitude: 40.5389

Land Use within 1 mile of Site:

% Urban: 30%
% Rural:
% Residential: 40%
% Industrial: 20%
% Ag (describe crops):
% Recreational (describe): ~5%
% Undisturbed: ~5%
% Other:

Longitude: -90.2637

LAND USE WITHIN 500 FEET OF THE FACILITY

Primarily commercial/industrial land use.

LAND USE WITHIN 1,000 FEET OF THE FACILITY

Primarily industrial and commercial land use although there are some residential areas within 1000 feet to the north of the facility.

EVIDENCE OF WATER WELLS IN AREA

Possible well in backyard of house near Ash and 7th.

SENSITIVE RECEPTORS IN AREA

Community Garden at First Street Park due north of the facility.

Grand Park is roughly 2400 ft southwest of the facility.

Frisco Child Development Center with a playground is within 1000 feet of the facility, to the northeast.

There are several neighborhood parks to the north and east of the facility at distances greater than 1000 feet from the facility.

A pre-school is approximately 1500 feet to the southeast of the facility.

SURFACE WATER IN THE AREA

Upstream of the facility in Stewart Creek and the North Tributary, the streams run through neighborhoods and appear to be fed by runoff and residential irrigation.

On-site, Stewart Creek and the North Tributary converge, and then exit the property. Stewart Creek runs mostly through undeveloped land until it discharges into Lake Lewisville.

ADDITIONAL INFORMATION

See attached notes on area figure collected during the Site visit.

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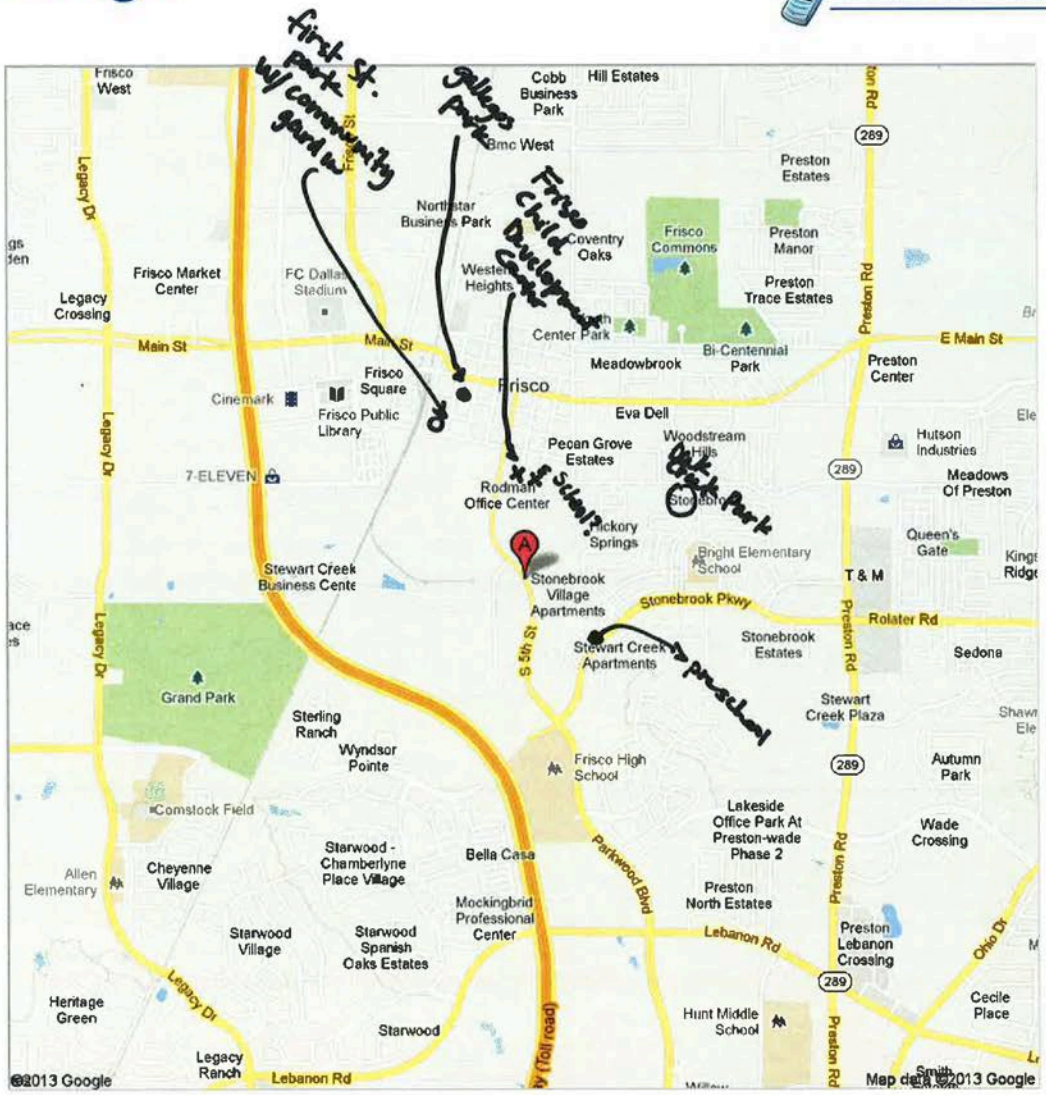
ROUND ROCK, TEXAS 78664
(512) 671-3434
FAX: (512) 671-3446

7471 S 5th St, Frisco, TX - Google Maps

Google

Address **7471 S 5th St**
Frisco, TX 75034

Get Google Maps on your phone
Text the word "GMAPS" to 466453



ECOLOGICAL SURVEY SITE VISIT

Date: October 22, 2012

Project No: 1755 Project Name: Exide Frisco Facility located at 7471 S. Fifth St. Frisco, TX Collin County Page 1 of 1

Site Visit by: Kirby Tyndall and Margaret Roy Arrival Time: about 9:00 am

Weather (@ arrival): 75 degrees, partial cloud cover Weather (past 48 hrs.): mild, no precipitation

General Survey Location (i.d., description) Secondary Lead Smelter, Lead Metal Recycling

Air Temperature @ arrival: Departure Time: 2:00 pm

Is Access to the Site restricted? Yes If so, how (eg., fencing, security, etc.): fencing, security, active operations

GENERAL SITE INFORMATION

Current Site Conditions and Operations (describe): Approximate Site Area: approx. 87 acres

Operating facility with health and safety program in place. Runoff from operating area contained and treated per SWPPP. Little evidence of overland flow from areas outside of SWPPP control.

Land Use On Site:

% Urban:
% Rural:
% Residential:
% Industrial: 75% Heavy Industrial
% Ag (describe crops): 10% hayfield (crop not sold)
% Recreational (describe):
% Undisturbed: 15% overgrowth of trees
% Other:

Land Use within 1 mile of Site:

% Urban: 30%
% Rural:
% Residential: 40%
% Industrial: 20%
% Ag (describe crops):
% Recreational (describe): ~5%
% Undisturbed: ~5%
% Other:

Latitude: 40.5389 **Longitude:** -90.2637

UPLAND/TERRESTRIAL HABITAT

Estimate the percentage of the site's surface that is Eco Habitat – approximately 25%
Of the estimated percentage that is Eco Habitat, what percentage is wooded? 15% Shrub/Scrub? Open Field? 10% (hayfield) Misc.?

Estimate the percentage of the site's surface that is: Exposed soil – less than 1%
Covered by pavement – ~5%
Covered by buildings/slab (capped landfills included) – ~ 60%
Covered by water (surface water impoundments included) – ~ 5%
Covered by vegetation – ~30

Described the predominant type and size of vegetation in the area of potential Eco Habitat, and how dense the vegetation is: there are two areas of dense overgrown trees and one open/cultivated hay field.

SURFACE WATER HABITAT

Is there open-water flowing or non-flowing aquatic system present at the Site? yes Please describe: intermittent stream

If known, what is the name of the waterbody(ies) on or adjacent to the site? Stewart Creek and North Tributary What are its known uses? Part of the City's Municipal Stormwater permit

What is the approximate size of the waterbody(ies) in acres? What is average depth of the water? Varies

Is any aquatic vegetation present? No If yes, please describe as emergent, submergent or floating:

What is the source of the water in the waterbody? Upstream residential irrigation and storm runoff

Where does the waterbody discharge and indicate where the discharge occurs (onsite vs off; and distance)? Lake Lewisville, approx. 6 miles away

What is the general composition of the substrate? Bedrock with some boulders, cobble, and gravel present.

What is the condition of the bank? On-site the creek is channelized with a slight slope and maintained

ADDITIONAL INFORMATION

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FAX: (512) 671-3446

Figure 2B.2 2014 Field Survey Photographs

PHOTO 1 – WEST AREA Looking west from Exide property across railroad tracks along west property boundary.	
PHOTO 2 – WEST AREA Looking west from Exide property across railroad tracks along west property boundary.	

PHOTO 3 – NORTHWEST AREA View of Martin Marietta property looking north-northwest from Exide fence line.	
PHOTO 4 – NORTHWEST AREA View of Martin Marietta property looking east from Exide fence line.	

PHOTO 5 – NORTHWEST AREA View of Martin Marietta property looking southwest from Exide property. View of fueling station.	
PHOTO 6 – NORTHWEST AREA View of Martin Marietta property looking west from Exide property. View of scale house/office.	

PHOTO 7 – EAST AREA View of Parkwood Boulevard looking north from north side of Exide entrance.	
PHOTO 8 – EAST AREA View of Parkwood Boulevard looking northeast towards commercial property from west side of Parkwood Boulevard.	

PHOTO 9 – EAST AREA Air monitoring station east of Parkwood Boulevard. Note electric service meter on far fence.	
PHOTO 10 - EAST AREA Below grade utility (possibly water or fiber optic cable). Located on west side of Parkwood Boulevard.	

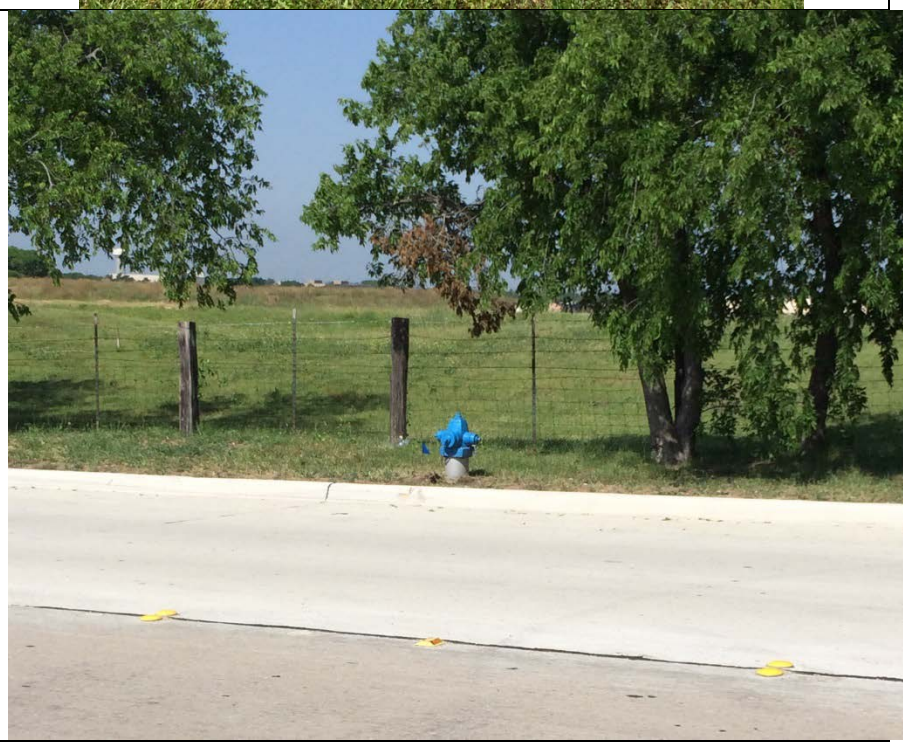
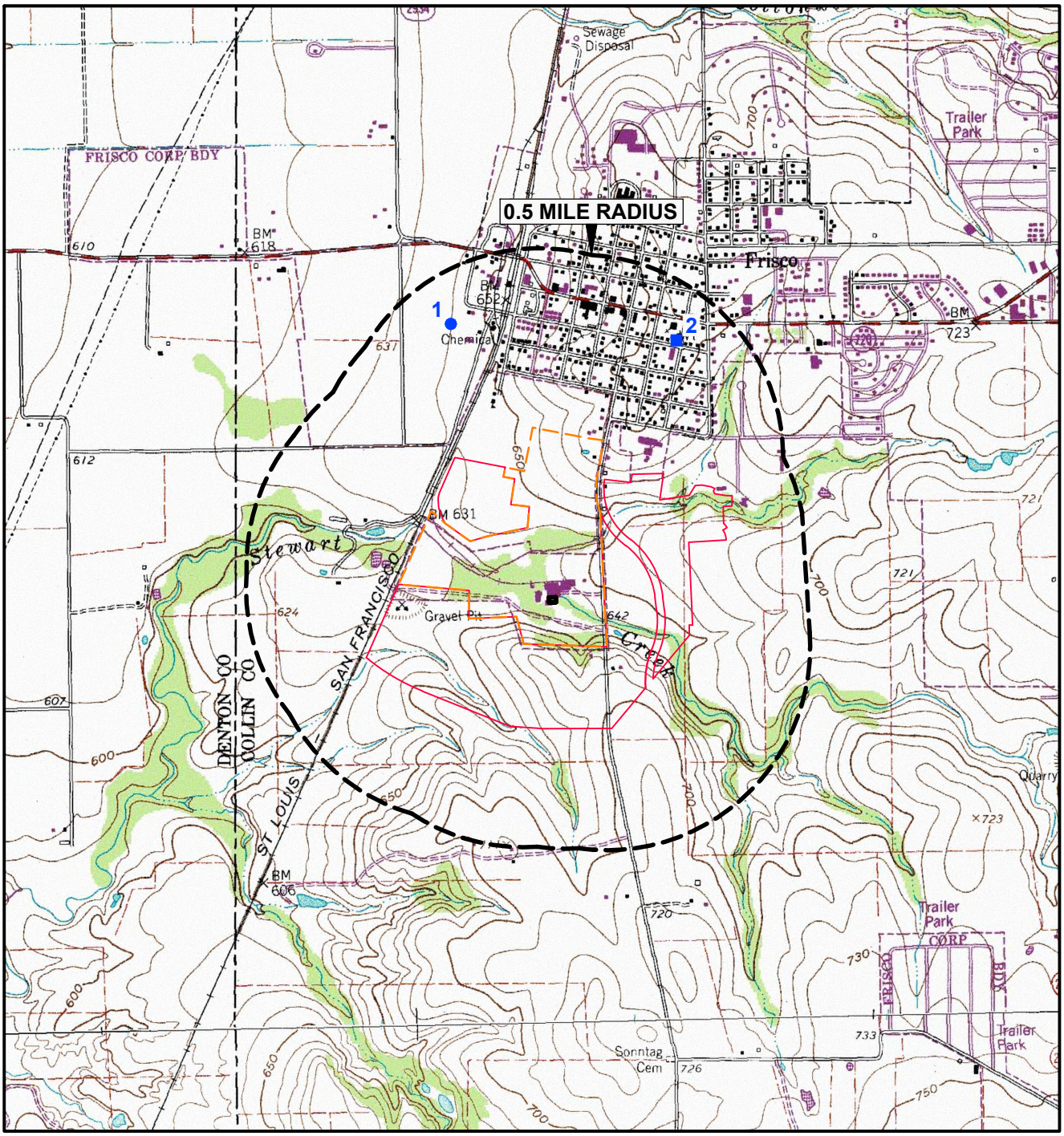
PHOTO 11 – EAST AREA Below grade utility (assumed fiber optic cable). Located on east side of Parkwood Boulevard.	
PHOTO 12 – EAST AREA Fire hydrant located on west side of Parkwood Boulevard, west of commercial property.	

PHOTO 13 – ADJACENT TO STEWART CREEK School observed near northern portion of Bert Fields properties from Stewart Creek.	
PHOTO 14 – ADJACENT TO STEWART CREEK Residential area observed near northern portion of Bert Fields properties from Stewart Creek.	

PHOTO 15 – ADJACENT TO STEWART CREEK Typical wooded areas observed along Stewart Creek (south of Bert Fields properties).	
PHOTO 16 – ADJACENT TO STEWART CREEK Stonebrook Parkway extension (view east-northeast from Stewart Creek).	



EXPLANATION

- Water Well (Destroyed or Plugged and Abandoned)
- Water Well Cluster (Unused or Plugged and Abandoned)
- On-Site Property Boundary
- FRC Property Boundary

N

Scale in Feet

0 1000 2000

SOURCE:
Base map from www.tnris.org, Frisco, TX 7.5 min. USGS quadrangle dated 1995.

FORMER OPERATING PLANT
FRISCO RECYCLING CENTER
FRISCO, TEXAS

Figure 2C

WATER WELL MAP

PROJECT: 1755	BY: AJD	REVISIONS
DATE: JUNE, 2013	CHECKED: EFP	

PASTOR, BEHLING & WHEELER, LLC
CONSULTING ENGINEERS AND SCIENTISTS

3.0 ASSESSMENT STRATEGY

As detailed below, the initial assessment strategy was described in the EPA-approved Work Plan (CRA, 2011). Subsequent steps involved a review of all previous Site investigations and identification of data gaps or uncompleted agency recommendations on these investigations (including EPA comments on the SIR). Data gaps, including data gaps identified by the TCEQ were discussed in a series of three meetings with EPA and the TCEQ representatives in February 2013 to refine the assessment approach used for this APAR. Additional data gaps identified through TCEQ and EPA comments on the initial APAR (PBW, 2013c) and subsequent discussions further refined the investigation approach described herein.

3.1 General Assessment Issues

3.1.1 Environmental Media Assessed

The environmental media assessed during the SIR and APAR investigations included all media associated with the potentially complete exposure pathways identified for the Site, which are discussed in detail in Section 2.6 and are presented in the table below:

Potentially Complete Exposure Pathway	Environmental Media Assessed
${}^{Tot}Soil_{Comb}$	Surface Soil
${}^{GW}Soil_{Ing}$	Surface Soil; Subsurface Soil
${}^{Air}Soil_{Inh}$	Surface Soil (included in ${}^{Tot}Soil_{Comb}$ assessment); Subsurface Soil
${}^{GW}GW_{Ing}$	Groundwater
${}^{Air}GW_{Inh\text{-}V}$	Groundwater
${}^{SW}GW$	Groundwater
${}^{Sed}Sed$	Sediment
${}^{SW}SW$	Surface Water

3.1.2 Target COCs

COCs are defined by TRRP Rule §350.4(a)(11) as “any chemical that has the potential to adversely affect ecological or human receptors due to its concentration, distribution, and mode of toxicity.” Target COCs are defined by TCEQ in RG-366/TRRP-10 (TCEQ, 2008) as those COCs that are known or are reasonably anticipated to be associated with historical or current activities for a specific project and are the focus of the investigation. TRRP allows the use of several approaches to identify target COCs for an investigation. These include using a permit, order, or program requirements to assist in focusing the list

of target COCs, while evaluating project objectives, using professional judgment, and using previously collected analytical data. TRRP-10 provides an eight step process to follow when identifying target COCs during project planning of an environmental investigation, which are described below in relation to the Site.

3.1.2.1 Step 1 – Evaluate Permit, Order, or Program Requirements

The first step identified in TRRP-10 for selecting target COCs begins with 1) Evaluation of permits, orders, or program requirements. This section describes the evaluation of previous administrative records and program requirements for the Site.

The initial RCRA Permit issued by the TWC for the FRC (RCRA Permit 50206) required investigation for nine WMUs at the Site. The permit specifies in Sections VII and VIII that lead and cadmium are to be analyzed in waste materials, soil, and groundwater at these WMUs.

The Phase I RFI Report (Lake, 1991), and the Addendum to the Phase I RFI Report (Lake, 1993) identified lead as the primary COC at the Site, and soil as the primary environmental media of concern. The reports also identified cadmium as being present in Site soils. The TNRCC approved the Phase I RFI Report and Addendum in correspondence dated June 3, 1994, and requested a Phase II RFI of selected areas of the Site, and specifically limited the COCs to lead and cadmium.

Since institution of the RFI process, numerous correspondences and approvals for various investigations conducted under different TNRCC/TCEQ programs have been conducted for the Site, most of which specified lead and cadmium as the primary COCs. In specific instances when information was available to suggest that a potential release may have occurred or a specific operation/activity had taken place, such as following the discovery of a release from the Former Diesel Tank, additional COCs were analyzed for that area.

In 2011, the Work Plan was submitted to the EPA in response to Section VI of the Administrative Order issued to Exide by the EPA. The Work Plan, which was approved by the EPA on December 2, 2011, identified lead and cadmium as the primary COCs to be evaluated in soil, groundwater, surface water, and sediment samples.

In APAR scoping discussions with Exide in February 2013, the TCEQ noted that, although lead and cadmium are the presumptive COCs, “a complete historical review should be conducted of all products, waste management activities, and past COC occurrences and investigations, such as arsenic and selenium as measured in a landfill leachate sample by a 2009 EPA investigation, PST removals and final closure documentation, spills around the above ground diesel tank, corrosive liquids from battery acid at

Battery Breaking area, herbicides, pesticide storage etc. and justification as to why/why not these constituents are being screened according to TRRP-10 and TRRP-14" (TCEQ, 2013d). In response to this request, Exide prepared and reviewed with TCEQ a detailed screening table evaluating each of these requested factors on February 15, 2013. An updated version of that table is provided as Table 3B.

The following analytes were identified as additional COCs at the specific areas listed below where they were associated with a potential release or a specific operation/activity that had taken place in those specific areas:

- Class 2 Landfill – As detailed in Section 5 of the APAR, arsenic and selenium were added as COCs for groundwater in the Class 2 landfill area to evaluate the potential for a release of leachate containing these metals to groundwater. Soil samples from PMW-19R and LMW-22 were additionally analyzed for arsenic to evaluate potential aerial deposition of arsenic in this area. Arsenic and selenium analyses were performed on soil samples collected on the landfill perimeter in response to TCEQ comments on the July 9, 2013 APAR submittal. During the 2014 investigations, samples were initially collected at 11 locations around the perimeter of the Class 2 Landfill. Samples from the 0.0 to 0.5-foot intervals were analyzed for lead, cadmium, arsenic, and selenium; and also for antimony in three locations. Deeper samples were held for analysis should shallow sample results exceed RALs. Additional samples were collected of the shale at the three locations north of the Class 2 Landfill. Shale samples from two of these locations were analyzed for all five metals. Based on the results of the shallow samples at 2013-C2L-01 and 2013-C2LF-06, three additional samples were collected to further delineate near each of two of the sample locations. A groundwater monitoring well (MW-45) was installed near the north property boundary, north of the northwest corner of the Class 2 Landfill. Groundwater was sampled for total and dissolved arsenic, cadmium, lead, and selenium in separate events.

- Underground Storage Tank and Diesel Fuel Spill Area – Groundwater samples collected downgradient of the former diesel tank release area were additionally analyzed for total petroleum hydrocarbons (TPH) and polycyclic aromatic hydrocarbons (PAHs). Soil samples collected along the Stewart Creek floodwall (creek side and facility side) during 2012 were analyzed for TPH. In addition, soil samples between the Stewart Creek floodwall and Stewart Creek were analyzed for PAHs in soil samples collected in this area in January 2013. Soil samples collected in March-April 2013 from inside and adjacent to the Slag Treatment Building, located on the west side of the former spill area, were also analyzed for TPH and volatile organic compounds (VOCs). An additional boring was sampled in this area in 2013. Samples from the 0.5 to 5-, 10 to 12-, and 14 to 16-foot bgs intervals were analyzed for lead and cadmium, and samples from the 0.5 to 5- and 10 to 12-foot bgs intervals were also analyzed for VOCs, SVOCs, and TPH.

- Battery Breaking Area – Breaking of lead-acid batteries resulted in the presence of dilute sulfuric acid in this area. Soil samples collected near the locations of the sump in this area where battery breaking occurred were analyzed for pH.

- Vehicle Maintenance Building – Annual waste activity reports declared shipments of Safety-Kleen parts cleaner off-site. Discussions with Exide personnel indicated that

these parts cleaners were used in the vehicle maintenance building. Soil samples collected within the vehicle maintenance building were analyzed for VOCs to evaluate the potential presence of chlorinated solvents.

- Raw Materials Storage Building (RMSB) – Consistent with RCRA Permit requirements for this permitted unit, Exide reviewed and discussed with TCEQ the Permit requirements related to closure of the this unit (Permit Provision VII.D), which included analyses for "representative constituents identified in 40 CFR Part 261, Appendix VIII which would reasonably be expected to be present in the waste." Fifty-two soil samples (including duplicate samples) were collected from the Raw Material Storage Building ("RMSB" samples) or adjacent Raw Materials Storage Area ("RMSA" samples) during the SIR and APAR investigations, including forty soil samples (including duplicate samples) from ten borings completed inside the Raw Material Storage Building. Based on closure requirements in the RCRA Permit, discussions with TCEQ personnel, and procedures detailed in the Final (January 25, 2013) Decontamination and Demolition Work Plan, all soil samples collected from the Raw Material Storage Building were analyzed for arsenic, cadmium, lead and selenium, and all samples collected at three of the boring locations were analyzed for a broader suite of compounds, including RCRA 8 metals, VOCs, and SVOCs. Concentrations of TPH, VOCs, SVOCs, and all RCRA metals except for arsenic, cadmium, lead, and selenium were below their respective residential assessment levels (RALs) in all of the soil samples collected from inside and in the immediate vicinity of the RMSB, which included samples with lead concentrations as high as 10,200 mg/kg (Section 4.2.2, Tables 4D.2A, 4D.3A and 4D.4A), .

- Crystallization Unit Frac Tank – Based on analytical results of boil out water from the crystallizer, the EPA requested additional analytical parameters to be added to this area. Two soil samples were collected from this area during the SIR investigation and analyzed for antimony, arsenic, barium, beryllium, cadmium, chromium, lead, nickel, selenium, silver, zinc, and select geochemical parameters (pH and sulfate). All sample concentrations were below their respective RALs. During a site visit conducted by TCEQ Region 4 in June 2013, two 55-gallon drums labeled as containing PCBs were noted in the Crystallization Unit area by the TCEQ inspector (see Photo 20 in Appendix 13). Exide did not use PCBs as part of the secondary lead smelting process or associated operations. Exide representatives familiar with the drums indicated that the drums contained PCB light ballasts. The drums were moved from the former production area by Exide during decontamination and demolition activities in 2013 and were temporarily stored on the concrete slab near the Crystallization Unit. The drums were later moved back to the main facility before being disposed off-site. Although indications of a release, such as staining, were not observed on the concrete where the drums had been temporarily stored, a soil boring was completed in 2014 at the approximate former location of the drums (2013-CUFT-14) and was also analyzed for PCBs (PCBs were not detected).

- City of Frisco Firefighter Training Facility – Based on discussions with the City of Frisco (as discussed above), historic activities in this area included the use of diesel and propane (as accelerants) and Class "A" and "B" foams. VOCs, SVOCs, TPH, Perfluorinated compounds (PFCs), and metals were added as COCs at several locations near this area in the 2014 APAR investigation.

- Former Burn Pile Area – Based on information provided by Mr. Larry Eagan (as discussed above), a burn pile area associated with the Firefighter Training Facility was formerly located approximately 200 feet west-northwest of the Firefighter Training Facility. VOCs, SVOCs, and metals were added as COCs at several locations near this area in the 2014 APAR investigation.

In addition to further evaluation of the above areas, Exide also reviewed historical herbicide and pesticide usage with a long-term facility employee who was familiar with that information. As indicated in Table 3B, Mr. Wendell Carlile indicated that only minor amounts of weed killer, such as Round Up, were used by a landscaping contractor in landscaped areas around the office building and the employee parking lot. Mr. Carlile also indicated that only small amounts of wasp killer were used when needed for wasp control. Based on the reported limited use of herbicides and pesticides at the Site and consistent with TRRP-10 guidance, herbicides and pesticides were not considered site COCs.

3.1.2.2 Step 2 – Evaluate Project Objectives

The project objectives, over the approximate 30 years of numerous investigations and remediation projects conducted at the Site, have been primarily to identify the nature and extent of Site-related impacts to environmental media and remediate to appropriate standards that are protective of human health and the environment. Most recently, the project objective identified in the 2011 Work Plan was to define the nature and extent of contamination at the identified WMUs and several non-RFI areas. Additional samples were also collected to meet delineation requirements of TRRP and to provide data to support the SLERA for the areas that might provide ecological habitat.

3.1.2.3 Step 3 – Collect Information That Will Help Determine the Target COC List

The target COC list can be developed based on current and historical operations, chemical release information, knowledge of chemical processes and activities, applicable industry specific lists, information from similar sites, or nearby potential sources, chemical information, and analytical data. Historical operations were reviewed for potential chemicals that may have been used and/or released at the Site. Secondary lead smelting at a battery recycling plant is a fairly simple metallurgical process with few feed stocks, very little chemical use, and a fairly well-defined waste stream. As shown in a feed summary table for 2011, the last full year of operation (Appendix 23), over 88% of the feed materials used at the FRC smelter in 2011 were scrap junk batteries, with industrial battery plates from the same type of batteries being the second most predominant feed material. Mr. Larry Eagan, a former FRC plant manager, confirmed that this feed composition was generally similar during the operational period of the plant for which he was familiar. As noted on the Material Safety Data Sheet (MSDS) for lead acid batteries, the primary component of the battery is inorganic lead (Appendix 23). The MSDS indicates that antimony and arsenic are minor battery components at only 0.4% and 0.01% by weight, respectively, which is far less than the lead component percentage (54 – 62% by weight). However, based on this information and comments from the TCEQ and EPA (TCEQ 2013e; TCEQ, 2013f; EPA, 2013), Exide has included antimony and arsenic in the analytical suite for a subset of soil samples to be collected in response to TCEQ and EPA comments on this APAR.

TRRP-10 mentions applicable industry specific lists including two documents that were evaluated to support the COC list determination for this APAR. The federal EPA document, Compliance Sector Notebook for Nonferrous Metals Industry (EPA, 1995) for secondary lead processing only lists pollution outputs for this industry sector as air emissions containing sulfur dioxide and particulate matter containing lead and cadmium, and other wastes that include slag and emission control dust (K069 waste). Once in the atmosphere, it is noted that sulfur dioxide can easily form negatively charged sulfate ions which readily combine with water vapor in the atmosphere to form small droplets of sulfuric acid. Sulfates formed in the atmosphere at low altitudes are typically removed from the atmosphere quickly through settling and precipitation. Based on this information, comments from the TCEQ (TCEQ 2013e; TCEQ, 2013f), and variable sulfate concentrations detected in groundwater, Exide has included a discussion of the potential effects that sulfate levels measured in monitoring wells adjacent to Stewart Creek might have on surface water quality in this APAR (see Section 5.3).

The Battery Reclamation Industry Profile in EPA (1995) (used to assist in the planning and evaluation of sites being considered for remediation, redevelopment, and re-use) states that "common waste products encountered at Superfund assessment and remediation projects include lead-contaminated soil and ground water, highly acidified soils and leachate, and large volumes of contaminated battery casings." General data in the open literature shows that slag and K069 are predominantly lead, with lesser constituents including cadmium, arsenic, and selenium reported anywhere from one-tenth to one-hundredth of the concentration of lead (EPA, 1997; Lewis and Hugo, 2000; Paintal, 1990). AP-42 (EPA, 1997) provides some estimates on percentages of lead in the particulates from different furnace operations; generally, lead accounts for the majority of the particulate material (ranging from 42 percent to 85 percent), with other elements generally accounting for less than 1% of the particulate material.

3.1.2.4 Step 4 – Review the Information Using Professional Judgment

TRRP-10 states that "In cases where sufficient requirements or evidence exists, collecting additional analytical data may be unnecessary to designate a target COC list for a project. Professional judgment, combined with institutional knowledge may dictate that a COC or a class of COCs is realistically a target COC for a project. Common examples include… lead for a battery manufacturing facility (TCEQ, 2008)." Professional judgment may also be used to tailor the list of COCs associated with a specific release.

Professional judgment, based on process knowledge about operations and data from the numerous previous investigations at the Site, indicates that lead and cadmium, are the appropriate target COCs for the FOP. In order to address specific requests from the TCEQ, antimony, arsenic, and selenium have also been evaluated in several areas of the Site.

3.1.2.5 Step 5 – Select Options When Information Is Insufficient

Based on the information presented above, it is believed that there is sufficient information to reliably identify the primary COCs for the Site and adequately characterize the Site conditions so that the Site conditions may be protective of human health and the environment.

3.1.2.6 Step 6 – Designate the Target COCs

The last step prior to initiating an investigation is identified in TRRP-10 as designating the Target COCs and indicates "If a permit, order or program requirement dictates a target COC and/or analyte list that is applicable and appropriate for the TRRP project, further efforts in identifying target COCs for the project are not necessary. Document the target COCs from this list and proceed. If Step 1 does not meet the project-specific needs, proceed to Steps 2 through 5."

After following the steps of TRRP-10, the primary COCs for the Site are lead and cadmium, based on historical operations, process knowledge, previous investigations, and guidance, direction, and/or approval given by the EPA and TCEQ as part of permits, orders, and program requirements. All of the above steps strongly support the conclusion that the primary COCs for the Site are lead and cadmium. Process area-specific COCs, such as TPH, VOCs, and SVOCs were also evaluated in potential source areas for these compounds (e.g., VOCs were analyzed in soil samples from the Maintenance Building to evaluate the potential presence of solvents in this area). As discussed in greater detail in Section 4.0, none of these process area-specific COCs resulted in areas of concern different than those for lead and cadmium. As previously noted, arsenic and selenium were also analyzed in samples from specified areas of the Site and, based on TCEQ comments, antimony analyses have been performed on additional soil samples.

The results of this assessment has confirmed that the other inorganic COCs analyzed in soil samples (antimony, arsenic, and selenium) are found, in most cases, to be co-located with elevated lead concentrations, as detailed in Section 4.0. The assessment further confirms that, in most cases, elevated inorganic COC concentrations are limited to surficial soils, except for the known disposal areas, and have not migrated to groundwater or surface water above applicable RALs based on the most recent sampling data. This assessment has further indicated that low-level concentrations of organics (VOCs, SVOCs, and TPH) in process area soils are localized, and will be concurrently addressed by the selected response action. Additionally, there are no organic COCs present in groundwater sampled above applicable RALs based on the most recent sampling results. Based on this, the primary target COCs (lead and cadmium) should be used as indicator COCs during future assessment and remedial activities.

The remaining Steps of TRRP-10 include conducting the project and documenting and reporting the results. This APAR serves to document the project investigation and report the findings.

3.1.3 Background

Consistent with 30 TAC §350.51(l), site-specific background concentrations were calculated for arsenic and lead in soil using background soil samples collected on March 29, 2012 and May 9, 2013 from within an area of the City of Frisco's Grand Park area, located approximately 0.75 miles southwest of the Site near the intersection of Legacy Drive and Stonebrook Parkway. The background sample area was approved by the EPA in a meeting on January 4, 2012. Background samples from the March 29, 2012 sampling event were also analyzed for cadmium, but a site-specific background concentration for cadmium was not calculated due to the high number of non-detect results for cadmium in these samples. A letter summarizing the background study was submitted to the TCEQ on May 31, 2013 (Appendix 8). As detailed in the letter, the representative site-specific background concentration calculated for arsenic was 15.9 mg/kg and the representative site-specific background concentration calculated for lead was 31.5 mg/kg.

As described in Section 1.2.1.1, The Site and surrounding areas (including areas surrounding Stewart Creek from upstream of the FRC to Lake Lewisville) were historically used for agricultural purposes likely dating to prior to the early 1900s (City of Frisco, 2014), with some areas currently still developed as unused pasture (CJI, 2014). The Bureau of Economic Geology (BEG) report on arsenic contamination in Texas (also discussed in Section 1.2.1.1) stated that "background arsenic concentrations in soil are in the 0.1 to 40 mg/kg range" (BEG, 2005).

SWG performed a background study of metals for the City of Frisco in 2014 (SWG, 2014a). The SWG study was limited to samples from undeveloped areas with the exception of one property that was cultivated at the time of sample collection. The study included arsenic, barium, cadmium, chromium, lead, mercury, selenium and silver. The range of arsenic concentrations detected by SWG was between 3.6 and 11.4 mg/kg. In addition to sampling, SWG also performed a literature review including BEG, 2005 (described above) and excerpts from the 1991 publication by Hazardous Materials Control Resources Institute (HMCRI) titled "Elements in North American Soils". The background arsenic referenced in the HMCRI report was 1 mg/kg to 18 mg/kg. The SWG report concluded that, "The arsenic values detected during SWG's background study fall within the range of concentrations documented in the HMCRI report; however, background arsenic concentrations in the Frisco area could be higher depending on the proximity and duration of agricultural land use, specifically cotton farming."

3.2 Assessment Strategy

The Site assessment strategy was guided by knowledge of historical Site operations, data from previous investigations, and the physical setting of the Site. The SIR assessment was performed in accordance with the Work Plan (CRA, 2011) and guidance provided by the EPA during the SIR investigation. The

sampling assessment for the APAR investigation was developed based on comments by the TCEQ and EPA on the SIR, guidance provided by the TCEQ and EPA during a series of meetings conducted in February 2013 (February 8, 2013; February 15, 2013; and February 21, 2013), and comments by the TCEQ and EPA on the initial FOP APAR.

3.2.1 Soil Assessment Strategy

The primary soil assessment strategy during the SIR and APAR investigations consisted of an evaluation of lead and cadmium concentrations in soil samples from within and/or in the vicinity of the potential source areas identified in Section 1.2.4. As specified in a memorandum dated February 7, 2013 provided by Gary Beyer of the TCEQ in the February 8, 2013 meeting (TCEQ, 2013d), historic soil samples (i.e., samples collected prior to the SIR investigation) were not used to delineate the affected property boundaries. To account for potential environmental impacts that might have occurred since the collection of historic samples, several historic sample locations with reported soil sample COC concentrations below applicable RALs (or applicable background) were re-sampled to confirm delineation of the affected property boundaries at these locations.

The soil sampling and analysis strategy varied slightly in specific areas of the Site. Soil samples from the RCRA-permitted units were collected and analyzed based on requirements in the current RCRA Permit (Exide, 2001), the Decontamination and Demolition Work Plan (PBW/RSI, 2013a), and discussions with TCEQ personnel. Soil samples collected from the vicinity of the Former Diesel Tank release (Lake, 1991) and from the Maintenance Building (where solvents were reported to have been previously used) were analyzed for petroleum hydrocarbon constituents, including TPH, VOCs, and/or SVOCs, in addition to lead and cadmium. The Lake Parcel, an area along the western boundary of the Site that was not identified as a potential source area, was sampled to evaluate lead and cadmium in this area.

As noted previously, specific soil samples collected from within or in the vicinity of the former production area and from areas representative of potential atmospheric deposition of COCs were identified for arsenic analysis. Sixty soil samples were analyzed for arsenic during Phase I of the APAR investigation (Table 4D.2A). During the February 21, 2013 meeting, the TCEQ requested that several soil samples within the former production area be analyzed for selenium. Based on this request, forty soil samples from this area were analyzed for selenium during the first phase of the APAR investigation.

In August-November 2012, W&M installed a French drain system along the facility side of the Flood Wall to convey shallow perched water away from the Flood Wall to sumps, where it could be routed to the on-site storm water treatment system. During construction of the French drain, PBW collected soil samples from the walls and floor of the French drain excavation at nine locations (FWFS-1 through FWFS-9). In accordance with the Work Plan, these samples were analyzed for lead, cadmium, and TPH. Data for

these soil samples are provided in Section 4. A report summarizing the French drain construction activities is provided in Appendix 11.

Select soil samples within the Bale Stabilization Area were analyzed using the Synthetic Precipitation Leaching Procedure (SPLP) method during the SIR investigation. In 2014, additional samples were selected for SPLP lead and cadmium analysis from a range of concentrations across various areas of the Site to use in further development of critical PCLs. However in most cases for the samples analyzed, SPLP results did not support development of a different critical PCL. The results of the SPLP evaluations are presented in Appendix 24.

Based on comments by the TCEQ and EPA on the initial FOP APAR, and subsequent correspondence and discussions with TCEQ, a second Phase of APAR investigation activities was performed. The second Phase of APAR investigation activities included assessment of specific areas of interest (as documented in the October 29, 2013 response to comments) as well as the collection of soil samples throughout the Site in order to delineate lead in cadmium in soil both vertically and horizontally to applicable RALs (or applicable background) based on the change in groundwater classification. In addition, the analysis for additional COCs, specifically arsenic, selenium, and antimony was included in select locations to further evaluate the distribution of these COCs horizontally and vertically.

Two additional specific investigation areas were also added in 2014 as discussed above. Soil assessment in the vicinity of the City of Frisco Firefighter Training Facility included evaluation of VOCs, SVOCs, TPH, PFCs, and metals at four locations. Soil assessment in the vicinity of the former burn pile area included VOCs, SVOCs, and metals added as COCs at four locations.

3.2.2 Groundwater Assessment Strategy

In accordance with the EPA-approved Work Plan, groundwater samples collected during the SIR investigation included samples from three monitoring wells (MW-19, MW-20, and LMW-19) designated as background wells and twelve monitoring wells (MW-12, MW-13, MW-14, MW-16, MW-16S, MW-17, MW-18, B8N, B5N, B2R, B3R, and B4R) located downgradient of RFI-designated WMAs. Monitoring wells B8N, B2R, and B3R were not sampled during the SIR investigation (B8N and B2R were damaged beyond repair and B3R was dry). In accordance with the TCEQ Agreed Order, SIR groundwater data have been included in this APAR (see Tables 5B.1, 5C, and 5D).

Monitoring wells installed in 2013 as part of the APAR investigation included three wells located between the former production area and Stewart Creek (MW-26, MW-27, and MW-29), one well located within the Battery Receiving/Storage Building (MW-31), four wells located within the projected former creek paths of Stewart Creek and/or the North Tributary (MW-21, MW-22, MW-24, and MW-30), one well in the vicinity

of the Bale Stabilization Area and Truck Staging Area (MW-23), one well located downgradient of the Crystallization Unit and Crystallization Unit frac tank (MW-25), and four wells located in the vicinity of the Class 2 Landfill (LMW-21, LMW-22, PMW-19R, and PMW-20R). Monitoring wells PMW-19R and PMW-20R are replacement wells for PMW-19 and PMW-20, respectively, which were plugged and abandoned during the APAR investigation due to the absence of completion information for these previously existing wells.

During the first phase of the APAR and the SIR investigations, groundwater samples were collected from thirty-five on-site monitoring wells, including the newly installed wells listed above and wells previously installed during the SIR and RFI assessments, and three monitoring wells (MW-19, MW-20, and MW-28) located adjacent to the FOP on the Undeveloped Buffer Property (additional monitoring wells were installed on the Undeveloped Buffer Property. The SIR and APAR groundwater data are presented in Section 5 of this APAR and in the Undeveloped Buffer Property APAR (PBW, 2014).

All monitoring wells sampled during the first phase of the APAR and SIR investigations were analyzed for total and dissolved lead and cadmium (subject to the production of sufficient sample volume by the well being sampled). Groundwater samples collected during the SIR investigation were additionally analyzed for total dissolved solids (TDS) and sulfate. As specified in the February 7, 2013 memorandum from the TCEQ (TCEQ, 2013d), sulfate was also analyzed in all groundwater samples collected during the APAR investigation. Additional process-specific COCs were analyzed in certain areas, including TPH and PAHs in well MW-27, located downgradient of the Former Diesel Tank release area, and arsenic and selenium in wells located in the Class 2 Landfill area.

In 2014, as part of the second phase of APAR investigation, fifteen new wells were installed. These wells include:

- Two wells downgradient from the storm water retention pond (MW-37 and MW-38);
- One well near the wastewater treatment building (MW-46),
- One well between the truck washing station and Stewart Creek (MW-44),
- Two wells near the Slag Landfill (MW-39 and MW-40);
- Two wells north of the North Tributary and south of Affected Property No. 1 (MW-41 and MW-42);
- One well in the FFTA (MW-43); and
- One well northwest of the Class 2 Landfill to provide background data (MW-45).

Additional groundwater samples were also collected from select existing wells in February and March 2014. These samples included:

- Stewart Creek POE wells (Upper GWBU wells along Stewart Creek) were sampled to address the revised applicable groundwater to surface water PCL (^{SW}GW) ambient water quality criteria that were prepared based on the reclassification of Stewart Creek (MW-11, MW-14, MW-16S, MW-17, MW-26, MW-27, MW-29, MW-37, MW-38, MW-44 and MW-46)
- MW-16, a deep well paired with the MW-16S well, was resampled for comparison purposes.
- B4R (Upper GWBU well west of the South Disposal Area) was resampled to provide comparison with previous data collected at this well.

To evaluate groundwater flow directions at the Site, static water levels were gauged in Site wells and at two surface water gauges located in Stewart Creek several times over the course of the SIR and APAR assessments. Water elevation data are provided in Table 5D and groundwater potentiometric surface maps are provided as Figures 5A.1 through 5A.4.

3.2.3 Flood Wall, Structural Sub-base and Perched Water Assessment Strategy

During the SIR, several soil borings (2012-RMSA-2, 2012-RMSA-4, 2012-NDA-1, 2012-SL-2, and 2012-SL-3) filled with water after soil samples were collected. In accordance with field procedures for these areas in the Work Plan (CRA, 2011), a soil boring water sample was collected from each of these borings. Monitoring wells were not constructed at these locations and the borings were not developed prior to collection of the boring water samples. Given the location of samples 2012-RMSA-2 and 2012-RMSA-4 within the center of the former production area and the very shallow depth where the water was observed in these borings (less than 3 feet bgs), these samples likely represent washdown water perched directly below the concrete slab floor in the gravel sub-base. The remaining soil boring water samples (2012-NDA-1, 2012-SL-2, and 2012-SL-3) were collected from borings with saturated depths more consistent with typical groundwater levels observed at the Site, and may represent groundwater within the upper GWBU; however, because these locations were not completed as permanent monitoring wells and the borings were not developed prior to sampling, the boring water sample results are not compared to groundwater PCLs. The soil boring water sample data are provided in Table 4E.

During the Phase II APAR Investigation Activities, in addition to the ten groundwater monitoring wells discussed in Section 3.2.2, five wells were installed to evaluate potential perched water (MW-32, MW-33, MW-34, MW-35, and MW-36) in the former production area. To further investigate potential connections between perched water and groundwater, the MW-32/MW-46 well pair was installed inside the Flood Wall, near the Wastewater Treatment Plant, with the shallow MW-32 installed to approximately five ft bgs, and MW-46 screened in the Upper GWBU at approximately 10-20 feet bgs. Boring data indicate the presence of approximately 4.5 to 6 feet of fine-grained, predominantlyclay soils between the perched zone and the underlying Upper GWBU. The fine grained soils between the perched zone and GWBU were noted as predominantly dry to damp on the boring logs. Analytical data have not shown

connections between the perched water and the groundwater or surface water at the site (analytical results from perched wells and MW-46 are discussed in Section 5.2). Cross section transects G-G' and H-H' depict the area immediately adjacent to the floodwall in the vicinity of the waste water treatment plant. Water levels and screened intervals for MW-32 (perched) and MW-46 (upper GWBU) are shown on the cross sections as well as their spatial orientation with respect to the flood wall, French drain, Stewart Creek and other surrounding wells. The water level in MW-46 measured on March 18, 2014 was approximately 1.2 feet below the bottom of the screen in MW-32 which was dry. As shown in the cross sections, the screened interval (including filter pack) for MW-32 intersects the shallow fill material and the underlying native clayey material. Yield from this well during sample collection was limited, and may have consisted of perched water in the well end cap after a temporary rise of the perched water level, such as during a precipitation event or when the French drain system was temporarily inactive, as described below. Based on boring data, a sub-base up to approximately eight inches thick and consisting of silty clay, clayey sand, and gravel with varying amounts of fines, exists under some portions of the concrete paved portions of the process area. The coarser grained materials which comprise the sub-base likely exhibits relatively high hydraulic conductivity compared to underlying silts and clays and could act as a pathway for water flow when saturated. In the event the sub-base became saturated (water infiltration potentially through construction joints, cracks and utility trenches), water would flow down-gradient to the southwest of the process area, near the storm water collection sump, where the French Drain is located.

As noted in Section 1.2.3.15, prior to construction of the French drain, water seepage and white crystalline material were observed along the exterior of the Flood Wall during EPA and TCEQ inspections (EPA, 2011a;TCEQ, 2011a). To maintain the Flood Wall, Exide periodically sealed cracks on the exterior face of the Flood Wall in a number of locations. However, seepage continued in some areas, resulting in spalling and deterioration of the exterior wall face and localized areas of wet soil and/or standing water at the exterior base of the wall. The French Drain was installed in 2012 to dewater the shallow fill and sub-base behind the wall (this would include water from areas where shallow boring water samples were collected and areas where perched water wells were installed and sampled as described above) and prevent seepage of water through the Flood Wall. The French drain system was designed to collect and convey water from the zone of saturated, shallow fill behind the Flood Wall to a sump, where it is collected and pumped to the acid receiving tank in the wastewater treatment building.

When in operation, the French drain has been effective in collecting and conveying water away from the facility side of the Flood Wall. As described in Section 1.2.3.23, W&M visited the wall on three occasions (un-specified date in November 2012; March 28, 2013; and June 6, 2013) after the drain was completed to observe the condition of the wall. On each occasion, the entire perimeter of the wall was walked and inspected for evidence of ongoing seepage. W&M indicated that no evidence of recent seepage was

observed during the site visits. Photographs of the Flood Wall were taken by W&M during the March 28, 2013 site visit. These photographs are included directly after the Wall Seepage Report in Appendix 11.

A flood wall inspection was performed by Golder on January 7th and 8th, 2014 to observe the condition of the wall. The French Drain was not being pumped at the time of the inspection due to maintenance issues and the water levels in the French Drain were above those during normal operation. Moisture and "white crystalline material" were observed in several locations on the exterior of the Flood Wall, but no standing water was observed. There was no visible flow through the wall. Golder visited the Flood Wall on March 18, 2014 to inspect the wall after the French Drain had been operating for several weeks but at the time of the Site visit, Golder noted that the system had recently shut down again due to a power outage from severe weather. The "white crystalline material" and moisture were observed in similar locations to those observed during the January 2014 inspection. However, no visible flow through the wall or standing water were observed.

Based on the information described above, when the French Drain is in operation, it appears to be effective in preventing seepage through the wall and effective in collecting and conveying the shallow perched water from the zone of saturated, shallow fill behind the Flood Wall to the collection sump. During the time the French Drain was not in operation and water accumulated behind the Flood Wall, conditions similar to those noted before the French Drain was installed were observed. Since the time of the Golder inspections, a significant amount of work has been done to improve the French Drain system, including installation of a new pump with a float activated switch and raising the manhole access.

Golder prepared a French Drain Monitoring Plan for the facility which prescribes regularly scheduled monitoring, record keeping, and responsible parties for long term operation of the French Drain. Key aspects of this plan include:

- Regular inspections;
- Activities to keep the collection the collection sump and sump outlet free of materials;
- Verify the pump system is operating; and
- Recordkeeping (inspection sheets).

3.2.4 Surface Water and Sediment Assessment Strategy

An assessment of potential impacts to surface water and sediment has been conducted at the Site. During the SIR and APAR investigations, surface water and sediment samples were collected from fifteen locations within Stewart Creek and ten locations within the North Tributary (Figures 6A.1 and 7A.1). The surface water and sediment samples were collected from the same approximate locations at semi-regular intervals along the entire reach of the on-site portions of the creeks. Two surface water and sediment

samples were additionally collected from a section of Stewart Creek upstream from the Site (at sample points 14 and 15). Surface water samples were analyzed for total and dissolved lead and cadmium. Sediment samples were analyzed for lead, cadmium, and grain size distribution. Per the Work Plan (CRA, 2011), sediment samples were also analyzed for organic carbon to provide additional information related to the potential bioavailability of compounds in the sediment for hypothetical ecological receptors.

As part of the Phase II APAR investigation, an additional 63 sediment samples were collected from Stewart creek in January, March, and April 2014 in segments of Stewart Creek upstream (10 samples) and downstream (53 samples, excluding duplicates), with downstream samples extending downstream as far as the USACE property upstream of Lake Lewisville. Sediment samples were analyzed for lead, cadmium, arsenic, grain size distribution and organic carbon. In addition, surface water samples were collected from Stewart Creek at an additional 29 locations. Surface water sampling locations included six locations within the perimeter of the FOP, ten locations upstream from the FOP, and eight samples downstream of the FOP. Samples of surface water were also collected at five locations in upstream points along tributaries that flowed into Stewart Creek downstream from the FOP (i.e. tributary reaches unaffected by flow in Stewart Creek which passes through the FOP). The samples were analyzed for total and dissolved arsenic, lead, and cadmium and/or sulfate.

3.2.5 Reconnaissance Slag and Battery Case Chip Assessment

As noted previously, W&M conducted visual inspections of the FOP in 2009 and 2011 to identify exposed slag, battery case fragments, and other site related debris within and along the banks of the on-site portion of Stewart Creek west of the former production area (W&M, 2011a) and in the vicinity of the North Disposal Area and South Disposal Area (W&M, 2011c). In November 2009, representative samples of suspected slag were collected from twelve specimens located within or along the banks of the on-site portion of Stewart Creek west of the former production area. The analytical results for the suspected slag samples were presented in a report prepared by W&M in 2011 (W&M, 2011a), which is provided in Appendix 18. In 2013, W&M completed additional inspections on the remaining areas of the FOP. W&M summarized the results of the 2013 inspection and previous inspections in a report dated March 28, 2013 (W&M, 2013a), which is also provided in Appendix 18. W&M identified exposed slag and/or battery case fragments in several areas of the Site, including the South Disposal Area, the south wooded area east of the South Disposal Area, the North Disposal Area/Slag Landfill area, the north wooded area, the Class 2 Landfill area, and within and along the banks of Stewart Creek west of the former production area. Locations of the slag and/or battery case fragments identified during the inspections are shown on Figures 4 through 7 in the 2013 W&M report (W&M, 2013a) provided in Appendix 18.

Based on the visual inspections conducted by W&M, an interim action was performed in July-August 2013 to identify and remove exposed slag and battery case fragments from the ground surface using

hand shoveling and other manual methods in areas where these items had previously been identified. Information was also collected regarding lead concentrations in areas where these materials were removed to evaluate whether future larger scale response actions may be necessary in these areas. The scope of work for the interim action activities was submitted to the TCEQ as an Interim Action Work Plan (IAWP) dated April 29, 2013 prior to the start of work. The IAWP was approved by the TCEQ in correspondence dated July 1, 2013. After completion of the interim action, W&M prepared a summary report (W&M, 2013d) of the results dated October 14, 2013, which was submitted to the TCEQ. The W&M interim action report was approved by the TCEQ in a letter dated January 10, 2014 (TCEQ, 2014). The W&M interim action report and TCEQ approval letter are provided in Appendix 11.

The evaluation of Stewart Creek conducted for this APAR included a visual survey of the creek from on-site areas of the FOP property to Lake Lewisville. During the evaluation, potential slag and battery case fragments were identified within and along the banks of the creek. Potential slag materials were generally observed in the same areas on-site as identified by W&M. Slag materials were also observed in the area immediately downstream from the Site near the BNSF Bridge. Battery case fragments were observed in downstream areas from the Site that extended to the USACE-owned property. No battery case fragments were observed on the downstream portion of Stewart Creek owned by USACE. During previous investigations conducted on behalf of the City of Frisco, SWG also identified potential slag and/or battery case fragments in downstream portions of Stewart Creek (SWG, 2013a; SWG, 2013b). Details of the downstream evaluation conducted for this APAR are provided in Sections 6, 7, and 9 and the SWG downstream study reports are provided in Appendix 19. On behalf of Exide, Golder submitted an IAWP to the TCEQ dated November 7, 2013 for removal of slag and battery case fragments identified in downstream portions of Stewart Creek during the APAR investigation. The TCEQ issued a conditional approval letter dated December 17, 2013 for this IAWP. At the time of this report preparation, interim actions were on-going. The results of the interim actions will be submitted to TCEQ within 60 days of the completion of on-site activities in accordance with the conditional approval letter dated December 17, 2013.

3.2.6 Storm Water Retention Pond and Solar Evaporation Pond Evaluations

In 2008, W&M performed an assessment of the storm water retention pond that included a survey of the pond and characterization of the liner to document the as-installed condition of the pond. W&M completed a summary report of the 2008 assessment activities in 2011, which is provided in Appendix 20. W&M indicated that the storm water retention pond is lined with at least two layers of HDPE liner separated by fill sand. Due to storm damage in the 1990s, a 60-mil HDPE liner was placed over the original liner system. Underlying the HDPE liners is a compacted clay soil liner at least 2.5 feet thick. The W&M report concluded that the estimated leakage rates met the design criteria for the pond.

In December 2013, Golder conducted an inspection of the storm water retention pond. The inspection was limited to visual observations of the membrane liner from the top of the pond slopes. The perimeter of the pond was traversed twice, slowly, as the liner was visually inspected. Photographs of the pond liner were taken from various perspectives along the perimeter of the pond. No breaches of the liner system were noted. Golder's Inspection report is provided in Appendix 20. It was not possible to estimate the volume of sediment in the pond. Pond sediment volume and waste classification will be determined when the ponds are drained at the time of maintenance or decommissioning. A detailed inspection of the liner will also be performed at that time. It is anticipated that the storm water retention pond will be needed until either active management of storm water is no longer required or an alternative approach for storm water management is developed; the currently that timeframe is uncertain.

Two additional monitoring wells were installed to evaluate groundwater downgradient (northwest) from the storm water retention pond (MW-37) and to the north, between the storm water retention pond and Stewart Creek (MW-38). Wells were sampled January 2014 (MW-38 and duplicate sample) and February 2014 (MW-37, which did not have sufficient water to allow sampling in January 2014).

Multiple groundwater monitoring wells were installed in the generally downgradient direction and near vicinity of the Solar Evaporation Pond, including: (1) monitoring well MW-28, which was installed directly downgradient (southwest) of the solar evaporation pond (see Section 5); and (2) monitoring wells VCP-MW-5 and VCP-MW-6, which were installed west (VCP-MW-6) and south (VCP-MW-5) of the solar evaporation pond as part of the APAR for the adjacent Undeveloped Buffer Property (see Section 5).

In December 2013, Golder conducted an inspection of the solar evaporation pond. The inspection was limited to visual observations of the membrane liner from the top of the pond slopes. The perimeter of the pond was traversed twice, slowly, as the liner was visually inspected. Photographs of the pond liner were taken from various perspectives along the perimeter of the pond. No breaches of the liner system were observed. Golder's Inspection report is provided in Appendix 20. In February 2014, Golder attempted to collect a sample of sediment from the solar evaporation pond using a smooth-faced ponar dredge sampler. Pond sediments were generally observed to be very fine grained and not present in sufficient amounts for sampling. It was not possible to estimate the volume of sediment in the pond. Pond sediment volume and waste classification will be determined when the pond is drained at the time of maintenance or decommissioning. A detailed inspection of the liner will also be performed at that time. It is anticipated that the Solar Evaporation Pond will be needed at least until the Class 2 landfill is closed; currently that timeframe is uncertain.

3.2.7 Utilities/Preferential Pathways

In addition to the perched water evaluation discussed above, other types of preferential pathways were discussed in the original APAR and in the subsequent comments from TCEQ and EPA. These potential preferential pathways included utilities, the historical stream channels of Stewart Creek and the North Tributary, and fill material containing slag. Investigations were conducted to gather data regarding these potential pathways in 2014. Results are summarized below, and additional information is provided in Appendix 11.

Some soil staining, elevated photo ionization detector (PID) readings, and petroleum hydrocarbon odors were noted in borings completed in the Raw Material Storage Building, Slag Treatment Building and vicinity, and the French drain excavation. However, NAPL was not observed in these areas or elsewhere at the Site; and no effects due to preferential NAPL pathways were indicated.

3.2.7.1 Utilities

Multiple underground utilities are present at and in the general vicinity of the Site, including buried natural gas, water, storm water, wastewater, and fiber optic lines (Figure 1 in Appendix 11.6). Golder conducted additional utility investigation within the former process area in January 2014. Golder used existing facility drawings and performed a visual survey of the facility to identify subsurface utility areas. Storm sewers, sanitary sewers and remnants of facility processes were identified during the investigation. Appendix 11.6 provides a full description of utility investigation activities and includes a map showing the location of identified utilities relative to former process structures (Figure 1 in Appendix 11.6). Table 3A contains a summary of utility construction, approximate depth and owner, where available.

Based on facility drawings, within the former production area, shallow (approximately 2 feet deep) process lines (such as acid drain lines, battery breaker drain and cooling water lines) were encased in concrete without gravel backfill were noted on drawings. For the diesel pipe trench (see below), the trench depth was noted to be two feet on facility drawings. However, backfill material type was not observed in facility drawings for the diesel pipe trench. Additionally, depths and backfill types of the sanitary and storm sewer lines were not observed on facility drawings and were not observable during the site walk. Specific utilities identified are discussed below.

Five storm sewer lines were identified in the process area during the utility investigation:

- *Sewer running east to west along the northern half of the Blast Furnace Building, Battery Breaker and Battery Storage and Receiving Building (BSB) (#1).* The sewer is described as a 12-inch pipe on facility drawings with a termination point near existing French drain sump. The depth of the sewer was not indicated on facility drawings. The discharge pipe for this sewer was found to be plugged at its downstream end in the flood wall, and is

believed to be inactive. The upstream end of the sewer is believed to be plugged with concrete outside of the building foundations, based on facility drawings.

- *Sewer running along the south and east sides of the BSB and continuing north to the private drive (#2).* The sewer is described as a 12-inch pipe on facility drawings and originates at a sump near the existing French drain sump and terminates near the private drive to the north of the process area. The depth of the sewer was not indicated on facility drawings. One manhole associated with the sewer was observed near the base of the ramp between the BSB and Battery Breaker. However, the sewer is believed to be inactive as the associated sump near the French drain sump was not observed to be present. The upstream end of the sewer is believed to be plugged with concrete outside of the building foundations, based on facility drawings.
- *Sewer running east to west along the approximate center of the Battery Breaker before turning to the south and terminating near the existing floodwall (#3).* The sewer is described as a 15-inch pipe on facility drawings. The depth of the sewer was not indicated on facility drawings. The sewer was not observed to be present during the site walk and is believed to be inactive as it predates the floodwall based on facility drawings.
- *Sewer running east to west along the south side of the Oxide Building before turning south and running through Maintenance Building (#4)*. The sewer is described as a 12-inch pipe on facility drawings and is shown to terminate near the existing floodwall. The depth of the sewer was not indicated on facility drawings. The sewer was not observed during the site walk and is believed to be inactive. The upstream end of the sewer is believed to be plugged with concrete outside of the building foundations, based on facility drawings.
- *Sewer running east to west across the pipe bridge to the south of the BSB prior to discharging into the storm water retention pond (#5).* The sewer is approximately 30 inches in diameter and conveys former process area storm water, which collects in and around the storm water collection sump, to the storm water retention pond (see figure 1 in appendix 11.6). This storm sewer was active at the time of report preparation.

Ten sanitary sewer lines were identified in the vicinity of the process area during the utility investigation:

- *Sewer running north-northeast to south-southwest from the Breaker Building to the Slag Treatment Building, where it appears to form a junction with the 15-inch sewer main that runs along Stewart Creek (#1).* The sewer is described as an 8-inch pipe on facility drawings. Additionally, the sewer was not observed to be present during the site walk and is believed to be inactive. The upstream end of the sewer is believed to be plugged with concrete outside of the building foundations, based on facility drawings.
- *Sewer running north to south from the Oxide Building Addition to the 15-inch sewer main along Stewart Creek (#2).* The sewer is described as a 4-inch pipe on facility drawings. The sewer was not observed to be present during the site walk and is believed to be inactive. The upstream end of the sewer is believed to be plugged with concrete outside of the building foundations, based on facility drawings.
- *Sewer running north to south from the Oxide Building to the 15-inch sewer main along Stewart Creek, where it appears to form a junction at an existing manhole (#3).* The sewer is described as a 6-inch pipe on facility drawings. The sewer was identified at the sewer manhole to the south of the Administrative Building. The sewer is believed to be inactive and the upstream end is believed to be plugged with concrete outside of the building foundations, based on facility drawings.
- *Sewer runs along Stewart Creek (#4).* This sewer is a sanitary main based on facility drawings and based on discussions with facility personnel. The sewer is described as a

15-inch pipe on facility drawings, with a depth of approximately 14 feet based on visual observations in adjacent manholes. The sewer was active at the time of report preparation.

- *Sewers exiting the Administration Building and intersecting the 15-inch sanitary sewer running adjacent to Stewart Creek (#5 & #6).* The sewers are described as 6-inch pipe on facility drawings and intersect the 15-inch sanitary sewer at manholes to the south of the Administration Building. The sewers are believed to be active.
- *Sewer running from South to North out of the Crystallizer Plant (#7) where it intersects a city sanitary sewer (#8).* Both of these sewers are believed to be active and servicing the Crystallizer Plant.
- *Sewer running from northeast to southwest between the Oxide Building and Administration building (#9) and sewer (#10) running from the former smelter to the southeast where it intersects sanitary sewer (#9).* Both of these sewers are believed to be inactive with the upstream ends believed to be plugged with concrete outside of the building foundations, based on facility drawings.

Additional utilities were identified related to specific processes and areas of the FOP:

- *Battery Receiving & Storage Building.* Former process utilities were observed at the BSB. Two sumps with grated inlets were observed on the BSB floor. Based on facility drawings, the sumps were connected to a 6-inch diameter acid drain pipe which terminated at the southeast end of the wastewater treatment plant.
- *Battery Breaker.* Three surface trenches were observed in the Battery Breaker. The longest of the three surface trenches, which runs north to south through the middle of the building, appears to have conveyed battery fluid via a utility trench to the waste water treatment plant (see figure 1 in Appendix 11.6). The depth of the trenches within the Battery Breaker building were approximately two feet and the trenches were constructed of concrete and brick. The depth of the utility trench was not indicated on facility drawings. Three pits were also observed within the Battery Breaker. The pits were approximately five feet wide with a depth of approximately two feet. The pits were constructed of concrete. There was no piping observed to be associated with the pits based on facility drawings.
- *Blast Furnace.* Several former utilities were observed in the Blast Furnace area. Two manholes were observed which may have been associated with a former heat exchanger and cooling water trench. Additionally, a trench was observed which ran to the location of the former cooling tower. Based on the accounts of facility personnel, the depth of the trench is approximately one foot. Finally, the smelter building gallery basement was observed to have been filled with gravel.
- *Oxide Building.* Within the Oxide Building, a series of process hoppers was observed during the site walk. However, remnants of underground utilities were not observed during the site walk or in facility drawings other than the sanitary and storm sewers mentioned in the sections above.
- *Slag Treatment Building.* One sump with a grated inlet was observed on the Slag Treatment Building floor. Based on discussions with facility personnel, the sump was connected to a drain pipe which flowed to the waste water treatment plant.
- *Maintenance Building.* The Maintenance Building appears to have a trench drain running north to south in the middle of the building. A conveyance pipe associated with the trench drain was not observed in facility drawings or during the site walk. In addition, a utility trench associated with the former diesel storage tank was observed during the site

walk and on facility drawings. The trench runs from the former diesel tank to the former smelter area. Based on facility drawings, the trench is approximately two feet deep.

- *Administration Building.* In addition to the sanitary sewer lines mentioned above, the grey water pipeline is shown on facility drawings to exit the building on the southwest side where it is underground until it reaches the grey water surge tank and pump building. From the surge & pump building to the waste water treatment plant, the grey water pipeline is above ground, running parallel to the floodwall.

Sample data from the Site do not suggest that these buried utilities are acting as preferential pathways for Site COCs to impact groundwater or surface water, as is evident in the observed concentrations of lead and cadmium in groundwater, which were all below applicable PCLs (Table 5B.1 through 5B.4A). Furthermore, the distribution of soil samples that exceeded the applicable PCLs for cadmium or lead (i.e., the distribution of the affected property boundaries), does not appear to be affected by the locations of buried utilities.

3.2.7.2 Historical Stewart Creek and North Tributary Stream Channels

During the 2013 APAR investigation, several monitoring wells (MW-21, MW-22, MW-24, and MW-30) were completed within the projected former Stewart Creek and North Tributary creek channels to evaluate these features as potential preferential pathways for migration of Site COCs. Fill material associated with the projected former infilled creek paths was observed at MW-24, located south of the Slag Landfill, and MW-30, located near the northwest corner of the Battery Breaker Building. At MW-30, the well was screened within clayey fill and terminated in shale. Slag was noted in the MW-30 boring log at 28 feet below ground surface (within the screened interval) within a fine grained matrix in which the hydraulic conductivity is relatively low compared to sands and gravels and not as conducive to groundwater flow. Native alluvial material was not noted on the boring log for MW-30. At MW-24, the well was screened across the clayey fill and native materials which consist of silty clay with interbedded sand, clayey silt, gravelly clay and clayey sand, and terminated in shale. Fill material was not observed at MW-21 or MW-22, located within the projected former paths of the North Tributary east of the Slag Landfill. Based on boring logs, coarse grained/high permeability fill materials were not observed to have been used to fill the channels. The groundwater results for each of the wells for cadmium and lead were either non-detected or between the method detection limit and quantitation limit. In all cases, RALs were not exceeded. Based on the analytical data from the samples taken in MW-21, MW-22, MW-24, and MW-30, the former creek channels are not considered a pathway for contaminant migration originating at the facility and do not appear to be adversely impacted by potential intersections of utilities or other features within the former stream channels.

3.2.7.3 Use of Slag as Fill Material

Golder performed an evaluation of existing Site data for the notation of slag and fill on boring longs, well completion logs and previous investigation drawings. Based on the locations of fill observed during

previous investigations, additional borings were placed around the Battery Receiving/Storage Building to further delineate slag extent during the January 2014 investigation. Additionally, all other boring logs and monitoring well logs completed during the January 2014 investigation were evaluated for the notation of fill containing slag. The use of slag as fill was investigated with the following results:

- *Battery Storage Building Area.* In the vicinity of the BSB, borings 2013-FWCS-12A, 2013-RRS-2A, 2013-BSB-8A, 2013-WMU14-1A, were advanced primarily to delineate the lateral and vertical extent of fill containing slag around the Battery Storage Building (BSB). Slag was noted on boring logs from 2013-FWCS-12A and 2013-RRS-2A. Based on previous boring log information and 2014 investigation information mentioned above, the Slag Extent Map has been prepared (see Figure 3A).
- *North Disposal Area.* In the vicinity of the North Disposal Area (NDA), the lateral extent had previously been delineated in the Addendum to the RCRA Facility Investigation for GNB Incorporated, December 10, 1993 by Lake Engineering, Inc. (Lake 1993). A series of 54 borings were used to delineate the lateral boundary of the disposal area. The vertical extent of slag in the NDA was delineated using the results of several test pits noted in the December 10, 1993 report mentioned above, geotechnical boring logs from the Geotechnical Engineering Report (Final), October 2011, by Rone Engineering, the 2013 APAR investigation borings and January 2014 borings. Based on observations from borings and test pits, the NDA lateral extent is approximately 5.5 acres and extends to a maximum vertical depth of approximately 20 feet below ground surface before tapering at the lateral limits.
- *Slag Landfill Area.* Based on Lake 1993, the Slag Landfill was developed as an excavated trench as well as having slag containing fill piled above the native land surface. Overall, the slag is piled approximately 8 to 10 above natural grade and approximately three to four feet below grade. The vertical and horizontal extent of slag in the Slag Landfill was adapted from (Lake 1993) and included in Figure 3A.
- Slag Treatment Building. One boring in the Slag Treatment Building area (2012-FWFS-8) encountered a limited thickness of soil containing slag (2.1 feet) at shallow depth. Slag was not encountered in other borings in the area. Based on previous boring log information and subsequent investigations, the Slag Extent Map has been prepared including this limited area (see Figure 3A).
- *South Landfill.* In the vicinity of the South Disposal Area (SDA), the lateral extent had previously been delineated in the Addendum to the RCRA Facility Investigation for GNB Incorporated, December 10, 1993 by Lake Engineering, Inc. (Lake 1993) A series of 27 borings were used to delineate the lateral boundary of the disposal area which has an extent of approximately one acre. The vertical extent of slag in the SDA was delineated using test pit observations from the (Lake 1993) report which noted blast furnace slag and rubber battery case fragments at a depth of approximately 8 feet below ground surface.

Concerning the nature and timing of fill placement, Exide indicated that, from November 16, 1980 to present, hazardous waste was not disposed of on-Site, other than treatment failures associeated with waste deposited in the on-site Class 2 Landfill, nor was hazardous waste used as fill during the construction of the BSB building during the late 1980s (Appendix 21).

3.2.7.4 Potential of Slag in Fill as Preferential Pathway

In the vicinity of the Battery Storage Building, slag was observed within fill of a predominantly fine grained matrix in which the hydraulic conductivity is relatively low compared to sands and gravels and not as conducive to groundwater flow. For example, in borings 2013-BSB-1 through 2013-BSB-10, slag was noted in fine grained matrix fill between 5 and 10.5 feet below ground surface. The fine grained matrix fill was not observed to be saturated and was noted as dry or moist on boring logs. Additionally, the boring log for MW-31 indicated battery case fragments and slag between 6 and 8 feet below ground surface within a fine grained matrix. Groundwater RALs were not exceeded in samples collected from MW-31.

In the vicinity of former creek channels, slag was noted in the MW-30 boring log at 28 feet below ground surface (within the screened interval) within a fine grained matrix in which the hydraulic conductivity is relatively low compared to sands and gravels and not as conducive to groundwater flow. Groundwater RALs were not exceeded based on analytical data for a groundwater sample collected from this monitoring well.

3.2.8 Landfill/Disposal Area Caps

During the second phase of the APAR, the caps for the North Disposal Area, Slag Landfill, Class 2 Landfill, and South Disposal area were inspected, sampled for permeability analyses, and sampled for COC analyses. The purpose of the inspection and permeability sampling was to document known information regarding the cap configurations, to verify by visual inspection the condition of the caps, and to document the permeability of each cap. The COC sampling program was conducted to evaluate whether the existing cap materials are impacted by the COC metals.

3.2.8.1 Cap Inspections and Permeability Sampling/Analyses

Golder understands that the North and South Disposal Areas and the Slag Landfill have been capped and closed by placement and compaction of a clay soil cover over the surface of the respective disposal areas. We further understand that that the Class 2 landfill has been partially closed, and that waste placement continues in the open (active) portion of the Class 2 landfill.

Field inspections of the final covers for the North Disposal Area, Slag Landfill, Class 2 Landfill, and South Disposal Area were completed in December 2013. The limits of waste/final cover limits referenced in this inspection report were obtained from a 1993 RCRA Facility Investigation Report (Lake, 1993). Waste limits (both lateral and vertical), limits of final cover, and topographic survey of the caps were not confirmed as part of this inspection. The field inspections were limited to visual observation of the final covers, as observed by walking the covers in serpentine patterns. The inspections were sufficient that all areas of the final covers were observed. No areas of cover were inaccessible during the field inspection.

Conclusions regarding the integrity and suitability of existing protective vegetative cover assumes that the vegetation is maintained, and repairs made as necessary.

Undisturbed samples of the soil covers at the North and South Disposal Areas and the Slag Landfill were collected in January 2014. Undisturbed samples were collected using Shelby tubes. The Shelby tubes were advanced to an approximate depth of two feet below ground surface, and the tube was then withdrawn and prepared for transport to the laboratory. The Shelby tube ends were sealed and taped to preserve the samples for delivery to the geotechnical laboratory for permeability testing in accordance with ASTM D-5084, Method F, Constant Volume-Falling Head. Permeability sampling of the cover at the Class 2 Landfill (which is comprised of compacted clay soils overlain by a high density polyethylene (HDPE) membrane) was not performed as part of this inspection.

The configurations of the disposal areas and location of the undisturbed samples of the final covers are shown on Figures 1 through 4 of Exhibit A in the Inspection and Geotechnical Testing Memorandum (Appendix 11). The results of the permeability testing are presented in Exhibit C of the Inspection and Geotechnical Testing Memorandum.

All four caps were observed to be generally firm and well drained, with no cracking, erosion, or rilling. Vegetative cover in most areas was generally well established across the cover, although localized areas of potentially sparse vegetation were observed, and part of the Class 2 Landfill is still undergoing establishment of vegetative cover. Minor undulations and equipment tracking were observed on the cover and in the vegetation, although neither appeared to impact the integrity of the cover. It was noted that, because the inspection was performed in December, the overall health of the vegetation could not be assessed as it was dormant or partially dormant at the time of inspection. Additional results for each cap are discussed in the respective portions of Section 4.

3.2.8.2 COC Sampling of Disposal Areas

Shallow samples were collected and analyzed from each cap areas. Samples were collected from the 0 to 6-inch and 6 to 12-inch bgs depth intervals on an approximate grid pattern. Selected samples were also analyzed for arsenic, selenium, and antimony. The sampling program for the four cap areas included:

- North Disposal Area: Twenty-five locations analyzed for lead and cadmium, with shallow samples also analyzed for antimony, arsenic, and selenium at two locations.
- Slag Landfill: Sixteen locations analyzed for lead and cadmium (some deep samples only analyzed for lead), with the shallow sample also analyzed for antimony, arsenic, and selenium at one location

- Class 2 Landfill: Six locations analyzed for lead, cadmium, arsenic, and selenium, with the shallow sample at one location also analyzed for antimony; three additional step-out samples collected near 2013-CL2-01 were analyzed for all five COC metals
- South Disposal Area: Six locations analyzed for lead and cadmium (some deep samples only analyzed for lead), with the shallow sample at one locations also analyzed for antimony, arsenic, and selenium

3.3 Assessment Methods

Field and laboratory investigation activities described herein were performed during the periods from January 2012 to May 2012 (SIR investigation) and February 2013 to June 2013 and December 2013 to April 2014 (APAR Phase I and Phase II investigations). The field and laboratory activities were implemented in general conformance with TRRP requirements and with the methods and procedures described in the EPA-approved Work Plan (CRA, 2011), subject to minor modifications as discussed in meetings with the TCEQ and EPA.

3.3.1 Soil Assessment Methods

Soil samples were collected using several methods, including a Geoprobe drilling rig with direct push technology (DPT) outfitted with 4-foot or 5-foot core barrel lined with a cellulose acetate butyrate (CAB) disposable liner, a hollow-stem auger drilling rig utilizing a 5-foot split core barrel, and hand tools (i.e., a hammer drive sampler with a CAB disposable liner, hand augers, and disposable trowels). Samples were lithologically logged and classified based on the Unified Soil Classification System (USCS). PID and field soil pH readings (conducted during the SIR investigation) were collected within certain process areas, where applicable. PID and soil pH meters were calibrated daily in accordance with the manufacturer's specifications. Following completion of sampling activities, boreholes were plugged with hydrated bentonite pellets. Non-disposable equipment contacting sampled material was decontaminated prior to use and between each sample location, and equipment blanks were collected to ensure that decontamination procedures were adequate.

Fill material was assessed using the same methods as those used to assess native soil described above. Fill was generally distinguished from native soil by the presence of non-native materials (e.g., slag, concrete, etc.) within the fill zone or by the presence of sharp contact boundaries between distinct lithologic zones (i.e., unconformities).

Sample locations were typically located in the field with a Trimble global positioning system (GPS) with real-time differential correction capabilities, or were pre-loaded onto the GPS unit and marked in the field prior to sampling. Coordinates for SIR and APAR sample locations are provided in Appendix 25.

Multiple soil samples were typically collected at various depth intervals from borings completed at the Site and were analyzed, as necessary, to evaluate/delineate affected property areas at the Site. Samples

were placed in containers supplied by Test America, sealed, labeled, and placed on ice in an insulated ice chest for delivery to Test America's Houston, Texas laboratory. Appropriate chain of custody documentation, blanks, and seals accompanied the samples in accordance with TRRP requirements.

For most soil samples, the analytical program consisted of analysis for lead and cadmium by EPA Method 6000 series. For soil samples from select process areas, the analytical suite included VOCs by EPA Method 8260, SVOCs or PAHs by EPA Method 8270, TPH by TCEQ Method TX1005, PFCs (Method DV-LC-0012) and/or additional metals by EPA Method 6000/7000 series. Analyses were conducted in accordance with the appropriate EPA SW-846 methodologies by Test America.

3.3.2 Groundwater Assessment Methods

Monitoring wells installed during the SIR and APAR investigations were constructed of 2-inch flush-threaded PVC with 0.010-inch slotted screen generally installed from near the top of the Eagle Ford Shale unit to at least the top of the observed saturated zone. A filter pack of silica sand was installed within the annulus of each well around the screened interval and a bentonite seal was placed on top of the filter pack. The wells were completed to ground surface with cement. Surface completions consisted of above-grade protective steel casing stick-ups or flush-grade steel well vaults. Each permanent monitoring well sampled during the SIR and APAR investigations was surveyed by a licensed, professional surveyor using the Texas State Plane coordinate system, North American Datum of 1983 (NAD 83), and North American Vertical Datum of 1988 (NAVD88) (Appendix 25). Monitoring well boring logs with completion details are provided in Appendix 2 and the State monitoring well records for the monitoring wells installed during the SIR and APAR investigations are provided in Appendix 6.

After installation, monitoring wells were developed by surging and pumping or bailing the well until physical parameters (e.g., temperature, ORP, conductivity, pH, turbidity, and DO) had stabilized or the well went dry (wells that went dry were typically allowed to go dry and recharge several times during development). Groundwater samples were collected using low-flow sampling procedures and dedicated or disposable sample tubing. Monitoring wells were purged using low-flow techniques. Prior to sampling and during purging, depth-to-water measurements were collected to the nearest one-hundredth of a foot using an electronic water level meter with a graduated tape. Groundwater samples were collected following stabilization of physical parameters (e.g., temperature, ORP, conductivity, pH, turbidity, and DO). Monitoring wells in which water levels did not stabilize were pumped dry and were sampled the following day with no additional purging. Groundwater samples for dissolved metals analysis were filtered in the field using a 10 micron filter during the SIR investigation in accordance with the EPA-approved Work Plan (CRA, 2011). In accordance with generally accepted procedures for the collection of water samples for dissolved metals analysis (TCEQ, 2012a; Boghichi, 2003), groundwater samples collected for dissolved metals analysis during the APAR investigation were filtered in the field using a 0.45 micron

filter. Groundwater samples analyzed for total metals were typically not filtered in the field. However, groundwater samples collected for total metals analysis during the APAR investigation were filtered with a 10 micron filter if turbidity measurements were above 10 NTUs during sampling. Groundwater samples were collected in method-specified containers with appropriate preservatives and were placed on ice pending transport to the laboratory under chain-of-custody control.

During the SIR investigation, groundwater samples were analyzed for total and dissolved cadmium and lead (EPA Method 6000 series), sulfate (EPA Method 300.0), and TDS (Method 2540C). During the APAR investigation, groundwater samples were analyzed for total and dissolved cadmium and lead and sulfate using the same analytical methods used during the SIR investigation. Groundwater samples collected downgradient of the Former Diesel Tank release area (from MW-27) were additionally analyzed for TPH (TCEQ Method TX1005) and PAHs (EPA Method 8270). The groundwater sample collected in the former firefighting training area (MW-43) was analyzed for volatile organic compounds (VOCs, EPA Method 8260), TPH, semi-volatile organic compounds (SVOCs, EPA Method 8270), and Perfluorinated Compounds (PFCs Method DV-LC-0012). Samples collected in the vicinity of the Class 2 Landfill, storm water pond, and north wooded area were additionally analyzed for arsenic and selenium (EPA Method 6000 series). Analyses were conducted in accordance with EPA SW-846, or other appropriate methodologies, by Test America

3.3.3 Surface Water Assessment Methods

Surface water samples were collected using a peristaltic pump with disposable tubing or a clean and sealed disposable container lowered to approximately the mid-depth within the water column at each sample location. Samples were collected from the most downstream sample location first, and were then collected progressively upstream. Samples were collected for both total and dissolved lead, arsenic, and cadmium. The samples collected from Stewart Creek for dissolved analysis were filtered in the field using a 10 micron filter during the SIR investigation in accordance with the EPA-approved Work Plan. In accordance with TCEQ guidelines (TCEQ, 2012a), surface water samples collected for dissolved metals analysis from the North Tributary and upstream and downstream areas of Stewart Creek during the APAR investigation were filtered in the field using a 0.45 micron filter. Sample locations were typically logged in the field with a Trimble GPS with real-time differential correction capabilities, or were pre-loaded onto the GPS unit and marked in the field prior to sampling. Coordinates for SIR and APAR surface water sample locations are provided in Appendix 25.

Samples were placed in containers supplied by Test America, sealed, labeled, and placed on ice in an insulated ice chest for delivery to Test America's Houston, Texas laboratory or Test America's Savannah, Georgia laboratory. Appropriate chain of custody documentation, blanks, and seals accompanied the samples to the laboratory. Total and dissolved lead, arsenic, and cadmium analyses were performed by

EPA Method 6000 series. Analyses were conducted in accordance with the appropriate EPA SW-846 methodologies by Test America. During the Phase II APAR Investigation activities, three surface water samples were also analyzed for sulfate via Method EPA 300.

3.3.4 Sediment Assessment Methods

On-Site sediment samples were collected starting at the farthest downstream Site location within Stewart Creek (2012-SED-1), with subsequent samples collected sequentially upstream. Likewise, sediment samples were collected starting at the farthest downstream location of the North Tributary (2012-SED-16), with subsequent samples collected sequentially upstream. Sediment samples were also collected in the upstream and downstream portions of Stewart Creek from the Site location in several segments as access was obtained. In each segment, samples were collected starting at the farthest downstream location and moving upstream. Sample locations were typically located in the field with a Trimble GPS with real-time differential correction capabilities, or were pre-loaded onto the GPS unit and marked in the field prior to sampling. Coordinates for SIR and APAR sediment sample locations are provided in Appendix 25.

Sediment samples were collected to a depth of approximately 6 inches below the sediment surface using a Petite Ponar grab sampler. The open sampler was dropped through the water column into the sediments, locked closed, removed from the water and placed in a stainless steel pan for delivery to the sample processing area. At some locations if sufficient sample volume was not collected during the first drop attempt, a second drop was performed to collect additional sample volume. During the upstream and downstream Stewart Creek sampling effort, the open sampler was dropped three times through the water column into the sediments, locked closed, removed from the water and placed in a stainless steel pan for compositing. At some locations if sufficient sample volume was not collected during the first three drop attempts, additional drops were performed to collect additional sample volume.

Samples were placed in containers supplied by Test America, sealed, labeled, and placed on ice in an insulated ice chest for delivery to Test America's Houston, Texas laboratory or Test America's South Burlington, Vermont laboratory (for grain size). Appropriate chain of custody documentation, blanks, and seals accompanied the samples to the laboratory.

Per the EPA-approved Work Plan, the analytical program for Site sediment samples consisted of analysis for lead, arsenic, and cadmium by EPA Method 6000 series. Analyses were conducted in accordance with the appropriate EPA SW-846 methodologies by Test America. Sediment samples were also analyzed for grain size (ASTM D422) and total organic carbon using the Walkley Black Method.

3.4 Investigation-Derived Waste

Soil and monitoring well purge/development water investigation-derived waste (IDW) was initially stored in 55-gallon steel drums at the Site pending disposition. Purge/development water IDW was disposed in the on-site Wastewater Treatment Facility during the SIR and Phase I of the APAR activities. Soil IDW from the Phase I APAR activities was characterized and removed from the Site in accordance with state and federal regulations. All IDW for the SIR and first Phase of APAR investigations has been removed from the Site or processed on-site (in the case of purge/development water). Soil, concrete cores and monitoring well development/decontamination water from the second phase of APAR activities has been characterized as non-hazardous waste and is staged at the Site for off-Site removal in accordance with state and federal regulations. The waste characterization and disposition documentation for the soil IDW from the SIR and APAR investigations is provided in Appendix 12 of this APAR.

3.5 Data Quality

The laboratory analytical methods utilized for the analysis of the COCs outlined in Section 3.1 were appropriate and commonly utilized EPA SW-846 methodologies, or other appropriate methodology, for the type of COCs in each analysis group. Sample quantitation limits (SQLs) for all analytes were below applicable PCLs for all media evaluated, with the exception of the SVOCs benzidine and n-nitrosodimethylamine (see Section 10). Field duplicate sample data for soil, groundwater, and surface water are included in the data summary tables provided in Sections 4, 5, and 6. Per the Work Plan, field duplicates were not collected for soil or sediment samples collected during the SIR. Laboratory quality assurance/quality control (QA/QC) data and blank data (trip blanks and equipment blanks) are discussed in the data usability summaries (DUS) and validation reports in Appendix 10. A summary of the data validation procedures for the 2012 SIR, Phase I (2013) APAR, and Phase II (2014) APAR investigations are provided in the following sections.

3.5.1 SIR Investigation Data Validation Summary

Consistent with Quality Assurance Project Plan (QAPP) procedures provided in the Work Plan, data validation was performed on 100% of the environmental samples. The data validation for the SIR investigation consisted of a systematic review of the analytical results, associated quality control (QC) methods and results, and all of the supporting data as presented in Level IV data packages supplied by the laboratory. The validation also included a data verification process and usability determination and was performed using the guidelines presented in the EPA Contract Laboratory Program *National Functional Guidelines (NFG) for Inorganic Superfund Data Review* (EPA, 2010b) and *National Functional Guidelines (NFG) for Superfund Organic Methods Data Review* (EPA, 2008). Results of the validation are presented in data validation and usability summary reports by sampling event (Appendix 10).

The validator performed the validation using the following QC criteria:

- Laboratory Accuracy – the method-specified recovery control limits of 75-125% for metals and TPH and the laboratory-derived control limits for PAH and the wet chemistry parameters (as specified in the QAPP) with a data rejection limit of 30% for inorganics and 10% for organics.
- Laboratory Precision – the method-specified RPD control limit of 20% (as specified in the QAPP) or an absolute difference control limit of 1x the reporting limit (if either result is less than or equal to 5x the reporting limit) per the NFG.
- Field Precision (for the groundwater and surface water field duplicates) – an RPD control limit of 20% or an absolute difference control limit of 2x the reporting limit (if either result is less than or equal to 5x the reporting limit), which is considered typical for data quality assessment of an aqueous matrix.

Analytical results associated with a QC deficiency were flagged using the QAPP-specified data validation qualifiers, which are defined as follows:

- U Blank contamination; the analyte was not detected substantially above the level reported in an associated laboratory and/or field blank. Using a U-flag for blank contamination is consistent with the guidance document *National Functional Guidelines (NFG) for Inorganic Superfund Data Review* (EPA, 2010b).
- UJ Estimated; the analyte was not detected above the reporting limit; however, the reporting limit is approximate due to exceedance of one or more QC requirements.
- J Estimated; the reported sample concentration is approximate due to exceedance of one or more QC requirements. Directional bias cannot be determined.
- J- Estimated low; the reported sample concentration is approximate due to exceedance of one or more QC requirements. The actual value is expected to be lower.
- J+ Estimated high; the reported sample concentration is approximate due to exceedance of one or more QC requirements. The actual value is expected to be higher.
- R Rejected; the sample result is rejected due to serious QC deficiencies that make it impossible to verify the presence or absence of the analyte.

When an option exists to assign two different flags, the flag higher in the data quality hierarchy was assigned (R > UJ > U > NJ > J > J+ or J-).

In order to determine if data quality objectives were met, the completeness of the analytical results data set was evaluated. The field completeness, which is the percentage of tests performed compared to the total number of tests planned for environmental samples, was calculated as 98.7%. The laboratory completeness, which is the percentage of valid analytical results (i.e., those without an R flag) compared to the total number of results reported for environmental samples, was calculated as 99.6%. Both of these are above the standard goal of 90%. The quality of the investigation data is acceptable for the goals of this report.

All analytical results presented in the tables and figures of this report include the data validation qualifier, if any was applied. Appendix 10 lists all of the qualified results along with the specific reasons for qualification.

Results with no qualification and those qualified as estimated are of acceptable quality for the intended use. Some results are qualified as estimated (J, J+, J- or UJ) due to minor QC issues, primarily poor laboratory duplicate precision for metals in the soil or sediment samples. This is not considered unusual due to the inherent variability of soil and sediment samples. Note that a data validation qualifier of J may be assigned solely because the analytical result was qualified by the laboratory as an estimated concentration between the sample detection limit and the sample quantitation limit. The concentration reported for detects or the reporting limit for non-detects is considered estimated with a high bias (J+ flag), low bias (J- flag), or unknown bias (J or UJ flag).

Results that are qualified as associated with a contaminated blank (U) are also useable. Nine results for cadmium are U-qualified because the analyte was not detected substantially above the level in an associated laboratory blank or field QC blank. In each case, cadmium should be considered not detected at the sample location.

Results that are rejected (R) are typically not useable. Two antimony results are qualified as rejected (R) per EPA recommendations in the National Functional Guidelines (EPA, 2008 and EPA, 2010b). However, these non-detected results (in soil samples 2012-CUFT-1(0-2') and 2012-CUFT-2 (0-2')) are rejected due to a matrix spike duplicate recovery of 29%, which is just below the data rejection limit for inorganics of 30%, while the corresponding matrix spike recovery is 30%. This indicates the results may be up to 4x below the actual value. The sample detection limits (SDLs) for these two non-detects (0.293 mg/Kg and 0.283 mg/Kg) are more than 50x below the delineation standard for antimony in soils (15 mg/Kg). Thus, the results are considered useable for demonstrating conformance with the assessment goals and criteria.

3.5.2 APAR Phase I Investigation Data Validation Summary

Data collected for the 2013 affected property assessment were validated in accordance with TRRP requirements. A review was completed on 100% of the environmental samples to determine conformance with the requirements of the TRRP guidance document, *Review and Reporting of COC Concentration Data* (RGG-366/TRRP-13) (TCEQ, 2010b) and for adherence to project objectives. Results of the review are presented in data usability summaries (DUS) by sample media and month (Appendix 10).

Criteria used for the data usability review are as follows:

- Inorganics: 70-130% spike recovery (and not less than 30% or data are rejected) and ±MQL difference or 30% RPD (for laboratory duplicates) as recommended in TRRP-13.
- Organics: 60-140% spike recovery (and not less than 10% or data are rejected) and ±MQL difference or 40% RPD (for laboratory duplicates) as recommended in TRRP-13.
- Soil Samples: ± 3x MQL difference (if either result is less than 5x MQL) or 50% RPD (for field duplicates) as recommended in TRRP-13.
- Groundwater Samples: ± 2x MQL difference (if either result is less than 5x MQL) or 30% RPD (for field duplicates) as recommended in TRRP-13.

If an item was found outside of the review criteria, the reviewer applied a data qualifier and bias code to the results for the affected samples in accordance with TRRP-13. Per TRRP-13, the qualifiers and codes are defined as follows:

- U Not detected; the analyte was not detected >5x (10x for common contaminants) the level in an associated blank and thus should be considered not detected above the level of the associated numerical value (i.e., the reported sample concentration).
- UJ Estimated data; the analyte was not detected above the reported sample detection limit (SDL). The numerical value of the SDL is estimated and may be inaccurate.
- J Estimated data; the analyte was detected and identified. The associated numerical value (i.e., the reported sample concentration) is the approximate concentration of the analyte in the sample.
- NJ Tentatively identified, estimated data; the analysis indicates the presence of the analyte for which there is presumptive evidence to make a tentative identification and the associated numerical value represents its approximate concentration.
- NS Not selected; another result (from a secondary dilution, different analytical method, re-sampling, etc.) is selected for use based on QC outcomes and/or reported concentrations.
- R Rejected data; the result is unusable. Serious QC deficiencies make it impossible to verify the absence or presence of this analyte.
- X7 The laboratory is not NELAC accredited under the Texas Laboratory Accreditation Program for this analyte in this matrix analyzed by this method. The TCEQ does not offer accreditation for this analyte, in this matrix, analyzed by this method.
- X8 The laboratory is not NELAC accredited under the Texas Laboratory Accreditation Program for this analyte in this matrix analyzed by this method. The TCEQ offers accreditation for this analyte in this matrix by this method, but the laboratory is not accredited for this analyte in this matrix by this method. The analyte result is validated and reported as part of a suite of analytes for the method.
- H Bias in sample result is likely to be high.
- L Bias in sample result is likely to be low.

When an option exists to assign two different flags, the flag higher in the data quality hierarchy was assigned (R > U > NJ > J > JL/JH for detects and R > UJ > UJL for non-detects).

All analytical results presented in the tables and figures of this report include the data qualifier, if any was applied. Appendix 10 lists all of the qualified results along with the specific reasons for qualification.

Results with no qualification and those qualified as estimated are of acceptable quality for the intended use. Some results are qualified as estimated (J, JH, JL, UJ or UJL) due to minor QC issues, primarily poor laboratory duplicate precision for metals in the soil samples. This is not considered unusual due to the inherent variability of soil samples. Note that a data qualifier of J may be assigned solely because the analytical result was qualified by the laboratory as an estimated concentration between the sample detection limit and the quantitation limit. The concentration reported for detects or the reporting limit for non-detects is considered estimated with a high bias (JH flag), low bias (JL or UJL flag), or unknown bias (J or UJ flag).

Results that are qualified as not detected because the result is associated with a contaminated blank (U) are also useable. One result for methylene chloride and ten (10) results for chloroform are U-qualified because the analyte was not detected substantially above the level in an associated laboratory blank. In each case, the analyte should be considered not detected at or above the reported concentration for the sample location.

Results that are rejected (R) are not useable. Two non-detects (for benzidine and 3,3'-dichlorobenzidine in soil sample MW-27 (0-1')) are qualified as rejected (R) per TRRP-13 guidelines due to extremely low laboratory control spike (LCS) recovery (0%). In each case, it is not possible to determine the absence or presence of the analyte due to serious QC deficiencies.

3.5.3 Data Quality Issues Regarding Sample MW-31 (0.9-2')

Significant discrepancies in duplicate soil sample results for the 0.9 to 2-foot depth bgs sample interval at sample location MW-31 (parent sample lead concentration = 12,900 mg/kg; duplicate sample lead concentration = 68 mg/kg) indicated possible incorrect labeling of the 0.9 to 2-foot sample interval for this location. An examination of the 0.9 to 2-foot samples by laboratory personnel indicate that the physical appearance of the duplicate sample was consistent with the physical appearance of the 0.9 to 2-foot depth interval as described on the boring log for MW-31. The physical appearance of the parent sample from this interval was consistent with the boring log description of deeper intervals, suggesting that the 0.9 to 2-foot parent sample was collected from a deeper depth. To confirm the suspected incorrect depth label for the 0.9 to 2-foot parent sample, a second soil boring (MW-31R) was drilled and sampled adjacent to MW-31. The results for soil samples collected from this boring (also sampled in duplicate) were similar to the MW-31 (0.9-2) duplicate sample, thus confirming the suspected incorrect depth label on the original parent sample. As a conservative measure, all soil samples from boring MW-31 were

flagged as "NS", indicating that other results (i.e., results from boring MW-31R) were selected for use based on the QC outcomes.

3.5.4 APAR Phase II Data Validation Summary

Data collected for the 2014 affected property assessment were validated in accordance with TRRP requirements. A review was completed on 100% of the environmental samples to determine conformance with the requirements of the TRRP guidance document, *Review and Reporting of COC Concentration Data* (RGG-366/TRRP-13) (TCEQ, 2010b) and for adherence to project objectives. Results of the review are presented in data usability summaries (DUS) by sample media (Appendix 10).

Criteria used for the data usability review are as follows:

- Inorganics: 70-130% spike recovery (and not less than 30% or data are rejected) and ±MQL difference or 30% RPD (for laboratory duplicates) as recommended in TRRP-13.
- Organics: 60-140% spike recovery (and not less than 10% or data are rejected) and ±MQL difference or 40% RPD (for laboratory duplicates) as recommended in TRRP-13.
- Soil/Sediment Samples: ± 3x MQL difference (if either result is less than 5x MQL) or 50% RPD (for field duplicates) as recommended in TRRP-13.
- Groundwater/Surface Water Samples: ± 2x MQL difference (if either result is less than 5x MQL) or 30% RPD (for field duplicates) as recommended in TRRP-13.

If an item was found outside of the review criteria, the reviewer applied a data qualifier and bias code to the results for the affected samples in accordance with TRRP-13. Per TRRP-13, the qualifiers and codes are defined as follows:

- U - Not detected; the analyte was not detected >5x (10x for common contaminants) the level in an associated blank and thus should be considered not detected above the level of the associated numerical value (i.e., the reported sample concentration).
- UJ - Estimated data; the analyte was not detected above the reported sample detection limit (SDL). The numerical value of the SDL is estimated and may be inaccurate.
- J - Estimated data; the analyte was detected and identified. The associated numerical value (i.e., the reported sample concentration) is the approximate concentration of the analyte in the sample.
- NJ - Tentatively identified, estimated data; the analysis indicates the presence of the analyte for which there is presumptive evidence to make a tentative identification and the associated numerical value represents its approximate concentration.
- NS - Not selected; another result (from a secondary dilution, different analytical method, re-sampling, etc.) is selected for use based on QC outcomes and/or reported concentrations.
- R - Rejected data; the result is unusable. Serious QC deficiencies make it impossible to verify the absence or presence of this analyte.

- X7 - The laboratory is not NELAC accredited under the Texas Laboratory Accreditation Program for this analyte in this matrix analyzed by this method. The TCEQ does not offer accreditation for this analyte, in this matrix, analyzed by this method.
- X8 - The laboratory is not NELAC accredited under the Texas Laboratory Accreditation Program for this analyte in this matrix analyzed by this method. The TCEQ offers accreditation for this analyte in this matrix by this method, but the laboratory is not accredited for this analyte in this matrix by this method. The analyte result is validated and reported as part of a suite of analytes for the method.
- H - Bias in sample result is likely to be high.
- L - Bias in sample result is likely to be low.

When an option exists to assign two different flags, the flag higher in the data quality hierarchy was assigned (R > U > NJ > J > JL/JH for detects and R > UJ > UJL for non-detects).

All analytical results presented in the tables and figures of this report include the data qualifier, if any was applied. Appendix 10 lists all of the qualified results along with the specific reasons for qualification.

Results with no qualification and those qualified as estimated are of acceptable quality for the intended use. Some results are qualified as estimated (J, JH, JL, UJ or UJL) due to minor QC issues, primarily poor matrix spike recoveries or poor duplicate precision. This is not considered unusual due to the inherent variability of soil samples. Note that a data qualifier of J may be assigned solely because the analytical result was qualified by the laboratory as an estimated concentration between the sample detection limit and the quantitation limit. The concentration reported for detects or the reporting limit for non-detects is considered estimated with a high bias (JH flag), low bias (JL or UJL flag), or unknown bias (J or UJ flag).

Results that are qualified as not detected because the result is associated with a contaminated blank (U) are also useable. Five results for butyl benzyl phthalate, seven results for diethyl phthalate, seven results for di-n-butyl phthalate, one result for toluene, and one result for antimony are U-qualified because the analyte was not detected substantially above the level in an associated laboratory blank or field blank. In each case, the analyte should be considered not detected at or above the reported concentration for the sample location.

Results that are rejected (R) are not useable. The following three non-detects for benzidine are qualified as rejected (R) per TRRP-13 guidelines due to extremely low laboratory control spike (LCS) recovery (0%). In each case, it is not possible to determine the absence or presence of the analyte due to serious QC deficiencies:

- Sample MW-43 [600-85797-4];

- Sample RINSE BLANK – GEOPROBE [600-85272-18]; and
- Sample RINSE BLANK – CME [600-85272-19].

The following samples (non-detects) for benzidine, benzyl alcohol, 3,3'-dichlorobenzidine, and/or hexachlorocyclopentadiene are qualified as rejected (R) per TRRP-13 guidelines due to extremely low matrix spike recoveries (0%):

- Sample 2014-NDA-7 (0-0.5) [600-89799-1]
- Sample DUP-4 [600-89799-4]
- Sample 2014-FFTA-07 (0-0.5) [600-89799-5]
- Sample 2014-FFTA-08 (0-0.5) [600-89799-8]
- Sample 2014-FFTA-06 (0-0.5) [600-89799-11]
- Sample Rinse Blank Geo [600-89799-11] (benzidine only)

These SVOCs are not considered primary COCs and thus the data rejection does not pose any significant issues.

In package 600-89799-2, sample 2014-FFTA-08 (0.5-2), which had originally been placed on hold, was analyzed marginally past the recommended holding time in support of vertical delineation of the methylene chloride and bis(2-chloroethyl)ether exceedences in the surficial depth interval. Note that the methylene chloride concentration in the shallow interval was not correlated directly with a laboratory blank contamination issue for the batch; however another batch did exhibit detections of methylene chloride and this is a common laboratory artifact. The deeper interval result for methylene chloride was non-detect, and although analyzed outside holding time, may be considered usable (qualified as UJL). Bis(2-chloroethyl) ether was non-detect in the deeper interval, also analyzed marginally outside the recommended holding time, and exhibited very poor LCS recovery. A relatively high method blank concentration was associated with the batch. The data user is advised that this result be rejected (R) since it is not possible to determine the presence or absence of this analyte.

Four results for Total cadmium and Total lead in groundwater were rejected (R) due to improper field filtering techniques prior to collection of the sample.

- Sample MW-32 [600-86073-4];
- Sample MW-33 [600-86073-1];
- Sample MW-44 [600-86073-3]; and
- Sample MW-46 [600-86073-2].

Samples from these four locations were recollected using proper field filtering techniques, and reanalyzed.

As recommended in TRRP-13, non-detect inorganic results are not unusable when MS/MSD recoveries are lower than 30%. The MS/MSD recoveries for antimony in the below samples were less than 30%; thus antimony results for the following two samples were not accepted.

- Sample SRB-VS-11B (2-4)
- Sample 2014-SDA-7 (0.5-2)

A number of other samples were affected by MS/MSD recoveries for antimony that were marginally lower than 30%. Low antimony recoveries have been well documented as an issue with the preparation and analytical method in some soils. The laboratory control samples (or laboratory fortified blanks) were in control, indicating the analysis and sample preparation were in control with respect to antimony. Although a low bias was identified, the data required only ‘J’ or ‘UJ’ flagging and are still considered usable results.

Table 3A

Underground Utilities

Utility Type	Construction Material	Backfill Material	Approximate Depth (ft)	Utility Company Name	Potential Migration Pathway?		Affected?	
					Yes	No	Yes	No
Fiber Optic Cable	NA	Unknown	4-5	Various		x		x
Natural Gas	Unknown	Unknown	Unknown	Atmos Energy		x		x
Process Drain Lines	PVC	Concrete Encasement	2	Exide		x	x[1]	
Sanitary Sewer	Unknown	Unknown	Unknown	City of Frisco		x	x[1]	
City Water	Unknown	Unknown	Unknown	City of Frisco		x	x[1]	
Storm Water	PVC/HDPE	Unknown	Unknown	Exide		x	x[1]	
Wastewater	Unknown	Unknown	Unknown	Exide		x	x[1]	

Notes:

1. [1] - Sections of these utilities are within areas of the affected property where soil concentrations exceed applicable PCLs, and may be affected. As noted in Section 3.2.7, Site data do not suggest that these utilities are acting as preferential pathways for migration of Site COCs.

Table 3B
Constituent of Concern Evaluation

Topic	Documents	Discussion	Comment
Pb and Cd are primary COCs; additional parameters/COCs identified in specific process areas	Permit for Industrial Solid Waste Management Site (Permit No. HW-50206), dated May 24, 1988 (TWC).	A RCRA Facility Investigation was ordered in the permit provisions. TWC requested that Pb and Cd concentrations be evaluated for soil samples collected during the drilling of monitoring wells, soil samples collected in and around the permitted units, and groundwater samples.	TCEQ publication RG-366/TRRP-10 recommends the first step of COC selection is to evaluate the permit requirements.
	RCRA Facility Investigation Workplan for GNB Incorporated, Frisco, TX (Lake, 1989)	In this workplan, Pb and Cd were identified as the primary COCs at the site. All soil, groundwater, surface water and sediment samples were proposed to be evaluated for pH, Pb and Cd, except the samples collected in the vicinity of the former diesel oil spill, which were also proposed to be evaluated for TPH in addition to Pb and Cd. This workplan was approved by TNRCC letter dated February 6, 1990.	TNRCC approved Pb and Cd as the primary COCs at the site, in addition to TPH in the vicinity of the former diesel fuel spill.
	Phase I and Phase I Addendum Approval (TNRCC, 1994)	A Phase II investigation was requested. TNRCC stated that all soil samples in the Phase II should be analyzed for pH, Pb and Cd. Groundwater samples were to be evaluated for pH, sulfate, Pb and Cd.	TNRCC ordered that all soil samples be evaluated for pH, Pb and Cd and groundwater samples to be evaluated for pH, sulfate, Pb and Cd.
	Workplan for Phase II RCRA Facility Investigation; GNB Facility, Frisco, Texas (RMT/Jones and Neuse, 1994)	Proposed all soil samples be evaluated for Pb, Cd and pH; groundwater samples to be evaluated for Pb, Cd, TDS, sulfates and pH. This workplan conditionally approved by TNRCC by letter dated February 27, 1998. No additional constituents were requested in the conditional approval.	TNRCC approved Pb and Cd as the primary COCs at the site.
	Administrative Order (EPA, 2011)	In V.47, Pb, Cd and Se are recognized as the constituents hazardous to human health identified at the facility. Se (and Cd) was specified as having been previously encountered in the contents of the Crystallizer frac tank.	EPA recognized Pb, Cd and Se as the constituents identified at the facility. Se was specified as having previously been detected in the contents of the frac tank.
	Sampling and Analysis Workplan (CRA, 2011) for the Site Investigation	Pb was identified as the primary COC in the preliminary Conceptual Site Model, with Cd and TPH noted as having been detected on the site historically. For soil, groundwater, sediment and surface water samples, Cd and Pb were the presumptive COCs. Soil samples in the Crystallizer area were also to be evaluated for Sb, As, Ba, Be, Cd, Cr, Pb, Ni, Se, Ag and Zn. The workplan was approved by the EPA by email on December 2, 2011.	EPA approved Pb and Cd to be the primary COCs for all investigated areas at the site, with the exception of the Crystallizer, which was evaluated for Pb, Cd, and other metals. TPH analysis was also proposed for soil samples from specific areas.
	TCEQ publication RG-366/TRRP-10	For Step 4 of the selected target chemicals of concern, Review the Information Using Professional Judgment, paragraph 2 states "...Professional judgment, combined with institutional knowledge...may dictate that a COC, or a class of COCs, is realistically a target COC for a project. Common examples include...lead for a battery manufacturing facility..."	Pb identified in RG-366/TRRP-10 as a target COC for battery manufacturing facilities.
As and Se in tank sample at Class 2 landfill	From December 14-18, 2009, a multi-media inspection was conducted at Exide (EPA, 2011). A sample was collected from the leachate collection tank associated with the non-hazardous landfill and tested characteristically hazardous for arsenic and selenium.		As and Se were added as COCs for groundwater samples from the Class 2 landfill area. As and Se analyses will also be performed on soil samples to be collected on the landfill perimeter in response to TCEQ comments on the July 9, 2013 APAR submittal.
PST removals and final closure documentation	Letter notification of in-place abandonment of one 2,000 gallon underground storage tank for gasoline (United States Environmental Services, Inc., 1993).	The letter detailed the in-place abandonment of a 2,000 gallon underground storage tank used to store gasoline. It was noted in the letter that the UST was in the vicinity of the diesel fuel spill (see below). It noted that the diesel oil spill was being remediated in accordance to the April 29, 1988 letter from GNB to TWC. It also noted that soil samples were collected and that no evidence of gasoline contamination of surrounding soils was encountered following sampling and analysis. Diesel fuel was encountered in the samples, however, this was expected given the historical diesel fuel spill (see below).	No evidence of gasoline contamination of soil or groundwater was encountered during the in-place abandonment of the underground storage tank. TPH, PAHs and VOCs added as COCs at several locations near this area in SIR and APAR investigation.

Table 3B
Constituent of Concern Evaluation

Topic	Documents	Discussion	Comment
Spills around above ground diesel tank	Letter regarding diesel oil spill to TWC (Lake, 1988), Appendix F of Phase I RFI (Lake, 1991), and TCEQ closure letter for LPST No. 106075 (TCEQ, 2003)	The letter details the discovery of the diesel fuel spill in the subsurface during construction of the stormwater containment wall. The release was discovered and remedied approximately five years prior to the letter date. Lake Engineering stated that an oil spill recovery system was installed in Appendix F of the Phase I RFI. As of the time of the report, approximately 687 gallons of diesel fuel had been recovered. No further action was required by TCEQ by letter dated July 15, 2003.	Soil samples collected along the Stewart Creek floodwall investigation (creek side and facility side) during 2012 were evaluated for TPH. In addition, soil samples between the Stewart Creek floodwall and Stewart Creek were evaluated for PAHs in soil samples collected in this area in January 2013. TPH and VOCs were also analyzed in several soil samples collected in March-April 2013 inside and outside of the Slag Treatment Building, adjacent to the spill area.
Corrosive liquids from battery acid at Battery Breaking area	TNRCC Approval of Phase I and Phase I Addendum (TNRCC, 1994)	TNRCC suggested subsurface soil sampling may be needed in the vicinity of the battery breaker due to questions of integrity of the concrete in the area surrounding the acid sump.	Soil pH analysis were included for samples collected in this area.
Herbicide storage	During an interview conducted February 13, 2013, Wendell Carlile (Exide) indicated that only minor amounts of weed killer such as Round Up were stored on-site by the site landscaping contractor.	Herbicides may have been applied in minor amounts in landscaped areas such as around the office building and employee parking lot.	TCEQ publication RG-366/TRRP-10 states "Release determinations do not apply to situations where materials or products are used as intended, such as lawful application of chemical pesticides and agricultural chemicals..."
Pesticide storage	During an interview conducted February 13, 2013, Wendell Carlile (Exide) indicated that small amounts of wasp spray in small (e.g. 14 oz) canisters were stored on the site.	Minor amounts were used as needed for the removal of wasp nests at the site.	TCEQ publication RG-366/TRRP-10 states "Release determinations do not apply to situations where materials or products are used as intended, such as lawful application of chemical pesticides and agricultural chemicals..."
Chlorinated solvents	Annual Activity Reports, 1993, 1996, 1997 (GNB).	Annual waste activity reports declared shipments of Safety-Kleen parts cleaner off-site.	Safety-Kleen parts cleaner, which contains chlorinated solvents, was used in the maintenance building that is located east of the Raw Material Storage Building. Select samples below the Raw Materials Storage Building were analyzed for VOCs and SVOCs. Additional samples near the maintenance building were analyzed for VOCs.
Burn Area	During an interview conducted January 8, 2014, Larry Eagan (former Exide Plant Manager) indicated that a burn pile area was formerly located approximately 200 feet west-northwest of the Fire Fighting Training Facility.	Materials historically burned in the burn area included scrap wood from blocking stacks of lead bars that were shipped into the plant by rail or "dunnage", and other materials such as brush from the Site and from areas throughout the City of Frisco, such as trees and brush from City landscaping/drainage cleanout activities that were brought by the City of Frisco to the Site to be burned by the City of Frisco's Fire Department during Fire Fighter training exercises.	VOCs, SVOCs, and metals added as COCs at several locations near this area in the 2014 APAR investigation.
Fire Fighting Training Area	Information provided by the City of Frisco	The Fire Fighting Training Facility, located on the north side of the Truck Staging Area was formerly used by the City of Frisco Fire Department to conduct training exercises. Chemicals used at the facility by the City Fire Department included diesel and propane (as accelerants) and Class "A" and "B" foams	VOCs, SVOCs, TPH, PFCs, and metals added as COCs at several locations near this area in the 2014 APAR investigation.

Legend

Type of Sampling Location

- Monitoring Well Location
- Soil Sample / Soil Boring Location
- Boring with no slag observed

Thickness of Fill Zone with Slag (ft)

- 0.0 - 0.1
- 0.1 - 1.0
- 1. - 5.0
- 5.0 - 15.0

- 1-ft Contour Interval
- Former Operating Plant
- Undeveloped Buffer Property
- Extent of Disposal Area
- Critical PCL Exceedance Zone (PCLE Zone)
- French Drain
- Stewart Creek (Appoximate Creek Centerline)
- North Tributary (Appoximate Creek Centerline)
- Former Path of North Tributary (1951 Aerial Photo)
- Former Path of North Tributary (1972 Aerial Photo)
- Former Path of Stewart Creek (1951 Aerial Photo)

Notes:
1. ZERO (0) SLAG THICKNESS INDICATES THAT NO SLAG WAS OBSERVED IN THE BORING.

2. CONTOURS INDICATE SLAG THICKNESS AS NOTED IN BORING LOGS.

3. THICKNESS WAS CONTOURED IN ARCGIS USING NEAREST NEIGHBOR INTERPOLATION EXCEPT WHERE DELINEATION SAMPLING HAS DEFINED THE SLAG WASTE BOUNDARY.

4. SLAG LANDFILL WASTE DEPTH BASED ON INFORMATION CONTAINED IN "ADDENDUM TO THE RCRA FACILITY INVESTIGATION FOR GNB INC.", DECEMBER 1993 BY LAKE ENGINEERING, INC.

Source:
1. IMAGERY - 2009 ORTHOIMAGERY

N

60 30 0 60 Feet

Scale: AS SHOWN

File No. 1302086-B022 FIG 3A.mxd

FORMER OPERATING PLANT
FRISCO RECYCLING CENTER
FRISCO, TEXAS

FIGURE 3A

THICKNESS OF FILL ZONES IN WHICH SLAG WAS OBSERVED

PROJECT NO. 13-02086	BY: JWT	REVISIONS
DATE: 4/22/2014	CHECKED: JW	

GOLDER ASSOCIATES INC.

Map Document: N:\File\2013\13-02086 Exide Frisco\B - APAR Phase II\map documents\1302086-B022 FIG 3A.mxd / Modified 5/21/2014 2:37:17 PM by jthomas / Exported 5/21/2014 2:37:34 PM by jthomas

4.0 SOIL ASSESSMENT

4.1 Derivation of Assessment Levels

As discussed in Section 2.6, applicable soil assessment levels are based on the following exposure pathways:

- *Surface Soil*: The ${}^{Tot}Soil_{Comb}$ and ${}^{GW}Soil_{Ing}$ pathways are considered potentially complete for surface soil, defined as soil from ground surface to 15 feet bgs for residential land use and from ground surface to 5 feet bgs for commercial-industrial land use.
- *Subsurface Soil:* The ${}^{Air}Soil_{Inh\text{-}V}$ and ${}^{GW}Soil_{Ing}$ pathways are considered potentially complete for subsurface soils, defined as soil below 15 feet bgs for residential land use and below 5 feet bgs for commercial-industrial land use.

As listed above, soil assessment levels are based on potential human health exposure pathways. An evaluation of potential ecological pathways is provided in the SLERA in Section 9 of this APAR. TRRP [30 TAC §350.51(c)] requires delineation of COCs in soil samples for assessment purposes be performed using assessment levels established for residential land use (RALs) (even for properties with commercial-industrial land use) to determine whether off-site properties may be affected. For this APAR, RALs are defined as the lowest of the applicable TRRP Tier 1 or Tier 2 residential PCLs for each COC, based on the applicable exposure pathways described above and an assumed 30-acre source area size for inorganics, and a 0.5 acre source area size for organics. In accordance with 30 TAC §350.51(d)(2), the vertical assessment of COCs in soil was generally performed to the appropriate RAL in areas where a groundwater assessment was performed. Background soil concentrations listed in Table 4A and 4C are Texas-specific median background values from Figure 30 TAC 35.51(m) except for arsenic and lead, for which site-specific background concentrations were determined, as presented in Appendix 8. Additionally, TCEQ Method 1006 data was used to develop a site-specific TPH PCL from fractionation of seven aliphatic boiling point ranges and six aromatic boiling point ranges for the TPH mixture. The derivation of RALs for surface soil and subsurface soil is summarized in Tables 4A and 4C, respectively. Documentation on the development of Tier 2 PCLs is provided in Appendix 9.

For this APAR, critical PCLs are defined as the lowest applicable TRRP commercial-industrial PCL for each COC, based on the applicable exposure pathways described above and an assumed 30-acre source area size for inorganics, and a 0.5 acre source area size for organics. Critical PCL exceedances in soil samples from the Site are discussed in this section of the APAR, but are also addressed in Section 11.

4.2 Nature and Extent of COCs and NAPL in Soil

Affected property soil boundaries have been delineated based on the lateral and vertical extent of RAL exceedances of the primary COCs (i.e., lead and cadmium) and, as applicable, process area-specific COCs (e.g., TPH in the Former Diesel Tank release area, etc.) observed in soil samples collected as part of the SIR and APAR investigations. A discussion of the extent of soil affected properties is provided in Section 1.2.5. The following sections address the nature and extent of RAL exceedances of lead and cadmium (which are equivalent to critical PCL exceedances), as well as exceedances of RALs for process area-specific COCs in soil samples collected within or in the vicinity of the WMUs listed on the FRC's NOR and within or in the vicinity of the potential source areas identified in the Work Plan (CRA, 2011), or identified in EPA comments on the SIR or in subsequent discussions with the TCEQ and EPA (see Section 3). Additional data from soil samples collected to evaluate potential atmospheric deposition of COCs, areas of potential ecological habitat, and other areas sampled at the Site during the SIR and APAR investigations are also discussed in the following sections, along with data from the soil boring water samples collected in accordance with the Work Plan requirements, as described in Section 3.2.1.

SIR and APAR investigation soil sample data discussed in Sections 4.2.1 through 4.2.19 are summarized in Tables 4D.1 through 4D.6. Soil boring water sample data are summarized in Table 4E. Laboratory reports for the SIR and APAR investigation data are provided in Appendix 10 and a summary of available historical soil data are presented in Appendix 17. A soil sample location map, which depicts RAL exceedances of lead is provided on Figure 4A and soil boring logs are provided in Appendix 2. A cross section location map is presented on Figure 4C.1 and cross sections based on soil borings completed at the Site are presented on Figures 4C.2 and 4C.3.

During the second phase of the APAR investigations, many of the samples collected addressed additional vertical or horizontal delineation of areas of the site. At the request of TCEQ, samples were also collected to assess the distribution of arsenic, selenium, and antimony at the Site. Select samples were collected to evaluate the distribution of these COCs horizontally and vertically. In almost all cases, wherever one of the new COCs was present in exceedance of the RALs, lead was also present in exceedance of the RAL at the same location. Two exceptions were noted:

- Concentration of antimony at SRB-VS-11B exceeded the RAL (2.7 mg/kg) for the 0.5 to 2 foot bgs sample (3.10 mg/kg), collected in the shooting range/south berm area. However, antimony was not detected in the duplicate sample or the underlying sample. The sample concentration is considered anomalous.
- Concentrations of arsenic in several locations exceeded the RAL (15.9 mg/kg). These included surficial samples at D-11A (27.2 mg/kg), D-11B (21.0 mg/kg), and 2013-C2L-01 (17.2 mg/kg); as well as the 15 to 17 feet bgs interval at 2013-C2L-08 (18.5 mg/kg). However, exceedances, which all occurred in the northern part of the site, were within the

expected range of background concentrations for agricultural use based on published documents (BEG, 2005).

During remediation, areas exceeding the critical PCLs will be addressed. Because lead is the primary COC in almost all locations, areas already planned to be remediated to address known impacts of lead and cadmium will also address impacts due to the other COC metals. In addition, confirmation samples will be collected during remediation, which will allow final delineation as part of the remedial actions.

4.2.1 Battery Receiving/Storage Building (RCRA HW Permit Unit No. 001; NOR WMU No. 11)

During the first phase of the APAR investigation, sixty-one soil samples (including duplicate samples) were collected from the Battery Receiving/Storage Building from twelve boring locations inside the building. In accordance with the closure requirements provided in the RCRA Permit (Exide, 2001), soil samples were collected from soil underlying the concrete slab in the Battery Receiving/Storage Building at locations where potential exposure pathways existed to the underlying soil (cracks or other defects in the foundation noted during the unit inspection). As specified in the closure plan, soil samples were collected from each boring at various depth intervals until the saturated zone was encountered. Consistent with permit requirements and as detailed in the Decontamination and Demolition Work Plan (PBW/RSI, 2013a), soil samples were analyzed for lead and cadmium.

During the second phase of the APAR, an additional delineation sample, with a duplicate, was collected to verify the deepest lead impact detected during the first phase.

Two distinct zones of non-native material, or fill zones, were typically encountered below the concrete slab in borings completed below the Battery Receiving/Storage Building. The upper fill zone, directly below the building, generally consisted of select fill material (reddish-yellow clayey sand) within the upper 4 to 8 feet bgs. No slag material was observed in the upper fill zone. The lower fill zone generally consisted of silty clay or sandy clay extending from the base of the upper fill zone to a depth of 10.5 feet bgs or less. Slag material was observed within the lower fill zone. Based on information from Exide personnel, which is provided in Appendix 21, the slag material in the lower fill zone was not placed in connection with, and pre-dated, construction of the Battery Receiving/Storage Building.

The exact date of placement of material in the lower fill zone is not known, but long time company personnel have reported that the placement is believed to have occurred in the late 1970s (Appendix 21). In addition, historical aerial photographs of the Site were reviewed to evaluate likely periods of fill placement. While the nature of the fill placed cannot be determined from the historical aerial photographs, general timeframes for fill placement were evaluated for locations where slag has been observed in subsurface samples (Figure 3A). The primary area where slag was placed prior to building

construction is beneath the Battery Receiving/Storage Building. Aerial photographs dated 1951, 1956, 1968, 1972, 1984, 1995, 2004, 2005, 2006, and 2008 (Appendix 20) were reviewed. Based on review of the historical aerial photographs, the following observations are presented relevant to this discussion (note that both slag areas are discussed here, and not repeated in subsequent sections):

- The Battery Receiving/Storage Building was constructed between 1984 and 1995.
- In 1984, the location appears to be graded. Trailers or other small features are present, and there are no visible indications of active filling operations. The creeks have been routed to approximately their current configurations.
- In 1972, some filling and/or stockpiling activities are visible on-site, possibly including this area.
- In 1968, the North Tributary appears to have been re-routed to its second location, but no other activities are evident in the areas in question.
- In 1956, no activities are evident on-site, and Stewart Creek and the North Tributary are in the original locations.

Based on information from Site personnel (Appendix 21), the placement of the material observed in the lower fill zone is assumed to be pre-RCRA. Analysis of the historical aerial photographs does not contradict this information, and does show that fill was placed by 1984. Native silty clay soil was typically encountered below the lower fill zone, at a depth of 10.5 feet bgs or below.

Lead concentrations in at least one soil sample from each soil boring completed in the Battery Receiving/Storage Building exceeded the applicable RAL for lead (274.51 mg/kg). Cadmium results for all soil samples from the building were below the applicable RAL (30 mg/kg). The lead RAL exceedances typically occurred in samples collected from the lower zone of fill where slag was observed.

The entire Battery Receiving/Storage Building lies within Affected Property No. 2. It is bordered to the east and north by other areas of the affected property. The affected property is delineated to the south by soil samples from locations 2012-FWCS-2, 2012-FWCS-3, 2012-FWCS-4, and 2013-FWFS-1A, 2012-FWFS-2, and to the west by 2012-FWCS-11, and 2013-FWCS-1B.

Vertical delineation of lead to the applicable RAL in the Battery Receiving/Storage Building was typically completed to approximately 11 feet bgs or less, including the highest detected concentration, from the 8 to 10 foot bgs interval in 2013-BSB-8. However, in borings 2013-BSB-2, BSB-8A, and 2013-BSB-9, soil samples collected from the depth of observed saturation (approximately 10 to 11 feet bgs) exceeded the applicable RAL for lead. Consistent with 30 TAC §350.51(d)(3), groundwater samples analyzed for total and dissolved lead and cadmium were collected from monitoring well MW-31, completed within the Battery Receiving/Storage Building (see Figure 5A.4). As shown in Table 5B.1, lead and cadmium were not detected in the groundwater samples from MW-31.

The RAL for lead was exceeded in nineteen soil samples from the Battery Receiving/Storage Building, including samples at each location and from both phases of the APAR investigation As detailed in Section 3.5.3 and in Table 4D.1 (footnote 3), it is suspected that the sample depth for MW-31 (0.9-2') was incorrectly labeled in the field. This sample likely represents a deeper sample interval based on the sample appearance and inconsistent lead concentrations between that sample relative to a field duplicate sample and two resamples (parent and field duplicate) of this depth interval from immediately adjacent boring MW-31R. As noted in Section 3.5.2, soil sample results from boring MW-31 were NS-flagged (not selected for use), indicating that other results (i.e., soil sample results from boring MW-31R) were selected for use as representative results for this location based on the QC evaluation.

Fifty-three soil samples from the Battery Receiving/Storage Building were also analyzed for pH (Table 4F). The average pH for these samples was 7.54, and all but two of the samples had a pH value greater than 6.00. These two samples, 2013-BSB-4 (0.9-2') and 2013-BSB-8 (2-4'), had relatively low pH results of 4.44 and 4.45, respectively. PCLs have not been established for this geochemical parameter.

4.2.2 Raw Material Storage Building (RCRA HW Permit Unit No. 002; NOR WMU No. 5)

During the first phase of the APAR investigation, fifty-two soil samples (including duplicate samples) were collected from beneath the concrete slab in the Raw Material Storage Building ("RMSB" samples) or adjacent vicinity ("RMSA" samples), including forty soil samples (including duplicate samples) from ten borings completed inside the Raw Material Storage Building. The RCRA Permit requirements for the Raw Material Storage Building provided that sub-slab closure soil samples be collected from various depth intervals to the depth of the saturated zone at locations arranged on a grid system within the building. As discussed with TCEQ personnel and detailed in the Decontamination and Demolition Work Plan (PBW/RSI, 2013a), a nine sample grid system was proposed for this unit. Due to inaccessibility or prohibitive slab thicknesses at several of the proposed sample locations, some sample locations within the building had to be adjusted slightly from an exact grid configuration (Figures 4A.1 through Figures 4A.5). One sample location was also added within the building, for a total of ten sample locations inside the building. Consistent with the RCRA Permit requirements, these adjusted/added locations corresponded to areas where potential exposure pathways to the underlying soil (cracks or other defects in the foundation noted during the unit inspection) were observed.

Based on closure requirements in the RCRA Permit, discussions with TCEQ personnel, and procedures detailed in the Decontamination and Demolition Work Plan, all soil samples collected from the Raw Material Storage Building were analyzed for lead and cadmium, and samples collected from three sample locations were analyzed for a broader suite of compounds, including RCRA 8 metals, VOCs, and SVOCs. The three sample locations identified for the expanded analyte suite (2013-RMSB-4, 2013-RMSB-2, and 2013-RMSB-10) were selected to correspond to locations where, based on observations during the unit

inspection, the potential exposure pathways to the underlying soil were believed to be more likely to be complete. All RMSB soil samples were also analyzed for arsenic and selenium. Several soil samples from borings 2012-RMSA-1, 2012-RMSA-2, 2012-RMSA-3, 2012-RMSA-4, and 2012-RMSA-6, located adjacent to the Raw Material Storage Building, were additionally analyzed for TPH (TX1005), per the Work Plan (CRA, 2011) requirements.

During the second phase of the APAR, additional samples were collected and analyzed for lead or lead and cadmium in areas where potentially impacted subgrade material was identified during the first phase of the APAR investigation (lead at 2013-RMSB-5A near 2012-RMSB-5; and lead and cadmium at MW-35 near 2012-RMSA-3, and at MW-36 near 2012-RMSA-7).

The soil borings completed in the Raw Material Storage Building and immediate vicinity generally contained a zone of fill material immediately below the concrete slab measuring from less than 0.5 feet to approximately 5 feet in thickness. Trace amounts of battery case fragments were noted in boring 2013-RMSB-4 within the zone of fill from 2 to 3.8 feet bgs. Battery case fragments and/or slag were not observed in any of the other borings completed inside or in the immediate vicinity of the Raw Material Storage Building. Black staining and hydrocarbon odors were noted in several borings from the Raw Material Storage Building. All borings completed in the Raw Material Storage Building were field-screened for organic vapors using a PID. The PID readings were generally low (<5 ppm-v); however, a PID reading of 1,957 ppm-v was noted in boring 2013-RMSB-5 within the 2 to 5-foot bgs depth interval. Based on that observation, this sample was analyzed for VOCs in addition to cadmium, lead, arsenic, and selenium. All VOC results for this sample were below applicable RALs (Table 4D.5A). NAPL was not observed in soil samples from any of the borings completed in the Raw Material Storage Building or immediate vicinity. As a further check on the possible presence of NAPL, an oil-water interface probe was used to evaluate NAPL within the observed saturated zone in several borings within the Raw Material Storage Building (see boring logs in Appendix 2). NAPL was not detected in any of the borings evaluated with the oil-water interface probe.

Lead concentrations in one or more samples from fifteen of twenty soil sampling locations and cadmium concentrations in three soil sampling locations from the Raw Material Storage Building or immediate vicinity exceeded their respective RALs (Tables 4D.1 and 4D.2B). Arsenic concentrations in five soil sampling locations from this area exceeded the RAL (Table 4D.2A and 4D.2B). Selenium concentrations in three soil sampling locations from this area exceeded the RAL (Table 4D.2A and 4D.2B). The cadmium, arsenic, and selenium RAL exceedances were co-located with corresponding lead RAL exceedances. Other analyzed constituents, including TPH, VOCs, SVOCs, and additional RCRA 8 metals were below RALs for all samples collected in this area. As a conservative measure, the entire Raw Material Storage Building was included within Affected Property No. 2, even though some borings

did not contain samples that exceeded applicable RALs for any analyte. The Raw Material Storage Building is bordered to the east, west, and north by other areas within the affected property (Figure 4A). The maximum depth at which the affected property zone was vertically delineated in the vicinity of the Raw Material Storage Building was 9 feet bgs, at boring location 2013-RMSB-5. However, in three other borings soil samples collected from the depth of observed saturation or maximum sample depth [2012-RMSA-3 (1-3'), 2012-RMSA-2012-4 (1.5-3.5'), and 2013-RMSB-4 (5-6')] exceeded the RAL for lead. Consistent with 30 TAC §350.51(d)(3), groundwater samples were collected from monitoring well MW-29, located near and downgradient of the Raw Material Storage Building. Lead and cadmium concentrations in the groundwater samples from MW-29 were below applicable RALs (Table 5B.1).

Select soil samples collected from this area were also analyzed for pH and sulfate during the 2012 SIR investigation. Results for pH ranged from 6.83 to 10.76 and results for sulfate ranged from 1,030 mg/kg to 6,700 mg/kg (Table 4F). PCLs are not established for these geochemical parameters.

As noted in Section 3.2.3, water samples were collected from borings 2012-RMSA-2 and 2012-RMSA-4 during the SIR investigation in accordance with the Work Plan (CRA, 2011) requirements and based on the observation of perched water in the subslab soils at these locations. The total depths of these borings were 2.5 feet bgs and 3.5 feet bgs, respectively. Given the locations of these borings, the very shallow depth where the water was observed (less than 3 feet bgs), these samples represent washdown water and/or storm water perched directly below the concrete slab floor in this area. The soil boring water samples were analyzed for lead and cadmium. As shown on Table 4E, the reported concentrations in these samples ranged from 0.04 mg/L to 0.089 mg/L for cadmium and from 0.421 mg/L to 1.68 mg/L for lead. The shallow washdown water and/or storm water observed below the concrete slab is not considered groundwater and consistent with the provisions of the Work Plan specifying collection of these samples, the lead and cadmium concentrations in these reconnaissance soil boring water samples are not considered representative of concentrations of these metals in groundwater. As such, these data were used for screening purposes only and were not compared to groundwater RALs. Additional perched water samples were collected in 2014, and are discussed in Section 5.2.

4.2.3 Slag Treatment Building (NOR WMU No. 8)

During the first phase of the APAR investigation, ten subslab soil samples (including duplicates) were collected at depths up to 5.5 feet bgs at eight locations (2013-STB-5 through 2013-STB-12) inside the Slag Treatment Building, and were analyzed for lead and cadmium. These locations correspond to areas where evidence of cracks or other defects in the foundation were noted during inspection of the building. Ten additional soil samples (including duplicates) were collected in the immediate vicinity on the northern side of the building at four locations (2013-STB-1 through 2013-STB-4), including samples from one boring (2013-STB-2) completed at the approximate location of the sample collected on top of the concrete

slab by the TCEQ during the TCEQ Site inspection in May-June 2011. The reported lead concentration of the TCEQ sample from this location was 47,100 mg/kg (TCEQ, 2011a). Samples from 2013-STB-2 were collected from below the slab to evaluate the potential for a COC release to the subsurface in this area.

During the second phase of the APAR, an attempt was made to replicate the results from the highest lead concentration detected during the first phase of the ARAR investigation, with the intent to then analyze for the additional metals COCs at that location. However, the new sample ([2013-STB-4A (2-4)] did not have lead concentrations similar to those in the original sample ([2013-STB-4A (2-4)]. A soil sample was also collected at MW-29A, to further laterally delineate the lead and cadmium concentrations on the Stewart Creek side of the Flood Wall from MW-29.

A zone of fill material was noted below the concrete slab in this area to a typical depth of approximately 2 to 3 feet bgs. No slag or battery case fragments were observed within the fill material except in one location, 2012-FWFS-8, where slag was present in shallow soil (2.1 feet thick zone at maximum 3 foot bgs depth, discussed below). Black staining and hydrocarbon odors were noted in several borings from this area. Select samples from these borings (2013-STB-2, 2013-STB-6, and 2013-STB-11) were also analyzed for SVOCs, TPH, VOCs, and/or PAHs. All TPH, VOC, and PAH results for all samples analyzed for these constituents were below applicable RALs (see Tables 4D.3 through 4D.5). Some individual, fractionated TPH RALs were exceeded at 2013-STB-6 and 2013-STB-11. The samples exhibiting the most elevated levels of TPH 2013-STB-6 (0.5-1.1') was further analyzed for TPH by Method TX1006 to develop a TPH Mixture RAL in accordance with TCEQ RG-366/TRRP-27 (TCEQ, 2010c). Documentation on the development of the TPH Mixture RAL is provided in Appendix 9. The concentration of total TPH (i.e., the C6-C35 range) in the sample was below the calculated TPH Mixture RAL; therefore, though exceedances of applicable TPH RALs were detected in soil samples analyzed for TPH during the SIR or APAR investigations, the Total TPH RAL was not exceeded for either sample. Benzene was detected at 0.0406 mg/kg at 2013-STB-6, which marginally exceeded the RAL.

Lead concentrations exceeded RALs in one or more samples from ten of the fourteen soil sampling locations from this area, including samples collected inside and north of the Slag Treatment Building. Cadmium concentrations exceeded the RAL in samples at five soil sampling locations, each co-located with a lead RAL exceedance. Arsenic and selenium analyses were performed on samples 2013-STB-1 (0-2') and 2013-STB-4 (0-2'). Concentrations of arsenic in both samples exceeded the applicable RAL (15.9 mg/kg). The concentration of selenium at 2013-STB-1 (0-2') also exceeded the RAL (1.6 mg/kg). Arsenic and selenium RAL exceedances were co-located with lead RAL exceedances. Lead concentrations for samples 2013-STB-2 (2.5-4') and 2013-STB-2 (4-5'), collected from below the concrete

slab at the approximate location of the previous TCEQ Site inspection sample, were 773 J mg/kg (the maximum concentration of two field duplicates) and 18.8 mg/kg, respectively.

The exact date of placement of slag-bearing fill material is not known, but former Site personnel have reported that any use of slag as fill is believed to have occurred in the late 1970s (Appendix 21). In addition, historical aerial photographs of the Site were reviewed to evaluate likely periods of fill placement. While the nature of the fill placed cannot be determined from the historical aerial photographs, general timeframes for fill placement were evaluated for locations where slag has been observed to be present in the subsurface (Figure 3A). A small area of slag-bearing fill was identified based on a single boring in the Slag Treatment Building area. Aerial photographs dated 1951, 1956, 1968, 1972, 1984, 1995, 2004, 2005, 2006, and 2008 (Appendix 20) were reviewed. Based on review of the historical aerial photographs, the following observations are presented relevant to this discussion (note that both slag areas are discussed here, and not repeated in subsequent sections):

- The Slag Treatment Building was constructed between 1984 and 1995.
- In 1984, the location appears to be graded. Trailers or other small features are present, and there are no visible indications of active filling operations. The creeks have been routed to approximately their current configurations.
- In 1972, some filling and/or stockpiling activities are visible on-site, possibly including this location.
- In 1968, the North Tributary appears to have been re-routed to its second location, but no other activities are evident in the areas in question.
- In 1956, no activities are evident on-site, and Stewart Creek and the North Tributary are in the original locations.

Based on information from Site personnel, the placement of the material observed in this area is considered pre-RCRA. Analysis of the historical aerial photographs is consistent with this information, and does show that fill was placed prior to 1984.

As a conservative measure, the entire Slag Treatment Building was included within Affected Property No. 2. The Slag Treatment Building is bordered to the northwest and north by other areas of the affected property. Affected Property No. 2 in the vicinity of the Slag Treatment Building is delineated south toward Stewart Creek and east by soil samples from borings 2012-FWCS-6, 2012-FWCS-7, MW-29A, and 2012-FWCS-9, (Figures 4A.1 through 4A.5). The highest detected concentration of lead at the Slag Treatment Building occurred in boring 2013-STB-4 (16,100 mg/kg in the 2 to 4-foot bgs sample depth interval). Vertical delineation of the lead in this area was completed to the RAL, at a depth of 4 feet bgs, where a lead concentration of 77.9 mg/kg was observed. Consistent with 30 TAC §350.51(d)(2), RALs were used for vertical delineation purposes since a groundwater assessment was performed in this area.

Groundwater sampled at MW-29, on the downgradient edge of the Slag Treatment Building area, did not exceed the critical PQL for groundwater.

4.2.4 Stewart Creek Flood Wall

4.2.4.1 Flood Wall Facility Side

During the first phase of the APAR investigation, twenty-three soil samples were collected along the facility side of the Flood Wall. The majority of these samples were collected from the walls or floor of the French drain excavation in September-October 2012. Additional soil samples were collected during the first phase of the APAR investigation to vertically delineate COC exceedances at the French drain excavation sample locations. The 2012 French drain samples were analyzed for lead and cadmium, and the shallow samples were also analyzed for TPH (TX1005). The 2013 facility side Flood Wall soil samples collected during the APAR investigation were analyzed for lead and cadmium (as necessary to delineate the affected property). One APAR sample, 2012-FWFS-9 (4-5'), was additionally analyzed for TPH (TX1005 and TX1006) and VOCs based on a hydrocarbon odor and an elevated PID reading of 1,800 ppm-v noted for this sample interval.

During the second phase of the APAR investigation, two additional samples were collected at MW-27D to attempt to provide further lateral and vertical delineation for lead and cadmium; this location was also sampled for VOCs, SVOCs, and TPH. Three additional samples were collected at 2013-FWFS-5B to attempt to provide vertical delineation of lead and cadmium at the highest detected lead concentration from the first phase of the APAR investigation.

RAL exceedances for lead were detected in nine of the twelve sampling locations in this area. Six cadmium RAL exceedance locations were also identified, which were all co-located with lead RAL exceedances. Sample 2012-FWFS-9 (4-5') was the only soil sample collected during the SIR or APAR investigations that exceeded default RAL for TPH in this area. The concentration of TPH at 2012-FWFS-9 (4-5') was further analyzed for TPH by Method TX1006 to develop a TPH Mixture RAL in accordance with TCEQ RG-366/TRRP-27 (TCEQ, 2010c). Documentation on the development of the TPH Mixture RAL is provided in Appendix 9. The concentration of total TPH (i.e., the C6-C35 range) in the sample was below the calculated TPH Mixture RAL; therefore, no exceedances of applicable TPH RALs were detected in any soil sample analyzed for TPH during the SIR or APAR investigations.

The facility side Flood Wall soil samples are located along the southern edge of Affected Property No. 2. The affected property is delineated to the south toward Stewart Creek by soil samples from multiple locations on the facility side (2012-FWFS-2 and 2012-FWFS-3) and by soil samples from multiple locations on the creek side of the Flood Wall (2013-FWFS-1A, 2013-FWFS-5A, 2012-FWCS-2, 2012-

FWCS-3, 2012-FWCS-4, 2012-FWCS-5, 2012-FWCS-6, 2012-FWCS-7, 2012-FWFS-7A, MW-29A, and 2012-FWCS-9). The lateral ends of the flood wall to the east and northwest are bounded by other affected areas. The highest detected concentration of lead along the facility side of the Flood Wall occurred at 2012-FWFS-5 (52,000 mg/kg at 1.7 feet bgs), located between the Slag Treatment Building and the Wastewater Treatment Facility. Vertical delineation of the affected property at 2012-FWFS-5 was attempted at 2013-FWFS-5B, but the lead concentration for the deepest sample interval, 5 to 6 feet bgs (10,200 mg/kg) exceeded the RAL for lead. The maximum observed vertical delineation depth of the affected property along the facility side of the Flood Wall was 4 feet bgs at 2012-FWFS-1, where a lead concentration of 30.9 J mg/kg was observed. However, some locations remain undelineated to the RAL for lead at shallower depths. Consistent with 30 TAC §350.51(d)(2), groundwater samples collected from the Upper GWBU on the facility side (MW-46) and creek side of the Flood Wall (MW-26, MW-27, and MW-29) did not exceed Critical PCLs for lead or cadmium.

4.2.4.2 Flood Wall Creek Side

Nine soil samples were collected from the 0 to 2-foot bgs depth interval from nine borings (2012-FWCS-1 through 2012-FWCS-9) along the creek side of the Stewart Creek Flood Wall during the SIR investigation in 2012. The sample locations were selected with EPA's corroboration to generally correspond to areas where indications of seepage along the Stewart Creek Flood Wall were observed. These samples were analyzed for lead, cadmium, and TPH. During the first phase of the APAR investigation, soil samples were collected from the approximate locations of several of the SIR borings and from additional locations in this area to delineate lead RAL exceedances detected in the SIR facility side Flood Wall or creek side Flood Wall soil samples. During the first phase of the APAR investigation, soil samples were also collected on the creek side of the Flood Wall to evaluate the former Diesel Fuel Tank release area and Old Drum Storage Area (soil boring MW-27) and to evaluate areas of potential ecological habitat along Stewart Creek ("SCC" samples). The soil sample collected at MW-27 (MW-27(0-1')) was analyzed for lead, TPH, and SVOCs, while samples from the four SCC locations in the vicinity of the Flood Wall (SCC-3, SCC-3A, SCC-6, and SCC-8) were analyzed for lead and cadmium (as necessary to evaluate soil in this area and to delineate the affected property).

During the second phase of the APAR investigation, eight additional soil samples were collected at locations MW-27A, MW-27B, MW-27C, MW-27E to provide further lateral and vertical delineation for lead and cadmium. The shallow samples from the first four of these locations were also sampled for VOCs, PAHs, and TPH. The surficial sample at MW-27B was also analyzed for antimony, arsenic, and selenium. An attempt was made to replicate the results from the highest lead concentration detected during the first phase of the APAR investigation, with the intent to then analyze for the additional metals COCs at that location. However, the new sample ([2013-FWCS-12A (2-2.7)] did not have lead

concentrations similar to those in the original sample ([2013- FWCS-12 (2-2.7)], and in fact did not exceed the RAL for lead. Sample 2013-FWFS-5A was collected to provide lateral delineation on the creek side of the Flood Wall from the two facility side samples with highest exceedances, 2012-FWFS-5 and 2013-FWFS-5B. Ten of the twenty-two creek side Flood Wall locations sampled during the SIR and APAR investigations contained samples that exceeded the applicable RAL for lead. Two samples analyzed for cadmium in this area, co-located with lead RAL exceedances, exceeded the RAL for cadmium. One sample from MW-27B was also analyzed for arsenic, antimony, and selenium, and exceeded the respective RALs for arsenic and antimony. Two APAR investigation soil samples [2012-FWCS-1A (1-2') and SCC-3 (2-4')] collected in this area were also analyzed for arsenic and selenium. As shown on Table 4D.2A, the concentrations of arsenic and selenium in sample 2012-FWCS-1A were above the RAL; however, these exceedances were co-located with a lead RAL exceedance. VOC, PAH, and TPH results were below applicable RALs for all soil samples analyzed for those constituents in the Flood Wall area, including at MW-27 and its step-out sampling locations.

RAL exceedances of lead were detected in boring 2012-FWCS-8 located south of the Slag Treatment Building, SCC-3 located south of the truck washing station, several borings (2012-FWCS-1, 2012-FWCS-1A, 2012-FWCS-12, and SCC-8) located on the west side of the Flood Wall near the Battery Receiving/Storage Building, and at MW-27 and the succeeding step-out borings (MW-27A through MW-27E) located to the west, south, and east of MW-27. The lead RAL exceedance in 2012-FWCS-8 is delineated toward Stewart Creek by boring MW-29A. The lead RAL exceedance at SCC-3 is delineated to the south by SCC-3A and to the west by other affected areas. The lead RAL exceedances on the west side of the Battery Receiving/Storage Building are delineated to the west by 2012-FWCS-11 and to the south toward Stewart Creek by 2013-FWCS-1B. The RAL exceedances in the MW-27 borings are not yet delineated.

Consistent with 30 TAC §350.51(d)(1), background was used for vertical delineation purposes for lead because a groundwater assessment was not performed in this area. The affected property was delineated vertically at the boring location with the highest detected sample concentration for lead [31,000 mg/kg in sample 2012-FWCS-12 (2-2.7')] along the creek side of the Flood Wall at a depth of 4 feet bgs, where a lead concentration of 19.1 mg/kg was observed. Groundwater samples collected from the Upper GWBU on the creek side of the Flood Wall (MW-26, MW-27, and MW-29) did not exceed Critical PCLs for lead or cadmium.

4.2.5 Additional NOR WMUs within the Former Production Area (NOR WMU Nos. 6, 9, 14, and 16)

Soil samples have been collected from within or in the immediate vicinity of each of the remaining NOR WMUs located within the former production area (i.e., NOR WMUs other than the Raw Material Storage

Building, Battery Receiving/Storage Building, and Slag Treatment Building, discussed separately above). WMU No. 1 is not included in this discussion. Based on information from Exide personnel, WMU No. 1 corresponds to the Former Product Waste Pile (see Section 1.2.4.1 for unit description) that was removed in 1988, and was issued a closure letter by the TNRCC dated January 13, 2000. A list of the remaining WMUs located within the former production area, along with the names of the soil sample borings collected from within or in the immediate vicinity of these units, is provided in the table below.

WMU ID No.	Description	General Location	Representative Soil Boring(s)
6	Former location of battery chip hoppers	West side of Battery Breaker Building	2013-WMU6-1, MW-30, 2013-RRS-3A, 2013-RRS-4A, BB-1; 2013-RRS-4A-A, MW-30A
9	Wastewater Treatment Facility	Between Battery Receiving/ Storage Building and Slag Treatment Building	2012-FWFS-2, 2012-FWFS-3, 2012-FWFS-4, and 2012-FWFS-5
14	Former locations of roll-off boxes containing hazardous waste; located in four separate areas	Battery Receiving/Storage Building loading dock (WMU No. 14-1), west side of Raw Material Storage Building (WMU No. 14-2), south side of Oxide Building (WMU No. 14-3), and within the Bale Stabilization Area (WMU No. 14-4)	2013-WMU14-1, 2013-WMU14-2, 2013-WMU14-3, and Bale Stabilization Area borings; 2013-WMU14-1A
16	Temporary drum staging area	South side of Refines and Shipping	2013-WMU16-1

All of these WMUs are located within the pavement that is prevalent throughout the former production area, except for WMU No. 14-4, which is located in the Bale Stabilization Area. The Bale Stabilization Area is discussed separately in Section 4.2.10. The remainder of this section applies only to the WMUs located within the paved area of the former production area (WMU Nos. 6, 9, 14-1, 14-2, 14-3, and 16).

During the second phase of the APAR, an attempt was made to replicate the results from the highest lead concentrations detected in WMU 6 and WMU 14 during the first phase of the ARAR investigation, with the intent to then analyze for the additional metals COCs at that location. However, the new samples ([2013-RRS-4A-A (3-4); MW-30A (2-4); and 2013-WMU-14-1A (0.9-2) and (5-7)] did not have lead concentrations sufficiently similar to those in the original samples. Soil samples analyzed for lead and/or cadmium were collected within the upper 5 feet bgs from or in the immediate vicinity of these units. Samples from the immediate vicinity of the Wastewater Treatment Facility (WMU No. 9), which included four French drain soil samples (2012-FWFS-2 through 2012-FWFS-5), were additionally analyzed for TPH (TX1005).

In the WMU 6 area, samples from five of seven sampling locations exceeded the RAL for lead, and one sample, co-located with a lead RAL exceedance, also exceeded the RAL for cadmium. In the WMU 9

area (excluding the Bale Stabilization Area, discussed separately in Section 4.2.10), represented by Flood Wall samples, lead exceeded the RAL in samples from two of four locations, and one sample, co-located with a lead exceedance, also exceeded the RAL for cadmium. In the WMU 14 area, samples from three of four locations exceeded the RAL for lead, and also RAL for cadmium in three co-located samples. No RAL exceedances were detected in the WMU 16 area.

Each of the units is located within the boundaries of Affected Property No. 2. Although COC exceedances were not detected in all samples, these units are surrounded by other areas of the affected property, and are included within the affected property boundary. Delineation for each WMU includes:

- WMU No. 6 is bordered on all sides by other areas of the affected property. Consistent with 30 TAC §350.51(d)(2), RALs were used for vertical delineation since a groundwater assessment was performed in this area. Vertical delineation to the applicable RAL for lead was completed at WMU No. 6 at a maximum depth of 4 feet bgs (in boring 2013-WMU6-1, where a lead concentration of 46.5 mg/kg was observed). Groundwater samples from MW-30 did not exceed the Critical PCL..
- WMU No. 9 is bordered to the northwest, north, and east by other areas of the affected property. RAL exceedances for lead and cadmium in samples from WMU No. 9 are delineated to the south by soil data from borings 2012-FWFS-2, 2012-FWFS-3, 2012-FWCS-2, 2012-FWCS-3, 2012-FWCS-4, 2012-FWCS-5, and 2012-FWCS-6. Consistent with 30 TAC §350.51(d)(2), RALs were used for vertical delineation since a groundwater assessment was performed in this area. Vertical delineation to the RAL for lead has not been completed at WMU No. 9, where the lead concentration at the deepest sample in the maximum concentration location exceeds the RAL for lead. As a conservative measure and consistent with TRRP provisions, it was thus assumed that the lead RAL exceedance zone at this location extends to the saturated zone. Consistent with 30 TAC §350.51(d)(3), a groundwater investigation has been completed. Groundwater was observed and sampled at MW-26, located immediately southwest of WMU No. 9. Neither lead nor cadmium were detected above RALs in the groundwater sample from MW-26.
- WMU No. 14 is comprised of four discreet areas:
  - The Bale Stabilization Area is discussed in Section 4.2.10.
  - Samples from the area at the Battery Receiving/Storage Building loading dock exceeded the RAL for lead to a depth of 7 feet bgs. Consistent with 30 TAC §350.51(d)(2), RALs were used for vertical delineation since a groundwater assessment was performed in this area. Vertical delineation to the RAL for lead has not been completed at WMU No. 14, where soil samples were collected to a total depth of 7 feet bgs at 2013-WMU14-1A. As a conservative measure and consistent with TRRP provisions, it was thus assumed that the lead RAL exceedance zone at this location extends to the saturated zone, as observed in adjacent samples collected from the Battery Receiving/Storage Building. Consistent with 30 TAC §350.51(d)(3), a groundwater investigation has been completed. As noted previously, a groundwater sample was collected from monitoring well MW-46, located downgradient from 2013-WMU14-1. Lead was not detected above the RAL in the groundwater sample from MW-46.
  - The sample from the area west of the Raw Material Storage Building (2013-WMU14-2) did not exceed the RALs for lead or cadmium.

- The sample from the area south of the Oxide Building (2013-WMU14-3) did not exceed the RALs for lead or cadmium.

4.2.6 North Disposal Area (NOR WMU No. 3)

During the first phase of the APAR investigation, ten soil samples analyzed for lead and cadmium were collected from five locations along the north side of the North Disposal Area as part of the SIR investigation in 2012. Initially, borings were completed at 2012-NDA-1, 2012-NDA-2, and 2012-NDA-3. Foreign materials, including slag and/or rubbish [(as defined in 30 TAC §330.3(A)(130)], were observed in all three of these borings. Lead concentrations in the 2 to 4-foot bgs depth interval from borings 2012-NDA-1 and 2012-NDA-2 and in the 0 to 2-foot bgs depth interval from boring 2012-NDA-3 exceeded the RAL for lead. Additional borings were completed to the north at 2012-NDA-4 and 2012-NDA-6 to evaluate the northern extent of the North Disposal Area, which was delineated by 2012-NDA-4 and 2012-NDA-6.

In accordance with the Work Plan (CRA, 2011), soil boring water within boring 2012-NDA-1 (observed at a depth of 4.5 feet bgs) was collected and analyzed for lead and cadmium during the SIR investigation. The cadmium concentration was 0.00079J mg/L and the lead concentration was 0.0192 mg/L (Table 4E). Since this boring water sample was not collected from a developed permanent monitoring well, and in accordance with Work Plan provisions, the sample results are not considered representative of metals concentrations in groundwater. As such, these data were not compared to groundwater PCLs.

Additional soil samples were collected in this area from the upper 5 feet bgs, and generally in the upper 0.5 feet bgs, as part of the APAR investigation at ECO-11, ECO-12, and at monitoring wells MW-21 and MW-22. As shown on Figure 4A, monitoring wells MW-21 and MW-22 were completed within the projected former creek paths of the North Tributary, based on the projected location of these creek paths in 1951 and 1972 aerial photographs (Appendix 22), to evaluate possible fill material in the former creek channels. As noted on the boring logs for MW-21 and MW-22 (Appendix 2), obvious fill material was not observed at either of these locations. Lead and cadmium concentrations in all samples collected between the North Disposal Area and the North Tributary during the APAR investigation were below applicable RALs.

Four APAR investigation surface soil samples (ECO-11, ECO-12, MW-21, and MW-22) collected from the 0.0 to 0.5 feet bgs depth interval in this area were additionally analyzed for arsenic to evaluate potential atmospheric deposition of arsenic in the prevailing downwind direction from the former production area. As shown in Table 4D.2A, all arsenic results in these samples were below the RAL.

During the first phase of the APAR investigation, soil samples were collected on the south side of the North Disposal Area within the former production area from three borings completed in the Battery

Breaker Building (2013-RRS-3A, 2013-RRS-4A, and 2013-BB-1) and from one boring completed within the projected location of the infilled former creek channel of Stewart Creek in this area (MW-30). The former Stewart Creek channel was projected as shown on Figure 4A based on a 1951 aerial photograph (Appendix 22). These samples were analyzed for lead and cadmium. RAL and critical PCL exceedances for lead were detected at each soil sample location within the Battery Breaker Building and at MW-30. A RAL exceedance for cadmium was also detected at MW-30. The RAL exceedance zone was delineated to 2 feet bgs in the Battery Breaker Building (based on a lead concentration of 84.2 mg/kg at location 2013-RRS-3A) and 0.5 feet bgs at MW-30 (based on a lead concentration of 128 mg/kg at this location).

Sample 2013-BB-1, located near the sump in the Battery Breaker Building, was additionally analyzed for pH. The pH result for this sample was 7.15 (Table 4F). PCLs are not established for this geochemical parameter.

Fill material (primarily composed of silty or gravelly clay) was encountered in MW-30 to a depth of 28.5 feet bgs, which corresponds to the top of the Eagle Ford Shale. Pieces of slag were observed at approximately 28 feet bgs in MW-30 (but were not observed elsewhere in this boring). Based on historical aerial photographs, it appears that the slag containing material was placed within the infilled area prior to 1972. A monitoring well was completed at this location and a groundwater sample was collected and analyzed for total and dissolved lead and cadmium, and sulfate. As shown on Table 5B.1, all lead and cadmium concentrations in groundwater samples from this location were below applicable PCLs.

During the second phase of the APAR investigation, additional samples were collected and analyzed for lead and cadmium to provide further delineation to the north of the North Disposal Area. Sample 2013-NDA-1A was collected in an attempt to replicate the results from the highest lead concentration detected during the first phase of the ARAR investigation, with the intent to then analyze for the additional metals COCs at that location. However, the new samples ([2013-NDA-1A (2-4)] did not have lead concentrations sufficiently similar to those in the original sample. Sample locations 2014-NDA-7, 2014-NDA-8, and 2014-NDA-9 were collected to provide further delineations to the north. Sample 2013-NDA-7 was also collected to provide information regarding the former burn area (discussed in Section 4.2.18), and was also analyzed for VOCs and SVOCs. Results of the additional delineation samples showed that lead concentrations exceeded the RAL at all four locations, and antimony exceeded the RAL in the duplicate sample collected at 2014-NDA-7, co-located with a lead RAL exceedance. Methylene chloride exceeded the RAL in the duplicate sample collected at 2014-NDA-7; methylene chloride is a common laboratory contaminant. In addition, the North Disposal Area cap was sampled and analyzed for lead and cadmium on a grid. Samples were collected from the 0 to 6 inch and 6 to 12 inch bgs depth intervals at twenty-five locations on the North Disposal Area cap. At two locations, shallow samples were also

analyzed for antimony, arsenic, and selenium. Results of the cap grid sampling showed that concentrations of lead exceeded the RAL in all but three samples. Cadmium exceeded the RAL in samples from four locations. Arsenic, antimony, and selenium exceeded the respective RALs at both locations where these COCs were analyzed. All antimony, arsenic, cadmium, and selenium exceedances were co-located with lead exceedances.

Based on the additional delineation sampling, the North Disposal Area is delineated to the north by samples ECO-11, ECO-12, MW-21, MW-22, and 2012-NDA-6. Vertical delineation of the capped area is not required because it is the cap of a landfill overlying known waste. Groundwater samples from generally downgradient wells (MW-21, MW-22, and B7N) did not exceed Critical PCLs for lead and cadmium.

The entire North Disposal Area lies within the boundaries of Affected Property No. 2. As noted previously, the lateral and vertical extents of the North Disposal Area were evaluated during an extensive investigation as part of the Phase I RFI and are documented in the 1993 Addendum to the Phase I RFI Report (Lake, 1993); copies are included in Appendix 2. The northern boundary of the North Disposal Area, as estimated in the 1993 Addendum to the Phase I RFI Report, has been adjusted northward to incorporate borings 2012-NDA-1, 2012-NDA-2, 2012-NDA-3, 2012-NDA-5, 2013-NDA-7, 2013-NDA-8, and 2013-NDA-9 based on observations of slag and/or other debris in these borings, or concentrations of COCs detected in the borings. No evidence of fill or non-native material was observed in borings completed north of these locations, which includes borings MW-21, MW-22, 2012-NDA-4, 2012-NDA-6, ECO-11, and ECO-12.

NOR WMU No. 13, the Stewart Creek dredged sediment waste pile, overlies the western section of the North Disposal Area adjacent to the Slag Landfill. This unit was capped and closed in 1989, and approval of the closure was issued by the TNRCC in a letter dated January 13, 2000. The evaluations of North Disposal Area and the Slag Landfill are also applicable to this unit.

In December 2013, and inspection and permeability sampling and analysis were conducted for the North Disposal Area. Historical information, as described in a 1993 RCRA Facility Investigation Report, “the north disposal area lies between the main plant and the northern boundary of the plant. This landfill originally started at or just below the natural grade. Depth of the landfill is approximately eight to ten feet. A layer of natural soil caps the landfill. RFI activities ascertained the actual depth and dimensions of the landfill. This inactive unit was capped and closed in 1978 (Lake, 1993).” The disposal area cover is approximately 5.6 acres in size (as delineated in the 1993 RCRA Facility Investigation Report), and the cap is comprised of compacted clayey soil approximately two feet in thickness. The disposal area is relatively flat.

The following summarizes the field inspection observations of the North Disposal Area:

- The cover soils appeared generally firm and well drained, even after recent snowmelt. Several small, localized areas of shallow ponded water were observed on the cover resulting from the recent snowmelt.
- No cracking, erosion, or rilling were observed on the cover.
- Minor undulations and equipment tracking were observed on the cover and in the vegetation, although neither appeared to impact the integrity of the cover.
- Vegetation is generally well established across the cover, although localized areas of potentially sparse vegetation were observed. However, as the inspection was performed in December, the overall health of the vegetation could not be assessed as it was dormant or partially dormant at the time of inspection.

Overall, the cover was observed to be in good condition, well established, competent, with sufficient run-on controls to minimize the impacts of surface water across the surface of the cover. The cover vegetation was observed to be well established, with the exception of several localized areas of potentially sparse vegetation.

Undisturbed Shelby tube samples were obtained at the three locations. Permeability testing results for the undisturbed cover samples ranged from 1.0×10^{-7} to 1.5×10^{-8} centimeters per second (cm/sec), with a geometric mean value of 4.3×10^{-8} cm/sec for the three samples analyzed.

4.2.7 Slag Landfill (NOR WMU No. 7) and Former Stewart Creek and North Tributary Railroad Outfall

Seven soil samples were collected from three borings (2012-SL-1 through 2012-SL-3) within or in the immediate vicinity of the Slag Landfill during the SIR investigation (does not include samples collected within the Boneyard, which is discussed in Section 4.2.8). Each of the Slag Landfill area samples were analyzed for lead and cadmium. The lead concentrations in the 2012-SL-1 samples, to a depth of 5 feet bgs, exceeded the applicable lead RAL. Slag fragments were also noted in this boring. Subsequent interviews with long-time facility personnel indicated that the Slag Landfill extends south to the railroad spur, which is believed to precede the construction of the landfill. The projected extent of the Slag Landfill is bounded to the north and west by borings in which fill was not observed, including 2012-SL-2, 2012-SL-3, B8N (west), and MW-18 (see Appendix 2 for logs of these borings). The Slag Landfill is bounded to the east by the North Disposal Area.

Additional borings were completed on the south side of the Slag Landfill during the 2013 APAR investigation to assess the southern extent of the landfill, to assess the infilled former outfall of Stewart Creek and the North Tributary in this area, and to delineate Affected Property No. 2 in the direction of Stewart Creek.

South of the railroad spur, the ground surface slopes steeply toward Stewart Creek. Borings 2013-SL-4 and MW-24 were completed on the immediate south side of the railroad spur, at the top of this slope. As shown on the boring logs in Appendix 2, slag was not observed in either of these borings, which supports the information provided by facility personnel that the Slag Landfill does not extend south of the railroad spur.

Monitoring well MW-24 was completed within the infilled portion of the former path of Stewart Creek and the North Tributary south of the Slag Landfill. A series of concrete culverts (plugged with concrete according to former facility personnel) that run under the railroad spur are visible along the north bank of Stewart Creek in this area (photo provided in Appendix 13), confirming the projected former creek path in this area. The location of these culverts is shown on Figure 4A. Three additional borings (RO-1 through RO-3) were completed at the outfall of these culverts next to Stewart Creek. As noted in the slag survey report by W&M (Appendix 18), pieces of slag were observed on the ground surface along the north bank of Stewart Creek in the vicinity of the railroad outfall.

During the second phase of the APAR investigation, a step-out sample (MW-17B) was collected near MW-17A in an attempt to complete lateral delineation in that direction. In addition, the Slag Landfill cap was sampled and analyzed for lead and cadmium on a grid. Samples were collected from the 0 to 6 inch and 6 to 12 inch bgs depth intervals at 16 locations on the Slag Landfill cap. At one location, the shallow sample was also analyzed for antimony, arsenic, and selenium. Note that some locations of cap samples were on areas overlapping the Boneyard.

The entire Slag Landfill is included within the boundaries of Affected Property No. 2. The affected property is delineated to the north by 2012-SL-2 and 2012-SL-3, and to the east by MW-22. Lead RAL exceedances west and south of the Slag Landfill were detected at SCC-11, 2013-RO-1, 2013-RO-2, MW-17 (historical data provided in Appendix 17), B5N (historical data provided in Appendix 17), and in a cluster of borings (2012-FWCS-1, 2012-FWCS-1A, and 2012-FWCS-12) located on the west side of the Flood Wall near the Battery Receiving/Storage Building. Exceedances were also noted to the west in the Boneyard (discussed in Section 4.2.8). The RAL for cadmium was only exceeded in SCC-11. Lateral delineation of the affected property between the Slag Landfill and Stewart Creek was completed by soil samples from borings SCC-11A, SCC-12, 2013-SL-4, 2013-RO-3, 2012-FWCS-11, and 2013-FWCS-1B. Lateral delineation is incomplete in the area of SSC-10B and MW-17B (west-northwest of the Battery Receiving/Storage Building). The vertical extent of the affected property in this area is not required because the area is capped, with the cap overlying known waste material.

Surficial concentrations of lead and cadmium in the soil sample collected from MW-24 were below RALs. However, MW-24 was included within the affected property boundary because it is bordered to the north by the Slag Landfill and to the east, south, and west by other areas of the affected property.

Soil sample SCC-12, collected from the 0.0 to 0.5-foot bgs depth interval, was also analyzed for arsenic to evaluate potential atmospheric deposition of arsenic in this area. As shown on Table 4D.2A, the arsenic result for this sample was below the RAL.

Results of the cap grid sampling showed that concentrations of lead exceeded the RAL in one or more samples in eleven of sixteen locations. Cadmium and antimony, arsenic, and selenium, where sampled, did not exceed the respective RALs. Vertical delineation of the capped area is not required because the cap overlies a known landfill area.

In accordance with the Work Plan (CRA, 2011), soil boring water within borings 2012-SL-2 and 2012-SL-3 (observed at depths of 7.5 feet bgs and 10.3 feet bgs, respectively) was collected and analyzed for lead and cadmium during the SIR investigation. Cadmium concentrations in both samples were 0.005 mg/L (U-flagged for blank contamination). The lead concentration was 0.0141 mg/L in the 2012-SL-2 sample and <0.0029 mg/L in the 2012-SL-3 sample (Table 4E). Since these samples were not collected from developed permanent monitoring wells, and in accordance with Work Plan provisions, the sample results are not considered representative of metals concentrations in groundwater. As such, these data were not compared to groundwater PCLs.

In December 2013, and inspection and permeability sampling and analysis were conducted for the Slag Landfill. As described in a RCRA Facility Investigation Report (Lake, 1993), the slag was landfilled in excavated trenches and covered with backfill material. Trench depths were reported to be 3 to 4 feet below national grade, and piled an estimated 6 to 10 feet or more (from site observations) above natural grade. The disposal area cover is approximately 3.9 acres in size (as delineated in the 1993 RCRA Facility Investigation Report), and comprised of compacted clayey soil as identified during geotechnical investigations described below. The eastern portion of the disposal area is a mound rising 6 to 10 feet or more above existing grade, and the west portion of the disposal area is at or near surrounding grade. The western portion of the disposal area previously was used as an equipment and materials storage area (boneyard), and a portion of the cover is not covered with established vegetation but instead appears to have previously been covered with crushed stone, but stone material had settled into the surface of the cap. Drainage patterns for both off and on-site drainage could not be readily established from field observations.

The following summarizes the field inspection observations of the Slag Disposal Area:

- The cover soils appeared firm and well drained, even after recent snowmelt. No muddy, soft, or wet areas were observed on the cover.
- No cracking, erosion, or rilling was observed on the cover.
- Minor undulations and equipment tracking were observed on the cover and in the vegetation, although neither appeared to impact the integrity of the cover.
- Vegetation is generally well established across the cover. As the inspection was performed in December, the overall health of the vegetation could not be assessed, as it appeared dormant or partially dormant.
- A localized area that might be subject to ponding was observed near the center of the slag disposal area. It appears this area has been subjected to regrading in the past to promote drainage off of the cover. Ponded water was not observed during the field inspection.

Overall, the cover was observed to be in good condition, well established, competent, with sufficient run-on controls to minimize the impacts of surface water across the surface of the cover. The cover vegetation was observed to be well established.

Undisturbed Shelby tube samples were obtained at the three locations. Permeability testing results for the undisturbed cover samples ranged from 3.5×10^{-7} to 2.5×10^{-8} cm/sec, with a geometric mean value of 1.3×10^{-7} cm/sec for the three samples.

4.2.8 Boneyard and NOR WMU No. 17

During the SIR investigation, five soil samples were collected from the 0 to 2-foot bgs interval at five borings (2012-BY-1 through 2012-BY-5) within the Boneyard, located on the western portion of the Slag Landfill. The samples were analyzed for lead and cadmium. Consistent with the Work Plan (CRA, 2011) provisions, TPH analyses were not performed on these samples because no soil staining, odor, or elevated PID readings were observed during completion of the borings. The lead concentration in borings 2012-BY-2, 2012-BY-4, and 2012-BY-5 exceeded the applicable RAL for lead, and the sample at 2012-BY-4 also exceeded the RAL for cadmium. Slag was encountered at the base of boring 2012-BY-4 at a depth of 2 feet bgs, consistent with the location of slag in the borings within the Slag Landfill.

During the first phase of the APAR investigation, two soil samples analyzed for lead and cadmium were collected from the 0 to 0.5-foot bgs depth interval at the former locations of two debris piles within the Boneyard area (2013-WMU17-1 and 2013-WMU17-2). The debris piles had been removed prior to the collection of soil samples. Lead concentrations in both samples exceeded the applicable RAL. Cadmium results were below the applicable RAL in both samples.

The Boneyard is completely contained within the Slag Landfill, which, in turn, is located entirely within Affected Property No. 2. Because the Boneyard overlies the Slag Landfill, vertical delineation to RALs was not performed in this area, where a cap overlies known waste.

4.2.9 Class 2 Landfill (NOR WMU No. 12)

During the first phase of the APAR investigation, four monitoring wells (PMW-19R, PMW-20R, LMW-21, and LMW-22) were installed around the Class 2 Landfill, located near the northern boundary of the Site. Soil samples were collected continuously from the monitoring well borings for lithologic purposes. Samples from the 0.0 to 0.5-foot bgs depth interval from these borings were analyzed for lead and cadmium to evaluate the potential for atmospheric deposition of these metals in this area in the prevailing downwind direction from the former production area. Soil samples from PMW-19R and LMW-22 were additionally analyzed for arsenic to evaluate potential aerial deposition of arsenic in this area. The concentration of lead at LMW-22 exceeded the RALs for lead and arsenic. In the remaining samples, concentrations of lead, cadmium, and arsenic were below applicable RALs in all of these soil samples analyzed in the Class 2 Landfill area.

During the second phase of the APAR investigation, samples were collected at ten locations around the Class 2 Landfill to provide additional horizontal and vertical delineation. All samples were analyzed for lead, cadmium, arsenic, and selenium, and some samples were also analyzed for antimony. Based on results of the initial samples, step-out samples were collected to further delineate near locations where exceedances were detected. The boring for MW-45, installed to provide upgradient groundwater data per the work plan (PBW, 2013a), was also sampled for lead, cadmium, arsenic, and selenium. Grid samples of surficial soils were collected at six locations on the Class 2 Landfill cap. Samples were analyzed for lead, cadmium, arsenic, selenium, and in the shallow sample at 2013-CL2-C01, also for antimony. Subsequently, step-out samples collected near 2013-CL2-C01 were analyzed for all five COC metals.

Results showed concentrations exceeding the lead RAL in the shallow sample interval (0 to 0.5 feet bgs) at 2013-C2L-6, located west of the Class 2 Landfill. Subsequent step-out samples exceeded the lead RAL at the 2014-CL2-06A and 2014-CL2-06C locations, north and southeast of the original sample, respectively. The RALs for antimony, arsenic, and selenium were also exceeded at the 2014-CL2-06 and 2014-CL2-06C locations. The arsenic concentration slightly exceeded the RAL in the shallow sample at 2013-C2L-01 (17.2 mg/kg), located north of the Class 2 Landfill, near the north Site boundary, in a former agricultural area. This exceedance is believed to represent a background concentration. The arsenic concentration slightly exceeded the RAL in the 15 to 17 feet bgs sample at 2013-C2L-08 (18.5 mg/kg), located north of the Class 2 Landfill, near the north Site boundary.

The cap sample at 2013-CL2-C01 exceeded the RAL for lead and arsenic, and arsenic also exceeded the RAL at 2014-CL2-C01B. None of the other samples exceeded the respective RALs for the five COC metals, as applicable.

With the exception of the two anomalous and/or background arsenic exceedances on the northern boundary, the Class 2 Landfill is laterally delineated for lead, cadmium, arsenic, and selenium by MW-45, PMW-19R, and 2013-CL2-08 to the north; by 2013-CL2-02, 2013-CL2-03, ND 2013-CL2-04 to the east; by 2013-CL2-05, 2013-CL2-09, 2013-CL2-10 to the south; and by LMW-21, 2014-C2L-06B, PMW-20R, and 2013-CL2-07 to the west with the exception of the arsenic RAL exceedance at depth at 2013-CL2-08 which was within the range of expected background concentrations. Consistent with 30 TAC §350.51(d)(2), RALs were used for vertical delineation since a groundwater assessment was performed in this area. Concentrations of lead, cadmium, arsenic, and selenium are below the RAL in the Class 2 Landfill cap except lead and arsenic at 2013-CL2-C01 and arsenic at 2014-CL2-C01B. Lead, cadmium, arsenic, and selenium are vertically delineated in the upper 0.5 feet bgs where RALs were exceeded. With the exception of LMW-9, where the RAL for selenium was exceeded, the monitoring system wells for the Class 2 Landfill do not show impacts above the Critical PCLs. Groundwater monitoring results, including a discussion of LMW-9, are presented in Section 5.2.

In December 2013, and inspection was conducted for the Slag Landfill. Due to the presence of an HDPE membrane in the cap system, permeability samples were not collected. The Class 2 landfill incorporates an active area (into which waste is being disposed) as well as inactive areas over which cover soils or final cover have been placed. The Class 2 landfill footprint is approximately 6.9 acres in size, and is divided into 15 cells, including both active and inactive areas. Drainage patterns for both off and on-site drainage could not be readily established from field observations, although it appears that runon onto the landfill is prevented by the mound configuration of the landfill (i.e., landfill is mounded above surrounding grade).

The following summarizes the field inspection observations of the Class 2 landfill:

- Review of project files indicated that all or most of cells 1 through 6 (the southern approximately 40% of the landfill) have received final cover. The final cover is comprised of 3 to 4 feet of compacted clay soils, overlain by a 40 mil HDPE membrane, overlain by approximately 1.5 feet of vegetated protective soil.
- The southernmost portion of the Class 2 Landfill (closed portion) has established vegetation, and the surface is firm and appears well drained. Localized areas of potentially sparse vegetative cover were observed. Overall, this area of cover appeared in good condition.
- The northernmost area of cover was well graded, although the cover area is relatively flat, and localized areas of the cover had softened from the recent snow melt and the lack of established vegetation. Vegetation over this area is not well established, although it is evident that efforts to establish vegetation are ongoing.
- No cracking, erosion, or rilling was observed on the cover.
- Minor undulations and equipment tracking were observed on the cover and in the vegetation, although neither appeared to impact the integrity of the cover.

- Vegetation on the southernmost third of the Class 2 landfill is generally well established. Vegetation in the second third of the cover is not yet established due to recent cover placement activities.

Overall, the cover was observed to be in good condition, competent, with sufficient run-on controls to minimize the impacts of surface water across the surface of the cover. The cover vegetation was observed to be well established in some areas (primarily southern portion of landfill, which has received final cover), and requiring additional efforts to complete establishment in others (northern portion of landfill at final grade).

4.2.10 Bale Stabilization Area

Initially, five soil samples were collected from five locations (2012-BSA-1 through 2012-BSA-5) in the Bale Stabilization Area during the SIR investigation. These samples were analyzed for cadmium and lead.

As part of the SIR investigation, SPLP analysis was performed for a preliminary evaluation of the potential for soil leaching to groundwater. Samples 2012-BSA-1A (0-2') and 2012-BSA-3A (0-2') were collected as resamples of samples 2012-BSA-1 and 2012-BSA-3, respectively to allow for SPLP analysis at those locations (after initial total lead and/or cadmium analysis). SPLP-cadmium analysis was performed on sample 2012-BSA-3A (0-2'). Similarly, additional samples 2012-BSA-4a (0-1'), 2012-BSA–4b (0-1'), 2012-BSA–4c (0-1'), 2012-BSA–4d (0-1'), and 2012-BSA–4e (0-1') were collected in a one-foot radius around previous sample location 2012-BSA-4. Cadmium and lead analyses were performed on all five of these samples. Based on those results, SPLP analyses were performed on samples 2012-BSA-4a (0-1'), 2012-BSA–4c (0-1') and 2012-BSA–4d (0-1'). The SPLP analysis results are provided in Appendix 24.

Lead concentrations in nine of the thirteen soil samples collected from the Bale Stabilization Area during the SIR investigations in 2012 and 2013 exceeded the applicable RAL for lead. Cadmium concentrations exceeded the applicable RAL in three of the SIR samples. At two locations, the cadmium exceedance was not co-located with lead exceedances.

Additional soil samples were collected as part of the APAR investigation in 2013 to vertically delineate the affected property at the location where the highest concentration of lead was observed in this area during the 2012 SIR investigation (2012-BSA-2) and to gather pH data for this area (2013-BSA-6 and 2013-BSA-7). Soil samples were also collected during the installation of monitoring well MW-23, located on the southeast side of the Bail Stabilization Area, and exceeded the RAL for lead to the maximum sampled depth, 2 feet bgs. The upper sample from MW-23 was additionally analyzed for cadmium, and the result was less than the RAL.

During the second phase of the APAR investigation, an attempt was made to duplicate sampling results from the highest lead exceedance detected during the first phase of the APAR investigation. A sample

was collected at 2013-BSA-2A and analyzed for the five COC metals. This sample did not have similar lead concentrations to the original sample. Lead, antimony and arsenic exceeded their respective RALs.

The western portion of the Bale Stabilization Area lies on top of the North Disposal Area. Some debris was observed in borings completed in this area, including a black plastic fragment in the upper two feet in 2012-BSA-4 and a plastic bag fragment and mulch at 4.9 feet bgs in 2013-BSA-6. Additional fill material (sand and silt not associated with the North Disposal Area) was observed within the upper 2.5 feet bgs at MW-23. Slag, battery case fragments, rubbish, or other types of debris were not observed at this location. The fill material at MW-23 is likely associated with construction of the Truck Staging Area parking lot or landscaping activities in this area.

The Bale Stabilization Area lies entirely within the boundaries of Affected Property No. 2. It is bordered to the south by other areas within the affected property and to the west by the North Disposal Area, which also lies within Affected Property No. 2. RAL exceedances within the Bale Stabilization Area are bounded to the North by 2012-NDA-6, to the northeast by 2014-FFTA-05 and 2014-FFTA-04, and to the east by 2013-TS-1 and 2013-TS-2, but is unbounded at 2014-TS-3. As noted previously, a large portion of the Bale Stabilization Area is located within the North Disposal Area. Consistent with 30 TAC §350.51(d)(2), RALs were used for vertical delineation since a groundwater assessment was performed in this area. Downgradient groundwater samples at MW-23 did not exceed the critical PCL for lead and cadmium. Outside of the landfill, the affected property was vertically delineated to the RAL at the location with the highest detected lead concentration (25,900 mg/kg in sample 2012-BSA-2 (0-2')), at a depth of 2 feet bgs, where a lead concentration of 123 mg/kg was observed. Outside the landfill, cadmium concentrations were also vertically delineated to below the RAL at 2012-BSA-2 at 2 feet bgs, where a cadmium concentration of 0.652 mg/kg was observed. Cadmium was not vertically delineated to below the RAL at 2012-BSA-3A, the location where the highest cadmium concentration (935 mg/kg in the 0 to 2-foot bgs sample depth interval) was detected in this area, because 2012-BSA-3A is located within the North Disposal Area.

During the APAR investigation, pH data were evaluated at three locations in the Bail Stabilization Area (2013-BSA-6, 2013-BSA-7, and MW-23). The pH data ranged from 8.03 to 8.51 (Table 4F). PCLs are not established for this geochemical parameter.

4.2.11 Truck Staging Area, Administrative Building Area, and Maintenance Building

During the first phase of the APAR investigation, although not identified as a potential source area in the Work Plan, soil samples were collected adjacent to the Truck Staging Area and Administrative Building (east of the former production area) within the upper 5 feet bgs to delineate RAL for lead detected in historical samples from boring MW-10 (Appendix 17) and to evaluate shallow soils on the north side of

the Administrative Building. Soil samples were also collected at sample locations 2013-TS-1 and 2013-TS-2 to verify that concentrations of lead were below RALs, as indicated by historical data from Phase II RFI borings TS-1 and TS-2 (Appendix 17). Lead was analyzed in all samples from this area and cadmium was analyzed in at least one sample at each location. Sample 2013-AD-2 (0-0.5') was additionally analyzed for arsenic to evaluate potential atmospheric deposition of arsenic at this location.

During the second phase of the ARAR investigation, additional delineation samples were collected at 2013-AD-1A (five COC metals below 0.5 feet bgs, lead and cadmium at surface), 2013-AD-3 (five COC metals), 2014-AD-3A (five COC metals), 2013-AD-4 (lead and cadmium), 2013-AD-5 (five COC metals below 0.5 feet bgs, lead and cadmium at surface), 2013-AD-6 (five COC metals), 2013-FOP-1A (lead), and 2014-TS-3 (5 COC metals at surface, lead below 0.5 feet bgs).

Lead RAL exceedances were detected in soil samples collected near the Administrative Building in borings 2013-FOP-1, 2013-AD-1, 2013-AD-1A, 2013-AD-3, and 2013-AD-5; in soil samples collected west and south of MW-10 in borings 2013-MW10-3, 2013-MW10-2, and 2013-AD-2 (collected within grass median at entrance to Site); and in sample 2014-TS-3, located east of the truck staging area between samples 2013-TS-1 and 2013-TS-2. The RAL for antimony was exceeded at 2013-AD-3 and 2013-AD-5. The RAL for arsenic was exceeded at 2013-AD-2. The lead RAL exceedance zone was laterally delineated on-site in this area by soil samples from borings 2013-TS-1, 2013-TS-2, 2013-MW10-1, 2013-AD-2A, 2013-AD-4, 2013-AD-6, and MW-44. Delineation is not complete east of 2013-AD-3 or east of 2013-TS-3 on-site. The Undeveloped Buffer Property to the east of the Site is being addressed separately (PBW, 2014). The area is bounded to the west by the maintenance building, discussed below. The affected property was vertically delineated to the RAL at the location in this area that had the highest detected lead concentration [6,460 mg/kg in soil sample 2013-FOP-1 (0-0.5')] at a depth of 2 feet bgs, where a lead concentration of 90.4 J mg/kg was observed. All cadmium and selenium results for the samples collected in this area were below applicable RALs.

During the first phase of the APAR investigation, two soil samples were collected below the concrete slab in the Maintenance Building and were analyzed for lead and cadmium. These samples were also analyzed for VOCs, based on the reported use of solvents in this building.

During the second phase of the APAR investigation, samples were collected at three additional locations in the Maintenance Building area (2013-MB-3, 2013-MB-4, and 2013-MB-5). Samples were analyzed for lead and cadmium. The shallow depth samples from each boring, as well as the 10 to 12 foot bgs sample from 2013-MB-5, were also analyzed for VOCs, and the samples from 2013-MB-5 were also analyzed for SVOCs and TPH. Concentrations exceeded the lead RAL in one or more samples from each location except 2013-MB-4, and the shallow sample from 2013-MB-5 exceeded the cadmium RAL. None of the

VOC or SVOC RALs were exceeded. The concentrations of TPH as C6-C12 (299 mg/kg), >C12-C28 (2,410 mg/kg), and >C28-C35 (334 mg/kg) in the 10 to 12 foot bgs sample from 2013-MB-5 exceeded the RALs (65 mg/kg, 200 mg/kg, and 200 mg/kg, respectively), but the detected TPH as C6-C35 concentration (3,050 mg/kg) was below the TPH mixture RAL (12,500 mg/kg).

Lead RAL exceedances near the Maintenance Building area is bounded to the west by other affected areas, to the north by 2013-MB-4, to the east by the Administrative Building area, and it is partially bounded to the south by SSC-3A. Consistent with 30 TAC §350.51(d)(1), background was used for vertical delineation purposes for lead because since a groundwater assessment was not performed in this area. The location of maximum lead concentration, 2013-MB-5 (21,200 mg/kg in the 0.5 to 5 foot bgs interval) is vertically delineated to background at 14 feet bgs, where lead was detected at 13.3 mg/kg.

4.2.12 South Disposal Area (NOR WMU No. 4)

As noted previously in Section 1.2, multiple delineation borings were drilled in the South Disposal Area as part of the Phase I RFI activities (Lake, 1993). During the SIR investigation, ten soil samples were collected from five borings in the vicinity of the South Disposal Area. These samples were analyzed for lead and cadmium. RAL exceedances for lead were detected in boring 2012-SDA-2. No RAL exceedances were detected for cadmium.

As part of the first phase of the APAR investigation, additional soil borings were completed in the vicinity of the South Disposal Area to laterally and/or vertically delineate lead RAL exceedances at 2012-SDA-2 and at historical boring locations BS-2, BS-3, BS-5, SDA-3, and SDA-4. Samples collected from locations that had not previously been sampled were analyzed for cadmium in addition to lead. Samples from two locations (SDA-4A and ECO-7) were also analyzed for arsenic to evaluate potential aerial deposition of arsenic in this area. Concentrations of lead exceeded the RAL in five locations. Arsenic exceeded the RAL at ECO-7. All cadmium results were below RALs for samples analyzed for these constituents in this area.

During the second phase of the APAR investigation, additional locations were sampled to provide further delineation in the South Disposal Area and south wooded area (2013-SDA-3B, 2013-SDA-4B, 2014-SDA-6, 2014-SDA-7, B3RA. ECO-1A, ECO-2A, ECO-4A, ECO-4B, ECO-7C, ECO-7D, ECO-8A, and ECO-8B). Most samples were analyzed for the five COC metals, except 2013-SDA-3B (lead and cadmium); 2014-SDA-7 (0.5 to 2 foot bgs sample, lead, antimony, and arsenic); B3RA (arsenic and lead); ECO-8B (lead, arsenic, antimony, and selenium); and ECO-4A, ECO-4B, and ECO-7C (lead and cadmium).

Lead concentrations exceeded the RAL in shallow samples (0 to 0.5-foot bgs interval) at 2013-SDA-3B; 2013-SDA-7; B3RA; ECO-2A; ECO-7C; ECO-8A; and ECO-8B. Concentrations of antimony and/or

arsenic also exceeded the respective RALs at 2014-SDA-7 (antimony and arsenic); ECO-8A (antimony); and B3RA, ECO-2A, and ECO-8B (arsenic). No deeper samples were analyzed for the shallow exceedances at 2013-SDA-3B and ECO-8A. The concentration of lead in the deeper sample interval (0.5 to 2-feet bgs interval) at 2014-SDA-7 also exceeded the RAL (287 mg/kg). RAL exceedances for lead were detected within Affected Property No. 3 in several historic soil borings completed near the South Disposal Area (BS-2, BS-3, SDA-2, SDA-3, SDA-4, SDA-9-1, and SDA-9-2; data provided in Appendix 17) and from one or more samples in 23 locations on or surrounding the South Disposal Area (excluding cap samples), including locations BS-3, 2013-B4R-A, 2012-SDA-2, 2013-SDA-3A, 2013-SDA-4A, ECO-1, ECO-2, ECO-3, ECO-4, ECO-6, ECO-7, ECO-7A, ECO-7B, ECO-8, ECO-9, and ECO-10 (Table 4D.1); and locations 2013-SDA-3B, 2013-SDA-7, B3RA, ECO-2A, ECO-7C, ECO-8A, and ECO-8B (Table 4D.2B). Concentrations of antimony and/or arsenic also exceeded RALs in three locations, co-located with lead RAL exceedances.

In addition to delineation samples, during the second Phase of the APAR investigation, six locations were sampled (0 to 6 inch and 6 to 12 inch bgs intervals at each location) on a grid on the South Disposal Area cap. All samples were analyzed for lead; all samples from the 0 to 6 inch bgs intervals were analyzed for cadmium, as were the 6 to 12 inch bgs samples in two locations; and one sample (2013-SDA-C03) was analyzed for the five COC metals. Results of the grid sampling showed that lead exceeded the RAL in all of the shallow samples, and in all but two of the deeper samples. No cadmium exceedances were detected. Concentrations of antimony and arsenic exceeded the RALs in the 2013-SDA-C03 (0-6) sample (co-located with lead as described above).

The South Disposal Area lies entirely within the boundaries of Affected Property No. 3, which includes, in addition to the South Disposal area, the area to the north, extending toward Stewart Creek; the south wooded area to the east; and the former South Berm and Shooting Range Berm (discussed in Section 4.2.14). As noted previously, the lateral and vertical extent of the South Disposal Area was evaluated during an extensive investigation as part of the Phase I RFI and are documented in the 1993 Addendum to the Phase I RFI Report (Lake, 1993) (see Appendix 2). The area is also delineated by the Undeveloped Buffer Property area to the west, south, and east. During the APAR investigation, Affected Property No. 3 was laterally delineated to the north by sample locations 2014-SDA-6, 2012-SDA-1, SCC-5A, 2013-SDA-4B, SCC-4, SCC-2, and ECO-5; to the east by ECO-1A ECO-4A, and ECO-4B; to the south by 2012-SDA-4, 2012-SDA-5, SB-VS-1, and SB-VS-2; and to the west by 2013-B4R and numerous verification samples collected within the footprint of the former Shooting Range Berm (see Section 4.2.14 below), after the berm had been removed. The Undeveloped Buffer Property boundary (and associated PCLE Zone) also bounds the area to the east (PBW, 2014), “SCC” and “ECO” samples are samples collected during the APAR investigation from the 0 to 0.5-foot bgs interval in various areas of the Site to

evaluate areas of potential ecological habitat in accordance with the approved SLERA Work Plan (PBW, 2012b). Lateral delineation remains incomplete in the vicinity of 2013-SDA-3B and ECO-8B. The ecological samples in the vicinity of the South Disposal Area were collected to evaluate the south wooded area located east of the South Disposal Area and areas along Stewart Creek (the Stewart Creek corridor).

Consistent with 30 TAC §350.51(d)(2), RALs were used for vertical delineation since a groundwater assessment was performed in this area. Vertical delineation of the affected property was not completed in the vicinity of the South Disposal Area (outside of the landfill) and south wooded area at the sample location with the highest detected lead concentration in this area [6,150 mg/kg in sample 2014-SDA-7 (0-0.5')]. A lead concentration of 287 b mg/kg was detected in the deepest sample interval (0.5 to 2 feet bgs), where the "b" flag indicates lead was also detected in the method blank. The maximum detections of arsenic (96.6 mg/kg) was delineated to background at a depth of 0.5 mg/kg at this location. Antimony was not delineated because the antimony result from the deeper sample was not accepted during the data validation process due to low recovery. The maximum delineation depth of the affected property in this area (outside the landfill) was observed at 2 feet bgs at locations BS-3 and 2012-SDA-2, where lead concentrations of 40.2 mg/kg and 11.3 mg/kg, respectively, were observed. The RAL exceedance zone in historical boring SDA-8 was delineated at that location at a depth of 4 feet bgs during the Phase II RFI (JDC, 1998a). Based on the description of fill material within this boring, as noted on the boring log provided in the Phase II RFI, SDA-8 appears to be located within the boundaries of the South Disposal Area; therefore, additional verification of the historical vertical delineation depth at this location was not performed. Additional locations were not vertically delineated to the RAL for lead (2013-B4R-A to 0.5 feet bgs, 2013-SDA-3A to 0.5 feet bgs, and 2013-SDA-3B to 0.5 feet). Vertical delineation to background was not completed in several locations. Groundwater monitoring well B4R is located downgradient from the South Disposal Area. This well was sampled for lead, cadmium, arsenic, and selenium, and results did not exceed the Critical PCLs in the 2013 sampling event, though an exceedance of lead was detected in 2012.

In December 2013, and inspection and permeability sampling and analysis were conducted for the South Disposal Area. As described in a 1993 RCRA Facility Investigation Report, the South Disposal Area received battery case fragments and blast furnace slag. The unit was closed in 1974. A surface cap composed of native soils up to five feet thick, covers the landfill (Lake, 1993). The disposal area cover is approximately 1.05 acres in size (as delineated in the 1993 RCRA Facility Investigation Report), and comprised of compacted clayey soil. The cover is situated on a generally uniform slope (hill) that drains towards Stewart Creek. Upstream surface water runon control or diversion appears to be provided by a

berm and exposed bedrock, although actual drainage patterns for both off- and on-site drainage could not be readily established from field observations.

The following summarizes the field inspection observations of the South Disposal Area:

- The cover soils appeared firm and well drained, even after recent snowmelt. No muddy, soft, or wet areas were observed.
- No cracking, erosion, or rilling were observed on the cover.
- Minor undulations and equipment tracking were observed on the cover and in the vegetation, although neither appeared to impact the integrity of the cover.
- Vegetation is generally well established across the cover, although localized areas of recent surficial repair were observed. As the inspection was performed in December, the overall health of the vegetation could not be assessed, as it appeared dormant or partially dormant.
- Several localized areas of recent regrading, topsoil placement and re-vegetation were observed on the cover. Straw erosion control tubes were observed downslope from the repair areas, and degradable erosion blankets were observed to have been placed over the repair areas. These repairs were performed in June 2013 in response to a TCEQ inspection, as documented in the report included in Appendix 11 of the APAR (W&M, 2013c).

Overall, the cover was observed to be in good condition, well established, competent, with sufficient run-on controls to minimize the impacts of surface water across the surface of the cover. The cover vegetation was observed to be well established, with the exception of several localized repair areas that appear to have been recently regraded with additional topsoil.

Undisturbed Shelby tube samples were obtained at the three locations. Permeability testing results for the undisturbed cover samples ranged from 1.3×10^{-7} to 4.5×10^{-8} cm/sec, with a geometric mean value of 9.8×10^{-8} cm/sec for the three samples.

4.2.13 Crystallization Unit Frac Tank (NOR WMU No. 15)

As part of the 2012 SIR, two soil samples were collected from two locations in the vicinity of the Crystallization Unit Frac Tank. Sampling was performed in this area to assess potential impacts due to observations during regulatory agency inspections of liquid leaking from the frac tank, as well as visible drainage pathways leading from the frac tank to the edge of the concrete pad. These soil samples were analyzed for antimony, arsenic, barium, beryllium, cadmium, chromium, lead, nickel, selenium, silver, and zinc. All sample concentrations were below their respective RALs.

During the first phase of the APAR investigation, additional soil samples were collected within the upper 5-foot bgs interval along the surface water drainage pathway on the west side of the Crystallization Unit. Soil samples were initially collected from seven locations along the drainage pathway next to the

Crystallization Unit and the drainage ditch that runs west along the south side of Crystallizer Road Way, and were analyzed for lead and cadmium. The 0 to 0.5-foot sample from boring 2013-CUFT-7 was additionally analyzed for arsenic to evaluate potential atmospheric deposition of arsenic in this area. All sample results in all samples collected in this area were below applicable RALs, except for the 0 to 0.5-foot bgs samples in borings 2013-CUFT-5, 2013-CUFT-6, and 2013-CUFT-7, which exceeded the applicable RAL for lead. Additional samples were collected west and south of 2013-CUFT-7 from borings 2013-CUFT-7A and 2013-CUFT-10 (within the ditch area down slope from 2013-CUFT-7) to laterally delineate the RAL exceedance zone in this area. The samples from the two additional borings were analyzed for lead and cadmium. The sample results exceeded the RAL for lead in 2013-CUFT-10.

During the second phase of the APAR investigation, additional samples were collected to further delineate the Crystallization Unit Frac Tank area, including the Crystallizer Way ditch extending to the west. Site personnel were interviewed and the Crystallization Unit area was inspected to identify areas where potential leaks could have occurred, such as beneath piping and valves and for likely surface water flow direction. A boring location near a sump near the northeast corner of the Crystallization Unit (2013-CUFT-11) was selected for evaluation. Additional evaluation of this unit will be performed at the time of decommissioning, as warranted. Step-out samples were collected around 2013-CUFT-5, 2013-CUFT-6, 2013-CUFT-7, and 2013-CUFT-10. 2013-CUFT-11 and 2013-CUFT-14 were sampled north of the Crystallization Unit area; 2014-CUFT-15, 2014-CUFT-16, and 2014-CUFT-17 were sampled at points farther west along the road; and sample 2014-CUFT-18 was collected between Crystallizer Way and the storm water pond, north of 2013-CUFT-6 samples. All samples were analyzed for lead. Select shallow samples were analyzed for cadmium or all five of the metals COCs. In addition, the sample at 2013-CUFT-14 was analyzed for PCBs based on a report of PCB-labelled drums identified at this location as described above.

Lead concentrations in the surficial samples at 2013-CUFT-5B, 2013-CUFT-5B-A, 2013-CUFT-6A, 2013-CUFT-10B, 2014-CUFT-15, and 2014-CUFT-16 exceeded the RAL. No samples exceeded the RALs for other metals, and no PCBs were detected in the sample from 2013-CUFT-14. The Crystallizer Unit Frac Tank area is delineated for lead to the east by 2013-CUFT-4 and the samples in the Crystallizer Unit area; to the south by 2013-CUFT-5C, 2013-CUFT-6B, 2013-CUFT-7A, 2013-CUFT-10C, and by the Undeveloped Buffer Property area PCLE Zone (being addressed separately) to the south; and to the north by 2013-CUFT-10A, 2013-CUFT-7B, 2013-CUFT-18, and 2013-CUFT-5A.

The maximum lead concentration was detected in the 0 to 0.5 foot bgs interval at 2014-CUFT-16 (1,530 mg/kg). The lead concentration in the 0.5 to 2-foot bgs depth interval from boring 2014-CUFT-16 was 117 mg/kg, which is below the RAL; however, per 30 TAC §350.51(d)(1) vertical delineation should be

completed to below the site-specific background concentration since a groundwater investigation was not conducted in this area, and vertical delineation is not complete.

Specific samples collected from this area were also analyzed for pH during the SIR investigation and sulfate during both the SIR and APAR investigations (Table 4F). Results for pH in these samples ranged from 6.32 to 6.82. The sulfate results were highly variable, ranging from 56.7 to 8,710 mg/kg. PCLs are not established for these geochemical parameters.

4.2.14 Former Shooting Range Berm and the South Berm

In accordance with the TCEQ Agreed Order, soil that composed the former Shooting Range Berm, located immediately west of the South Disposal Area, was removed in 2013. Near surface verification soil samples were collected at fourteen locations within the footprint of the former berm, and the soil samples were analyzed for lead and cadmium. Some additional step-out samples were collected.

During the second phase of the APAR investigation, step-out samples were collected to provide further delineation near SRB-VS-9, SRB-VS-9A, SRB-VS-9B, and SRV-VS-9C (location SRB-VS-9E, analyzed for lead and cadmium); and near SRV-VS-11 (locations SRB-VS-11A and SRB-VS-11B, analyzed for five COC metals).

Concentrations of lead in six of the samples (SRB-VS-5, SRB-VS-9, SRB-VS-9A, SRB-VS-9B, SRB-VS-9C, SRB-VS-11) exceeded the applicable RAL for lead. One sample, SRB-VS-11B, also exceeded the RAL for antimony. The RAL exceedance zone at the former Shooting Range Berm is contained within Affected Property No. 3. The affected property is delineated on-site in the vicinity of the former Shooting Range Berm by samples SRB-VS-1 through SRB-VS-4, 2012-SDA-4, SRB-VS-11A, SRB-VS-6 through SRB-VS-8, SRB-VS-10, and SRB-VS-9E. It is also bounded farther to the west by the adjacent Undeveloped Buffer Property PCLE Zone (PBW, 2014). Consistent with 30 TAC §350.51(d)(1), background was used for vertical delineation purposes for lead because since a groundwater assessment was not performed in this area. Vertical delineation of the affected property to background in this area was completed for lead at SRB-VS-9, where the highest lead concentration was detected (1,330 mg/kg in the 0 to 0.5-foot bgs sample depth interval), at a depth of 0.5 feet bgs, where a lead concentration of 14.8 J mg/kg was observed, below the site-specific background concentration. Critical PCLs were not exceeded in the verification samples from the former Shooting Range Berm.

Bermed material (the South Berm) identified by the TCEQ southeast-adjacent to the former Shooting Range Berm was also removed in 2013. Two verification soil samples (SB-VS-1 and SB-VS-2) were collected from the footprint of the South Berm after it was removed, and were analyzed for lead and cadmium. Lead and cadmium concentrations in both of these samples were below their respective RALs.

4.2.15 Potential Ecological Habitat Areas

As discussed in the SLERA in Section 9 and per the SLERA Work Plan (PBW, 2012b), soil samples were collected from the 0 to 0.5-foot bgs depth interval from various parts of the Site designated as areas of potential ecological habitat. These include the north wooded area adjacent to the North Tributary, the south wooded area adjacent to the South Disposal Area, and along the Stewart Creek corridor. Evaluations of the ecological soil samples collected within the south wooded area and the Stewart Creek corridor were discussed in previous sections covering the South Disposal Area, Stewart Creek Flood Wall, and Slag Landfill.

During the SLERA, over thirty soil samples were collected within the north wooded area located adjacent to the North Tributary. These samples were analyzed for lead and/or cadmium. Five of the north wooded area samples (from borings E-11A, ECO-11, ECO-12, MW-21, and MW-22) were additionally analyzed for arsenic to evaluate potential aerial deposition of arsenic in this area.

During the second phase of the APAR investigation, additional locations were sampled to further delineate for metals in the north wooded area and North Tributary area (D-11A, D-11B, D-12A, D-13A, E-11C, E-11C-A, E-11D, E-11E, E-12A, E-13A, E-14A, 2013-NT-01, and 2013-NT-02). Samples were analyzed for various combinations of the five COC metals, to assess distribution of additional COC metals at the Site. Samples were also collected at MW-41 (analyzed for lead, cadmium, arsenic, and selenium) and MW-42 (analyzed for five COC metals). Lead RAL exceedances were detected at twelve sample locations within the wooded area on the north side of the North Tributary (Affected Property No. 1). Arsenic RAL exceedances were detected at D-11A, D-11B, E-11A, E-11C, and 2013-NT-01. The 2013-NT-01, D-11A, E-11B, and D-11B exceedances were not co-located with lead exceedances. All of the arsenic RAL exceedances were below the background concentrations that could be expected in this former agricultural area, except at E—11C (79.8 mg/kg, co-located with a lead exceedance). Cadmium and antimony concentrations also exceeded the RALs in the surficial sample at E-11C (where lead was detected at 11,200 mg/kg).

Affected Property No. 1 was delineated for lead to the north by soil samples D-11A, D-12A, D-13A, D-14, D-15, and soil samples from several of the Class 2 Landfill monitoring wells, including LMW-22 and LMW-21; to the west by E-11B; to the south by MW-41, E-11D, E-11E, sediment samples collected within the North Tributary (see Section 7 of this APAR), and MW-42; and to the east by E-15A and the property boundary. The Undeveloped Buffer Property is located east of Parkwood Drive and is being assessed separately (PBW, 2014). Vertical delineation of the affected property at the highest detected lead concentration in the area (11,200 mg/kg at E-11C) was not delineated below the detected depth (0 to 0.5 feet bgs), and was also not delineated for other metals at that depth. However, groundwater sampling results for wells surrounding the area (MW-41, MW-42, LMW-5, LMW-17, and LMW-8) do not exceed the

Critical PCLs for lead, cadmium, arsenic, or selenium, and do not exceed the Critical PCLs for lead and cadmium (other metals not sampled) at P-1. Sediment and surface water samples in the North Tributary also do not show impacts above RALs/Critical PCLs.

4.2.16 Lake Parcel

During the SIR and first phase of the APAR investigation, fifteen soil samples were collected from ten locations on the Lake Parcel, located near the western boundary of the Site (Figure 4A). Soil samples were collected from the 0 to 3-inch bgs interval at each of the sampling locations in this area. Additional samples were collected at 1 foot bgs at four of the sampling locations (G-4, G-5, H-4, and H-5). All of the soil samples collected from the Lake Parcel were analyzed for lead and cadmium, and all results were below applicable RALs with the exception of F-5, which exceeded the RAL for lead. The lead results for all of the soil samples collected at 1 foot bgs were also below the site-specific background concentration for lead.

During the second phase of the APAR investigation, step-out samples were collected around F-5 to provide lateral and vertical delineation. Locations F-5A though F-5E were sampled for lead and cadmium in the 0 to 3 inch bgs interval, and a sample was collected at the 1 foot bgs interval at F-5A. All samples were below the RALs, completing delineation horizontally. Consistent with 30 TAC §350.51(d)(1), background was used for vertical delineation purposes for lead because since a groundwater assessment was not performed in this area. The deeper sample interval was below the background level, completing vertical delineation.

4.2.17 Firefighter Training Area

During the second phase of the APAR investigation, six borings were completed and sampled in the Firefighter Training Facility area (MW-43, 2013-FFTA-1, 2013-FFTA-2, 2013-FFTA-3, 2014-FFTA-4, and 2014-FFTA-5). The first four borings were advanced to depths of 18 to 20 feet bgs based on depth of bedrock. In general, each of these borings encountered fine-grained soils up to the depth where shale bedrock was encountered (approximately 18 to 20 feet bgs), with a 1- to 2-foot thick strata of coarser-grained material present at a depth of approximately 10.5 to 13 feet bgs in some borings. The near surface samples were analyzed. In two borings (MW-43 and 2013-FFTA-3), additional samples were analyzed at depth based on elevated PID screening detections. Samples from these boreholes were analyzed for VOCs, SVOCs, and TPH; and two of the samples were also analyzed for PFCs. Sample results indicated detections of some analytes, but all detections were below the soil RALs. Although no specific RALs have been established for PFCs, the low level detections were below the MQLs or USEPA Region 4 Regional Screening Levels, where available. The final two borings (2014-FFTA-4 and 2014-

FFTA-5) were sampled to delineate for the five COC metals in the upper five feet of soil. No metals exceeded the respective RALs.

4.2.18 Former Burn Pile Area

During the second Phase of the APAR investigation four borings were completed in the former burn pile area (2014-FFTA-06, 2014-FFTA-07, 2014-FFTA-08, and 2014-NDA-7). These borings were advanced to depths of 12 to 15 feet, where bedrock was encountered. The near-surface samples were analyzed for the five COC metals, VOCs and SVOCs. Sample results indicated concentrations of lead exceeded the RAL at all four locations, and all except 2014-NDA-7 exceeded the RAL for arsenic. The arsenic detections were only slightly above the Site-specific background value of 15.9 mg/kg and were within the range of published background values for areas historically used for agricultural purposes. There were no VOC or SVOC exceedances except for bis(2-chloroethyl) ether detected in the 0-0.5 ft bgs sample at 2014-FFTA-08 and methylene chloride detected in the duplicate sample for 2014-NDA-7 (0-0.5). Neither of these compounds were detected in the associated deeper samples.

The former Burn Pile Area is entirely within Affected Property No. 2. It is bounded to the west and south by the North Disposal Area. It is delineated to the north by MW-21 and, 2012-NDA-6; and to the east by 2014-FFTA-4 and 2014-FFTA-5. Consistent with 30 TAC §350.51(d)(1), background was used for vertical delineation purposes for metals because since a groundwater assessment was not performed in this area. Metals exceedances were not vertically delineated by deeper samples. However, groundwater samples at B7N, located on the downgradient side of the former Burn Pile area, did not exceed the RAL/Critical PCL for lead.

4.2.19 Western Part of North Tributary

During the second phase of the APAR investigation, samples were collected to provide delineation of metals along the North Tributary west of the area delineated in the North Woods and North Tributary potential ecological habitat study and north of the Slag Landfill delineated area. Two locations were sampled (2014-NT-3 and 2014-NT-4), with shallow samples analyzed for the five COC metals. Lead exceeded the RAL in the 0 to 0.5-foot bgs interval at 2014-NT-3. Lead concentrations in the 0.5 to 2-foot bgs sample were below the RAL.

The affected property west of the North Wooded Area and north of the North Tributary extends to the northern edge of the North Tributary (sediment samples collected from the North Tributary in this area contained COC lead and cadmium concentrations below the applicable sediment PCLs). The affected property is further delineated to the north by the adjacent Undeveloped Buffer Property area; to the east by MW-41; and to the west by 2014-NT-4. Consistent with 30 TAC §350.51(d)(1), background was used for vertical delineation purposes for lead because since a groundwater assessment was not performed in

this area. At 2014-NT-3, where the maximum concentration of lead in the 0 to 0.5-foot bgs interval was 353 mg/kg, the concentration of lead in the 0.5 to 2-foot bgs sample was 59.3 b mg/kg, which was below the RAL but above background levels. The “b” notation indicates lead was also detected in the method blank, suggesting results may be biased high. However, areas immediately adjacent to the north on the Undeveloped Buffer Property with higher concentrations of lead in surface soil samples (have been vertically delineated (PBW, 2014).

Table 4A
Surface Soil Residential Assessment Levels
with No Ecological Component

COC	Source Area Size (acres)	$^{Tot}Soil_{Comb}$ PCL (mg/kg)	$^{GW}Soil_{Ing}$ PCL (mg/kg)	Tier	RAL[1] (mg/kg)	MQL (mg/kg)	Background[2] (mg/kg)	Maximum Concentration Detected: Sample ID	Sample Depth (feet bgs)	Sample Date	Conc (mg/kg)
Metals											
Antimony	30	1.5E+01	**2.7E+00**	1	2.7E+00	2.5E+00	1.0E+00	2014-SDA-7 (0-0.5)	0-0.5	03/31/14	**102**
Arsenic	30	2.4E+01	3.1E+00	2	1.6E+01	1.0E+00	**1.6E+01**	2012-FWCS-1A (1-2')	1-2*	03/05/13	**115**
Barium	30	8.1E+03	**2.2E+02**	1	2.2E+02	1.0E+00	3.0E+02	2013-RMSB-4 (5-6)	5-6	05/07/13	131
Beryllium	30	3.8E+01	**9.2E-01**	1	9.2E-01	3.2E-01	1.5E+00	2012 CUFT-2 (0-2')	0-2	01/06/12	0.806
Cadmium	30	5.2E+01	**3.0E+01**	2	3.0E+01	2.5E-01	NP	2012-FWFS-9 (Floor)	2.4	09/04/12	**984**
Chromium	30	2.7E+04	**1.2E+03**	1	1.2E+03	5.0E-01	3.0E+01	2013-RMSB-2 (2.5-5)	2.5-5*	05/08/13	22.4
Lead	30	5.0E+02	**2.8E+02**	2	2.8E+02	5.0E-01	3.2E+01	2013-WMU14-1 (0.9-2)	0.9-2*	05/07/13	**95000**
Mercury	30	2.1E+00	3.9E-03	1	4.0E-02	5.0E-02	**4.0E-02**	2013-RMSB-4 (5-6)	5-6	05/07/13	0.013 J
Nickel	30	8.4E+02	**7.9E+01**	1	7.9E+01	1.3E+00	1.0E+01	2012 CUFT-1 (0-2')	0-2	01/06/12	12.4
Selenium	30	3.1E+02	**1.6E+00**	2	1.6E+00	2.0E+00	3.0E-01	E-11C (0-0.5)	0-0.5	01/09/14	**29.2**
Silver	30	9.7E+01	**2.4E-01**	1	2.4E-01	5.0E-01	NP	--	--	--	--
Zinc	30	9.9E+03	**1.2E+03**	1	1.2E+03	1.9E+00	3.0E+01	2012 CUFT-1 (0-2')	0-2	01/06/12	55
Total Petroleum Hydrocarbons (TPH) by TX1005[3]											
T/R Hydrocarbons: C6-C12	0.5	--	--	--	--	1.0E+01	--	2012-FWFS-9 (4-5)	4-5	04/29/13	532 JH
T/R Hydrocarbons: >C12-C28	0.5	--	--	--	--	1.0E+01	--	2012-FWFS-9 (4-5)	4-5	04/29/13	4730 JH
T/R Hydrocarbons: >C28-C35	0.5	--	--	--	--	1.0E+01	--	2013-STB-11 (0.5-1.3')	0.5-1.3	03/14/13	1380
T/R Hydrocarbons: C6-C35	0.5	--	--	1	1.3E+04	1.0E+01	--	2012-FWFS-9 (4-5)	4-5	04/29/13	5490 JH
Total Petroleum Hydrocarbons (TPH) by TX1006[3]											
nC6 Aliphatics	0.5	--	--	1	--	1.0E+01	--	--	--	--	--
<C6-C8 Aliphatics	0.5	--	--	1	--	1.0E+01	--	--	--	--	--
>C8-C10 Aliphatics	0.5	--	--	1	--	1.0E+01	--	2012-FWFS-9 (4-5)	4-5	04/29/13	67 X7,J
>C10-C12 Aliphatics	0.5	--	--	1	--	1.0E+01	--	2012-FWFS-9 (4-5)	4-5	04/29/13	856 JH
>C12-C16 Aliphatics	0.5	--	--	1	--	1.0E+01	--	2012-FWFS-9 (4-5)	4-5	04/29/13	999 X7, JH
>C16-C21 Aliphatics	0.5	--	--	1	--	1.0E+01	--	2012-FWFS-9 (4-5)	4-5	04/29/13	1110 X7, JH
>C21-C35 Aliphatics	0.5	--	--	1	--	1.0E+01	--	2013-STB-11(0.5-1.3)	0.5-1.3	03/14/13	168 X7
>C7-C8 Aromatics	0.5	--	--	1	--	1.0E+01	--	2012-FWFS-9 (4-5)	4-5	04/29/13	12.8 X7,J
>C8-C10 Aromatics	0.5	--	--	1	--	1.0E+01	--	2013-STB-11(0.5-1.3)	0.5-1.3	03/14/13	6.17 X7, J
>C10-C12 Aromatics	0.5	--	--	1	--	1.0E+01	--	2012-FWFS-9 (4-5)	4-5	04/29/13	62.9 X7,J
>C12-C16 Aromatics	0.5	--	--	1	--	1.0E+01	--	2012-FWFS-9 (4-5)	4-5	04/29/13	684 X7, JH
>C16-C21 Aromatics	0.5	--	--	1	--	1.0E+01	--	2012-FWFS-9 (4-5)	4-5	04/29/13	737 X7, JH
>C21-C35 Aromatics	0.5	--	--	1	--	1.0E+01	--	2013-STB-11(0.5-1.3)	0.5-1.3	03/14/13	383 X7
>C6-C35	0.5	--	--	--	1.3E+04	1.0E+01	--	2012-FWFS-9 (4-5)	4-5	04/29/13	4810 X7, JH

Table 4A
Surface Soil Residential Assessment Levels
with No Ecological Component

COC	Source Area Size (acres)	$^{Tot}Soil_{Comb}$ PCL (mg/kg)	$^{GW}Soil_{Ing}$ PCL (mg/kg)	Tier	RAL[1] (mg/kg)	MQL (mg/kg)	Background[2] (mg/kg)	Maximum Concentration Detected: Sample ID	Sample Depth (feet bgs)	Sample Date	Conc (mg/kg)
Polychlorinated Biphenyls (PCBs)											
Aroclor 1016	0.5	**1.1E+00**	1.1E+01	--	1.1E+00	1.7E-02	--	--	--	--	--
Aroclor 1221	0.5	**1.1E+00**	1.1E+01	--	1.1E+00	1.7E-02	--	--	--	--	--
Aroclor 1232	0.5	**1.1E+00**	1.1E+01	--	1.1E+00	1.7E-02	--	--	--	--	--
Aroclor 1242	0.5	**1.1E+00**	1.1E+01	--	1.1E+00	1.7E-02	--	--	--	--	--
Aroclor 1248	0.5	**1.1E+00**	1.1E+01	--	1.1E+00	1.7E-02	--	--	--	--	--
Aroclor 1254	0.5	**1.1E+00**	1.1E+01	--	1.1E+00	1.7E-02	--	--	--	--	--
Aroclor 1260	0.5	**1.1E+00**	1.1E+01	--	1.1E+00	1.7E-02	--	--	--	--	--
Perfluorinated Compounds (PFCs)											
Perfluoro-1-Octanesulfonate (PFOS)	0.5	--	--	--	6 (13)	8.0E-04	--	2013-FFTA-03 (0.25-2)	0.25-2	01/07/14	0.00737
Perfluorobutane Sulfonate	0.5	--	--	--	8.0E-04	8.0E-04	--	--	--	--	--
Perfluorobutyric acid	0.5	--	--	--	8.0E-04	8.0E-04	--	--	--	--	--
Perfluorodecane Sulfonate	0.5	--	--	--	8.0E-04	8.0E-04	--	--	--	--	--
Perfluorodecanoic acid	0.5	--	--	--	2.0E-03	2.0E-03	--	--	--	--	--
Perfluorododecanoic acid	0.5	--	--	--	8.0E-04	8.0E-04	--	--	--	--	--
Perfluoroheptanoic acid	0.5	--	--	--	8.0E-04	8.0E-04	--	2013-FFTA-03 (0.25-2)	0.25-2	01/07/14	0.000181 J
Perfluorohexane Sulfonate	0.5	--	--	--	8.0E-04	8.0E-04	--	2013-FFTA-03 (0.25-2)	0.25-2	01/07/14	0.000537 J
Perfluorohexanoic acid	0.5	--	--	--	8.0E-04	8.0E-04	--	2013-FFTA-03 (0.25-2)	0.25-2	01/07/14	0.000579 J
Perfluoro-n-octanoic acid (PFOA)	0.5	--	--	--	16 (13)	8.0E-04	--	2013-FFTA-03 (0.25-2)	0.25-2	01/07/14	0.000910 J
Perfluorononanoic acid	0.5	--	--	--	8.0E-04	8.0E-04	--	2013-FFTA-03 (0.25-2)	0.25-2	01/07/14	0.000614 J
Perfluorooctane Sulfonamide	0.5	--	--	--	8.0E-04	8.0E-04	--	--	--	--	--
Perfluoropentanoic acid	0.5	--	--	--	8.0E-04	8.0E-04	--	2013-FFTA-03 (0.25-2)	0.25-2	01/07/14	0.000538 J
Perfluorotetradecanoic acid	0.5	--	--	--	2.0E-03	2.0E-03	--	--	--	--	--
Perfluorotridecanoic acid	0.5	--	--	--	8.0E-04	8.0E-04	--	--	--	--	--
Perfluoroundecanoic acid	0.5	--	--	--	8.0E-04	8.0E-04	--	--	--	--	--
Volatile Organic Compounds (VOCs)											
1,1,1-Trichloroethane	0.5	5.3E+04	**1.6E+00**	1	1.6E+00	5.0E-03	--	--	--	--	--
1,1,2,2-Tetrachloroethane	0.5	3.0E+01	**2.3E-02**	1	2.3E-02	5.0E-03	--	--	--	--	--
1,1,2-Trichloroethane	0.5	1.8E+01	**2.0E-02**	1	2.0E-02	5.0E-03	--	--	--	--	--
1,1-Dichloroethane	0.5	1.1E+04	**1.8E+01**	1	1.8E+01	5.0E-03	--	--	--	--	--
1,1-Dichloroethene	0.5	2.3E+03	**5.0E-02**	1	5.0E-02	5.0E-03	--	--	--	--	--
1,2-Dichloroethane	0.5	1.1E+01	**1.4E-02**	1	1.4E-02	5.0E-03	--	--	--	--	--
1,2-Dichloroethene, Total	0.5	NP	NP	--	--	1.0E-02	--	--	--	--	--
1,2-Dichloropropane	0.5	6.1E+01	**2.3E-02**	1	2.3E-02	5.0E-03	--	--	--	--	--
2-Butanone (MEK)	0.5	4.0E+04	**2.9E+01**	1	2.9E+01	1.0E-02	--	2013-MB-3 (0.75-1.25)	0.75-1.25	01/08/14	0.0392
2-Hexanone	0.5	2.7E+02	**3.2E-01**	1	3.2E-01	1.0E-02	--	--	--	--	--
4-Methyl-2-pentanone (MIBK)	0.5	5.9E+03	**4.9E+00**	1	4.9E+00	1.0E-02	--	--	--	--	--
Volatile Organic Compounds (VOCs) Continued											
Acetone	0.5	6.6E+04	**4.3E+01**	1	4.3E+01	1.0E-02	--	2013-MB-1 (4-5')	4-5	03/14/13	0.358

Table 4A
Surface Soil Residential Assessment Levels
with No Ecological Component

COC	Source Area Size (acres)	$^{Tot}Soil_{Comb}$ PCL (mg/kg)	$^{GW}Soil_{Ing}$ PCL (mg/kg)	Tier	RAL[1] (mg/kg)	MQL (mg/kg)	Background[2] (mg/kg)	Maximum Concentration Detected			
								Sample ID	Sample Depth (feet bgs)	Sample Date	Conc (mg/kg)
Benzene	0.5	1.2E+02	**2.6E-02**	1	2.6E-02	5.0E-03	--	2013-STB-6 (0.5-1.1')	0.5-1.1	03/14/13	**0.0406**
Bromodichloromethane	0.5	9.8E+01	**6.5E-02**	1	6.5E-02	5.0E-03	--	--	--	--	--
Bromoform	0.5	4.0E+02	**6.3E-01**	1	6.3E-01	5.0E-03	--	--	--	--	--
Bromomethane	0.5	4.6E+01	**1.3E-01**	1	1.3E-01	1.0E-02	--	--	--	--	--
Carbon disulfide	0.5	4.6E+03	**1.4E+01**	1	1.4E+01	1.0E-02	--	2013-RMSB-10 (7')	7	05/08/13	0.00399 J
Carbon tetrachloride	0.5	3.5E+01	**6.2E-02**	1	6.2E-02	5.0E-03	--	--	--	--	--
Chlorobenzene	0.5	5.2E+02	**1.1E+00**	1	1.1E+00	5.0E-03	--	--	--	--	--
Chlorobromomethane	0.5	3.3E+03	**3.0E+00**	1	3.0E+00	5.0E-03	--	--	--	--	--
Chloroethane	0.5	2.7E+04	**3.1E+01**	1	3.1E+01	1.0E-02	--	--	--	--	--
Chloroform	0.5	1.6E+01	**1.0E+00**	1	1.0E+00	5.0E-03	--	2012-FWFS-9 (4-5')	4-5	04/29/13	0.01220 U
Chloromethane	0.5	1.4E+02	**4.1E-01**	1	4.1E-01	1.0E-02	--	--	--	--	--
cis-1,2-Dichloroethene	0.5	1.4E+02	**2.5E-01**	1	2.5E-01	5.0E-03	--	--	--	--	--
cis-1,3-Dichloropropene	0.5	8.0E+00	**6.6E-03**	1	6.6E-03	5.0E-03	--	--	--	--	--
Dibromochloromethane	0.5	7.2E+01	**4.9E-02**	1	4.9E-02	5.0E-03	--	--	--	--	--
Ethylbenzene	0.5	6.4E+03	**7.6E+00**	1	7.6E+00	5.0E-03	--	2013-STB-6 (0.5-1.1')	0.5-1.1	03/14/13	0.0765
Methyl tert-butyl ether	0.5	8.0E+02	**6.2E-01**	1	6.2E-01	5.0E-03	--	2013-RMSB-5 (2-5')	2-5	05/07/13	0.00233
Methylene Chloride	0.5	4.8E+02	**1.3E-02**	1	1.3E-02	1.0E-02	--	DUP-4 (2014-NDA-7)	0-0.5	04/01/14	**0.0183**
m-Xylene and p-Xylene[12]	0.5	8.9E+03	**1.1E+02**	1	1.1E+02	1.0E-02	--	--	--	--	--
o-Xylene	0.5	4.8E+04	**7.1E+01**	1	7.1E+01	5.0E-03	--	2013-STB-6 (0.5-1.1')	0.5-1.1	03/14/13	0.0148
Styrene	0.5	6.7E+03	**3.3E+00**	1	3.3E+00	5.0E-03	--	--	--	--	--
Tetrachloroethene	0.5	4.5E+02	**5.0E-02**	1	5.0E-02	5.0E-03	--	2013-STB-6 (0.5-1.1')	0.5-1.1	03/14/13	0.0116
Toluene	0.5	5.9E+03	**8.2E+00**	1	8.2E+00	5.0E-03	--	MW-27D (0.5-2)	0.5-2	01/08/14	0.00197 J
trans-1,2-Dichloroethene	0.5	5.9E+02	**4.9E-01**	1	4.9E-01	5.0E-03	--	--	--	--	--
trans-1,3-Dichloropropene	0.5	3.6E+01	**3.6E-02**	1	3.6E-02	5.0E-03	--	--	--	--	--
Trichloroethene	0.5	1.8E+01	**3.4E-02**	1	3.4E-02	5.0E-03	--	--	--	--	--
Vinyl acetate	0.5	3.0E+03	**5.3E+01**	1	5.3E+01	5.0E-03	--	--	--	--	--
Vinyl chloride	0.5	3.7E+00	**2.2E-02**	1	2.2E-02	1.0E-02	--	--	--	--	--
Xylenes, Total	0.5	6.0E+03	**1.2E+02**	1	1.2E+02	5.0E-03	--	2013-STB-6 (0.5-1.1')	0.5-1.1	03/14/13	0.0319

Table 4A
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with No Ecological Component

COC	Source Area Size (acres)	$^{Tot}Soil_{Comb}$ PCL (mg/kg)	$^{GW}Soil_{Ing}$ PCL (mg/kg)	Tier	RAL[1] (mg/kg)	MQL (mg/kg)	Background[2] (mg/kg)	Maximum Concentration Detected: Sample ID	Sample Depth (feet bgs)	Sample Date	Conc (mg/kg)
Semivolatile Organic Compounds (SVOCs)											
1,2,4-Trichlorobenzene	0.5	1.2E+02	**4.8E+00**	1	4.8E+00	1.7E-02	--	--	--	--	--
1,2-Dichlorobenzene	0.5	7.2E+02	**1.8E+01**	1	1.8E+01	1.7E-02	--	--	--	--	--
1,3-Dichlorobenzene	0.5	1.2E+02	**6.7E+00**	1	6.7E+00	1.7E-02	--	--	--	--	--
1,4-Dichlorobenzene	0.5	2.5E+02	**2.1E+00**	1	2.1E+00	3.3E-02	--	--	--	--	--
1-Methylnaphthalene	0.5	1.5E+02	**2.9E+00**	1	2.9E+00	1.7E+01	--	2013-STB-6 (0.5-1.1')	0.5-1.1	03/14/13	0.358 J
2,4,5-Trichlorophenol	0.5	6.7E+03	**3.4E+01**	1	3.4E+01	2.5E-02	--	--	--	--	--
2,4,6-Trichlorophenol	0.5	6.7E+01	**1.7E-01**	1	1.7E-01	2.5E-02	--	--	--	--	--
2,4-Dichlorophenol	0.5	2.0E+02	**3.5E-01**	1	3.5E-01	1.7E-02	--	--	--	--	--
2,4-Dimethylphenol	0.5	1.3E+03	**3.2E+00**	1	3.2E+00	1.7E-02	--	--	--	--	--
2,4-Dinitrophenol	0.5	1.3E+02	**9.4E-02**	1	9.4E-02	1.0E-01	--	--	--	--	--
2,4-Dinitrotoluene	0.5	6.9E+00	**5.3E-03**	1	5.3E-03	3.3E-02	--	--	--	--	--
2,6-Dinitrotoluene	0.5	6.9E+00	**4.8E-03**	1	4.8E-03	1.7E-02	--	--	--	--	--
2-Chloronaphthalene	0.5	5.0E+03	**6.7E+02**	1	6.7E+02	1.7E-02	--	--	--	--	--
2-Chlorophenol	0.5	4.1E+02	**1.6E+00**	1	1.6E+00	1.7E-02	--	--	--	--	--
2-Methylnaphthalene	0.5	2.5E+02	**1.7E+01**	1	1.7E+01	1.7E-02	--	2013-RMSB-2 (5-6)	5-6	05/08/13	3.68
2-Methylphenol (o-Cresol)	0.5	3.3E+03	**7.1E+00**	1	7.1E+00	1.7E-02	--	--	--	--	--
2-Nitroaniline	0.5	1.1E+01	**2.2E-02**	1	2.2E-02	1.7E-02	--	--	--	--	--
2-Nitrophenol	0.5	1.3E+02	**1.3E-01**	1	1.3E-01	1.7E-02	--	--	--	--	--
3 & 4 Methylphenol[12] (m & p-Cresol)	0.5	3.3E+02	**6.3E-01**	1	6.3E-01	3.3E-02	--	2013-FFTA-03 (18-19)	18-19	01/08/14	0.572
3,3'-Dichlorobenzidine	0.5	1.0E+01	**6.3E-02**	1	6.3E-02	3.3E-02	--	--	--	--	--
3-Nitroaniline	0.5	1.5E+01	**2.6E-02**	1	2.6E-02	1.7E-02	--	--	--	--	--
4,6-Dinitro-2-methylphenol	0.5	6.7E+00	**4.7E-03**	1	4.7E-03	1.0E-01	--	--	--	--	--
4-Bromophenyl phenyl ether	0.5	**2.8E-01**	3.5E-01	1	2.8E-01	1.7E-02	--	--	--	--	--
4-Chloro-3-methylphenol	0.5	3.3E+02	**4.5E+00**	1	4.5E+00	1.7E-02	--	--	--	--	--
4-Chloroaniline	0.5	2.3E+01	**2.1E-02**	1	2.1E-02	3.3E-02	--	--	--	--	--
4-Chlorophenyl phenyl ether	0.5	1.6E-01	**3.2E-02**	1	3.2E-02	1.7E-02	--	--	--	--	--
4-Nitroaniline	0.5	2.2E+02	**1.1E-01**	1	1.1E-01	1.7E-02	--	--	--	--	--
4-Nitrophenol	0.5	1.3E+02	**1.0E-01**	1	1.0E-01	1.7E-02	--	--	--	--	--
Acenaphthene	0.5	3.0E+03	**2.4E+02**	1	2.4E+02	1.7E-02	--	--	--	--	--
Acenaphthylene	0.5	3.8E+03	**4.1E+02**	1	4.1E+02	1.7E-02	--	--	--	--	--
Anthracene	0.5	1.8E+04	**6.9E+03**	1	6.9E+03	1.7E-02	--	MW-27C (0-2)	0-2	01/08/14	0.00824 J
Benzidine	0.5	1.5E-02	**1.1E-05**	1	1.1E-05	3.3E-01	--	--	--	--	--
Benzo[a]anthracene	0.5	**5.7E+00**	1.8E+01	1	5.7E+00	1.7E-02	--	SCC-8 (0-0.5')	0-0.5	01/15/13	0.0169 J
Benzo[a]pyrene	0.5	**5.6E-01**	7.6E+00	1	5.6E-01	1.7E-02	--	SCC-8 (0-0.5')	0-0.5	01/15/13	0.0323
Benzo[b]fluoranthene	0.5	**5.7E+00**	6.0E+01	1	5.7E+00	3.3E-02	--	SCC-8 (0-0.5')	0-0.5	01/15/13	0.0542

Surface Soil Residential Assessment Levels
with No Ecological Component

COC	Source Area Size (acres)	$^{Tot}Soil_{Comb}$ PCL (mg/kg)	$^{GW}Soil_{Ing}$ PCL (mg/kg)	Tier	RAL[1] (mg/kg)	MQL (mg/kg)	Background[2] (mg/kg)	Maximum Concentration Detected: Sample ID	Sample Depth (feet bgs)	Sample Date	Conc (mg/kg)
Semivolatile Organic Compounds (SVOCs) Continued											
Benzo[g,h,i]perylene	0.5	**1.8E+03**	4.6E+04	1	1.8E+03	1.7E-02	--	SCC-8 (0-0.5')	0-0.5	01/15/13	0.0336
Benzo[k]fluoranthene	0.5	**5.7E+01**	6.2E+02	1	5.7E+01	1.7E-02	--	SCC-8 (0-0.5')	0-0.5	01/15/13	0.0161 J
Benzyl alcohol	0.5	6.7E+03	**5.9E+00**	1	5.9E+00	1.7E-02	--	--	--	--	--
bis (2-Chloroisopropyl) ether	0.5	5.1E+01	**1.9E-01**	1	1.9E-01	1.7E-02	--	--	--	--	--
Bis(2-chloroethoxy)methane	0.5	3.1E+00	**1.2E-02**	1	1.2E-02	3.3E-02	--	--	--	--	--
Bis(2-chloroethyl)ether	0.5	2.2E+00	**2.1E-03**	1	2.1E-03	1.7E-02	--	2014-FFTA-08 (0-0.5)	0-0.5	04/01/14	**0.0371**
Bis(2-ethylhexyl) phthalate	0.5	**4.3E+01**	1.6E+02	1	4.3E+01	6.7E-02	--	MW-43 (0-2)	0-2	01/07/14	39.6
Butyl benzyl phthalate	0.5	1.6E+03	**2.6E+02**	1	2.6E+02	6.7E-02	--	2013-RMSB-10 (5-6')	5-6	05/08/13	0.0106 J
Carbazole	0.5	2.3E+02	**4.6E+00**	1	4.6E+00	1.7E-02	--	2013-MB-5 (0.5-5)	0.5-5	01/08/14	0.0224 J
Chrysene	0.5	**5.6E+02**	1.5E+03	1	5.6E+02	1.7E-02	--	SCC-8 (0-0.5')	0-0.5	01/15/13	0.0394
Dibenz(a,h)anthracene	0.5	**5.5E-01**	1.5E+01	1	5.5E-01	1.7E-02	--	SCC-8 (0-0.5')	0-0.5	01/15/13	0.0386
Dibenzofuran	0.5	2.7E+02	**3.3E+01**	1	3.3E+01	1.7E-02	--	2013-MB-5 (10-12)	10-12	01/08/14	6.33
Diethyl phthalate	0.5	5.3E+04	**1.6E+02**	1	1.6E+02	6.7E-02	--	2013-RMSB-10 (5-6')	5-6	05/08/13	0.0459 J
Dimethyl phthalate	0.5	5.3E+04	**6.2E+01**	1	6.2E+01	6.7E-02	--	2013-FFTA-03 (14-16)	14-16	01/07/14	0.167 J
Di-n-butyl phthalate	0.5	6.2E+03	**3.3E+03**	1	3.3E+03	6.7E-02	--	--	--	--	--
Di-n-octyl phthalate	0.5	**2.6E+03**	1.0E+06	1	2.6E+03	6.7E-02	--	--	--	--	--
Fluoranthene	0.5	2.3E+03	**1.9E+03**	1	1.9E+03	1.7E-02	--	SCC-8 (0-0.5')	0-0.5	01/15/13	0.0239
Fluorene	0.5	2.3E+03	**3.0E+02**	1	3.0E+02	1.7E-02	--	2013-MB-5 (10-12)	10-12	01/08/14	6.48
Hexachlorobenzene	0.5	**1.1E+00**	1.1E+00	1	1.1E+00	1.7E-02	--	--	--	--	--
Hexachlorobutadiene	0.5	2.0E+01	**3.3E+00**	1	3.3E+00	1.7E-02	--	--	--	--	--
Hexachlorocyclopentadiene	0.5	**1.4E+01**	1.9E+01	1	1.4E+01	1.7E-02	--	--	--	--	--
Hexachloroethane	0.5	4.6E+01	**1.3E+00**	1	1.3E+00	1.7E-02	--	--	--	--	--
Indeno[1,2,3-cd]pyrene	0.5	**5.7E+00**	1.7E+02	1	5.7E+00	1.7E-02	--	SCC-8 (0-0.5')	0-0.5	01/15/13	0.0495
Isophorone	0.5	4.9E+03	**3.0E+00**	1	3.0E+00	1.7E-02	--	2013-FFTA-03 (18-19)	18-19	01/08/14	0.153
Naphthalene	0.5	2.2E+02	**3.1E+01**	1	3.1E+01	1.7E-02	--	2013-RMSB-2 (5-6)	5-6	05/08/13	0.963
Nitrobenzene	0.5	6.6E+01	**3.5E-01**	1	3.5E-01	1.7E-02	--	--	--	--	--
N-Nitrosodimethylamine	0.5	7.4E-02	**3.7E-05**	1	3.7E-05	3.3E-02	--	--	--	--	--
N-Nitrosodi-n-propylamine	0.5	4.0E-01	**3.5E-04**	1	3.5E-04	3.3E-02	--	--	--	--	--
N-Nitrosodiphenylamine	0.5	5.7E+02	**2.8E+00**	1	2.8E+00	3.3E-02	--	--	--	--	--
Pentachlorophenol	0.5	7.3E-01	**1.8E-02**	1	1.8E-02	8.3E-02	--	--	--	--	--
Phenanthrene	0.5	1.7E+03	**4.2E+02**	1	4.2E+02	1.7E-02	--	2013-MB-5 (10-12)	10-12	01/08/14	5.36 JH
Phenol	0.5	2.0E+04	**1.9E+01**	1	1.9E+01	1.7E-02	--	2013-FFTA-01 (0.25-2)	0.25-2	01/08/14	0.726 J
Pyrene	0.5	1.7E+03	**1.1E+03**	1	1.1E+03	1.7E-02	--	2013-MB-5 (10-12)	10-12	01/08/14	1.26 J

Table 4A

Surface Soil Residential Assessment Levels with No Ecological Component

COC	Source Area Size (acres)	$^{Tot}Soil_{Comb}$ PCL (mg/kg)	$^{GW}Soil_{Ing}$ PCL (mg/kg)	Tier	RAL[1] (mg/kg)	MQL (mg/kg)	Background[2] (mg/kg)	Maximum Concentration Detected			
								Sample ID	Sample Depth (feet bgs)	Sample Date	Conc (mg/kg)

Notes:

MQL values that exceed RALs are shaded orange.

Maximum sample concentrations that exceed RALs are shaded tan.

1. The Residential Assessment Level (RAL) for metals is the lower of the TRRP Tier 1 $^{GW}Soil_{Ing}$ and $^{Tot}Soil_{Comb}$ PCLs for a 30-acre source area (TCEQ, 2012c), except where Tier 2 PCLs are applicable. The lower of the applicable PCLs is bolded.
2. The Residential Assessment Level (RAL) for TPH, VOCs, and SVOCs is the lower of the TRRP Tier 1 $^{GW}Soil_{Ing}$ and $^{Tot}Soil_{Comb}$ PCLs for a 0.5-acre source area (TCEQ, 2012c), except where Tier 2 PCLs are applicable. The lower of the applicable PCLs is bolded.
3. Background values for metals are Texas-specific background values based on Figure 30 TAC 350.51(m), except for arsenic and lead. Arsenic and lead values are site specific background values (see Appendix 8).
4. As detailed in Appendix 9, a TPH Mixture RAL was developed for sample 2012-FWFS-9 (4-5'), developed in accordance with RG-366/TRRP-27 (see Appendix 9)
5. NP - PCL not published.
6. Data Qualifiers: J - estimated result; JH - estimated result, biased high; U - not detected, detected in associated blank; X7 - TCEQ does not offer accreditation for this analyte.
8. "--" - not applicable.
9. * - Sub-slab or sub-gabion basket sample; top depth represents the approximate top of soil.
10. Ecological component evaluated in SLERA (Section 9).
11. Where constituents of concern are combined, the lowest value RAL is used between them.
12. TRRP PCLs are not established for PFCs. PFCs are classified by EPA as emerging contaminants. Region 4 screening levels for Perfluorooctanic acid (PFOA) of 16 mg/kg and Perfluoroocytl Sulfonate (PFOS) of 6 mg/kg are provided for reference. MQLs are listed as RALs for other PFCs.

Table 4C

Subsurface Soil Residential Assessment Levels with No Ecological Component

COC	Source Area Size	$^{Air}Soil_{Inh-V}$ PCL	$^{GW}Soil_{Ing}$ PCL		RAL[1]	MQL	Background[2]	Maximum Concentration Detected			
	(acres)	(mg/kg)	(mg/kg)	Tier	(mg/kg)	(mg/kg)	(mg/kg)	Sample ID	Sample Depth (feet bgs)	Sample Date	Conc (mg/kg)
Metals											
Antimony	30	NP	**2.7E+00**	1	2.7E+00	2.5E+00	1.0E+00	--	--	--	--
Arsenic	30	NP	3.1E+00	2	**1.6E+01**	1	**1.6E+01**	2013-CL2-08 (15-17)	15-17	1/14/2014	**18.5**
Cadmium	30	NP	**3.0E+01**	2	3.0E+01	2.5E-01	NP	2012-NDA-2 (16-18')	16-18	01/10/12	0.0364
Lead	30	NP	**2.8E+02**	2	2.8E+02	5.0E-01	3.2E+01	2013-CL2-08 (15-17)	15-17	1/14/2014	26.6
Selenium	30	NP	**1.6E+00**	2	1.6E+00	2.0E+00	3.0E-01	2013-CL2-08 (18-20)	18-20	01/14/14	1.49 J
VOCs											
1,1,1-Trichloroethane	0.5		1.6E+00	1	1.6E+00	0.005	NP	--	--	--	--
1,1,2,2-Tetrachloroethane	0.5		2.3E-02	1	2.3E-02	0.005	NP	--	--	--	--
1,1,2-Trichloroethane	0.5		2.0E-02	1	2.0E-02	0.005	NP	--	--	--	--
1,1-Dichloroethane	0.5		1.8E+01	1	1.8E+01	0.005	NP	--	--	--	--
1,1-Dichloroethene	0.5		5.0E-02	1	5.0E-02	0.005	NP	--	--	--	--
1,2-Dichloroethane	0.5		1.4E-02	1	1.4E-02	0.005	NP	--	--	--	--
1,2-Dichloroethene, Total	0.5		N/A	1	0.0E+00	0.01	NP	--	--	--	--
1,2-Dichloropropane	0.5		2.3E-02	1	2.3E-02	0.005	NP	--	--	--	--
2-Butanone (MEK)	0.5		2.9E+01	1	2.9E+01	0.01	NP	--	--	--	--
2-Hexanone	0.5		3.2E-01	1	3.2E-01	0.01	NP	--	--	--	--
4-Methyl-2-pentanone (MIBK)	0.5		4.9E+00	1	4.9E+00	0.01	NP	--	--	--	--
Acetone	0.5		4.3E+01	1	4.3E+01	0.01	NP	2013-FFTA-03 (18-19)	18-19	1/8/2014	0.029
Benzene	0.5		2.6E-02	1	2.6E-02	0.005	NP	--	--	--	--
Chlorobromomethane	0.5		3.0E+00	1	3.0E+00	0.005	NP	--	--	--	--
Bromodichloromethane	0.5		6.5E-02	1	6.5E-02	0.005	NP	--	--	--	--
Bromoform	0.5		6.3E-01	1	6.3E-01	0.005	NP	--	--	--	--
Bromomethane	0.5		1.3E-01	1	1.3E-01	0.01	NP	--	--	--	--
Carbon Disulfide	0.5		1.4E+01	1	1.4E+01	0.01	NP	--	--	--	--
Carbon Tetrachloride	0.5		6.2E-02	1	6.2E-02	0.005	NP	--	--	--	--
Chlorobenzene	0.5		1.1E+00	1	1.1E+00	0.005	NP	--	--	--	--
Chloroethane	0.5		3.1E+01	1	3.1E+01	0.01	NP	--	--	--	--
Chloroform	0.5		1.0E+00	1	1.0E+00	0.005	NP	--	--	--	--
Chloromethane	0.5		4.1E-01	1	4.1E-01	0.01	NP	--	--	--	--
cis-1,2-Dichloroethene	0.5		2.5E-01	1	2.5E-01	0.005	NP	--	--	--	--
cis-1,3-Dichloropropene	0.5		6.6E-03	1	6.6E-03	0.005	NP	--	--	--	--
Dibromochloromethane	0.5		4.9E-02	1	4.9E-02	0.005	NP	--	--	--	--
Ethylbenzene	0.5		7.6E+00	1	7.6E+00	0.005	NP	--	--	--	--
m,p-Xylenes	0.5		1.1E+02	1	1.1E+02	0.01	NP	--	--	--	--
Methylene Chloride	0.5		1.3E-02	1	1.3E-02	0.01	NP	2013-FFTA-03 (18-19)	18-19	1/8/2014	0.00366 J
VOCs (continued)											

Subsurface Soil Residential Assessment Levels with No Ecological Component

COC	Source Area Size	$^{Air}Soil_{Inh-V}$ PCL	$^{GW}Soil_{Ing}$ PCL		RAL[1]	MQL	Background[2]	Maximum Concentration Detected			
	(acres)	(mg/kg)	(mg/kg)	Tier	(mg/kg)	(mg/kg)	(mg/kg)	Sample ID	Sample Depth (feet bgs)	Sample Date	Conc (mg/kg)
o-Xylene	0.5		7.1E+01	1	7.1E+01	0.005	NP	--	--	--	--
Styrene	0.5		3.3E+00	1	3.3E+00	0.005	NP	--	--	--	--
Tetrachloroethene	0.5		5.0E-02	1	5.0E-02	0.005	NP	--	--	--	--
Toluene	0.5		8.2E+00	1	8.2E+00	0.005	NP	--	--	--	--
trans-1,2-Dichloroethene	0.5		4.9E-01	1	4.9E-01	0.005	NP	--	--	--	--
trans-1,3-Dichloropropene	0.5		3.6E-02	1	3.6E-02	0.005	NP	--	--	--	--
Trichloroethene	0.5		3.4E-02	1	3.4E-02	0.005	NP	--	--	--	--
Vinyl Acetate	0.5		5.3E+01	1	5.3E+01	0.005	NP	--	--	--	--
Vinyl Chloride	0.5		2.2E-02	1	2.2E-02	0.01	NP	--	--	--	--
Xylenes, Total	0.5		1.2E+02	1	1.2E+02	0.005	NP	--	--	--	--
SVOCs											
1,2,4-Trichlorobenzene	0.5		4.8E+00	1	4.8E+00	0.01667	NP	--	--	--	--
1,2-Dichlorobenzene	0.5		1.8E+01	1	1.8E+01	0.01667	NP	--	--	--	--
1,3-Dichlorobenzene	0.5		6.7E+00	1	6.7E+00	0.01667	NP	--	--	--	--
1,4-Dichlorobenzene	0.5		2.1E+00	1	2.1E+00	0.03333	NP	--	--	--	--
1-Methylnaphthalene	0.5		2.9E+00	1	2.9E+00	0.01667	NP	--	--	--	--
2,4,5-Trichlorophenol	0.5		3.4E+01	1	3.4E+01	0.025	NP	--	--	--	--
2,4,6-Trichlorophenol	0.5		1.7E-01	1	1.7E-01	0.025	NP	--	--	--	--
2,4-Dichlorophenol	0.5		3.5E-01	1	3.5E-01	0.01667	NP	--	--	--	--
2,4-Dimethylphenol	0.5		3.2E+00	1	3.2E+00	0.01667	NP	--	--	--	--
2,4-Dinitrophenol	0.5		9.4E-02	1	9.4E-02	0.1	NP	--	--	--	--
2,4-Dinitrotoluene	0.5		5.3E-03	1	5.3E-03	0.03333	NP	--	--	--	--
2,6-Dinitrotoluene	0.5		4.8E-03	1	4.8E-03	0.01667	NP	--	--	--	--
2-Chloronaphthalene	0.5		6.7E+02	1	6.7E+02	0.01667	NP	--	--	--	--
2-Chlorophenol	0.5		1.6E+00	1	1.6E+00	0.01667	NP	--	--	--	--
2-Methylnaphthalene	0.5		1.7E+01	1	1.7E+01	0.01667	NP	2013-FFTA-03 (18-19)	18-19	1/8/2014	0.0311 J
2-Methylphenol (o-cresol)	0.5		7.1E+00	1	7.1E+00	0.01667	NP	--	--	--	--
2-Nitroaniline	0.5		2.2E-02	1	2.2E-02	0.01667	NP	--	--	--	--
2-Nitrophenol	0.5		1.3E-01	1	1.3E-01	0.01667	NP	--	--	--	--
3,3'-Dichlorobenzidine	0.5		6.3E-02	1	6.3E-02	0.03333	NP	--	--	--	--
3-Nitroaniline	0.5		2.6E-02	1	2.6E-02	0.01667	NP	--	--	--	--
4,6-Dinitro-2-methylphenol	0.5		4.7E-03	1	4.7E-03	0.1	NP	--	--	--	--
4-Bromophenyl Phenyl Ether	0.5		2.8E-01	1	2.8E-01	0.01667	NP	--	--	--	--
4-Chloro-3-methylphenol	0.5		4.5E+00	1	4.5E+00	0.01667	NP	--	--	--	--
4-Chloroaniline	0.5		2.1E-02	1	2.1E-02	0.03333	NP	--	--	--	--
SVOCs (continued)											
4-Chlorophenyl-phenylether	0.5		3.2E-02	1	3.2E-02	0.01667	NP	--	--	--	--

Subsurface Soil Residential Assessment Levels
with No Ecological Component

COC	Source Area Size	$^{Air}Soil_{Inh-V}$ PCL	$^{GW}Soil_{Ing}$ PCL		RAL[1]	MQL	Background[2]	Maximum Concentration Detected			
	(acres)	(mg/kg)	(mg/kg)	Tier	(mg/kg)	(mg/kg)	(mg/kg)	Sample ID	Sample Depth (feet bgs)	Sample Date	Conc (mg/kg)
4-Nitroaniline	0.5		1.1E-01	1	1.1E-01	0.01667	NP	--	--	--	--
4-Nitrophenol	0.5		1.0E-01	1	1.0E-01	0.01667	NP	--	--	--	--
Acenaphthene	0.5		2.4E+02	1	2.4E+02	0.01667	NP	--	--	--	--
Acenaphthylene	0.5		4.1E+02	1	4.1E+02	0.01667	NP	--	--	--	--
Anthracene	0.5		6.9E+03	1	6.9E+03	0.01667	NP	--	--	--	--
Benzidine	0.5		1.1E-05	1	1.1E-05	0.33	NP	--	--	--	--
Benzo[a]anthracene	0.5		5.7E+00	1	5.7E+00	0.01667	NP	--	--	--	--
Benzo[a]pyrene	0.5		5.6E-01	1	5.6E-01	0.01667	NP	--	--	--	--
Benzo[b]fluoranthene	0.5		5.7E+00	1	5.7E+00	0.03333	NP	--	--	--	--
Benzo[g,h,i]perylene	0.5		1.8E+03	1	1.8E+03	0.01667	NP	--	--	--	--
Benzo[k]fluoranthene	0.5		5.7E+01	1	5.7E+01	0.01667	NP	--	--	--	--
Benzyl Alcohol	0.5		5.9E+00	1	5.9E+00	0.01667	NP	--	--	--	--
Bis(2-chloroethoxy)methane	0.5		1.2E-02	1	1.2E-02	0.01667	NP	--	--	--	--
Bis(2-chloroethyl) Ether	0.5		2.1E-03	1	2.1E-03	0.03333	NP	--	--	--	--
Bis(2-chloroisopropyl) Ether	0.5		1.9E-01	1	1.9E-01	0.01667	NP	--	--	--	--
Bis(2-ethylhexyl) Phthalate	0.5		4.3E+01	1	4.3E+01	0.06668	NP	2013-FFTA-03 (18-19)	18-19	1/8/2014	0.0326 J
Butylbenzyl Phthalate	0.5		2.6E+02	1	2.6E+02	0.06668	NP	--	--	--	--
Carbazole	0.5		4.6E+00	1	4.6E+00	0.01667	NP	--	--	--	--
Chrysene	0.5		5.6E+02	1	5.6E+02	0.01667	NP	--	--	--	--
Dibenz[a,h]anthracene	0.5		5.5E-01	1	5.5E-01	0.01667	NP	--	--	--	--
Dibenzofuran	0.5		3.3E+01	1	3.3E+01	0.01667	NP	--	--	--	--
Diethyl Phthalate	0.5		1.6E+02	1	1.6E+02	0.06668	NP	--	--	--	--
Dimethyl Phthalate	0.5		6.2E+01	1	6.2E+01	0.06668	NP	2013-FFTA-03 (18-19)	18-19	1/8/2014	0.0925 J
Di-n-Butyl Phthalate	0.5		3.3E+03	1	3.3E+03	0.06668	NP	--	--	--	--
Di-n-octyl Phthalate	0.5		2.6E+03	1	2.6E+03	0.06668	NP	--	--	--	--
Fluoranthene	0.5		1.9E+03	1	1.9E+03	0.01667	NP	--	--	--	--
Fluorene	0.5		3.0E+02	1	3.0E+02	0.01667	NP	--	--	--	--
Hexachlorobenzene	0.5		1.1E+00	1	1.1E+00	0.01667	NP	--	--	--	--
Hexachlorobutadiene	0.5		3.3E+00	1	3.3E+00	0.01667	NP	--	--	--	--
Hexachlorocyclopentadiene	0.5		1.4E+01	1	1.4E+01	0.01667	NP	--	--	--	--
Hexachloroethane	0.5		1.3E+00	1	1.3E+00	0.01667	NP	--	--	--	--
Indeno[1,2,3-cd]pyrene	0.5		5.7E+00	1	5.7E+00	0.01667	NP	--	--	--	--
Isophorone	0.5		3.0E+00	1	3.0E+00	0.01667	NP	2013-FFTA-03 (18-19)	18-19	1/8/2014	0.153
3 & 4 Methylphenol	0.5		6.3E-01	1	6.3E-01	0.03333	NP	2013-FFTA-03 (18-19)	18-19	1/8/2014	0.572
SVOCs (continued)											
Naphthalene	0.5		3.1E+01	1	3.1E+01	0.01667	NP	2013-FFTA-03 (18-19)	18-19	1/8/2014	0.0150 J
Nitrobenzene	0.5		3.5E-01	1	3.5E-01	0.01667	NP	--	--	--	--

Subsurface Soil Residential Assessment Levels with No Ecological Component

COC	Source Area Size	$^{Air}Soil_{Inh-V}$ PCL	$^{GW}Soil_{Ing}$ PCL		RAL[1]	MQL	Background[2]	Maximum Concentration Detected			
	(acres)	(mg/kg)	(mg/kg)	Tier	(mg/kg)	(mg/kg)	(mg/kg)	Sample ID	Sample Depth (feet bgs)	Sample Date	Conc (mg/kg)
N-Nitrosodimethylamine	0.5		3.7E-05	1	3.7E-05	0.03333	NP	--	--	--	--
N-Nitroso-di-n-propylamine	0.5		3.5E-04	1	3.5E-04	0.03333	NP	--	--	--	--
N-Nitrosodiphenylamine	0.5		2.8E+00	1	2.8E+00	0.03333	NP	--	--	--	--
Pentachlorophenol	0.5		1.8E-02	1	1.8E-02	0.08333	NP	--	--	--	--
Phenanthrene	0.5		4.2E+02	1	4.2E+02	0.01667	NP	--	--	--	--
Phenol	0.5		1.9E+01	1	1.9E+01	0.01667	NP	--	--	--	--
Pyrene	0.5		1.1E+03	1	1.1E+03	0.01667	NP	--	--	--	--

NOTES

Maximum sample concentrations that exceed RALs are bolded and highlighted.

MQL values that exceed RALs are shaded gray.

1. The Residential Assessment Level (RAL) is the lower of the TRRP Tier 1 $^{GW}Soil_{Ing}$ and $^{Air}Soil_{Inh-v}$ (if applicable) PCLs for a 30-acre source aera (TCEQ, 2012c), except where Tier 2 PCLs are applicable. The lower of the applicable PCLs is bolded.
2. The background value for lead is as site-specific background value (see Appendix 8).
3. NP = PCL not published.
4. "--" - not applicable.
5. * - Sub-slab or sub-gabion basket sample; top depth represents the approximate top of soil.
6. The RAL for TPH is a TPH Mixture RAL developed in accordance with RG-366/TRRP-27 (see Appendix 9).
7. Ecological component evaluated in SLERA (Section 9).

Data Qualifiers: J - estimated result; JH - estimated result, biased high; U - not detected, detected in associated blank; X7 - TCEQ does not offer accreditation for this analyte.

Soil Data Summary -
Cadmium and Lead (2012/2013)

Sample ID	Sample Date	Sample Depth (feet bgs)	Cadmium (mg/kg)	Lead (mg/kg)
Surface Soil Residential Assessment Level (0-15 feet bgs)[1]:			30	274.51
Surface Soil Critical PCL (0-5 feet bgs)[2]:			30	274.51
Subsurface Soil Residential Assessment Level (>15 feet bgs)[1]:			30	274.51
Subsurface Soil Critical PCL (>5 feet bgs)[2]:			30	274.51
FORMER PRODUCTION AREA				
Battery Receiving/Storage Building				
2013-BSB-1 (0.9-2)	04/11/13	0.9-2*	<0.0266	**9.56**
2013-BSB-1 (2-4)	04/11/13	2-4	**0.0409 J**	**56.2**
2013-BSB-1 (4-5)	04/11/13	4-5	**0.0977 J**	**31.6**
2013-BSB-1 (6.3-7.7)	04/11/13	6.3-7.7	**3.64**	**14100**
2013-BSB-1 (8-10)	04/11/13	8-10	**7.99**	**42700**
2013-BSB-1 (11.6)	04/11/13	11.6	**0.487**	**124**
2013-BSB-2 (0.9-2)	04/11/13	0.9-2*	<0.0276	**70.4**
2013-BSB-2 (2-4)	04/11/13	2-4	**0.0399 J**	**9.36**
2013-BSB-2 (4-5)	04/11/13	4-5	**0.334**	**1080**
2013-BSB-2 (8-10)	04/11/13	8-10	**0.484**	**41.6**
2013-BSB-2 (11.2)	04/11/13	11.2	**0.638**	**684**
2013-BSB-3 (0.9-2)	04/10/13	0.9-2*	<0.0279	**14.8**
2013-BSB-3 (2-4)	04/10/13	2-4	**0.626**	**206**
2013-BSB-3 (4-5)	04/10/13	4-5	**0.909**	**499**
2013-BSB-3 (8-10)	04/10/13	8-10	**0.509**	**368**
2013-BSB-3 (11)	04/10/13	11	**0.434**	**26.1**
2013-BSB-4 (0.9-2)	04/10/13	0.9-2*	**1.65**	**37.9**
2013-BSB-4 (2-4)	04/10/13	2-4	**2.86**	**1110**
2013-BSB-4 (4-5)	04/10/13	4-5	**0.158 J**	**111**
2013-BSB-4 (8-10)	04/10/13	8-10	**0.411**	**214**
2013-BSB-4 (11)	04/10/13	11	**0.365**	**19.4**
2013-BSB-5 (0.9-2)	04/11/13	0.9-2*	**0.137 J**	**5.28**
2013-BSB-5 (0.9-2) Dup	04/11/13	0.9-2*	**0.341**	**6.48**
2013-BSB-5 (2-4)	04/11/13	2-4	**0.0557 J**	**21.6**
2013-BSB-5 (4-5)	04/11/13	4-5	**0.299**	**122**
2013-BSB-5 (8-10)	04/11/13	8-10	**0.479**	**1580**
2013-BSB-5 (11.2)	04/11/13	11.2	**0.458**	**53.9**
2013-BSB-6 (0.9-2)	04/11/13	0.9-2*	<0.0304	**24.4**
2013-BSB-6 (2-4)	04/11/13	2-4	**0.0393 J**	**23.7**
2013-BSB-6 (4-5)	04/11/13	4-5	**0.695**	**586 J**
2013-BSB-6 (8-10)	04/11/13	8-10	**0.91**	**3150**
2013-BSB-6 (11.1)	04/11/13	11.1	**0.439**	**20.3**

Soil Data Summary -
Cadmium and Lead (2012/2013)

Sample ID	Sample Date	Sample Depth (feet bgs)	Cadmium (mg/kg)	Lead (mg/kg)
Surface Soil Residential Assessment Level (0-15 feet bgs)[1]:			30	274.51
Surface Soil Critical PCL (0-5 feet bgs)[2]:			30	274.51
Subsurface Soil Residential Assessment Level (>15 feet bgs)[1]:			30	274.51
Subsurface Soil Critical PCL (>5 feet bgs)[2]:			30	274.51
***Battery Receiving/Storage Building* (Continued)**				
2013-BSB-7 (0.9-2)	04/11/13	0.9-2*	**0.37**	**26.8 J**
2013-BSB-7 (2-4)	04/11/13	2-4	**0.13 J**	**221**
2013-BSB-7 (4-5)	04/11/13	4-5	**0.13 J**	**56.6**
2013-BSB-7 (8-10)	04/11/13	8-10	**1.98**	**3050**
2013-BSB-7 (11)	04/11/13	11	**0.449**	**17.6**
2013-BSB-8 (0.9-2)	04/10/11	0.9-2*	**0.782**	**22.6**
2013-BSB-8 (2-4)	04/10/13	2-4	**1.93**	**6.75**
2013-BSB-8 (4-5)	04/10/13	4-5	**0.117 J**	**70.7**
2013-BSB-8 (8-10)	04/10/13	8-10	**10.1**	**54600**
2013-BSB-8 (11)	04/10/13	11	**0.592**	**43.3**
2013-BSB-9 (0.9-2)	04/10/11	0.9-2*	**0.783 J**	**23.6 J**
2013-BSB-9 (0.9-2) Dup	04/10/11	0.9-2*	**2.08 J**	**93.4 J**
2013-BSB-9 (2-4)	04/10/13	2-4	<0.0287	**15.7 J**
2013-BSB-9 (4-5)	04/10/13	4-5	**0.107 J**	**13**
2013-BSB-9 (8-10)	04/10/13	8-10	**1.31**	**1830**
2013-BSB-9 (11)	04/10/13	11	**1.17**	**672**
2013-BSB-10 (0.9-2)	04/11/13	0.9-2*	<0.0286	**15.2**
2013-BSB-10 (2-4)	04/11/13	2-4	<0.0308	**8.88 J**
2013-BSB-10 (4-5)	04/11/13	4-5	**0.0713 J**	**25.2**
2013-BSB-10 (8-10)	04/11/13	8-10	**7.68**	**2590**
2013-BSB-10 (11.4)	04/11/13	11.4	**0.488**	**30.9**
MW-31 (0.9-2)[3]	05/09/13	0.9-2	**1.67 NS**	**12900 NS**
MW-31 (0.9-2) Dup[3]	05/09/13	0.9-2	<0.0304 NS	**68 NS**
MW-31 (5.8-8)	05/09/13	5.8-8	**1.35 NS**	**1210 NS**
MW-31 (9.5)	05/09/13	9.5	**0.245 J, NS**	**41 NS**
MW-31R (0.9-2)	05/21/13	0.9-2	**0.0737 J**	**18.3 J**
MW-31R (0.9-2) Dup	05/21/13	0.9-2	**0.0397 J**	**10.7 J**
MW-31R (5.8-7.3)	05/21/13	5.8-7.3	**5.8**	**3150**
MW-31R (9.5)	05/21/13	9.5	**0.288 J**	**35.4 J**
Raw Material Storage Building and Immediate Vicinity				
2012-RMSA-1(1.5-2.5')	01/06/12	1.5-2.5	**1.3**	**116**
2012-RMSA-2 (0.5-2.5')	01/05/12	0.5-2.5	**2.9**	**2950**
2013-RMSA-2 (2.5-4')	03/06/13	2.5-4	--	**1520**
2013-RMSA-2 (4-5')	03/06/13	4-5	--	**18.9**

Soil Data Summary -
Cadmium and Lead (2012/2013)

Sample ID	Sample Date	Sample Depth (feet bgs)	Cadmium (mg/kg)	Lead (mg/kg)
Surface Soil Residential Assessment Level (0-15 feet bgs)[1]:			30	274.51
Surface Soil Critical PCL (0-5 feet bgs)[2]:			30	274.51
Subsurface Soil Residential Assessment Level (>15 feet bgs)[1]:			30	274.51
Subsurface Soil Critical PCL (>5 feet bgs)[2]:			30	274.51
***Raw Material Storage Building and Immediate Vicinity* (Continued)**				
2012-RMSA-3 (1-3')	01/05/12	1-3	**3.9**	**412**
2012-RMSA-4 (1.5-3.5')	01/06/12	1.5-3.5	**2.5**	**856**
2013-RMSA-5 (0-2')	03/06/13	0-2	**0.96**	**63.4**
2013-RMSA-6 (0-2')	03/06/13	0-2	**4.00**	**6690**
2013-RMSA-6 (2-4')	03/06/13	2-4	--	**4230**
2013-RMSA-6 (4-5')	03/06/13	4-5	--	**24.2**
2013-RMSA-7 (0-2')	03/06/13	0-2	**4.16**	**2130**
2013-RMSA-7 (2-4)	03/06/13	2-4	--	**35.5**
2013-RMSB-1 (1.5-2)	05/08/13	1.5-2*	**14.3 J**	**1920 J**
2013-RMSB-1 (2-5)	05/08/13	2-5	**0.265 J**	**18.4**
2013-RMSB-1 (2-5) Dup	05/08/13	2-5	**0.463 J**	**49.3 J**
2013-RMSB-1 (5-5.5)	05/08/13	5-5.5	**1.37**	**240**
2013-RMSB-1 (6)	05/08/13	6	**0.46**	**27.8**
2013-RMSB-2 (2.5-5)	05/08/13	2.5-5*	**2.31**	**114**
2013-RMSB-2 (5-6)	05/08/13	5-6	**3.86**	**226**
2013-RMSB-3 (1.5-2')	05/08/13	1.5-2*	**0.303**	**56.4**
2013-RMSB-3 (1.5-2') Dup	05/08/13	1.5-2*	**0.233 J**	**66.7**
2013-RMSB-3 (2-3)	05/08/13	2-3	<0.0283	**8.78 J**
2013-RMSB-3 (5-5.5)	05/08/13	5-5.5	**0.719**	**142**
2013-RMSB-3 (6)	05/08/13	6	**0.183 J**	**37.6**
2013-RMSB-4 (0-2)	05/07/13	0-2	**0.471 J**	**39.7**
2013-RMSB-4 (2-5)	05/07/13	2-5	<0.0278	**8.26**
2013-RMSB-4 (5-6)	05/07/13	5-6	**7.40**	**2820**
2013-RMSB-5 (1.3-2)	05/07/13	1.3-2*	**72.1**	**1790 J**
2013-RMSB-5 (1.3-2) Dup	05/07/13	1.3-2*	**65.2**	**1580 J**
2013-RMSB-5 (2-5)	05/07/13	2-5	**23.9**	**4330**
2013-RMSB-5 (5-7)	05/07/13	5-7	**60.7**	**10200**
2013-RMSB-5 (9)	05/07/13	9	**1.07**	**36.8**
2013-RMSB-6 (1.3-2)	05/07/13	1.3-2*	**0.949**	**615**
2013-RMSB-6 (1.3-2) Dup	05/07/13	1.3-2*	**0.878**	**716**
2013-RMSB-6 (2-2.5)	05/07/13	2-2.5	**0.0522 J**	**16.6**
2013-RMSB-6 (5-7)	05/07/13	5-7	**0.49**	**25.3**
2013-RMSB-6 (7.5)	05/07/13	7.5	**0.499**	**20.9**
2013-RMSB-7 (1.5-2)	05/08/13	1.5-2*	**0.372**	**115**

Soil Data Summary -
Cadmium and Lead (2012/2013)

Sample ID	Sample Date	Sample Depth (feet bgs)	Cadmium (mg/kg)	Lead (mg/kg)
Surface Soil Residential Assessment Level (0-15 feet bgs)[1]:			30	274.51
Surface Soil Critical PCL (0-5 feet bgs)[2]:			30	274.51
Subsurface Soil Residential Assessment Level (>15 feet bgs)[1]:			30	274.51
Subsurface Soil Critical PCL (>5 feet bgs)[2]:			30	274.51
***Raw Material Storage Building and Immediate Vicinity* (Continued)**				
2013-RMSB-7 (2-4)	05/08/13	2-4	**0.405**	**25.9**
2013-RMSB-7 (5-6)	05/08/13	5-6	**0.379**	**175**
2013-RMSB-7 (6.5)	05/08/13	6.5	**0.475**	**63.5**
2013-RMSB-8 (2.1-3.1)	05/08/13	2.1-3.1*	**1.93**	**314**
2013-RMSB-8 (5-7)	05/08/13	5-7	**18.7**	**4240**
2013-RMSB-8 (7.5)	05/08/13	7.5	**0.379**	**23**
2013-RMSB-9 (1.3-2)	05/07/13	1.3-2*	**4.05**	**1210**
2013-RMSB-9 (2-2.5)	05/07/13	2-2.5	**0.402**	**68.5**
2013-RMSB-9 (5-7)	05/07/13	5-7	**0.449**	**50.1**
2013-RMSB-9 (8)	05/07/13	8	**0.435**	**16.7**
2013-RMSB-10 (1.3-2)	05/08/13	1.3-2*	**23.5**	**12.9**
2013-RMSB-10 (2-3)	05/08/13	2-3	**17.2**	**1030**
2013-RMSB-10 (5-6)	05/08/13	5-6	**35.8**	**911**
2013-RMSB-10 (7)	05/08/13	7	**0.506**	**19.2**
Slag Treatment Building				
2013-STB-1 (0-2')	03/06/13	0-2	**181**	**7050**
2013-STB-1 (2-4')	03/06/13	2-4	**483**	**634**
2013-STB-1 (4-5')	03/06/13	4-5	**7.06**	**149**
2013-STB-2 (2.5-4')	03/06/13	2.5-4	**1.13 J**	**150 J**
2013-STB-2 (2.5-4') Dup	03/06/13	2.5-4	**3.43 J**	**773 J**
2013-STB-2 (4-5')	03/06/13	4-5	**--**	**18.8**
2013-STB-3 (0-2')	03/06/13	0-2	**8.21 J**	**82.1 J**
2013-STB-4 (0-2')	03/06/13	0-2	**69.5**	**3720**
2013-STB-4 (2-4')	03/06/13	2-4	**124**	**16100**
2013-STB-4 (4-5')	03/06/13	4-5	**9.21**	**77.9**
2013-STB-5 (0.5-1.5')	03/14/13	0.5-1.5*	**2.35**	**178**
2013-STB-5 (0.5-1.5') Dup	03/14/13	0.5-1.5*	**2.26**	**159**
2013-STB-6 (0.5-1.1')	03/14/13	0.5-1.1*	**146**	**620**
2013-STB-7 (0.5-1.2')	03/14/13	0.5-1.2*	**6.65**	**1430**
2013-STB-8 (0.8-1.3')	03/14/13	0.8-1.3*	**7.80**	**1190**
2013-STB-9 (0.5-1.0')	03/14/13	0.5-1*	**24.9**	**2640**
2013-STB-9 (5-5.5)	05/07/13	5-5.5	**0.467**	**38.8**
2013-STB-10 (0.5-1.1')	03/14/13	0.5-1.1*	**7.5 J**	**137**
2013-STB-11 (0.5-1.3')	03/14/13	0.5-1.3*	**16.6**	**1100**

Soil Data Summary -
Cadmium and Lead (2012/2013)

Sample ID	Sample Date	Sample Depth (feet bgs)	Cadmium (mg/kg)	Lead (mg/kg)
Surface Soil Residential Assessment Level (0-15 feet bgs)[1]:			30	274.51
Surface Soil Critical PCL (0-5 feet bgs)[2]:			30	274.51
Subsurface Soil Residential Assessment Level (>15 feet bgs)[1]:			30	274.51
Subsurface Soil Critical PCL (>5 feet bgs)[2]:			30	274.51
Slag Treatment Building (continued)				
2013-STB-12 (0.5-1.2')	03/14/13	0.5-1.2*	**103**	**1070**
Flood Wall - Facility Side				
2012-FWFS-1 (Wall)	10/22/12	2.0	**4.7**	**22900**
2012-FWFS-1 (Floor)	10/22/12	4.0	**143**	**4410**
2012-FWFS-1 (4-5')	03/06/13	4-5	**0.528**	**30.9 J**
2012-FWFS-2 (Wall)	10/22/12	2.4	**0.27**	**13**
2012-FWFS-2 (Floor)	10/22/12	4.0	**0.11**	**18**
2012-FWFS-3 (Wall)	10/22/12	1.9	**0.26**	**32**
2012-FWFS-3 (Floor)	10/22/12	3.0	**0.27**	**33**
2012-FWFS-4 (Wall)	09/24/12	1.6	**0.47**	**47**
2012-FWFS-4 (Floor)	09/24/12	3.1	**4.0**	**504**
2012-FWFS-4 (3-4')	04/29/13	3-4	--	**17.2**
2012-FWFS-5 (Wall)	09/24/12	1.7	**273**	**52000**
2012-FWFS-5 (Floor)	09/24/12	3.3	**1.4**	**358**
2012-FWFS-6 (Wall)	09/04/12	1.1	**69**	**6970**
2012-FWFS-6 (Floor)	09/04/12	2.1	**387**	**4860**
2012-FWFS-6 (2-4')	04/29/13	2-4	**13.3**	**324**
2012-FWFS-7 (Wall)	09/04/12	1.2	**35**	**8540**
2012-FWFS-7 (Floor)	09/04/12	2.3	**0.56**	**29**
2012-FWFS-8 (Wall)	09/04/12	1.1	**3.3**	**1550**
2012-FWFS-8 (Floor)	09/04/12	2.2	**10**	**537**
2012-FWFS-8 (2-4')	04/29/13	2-4	--	**13.5**
2012-FWFS-9 (Wall)	09/04/12	1.8	**15**	**7480**
2012-FWFS-9 (Floor)	09/04/12	2.4	**984**	**2800**
2012-FWFS-9 (2.5-4')	04/29/13	2.5-4	**0.624**	**21**
NOR WMU Nos. 6, 14, and 16				
2013-WMU6-1 (0.9-2)	05/07/13	0.9-2*	**2.41 J**	**10800 J**
2013-WMU6-1 (2-4)	05/07/13	2-4	--	**33200**
2013-WMU6-1 (4-5)	05/07/13	4-5	--	**46.5**
2013-WMU14-1 (0.9-2)	05/07/13	0.9-2*	**16.6**	**95000**
2013-WMU14-1 (0.9-2) Dup	05/07/13	0.9-2*	**13.6**	**69000**
2013-WMU14-1 (2-4)	05/07/13	2-4	--	**31400**
2013-WMU14-1 (4-5)	05/07/13	4-5	--	**3470**
2013-WMU14-2 (0.9-2)	05/07/13	0.9-2*	**2.52**	**100**

Soil Data Summary -
Cadmium and Lead (2012/2013)

Sample ID	Sample Date	Sample Depth (feet bgs)	Cadmium (mg/kg)	Lead (mg/kg)
Surface Soil Residential Assessment Level (0-15 feet bgs)[1]:			30	274.51
Surface Soil Critical PCL (0-5 feet bgs)[2]:			30	274.51
Subsurface Soil Residential Assessment Level (>15 feet bgs)[1]:			30	274.51
Subsurface Soil Critical PCL (>5 feet bgs)[2]:			30	274.51
NOR WMU Nos. 6, 14, and 16 (continued)				
2013-WMU14-3 (0.9-2)	05/07/13	0.9-2*	**0.357**	**11.6**
2013-WMU16-1 (0.9-2)	05/07/13	0.9-2*	**0.415**	**18.2**
Bale Stabilization Area				
2012-BSA-1 (0-2')	01/04/12	0-2	**5.1**	**1250**
2012-BSA-1A (0-2')	03/23/12	0-2	--	**97**
2012-BSA-2 (0-2')	01/04/12	0-2	**102**	**25900**
2012-BSA-2 (2-4')	04/29/13	2-4	**0.652**	**123**
2012-BSA-3 (0-2')	01/04/12	0-2	**95**	**106**
2012-BSA-3A (0-2')	03/23/12	0-2	**935**	`
2012-BSA-4 (0-2')	01/04/12	0-2	**1.0**	**1090**
2012-BSA-4a (0-1')	03/29/12	0-1	**9.8**	**1510**
2012-BSA-4b (0-1')	03/29/12	0-1	**3.3**	**344**
2012-BSA-4c (0-1')	03/29/12	0-1	**17**	**2730**
2012-BSA-4d (0-1')	03/29/12	0-1	**17**	**3000**
2012-BSA-4e (0-1')	03/29/12	0-1	**6.2**	**634**
2012-BSA-5 (0-2')	01/04/12	0-2	**13**	**858**
MW-23 (0-0.5)	03/05/13	0-0.5	**3.5**	**1280**
MW-23 (0.5-2)	03/05/13	0.5-2	--	**481**
Maintenance Building				
2013-MB-1 (0-2')	03/14/13	0-2	**0.04 J**	**46.7**
2013-MB-2 (0-2')	03/14/13	0-2	**2.32**	**245**
Battery Breaker Area				
MW-30 (0-0.5')	03/27/13	0-0.5	**62.7 J**	**20300**
MW-30 (0-0.5') Dup	03/27/13	0-0.5	32 J	**19200**
MW-30 (0.5-2')	03/27/13	0.5-2	--	**128**
2013-RRS-3A (0.8-2')	03/27/13	0.8-2*	**13.0**	**2610**
2013-RRS-3A (2-4')	03/27/13	2-4	--	**84.2**
2013-RRS-4A (0.9-2')	05/21/13	0.9-2	**18.2**	**5540**
2013-RRS-4A (2-3')	05/21/13	3-4	**--**	**17400**
2013-BB-1 (0.9-2)	05/21/13	0.9-2	**16.1**	**3960**

Soil Data Summary -
Cadmium and Lead (2012/2013)

Sample ID	Sample Date	Sample Depth (feet bgs)	Cadmium (mg/kg)	Lead (mg/kg)
Surface Soil Residential Assessment Level (0-15 feet bgs)[1]:			30	274.51
Surface Soil Critical PCL (0-5 feet bgs)[2]:			30	274.51
Subsurface Soil Residential Assessment Level (>15 feet bgs)[1]:			30	274.51
Subsurface Soil Critical PCL (>5 feet bgs)[2]:			30	274.51
Truck Staging Area and Administrative Building Area				
2013-AD-1 (0-0.5')	3/14/2013	0-0.5	**7.52**	**2570**
2013-AD-1 (0.5-2')	3/14/2013	0.5-2	--	**174 J**
2013-AD-2 (0-0.5')	3/15/2013	0-0.5	**9.62**	**3770**
2013-AD-2 (0.5-2')	4/29/2013	0.5-2	--	**569 J**
2013-AD-2 (0.5-2') Dup	4/29/2013	0.5-2	--	**306 J**
2013-AD-2 (2-4')	4/29/2013	2-4	--	**114 J**
2013-AD-2A (0-0.5')	3/27/2013	0-0.5	**0.296 J**	**175**
2013-FOP-1 (0-0.5')	3/14/2013	0-0.5	**20.1**	**6460**
2013-FOP-1 (0.5-2')	3/14/2013	0.5-2	--	**505**
2013-FOP-1 (2-4)	3/14/2013	2-4	--	**90.4 J**
2013-MW10-1 (0-0.5')	03/05/13	0-0.5	**0.578**	**202 J**
2013-MW10-2 (0-0.5)	03/05/13	0-0.5	**3.25**	**1200**
2013-MW10-2 (0.5-2)	03/05/13	0.5-2	--	**44.1**
2013-MW10-3 (0-0.5')	03/05/13	0-0.5	**18.8**	**3920 J**
2013-MW10-3 (0-0.5') Dup	03/05/13	0-0.5	**13.6**	**1520 J**
2013-MW10-3 (0.5-2')	03/05/13	0.5-2	--	**208**
2013-TS-1 (0-0.5')	03/14/13	0-0.5	**0.183J**	**10.2 J**
2013-TS-2 (0-0.5')	03/14/13	0-0.5	**0.591**	**98.6**
STEWART CREEK CORRIDOR				
2012-FWCS-1 (0-2')	01/18/12	0-2	**10**	**2240**
2012-FWCS-1 (2-2.5')	09/04/12	2-2.5	--	**6270**
2012-FWCS-1 (2.5-4')	03/05/13	2.5-4	--	**780**
2012-FWCS-1 (4-5')	03/05/13	4-5	--	**22**
2012-FWCS-1A (1-2')	03/05/13	1-2*	--	**19400**
2012-FWCS-1A (1-2') Dup	03/05/13	1-2	--	**12100**
2012-FWCS-1A (2-4')	03/05/13	2-4	--	**12.4**
2013-FWCS-1B (1.1-1.6')	03/15/13	1.1-1.6*	**0.783**	**80.1 JH**
2012-FWCS-2 (0-2')	01/19/12	0-2	**0.076**	**24**
2012-FWCS-3 (0-2')	01/19/12	0-2	**0.15**	**35**

Soil Data Summary -
Cadmium and Lead (2012/2013)

Sample ID	Sample Date	Sample Depth (feet bgs)	Cadmium (mg/kg)	Lead (mg/kg)
Surface Soil Residential Assessment Level (0-15 feet bgs)[1]:			30	274.51
Surface Soil Critical PCL (0-5 feet bgs)[2]:			30	274.51
Subsurface Soil Residential Assessment Level (>15 feet bgs)[1]:			30	274.51
Subsurface Soil Critical PCL (>5 feet bgs)[2]:			30	274.51
STEWART CREEK CORRIDOR (Continued)				
2012-FWCS-4 (0-2')	01/19/12	0-2	**0.12**	**158**
2012-FWCS-5 (0-2')	01/19/12	0-2	**1.3**	**224**
2012-FWCS-6 (0-2')	01/19/12	0-2	**0.90**	**253**
2012-FWCS-7 (0-2')	01/19/12	0-2	**0.58**	**64**
2012-FWCS-8 (0-2')	01/18/12	0-2	**234**	**853**
2012-FWCS-9 (0-2')	01/18/12	0-2	**3.1**	**81**
2012-FWCS-11 (0-2')	09/04/12	0-2	--	**217**
2012-FWCS-12 (0-2')	09/04/12	0-2	--	**20500**
2012-FWCS-12 (2-2.7')	03/15/13	2-2.7	**4.09**	**31000**
2012-FWCS-12 (4-5')	03/15/13	4-5	--	**19.1**
2013-FWFS-1A (2-4')	03/05/13	2-4	--	**15**
2013-FWFS-1A (4-5')	03/05/13	4-5	--	**14.9**
2012-FWFS-7A (0-0.5)	05/21/13	0-0.5	**0.32**	**44.7 J**
2013-MW-17A (0-0.5')	03/15/13	0-0.5	**0.921**	**279**
2013-RO-1 (0-0.5')	03/05/13	0-0.5	**2.91**	**1170**
2013-RO-1 (0.5-1')	03/05/13	0.5-1	--	**19.8**
2013-RO-2 (0-0.5')	03/05/13	0-0.5	**5.26**	**811**
2013-RO-3 (0-0.5')	03/15/13	0-0.5	**0.347**	**26.1 J**
MW-24 (0-0.5')	03/05/13	0-0.5	**0.0829 J**	**8.82 J**
MW-27 (0-1')	03/05/13	0-1	--	**400**
MW-29 (0-0.5')	03/06/13	0-0.5	**3.38**	**455**
MW-29 (2.5-4')	03/05/13	2.5-4	**1.56**	**87.3**
MW-29 (4-5')	03/05/13	4-5	< 0.0306	**8.6**
SCC-1 (0-0.5')	01/15/13	0-0.5	**1.21**	**188**
SCC-2 (0-0.5')	01/15/13	0-0.5	**0.897**	**99.4**
SCC-3 (0-0.5')	01/15/13	0-0.5	**33.3**	**3510**
SCC-3 (0.5-2')	03/05/13	0.5-2	--	**535**
SCC-3 (2-4')	03/05/13	2-4	--	**1300 J**
SCC-3 (4-5')	03/05/13	4-5	--	**15.2**
SCC-3A (0-0.5')	03/05/13	0-0.5	--	**140**
SCC-4 (0-0.5')	01/15/13	0-0.5	**0.851**	**199**
SCC-5 (0-0.5')	01/15/13	0-0.5	**1.51**	**443**
SCC-6 (0-0.5')	01/15/13	0-0.5	**1.04**	**200**
SCC-7 (0-0.5')	01/15/13	0-0.5	**0.681**	**186**

Soil Data Summary -
Cadmium and Lead (2012/2013)

Sample ID	Sample Date	Sample Depth (feet bgs)	Cadmium (mg/kg)	Lead (mg/kg)
Surface Soil Residential Assessment Level (0-15 feet bgs)[1]:			30	274.51
Surface Soil Critical PCL (0-5 feet bgs)[2]:			30	274.51
Subsurface Soil Residential Assessment Level (>15 feet bgs)[1]:			30	274.51
Subsurface Soil Critical PCL (>5 feet bgs)[2]:			30	274.51
STEWART CREEK CORRIDOR (Continued)				
SCC-8 (0-0.5')	01/15/13	0-0.5	**6.93**	**4870**
SCC-9 (0-0.5')	01/15/13	0-0.5	**2.36**	**149**
SCC-10 (0-0.5')	01/15/13	0-0.5	**6.55**	**1510**
SCC-10 (0.5-2')	03/05/13	0.5-2	--	**23.5**
SCC-10A (0-0.5')	03/05/13	0-0.5	**1.40**	**296**
SCC-11 (0-0.5')	01/15/13	0-0.5	**106**	**788**
SCC-11 (2-4')	03/06/13	2-4	**0.538**	**17.6 J**
SCC-11 (2-4') Dup	03/06/13	2-4	**0.697**	**60.9 J**
SCC-11A (0-0.5')	03/06/13	0-0.5	**2.45**	**268**
SCC-12 (0-0.5')	01/15/13	0-0.5	**1.44**	**210**
SCC-13 (0-0.5')	01/15/13	0-0.5	**0.253 J**	**34.6**
SCC-14 (0-0.5')	01/15/13	0-0.5	**0.158 J**	**42.7**
SCC-15 (0-0.5')	01/15/13	0-0.5	**1.62 J**	**177**
NORTH AREA				
Slag Landfill and Boneyard				
2012-BY-1 (0-2')	01/04/12	0-2	**1.0**	**28**
2012-BY-2 (0-2')	01/04/12	0-2	**13**	**1420**
2012-BY-3 (0-2')	01/04/12	0-2	**0.90**	**75**
2012-BY-4 (0-2')	01/04/12	0-2	**66**	**47000**
2012-BY-5 (0-2')	01/04/12	0-2	**5.4**	**431**
2012-SL-1 (0-2')	01/10/12	0-2	**2.3**	**379**
2012-SL-1 (2-4')	01/10/12	2-4	**50**	**7970**
2012-SL-1 (4-5')	03/06/13	4-5	--	**48500**
2012-SL-2 (0-2')	01/10/12	0-2	**0.80**	**84**
2012-SL-2 (5-7')	01/10/12	5-7	**0.58**	**7.3**
2012-SL-3 (0-2')	01/10/12	0-2	**0.75**	**47**
2012-SL-3 (8-10')	01/10/12	8-10	**1.0**	**7.2**
2013-SL-4 (0-0.5')	03/07/13	0-0.5	**21.5**	**82.3**
2013-WMU17-1 (0-0.5')	3/15/2013	0-0.5	**6.14**	**1350**
2013-WMU17-2 (0-0.5')	3/15/2013	0-0.5	**6.09**	**1460**
North Disposal Area				
2012-NDA-1 (0-2')	01/10/12	0-2	**4.0**	**318**
2012-NDA-1 (2-4')	01/10/12	2-4	**27**	**7060**
2012-NDA-1 (4-5')	03/05/13	4-5	--	**19**

Soil Data Summary -
Cadmium and Lead (2012/2013)

Sample ID	Sample Date	Sample Depth (feet bgs)	Cadmium (mg/kg)	Lead (mg/kg)
Surface Soil Residential Assessment Level (0-15 feet bgs)[1]:			30	274.51
Surface Soil Critical PCL (0-5 feet bgs)[2]:			30	274.51
Subsurface Soil Residential Assessment Level (>15 feet bgs)[1]:			30	274.51
Subsurface Soil Critical PCL (>5 feet bgs)[2]:			30	274.51
North Disposal Area (continued)				
2012-NDA-2 (0-2')	01/10/12	0-2	**1.8**	**284**
2012-NDA-2 (2-4')	01/10/12	2-4	**0.68**	**1030**
2012-NDA-2 (16-18')	01/10/12	16-18	**0.036**	**14**
2012-NDA-3 (0-2')	01/10/12	0-2	**11**	**2410**
2012-NDA-3 (17-19')	01/10/12	17-19	**0.034**	**8.9**
2012-NDA-4 (2-4')	02/22/12	2-4	--	**228**
2012-NDA-6 (0-2')	02/22/12	0-2	--	**113**
North Tributary Corridor and North Wooded Area				
D-11	03/28/12	0-0.5	**3.62**	**524**
D-11 (0.5-1.0')	04/22/13	0.5-1	--	**312**
D-12	03/28/12	0-0.5	**3.71**	**522**
D-12 (0.5-1')	04/22/13	0.5-1	--	**29.7**
D-13	03/28/12	0-0.5	**2.98**	**434**
D-14	03/28/12	0-0.5	**1.445 J**	**204**
D-15	03/28/12	0-0.5	**1.61 J**	**245**
E-11	03/28/12	0-0.5	**17.8**	**2920**
E-11 (0.5-2')	03/06/13	0.5-2	--	**109**
E-11 (2-4')	03/06/13	2-4	**0.865**	**46**
E-11 (4-5')	03/06/13	4-5	**0.511**	**5.26**
E-11 (5-7')	04/29/13	5-7	**0.385**	--
E-11 (7-9')	04/29/13	7-9	**0.485**	--
E-11 (9-10.7')	04/29/13	9-10.9	**0.367**	--
E-11A (0-0.5')	03/06/13	0-0.5	**3.89**	**816**
E-11A (0.5-1')	04/22/13	0.5-1	--	**285**
E-11B (0-0.5')	03/15/13	0-0.5	**0.922**	**216**
E-12	03/28/12	0-0.5	**18.3**	**2610**
E-12 (0.5-1')	04/22/13	0.5-1	--	**70**
E-13	03/28/12	0-0.5	**10.1**	**1850**
E-13 (0.5-1)	04/22/13	0.5-1	--	**33.6**
E-14	03/28/12	0-0.5	**5.64**	**1090**
E-14 (0.5-1')	04/22/13	0.5-1	--	**54.9**
E-15	03/28/12	0-0.5	**4.34**	**893**
E-15 (0.5-1')	04/22/13	0.5-1	--	**43.6**
E-15A (0-0.5')	03/06/13	0-0.5	**1.51**	**234**

Soil Data Summary -
Cadmium and Lead (2012/2013)

Sample ID	Sample Date	Sample Depth (feet bgs)	Cadmium (mg/kg)	Lead (mg/kg)
Surface Soil Residential Assessment Level (0-15 feet bgs)[1]:			30	274.51
Surface Soil Critical PCL (0-5 feet bgs)[2]:			30	274.51
Subsurface Soil Residential Assessment Level (>15 feet bgs)[1]:			30	274.51
Subsurface Soil Critical PCL (>5 feet bgs)[2]:			30	274.51
North Tributary Corridor and North Wooded Area (continued)				
ECO-11 (0-0.5')	03/05/13	0-0.5	**0.809**	**45.3**
ECO-12 (0-0.5')	03/05/13	0-0.5	**0.953**	**240**
MW-21 (0-0.5')	03/05/13	0-0.5	**0.340**	**8.6**
MW-22 (0-0.5')	03/05/13	0-0.5	**0.853**	**84.2**
Class 2 Landfill Area				
2013-PMW-19R (0-0.5)	02/26/13	0-0.5	< 0.0302	**20.4**
2013-PMW-20R (0-0.5)	02/26/13	0-0.5	**0.362**	**149**
2013-LMW-21 (0-0.5)	02/27/13	0-0.5	**0.796**	**209**
2013-LMW-22 (0-0.5)	02/27/13	0-0.5	**1.32**	**282**
SOUTH AREA				
South Disposal Area				
2013-BS2-1 (0.5-2')	4/29/2013	0.5-2	--	**73.9**
BS-3 (1-2')	03/04/13	1-2	--	**610**
BS-3 (2-4')	03/04/13	2-4	--	**40.2**
2013-B4R-A (0-0.5')	04/29/13	0-0.5	**0.181J**	**187 J**
2013-B4R-A (0-0.5') Dup	04/29/13	0-0.5	**0.712**	**382 J**
2013-BS5-1 (0.5-2')	04/29/13	0.5-2	--	**3.85**
2012-SDA-1 (0-2')	01/04/12	0-2	**1.2**	**164**
2012-SDA-1 (2-4')	01/04/12	2-4	**0.32**	**33**
2012-SDA-2 (0-2')	01/04/12	0-2	**7.0**	**1090**
2012-SDA-2 (2-4')	01/04/12	2-4	**0.30**	**11.3**
2012-SDA-3 (0-2')	01/04/12	0-2	**1.0**	**74**
2012-SDA-3 (2-4')	01/04/12	2-4	**0.57**	**13**
2013-SDA-3A (0-0.5')	03/04/13	0-0.5	**1.14**	**452**
2012-SDA-4 (0-2')	01/04/12	0-2	**0.83**	**20**
2012-SDA-4 (2-4')	01/04/12	2-4	**0.53**	**4.2**
2013-SDA-4A (0-0.5')	03/04/13	0-0.5	**5.02**	**1570**
2013-SDA-4A (0.5-2')	03/04/13	0.5-2	--	**69.6**
2012-SDA-5 (0-2')	01/04/12	0-2	**1.1**	**91**
2012-SDA-5 (2-2.9')	01/04/12	2-2.9	**0.36**	**3.7**
South Wooded Area				
ECO-1 (0-0.5')	01/15/13	0-0.5	**1.85**	**431**
ECO-2 (0-0.5')	01/15/13	0-0.5	**3.19**	**396**
ECO-3 (0-0.5')	01/15/13	0-0.5	**10.1**	**1740**

Soil Data Summary -
Cadmium and Lead (2012/2013)

Sample ID	Sample Date	Sample Depth (feet bgs)	Cadmium (mg/kg)	Lead (mg/kg)
Surface Soil Residential Assessment Level (0-15 feet bgs)[1]:			30	274.51
Surface Soil Critical PCL (0-5 feet bgs)[2]:			30	274.51
Subsurface Soil Residential Assessment Level (>15 feet bgs)[1]:			30	274.51
Subsurface Soil Critical PCL (>5 feet bgs)[2]:			30	274.51
South Wooded Area (continued)				
ECO-3 (0.5-2')	03/06/13	0.5-2	--	**43.9**
ECO-4 (0-0.5')	01/15/13	0-0.5	**2.97**	**373**
ECO-5 (0-0.5')	01/15/13	0-0.5	**1.62**	**221**
ECO-6 (0-0.5')	01/15/13	0-0.5	**7.92**	**1030**
ECO-6 (0.5-2')	03/04/13	0.5-2	--	**22.7**
ECO-7 (0-0.5')	01/15/13	0-0.5	**14.6**	**2340**
ECO-7 (0.5-2')	03/06/13	0.5-2	--	**76.5 J**
ECO-7 (0.5-2') Dup	03/06/13	0.5-2	**2.64**	**400 J**
ECO-7A (0-0.5')	03/06/13	0-0.5	**3.61**	**606**
ECO-7B (0-0.5')	03/15/13	0-0.5	**2.48**	**327**
ECO-8 (0-0.5')	01/15/13	0-0.5	**3.61**	**600**
ECO-8 (0.5-2')	03/04/13	0.5-2	--	**112**
ECO-9 (0-0.5')	01/15/13	0-0.5	**12.6**	**2050**
ECO-9 (0.5-2')	03/04/13	0.5-2	--	**412**
ECO-10 (0-0.5')	01/15/13	0-0.5	**3.30**	**345**
Crystallization Unit Area				
2012 CUFT-1(0-2')	01/06/12	0-2	**0.34**	**13**
2012 CUFT-2 (0-2')	01/06/12	0-2	**0.47**	**33**
2013-CUFT-3 (0-0.5')	03/04/13	0-0.5	**1.58 J**	**25.4 J**
2013-CUFT-4 (0-0.5')	03/04/13	0-0.5	**4.38**	**107**
2013-CUFT-5 (0-0.5')	03/04/13	0-0.5	**3.10**	**442**
2013-CUFT-6 (0-0.5')	03/04/13	0-0.5	**7.65**	**71.3 J**
2013-CUFT-6 (0-0.5') Dup	03/04/13	0-0.5	**7.80**	**365 J**
2013-CUFT-7 (0-0.5')	03/04/13	0-0.5	**5.68**	**746**
2013-CUFT-7 (0.5-2')	03/04/13	0.5-2	--	**267**
2013-CUFT-7A (0-0.5')	03/07/13	0-0.5	**5.83**	**80.2**
2013-CUFT-8 (0-0.5')	03/04/13	0-0.5	**0.192 J**	**28.8**
2013-CUFT-9 (0-0.5')	03/04/13	0-0.5	**0.307**	**32.8**
2013-CUFT-10 (0-0.5')	03/07/13	0-0.5	**1.53**	**319**
Shooting Range Berm and South Berm Verification Samples				
SRB-VS-1	05/15/13	0-0.5	**0.186 J**	**27.8**
SRB-VS-2	05/15/13	0-0.5	**0.132 J**	**58.1**
SRB-VS-3	05/15/13	0-0.5	**0.891**	**20.7**
SRB-VS-4	05/15/13	0-0.5	**0.551**	**21.8**

Soil Data Summary -
Cadmium and Lead (2012/2013)

Sample ID	Sample Date	Sample Depth (feet bgs)	Cadmium (mg/kg)	Lead (mg/kg)
Surface Soil Residential Assessment Level (0-15 feet bgs)[1]:			30	274.51
Surface Soil Critical PCL (0-5 feet bgs)[2]:			30	274.51
Subsurface Soil Residential Assessment Level (>15 feet bgs)[1]:			30	274.51
Subsurface Soil Critical PCL (>5 feet bgs)[2]:			30	274.51
Shooting Range Berm and South Berm Verification Samples (continued)				
SRB-VS-5	05/15/13	0-0.5	**2.43**	**477**
SRB-VS-6	05/15/13	0-0.5	**0.159 J**	**11.3**
SRB-VS-7	05/15/13	0-0.5	**0.729**	**24.8**
SRB-VS-8	05/15/13	0-0.5	**0.682**	**40.4**
SRB-VS-9	05/15/13	0-0.5	**7.79**	**1330**
SRB-VS-9 (0.5-2)	05/21/13	0.5-2	**0.0522 J**	**14.8 J**
SRB-VS-9A (0-0.5)	05/21/13	0-0.5	**6.58**	**1040**
SRB-VS-9B (0-0.5)	05/21/13	0-0.5	**1.39**	**305**
SRB-VS-9C	06/03/13	0-0.5	**1.81**	**333**
SRB-VS-10	05/15/13	0-0.5	**1.35**	**203**
SRB-VS-11	05/15/13	0-0.5	**2.47**	**384**
SB-VS-1	06/03/13	0-0.5	**1.20**	**6.1**
SB-VS-2	06/03/13	0-0.5	**1.13**	**12.9**
LAKE PARCEL				
F-4	3/28/2012	0-0.25	**2.51 J**	**255**
F-5	3/28/2012	0-0.25	**3.51**	**367**
G-4	3/28/2012	0-0.25	**2.17**	**222**
G-4 (1ft)	3/27/2013	1	< 0.0325	**18.2**
G-5	3/28/2012	0-0.25	**2.61 J**	**273**
G-5 (1ft)	3/27/2013	1	< 0.0346	**13.9**
G-6	3/28/2012	0-0.25	**1.96 J**	**268**
H-3	3/28/2012	0-0.25	**1.06 J**	**154**
H-4	3/28/2012	0-0.25	< 1.05	**120**
H-4 (1ft)	3/27/2013	1	**0.0782 J**	**17.9**
H-5	3/28/2012	0-0.25	**1.54 J**	**147**
H-5 (1ft)	3/27/2013	1	< 0.0325	**15.9**
H5-2	2/7/2013	0-0.25	**1.40**	**154**
H4-2	2/7/2013	0-0.25	**1.30**	**145**
G4-2	2/7/2013	0-0.25	**1.50**	**166**

Soil Data Summary -
Cadmium and Lead (2012/2013)

Sample ID	Sample Date	Sample Depth (feet bgs)	Cadmium (mg/kg)	Lead (mg/kg)
Surface Soil Residential Assessment Level (0-15 feet bgs)[1]:			30	274.51
Surface Soil Critical PCL (0-5 feet bgs)[2]:			30	274.51
Subsurface Soil Residential Assessment Level (>15 feet bgs)[1]:			30	274.51
Subsurface Soil Critical PCL (>5 feet bgs)[2]:			30	274.51

Notes:

Detections are bolded.

Analytes that exceed RAL are in yellow.

1. [1] - The Residential Assessment Level (RAL) is the lower of the TRRP residential Tier 1 $^{Tot}Soil_{Comb}$ (applicable to surface soil only) and Tier 2 $^{GW}Soil_{Ing}$ PCLs for a 30-acre source area (TCEQ, 2012c). The $^{Air}Soil_{Inh-V}$ pathway is not applicable to lead or cadmium and was therefore not used to develop RALs.
2. [2] - The critical PCL is the lower of the TRRP commercial-industrial Tier 1 $^{Tot}Soil_{Comb}$ (applicable to surface soil only) and Tier 2 $^{GW}Soil_{Ing}$ PCLs for a 30-acre source area (TCEQ, 2012c). The $^{Air}Soil_{Inh-V}$ pathway is not applicable to lead or cadmium and was therefore not used to develop critcial PCLs.
3. [3] - Discrepancies in the duplicate soil sample results for the 0.9- to 2-foot interval at sample location MW-31 (12,900 mg/kg and 68 mg/kg) indicate possible incorrect labeling of the 0.9- to 2-foot sample depth interval for this sample. Furthermore, an examinaton of the 0.9- to 2-foot samples by laboratory personnel indicate that the physical appearance of the duplicate sample is consistent with the physical appearance of the 0.9- to 2-foot interval as described on the boring log. The physical appearance of the parent sample from the 0.9- to 2-foot interval was consistent with the boring log descriptions of samples collected deeper in the core, suggesting that the 0.9- to 2-foot parent sample was collected from a deeper depth. To confirm the incorrect depth label, the approximate location of MW-31 was re-sampled on May 21, 2013 at the approximate depth intervals sampled on May 9, 2013. As shown above, the resample MW-31R results (also sampled in duplicate) confirm the suspect incorrect depth label on the original parent sample. As a conservative measure, all samples from boring MW-31 were flagged "NS" (not selected for use) and data from adjacent boring MW-31R were used for assessing soil concentrations at this location.
4. Surface Soil = 0-15 feet bgs for residential land use and 0-5 feet bgs for commercial-industrial land use; subsurface soil = greater than 15 feet bgs for residential land use and greater than 5 feet bgs for commercial-industrial land use.
5. RAL/critical PCL exceedances are highlighted and bolded.
6. Data qualifiers: J - estimated result; JH - estimated result, biased high, NS - not selected for use.
7. bgs - Below ground surface.
8. * - Sub-slab or sub-gabion basket sample; top depth represents the approximate top of soil.
9. "--" - Not analyzed.

Table 4D.2A

Soil Data Summary -
Lead, Cadmium, and Additional Metals (2012/2013)

Sample ID	Sample Date	Sample Depth (feet)	Antimony (mg/kg)	Arsenic (mg/kg)	Barium (mg/kg)	Beryllium (mg/kg)	Cadmium (mg/kg)	Chromium (mg/kg)	Lead (mg/kg)	Mercury (mg/kg)	Nickel (mg/kg)	Selenium (mg/kg)	Silver (mg/kg)	Zinc (mg/kg)
Surface Soil Residential Assessment Level[1]:			2.71	15.90	300[9]	0.92	30.00	1200.10	274.51	0.04[9]	78.68	1.60	0.24	1180.24
Surface Soil Critical PCL[2]:			2.71	15.90	-	-	30.00	-	274.51	-	-	1.60	-	-
Subsurface Soil Residential Assessment Level[1]:			2.71	15.90	300[9]	0.92	30.00	1200.10	274.51	0.04[9]	78.68	1.60	0.24	1180.24
Subsurface Soil Critical PCL[2]:			2.71	15.90	-	-	30.00	-	274.51	-	-	1.60	-	-
FORMER PRODUCTION AREA														
Raw Material Storage Area														
2013-RMSA-7 (0-2')	03/06/13	0-2	--	**25**	--	--	**4.16**	--	**2130**	--	--	**0.669J**	--	--
Raw Material Storage Building														
2013-RMSB-1 (1.5-2)	05/08/13		--	**19.4**	--	--	**14.3**	--	**1920**	--	--	< 0.351	--	--
2013-RMSB-1 (2-5)	05/08/13	1.5-2*	--	**10.7**	--	--	**0.265 J**	--	**18.4**	--	--	< 0.335	--	--
2013-RMSB-1 (2-5) Dup	05/08/13	2-5	--	**12.0**	--	--	**0.463**	--	**49.3**	--	--	**0.715 J**	--	--
2013-RMSB-1 (5-5.5)	05/08/13	5-5.5	--	**13.2**	--	--	**1.37**	--	**240**	--	--	**0.741 J**	--	--
2013-RMSB-1 (6)	05/08/13	6	--	**11.7**	--	--	**0.46**	--	**27.8**	--	--	**0.661 J**	--	--
2013-RMSB-2 (2.5-5)	05/08/13	2.5-5*	--	**12.5**	**127**	--	**2.31**	**22.4**	**114**	**0.0104 J**	--	**0.722 J**	<0.159	--
2013-RMSB-2 (5-6)	05/08/13	5-6	--	**11.3**	**108**	--	**3.86**	**18.6**	**226**	<0.00501	--	**0.681 J**	<0.153	--
2013-RMSB-3 (1.5-2')	05/08/13	1.5-2*	--	**6.19**	--	--	**0.303**	--	**56.4**	--	--	<0.308	--	--
2013-RMSB-3 (1.5-2') Dup	05/08/13	1.5-2*	--	**4.50**	--	--	**0.233 J**	--	**66.7**	--	--	<0.302	--	--
2013-RMSB-3 (2-3')	05/08/13	2-3	--	**4.08 J**	--	--	<0.0283	--	**8.78 J**	--	--	<0.285	--	--
2013-RMSB-3 (5-5.5')	05/08/13	5-5.5	--	**5.92**	--	--	**0.72**	--	**142**	--	--	<0.298	--	--
2013-RMSB-3 (6')	05/08/13	6	--	**3.95**	--	--	**0.183 J**	--	**37.6**	--	--	<0.327	--	--
2013-RMSB-4 (0-2)	05/07/13	0-2	--	**4.78**	**121**	--	**0.0471 J**	**8.97**	**39.7**	**0.00537 J**	--	<0.305	<0.14	--
2013-RMSB-4 (2-5)	05/07/13	2-5	--	**6.41**	**48.6**	--	<0.0278	**8.94**	**8.26**	<0.00385	--	<0.281	<0.129	--
2013-RMSB-4 (5-6)	05/07/13	5-6	--	**16.8**	**131**	--	**7.40**	**21.6**	**2820**	**0.013 J**	--	**2.37 J**	<0.14	--
2013-RMSB-5 (1.3-2)	05/07/13	1.3-2*	--	**17.5**	--	--	**72.1**	--	**1790**	--	--	**4.77**	--	--
2013-RMSB-5 (1.3-2) Dup	05/07/13	1.3-2*	--	**14.7**	--	--	**65.2**	--	**1580**	--	--	**4.21**	--	--
2013-RMSB-5 (2-5)	05/07/13	2-5	--	**43.3**	--	--	**23.9**	--	**4330**	--	--	**0.544 J**	--	--
2013-RMSB-5 (5-7)	05/07/13	5-7	--	**44.5**	--	--	**60.7**	--	**10200**	--	--	**2.99**	--	--
2013-RMSB-5 (9)	05/07/13	9	--	**11.5**	--	--	**1.07**	--	**36.8**	--	--	**0.833 J**	--	--
2013-RMSB-6 (1.3-2)	05/07/13	1.3-2*	--	**8.6**	--	--	**0.949**	--	**615**	--	--	**0.318 J**	--	--
2013-RMSB-6 (1.3-2) Dup	05/07/13	1.3-2*	--	**6.32**	--	--	**0.878**	--	**716**	--	--	<0.305	--	--
2013-RMSB-6 (2-2.5)	05/07/13	2-2.5	--	**5.15**	--	--	**0.0522 J**	--	**16.6**	--	--	<0.300	--	--
2013-RMSB-6 (5-7)	05/07/13	5-7	--	**12.1**	--	--	**0.490**	--	**25.3**	--	--	**0.757 J**	--	--
2013-RMSB-6 (7.5)	05/07/13	7.5	--	**11.5**	--	--	**0.499**	--	**20.9**	--	--	**0.418 J**	--	--
2013-RMSB-7 (1.5-2)	05/08/13	1.5-2*	--	**3.96**	--	--	**0.372**	--	**115**	--	--	<0.306	--	--
2013-RMSB-7 (2-4)	05/08/13	2-4	--	**11.1**	--	--	**0.405**	--	**25.9**	--	--	**0.478 J**	--	--
2013-RMSB-7 (5-6)	05/08/13	5-6	--	**4.23**	--	--	**0.379**	--	**175**	--	--	<0.293	--	--
2013-RMSB-7 (6.5)	05/08/13	6.5	--	**10.7**	--	--	**0.475**	--	**63.5**	--	--	**0.411 J**	--	--

Table 4D.2A
Soil Data Summary -
Lead, Cadmium, and Additional Metals (2012/2013)

Sample ID	Sample Date	Sample Depth (feet)	Antimony (mg/kg)	Arsenic (mg/kg)	Barium (mg/kg)	Beryllium (mg/kg)	Cadmium (mg/kg)	Chromium (mg/kg)	Lead (mg/kg)	Mercury (mg/kg)	Nickel (mg/kg)	Selenium (mg/kg)	Silver (mg/kg)	Zinc (mg/kg)
Surface Soil Residential Assessment Level[1]:			2.71	15.90	300[(9)]	0.92	30.00	1200.10	274.51	0.04[(9)]	78.68	1.60	0.24	1180.24
Surface Soil Critical PCL[2]:			2.71	15.90	-	-	30.00	-	274.51	-	-	1.60	-	-
Subsurface Soil Residential Assessment Level[1]:			2.71	15.90	300[(9)]	0.92	30.00	1200.10	274.51	0.04[(9)]	78.68	1.60	0.24	1180.24
Subsurface Soil Critical PCL[2]:			2.71	15.90	-	-	30.00	-	274.51	-	-	1.60	-	-
Raw Material Storage Building (Continued)														
2013-RMSB-8 (2.1-3.1)	05/08/13	2.1-3.1*	--	**16.3**	--	--	**1.93**	--	**314**	--	--	**1.59 J**	--	--
2013-RMSB-8 (5-7)	05/08/13	5-7	--	**36.9**	--	--	**18.7**	--	**4240**	--	--	**3.62J**	--	--
2013-RMSB-8 (7.5)	05/08/13	7.5	--	**10.7**	--	--	**0.379**	--	**23**	--	--	**0.526 J**	--	--
2013-RMSB-9 (1.3-2)	05/07/13	1.3-2*	--	**6.62**	--	--	**4.05**	--	**1210**	--	--	**0.467 J**	--	--
2013-RMSB-9 (2-2.5)	05/07/13	2-2.5	--	**4.79**	--	--	**0.402**	--	**68.5**	--	--	<0.302	--	--
2013-RMSB-9 (5-7)	05/07/13	5-7	--	**12.7**	--	--	**0.449**	--	**50.1**	--	--	**0.754 J**	--	--
2013-RMSB-9 (8)	05/07/13	8	--	**12.3**	--	--	**0.435**	--	**16.7**	--	--	**0.751 J**	--	--
2013-RMSB-10 (1.3-2)	05/08/13	1.3-2*	--	**5.07**	**55.3**	--	**23.5**	**9.51**	**12.9**	<0.00439	--	**0.346 J**	<0.144	--
2013-RMSB-10 (2-3)	05/08/13	2-3	--	**7.1**	**87.2**	--	**17.2**	**12.9**	**1030**	**0.0125 J**	--	<0.311	<0.143	--
2013-RMSB-10 (5-6)	05/08/13	5-6	--	**9.2**	**87.8**	--	**35.8**	**15.8**	**911**	**0.00409 J**	--	**0.43J**	<0.138	--
2013-RMSB-10 (7)	05/08/13	7	--	**12.1**	**122**	--	**0.506**	**21.6**	**19**	<0.00445	--	**0.57J**	<0.152	--
Slag Treatment Building														
2013-STB-1 (0-2')	03/06/13	0-2	--	**97**	--	--	**181**	--	**7050**	--	--	**1.62J**	--	--
2013-STB-4 (0-2')	03/06/13	0-2	--	**38**	--	--	**69.5**	--	**3720**	--	--	**0.866J**	--	--
Bale Stabilization Area														
MW-23 (0-0.5')	03/05/13	0-0.5	--	**11.2**	--	--	**3.5**	--	**1280**	--	--	<0.298	--	--
Administrative Building Area														
2013-AD-2 (0-0.5)	03/15/13	0-0.5	--	**16.8**	--	--	**9.62**	--	**3770**	--	--	--	--	--
STEWART CREEK CORRIDOR														
2012-FWCS-1A (1-2')	03/05/13	1-2*	--	**115**	--	--	--	--	**19400**	--	--	**12.6**	--	--
SCC-3 (2-4')	03/05/13	2-4	--	**9.0**	--	--	--	--	**1300**	--	--	<0.302	--	--
SCC-12	01/15/13	0-0.5	--	**14.2**	--	--	**1.44**	--	**210**	--	--	--	--	--
NORTH AREA														
North Tributary Corridor and North Wooded Area														
E-11A (0-0.5)	03/06/13	0-0.5	--	**27.4**	--	--	**3.89**	--	**816**	--	--	--	--	--
E-11B (0-0.5)	03/15/13	0-0.5	--	**13.7**	--	--	**0.922**	--	**216**	--	--	--	--	--
ECO-11 (0-0.5)	03/05/13	0-0.5	--	**11.1**	--	--	**0.809**	--	**45.3**	--	--	--	--	--
ECO-12 (0-0.5)	03/05/13	0-0.5	--	**11.9**	--	--	**0.953**	--	**240**	--	--	--	--	--
MW-21 (0-0.5)	03/05/13	0-0.5	--	**7.09**	--	--	**0.34**	--	**8.59**	--	--	--	--	--
MW-22 (0-0.5)	03/05/13	0-0.5	--	**13.0**	--	--	**0.853**	--	**84.2**	--	--	--	--	--
Class 2 Landfill Area														
PMW-19R (0-0.5)	02/26/13	0-0.5	--	**11.2**	--	--	<0.0302	--	**20.4**	--	--	--	--	--
LMW-22	02/27/13	0-0.5	--	**22.7**	--	--	**1.32**	--	**282**	--	--	--	--	--

Table 4D.2A

Soil Data Summary -
Lead, Cadmium, and Additional Metals (2012/2013)

Sample ID	Sample Date	Sample Depth (feet)	Antimony (mg/kg)	Arsenic (mg/kg)	Barium (mg/kg)	Beryllium (mg/kg)	Cadmium (mg/kg)	Chromium (mg/kg)	Lead (mg/kg)	Mercury (mg/kg)	Nickel (mg/kg)	Selenium (mg/kg)	Silver (mg/kg)	Zinc (mg/kg)
Surface Soil Residential Assessment Level[1]:			2.71	15.90	300[(9)]	0.92	30.00	1200.10	274.51	0.04[(9)]	78.68	1.60	0.24	1180.24
Surface Soil Critical PCL[2]:			2.71	15.90	-	-	30.00	-	274.51	-	-	1.60	-	-
Subsurface Soil Residential Assessment Level[1]:			2.71	15.90	300[(9)]	0.92	30.00	1200.10	274.51	0.04[(9)]	78.68	1.60	0.24	1180.24
Subsurface Soil Critical PCL[2]:			2.71	15.90	-	-	30.00	-	274.51	-	-	1.60	-	-
SOUTH AREA														
South Disposal Area														
SDA-4A (0.0-0.5)	03/04/13	0-0.5	--	**12.4**	--	--	**5.02**	--	**1570**	--	--	--	--	--
South Wooded Area														
ECO-7	01/15/13	0-0.5	--	**18.1**	--	--	**14.6**	--	**2340**	--	--	--	--	--
Crystalization Unit Area														
2012 CUFT-1 (0-2')	01/06/12	0-2	<0.29 R	**7.2 J**	**51 J**	**0.764**	**0.34**	**8.22**	**13**	--	**12.4**	<0.33	<0.15	**55 J**
2012 CUFT-2 (0-2')	01/06/12	0-2	<0.28 R	**6.8 J**	**50 J**	**0.806**	**0.47**	**9.52**	**33**	--	**9.1**	<0.32	<0.15	**45 J**
2013-CUFT-7(0-0.5)	03/04/13	0-0.5	--	**13.2 J**	--	--	**5.68**	--	**746**	--	--	--	--	--

Notes:

RAL/Critical PCL exceedances are highlighted and bolded.

1. [1] - The Residential Assessment Level (RAL) is the lower of the TRRP residential Tier 1 $^{Tot}Soil_{Comb}$ (applicable to surface soil only), $^{Air}Soil_{Inh-V}$ (applicable to mercury only), and Tier 1 or Tier 2 $^{GW}Soil_{Ing}$ PCLs for a 30-acre source area (TCEQ, 2012c).
2. [2] - The critical PCL is the lower of the TRRP commercial-industrial Tier 1 $^{Tot}Soil_{Comb}$ (applicable to surface soil only), $^{Air}Soil_{Inh-V}$ (applicable to mercury only), and Tier 1 or Tier 2 $^{GW}Soil_{Ing}$ PCLs for a 30-acre source area (TCEQ, 2012c).
3. Surface Soil = 0-15 feet bgs for residential land use and 0-5 feet bgs for commercial-industrial land use; subsurface soil = greater than 15 feet bgs for residential land use and greater than 5 feet bgs for commercial-industrial land use.
4. Data Qualifiers: J - estimated result; R - rejected data.
5. bgs - Below ground surface.
6. * - Sub-slab or sub-gabion basket sample; top depth represents the approximate top of soil.
7. "--" - Not analyzed.
8. Texas-Specific Background used as RAL.

Table 4D.2B
Soil Data Summary -
Lead, Cadmium, and Additional Metals (2014)

		Fraction	Total				
		Analyte	Antimony	Arsenic	Cadmium	Lead	Selenium
		Site Specific Background	-	15.9	-	31.5	-
		Surface Soil RAL (0-15 ft bgs)	2.7	15.9	30	274.51	1.6
		Surface Soil Critical PCL (0-5 ft bgs)	2.7	15.9	30	274.51	1.6
		Subsurface Soil RAL (>15 ft bgs)	2.7	15.9	30	274.51	1.6
		Subsurface Soil Critical PCL (>5 ft bgs)	2.7	15.9	30	274.51	1.6
		Units	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
Location ID	Sample ID	Date Sampled					
2013-AD-1A	2013-AD-1A (0-0.5)	2014-01-09	NA	NA	1.22	452 JL	NA
2013-AD-1A	2013-AD-1A (0.5-2)	2014-01-09	<0.258 UJL	2.37	< 0.0286	8.15	< 0.288 U
2013-AD-3	2013-AD-03 (0-0.5)	2014-01-09	2.92	11.0	1.51	734	0.295 J
2013-AD-3	2013-AD-03 (0.5-2)	2014-01-09	2.17 J	10.7	0.509	1150	< 0.278 U
2014-AD-3A	2014-AD-03A (2-4)	2014-04-04	< 0.258 U	9.16	0.423	13.8	< 0.288 U
2014-AD-3A	Dup-01 (2-4)	2014-04-04	< 0.288 U	8.91	0.367	15.5	< 0.322 U
2013-AD-4	2013-AD-04 (0-0.5)	2014-01-09	NA	NA	0.286 J	31.9	NA
2013-AD-5	2013-AD-5 (0-0.5)	2014-01-09	NA	NA	7.39	2320 JL	NA
2013-AD-5	2013-AD-5 (0.5-2)	2014-01-09	8.15 JL	13.2	5.66	1830	0.482 J
2014-AD-6	2014-AD-06 (0-0.5)	2014-04-04	< 0.284 U	12.2	0.540	19.1	0.319 J
2013-BSA-2A	2013-BSA-2A(0-2)	2014-01-09	17.1 JL	34.9 J	16.5	2880	1.07 J
2013-BSB-8A	2013-BSB-8A (8-10)	2014-01-13	NA	NA	NA	14800 JL	NA
2013-BSB-8A	DUP-11 (8-10)	2014-01-13	NA	NA	0.200 JL	59.2 JL	NA
2013-C2L-01	2013-C2L-01 (0-0.5)	2014-01-14	NA	17.2	0.570 JL	105	< 0.311 U
2013-C2L-01	2013-C2L-01 (1-2)	2014-01-14	NA	10.4	0.0640 J	15.1	< 0.301 U
2013-C2L-01	2013-C2L-01 (10-12)	2014-01-14	< 0.290 UJL	11.5	< 0.0322 UJL	12.3	< 0.325 U
2013-C2L-01	2013-C2L-01 (12-13)	2014-01-14	< 0.297 UJL	12.2	< 0.0329 UJL	15.6	0.809 J
2013-C2L-01	2013-C2L-01 (13-15)	2014-01-14	< 0.277 UJL	5.07	0.0359 JL	13.3	0.911 J
2013-C2L-02	2013-C2L-02 (0-0.5)	2014-01-14	NA	13.7	0.301 JL	18.1	< 0.305 U
2013-C2L-03	2013-C2L-03-(0-0.5)	2014-01-09	NA	12.2	0.651	79.5	< 0.330 U
2013-C2L-04	2013-C2L-04 (0-0.5)	2014-01-14	NA	13.5	0.303 JL	13.8	< 0.313 U
2013-C2L-05	2013-C2L-05 (0-0.5)	2014-01-14	NA	5.23	0.0522 JL	22.9	< 0.300 U
2013-C2L-06	2013-C2L-06 (0-0.5)	2014-01-14	4.13 JL	22.6	3.68 JL	584	1.79 J
2013-C2L-06	2013-C2L-06 (1-2)	2014-01-14	<0.257 U	12.1	0.144 J	23.4	< 0.287 U
2014-C2L-06A	2014-C2L-06A (0-0.5)	2014-03-31	2.18 J	15.1	6.75	1150	2.22 J
2014-C2L-06A	2014-C2L-06A (0.5-2))	2014-03-31	NA	NA	NA	132 b	0.529 J
2014-C2L-06B	2014-C2L-06B (0-0.5)	2014-03-31	< 0.237 U	6.16	0.261	47.1	0.297 J
2014-C2L-06C	2014-C2L-06C (0-0.5)	2014-03-31	7.99	28.0	16.5	2970	7.09
2014-C2L-06C	2014-C2L-06C (0.5-2)	2014-03-31	< 0.294 U	7.88	NA	51.6 b	< 0.329 U
2013-C2L-07	2013-C2L-07 (0-0.5)	2014-01-14	NA	10.3	0.355 JL	32.5	< 0.302 U
2013-C2L-08	2013-C2L-08 (0-0.5)	2014-01-14	NA	14.2	0.390 JL	59.7	< 0.325 U
2013-C2L-08	2013-C2L-08 (15-17)	2014-01-14	< 0.270 UJL	18.5	< 0.0299 UJL	26.6	< 0.302 U
2013-C2L-08	2013-C2L-08 (18-20)	2014-01-14	< 0.288 UJL	14.0	< 0.0319 UJL	7.80	1.49 J
2013-C2L-09	2013-C2L-09 (0-0.5)	2014-01-14	NA	10.8	0.401 JL	18.7	< 0.297 U
2013-C2L-10	2013-C2L-10 (0-0.5)	2014-01-14	NA	10.5	0.659 JL	66.9	< 0.299 U
2013-CUFT-10A	2013-CUFT-10A (0-0.5)	2014-01-10	NA	NA	0.618	76.1	NA
2013-CUFT-10B	2013-CUFT-10B (0-0.5)	2014-01-10	1.19 JL	11.1	2.19	1290	0.414 J
2013-CUFT-10C	2013-CUFT-10C (0-0.5)	2014-01-10	NA	NA	0.878	92.7	NA
2013-CUFT-10D	2013-CUFT-10D (2-4)	2014-01-10	NA	NA	0.606	16.6	NA
2013-CUFT-11	2013-CUFT-11 (0-0.5)	2014-01-10	NA	NA	NA	51.1	NA
2013-CUFT-14	2013-CUFT-14 (0-2)	2014-01-10	NA	NA	0.240 J	14.7	NA
2014-CUFT-15	2014-CUFT-15 (0-0.5)	2014-04-04	1.03 J	7.52	2.06	1090	< 0.293 U
2014-CUFT-15	2014-CUFT-15 (0.5-2))	2014-04-04	NA	NA	NA	65.8	NA
2014-CUFT-16	2014-CUFT-16 (0-0.5)	2014-04-04	0.459 J	10.4	1.06	1530	< 0.301 U
2014-CUFT-16	2014-CUFT-16 (0.5-2)	2014-04-04	NA	NA	NA	117	NA
2014-CUFT-17	2014-CUFT-17 (0-0.5)	2014-04-04	< 0.271 U	6.74	4.43	172	< 0.303 U
2014-CUFT-18	2014-CUFT-18 (0-0.5)	2014-04-04	< 0.284 U	6.01	4.20	261	< 0.318 U
2013-CUFT-5A	2013-CUFT-5A (0-0.5)	2014-01-10	NA	NA	0.492	87.8	NA
2013-CUFT-5B	2013-CUFT-5B (0-0.5)	2014-01-10	1.00 J	7.23	2.35	1340	< 0.333 U
2014-CUFT-5B-A	2014-CUFT-5B-A (0.5-2)	2014-04-04	< 0.292 U	9.51	2.05	308	< 0.326 U
2014-CUFT-5B-A	2014-CUFT-5B-A (2-4)	2014-04-04	NA	NA	NA	30.4	NA
2013-CUFT-5C	2013-CUFT-5C (0-0.5)	2014-01-10	NA	NA	0.719	60.0	NA
2013-CUFT-5D	2013-CUFT-5D (2-4)	2014-01-10	NA	NA	0.564	20.0	NA
2013-CUFT-6A	2013-CUFT-6A (0-0.5)	2014-01-10	NA	NA	5.50	603	NA
2013-CUFT-6B	2013-CUFT-6B (0-0.5)	2014-01-10	NA	NA	0.624	26.5	NA
2013-CUFT-6C	2013-CUFT-6C (2-4)	2014-01-10	NA	NA	0.760 J	20.3 J	NA
2013-CUFT-6C	DUP-9 (2-4)	2014-01-10	NA	NA	0.888	21.6	NA
2013-CUFT-7B	2013-CUFT-7B (0-0.5)	2014-01-10	NA	NA	0.545	48.0	NA
2013-CUFT-7B	2013-CUFT-7B (2-4)	2014-01-10	NA	NA	0.730	41.8	NA
2013-FOP-1A	2013-FOP-1A (0-0.5)	2014-01-09	NA	NA	NA	85.1 JL	NA
2013-FWCS-12A	2013-FWCS-12A (2-2.7)	2014-01-13	NA	NA	NA	106 JL	NA
2013-FWFS-5A	2013-FWFS-5A (0-2)	2014-01-13	< 0.275 UJL	11.4	0.529 JL	100 JL	< 0.308 U
2013-FWFS-5B	MW-33/2013-FWFS-5B (1-2)	2014-01-10	NA	NA	40.5	1420	NA
2013-FWFS-5B	MW-33/2013-FWFS-5B (2-4)	2014-01-10	NA	NA	5.30	7390	NA
2013-FWFS-5B	MW-33/2013-FWFS-5B (4-5)	2014-01-10	NA	NA	7.20	10200	NA
2013-MB-3	2013-MB-3 (0.75-1.25)	2014-01-08	NA	NA	2.19	732	NA
2013-MB-3	2013-MB-3 (1.25-2)	2014-01-08	NA	NA	0.489	157	NA
2013-MB-4	2013-MB-4 (0.83-1.33)	2014-01-08	NA	NA	0.495	24.4	NA
2013-MB-5	2013-MB-5 (0.5-5)	2014-01-08	NA	NA	46.6	21200	NA
2013-MB-5	2013-MB-5 (10-12)	2014-01-08	NA	NA	2.15	2390	NA

Table 4D.2B
Soil Data Summary -
Lead, Cadmium, and Additional Metals (2014)

		Fraction	Total				
		Analyte	Antimony	Arsenic	Cadmium	Lead	Selenium
		Site Specific Background	-	15.9	-	31.5	-
		Surface Soil RAL (0-15 ft bgs)	2.7	15.9	30	274.51	1.6
		Surface Soil Critical PCL (0-5 ft bgs)	2.7	15.9	30	274.51	1.6
		Subsurface Soil RAL (>15 ft bgs)	2.7	15.9	30	274.51	1.6
		Subsurface Soil Critical PCL (>5 ft bgs)	2.7	15.9	30	274.51	1.6
		Units	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
Location ID	Sample ID	Date Sampled					
2013-MB-5	2013-MB-5 (14-16)	2014-01-08	NA	NA	0.162 J	13.3	NA
2013-MW-17B	2013-MW-17B (0-0.5)	2014-01-13	32.4 JL	36.7	5.19 JL	6830 JL	1.35 J
2013-NDA-1A	2013-NDA-1A (2-4)	2014-01-09	NA	NA	4.32	946	NA
2014-NDA-7	2014-NDA-7 (0-0.5)	2014-04-01	1.98 JL	14.3	4.17	633	0.659 J
2014-NDA-7	2014-NDA-7 (0.5-2)	2014-04-01	< 0.276 U	NA	NA	27.9	NA
2014-NDA-7	DUP-4 (0-0.5)	2014-04-01	2.82 JL	13.4	3.20	577	0.586 J
2014-NDA-8	2014-NDA-8 (0-0.5)	2014-04-01	< 0.280 U	11.8	2.97	318	0.338 J
2014-NDA-8	2014-NDA-8 (0.5-2)	2014-04-01	NA	NA	NA	< 0.116 U	NA
2014-NDA-9	2014-NDA-9 (0-0.5)	2014-04-01	< 0.294 U	12.8	2.26	282	0.412 J
2014-NDA-9	2014-NDA-9 (0.5-2)	2014-04-01	NA	NA	NA	130	NA
2013-NDA-C01	2013-NDA-C01 (0-6)	2013-12-19	NA	NA	5.8	1330	NA
2013-NDA-C01	2013-NDA-C01 (6-12)	2013-12-19	NA	NA	NA	446	NA
2013-NDA-C02	2013-NDA-C02 (0-6)	2013-12-19	NA	NA	7.09	1130	NA
2013-NDA-C02	2013-NDA-C02 (6-12)	2013-12-19	NA	NA	NA	190	NA
2013-NDA-C03	2013-NDA-C03 (0-6)	2013-12-19	NA	NA	21.5	5260	NA
2013-NDA-C03	2013-NDA-C03 (6-12)	2013-12-19	NA	NA	4.49	805	NA
2013-NDA-C04	2013-NDA-C04 (0-6)	2013-12-19	NA	NA	33.6	4010	NA
2013-NDA-C04	2013-NDA-C04 (6-12)	2013-12-19	NA	NA	2.43	14700	NA
2013-NDA-C04	DUP-2	2013-12-19	NA	NA	4.88	37100 b	NA
2013-NDA-C05	2013-NDA-C05 (0-6)	2013-12-19	NA	NA	22.4	2220	NA
2013-NDA-C05	2013-NDA-C05 (6-12)	2013-12-19	NA	NA	NA	845	NA
2013-NDA-C06	2013-NDA-C06 (0-6)	2013-12-19	NA	NA	15.6	3180	NA
2013-NDA-C06	2013-NDA-C06 (6-12)	2013-12-19	NA	NA	NA	7960 b	NA
2013-NDA-C07	2013-NDA-C07 (0-6)	2013-12-19	NA	NA	13.6	2220	NA
2013-NDA-C07	2013-NDA-C07 (6-12)	2013-12-19	NA	NA	NA	713 b	NA
2013-NDA-C08	2013-NDA-C08 (0-6)	2013-12-19	NA	NA	2.63	419	NA
2013-NDA-C08	2013-NDA-C08 (6-12)	2013-12-19	NA	NA	NA	384 b	NA
2013-NDA-C09	2013-NDA-C09 (0-6)	2013-12-19	NA	NA	10.5	1850	NA
2013-NDA-C09	2013-NDA-C09 (6-12)	2013-12-19	NA	NA	NA	46000 b	NA
2013-NDA-C10	2013-NDA-C10 (0-6)	2013-12-19	NA	NA	5.93	683	NA
2013-NDA-C10	2013-NDA-C10 (6-12)	2013-12-19	NA	NA	NA	379 b	NA
2013-NDA-C11	2013-NDA-C11 (0-6)	2013-12-19	NA	NA	9.42	963	NA
2013-NDA-C11	2013-NDA-C11 (6-12)	2013-12-19	NA	NA	NA	508 b	NA
2013-NDA-C12	2013-NDA-C12 (0-6)	2013-12-19	NA	NA	11.5	1450	NA
2013-NDA-C12	2013-NDA-C12 (6-12)	2013-12-19	NA	NA	NA	1170 b	NA
2013-NDA-C13	2013-NDA-C13 (0-6)	2013-12-19	NA	NA	6.21	997	NA
2013-NDA-C13	2013-NDA-C13 (6-12)	2013-12-19	NA	NA	2.08	240	NA
2013-NDA-C14	2013-NDA-C14 (0-6)	2013-12-19	NA	NA	2.91	435	NA
2013-NDA-C14	2013-NDA-C14 (6-12)	2013-12-19	NA	NA	5.78	819 b	NA
2013-NDA-C14	DUP-3	2013-12-19	NA	NA	9.81	700 b	NA
2013-NDA-C15	2013-NDA-C15 (0-6)	2013-12-19	NA	NA	7.45	2160	NA
2013-NDA-C15	2013-NDA-C15 (6-12)	2013-12-19	NA	NA	NA	1150 b	NA
2013-NDA-C16	2013-NDA-C16 (0-6)	2013-12-20	NA	NA	1.95	491	NA
2013-NDA-C16	2013-NDA-C16 (6-12)	2013-12-20	NA	NA	NA	667	NA
2013-NDA-C17	2013-NDA-C17 (0-6)	2013-12-20	NA	NA	1.54	318	NA
2013-NDA-C17	2013-NDA-C17 (6-12)	2013-12-20	NA	NA	NA	726	NA
2013-NDA-C18	2013-NDA-C18 (0-6)	2013-12-20	NA	NA	2.3	600	NA
2013-NDA-C18	2013-NDA-C18 (6-12)	2013-12-20	NA	NA	NA	42.8	NA
2013-NDA-C19	2013-NDA-C19 (0-6)	2013-12-20	NA	NA	1.83	419	NA
2013-NDA-C19	2013-NDA-C19 (6-12)	2013-12-20	NA	NA	NA	386	NA
2013-NDA-C20	2013-NDA-C20 (0-6)	2013-12-20	NA	NA	10.9	44400	NA
2013-NDA-C20	2013-NDA-C20 (6-12)	2013-12-20	NA	NA	NA	6850	NA
2013-NDA-C21	2013-NDA-C21 (0-6)	2013-12-20	NA	NA	49.9	37700	NA
2013-NDA-C21	2013-NDA-C21 (6-12)	2013-12-20	NA	NA	24.8	35800	NA
2013-NDA-C22	2013-NDA-C22 (0-6)	2013-12-20	NA	NA	21.8	1220	NA
2013-NDA-C22	2013-NDA-C22 (6-12)	2013-12-20	NA	NA	NA	4110	NA
2013-NDA-C23	2013-NDA-C23 (0-6)	2013-12-20	NA	NA	10.8	1480	NA
2013-NDA-C23	2013-NDA-C23 (6-12)	2013-12-20	NA	NA	32.1	19900	NA
2013-NDA-C24	2013-NDA-C24 (0-6)	2013-12-20	NA	NA	44.4	4980	NA
2013-NDA-C24	2013-NDA-C24 (6-12)	2013-12-20	NA	NA	3.23	2010	NA
2013-NDA-C24	DUP-4	2013-12-20	NA	NA	5.05	1880	NA
2013-NDA-C25	2013-NDA-C25 (0-6)	2013-12-20	NA	NA	17.9	26700	NA
2013-NDA-C25	2013-NDA-C25 (6-12)	2013-12-20	NA	NA	NA	4140	NA
2013-NT-01	2013-NT-01 (0-0.5)	2014-01-10	NA	15.9	0.571	19.5	< 0.328 U
2013-NT-01	2013-NT-01 (0.5-2)	2014-01-10	NA	14.4	0.618	18.5	0.546 J
2013-NT-02	2013-NT-02 (0-0.5)	2014-01-10	NA	14.9	4.89	837	0.654 J
2013-NT-02	2013-NT-02 (0.5-2)	2014-01-10	NA	14.1	0.354	21.2	0.324 J
2014-NT-3	2014-NT-3 (0.5-2)	2014-03-31	NA	NA	NA	59.3 b	NA
2014-NT-3	2014-NT-3 (0-0.5)	2014-03-31	< 0.267 U	12.3	1.92	353	< 0.298 U
2014-NT-4	2014-NT-4 (0-0.5)	2014-03-31	< 0.262 U	10.9	0.402	42.8	< 0.293 U

Table 4D.2B
Soil Data Summary -
Lead, Cadmium, and Additional Metals (2014)

		Fraction	Total				
		Analyte	Antimony	Arsenic	Cadmium	Lead	Selenium
		Site Specific Background	-	15.9	-	31.5	-
		Surface Soil RAL (0-15 ft bgs)	2.7	15.9	30	274.51	1.6
		Surface Soil Critical PCL (0-5 ft bgs)	2.7	15.9	30	274.51	1.6
		Subsurface Soil RAL (>15 ft bgs)	2.7	15.9	30	274.51	1.6
		Subsurface Soil Critical PCL (>5 ft bgs)	2.7	15.9	30	274.51	1.6
		Units	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
Location ID	Sample ID	Date Sampled					
2013-RMSB-5A	2013-RMSB-5A (5-7)	2014-01-13	NA	NA	NA	35300	NA
2013-RRS-4A-A	2013-RRS-4A-A (3-4)	2014-01-13	NA	NA	0.714 JL	39.2	NA
2013-SDA-3B	2013-SDA-3B (0-0.5)	2014-01-09	NA	NA	4.02	1000 JL	NA
2013-SDA-4B	2013-SDA-4B (0-0.5)	2014-01-10	0.315 J	11.7	0.671	44.5	0.403 J
2014-SL-5	2014-SL-5 (0.5-2)	2014-03-31	NA	NA	NA	9.99 b	NA
2014-SL-5	2014-SL-5 (0-0.5)	2014-03-31	< 0.285 U	14.6	1.79	346	0.671 J
2014-SL-6	2014-SL-6 (0-0.5)	2014-03-31	< 0.260 U	9.90	0.736	99.5	< 0.291 U
2014-SL-7	2014-SL-7 (0-0.5)	2014-03-31	< 0.250 U	9.45	1.28	85.2	< 0.279 U
2013-STB-4A	2013-STB-4A (2-4)	2014-01-13	NA	NA	92.4 JL	1540	NA
2013-WMU14-1A	2013-WMU14-1A (0.9-2)	2014-01-09	NA	NA	NA	35500 JL	NA
2013-WMU14-1A	2013-WMU14-1A (5-7)	2014-01-09	NA	NA	5.14 J	17000 J	NA
2013-WMU14-1A	DUP-7 (5-7)	2014-01-09	NA	NA	NA	10500 JL	NA
2014-FFTA-04	2014-FFTA-04 (0-0.5)	2014-03-31	< 0.297 U	6.13	0.340	15.3	< 0.332 U
2014-FFTA-05	2014-FFTA-05 (0-0.5)	2014-03-31	< 0.294 U	9.64	0.909	152	< 0.329 U
2014-FFTA-06	2014-FFTA-06 (0-0.5)	2014-04-01	1.89 JL	16.9	2.51	736	< 0.296 U
2014-FFTA-06	2014-FFTA-06 (0.5-2)	2014-04-01	NA	13.5	NA	171	NA
2014-FFTA-07	2014-FFTA-07 (0-0.5)	2014-04-01	1.97 JL	16.4	4.42	663	0.450 J
2014-FFTA-07	2014-FFTA-07 (0.5-2)	2014-04-01	NA	7.11	NA	815	NA
2014-FFTA-08	2014-FFTA-08 (0-0.5)	2014-04-01	2.19 JL	17.4	6.43	566	0.508 J
2014-FFTA-08	2014-FFTA-08 (0.5-2)	2014-04-01	NA	11.4	NA	108	NA
2014-SDA-6	2014-SDA-6 (0-0.5)	2014-03-31	< 0.229 U	3.88	0.917	153	< 0.257 U
2014-SDA-7	2014-SDA-7 (0.5-2)	2014-03-31	< 0.275 UR	14.0	NA	287	NA
2014-SDA-7	2014-SDA-7 (0-0.5)[6]	2014-03-31	102	96.6	1.36	6150	0.453 J
2014-SDA-7	2014-SDA-7 (0-0.5)[6]	2014-05-12	20.1	NA	NA	NA	NA
2014-SDA-7	2014-SDA-7 (0.5-2)	2014-05-12	< 0.275 U	14	NA	287	NA
2014-TS-3	2014-TS-3 (0.5-2)	2014-03-31	NA	NA	NA	14.0	NA
2014-TS-3	2014-TS-3 (0-0.5)	2014-03-31	1.95 J	8.40	4.90	1420	0.419 J
B3RA	B3RA (0.5-2)	2014-03-31	NA	11.4	NA	26.2	NA
B3RA	B3RA (0-0.5)	2014-03-31	1.81 J	17.4	4.47	861	0.530 J
D-11A	D11A (0-0.5)	2014-01-09	1.76 J	27.2	1.77	257	< 0.353 U
D-11B	D-11B (0.5-2)	2014-03-31	NA	9.53	NA	NA	NA
D-11B	D-11B (0-0.5)	2014-03-31	NA	21.0	NA	NA	NA
D-12A	D12A (0-0.5)	2014-01-09	NA	10.9	0.652	80.2	< 0.324 U
D-13A	D13A (0-0.5)	2014-01-09	NA	NA	0.503	67.3	NA
E-11C	E-11C (0-0.5)	2014-01-09	49.8	79.8	62.8	11200	29.2
E-11C-A	E-11C-A (0.5-2)	2014-03-31	NA	13.8	NA	NA	NA
E-11D	E-11D (0-0.5)	2014-01-10	NA	NA	1.22	152	NA
E-11E	E-11E- (0-0.5)	2014-03-31	< 0.281 U	8.75	0.959	126	< 0.314 U
E-12A	E-12A (0-0.5)	2014-01-10	NA	NA	1.54	201	NA
E-13A	E-13A (0-0.5)	2014-01-10	NA	NA	0.492	44.4	NA
E-14A	E-14A (0-0.5)	2014-01-10	NA	NA	1.84	349	NA
ECO-10A	ECO-10A (0-0.5)	2014-01-10	NA	NA	0.409 J	21.4 J	NA
ECO-1A	ECO-1A (0-0.5)	2014-01-09	0.463 J	12.4	0.692	151 JL	<0.312 U
ECO-2A	ECO-2A (0-0.5)	2014-01-09	1.46 JL	16.3 JL	3.29	303 JL	0.564 J
ECO-2A	ECO-2A (0.5-2)	2014-01-09	< 0.284 UJL	9.87	0.557	26.6	0.410 J
ECO-4A	ECO-4A (0-0.5)	2014-01-10	NA	NA	1.64	245	NA
ECO-4B	ECO-4B (0-0.5)	2014-01-13	NA	NA	1.21 JL	201 JL	NA
ECO-7C	ECO-7C (0-0.5)	2014-01-14	NA	NA	3.35	375	NA
ECO-7C	ECO-7C (2-3)	2014-01-14	NA	NA	< 0.0294 U	12.7	NA
ECO-7C	DUP-15 (2-3)	2014-01-14	NA	NA	0.168 J	11.9	NA
ECO-7D	ECO-7D (0-0.5)	2014-01-14	0.463 JL	15.1	2.30 JL	192	0.512 J
ECO-8A	ECO-8A (0-0.5)	2014-01-09	6.70 JL	13.1	5.65	1090 JL	0.486 J
ECO-8B	ECO-8B (0.5-2)	2014-03-31	2.70 J	15.5	NA	1860 b	NA
ECO-8B	ECO-8B (0-0.5)	2014-03-31	4.65	16.4	12.4	1900	0.809 J
F-5A	F-5A (0-0.25)	2014-01-10	NA	NA	1.11	60.7	NA
F-5A	F-5A (1)	2014-01-10	NA	NA	0.275 J	17.6	NA
F-5B	F-5B (0-0.25)	2014-01-10	NA	NA	1.30	116	NA
F-5C	F-5C (0-0.25)	2014-01-10	NA	NA	1.55	162	NA
F-5D	F-5D (0.0-0.25)	2014-01-10	NA	NA	1.07	101	NA
F-5E	F-5E (0-0.25)	2014-01-10	NA	NA	2.14	161	NA
MW-27A	MW-27A (0-2)	2014-01-09	NA	NA	12 J	829	NA
MW-27A	MW-27A (2-4)	2014-01-09	NA	NA	0.547 J	51.9	NA
MW-27B	MW-27B (0-2)	2014-01-09	6.99 JL	16.8	9.85 J	2420	0.536 J
MW-27B	MW-27B (2-4)	2014-01-09	NA	NA	0.48 J	27.6	NA
MW-27C	MW-27C (0-2)	2014-01-08	NA	NA	9.11	1830	NA
MW-27D	MW-27D (0.5-2)	2014-01-08	NA	NA	15.1	315	NA
MW-27D	MW-27D (2-4)	2014-01-08	NA	NA	3.51	1530	NA
MW-27E	DUP-10 (0-1)	2014-01-13	NA	NA	28.3 JL	1130 JL	NA
MW-27E	MW-27E (0-1)	2014-01-13	NA	NA	1.58 JL	298 JL	NA
MW-27E	MW-27E (1-2)	2014-01-13	NA	NA	15.2	4830	NA

Table 4D.2B
Soil Data Summary -
Lead, Cadmium, and Additional Metals (2014)

		Fraction	Total				
		Analyte	Antimony	Arsenic	Cadmium	Lead	Selenium
		Site Specific Background	-	15.9	-	31.5	-
		Surface Soil RAL (0-15 ft bgs)	2.7	15.9	30	274.51	1.6
		Surface Soil Critical PCL (0-5 ft bgs)	2.7	15.9	30	274.51	1.6
		Subsurface Soil RAL (>15 ft bgs)	2.7	15.9	30	274.51	1.6
		Subsurface Soil Critical PCL (>5 ft bgs)	2.7	15.9	30	274.51	1.6
		Units	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
Location ID	Sample ID	Date Sampled					
MW-29A	MW-29A (0-0.5)	2014-01-13	NA	NA	**1.27 JL**	**171 JL**	NA
MW-30A	DUP-8 (2-4)	2014-01-09	NA	NA	NA	**28.9 JL**	NA
MW-30A	MW-30A (2-4)	2014-01-09	NA	NA	NA	**52.4 JL**	NA
MW-35	MW-35 (1-3)	2014-01-10	NA	NA	**40.0**	**3300**	NA
MW-36	MW-36 (0-2)	2014-01-10	NA	NA	**2.74**	**3120 JL**	NA
MW-41	MW-41 (0.5-2)	2014-01-08	NA	**10.1**	**0.810**	**92.5**	< 0.338 U
MW-41	MW-41 (0-0.5)	2014-01-08	NA	**8.00**	**0.474**	**18.4**	< 0.323 U
MW-42	DUP-6 (0.5-2)	2014-01-08	NA	**7.39**	**0.385**	**15.0**	< 0.311 U
MW-42	MW-42 (0.5-2)	2014-01-08	< 0.287 UJL	**13.9 J**	**1.82 J**	**241 J**	**0.502 J**
MW-42	MW-42 (0-0.5)	2014-01-08	NA	**14.2**	**1.56**	**230**	**0.580 J**
MW-44	MW-44 (0-0.5)	2014-01-09	NA	NA	**0.689**	**38.6 JL**	NA
MW-45	MW-45 (0-0.5')	2014-01-07	NA	**12.8**	**0.314**	**44.6**	< 0.313 U
MW-45	MW-45 (15-17')	2014-01-07	NA	NA	NA	NA	< 0.318 U
MW-45	MW-45 (17-18')	2014-01-07	NA	NA	NA	NA	< 0.307 U
MW-45	MW-45 (18-20')	2014-01-07	NA	NA	NA	NA	< 0.321 U
SCC-10B	SCC-10B (0-0.5)	2014-01-13	**1.69 JL**	**14.0**	**1.85 JL**	**333 JL**	**0.601 J**
SCC-5A	SCC-5A (0-0.5)	2014-01-10	NA	NA	**0.258 J**	**29.8**	NA
SCC-5B	SCC-5B (0-0.5)	2014-01-10	**3.11 JL**	**11.1**	**2.48**	**1400**	< 0.299 U
SRB-VS-11A	SRB-VS-11A (0-0.5)	2014-01-10	**0.602 JL**	**11.4**	**1.44**	**273**	**0.491 J**
SRB-VS-11B	DUP-3 (0.5-2)	2014-03-31	< 0.296 U	**12.2**	**1.41**	**215**	**0.442 J**
SRB-VS-11B	SRB-VS-11B (0.5-2)	2014-03-31	**3.10**	**11.3**	**0.777**	**74.2**	**0.402 J**
SRB-VS-11B	SRB-VS-11B (2-4)	2014-03-31	< 0.245 UR	NA	NA	NA	NA
SRB-VS-9E	SRB-VS-9E (0-0.5)	2014-01-10	NA	NA	**0.210 J**	**31.0**	NA

NOTES

Detected analytes are bolded.

Analytes that exceede applicable Protective Concentration Level (PCL) are in green.

1. The Residential Assessment Level (RAL) is the lower of the TRRP residential Tier 1 $^{Tot}Soil_{Comb}$ (applicable to surface soil only) and Tier 2 $^{GW}Soil_{Ing}$ PCLs for a 30-acre source area (TCEQ, 2012c). The $^{Air}Soil_{Inh-V}$ pathway is not applicable to metals and was therefore not used for RALs.
2. The critical PCL is typically the lower of the TRRP commercial-industrial Tier 1 $^{Tot}Soil_{Comb}$ (applicable to surface soil only) and Tier 2 $^{GW}Soil_{Ing}$ PCLs for a 30-acre source area (TCEQ, 2012c). The $^{Air}Soil_{Inh-V}$ pathway is not applicable to metals and was therefore not used for critical PCLs.
3. The arsenic RAL/critical PCL is based on site specific background study.
4. The lead, cadmium, and selenium RAL/critical PCL is based on the Tier 2 PCL calculation.
5. Surface Soil = 0-15 feet bgs for residential land use and 0-5 feet bgs for commercial-industrial land use; subsurface soil = greater than 15 feet bgs for residential land use and greater than 5 feet bgs for commercial-industrial land use.
6. Laboratory reanalyzed 2014-SDA-7 (0-0.5) for antimony on May 12, 2014, due to an anomalously high antimony concentration in the original sample.

< - Indicates analyte not detected above method detection limit (MDL).
NA - Analyte not analyzed.
J - Analyte concentration estimated.
mg/kg - Milligrams per kilogram.
-- Indicates PCL not available.
* indicates data was qualified as non-detect based on blank concentration
J Estimated data; The analyte was detected and identified. The associated numerical value (i.e., the reported sample concentration) is the approximate concentration of the analyte in the sample.
U Not detected.
UJ Estimated data; The analyte was not detected above the reported sample detection limit (SDL). The numerical value of the SDL is estimated and may be inaccurate.
H Bias in sample result is likely to be high
L Bias in sample result is likely to be low
R Antimony results were rejected due to extremely low matrix spike recovery

Created By: BEF 2-14-2014
Checked by: JSI 2-14-2014
Reviewed by: CMH 3-31-14

Soil Data Summary - Lead, Cadmium, and Additional Metals
(2014 Cap Samples)

		Fraction	Total				
		Analyte	Antimony	Arsenic	Cadmium	Lead	Selenium
		Background					
		Surface Soil RAL (0-15 ft bgs)	2.7	15.9	30	274.51	1.6
		Surface Soil Critical PCL (0-5 ft bgs)	2.7	15.9	30	274.51	1.6
		Subsurface Soil RAL (>15 ft bgs)	2.7	15.9	30	274.51	1.6
		Subsurface Soil Critical PCL (>5 ft bgs)	2.7	15.9	30	274.51	1.6
		Units	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
Location ID	Sample ID	Date Sampled					
2013-C2L-C01	2013-C2L-C01 (0-6)	2013-12-20	2.27 J	16.4 JL	3.05 JL	435	1.58 J
2013-C2L-C01	2013-C2L-C01 (6-12)	2013-12-20	NA	17.2	NA	93.8	NA
2014-C2L-C01A	2014-C2L-C01A (0-1)	2014-04-04	< 0.278 U	11.9	1.12	201	0.708 J
2014-C2L-C01B	2014-C2L-C01B (0-1)	2014-04-04	< 0.254 U	19.3	0.581	35.6	0.460 J
2014-C2L-C01C	2014-C2L-C01C (0-1)	2014-04-04	< 0.259 U	6.36	0.0951 J	14.4	< 0.290 U
2013-C2L-C02	2013-C2L-C02 (0-6)	2013-12-20	NA	10.8 JL	0.769 JL	90.8	< 0.316 U
2013-C2L-C03	2013-C2L-C03 (0-6)	2013-12-20	NA	10.8 JL	0.621 JL	74.3	0.339 J
2013-C2L-C04	2013-C2L-C04 (0-6)	2013-12-20	NA	10.6 JL	0.305 JL	52.7	< 0.329 U
2013-C2L-C05	2013-C2L-C05 (0-6)	2013-12-20	NA	6.68 JL	0.207 JL	28.8	< 0.325 U
2013-C2L-C06	2013-C2L-C06 (0-6)	2013-12-20	NA	6.99	0.104 J	20.7	< 0.316 U
2013-NDA-C01	2013-NDA-C01 (0-6)	2013-12-19	NA	NA	5.80	1330	NA
2013-NDA-C01	2013-NDA-C01 (6-12)	2013-12-19	NA	NA	NA	446	NA
2013-NDA-C02	2013-NDA-C02 (0-6)	2013-12-19	NA	NA	7.09	1130	NA
2013-NDA-C02	2013-NDA-C02 (6-12)	2013-12-19	NA	NA	NA	190	NA
2013-NDA-C03	2013-NDA-C03 (0-6)	2013-12-19	NA	NA	21.5	5260	NA
2013-NDA-C03	2013-NDA-C03 (6-12)	2013-12-19	NA	NA	4.49	805 J	NA
2013-NDA-C04	2013-NDA-C04 (0-6)	2013-12-19	NA	NA	33.6	4010	NA
2013-NDA-C04	2013-NDA-C04 (6-12)	2013-12-19	NA	NA	2.43 J	14700 J	NA
2013-NDA-C04	DUP-2	2013-12-19	NA	NA	4.88 J	37100 J	NA
2013-NDA-C05	2013-NDA-C05 (0-6)	2013-12-19	NA	NA	22.4	2220	NA
2013-NDA-C05	2013-NDA-C05 (6-12)	2013-12-19	NA	NA	NA	845	NA
2013-NDA-C06	2013-NDA-C06 (0-6)	2013-12-19	NA	NA	15.6	3180	NA
2013-NDA-C06	2013-NDA-C06 (6-12)	2013-12-19	NA	NA	NA	7960	NA
2013-NDA-C07	2013-NDA-C07 (0-6)	2013-12-19	NA	NA	13.6	2220	NA
2013-NDA-C07	2013-NDA-C07 (6-12)	2013-12-19	NA	NA	NA	713	NA
2013-NDA-C08	2013-NDA-C08 (0-6)	2013-12-19	NA	NA	2.63	419	NA
2013-NDA-C08	2013-NDA-C08 (6-12)	2013-12-19	NA	NA	NA	384	NA
2013-NDA-C09	2013-NDA-C09 (0-6)	2013-12-19	NA	NA	10.5	1850	NA
2013-NDA-C09	2013-NDA-C09 (6-12)	2013-12-19	NA	NA	NA	46000	NA
2013-NDA-C10	2013-NDA-C10 (0-6)	2013-12-19	NA	NA	5.93	683	NA
2013-NDA-C10	2013-NDA-C10 (6-12)	2013-12-19	NA	NA	NA	379	NA
2013-NDA-C11	2013-NDA-C11 (0-6)	2013-12-19	NA	NA	9.42	963	NA
2013-NDA-C11	2013-NDA-C11 (6-12)	2013-12-19	NA	NA	NA	508	NA
2013-NDA-C12	2013-NDA-C12 (0-6)	2013-12-19	NA	NA	11.5	1450	NA
2013-NDA-C12	2013-NDA-C12 (6-12)	2013-12-19	NA	NA	NA	1170	NA
2013-NDA-C13	2013-NDA-C13 (0-6)	2013-12-19	NA	NA	6.21	997	NA
2013-NDA-C13	2013-NDA-C13 (6-12)	2013-12-19	NA	NA	2.08	240	NA
2013-NDA-C14	2013-NDA-C14 (0-6)	2013-12-19	NA	NA	2.91	435	NA
2013-NDA-C14	2013-NDA-C14 (6-12)	2013-12-19	NA	NA	5.78 J	819 J	NA
2013-NDA-C14	DUP-3	2013-12-19	NA	NA	9.81 J	700 J	NA
2013-NDA-C15	2013-NDA-C15 (0-6)	2013-12-19	NA	NA	7.45	2160	NA
2013-NDA-C15	2013-NDA-C15 (6-12)	2013-12-19	NA	NA	NA	1150	NA
2013-NDA-C16	2013-NDA-C16 (0-6)	2013-12-20	NA	NA	1.95	491 JL	NA
2013-NDA-C16	2013-NDA-C16 (6-12)	2013-12-20	NA	NA	NA	667	NA
2013-NDA-C17	2013-NDA-C17 (0-6)	2013-12-20	NA	NA	1.54	318 JL	NA
2013-NDA-C17	2013-NDA-C17 (6-12)	2013-12-20	NA	NA	NA	726	NA
2013-NDA-C18	2013-NDA-C18 (0-6)	2013-12-20	NA	NA	2.30	600 JL	NA
2013-NDA-C18	2013-NDA-C18 (6-12)	2013-12-20	NA	NA	NA	42.8	NA
2013-NDA-C19	2013-NDA-C19 (0-6)	2013-12-20	NA	NA	1.83	419 JL	NA
2013-NDA-C19	2013-NDA-C19 (6-12)	2013-12-20	NA	NA	NA	386	NA
2013-NDA-C20	2013-NDA-C20 (0-6)	2013-12-20	168 J	50.2	10.9	44400 JL	1.73 J
2013-NDA-C20	2013-NDA-C20 (6-12)	2013-12-20	NA	NA	NA	6850	NA
2013-NDA-C21	2013-NDA-C21 (0-6)	2013-12-20	98.0 J	72.5	49.9	37700 JL	2.03 J
2013-NDA-C21	2013-NDA-C21 (6-12)	2013-12-20	NA	NA	24.8	35800	NA
2013-NDA-C22	2013-NDA-C22 (0-6)	2013-12-20	NA	NA	21.8 JL	1220	NA
2013-NDA-C22	2013-NDA-C22 (6-12)	2013-12-20	NA	NA	NA	4110	NA
2013-NDA-C23	2013-NDA-C23 (0-6)	2013-12-20	NA	NA	10.8 JL	1480	NA
2013-NDA-C23	2013-NDA-C23 (6-12)	2013-12-20	NA	NA	32.1 JL	19900	NA
2013-NDA-C24	2013-NDA-C24 (0-6)	2013-12-20	NA	NA	44.4 JL	4980	NA
2013-NDA-C24	2013-NDA-C24 (6-12)	2013-12-20	NA	NA	3.23	2010	NA
2013-NDA-C24	DUP-4	2013-12-20	NA	NA	5.05	1880 J	NA
2013-NDA-C25	2013-NDA-C25 (0-6)	2013-12-20	NA	NA	17.9 JL	26700	NA
2013-NDA-C25	2013-NDA-C25 (6-12)	2013-12-20	NA	NA	NA	4140	NA
2013-SDA-C01	2013-SDA-C01 (0-6)	2013-12-20	NA	NA	5.36	2500 JL	NA
2013-SDA-C01	2013-SDA-C01 (6-12)	2013-12-20	NA	NA	NA	24.9	NA
2013-SDA-C02	2013-SDA-C02 (0-6)	2013-12-20	NA	NA	9.71	4260 JL	NA
2013-SDA-C02	2013-SDA-C02 (6-12)	2013-12-20	NA	NA	0.691 J	202 JL	NA
2013-SDA-C03	2013-SDA-C03 (0-6)	2013-12-20	52.2 J	27.2	1.76	8680 JL	1.51 J
2013-SDA-C03	2013-SDA-C03 (6-12)	2013-12-20	NA	NA	0.714	3560 J	NA

Soil Data Summary - Lead, Cadmium, and Additional Metals
(2014 Cap Samples)

		Fraction	Total				
		Analyte	Antimony	Arsenic	Cadmium	Lead	Selenium
		Background					
		Surface Soil RAL (0-15 ft bgs)	2.7	15.9	30	274.51	1.6
		Surface Soil Critical PCL (0-5 ft bgs)	2.7	15.9	30	274.51	1.6
		Subsurface Soil RAL (>15 ft bgs)	2.7	15.9	30	274.51	1.6
		Subsurface Soil Critical PCL (>5 ft bgs)	2.7	15.9	30	274.51	1.6
		Units	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
Location ID	**Sample ID**	**Date Sampled**					
2013-SDA-C03	DUP-5	2013-12-20	NA	NA	**0.906 J**	**1110 J**	NA
2013-SDA-C04	2013-SDA-C04 (0-6)	2013-12-20	NA	NA	**4.48**	**944 JL**	NA
2013-SDA-C04	2013-SDA-C04 (6-12)	2013-12-20	NA	NA	NA	**328**	NA
2013-SDA-C05	2013-SDA-C05 (0-6)	2013-12-20	NA	NA	**3.63**	**517 J**	NA
2013-SDA-C05	2013-SDA-C05 (6-12)	2013-12-20	NA	NA	NA	**302**	NA
2013-SDA-C06	2013-SDA-C06 (0-6)	2013-12-20	NA	NA	**1.47**	**348 J**	NA
2013-SDA-C06	2013-SDA-C06 (6-12)	2013-12-20	NA	NA	NA	**1580**	NA
2013-SL-C01	2013-SL-01 (0-6)	2013-12-18	NA	NA	**0.139 J**	**32.2**	NA
2013-SL-C01	2013-SL-01 (6-12)	2013-12-18	NA	NA	< 0.0324 U	**21.1**	NA
2013-SL-C02	2013-SL-02 (0-6)	2013-12-18	NA	NA	**3.32**	**395**	NA
2013-SL-C02	2013-SL-02 (6-12)	2013-12-18	NA	NA	**2.13**	**272**	NA
2013-SL-C03	2013-SL-03 (0-6)	2013-12-18	NA	NA	**2.95**	**6950 J**	NA
2013-SL-C03	2013-SL-03 (6-12)	2013-12-18	NA	NA	**0.880**	**2060 J**	NA
2013-SL-C04	2013-SL-CO4 (0-6)	2013-12-18	NA	NA	**1.67**	**245 J**	NA
2013-SL-C04	2013-SL-CO4 (6-12)	2013-12-18	NA	NA	**0.810**	**113 J**	NA
2013-SL-C05	2013-SL-C05 (0-6)	2013-12-18	NA	NA	**1.86**	**273 J**	NA
2013-SL-C05	2013-SL-CO5 (6-12)	2013-12-18	NA	NA	**1.16**	**141 J**	NA
2013-SL-C06	2013-SL-CO6 (0-6)	2013-12-18	NA	NA	**1.66**	**297 J**	NA
2013-SL-C06	2013-SL-CO6 (6-12)	2013-12-18	NA	NA	**1.25**	**174 J**	NA
2013-SL-C07	2013-SL-07 (0-6)	2013-12-18	NA	NA	**1.73**	**289**	NA
2013-SL-C07	2013-SL-07 (6-12)	2013-12-18	NA	NA	**1.94**	**380**	NA
2013-SL-C08	2013-SL-08 (0-6)	2013-12-18	NA	NA	**1.23**	**242**	NA
2013-SL-C08	2013-SL-08 (6-12)	2013-12-18	NA	NA	**0.630**	**75.6 J**	NA
2013-SL-C09	2013-SL-CO9 (0-6)	2013-12-18	NA	NA	**0.657**	**84 J**	NA
2013-SL-C09	2013-SL-CO9 (6-12)	2013-12-18	NA	NA	**0.296**	**14.2 J**	NA
2013-SL-C10	2013-SL-C10 (0-6)	2013-12-18	NA	NA	**2.62**	**528 J**	NA
2013-SL-C10	2013-SL-C10 (6-12)	2013-12-18	NA	NA	**0.450**	**57.6 J**	NA
2013-SL-C11	2013-SL-C11 (0-6)	2013-12-18	NA	NA	**2.01**	**470 J**	NA
2013-SL-C11	2013-SL-C11 (6-12)	2013-12-18	NA	NA	**1.37 J**	**243 J**	NA
2013-SL-C11	DUP-1	2013-12-18	NA	NA	**0.649 J**	**78.9 J**	NA
2013-SL-C12	2013-SL-C12 (0-6)	2013-12-19	NA	NA	**1.71**	**406**	NA
2013-SL-C12	2013-SL-C12 (6-12)	2013-12-19	NA	NA	NA	**240**	NA
2013-SL-C13	2013-SL-C13 (0-6)	2013-12-19	NA	NA	**3.76**	**869**	NA
2013-SL-C13	2013-SL-C13 (6-12)	2013-12-19	NA	NA	NA	**315**	NA
2013-SL-C14	2013-SL-C14 (0-6)	2013-12-19	NA	NA	**9.11**	**2690**	NA
2013-SL-C14	2013-SL-C14 (6-12)	2013-12-19	NA	NA	NA	**407**	NA
2013-SL-C15	2013-SL-C15 (0-6)	2013-12-19	< 2.075 U *	**12.1**	**2.10**	**476**	**0.767 J**
2013-SL-C15	2013-SL-C15 (6-12)	2013-12-19	NA	NA	NA	**63.6**	NA
2013-SL-C16	2013-SL-C16 (0-6)	2013-12-19	NA	NA	**2.13**	**444**	NA
2013-SL-C16	2013-SL-C16 (6-12)	2013-12-19	NA	NA	NA	**39.3**	NA

NOTES

Detected analytes are bolded.

Analyte exceeds applicable Protective Concentration Level (PCL).

< - Indicates analyte not detected above method detection limit (MDL).

NA - Not analyzed.

mg/kg - Milligrams per kilogram.

-- Indicates PCL not available.

PCL - Protective Concentration Level.

1. The Residential Assessment Level (RAL) is the lower of the TRRP residential Tier 1 TotSoilComb (applicable to surface soil only) and Tier 2 GWSoilIng PCLs for a 30-acre source area (TCEQ, 2012c). The AirSoilInh-V pathway is not applicable to metals and was therefore not used for RALs.

2. The critical PCL is typically the lower of the TRRP commercial-industrial Tier 1 TotSoilComb (applicable to surface soil only and Tier 2 GWSoilIng PCLs for a 30-acre source area (TCEQ, 2012c). The AirSoilInh-V pathway is not applicable to metals and was therefore not used for critical PCLs. Additional Synthetic Precipitation Leachate Procedure (SPLP) data may allow use of the Tier 1 TotSoilComb PCLs as the critical PCLs for surface soil. Those potential critical PCLs are highlighted above.

3. The arsenic RAL/critical PCL is based on site specific background study.

4. The selenium RAL/critical PCL is based on the Tier 2 PCL calculation.

5. Surface Soil = 0-15 feet bgs for residential land use and 0-5 feet bgs for commercial-industrial land use; subsurface soil = greater than 15 feet bgs for residential land use and greater than 5 feet bgs for commercial-industrial land use.

J Estimated data; The analyte was detected and identified. The associated numerical value (i.e., the reported sample concentration) is the approximate concentration of the analyte in the sample.)

U Not detected.

UJ Estimated data; The analyte was not detected above the reported sample detection limit (SDL). The numerical value of the SDL is estimated and may be inaccurate.

H Bias in sample result is likely to be high

L Bias in sample result is likely to be low

* Analyte is non-detect due to method blank detection

Created By: BEF 2-14-2014
Checked By: JSI 2-14-2014
Reviewed by: CMH 3-31-14

Former Operating Plant
Frisco Recycling Center
Frisco, Texas

Table 4D.3A

Soil Data Summary -
Total Petroleum Hydrocarbons - TX1005
(2012/2013)

Sample ID	Sample Date	Sample Depth (feet bgs)	TPH: C6-C12 (mg/kg)	TPH: >C12-C28 (mg/kg)	TPH: >C28-C35 (mg/kg)	TPH: C6-C35 (mg/kg)
Default Residential Assessment Level[1]:			65	200	200	NA
TPH Mixture Residential Assessment Level[2]:			NA	NA	NA	12500
FORMER PROCESS AREA						
Raw Material Storage Area						
2012-RMSA-1(1.5-2.5')	01/06/12	1.5-2.5	<4.94	<6.41	<10.1	<10.1
2012-RMSA-2 (0.5-2.5')	01/05/12	0.5-2.5	<6.59	<8.55	<13.5	<13.5
2012-RMSA-3(1-3')	01/05/12	1-3	<5.9	<7.66	<12.1	<12.1
2012-RMSA-4(1.5-3.5')	01/06/12	1.5-3.5	<6.29	<8.16	<12.9	<12.9
2013-RMSA-6 (2.6-3.3')	03/07/13	2.6-3.3	<5.39	<5.75	<5.75	<10.6
Flood Wall Facility Side						
2012-FWFS-1 (Floor)	10/22/12	4.0	<4.02 UJ	<4.30 UJ	<4.30 UJ	<7.92 UJ
2012-FWFS-1 (Wall)	10/22/12	2.0	<4.97 UJ	<5.31 UJ	<5.31 UJ	<9.79 UJ
2012-FWFS-2 (Floor)	10/22/12	4.0	<5.06 UJ	<5.40 UJ	<5.40 UJ	<9.95 UJ
2012-FWFS-2 (Wall)	10/22/12	2.4	<4.75 UJ	<5.07 UJ	<5.07 UJ	<9.35 UJ
2012-FWFS-3 (Floor)	10/22/12	3.0	<5.06 UJ	<5.40 UJ	<5.40 UJ	<9.95 UJ
2012-FWFS-3 (Wall)	10/22/12	1.9	<4.84 UJ	<5.17 UJ	<5.17 UJ	<9.53 UJ
2012-FWFS-4 (Floor)	09/24/12	3.1	<4.99	<5.33	<5.33	<9.82
2012-FWFS-4 (Wall)	09/24/12	1.6	<4.67	<4.99	<4.99	<9.2
2012-FWFS-5 (Floor)	09/24/12	3.3	<5.09	<5.44	<5.44	<10.0
2012-FWFS-5 (Wall)	09/24/12	1.7	<4.85	<5.18	<5.18	<9.54
2012-FWFS-6 (Floor)	09/04/12	2.1	<4.95	<5.29	<5.29	<9.74
2012-FWFS-6 (Wall)	09/04/12	1.1	<4.84	<5.17	<5.17	<9.53
2012-FWFS-7 (Floor)	09/04/12	2.3	<4.93	<5.27	<5.27	<9.71
2012-FWFS-7 (Wall)	09/04/12	1.2	<4.66	<4.98	<4.98	<9.18
2012-FWFS-8 (Floor)	09/04/12	2.2	<4.99	<5.33	<5.33	<9.82
2012-FWFS-8 (Wall)	09/04/12	1.1	<4.79	<5.12	<5.12	<9.43
2012-FWFS-9 (Floor)	09/04/12	2.4	<3.93	<4.20	<4.20	<7.74
2012-FWFS-9 (Wall)	09/04/12	1.8	<5.20	<5.56	<5.56	<10.2
2012-FWFS-9 (4-5')[2]	04/29/13	4-5	**532 JH**	**4730 JH**	**228 JH**	**5490 JH**
Slag Treatment Building						
2013-STB-2 (4-5')	03/07/13	4-5	<5.18	<5.53	<5.53	<10.2
2013-STB-6 (0.5-1.1')	03/14/13	0.5-1.1	**71.4**	**550**	**1130**	**1750**
2013-STB-11 (0.5-1.3')	03/14/13	0.5-1.3	**55.5**	**416**	**1380**	**1850**

Soil Data Summary -
Total Petroleum Hydrocarbons - TX1005
(2012/2013)

Sample ID	Sample Date	Sample Depth (feet bgs)	TPH: C6-C12 (mg/kg)	TPH: >C12-C28 (mg/kg)	TPH: >C28-C35 (mg/kg)	TPH: C6-C35 (mg/kg)
Default Residential Assessment Level[1]:			65	200	200	NA
TPH Mixture Residential Assessment Level[2]:			NA	NA	NA	12500
STEWART CREEK CORRIDOR						
2012-FWCS-1 (0-2')	01/18/12	0-2	<5.99	<7.78	<12.3	<12.3
2012-FWCS-2 (0-2')	01/19/12	0-2	<5.85	**30.5J**	<12	**30.5 J**
2012-FWCS-3 (0-2')	01/19/12	0-2	<6.05	<7.85	<12.4	<12.4
2012-FWCS-4 (0-2')	01/19/12	0-2	<6.58	<8.54	<13.5	<13.5
2012-FWCS-5 (0-2')	01/19/12	0-2	<6.12	<7.95	<12.6	<12.6
2012-FWCS-6 (0-2')	01/19/12	0-2	<6.33	<8.21	<13	<13
2012-FWCS-7 (0-2')	01/19/12	0-2	<6.66	<8.64	<13.7	<13.7
2012-FWCS-8 (0-2')	01/18/12	0-2	<6.22	<8.08	<12.8	<12.8
2012-FWCS-9 (0-2')	01/18/12	0-2	<6.73	<8.74	<13.8	<13.8
MW-27 (0-1')	03/05/13	0-1	<4.84	<5.17	<5.17	<9.53

Notes:

Detected analytes are bolded.

Analytes that exceed RAL are in yellow;however no exceedences of the RAL developed for the TPH Mixture were observed.

1. [1] - Default Residential Assessment Levels (RALs) are the lower of the TRRP residential Tier 1 $^{Tot}Soil_{Comb}$ and $^{GW}Soil_{Ing}$ PCLs for a 0.5-acre source (TCEQ, 2012c).
2. [2] - Default RALs were used as the applicable assessment levels for all soil samples analyzed for TPH except for sample 2012-FWFS-9 (4-5'), 2013-STB-6 (0.5-1.1'), and 2013-STB-11 (0.5-1.3') which were the only samples that exceeded a default RAL. A TPH Mixture RAL was developed with TPH TX1006 data from sample 2012-FWFS-9 (4-5') (see Appendix 9).
3. Results exceeding applicable RALs are bolded (no exceedances were observed).
4. Data Qualifiers: UJ - estimated result, not detected; JH - estimated result, biased high.
5. NA - Not applicable.

Table 4D.3B
Soil Data Summary -
Total Petroleum Hydrocarbons - TX1005
(2014)

		Analyte	TPH as C6-C12	TPH as >C12-C28	TPH as >C28-C35	TPH as C6-C35
		Soil RAL (1)	65	200	200	--
		TPH Mixture RAL (2)	--	--	--	12500
		Units	mg/kg	mg/kg	mg/kg	mg/kg
Location ID	**Sample ID**	**Date Sampled**				
2013-FFTA-01	2013-FFTA-01 (0.25-2)	2014-01-08	< 4.83 U	< 5.16 U	< 5.16 U	< 9.51 U
2013-FFTA-02	2013-FFTA-02 (0.25-2)	2014-01-07	< 4.41 U	**21.9**	**132**	**154**
2013-FFTA-03	2013-FFTA-03 (0-2)	2014-01-07	< 4.93 U	< 5.26 U	< 5.26 U	< 9.70 U
2013-FFTA-03	2013-FFTA-03 (14-16)	2014-01-07	< 4.85 U	< 5.19 U	< 5.19 U	< 9.55 U
2013-FFTA-03	2013-FFTA-03 (18-19)	2014-01-08	< 4.04 U	< 4.32 U	< 4.32 U	< 7.96 U
2013-MB-5	2013-MB-5 (0.5-5)	2014-01-08	< 4.95 U	< 5.28 U	< 5.28 U	< 9.74 U
2013-MB-5	2013-MB-5 (10-12)	2014-01-08	**299**	**2,410**	**334**	**3,050**
MW-27A	MW-27A (0-2)	2014-01-09	< 4.85 U	< 5.18 U	< 5.18 U	< 9.54 U
MW-27B	MW-27B (0-2)	2014-01-09	< 4.87 U	< 5.20 U	< 5.20 U	< 9.59 U
MW-27C	MW-27C (0-2)	2014-01-08	< 4.87 U	< 5.20 U	< 5.20 U	< 9.58 U
MW-27D	MW-27D (0.5-2)	2014-01-08	< 4.87 U	< 5.20 U	< 5.20 U	< 9.59 U
MW-43	MW-43 (0-2)	2014-01-07	< 4.46 U	< 4.76 U	< 4.76 U	< 8.78 U
MW-43	MW-43 (17-20)	2014-01-07	< 4.28 U	< 4.58 U	< 4.58 U	< 8.43 U
MW-43	MW-43 (8-10)	2014-01-07	< 4.50 U	< 4.81 U	< 4.81 U	< 8.86 U

NOTES

Detected analytes are bolded.

Analytes that exceed RAL are in yellow.

(no exceedences of site specific RAL for the TPH mixture).

< - Analyte not detected above sample detection limit (SDL).

mg/kg - Milligrams per kilogram.

-- Indicates PCL not available.

TPH - Total Petroleum Hydrocarbons

(1) - Default RALs are the lower of the TRRP residential Tier 1 $^{Tot}Soil_{Comb}$ and $^{GW}Soil_{Ing}$ PCLs for a 0.5-acre source (TCEQ, 2012c).

(2) - Soil sample 2012-FWFS-9 (4-5') was further analyzed for TPH by TX1006 (see Table 4D.4).

The TPH Mixture RAL calculation is provided in APAR Appendix 9. Sample 2013-MB-5 (10-12), since in close proximity to 2012-FWFS-9 (4-5), is being comapred to the TPH Mixture RAL. All other samples are being compared to the default RALs.

Created By: JT 02-19-2014
Checked by: JS 02-20-2014
Reviewed by: CH 4-27-2014

Table 4D.4
Soil Data Summary -
Total Petroleum Hydrocarbson (TX1006)

		Sample ID:	**2012-FWFS-9 (4-5)**	**2013-STB-11(0.5-1.3)**
		Sample Date:	04/29/13	03/14/13
		Sample Depth (feet):	4-5	0.5-1.3
	Default	**TPH Mixture**	(mg/kg)	(mg/kg)
TPH TX1006 Fraction	**RAL[1]**	**RAL[2]**		
nC6 Aliphatics	1.71E+02	--	<5.58 X7	<1.77 X7
<C6-C8 Aliphatics	4.21E+02	--	<5.30 X7	<1.68 X7
>C8-C10 Aliphatics	3.59E+03	--	**67 X7, J**	**15.1 X7, J**
>C10-C12 Aliphatics	2.53E+04	--	**856 X7, JH**	**19.3 X7, J**
>C12-C16 Aliphatics	4.93E+05	--	**999 X7, JH**	**8.83 X7, J**
>C16-C21 Aliphatics	1.33E+05	--	**1110 X7, JH**	**22.9 X7**
>C21-C35 Aliphatics	1.07E+05	--	**126 X7, JH**	**168 X7**
>C7-C8 Aromatics	2.01E+01	--	**12.8 X7, J**	**11.7 X7, J**
>C8-C10 Aromatics	6.50E+01	--	<14.4 X7	**6.17 X7, J**
>C10-C12 Aromatics	1.00E+02	--	**62.9 X7, J**	**4.81 X7, J**
>C12-C16 Aromatics	2.00E+02	--	**684 X7, JH**	**13.3 X7, J**
>C16-C21 Aromatics	4.70E+02	--	**737 X7, JH**	**31.4 X7**
>C21-C35 Aromatics	3.70E+03	--	**157 X7, JH**	**383 X7**
>C6-C35	--	1.25E+04	**4810 X7, JH**	**684 X7**

Notes:

Results that exceed applicable RALs are in yellow (no exceedances detected of the RAL for the mixture).

1. [1] - Default Residential Assessment Levels (RALs) are the lower of the TRRP Tier 1 residential $^{Tot}Soil_{Comb}$ and $^{GW}Soil_{Ing}$ PCLs for a 0.5-acre source area (TCEQ, 2012c).
2. [2] - Default RALs were used as the applicable assessment levels for all soil samples analyzed for TPH except for sample 2012-FWFS-9 (4-5'), 2013-STB-6 (0.5-1.1'), and 2013-STB-11 (0.5-1.3') which were the only samples that exceeded a default RAL. (see TX1005 analysis of this sample; see Table 4D.3). Of these, the two highest were further analyzed by TX Method 1006 to fractionate the TPH mixture into aliphatic and aromatic boiling point ranges, and develop a site-specific PCL for the site using the TCEQ-provided TPH PCL Calculator.
3. Data Qualifiers: J - estimated result; JH - estimated result, biased high; X7 - TCEQ does not offer lab accreditation for this analyte.

Table 4D.5A

Soil Data Summary - Volatile Organic Compounds and Semivolatile Organic Compounds
(2012/2013)

		Sample ID:	2012-FWFS-9 (4-5')	2013-MB-1 (0-2')	2013-MB-1 (4-5')	2013-MB-2 (0-2')	MW-27 (0-1')
		Sample Date:	4/29/2013	03/14/13	03/14/13	03/14/13	03/05/13
		Sample Depth (feet bgs):	4-5	0-2	4-5	0-2	0-1
	RAL[1]	Critical PCL[2]	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)
Volatile Organic Compounds (SW8260B)							
1,1,1-Trichloroethane	2	2	<0.01010	<0.000844	<0.000967	<0.000944	--
1,1,2,2-Tetrachloroethane	0.02	0.05	<0.01180	<0.000992	<0.00114	<0.00111	--
1,1,2-Trichloroethane	0.02	0.02	<0.00993	<0.000833	<0.000954	<0.000931	--
1,1-Dichloroethane	18	55	<0.01180	<0.000992	<0.00114	<0.00111	--
1,1-Dichloroethene	0.05	0.05	<0.01660	<0.00139	<0.00159	<0.00156	--
1,2-Dichloroethane	0.014	0.014	<0.01220	<0.00103	<0.00118	<0.00115	--
1,2-Dichloroethene, Total	N/A	N/A	<0.02580	<0.00217	<0.00248	<0.00242	--
1,2-Dichloropropane	0.02	0.02	<0.00965	<0.00081	<0.000927	<0.000905	--
2-Butanone (MEK)	29	87	<0.0258 UJ	<0.00217 UJ	<0.0367 UJ	<0.00242 UJ	--
2-Hexanone	0.3	1.0	<0.01370	<0.00115	<0.00132	<0.00129	--
4-Methyl-2-pentanone (MIBK)	5	15	<0.02000	<0.00168	<0.00192	<0.00187	--
Acetone	43	128	0.04830J	0.172	0.347	0.241	--
Benzene	0.026	0.026	<0.00857	<0.000719	<0.000823	0.00711	--
Bromodichloromethane	0.07	0.15	<0.00897	<0.000753	<0.000862	<0.000842	--
Bromoform	0.6	1.4	<0.01860	<0.00156	<0.00179	<0.00175	--
Bromomethane	0.13	0.39	<0.0113 X8	<0.000947 X8	<0.00108 X8	<0.00106 X8	--
Carbon disulfide	14	41	<0.00748	<0.000627	<0.000718	<0.000701	--
Carbon tetrachloride	0.06	0.06	<0.01540	<0.00129	<0.00148	<0.00144	--
Chlorobenzene	1.1	1.1	<0.01310	<0.0011	<0.00125	<0.00122	--
Chlorobromomethane	3	9	<0.02420	<0.00203	<0.00233	<0.00227	--
Chloroethane	31	92	<0.01900	<0.0016	<0.00183	<0.00179	--
Chloroform	1.02	3.04	0.0122 U	0.00134J	0.0013J	0.00139J	--
Chloromethane	0.4	0.9	<0.02260	<0.00189	<0.00217	<0.00212	--
cis-1,2-Dichloroethene	0.2	0.2	<0.01130	<0.000947	<0.00108	<0.00106	--
cis-1,3-Dichloropropene	0.007	0.015	<0.00734	<0.000616	<0.000705	<0.000689	--
Dibromochloromethane	0.05	0.11	<0.01280	<0.00107	<0.00123	<0.0012	--
Ethylbenzene	8	8	<0.01390	<0.00116	0.00145J	<0.0013	--
Methyl tert-butyl ether	1	2	<0.02490	--	--	--	--
Methylene Chloride	0.013	0.013	0.14 U	<0.0025	<0.00286	<0.00279	--
m-xylene & p-xylene	105	105	<0.02070	<0.00173	0.0068J	<0.00194	--
o-Xylene	71	71	<0.01540	<0.00129	0.00422J	<0.00144	--
Styrene	3	3	<0.00965	<0.00081	<0.000927	<0.000905	--
Tetrachloroethene	0.05	0.05	<0.00965	<0.00081	<0.000927	<0.000905	--
Toluene	8	8	<0.01880	0.00436J	0.00752	0.00857	--

Table 4D.5A

Soil Data Summary - Volatile Organic Compounds and Semivolatile Organic Compounds
(2012/2013)

		Sample ID:	2013-STB-2 (4-5')	2013-STB-6 (0.5-1.1')	2013-STB-11 (0.5-1.3')	SCC-3 (0-0.5')	SCC-6 (0-0.5')
		Sample Date:	03/07/13	03/14/13	03/14/13	1/15/2013	1/15/2013
		Sample Depth (feet bgs):	4-5	0.5-1.1*	0.5-1.3*	0-0.5	0-0.5
	RAL[1]	Critical PCL[2]	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)
Volatile Organic Compounds (SW8260B)							
1,1,1-Trichloroethane	2	2	<0.00101	<0.000813	<0.000819	--	--
1,1,2,2-Tetrachloroethane	0.02	0.05	<0.00119	<0.000956	<0.000963	--	--
1,1,2-Trichloroethane	0.02	0.02	<0.000998	<0.000802	<0.000808	--	--
1,1-Dichloroethane	18	55	<0.00119	<0.000956	<0.000963	--	--
1,1-Dichloroethene	0.05	0.05	<0.00167	<0.00134	<0.00135	--	--
1,2-Dichloroethane	0.014	0.014	<0.00123	<0.000989	<0.000997	--	--
1,2-Dichloroethene, Total	N/A	N/A	<0.0026	<0.00209	<0.0021	--	--
1,2-Dichloropropane	0.02	0.02	<0.000971	<0.00078	<0.000786	--	--
2-Butanone (MEK)	29	87	<0.0266 UJ	<0.00209 UJ	<0.0021 UJ	--	--
2-Hexanone	0.3	1.0	<0.00138	<0.00111	<0.00112	--	--
4-Methyl-2-pentanone (MIBK)	5	15	<0.00201	<0.00161	<0.00163	--	--
Acetone	43	128	0.1260	0.137	0.0361	--	--
Benzene	0.026	0.026	<0.000862	0.0406	0.0044J	--	--
Bromodichloromethane	0.07	0.15	<0.000903	<0.000725	<0.000731	--	--
Bromoform	0.6	1.4	<0.00187	<0.0015	<0.00152	--	--
Bromomethane	0.13	0.39	<0.00114 X8	<0.000912 X8	<0.000919 X8	--	--
Carbon disulfide	14	41	<0.000752	<0.000604	<0.000609	--	--
Carbon tetrachloride	0.06	0.06	<0.00155	<0.00124	<0.00125	--	--
Chlorobenzene	1.1	1.1	<0.00131	<0.00105	<0.00106	--	--
Chlorobromomethane	3	9	<0.00243	<0.00196	<0.00197	--	--
Chloroethane	31	92	<0.00191	<0.00154	<0.00155	--	--
Chloroform	1.02	3.04	<0.000903	0.00128J	0.00109J	--	--
Chloromethane	0.4	0.9	<0.00227	<0.00182	<0.00184	--	--
cis-1,2-Dichloroethene	0.2	0.2	<0.00114	<0.000912	<0.000919	--	--
cis-1,3-Dichloropropene	0.007	0.015	<0.000738	<0.000593	<0.000598	--	--
Dibromochloromethane	0.05	0.11	<0.00129	<0.00103	<0.00104	--	--
Ethylbenzene	8	8	<0.00139	0.0765	0.0322	--	--
Methyl tert-butyl ether	1	2	--	--	--	--	--
Methylene Chloride	0.013	0.013	<0.00299	<0.00241	<0.00242	--	--
m-xylene & p-xylene	105	105	<0.00208	0.0171	<0.00168	--	--
o-Xylene	71	71	<0.0015	0.0148	0.00454J	--	--
Styrene	3	3	<0.000971	<0.00078	<0.000786	--	--
Tetrachloroethene	0.05	0.05	<0.000971	<0.00078	<0.000786	--	--
Toluene	8	8	<0.00189	0.0116	0.00555	--	--

Table 4D.5A

Soil Data Summary - Volatile Organic Compounds and Semivolatile Organic Compounds
(2012/2013)

		Sample ID:	SCC-8 (0-0.5')	2013-RMSA-6 (2.6-3.3')	2013-RMSB-2 (2.5-5')	2013-RMSB-2 (5-6')	2013-RMSB-4 (0-2')
		Sample Date:	1/15/2013	03/07/13	5/8/2013	5/8/2013	5/7/2013
		Sample Depth (feet bgs):	0-0.5	2.6-3.3	2.5-5*	5-6	0-2
	RAL[1]	Critical PCL[2]	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)
Volatile Organic Compounds (SW8260B)							
1,1,1-Trichloroethane	2	2	--	<0.00105	<0.000989	<0.00518	<0.00092
1,1,2,2-Tetrachloroethane	0.02	0.05	--	<0.00123	<0.00116	<0.00609	<0.00108 UJL
1,1,2-Trichloroethane	0.02	0.02	--	<0.00104	<0.000976	<0.00511	<0.00090
1,1-Dichloroethane	18	55	--	<0.00123	<0.00116	<0.00609	<0.00108
1,1-Dichloroethene	0.05	0.05	--	<0.00173	<0.00163	<0.00854	<0.00151
1,2-Dichloroethane	0.014	0.014	--	<0.00128	<0.00120	<0.00630	<0.00111
1,2-Dichloroethene, Total	N/A	N/A	--	<0.0027	<0.00254	<0.01330	<0.00235
1,2-Dichloropropane	0.02	0.02	--	<0.00101	<0.000949	<0.00497	<0.00088
2-Butanone (MEK)	29	87	--	<0.0027 UJ	<0.0157 UJ	<0.0133 UJ	<0.00235 UJL
2-Hexanone	0.3	1.0	--	<0.00143	<0.00135	<0.00707	<0.00125 UJL
4-Methyl-2-pentanone (MIBK)	5	15	--	<0.00209	<0.00196	<0.01030	<0.00182 UJL
Acetone	43	128	--	<0.00236	0.133	<0.01160	<0.00205 UJL
Benzene	0.026	0.026	--	0.00151J	<0.000842	<0.00441	<0.00078
Bromodichloromethane	0.07	0.15	--	<0.000936	<0.000882	<0.00462	<0.00082
Bromoform	0.6	1.4	--	<0.00194	<0.00183	<0.00960	<0.00169
Bromomethane	0.13	0.39	--	<0.00118 X8	<0.00111 X8	<0.00581 X8	<0.00103 X8
Carbon disulfide	14	41	--	<0.00078	<0.000735	<0.00385	<0.00068 UJL
Carbon tetrachloride	0.06	0.06	--	<0.0016	<0.00151	<0.00791	<0.00140
Chlorobenzene	1.1	1.1	--	<0.00136	<0.00128	<0.00672	<0.00119
Chlorobromomethane	3	9	--	<0.00253	<0.00238	<0.01250	<0.00220
Chloroethane	31	92	--	<0.00199	<0.00187	<0.00981	<0.00173
Chloroform	1.02	3.04	--	<0.000936	0.00114 U	0.00617 U	0.00138 U
Chloromethane	0.4	0.9	--	<0.00236	<0.00222	<0.01160	<0.00205
cis-1,2-Dichloroethene	0.2	0.2	--	<0.00118	<0.00111	<0.00581	<0.00103
cis-1,3-Dichloropropene	0.007	0.015	--	<0.000766	<0.000722	<0.00378	<0.00067
Dibromochloromethane	0.05	0.11	--	<0.00133	<0.00126	<0.00658	<0.00116
Ethylbenzene	8	8	--	<0.00145	<0.00136	<0.00714	<0.00126
Methyl tert-butyl ether	1	2	--	--	<0.00245	<0.01280	< 0.0023 UJL
Methylene Chloride	0.013	0.013	--	<0.00311	0.00539 J	0.0186 J	<0.00271
m-xylene & p-xylene	105	105	--	<0.00216	<0.00203	<0.01060	<0.00188
o-Xylene	71	71	--	<0.0016	<0.00151	<0.00791	<0.00140
Styrene	3	3	--	<0.00101	<0.000949	<0.00497	<0.00088
Tetrachloroethene	0.05	0.05	--	<0.00101	<0.000949	<0.00497	<0.00088
Toluene	8	8	--	<0.00196	<0.00184	<0.00967	<0.00171

Table 4D.5A

Soil Data Summary - Volatile Organic Compounds and Semivolatile Organic Compounds
(2012/2013)

		Sample ID:	2013-RMSB-4 (2-5')	2013-RMSB-4 (5-6')	2013-RMSB-5 (2-5')	2013-RMSB-10 (1.3-2')	2013-RMSB-10 (2-3')
		Sample Date:	5/7/2013	5/7/2013	5/7/2013	5/8/2013	5/8/2013
		Sample Depth (feet bgs):	2-5	5-6	2-5	1.3-2*	2-3
	RAL[1]	Critical PCL[2]	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)
Volatile Organic Compounds (SW8260B)							
1,1,1-Trichloroethane	2	2	<0.00088	<0.00097	<0.00094	<0.000906	<0.000915
1,1,2,2-Tetrachloroethane	0.02	0.05	<0.00103 UJL	<0.00114 UJL	<0.00111	<0.00107	<0.00108
1,1,2-Trichloroethane	0.02	0.02	<0.00086	<0.00095	<0.000928	<0.000894	<0.000903
1,1-Dichloroethane	18	55	<0.00103	<0.00114	<0.00111	<0.00107	<0.00108
1,1-Dichloroethene	0.05	0.05	<0.00144	<0.00159	<0.00155	<0.00149	<0.00151
1,2-Dichloroethane	0.014	0.014	<0.00107	<0.00118	<0.00114	<0.0011	<0.00111
1,2-Dichloroethene, Total	N/A	N/A	<0.00225	<0.00248	<0.00241	<0.00233	<0.00235
1,2-Dichloropropane	0.02	0.02	<0.00084	<0.00093	<0.000902	<0.00087	<0.000878
2-Butanone (MEK)	29	87	<0.00225 UJL	<0.0175 J	<0.028	<0.00233	<0.00235
2-Hexanone	0.3	1.0	<0.00120 UJL	<0.00132 UJL	<0.00128	<0.00124	<0.00125
4-Methyl-2-pentanone (MIBK)	5	15	<0.00174 UJL	<0.00192 UJL	0.00202 J	<0.0018	<0.00182
Acetone	43	128	<0.00196 UJL	0.114 J	0.23	0.0346	<0.00205
Benzene	0.026	0.026	<0.00075	<0.00082	<0.000801	<0.000772	<0.000779
Bromodichloromethane	0.07	0.15	<0.00078	<0.00086	<0.000839	<0.000808	<0.000816
Bromoform	0.6	1.4	<0.00162	<0.00179	<0.00174	<0.00168	<0.00169
Bromomethane	0.13	0.39	<0.000982 X8	<0.00108 X8	<0.00105 X8	<0.00102 X8	<0.00103 X8
Carbon disulfide	14	41	<0.000651 UJL	<0.000718 UJL	0.00418	<0.000674	<0.00068
Carbon tetrachloride	0.06	0.06	<0.00134	<0.00148	<0.00144	<0.00138	<0.0014
Chlorobenzene	1.1	1.1	<0.00114	<0.00125	<0.00122	<0.00118	<0.00119
Chlorobromomethane	3	9	<0.00211	<0.00233	<0.00226	<0.00218	<0.0022
Chloroethane	31	92	<0.00166	<0.00183	<0.00178	<0.00171	<0.00173
Chloroform	1.02	3.04	0.00131 U	0.00154 U	0.00109 U	0.00127 U	0.000861 U
Chloromethane	0.4	0.9	<0.00196	<0.00217	<0.00211	<0.00203	<0.00205
cis-1,2-Dichloroethene	0.2	0.2	<0.00098	<0.00108	<0.00105	<0.00102	<0.00103
cis-1,3-Dichloropropene	0.007	0.015	<0.00064	<0.00071	<0.000686	<0.000661	<0.000668
Dibromochloromethane	0.05	0.11	<0.00111	<0.00123	<0.00119	<0.00115	<0.00116
Ethylbenzene	8	8	<0.00121	<0.00133	<0.0013	<0.00125	<0.00126
Methyl tert-butyl ether	1	2	< 0.0022 UJL	< 0.0024 UJL	0.00233	<0.00224	<0.00226
Methylene Chloride	0.013	0.013	0.00434J	0.00504J	<0.00278	<0.00268	<0.00271
m-xylene & p-xylene	105	105	<0.00180	<0.00199	<0.00193	<0.00186	<0.00188
o-Xylene	71	71	<0.00134	<0.00148	<0.00144	<0.00138	<0.0014
Styrene	3	3	<0.00084	<0.00093	<0.000902	<0.00087	<0.000878
Tetrachloroethene	0.05	0.05	<0.00084	<0.00093	<0.000902	<0.00087	<0.000878
Toluene	8	8	<0.00163	<0.00180	<0.00175	<0.00169	<0.00171

Table 4D.5A

Soil Data Summary - Volatile Organic Compounds and Semivolatile Organic Compounds
(2012/2013)

		Sample ID:	2013-RMSB-10 (5-6')	2013-RMSB-10 (7')
		Sample Date:	5/8/2013	5/8/2013
		Sample Depth (feet bgs):	5-6	7
	RAL[1]	Critical PCL[2]	(mg/kg)	(mg/kg)
Volatile Organic Compounds (SW8260B)				
1,1,1-Trichloroethane	2	2	<0.000904	<0.000995
1,1,2,2-Tetrachloroethane	0.02	0.05	<0.00106	<0.00117
1,1,2-Trichloroethane	0.02	0.02	<0.000892	<0.000982
1,1-Dichloroethane	18	55	<0.00106	<0.00117
1,1-Dichloroethene	0.05	0.05	<0.00149	<0.00164
1,2-Dichloroethane	0.014	0.014	<0.0011	<0.00121
1,2-Dichloroethene, Total	N/A	N/A	<0.00232	<0.00256
1,2-Dichloropropane	0.02	0.02	<0.000867	<0.000955
2-Butanone (MEK)	29	87	<0.023 UJ	<0.0535 UJ
2-Hexanone	0.3	1.0	<0.00123	<0.00136
4-Methyl-2-pentanone (MIBK)	5	15	<0.0018	<0.00198
Acetone	43	128	0.181	0.358
Benzene	0.026	0.026	<0.00077	<0.000847
Bromodichloromethane	0.07	0.15	<0.000806	<0.000888
Bromoform	0.6	1.4	<0.00167	<0.00184
Bromomethane	0.13	0.39	<0.00101 X8	<0.00112 X8
Carbon disulfide	14	41	<0.000672	0.00399 J
Carbon tetrachloride	0.06	0.06	<0.00138	<0.00152
Chlorobenzene	1.1	1.1	<0.00117	<0.00129
Chlorobromomethane	3	9	<0.00217	<0.00239
Chloroethane	31	92	<0.00171	<0.00188
Chloroform	1.02	3.04	0.00115 U	<0.000888
Chloromethane	0.4	0.9	<0.00203	<0.00223
cis-1,2-Dichloroethene	0.2	0.2	<0.00101	<0.00112
cis-1,3-Dichloropropene	0.007	0.015	<0.00066	<0.000726
Dibromochloromethane	0.05	0.11	<0.00115	<0.00126
Ethylbenzene	8	8	<0.00125	<0.00137
Methyl tert-butyl ether	1	2	0.00316 J	<0.00246
Methylene Chloride	0.013	0.013	<0.00268	<0.00295
m-xylene & p-xylene	105	105	<0.00186	<0.00204
o-Xylene	71	71	<0.00138	<0.00152
Styrene	3	3	<0.000867	<0.000955
Tetrachloroethene	0.05	0.05	<0.000867	<0.000955
Toluene	8	8	<0.00169	<0.00186

Table 4D.5A

Soil Data Summary - Volatile Organic Compounds and Semivolatile Organic Compounds
(2012/2013)

		Sample ID:	2012-FWFS-9 (4-5')	2013-MB-1 (0-2')	2013-MB-1 (4-5')	2013-MB-2 (0-2')	MW-27 (0-1')
		Sample Date:	4/29/2013	03/14/13	03/14/13	03/14/13	03/05/13
		Sample Depth (feet bgs):	4-5	0-2	4-5	0-2	0-1
	RAL[1]	Critical PCL[2]	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)
Volatile Organic Compounds (SW8260B)							
trans-1,2-Dichloroethene	0.5	0.5	<0.01550	<0.0013	<0.00149	<0.00145	--
trans-1,3-Dichloropropene	0.04	0.08	<0.00789	<0.000662	<0.000758	<0.00074	--
Trichloroethene	0.03	0.03	<0.01900	<0.0016	<0.00183	<0.00179	--
Vinyl acetate	53	159	<0.01260	<0.00106	<0.00121	<0.00119	--
Vinyl chloride	0.02	0.02	<0.01220	<0.00103	<0.00118	<0.00115	--
Xylenes, Total	123	123	<0.01540	<0.00129	0.011	<0.00144	--
Semivolatile Organic Compounds (SW8270C)							
1,2,4-Trichlorobenzene	4.8	4.8	--	--	--	--	<0.00268
1,2-Dichlorobenzene	18	18	--	--	--	--	<0.00385
1,3-Dichlorobenzene	6.7	20.1	--	--	--	--	<0.00196
1,4-Dichlorobenzene	2	2	--	--	--	--	<0.00287
1-Methylnaphthalene	3	7	--	--	--	--	--
2,4,5-Trichlorophenol	34	101	--	--	--	--	<0.0128
2,4,6-Trichlorophenol	0.17	0.52	--	--	--	--	<0.00342
2,4-Dichlorophenol	0.4	1.1	--	--	--	--	<0.00493
2,4-Dimethylphenol	3	10	--	--	--	--	<0.0109
2,4-Dinitrophenol	0.09	0.28	--	--	--	--	<0.00602
2,4-Dinitrotoluene	0.005	0.012	--	--	--	--	<0.0046
2,6-Dinitrotoluene	0.005	0.011	--	--	--	--	<0.00376
2-Chloronaphthalene	670	2000	--	--	--	--	<0.00154
2-Chlorophenol	1.6	4.9	--	--	--	--	<0.00251
2-Methylnaphthalene	17	51	--	--	--	--	<0.00349
2-Methylphenol	7	21	--	--	--	--	<0.00412
2-Nitroaniline	0.02	0.07	--	--	--	--	<0.00623
2-Nitrophenol	0.13	0.40	--	--	--	--	<0.00496
3 & 4 Methylphenol	1	2	--	--	--	--	<0.00356
3,3'-Dichlorobenzidine	0.06	0.14	--	--	--	--	<0.013 R
3-Nitroaniline	0.03	0.08	--	--	--	--	<0.00911
4,6-Dinitro-2-methylphenol	0.005	0.014	--	--	--	--	<0.00635
4-Bromophenyl phenyl ether	0.276	0.791	--	--	--	--	<0.00362
4-Chloro-3-methylphenol	5	14	--	--	--	--	<0.0199
4-Chloroaniline	0.02	0.05	--	--	--	--	<0.00742
4-Chlorophenyl phenyl ether	0.032	0.072	--	--	--	--	<0.00229
4-Nitroaniline	0.11	0.24	--	--	--	--	<0.0142
4-Nitrophenol	0.10	0.30	--	--	--	--	<0.00648

Table 4D.5A

Soil Data Summary - Volatile Organic Compounds and Semivolatile Organic Compounds
(2012/2013)

		Sample ID:	2013-STB-2 (4-5')	2013-STB-6 (0.5-1.1')	2013-STB-11 (0.5-1.3')	SCC-3 (0-0.5')	SCC-6 (0-0.5')
		Sample Date:	03/07/13	03/14/13	03/14/13	1/15/2013	1/15/2013
		Sample Depth (feet bgs):	4-5	0.5-1.1*	0.5-1.3*	0-0.5	0-0.5
	RAL[1]	Critical PCL[2]	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)
Volatile Organic Compounds (SW8260B)							
trans-1,2-Dichloroethene	0.5	0.5	<0.00156	<0.00125	<0.00126	--	--
trans-1,3-Dichloropropene	0.04	0.08	<0.000793	<0.000637	<0.000642	--	--
Trichloroethene	0.03	0.03	<0.00191	<0.00154	<0.00155	--	--
Vinyl acetate	53	159	<0.00127	<0.00102	<0.00103	--	--
Vinyl chloride	0.02	0.02	<0.00123	<0.000989	<0.000997	--	--
Xylenes, Total	123	123	<0.00155	0.0319	0.00454J	--	--
Semivolatile Organic Compounds (SW8270C)							
1,2,4-Trichlorobenzene	4.8	4.8	--	--	--	--	--
1,2-Dichlorobenzene	18	18	--	--	--	--	--
1,3-Dichlorobenzene	6.7	20.1	--	--	--	--	--
1,4-Dichlorobenzene	2	2	--	--	--	--	--
1-Methylnaphthalene	3	7	--	0.358J	0.336J	<0.002	<0.0021
2,4,5-Trichlorophenol	34	101	--	--	--	--	--
2,4,6-Trichlorophenol	0.17	0.52	--	--	--	--	--
2,4-Dichlorophenol	0.4	1.1	--	--	--	--	--
2,4-Dimethylphenol	3	10	--	--	--	--	--
2,4-Dinitrophenol	0.09	0.28	--	--	--	--	--
2,4-Dinitrotoluene	0.005	0.012	--	--	--	--	--
2,6-Dinitrotoluene	0.005	0.011	--	--	--	--	--
2-Chloronaphthalene	670	2000	--	--	--	--	--
2-Chlorophenol	1.6	4.9	--	--	--	--	--
2-Methylnaphthalene	17	51	--	0.391J	<0.147	<0.0035	<0.0036
2-Methylphenol	7	21	--	--	--	--	--
2-Nitroaniline	0.02	0.07	--	--	--	--	--
2-Nitrophenol	0.13	0.40	--	--	--	--	--
3 & 4 Methylphenol	1	2	--	--	--	--	--
3,3'-Dichlorobenzidine	0.06	0.14	--	--	--	--	--
3-Nitroaniline	0.03	0.08	--	--	--	--	--
4,6-Dinitro-2-methylphenol	0.005	0.014	--	--	--	--	--
4-Bromophenyl phenyl ether	0.276	0.791	--	--	--	--	--
4-Chloro-3-methylphenol	5	14	--	--	--	--	--
4-Chloroaniline	0.02	0.05	--	--	--	--	--
4-Chlorophenyl phenyl ether	0.032	0.072	--	--	--	--	--
4-Nitroaniline	0.11	0.24	--	--	--	--	--
4-Nitrophenol	0.10	0.30	--	--	--	--	--

Table 4D.5A

Soil Data Summary - Volatile Organic Compounds and Semivolatile Organic Compounds
(2012/2013)

		Sample ID:	SCC-8 (0-0.5')	2013-RMSA-6 (2.6-3.3')	2013-RMSB-2 (2.5-5')	2013-RMSB-2 (5-6')	2013-RMSB-4 (0-2')
		Sample Date:	1/15/2013	03/07/13	5/8/2013	5/8/2013	5/7/2013
		Sample Depth (feet bgs):	0-0.5	2.6-3.3	2.5-5*	5-6	0-2
	RAL[1]	Critical PCL[2]	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)
Volatile Organic Compounds (SW8260B)							
trans-1,2-Dichloroethene	0.5	0.5	--	<0.00162	<0.00152	<0.00798	<0.00141
trans-1,3-Dichloropropene	0.04	0.08	--	<0.000823	<0.000775	<0.00406	<0.00072
Trichloroethene	0.03	0.03	--	<0.00199	<0.00187	<0.00981	<0.00173
Vinyl acetate	53	159	--	<0.00132	<0.00124	<0.00651	<0.00115 UJL
Vinyl chloride	0.02	0.02	--	<0.00128	<0.00120	<0.00630	<0.00111
Xylenes, Total	123	123	--	<0.0016	<0.00151	<0.00791	<0.00140
Semivolatile Organic Compounds (SW8270C)							
1,2,4-Trichlorobenzene	4.8	4.8	--	--	<0.00279	<0.00293	<0.00259
1,2-Dichlorobenzene	18	18	--	--	<0.00402	<0.00422	<0.00373
1,3-Dichlorobenzene	6.7	20.1	--	--	<0.00205	<0.00215	<0.00190
1,4-Dichlorobenzene	2	2	--	--	<0.00299	<0.00314	<0.00278
1-Methylnaphthalene	3	7	<0.0021	--	--	--	--
2,4,5-Trichlorophenol	34	101	--	--	<0.0133	<0.014	<0.01240
2,4,6-Trichlorophenol	0.17	0.52	--	--	<0.00357	<0.00374	<0.00331
2,4-Dichlorophenol	0.4	1.1	--	--	<0.00515	<0.0054	<0.00478
2,4-Dimethylphenol	3	10	--	--	<0.0114	<0.012	<0.01060
2,4-Dinitrophenol	0.09	0.28	--	--	<0.00628	<0.00659	<0.00583
2,4-Dinitrotoluene	0.005	0.012	--	--	<0.0048	<0.00504	<0.00446
2,6-Dinitrotoluene	0.005	0.011	--	--	<0.00393	<0.00412	<0.00364
2-Chloronaphthalene	670	2000	--	--	<0.00161	<0.00169	<0.00149
2-Chlorophenol	1.6	4.9	--	--	<0.00262	<0.00275	<0.00243
2-Methylnaphthalene	17	51	<0.0037	--	0.00709 J	3.68	<0.00339
2-Methylphenol	7	21	--	--	<0.0043	<0.00451	<0.00399
2-Nitroaniline	0.02	0.07	--	--	<0.00651	<0.00682	<0.00604
2-Nitrophenol	0.13	0.40	--	--	<0.00518	<0.00543	<0.00481
3 & 4 Methylphenol	1	2	--	--	<0.00371	<0.00389	<0.00345
3,3'-Dichlorobenzidine	0.06	0.14	--	--	<0.0135	<0.0142	<0.01260
3-Nitroaniline	0.03	0.08	--	--	<0.00951	<0.00998	<0.00883 UJL
4,6-Dinitro-2-methylphenol	0.005	0.014	--	--	< 0.00663 UJL	< 0.00695 UJL	< 0.00615 UJL
4-Bromophenyl phenyl ether	0.276	0.791	--	--	<0.00378	<0.00396	<0.00351
4-Chloro-3-methylphenol	5	14	--	--	<0.0207	<0.0217	<0.01920
4-Chloroaniline	0.02	0.05	--	--	<0.00774	<0.00812	<0.00719
4-Chlorophenyl phenyl ether	0.032	0.072	--	--	<0.0024	<0.00251	<0.00222
4-Nitroaniline	0.11	0.24	--	--	<0.0148	<0.0156	<0.01380
4-Nitrophenol	0.10	0.30	--	--	<0.00676	<0.00709	<0.00628

Table 4D.5A

Soil Data Summary - Volatile Organic Compounds and Semivolatile Organic Compounds
(2012/2013)

		Sample ID:	2013-RMSB-4 (2-5')	2013-RMSB-4 (5-6')	2013-RMSB-5 (2-5')	2013-RMSB-10 (1.3-2')	2013-RMSB-10 (2-3')
		Sample Date:	5/7/2013	5/7/2013	5/7/2013	5/8/2013	5/8/2013
		Sample Depth (feet bgs):	2-5	5-6	2-5	1.3-2*	2-3
	RAL[1]	Critical PCL[2]	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)
Volatile Organic Compounds (SW8260B)							
trans-1,2-Dichloroethene	0.5	0.5	<0.00135	<0.00149	<0.00145	<0.0014	<0.00141
trans-1,3-Dichloropropene	0.04	0.08	<0.00069	<0.00076	<0.000737	<0.00071	<0.000717
Trichloroethene	0.03	0.03	<0.00166	<0.00183	<0.00178	<0.00171	<0.00173
Vinyl acetate	53	159	<0.0011 UJL	<0.00121 UJL	<0.00118	<0.00114	<0.00115
Vinyl chloride	0.02	0.02	<0.00107	<0.00118	<0.00114	<0.0011	<0.00111
Xylenes, Total	123	123	<0.00134	<0.00148	<0.00144	<0.00138	<0.0014
Semivolatile Organic Compounds (SW8270C)							
1,2,4-Trichlorobenzene	4.8	4.8	<0.00247	<0.00273	--	<0.00257	<0.0026
1,2-Dichlorobenzene	18	18	<0.00355	<0.00393	--	<0.00369	<0.00373
1,3-Dichlorobenzene	6.7	20.1	<0.00181	<0.00200	--	<0.00188	<0.0019
1,4-Dichlorobenzene	2	2	<0.00264	<0.00293	--	<0.00275	<0.00278
1-Methylnaphthalene	3	7	--	--	--	--	--
2,4,5-Trichlorophenol	34	101	<0.01180	<0.01300	--	<0.0122	<0.0124
2,4,6-Trichlorophenol	0.17	0.52	<0.00315	<0.00349	--	<0.00328	<0.00331
2,4-Dichlorophenol	0.4	1.1	<0.00455	<0.00504	--	<0.00473	<0.00478
2,4-Dimethylphenol	3	10	<0.01010	<0.01120	--	<0.0105	<0.0106
2,4-Dinitrophenol	0.09	0.28	<0.00555	<0.00614	--	<0.00577	<0.00584
2,4-Dinitrotoluene	0.005	0.012	<0.00424	<0.00470	--	<0.00441	<0.00446
2,6-Dinitrotoluene	0.005	0.011	<0.00347	<0.00384	--	<0.00361	<0.00365
2-Chloronaphthalene	670	2000	<0.00142	<0.00158	--	<0.00148	<0.0015
2-Chlorophenol	1.6	4.9	<0.00231	<0.00256	--	<0.00241	<0.00244
2-Methylnaphthalene	17	51	<0.00322	0.01140J	--	<0.00335	<0.00339
2-Methylphenol	7	21	<0.00379	<0.00421	--	<0.00395	<0.00399
2-Nitroaniline	0.02	0.07	<0.00574	<0.00637	--	<0.00598	<0.00605
2-Nitrophenol	0.13	0.40	<0.00457	<0.00506	--	<0.00476	<0.00481
3 & 4 Methylphenol	1	2	<0.00328	<0.00363	--	<0.00341	<0.00345
3,3'-Dichlorobenzidine	0.06	0.14	<0.01190	<0.01320	--	<0.0124	<0.0126
3-Nitroaniline	0.03	0.08	<0.0084 UJL	<0.00931 UJL	--	<0.00874	<0.00884
4,6-Dinitro-2-methylphenol	0.005	0.014	< 0.00585 UJL	< 0.00648 UJL	--	< 0.00609 UJL	< 0.00616 UJL
4-Bromophenyl phenyl ether	0.276	0.791	<0.00334	<0.00370	--	<0.00347	<0.00351
4-Chloro-3-methylphenol	5	14	<0.01830	<0.02030	--	<0.019	<0.0193
4-Chloroaniline	0.02	0.05	<0.00684	<0.00758	--	<0.00712	<0.0072
4-Chlorophenyl phenyl ether	0.032	0.072	<0.00211	<0.00234	--	<0.0022	<0.00223
4-Nitroaniline	0.11	0.24	<0.01310	<0.01450	--	<0.0136	<0.0138
4-Nitrophenol	0.10	0.30	<0.00597	<0.00661	--	<0.00621	<0.00628

Table 4D.5A

Soil Data Summary - Volatile Organic Compounds and Semivolatile Organic Compounds (2012/2013)

		Sample ID:	2013-RMSB-10 (5-6')	2013-RMSB-10 (7')
		Sample Date:	5/8/2013	5/8/2013
		Sample Depth (feet bgs):	5-6	7
	RAL[1]	Critical PCL[2]	(mg/kg)	(mg/kg)
Volatile Organic Compounds (SW8260B)				
trans-1,2-Dichloroethene	0.5	0.5	<0.00139	<0.00153
trans-1,3-Dichloropropene	0.04	0.08	<0.000708	<0.00078
Trichloroethene	0.03	0.03	<0.00171	<0.00188
Vinyl acetate	53	159	<0.00114	<0.00125
Vinyl chloride	0.02	0.02	<0.0011	<0.00121
Xylenes, Total	123	123	<0.00138	<0.00152
Semivolatile Organic Compounds (SW8270C)				
1,2,4-Trichlorobenzene	4.8	4.8	<0.00256	<0.00282
1,2-Dichlorobenzene	18	18	<0.00368	<0.00405
1,3-Dichlorobenzene	6.7	20.1	<0.00188	<0.00207
1,4-Dichlorobenzene	2	2	<0.00274	<0.00302
1-Methylnaphthalene	3	7	--	--
2,4,5-Trichlorophenol	34	101	<0.0122	<0.0134
2,4,6-Trichlorophenol	0.17	0.52	<0.00327	<0.0036
2,4-Dichlorophenol	0.4	1.1	<0.00472	<0.0052
2,4-Dimethylphenol	3	10	<0.0105	<0.0115
2,4-Dinitrophenol	0.09	0.28	<0.00576	<0.00634
2,4-Dinitrotoluene	0.005	0.012	<0.0044	<0.00485
2,6-Dinitrotoluene	0.005	0.011	<0.0036	<0.00396
2-Chloronaphthalene	670	2000	<0.00148	<0.00162
2-Chlorophenol	1.6	4.9	<0.0024	<0.00264
2-Methylnaphthalene	17	51	0.01 J	0.165
2-Methylphenol	7	21	<0.00394	<0.00434
2-Nitroaniline	0.02	0.07	<0.00597	<0.00656
2-Nitrophenol	0.13	0.40	<0.00475	<0.00522
3 & 4 Methylphenol	1	2	<0.0034	<0.00375
3,3'-Dichlorobenzidine	0.06	0.14	<0.0124	<0.0136
3-Nitroaniline	0.03	0.08	<0.00872	<0.0096
4,6-Dinitro-2-methylphenol	0.005	0.014	< 0.00608 UJL	< 0.00669 UJL
4-Bromophenyl phenyl ether	0.276	0.791	<0.00346	<0.00381
4-Chloro-3-methylphenol	5	14	<0.019	<0.0209
4-Chloroaniline	0.02	0.05	<0.0071	<0.00781
4-Chlorophenyl phenyl ether	0.032	0.072	<0.0022	<0.00242
4-Nitroaniline	0.11	0.24	<0.0136	<0.015
4-Nitrophenol	0.10	0.30	<0.0062	<0.00682

Table 4D.5A

Soil Data Summary - Volatile Organic Compounds and Semivolatile Organic Compounds
(2012/2013)

		Sample ID:	2012-FWFS-9 (4-5')	2013-MB-1 (0-2')	2013-MB-1 (4-5')	2013-MB-2 (0-2')	MW-27 (0-1')
		Sample Date:	4/29/2013	03/14/13	03/14/13	03/14/13	03/05/13
		Sample Depth (feet bgs):	4-5	0-2	4-5	0-2	0-1
	RAL[1]	Critical PCL[2]	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)
Semivolatile Organic Compounds (SW8270C)							
Acenaphthene	236	706	--	--	--	--	<0.00184
Acenaphthylene	409	1221	--	--	--	--	<0.00127
Anthracene	6890	20578	--	--	--	--	<0.00163
Benzidine	0.0000	0.0000	--	--	--	--	<0.0115 R
Benzo[a]anthracene	5.65	23.67	--	--	--	--	<0.00176
Benzo[a]pyrene	0.564	2.372	--	--	--	--	<0.00205
Benzo[b]fluoranthene	5.71	23.70	--	--	--	--	<0.00219
Benzo[g,h,i]perylene	1780	18582	--	--	--	--	<0.00646
Benzo[k]fluoranthene	57.2	237.3	--	--	--	--	<0.0019
Benzyl alcohol	6	17	--	--	--	--	<0.00743
bis (2-Chloroisopropyl) ether	0.01	0.43	--	--	--	--	<0.0113
Bis(2-chloroethoxy)methane	0.002	0.026	--	--	--	--	<0.00181
Bis(2-chloroethyl)ether	0.190	0.005	--	--	--	--	<0.0021
Bis(2-ethylhexyl) phthalate	43.2	163.5	--	--	--	--	<0.00684
Butyl benzyl phthalate	265	594	--	--	--	--	<0.00789
Carbazole	5	10	--	--	--	--	<0.00398
Chrysene	561	2370	--	--	--	--	<0.0013
Dibenz(a,h)anthracene	0.550	2.374	--	--	--	--	<0.00463
Dibenzofuran	33	100	--	--	--	--	<0.00227
Diethyl phthalate	156	465	--	--	--	--	<0.0107
Dimethyl phthalate	62	186	--	--	--	--	<0.00623
Di-n-butyl phthalate	3317	9908	--	--	--	--	<0.0033
Di-n-octyl phthalate	2578	27253	--	--	--	--	<0.00242
Fluoranthene	1917	5726	--	--	--	--	<0.00396
Fluorene	299	892	--	--	--	--	<0.00301
Hexachlorobenzene	1.07	1.13	--	--	--	--	<0.00194
Hexachlorobutadiene	3.3	7.4	--	--	--	--	<0.00245
Hexachlorocyclopentadiene	13.69	19.29	--	--	--	--	<0.00588
Hexachloroethane	1.3	3.8	--	--	--	--	<0.00294
Indeno[1,2,3-cd]pyrene	5.72	23.74	--	--	--	--	<0.00446
Isophorone	3	7	--	--	--	--	<0.00127
Naphthalene	31	93	--	--	--	--	<0.00172
Nitrobenzene	0.4	1.0	--	--	--	--	<0.00377
N-Nitrosodimethylamine	0.000	0.000	--	--	--	--	<0.00534
N-Nitrosodi-n-propylamine	0.000	0.001	--	--	--	--	<0.00283

Table 4D.5A

Soil Data Summary - Volatile Organic Compounds and Semivolatile Organic Compounds (2012/2013)

		Sample ID:	2013-STB-2 (4-5')	2013-STB-6 (0.5-1.1')	2013-STB-11 (0.5-1.3')	SCC-3 (0-0.5')	SCC-6 (0-0.5')
		Sample Date:	03/07/13	03/14/13	03/14/13	1/15/2013	1/15/2013
		Sample Depth (feet bgs):	4-5	0.5-1.1*	0.5-1.3*	0-0.5	0-0.5
	RAL[1]	Critical PCL[2]	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)
Semivolatile Organic Compounds (SW8270C)							
Acenaphthene	236	706	--	<0.079	<0.0774	<0.0019	<0.0019
Acenaphthylene	409	1221	--	<0.0548	<0.0537	<0.0013	<0.0013
Anthracene	6890	20578	--	<0.0702	<0.0688	0.002J	<0.0017
Benzidine	0.0000	0.0000	--	--	--	--	--
Benzo[a]anthracene	5.65	23.67	--	<0.0757	<0.0742	0.009J	0.0033J
Benzo[a]pyrene	0.564	2.372	--	<0.0883	<0.0865	0.0245	0.0194J
Benzo[b]fluoranthene	5.71	23.70	--	<0.0943	<0.0924	0.0333J	0.0194J
Benzo[g,h,i]perylene	1780	18582	--	<0.278	<0.272	0.0263	0.0202J
Benzo[k]fluoranthene	57.2	237.3	--	<0.0817	<0.0801	0.0072J	0.0022J
Benzyl alcohol	6	17	--	--	--	--	--
bis (2-Chloroisopropyl) ether	0.01	0.43	--	--	--	--	--
Bis(2-chloroethoxy)methane	0.002	0.026	--	--	--	--	--
Bis(2-chloroethyl)ether	0.190	0.005	--	--	--	--	--
Bis(2-ethylhexyl) phthalate	43.2	163.5	--	--	--	--	--
Butyl benzyl phthalate	265	594	--	--	--	--	--
Carbazole	5	10	--	--	--	--	--
Chrysene	561	2370	--	<0.0559	<0.0548	0.0137	0.0085J
Dibenz(a,h)anthracene	0.550	2.374	--	<0.199	<0.195	0.0047	0.0048
Dibenzofuran	33	100	--	--	--	--	--
Diethyl phthalate	156	465	--	--	--	--	--
Dimethyl phthalate	62	186	--	--	--	--	--
Di-n-butyl phthalate	3317	9908	--	--	--	--	--
Di-n-octyl phthalate	2578	27253	--	--	--	--	--
Fluoranthene	1917	5726	--	<0.171	<0.167	0.0198	0.0089
Fluorene	299	892	--	<0.129	<0.127	0.0031	0.0031
Hexachlorobenzene	1.07	1.13	--	--	--	--	--
Hexachlorobutadiene	3.3	7.4	--	--	--	--	--
Hexachlorocyclopentadiene	13.69	19.29	--	--	--	--	--
Hexachloroethane	1.3	3.8	--	--	--	--	--
Indeno[1,2,3-cd]pyrene	5.72	23.74	--	<0.192	<0.188	0.0427	0.0047
Isophorone	3	7	--	--	--	--	--
Naphthalene	31	93	--	<0.074	<0.0726	0.0017	0.0018
Nitrobenzene	0.4	1.0	--	--	--	--	--
N-Nitrosodimethylamine	0.000	0.000	--	--	--	--	--
N-Nitrosodi-n-propylamine	0.000	0.001	--	--	--	--	--

Table 4D.5A

Soil Data Summary - Volatile Organic Compounds and Semivolatile Organic Compounds
(2012/2013)

		Sample ID:	SCC-8 (0-0.5')	2013-RMSA-6 (2.6-3.3')	2013-RMSB-2 (2.5-5')	2013-RMSB-2 (5-6')	2013-RMSB-4 (0-2')
		Sample Date:	1/15/2013	03/07/13	5/8/2013	5/8/2013	5/7/2013
		Sample Depth (feet bgs):	0-0.5	2.6-3.3	2.5-5*	5-6	0-2
	RAL[1]	Critical PCL[2]	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)
Semivolatile Organic Compounds (SW8270C)							
Acenaphthene	236	706	<0.0019	--	<0.00192	<0.00201	<0.00178
Acenaphthylene	409	1221	<0.0013	--	<0.00133	<0.0014	<0.00124
Anthracene	6890	20578	0.005J	--	<0.0017	<0.00179	<0.00158
Benzidine	0.0000	0.0000	--	--	< 0.012 UJ	< 0.0126 UJ	< 0.0111 UJL
Benzo[a]anthracene	5.65	23.67	0.0169J	--	<0.00184	<0.00193	<0.00171
Benzo[a]pyrene	0.564	2.372	0.0323	--	<0.00214	<0.00225	<0.00199
Benzo[b]fluoranthene	5.71	23.70	0.0542	--	<0.00229	<0.0024	<0.00213
Benzo[g,h,i]perylene	1780	18582	0.0336	--	<0.00675	<0.00708	<0.00626
Benzo[k]fluoranthene	57.2	237.3	0.0161J	--	<0.00198	<0.00208	<0.00184
Benzyl alcohol	6	17	--	--	<0.00776	<0.00814	<0.00720
bis (2-Chloroisopropyl) ether	0.01	0.43	--	--	<0.0118	<0.0123	<0.01090
Bis(2-chloroethoxy)methane	0.002	0.026	--	--	<0.00189	<0.00198	<0.00175
Bis(2-chloroethyl)ether	0.190	0.005	--	--	<0.0022	<0.0023	<0.00204
Bis(2-ethylhexyl) phthalate	43.2	163.5	--	--	0.00737 J	0.0652 J	0.01190J
Butyl benzyl phthalate	265	594	--	--	<0.00824	<0.00864	<0.00765
Carbazole	5	10	--	--	<0.00415	<0.00435	<0.00385
Chrysene	561	2370	0.0394	--	<0.00136	<0.00142	<0.00126
Dibenz(a,h)anthracene	0.550	2.374	0.0386	--	<0.00483	<0.00507	<0.00448
Dibenzofuran	33	100	--	--	<0.00237	0.248	<0.00220
Diethyl phthalate	156	465	--	--	<0.0112	<0.0118	0.01960J
Dimethyl phthalate	62	186	--	--	<0.00651	<0.00682	<0.00604
Di-n-butyl phthalate	3317	9908	--	--	<0.00345	<0.00361	<0.00320
Di-n-octyl phthalate	2578	27253	--	--	<0.00253	<0.00265	<0.00235
Fluoranthene	1917	5726	0.0239	--	<0.00414	<0.00434	<0.00384
Fluorene	299	892	<0.0032	--	<0.00314	0.317	<0.00292
Hexachlorobenzene	1.07	1.13	--	--	<0.00202	<0.00212	<0.00188
Hexachlorobutadiene	3.3	7.4	--	--	<0.00256	<0.00268	<0.00237
Hexachlorocyclopentadiene	13.69	19.29	--	--	<0.00613	<0.00643	<0.00570
Hexachloroethane	1.3	3.8	--	--	<0.00307	<0.00322	<0.00285
Indeno[1,2,3-cd]pyrene	5.72	23.74	0.0495	--	<0.00466	<0.00488	<0.00432
Isophorone	3	7	--	--	<0.00133	<0.0014	<0.00124
Naphthalene	31	93	<0.0018	--	<0.0018	0.963	<0.00167
Nitrobenzene	0.4	1.0	--	--	<0.00394	<0.00413	<0.00366
N-Nitrosodimethylamine	0.000	0.000	--	--	<0.00558	<0.00585	<0.00518
N-Nitrosodi-n-propylamine	0.000	0.001	--	--	<0.00295	<0.0031	<0.00274

Table 4D.5A

Soil Data Summary - Volatile Organic Compounds and Semivolatile Organic Compounds
(2012/2013)

		Sample ID:	2013-RMSB-4 (2-5')	2013-RMSB-4 (5-6')	2013-RMSB-5 (2-5')	2013-RMSB-10 (1.3-2')	2013-RMSB-10 (2-3')
		Sample Date:	5/7/2013	5/7/2013	5/7/2013	5/8/2013	5/8/2013
		Sample Depth (feet bgs):	2-5	5-6	2-5	1.3-2*	2-3
	RAL[1]	Critical PCL[2]	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)
Semivolatile Organic Compounds (SW8270C)							
Acenaphthene	236	706	<0.00169	<0.00187	--	<0.00176	<0.00178
Acenaphthylene	409	1221	<0.00117	<0.00130	--	<0.00122	<0.00124
Anthracene	6890	20578	<0.00150	<0.00167	--	<0.00156	<0.00158
Benzidine	0.0000	0.0000	< 0.0106 UJL	< 0.0117 UJL	--	< 0.011 UJL	< 0.0112 UJL
Benzo[a]anthracene	5.65	23.67	<0.00162	<0.00180	--	<0.00169	<0.00171
Benzo[a]pyrene	0.564	2.372	<0.00189	<0.00210	--	<0.00197	<0.00199
Benzo[b]fluoranthene	5.71	23.70	<0.00202	<0.00224	--	<0.0021	<0.00213
Benzo[g,h,i]perylene	1780	18582	<0.00596	<0.00660	--	<0.0062	<0.00627
Benzo[k]fluoranthene	57.2	237.3	<0.00175	<0.00194	--	<0.00182	<0.00184
Benzyl alcohol	6	17	<0.00685	<0.00759	--	<0.00713	<0.00721
bis (2-Chloroisopropyl) ether	0.01	0.43	<0.01040	<0.01150	--	<0.0108	<0.0109
Bis(2-chloroethoxy)methane	0.002	0.026	<0.00167	<0.00185	--	<0.00174	<0.00176
Bis(2-chloroethyl)ether	0.190	0.005	<0.00194	<0.00215	--	<0.00202	<0.00204
Bis(2-ethylhexyl) phthalate	43.2	163.5	0.00939J	0.365	--	<0.00656	0.0222 J
Butyl benzyl phthalate	265	594	<0.00727	<0.00806	--	<0.00757	0.01 J
Carbazole	5	10	<0.00367	<0.00406	--	<0.00381	<0.00386
Chrysene	561	2370	<0.00120	<0.00133	--	<0.00125	<0.00126
Dibenz(a,h)anthracene	0.550	2.374	<0.00426	<0.00473	--	<0.00444	<0.00449
Dibenzofuran	33	100	<0.00209	<0.00232	--	<0.00218	<0.0022
Diethyl phthalate	156	465	0.02590J	0.01580J	--	<0.0103	0.0381 J
Dimethyl phthalate	62	186	<0.00574	<0.00637	--	<0.00598	<0.00605
Di-n-butyl phthalate	3317	9908	<0.00304	<0.00337	--	<0.00317	<0.0032
Di-n-octyl phthalate	2578	27253	<0.00223	<0.00247	--	<0.00232	<0.00235
Fluoranthene	1917	5726	<0.00365	<0.00405	--	<0.0038	<0.00384
Fluorene	299	892	<0.00277	<0.00307	--	<0.00289	<0.00292
Hexachlorobenzene	1.07	1.13	<0.00179	<0.00198	--	<0.00186	<0.00188
Hexachlorobutadiene	3.3	7.4	<0.00226	<0.00250	--	<0.00235	<0.00237
Hexachlorocyclopentadiene	13.69	19.29	<0.00542	<0.00600	--	<0.00564	<0.0057
Hexachloroethane	1.3	3.8	<0.00271	<0.00301	--	<0.00282	<0.00286
Indeno[1,2,3-cd]pyrene	5.72	23.74	<0.00411	<0.00456	--	<0.00428	<0.00433
Isophorone	3	7	<0.00117	<0.00130	--	<0.00122	<0.00124
Naphthalene	31	93	<0.00159	0.00859J	--	<0.00165	<0.00167
Nitrobenzene	0.4	1.0	<0.00348	<0.00385	--	<0.00362	<0.00366
N-Nitrosodimethylamine	0.000	0.000	<0.00492	<0.00545	--	<0.00512	<0.00518
N-Nitrosodi-n-propylamine	0.000	0.001	<0.00261	<0.00289	--	<0.00271	<0.00274

Table 4D.5A

Soil Data Summary - Volatile Organic Compounds and Semivolatile Organic Compounds (2012/2013)

		Sample ID:	2013-RMSB-10 (5-6')	2013-RMSB-10 (7')
		Sample Date:	5/8/2013	5/8/2013
		Sample Depth (feet bgs):	5-6	7
	RAL[1]	Critical PCL[2]	(mg/kg)	(mg/kg)
Semivolatile Organic Compounds (SW8270C)				
Acenaphthene	236	706	<0.00176	<0.00193
Acenaphthylene	409	1221	<0.00122	<0.00134
Anthracene	6890	20578	<0.00156	<0.00172
Benzidine	0.0000	0.0000	< 0.011 UJL	< 0.0121 UJL
Benzo[a]anthracene	5.65	23.67	<0.00168	<0.00185
Benzo[a]pyrene	0.564	2.372	<0.00196	<0.00216
Benzo[b]fluoranthene	5.71	23.70	<0.0021	<0.00231
Benzo[g,h,i]perylene	1780	18582	<0.00618	<0.00681
Benzo[k]fluoranthene	57.2	237.3	<0.00182	<0.002
Benzyl alcohol	6	17	<0.00711	<0.00783
bis (2-Chloroisopropyl) ether	0.01	0.43	<0.0108	<0.0119
Bis(2-chloroethoxy)methane	0.002	0.026	<0.00173	<0.00191
Bis(2-chloroethyl)ether	0.190	0.005	<0.00201	<0.00221
Bis(2-ethylhexyl) phthalate	43.2	163.5	0.216	<0.00721
Butyl benzyl phthalate	265	594	0.0106 J	<0.00831
Carbazole	5	10	<0.00381	<0.00419
Chrysene	561	2370	<0.00124	<0.00137
Dibenz(a,h)anthracene	0.550	2.374	<0.00443	<0.00487
Dibenzofuran	33	100	<0.00217	<0.00239
Diethyl phthalate	156	465	0.0459 J	<0.0113
Dimethyl phthalate	62	186	<0.00597	<0.00656
Di-n-butyl phthalate	3317	9908	<0.00316	<0.00348
Di-n-octyl phthalate	2578	27253	<0.00232	<0.00255
Fluoranthene	1917	5726	<0.00379	<0.00417
Fluorene	299	892	<0.00288	<0.00317
Hexachlorobenzene	1.07	1.13	<0.00185	<0.00204
Hexachlorobutadiene	3.3	7.4	<0.00234	<0.00258
Hexachlorocyclopentadiene	13.69	19.29	<0.00562	<0.00619
Hexachloroethane	1.3	3.8	<0.00282	<0.0031
Indeno[1,2,3-cd]pyrene	5.72	23.74	<0.00427	<0.0047
Isophorone	3	7	<0.00122	<0.00134
Naphthalene	31	93	0.0659	0.167
Nitrobenzene	0.4	1.0	<0.00361	<0.00397
N-Nitrosodimethylamine	0.000	0.000	<0.00511	<0.00562
N-Nitrosodi-n-propylamine	0.000	0.001	<0.00271	<0.00298

Table 4D.5A

Soil Data Summary - Volatile Organic Compounds and Semivolatile Organic Compounds
(2012/2013)

		Sample ID:	2012-FWFS-9 (4-5')	2013-MB-1 (0-2')	2013-MB-1 (4-5')	2013-MB-2 (0-2')	MW-27 (0-1')
		Sample Date:	4/29/2013	03/14/13	03/14/13	03/14/13	03/05/13
		Sample Depth (feet bgs):	4-5	0-2	4-5	0-2	0-1
	RAL[1]	Critical PCL[2]	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)
Semivolatile Organic Compounds (SW8270C)							
N-Nitrosodiphenylamine	3	6	--	--	--	--	<0.00241
Pentachlorophenol	0.018	0.018	--	--	--	--	<0.0051
Phenanthrene	416	1242	--	--	--	--	<0.00631
Phenol	19	57	--	--	--	--	<0.0054
Pyrene	1117	3335	--	--	--	--	<0.00233

Table 4D.5A

Soil Data Summary - Volatile Organic Compounds and Semivolatile Organic Compounds (2012/2013)

		Sample ID:	2013-STB-2 (4-5')	2013-STB-6 (0.5-1.1')	2013-STB-11 (0.5-1.3')	SCC-3 (0-0.5')	SCC-6 (0-0.5')
		Sample Date:	03/07/13	03/14/13	03/14/13	1/15/2013	1/15/2013
		Sample Depth (feet bgs):	4-5	0.5-1.1*	0.5-1.3*	0-0.5	0-0.5
	RAL[1]	Critical PCL[2]	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)
Semivolatile Organic Compounds (SW8270C)							
N-Nitrosodiphenylamine	3	6	--	--	--	--	--
Pentachlorophenol	0.018	0.018	--	--	--	--	--
Phenanthrene	416	1242	--	<0.271	<0.266	0.0083	0.0066
Phenol	19	57	--	--	--	--	--
Pyrene	1117	3335	--	<0.1	<0.0984	0.0158	0.0079

Table 4D.5A

Soil Data Summary - Volatile Organic Compounds and Semivolatile Organic Compounds (2012/2013)

		Sample ID:	SCC-8 (0-0.5')	2013-RMSA-6 (2.6-3.3')	2013-RMSB-2 (2.5-5')	2013-RMSB-2 (5-6')	2013-RMSB-4 (0-2')
		Sample Date:	1/15/2013	03/07/13	5/8/2013	5/8/2013	5/7/2013
		Sample Depth (feet bgs):	0-0.5	2.6-3.3	2.5-5*	5-6	0-2
	RAL[1]	Critical PCL[2]	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)
Semivolatile Organic Compounds (SW8270C)							
N-Nitrosodiphenylamine	3	6	--	--	<0.00252	<0.00264	<0.00234
Pentachlorophenol	0.018	0.018	--	--	<0.00532	<0.00558	<0.00494
Phenanthrene	416	1242	0.0113J	--	<0.00659	0.496	<0.00612
Phenol	19	57	--	--	<0.00564	<0.00592	<0.00524
Pyrene	1117	3335	0.0223	--	<0.00244	<0.00255	<0.00226

Table 4D.5A

Soil Data Summary - Volatile Organic Compounds and Semivolatile Organic Compounds (2012/2013)

		Sample ID:	2013-RMSB-4 (2-5')	2013-RMSB-4 (5-6')	2013-RMSB-5 (2-5')	2013-RMSB-10 (1.3-2')	2013-RMSB-10 (2-3')
		Sample Date:	5/7/2013	5/7/2013	5/7/2013	5/8/2013	5/8/2013
		Sample Depth (feet bgs):	2-5	5-6	2-5	1.3-2*	2-3
	RAL[1]	Critical PCL[2]	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)
Semivolatile Organic Compounds (SW8270C)							
N-Nitrosodiphenylamine	3	6	<0.00222	<0.00246	--	<0.00231	<0.00234
Pentachlorophenol	0.018	0.018	<0.00470	<0.00521	--	<0.00489	<0.00495
Phenanthrene	416	1242	<0.00582	<0.00644	--	<0.00605	<0.00612
Phenol	19	57	<0.00498	<0.00552	--	<0.00518	<0.00524
Pyrene	1117	3335	<0.00215	<0.00238	--	<0.00224	<0.00226

Table 4D.5A

Soil Data Summary - Volatile Organic Compounds and Semivolatile Organic Compounds (2012/2013)

		Sample ID:	2013-RMSB-10 (5-6')	2013-RMSB-10 (7')
		Sample Date:	5/8/2013	5/8/2013
		Sample Depth (feet bgs):	5-6	7
	RAL[1]	Critical PCL[2]	(mg/kg)	(mg/kg)
Semivolatile Organic Compounds (SW8270C)				
N-Nitrosodiphenylamine	3	6	<0.00231	<0.00254
Pentachlorophenol	0.018	0.018	<0.00488	<0.00537
Phenanthrene	416	1242	<0.00604	<0.00664
Phenol	19	57	<0.00517	<0.00569
Pyrene	1117	3335	<0.00223	<0.00246

Table 4D.5A

Soil Data Summary - Volatile Organic Compounds and Semivolatile Organic Compounds
(2012/2013)

NOTES

1. [1] - Residential Assessment Levels (RALs) are the lower of the TRRP Tier 1 residential $^{Tot}Soil_{Comb}$ and $^{GW}Soil_{Ing}$ PCLs for a 0.5-acre source area (TCEQ, 2012c).
2. [2] - Critical PCLs are the lower of the TRRP commercial-industrial Tier 1 $^{Tot}Soil_{Comb}$ and Tier 1 $^{GW}Soil_{Ing}$ PCLs for a 0.5-acre source area (TCEQ, 2012c).
3. RAL exceedances are bolded and critical PCL exceedances are highlighted (no exceedances were observed).
4. Data Qualifiers (see Section 3.5): J - estimated result; UJ - estimated result, not detected; UJL - estimated result, not detected, biased low;
   U - not detected, detected in associated blank; X8 - laboratory not accredited for this analyte.
5. * - Sub-slab or sub-gabion basket sample; top depth represents the approximate top of soil.

Table 4D.5B
Soil Data Summary
Volatile Organic Compounds and Semivolatile Organic Compounds (2014)

	Sample ID	2013-FFTA-01 (0.25-2)	2013-FFTA-02 (0.25-2)	2013-FFTA-03 (0-2)	2013-FFTA-03 (14-16)	2013-FFTA-03 (18-19)
	Location ID	2013-FFTA-01	2013-FFTA-02	2013-FFTA-03	2013-FFTA-03	2013-FFTA-03
	Date Sampled	2014-01-08	2014-01-07	2014-01-07	2014-01-07	2014-01-08
	Units	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
Analyte	**Soil RAL[1]**					
Volatile Organic Compounds (SW8260B)						
1,1,1-Trichloroethane	1.6201	< 0.000943 U	< 0.000860 U	< 0.000967 U	< 0.000952 U	< 0.000793 U
1,1,2,2-Tetrachloroethane	0.0231	< 0.00111 U	< 0.00101 U	< 0.00114 U	< 0.00112 U	< 0.000932 U
1,1,2-Trichloroethane	0.0201	< 0.000930 U	< 0.000848 U	< 0.000954 U	< 0.000939 U	< 0.000782 U
1,1-Dichloroethane	18.4941	< 0.00111 U	< 0.00101 U	< 0.00114 U	< 0.00112 U	< 0.000932 U
1,1-Dichloroethene	0.0501	< 0.00155 U	< 0.00142 U	< 0.00159 U	< 0.00157 U	< 0.00131 U
1,2-Dichloroethane	0.0137	< 0.00115 U	< 0.00105 U	< 0.00118 U	< 0.00116 U	< 0.000964 U
1,2-Dichloroethene, Total	N/A	< 0.00242 U	< 0.00221 U	< 0.00248 U	< 0.00244 U	< 0.00204 U
1,2-Dichloropropane	0.0228	< 0.000905 U	< 0.000825 U	< 0.000928 U	< 0.000913 U	< 0.000761 U
2-Butanone (MEK)	29.2869	< 0.00242 U	< 0.00221 U	< 0.00248 U	< 0.00244 U	< 0.00204 U
2-Hexanone	0.3227	< 0.00129 U	< 0.00117 U	< 0.00132 U	< 0.00130 U	< 0.00108 U
4-Methyl-2-pentanone (MIBK)	4.9486	< 0.00187 U	< 0.00171 U	< 0.00192 U	< 0.00189 U	< 0.00157 U
Acetone	42.7422	**0.0111 J**	**0.00552 J**	< 0.00217 U	**0.00511 J**	**0.0290**
Benzene	0.0257	< 0.000803 U	< 0.000732 U	< 0.000824 U	< 0.000810 U	< 0.000675 U
Chlorobromomethane	3.0393	< 0.00227 U	< 0.00207 U	< 0.00233 U	< 0.00229 U	< 0.00191 U
Bromodichloromethane	0.0654	< 0.000841 U	< 0.000767 U	< 0.000863 U	< 0.000849 U	< 0.000707 U
Bromoform	0.6312	< 0.00175 U	< 0.00159 U	< 0.00179 U	< 0.00176 U	< 0.00147 U
Bromomethane	0.1307	< 0.00106 U	< 0.000964 U	< 0.00108 U	< 0.00107 U	< 0.000889 U
Carbon Disulfide	13.5835	< 0.000701 U	< 0.000639 U	< 0.000719 U	< 0.000707 U	< 0.000589 U
Carbon Tetrachloride	0.0619	< 0.00144 U	< 0.00131 U	< 0.00148 U	< 0.00145 U	< 0.00121 U
Chlorobenzene	1.0925	< 0.00122 U	< 0.00112 U	< 0.00125 U	< 0.00123 U	< 0.00103 U
Chloroethane	30.9012	< 0.00178 U	< 0.00163 U	< 0.00183 U	< 0.00180 U	< 0.00150 U
Chloroform	1.0194	< 0.000841 U	< 0.000767 U	< 0.000863 U	< 0.000849 U	< 0.000707 U
Chloromethane	0.4052	< 0.00212 U	< 0.00193 U	< 0.00217 U	< 0.00214 U	< 0.00178 U
cis-1,2-Dichloroethene	0.2483	< 0.00106 U	< 0.000964 U	< 0.00108 U	< 0.00107 U	< 0.000889 U
cis-1,3-Dichloropropene	0.0066	< 0.000688 U	< 0.000627 U	< 0.000706 U	< 0.000695 U	< 0.000578 U
Dibromochloromethane	0.0491	< 0.00120 U	< 0.00109 U	< 0.00123 U	< 0.00121 U	< 0.00101 U
Ethylbenzene	7.6300	< 0.00130 U	< 0.00118 U	< 0.00133 U	< 0.00131 U	< 0.00109 U
m,p-Xylenes	105.2355	< 0.00194 U	< 0.00177 U	< 0.00199 U	< 0.00196 U	< 0.00163 U
Methylene Chloride	0.0131	< 0.00279 U	< 0.00254 U	< 0.00286 U	< 0.00282 U	**0.00366 J**
o-Xylene	70.7102	< 0.00144 U	< 0.00131 U	< 0.00148 U	< 0.00145 U	< 0.00121 U
Styrene	3.2547	< 0.000905 U	< 0.000825 U	< 0.000928 U	< 0.000913 U	< 0.000761 U
Tetrachloroethene	0.0502	< 0.000905 U	< 0.000825 U	< 0.000928 U	< 0.000913 U	< 0.000761 U
Toluene	8.2104	< 0.00176 U	< 0.00160 U	< 0.00180 U	< 0.00178 U	< 0.00148 U
trans-1,2-Dichloroethene	0.4902	< 0.00145 U	< 0.00132 U	< 0.00149 U	< 0.00147 U	< 0.00122 U
trans-1,3-Dichloropropene	0.0359	< 0.000739 U	< 0.000674 U	< 0.000758 U	< 0.000746 U	< 0.000621 U
Trichloroethene	0.0336	< 0.00178 U	< 0.00163 U	< 0.00183 U	< 0.00180 U	< 0.00150 U
Vinyl Acetate	53.3713	< 0.00119 U	< 0.00108 U	< 0.00122 U	< 0.00120 U	< 0.000996 U
Vinyl Chloride	0.0223	< 0.00115 U	< 0.00105 U	< 0.00118 U	< 0.00116 U	< 0.000964 U
Xylenes, Total	122.5218	< 0.00144 U	< 0.00131 U	< 0.00148 U	< 0.00145 U	< 0.00121 U

Table 4D.5B
Soil Data Summary
Volatile Organic Compounds and Semivolatile Organic Compounds (2014)

	Sample ID	2013-MB-3 (0.75-1.25)	2013-MB-4 (0.83-1.33)	2013-MB-5 (0.5-5)	2013-MB-5 (10-12)	MW-27A (0-2)
	Location ID	2013-MB-3	2013-MB-4	2013-MB-5	2013-MB-5	MW-27A
	Date Sampled	2014-01-08	2014-01-08	2014-01-08	2014-01-08	2014-01-09
	Units	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
Analyte	**Soil RAL[1]**					
Volatile Organic Compounds (SW8260B)						
1,1,1-Trichloroethane	1.6201	< 0.000959 U	< 0.000968 U	< 0.000965 U	< 0.000987 U	< 0.000945 U
1,1,2,2-Tetrachloroethane	0.0231	< 0.00113 U	< 0.00114 U	< 0.00113 U	< 0.00116 U	< 0.00111 U
1,1,2-Trichloroethane	0.0201	< 0.000946 U	< 0.000955 U	< 0.000952 U	< 0.000973 U	< 0.000933 U
1,1-Dichloroethane	18.4941	< 0.00113 U	< 0.00114 U	< 0.00113 U	< 0.00116 U	< 0.00111 U
1,1-Dichloroethene	0.0501	< 0.00158 U	< 0.00160 U	< 0.00159 U	< 0.00163 U	< 0.00156 U
1,2-Dichloroethane	0.0137	< 0.00117 U	< 0.00118 U	< 0.00117 U	< 0.00120 U	< 0.00115 U
1,2-Dichloroethene, Total	N/A	< 0.00246 U	< 0.00249 U	< 0.00248 U	< 0.00253 U	< 0.00243 U
1,2-Dichloropropane	0.0228	< 0.000920 U	< 0.000929 U	< 0.000926 U	< 0.000947 U	< 0.000907 U
2-Butanone (MEK)	29.2869	**0.0392**	**0.0358**	**0.0135**	**0.0101 J**	< 0.00243 U
2-Hexanone	0.3227	< 0.00131 U	< 0.00132 U	< 0.00132 U	< 0.00135 U	< 0.00129 U
4-Methyl-2-pentanone (MIBK)	4.9486	< 0.00191 U	< 0.00192 U	< 0.00192 U	< 0.00196 U	< 0.00188 U
Acetone	42.7422	**0.306**	**0.298**	**0.127**	**0.0671**	**0.00415 J**
Benzene	0.0257	< 0.000816 U	< 0.000824 U	< 0.000822 U	< 0.000840 U	< 0.000805 U
Chlorobromomethane	3.0393	< 0.00231 U	< 0.00233 U	< 0.00232 U	< 0.00237 U	< 0.00227 U
Bromodichloromethane	0.0654	< 0.000855 U	< 0.000863 U	< 0.000861 U	< 0.000880 U	< 0.000843 U
Bromoform	0.6312	< 0.00178 U	< 0.00179 U	< 0.00179 U	< 0.00183 U	< 0.00175 U
Bromomethane	0.1307	< 0.00108 U	< 0.00109 U	< 0.00108 U	< 0.00111 U	< 0.00106 U
Carbon Disulfide	13.5835	**0.00168 J**	**0.00386 J**	**0.00180 J**	**0.000745 J**	< 0.000703 U
Carbon Tetrachloride	0.0619	< 0.00146 U	< 0.00148 U	< 0.00147 U	< 0.00151 U	< 0.00144 U
Chlorobenzene	1.0925	< 0.00124 U	< 0.00126 U	< 0.00125 U	< 0.00128 U	< 0.00123 U
Chloroethane	30.9012	< 0.00181 U	< 0.00183 U	< 0.00183 U	< 0.00187 U	< 0.00179 U
Chloroform	1.0194	< 0.000855 U	< 0.000863 U	< 0.000861 U	< 0.000880 U	< 0.000843 U
Chloromethane	0.4052	< 0.00215 U	< 0.00217 U	< 0.00217 U	< 0.00221 U	< 0.00212 U
cis-1,2-Dichloroethene	0.2483	< 0.00108 U	< 0.00109 U	< 0.00108 U	< 0.00111 U	< 0.00106 U
cis-1,3-Dichloropropene	0.0066	< 0.000700 U	< 0.000706 U	< 0.000704 U	< 0.000720 U	< 0.000690 U
Dibromochloromethane	0.0491	< 0.00122 U	< 0.00123 U	< 0.00123 U	< 0.00125 U	< 0.00120 U
Ethylbenzene	7.6300	< 0.00132 U	< 0.00133 U	< 0.00133 U	< 0.00136 U	< 0.00130 U
m,p-Xylenes	105.2355	< 0.00197 U	< 0.00199 U	< 0.00198 U	< 0.00203 U	< 0.00194 U
Methylene Chloride	0.0131	< 0.00284 U	< 0.00286 U	**0.00505 J**	**0.00549 J**	< 0.00280 U
o-Xylene	70.7102	< 0.00146 U	< 0.00148 U	< 0.00147 U	< 0.00151 U	< 0.00144 U
Styrene	3.2547	< 0.000920 U	< 0.000929 U	< 0.000926 U	< 0.000947 U	< 0.000907 U
Tetrachloroethene	0.0502	< 0.000920 U	< 0.000929 U	< 0.000926 U	< 0.000947 U	< 0.000907 U
Toluene	8.2104	< 0.00179 U	< 0.00181 U	< 0.00180 U	<0.01169 U *	< 0.00176 U
trans-1,2-Dichloroethene	0.4902	< 0.00148 U	< 0.00149 U	< 0.00149 U	< 0.00152 U	< 0.00146 U
trans-1,3-Dichloropropene	0.0359	< 0.000752 U	< 0.000759 U	< 0.000756 U	< 0.000773 U	< 0.000741 U
Trichloroethene	0.0336	< 0.00181 U	< 0.00183 U	< 0.00183 U	< 0.00187 U	< 0.00179 U
Vinyl Acetate	53.3713	< 0.00121 U	< 0.00122 U	< 0.00121 U	< 0.00124 U	< 0.00119 U
Vinyl Chloride	0.0223	< 0.00117 U	< 0.00118 U	< 0.00117 U	< 0.00120 U	< 0.00115 U
Xylenes, Total	122.5218	< 0.00146 U	< 0.00148 U	< 0.00147 U	< 0.00151 U	< 0.00144 U

Table 4D.5B
Soil Data Summary
Volatile Organic Compounds and Semivolatile Organic Compounds (2014)

	Sample ID	MW-27B (0-2)	MW-27C (0-2)	MW-27D (0.5-2)	MW-43 (0-2)	MW-43 (17-20)
	Location ID	MW-27B	MW-27C	MW-27D	MW-43	MW-43
	Date Sampled	2014-01-09	2014-01-08	2014-01-08	2014-01-07	2014-01-07
	Units	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
Analyte	Soil RAL[1]					
Volatile Organic Compounds (SW8260B)						
1,1,1-Trichloroethane	1.6201	< 0.000955 U	< 0.000949 U	< 0.000955 U	< 0.000871 U	< 0.000837 U
1,1,2,2-Tetrachloroethane	0.0231	< 0.00112 U	< 0.00112 U	< 0.00112 U	< 0.00102 U	< 0.000985 U
1,1,2-Trichloroethane	0.0201	< 0.000942 U	< 0.000936 U	< 0.000942 U	< 0.000859 U	< 0.000826 U
1,1-Dichloroethane	18.4941	< 0.00112 U	< 0.00112 U	< 0.00112 U	< 0.00102 U	< 0.000985 U
1,1-Dichloroethene	0.0501	< 0.00157 U	< 0.00156 U	< 0.00157 U	< 0.00144 U	< 0.00138 U
1,2-Dichloroethane	0.0137	< 0.00116 U	< 0.00115 U	< 0.00116 U	< 0.00106 U	< 0.00102 U
1,2-Dichloroethene, Total	N/A	< 0.00245 U	< 0.00244 U	< 0.00245 U	< 0.00224 U	< 0.00215 U
1,2-Dichloropropane	0.0228	< 0.000916 U	< 0.000910 U	< 0.000916 U	< 0.000836 U	< 0.000803 U
2-Butanone (MEK)	29.2869	< 0.00245 U	< 0.00244 U	**0.0165**	< 0.00224 U	< 0.00215 U
2-Hexanone	0.3227	< 0.00130 U	< 0.00129 U	< 0.00130 U	< 0.00119 U	< 0.00114 U
4-Methyl-2-pentanone (MIBK)	4.9486	< 0.00190 U	< 0.00188 U	< 0.00190 U	< 0.00173 U	< 0.00166 U
Acetone	42.7422	< 0.00214 U	< 0.00213 U	**0.0549**	< 0.00195 U	**0.00799 J**
Benzene	0.0257	**0.000959 J**	< 0.000808 U	< 0.000813 U	< 0.000741 U	< 0.000713 U
Chlorobromomethane	3.0393	< 0.00230 U	< 0.00228 U	< 0.00230 U	< 0.00209 U	< 0.00201 U
Bromodichloromethane	0.0654	< 0.000852 U	< 0.000846 U	< 0.000852 U	< 0.000777 U	< 0.000747 U
Bromoform	0.6312	< 0.00177 U	< 0.00176 U	< 0.00177 U	< 0.00161 U	< 0.00155 U
Bromomethane	0.1307	< 0.00107 U	< 0.00106 U	< 0.00107 U	< 0.000977 U	< 0.000939 U
Carbon Disulfide	13.5835	< 0.000710 U	< 0.000705 U	**0.00364 J**	< 0.000647 U	< 0.000622 U
Carbon Tetrachloride	0.0619	< 0.00146 U	< 0.00145 U	< 0.00146 U	< 0.00133 U	< 0.00128 U
Chlorobenzene	1.0925	< 0.00124 U	< 0.00123 U	< 0.00124 U	< 0.00113 U	< 0.00109 U
Chloroethane	30.9012	< 0.00181 U	< 0.00179 U	< 0.00181 U	< 0.00165 U	< 0.00158 U
Chloroform	1.0194	< 0.000852 U	< 0.000846 U	< 0.000852 U	< 0.000777 U	< 0.000747 U
Chloromethane	0.4052	< 0.00214 U	< 0.00213 U	< 0.00214 U	< 0.00195 U	< 0.00188 U
cis-1,2-Dichloroethene	0.2483	< 0.00107 U	< 0.00106 U	< 0.00107 U	< 0.000977 U	< 0.000939 U
cis-1,3-Dichloropropene	0.0066	< 0.000697 U	< 0.000692 U	< 0.000697 U	< 0.000635 U	< 0.000611 U
Dibromochloromethane	0.0491	< 0.00121 U	< 0.00120 U	< 0.00121 U	< 0.00111 U	< 0.00106 U
Ethylbenzene	7.6300	< 0.00132 U	< 0.00131 U	< 0.00132 U	< 0.00120 U	< 0.00115 U
m,p-Xylenes	105.2355	< 0.00196 U	< 0.00195 U	< 0.00196 U	< 0.00179 U	< 0.00172 U
Methylene Chloride	0.0131	< 0.00283 U	< 0.00281 U	**0.00932 J**	< 0.00258 U	< 0.00248 U
o-Xylene	70.7102	< 0.00146 U	< 0.00145 U	< 0.00146 U	< 0.00133 U	< 0.00128 U
Styrene	3.2547	< 0.000916 U	< 0.000910 U	< 0.000916 U	< 0.000836 U	< 0.000803 U
Tetrachloroethene	0.0502	< 0.000916 U	< 0.000910 U	< 0.000916 U	< 0.000836 U	< 0.000803 U
Toluene	8.2104	< 0.00178 U	< 0.00177 U	**0.00197 J**	< 0.00162 U	< 0.00156 U
trans-1,2-Dichloroethene	0.4902	< 0.00147 U	< 0.00146 U	< 0.00147 U	< 0.00134 U	< 0.00129 U
trans-1,3-Dichloropropene	0.0359	< 0.000748 U	< 0.000743 U	< 0.000748 U	< 0.000683 U	< 0.000656 U
Trichloroethene	0.0336	< 0.00181 U	< 0.00179 U	< 0.00181 U	< 0.00165 U	< 0.00158 U
Vinyl Acetate	53.3713	< 0.00120 U	< 0.00119 U	< 0.00120 U	< 0.00109 U	< 0.00105 U
Vinyl Chloride	0.0223	< 0.00116 U	< 0.00115 U	< 0.00116 U	< 0.00106 U	< 0.00102 U
Xylenes, Total	122.5218	< 0.00146 U	< 0.00145 U	< 0.00146 U	< 0.00133 U	< 0.00128 U

Table 4D.5B
Soil Data Summary
Volatile Organic Compounds and Semivolatile Organic Compounds (2014)

	Sample ID	MW-43 (8-10)	2014-FFTA-06 (0.-0.5)	2014-FFTA-06 (0.5-2)	2014-FFTA-07 (0-0.5)	2014-FFTA-07 (0.5-2)
	Location ID	MW-43	2014-FFTA-06	2014-FFTA-06	2014-FFTA-07	2014-FFTA-07
	Date Sampled	2014-01-07	2014-04-01	2014-04-01	2014-04-01	2014-04-01
	Units	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
Analyte	**Soil RAL[1]**					
Volatile Organic Compounds (SW8260B)						
1,1,1-Trichloroethane	1.6201	< 0.000879 U	< 0.000888 U	NA	< 0.000897 U	NA
1,1,2,2-Tetrachloroethane	0.0231	< 0.00103 U	< 0.00104 U	NA	< 0.00105 U	NA
1,1,2-Trichloroethane	0.0201	< 0.000867 U	< 0.000876 U	NA	< 0.000885 U	NA
1,1-Dichloroethane	18.4941	< 0.00103 U	< 0.00104 U	NA	< 0.00105 U	NA
1,1-Dichloroethene	0.0501	< 0.00145 U	< 0.00146 U	NA	< 0.00148 U	NA
1,2-Dichloroethane	0.0137	< 0.00107 U	< 0.00108 U	NA	< 0.00109 U	NA
1,2-Dichloroethene, Total	N/A	< 0.00226 U	< 0.00228 U	NA	< 0.00230 U	NA
1,2-Dichloropropane	0.0228	< 0.000843 U	< 0.000852 U	NA	< 0.000861 U	NA
2-Butanone (MEK)	29.2869	< 0.00226 U	< 0.00228 U	NA	< 0.00230 U	NA
2-Hexanone	0.3227	< 0.00120 U	< 0.00121 U	NA	< 0.00122 U	NA
4-Methyl-2-pentanone (MIBK)	4.9486	< 0.00175 U	< 0.00176 U	NA	< 0.00178 U	NA
Acetone	42.7422	**0.0714 J**	< 0.00199 UJL	NA	< 0.00201 UJL	NA
Benzene	0.0257	**0.00106 J**	< 0.000756 U	NA	< 0.000764 U	NA
Chlorobromomethane	3.0393	< 0.00211 U	< 0.00214 U	NA	< 0.00216 U	NA
Bromodichloromethane	0.0654	< 0.000784 U	< 0.000792 U	NA	< 0.000800 U	NA
Bromoform	0.6312	< 0.00163 U	< 0.00164 U	NA	< 0.00166 U	NA
Bromomethane	0.1307	< 0.000986 U	< 0.000996 U	NA	< 0.00101 U	NA
Carbon Disulfide	13.5835	**0.00265 J**	< 0.000660 U	NA	< 0.000667 U	NA
Carbon Tetrachloride	0.0619	< 0.00134 U	< 0.00136 U	NA	< 0.00137 U	NA
Chlorobenzene	1.0925	< 0.00114 U	< 0.00115 U	NA	< 0.00116 U	NA
Chloroethane	30.9012	< 0.00166 U	< 0.00168 U	NA	< 0.00170 U	NA
Chloroform	1.0194	< 0.000784 U	< 0.000792 U	NA	< 0.000800 U	NA
Chloromethane	0.4052	< 0.00197 U	< 0.00199 U	NA	< 0.00201 U	NA
cis-1,2-Dichloroethene	0.2483	< 0.000986 U	< 0.000996 U	NA	< 0.00101 U	NA
cis-1,3-Dichloropropene	0.0066	< 0.000641 U	< 0.000648 U	NA	< 0.000655 U	NA
Dibromochloromethane	0.0491	< 0.00112 U	< 0.00113 U	NA	< 0.00114 U	NA
Ethylbenzene	7.6300	< 0.00121 U	< 0.00122 U	NA	< 0.00124 U	NA
m,p-Xylenes	105.2355	< 0.00181 U	< 0.00182 U	NA	< 0.00184 U	NA
Methylene Chloride	0.0131	< 0.00260 U	**0.0110 J**	**0.00756 JH**	< 0.00266 U	NA
o-Xylene	70.7102	< 0.00134 U	< 0.00136 U	NA	< 0.00137 U	NA
Styrene	3.2547	< 0.000843 U	< 0.000852 U	NA	< 0.000861 U	NA
Tetrachloroethene	0.0502	< 0.000843 U	< 0.000852 U	NA	< 0.000861 U	NA
Toluene	8.2104	< 0.00164 U	< 0.00166 U	NA	< 0.00167 U	NA
trans-1,2-Dichloroethene	0.4902	< 0.00135 U	< 0.00137 U	NA	< 0.00138 U	NA
trans-1,3-Dichloropropene	0.0359	< 0.000689 U	< 0.000696 U	NA	< 0.000703 U	NA
Trichloroethene	0.0336	< 0.00166 U	< 0.00168 U	NA	< 0.00170 U	NA
Vinyl Acetate	53.3713	< 0.00110 U	< 0.00112 UJL	NA	< 0.00113 UJL	NA
Vinyl Chloride	0.0223	< 0.00107 U	< 0.00108 U	NA	< 0.00109 U	NA
Xylenes, Total	122.5218	< 0.00134 U	< 0.00136 U	NA	< 0.00137 U	NA

Table 4D.5B
Soil Data Summary
Volatile Organic Compounds and Semivolatile Organic Compounds (2014)

	Sample ID	2014-FFTA-08 (0-0.5)	2014-FFTA-08 (0.5-2)	2014-NDA-7 (0-0.5)	DUP-4	2014-NDA-7 (0.5-2)
	Location ID	2014-FFTA-08	2014-FFTA-08	2014-NDA-7	2014-NDA-7	2014-NDA-7
	Date Sampled	2014-04-01	2014-04-01	4/1/2014	4/1/2014	2014-04-01
	Units	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
Analyte	**Soil RAL[1]**					
Volatile Organic Compounds (SW8260B)						
1,1,1-Trichloroethane	1.6201	< 0.000830 U	NA	< 0.000895 U	< 0.000851 U	NA
1,1,2,2-Tetrachloroethane	0.0231	< 0.000976 U	NA	< 0.00105 U	< 0.00100 U	NA
1,1,2-Trichloroethane	0.0201	< 0.000819 U	NA	< 0.000883 U	< 0.000840 U	NA
1,1-Dichloroethane	18.4941	< 0.000976 U	NA	< 0.00105 U	< 0.00100 U	NA
1,1-Dichloroethene	0.0501	< 0.00137 U	NA	< 0.00148 U	< 0.00140 U	NA
1,2-Dichloroethane	0.0137	< 0.00101 U	NA	< 0.00109 U	< 0.00104 U	NA
1,2-Dichloroethene, Total	N/A	< 0.00213 U	NA	< 0.00230 U	< 0.00219 U	NA
1,2-Dichloropropane	0.0228	< 0.000797 U	NA	< 0.000859 U	< 0.000817 U	NA
2-Butanone (MEK)	29.2869	< 0.00213 U	NA	< 0.00230 U	< 0.00219 U	NA
2-Hexanone	0.3227	< 0.00113 U	NA	< 0.00122 U	< 0.00116 U	NA
4-Methyl-2-pentanone (MIBK)	4.9486	< 0.00165 U	NA	< 0.00178 U	< 0.00169 U	NA
Acetone	42.7422	< 0.00186 UJL	NA	< 0.00201 UJL	< 0.00191 UJL	NA
Benzene	0.0257	< 0.000707 U	NA	< 0.000762 U	< 0.000725 U	NA
Chlorobromomethane	3.0393	< 0.00200 U	NA	< 0.00215 U	< 0.00205 U	NA
Bromodichloromethane	0.0654	< 0.000741 U	NA	< 0.000798 U	< 0.000759 U	NA
Bromoform	0.6312	< 0.00154 U	NA	< 0.00166 U	< 0.00158 U	NA
Bromomethane	0.1307	< 0.000931 U	NA	< 0.00100 U	< 0.000955 U	NA
Carbon Disulfide	13.5835	< 0.000617 U	NA	< 0.000665 U	< 0.000633 U	NA
Carbon Tetrachloride	0.0619	< 0.00127 U	NA	< 0.00137 U	< 0.00130 U	NA
Chlorobenzene	1.0925	< 0.00108 U	NA	< 0.00116 U	< 0.00110 U	NA
Chloroethane	30.9012	< 0.00157 U	NA	< 0.00169 U	< 0.00161 U	NA
Chloroform	1.0194	< 0.000741 U	NA	< 0.000798 U	< 0.000759 U	NA
Chloromethane	0.4052	< 0.00186 U	NA	< 0.00201 U	< 0.00191 U	NA
cis-1,2-Dichloroethene	0.2483	< 0.000931 U	NA	< 0.00100 U	< 0.000955 U	NA
cis-1,3-Dichloropropene	0.0066	< 0.000606 U	NA	< 0.000653 U	< 0.000621 U	NA
Dibromochloromethane	0.0491	< 0.00105 U	NA	< 0.00114 U	< 0.00108 U	NA
Ethylbenzene	7.6300	< 0.00114 U	NA	< 0.00123 U	< 0.00117 U	NA
m,p-Xylenes	105.2355	< 0.00171 U	NA	< 0.00184 U	< 0.00175 U	NA
Methylene Chloride	0.0131	< 0.00246 U	NA	**0.00530 J**	**0.0183**	< 0.00274 UJL
o-Xylene	70.7102	< 0.00127 U	NA	< 0.00137 U	< 0.00130 U	NA
Styrene	3.2547	< 0.000797 U	NA	< 0.000859 U	< 0.000817 U	NA
Tetrachloroethene	0.0502	**0.00177 J**	NA	< 0.000859 U	< 0.000817 U	NA
Toluene	8.2104	< 0.00155 U	NA	< 0.00167 U	< 0.00159 U	NA
trans-1,2-Dichloroethene	0.4902	< 0.00128 U	NA	< 0.00138 U	< 0.00131 U	NA
trans-1,3-Dichloropropene	0.0359	< 0.000651 U	NA	< 0.000701 U	< 0.000667 U	NA
Trichloroethene	0.0336	< 0.00157 U	NA	< 0.00169 U	< 0.00161 U	NA
Vinyl Acetate	53.3713	< 0.00104 UJL	NA	< 0.00112 UJL	< 0.00107 UJL	NA
Vinyl Chloride	0.0223	< 0.00101 U	NA	< 0.00109 U	< 0.00104 U	NA
Xylenes, Total	122.5218	< 0.00127 U	NA	< 0.00137 U	< 0.00130 U	NA

Table 4D.5B
Soil Data Summary
Volatile Organic Compounds and Semivolatile Organic Compounds (2014)

	Sample ID	2013-FFTA-01 (0.25-2)	2013-FFTA-02 (0.25-2)	2013-FFTA-03 (0-2)	2013-FFTA-03 (14-16)	2013-FFTA-03 (18-19)
	Location ID	2013-FFTA-01	2013-FFTA-02	2013-FFTA-03	2013-FFTA-03	2013-FFTA-03
	Date Sampled	2014-01-08	2014-01-07	2014-01-07	2014-01-07	2014-01-08
	Units	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
Analyte	**Soil RAL[1]**					
Semivolatile Organic Compounds (SW8270C)						
1,2,4-Trichlorobenzene	4.7914	< 0.107 U	< 0.00487 U	< 0.00548 U	< 0.00537 U	< 0.00449 U
1,2-Dichlorobenzene	17.8854	< 0.153 U	< 0.00700 U	< 0.00788 U	< 0.00773 U	< 0.00646 U
1,3-Dichlorobenzene	6.7457	< 0.0782 U	< 0.00357 U	< 0.00402 U	< 0.00394 U	< 0.00329 U
1,4-Dichlorobenzene	2.1027	< 0.114 U	< 0.00522 U	< 0.00587 U	< 0.00576 U	< 0.00481 U
1-Methylnaphthalene	2.9449	NA	NA	NA	NA	NA
2,4,5-Trichlorophenol	33.8194	< 0.508 U	< 0.0232 U	< 0.0261 U	< 0.0256 U	< 0.0214 U
2,4,6-Trichlorophenol	0.1749	< 0.136 U	< 0.00621 U	< 0.00699 U	< 0.00686 U	< 0.00573 U
2,4-Dichlorophenol	0.3517	< 0.197 U	< 0.00897 U	< 0.0101 U	< 0.00990 U	< 0.00827 U
2,4-Dimethylphenol	3.2341	< 0.436 U	< 0.0199 U	< 0.0224 U	< 0.0220 U	< 0.0183 U
2,4-Dinitrophenol	0.0937	< 0.240 U	< 0.0109 U	< 0.0123 U	< 0.0121 U	< 0.0101 U
2,4-Dinitrotoluene	0.0053	< 0.183 U	< 0.00837 U	< 0.00942 U	< 0.00924 U	< 0.00772 U
2,6-Dinitrotoluene	0.0048	< 0.150 U	< 0.00684 U	< 0.00770 U	< 0.00755 U	< 0.00631 U
2-Chloronaphthalene	669.5835	< 0.0614 U	< 0.00281 U	< 0.00316 U	< 0.00310 U	< 0.00259 U
2-Chlorophenol	1.6325	< 0.100 U	< 0.00457 U	< 0.00514 U	< 0.00504 U	< 0.00421 U
2-Methylnaphthalene	17.0674	< 0.139 U	< 0.00635 U	< 0.00715 U	< 0.00701 U	**0.0311 J**
2-Methylphenol	7.1191	< 0.164 U	< 0.00749 U	< 0.00843 U	< 0.00827 U	< 0.00691 U
2-Nitroaniline	0.0219	< 0.248 U	< 0.0113 U	< 0.0128 U	< 0.0125 U	< 0.0105 U
2-Nitrophenol	0.1345	< 0.198 U	< 0.00902 U	< 0.0101 U	< 0.00995 U	< 0.00832 U
3,3'-Dichlorobenzidine	0.0626	< 0.516 U	< 0.0236 U	< 0.0265 U	< 0.0260 U	< 0.0217 U
3-Nitroaniline	0.0256	< 0.363 U	< 0.0166 U	< 0.0187 U	< 0.0183 U	< 0.0153 U
4,6-Dinitro-2-methylphenol	0.0047	< 0.253 U	< 0.0115 U	< 0.0130 U	< 0.0127 U	< 0.0106 U
4-Bromophenyl Phenyl Ether	0.2756	< 0.144 U	< 0.00658 U	< 0.00741 U	< 0.00727 U	< 0.00607 U
4-Chloro-3-methylphenol	4.5285	< 0.791 U	< 0.0361 U	< 0.0407 U	< 0.0399 U	< 0.0333 U
4-Chloroaniline	0.0208	< 0.296 U	< 0.0135 U	< 0.0152 U	< 0.0149 U	< 0.0124 U
4-Chlorophenyl-phenylether	0.0320	< 0.0914 U	< 0.00417 U	< 0.00470 U	< 0.00461 U	< 0.00385 U
4-Nitroaniline	0.1079	< 0.566 U	< 0.0259 U	< 0.0291 U	< 0.0285 U	< 0.0238 U
4-Nitrophenol	0.0999	< 0.258 U	< 0.0118 U	< 0.0133 U	< 0.0130 U	< 0.0109 U
Acenaphthene	236.3663	< 0.0731 U	< 0.00334 U	< 0.00376 U	< 0.00368 U	< 0.00308 U
Acenaphthylene	408.6605	< 0.0508 U	< 0.00232 U	< 0.00261 U	< 0.00256 U	< 0.00214 U
Anthracene	6889.8406	< 0.0650 U	< 0.00297 U	**0.00480 J**	< 0.00328 U	< 0.00274 U
Benzidine	0.000011	< 0.458 UJ	< 0.0209 U	< 0.0235 U	< 0.0231 U	< 0.0193 UJ
Benzo[a]anthracene	5.6534	< 0.0701 U	< 0.00320 U	< 0.00360 U	< 0.00353 U	< 0.00295 U
Benzo[a]pyrene	0.5640	< 0.0818 U	< 0.00373 U	< 0.00420 U	< 0.00412 U	< 0.00344 U
Benzo[b]fluoranthene	5.7133	< 0.0873 U	< 0.00399 U	< 0.00449 U	< 0.00440 U	< 0.00368 U
Benzo[g,h,i]perylene	1780.3406	< 0.257 U	< 0.0118 U	< 0.0132 U	< 0.0130 U	< 0.0108 U
Benzo[k]fluoranthene	57.2317	< 0.0757 U	< 0.00345 U	< 0.00389 U	< 0.00381 U	< 0.00319 U
Benzyl Alcohol	5.8590	< 0.296 U	< 0.0135 UJ	< 0.0152 UJ	< 0.0149 UJ	< 0.0125 UJ
Bis(2-chloroethoxy)methane	0.0118	< 0.0721 U	< 0.00329 U	< 0.00370 U	< 0.00363 U	< 0.00304 U
Bis(2-chloroethyl) Ether	0.0021	< 0.0838 U	< 0.00383 U	< 0.00431 U	< 0.00422 U	< 0.00353 U
Bis(2-chloroisopropyl) Ether	0.1900	< 0.449 U	< 0.0205 U	< 0.0231 U	< 0.0226 U	< 0.0189 U
Bis(2-ethylhexyl) Phthalate	43.1577	< 0.273 U	**0.0778 J**	**0.0146 J**	**0.0624 J**	**0.0326 J**
Butylbenzyl Phthalate	264.9883	< 0.314 U	0.0306 U*	0.0259 U *	0.0402 U*	< 0.0132 U
Carbazole	4.5677	< 0.158 U	< 0.00723 U	< 0.00814 U	< 0.00798 U	< 0.00667 U

Table 4D.5B
Soil Data Summary
Volatile Organic Compounds and Semivolatile Organic Compounds (2014)

	Sample ID	2013-MB-3 (0.75-1.25)	2013-MB-4 (0.83-1.33)	2013-MB-5 (0.5-5)	2013-MB-5 (10-12)	MW-27A (0-2)
	Location ID	2013-MB-3	2013-MB-4	2013-MB-5	2013-MB-5	MW-27A
	Date Sampled	2014-01-08	2014-01-08	2014-01-08	2014-01-08	2014-01-09
	Units	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
Analyte	**Soil RAL[1]**					
Semivolatile Organic Compounds (SW8270C)						
1,2,4-Trichlorobenzene	4.7914	NA	NA	< 0.00545 U	< 0.560 U	NA
1,2-Dichlorobenzene	17.8854	NA	NA	< 0.00784 U	< 0.805 U	NA
1,3-Dichlorobenzene	6.7457	NA	NA	< 0.00400 U	< 0.411 U	NA
1,4-Dichlorobenzene	2.1027	NA	NA	< 0.00584 U	< 0.600 U	NA
1-Methylnaphthalene	2.9449	NA	NA	NA	NA	**0.00693 J**
2,4,5-Trichlorophenol	33.8194	NA	NA	< 0.0260 U	< 2.67 U	NA
2,4,6-Trichlorophenol	0.1749	NA	NA	< 0.00695 U	< 0.715 U	NA
2,4-Dichlorophenol	0.3517	NA	NA	< 0.0100 U	< 1.03 U	NA
2,4-Dimethylphenol	3.2341	NA	NA	< 0.0223 U	< 2.29 U	NA
2,4-Dinitrophenol	0.0937	NA	NA	< 0.0122 U	< 1.26 U	NA
2,4-Dinitrotoluene	0.0053	NA	NA	< 0.00937 U	< 0.963 U	NA
2,6-Dinitrotoluene	0.0048	NA	NA	< 0.00765 U	< 0.787 U	NA
2-Chloronaphthalene	669.5835	NA	NA	< 0.00314 U	< 0.323 U	NA
2-Chlorophenol	1.6325	NA	NA	< 0.00511 U	< 0.525 U	NA
2-Methylnaphthalene	17.0674	NA	NA	**0.0887**	**3.19 J**	**0.0146 J**
2-Methylphenol	7.1191	NA	NA	< 0.00838 U	< 0.861 U	NA
2-Nitroaniline	0.0219	NA	NA	< 0.0127 U	< 1.30 U	NA
2-Nitrophenol	0.1345	NA	NA	< 0.0101 U	< 1.04 U	NA
3,3'-Dichlorobenzidine	0.0626	NA	NA	< 0.0264 U	< 2.71 U	NA
3-Nitroaniline	0.0256	NA	NA	< 0.0186 U	< 1.91 U	NA
4,6-Dinitro-2-methylphenol	0.0047	NA	NA	< 0.0129 U	< 1.33 U	NA
4-Bromophenyl Phenyl Ether	0.2756	NA	NA	< 0.00737 U	< 0.757 U	NA
4-Chloro-3-methylphenol	4.5285	NA	NA	< 0.0404 U	< 4.16 U	NA
4-Chloroaniline	0.0208	NA	NA	< 0.0151 U	< 1.55 U	NA
4-Chlorophenyl-phenylether	0.0320	NA	NA	< 0.00467 U	< 0.480 U	NA
4-Nitroaniline	0.1079	NA	NA	< 0.0289 U	< 2.97 U	NA
4-Nitrophenol	0.0999	NA	NA	< 0.0132 U	< 1.35 U	NA
Acenaphthene	236.3663	NA	NA	< 0.00374 U	< 0.384 U	< 0.00366 U
Acenaphthylene	408.6605	NA	NA	< 0.00259 U	< 0.267 U	< 0.00254 U
Anthracene	6889.8406	NA	NA	< 0.00332 U	< 0.341 U	**0.00760 J**
Benzidine	0.000011	NA	NA	< 0.0234 UJ	< 2.41 UJ	NA
Benzo[a]anthracene	5.6534	NA	NA	**0.00823 J**	< 0.368 U	**0.0138 J**
Benzo[a]pyrene	0.5640	NA	NA	< 0.00418 U	< 0.429 U	< 0.00409 U
Benzo[b]fluoranthene	5.7133	NA	NA	< 0.00446 U	< 0.459 U	< 0.00437 U
Benzo[g,h,i]perylene	1780.3406	NA	NA	< 0.0132 U	< 1.35 U	< 0.0129 U
Benzo[k]fluoranthene	57.2317	NA	NA	< 0.00387 U	< 0.397 U	< 0.00379 U
Benzyl Alcohol	5.8590	NA	NA	< 0.0151 UJ	< 1.55 U	NA
Bis(2-chloroethoxy)methane	0.0118	NA	NA	< 0.00368 U	< 0.379 U	NA
Bis(2-chloroethyl) Ether	0.0021	NA	NA	< 0.00428 U	< 0.440 U	NA
Bis(2-chloroisopropyl) Ether	0.1900	NA	NA	< 0.0229 U	< 2.36 U	NA
Bis(2-ethylhexyl) Phthalate	43.1577	NA	NA	**0.0788 J**	< 1.43 U	NA
Butylbenzyl Phthalate	264.9883	NA	NA	< 0.0161 U	< 1.65 U	NA
Carbazole	4.5677	NA	NA	**0.0224 J**	< 0.832 U	NA

Table 4D.5B
Soil Data Summary
Volatile Organic Compounds and Semivolatile Organic Compounds (2014)

	Sample ID	MW-27B (0-2)	MW-27C (0-2)	MW-27D (0.5-2)	MW-43 (0-2)	MW-43 (17-20)
	Location ID	MW-27B	MW-27C	MW-27D	MW-43	MW-43
	Date Sampled	2014-01-09	2014-01-08	2014-01-08	2014-01-07	2014-01-07
	Units	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
Analyte	**Soil RAL[1]**					
Semivolatile Organic Compounds (SW8270C)						
1,2,4-Trichlorobenzene	4.7914	NA	NA	NA	< 0.492 U	< 0.00475 U
1,2-Dichlorobenzene	17.8854	NA	NA	NA	< 0.707 U	< 0.00683 U
1,3-Dichlorobenzene	6.7457	NA	NA	NA	< 0.361 U	< 0.00348 U
1,4-Dichlorobenzene	2.1027	NA	NA	NA	< 0.527 U	< 0.00509 U
1-Methylnaphthalene	2.9449	< 0.0809 U	< 0.00399 U	< 0.00404 U	NA	NA
2,4,5-Trichlorophenol	33.8194	NA	NA	NA	< 2.34 U	< 0.0226 U
2,4,6-Trichlorophenol	0.1749	NA	NA	NA	< 0.628 U	< 0.00606 U
2,4-Dichlorophenol	0.3517	NA	NA	NA	< 0.907 U	< 0.00875 U
2,4-Dimethylphenol	3.2341	NA	NA	NA	< 2.01 U	< 0.0194 U
2,4-Dinitrophenol	0.0937	NA	NA	NA	< 1.11 U	< 0.0107 U
2,4-Dinitrotoluene	0.0053	NA	NA	NA	< 0.846 U	< 0.00816 U
2,6-Dinitrotoluene	0.0048	NA	NA	NA	< 0.691 U	< 0.00667 U
2-Chloronaphthalene	669.5835	NA	NA	NA	< 0.283 U	< 0.00273 U
2-Chlorophenol	1.6325	NA	NA	NA	< 0.462 U	< 0.00445 U
2-Methylnaphthalene	17.0674	< 0.141 U	**0.00706 J**	< 0.00704 U	< 0.642 U	< 0.00619 U
2-Methylphenol	7.1191	NA	NA	NA	< 0.757 U	< 0.00730 U
2-Nitroaniline	0.0219	NA	NA	NA	< 1.15 U	< 0.0111 U
2-Nitrophenol	0.1345	NA	NA	NA	< 0.911 U	< 0.00879 U
3,3'-Dichlorobenzidine	0.0626	NA	NA	NA	< 2.38 U	< 0.0230 U
3-Nitroaniline	0.0256	NA	NA	NA	< 1.67 U	< 0.0162 U
4,6-Dinitro-2-methylphenol	0.0047	NA	NA	NA	< 1.17 U	< 0.0113 U
4-Bromophenyl Phenyl Ether	0.2756	NA	NA	NA	< 0.665 U	< 0.00642 U
4-Chloro-3-methylphenol	4.5285	NA	NA	NA	< 3.65 U	< 0.0352 U
4-Chloroaniline	0.0208	NA	NA	NA	< 1.36 U	< 0.0132 U
4-Chlorophenyl-phenylether	0.0320	NA	NA	NA	< 0.422 U	< 0.00407 U
4-Nitroaniline	0.1079	NA	NA	NA	< 2.61 U	< 0.0252 U
4-Nitrophenol	0.0999	NA	NA	NA	< 1.19 U	< 0.0115 U
Acenaphthene	236.3663	< 0.0742 U	< 0.00366 U	< 0.00370 U	< 0.337 U	< 0.00325 U
Acenaphthylene	408.6605	< 0.0516 U	< 0.00254 U	< 0.00257 U	< 0.234 U	< 0.00226 U
Anthracene	6889.8406	< 0.0660 U	**0.00824 J**	< 0.00329 U	< 0.300 U	< 0.00289 U
Benzidine	0.000011	NA	NA	NA	< 2.11 U	< 0.0204 U
Benzo[a]anthracene	5.6534	< 0.0711 U	**0.0123 J**	< 0.00355 U	< 0.323 U	< 0.00312 U
Benzo[a]pyrene	0.5640	< 0.0830 U	**0.0138 J**	< 0.00414 U	< 0.377 U	< 0.00364 U
Benzo[b]fluoranthene	5.7133	< 0.0887 U	**0.0202 J**	< 0.00442 U	< 0.403 U	< 0.00389 U
Benzo[g,h,i]perylene	1780.3406	< 0.261 U	< 0.0129 U	< 0.0130 U	< 1.19 U	< 0.0115 U
Benzo[k]fluoranthene	57.2317	< 0.0768 U	< 0.00379 U	< 0.00383 U	< 0.349 U	< 0.00337 U
Benzyl Alcohol	5.8590	NA	NA	NA	< 1.37 U	< 0.0132 UJ
Bis(2-chloroethoxy)methane	0.0118	NA	NA	NA	< 0.333 U	< 0.00321 U
Bis(2-chloroethyl) Ether	0.0021	NA	NA	NA	< 0.387 U	< 0.00373 U
Bis(2-chloroisopropyl) Ether	0.1900	NA	NA	NA	< 2.07 U	< 0.0200 U
Bis(2-ethylhexyl) Phthalate	43.1577	NA	NA	NA	**39.6**	**0.0232 J**
Butylbenzyl Phthalate	264.9883	NA	NA	NA	< 1.45 U	0.0267 U*
Carbazole	4.5677	NA	NA	NA	< 0.731 U	< 0.00705 U

Table 4D.5B
Soil Data Summary
Volatile Organic Compounds and Semivolatile Organic Compounds (2014)

	Sample ID	MW-43 (8-10)	2014-FFTA-06 (0.-0.5)	2014-FFTA-06 (0.5-2)	2014-FFTA-07 (0-0.5)	2014-FFTA-07 (0.5-2)
	Location ID	MW-43	2014-FFTA-06	2014-FFTA-06	2014-FFTA-07	2014-FFTA-07
	Date Sampled	2014-01-07	2014-04-01	2014-04-01	2014-04-01	2014-04-01
	Units	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
Analyte	**Soil RAL[1]**					
Semivolatile Organic Compounds (SW8270C)						
1,2,4-Trichlorobenzene	4.7914	< 0.00497 U	< 0.00251 U	NA	< 0.0126 U	NA
1,2-Dichlorobenzene	17.8854	< 0.00715 U	< 0.00361 U	NA	< 0.0182 U	NA
1,3-Dichlorobenzene	6.7457	< 0.00364 U	< 0.00184 UJL	NA	< 0.00927 UJL	NA
1,4-Dichlorobenzene	2.1027	< 0.00532 U	< 0.00269 UJL	NA	< 0.0135 UJL	NA
1-Methylnaphthalene	2.9449	NA	NA	NA	NA	NA
2,4,5-Trichlorophenol	33.8194	< 0.0237 U	< 0.0120 U	NA	< 0.0602 U	NA
2,4,6-Trichlorophenol	0.1749	< 0.00634 U	< 0.00321 U	NA	< 0.0161 U	NA
2,4-Dichlorophenol	0.3517	< 0.00916 U	< 0.00463 U	NA	< 0.0233 U	NA
2,4-Dimethylphenol	3.2341	< 0.0203 U	< 0.0103 U	NA	< 0.0516 U	NA
2,4-Dinitrophenol	0.0937	< 0.0112 U	< 0.00565 U	NA	< 0.0284 U	NA
2,4-Dinitrotoluene	0.0053	< 0.00854 U	< 0.00432 U	NA	< 0.0217 U	NA
2,6-Dinitrotoluene	0.0048	< 0.00698 U	< 0.00353 U	NA	< 0.0178 U	NA
2-Chloronaphthalene	669.5835	< 0.00286 U	< 0.00145 U	NA	< 0.00728 U	NA
2-Chlorophenol	1.6325	< 0.00466 U	< 0.00236 U	NA	< 0.0119 U	NA
2-Methylnaphthalene	17.0674	< 0.00648 U	< 0.00328 U	NA	**0.0181 J**	NA
2-Methylphenol	7.1191	< 0.00764 U	< 0.00386 U	NA	< 0.0194 U	NA
2-Nitroaniline	0.0219	< 0.0116 U	< 0.00585 U	NA	< 0.0294 U	NA
2-Nitrophenol	0.1345	< 0.00920 U	< 0.00465 U	NA	< 0.0234 U	NA
3,3'-Dichlorobenzidine	0.0626	< 0.0240 U	< 0.0122 R	NA	< 0.0611 R	NA
3-Nitroaniline	0.0256	< 0.0169 U	< 0.00855 UJL	NA	< 0.0430 UJL	NA
4,6-Dinitro-2-methylphenol	0.0047	< 0.0118 U	< 0.00596 U	NA	< 0.0300 U	NA
4-Bromophenyl Phenyl Ether	0.2756	< 0.00672 U	< 0.00340 U	NA	< 0.0171 U	NA
4-Chloro-3-methylphenol	4.5285	< 0.0369 U	< 0.0186 UJL	NA	< 0.0938 UJL	NA
4-Chloroaniline	0.0208	< 0.0138 U	< 0.00696 UJL	NA	< 0.0350 UJL	NA
4-Chlorophenyl-phenylether	0.0320	< 0.00426 U	< 0.00215 U	NA	< 0.0108 U	NA
4-Nitroaniline	0.1079	< 0.0264 U	< 0.0133 U	NA	< 0.0671 U	NA
4-Nitrophenol	0.0999	< 0.0120 U	< 0.00608 U	NA	< 0.0306 U	NA
Acenaphthene	236.3663	< 0.00341 U	< 0.00172 U	NA	< 0.00867 U	NA
Acenaphthylene	408.6605	< 0.00237 U	< 0.00120 U	NA	< 0.00602 U	NA
Anthracene	6889.8406	< 0.00303 U	< 0.00153 U	NA	< 0.00770 U	NA
Benzidine	0.000011	< 0.0213 U	< 0.0108 R	NA	< 0.0543 R	NA
Benzo[a]anthracene	5.6534	< 0.00327 U	< 0.00165 U	NA	< 0.00830 U	NA
Benzo[a]pyrene	0.5640	< 0.00381 U	< 0.00193 U	NA	< 0.00969 U	NA
Benzo[b]fluoranthene	5.7133	< 0.00407 U	< 0.00206 U	NA	< 0.0104 U	NA
Benzo[g,h,i]perylene	1780.3406	< 0.0120 U	< 0.00607 U	NA	< 0.0305 U	NA
Benzo[k]fluoranthene	57.2317	< 0.00353 U	< 0.00178 U	NA	< 0.00897 U	NA
Benzyl Alcohol	5.8590	< 0.0138 UJ	< 0.00697 R	NA	< 0.0351 R	NA
Bis(2-chloroethoxy)methane	0.0118	< 0.00336 U	< 0.00170 U	NA	< 0.00854 U	NA
Bis(2-chloroethyl) Ether	0.0021	< 0.00390 U	< 0.00197 U	NA	< 0.00993 U	NA
Bis(2-chloroisopropyl) Ether	0.1900	< 0.0209 U	< 0.0106 U	NA	< 0.0532 U	NA
Bis(2-ethylhexyl) Phthalate	43.1577	**0.0355 J**	**0.0595 J**	NA	< 0.0323 U	NA
Butylbenzyl Phthalate	264.9883	0.0199 U*	**0.0459 J**	NA	< 0.0372 U	NA
Carbazole	4.5677	< 0.00738 U	< 0.00373 U	NA	< 0.0188 U	NA

Table 4D.5B
Soil Data Summary
Volatile Organic Compounds and Semivolatile Organic Compounds (2014)

	Sample ID	2014-FFTA-08 (0-0.5)	2014-FFTA-08 (0.5-2)	2014-NDA-7 (0-0.5)	DUP-4	2014-NDA-7 (0.5-2)
	Location ID	2014-FFTA-08	2014-FFTA-08	2014-NDA-7	2014-NDA-7	2014-NDA-7
	Date Sampled	2014-04-01	2014-04-01	4/1/2014	4/1/2014	2014-04-01
	Units	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
Analyte	**Soil RAL[1]**					
Semivolatile Organic Compounds (SW8270C)						
1,2,4-Trichlorobenzene	4.7914	< 0.00234 U	NA	< 0.0253 U	< 0.00240 U	NA
1,2-Dichlorobenzene	17.8854	< 0.00336 U	NA	< 0.0364 U	< 0.00345 U	NA
1,3-Dichlorobenzene	6.7457	< 0.00171 UJL	NA	< 0.0186 UJL	< 0.00176 UJL	NA
1,4-Dichlorobenzene	2.1027	< 0.00250 UJL	NA	< 0.0271 UJL	< 0.00257 UJL	NA
1-Methylnaphthalene	2.9449	NA	NA	NA	NA	NA
2,4,5-Trichlorophenol	33.8194	< 0.0111 U	NA	< 0.121 U	< 0.0114 U	NA
2,4,6-Trichlorophenol	0.1749	< 0.00298 U	NA	< 0.0323 U	< 0.00306 U	NA
2,4-Dichlorophenol	0.3517	< 0.00431 U	NA	< 0.0466 U	< 0.00443 U	NA
2,4-Dimethylphenol	3.2341	< 0.00954 U	NA	< 0.103 U	< 0.00981 U	NA
2,4-Dinitrophenol	0.0937	< 0.00525 U	NA	< 0.0569 U	< 0.00540 U	NA
2,4-Dinitrotoluene	0.0053	< 0.00402 U	NA	< 0.0435 U	< 0.00413 U	NA
2,6-Dinitrotoluene	0.0048	< 0.00328 U	NA	< 0.0355 U	< 0.00337 U	NA
2-Chloronaphthalene	669.5835	< 0.00135 U	NA	< 0.0146 U	< 0.00138 U	NA
2-Chlorophenol	1.6325	< 0.00219 U	NA	< 0.0237 U	< 0.00225 U	NA
2-Methylnaphthalene	17.0674	**0.0270**	NA	< 0.0330 U	**0.0185 J**	NA
2-Methylphenol	7.1191	< 0.00359 U	NA	< 0.0389 U	< 0.00369 U	NA
2-Nitroaniline	0.0219	< 0.00544 U	NA	< 0.0589 U	< 0.00559 U	NA
2-Nitrophenol	0.1345	< 0.00433 U	NA	< 0.0469 U	< 0.00445 U	NA
3,3'-Dichlorobenzidine	0.0626	< 0.0113 R	NA	< 0.122 R	< 0.0116 R	NA
3-Nitroaniline	0.0256	< 0.00795 UJL	NA	< 0.0861 UJL	< 0.00818 UJL	NA
4,6-Dinitro-2-methylphenol	0.0047	< 0.00554 U	NA	< 0.0600 U	< 0.00570 U	NA
4-Bromophenyl Phenyl Ether	0.2756	< 0.00316 U	NA	< 0.0342 U	< 0.00325 U	NA
4-Chloro-3-methylphenol	4.5285	< 0.0173 UJL	NA	< 0.188 UJL	< 0.0178 UJL	NA
4-Chloroaniline	0.0208	< 0.00647 UJL	NA	< 0.0701 UJL	< 0.00666 UJL	NA
4-Chlorophenyl-phenylether	0.0320	< 0.00200 U	NA	< 0.0217 U	< 0.00206 U	NA
4-Nitroaniline	0.1079	< 0.0124 U	NA	< 0.134 U	< 0.0128 U	NA
4-Nitrophenol	0.0999	< 0.00565 U	NA	< 0.0612 U	< 0.00581 U	NA
Acenaphthene	236.3663	< 0.00160 U	NA	< 0.0173 U	< 0.00165 U	NA
Acenaphthylene	408.6605	< 0.00111 U	NA	< 0.0120 U	< 0.00114 U	NA
Anthracene	6889.8406	< 0.00142 U	NA	< 0.0154 U	< 0.00146 U	NA
Benzidine	0.000011	< 0.0100 R	NA	< 0.109 R	< 0.0103 R	NA
Benzo[a]anthracene	5.6534	< 0.00154 U	NA	< 0.0166 U	**0.00547 J**	NA
Benzo[a]pyrene	0.5640	< 0.00179 U	NA	< 0.0194 U	< 0.00184 U	NA
Benzo[b]fluoranthene	5.7133	< 0.00191 U	NA	< 0.0207 U	< 0.00197 U	NA
Benzo[g,h,i]perylene	1780.3406	< 0.00564 U	NA	< 0.0611 U	< 0.00580 U	NA
Benzo[k]fluoranthene	57.2317	< 0.00166 U	NA	< 0.0179 U	< 0.00170 U	NA
Benzyl Alcohol	5.8590	< 0.00649 R	NA	< 0.0702 R	< 0.00667 R	NA
Bis(2-chloroethoxy)methane	0.0118	< 0.00158 U	NA	< 0.0171 U	< 0.00162 U	NA
Bis(2-chloroethyl) Ether	0.0021	**0.0371**	< 0.00180 R	< 0.0199 U	< 0.00189 U	NA
Bis(2-chloroisopropyl) Ether	0.1900	< 0.00983 U	NA	< 0.106 U	< 0.0101 U	NA
Bis(2-ethylhexyl) Phthalate	43.1577	**0.132**	NA	< 0.0647 U	**0.0961**	NA
Butylbenzyl Phthalate	264.9883	**0.0257 J**	NA	< 0.0746 U	**0.0226 J**	NA
Carbazole	4.5677	< 0.00347 U	NA	< 0.0376 U	< 0.00357 U	NA

Table 4D.5B
Soil Data Summary
Volatile Organic Compounds and Semivolatile Organic Compounds (2014)

	Sample ID	2013-FFTA-01 (0.25-2)	2013-FFTA-02 (0.25-2)	2013-FFTA-03 (0-2)	2013-FFTA-03 (14-16)	2013-FFTA-03 (18-19)
	Location ID	2013-FFTA-01	2013-FFTA-02	2013-FFTA-03	2013-FFTA-03	2013-FFTA-03
	Date Sampled	2014-01-08	2014-01-07	2014-01-07	2014-01-07	2014-01-08
	Units	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
Analyte	**Soil RAL[1]**					
Semivolatile Organic Compounds (SW8270C)						
Chrysene	560.6295	< 0.0518 U	< 0.00236 U	< 0.00266 U	< 0.00261 U	< 0.00218 U
Dibenz[a,h]anthracene	0.5495	< 0.184 U	< 0.00842 U	< 0.00947 U	< 0.00929 U	< 0.00776 U
Dibenzofuran	33.3794	< 0.0904 U	< 0.00413 U	< 0.00464 U	< 0.00455 U	< 0.00381 U
Diethyl Phthalate	155.8510	< 0.428 U	0.234 U *	0.193 U*	0.192 U*	0.262 U *
Dimethyl Phthalate	62.2026	< 0.248 U	< 0.0113 U	**0.143 J**	**0.167 J**	< 0.0105 U
Di-n-Butyl Phthalate	3317.4922	< 0.132 U	0.126 U*	0.0216 U*	0.0318 U*	0.0914 U *
Di-n-octyl Phthalate	2578.3372	< 0.0965 U	< 0.00441 U	< 0.00496 U	< 0.00486 U	< 0.00406 U
Fluoranthene	1917.2596	< 0.158 U	< 0.00721 U	**0.0110 J**	< 0.00796 U	< 0.00665 U
Fluorene	298.5380	< 0.120 U	< 0.00547 U	< 0.00616 U	**0.0131 J**	< 0.00505 U
Hexachlorobenzene	1.0742	< 0.0772 U	< 0.00352 U	< 0.00397 U	< 0.00389 U	< 0.00325 U
Hexachlorobutadiene	3.2891	< 0.0975 U	< 0.00445 U	< 0.00501 U	< 0.00491 U	< 0.00411 U
Hexachlorocyclopentadiene	13.6896	< 0.234 U	< 0.0107 U	< 0.0120 U	< 0.0118 U	< 0.00986 U
Hexachloroethane	1.2851	< 0.117 U	< 0.00536 U	< 0.00603 U	< 0.00591 U	< 0.00494 U
Indeno[1,2,3-cd]pyrene	5.7223	< 0.178 U	< 0.00812 U	< 0.00913 U	< 0.00896 U	< 0.00748 U
Isophorone	3.0014	< 0.0508 U	< 0.00232 U	< 0.00261 U	< 0.00256 U	**0.153**
3 & 4 Methylphenol	0.6315	**0.355 J**	< 0.00647 U	< 0.00728 U	< 0.00714 U	**0.572**
Naphthalene	31.2462	< 0.0685 U	< 0.00313 U	**0.00410 J**	**0.00591 J**	**0.0150 J**
Nitrobenzene	0.3515	< 0.150 U	< 0.00686 U	< 0.00772 U	< 0.00757 U	< 0.00633 U
N-Nitrosodimethylamine	0.00004	< 0.213 U	< 0.00972 U	< 0.0109 U	< 0.0107 U	< 0.00896 U
N-Nitroso-di-n-propylamine	0.0004	< 0.113 U	< 0.00515 U	< 0.00579 U	< 0.00568 U	< 0.00475 U
N-Nitrosodiphenylamine	2.8235	< 0.0960 U	< 0.00438 U	< 0.00493 U	< 0.00484 U	< 0.00404 U
Pentachlorophenol	0.01832	< 0.203 U	< 0.00927 U	< 0.0104 U	< 0.0102 U	< 0.00855 U
Phenanthrene	415.7174	< 0.251 U	< 0.0115 U	< 0.0129 U	< 0.0127 U	**0.0116 J**
Phenol	19.1480	**0.726 J**	< 0.00983 U	< 0.0111 U	< 0.0109 U	**0.247**
Pyrene	1116.5148	< 0.0929 U	< 0.00424 U	**0.00630 J**	**0.0287 J**	< 0.00391 U

Table 4D.5B
Soil Data Summary
Volatile Organic Compounds and Semivolatile Organic Compounds (2014)

	Sample ID	2013-MB-3 (0.75-1.25)	2013-MB-4 (0.83-1.33)	2013-MB-5 (0.5-5)	2013-MB-5 (10-12)	MW-27A (0-2)
	Location ID	2013-MB-3	2013-MB-4	2013-MB-5	2013-MB-5	MW-27A
	Date Sampled	2014-01-08	2014-01-08	2014-01-08	2014-01-08	2014-01-09
	Units	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
Analyte	**Soil RAL[1]**					
Semivolatile Organic Compounds (SW8270C)						
Chrysene	560.6295	NA	NA	**0.0183 J**	< 0.272 U	**0.0361 JH**
Dibenz[a,h]anthracene	0.5495	NA	NA	< 0.00942 U	< 0.968 U	< 0.00923 U
Dibenzofuran	33.3794	NA	NA	< 0.00462 U	**6.33**	NA
Diethyl Phthalate	155.8510	NA	NA	0.263 U *	< 2.25 U	NA
Dimethyl Phthalate	62.2026	NA	NA	< 0.0127 U	< 1.30 U	NA
Di-n-Butyl Phthalate	3317.4922	NA	NA	0.0770 U *	< 0.691 U	NA
Di-n-octyl Phthalate	2578.3372	NA	NA	< 0.00493 U	< 0.507 U	NA
Fluoranthene	1917.2596	NA	NA	**0.0184 J**	< 0.829 U	< 0.00790 U
Fluorene	298.5380	NA	NA	< 0.00612 U	**6.48**	< 0.00600 U
Hexachlorobenzene	1.0742	NA	NA	< 0.00394 U	< 0.405 U	NA
Hexachlorobutadiene	3.2891	NA	NA	< 0.00498 U	< 0.512 U	NA
Hexachlorocyclopentadiene	13.6896	NA	NA	< 0.0120 U	< 1.23 U	NA
Hexachloroethane	1.2851	NA	NA	< 0.00599 U	< 0.616 U	NA
Indeno[1,2,3-cd]pyrene	5.7223	NA	NA	< 0.00908 U	< 0.933 U	< 0.00890 U
Isophorone	3.0014	NA	NA	< 0.00259 U	< 0.267 U	NA
3 & 4 Methylphenol	0.6315	NA	NA	**0.0929**	< 0.744 U	NA
Naphthalene	31.2462	NA	NA	**0.0746**	< 0.360 U	**0.0101 J**
Nitrobenzene	0.3515	NA	NA	< 0.00768 U	< 0.789 U	NA
N-Nitrosodimethylamine	0.00004	NA	NA	< 0.0109 U	< 1.12 U	NA
N-Nitroso-di-n-propylamine	0.0004	NA	NA	< 0.00576 U	< 0.592 U	NA
N-Nitrosodiphenylamine	2.8235	NA	NA	< 0.00490 U	< 0.504 U	NA
Pentachlorophenol	0.01832	NA	NA	< 0.0104 U	< 1.07 U	NA
Phenanthrene	415.7174	NA	NA	**0.0321 J**	**5.36 JH**	**0.0148 J**
Phenol	19.1480	NA	NA	**0.241**	< 1.13 U	NA
Pyrene	1116.5148	NA	NA	**0.0181 J**	**1.26 J**	< 0.00465 U

Table 4D.5B
Soil Data Summary
Volatile Organic Compounds and Semivolatile Organic Compounds (2014)

	Sample ID	MW-27B (0-2)	MW-27C (0-2)	MW-27D (0.5-2)	MW-43 (0-2)	MW-43 (17-20)
	Location ID	MW-27B	MW-27C	MW-27D	MW-43	MW-43
	Date Sampled	2014-01-09	2014-01-08	2014-01-08	2014-01-07	2014-01-07
	Units	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
Analyte	**Soil RAL[1]**					
Semivolatile Organic Compounds (SW8270C)						
Chrysene	560.6295	< 0.0526 U	**0.0297 J**	< 0.00262 U	< 0.239 UJ	< 0.00231 U
Dibenz[a,h]anthracene	0.5495	< 0.187 U	< 0.00923 U	< 0.00933 U	< 0.850 U	< 0.00820 U
Dibenzofuran	33.3794	NA	NA	NA	< 0.417 U	< 0.00402 U
Diethyl Phthalate	155.8510	NA	NA	NA	< 1.97 U	0.0847 U*
Dimethyl Phthalate	62.2026	NA	NA	NA	< 1.15 U	**0.0925 J**
Di-n-Butyl Phthalate	3317.4922	NA	NA	NA	< 0.607 U	0.0627 U*
Di-n-octyl Phthalate	2578.3372	NA	NA	NA	< 0.445 U	< 0.00429 U
Fluoranthene	1917.2596	< 0.160 U	< 0.00790 U	**0.0155 J**	< 0.729 U	< 0.00703 U
Fluorene	298.5380	< 0.122 U	< 0.00600 U	< 0.00607 U	< 0.553 U	< 0.00533 U
Hexachlorobenzene	1.0742	NA	NA	NA	< 0.356 U	< 0.00344 U
Hexachlorobutadiene	3.2891	NA	NA	NA	< 0.450 U	< 0.00434 U
Hexachlorocyclopentadiene	13.6896	NA	NA	NA	< 1.08 U	< 0.0104 U
Hexachloroethane	1.2851	NA	NA	NA	< 0.541 U	< 0.00522 U
Indeno[1,2,3-cd]pyrene	5.7223	< 0.180 U	< 0.00890 U	< 0.00900 U	< 0.820 U	< 0.00791 U
Isophorone	3.0014	NA	NA	NA	< 0.234 U	< 0.00226 U
3 & 4 Methylphenol	0.6315	NA	NA	NA	< 0.654 U	< 0.00631 U
Naphthalene	31.2462	< 0.0696 U	**0.00612 J**	< 0.00347 U	< 0.316 U	< 0.00305 U
Nitrobenzene	0.3515	NA	NA	NA	< 0.693 U	< 0.00669 U
N-Nitrosodimethylamine	0.00004	NA	NA	NA	< 0.982 U	< 0.00947 U
N-Nitroso-di-n-propylamine	0.0004	NA	NA	NA	< 0.520 U	< 0.00502 U
N-Nitrosodiphenylamine	2.8235	NA	NA	NA	< 0.443 U	< 0.00427 U
Pentachlorophenol	0.01832	NA	NA	NA	< 0.937 U	< 0.00904 U
Phenanthrene	415.7174	< 0.255 U	**0.0133 J**	< 0.0127 U	< 1.16 UJ	< 0.0112 U
Phenol	19.1480	NA	NA	NA	< 0.993 U	< 0.00958 U
Pyrene	1116.5148	< 0.0943 U	**0.0106 J**	**0.0166 J**	< 0.429 U	< 0.00414 U

Table 4D.5B
Soil Data Summary
Volatile Organic Compounds and Semivolatile Organic Compounds (2014)

	Sample ID	MW-43 (8-10)	2014-FFTA-06 (0.-0.5)	2014-FFTA-06 (0.5-2)	2014-FFTA-07 (0-0.5)	2014-FFTA-07 (0.5-2)
	Location ID	MW-43	2014-FFTA-06	2014-FFTA-06	2014-FFTA-07	2014-FFTA-07
	Date Sampled	2014-01-07	2014-04-01	2014-04-01	2014-04-01	2014-04-01
	Units	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
Analyte	**Soil RAL[1]**					
Semivolatile Organic Compounds (SW8270C)						
Chrysene	560.6295	< 0.00241 U	< 0.00122 U	NA	< 0.00614 U	NA
Dibenz[a,h]anthracene	0.5495	< 0.00859 U	< 0.00434 U	NA	< 0.0218 U	NA
Dibenzofuran	33.3794	< 0.00421 U	< 0.00213 U	NA	< 0.0107 U	NA
Diethyl Phthalate	155.8510	0.106 U*	< 0.0101 U	NA	< 0.0507 U	NA
Dimethyl Phthalate	62.2026	**0.135 J**	< 0.00585 U	NA	< 0.0294 U	NA
Di-n-Butyl Phthalate	3317.4922	0.0466 U*	< 0.00310 U	NA	< 0.0156 U	NA
Di-n-octyl Phthalate	2578.3372	< 0.00450 U	< 0.00227 U	NA	< 0.0114 U	NA
Fluoranthene	1917.2596	< 0.00736 U	< 0.00372 U	NA	< 0.0187 U	NA
Fluorene	298.5380	< 0.00558 U	< 0.00282 U	NA	< 0.0142 U	NA
Hexachlorobenzene	1.0742	< 0.00360 U	< 0.00182 U	NA	< 0.00915 U	NA
Hexachlorobutadiene	3.2891	< 0.00454 U	< 0.00230 U	NA	< 0.0116 U	NA
Hexachlorocyclopentadiene	13.6896	< 0.0109 U	< 0.00551 R	NA	< 0.0277 R	NA
Hexachloroethane	1.2851	< 0.00547 U	< 0.00276 U	NA	< 0.0139 U	NA
Indeno[1,2,3-cd]pyrene	5.7223	< 0.00828 U	< 0.00419 U	NA	< 0.0211 U	NA
Isophorone	3.0014	< 0.00237 U	< 0.00120 U	NA	< 0.00602 U	NA
3 & 4 Methylphenol	0.6315	< 0.00660 U	**0.0120 J**	NA	< 0.0168 U	NA
Naphthalene	31.2462	**0.00393 J**	**0.00527 J**	NA	< 0.00812 U	NA
Nitrobenzene	0.3515	< 0.00700 U	< 0.00354 U	NA	< 0.0178 U	NA
N-Nitrosodimethylamine	0.00004	< 0.00991 U	< 0.00501 UJL	NA	< 0.0252 UJL	NA
N-Nitroso-di-n-propylamine	0.0004	< 0.00525 U	< 0.00266 U	NA	< 0.0134 U	NA
N-Nitrosodiphenylamine	2.8235	< 0.00447 U	< 0.00226 U	NA	< 0.0114 U	NA
Pentachlorophenol	0.01832	< 0.00947 U	< 0.00479 U	NA	< 0.0241 U	NA
Phenanthrene	415.7174	< 0.0117 U	**0.00710 J**	NA	< 0.0298 U	NA
Phenol	19.1480	< 0.0100 U	< 0.00507 U	NA	< 0.0255 U	NA
Pyrene	1116.5148	< 0.00433 U	< 0.00219 U	NA	< 0.0110 U	NA

Table 4D.5B
Soil Data Summary
Volatile Organic Compounds and Semivolatile Organic Compounds (2014)

	Sample ID	2014-FFTA-08 (0-0.5)	2014-FFTA-08 (0.5-2)	2014-NDA-7 (0-0.5)	DUP-4	2014-NDA-7 (0.5-2)
	Location ID	2014-FFTA-08	2014-FFTA-08	2014-NDA-7	2014-NDA-7	2014-NDA-7
	Date Sampled	2014-04-01	2014-04-01	4/1/2014	4/1/2014	2014-04-01
	Units	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
Analyte	**Soil RAL[1]**					
Semivolatile Organic Compounds (SW8270C)						
Chrysene	560.6295	< 0.00113 U	NA	< 0.0123 U	**0.00656 J**	NA
Dibenz[a,h]anthracene	0.5495	< 0.00404 U	NA	< 0.0437 U	< 0.00415 U	NA
Dibenzofuran	33.3794	< 0.00198 U	NA	< 0.0214 U	< 0.00204 U	NA
Diethyl Phthalate	155.8510	< 0.00938 U	NA	< 0.102 U	< 0.00964 U	NA
Dimethyl Phthalate	62.2026	< 0.00544 U	NA	< 0.0589 U	< 0.00559 U	NA
Di-n-Butyl Phthalate	3317.4922	< 0.00288 U	NA	< 0.0312 U	< 0.00296 U	NA
Di-n-octyl Phthalate	2578.3372	< 0.00211 U	NA	< 0.0229 U	< 0.00217 U	NA
Fluoranthene	1917.2596	< 0.00346 U	NA	< 0.0375 U	**0.00423 J**	NA
Fluorene	298.5380	< 0.00263 U	NA	< 0.0284 U	< 0.00270 U	NA
Hexachlorobenzene	1.0742	< 0.00169 U	NA	< 0.0183 U	< 0.00174 U	NA
Hexachlorobutadiene	3.2891	< 0.00214 U	NA	< 0.0231 U	< 0.00220 U	NA
Hexachlorocyclopentadiene	13.6896	< 0.00513 R	NA	< 0.0555 R	< 0.00527 R	NA
Hexachloroethane	1.2851	< 0.00257 U	NA	< 0.0278 U	< 0.00264 U	NA
Indeno[1,2,3-cd]pyrene	5.7223	< 0.00389 U	NA	< 0.0422 U	< 0.00400 U	NA
Isophorone	3.0014	< 0.00111 U	NA	< 0.0120 U	< 0.00114 U	NA
3 & 4 Methylphenol	0.6315	< 0.00310 U	NA	< 0.0336 U	< 0.00319 U	NA
Naphthalene	31.2462	**0.0208**	NA	< 0.0163 U	**0.0145 J**	NA
Nitrobenzene	0.3515	< 0.00329 U	NA	< 0.0357 U	< 0.00339 U	NA
N-Nitrosodimethylamine	0.00004	< 0.00466 UJL	NA	< 0.0505 UJL	< 0.00479 UJL	NA
N-Nitroso-di-n-propylamine	0.0004	< 0.00247 U	NA	< 0.0267 U	< 0.00254 U	NA
N-Nitrosodiphenylamine	2.8235	< 0.00210 U	NA	< 0.0228 U	< 0.00216 U	NA
Pentachlorophenol	0.01832	< 0.00445 U	NA	< 0.0482 U	< 0.00457 U	NA
Phenanthrene	415.7174	< 0.00551 U	NA	< 0.0596 U	< 0.00566 U	NA
Phenol	19.1480	< 0.00472 U	NA	< 0.0511 U	< 0.00485 U	NA
Pyrene	1116.5148	**0.00509 J**	NA	< 0.0220 U	**0.00559 J**	NA

Table 4D.5B

Soil Data Summary

Volatile Organic Compounds and Semivolatile Organic Compounds (2014)

NOTES

Detected analytes are bolded.

	Detections exceeding applicable Residential Assessment Level (RAL) are yellow.
	Sample Detection Limit (SDL) exceeds the RAL are gray

1. [1] - Residential Assessment Levels (RALs) are the lower of the TRRP Tier 1 residential $^{Tot}Soil_{Comb}$ and $^{GW}Soil_{Ing}$ PCLs for a 0.5-acre source area (TCEQ, 2012c).
2. Data Qualifiers (see Section 3.5, pending all final qualifications): J - estimated result; UJ - estimated result, not detected; UJL - estimated result, not detected, biased low; U - not detected; b-laboratory blank detection; *-LCS/LCSD recovery outside of lab control limits.
3. Where constituents of concern are combined, the lowest value RAL is used between them (such as in the case of m,p-cresol and m,p xylenes).

< - Indicates analyte not detected above the MDL.
NA - Not analyzed.
mg/kg - Milligrams per kilogram.
-- Indicates PCL not available.
* indicates data was qualified as non-detect based on blank concentration
J Estimated data; The analyte was detected and identified. The associated numerical value (i.e., the reported sample concentration) is the approximate concentration of the analyte in the sample.
U Not detected.
UJ Estimated data; The analyte was not detected above the reported sample detection limit (SDL). The numerical value of the SDL is estimated and may be inaccurate.
H Bias in sample result is likely to be high
L Bias in sample result is likely to be low
R Rejected data; The data is unusable. Serious QC deficiencies make it impossible to verify the absence or presence of this analyte.

Created By:	JT 02/19/2014
Checked by:	JX 4/28/14
Reviewed by:	CH 5/1/14

Table 4D.6
Soil Data Summary -
Perfluorinated Compounds (PFCs), Polychlorinated Biphenyls (PCBs), and Sulfate

	Sample ID	2013-C2L-01 (10-12)	2013-C2L-01 (12-13)	2013-C2L-01 (13-15)	2013-C2L-08 (15-17)	2013-C2L-08 (18-20)	2013-CUFT-14 (0-2)	2013-FFTA-02 (2-4)	2013-FFTA-03 (0.25-2)	MW-45 (15-17)	MW-45 (17-18)	MW-45 (18-20)
	Location ID	2013-C2L-01	2013-C2L-01	2013-C2L-01	2013-C2L-08	2013-C2L-08	2013-CUFT-14	2013-FFTA-02	2013-FFTA-03	MW-45	MW-45	MW-45
	Date Sampled	2014-01-14	2014-01-14	2014-01-14	2014-01-14	2014-01-14	2014-01-10	2014-01-07	2014-01-07	2014-01-07	2014-01-07	2014-01-07
	Units	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
Analyte	Soil RAL											
SW8082												
Aroclor 1016	1.14	NA	NA	NA	NA	NA	< 0.00188 U	NA	NA	NA	NA	NA
Aroclor 1221	1.14	NA	NA	NA	NA	NA	< 0.0101 U	NA	NA	NA	NA	NA
Aroclor 1232	1.14	NA	NA	NA	NA	NA	< 0.00786 U	NA	NA	NA	NA	NA
Aroclor 1242	1.14	NA	NA	NA	NA	NA	< 0.00145 U	NA	NA	NA	NA	NA
Aroclor 1248	1.14	NA	NA	NA	NA	NA	< 0.00292 U	NA	NA	NA	NA	NA
Aroclor 1254	1.14	NA	NA	NA	NA	NA	< 0.00259 U	NA	NA	NA	NA	NA
Aroclor 1260	1.14	NA	NA	NA	NA	NA	< 0.0158 U	NA	NA	NA	NA	NA
SW9056												
Sulfate	--	**485**	**711**	**669**	**128**	**56.2**	NA	NA	NA	**129**	**49.8**	**81.5**
TA SOP DV-LC-0012												
Perfluoro-1-Octanesulfonate (PFOS)	6 (1)	NA	NA	NA	NA	NA	NA	**0.000555 J**	**0.00737**	NA	NA	NA
Perfluorobutane Sulfonate	0.0008	NA	NA	NA	NA	NA	NA	< 0.000180 U	< 0.000179 U	NA	NA	NA
Perfluorobutyric acid	0.0008	NA	NA	NA	NA	NA	NA	< 0.000155 U	< 0.000153 U	NA	NA	NA
Perfluorodecane Sulfonate	0.0008	NA	NA	NA	NA	NA	NA	< 0.000386 U	< 0.000383 U	NA	NA	NA
Perfluorodecanoic acid	0.0020	NA	NA	NA	NA	NA	NA	< 0.000348 U	< 0.000345 U	NA	NA	NA
Perfluorododecanoic acid	0.0008	NA	NA	NA	NA	NA	NA	< 0.000734 U	< 0.000728 U	NA	NA	NA
Perfluoroheptanoic acid	0.0008	NA	NA	NA	NA	NA	NA	< 0.000155 U	**0.000181 J**	NA	NA	NA
Perfluorohexane Sulfonate	0.0008	NA	NA	NA	NA	NA	NA	< 0.000155 U	**0.000537 J**	NA	NA	NA
Perfluorohexanoic acid	0.0008	NA	NA	NA	NA	NA	NA	< 0.000193 U	**0.000579 J**	NA	NA	NA
Perfluoro-n-octanoic acid (PFOA)	16 (1)	NA	NA	NA	NA	NA	NA	< 0.000296 U	**0.000910 J**	NA	NA	NA
Perfluorononanoic acid	0.0008	NA	NA	NA	NA	NA	NA	< 0.000283 U	**0.000614 J**	NA	NA	NA
Perfluorooctane Sulfonamide	0.0008	NA	NA	NA	NA	NA	NA	< 0.000126 U	< 0.000125 U	NA	NA	NA
Perfluoropentanoic acid	0.0008	NA	NA	NA	NA	NA	NA	< 0.000309 U	**0.000538 J**	NA	NA	NA
Perfluorotetradecanoic acid	0.0020	NA	NA	NA	NA	NA	NA	< 0.00129 UJ	< 0.00128 UJ	NA	NA	NA
Perfluorotridecanoic acid	0.0008	NA	NA	NA	NA	NA	NA	< 0.000412 U	< 0.000409 U	NA	NA	NA
Perfluoroundecanoic acid	0.0008	NA	NA	NA	NA	NA	NA	< 0.000412 U	< 0.000409 U	NA	NA	NA

NOTES

Detections exceeding applicable Residential Assessment Level (RAL) are highlighted.
Gray highlighted cell indicates the Sample Detection Limit (SDL) exceeds the RAL.

1. [1] - Residential Assessment Levels (RALs) are the lower of the TRRP Tier 1 residential $^{Tot}Soil_{Comb}$ and $^{GW}Soil_{Ing}$ PCLs for a 0.5-acre source area (TCEQ, 2012c) for PCBs.

TRRP PCLs are not established for PFCs. PFCs are classified by EPA as emerging contaminants. Region 4 screening levels for Perfluorooctanic acid (PFOA) of 16 mg/kg and Perfluoroocytl Sulfonate (PFOS) of 6 mg/kg are provided for reference. MQLs are listed as RALs for other PFCs wherescreening levels are not available.

2. Where constituents of concern are combined, the lowest value RAL is used between them (such as in the case of m,p-cresol and m,p xylenes).

< - Indicates analyte not detected above the MDL / SDL.
NA - Not analyzed.
mg/kg - Milligrams per kilogram.
-- Indicates PCL not available.
* indicates data was qualified as non-detect based on blank concentration
J Estimated data; The analyte was detected and identified. The associated numerical value (i.e., the reported sample concentration) is the approximate concentration of the analyte in the sample
NJ Tentatively identified, estimated data; The analysis indicates the presence of the analyte for which there is presumptive evidence to make a tentative identification and the associated numerical value represents its approximate concentration
NS Not selected; Another result (from a secondary dilution, different analytical method, re-sampling, etc.) is selected for use based on QC outcomes and/or reported concentrations
R Rejected data; The data is unusable. Serious QC deficiencies make it impossible to verify the absence or presence of this analyte.
U Not detected.
UJ Estimated data; The analyte was not detected above the reported sample detection limit (SDL). The numerical value of the SDL is estimated and may be inaccurate
H Bias in sample result is likely to be high
L Bias in sample result is likely to be low

Created By: BEF 2-27-2014
Checked by: LAB 2-27-2014
Reviewed by: CMH 4-24-2014

Table 4E

Soil Boring Water Samples

Sample ID	Sample Date	Cadmium (mg/L)	Lead (mg/L)	Comments
2012-RMSA-2[1]	1/5/2012	0.089	0.421	Boring total depth - 2.5 ft bgs
2012-RMSA-4[1]	1/6/2012	0.04	1.68	Boring total depth - 3.5 ft bgs
2012-NDA-1	1/10/2012	0.00079J	0.0192	Boring total depth - 8.0 ft bgs
2012-SL-2	1/10/2012	0.005 U	0.0141	Boring total depth - 8.0 ft bgs
2012-SL-3	1/10/2012	0.005 U	<0.0029	Boring total depth - 12.0 ft bgs

Notes:

1. [1] - The RMSA samples represent washwater perched below the concrete slab near the Raw Material Storage Building.
2. The soil boring water samples were collected in accordance with the Sampling and Analysis Work Plan (CRA, 2011). Wells were not completed at these locations and the borings were not developed prior to sampling; therefore, comparison to groundwater PCLs is not applicable.
2. mg/L - milligrams/Liter.
3. Data Qualifiers (see Section 3.5): J = estimated result; U = blank contamination.
4. ft bgs - feet below ground surface.

Table 4F
Soil Geochemical Data

Sample ID	Sample Date	Sample Depth (feet)	pH std units	Sulfate (mg/kg)
Battery Receiving/Storage Building				
2013-BSB-1 (0.9-2)	04/11/13	--	7.02	--
2013-BSB-1 (2-4)	04/11/13	--	7.76	--
2013-BSB-1 (4-5)	04/11/13	--	7.77	--
2013-BSB-1 (6.3-7.7)	04/11/13	--	7.20	--
2013-BSB-1 (8-10)	04/11/13	--	7.14	--
2013-BSB-1 (11.6)	04/11/13	--	7.59	--
2013-BSB-2 (0.9-2)	04/11/13	--	7.89	--
2013-BSB-2 (2-4)	04/11/13	--	8.01	--
2013-BSB-2 (4-5)	04/11/13	--	7.88	--
2013-BSB-2 (8-10)	04/11/13	--	7.54	--
2013-BSB-2 (11.2)	04/11/13	--	7.46	--
2013-BSB-3 (0.9-2)	4/10/2013	--	7.61	--
2013-BSB-3 (2-4)	4/10/2013	--	8.47	--
2013-BSB-3 (4-5)	4/10/2013	--	8.13	--
2013-BSB-3 (8-10)	4/10/2013	--	7.72	--
2013-BSB-3 (11)	4/10/2013	--	7.87	--
2013-BSB-4 (0.9-2)	4/10/2013	--	4.44	--
2013-BSB-4 (2-4)	4/10/2013	--	6.74	--
2013-BSB-4 (4-5)	4/10/2013	--	7.90	--
2013-BSB-4 (8-10)	4/10/2013	--	7.64	--
2013-BSB-4 (11)	4/10/2013	--	8.17	--
2013-BSB-5 (0.9-2)	04/11/13	--	6.72	--
2013-BSB-5 (0.9-2) Dup	04/11/13	--	7.18	--
2013-BSB-5 (2-4)	04/11/13	--	7.66	--
2013-BSB-5 (4-5)	04/11/13	--	7.86	--
2013-BSB-5 (8-10)	04/11/13	--	7.22	--
2013-BSB-5 (11.2)	04/11/13	--	7.61	--
2013-BSB-6 (0.9-2)	04/11/13	--	8.14	--
2013-BSB-6 (2-4)	04/11/13	--	7.56	--
2013-BSB-6 (4-5)	04/11/13	--	9.39	--
2013-BSB-6 (8-10)	04/11/13	--	7.54	--
2013-BSB-6 (11.1)	04/11/13	--	7.82	--
2013-BSB-7 (0.9-2)	04/11/13	--	7.84	--
2013-BSB-7 (2-4)	04/11/13	--	7.74	--
2013-BSB-7 (4-5)	04/11/13	--	7.88	--
2013-BSB-7 (8-10)	04/11/13	--	7.26	--
2013-BSB-7 (11)	04/11/13	--	7.62	--
2013-BSB-8 (0.9-2)	4/10/2013	--	6.20	--
2013-BSB-8 (11)	4/10/2013	--	7.89	--
2013-BSB-8 (2-4)	4/10/2013	--	4.45	--
2013-BSB-8 (4-5)	4/10/2013	--	8.13	--
2013-BSB-8 (8-10)	4/10/2013	--	7.45	--
2013-BSB-9 (0.9-2)	4/10/2013	--	7.75	--
2013-BSB-9 (0.9-2) Dup	4/10/2013	--	7.75	--
2013-BSB-9 (2-4)	4/10/2013	--	7.66	--
2013-BSB-9 (4-5)	4/10/2013	--	8.00	--
2013-BSB-9 (8-10)	4/10/2013	--	7.68	--
2013-BSB-9 (11)	4/10/2013	--	7.41	--
2013-BSB-10 (0.9-2)	04/11/13	--	7.54	--
2013-BSB-10 (2-4)	04/11/13	--	7.92	--
2013-BSB-10 (4-5)	04/11/13	--	8.05	--
2013-BSB-10 (8-10)	04/11/13	--	7.26	--
2013-BSB-10 (11.4)	04/11/13	--	7.42	--

Table 4F
Soil Geochemical Data

Sample ID	Sample Date	Sample Depth (feet)	pH std units	Sulfate (mg/kg)
Raw Material Storage Area				
2012-RMSA-1(1.5-2.5')	01/06/12	1.5-2.5	7.10	1030
2012-RMSA-2 (0.5-2.5')	01/05/12	0.5-2.5	10.76	6700
2012-RMSA-3(1-3')	01/05/12	1-3	6.83	1820
2012-RMSA-4(1.5-3.5')	01/06/12	1.5-3.5	6.95	1060
Bale Stabilization Area				
2013-BSA-6 (0-2')	03/05/13	0-2	8.35	--
2013-BSA-7 (0-2')	03/05/13	0-2	8.03	--
MW-23 (0-0.5')	03/05/13	0-0.5	8.51	--
Crystalization Unit Area				
2012 CUFT-1(0-2')	01/06/12	0-2	6.50	7370
2012 CUFT-1(2-4')	01/06/12	2-4	6.82	--
2012 CUFT-2 (0-2')	01/06/12	0-2	6.38	8190
2012 CUFT-2 (2-4')	01/06/12	2-4	6.32	--
2013-CUFT-3 (0-0.5')	03/04/13	0-0.5	--	8710
2013-CUFT-4 (0-0.5')	03/04/13	0-0.5	--	7200
2013-CUFT-5 (0-0.5')	03/04/13	0-0.5	--	56.7
2013-CUFT-6 (0-0.5')	03/04/13	0-0.5	--	314
2013-CUFT-6 (0-0.5') Dup	03/04/13	0-0.5	--	294
2013-CUFT-7 (0-0.5')	03/04/13	0-0.5	--	69.6
2013-CUFT-7A (0-0.5')	03/07/13	0-0.5	--	371
2013-CUFT-8 (0-0.5')	03/04/13	0-0.5	--	5400
2013-CUFT-9 (0-0.5')	03/04/13	0-0.5	--	2960
2013-CUFT-10 (0-0.5')	03/07/13	0-0.5	--	68.2
Battery Breaker Building				
2013-BB-1 (0.9-2)	05/21/13	--	7.15	--

Notes:
1. Protective concentration levels (PCLs) are not established for pH or sulfate.

Legend

Location Type

- Monitoring Well Location
- Soil Boring / Soil Sample Location (2012 - 2014)

Action Level (0 - 5 feet bgs)

- Exceedence of Lead RAL/Critical PCL for Soil
- No Exceedence of Lead RAL/Critical PCL for Soil

Action Level (5 - 15 feet bgs)

- Exceedence of Lead RAL/Critical PCL for Soil
- No Exceedence of Lead RAL/Critical PCL for Soil

Action Level (>15 feet bgs)

- No Exceedence of Lead RAL/Critical PCL for Soil
- Former Path of North Tributary (1951 Aerial Photo)
- Former Path of North Tributary (1972 Aerial Photo)
- Former Path of Stewart Creek (1951 Aerial Photo)
- French Drain
- Stewart Creek (Appoximate Creek Centerline)
- North Tributary (Appoximate Creek Centerline)
- Approximate Extent of Disposal
- Critical PCL Exceedence for Lead (PCLE Zone)
- J-Parcel PCLE Zone
- Former Operating Plant
- Undeveloped Buffer Property

Notes:
1. A location with no action level symbol means the location was not sampled for the displayed constituent or was not sampled as a part of the SIR or APAR investigations.
2. Soil samples analyzed for the SIR and APAR investigations (2012-2014) were used to delineate affected property boundaries. Therefore, only SIR and APAR soil sample results are presented. Older historical soil sample data are presented in Appendix 17 of this APAR.

Source:
1. Basemap by PBW as part of the APAR dated July 9, 2013. Modified by Golder May 2014.
2. Locations - PBW and Golder, 2012 - 2014
3. Aerial Imagery: NCTCOG, 2009 photography.

150 75 0 150 Feet

Scale: AS SHOWN

File No. 1302086-B017 FIG 4A1 Pb.mxd

FORMER OPERATING PLANT
FRISCO RECYCLING CENTER
FRISCO, TEXAS

FIGURE 4A

SOIL COC CONCENTRATION MAP LEAD

PROJECT NO. 13-02086	BY: JWT	REVISIONS
DATE: 5/21/2014	CHECKED: - - -	

GOLDER ASSOCIATES INC.

Map Document: N:\File\2013\13-02086 Exide Frisco\B - APAR Phase II\map documents\1302086-B017 FIG 4A1 Pb.mxd / Modified 5/21/2014 2:14:38 PM by jthomas / Exported 5/21/2014 2:14:53 PM by jthomas

Legend

Location Type

- Monitoring Well Location
- Soil Boring / Soil Sample Location (2012 - 2014)
- French Drain
- Stewart Creek (Appoximate Creek Centerline)
- North Tributary (Appoximate Creek Centerline)
- Former Path of North Tributary (1951 Aerial Photo)
- Former Path of North Tributary (1972 Aerial Photo)
- Former Path of Stewart Creek (1951 Aerial Photo)

Cross Section Transect

- A - A'
- B - B'
- C - C'
- D - D'
- E - E'
- F - F'
- G - G'
- H - H'
- Critical PCL Exceedance Zone (PCLE Zone)
- Approximate Extent of Disposal Area
- Former Operating Plant
- Undeveloped Buffer Property

Source:
1. Basemap by PBW as part of the APAR dated July 9, 2013. Modified by Golder May 2014.
2. Locations - PBW and Golder, 2012 - 2014
3. Aerial Imagery: NCTCOG, 2009 photography.

150 75 0 150 Feet

Scale: AS SHOWN

File No. 1302086-B009 FIG 4C1 - Cross Section Location Map.mxd

FORMER OPERATING PLANT
FRISCO RECYCLING CENTER
FRISCO, TEXAS

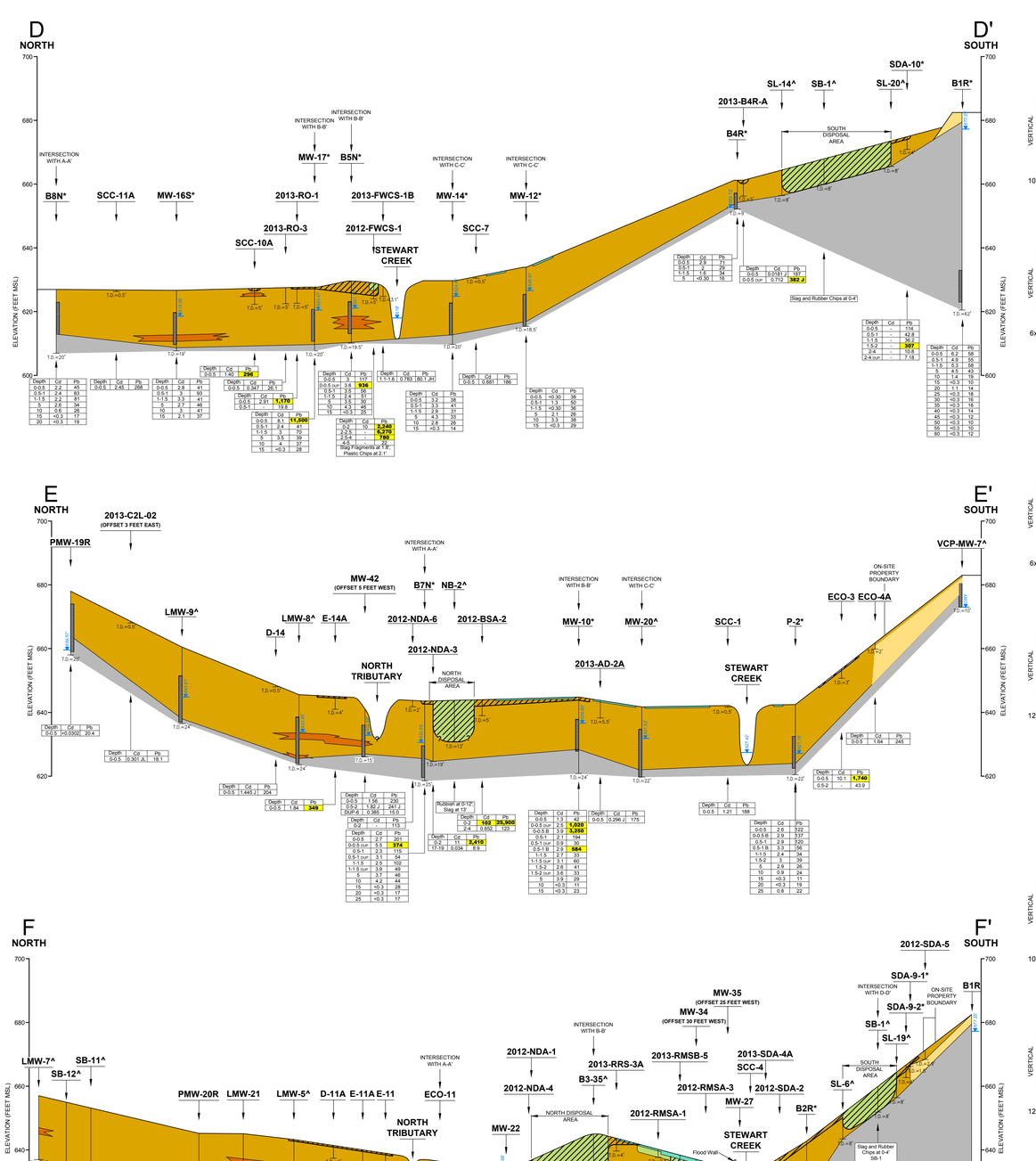
FIGURE 4C.1

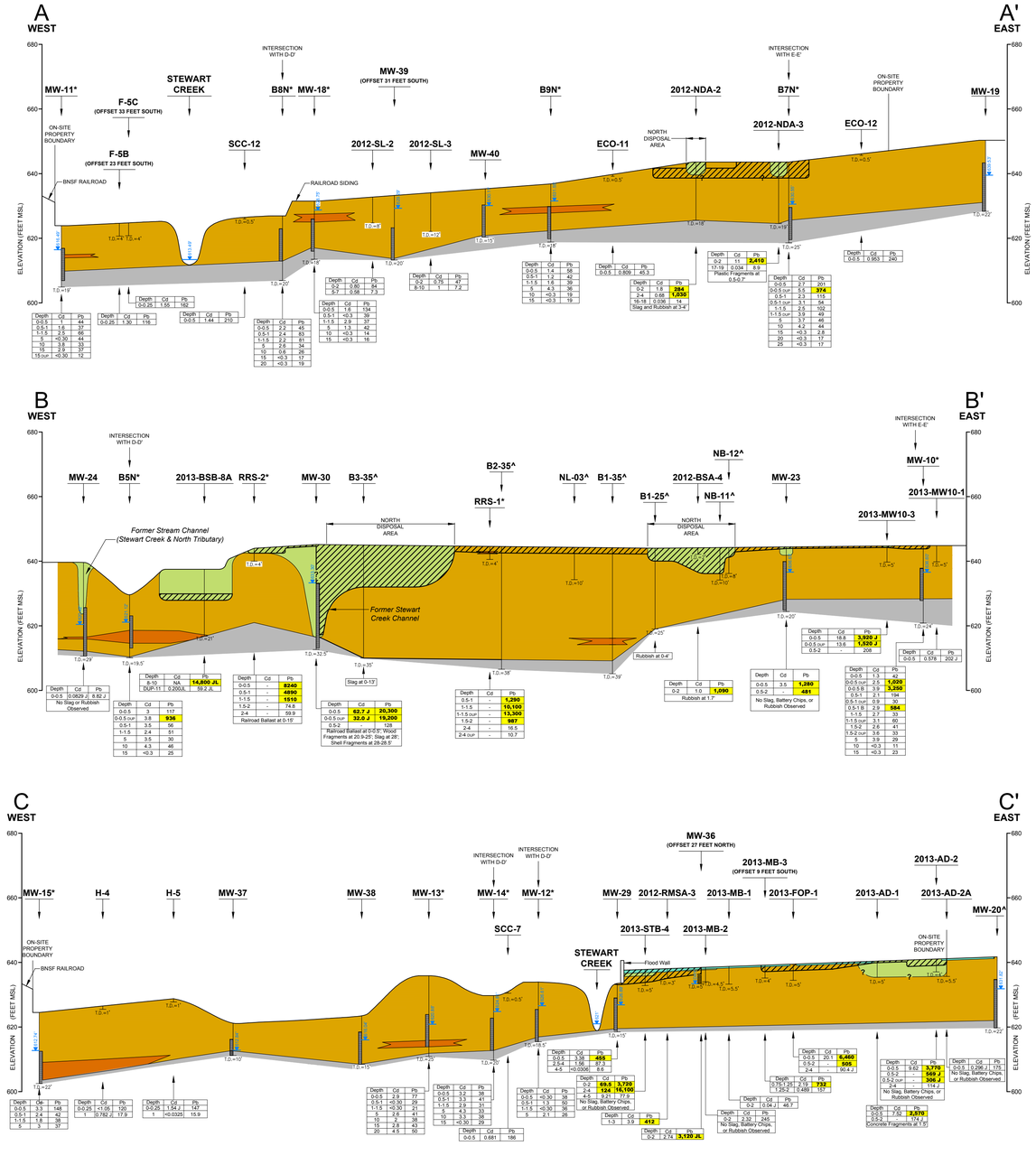
CROSS SECTION LOCATION MAP

PROJECT NO. 13-02086	BY: JWT	REVISIONS
DATE: 5/21/2014	CHECKED: - - -	

GOLDER ASSOCIATES INC.

Map Document: N:\File\2013\13-02086 Exide Frisco\B - APAR Phase II\map documents\1302086-B009 FIG 4C1 - Cross Section Location Map.mxd / Modified 5/21/2014 2:39:53 PM by jthomas / Exported 5/21/2014 2:40:02 PM by jthomas





Notes:

1. See Figure 4C.1 for cross section locations.
2. Ground surface elevations and creek bed topography are estimated. Monitoring well elevations were surveyed by a professional surveyor.
3. ^ - Soil samples not collected at this location.
4. * - Soil sample results based on historical data (see Appendix 17).
5. Surface water elevations in Stewart Creek interpolated from staff gauge elevations measured 4/29/2013.
6. ? - Boundary uncertain.
7. Depths given in feet bgs.
8. MSL - Above mean sea level.
9. "Rubbish" used as defined in 30 TAC 330.3(A)(130).
10. Monitoring wells B8N, LMW-7, and B2R either plugged and abandoned or destroyed.
11. Gabion basket present at 0.0 to 1.1 feet bgs at 2013-FWCS-1B.
12. Soil data provided for B1R is from B1N, which was replaced by B1R.
13. Based on historical use, the North Disposal Area, and Slag Landfill are included entirely within the affected property and critical PCLE zone boundaries.
14. Data qualifiers (See Section 3.5).
15. Concentrations of Pb and Cd reported in milligrams per kilogram (mg/kg).
16. Lead and Cadmium concentrations exceeding RAL/Critical PCL are highlighted and bolded.
    - Lead RAL/Critical PCL = 274.51mg/kg
    - Cadmium RAL/Critical PCL = 30 mg/kg

EXPLANATION

GENERALIZED LITHOLOGIC ABBREVIATIONS

- Concrete
- Fill
- Clay or Silty Clay with Minor Occurrences of Silt and Gravelly Clay (Gravel Suspended in Clay Matrix)
- Gravel or Sand (Typically Clayey)
- Austin Chalk Limestone
- Eagle Ford Shale
- RAL/Critical PCL Exceedance Zone

MONITORING WELL CONSTRUCTION

Screened Interval
Bottom Cap
Total Depth
Water Level (Ft MSL) Measured 1/21/14

STATE OF TEXAS
JAY A. WATERS
GEOLOGY
1202
LICENSED
PROFESSIONAL GEOSCIENTIST

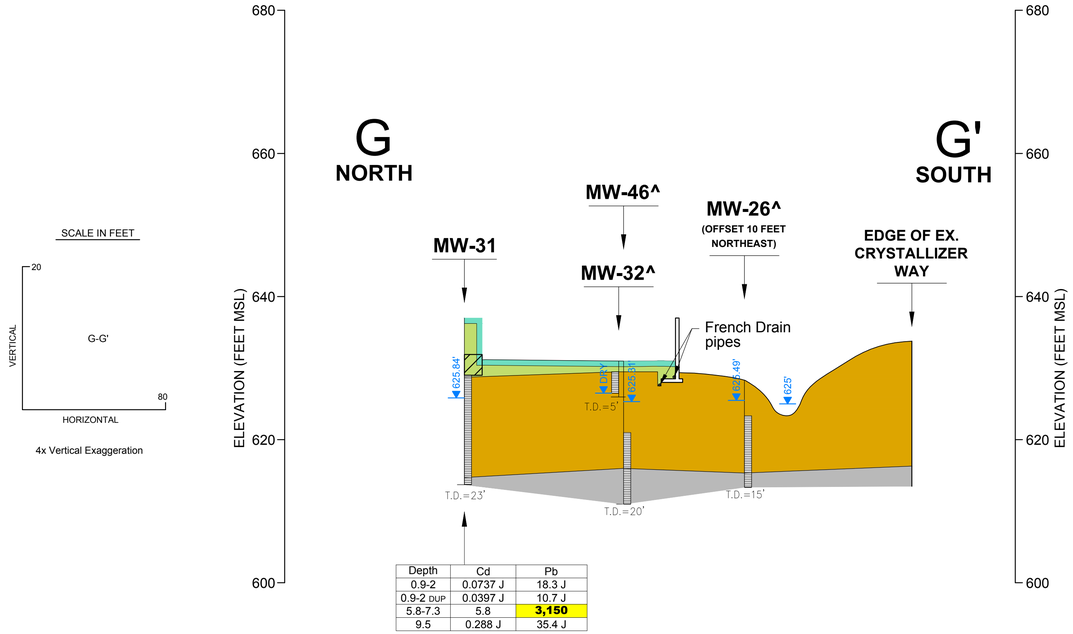
FORMER OPERATING PLANT
FRISCO RECYCLING CENTER
FRISCO, TEXAS

FIGURE 4C.2

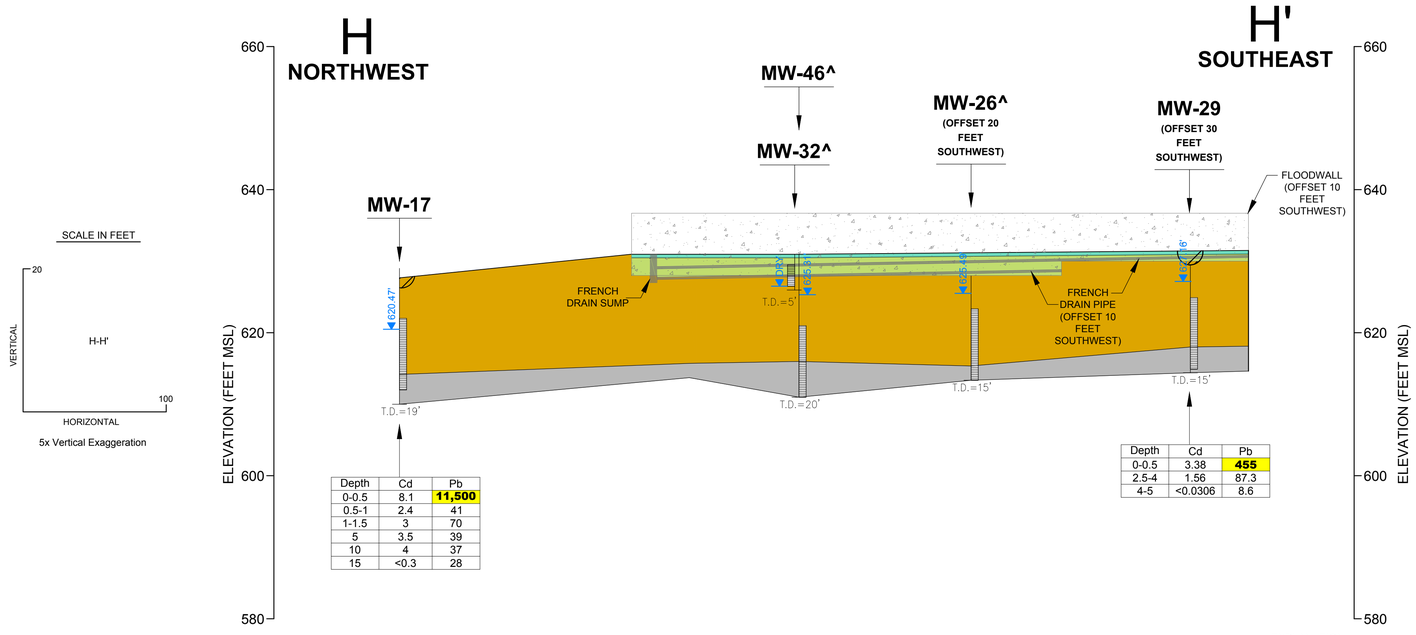
GEOLOGIC CROSS SECTIONS (1 of 2)

PROJECT: 13-02086	BY: BCL	REVISIONS
DATE: MARCH, 2014	CHECKED: .	

GOLDER ASSOCIATES, INC.



Depth	Cd	Pb
0.9-2	0.0737 J	18.3 J
0.9-2 DUP	0.0397 J	10.7 J
5.8-7.3	5.8	**3,150**
9.5	0.288 J	35.4 J



Depth	Cd	Pb
0-0.5	8.1	**11,500**
0.5-1	2.4	41
1-1.5	3	70
5	3.5	39
10	4	37
15	<0.3	28

Depth	Cd	Pb
0-0.5	3.38	**455**
2.5-4	1.56	87.3
4-5	<0.0306	8.6

Notes:

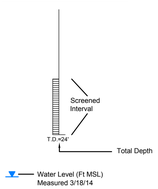
1. See Figure 4C.1 for cross section locations.
2. Ground surface elevations and creek bed topography are estimated. Monitoring well elevations were surveyed by a professional surveyor.
3. Surface water elevations in Stewart Creek interpolated from staff gauge elevations measured 1/21/2014. The staff gauge was observed to be damaged from from flooding prior to the 3/18/2014 site visit.
4. Approximately 0.4 feet of water was observed in the end cap of MW-32. However, water was not observed within the screened interval of the well.
5. Depths given in feet bgs.
6. MSL - Above mean sea level.
7. Data qualifiers (See Section 3.5).
8. Concentrations of Pb and Cd reported in milligrams per kilogram (mg/kg).
9. Lead and Cadmium concentrations exceeding RAL/Critical PCL are highlighted and bolded.
   - Lead RAL/Critical PCL = 274.51mg/kg
   - Cadmium RAL/Critical PCL = 30 mg/kg
10. ^ - Soil samples not collected at this location.
11. MW-17 soil analytical data from June 1990 investigation.
12. Fill depth along floodwall based on as-built drawings in the Wall Seepage Project Construction Report by W&M Environmental Group, Inc., dated May 10, 2013.

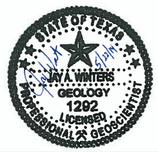
EXPLANATION

GENERALIZED LITHOLOGIC ABBREVIATIONS:

- Concrete
- Fill
- Clay or Silty Clay with Minor Occurrences of Silt and Gravelly Clay (Gravel Suspended in Clay Matrix)
- Gravel or Sand (Typically Clayey)
- Austin Chalk Limestone
- Eagle Ford Shale
- RAL/Critical PCL Exceedance Zone

MONITORING WELL CONSTRUCTION:





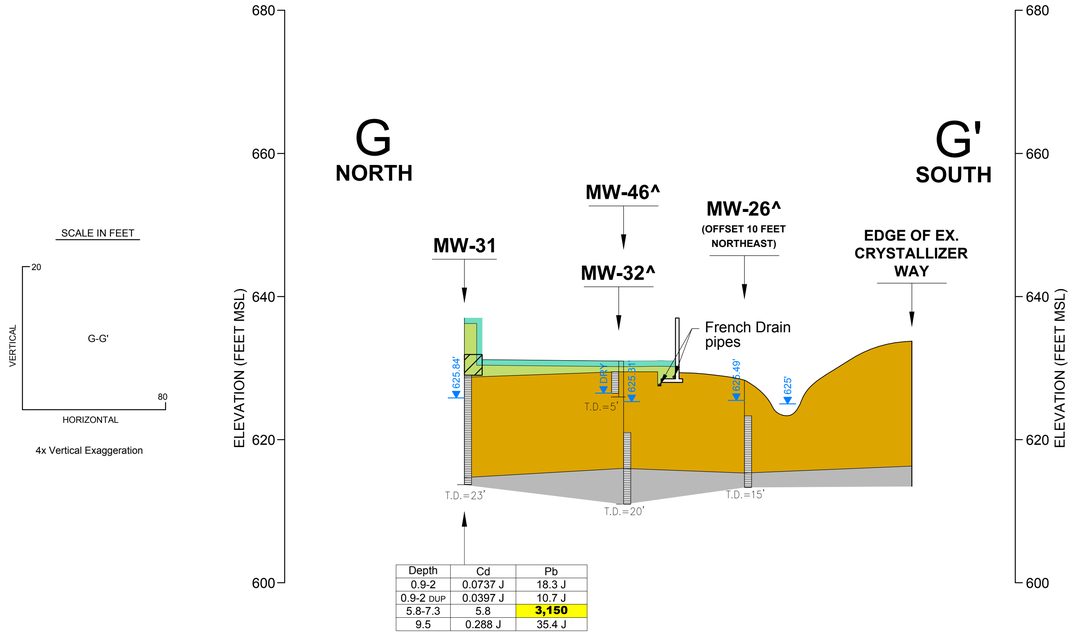
FORMER OPERATING PLANT
FRISCO RECYCLING CENTER
FRISCO, TEXAS

FIGURE 4C.3

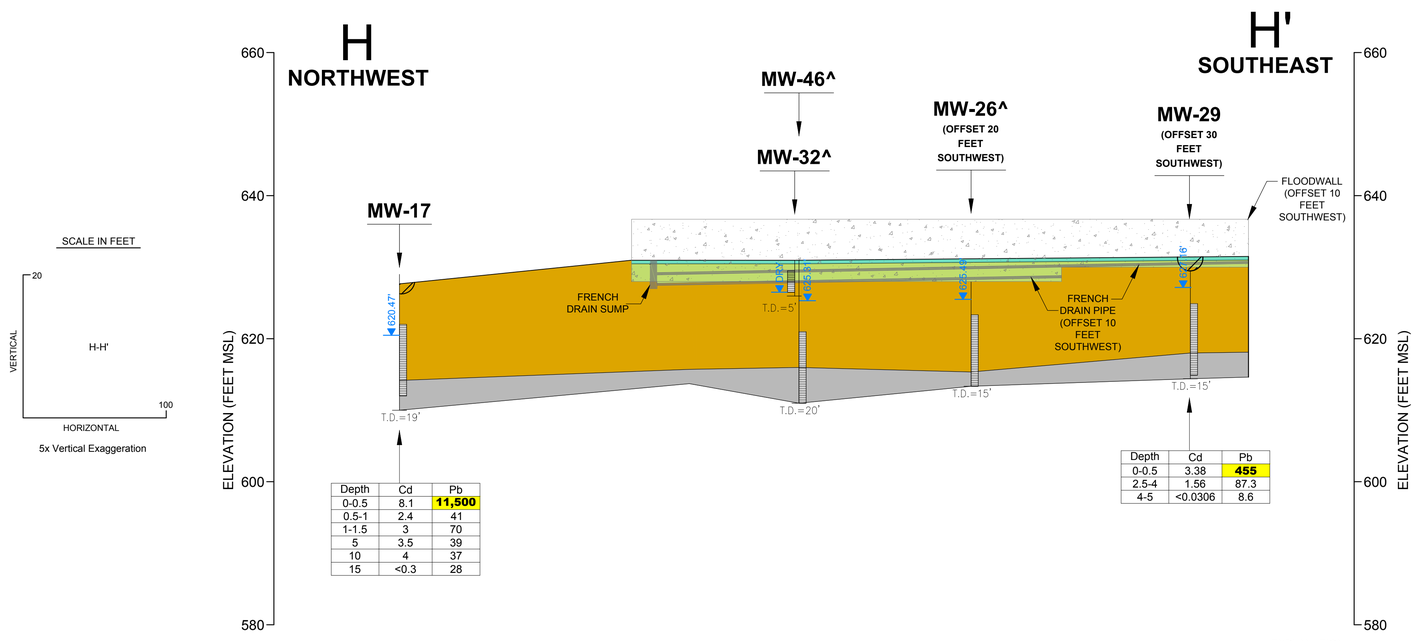
GEOLOGIC CROSS SECTIONS (2 of 2)

PROJECT: 13-02086	BY: BCL	REVISIONS
DATE: MARCH, 2014	CHECKED: .	

GOLDER ASSOCIATES, INC.



Depth	Cd	Pb
0.9-2	0.0737 J	18.3 J
0.9-2 DUP	0.0397 J	10.7 J
5.8-7.3	5.8	**3,150**
9.5	0.288 J	35.4 J



Depth	Cd	Pb
0-0.5	8.1	**11,500**
0.5-1	2.4	41
1-1.5	3	70
5	3.5	39
10	4	37
15	<0.3	28

Depth	Cd	Pb
0-0.5	3.38	**455**
2.5-4	1.56	87.3
4-5	<0.0306	8.6

Notes:

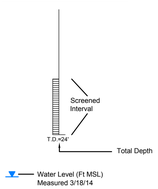
1. See Figure 4C.1 for cross section locations.
2. Ground surface elevations and creek bed topography are estimated. Monitoring well elevations were surveyed by a professional surveyor.
3. Surface water elevations in Stewart Creek interpolated from staff gauge elevations measured 1/21/2014. The staff gauge was observed to be damaged from from flooding prior to the 3/18/2014 site visit.
4. Approximately 0.4 feet of water was observed in the end cap of MW-32. However, water was not observed within the screened interval of the well.
5. Depths given in feet bgs.
6. MSL - Above mean sea level.
7. Data qualifiers (See Section 3.5).
8. Concentrations of Pb and Cd reported in milligrams per kilogram (mg/kg).
9. Lead and Cadmium concentrations exceeding RAL/Critical PCL are highlighted and bolded.
   - Lead RAL/Critical PCL = 274.51mg/kg
   - Cadmium RAL/Critical PCL = 30 mg/kg
10. ^ - Soil samples not collected at this location.
11. MW-17 soil analytical data from June 1990 investigation.
12. Fill depth along floodwall based on as-built drawings in the Wall Seepage Project Construction Report by W&M Environmental Group, Inc., dated May 10, 2013.

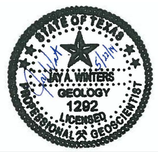
EXPLANATION

GENERALIZED LITHOLOGIC ABBREVIATIONS:

- Concrete
- Fill
- Clay or Silty Clay with Minor Occurrences of Silt and Gravelly Clay (Gravel Suspended in Clay Matrix)
- Gravel or Sand (Typically Clayey)
- Austin Chalk Limestone
- Eagle Ford Shale
- RAL/Critical PCL Exceedance Zone

MONITORING WELL CONSTRUCTION:





FORMER OPERATING PLANT
FRISCO RECYCLING CENTER
FRISCO, TEXAS

FIGURE 4C.3

GEOLOGIC CROSS SECTIONS (2 of 2)

PROJECT: 13-02086	BY: BCL	REVISIONS
DATE: MARCH, 2014	CHECKED: .	

GOLDER ASSOCIATES, INC.

5.0 GROUNDWATER ASSESSMENT

As detailed in Section 1.3, the uppermost groundwater-bearing unit (GWBU) at the Site is comprised of clay-rich colluvial soils lying on top of the Eagle Ford Shale. As described in Section 2.5, the uppermost GWBU has been classified as a Class 2 groundwater resource for the purposes of this APAR. During the first phase of the APAR and earlier investigations, potential COC impacts to this groundwater zone were evaluated through the collection of groundwater samples from thirty-eight groundwater monitoring wells, including fourteen monitoring wells installed as part of this 2013 assessment (MW-21 through MW-31, LMW-21, LMW-22, and PMW-20R), two monitoring wells (MW-19 and MW-20) installed on the adjacent Exide-owned Undeveloped Buffer Property east of the FOP as part of the 2012 SIR per the EPA-approved Work Plan (CRA, 2011), and twenty-two monitoring wells installed as part of previous Site investigations. Three of the 2013 monitoring wells (MW-26, MW-27, and MW-29) are located between the former production area and Stewart Creek. Two monitoring wells at the Site (B3R and PMW-19R) were not sampled because either the wells produced an insufficient volume of water for sampling.

Additional groundwater samples were collected from select existing wells in February and March 2014. These samples included:

- Stewart Creek POE wells (Upper GWBU wells along Stewart Creek) were sampled to address the revised applicable groundwater to surface water PCL (^{SW}GW) ambient water quality criteria that were prepared based on the reclassification of Stewart Creek from intermittent to perennial) by the TCEQ in 2013 (MW-11, MW-14, MW-16S, MW-17, MW-26, MW-27, and MW-29).
- MW-16, a deep well paired with the MW-16S well, was resampled for comparison purposes.
- B4R (Upper GWBU well west of the South Disposal Area) was resampled to provide comparison with previous data collected at this well.

Fifteen new wells were also installed in 2014. These wells include four Upper GWBU POE wells that were installed to provide additional information for specific areas of the Site (MW-37, MW-38, MW-44, and MW-46); two wells to provide additional Upper GWBU data near the Slag landfill (MW-39 and MW-40); two Upper GWBU wells to provide additional data along the North Tributary (MW-41 and MW-42); one well to provide additional Upper GWBU data in the FFTA (MW-43); and one well northwest of the Class 2 Landfill to provide background Upper GWBU data (MW-45). In addition to these nine groundwater monitoring wells, five very shallow wells (approximately five feet in total depth) were installed to evaluate potential perched water (MW-32, MW-33, MW-34, MW-35, and MW-36) in the FOP area. Well construction data are provided in Table D and Appendix 2. Two of the perched water wells (MW-35 and MW-36) were not sampled due to the wells being dry or having insufficient yield to allow sampling. As

detailed in Section 3, the limited perched water zones encountered in wells MW-32, MW-33 and MW-34 are not hydraulically connected to the uppermost GWBU. As such, laboratory results from these perched water zones were not compared to ingestion-based groundwater PCLs.

5.1 Derivation of Assessment Levels

Groundwater assessment levels are based on the $^{GW}GW_{Ing}$ and $^{Air}GW_{Inh\text{-}V}$ exposure pathways for all areas of the Site. The ^{SW}GW exposure pathway is also considered to be complete in areas where there is a potential point of discharge of groundwater to surface water (i.e., in the near vicinity of Stewart Creek or the North Tributary). Based on documentation provided by the TCEQ (TCEQ, 2013c; TCEQ, 2013g), Stewart Creek is classified as a perennial stream, and the North Tributary is classified as an intermittent stream. In accordance with those classifications and per TCEQ RG-194 (TCEQ, 2012b), ^{SW}GW PCLs were set to ^{SW}SW RBELs based on chronic ecological criteria for Stewart Creek POE monitoring wells and acute ecological criteria for North Tributary POE monitoring wells. The derivation of ^{SW}SW RBELs are discussed in detail in Section 6. The ^{SW}SW RBELs were calculated based on a hardness value of 106 mg/L for Lake Lewisville (Segment 0823), located approximately 7 miles downstream from the Site (Appendix 9).

In accordance with TCEQ RG-366/TRRP-24 (TCEQ, 2007), if the concentration of any COC detected in a ^{SW}GW POE well exceeds the respective ^{SW}SW RBEL at the time of affected property assessment, a dilution factor is allowed for COCs if the groundwater discharge is calculated to be clearly less than 15% of the 7Q2 of the flow of the receiving water. The 7Q2 is defined as “the lowest average stream flow for seven consecutive days with a recurrence interval of two years, as statistically determined from historical data”. As previously documented in Appendix H of the SIR (PBW, 2012a), the Stewart Creek 7Q2 flow rate is estimated to be 0.23 cfs. Based on the most recent groundwater sampling data, the potential ^{SW}GW PCLE zones for lead and cadmium (assuming no dilution factor) were bounded by wells that did not exceed the SW RBELs. The lateral width of impacted groundwater (for initial calculation purposes and consistent with TRRP-24 requirements, defined as groundwater with a concentration above the ^{SW}SW RBEL) was extended east and west towards the FOP property boundaries. These wells included MW-37 (western extent of FOP) and MW-44 (eastern extent of FOP).

Monitoring wells exhibiting exceedences of the lead ^{SW}SW PCL included MW-46 and MW-14. The site-specific influent width of groundwater (in excess of the SW RBEL) at the point of discharge to surface water for lead was conservatively assumed to be 600 feet (MW-17 to MW-26). Monitoring wells with exceedences of the cadmium SW RBEL included MW-26, MW-27, MW-29, and MW-46. The site-specific influent width of groundwater (in excess of the SW RBEL) at the point of discharge to surface for

cadmium is conservatively assumed to be 1600 feet (MW-37 to MW-44). It was noted that there were no dissolved cadmium exceedences in MW-38, MW-16, MW-16S, MW-14, and MW-17.

Based on this, the calculated groundwater discharge of 0.002 cfs for lead-affected groundwater represented about 0.87% of the 7Q2 discharge. The calculated groundwater discharge of 0.0054 cfs for cadmium-affected groundwater represented about 2.35% of the 7Q2 discharge. Therefore, the groundwater to surface water discharge is clearly less than 15% of the 7Q2, and a 0.15 dilution factor is appropriate. When the 0.15 dilution factor is applied to the ^{SW}SW RBELs for chronic ecological criteria for Stewart Creek POE monitoring wells, the resulting ^{SW}GW PCLs are 0.018 mg/L for lead, and 0,0017 mg/L for cadmium.

The dilution factor calculation was not applied for wells along the North Tributary since the chronic ^{SW}SW RBEL was not exceeded in POE monitoring wells. Appendix 9 details the groundwater discharge to surface water calculation and assumptions used.

As described in Section 2.6.3, the groundwater to sediment PCL (^{Sed}GW) pathway is not applicable.

Delineation of COCs in groundwater was completed using assessment levels established for residential land use (RALs) or ^{SW}GW PCLs (as applicable). As presented on Table 5A, groundwater RALs were established based on the lowest applicable TRRP Tier 1 residential PCL for Class 2 groundwater.

5.2 Nature and Extent of COCs in Groundwater

During the first phase of the APAR investigation, samples from all groundwater monitoring wells were analyzed for total and dissolved concentrations of the primary COCs of lead and cadmium; 39 wells were sampled. The concentrations of these COCs were compared to applicable PCLs, as described in Table 5B.1. Based on the observation of elevated arsenic and selenium concentrations in a sample collected from the Class 2 Landfill leachate collection tank (see Section 3.1.2 for additional information), groundwater samples from the Class 2 Landfill area were also analyzed for total and dissolved concentrations of arsenic and selenium. Monitoring well MW-27 was installed in the vicinity of the Former Diesel Fuel Tank release area, between the former tank location and Stewart Creek (see Figure 1B.1). The groundwater sample from MW-27 was analyzed for TPH and PAHs in addition to total and dissolved cadmium and lead.

During the 2014 sampling event, nine selected existing wells were sampled, and fifteen new wells were installed and sampled. New wells included ten groundwater monitoring wells installed to monitor the Upper GWBU, as well as five wells installed to monitor perched water. New and existing wells were generally sampled for total and dissolved lead and cadmium. Exceptions included:

- B4R (Upper GWBU, west of South Disposal Area, confirmation sample) was also sampled for dissolved arsenic and selenium
- MW-11 (Upper GWBU, at downstream property boundary, POE well) was sampled only for dissolved lead
- MW-37 (Upper GWBU, northwest of Storm Water Pond) was also sampled for total and dissolved arsenic and selenium
- MW-38 (Upper GWBU, north of Storm Water Pond) was also sampled for total and dissolved arsenic and selenium
- MW-43 (Upper GWBU, Firefighter Training Area) was sampled for VOCs, SVOCs, TPH, and PFCs
- MW-45 (Upper GWBU, north of Class 2 Landfill, background well) was also sampled for total and dissolved arsenic and selenium.
- MW-32 (perched water, adjacent to the Wastewater Treatment Plant) was sampled only for dissolved lead and cadmium due to insufficient volume
- MW-35 (perched water, RMSA) was not sampled due to insufficient volume
- MW-36 (perched water, RMSA) was not sampled due to insufficient volume

Monitoring wells PMW-19R, PMW-20R, LMW-5, LMW-8, LMW-9, LMW-17, LMW-21, LMW-22, and MW-45 are included in the proposed monitoring network for the Class 2 Landfill.

During both phases of the APAR investigation, most of the groundwater samples (samples collected from wells screened to sample the Upper GWBU or deeper within the Eagle Ford Shale), were analyzed for metals, VOC, SVOC, TPH, and PFC concentrations, as applicable, were either not detected or were not detected above the applicable RAL(Tables 5B.1 through 5B.5). Exceptions are described below:

- Total concentrations of lead at B4R exceeded the RAL for lead in 2012, but did not exceed the RAL in 2013 or 2014.
- At MW-46, installed adjacent to the perched water well MW-32, between the Wastewater Treatment Plant and Stewart Creek, samples (primary and duplicate) exceeded the PCL (^{SW}GW) for lead and cadmium in January 2014. The well was purged further and resampled in February and March 2014, including a duplicate sample in March 2014, and results were below the applicable PCL (^{SW}GW).
- At LMW-9, total and dissolved selenium concentrations exceeded the RAL in March and April 2013. The Eagle Ford Shale is known to contain gypsum. Selenium commonly is an impurity in gypsum, where selenium replaces calcium in the crystal matrix, potentially serving as a natural source of selenium. In addition, LMW-9 is not located at a potential point of discharge of groundwater to surface water. An attenuation evaluation (Appendix 11) for potential migration of selenium to the nearest stream (the North Tributary) demonstrates that potential migration will not result in an exceedance at the POE. Selenium in LMW-9 is defined to RALs at downgradient wells LMW-17 and LMW-8.

In addition to the groundwater exceedances discussed above, perched water (Table 5B.1) samples had the following exceedances of RALs:

- Total and dissolved samples of perched water at MW-33 (STB) exceeded RAL for lead, and the dissolved samples also exceeded the RAL for cadmium
- Total and dissolved samples of perched water at MW-34 (RMSA) exceeded RALs for cadmium and lead
- Dissolved samples of perched water at MW-32 exceeded the RAL for cadmium.

Results show localized impacts to perched water present in the shallow fill material beneath paved areas of the Site's FOP production area. The perched water is resultant of storm water flows to and infiltrates this area. As discussed in Section 3.2.6, shallow perched water is being collected by the French Drain system. Furthermore, soil boring data indicate the shallow sub-base containing the perched water is separated from the upper GWBU by 4-6 feet of fine-grained soils, and both laboratory analytical data and static water level data do not support hydraulic interconnectivity of the perched water and upper GWBU. Final capping of the FOP production area, where these exceedances were detected, will mitigate the infiltration of surface water to fill area and reduce the amount of perched water. A discussion of the hydraulic and geochemical comparisons for wells installed to monitor the perched water and the GWBU is presented in the paragraphs below.

MW-32 was installed to monitor the perched water zone near the floodwall. MW-32 was drilled and constructed on January 9, 2014 to a total depth of approximately five feet below ground surface, which corresponds to 4.83 feet below the top of casing and a screened interval from 4.4 feet to 2.5 feet below the top of casing with 0.4 feet at the bottom consisting of blank PVC and end cap (i.e. well sump). The sand pack was installed from 1.5 feet below ground surface to approximately five feet below ground surface which intersects shallow fill material and the top of the underlying native clayey material. The well was installed during a period of steady rain. Prior to development on January 11, 2014, the water level was gauged at 0.17 feet below the top of casing. During well development on January 11, 2014, the well purged dry after evacuating approximately one-half gallon of water. The well did not recover within a timely manner and was allowed to recover for several days. An additional round of well development was conducted on January 15, 2014. Prior to development on January 15, 2014, the water level was gauged at 2.86 feet below the top of casing. During development, the well purged dry, did not recover in a timely manner and was allowed to recover for a week prior to sampling. On January 22, 2014, the water level in MW-32 was gauged at 4.14 feet below the top of casing (0.69 feet of water column) prior to sampling. The well purged dry and was allowed to recover for enough water to sample. After five and a half hours, approximately 125 milliliters was recovered from the well, sufficient to allow collection of a sample for total and dissolved metals, prior to going dry.

During a floodwall inspection on March 18, 2014, MW-32 was gauged to evaluate potential changes in water levels based near the floodwall after approximately a month of operation of the French Drain pumping system. The water level in MW-32 was measured at 4.46 feet below the top of casing, which corresponds to a water level below the screened interval and within the well sump. The dry screened interval in MW-32 after continued operation of the French drain indicates the French drain is collecting perched water from shallow fill material.

During a floodwall inspection on March 18, 2014, MW-32 was gauged to evaluate potential changes in water levels based near the floodwall after approximately a month of operation of the French Drain pumping system. The water level in MW-32 was measured at 4.46 feet below the top of casing, which corresponds to a water level below the screened interval and within the well sump. The observation that the screened interval in MW-32 was dry after continued operation of the French drain indicates the French drain is effectively collecting perched water from shallow fill material.

Cross section transects G-G' and H-H' depict the area immediately adjacent to the floodwall in the vicinity of the FOP plant area. Water levels and screened intervals for MW-32 (perched) and MW-46 (upper GWBU) are shown on the cross sections as well as their spatial orientation with respect to the flood wall, French drain, Stewart Creek and other surrounding wells. The water level in MW-46 measured on March 18, 2014 was approximately 1.2 feet below the bottom of the screen in MW-32, which was dry. MW-26, MW-29, and MW-17, which are located on the creek side of the floodwall, did not contain shallow fill such as was identified in the perched water wells on the facility side of the floodwall. As discussed in the paragraph above, when operating, the French drain effectively collects perched water from the shallow fill and controls seepage through the floodwall.

Water quality parameters were compared for data from the January/February 2014 sampling in perched water wells (MW-32, MW-33, and MW-34) and nearby Upper GWBU groundwater monitoring wells (MW-17, MW-26, MW-29, and MW-46). Samples from the perched water wells had dissolved oxygen concentrations ranging from 2.50 to 9.01 milligrams per liter (mg/L) (more consistent with surface water), whereas nearby monitoring wells screened in the upper GWBU had dissolved oxygen concentrations ranging from 0.25 to 0.77 mg/L (more consistent with groundwater), indicating a distinct difference in geochemistry. Additionally, perched zone wells had a pH levels ranging from 6.83 to 8.37 SU, whereas nearby wells screened in the upper GWBU had pH levels ranging from 5.64 to 6.48 SU, possibly indicating a buffered (less acidic) condition in the perched water, which is in contact with limestone aggregate in the sub-base. Perched zone wells MW-35 and MW-36 were not used in this comparison because they were dry at the time of sampling.

-The perched water encountered in shallow fill material beneath paved areas of the Site does not appear to meet the definition of a groundwater bearing unit, and is thus not subject to classification requirements under TRRP.

Sulfate and TDS were also evaluated in monitoring wells sampled at the Site. Both parameters were analyzed during the SIR investigation per the EPA-approved Work Plan (CRA, 2011). Per the February 7, 2013 memorandum issued by the TCEQ (TCEQ, 2013d), sulfate was also analyzed during the APAR investigation. As shown in Table 5C, sulfate and TDS sample concentrations were variable at the Site. Variability in these parameters does not appear to be related to potential source areas. For example, the second highest sulfate concentration (4,040 mg/L) observed was at background well MW-20 located on the Undeveloped Buffer Property east of the former production area. Moreover, the sulfate concentration in monitoring well MW-31, located in the Battery Receiving/Storage Building and screened within an interval where slag was observed, was reported at a much lower concentration of 927 mg/L. As discussed above and in Section 6.3 below, bedrock at the Site is comprised of the Eagle Ford shale which contains gypsum (calcium sulfate = CaSO4) which is likely the source of the variable concentrations of sulfate in groundwater at the Site and surrounding buffer property. Elevated naturally occurring sulfate concentrations in these soils and associated groundwater would not be unexpected, since, as noted in Burkart, Cross and Kern (1999), gypsum is common in soils developed on Eagle Ford Group shales in North Texas [Burkart, Berke, Cross, Glenn C., and Kern, James P., 1999, “The role of gypsum in production of sulfate-induced deformation of lime-stabilized soils,” Environmental & Engineering Geoscience, v. 5, no. 2, pp. 173-187, May.]. The local presence of potentially elevated sulfate concentrations in Eagle Ford Formation derived clays is recognized in the City of Frisco’s Engineering Standards (City of Frisco, 1999), which include stabilization requirements for Eagle Ford clays with sulfate concentrations greater than 25,000 ppm sulfate.

There is no current ongoing source of sulfate from FOP operations, and concentrations do not appear to correlate with any specific source area. It is reasonably assumed that any FOP surface water runoff containing sulfates would be prevented from entering Stewart Creek by the floodwall, or would be negligible. Theoretically, any sulfates that may have accumulated on-site may infiltrate into surface and subsurface soils; therefore, sulfates in shallow groundwater discharging to surface water could potentially affect surface water quality. A generalized mass balance calculation demonstrates the potential effect that sulfate levels measured in groundwater in monitoring wells adjacent to Stewart Creek might have on surface water quality. The calculation is based on the following assumptions, as further detailed in Appendix 9:

- Groundwater discharge rate= 0.009 cfs, based on the estimation of groundwater to surface water discharge provided in Appendix 9

- Average sulfate concentrations from monitoring wells along the Stewart Creek and the North Tributary to Stewart Creek of 1740 mg/L. This is based on sulfate data collected from monitoring wells B5N, MW-16S, MW-14, MW-17, MW-18, MW-24, MW-26, MW-27, MW-29, and MW-31 that are located in close proximity to Stewart Creek.
- Stream flow rate=0.23 cfs. This is based on the 7Q2 stream flow calculated in the SIR (2012a).

The product of the average sulfate concentrations multiplied by the conservative groundwater discharge, divided by the stream flow rate yields a theoretical concentration of sulfate in surface water of 68 mg/L. The actual measured concentrations in Stewart Creek range between 125 mg/L (upstream sample SW-16), 123 mg/L (midstream sample SW-17), and 127 mg/L (downstream sample SW-21). The maximum sulfate contribution from the FOP (based on the sample data) is approximately 4 mg/L. Therefore, the contribution of sulfate from on-site is not anticipated to appreciably impact surface water quality above current ambient conditions.

5.3 Nature and Extent of NAPL in Groundwater

NAPL was not observed in groundwater at the Site.

Table 5A
Groundwater Residential Assessment Levels

COC	$^{GW}GW_{Ing}$ PCL (mg/L)	$^{Air}GW_{Inh-V}$ PCL (mg/L)	RAL[1] (mg/L)	MQL (mg/L)	Maximum Concentration Detected			
					Sample ID	Screen Depth (feet bgs)	Sample Date	Conc (mg/L)
Metals								
Arsenic	**1.0E-02**	--	1.0E-02	1.0E-02	--	--	--	--
Cadmium	**5.0E-03**	--	5.0E-03	5.0E-03	MW-25	7-22	03/19/13	0.0031J
Lead	**1.5E-02**	--	1.5E-02	1.0E-02	B4R	4-9	01/18/12	0.076 J-
Selenium	**5.0E-02**	--	5.0E-02	4.0E-02	LMW-9	9-23	04/12/13	0.944
TPH								
T/R Hydrocarbons: C6-C12	**9.8E-01**	2.3E+02	9.8E-01	5.0E+00	--	--	--	--
T/R Hydrocarbons: >C12-C28	**9.8E-01**	9.7E+02	9.8E-01	5.0E+00	--	--	--	--
T/R Hydrocarbons: >C28-C35	**9.8E-01**	9.7E+02	9.8E-01	5.0E+00	--	--	--	--
T/R Hydrocarbons: C6-C35	--	--	--	5.0E+00	--	--	--	--
VOCs								
1,1,1-Trichloroethane	**2.0E-01**	4.1E+04	2.0E-01	1.0E-03	--	--	--	--
1,1,2,2-Tetrachloroethane	**4.6E-03**	--	4.6E-03	1.0E-03	--	--	--	--
1,1,2-Trichloroethane	**5.0E-03**	8.0E+01	5.0E-03	1.0E-03	--	--	--	--
1,1-Dichloroethane	**4.9E+00**	4.3E+04	4.9E+00	1.0E-03	--	--	--	--
1,2-Dichloroethane	**5.0E-03**	3.3E+01	5.0E-03	1.0E-03	--	--	--	--
1,2-Dichloroethene, Total	**7.0E-02**	7.7E+02	7.0E-02	1.0E-03	--	--	--	--
1,2-Dichloropropane	**5.0E-03**	1.2E+02	5.0E-03	1.0E-03	--	--	--	--
2-Butanone	**1.5E+01**	1.0E+06	1.5E+01	2.0E-03	--	--	--	--
2-Hexanone	**1.2E-01**	1.2E+04	1.2E-01	2.0E-03	--	--	--	--
4-Methyl-2-pentanone	**2.0E+00**	6.7E+05	2.0E+00	2.0E-03	--	--	--	--
Acetone	**2.2E+01**	1.0E+06	2.2E+01	5.0E-03	--	--	--	--
Benzene	**5.0E-03**	1.8E+02	5.0E-03	1.0E-03	--	--	--	--
Chlorobromomethane	**9.8E-01**	--	9.8E-01	1.0E-03	--	--	--	--
Dichlorobromomethane	**1.5E-02**	--	1.5E-02	1.0E-03	--	--	--	--
Bromoform	**1.2E-01**	5.1E+03	1.2E-01	1.0E-03	--	--	--	--
Bromomethane	**3.4E-02**	4.6E+01	3.4E-02	2.0E-03	--	--	--	--
Carbon Disulfide	**2.4E+00**	4.9E+03	2.4E+00	2.0E-03	--	--	--	--
Carbon Tetrachloride	**5.0E-03**	2.0E+01	5.0E-03	1.0E-03	--	--	--	--
Chlorobenzene	**1.0E-01**	1.2E+03	1.0E-01	1.0E-03	--	--	--	--
Chloroethane	**9.8E+00**	1.2E+05	9.8E+00	2.0E-03	--	--	--	--
Chloroform	**2.4E-01**	2.0E+01	2.4E-01	1.0E-03	--	--	--	--
Chloromethane	**7.0E-02**	3.6E+01	7.0E-02	2.0E-03	--	--	--	--
cis-1,2-Dichloroethene	**7.0E-02**	1.2E+03	7.0E-02	1.0E-03	--	--	--	--
cis-1,3-Dichloropropene	**1.7E-03**	6.9E+02	1.7E-03	1.0E-03	--	--	--	--
Chlorodibromomethane	**1.1E-02**	--	1.1E-02	1.0E-03	--	--	--	--
Ethylbenzene	**7.0E-01**	3.0E+04	7.0E-01	1.0E-03	--	--	--	--
m,p-Xylenes	**1.0E+01**	9.4E+03	1.0E+01	1.0E-03	--	--	--	--
Methylene Chloride	**5.0E-03**	2.1E+04	5.0E-03	5.0E-03	--	--	--	--
o-Xylene	**1.0E+01**	7.6E+05	1.0E+01	1.0E-03	--	--	--	--
Styrene	**1.0E-01**	1.5E+04	1.0E-01	1.0E-03	--	--	--	--
Tetrachloroethene	**5.0E-03**	5.0E+02	5.0E-03	1.0E-03	--	--	--	--
Toluene	**1.0E+00**	6.4E+04	1.0E+00	1.0E-03	--	--	--	--
trans-1,2-Dichloroethene	**1.0E-01**	7.7E+02	1.0E-01	1.0E-03	--	--	--	--
trans-1,3-Dichloropropene	**9.1E-03**	1.8E+02	9.1E-03	1.0E-03	--	--	--	--
Trichloroethene	**5.0E-03**	2.4E+01	5.0E-03	1.0E-03	--	--	--	--
Vinyl Acetate	**2.4E+01**	1.4E+04	2.4E+01	2.0E-03	--	--	--	--
Vinyl Chloride	**2.0E-03**	3.8E+00	2.0E-03	2.0E-03	--	--	--	--
Xylenes, Total	**1.0E+01**	1.0E+04	1.0E+01	1.0E-03	--	--	--	--

Table 5A
Groundwater Residential Assessment Levels

COC	$^{GW}GW_{Ing}$ PCL (mg/L)	$^{Air}GW_{Inh-V}$ PCL (mg/L)	RAL[1] (mg/L)	MQL (mg/L)	Maximum Concentration Detected			
					Sample ID	Screen Depth (feet bgs)	Sample Date	Conc (mg/L)
PAHs/SVOCs								
1,2,4-Trichlorobenzene	**7.0E-02**	1.6E+02	7.0E-02	1.0E-02	--	--	--	--
1,2-Dichlorobenzene	**6.0E-01**	--	6.0E-01	1.0E-02	--	--	--	--
1,3-Dichlorobenzene	**7.3E-01**	1.9E+02	7.3E-01	1.0E-02	--	--	--	--
1,4-Dichlorobenzene	**7.5E-02**	3.6E+03	7.5E-02	1.0E-02	--	--	--	--
2,4,5-Trichlorophenol	**2.4E+00**	--	2.4E+00	1.0E-02	--	--	--	--
2,4,6-Trichlorophenol	**2.4E-02**	--	2.4E-02	1.0E-02	--	--	--	--
2,4-Dichlorophenol	**7.3E-02**	--	7.3E-02	1.0E-02	--	--	--	--
2,4-Dimethylphenol	**4.9E-01**	--	4.9E-01	1.0E-02	--	--	--	--
2,4-Dinitrophenol	**4.9E-02**	--	4.9E-02	5.0E-02	--	--	--	--
2,4-Dinitrotoluene	**1.3E-03**	--	1.3E-03	1.0E-02	--	--	--	--
2,6-Dinitrotoluene	**1.3E-03**	--	1.3E-03	1.0E-02	--	--	--	--
2-Chloronaphthalene	**2.0E+00**	--	2.0E+00	1.0E-02	--	--	--	--
2-Chlorophenol	**1.2E-01**	--	1.2E-01	1.0E-02	--	--	--	--
1-Methylnaphthalene	**3.1E-02**	--	3.1E-02	2.0E-03	MW-27	5-15	04/09/13	0.00138 J
2-Methylnaphthalene	**9.8E-02**	--	9.8E-02	1.5E-03	MW-27	5-15	04/09/13	0.000222 J
2-Methylphenol	**1.2E+00**	--	1.2E+00	1.0E-02	--	--	--	--
2-Nitroaniline	**7.3E-03**	4.0E+03	7.3E-03	5.0E-02	--	--	--	--
2-Nitrophenol	**4.9E-02**	--	4.9E-02	1.0E-02	--	--	--	--
3,3'-Dichlorobenzidine	**2.0E-03**	--	2.0E-03	2.0E-02	--	--	--	--
3-Nitroaniline	**7.3E-03**	4.7E+03	7.3E-03	5.0E-02	--	--	--	--
4,6-Dinitro-2-methylphenol	**2.4E-03**	--	2.4E-03	5.0E-02	--	--	--	--
4-Bromophenyl Phenyl Ether	**6.1E-05**	1.6E+00	6.1E-05	1.0E-02	--	--	--	--
4-Chloro-3-methylphenol	**1.2E-01**	--	1.2E-01	1.0E-02	--	--	--	--
4-Chloroaniline	**4.6E-03**	--	4.6E-03	1.0E-02	--	--	--	--
4-Chlorophenyl-phenylether	**6.1E-05**	1.2E+00	6.1E-05	1.0E-02	--	--	--	--
4-Nitroaniline	**4.6E-02**	1.4E+05	4.6E-02	5.0E-02	--	--	--	--
4-Nitrophenol	**4.9E-02**	--	4.9E-02	5.0E-02	--	--	--	--
Acenaphthene	**1.5E+00**	--	1.5E+00	1.0E-03	MW-27	5-15	04/09/13	0.00016
Acenaphthylene	**1.5E+00**	--	1.5E+00	1.0E-02	--	--	--	--
Anthracene	**7.3E+00**	--	7.3E+00	1.0E-02	--	--	--	--
Benzidine	**4.0E-06**	5.0E+00	4.0E-06	5.0E-02	--	--	--	--
Benzo[a]anthracene	**1.3E-03**	2.0E+03	1.3E-03	1.0E-02	--	--	--	--
Benzo[a]pyrene	**2.0E-04**	3.9E+02	2.0E-04	1.0E-02	--	--	--	--
Benzo[b]fluoranthene	**1.3E-03**	1.6E+03	1.3E-03	1.0E-02	--	--	--	--
Benzo[g,h,i]perylene	**7.3E-01**	--	7.3E-01	1.0E-02	--	--	--	--
Benzo[k]fluoranthene	**1.3E-02**	9.7E+04	1.3E-02	1.0E-02	--	--	--	--
Benzyl Alcohol	**2.4E+00**	--	2.4E+00	1.0E-02	--	--	--	--
Bis(2-chloroethoxy)methane	**8.3E-04**	8.0E+01	8.3E-04	1.0E-02	--	--	--	--
Bis(2-chloroethyl) Ether	**8.3E-04**	9.3E+01	8.3E-04	1.0E-02	--	--	--	--
Bis(2-chloroisopropyl) Ether	**1.3E-02**	8.7E+02	1.3E-02	1.0E-02	--	--	--	--
Bis(2-ethylhexyl) Phthalate	**6.0E-03**	--	6.0E-03	1.0E-02	--	--	--	--
Butylbenzyl Phthalate	**4.8E-01**	--	4.8E-01	1.0E-02	--	--	--	--
Carbazole	**4.6E-02**	--	4.6E-02	1.0E-02	--	--	--	--
Chrysene	**1.3E-01**	5.8E+05	1.3E-01	1.0E-02	--	--	--	--
Dibenz[a,h]anthracene	**2.0E-04**	1.0E+03	2.0E-04	1.0E-02	--	--	--	--
Dibenzofuran	**9.8E-02**	--	9.8E-02	1.0E-02	--	--	--	--
Diethyl Phthalate	**2.0E+01**	--	2.0E+01	1.0E-02	--	--	--	--
Dimethyl Phthalate	**2.0E+01**	--	2.0E+01	1.0E-02	--	--	--	--
Di-n-Butyl Phthalate	**2.4E+00**	--	2.4E+00	1.0E-02	--	--	--	--
Di-n-octyl Phthalate	**9.8E-01**	--	9.8E-01	1.0E-02	--	--	--	--
Fluoranthene	**9.8E-01**	--	9.8E-01	1.0E-02	--	--	--	--
Fluorene	**9.8E-01**	--	9.8E-01	1.5E-03	MW-27	5-15	04/09/13	0.00019 J
Hexachlorobenzene	**1.0E-03**	5.7E+00	1.0E-03	1.0E-02	--	--	--	--

Table 5A
Groundwater Residential Assessment Levels

COC	$^{GW}GW_{Ing}$ PCL (mg/L)	$^{Air}GW_{Inh-V}$ PCL (mg/L)	RAL[1] (mg/L)	MQL (mg/L)	Maximum Concentration Detected			
					Sample ID	Screen Depth (feet bgs)	Sample Date	Conc (mg/L)
PAHs/SVOCs (continued)								
Hexachlorobutadiene	**1.2E-02**	8.9E+00	1.2E-02	1.0E-02	--	--	--	--
Hexachlorocyclopentadiene	**5.0E-02**	5.4E+00	5.0E-02	1.0E-02	--	--	--	--
Hexachloroethane	**1.7E-02**	7.3E+03	1.7E-02	1.0E-02	--	--	--	--
Indeno[1,2,3-cd]pyrene	**1.3E-03**	9.4E+03	1.3E-03	1.0E-02	--	--	--	--
Isophorone	**9.6E-01**	--	9.6E-01	1.0E-02	--	--	--	--
3 & 4 Methylphenol	**1.2E-01**	--	1.2E-01	2.0E-02	--	--	--	--
Naphthalene	**4.9E-01**	3.2E+02	4.9E-01	5.0E-03	MW-27	5-15	04/09/13	0.00152 J
Nitrobenzene	**4.9E-02**	7.2E+02	4.9E-02	1.0E-02	--	--	--	--
N-Nitrosodimethylamine	**1.8E-05**	2.0E+01	1.8E-05	1.0E-02	--	--	--	--
N-Nitroso-di-n-propylamine	**1.3E-04**	--	1.3E-04	1.0E-02	--	--	--	--
N-Nitrosodiphenylamine	**1.9E-01**	--	1.9E-01	1.0E-02	--	--	--	--
Pentachlorophenol	**1.0E-03**	--	1.0E-03	5.0E-02	--	--	--	--
Phenanthrene	**7.3E-01**	--	7.3E-01	1.0E-02	--	--	--	--
Phenol	**7.3E+00**	--	7.3E+00	1.0E-02	--	--	--	--
Pyrene	**7.3E-01**	--	7.3E-01	1.0E-02	--	--	--	--
Perfluorinated Compounds								
Perfluorooctanoic Sulfonate	--	--	0.0003 (6)	2.1E-05	--	--	--	--
Perfluorobutane Sulfonate	--	--	--	2.1E-05	--	--	--	--
Perfluorobutyric acid	--	--	0.007 (6)	2.1E-05	--	--	--	--
Perfluorodecane Sulfonate	--	--	--	2.1E-05	--	--	--	--
Perfluorodecanoic acid	--	--	--	3.1E-05	--	--	--	--
Perfluorododecanoic acid	--	--	--	3.1E-05	--	--	--	--
Perfluoroheptanoic acid	--	--	--	3.1E-05	--	--	--	--
Perfluorohexane Sulfonate	--	--	--	2.1E-05	--	--	--	--
Perfluorohexanoic acid	--	--	--	4.1E-05	--	--	--	--
Perfluorooctanoic acid	--	--	0.0005 (6)	2.1E-05	--	--	--	--
Perfluorononanoic acid	--	--	--	3.1E-05	--	--	--	--
Perfluoropentanoic acid	--	--	--	3.1E-05	--	--	--	--
Perfluorotetradecanoic acid	--	--	--	3.1E-05	--	--	--	--
Perfluorotridecanoic acid	--	--	--	4.1E-05	--	--	--	--
Perfluoroundecanoic acid	--	--	--	2.1E-05	--	--	--	--

MQL exceeds RAL notated by orange.

1. [1] - The Residential Assessment Level (RAL) is the lower of the TRRP Tier 1 residential $^{GW}GW_{Ing}$ and $^{Air}GW_{Inh-V}$ PCLs (TCEQ, 2012c). Per TRRP-24, the ^{SW}GW PCL also applies (to dissolved-phase COCs) for monitoring wells in locations where there is a potential point of discharge of groundwater to surface water (i.e., in the near vicinity of Stewart Creek or the North Tributary). ^{SW}GW PCLs and RALs are presented in Tables 5B.1 through 5B.3 for comparison with site groundwater data.
2. Data qualifiers (see Section 3.5): J - estimated result; J- - estimated result, biased low.
3. MQL values that exceed the RAL are highlighted. All MQLs based on 2014 data, except for maximum detections listed from 2013.
4. Maximum sample concentrations that exceed RALs are hightlighted and bolded (no exceedances observed).
5. "--" - Not applicable.
6. For reference only, since TRRP PCLs are not published for PFCs, drinking water standards mandated by the Minnesota Legislature and set by the Minnesota Department of Health are provided. The current standards are 0.5 ppb for PFOA, 0.3 ppb for PFOS and 7 ppb for PFBA.

Table 5B.1
Groundwater Data Summary -
Cadmium and Lead (2012/2013)

Well ID	Screen Interval (ft bgs)	Sample Date	Total		Dissolved	
			Cadmium (mg/L)	Lead (mg/L)	Cadmium (mg/L)	Lead (mg/L)
GW RAL[1]			**0.005**	**0.015**	**0.005**	**0.015**
[SW]GW PCL (SW RBEL based on chronic aquatic life criteria, with dilution factor of 0.15)			**--**	**--**	**0.0017**	**0.018**
[SW]GW PCL[2] (SW RBEL based on acute aquatic life criteria)			**--**	**--**	**0.00908**	**0.0688**
Upper GWBU / Along Stewart Creek[4]						
B5N	6.5-16.5	1/17/2012	<0.00035	<0.0029	<0.00035	<0.0029
		3/22/2013	<0.00035	<0.0029	<0.00035	<0.0029
MW-14	7-17	1/16/2012	<0.00035	**0.00311J**	<0.00035	<0.0029
		3/13/2013	<0.00035	<0.0029	**0.0007J**	<0.0029
MW-16S	7-17	1/17/2012	<0.00035	<0.0029	<0.00035	**0.00299J**
		4/9/2013	**0.0012J**	**0.005J**	**0.0007J**	**0.0041J**
MW-17	7-17	1/18/2012	<0.00035	**0.00411J**	<0.00035	0.0029 UJ
		3/22/2013	**0.0004J**	<0.0029	<0.00035	<0.0029
MW-26	5-15	4/9/2013	**0.0006J**	<0.0029	**0.0004J**	<0.0029
MW-27	5-15	4/9/2013	**0.001J**	**0.0029J**	**0.0009J**	**0.0035J**
MW-29	4.5-14.5	4/9/2013	**0.0015J**	<0.0029	**0.0014J**	<0.0029
Upper GWBU / North Tributary[5]						
B9N	7-17	4/10/2013	<0.00035	<0.0029	<0.00035	<0.0029
field duplicate		4/10/2013	<0.00035	<0.0029	<0.00035	<0.0029
MW-18	5.5-15.5	1/17/2012	<0.00035	<0.0029	<0.00035	<0.0029
Dup		1/17/2012	<0.00035	<0.0029	<0.00035	<0.0029
		3/18/2013	<0.00035	<0.0029	<0.00035	<0.0029
Other Wells						
B1R	49.5-59.5	3/22/2013	**0.0004J**	**0.0036J**	**0.0004J**	<0.0029
B3R	4-14	1/16/2012	Dry			
		3/18/2013	NS	NS	NS	NS
B4R	4-9	1/18/2012	**0.00062J**	**0.0761J**	NS	NS
		3/19/2013	**0.0015J**	**0.0081J**	**0.0017J**	**0.0058J**
B7N	14-24	3/18/2013	<0.00035	<0.0029	<0.00035	<0.0029
MW-10	7-17	3/18/2013	**0.0012J**	**0.0076J**	**0.0013J**	**0.003J**
MW-11	7-17	4/9/2013	<0.00035	<0.0029	<0.00035	<0.0029
MW-12	8-18.5	1/16/2012	<0.00035	<0.0029	<0.00035	<0.0029
		3/13/2013	**0.00103J**	**0.0029J**	<0.00035	<0.0029
MW-13	12-22	1/16/2012	<0.00035	<0.0029	<0.00035	<0.0029
		3/13/2013	<0.00035	<0.0029	<0.00035	<0.0029
MW-15	12-22	4/10/2013	<0.00035	<0.0029	<0.00035	<0.0029
MW-16	67.5-77.5	1/17/2012	<0.00035	<0.0029	<0.00035	<0.0029
		4/9/2013	<0.00035	**0.0044J**	<0.00035	**0.0039J**
MW-19*	7-22	1/17/2012	<0.00035	<0.0029	<0.00035	<0.0029
MW-20*	7-22	1/18/2012	<0.00035	<0.0029	NS	NS
MW-21	3-13	4/9/2013	**0.0005J**	<0.0029	**0.0005J**	<0.0029
MW-22	3-13	4/9/2013	**0.0029J**	**0.0063J**	**0.0029J**	**0.004J**
MW-23	4.5-19.5	3/19/2013	<0.00035	<0.0029	<0.00035	<0.0029
MW-24	14-29	3/18/2013	<0.00035	**0.0038J**	<0.00035	**0.0054J**
MW-25	7-22	3/19/2013	**0.0031J**	**0.0064J**	**0.003J**	**0.0074J**
MW-28*	5-20	3/21/2013	<0.00035	<0.0029	<0.00035	<0.0029
MW-30	12-32	4/10/2013	<0.00035	**0.0031J**	<0.00035	<0.0029
MW-31	8-23	5/13/2013	<0.00035	<0.0029	<0.00035	<0.0029
P-1	10-20	4/9/2013	<0.00035	<0.0029	<0.00035	<0.0029
P-2	10-20	3/19/2013	**0.0012J**	**0.005J**	**0.0014J**	**0.005J**
LMW-5	7-21	3/13/2013	< 0.00035	< 0.0029	< 0.00035 UJ	< 0.0029
LMW-8	7-21	3/13/2013	< 0.00035	< 0.0029	< 0.00035 UJ	< 0.0029
LMW-9	9-23	3/13/2013	< 0.00035	< 0.0029	< 0.00035 UJ	< 0.0029
LMW-17	10-20	3/12/2013	< 0.00035	< 0.0029	< 0.00035	< 0.0029

Table 5B.1
Groundwater Data Summary -
Cadmium and Lead (2012/2013)

Well ID	Screen Interval (ft bgs)	Sample Date	Total		Dissolved	
			Cadmium (mg/L)	Lead (mg/L)	Cadmium (mg/L)	Lead (mg/L)
GW RAL[1]			**0.005**	**0.015**	**0.005**	**0.015**
^{SW}GW PCL (SW RBEL based on chronic aquatic life criteria, with dilution factor of 0.15)			**--**	**--**	**0.0017**	**0.018**
^{SW}GW PCL[2] (SW RBEL based on acute aquatic life criteria)			**--**	**--**	**0.00908**	**0.0688**
Other Wells (cont'd)						
LMW-21	10-25	3/12/2013	< 0.00035	< 0.0029	< 0.00035	< 0.0029
field duplicate		3/12/2013	< 0.00035	< 0.0029	< 0.00035	< 0.0029
LMW-22	5-20	3/13/2013	< 0.00035	< 0.0029	< 0.00035 UJ	< 0.0029
LMW-19[3]	ND	1/18/2012	<0.00035	<0.0029	<0.00035	<0.0029
PMW-19R[3]	4-19	3/12/2013	Dry			
		4/12/2013	Dry			
PMW-20R[3]	10-25	3/12/2013	< 0.00035	< 0.0029	< 0.00035 UJ	< 0.0029

Notes:

RAL exceedances are highlighted in yellow.

1. [1] - The Groundwater Residential Assessment Level (GW RAL) is the TRRP Tier 1 Residential $^{GW}GW_{Ing}$ PCL applicable for Class 2 groundwater ingestion ($^{Air}GW_{Inh-V}$ PCL not applicable).
2. [2] - ^{SW}GW PCL set to ^{SW}SW RBEL for monitoring wells along Stewart Creek assuming chronic ecological criteria (perennial streams) assuming use of a 0.15 dilution factor, and wells along the North Tributary assuming acute ecological criteria (intermittent streams). Per TRRP-24, specific aquatic life criteria for cadmium and lead apply to dissolved rather than total concentrations since the dissolved phase represents the bioavailable form. Also per TRRP-24, the ^{SW}GW PCL applies to monitoring wells where there is a potential point of discharge of groundwater to surface water (i.e., in the near vicinity of Stewart Creek or the North Tributary). Potentially applicable wells are noted by footnotes (4) and (5). Cd and Pb RBELs based on hardness value of 106 mg/L for Segment 0823.
3. [3] - Wells PMW-19R and PMW-20R are replacement wells for LMW-19 and PMW-20, respectively. LMW-19 and PMW-20 were plugged and replaced in February 2013 due to absence of boring logs and well construction data.
4. [4] - Monitoring wells along Stewart Creek considered a potential point of discharge where the ^{SW}GW PCL (chronic) may apply.
5. [5] - Monitoring wells along the North Tributary of Stewart Creek considered potential point of exposure wells where the ^{SW}GW PCL (acute) may apply.
6. NS - Well did not yield sufficient volume of water for sample analysis.
7. * - Well located on Undeveloped Buffer Property. MW-19 and MW-20 were installed and sampled as part of the 2012 SIR per the Sampling and Analysis Work Plan (CRA, 2011) as background monitoring wells.
8. Samples for dissolved analysis field filtered with either a 10 micron filter (2012 samples) or 0.45 micron filter (2013 samples) (see Section 3.3.2).
9. Data qualifiers (see Section 3.5): J - estimated result; J- - estimated result, biased low; UJ - estimated result, not detected
10. Detected concentrations are bolded.
11. -- Indicates PCL not available.
12. < Indicates analyte not detected above sample detection limit (SDL).

Table 5B.2
Groundwater Data Summary -
Arsenic and Selenium (2012/2013)

Well ID	Screen Interval (ft bgs)	Sample Date	Total Metals		Dissolved Metals	
			Arsenic (mg/L)	Selenium (mg/L)	Arsenic (mg/L)	Selenium (mg/L)
^{SW}GW PCL (SW RBEL based on chronic aquatic life criteria, with dilution factor of 0.15)			--	--	--	--
^{SW}GW PCL (SW RBEL based on acute aquatic life criteria)			--	--	--	--
GW RAL[1]			**0.01**	**0.05**	**0.01**	**0.05**
LMW-5	7-21	3/13/2013	< 0.00328	< 0.00417	< 0.00328	<0.00417 UJ
LMW-8	7-21	3/13/2013	< 0.00328	**0.0104 J**	< 0.00328	**0.0057 J**
		4/12/2013	NA	**0.0055 J**	NA	**0.0056 J**
LMW-9	9-23	3/13/2013	< 0.00328	**0.491[3]**	< 0.00328	**0.489[3]**
		4/12/2013	NA	**0.944[3]**	NA	**0.844[3]**
LMW-17	10-20	3/12/2013	< 0.00328	< 0.00417	< 0.00328	< 0.00417
LMW-21	10-25	3/12/2013	< 0.00328	< 0.00417	< 0.00328	< 0.00417
field duplicate		3/12/2013	< 0.00328	< 0.00417	< 0.00328	< 0.00417
		4/11/2013	NA	< 0.00417	NA	< 0.00417
LMW-22	5-20	3/13/2013	< 0.00328	< 0.00417	< 0.00328	< 0.00417
LMW-19[2]	ND	1/18/2012	NA	NA	NA	NA
MW-28	5-20	3/21/2013	< 0.00328	< 0.00417	< 0.00328	<0.00417 UJ
PMW-19R[2]	4-19	3/12/2013	DRY			
		4/12/2013	DRY			
PMW-20R[2]	10-25	3/12/2013	< 0.00328	**0.00931 J**	< 0.00328	**0.00509 J**
		4/11/2013	NA	**0.009 J**	NA	**0.0073 J**

Notes:

Detections are bolded.

RAL exceedances are highlighted in yellow.

1. [1] - The Groundwater Residential Assessment Level (GW RAL) is the TRRP Tier 1 Residential $^{GW}GW_{Ing}$ PCL applicable for Class 2 groundwater ingestion ($^{Air}GW_{Inh-V}$ PCL not applicable).
2. [2] - Wells PMW-19R and PMW-20R are replacement wells for LMW-19 and PMW-20, respectively. LMW-19 and PMW-20 were plugged and replaced in February 2013 due to absence of boring logs and well construction data.
3. [3] - LMW-9 is not located at a potential point of discharge to surface water; therefore, a direct comparison of the LMW-9 data to ^{SW}GW PCLs is not applicable. An attenuation evaluation (see Appendix 11) for the potential migration of selenium from this well to the North Tributary demonstrates that the potential migration of selenium from LMW-9 will not result in an exceedance of the ^{SW}GW PCL at the North Tributary POE.
4. Samples for dissolved analysis field filtered with either a 10 micron filter (2012 samples) or 0.45 micron filter (2013 samples) (see Section 3.3.2).
5. NA - Analyte not analyzed.
6. ND - Data not available.
7. Data qualifiers (see Section 3.5): J - estimated result; UJ - estimated result, not detected.
8. -- Indicates PCL not available.
9. < Indicates analyte not detected above sample detection limit (SDL).
10. [2] - ^{SW}GW PCL set to ^{SW}SW RBEL for monitoring wells along Stewart Creek assuming chronic ecological criteria (perennial streams) assuming use of a 0 dilution factor, and wells along the North Tributary assuming acute ecological criteria (intermittent streams).
    Also per TRRP-24, the ^{SW}GW PCL applies to monitoring wells where there is a potential point of discharge of groundwater to surface water (i.e., in Stewart Creek or the North Tributary). Potentially applicable wells are noted by footnotes (11) and (12). Cd and Pb RBELs based on hardness value mg/L for Segment 0823.

Groundwater Data Summary -
Total Petroleum Hydrocarbons and Polycyclic Aromatic Hydrocarbons

Sample ID:	Minimum of	Minimum of	Chronic	Acute	Contact[3]	RAL[1]	Critical	MW-27
Sample Date:	TRRP Tier 1 Residential	TRRP Tier 1 C/I	Aquatic	Aquatic	Recreation			04/09/13
Screen Depth (feet bgs):	$^{GW}GW_{Ing}$ and $^{Air}GW_{Inh-V}$	$^{GW}GW_{Ing}$ and $^{Air}GW_{Inh-V}$	Receptor	Receptor	Receptor			5-15
	PCLs	PCLs	^{SW}GW PCL	^{SW}GW PCL	^{SW}GW PCL		PCL[2]	(mg/L)
Total Petroleum Hydrocarbons (TX1005)								
C6-C12	0.98	2.9	--	--	--	0.98	2.9	<0.808
>C12-C28	0.98	2.9	--	--	--	0.98	2.9	<0.935
>C28-C35	0.98	2.9	--	--	--	0.98	2.9	<0.935
C6-C35	--	--	--	--	--	--	--	<1.52
Polycyclic Aromatic Hydrocarbons (8270C - Low Level)								
1-Methylnaphthalene [8]	0.03	0.07	0.0021	--	4.8	0.0021	--	0.00138 J, X7
2-Methylnaphthalene [8,9]	0.10	0.29	0.06	0.38	0.28	0.06	--	0.000222 J
Acenaphthene [8]	1.47	4.38	0.02	--	2.4	0.02	--	0.000156 J
Acenaphthylene	1.47	4.38	--	--	3.3	1.47	--	<0.00006
Anthracene [8,9]	7.33	21.9	0.0003	0.0018	10.7	0.0003	--	<0.00005
Benzo[a]anthracene [8,9]	0.0013	0.0028	0.0346	0.21	--	0.0013	--	<0.00008
Benzo[a]pyrene [8]	0.0002	0.0002	0.000014	--	--	0.000014	--	<0.00008
Benzo[b]fluoranthene	0.0013	0.0028	--	--	--	0.0013	--	<0.00007
Benzo[g,h,i]perylene	0.73	2.2	--	--	--	0.73	--	<0.00008
Benzo[k]fluoranthene	0.013	0.028	--	--	--	0.013	--	<0.00009
Chrysene [8,9]	0.125	0.280	0.007	0.207	--	0.007	--	<0.00008
Dibenz(a,h)anthracene [8,9]	0.00020	0.00028	0.005	0.149	--	0.0002	--	<0.00008
Fluoranthene 8	0.98	2.9	--	--	--	0.98	--	<0.00007
Fluorene [8,9]	0.98	2.9	0.00616	0.064	2.1	0.00616	--	0.00019 J
Indeno[1,2,3-cd]pyrene	0.00125	0.0028	--	--	--	0.0013	--	<0.00007
Naphthalene [8,9]	0.49	1.5	0.250	1.48	2.55	0.2500	--	0.00152 J
Phenanthrene	0.73	2.2	0.030	0.030	1.07	0.030	--	<0.00006
Pyrene [8,9]	0.73	2.2	0.007	0.206	--	0.0070	--	<0.00011

1. [1] - Residential Assessment Levels (RALs) are the minimum of the TRRP residential Tier 1 $^{GW}GW_{Ing}$ and $^{Air}GW_{Inh-V}$ PCLs, or applicable ^{SW}GW PCLs.
2. [2] - Critical PCLs are the minimum of the TRRP commercial-industrial Tier 1 $^{GW}GW_{Ing}$ and $^{Air}GW_{Inh-V}$ PCLs, or applicable ^{SW}GW PCLs.
3. RAL exceedances are bolded and critical PCL exceedances are highlighted (no exceedances were observed).
5. Data qualifiers (see Section 3.5): J - estimated result; X7 - TCEQ does not offer lab accreditation for this analyte analyzed by EPA Method 8270.
6. "--" - Not applicable.
7. All values in mg/L.
8. Chronic values are surface water benchmarks from TCEQ ecological risk assessment guidance (RG-263).
9. Acute values derived by TCEQ Water Quality Division. In-house water quality chronic and acute values derived for wastewater permits and requests from the Office of Waste based on LC50 values in accordance with methodology defined in the TSWQS.

Table 5B.4A
Groundwater Data Summary: Metals (2014)

				Fraction	Total				Dissolved [6]			
				Analyte	Arsenic	Cadmium	Lead	Selenium	Arsenic	Cadmium	Lead	Selenium
				SW GW PCL (SW RBEL based on chronic aquatic life criteria, no dilution factor)	--	--	--	--	0.34 [7]	0.000256 [7]	0.00268 [7]	0.02 [2]
				SW GW PCL for POE wells near North Tributary (SW RBEL based on acute aquatic life criteria)	--	--	--	--	--	0.00908 [2]	0.0688 [2]	--
				SW GW PCL for POE wells near Stewart Creek (SW RBEL based on chronic aquatic life criteria, with dilution factor of 0.15)	--	--	--	--	--	0.0017	0.018	--
				GW RAL [1]	0.01	0.005	0.015	0.05	0.01	0.005	0.015	0.05
				Units	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Location ID	Sample ID	GWBU/AOC	Date Sampled	Method								
MW-11	MW-11	Upper GWBU/downstream property boundary	2014-03-28	6020	NA	NA	NA	NA	NA	<0.0000950 U	NA	NA
MW-14	MW-14[4]	Upper GWBU/Along Stewart Creek	2014-02-17	6020	NA	<0.0000950 U	**0.000302 J**	NA	NA	**0.000120 J**	**0.00433**	NA
MW-16S	MW-16S[4]	Upper GWBU/Along Stewart Creek	2014-02-14	6020	NA	**0.00240**	**0.00602**	NA	NA	< 0.0000950 U	**0.000430 J**	NA
MW-17	MW-17[4]	Upper GWBU/Along Stewart Creek	2014-02-17	6020	NA	**0.000182 J**	< 0.000200 U	NA	NA	**0.000130 J**	< 0.000200 U	NA
MW-26	MW-26[4]	Upper GWBU/Along Stewart Creek	2014-02-17	6020	NA	**0.000311 J**	**0.000287 J**	NA	NA	**0.000302 J**	**0.000327 J**	NA
MW-29	MW-29[4]	Upper GWBU/Along Stewart Creek	2014-02-17	6020	NA	**0.000765**	**0.000433 J**	NA	NA	**0.000865**	**0.000937 J**	NA
MW-27	MW-27[4]	Upper GWBU/Along Stewart Creek	2014-02-17	6020	NA	**0.000354 J**	**0.000718 J**	NA	NA	**0.000410 J**	**0.000743 J**	NA
MW-37	MW-37 [4]	Upper GWBU/NW of Stormwater Pond	2014-01-21	NA	NS [3]	NS [3]	NS [3]	NS [3]	NS [3]	NS [3]	NS [3]	NS [3]
			2014-02-13	6020	< 0.00130 U	**0.000375 J**	**0.00173**	< 0.00100 U	**0.00132 J**	**0.000350 J**	**0.00132 J**	**0.00193 J**
			2014-03-28	6020	NA	NA	NA	NA	**NA**	<0.0000950 U	NA	NA
MW-38	MW-38 [4]	Upper GWBU/Stormwater Pond	2014-01-16	6010	< 0.00328 U	< 0.000350 U	< 0.00290 U	**0.00603 J**	< 0.00328 U	< 0.000350 U	< 0.00290 U	**0.00470 J**
			2014-01-16	6020	NA	NA	NA	NA	**0.00165 J**	**0.000150 J**	**0.000281 J**	< 0.00100 U
	DUP-2 [4]		2014-01-16	6010	< 0.00328 U	< 0.000350 U	< 0.00290 U	**0.00630 J**	< 0.00328 U	< 0.000350 U	< 0.00290 U	< 0.00417 U
			2014-01-16	6020	NA	NA	NA	NA	**0.00162 J**	**0.000138 J**	**0.000385 J**	< 0.00100 U
MW-44	MW-44 [4]	Upper GWBU/Truck Wash	2014-01-22	6010	NA	R	R	NA	NA	**0.00100 J**	< 0.00290 U	NA
			2014-01-22	6020	NA	NA	NA	NA	NA	**0.000495 J**	**0.00148 J**	NA
			2014-02-17	6020	NA	**0.000109 J**	**0.00611**	NA	NA	**0.000131 J**	**0.00192**	NA
MW-46	MW-46 [4]	Upper GWBU/adjacent to perched well MW-32	2014-01-22	6010	NA	R	R	NA	NA	**0.00190 J**	**0.0259**	NA
			2014-02-17	6020	NA	**0.000812**	**0.00185**	NA	NA	**0.000834**	**0.00488**	NA
			2014-03-27	6020	NA	**0.000794**	**0.00546**	NA	NA	**0.000797**	**0.00302 J**	NA
	DUP-08 [4]		2014-03-27	6020	NA	**0.000805**	**0.00513**	NA	NA	**0.000745**	**0.00540**	NA
MW-39	MW-39 [5]	Upper GWBU/Slag Landfill	2014-01-17	6010	NA	< 0.000350 U	< 0.00290 U	NA	NA	< 0.000350 U	**0.00440 J**	NA
MW-40	MW-40 [5]	Upper GWBU/Slag Landfill	2014-01-17	6010	NA	< 0.000350 U	< 0.00290 U	NA	NA	< 0.000350 U	< 0.00290 U	NA
MW-41	MW-41 [5]	Upper GWBU/N. Tributary	2014-01-17	6010	NA	< 0.000350 U	**0.00699 J**	NA	NS [3]	NS [3]	NS [3]	NS [3]
			2014-01-17	6020	NA	NA	**0.00207**	NA	NA	NA	NA	NA
			2014-02-14	6010	NA	NA	NA	NA	< 0.00328 U	< 0.000350 U	< 0.00290 U	< 0.00417 U
MW-42	MW-42 [5]	Upper GWBU/N. Tributary	2014-01-17	6010	NA	< 0.000350 U	**0.00369 J**	NA	NS [3]	NS [3]	NS [3]	NS [3]
			2014-01-17	6020	NA	NA	< 0.000200 U	NA	NA	NA	NA	NA
			2014-02-14	6010	NA	NA	NA	NA	< 0.00328 U	< 0.000350 U	< 0.00290 U	< 0.00417 U
B4R	B4R	Upper GWBU/West of South Disposal Area	2014-01-17	6010	NA	**0.000500 J**	< 0.00290 U	NA	< 0.00328 U	< 0.000350 U	**0.00569 J**	< 0.00417 U
MW-16	MW-16[4]	Screened between 67.5 -77.5 ft bgs/ Along Stewart Creek	2014-02-14	6020	NA	< 0.0000950 U	**0.00409**	NA	NA	< 0.0000950 U	**0.00220**	NA
	DUP-1[4]		2014-02-14	6020	NA	**0.0000950 J**	**0.00463**	NA	NA	< 0.0000950 U	**0.000360**	NA
MW-45	MW-45	Upper GWBU/C2L (Background)	2014-01-17	6010	< 0.00328 U	< 0.000350 U	**0.00461 J**	< 0.00417 U	NA	NA	NA	NA
			2014-03-27	6010	NA	NA	NA	NA	<0.00328 U	<0.000350 U	<0.00290 U	<0.00417 U

Table 5B.4A
Groundwater Data Summary: Metals (2014)

				Fraction	Total				Dissolved [6]			
				Analyte	Arsenic	Cadmium	Lead	Selenium	Arsenic	Cadmium	Lead	Selenium
				^{SW}GW PCL (SW RBEL based on chronic aquatic life criteria, no dilution factor)	--	--	--	--	0.34 [7]	0.000256 [7]	0.00268 [7]	0.02 [2]
				^{SW}GW PCL for POE wells near North Tributary (SW RBEL based on acute aquatic life criteria)	--	--	--	--	--	0.00908 [2]	0.0688 [2]	--
				^{SW}GW PCL for POE wells near Stewart Creek (SW RBEL based on chronic aquatic life criteria, with dilution factor of 0.15)	--	--	--	--	--	0.0017	0.018	--
				GW RAL [1]	0.01	0.005	0.015	0.05	0.01	0.005	0.015	0.05
				Units	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Location ID	Sample ID	GWBU/AOC	Date Sampled	Method								
MW-32	MW-32 [4]	Perched/adjacent to WWTB	2014-01-22	6010	NA	R	R	NA	NA	NS [3]	NS [3]	NA
			2014-02-14	6020	NA	NS [3]	NS [3]	NA	NA	**0.00639**	**0.0164**	NA
MW-33	MW-33	Perched/STB	2014-01-22	6010	NA	R	R	NA	NA	**0.00360 J**	**0.0557**	NA
			2014-02-17	6010	NA	**0.00715**	**0.694**	NA	NA	**0.00414 J**	**0.101**	NA
MW-34	MW-34	Perched/RMSA	2014-01-21	6010	NA	NS [3]	NS [3]	NA	NA	NS [3]	NS [3]	NA
			2014-02-14	6010	NA	**0.0346**	**0.0357**	NA	NA	NA	NA	NA
			2014-02-17	6010	NA	NA	NA	NA	NA	**0.0386**	**0.0575**	NA
MW-35	MW-35	Perched/RMSA	2014-01-21	NA	NA	NS [3]	NS [3]	NA	NA	NS [3]	NS [3]	NA
			2014-02-13	NA	NA	NS [3]	NS [3]	NA	NA	NS [3]	NS [3]	NA
MW-36	MW-36	Perched/RMSA	2014-01-21	NA	NA	NS [3]	NS [3]	NA	NA	NS [3]	NS [3]	NA
			2014-02-13	NA	NA	NS [3]	NS [3]	NA	NA	NS [3]	NS [3]	NA

NOTES

Created by: BEF 03-04-2014
Checked by: LAB 03-05-2014
Reviewed by: CMH 04-06-2014

Detected analytes are bolded.
Analyte exceeds applicable ^{SW}GW PCL.
Indicates analyte MDL exceeds PCL.
Analyte exceeds GW RAL.
< - Indicates analyte not detected above method detection limit (MDL).
NA - Analyte not analyzed.
J - Analyte concentration estimated.
U - Analyte not detected.
R - Indicates data rejection due to sample collection error (not properly filtered).
-- Indicates PCL not available.
(1)The Groundwater Residential Assessment Level (GW RAL) is the the TRRP Tier 1 Residential $^{GW}GW_{Ing}$ PCL applicable for Class 2 groundwater ingestion ($^{Air}GW_{Inh-V}$ PCL not applicable).
(2) ^{SW}GW PCL set to ^{SW}SW RBEL for monitoring wells along Stewart Creek assuming chronic ecological criteria (perennial streams) assuming use of a 0.15 dilution factor, and wells along the North Tributary assuming acute ecological criteria (intermittent streams) with no dilution factor. Per TRRP-24, specific aquatic life criteria for cadmium and lead apply to dissolved rather than total concentrations since the dissolved phase represents the bioavailable form. Also per TRRP-24, the ^{SW}GW PCL applies to monitoring wells where there is a potential point of discharge of groundwater to surface water (i.e., in the near vicinity of Stewart Creek or the North Tributary). Potentially applicable wells are noted by footnotes (4) and (5).
Cd and Pb RBELs based on hardness value of 106 mg/L for Segment 0823.
(3) NS - Not sampled. Well was dry or there was insuffient volume available for sample collection.
(4) Monitoring wells along Stewart Creek considered a potential point of discharge where the ^{SW}GW PCL (chronic) may apply.
(5) Monitoring wells along the North Tributary of Stewart Creek considered potential point of exposure wells where the ^{SW}GW PCL (acute) may apply.
(6) Samples for dissolved analysis field filtered with a 0.45 micron filter.
(7) ^{SW}SW RBEL assuming chronic ecological criteria for reference purposes.

Table 5B.4B
Groundwater Data Summary
VOCs, SVOCs, and TPH
(2014)

	Sample ID	DUP-1	MW-43
	Location ID	MW-43	MW-43
	Date Sampled	2014-01-17	2014-01-17
	Units	mg/L	mg/L
Analyte	GW to GW RAL(1) (mg/L)		
Volatile Organic Compounds (VOCs)			
1,1,1-Trichloroethane	0.2000	< 0.000980 U	< 0.000980 U
1,1,2,2-Tetrachloroethane	0.0046	< 0.000800 U	< 0.000800 U
1,1,2-Trichloroethane	0.0050	< 0.000530 U	< 0.000530 U
1,1-Dichloroethane	4.8884	< 0.000500 U	< 0.000500 U
1,1-Dichloroethene	0.0070	< 0.000760 U	< 0.000760 U
1,2-Dichloroethane	0.0050	< 0.00101 U	< 0.00101 U
1,2-Dichloroethene, Total	--	< 0.000840 U	< 0.000840 U
1,2-Dichloropropane	0.0050	< 0.00141 U	< 0.00141 U
2-Butanone	14.6652	< 0.00157 U	< 0.00157 U
2-Hexanone	0.1222	< 0.00142 U	< 0.00142 U
4-Methyl-2-pentanone	1.9554	< 0.00111 U	< 0.00111 U
Acetone	21.9978	< 0.00227 UJ	< 0.00227 UJ
Benzene	0.0050	< 0.000560 U	< 0.000560 U
Bromochloromethane	0.9777	< 0.000810 U	< 0.000810 U
Bromodichloromethane	0.0147	< 0.000760 U	< 0.000760 U
Bromoform	0.1155	< 0.000770 U	< 0.000770 U
Bromomethane	0.0342	< 0.00215 U	< 0.00215 U
Carbon Disulfide	2.4442	< 0.00170 U	< 0.00170 U
Carbon Tetrachloride	0.0050	< 0.000920 U	< 0.000920 U
Chlorobenzene	0.1000	< 0.000820 U	< 0.000820 U
Chloroethane	9.7768	< 0.00173 U	< 0.00173 U
Chloroform	0.2444	< 0.000820 U	< 0.000820 U
Chloromethane	0.0702	< 0.000850 U	< 0.000850 U
cis-1,2-Dichloroethene	0.0700	< 0.000560 U	< 0.000560 U
cis-1,3-Dichloropropene	0.0017	< 0.000970 U	< 0.000970 U
Dibromochloromethane	0.0109	< 0.000920 U	< 0.000920 U
Ethylbenzene	0.7000	< 0.00129 U	< 0.00129 U
m,p-Xylenes	10.0000	< 0.00126 U	< 0.00126 U
Methylene Chloride	0.0050	< 0.00143 U	< 0.00143 U
o-Xylene	10.0000	< 0.000930 U	< 0.000930 U
Styrene	0.1000	< 0.000560 U	< 0.000560 U
Tetrachloroethene	0.0050	< 0.00124 U	< 0.00124 U
Toluene	1.0000	< 0.000550 U	< 0.000550 U
trans-1,2-Dichloroethene	0.1000	< 0.000880 U	< 0.000880 U
trans-1,3-Dichloropropene	0.0091	< 0.000590 U	< 0.000590 U
Trichloroethene	0.0050	< 0.00158 U	< 0.00158 U
Vinyl Acetate	24.4420	< 0.000600 U	< 0.000600 U
Vinyl Chloride	0.0020	< 0.000850 U	< 0.000850 U
Xylenes, Total	10.0000	< 0.00198 U	< 0.00198 U

Table 5B.4B
Groundwater Data Summary
VOCs, SVOCs, and TPH
(2014)

	Sample ID	DUP-1	MW-43
	Location ID	MW-43	MW-43
	Date Sampled	2014-01-17	2014-01-17
	Units	mg/L	mg/L
Analyte	GW to GW RAL(1) (mg/L)		
Semivolatile Organic Compounds (SVOCs)			
1,2,4-Trichlorobenzene	0.0700	< 0.00016 U	< 0.000160 UJ
1,2-Dichlorobenzene	0.6000	< 0.00021 UJ	< 0.000210 UJ
1,3-Dichlorobenzene	0.7333	< 0.0001 UJ	< 0.000100 UJ
1,4-Dichlorobenzene	0.0750	< 0.00016 UJ	< 0.000160 UJ
2,4,5-Trichlorophenol	2.4442	< 0.00029 U	< 0.000290 U
2,4,6-Trichlorophenol	0.0244	< 0.00033 U	< 0.000330 UJ
2,4-Dichlorophenol	0.0733	< 0.00026 U	< 0.000260 U
2,4-Dimethylphenol	0.4888	< 0.00018 U	< 0.000180 U
2,4-Dinitrophenol	0.0489	< 0.0004 U	< 0.000400 UJ
2,4-Dinitrotoluene	0.0013	< 0.00032 UJ	< 0.000320 U
2,6-Dinitrotoluene	0.0013	< 0.00029 U	< 0.000290 U
2-Chloronaphthalene	1.9554	< 0.00019 UJ	< 0.000190 UJ
2-Chlorophenol	0.1222	< 0.00022 U	< 0.000220 U
2-Methylnaphthalene	0.0978	< 0.00014 UJ	< 0.000140 U
2-Methylphenol	1.2221	< 0.00019 U	< 0.000190 U
2-Nitroaniline	0.0073	< 0.00035 UJ	< 0.000350 UJ
2-Nitrophenol	0.0489	< 0.00022 U	< 0.000220 U
3,3'-Dichlorobenzidine	0.0020	< 0.00032 UJ	< 0.000320 UJ
3-Nitroaniline	0.0073	< 0.00013 U	< 0.000130 U
4,6-Dinitro-2-methylphenol	0.0024	< 0.00016 UJ	< 0.000160 UJ
4-Bromophenyl Phenyl Ether	0.000061	< 0.00025 UJ	< 0.000250 U
4-Chloro-3-methylphenol	0.1222	< 0.00025 U	< 0.000250 U
4-Chloroaniline	0.0046	< 0.00011 UJ	< 0.000110 UJ
4-Chlorophenyl-phenylether	0.000061	< 0.00023 UJ	< 0.000230 U
4-Nitroaniline	0.0456	< 0.00023 UJ	< 0.000230 U
4-Nitrophenol	0.0489	< 0.00033 U	< 0.000330 U
Acenaphthene	1.4665	< 0.00016 UJ	< 0.000160 U
Acenaphthylene	1.4665	< 0.00016 UJ	< 0.000160 U
Anthracene	7.3326	< 0.00044 UJ	< 0.000440 U
Benzidine	0.0000040	R	R
Benzo[a]anthracene	0.0013	< 0.00025 UJ	< 0.000250 U
Benzo[a]pyrene	0.0002	< 0.00013 UJ	< 0.000130 U
Benzo[b]fluoranthene	0.0013	< 0.00018 UJ	< 0.000180 U
Benzo[g,h,i]perylene	0.7333	< 0.00035 UJ	< 0.000350 U
Benzo[k]fluoranthene	0.0125	< 0.00016 UJ	< 0.000160 U
Benzyl Alcohol	2.4442	< 0.00051 U	< 0.000510 U
Bis(2-chloroethoxy)methane	0.0008	< 0.00019 UJ	< 0.000190 U
Bis(2-chloroethyl) Ether	0.0008	< 0.00018 UJ	< 0.000180 U
Bis(2-chloroisopropyl) Ether	0.0130	< 0.00018 UJ	< 0.000180 U
Bis(2-ethylhexyl) Phthalate	0.0060	< 0.00059 UJ	< 0.000590 U
Butylbenzyl Phthalate	0.4803	< 0.00085 UJ	< 0.000850 U
Carbazole	0.0456	< 0.00035 UJ	< 0.000350 U
Chrysene	0.1250	< 0.00024 UJ	< 0.000240 U

Table 5B.4B
Groundwater Data Summary
VOCs, SVOCs, and TPH
(2014)

	Sample ID	DUP-1	MW-43
	Location ID	MW-43	MW-43
	Date Sampled	2014-01-17	2014-01-17
	Units	mg/L	mg/L
Analyte	**GW to GW RAL(1) (mg/L)**		
Semivolatile Organic Compounds (SVOCs) (continued)			
Dibenz[a,h]anthracene	0.000200	< 0.00029 UJ	< 0.000290 U
Dibenzofuran	0.0978	< 0.00016 UJ	< 0.000160 U
Diethyl Phthalate	19.5536	< 0.00419 UJ	< 0.00419 U
Dimethyl Phthalate	19.5536	< 0.00018 UJ	< 0.000180 U
Di-n-Butyl Phthalate	2.4442	< 0.00187 UJ	< 0.00187 U
Di-n-octyl Phthalate	0.9777	< 0.00016 UJ	< 0.000160 U
Fluoranthene	0.9777	< 0.00031 UJ	< 0.000310 U
Fluorene	0.9777	< 0.00012 UJ	< 0.000120 U
Hexachlorobenzene	0.0010	< 0.00025 UJ	< 0.000250 U
Hexachlorobutadiene	0.0117	< 0.00019 UJ	< 0.000190 UJ
Hexachlorocyclopentadiene	0.0500	< 0.00015 UJ	< 0.000150 UJ
Hexachloroethane	0.0171	< 0.00017 UJ	< 0.000170 UJ
Indeno[1,2,3-cd]pyrene	0.0013	< 0.00029 UJ	< 0.000290 U
Isophorone	0.9605	< 0.00015 UJ	< 0.000150 U
m,p-Cresol	0.1222	< 0.00016 U	< 0.000160 U
Naphthalene	0.4888	< 0.00016 UJ	< 0.000160 U
Nitrobenzene	0.0489	< 0.0002 UJ	< 0.000200 U
N-Nitrosodimethylamine	0.000018	< 0.00016 UJ	< 0.000160 UJ
N-Nitroso-di-n-propylamine	0.000130	< 0.00024 UJ	< 0.000240 U
N-Nitrosodiphenylamine	0.1862	< 0.00033 UJ	< 0.000330 U
Pentachlorophenol	0.0010	< 0.00096 U	< 0.000960 UJ
Phenanthrene	0.7333	< 0.00029 UJ	< 0.000290 U
Phenol	7.3326	< 0.00014 U	< 0.000140 UJ
Pyrene	0.7333	< 0.00033 UJ	< 0.000330 U
Total Petroleum Hydrocarbons (TPHs)			
TPH as >C12-C28	0.9777	< 0.936 U	< 0.922 U
TPH as >C28-C35	0.9777	< 0.936 U	< 0.922 U
TPH as C6-C12	0.9777	< 0.809 U	< 0.797 U
TPH as C6-C35	--	< 1.52 U	< 1.50 U

NOTES

Detected analytes are bolded.

Analyte minimum detection limit (MDL) exceeds RAL is indicated by gray.

< - Indicates analyte not detected above method detection limit (MDL).

J - Analyte concentration estimated.

U - Analyte not detected.

UJ - Estimated data; The analyte was not detected above the reported sample detection limit (SDL). The numerical value of the SDL is estimated and may be inaccurate.

R - Indicates data rejection due to poor recovery in LCS.

-- Indicates GW RAL not available.

(1) The Groundwater Residential Assessment Level (GW RAL) is the the lower of the TRRP Tier 1 Residential $^{GW}GW_{Ing}$ PCL or AirGWInh-V PCL applicable for Class 2 groundwater ingestion.

Table 5B.5

Groundwater Data Summary
Perfluorinated Compounds (PFCs)
(2014)

Sample ID	RAL [1]	MW-43
Location ID		MW-43
Date Sampled		2014-01-17
units		mg/L
Analyte		
Perfluorooctanoic Sulfonate	0.0003 [2]	< 0.0000137 U
Perfluorobutane Sulfonate	--	< 0.00000847 U
Perfluorobutyric acid	0.007 [2]	< 0.0000101 U
Perfluorodecane Sulfonate	--	< 0.00000941 U
Perfluorodecanoic acid	--	< 0.00000804 U
Perfluorododecanoic acid	--	< 0.0000153 U
Perfluoroheptanoic acid	--	< 0.0000136 U
Perfluorohexane Sulfonate	--	< 0.00000717 U
Perfluorohexanoic acid	--	< 0.00000299 U
Perfluorooctanoic acid	0.0005 [2]	< 0.0000101 U
Perfluorononanoic acid	--	< 0.0000179 U
Perfluoropentanoic acid	--	< 0.0000112 U
Perfluorotetradecanoic acid	--	< 0.0000151 U
Perfluorotridecanoic acid	--	< 0.0000182 U
Perfluoroundecanoic acid	--	< 0.00000709 U

NOTES

< - Indicates analyte not detected above method detection limit (MDL).
U - Not detected.
mg/L - Milligrams per liter.
-- Indicates PCL not available.
1. Texas Risk Reduction Program (TRRP) Protective Concentration Levels (PCLs) for PFCs have not been established.
2. PFC drinking water standards were mandated by the Minnesota Legislature and set by the Minnesota Department of Health. The current standards are 0.5 ppb for PFOA, 0.3 ppb for PFOS and 7 ppb for PFBA, provided for reference.

Created By: CMH 5-6-2014
Checked by: DB 5-13-2014
Reviewed by: AF 5-13-2014

Table 5C

Groundwater Geochemical Data Summary

Well ID	Sample Date	Screen Interval (ft bgs)	Sulfate (mg/L)	TDS (mg/L)
B4R	1/18/2012	4-9	178	1170
	3/19/2013		953	--
B1R	3/22/2013	49.5-59.5	18	--
B5N	1/17/2012	6.5-16.5	889	1550
	3/22/2013		946	--
B7N	3/18/2013	14-24	1820	--
B9N	4/10/2013	7-17	720	--
field duplicate	4/10/2013		726	--
MW-10	3/18/2013	7-17	753	--
MW-11	4/9/2013	7-17	281	--
MW-12	1/16/2012	8-18.5	2520	1960
MW-12	4/9/2013		2490	--
MW-13	1/16/2012	12-22	1200	2230
	4/9/2013		1020	--
MW-14	1/16/2012	7-17	2630	4180
	4/9/2013		2560	--
MW-15	4/10/2013	12-22	736	--
MW-16	1/17/2012	67.5-77.5	298	1380
	4/9/2013		276	--
MW-16S	1/17/2012	7-17	1080	7980
	4/9/2013		1270	--
MW-17	1/18/2012	7-17	1590	3140
	3/22/2013		1510	--
MW-18	1/17/2012	5-15.5	453	1040
Dup	1/17/2012		455	1220
	3/18/2013		298	--
MW-19	1/17/2012	7-22	854	1760
MW-20	1/18/2012	7-22	4040	6020
MW-21	4/9/2013	3-13	2010	--
MW-22	4/9/2013	3-13	2180	--
MW-23	3/19/2013	4.5-19.5	2090	--
MW-24	3/18/2013	14-29	1640	--
MW-25	3/19/2013	7-22	3700	--
MW-26	4/9/2013	5-15	2480	--
MW-27	4/9/2013	5-15	1530	--
MW-28	4/12/2013	5-20	174	--
MW-29	4/9/2013	4.5-14.5	4260	--
MW-30	4/10/2013	12-32	711	--
MW-31	5/13/2013	8-23	927	--
P-1	4/9/2013	10-20	169	--
P-2	3/19/2013	10-20	2560	--
LMW-5	4/12/2013	7-21	157	--
LMW-8	3/13/2013	7-21	130	--
LMW-9	4/12/2013	9-23	1770	--
LMW-17	4/11/2013	10-20	142	--
LMW-21	4/11/2013	6-25	406	--
LMW-22	4/12/2013	5-20	99	--
LMW-19	1/18/2012	ND	813	3160
PMW-20R	4/11/2013	10-25	268	--

Notes:
1. ND - Data not available.
2. "--" - Not analyzed.

Table 5D
Groundwater Measurements

Well ID	TOC Elevation (ft msl)	Screen Interval (ft bgs)	Measurement Date	Depth to Groundwater (ft btoc)	Groundwater Elevation (ft msl)
Former Operating Plant Wells					
B1R	682.72	49.5-59.5	12/13/11	3.62	679.10
			01/16/12	3.74	678.98
			02/13/12	1.87	680.85
			03/11/13	4.64	678.08
			04/05/13	4.52	678.20
			04/29/13	4.81	677.91
			01/21/14	5.47	677.25
B3R	650.23	4-14	12/13/11	DRY	DRY
			01/16/12	DRY	DRY
			02/13/12	9.41	640.82
			03/11/13	14.92	635.31
			04/05/13	14.96	635.27
			04/29/13	12.96	637.27
			01/21/14	12.66	637.57
B4R	664.58	4-9	12/13/11	8.67	655.91
			01/16/12	8.01	656.57
			02/13/12	11.89	652.69
			03/11/13	7.66	656.92
			04/05/13	7.57	657.01
			04/29/13	8.79	655.79
			01/21/14	11.86	652.72
B5N	631.43	6.5-16.5	12/13/11	9.95	621.48
			01/16/12	9.91	621.52
			02/13/12	9.76	621.67
			03/11/13	9.72	621.71
			04/05/13	9.68	621.75
			04/29/13	10.04	621.39
			01/21/14	10.31	621.12
B7N	645.60	14-24	12/13/11	NM	NM
			01/16/12	13.84	631.76
			02/13/12	13.09	632.51
			03/11/13	14.33	631.27
			04/05/13	14.31	631.29
			04/29/13	14.52	631.08
			01/21/14	15.05	630.55
B9N	640.69	7-17	12/13/11	7.31	633.38
			01/16/12	8.78	631.91
			02/13/12	8.84	631.85
			03/11/13	8.39	632.30
			04/05/13	8.76	631.93
			04/29/13	9.06	631.63
			01/21/14	9.14	631.55
LMW-1	638.74	5-20	04/29/13	9.14	629.60
			01/21/14	11.30	627.44
LMW-2	641.01	6-21	04/29/13	11.12	629.89
			01/21/14	12.23	628.78
LMW-3	639.78	6-16	04/29/13	12.08	627.70
			01/21/14	13.41	626.37

Table 5D
Groundwater Measurements

Well ID	TOC Elevation (ft msl)	Screen Interval (ft bgs)	Measurement Date	Depth to Groundwater (ft btoc)	Groundwater Elevation (ft msl)
Former Operating Plant Wells (continued)					
LMW-4	641.42	12-22	04/29/13	11.69	629.73
			01/21/14	13.07	628.35
LMW-5	646.07	7-21	03/11/13	17.69	628.38
			04/05/13	17.02	629.05
			04/29/13	17.29	628.78
			01/21/14	18.10	627.97
LMW-8	648.72	7-21	03/11/13	14.93	633.79
			04/05/13	14.52	634.20
			04/29/13	14.63	634.09
			01/21/14	14.87	633.85
LMW-9	663.66	9-23	03/11/13	16.24	647.42
			04/05/13	20.21	643.45
			04/29/13	22.14	641.52
			01/21/14	19.85	643.81
LMW-17	648.70	10-20	03/11/13	18.52	630.18
			04/05/13	18.34	630.36
			04/29/13	16.81	631.89
			01/21/14	19.44	629.26
LMW-21	648.28	10-25	03/11/13	20.11	628.17
			04/05/13	19.29	628.99
			04/29/13	19.62	628.66
			01/21/14	20.18	628.10
LMW-22	646.99	5-20	03/11/13	17.18	629.81
			04/05/13	16.93	630.06
			04/29/13	17.16	629.83
			01/21/14	19.81	627.18
MW-10	644.82	7-17	12/13/11	8.76	636.06
			01/16/12	8.71	636.11
			02/13/12	6.64	638.18
			03/11/13	8.71	636.11
			04/05/13	8.63	636.19
			04/29/13	8.37	636.45
			01/21/14	8.22	636.60
MW-11	626.54	7-17	12/13/11	8.62	617.92
			01/16/12	19.61	606.93
			02/13/12	7.73	618.81
			03/11/13	5.94	620.60
			04/05/13	7.64	618.90
			04/29/13	9.13	617.41
			01/21/14	10.05	616.49
MW-12	635.16	8-18.5	12/13/11	8.54	626.62
			01/16/12	8.62	626.54
			02/13/12	8.14	627.02
			03/11/13	8.22	626.94
			04/05/13	8.17	626.99
			04/29/13	8.47	626.69
			01/21/14	8.55	626.61

Table 5D
Groundwater Measurements

Well ID	TOC Elevation (ft msl)	Screen Interval (ft bgs)	Measurement Date	Depth to Groundwater (ft btoc)	Groundwater Elevation (ft msl)
Former Operating Plant Wells (Continued)					
MW-13	637.08	12-22	12/13/11	15.75	621.33
			01/16/12	15.83	621.25
			02/13/12	15.57	621.51
			03/11/13	15.42	621.66
			04/05/13	15.33	621.75
			04/29/13	15.79	621.29
			01/21/14	16.20	620.88
MW-14	631.01	7-17	12/13/11	5.88	625.13
			01/16/12	5.94	625.07
			02/13/12	5.79	625.22
			03/11/13	5.81	625.20
			04/05/13	5.74	625.27
			04/29/13	6.03	624.98
			01/21/14	6.20	624.81
MW-15	626.58	12-22	12/13/11	12.08	614.50
			01/16/12	12.13	614.45
			02/13/12	6.83	619.75
			03/11/13	11.53	615.05
			04/05/13	10.97	615.61
			04/29/13	10.62	615.96
			01/21/14	13.84	612.74
MW-16	628.88	67.5-77.5	12/13/11	10.26	618.62
			01/16/12	10.33	618.55
			02/13/12	10.92	617.96
			03/11/13	9.67	619.21
			04/05/13	9.61	619.27
			04/29/13	10.01	618.87
			01/21/14	12.07	616.81
MW-16S	628.00	7-17	12/13/11	9.05	618.95
			01/16/12	9.12	618.88
			02/13/12	8.67	619.33
			03/11/13	8.92	619.08
			04/05/13	8.84	619.16
			04/29/13	9.22	618.78
			01/21/14	9.42	618.58
MW-17	629.00	7-17	12/13/11	8.55	620.45
			01/16/12	8.62	620.38
			02/13/12	8.28	620.72
			03/11/13	8.29	620.71
			04/05/13	8.27	620.73
			04/29/13	8.71	620.29
			01/21/14	8.53	620.47
MW-18	633.00	5.5-15.5	12/13/11	1.86	631.14
			01/16/12	1.96	631.04
			02/13/12	1.86	631.14
			03/11/13	2.53	630.47
			04/05/13	2.51	630.49
			04/29/13	3.19	629.81
			01/21/14	4.25	628.75

Table 5D
Groundwater Measurements

Well ID	TOC Elevation (ft msl)	Screen Interval (ft bgs)	Measurement Date	Depth to Groundwater (ft btoc)	Groundwater Elevation (ft msl)
Former Operating Plant Wells (Continued)					
MW-21	635.99	3-13	03/11/13	3.24	632.75
			04/05/13	3.17	632.82
			04/29/13	4.39	631.60
			01/21/14	3.50	632.49
MW-22	636.89	3-13	03/11/13	3.71	633.18
			04/05/13	3.62	633.27
			04/29/13	4.59	632.30
			01/21/14	4.21	632.68
MW-23	644.15	4.5-19.5	03/11/13	7.13	637.02
			04/05/13	7.04	637.11
			04/29/13	7.34	636.81
			01/21/14	7.52	636.63
MW-24	642.96	14-29	03/11/13	21.77	621.19
			04/05/13	21.72	621.24
			04/29/13	22.26	620.70
			01/21/14	22.54	620.42
MW-25	635.85	7-22	03/11/13	12.29	623.56
			04/05/13	11.71	624.14
			04/29/13	11.39	624.46
			01/21/14	11.59	624.26
MW-26	631.93	5-15	03/11/13	9.98	621.95
			04/05/13	9.52	622.41
			04/29/13	9.21	622.72
			01/21/14	5.80	626.13
MW-27	633.42	5-15	03/11/13	6.03	627.39
			04/05/13	5.92	627.50
			04/29/13	5.64	627.78
			01/21/14	4.90	628.52
MW-29	633.51	4.5-14.5	03/11/13	13.08	620.43
			04/05/13	6.96	626.55
			04/29/13	6.56	626.95
			01/21/14	6.62	626.89
MW-30	645.15	12-32	04/05/13	11.47	633.68
			04/29/13	11.26	633.89
			01/21/14	11.85	633.30
MW-31	636.71	8-23	05/13/13	10.58	626.13
			01/21/14	10.87	625.84
MW-32	630.96	2.5-5	01/21/14	4.16	626.80
MW-33	632.59	2.5-5	01/21/14	1.09	631.50
MW-34	632.83	2.5-5	01/21/14	4.31	628.52
MW-35	632.55	2.5-5	01/21/14	DRY	DRY
MW-36	633.63	2.5-5	01/21/14	DRY	DRY
MW-37	620.95	5-10	01/21/14	8.11	612.84
MW-38	623.14	5-15	01/21/14	7.10	616.04
MW-39	639.70	10-20	01/21/14	10.41	629.29
MW-40	635.51	5-15	01/21/14	5.40	630.11
MW-41	642.17	6-16	01/21/14	11.38	630.79
MW-42	642.24	5-15	01/21/14	9.38	632.86
MW-43	645.45	10-20	01/21/14	14.93	630.52

Table 5D
Groundwater Measurements

Well ID	TOC Elevation (ft msl)	Screen Interval (ft bgs)	Measurement Date	Depth to Groundwater (ft btoc)	Groundwater Elevation (ft msl)
Former Operating Plant Wells (Continued)					
MW-44	637.50	5-15	01/21/14	9.21	628.29
MW-45	660.86	10-20	01/21/14	13.29	647.57
MW-46	630.98	10-20	01/21/14	5.21	625.77
P-1	647.24	10-20	12/13/11	11.54	635.70
			01/16/12	11.47	635.77
			02/13/12	9.89	637.35
			03/11/13	13.91	633.33
			04/05/13	13.91	633.33
			04/29/13	13.72	633.52
			01/21/14	11.38	635.86
P-2	643.55	10-20	12/13/11	15.91	627.64
			01/16/12	15.94	627.61
			02/13/12	14.31	629.24
			03/11/13	16.34	627.21
			04/05/13	16.31	627.24
			04/29/13	15.44	628.11
			01/21/14	16.40	627.15
PMW-19R	681.79	4-19	03/11/13	DRY	DRY
			04/05/13	DRY	DRY
			04/29/13	DRY	DRY
			01/21/14	22.22	659.57
PMW-20R	648.09	10-25	03/11/13	18.91	629.18
			04/05/13	19.06	629.03
			04/29/13	19.16	628.93
			01/21/14	19.90	628.19
Undeveloped Buffer Property Wells					
MW-19	653.34	7-22	01/16/12	18.59	634.75
			02/13/12	11.73	641.61
			03/11/13	12.81	640.53
			04/05/13	12.87	640.47
			04/29/13	12.51	640.83
			01/21/14	13.81	639.53
MW-20	644.70	7-22	01/16/12	24.02	620.68
			02/13/12	12.79	631.91
			03/11/13	16.34	628.36
			04/05/13	16.31	628.39
			04/29/13	14.59	630.11
			01/21/14	12.88	631.82
MW-28	642.91	5-20	03/11/13	14.81	628.10
			04/05/13	14.68	628.23
			04/29/13	13.67	629.24
			01/21/14	15.09	627.82
VCP-MW-1	655.88	2.5-10	03/11/13	12.81	643.07
			04/05/13	12.80	643.08
			04/29/13	12.81	643.07
			01/21/14	12.35	643.53

Table 5D
Groundwater Measurements

Well ID	TOC Elevation (ft msl)	Screen Interval (ft bgs)	Measurement Date	Depth to Groundwater (ft btoc)	Groundwater Elevation (ft msl)
Undeveloped Buffer Property Wells (Continued)					
VCP-MW-2	631.16	5-15	03/11/13	12.17	618.99
			04/05/13	11.79	619.37
			04/29/13	11.26	619.90
			01/21/14	11.41	619.75
VCP-MW-3	634.06	5-15	03/11/13	13.99	620.07
			04/05/13	13.72	620.34
			04/29/13	13.74	620.32
			01/21/14	15.38	618.68
VCP-MW-4	635.43	5-15	03/11/13	7.18	628.25
			04/05/13	6.74	628.69
			04/29/13	6.91	628.52
			01/21/14	9.01	626.42
VCP-MW-5	643.97	5-20	03/11/13	15.31	628.66
			04/05/13	15.27	628.70
			04/29/13	14.44	629.53
			01/21/14	15.98	627.99
VCP-MW-6	644.71	5-20	03/11/13	16.32	628.39
			04/05/13	16.49	628.22
			04/29/13	16.04	628.67
			01/21/14	16.67	628.04
VCP-MW-7	685.18	2.5-10	04/29/13	DRY	DRY
			01/21/14	DRY	DRY
VCP-MW-8	651.02	6-16	04/29/13	12.40	638.62
			01/21/14	12.63	638.39
VCP-MW-9	666.96	2.5-20	04/29/13	13.82	653.14
			01/21/14	7.35	659.61
VCP-MW-10	669.74	2.5-15	04/29/13	13.21	656.53
			01/21/14	12.45	657.29
VCP-MW-11	672.73	2.5-15	04/29/13	DRY	DRY
			01/21/14	17.21	655.52
VCP-MW-12	656.04	9.5-29.5	01/21/14	30.25	625.79
VCP-MW-13	657.38	4-24	01/21/14	24.92	632.46

Table 5D

Groundwater Measurements

Well ID	TOC Elevation (ft msl)	Screen Interval (ft bgs)	Measurement Date	Depth to Groundwater (ft btoc)	Groundwater Elevation (ft msl)
Stewart Creek Staff Gauges					
Staff Gauge ID	**Zero Elevation (feet amsl)**		**Measurement Date**	**Surface Water Measurement (feet above zero)**	**Surface Water Elevation (feet amsl)**
Staff Gauge No. 1	627.75		01/17/12	0.25	628.00
			02/13/12	0.32	628.07
(re-surveyed 5/16/13	627.62		04/05/13	0.28	627.90
			04/29/13	-0.20	627.42
			1/21/2014*	NM	NM
Staff Gauge No. 2	613.75		01/17/12	0.09	613.84
			02/13/12	0.46	614.21
(re-surveyed 5/16/13	613.53		04/05/13	0.24	613.77
			04/29/13	-0.15	613.38
			01/21/14	0.04	613.49

Notes:

Prepared by: JJ 1/29/14
Checked by: JI 1/29/14
Reviewed by: JAW

1. bgs - below ground surface.
2. msl - above mean sea level.
3. btoc - below top of casing.
4. NM - not measured.
5. Stewart Creek staff gauges were re-surveyed on May 16, 2013 as a result of displacement that occurred since the previous survey event in 2012 due to a storm event.
6. * - Staff Gauge No. 1 damaged during storm event. No measurement collected.

EXPLANATION

- On-Site Property Boundary
- FRC Property Boundary
- Existing Monitoring Well Location
- Well Plugged and Abandoned, Destroyed, or Not Found
- Staff Gauge
- (620.60) Groundwater Elevation Measured 3/11/13 (Ft MSL)
- 645 Potentiometric Contour (Ft MSL) C.I.=5 Ft
- Inferred Potentiometric Contour

Notes:
1. Wells MW-16 and B1R are screened entirely in Eagle Ford Shale, and were not used to construct potentiometric contours.
2. Surface water Staff Gauges were not monitored during the water level measurement event.
3. NM - not measured.
4. At the time of this water measurement event, monitoring wells MW-30, MW-31, and VCP-MW-7 through VCP-MW-11 had not yet been installed.

STATE OF TEXAS
WILLIAM F. VIENNE
GEOLOGY
No. 10492
LICENSED
PROFESSIONAL GEOSCIENTIST

5/14/14

N

Scale in Feet
0 75 150

Source of photo:
Imagery from NCTCOG, 2009 photography.

FORMER OPERATING PLANT
FRISCO RECYCLING CENTER
FRISCO, TEXAS

Figure 5A.1

GROUNDWATER POTENTIOMETRIC SURFACE MAP MARCH 11, 2013

PROJECT: 1755	BY: AJD	REVISIONS
DATE: MAY, 2013	CHECKED: WFV	

PASTOR, BEHLING & WHEELER, LLC
CONSULTING ENGINEERS AND SCIENTISTS

EXPLANATION

- On-Site Property Boundary
- FRC Property Boundary
- Existing Monitoring Well Location
- Well Plugged and Abandoned, Destroyed, or Not Found
- Staff Gauge
- (620.60) Groundwater/Surface Water Elevation Measured 4/5/13 (Ft MSL)
- 645 Potentiometric Contour (Ft MSL) C.I.:5 Ft
- Inferred Potentiometric Contour

Notes:
1. Wells MW-16 and B1R are screened entirely in Eagle Ford Shale, and were not used to construct potentiometric contours.
2. NM - not measured.
3. At the time of this water measurement event, monitoring wells MW-31 and VCP-MW-7 through VCP-MW-11 had not yet been installed.

STATE OF TEXAS
WILLIAM F. VIENNE
GEOLOGY
No. 10492
LICENSED
PROFESSIONAL GEOSCIENTIST

5/14/14

N

Scale in Feet
0 75 150

Source of photo:
Imagery from NCTCOG, 2009 photography.

FORMER OPERATING PLANT
FRISCO RECYCLING CENTER
FRISCO, TEXAS

Figure 5A.2

GROUNDWATER POTENTIOMETRIC SURFACE MAP APRIL 5, 2013

PROJECT: 1755	BY: AJD	REVISIONS
DATE: MAY, 2013	CHECKED: WFV	

PASTOR, BEHLING & WHEELER, LLC
CONSULTING ENGINEERS AND SCIENTISTS

EXPLANATION

- On-Site Property Boundary
- FRC Property Boundary
- E□sting Monitoring Well Location
- Well Plugged and Abandoned, Destroyed, or Not Found
- Staff Gauge
- (620.60) Groundwater/Surface Water Elevation Measured 4/29/13 (Ft MSL)
- 645 Potentiometric Contour (Ft MSL) C.I.□5 Ft
- Inferred Potentiometric Contour

Notes:
1. Wells MW-16 and B1R are screened entirely in Eagle Ford Shale, and were not used to construct potentiometric contours.
2. At the time of this water measurement event, monitoring well MW-31 had not yet been installed.

STATE OF TEXAS
WILLIAM F. VIENNE
GEOLOGY
No. 10482
LICENSED
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7-23-13

N

Scale in Feet
0 75 150

Source of photo:
Imagery from NCTCOG, 2009 photography.

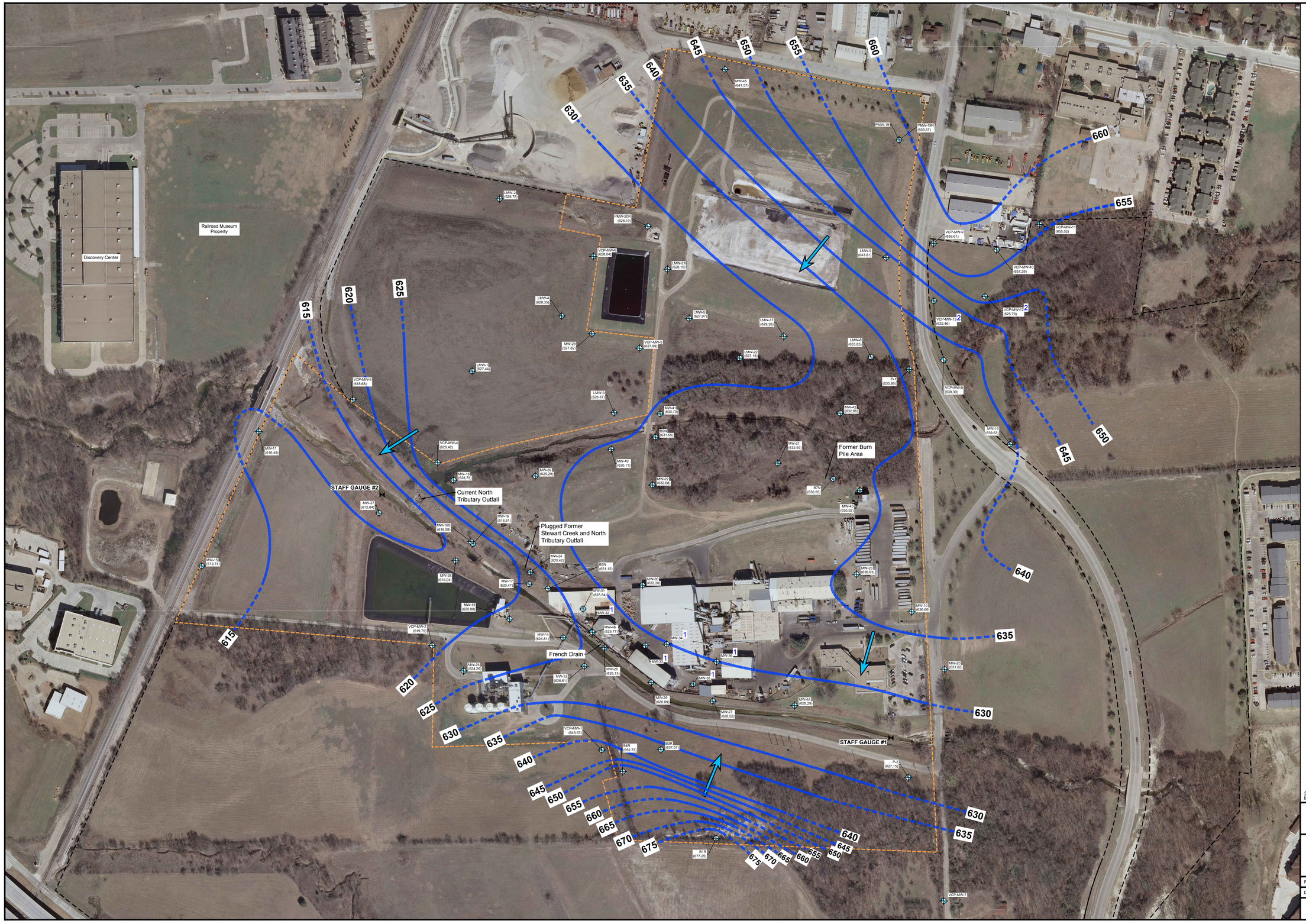
FORMER OPERATING PLANT
FRISCO RECYCLING CENTER
FRISCO, TE□AS

Figure 5A.3

GROUNDWATER POTENTIOMETRIC SURFACE MAP APRIL 29, 2013

PROJECT: 1755	BY: AJD	REVISIONS
DATE: MAY, 2013	CHECKED: WFV	

PASTOR, □E□LING □ W□EELER, LLC
CONSULTING ENGINEERS AND SCIENTISTS



STATE OF TEXAS
JAY A. WINTERS
GEOLOGY
1292
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PROFESSIONAL GEOSCIENTIST
5/9/14

LEGEND

- Well Location
- Former Operating Plant
- Undeveloped Buffer Property
- 645 Groundwater Contour Interval (Dashed Where Inferred)
- Staff Gauge
- (638.39) Water Table Elevations Measured 01/21/2014 (Ft MSL)
- Estimated Groundwater Flow Direction

NOTES

1.) Monitoring Wells MW-32, 33, 34, 35, and 36 are perched wells and not included in the contouring.

2.) VCP-MW-12 and VCP-MW-13 are not included in the contouring.

3.) Staff Gauge No. 1 damaged during storm event. No measurement collected.

4.) Basemap by PBW as part of the APAR dated july 9, 2013

N

150 0 150
SCALE FEET

Source of photo:
Imagery from NCTCOG, 2009 photography.

FORMER OPERATING PLANT
FRISCO RECYCLING CENTER
FRISCO, TEXAS

FIGURE 5A.4

GROUNDWATER POTENTIOMETRIC SURFACE MAP JANUARY 21, 2014

PROJECT: 13-02086	BY: BCL	REVISIONS
DATE: MARCH, 2014	CHECKED: BEF	

GOLDER ASSOCIATES, INC.

6.0 SURFACE WATER ASSESSMENT AND CRITICAL PCL DEVELOPMENT

6.1 Type of Surface Water and Applicable Water Quality Criteria

Stewart Creek in the area of the FOP has been classified by the TCEQ as a perennial stream (TCEQ, 2013c), while the North Tributary has been classified as an intermittent stream (TCEQ, 2013g). Further discussion of Stewart Creek and the North Tributary, and photographs of these streams, are provided in Figures 2B.1 and 2B.2 and in the SLERA (Section 9). The critical surface water PCL used for decision-making purposes is the lower value between the human health contact recreation PCL and the chronic or acute ambient water quality criteria, where applicable. Both criteria are important when evaluating potential impacts in perennial and intermittent streams. The human health PCLs are based on a recreational exposure scenario whereby surface water is routinely contacted via incidental ingestion and dermal contact as described in TCEQ's TRRP-24 Guidance Document (TCEQ, 2007). Based on TCEQ comments (TCEQ, 2013e) and because there is not a contact recreation PCL for lead, the drinking water standard is used as the human health surface water PCL for lead to protect exposure to surface water in Stewart Creek and the North Tributary.

The Texas Surface Water Quality Standards establish goals for the quality of water bodies throughout the state. Site-specific uses are listed for Segment 0823, Lake Lewisville, in 30 TAC§ 307, Appendix A, which include the following: Primary contact recreation 1 (activities that are presumed to involve a significant risk of ingestion of water (e.g., wading by children, swimming, water skiing, diving, tubing, surfing, handfishing as defined by Texas Parks and Wildlife Code, §66.115, and the following whitewater activities: kayaking, canoeing, and rafting); high aquatic life use, and domestic water supply. Based on designated use, the site-specific criteria for sulfate for Stream Segment 0823, Lake Lewisville includes the maximum annual average of 60 mg/L. TRRP PCLs are not available for sulfate, since sulfate is not considered a concern from a human health standpoint (other than the aesthetics-based EPA secondary MCL of 250 mg/L for ingestion of sulfate in drinking water). The 60 mg/L criteria for sulfate is applied to Stewart Creek as assessment criteria for the purposes of this APAR.

6.2 Surface Water Risk-Based Exposure Levels (RBELs) for Human Health and Aquatic Life Protection

Table 6A provides a summary of the numerous RBELs and PCLs potentially applicable for surface water exposure pathways. TRRP-24 (TCEQ, 2007) details the process for determining the surface water risk-based exposure limit (^{SW}RBEL). For aquatic life and human health protection, the ^{SW}RBEL is equivalent to the surface water exposure pathway PCL (^{SW}SW). Per the guidance, the source medium and the exposure medium is the surface water, and the receptors are aquatic biota and humans that are directly or indirectly exposed to COCs in surface water. Many of the potential RBEL and PCL values are

provided in the Texas Surface Water Quality Standards (TCEQ, 2012b), while others for non-typical uses such as contact recreation have been developed by the TCEQ based on default assumptions. In accordance with TRRP-24 (TCEQ, 2007), because Stewart Creek is a perennial stream and thus a potential incidental fishery, the fish ingestion pathway is considered complete for Stewart Creek. In addition, and consistent with discussions with TCEQ personnel in the February 2013 meetings described previously, the RBEL used in this evaluation is based on exposure assumptions for a contact recreation scenario since this pathway is potentially complete. Due to the perennial classification of Stewart Creek, chronic aquatic water criteria were compared to Site data from Stewart Creek to protect aquatic biota in accordance with TRRP-24 (TCEQ, 2007) guidance for perennial streams. Likewise, due to the intermittent classification of the North Tributary, acute aquatic water criteria were compared to Site data from the North Tributary.

6.3 Nature and Extent of COCs in Surface Water

Surface water sampling programs were conducted in 2012 and 2014. Table 6B.1 summarizes the analytical results for the fifteen Stewart Creek and ten North Tributary surface water samples collected in 2012 (sample locations are shown on Figure 6A.1). Samples were analyzed for total and dissolved cadmium and lead. Because human and ecological receptors have the potential to contact surface water, the surface water data were compared to conservative screening levels (i.e., PCLs) that were developed to be protective of these potential exposure scenarios and pathways.

Based on reclassification of Stewart Creek as a perennial stream by TCEQ, revised critical PCLs have been applied for Stewart Creek surface water samples (see below). The revised PCLs were applied to the original 15 Stewart Creek samples (Table 6B.1). Estimated (i.e., “J” flagged) concentrations of dissolved lead and cadmium were found to exceed the revised critical PCLs for lead and cadmium at two locations near the western FOP boundary (2012-SW-1 and 2012-SW-2), and estimated concentration of cadmium was found to exceed the critical PCL at a location south of the administration building (2012-SW-11).

In 2014, during the second phase of the APAR investigations, surface water samples were collected from Stewart Creek at an additional 29 locations (see Figures 6A.1 and 6A.2). Table 6B.2 summarizes the analytical results for the 2014 samples. Samples were collected at locations including

- six locations within the perimeter of the FOP,
- ten locations upstream from the FOP
- eight samples downstream of the FOP
- five locations in upstream points along tributaries that intercepted Stewart Creek downstream from the FOP.

The samples were analyzed for total and dissolved arsenic, lead, and cadmium. Twenty-one of the samples were analyzed using two methods (SW6010B and SW6020A), and all 29 samples were analyzed using the lower MDL SW6020A method. No samples from the second phase of the APAR investigations had COC concentrations that exceeded their respective critical surface water PCLs for metals, including samples collected near and downstream of the critical PCL exceedances measured in the 2012 samples.

Three on-site samples collected from the upstream, midpoint, and downstream portions of the Site were also analyzed for sulfate. Sulfate concentrations ranged between 123 mg/L and 127 mg/L. Although the reported sulfate concentrations exceed the Texas Surface Water Quality Standards (30 TAC§ 307, Appendix A) maximum annual average sulfate level of 60 mg/L for Stream Segment 0823, Lake Lewisville, the Eagle Ford Shale outcrops at the base of Stewart Creek in the area of the Site are the likely source of these sulfate levels. As described in Section 1.3.1, the Eagle Ford Shale contains gypsum [$CaSO_4 \cdot 2(H_2O)$] and is a naturally occurring source of sulfate in surface water. In addition, the upstream and downstream results for sulfate were not significantly different (125 mg/L and 127 mg/L, respectively), indicating there is not a significant contribution of sulfate from the portion of Stewart Creek crossing the Site.

Additionally, it is noted that for the nearest USGS stream gauging stations (USGS 08052700 Little Elm Creek near Aubrey, TX to the northwest, USGS 08058900 E Fork Trinity River at McKinney, TX to the northeast, and USGS 08053000 Elm Fork Trinity River near Lewisville, TX to the southwest), historical maximum sulfate concentrations were detected at 320 mg/L, 95 mg/L, and 180 mg/L, respectively.

6.4 Critical PCL for Surface Water

The ecological PCLs derived for all surface water COCs (i.e, lead, arsenic, and cadmium) were lower than the human health PCLs for those COCs (see Tables 6B.1 and 6B.2), and are therefore, the critical PCLs. The ecological PCLs were derived to be protective of chronic or acute aquatic life, where applicable, and were calculated per TCEQ guidance (TCEQ, 2006) using a hardness value for the nearest classified downstream segment. A hardness value of 106 mg/L for Segment 0823 was used per TCEQ guidance (2012b). A detailed evaluation of potential ecological risks associated with surface water is provided in the Stewart Creek SLERA included in Section 9 of this APAR.

While total and dissolved metals concentrations were measured in surface water samples, the TRRP screening criteria are only applicable to dissolved concentrations (TCEQ, 2012b), and thus only dissolved concentration data were used for comparison to the critical surface water PCLs.

As described above, three samples from Stewart Creek collected in 2012 exceeded the critical PCLs for dissolved cadmium and/or lead in surface water; however, no samples collected from Stewart Creek in 2014 (including samples collected in the near vicinity of the 2012 samples) had dissolved arsenic, cadmium, or lead concentrations that exceeded their respective critical PCLs. Sulfate exceeded the Texas Surface Water Quality Standard at three locations in 2014 but as discussed above and in Section 5.2, is not believed to be attributable to the Site.

Surface Water Critical PCLs

COC	Background	MQL	Human Health[1]			Aquatic Life and Ecological[2]			
			($^{SW}SW_{HH}$) Water and fish	Fish only	Contact Recreation	($^{SW}SW_{eco}$) Acute	Chronic[3]	Wildlife receptors	Conc Max
	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)
Arsenic	NA	0.0100	NC	NA	0.0285	0.34	0.150	NC	0.00393
Cadmium	NA	0.00500	NC	NA	0.149	0.00908	0.000256	NC	0.002J
Lead	NA	0.0100	NC	0.0383	0.015[4]	0.0688	0.00268	NC	0.0046J

NOTES

1. [1] - $^{SW}SW_{HH}$ – Surface water PCL protective of human health.
2. [2] - $^{SW}SW_{eco}$ – Surface water PCL protective of aquatic life and wildlife ecological receptors.
3. [3] - RBELs calculated based on a hardness value of 106 mg/L from Segment 0823.
4. [5] - Based on drinking water standard, per TCEQ request.
5. Data qualifiers (see Section 3.5): J - estimated result.
6. NA - Not available.
7. NC - Not a complete pathway.

Table 6B.1
Surface Water Data Summary
(2012/2013)

Sample ID	Sample Date	Total Metals		Dissolved Metals	
		Cadmium (mg/L)	Lead (mg/L)	Cadmium (mg/L)	Lead (mg/L)
Human Health Contact Recreation PCL[1]		**NA**	**NA**	**0.149**	**0.015[3]**
Acute Aquatic Life RBEL[2]		**NA**	**NA**	**0.00908**	**0.0688**
Chronic Aquatic Life RBEL[2]		**NA**	**NA**	**0.000256**	**0.00268**
Human Health Fish Only RBEL		**NA**	**NA**	**NA**	**0.00383**
Critical Surface Water PCL		**NA**	**NA**	**0.000256**	**0.00268**
2012-SW-1	1/17/2012	0.001J	<0.0029	**0.0019J**	**0.0046J**
2012-SW-2	1/17/2012	0.0009J	<0.0029	**0.002J**	**0.0037J**
2012-SW-3	1/17/2012	<0.00035	<0.0029	<0.00035	<0.0029
2012-SW-4	1/17/2012	<0.00035	<0.0029	<0.00035	<0.0029
2012-SW-5	1/17/2012	<0.00035	<0.0029	<0.00035	<0.0029
2012-SW-6	1/17/2012	<0.00035	<0.0029	<0.00035	<0.0029
2012-SW-7	1/17/2012	<0.00035	0.0032J	<0.00035	<0.0029
2012-SW-7 (Dup)	1/17/2013	<0.00035	0.003J	<0.00035	<0.0029
2012-SW-8	1/17/2012	<0.00035	0.0036J	<0.00035	<0.0029
2012-SW-9	1/17/2012	<0.00035	<0.0029	<0.00035	<0.0029
2012-SW-10	1/17/2012	<0.00035	<0.0029	<0.00035	<0.0029
2012-SW-11	1/17/2012	<0.00035	<0.0029	**0.0006J**	<0.0029
2012-SW-12	1/17/2012	<0.00035	<0.0029	<0.00035	<0.0029
2012-SW-13	1/17/2012	<0.00035	<0.0029	<0.00035	<0.0029
2012-SW-14	1/17/2012	<0.00035	<0.0029	<0.00035	<0.0029
2012-SW-15	1/17/2012	<0.00035	<0.0029	<0.00035	<0.0029
SW-NT-1	3/20/2013	<0.00035	<0.0029	<0.00035	<0.0029
SW-NT-2	3/20/2013	<0.00035	<0.0029	<0.00035	<0.0029
SW-NT-3	3/20/2013	<0.00035	<0.0029	<0.00035	<0.0029
SW-NT-4	3/20/2013	<0.00035	<0.0029	<0.00035	<0.0029
SW-NT-5	3/21/2013	<0.00035	<0.0029	<0.00035	<0.0029
SW-NT-6	3/21/2013	<0.00035	<0.0029	<0.00035	<0.0029
SW-NT-7	3/21/2013	<0.00035	<0.0029	<0.00035	<0.0029
SW-NT-8	3/21/2013	<0.00035	<0.0029	<0.00035	<0.0029
SW-NT-9	3/21/2013	<0.00035	<0.0029	**0.00044J**	<0.0029
SW-NT-10	3/21/2013	<0.00035	<0.0029	<0.00035	<0.0029

NOTES

Detections are bolded.

Highlighted cells have detected values which exceed the critical surface water PCL.

1. [1] - Contact Recreation Water PCLs, Updated March 2006.
2. [2] - RBELs calculated based on a hardness value of 106 mg/L from Segment 0823.
3. [3] - Based on drinking water standard, per TCEQ request.
4. Data qualifiers (see Section 3.5): J - estimated result.
5. NA - Not applicable.
6. < indicates analyte concentration not detected above sample detection limit (SDL); however, SDL exceeds critical surface water PCL.

Table 6B.2
Surface Water Data Summary
(2014)

		Fraction	Total				Dissolved		
		Analyte	Arsenic	Cadmium	Lead	Sulfate	Arsenic	Cadmium	Lead
Human Health Contact Recreation PCL [1]			--	--	--	--	0.0285	0.149	0.015 [5]
Freshwater Chronic Aquatic Life RBEL [2]			--	--	--	--	0.150	0.000256	0.00268
Human Health Fish Only RBEL [3]			--	--	--	--	--	--	0.00383
Critical Surface Water PCL [1, 2, 4]			--	--	--	60	0.0285	0.000256	0.002680
		Units	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Location ID	Sample ID	Date Sampled							
E300									
2014-SW-016	2014-SW-016	2014-01-31	NA	NA	NA	**125**	NA	NA	NA
2014-SW-016	DUPLICATE-3	2014-01-31	NA	NA	NA	**126**	NA	NA	NA
2014-SW-017	2014-SW-017	2014-01-31	NA	NA	NA	**123**	NA	NA	NA
2014-SW-021	2014-SW-021	2014-01-31	NA	NA	NA	**127**	NA	NA	NA
SW6010B									
2014-SW-001	2014-SW-001	2014-01-28	< 0.00328 U	< 0.000350 U	< 0.00290 U	NA	< 0.00328 U	< 0.000350 U	< 0.00290 U
2014-SW-002	2014-SW-002	2014-01-29	< 0.00328 U	< 0.000350 U	< 0.00290 U	NA	< 0.00328 U	< 0.000350 U	< 0.00290 U
2014-SW-002	DUPLICATE-1	2014-01-29	< 0.00328 U	< 0.000350 U	< 0.00290 U	NA	< 0.00328 U	< 0.000350 U	< 0.00290 U
2014-SW-003	2014-SW-003	2014-01-29	< 0.00328 U	< 0.000350 U	< 0.00290 U	NA	< 0.00328 U	< 0.000350 U	< 0.00290 U
2014-SW-004	2014-SW-004	2014-01-29	< 0.00328 U	< 0.000350 U	< 0.00290 U	NA	< 0.00328 U	< 0.000350 U	< 0.00290 U
2014-SW-005	2014-SW-005	2014-01-29	< 0.00328 U	< 0.000350 U	< 0.00290 U	NA	< 0.00328 U	< 0.000350 U	< 0.00290 U
2014-SW-006	2014-SW-006	2014-01-30	< 0.00328 U	< 0.000350 U	< 0.00290 U	NA	< 0.00328 U	< 0.000350 U	< 0.00290 U
2014-SW-007	2014-SW-007	2014-01-31	< 0.00328 U	< 0.000350 U	< 0.00290 U	NA	< 0.00328 U	< 0.000350 U	< 0.00290 U
2014-SW-008	2014-SW-008	2014-01-31	< 0.00328 U	< 0.000350 U	< 0.00290 U	NA	< 0.00328 U	< 0.000350 U	< 0.00290 U
2014-SW-009	2014-SW-009	2014-01-31	< 0.00328 U	< 0.000350 U	< 0.00290 U	NA	< 0.00328 U	< 0.000350 U	< 0.00290 U
2014-SW-010	2014-SW-010	2014-01-31	< 0.00328 U	< 0.000350 U	< 0.00290 U	NA	< 0.00328 U	< 0.000350 U	< 0.00290 U
2014-SW-011	2014-SW-011	2014-01-31	< 0.00328 U	< 0.000350 U	< 0.00290 U	NA	< 0.00328 U	< 0.000350 U	< 0.00290 U
2014-SW-012	2014-SW-012	2014-01-31	< 0.00328 U	< 0.000350 U	< 0.00290 U	NA	< 0.00328 U	< 0.000350 U	< 0.00290 U
2014-SW-013	2014-SW-013	2014-01-31	< 0.00328 U	< 0.000350 U	< 0.00290 U	NA	< 0.00328 U	< 0.000350 U	< 0.00290 U
2014-SW-014	2014-SW-014	2014-01-31	< 0.00328 U	< 0.000350 U	< 0.00290 U	NA	< 0.00328 U	< 0.000350 U	< 0.00290 U
2014-SW-015	2014-SW-015	2014-01-31	< 0.00328 U	< 0.000350 U	< 0.00290 U	NA	< 0.00328 U	< 0.000350 U	< 0.00290 U
2014-SW-016	2014-SW-016	2014-01-31	< 0.00328 U	< 0.000350 U	< 0.00290 U	NA	< 0.00328 U	< 0.000350 U	< 0.00290 U
2014-SW-017	2014-SW-017	2014-01-31	< 0.00328 U	< 0.000350 U	< 0.00290 U	NA	< 0.00328 U	< 0.000350 U	< 0.00290 U
2014-SW-018	2014-SW-018	2014-01-31	< 0.00328 U	< 0.000350 U	< 0.00290 U	NA	< 0.00328 U	< 0.000350 U	< 0.00290 U
2014-SW-019	2014-SW-019	2014-01-31	< 0.00328 U	< 0.000350 U	< 0.00290 U	NA	< 0.00328 U	< 0.000350 U	< 0.00290 U
2014-SW-020	2014-SW-020	2014-01-31	< 0.00328 U	< 0.000350 U	< 0.00290 U	NA	< 0.00328 U	< 0.000350 U	< 0.00290 U
2014-SW-021	2014-SW-021	2014-01-31	< 0.00328 U	< 0.000350 U	< 0.00290 U	NA	< 0.00328 U	< 0.000350 U	< 0.00290 U
2014-SW-021	DUPLICATE-2	2014-01-31	< 0.00328 U	< 0.000350 U	< 0.00290 U	NA	< 0.00328 U	< 0.000350 U	< 0.00290 U
SW6020A									
2014-SW-001	2014-SW-001	2014-01-28	< 0.00130 U	< 0.0000950 U	**0.000310 J**	NA	< 0.00130 U	< 0.0000950 U	**0.000205 J**
2014-SW-002	2014-SW-002	2014-01-29	< 0.00130 U	< 0.0000950 U	< 0.000200 U	NA	< 0.00130 U	< 0.0000950 U	< 0.000200 U
2014-SW-002	DUPLICATE-1	2014-01-29	< 0.00130 U	< 0.0000950 U	< 0.000200 U	NA	< 0.00130 U	< 0.0000950 U	< 0.000200 U
2014-SW-003	2014-SW-003	2014-01-29	< 0.00130 U	< 0.0000950 U	**0.00142 J**	NA	< 0.00130 U	< 0.0000950 U	**0.000250 J**
2014-SW-004	2014-SW-004	2014-01-29	< 0.00130 U	< 0.0000950 U	**0.000655 J**	NA	< 0.00130 U	< 0.0000950 U	< 0.000200 U
2014-SW-005	2014-SW-005	2014-01-29	< 0.00130 U	< 0.0000950 U	**0.00103 J**	NA	< 0.00130 U	< 0.0000950 U	**0.000205 J**
2014-SW-006	2014-SW-006	2014-01-30	< 0.00130 U	< 0.0000950 U	**0.000440 J**	NA	< 0.00130 U	< 0.0000950 U	**0.000240 J**
2014-SW-007	2014-SW-007	2014-01-31	< 0.00130 U	< 0.0000950 U	**0.000240 J**	NA	< 0.00130 U	< 0.0000950 U	< 0.000200 U
2014-SW-008	2014-SW-008	2014-01-31	< 0.00130 U	< 0.0000950 U	**0.000365 J**	NA	< 0.00130 U	< 0.0000950 U	< 0.000200 U
2014-SW-009	2014-SW-009	2014-01-31	< 0.00130 U	< 0.0000950 U	< 0.000200 U	NA	< 0.00130 U	< 0.0000950 U	< 0.000200 U

Table 6B.2
Surface Water Data Summary
(2014)

		Fraction	Total				Dissolved		
		Analyte	Arsenic	Cadmium	Lead	Sulfate	Arsenic	Cadmium	Lead
Human Health Contact Recreation PCL [1]			--	--	--	--	0.0285	0.149	0.015 [5]
Freshwater Chronic Aquatic Life RBEL [2]			--	--	--	--	0.150	0.000256	0.00268
Human Health Fish Only RBEL [3]			--	--	--	--	--	--	0.00383
Critical Surface Water PCL [1, 2, 4]			--	--	--	60	0.0285	0.000256	0.002680
		Units	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Location ID	Sample ID	Date Sampled							
SW6020A (Continued)									
2014-SW-010	2014-SW-010	2014-01-31	< 0.00130 U	< 0.0000950 U	**0.000420 J**	NA	< 0.00130 U	< 0.0000950 U	**0.000235 J**
2014-SW-011	2014-SW-011	2014-01-31	< 0.00130 U	< 0.0000950 U	< 0.000200 U	NA	< 0.00130 U	< 0.0000950 U	< 0.000200 U
2014-SW-012	2014-SW-012	2014-01-31	< 0.00130 U	< 0.0000950 U	< 0.000200 U	NA	< 0.00130 U	< 0.0000950 U	< 0.000200 U
2014-SW-013	2014-SW-013	2014-01-31	< 0.00130 U	< 0.0000950 U	**0.000390 J**	NA	< 0.00130 U	< 0.0000950 U	< 0.000200 U
2014-SW-014	2014-SW-014	2014-01-31	< 0.00130 U	< 0.0000950 U	**0.000450 J**	NA	< 0.00130 U	< 0.0000950 U	**0.000315 J**
2014-SW-015	2014-SW-015	2014-01-31	< 0.00130 U	< 0.0000950 U	**0.000325 J**	NA	< 0.00130 U	< 0.0000950 U	< 0.000200 U
2014-SW-016	2014-SW-016	2014-01-31	< 0.00130 U	< 0.0000950 U	< 0.000200 U	NA	< 0.00130 U	< 0.0000950 U	< 0.000200 U
2014-SW-017	2014-SW-017	2014-01-31	< 0.00130 U	< 0.0000950 U	**0.000990 J**	NA	< 0.00130 U	< 0.0000950 U	**0.000350 J**
2014-SW-018	2014-SW-018	2014-01-31	< 0.00130 U	< 0.0000950 U	**0.000585 J**	NA	< 0.00130 U	< 0.0000950 U	**0.000255 J**
2014-SW-019	2014-SW-019	2014-01-31	< 0.00130 U	< 0.0000950 U	**0.00133 J**	NA	< 0.00130 U	< 0.0000950 U	< 0.000200 U
2014-SW-020	2014-SW-020	2014-01-31	< 0.00130 U	< 0.0000950 U	**0.00174**	NA	< 0.00130 U	< 0.0000950 U	**0.000310 J**
2014-SW-021	2014-SW-021	2014-01-31	< 0.00130 U	< 0.0000950 U	**0.000635 J**	NA	< 0.00130 U	< 0.0000950 U	**0.000850 J**
2014-SW-021	DUPLICATE-2	2014-01-31	< 0.00130 U	< 0.0000950 U	**0.000595 J**	NA	< 0.00130 U	< 0.0000950 U	**0.000395 J**
2014-SW-022	2014-SW-022	2014-03-18	< 0.00130 U	< 0.0004775 U *	**0.000812 J**	NA	< 0.00130 U	**0.000217 J**	< 0.000200 U
2014-SW-023	2014-SW-023	2014-03-18	< 0.00130 U	< 0.0004775 U *	< 0.000200 U	NA	< 0.00130 U	**0.000204 J**	**0.000247 J**
2014-SW-024	2014-SW-024	2014-03-19	< 0.00130 U	< 0.0000950 U	**0.000286 J**	NA	< 0.00130 U	< 0.0000950 U	< 0.000200 U
2014-SW-025	2014-SW-025	2014-03-19	< 0.00130 U	< 0.0000950 U	**0.000421 J**	NA	< 0.00130 U	< 0.0000950 U	< 0.000200 U
2014-SW-025	DUP-06	2014-03-19	< 0.00130 U	< 0.0000950 U	< 0.000200 U	NA	< 0.00130 U	< 0.0000950 U	< 0.000200 U
2014-SW-026	2014-SW-026	2014-04-15	**0.00168 J**	**0.000107 J**	**0.000530 J**	NA	**0.00171 J**	**0.0000998 J**	< 0.000200 U
2014-SW-027	2014-SW-027	2014-04-15	**0.00393**	< 0.0000950 U	**0.00105 J**	NA	**0.00311**	< 0.0000950 U	< 0.000200 U
2014-SW-028	2014-SW-028	2014-04-16	**0.00130 J**	**0.000136 J**	**0.000324 J**	NA	**0.00151 J**	< 0.0000950 U	< 0.000200 U
2014-SW-029	2014-SW-029	2014-04-16	**0.00185 J**	< 0.0000950 U	**0.000279 J**	NA	**0.00194 J**	< 0.0000950 U	**0.000475 J**
2014-SW-029	DUP-1	2014-04-16	**0.00189 J**	< 0.0000950 U	**0.000209 J**	NA	**0.00178 J**	< 0.0000950 U	< 0.000200 U

Table 6B.2
Surface Water Data Summary
(2014)

		Fraction	Total				Dissolved		
		Analyte	Arsenic	Cadmium	Lead	Sulfate	Arsenic	Cadmium	Lead
Human Health Contact Recreation PCL [1]			--	--	--	--	0.0285	0.149	0.015 [5]
Freshwater Chronic Aquatic Life RBEL [2]			--	--	--	--	0.150	0.000256	0.00268
	Human Health Fish Only RBEL [3]		--	--	--	--	--	--	0.00383
	Critical Surface Water PCL [1, 2, 4]		--	--	--	60	0.0285	0.000256	0.002680
		Units	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Location ID	Sample ID	Date Sampled							

NOTES

Detected analytes are bolded.

Highlighted cells have detected values which exceed the critical surface water PCL or Texas Surface Water Quality Standard.

< - Indicates analyte not detected above sample detection limit (SDL).

NA - Not Analyzed.

J - Analyte concentration estimated.

U - Analyte not detected.

* analyte detected in field blank; sample result became non-detect (less than five times the field blank concentration).

mg/L - Milligrams per liter.

PCL - Protective Concentration Level.

-- Indicates PCL not available.

1. Contact Recreation Water PCLs, updated March 2006 based on combined pathways for incidental ingestion and dermal contact ($^{1ot}RW_{Comb}$).
2. Chronic Aquatic Life RBEL for cadmium and lead calculated based on a hardness value of 106 mg/L for Lake Lewisville Segment 0823 per Implementation Guidance (TCEQ, 2012b).
3. Texas Surface Water Quality Standards for human health protection from 30 TAC§ 307 Table 2, updated February 2014. There is not a Fish Only standard for arsenic or cadmium.
4. The Texas Surface Water Quality Standards (30 TAC§ 307, Appendix A) defines a maximum annual average sulfate level of 60 mg/L for Stream Segment 0823, Lake Lewisville,
5. Based on drinking water standard per TCEQ request.

Created By: BEF 2-25-2014/CH 4-30-14
Checked by: LAB 2-25-2014/AMF 4-30-14
Reviewed by: CMH 4-30-2014

Legend

- Surface Water Sample Location
- Exceedence of Pb or Cd RAL/Critical PCL for Surface Water
- No Exceedence of Pb or Cd RAL/Critical PCL for Surface Water
- French Drain
- Stewart Creek (Appoximate Creek Centerline)
- North Tributary (Appoximate Creek Centerline)
- Approximate Extent of Disposal Area
- Former Operating Plant
- Undeveloped Buffer Property

Notes:
1. Acute Aquatic Life RBEL (applicable as North Tributary critical surface water PCL for intermittent stream) is 0.00908 mg/L for Cd and 0.0688 mg/L for lead.
2. Chronic Aquatic Life RBEL (applicable as Stewart Creek critical surface water PCL for perennial stream) is 0.000256 mg/L for Cd and 0.00268 mg/L for lead.

Source:
1. Locations - PBW and Golder, 2012 - 2014
2. Aerial Imagery: NCTCOG, 2009 photography.

400 200 0 400 Feet

Scale: AS SHOWN

File No. 1302086-B018 FIG 6A1.mxd

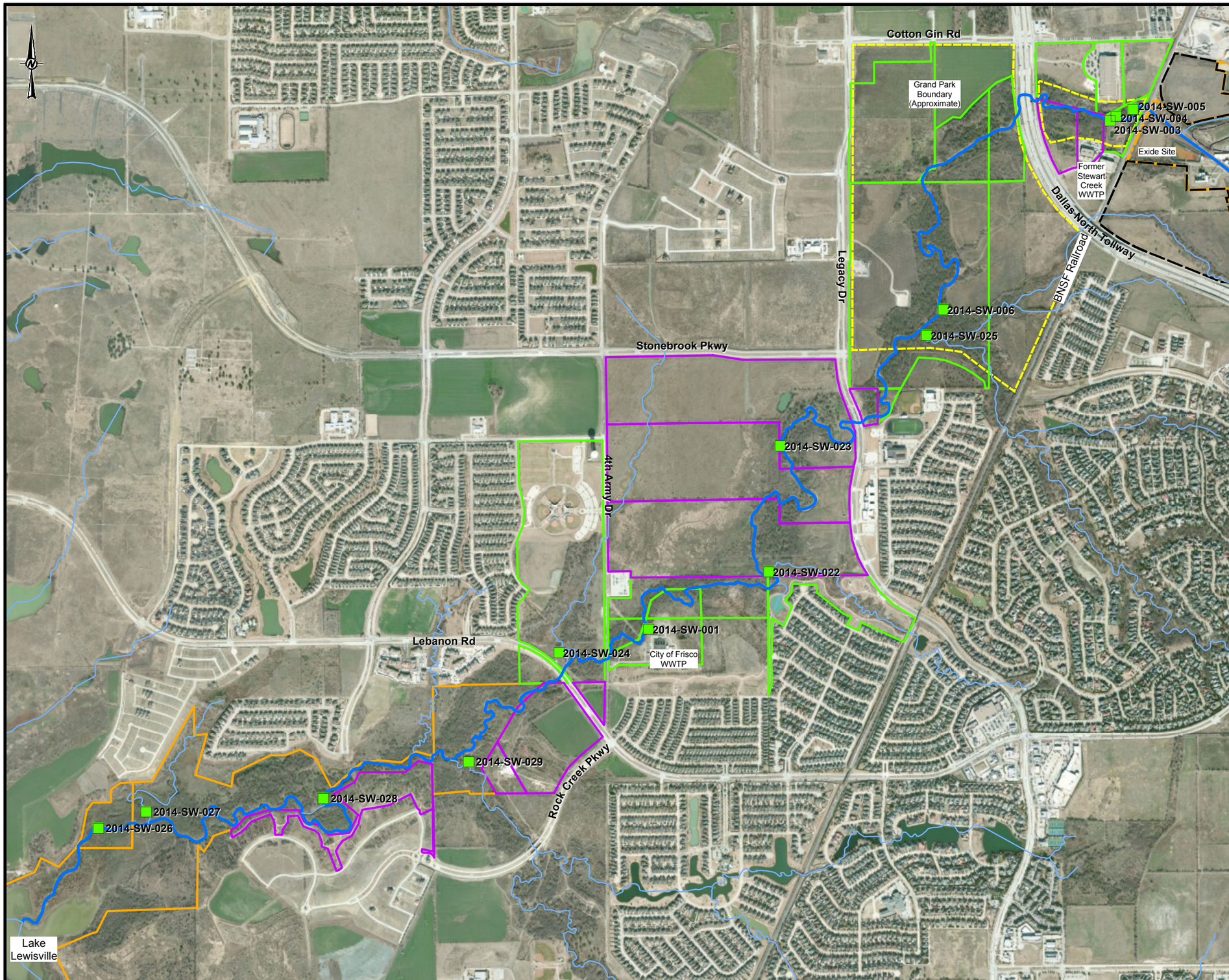
FORMER OPERATING PLANT
FRISCO RECYCLING CENTER
FRISCO, TEXAS

FIGURE 6A.1
ON-SITE AND UPSTREAM SURFACE WATER SAMPLE LOCATIONS

PROJECT NO. 13-02086	BY: JWT	REVISIONS
DATE: 5/21/2014	CHECKED: - - -	

GOLDER ASSOCIATES INC.

Map Document: N:\File\2013\13-02086 Exide Frisco\B - APAR Phase II\map documents\1302086-B018 FIG 6A1.mxd / Modified 5/21/2014 2:03:28 PM by jthomas / Exported 5/21/2014 2:03:36 PM by jthomas



Legend

- Surface Water Sample Location
- No Exceedence of Pb or Cd RAL/Critical PCL for Surface Water
- Stewart Creek (Appoximate Creek Centerline)
- Creek Tributary (Appoximate Creek Centerline)
- Private Owner Property
- City of Frisco or City of Frisco Entity Property
- USACE Property
- Grand Park Boundary (Approximate)
- Approximate Extent of Disposal Area
- Former Operating Plant
- Undeveloped Buffer Property

Notes:
1. Chronic Aquatic Life RBEL (applicable as Stewart Creek critical surface water PCL for perennial stream) is 0.000256 mg/L for Cd and 0.00268 mg/L for lead.

Source:
1. Locations - PBW and Golder, 2012 - 2014
2. Aerial Imagery: Source: Esri, DigitalGlobe, GeoEye, i-cubed, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, and the GIS User Community

1,500 750 0 1,500 Feet

Scale: AS SHOWN

File No. 1302086-B019 FIG 6A2.mxd

FORMER OPERATING PLANT
FRISCO RECYCLING CENTER
FRISCO, TEXAS

FIGURE 6A.2

DOWNSTREAM SURFACE WATER SAMPLE LOCATIONS

PROJECT NO. 13-02086	BY: JWT	REVISIONS
DATE: 5/20/2014	CHECKED: - - -	

GOLDER ASSOCIATES INC.

Map Document: N:\File\2013\13-02086 Exide Frisco\B - APAR Phase II\map documents\1302086-B019 FIG 6A2.mxd / Modified 5/20/2014 8:24:47 AM by jthomas / Exported 5/20/2014 8:25:06 AM by jthomas

7.0 SEDIMENT ASSESSMENT AND CRITICAL PCL DEVELOPMENT

7.1 Type of Sediment and Applicable Criteria

As indicated in the previous section, Stewart Creek has been classified by the TCEQ as a perennial stream (TCEQ, 2013c), while the North Tributary has been classified as an intermittent stream (TCEQ, 2013g). Further discussion of Stewart Creek and the North Tributary, and photographs of these streams, are provided in Figures 2B.1 and 2B.2 and in the SLERA (Section 9).

During the SIR investigation in 2012, fifteen sediment samples were collected from Stewart Creek either on or immediately upstream of the FOP property and ten sediment samples were collected from the North Tributary on the FOP property (see Figure 7A.1). An additional 63 sediment samples were collected from Stewart creek in January, March, and April 2014 in segments of Stewart Creek upstream (10 samples) and downstream (53 samples, excluding duplicates), with downstream samples extending downstream as far as the USACE property (see Figure 7A.2). Geographically, these samples included:

- 3 locations upstream from the FOP, east of the South 5th Street/Parkway Drive bridge (samples 2014-SED-033 through 2014-SED-035).
- 7 locations upstream from the FOP, between the eastern FOP boundary and South 5th Street/Parkway Drive bridge (samples 2014-SED-026 through 2014-SED-032).
- 5 locations downstream from the FOP, between the BNSF railroad bridge and the Dallas North Tollway bridge (samples 2014-SED-014 through 2014-SED-018).
- 9 locations downstream from the FOP, between the Dallas North Tollway bridge and the Legacy Drive Bridge (samples 2014-SED-019 through 2014-SED-025, 2014-SED-048, and 2014-SED-049); 2014-SED-048 was, more specifically, between Legacy Drive and Stonebrook Parkway; 2014-SED-049 was an upgradient location collected in a tributary flowing into Stewart Creek from the southeast.
- 21 locations downstream from the FOP, between the Legacy Drive bridge and the 4th Army Memorial Drive bridge (samples 2014-SED-004 through 2014-SED-013 and 2014-SED-036 through 2014-SED-046); 2014-SED-037 was an upstream location collected in a tributary flowing into Stewart Creek from the northeast, and providing background data for points downstream from the confluence of the tributary with Stewart Creek.
- 4 locations downstream from the FOP, in the short channel section between the 4th Army Memorial Drive bridge and the Lebanon Drive bridge (samples 2014-SED-001 through 2014-SED-003 and 2014-SED-047); 2014-SED-047 was an upstream location collected in a tributary flowing into Stewart Creek from the northwest, and providing background data for points downstream from the confluence of the tributary with Stewart Creek.
- 14 locations downstream from the FOP, in the USACE property west of the Lebanon Drive bridge (samples 2014-SED-050 through 2014-SED-063); 2014-SED-052 was an upstream location collected in a tributary flowing into Stewart Creek from the north; 2014-SED-060 was an upstream location collected in a tributary flowing into Stewart Creek from the east; these two streams provide background data for points downstream from the respective confluences of the tributaries with Stewart Creek.

In addition to consideration of sediment data, assessment of Stewart Creek sediment included an evaluation of the presence of battery case fragments. Areas containing visible battery case fragments or slag were considered part of the PCLE Zone for sediment for discussion purposes, and are being addressed as part of ongoing interim remedial actions.

In addition to samples collected and inspections performed as part of the APAR, other sediment investigations have been conducted, and are discussed below. Most recently, SWG conducted sediment sampling programs on behalf of the City in 2011 and 2013 (reports included in Appendix 19). The SWG programs included collection of sediment samples, samples of battery case fragments/slag/potential slag material, and base samples (samples sediment underlying battery case fragments/slag/potential slag material samples). Samples were collected in Stewart Creek downstream from the FOP.

Tables 7B.1 and 7B.2 summarize the analytical results for sediment samples collected from Stewart Creek and the North Tributary. Because human and ecological receptors may potentially contact these sediments, COCs were compared to conservative screening levels (i.e., PCLs) that were developed to be protective of those potential human and ecological exposure pathways (a detailed evaluation of potential ecological risks associated with sediments is provided in the Stewart Creek SLERA included in Section 9 of this APAR). Figures 7A.1 and 7A.2 show exceedances of the critical PCL by sampling location and also show the extent of the PCLE Zone based on visual observations of battery case fragments or slag.

7.2 Sediment Risk-Based Exposure Levels (RBELs)

Table 7A provides a summary of the RBELs and PCLs potentially applicable for sediment exposure pathways. TRRP-24 Guidance (TCEQ, 2007) details the process for determining the sediment risk-based exposure PCLs for human health exposure and provides default values for stakeholder use ($^{Tot}Sed_{Comb}$). Sediment PCLs protective of benthic organisms are provided in the TCEQ Ecological Risk Assessment Guidance (TCEQ, 2006), and are the midpoint of the benchmark value and the second effects level value for each compound. Stewart Creek and the North Tributary are freshwater bodies and, as such, PCLs for freshwater sediment were used in this evaluation.

Concentrations of arsenic in sediment samples in exceedance of the Critical PCL were found in Stewart Creek sediment samples both upstream and downstream from the FOP. Concentrations in the APAR and SWG investigations have ranged from 7.0 to 57.7 mg/kg, with a high degree of spatial variability. In most locations, the elevated arsenic levels are not correlated to elevated lead or cadmium concentrations. As described in Sections 1.2.1.1 and 3.1.3, over the past 100 years, arsenic compounds have had several uses including as a component of animal feed, herbicides and pesticides. The concentrations of arsenic identified in the sediment sampling are within a reasonable range of the published background

information. Consequently, arsenic is not considered to be related to activities at the FOP, and arsenic detections are not discussed in the following sections.

7.3 Nature and Extent of COCs in Sediment

The critical PCL used for decision-making purposes for both cadmium and lead is the lower value between the human health and ecological receptor values. The ecological PCL was the lower of the two and is, therefore, the critical PCL. The ecological PCL was derived to be protective of benthic and aquatic organisms, and is the mid-point of the ecological benchmark and the second effects level per TCEQ guidance (TCEQ, 2006). The human health PCL is based on a recreational exposure scenario whereby sediment is routinely contacted via incidental ingestion and dermal contact as described in TRRP-24 (TCEQ, 2007). None of the Site sediment samples collected as part of the SIR and the first phase of the APAR investigations contained cadmium or lead at concentrations in excess of the critical PCL. None of the second phase APAR investigation samples contained lead at concentrations in excess of the critical PCL. A limited number of samples did exceed the critical PCL for cadmium, as follows:

- 2014-SED-025, downstream from the Dallas North Tollway bridge
- 2014-SED-021, between the Dallas North Tollway bridge and the Legacy Drive bridge
- 2014-SED-046, downstream from the Legacy Drive bridge

Areas with exceedances will be addressed as part of the ongoing interim actions and remediation planning. Analytical data are summarized in Table 7B.1 and 7B.2.

As per the Work Plan (CRA, 2011), organic carbon analysis was performed on the sediment samples to provide additional information related to the potential bioavailability of compounds in the sediment to hypothetical ecological receptors. As shown in Tables 7B.1 and 7B.2, sediment organic carbon concentrations ranged from 1.7 to 92.3 g/kg (approximately 0.17 to 9.2 %) for the APAR investigations.

Grain size analysis was also performed on the sediment samples. These data, included in Tables 7B.1 and 7B.2, show that for all sediment samples collected and analyzed for grain size distribution during the SIR and APAR investigations, all but 19 of the 89 samples (located in various locations throughout the length of Stewart Creek up and downstream of the FOP), had grain size distributions with more than 50% of the sediment classified as coarse-grained (i.e., sand and gravel-sized) material. In 43 of the 89 sediment samples from Stewart Creek and the North Tributary, more than 80% of the sediment was coarse-grained material. It should be noted that the sediment samples were selectively obtained from areas with fine-grained sediments.

In addition to the sediment sampling described above, visual inspections for the presence of battery case fragments or slag in areas upstream and downstream of Stewart Creek have been conducted. As

described in Section 1.2.3.17, W&M conducted a visual survey of the western reach of Stewart Creek from the Battery Receiving/Storage Building to the BNSF railroad in 2011 (W&M, 2011a). Suspected slag samples collected from the banks of the creek were photographed and evaluated for lead, cadmium, and iron to develop visual criteria for identifying suspected slag in the field. Based on analytical results and the resultant visual criteria, occasional slag occurrences were observed along the majority of the study area on both sides of the creek but were noted to occur more frequently along the central portion and eastern portions of the study area. Upstream, on-site and downstream portions of Stewart Creek were also inspected by Golder in 2014 as part of the Interim Actions being performed in Stewart Creek. Potential slag materials were generally observed in the same areas on-site as identified by W&M. Slag materials were also observed in the area immediately downstream from the Site near the BNSF Bridge. Battery case fragments were observed in downstream areas from the Site to the USACE-owned property. No battery case fragments were observed on the downstream portion of Stewart Creek owned by USACE. At the time of this report preparation, interim actions to remove slag and battery case fragments (and associated sediment sampling) were on-going. Information collected as a part of those efforts will be provided under separate cover when interim actions are complete.

Several studies since the 1990s have been performed to investigate the surface water and sediments of Stewart Creek at the Site and in downstream areas (see Section 1.2.3). JD Consulting, LLC conducted a Human Health and Ecological Risk Assessment (HHERA) in 1998 (JDC, 1998b) that investigated Stewart Creek surface water and sediments. The study concluded that surface water did not pose a risk to human or ecological receptors while lead concentrations in sediment in the on-site portion of Stewart Creek may pose a risk to human and ecological receptors. The on-site sediments were subsequently remediated in 2000 (JDC, 2000). It was also noted in the HHERA (JDC, 1998b) that cadmium and/or lead levels in several hot spot sediment areas downstream of the facility boundary may pose an ecological risk. Historical surface water and sediment data available for Stewart Creek, including data from the JDC (1998b) study, are provided in Appendix 17.

Southwest Geoscience (SWG) conducted a study in 2011 that investigated potential impacts to sediments in areas downstream of the Site (SWG, 2013a). Sediment samples collected during the 2011 SWG downstream investigation were analyzed for lead, cadmium, arsenic, selenium, and sulfate. Several hot spot sediment sample locations within Stewart Creek near the Dallas North Tollway were noted as having elevated concentrations of lead or cadmium, as well as one sample approximately midway between the Dallas North Tollway and Legacy Drive. The SWG investigation report is provided in Appendix 19. PBW conducted a SLERA for the Former Stewart Creek Wastewater Treatment Plant (FSCWWTP) located immediately downstream of the Site during 2012 and 2013 (PBW, 2013d), and this

study noted hot spots with elevated concentrations of lead or cadmium in the stream segment adjacent to the FSCWWTP immediately downstream of the Site.

SWG conducted a second study (SWG, 2013b) that evaluated the presence of visible battery case fragments and slag in Stewart Creek downstream from the Site from Lake Lewisville to the BNSF railroad bridge (at the western boundary of the Site). Due to access restrictions, the survey excluded a portion of Stewart Creek located west of Legacy Drive and north of a high voltage utility easement located approximately 3,300 feet south of Stonebrook Parkway. SWG's walking survey report indicated that "frequent occurrences of concentrated battery chips and potential slag material were observed in the Stewart Creek channel in Grand Park from Stonebrook Parkway to the Dallas North Tollway bridge. In the vicinity of the BNSF railroad bridge, numerous occurrences of battery chips (including one battery chip containing a post) and concentrations of larger potential slag material were observed." Nine localized occurrences of potential slag and battery case fragments were noted downstream of Stonebrook Parkway, with the most downstream observation being a piece of potential slag located approximately 3,200 feet east of FM 423. SWG collected samples of battery case fragments/slag/potential slag in 11 locations. Of these samples, three were found to have concentrations of lead in exceedance of the critical PCL, two slag samples near the BNSF railroad bridge and a battery case fragment sample between Stonebrook Parkway and Legacy Drive. Where samples of battery case fragment/slag/potential slag material samples were collected, base samples of underlying sediment were also collected. At one sample location, the base sample lead concentration exceeded the critical PCL (base sample at one of the exceeding slag samples near the BNSF railroad bridge). One other base sample, associated with a potential slag sample near the Legacy Drive bridge that was found to have low concentrations of COCs, lead and cadmium concentrations exceeded the critical PCL; this is likely unrelated to the associated potential slag material, but will be addressed as a sediment impact. The SWG walking survey report is provided in Appendix 19.

Sediment Critical PCLs

COC	MQL (mg/kg)	Background (mg/kg)	Human Health ($^{Sed}Sed_{HH}$)[1]		Ecological ($^{Sed}Sed_{Eco}$)[2]				Conc Max (mg/kg)
			Contact recreation (mg/kg)	Ingestion of impacted fish/shellfish (FishSedPCL) (mg/kg)	Benthics (mg/kg)	Benchmarks (RG-263) (mg/kg)	Second Effects Level (mg/kg)	Wildlife receptors/fish (mg/kg)	
Arsenic	1.00	NA	24	NB	21.4	9.79	33	SLERA	57.9
Cadmium	0.250	NA	1100	28.9	2.985	0.99	4.98	SLERA	4.47
Lead	0.500	NA	500	NB	81.9	35.8	128	SLERA	59.8

Notes:

1. [1] - $^{Sed}SED_{HH}$ – Sediment PCL protective of human health.
2. [2] - $^{Sed}SED_{Eco}$ – Sediment PCL protective of ecological receptors.
3. NA - Not available.
4. NB - Arsenic and lead are not bioaccumulative in sediment per TCEQ RG-263.
5. SLERA - See SLERA (APAR Section 9) for evaluation of potential ecological effects of sediment on upper trophic level receptors (e.g., wildlife and fish).

Table 7B.1
Sediment Data Summary (2012)

Sample ID	Sample Date	Metals (mg/kg)		Total Organic Carbon (g/kg)	Grain Size (%)			
		Cadmium	Lead		Gravel	Sand	Silt	Clay
TRRP Ecological Benchmarks (RG-263)		**0.99**	**35.8**	--	--	--	--	--
TRRP Ecological Secondary Effects Level		**4.98**	**128**	--	--	--	--	--
TRRP Ecological Protective Concentration		**2.985**	**81.9**	--	--	--	--	--
TRRP Tier 1 Human Health $^{Tot}Sed_{Comb}$ PCL		**1100**	**500**	--	--	--	--	--
FishSedPCL adjusted for incidental fishery		**28.9**	--	--	--	--	--	--
Critical Sediment PCL		**3.0**	**81.9**	--	--	--	--	--
Stewart Creek								
2012-SED-1	1/11/2012	**0.338 J**	**7.09 J-**	**4.77**	**13.1**	**21.4**	**34.7**	**30.8**
2012-SED-2	1/11/2012	**0.794 J-**	**15.1 J-**	**5.31**	**42.6**	**41.4**	**8.0**	**8.1**
2012-SED-3	1/11/2012	**1.4 J-**	**17.1 J-**	**7.36**	**61.0**	**19.1**	**12.4**	**7.5**
2012-SED-4	1/11/2012	**2.08 J-**	**14.9 J-**	**13.2**	**35.2**	**35.2**	**19.9**	**9.7**
2012-SED-5	1/11/2012	**1.43 J-**	**10.9 J-**	**92.3**	**50.2**	**34.7**	**12.5**	**2.6**
2012-SED-6	1/11/2012	**1.03 J-**	**10.4 J-**	**71.4**	**49.1**	**36.3**	**10.2**	**4.4**
2012-SED-7	1/11/2012	**0.844 J-**	**10.4 J-**	**69.3**	**37.3**	**42.1**	**13.7**	**7.0**
2012-SED-8	1/11/2012	**0.858 J-**	**8.99 J-**	**71.5**	**52.4**	**28.4**	**14.8**	**4.4**
2012-SED-9	1/11/2012	**0.788 J-**	**11.5 J-**	**89.8**	**39.0**	**40.4**	**12.0**	**8.6**
2012-SED-10	1/12/2012	**0.897 J-**	**6.57 J**	**6.99**	**42.2**	**42.7**	**10.7**	**4.4**
2012-SED-11	1/12/2012	**0.768 J-**	**8.82 J**	**10.0**	**53.2**	**40.6**	**0.9**	**5.3**
2012-SED-12	1/12/2012	**0.723 J-**	**17.7 J**	**10.7**	**35.2**	**19.8**	**21.5**	**23.5**
2012-SED-13	1/12/2012	**1.05 J-**	**19.2 J**	**3.78 J**	**41.4**	**45.9**	**7.9**	**4.8**
2012-SED-14	1/12/2012	**0.968 J-**	**5.7 J**	**10.1**	**47.2**	**36.6**	**7.7**	**8.5**
2012-SED-15	1/12/2012	**0.71 J-**	**10.6 J**	**10.7**	**11.6**	**53.6**	**20.0**	**14.8**
North Tributary								
2012-SED-16	1/12/2012	**1.19 J-**	**17.8 J**	**9.6**	**30.9**	**50.5**	**9.6**	**9.0**
2012-SED-17	1/12/2012	**0.779 J-**	**28.2 J**	**13.9**	**38.4**	**44.0**	**6.9**	**10.7**
2012-SED-18	1/12/2012	**0.818 J-**	**20.1 J**	NA	**34.8**	**49.5**	**9.5**	**6.2**
2012-SED-19	1/12/2012	**0.975 J-**	**23.4 J**	**15.1**	**30.8**	**57.4**	**4.8**	**7.0**
2012-SED-20	1/12/2012	**0.688 J-**	**12.1 J**	**22.1**	**39.4**	**44.1**	**11.3**	**5.2**
2012-SED-21	1/12/2012	**1.11 J-**	**10.4 J**	**32.6**	**67.6**	**24.5**	**5.4**	**2.5**
2012-SED-22	1/12/2012	**1.06 J-**	**10.4 J**	**26.5**	**42.5**	**38.7**	**15.2**	**3.6**
2012-SED-23	1/12/2012	**0.996 J-**	**11.1 J**	**42.4**	**52.4**	**36.1**	**7.9**	**3.6**
2012-SED-24	1/12/2012	**0.743 J-**	**19.7 J**	**8.68**	**28.5**	**53.2**	**9.7**	**8.6**
2012-SED-25	1/12/2012	**0.827 J-**	**11.9 J**	**35.5**	**34.1**	**46.2**	**15.5**	**4.2**

Notes:
1. Detected analytes are bolded.
2. No cadmium or lead concentrations exceeded their respective critical PCLs.
3. mg/kg - milligrams per kilogram.
4. g/kg - grams per kilogram.
5. NA - Not Analyzed.
6. -- Indicates PCL not available.
7. Data qualifiers (see Section 3.5): J - estimated result; J- - estimated result, biased low.

Sediment Data Summary (2014)

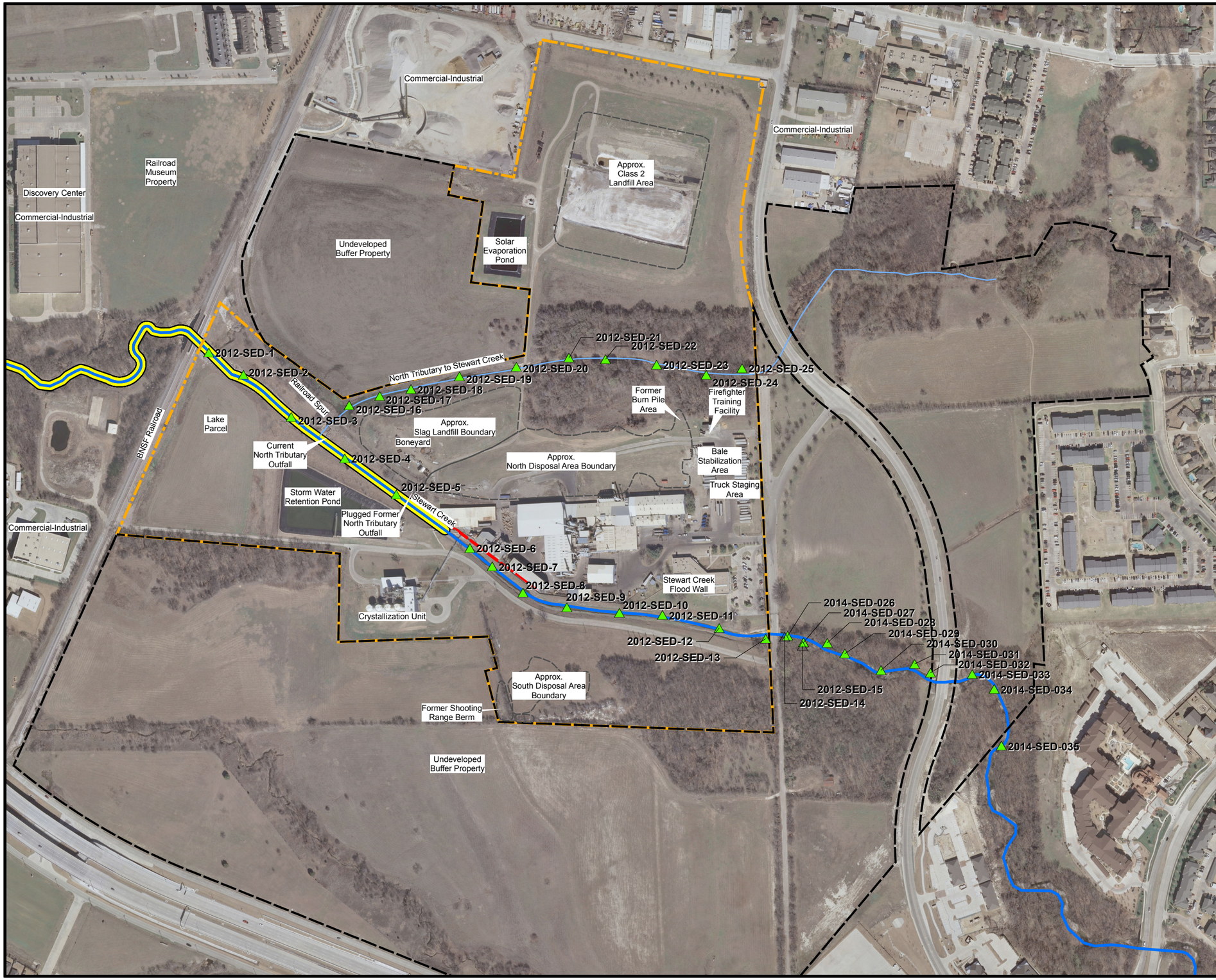
		Fraction	Total				Grain Size			
		Analyte	Arsenic	Cadmium	Lead	Total Organic Carbon[1]	Gravel Content	Sand Content	Silt Content	Clay Content
		TRRP Ecological Benchmarks (RG-263)	9.79	0.99	35.8	--	--	--	--	--
		TRRP Ecological Second Effects Level (SEL) for Sediment	33	4.98	128	--	--	--	--	--
		TRRP Ecological PCL for Sediment (mid-point of Benchmark and SEL)	21.4	2.985	81.9	--	--	--	--	--
		TRRP Tier 1 Human Health $^{Tot}Sed_{Comb}$ PCL	24	1100	500	--	--	--	--	--
		FishSedPCL adjusted for incidental fishery	--	28.9	--	--	--	--	--	--
		TRRP Critical Sediment PCL	21.4	3	81.9	--	--	--	--	--
		Units	mg/kg	mg/kg	mg/kg	%	%	%	%	%
Location ID	Sample ID	Date Sampled								
2014-SED-001	2014-SED-001	2014-01-28	10.2 J	0.298 J	15.8	1.49	0.0	14.5	24.2	61.3
2014-SED-002	2014-SED-002	2014-01-28	8.31 J	0.503	20.5	1.97	2.6	21.3	54.9	21.2
2014-SED-003	2014-SED-003	2014-01-28	57.7 J	0.956	19.5	0.460	25.3	57.1	12.0	5.6
2014-SED-004	2014-SED-004	2014-01-28	29.7 J	1.03	28.2	0.392	35.4	54.0	10.0	0.6
2014-SED-005	2014-SED-005	2014-01-28	27.2 J	0.981	25.3	0.628	21.3	57.1	15.0	6.6
2014-SED-006	2014-SED-006	2014-01-28	11.2 J	0.371	11.3	0.417	47.0	45.2	7.3	0.6
2014-SED-007	2014-SED-007	2014-01-28	20.4 J	0.892	16.0	0.679	40.8	48.5	8.9	1.8
2014-SED-008	2014-SED-008	2014-01-28	47.5 J	1.05	23.8	0.468	39.1	51.6	8.6	0.7
2014-SED-009	2014-SED-009	2014-01-28	42.9 J	0.920	20.5	0.301	42.6	44.2	8.1	5.1
2014-SED-009	DUPLICATE-01	2014-01-28	33.2 J	0.823	14.9	0.528	51.7	27.0	16.8	4.5
2014-SED-010	2014-SED-010	2014-01-28	31.1 J	1.00	16.3	0.745	40.0	47.7	8.8	3.5
2014-SED-011	2014-SED-011	2014-01-28	37.4 J	2.42	17.0	0.512	36.6	34.9	25.1	3.4
2014-SED-012	2014-SED-012	2014-01-28	22.0 J	1.03	15.9	0.480	37.4	34.2	18.9	9.5
2014-SED-013	2014-SED-013	2014-01-28	12.0 J	0.510	16.0	0.911	21.2	28.0	26.2	24.6
2014-SED-014	2014-SED-014	2014-01-29	12.0 J	0.439 J	25.0	0.825	46.9	26.0	11.8	15.3
2014-SED-014	DUPLICATE-02	2014-01-29	57.9	1.00	25.2	0.807	NA	NA	NA	NA
2014-SED-015	2014-SED-015	2014-01-29	22.0	0.522	32.9	0.684	56.2	22.0	16.5	5.3
2014-SED-016	2014-SED-016	2014-01-29	29.6	0.458	26.2	0.406	25.3	42.9	19.6	12.2
2014-SED-017	2014-SED-017	2014-01-29	20.6	0.660	30.1	0.423	22.4	44.4	18.2	15.0
2014-SED-018	2014-SED-018	2014-01-29	20.2	0.556	59.8	0.791	1.5	44.0	25.3	29.2
2014-SED-019	2014-SED-019	2014-01-30	10.0 J	1.25	47.3	0.928	0.0	35.8	31.7	32.5
2014-SED-019	DUPLICATE-04	2014-01-30	14.2	1.31	46.2	0.882	NA	NA	NA	NA
2014-SED-020	2014-SED-020	2014-01-30	15.0	1.77	26.0	0.263	38.0	46.1	5.9	10.0
2014-SED-021	2014-SED-021	2014-01-30	25.6	4.09	40.6	0.315	18.0	63.1	12.1	6.8
2014-SED-022	2014-SED-022	2014-01-30	11.6	0.301 J	11.7	0.643	0.0	21.7	30.0	48.3
2014-SED-023	2014-SED-023	2014-01-30	31.2	1.64	24.6	0.223	60.8	25.7	12.1	1.4
2014-SED-024	2014-SED-024	2014-01-30	25.4	1.28	15.7	0.208	48.9	38.6	7.6	4.9
2014-SED-025	2014-SED-025	2014-01-30	14.8	3.03	15.1	0.699	40.3	43.5	10.7	5.5
2014-SED-026	2014-SED-026	2014-01-31	8.55	0.358	11.5	0.863	46.4	31.2	8.9	13.5
2014-SED-027	2014-SED-027	2014-01-31	14.3	0.281 J	16.4	1.07	1.1	16.6	28.1	54.2
2014-SED-028	2014-SED-028	2014-01-31	10.3	0.392 J	13.5	2.70	1.9	43.9	32.0	22.2
2014-SED-029	2014-SED-029	2014-01-31	13.4	0.260 J	12.0	0.613	37.7	11.2	12.8	38.3
2014-SED-030	2014-SED-030	2014-01-31	20.3	0.691 J	14.0	0.546	29.7	46.6	18.5	5.2
2014-SED-030	DUPLICATE-05	2014-01-31	17.3	0.425	12.2	0.564	NA	NA	NA	NA
2014-SED-031	2014-SED-031	2014-01-31	12.5	0.588	11.3	0.604	49.9	38.0	7.3	4.8
2014-SED-032	2014-SED-032	2014-01-31	15.2	0.386	8.99	0.557	47.9	33.6	12.9	5.6
2014-SED-033	2014-SED-033	2014-01-31	10.5	0.331	6.56	0.737	34.1	40.7	21.4	3.8
2014-SED-034	2014-SED-034	2014-01-31	11.7	0.488	9.35	0.742	23.5	50.3	15.1	11.1
2014-SED-035	2014-SED-035	2014-01-31	42.7	0.612	19.8	1.07	21.7	46.5	19.3	12.5
2014-SED-036	2014-SED-036	2014-03-18	42.8	0.690	34.2	3.02	12.8	21.0	27.7	38.5
2014-SED-037	2014-SED-037	2014-03-18	10.6	0.246 J	17.3	1.86	1.4	23.1	27.6	47.9
2014-SED-038	2014-SED-038	2014-03-18	11.6	0.378	21.4	0.894	11.2	28.1	35.1	25.6
2014-SED-039	2014-SED-039	2014-03-18	25.0	1.90	18.7	0.231	42.0	49.5	7.5	1.1
2014-SED-040	2014-SED-040	2014-03-18	49.2	1.01	17.5	0.401	39.5	32.3	7.6	20.6
2014-SED-041	2014-SED-041	2014-03-18	41.8	1.13	19.0	0.287	19.0	53.0	26.0	2.0
2014-SED-042	2014-SED-042	2014-03-18	31.4	0.870	20.7	0.193	46.6	42.6	9.0	1.8

Table 7B.2
Sediment Data Summary (2014)

		Fraction	Total				Grain Size			
		Analyte	Arsenic	Cadmium	Lead	Total Organic Carbon[1]	Gravel Content	Sand Content	Silt Content	Clay Content
		TRRP Ecological Benchmarks (RG-263)	9.79	0.99	35.8	--	--	--	--	--
		TRRP Ecological Second Effects Level (SEL) for Sediment	33	4.98	128	--	--	--	--	--
		TRRP Ecological PCL for Sediment (mid-point of Benchmark and SEL)	21.4	2.985	81.9	--	--	--	--	--
		TRRP Tier 1 Human Health $^{Tot}Sed_{Comb}$ PCL	24	1100	500	--	--	--	--	--
		FishSedPCL adjusted for incidental fishery	--	28.9	--	--	--	--	--	--
		TRRP Critical Sediment PCL	21.4	3	81.9	--	--	--	--	--
		Units	mg/kg	mg/kg	mg/kg	%	%	%	%	%
Location ID	Sample ID	Date Sampled								
2014-SED-043	2014-SED-043	2014-03-18	**28.2**	**0.895**	**28.6**	**0.556**	**2.9**	**63.9**	**9.1**	**24.1**
2014-SED-044	2014-SED-044	2014-03-18	**11.3**	**0.501**	**24.8**	**1.79**	**0.6**	**25.2**	**30.8**	**43.4**
2014-SED-045	2014-SED-045	2014-03-18	**19.2**	**1.01**	**19.1**	**0.433**	**20.4**	**51.3**	**19.6**	**8.7**
2014-SED-046	2014-SED-046	2014-03-18	**26.6**	**4.47**	**19.6**	**0.273**	**37.0**	**32.8**	**25.8**	**4.4**
2014-SED-047	2014-Sed-047	2014-03-19	**15.4**	**0.239 J**	**15.4**	**1.39**	**6.0**	**20.0**	**30.5**	**43.5**
2014-SED-047	DUP-08	2014-03-19	**11.4**	**0.220 J**	**14.8**	**1.02**	NA	NA	NA	NA
2014-SED-048	2014-Sed-048	2014-03-19	**26.6**	**1.61**	**31.8**	**0.441**	**37.4**	**52.5**	**6.2**	**3.9**
2014-SED-049	2014-Sed-049	2014-03-19	**12.7**	**0.166 J**	**17.2 J**	**2.37 J**	**4.4**	**11.4**	**49.5**	**34.7**
2014-SED-049	DUP-09	2014-03-19	**18.0**	**1.96**	**45.9**	**0.674**	NA	NA	NA	NA
2014-SED-050	2014-SED-050	2014-04-15	**29.6**	**1.07**	**21.2**	**0.316**	**56.1**	**39.2**	**3.8**	**0.9**
2014-SED-051	2014-SED-051	2014-04-15	**49.9**	**0.273 J**	**18.5**	**0.311**	**42.5**	**45.5**	**9.0**	**3.0**
2014-SED-052	2014-SED-052	2014-04-15	**8.02**	**0.774**	**22.2**	**2.57**	0	**15.3**	**61.4**	**23.3**
2014-SED-052	Dup-1	2014-04-15	**7.95**	**0.764**	**23.8**	**2.39**	NA	NA	NA	NA
2014-SED-053	2014-SED-053	2014-04-15	**41.4**	**0.351**	**16.3**	**0.464**	**51.6**	**34.4**	**9.3**	**4.7**
2014-SED-054	2014-SED-054	2014-04-15	**22.3**	**0.824**	**21.0**	**0.451**	**21.0**	**61.0**	**7.3**	**10.7**
2014-SED-055	2014-SED-055	2014-04-15	**15.1**	**0.344 J**	**20.8**	**0.587**	**7.9**	**52.9**	**18.5**	**20.7**
2014-SED-056	2014-SED-056	2014-04-16	**9.81**	**0.464**	**21.6**	**2.09**	**0.6**	**9.0**	**42.4**	**48.0**
2014-SED-057	2014-SED-057	2014-04-16	**17.2**	**0.534**	**17.7**	**0.170**	**32.1**	**58.5**	**4.4**	**5.0**
2014-SED-058	2014-SED-058	2014-04-16	**18.6**	**0.785**	**15.0**	**0.486**	**27.7**	**58.2**	**6.3**	**7.8**
2014-SED-059	2014-SED-059	2014-04-16	**13.2**	**0.377**	**19.6**	**0.919**	**5.1**	**57.6**	**18.7**	**18.6**
2014-SED-059	Dup-2	2014-04-16	**11.0**	**0.358 J**	**18.2**	**0.861**	NA	NA	NA	NA
2014-SED-060	2014-SED-060	2014-04-16	**9.12**	**0.161 J**	**11.6**	**1.26**	**0**	**48.1**	**20.6**	**31.3**
2014-SED-061	2014-SED-061	2014-04-16	**13.2**	**0.421**	**17.9**	**0.566**	**7.8**	**58.0**	**13.8**	**20.4**
2014-SED-062	2014-SED-062	2014-04-16	**18.0**	**0.612**	**21.2**	**0.497**	**19.8**	**64.1**	**7.7**	**8.4**
2014-SED-063	2014-SED-063	2014-04-16	**19.6**	**0.630**	**29.0**	**0.677**	**11.2**	**67.8**	**7.6**	**13.4**

NOTES
[1]Final TOC values subject to change based on laboratory moisture percent correction error.
Detected analytes are bolded.
Detections exceeding TRRP Critical PCL for sediment are highlighted.
NA - Not Analyzed.
J - Analyte concentration estimated.
mg/kg - Milligrams per kilogram.
TRRP - Texas Risk Reduction Program.
PCL - Protective Concentration Level.
-- Indicates PCL not available.

Created By: BEF 2-14-2014/CMH 4-29-14
Checked by: JSI 2-14-2014/AMF 4-30-14
Reviewed by: CMH 4-30-2014/EK 5-2-14



Legend

- Sediment Sample Location
- No Exceedence of Pb or Cd RAL/Critical PCL for Sediment
- French Drain
- Approximate Extent of Disposal Area
- Former Operating Plant
- Undeveloped Buffer Property
- Stewart Creek (Appoximate Creek Centerline)
- North Tributary (Appoximate Creek Centerline)
- Stewart Creek PCLE Zone

Notes:
1. Screening Values:
Pb: 81.9 mg/kg
Cd: 3.0 mg/kg
2. PCLE Zone Boundary is based on sediment data and/or visual observations of slag or battery case fragments.

Source:
1. Locations - PBW and Golder, 2012 - 2014
2. Aerial Imagery: NCTCOG, 2009 photography.

400 200 0 400 Feet

Scale: AS SHOWN

File No. 1302086-B020 FIG 7A1.mxd

FORMER OPERATING PLANT
FRISCO RECYCLING CENTER
FRISCO, TEXAS

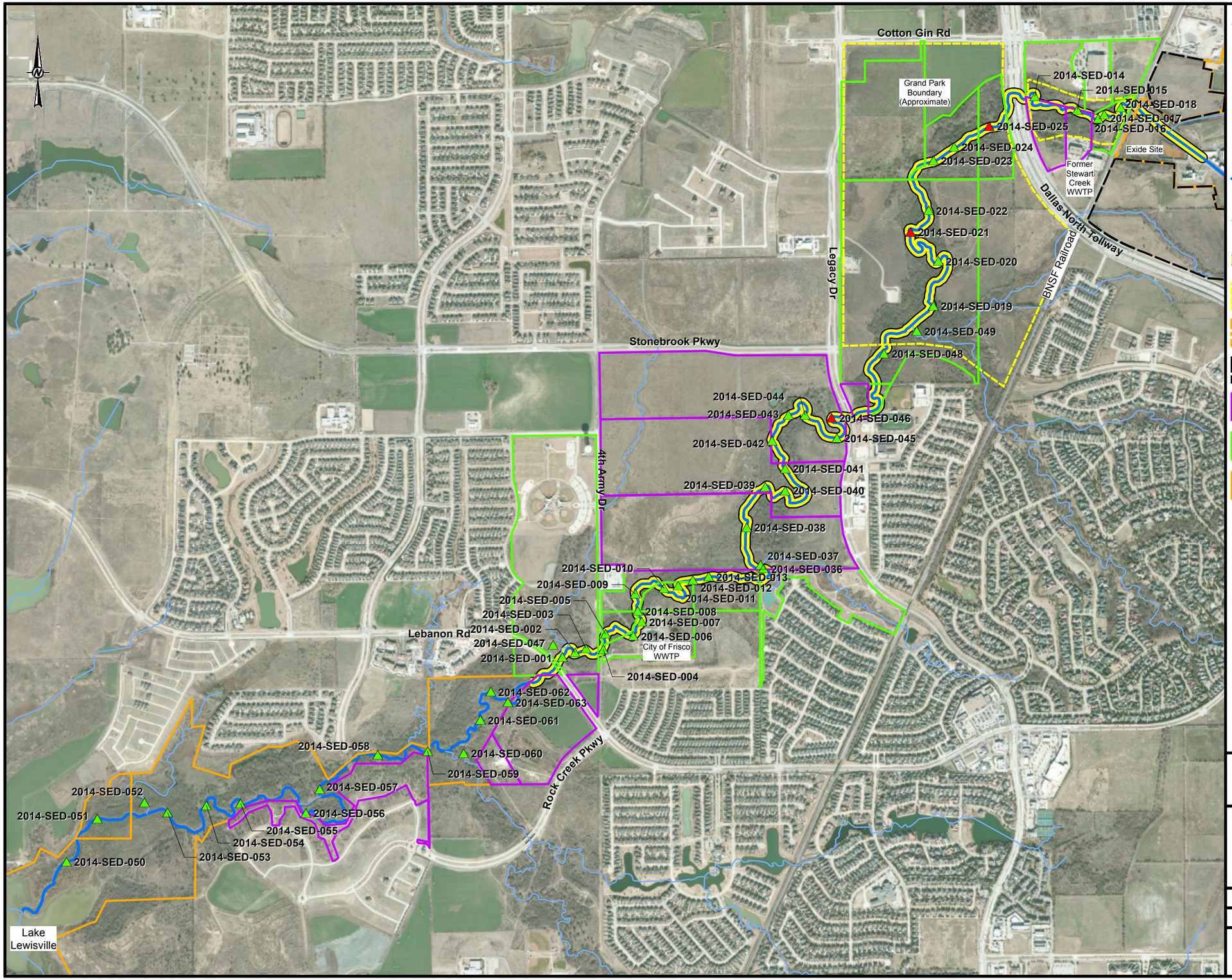
FIGURE 7A.1

ON-SITE AND UPSTREAM SEDIMENT SAMPLE LOCATIONS

PROJECT NO. 13-02086	BY: JWT	REVISIONS
DATE: 5/21/2014	CHECKED: - - -	

GOLDER ASSOCIATES INC.

Map Document: N:\File\2013\13-02086 Exide Frisco\B - APAR Phase II\map documents\1302086-B020 FIG 7A1.mxd / Modified 5/21/2014 2:07:04 PM by jthomas / Exported 5/21/2014 2:07:13 PM by jthomas



Legend

- Sediment Sample Location
- Exceedence of Pb or Cd RAL/Critical PCL for Sediment
- No Exceedence of Pb or Cd RAL/Critical PCL for Sediment
- Stewart Creek (Appoximate Creek Centerline)
- Creek Tributary (Appoximate Creek Centerline)
- Stewart Creek PCLE Zone
- Grand Park Boundary (Approximate)
- Former Operating Plant
- Undeveloped Buffer Property
- Private Owner Property
- City of Frisco or City of Frisco Entity Property
- USACE Property

Notes:
1. Screening Values:
Pb: 81.9 mg/kg
Cd: 3.0 mg/kg
2. PCLE Zone Boundary is based on sediment data and/or visual observations of slag or battery case fragments.

Source:
1. Locations - PBW and Golder, 2012 - 2014
2. Aerial Imagery: Source: Esri, DigitalGlobe, GeoEye, i-cubed, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, and the GIS User Community

1,500 750 0 1,500 Feet

Scale: AS SHOWN
File No. 1302086-B021 FIG 7A2.mxd

FORMER OPERATING PLANT
FRISCO RECYCLING CENTER
FRISCO, TEXAS

FIGURE 7A.2

DOWNSTREAM SEDIMENT SAMPLE LOCATIONS

PROJECT NO. 13-02086	BY: JWT	REVISIONS
DATE: 5/21/2014	CHECKED: - - -	

GOLDER ASSOCIATES INC.

Map Document: N:\File\2013\13-02086 Exide Frisco\B - APAR Phase II\map documents\1302086-B021 FIG 7A2.mxd / Modified 5/21/2014 1:53:16 PM by jthomas / Exported 5/21/2014 1:53:34 PM by jthomas

8.0 AIR ASSESSMENT AND CRITICAL PCL DEVELOPMENT

Not applicable.

9.0 ECOLOGICAL RISK ASSESSMENT

SCREENING LEVEL ECOLOGICAL RISK ASSESSMENT
STEWART CREEK

EXIDE TECHNOLOGIES
FRISCO, TEXAS

Agreed Order: Docket No. 2011-1712-IHW-E

May 24, 2014

Prepared for:

EXIDE TECHNOLOGIES

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TABLE OF CONTENTS

LIST OF TABLES ..... **iii**

LIST OF FIGURES ..... **iii**

LIST OF APPENDICIES ..... **iii**

LIST OF ACRONYMS ..... **iv**

1.0 INTRODUCTION **1**

2.0 SITE DESCRIPTION AND ENVIRONMENTAL SETTING **3**

2.1 Site History 3

2.2 Current Environmental Setting 5

2.3 Future Environmental Setting 6

3.0 PROBLEM FORMULATION **7**

3.1 Stewart Creek Surface Water and Sediment COCs 7
3.1.1 Data Summary 7
3.1.2 TCEQ Benchmarks/Initial Screening Comparison 9
3.1.2.1 Surface Water 10
3.1.2.2 Sediment 10
3.1.2.3 Groundwater 11
3.1.2.4 Conclusion of Initial Screening 12
3.1.3 Identification of Sediment Hot Spots 12
3.1.4 Arsenic, Cadmium and Lead Fate and Transport and Ecotoxicological Profiles 13
3.1.4.1 Arsenic 13
3.1.4.2 Cadmium 14
3.1.4.3 Lead 15

3.2 Conceptual Site Model 15
3.2.1 Chemical/Physical Properties Governing Transport of Arsenic, Cadmium and Lead 16
3.2.2 Transport of Arsenic, Cadmium and Lead in Surface Soil Via Surface Runoff .. 16

3.3 Assessment Endpoints 17

3.4 Exposure Assessment 18
3.4.1 Food Web Ingestion Modeling 18
3.4.2 Arsenic, Cadmium and Lead Uptake into Food Items 19
3.4.3 Expsoure Areas 19
3.4.4 Exposure Point Concentrations 20

4.0 TOXICITY ASSESSMENT **21**

4.1 Arsenic 21

4.2 Cadmium 22

4.3 Lead 22

5.0 RISK CHARACTERIZATION 23

5.1 Hazard Quotient Analyses 23
5.1.1 Potential Risks to Aquatic Life Organisms in Surface Water 23
5.1.2 Potential Risks to Benthic Invertebrates in Sediment 26
5.1.3 Potential Risks to Fish from Exposure to Sediment 27
5.1.4 Potential Risks to Upper Trophic Level Receptors 29

5.2 Risk Summary 32
5.2.1 Arsenic 32
5.2.2 Cadmium 33
5.2.3 Lead 34

6.0 UNCERTAINTY ANALYSIS 35

6.1 Hot Spot Analysis 35

6.2 Exposure Concentrations 36

6.3 Data Coverage 36

6.4 Presence of Special Status Species 37

6.5 Selection of Wildlife Species Subject to Evaluation 37
6.5.1 Amphibians 38
6.5.2 Reptiles 39

6.6 Fish Tissue Analysis 42

6.7 Simultaneous Exposure to Multiple Constituents 43

6.8 TRVs 43

6.9 Benthic PCLs 44

6.10 Bioavailability and Absorption 44

6.11 Surface Water Exposure 45

6.12 Availablility of Nearby Aquatic Resources 45

7.0 PCL CALCULATIONS AND SLERA RECOMMENDATIONS 46

8.0 REFERENCES 47

LIST OF TABLES

Table	Title
1	Summary of Surface Water Data for Stewart Creek and North Tributary
2	Summary of Upstream and On-Site Sediment Data for Stewart Creek and North Tributary
3	Summary of Downstream Sediment Data for Stewart Creek Collected in 2010, 2011 and 2013
4	Summary of Downstream Sediment Data for Stewart Creek Collected in 2014
5	Summary of Sediment Particle Size
6	Summary of Upper Groundwater Bearing Unit Data from Monitoring Wells in Vicinity of Stewart Creek and North Tributary
7	Threatened and Endangered Species – Collin and Denton Counties
8	Sediment Data Summary Statistics
9	Sediment-To-Fish Evaluation
10	NOAEL Based HQ Summary: Initial Conservative Assessment
11	NOAEL and LOAEL Based HQ Summary: Refined Less-Conservative Assessment

LIST OF FIGURES

Figure	Title
1	Site Map – Upstream and On-Site Stewart Creek
2	Site Map – Downstream Stewart Creek
3	Upstream and On-Site Surface Water and Sediment Sample Locations
4	2010, 2011, and 2013 Downstream Sample Locations
5	2014 Downstream Surface Water and Sediment Sample Locations
6	Monitoring Wells that Represent the Groundwater to Surface Water Pathway
7	Ecological Conceptual Site Model

LIST OF APPENDICIES

Appendix	Title
A	Photographic Log
B	ProUCL Statistical Output
C	Habitat Assessment Field Survey Report
D	Ecological Risk Assessment Calculations

LIST OF ACRONYMS

APAR	Affected Property Assessment Report
bgs	Below Ground Surface
BHHRA	Baseline Human Health Risk Assessment
BNSF	Burlington Northern Santa Fe
BSAF	Biota Sediment Accumulation Factor
BW	Body Weight
COC	Chemicals of Concern
CSM	Conceptual Site Model
EMF	Exposure Modifying Factor
ERA	Ecological Risk Assessment
EPA	Environmental Protection Agency
EPC	Exposure Point Concentration
F.M.	Farm to Market
FOP	Former Operating Plant
FSCWWTP	Former Stewart Creek Waste Water Treatment Plant
^{SW}GW	Groundwater to Surface Water PCL
HHERA	Human Health And Ecological Risk Assessment
HQ	Hazard Quotient
LOAEL	Lowest Observed Adverse Effect Level
mg/kg	Milligrams per Kilogram
mg/L	Milligram per Liter
MW	Monitoring Well
No.	Number
NOAEL	No Observed Adverse Effect Level
NTMWD	North Texas Municipal Water District
ODEQ	Oregon Department of Environmental Quality
PBW	Pastor, Behling & Wheeler, LLC
PCL	Protective Concentration Level
RBEL	Risk Based Exposure Limit
SWG	Southwest Geoscience
SLERA	Screening-Level Ecological Risk Assessment
SSL	Soil Screening Level
TCEQ	Texas Commission on Environmental Quality
TOC	Total Organic Carbon
TPDES	Texas Pollutant Discharge Elimination System
TRV	Toxicity Reference Value
UCL	95th percentile Upper Confidence Limit
W&M	Whitehead and Mueller

1.0 INTRODUCTION

This report describes the Tier 2 screening-level ecological risk assessment (SLERA) conducted for certain sections of Stewart Creek in Frisco, Texas. Stewart Creek is a perennial creek that runs through the Exide Technologies (Exide) former operating plant (FOP) (also known as the Site) to Lake Lewisville. The location of the former plant is shown on the Site Location Map presented on Figure 1. The stretch of Stewart Creek evaluated in this SLERA is from just upstream of the FOP to 7 miles downstream of the FOP (Figures 1 and 2) although Stewart Creek and its tributaries begin several miles upstream of the FOP (Figure A-1 in Appendix A).

The FOP was a lead oxide manufacturing plant and later a lead metal recycling facility (secondary lead smelter) that was in operation in Frisco, Texas since approximately 1964, with recycling operations commencing in 1969 until operations ceased in November 2012. The facility recycled spent lead-acid batteries and other lead-bearing scrap materials. This SLERA evaluates the potential ecological risk in Stewart Creek surface water and sediment from arsenic, cadmium and lead upstream, on-Site and downstream from the FOP.

Data collection and analysis for the SLERA has been based on the Texas Commission on Environmental Quality's (TCEQ's) *Guidance for Conducting Ecological Risk Assessments at Remediation Sites in Texas RG-263 (Revised January 2014)* (TCEQ, 2014) as the primary guidance document. The SLERA is a conservative assessment that is used to evaluate the likelihood of ecological risk. The SLERA is also used to assess the need for further ecological evaluation.

A SLERA that evaluated the portions of Stewart Creek located on the FOP was submitted to the TCEQ and Environmental Protection Agency (EPA) as part of an Affected Property Assessment Report (APAR) for the FOP on July 9, 2013. On October 8, 2013, the TCEQ issued a letter conveying comments on the APAR and SLERA from the TCEQ and EPA Region 6. Responses to those comments were submitted to TCEQ and EPA on October 29, 2013. The TCEQ subsequently conditionally approved the responses on November 19, 2013 (TCEQ. 2013a). This SLERA includes revisions based on the October 29, 2013 response to comments with the modifications detailed in the TCEQ approval letter and is specific to Stewart Creek over the area from just upstream of the FOP to 7 miles downstream of the FOP. A separate SLERA, also included with the FOP APAR, evaluates the upland (i.e., terrestrial) habitat located on the FOP. The methodology for both aquatic and terrestrial SLERAs was presented in the *Screening Level Ecological Risk Assessment Work Plan for the Exide Frisco Recycling Center, Frisco, Texas* (PBW, 2012a) submitted to the TCEQ on December 21, 2012 following discussions with the TCEQ regarding

data needs, sampling, and the general approach for the SLERAs. The Work Plan was approved by TCEQ on January 16, 2013.

2.0 SITE DESCRIPTION AND ENVIRONMENTAL SETTING

This section provides a summary of the history of the former operating plan (also known as the Site), current environmental setting and the anticipated future land use of the Site and Stewart Creek.

2.1 Site History

The FOP was a lead oxide manufacturing plant and later a secondary lead smelter (a lead metal recycling facility) that was in operation since approximately 1964 (lead smelting operations began in approximately 1969). The operations ceased at the end of November 2012. Spent lead-acid batteries and other lead-bearing scrap materials were recycled at the Site. The scrap lead was smelted and refined to produce lead, lead alloys and lead oxide.

Process wastewater generated when Site operations were on-going was treated in the on-Site Wastewater Treatment Facility (to remove metals) and then through the Crystallization Unit (to remove salts), producing condensate that was then discharged to the North Texas Municipal Water District (NTMWD) sanitary sewer. Prior to construction of the on-Site Wastewater Treatment Facility in approximately 1988, wastewater from the Site was treated off-site at the Former Stewart Creek Waste Water Treatment Plant (FSCWWTP) located west and adjacent to the Site (Figure 1).

Current storm water control features within the former production area include a concrete slab cover located throughout the former production area, a flood wall located between the former production area and Stewart Creek (which acts as a flood wall/retaining wall), and a French drain system located on the facility side of the flood wall that was constructed as an interim measure to address seepage of storm water and wash water to the exterior of the flood wall. These storm water control features route storm water and wash water to a conduit near the western end of the flood wall that directs the water to a storm water retention pond located on the south side of Stewart Creek. According to former Exide personnel, the storm water retention pond was constructed in approximately 1987-1988, which corresponds to the timing of the construction of the flood wall. Water within the retention pond historically was either treated and discharged to Stewart Creek or was used as make-up water in the plant's process streams. Discharge of water to Stewart Creek is regulated by the TCEQ under Texas Pollutant Discharge Elimination System (TPDES) Permit No. WQ0002964000, but such discharge has not occurred since 2009. Runoff from areas of the Site outside of the former production area flows into either Stewart Creek or the North Tributary. These areas generally have moderate relief and are stabilized with vegetation. The ultimate storm water management plan will be designed in conjunction with the final remediation and maintenance design to be developed in the Response Action Plan for the Site. All surface water features

within the City of Frisco, including Stewart Creek, are covered under the City's MS4 permit. Several studies since the 1990s, summarized below, have been performed to investigate the surface water and sediments of Stewart Creek at the Site and in downstream areas.

- JD Consulting, LLC conducted a Human Health and Ecological Risk Assessment (HHERA) for Exide in 1998 (JDC, 1998) that investigated Stewart Creek surface water and sediments. The study concluded that surface water did not pose a risk to human or ecological receptors while lead concentrations in sediment from the on-Site portion of Stewart Creek may pose a risk to human and ecological receptors. The on-Site sediments were subsequently remediated in 2000 (JDC, 2000). It was also noted in the HHERA (JDC, 1998) that cadmium and lead levels in sediment from areas downstream of the facility boundary may pose an ecological risk.
- PBW sampled sediment in October 2010 in support of a SLERA for the City of FSCWWTP, located immediately downstream of the Site (PBW, 2013a). The location of the FSCWWTP is shown on Figure 1. These data are incorporated into this SLERA and used in the evaluation of ecological risk.
- Whitehead and Mueller conducted a study for Exide in 2011 (W&M, 2011) to evaluate the presence of potential slag along the banks of the western reach of Stewart Creek on-Site. Several areas within and on the banks of the western reach of Stewart Creek were identified that contained isolated occurrences of slag. Although some slag samples were collected, no sediment or surface water samples were collected for laboratory analysis.
- Southwest Geoscience (SWG) conducted a study for the City of Frisco in 2011 to investigate potential impacts from lead and/or cadmium in sediments downstream of the FOP (SWG, 2013a). Several sediment sample locations within Stewart Creek near the Dallas North Tollway were noted as having elevated concentrations of lead or cadmium. These data are incorporated into this SLERA and used in the evaluation of ecological risk.
- SWG conducted a walking visual survey for the City of Frisco in March and April 2013 to identify the presence of visible battery chips and slag in Stewart Creek from Lake Lewisville east of F.M. 423 to the western edge of the Burlington Northern Santa Fe (BNSF) railroad bridge (minus a 1.2 mile stretch because of property access limitations) (SWG, 2013b). Battery chips and potential slag were observed in Stewart Creek. No sediment or surface water samples were collected for laboratory analysis.
- SWG completed a Supplemental Site Investigation in Stewart Creek from 4th Army Memorial Parkway to the BNSF Railroad Bridge in June 2013. Sediment and "as generated" wastes (e.g.,

chips, potential slag and slag) along Stewart Creek were sampled (SWG, 2014). Sediment data are incorporated into this SLERA and used in the evaluation of ecological risk.

2.2 Current Environmental Setting

The FOP is located within the shallow valley created by the drainages of Stewart Creek and an on-Site tributary to Stewart Creek located to the North ("North Tributary"). The on-Site portions of Stewart Creek and the North Tributary receive surface water flow from five distinct creeks that collect water from east of the Site. Appendix A shows a 2011 aerial photograph with the creeks visible and presents photographs taken from upstream locations during a Site visit on October 22, 2012. These creeks have been incorporated into parks as water features, run along roadways, through neighborhoods and other developments, and are part of the surface water features within the Frisco City limits that are contained within the City's MS4 storm water management permit. Urban runoff eventually feeds into the portion of Stewart Creek that is within the boundaries of the Site and is the primary source of water in Stewart Creek. Stewart Creek is classified as a perennial stream and the North Tributary is classified as an intermittent stream by the TCEQ (TCEQ, 2013b; TCEQ, 2013c).

Stewart Creek on-Site has banks on the east side that average 2 feet above the water line and the grasses growing along the banks are maintained and mowed. The banks along the creek on the west side of the FOP are greater than 8 feet and the vegetation consists of shrubs, small trees and grasses. Stewart Creek on-Site consists of riffles and a few pooling areas. The creek bed on-Site consists of gravel, shale, concrete, loose rip/rap, and rip/rap contained within chain link fencing. Stewart Creek downstream of the FOP contains a small number of perennial pools connected by segments of riffles and glides. The streambed is typical of a streambed that was formed by rapidly moving water. Most of the creek is dominated by long segments of exposed rock, shale and clay. During a walking survey conducted as part of the January and March 2014 habitat assessment (Appendix C), the streambed included only a few segments where a measureable amount of sediment had accumulated. Sediment was found in the small pools that were scattered along the stream course. The pooling areas were small and the water depth averaged less than 3 feet deep. The banks of Stewart Creek downstream of the FOP consist of steep eroded bluffs 4 – 6 feet high.

The ground surface in the northern portion of the FOP is relatively level and slopes gently toward either Stewart Creek or the North Tributary. In the southeastern portion of the Site, the ground surface slopes steeply downward toward the north (toward Stewart Creek) due to the natural topography. In the southwestern part of the Site, ground surface gently slopes north toward Stewart Creek.

2.3 Future Environmental Setting

For the purposes of this SLERA, it is assumed that Stewart Creek and the North Tributary will remain freshwater urban creeks that collect surface water runoff from the nearby residential areas. According to Cook-Joyce, Inc. (2014), the City of Frisco is planning to modify Stewart Creek downstream of the FOP between Cotton Gin Road, Legacy Drive, Stonebrook Parkway and the Dallas North Tollway for development of a 320 acre park. Stewart Creek west of the Dallas North Tollway will be restructured so that two lakes can be constructed on Stewart Creek (CJI, 2014). Stewart Creek will feed the lakes in the park and then will outflow into the lower downstream portions of Stewart Creek.

3.0 PROBLEM FORMULATION

Per TCEQ guidance (TCEQ, 2014), Problem Formulation is the first phase of the SLERA and establishes the goals, breadth, and focus of the assessment. Therefore, this section identifies the major factors that were considered in the assessment, such as the affected property size and ecology, distribution of chemicals of concern (COCs), and potential ecological receptors.

3.1 Stewart Creek Surface Water and Sediment COCs

A discussion of FOP COCs in surface water and sediment is presented in Sections 6 and 7 of the APAR, respectively. Consistent with that discussion, the primarily COCs evaluated in this SLERA are arsenic, cadmium, and lead.

Cadmium is considered bioaccumulative in sediment, but not water. Arsenic and lead are not considered bioaccumulative in sediment or water (Table 3-1 in TCEQ, 2014). Consistent with TCEQ guidance (TCEQ, 2014), the maximum detected concentration in a given media was used for benchmark screening in this SLERA and the 95 percent upper confidence limit on the mean (95% UCL) was used as the exposure point concentration in the food web analysis. EPA's most recent ProUCL version 5.0 software program was used to calculate the 95% UCL concentrations for the constituents in exposure areas (EPA, 2013). Appendix B provides the ProUCL output.

3.1.1 Data Summary

Multiple investigations have been conducted for Stewart Creek, as discussed and presented in greater detail in the APAR. Sediment and surface water data evaluated in this SLERA were collected from the following investigations:

Surface Water and Sediment Upstream:

- Ten surface water and ten sediment samples were collected by Golder Associates (Golder) in January 2014 from directly upstream of the FOP. Sediment samples were analyzed for arsenic, cadmium, lead, total organic carbon (TOC) and particle size. Surface water samples were analyzed for arsenic, cadmium and lead (total and dissolved).

Figure 3 shows the upstream sample locations. Analytical data are presented in Table 1 for surface water and Table 2 for sediment. Table 5 shows the sediment particle size distribution data.

Surface Water and Sediment On the Former Operating Plant:

- Sediment samples were collected in Stewart Creek and North Tributary on-Site during the 2012 PBW Site Investigation Report (PBW, 2012b) activities. Sediments were analyzed for cadmium, lead, TOC and sediment particle size.
- Surface water samples were collected in Stewart Creek on-Site during the 2012 PBW Site Investigation Report (PBW, 2012b) activities and analyzed for cadmium and lead (total and dissolved).
- Ten surface water samples were collected by PBW in the North Tributary in 2013 to support the APAR and analyzed for cadmium and lead (total and dissolved).
- Six surface water samples were taken in 2014 from Stewart Creek by Golder on-Site and analyzed for arsenic, cadmium and lead (total and dissolved).

Figure 3 shows the on-Site sample locations. Analytical data are presented in Table 1 for surface water and Table 2 for sediment. Table 5 shows the sediment particle size distribution data.

Surface Water and Sediment Downstream of the Former Operating Plant:

- Six sediment samples were collected by PBW in 2010 near the FSCWWTP and analyzed for arsenic, cadmium and lead (Figure 4 and Table 3).
- Thirty sediment samples were collected by SWG in November 2011 downstream of the FOP and analyzed for arsenic, cadmium, lead and selenium (Figure 4 and Table 3).
- In June 2013, SWG sampled sediments for arsenic, cadmium, lead, sediment TOC and sediment particle size. Additionally, there were 14 samples of sediment or "base material" co-located with battery chips, slag and potential slag (Figure 4 and Table 3). These samples included discrete and composited sediment samples taken directly beneath a chip, pieces of slag or pieces of potential slag. Samples of battery chips, slag and potential slag were not included in this SLERA per the TCEQ approved October 29, 2013 response to TCEQ and EPA comments on the APAR and SLERA (Exide, 2013; TCEQ 2013a) "battery case fragments and/or slag samples will not be included in the SLERA as an environmentally bioavailable media as they do not meet the TCEQ definition of environmentally bioavailable media".
- Sediment samples were taken in 2014 by Golder throughout the entire downstream stretch of Stewart Creek to Lake Lewisville (Figure 5 and Tables 4 and 5). Sediments were analyzed for arsenic, cadmium, lead, TOC and particle size.

- Surface water samples were taken from eight locations by Golder in 2014 downstream of the FOP (Figure 5 and Table 1) and analyzed for arsenic, cadmium and lead (total and dissolved).
- Five surface water (Table 1) and sediment (Tables 4 and 5) samples were taken by Golder in 2014 from several tributaries of Stewart Creek not impacted by FOP activities (Figure 5).

Groundwater:

- Groundwater data presented in this SLERA are from uppermost water bearing unit monitoring wells representing the groundwater to surface water pathway (Figure 6 and Table 6). Data are presented from 2012, 2013 and 2014. The majority of the data are for cadmium and lead, although there are some data for arsenic and selenium.

Tables 1 through 4 list data used for evaluating potential ecological exposures for surface water and sediment. Table 5 shows the sediment particle size distribution. Table 6 shows the groundwater data. The sample locations are shown on Figures 3 through 6.

3.1.2 TCEQ Benchmarks/Initial Screening Comparison

Tables 1 through 6 list the TCEQ freshwater sediment and surface water (freshwater acute and chronic) screenin levels (TCEQ, 2014; 2011) that per TCEQ guidance were used in this SLERA as an initial screening step. Acute surface water quality standards were used for comparison for surface water and potential groundwater discharge to surface water in the North Tributary since the TCEQ classifies the North Tributary as an intermittent stream (TCEQ, 2013b) and, as such, the acute surface water quality criteria are the applicable standards (TCEQ, 2014, 2011). Chronic surface water quality standards were used for comparison for surface water and potential groundwater discharge to surface water in Stewart Creek since the TCEQ classifies Stewart Creek as a perennial stream (TCEQ, 2013c) and, as such, the chronic surface water quality criteria are the applicable standards (TCEQ, 2014, 2011). The dilution factor of 0.15 was applied to the chronic surface water criteria for evaluation of the groundwater to surface water pathway (refer to Section 12 of the APAR for further discussion of the groundwater to surface water dilution factor).

Required Element #1 of the TCEQ guidance is the comparison of the maximum detected concentration from an exposure area to the benchmark. Note that if a constituent is considered bioaccumulative and is detected, then it is automatically retained for further evaluation. If a constituent is not considered bioaccumultive, but is detected at a concentration in at least one sample from the ecological exposure area

greater than the screening level benchmark, then the constituent is retained for further analysis. The screening comparison step for each media is presented below.

3.1.2.1 Surface Water

For surface water (Table 1) data, the preferred method of analysis is EPA Method 6020A due to lower sample detection limits than EPA Method 6010B for the analytes of interest; however, data generated using EPA Method 6010B are also presented (i.e., data were not censored). None of the samples taken in 2014 and analyzed using the more sensitive EPA Method 6020A had results that exceeded the surface water criteria. Three samples taken on the FOP in Stewart Creek in 2012 (SW-1, SW-2 and SW-11) had concentrations that exceeded the chronic criteria for cadmium and/or lead, but all samples taken in 2014 had concentrations below the chronic criteria for a perennial stream. All of the samples taken in the North Tributary in 2012 were below the acute surface water criteria for an intermittent stream. Based on the screening comparison, surface water was not carried forward for further evaluation in this SLERA.

3.1.2.2 Sediment

Table 2 shows the sediment samples taken upstream of the FOP and on the FOP in Stewart Creek and in the North Tributary. Tables 3 and 4 show the downstream sediment data. The freshwater benchmarks are also listed on these tables. Figures 3, 4 and 5 show the sampling locations.

- Arsenic data are available from the upstream samples (Table 2) and downstream of the FOP (Tables 3 and 4). Arsenic is not considered bioaccumulative. Several samples had arsenic concentrations greater than the benchmark of 9.79 mg/kg and therefore per TCEQ guidance, arsenic is carried forward for further evaluation in this SLERA.
- Cadmium is considered bioaccumulative in sediment. Because cadmium is bioaccumulative and has been detected in the sediment from Stewart Creek, per TCEQ 2014 ecological risk assessment guidance it is carried forward for risk evaluation to upper trophic level receptors. Additionally, several sediment samples had cadmium measured at concentrations greater than the benchmark.
- Lead data are available from sediment samples throughout the Stewart Creek study area. Similar to arsenic, lead is not considered bioaccumulative in sediment, but has been detected at concentrations greater than the benchmark of 35.8 mg/kg. Based on the benchmark exceedances and per TCEQ 2014 ecological risk assessment guidance, lead is carried forward for further evaluation.

- Selenium was analyzed in sediment in 2011 (Table 3), but all results are below the detection limits. TCEQ does not provide a sediment benchmark for selenium (TCEQ, 2014). The highest detection limit for a selenium sediment sample was 1.26 mg/kg. In 2013, SWG conducted a background soil study which included selenium (SWG, 2014). Lacking sediment background information, the use of area-specific background soil data can provide a reasonable understanding of the selenium concentrations in the soils that could be deposited through runoff into drainage channels. Background soil concentrations of selenium reported by SWG ranged from 0.21 mg/kg to 3.5 mg/kg (SWG, 2014). All of the detection limits from the selenium sediment data are within the background soil range. Based on the absence of selenium detections in the sediment samples, selenium was not carried forward for further evaluation in this SLERA.

3.1.2.3 Groundwater

Table 6 summarizes the groundwater data from the uppermost groundwater-bearing unit monitoring wells used to assess the groundwater to surface water pathway. Figure 6 shows the locations of the monitoring wells in relation to the North Tributary and Stewart Creek. Table 6 includes the most recent 2014 data analyzed by EPA Methods 6010B and 6020A and previous samples taken in 2012 and 2013 from relevant wells, but analyzed by EPA Method 6010B only.

There are no confirmed exceedances of the ^{SW}GW protective concentration levels (PCLs) from samples taken from the uppermost groundwater-bearing unit. The only exceedance of the ^{SW}GW PCL in these samples was from a sample taken in January 2014 from MW-46 and analyzed using EPA Method 6010B, which exceeded the ^{SW}GW PCL for both lead and cadmium; however, re-samplings of this well in February and March 2014 and analysis by EPA Method 6020A did not confirm the initial exceedance. None of the measured concentrations or detection limits in these wells near the North Tributary exceed the acute surface water criteria. Per the TCEQ guidance and Required Element # 1 (TCEQ, 2014), if the concentrations of non-bioaccumulative COCs are less than the ecological benchmarks, the COCs are not carried forward for further evaluation. As such, arsenic, cadmium and lead in groundwater were not carried forward for further evaluation in the SLERA. Selenium is considered bioaccumulative in water (Table 3.1 of TCEQ, 2014) and because there are detections of selenium in the groundwater that could enter surface water, selenium was retained for further analysis in the SLERA in accordance with TCEQ guidance.

3.1.2.4 Conclusion of Initial Screening

- **Surface Water –** Based on the screening evaluation and per TCEQ 2014 ecological risk assessment guidance, surface water as an ecological exposure medium was not carried forward in the SLERA process.
- **Sediment -** Based on the initial screening benchmark comparison and per TCEQ 2014 ecological risk assessment guidance, arsenic, lead and cadmium in sediment are carried forward for further evaluation. Selenium was not detected in sediment samples and was not carried forward.
- **Groundwater –** Based on the screening evaluation and per TCEQ 2014 ecological risk assessment guidance, the groundwater to surface water pathway is not carried forward in the SLERA process for arsenic, cadmium and lead; however, selenium in groundwater was retained because of its bioaccumulative properties.

3.1.3 Identification of Sediment Hot Spots

Following the initial screening evaluation of the data presented in Section 3.1.2 of this SLERA, the characteristics of Stewart Creek and the detected concentrations of cadmium and lead in sediment were evaluated critically for the identification of hot spots. As described in Section 3.9.2.7 of TCEQ, 2014 "a hot spot is a discrete area of substantially elevated COC concentration relative to the surrounding area. No standard approach has been developed for defining such areas. What constitutes a hot spot depends in part on the concentration, toxicity, and other properties of the COC; the medium in which it is detected; the extent of the area with elevated COC concentration; and the biological characteristics, such as receptor home range."

Two hot spot areas were identified in the downstream portion of Stewart Creek primarily based on the 2010, 2011 and 2013 data using a simple process: 1) sample locations with elevated lead (e.g., SC-Sed 5) clustered in an area; and 2) the documented presence of chip or slag material (e.g., Slag 6-24-2 base). A single location of an elevated concentration was not considered a hot spot, but a grouping of samples associated with potential source material. Sediment data associated with the hot spot areas are noted on Tables 3 and 4. Figures 4 and 5 show the general hot spot areaa in relation to the sediment sample points. The portion of Stewart Creek directly downstream of the FOP to the Dallas North Tollway is defined as Hot Spot #1. Hot Spot #1 includes the area near the FSCWWTP and several locations where slag was noted in 2013. Hot Spot #2 is tied to locations where potential slag was found in 2013 and is located east of Legacy Drive and south of Stonebrook Parkway if it extended east across Legacy Drive. These hot spots are focused on exposure to the benthic invertebrate population and not wide-ranging receptors (e.g., birds) because

sufficient aquatic habitat is available within Stewart Creek and these areas do not contain any preferred habitat or unique features.

As described by TCEQ (2013d) "the initial goal of the hot-spot evaluation will be to ensure that a statistical presentation of the sampling data (e.g., 95 % UCL) will not mask or dilute areas of elevated sediment concentrations that may otherwise pose a potential risk to the benthic community or cause risk from the remaining portions of the exposure areas to be overestimated." In the next phase of the SLERA, the statistics calculated to represent the downstream sediment data set are determined with and without the data associated with the samples from the hot spots. This evaluation is described in Section 3.2.2 (Risk Management for Benthic Hot Spots) in TCEQ 2013d and states "by definition, hot spots present an unacceptable risk to the benthic community. Therefore, if hot spots are identified within the benthic expsoure area, persons should recommend appropriate risk management practices. Where hot spots are identified and will be separately addressed with a remedy (e.g., removal), these data points should be removed from the 95% UCL determiniation and the resulting 95 % UCL should be used as the exposure point concentration."

3.1.4 Arsenic, Cadmium and Lead Fate and Transport and Ecotoxicological Profiles

Potential fate and transport mechanisms are discussed below for the retained compounds as discussed in Section 3.1.2: arsenic, cadmium, and lead (TCEQ's Ecological Risk Assessment Required Element #4).

3.1.4.1 Arsenic

Arsenic is an element that occurs naturally in a variety of sulfidic ores. Most anthropogenic releases of arsenic are to land or soil, primarily in the form of pesticides or solid wastes. Arsenic released to land is relatively immobile due to binding to soil particles (ATSDR, 1993). Arsenic is both reactive and mobile and can cycle extensively through both biotic and abiotic components of local aquatic and terrestrial systems. It can undergo a variety of chemical and biochemical transformations, such as oxidation, reduction, methylation, and demethylation (Environment Canada, 1993). Arsenic can exist in four oxidation states: +5, +3, 0 and -3. In soil, arsenic is a constituent of numerous minerals and is frequently found associated with sulfur, most commonly as arsenopyrite (FeAsS). Inorganic arsenate can also be bound to iron and aluminum cations or any other cation that may be present (e.g., calcium, zinc, magnesium, lead) as well as organic matter in soils (EPA, 2005a). The two primary forms of arsenic are trivalent (+3) arsenic and pentavalent (+5) arsenic. The relative toxicity of the trivalent and pentavalent forms may also be affected by factors such as the water solubility of the compound. Soluble inorganic arsenate (pentavalent state) predominates under normal conditions since it is thermodynamically more

stable in water than arsenite (trivalent state). Arsenic toxicity in water is not governed by hardness (Irwin et al., 1997a).

Over the past 100 years, arsenic compounds have had several uses including as a component of animal feed, herbicides and pesticides. Arsenic was used as a defoliant until 1992. Inorganic arsenical products were used as herbicides and insecticides in the first half of the 20th century until banned in 1988. Calcium arsenate was specifically used to fight a cotton pest, the boll weevil. Sodium arsenite was used in sheep and cattle dips. Another inorganic arsenical product, arsenic acid, was pervasively used as a cotton desiccant in Texas from approximately 1965 to 1992, when it was banned by EPA (Bureau of Economic Geology, 2005). Appendix 22 of the APAR shows historical aerial photographs of the area around the FOP and shows large tracts of land used for agriculture. Many of the agricultural tracts were likely used for cotton farming given: 1) cotton was historically identified as the main cash crop in Collin County (USDA, 1969) and 2) the development of the City of Frisco as a hub for area cotton farmers providing cotton gins and grain elevators (CCHC, 2014). Thus, it is probable that products containing arsenic were used in the general vicinity around the FOP and that the arsenic detected in the Stewart Creek sediments is sourced from agricultural products. Additionally, arsenic exceedances in sediment are not co-located with lead and cadmium exceedances suggesting that the source of the arsenic is not in association with the source of the lead and cadmium. See Sections 1.2.1.1 and 3.1.3 in the APAR for additional discussion of arsenic.

3.1.4.2 Cadmium

Cadmium is a naturally occurring element and is typically associated with other metals such as zinc and lead. Cadmium use was infrequent prior to the 20th century; however, recognition of its resistance to corrosion increased its demand, and it is now used in the manufacture of metal alloys, in nickel cadmium batteries, in pigments, metal coatings, and plastics. Cadmium emissions to the atmosphere result from combustion of fossil fuels, industrial emissions, or erosion of soils (Elinder, 1985). In nature, two oxidation states are possible (0 and +2), however, the zero or metallic state is rare. Mobility and bioavailability of cadmium in aquatic systems is enhanced under conditions of low pH, low hardness, low suspended solids, high conductivity, and low salinity (Irwin et al., 1997b). Cadmium in surface water accumulates more rapidly in the sediments than in living organisms. The toxicity of cadmium in sediments is affected by sediment content of acid volatile sulfides and total organic carbon. If released or deposited on soil, cadmium is largely retained in the surface layers of soil and is expected to convert to insoluble forms such as cadmium carbonate (EPA, 2005b).

Aquatic and terrestrial organisms bioaccumulate cadmium (Callahan et al., 1979) and TCEQ considers cadmium bioaccumulative in sediment (Table 3-1 in TCEQ, 2014). Bioaccumulation in fish is dependent on the pH and organic content of the water, which are the major determinants of water/sediment partitioning. Because cadmium accumulates in kidney and liver tissue rather than in muscle, and because intestinal absorption of cadmium is low, one would expect a low amount of biomagnification of cadmium in the food chain (ATSDR, 1991).

3.1.4.3 Lead

Lead, a naturally occurring element, is one of the most ubiquitous contaminants in the developed world because of its long history of a variety of domestic, medicinal and industrial uses. Lead is strongly sorbed in sediments and the rate is correlated with grain size and organic content. In the absence of soluble complexing species, lead is almost totally adsorbed to clay particles at pHs greater than 6 (Moore and Ramamoorthy, 1984). In surface water, lead is most soluble and bioavailable under conditions of low pH, low organic content, low levels of suspended solids, and low levels of salts of calcium, iron, manganese, zinc, and cadmium. In surface water, lead exists in three forms, dissolved labile, dissolved bound (e.g., colloids or strong complexes), or as a particulate (Benes et al,. 1985). Most lead in natural waters is precipitated to the sediment as carbonates or hydroxides (Demayo et al,. 1982). Lead in soil is relatively immobile and persistent. Lead forms complexes with organic matter and clay minerals, which limits its mobility (EPA, 2005c).

3.2 Conceptual Site Model

A conceptual site model (CSM) for the Site is presented as Figure 7 and illustrates the potential contaminant sources, release mechanisms, transport pathways, exposure media, and receptors considered for the SLERA. Development of a CSM is TCEQ's Ecological Risk Assessment Required Element #3.

The primary release mechanism and associated route of ecological exposure is through air deposition of arsenic, cadmium and lead onto surface soil on-Site and potential surface runoff of arsenic, cadmium and lead into Stewart Creek and the North Tributary as well as direct deposition onto the Stewart Creek and the North Tributary. Other potential sources of arsenic, cadmium and lead in the sediment include the presence of battery chips and slag material in the downstream portions of Stewart Creek. As previously presented, runoff from cotton farming areas in the vicinity is also a potential off-Site source of arsenic to Stewart Creek.

3.2.1 Chemical/Physical Properties Governing Transport of Arsenic, Cadmium and Lead

Arsenic, lead and cadmium, like all compounds, have the potential to move within environmental media (e.g., soil) to some degree. The ability for a compound to be transported within a medium or between media is based on the chemical and physical characteristics of the compound(s) and the source medium as well as the receiving medium. Physical characteristics include parameters such as grain size and moisture content for surface soil particles. Chemical characteristics include parameters such as soil/water partition coefficients, adsorption potential and degradation characteristics for potential contaminants. These chemical characteristics are specific to each chemical present, and may also be affected by the physical characteristics of the media in which the chemical is present. In surface water, physical and chemical characteristics are both important because transport may occur in solution or in association with suspended sediment. Dissolved-phase transport is the dominant contaminant migration mechanism in groundwater; therefore, chemical characteristics are often important with respect to that medium as well. Arsenic, lead and cadmium generally tend to remain bound to organic matter, minerals, clays, and silts in soil and, as such, they are relatively immobile. Arsenic, lead and cadmium are not considered water soluble although their solubility will increase in acidic conditions. If present in the dissolved phase, they can migrate in groundwater, although that migration can be significantly attenuated through sorption to the groundwater matrix, particularly in clay-rich soils such as those that predominate the uppermost groundwater-bearing unit at the Site.

3.2.2 Transport of Arsenic, Cadmium and Lead in Surface Soil Via Surface Runoff

Overland surface runoff from surface soil to Stewart Creek and the North Tributary has the potential to result in arsenic, cadmium and lead bound to soil particles being transported during/after rainfall events into these surface water bodies. Overland flow during runoff events would be expected to occur in the direction of topographic slope and would more likely occur with significant rainfall events when soils are fully saturated and/or precipitation rates are greater than infiltration rates. The Site is relatively flat, with limited elevation changes over the Site, generally less than five to ten feet over the entire Site, with a gradual slope increase in the vicinity of Stewart Creek and lesser so at the North Tributary. Because of the limited topographic slope and vegetative cover, the Site is generally not conducive to high runoff velocities or high sediment loads. In addition, the soils at the Site are predominantly clay, and clay soils have a relatively low erosive potential.

There is limited physical evidence of erodible impacts on-Site other than a small area of wash-out on the south side of the railroad spur on the western-most portion of the former operations area. Additionally,

there are areas of preferential surface water flow in the South Wooded Area on-Site that are stabilized by natural vegetation.

Dissolved arsenic, cadmium and lead associated with surface runoff from the Site would likewise be expected to be generally low due to the relatively low solubility of these metals. Arsenic, lead and cadmium will preferentially partition to organic matter in soil and sediment. Once bound to organic matter, these constituents may migrate as part of the sediment matrix if sediment is re-suspended during storm events and moved downstream. Stewart Creek and the North Tributary generally have a bedrock or gravel bed in the vicinity of the Site, suggesting that there is limited erosion of surface soils in this area. Table 5 shows the grain size of the sediment samples taken from Stewart Creek and the North Tributary. The grain size data indicate that the larger-sized particles (gravel and sand) are more prevalent than the smaller silt or clay particles. The relatively low measured lead and cadmium concentrations in the sediment in on-Site Stewart Creek and North Tributary also suggest that there is little evidence that overland erosion and transport of soil on-Site is a significant migration pathway. As noted in Appendix C, the creek bottom downstream of the FOP consists of mostly gravel, shale and clay and contained a few pooling areas. The streambed included only a few segments where measureable amounts of sediment had accumulated. Sediment was only found in small pools that were scattered along the stream course. The remainder of the streambed consisted of long segments of exposed rock, shale, and clay that had no accumulated sediment. On-Site, the creek bed consists of gravel, shale, concrete, loose rip/rap and rip/rap contained within chain link fencing (i.e., gabion basket). The creek bed within the pooling areas consisted of gravel, dead vegetation, and small amounts of sand or fine gravel.

3.3 Assessment Endpoints

Per TCEQ's Ecological Risk Assessment Required Element #2, ecological communities and major feeding guilds applicable to the Site were identified. Assessment endpoints are explicit expressions of the actual environmental value to be protected (EPA, 1997). If these endpoints are found to be significantly affected, they can trigger further action. The assessment endpoints for the Site are:

- Protection of aquatic life in Stewart Creek with no unacceptable effects on species diversity and abundance (and viable reproduction) due to Site-related arsenic, cadmium or lead in the surface water and sediment.
- Protection of benthic invertebrate community in Stewart Creek with no unacceptable effects on species diversity due to Site-related arsenic, cadmium or lead in the sediment.

- Protection of birds and mammals with no unacceptable effects on species diversity and abundance (and viable reproduction) due to Site-related arsenic, cadmium or lead in the surface water and sediment.

Appendix C contains the habitat evaluation conducted to evaluate the potential presence of special status species within the study area. The evaluation concludes that it is unlikely that any of these special status species would be present at the Site or associated with Stewart Creek downstream of the FOP. An evaluation of the likelihood of the presence of any of the state or federally listed species is summarized on Table 7.

3.4 Exposure Assessment

The exposure assessment phase expands the problem formulation and defines quantitative inputs for the exposures. A listing of input data available from the literature and exposure assumptions that leads to the calculation of the exposure dose for each receptor is TCEQ's Ecological Risk Assessment Required Element #5. Appendix D lists the assessment species and the input parameters that were used in this SLERA. The raccoon and snowy egret represent wildlife exposures to sediment in Stewart Creek and the North Tributary.

3.4.1 Food Web Ingestion Modeling

Food web ingestion-based modeling calculations were performed to characterize potential exposures to arsenic, cadmium and lead via the food web and to identify potential risks for upper trophic level mammals and birds. Ingestion modeling is based on species-specific exposure parameters and ingestion intake requirements using allometric equations (EPA, 1993). Species-specific ingestion models and input parameters are presented in Appendix D, but the following general equation (TCEQ, 2014) was used to estimate oral exposure for wildlife receptors:

$$\text{Dose (mg/kg - day)} = \left(\frac{(((\text{IRfood} \times \text{Cfood}) + (IRwater \times Cwater) + (IRsed \times Csed))EMF)}{\text{BW}} \right)$$

Where:

Dose	=	Estimated dose from ingestion (mg COC/kg body weight/day)
IRfood	=	Ingestion rate of food (prey) (kg/day)
Cfood	=	COC concentration in food (mg/kg)
IRwater	=	Ingestion rate of water (L/day)
Cwater	=	COC concentration in water (mg/L)
IRsoil/sed	=	Ingestion rate of sediment (kg/day)

Csoil/sed	=	COC concentration in sediment (mg/kg)
EMF	=	Exposure modifying factor (unitless)
BW	=	Body weight of the organism (kg)

The purpose of food web modeling is to characterize potential exposures to arsenic, cadmium and lead via the food web and to identify potential risks for upper trophic-level organisms. Through food web modeling, COCs are either retained for or eliminated from further steps of the SLERA. The food web modeling occurs in two phases per TCEQ Ecological Risk Assessment Required Elements #6 and #7 (TCEQ, 2014): first, a conservative no observed adverse effect level (NOAEL)- based analysis is performed followed by a less-conservative NOAEL - and lowest observed adverse effect level (LOAEL) - based analysis. As described by TCEQ (2014): "In the risk estimate generated in Required Element #6, an HQ is based on reasonably conservative exposure assumptions and representative NOAEL-based TRV." These initial or "conservative" assumptions include 100% bioavailability of the COCs and a site foraging factor of 100 % for each of the receptors. Required Element #7 of the Tier 2 SLERA provides for calculation of HQs using less conservative exposure assumptions and TRVs based on both the NOAEL and LOAEL data (TCEQ, 2014 Section 3.11). These refined or "less-conservative" assumptions can include changes to exposure modifying factors such as a site foraging factor of less than 100%.

3.4.2 Arsenic, Cadmium and Lead Uptake into Food Items

Chemicals in tissues of organisms of the food web are likely to be ingested by the species that feed on them (i.e., those occupying higher trophic levels); the result of which may be the expression of toxicological effects by the higher trophic level species. Chemical-specific uptake factors were taken from the EPA's *Screening Level Ecological Risk Assessment Protocol for Hazardous Waste Combustion Facilities* (EPA, 1999) when available as described in the TCEQ-approved SLERA Work Plan (PBW, 2012a). The sediment-to-fish uptake factors were found in the open literature. Appendix D shows all of the inputs and risk calculations.

3.4.3 Expsoure Areas

Stewart Creek can be broken down into several general exposure areas based on Site conditions and objective of this SLERA:

- Stewart Creek Upstream – Figure 1 shows the upstream exposure area. This area is located on the Undeveloped Buffer Property and is 0.2 miles in length.

- North Tributary On-Site – Figure 1 shows the North Tributary and designates the on-Site portion as 0.36 miles in length. The North Tributary is classified as intermittent and flows through the North Wooded Area which is a terrestrial exposure area evaluated as part of the terrestrial SLERA (a separate SLERA included with the FOP APAR).
- Stewart Creek On-Site – Figure 1 shows the on-Site portion of Stewart Creek which is 0.5 miles in length.
- Stewart Creek Downstream of the FOP – This exposure area is shown on Figures 4 and 5 and is 7 miles in length.
- Stewart Creek On-Site and Downstream (this exposure unit does not include upstream) - This exposure area represents the study area of Stewart Creek from the FOP to downstream (7.5 miles). This exposure unit represents the exposure area for the wide-ranging receptors. This exposure area includes two areas of elevated lead concentrations (focused on benthic invertebrates) which are discussed in Section 3.1.3 of this SLERA.

3.4.4 Exposure Point Concentrations

The basic unit of exposure is the exposure point concentration (EPC), defined as the concentration of a chemical in a specific environmental medium at the point of contact for a receptor. Both the maximum detected concentrations and the 95% UCLs for arsenic, cadmium and lead were evaluated in the SLERA. As previously discussed, the maximum detected concentrations were used for comparison to the benchmarks in the initial screening phase of the ecological risk process per TCEQ guidance. 95% UCLs were used as the EPC in the food web analysis for the exposure areas as described in Section 3.4.3.

Appendix B provides the statistical calculations for arsenic, cadmium and lead concentrations in Stewart Creek sediments. The EPA's ProUCL Version 5.0 software program (EPA, 2013) was used to test the distributions of the data for each compound and dataset and calculate parametric and distribution-free (i.e., nonparametric) 95% UCL concentrations and summary statistics from data sets. Note that the detection limits were used to represent the five nondetect cadmium values in the sediment data set (Table 3). There were no other nondetect results in the sediment data set. Table 8 summarizes the statistical evaluation of the sediment data.

4.0 TOXICITY ASSESSMENT

Mammal and bird toxicity reference values (TRVs) were taken from the EPA's Soil Screening Level (SSL) documents for arsenic, (EPA, 2005a), cadmium (EPA, 2005b), lead (EPA, 2005c), and the open literature. TRVs are the concentration of chemical exposure from an environmental media below which no significant ecological effects are anticipated. The TRVs used in this evaluation are considered screening level TRVs in that they are generally the lowest value available for that compound and endpoint based on a set of criteria and assumptions developed by EPA when estimating soil screening levels (EPA, 2005d). Because a NOAEL represents a concentration at which no adverse effects are noted, it is the preferred TRV in developing conservative soil screening values. For this SLERA, both NOAELs and LOAELs are required per TCEQ (2014). The LOAELs, or concentration at which the lowest effect was noted, were developed from the EPA SSL documents for each COC. To determine the LOAEL for each COC and receptor, the methodology employed by EPA to determine the NOAEL was replicated. For instance, if a NOAEL was based on the geometric mean of the NOAEL values for the growth endpoint, then the LOAEL was determined by calculating the geometric mean of the LOAEL values presented for the growth endpoint. When the NOAEL TRV recommended by EPA was based on a single study (as is the case for lead) the LOAEL TRV reported by this same study which determined the NOAEL was used. It is preferred to use the same study for both the NOAEL and LOAEL because the variability between study animals, study conditions and study endpoints is minimized. The mammalian and avian TRVs for each of the COCs are discussed below.

4.1 Arsenic

For birds, the TRV is the lowest NOAEL value in EPA (2005a) which is 2.24 mg/kg-day for reproduction, growth, or survival from a study by Holcman and Stibilj (1997). This study does not list a corresponding LOAEL, therefore, the geometric mean of the LOAEL values listed in EPA 2005a for reproduction, growth and survival of 4.5 mg/kg-day was determined and used as the avian LOAEL in this SLERA.

For mammals, the NOAEL TRVs (growth endpoint) listed by EPA (2005a) range from 0.0859 mg/kg-day to 10.3 mg/kg-day for growth, 0.601 mg/kg-day to 24 mg/kg-day for reproduction, and 0.533 mg/kg-day to 32 mg/kg-day for survival with a geometric mean of 2.8 mg/kg-day. The LOAELs from EPA (2005a) ranged from 0.663 mg/kg-day to 19.7 mg/kg-day for the growth endpoint, 0.0065 mg/kg-day to 48.0 mg/kg-day for the reproduction endpoint and 0.675 mg/kg-day to 43.4 mg/kg-day for the survival endpoint with a geometric mean of 6.9 mg/kg-day. The value of 2.8 mg/kg-day was used as the mammalian NOAEL TRV and 6.9 mg/kg-day was used as the LOAEL TRV for this SLERA.

4.2 Cadmium

The avian NOAEL of 1.47 mg/kg-day is a geometric mean based on growth and reproduction endpoints (EPA, 2005b). LOAELs reported in EPA 2005a ranged from 1.05 mg/kg-day to 37.6 mg/kg-day for growth and 2.37 mg/kg-day to 21.1 mg/kg-day for reproduction. A geometric mean of all of the avian LOAEL values listed in EPA 2005a based on growth and reproduction equals 6.35 mg/kg-day. The value of 6.35 mg/kg-day was used as the avian LOAEL TRV.

The mammalian NOAEL of 0.770 mg/kg-day presented in EPA (2005a) is based on a study by Yuhas et al. (1979) with a growth endpoint. Yuhas et al (1979) also defines a mammalian LOAEL of 7.70 mg/kg-day. The value of 7.70 mg/kg-day was used as the mammalian LOAEL TRV.

4.3 Lead

The avian NOAEL of 1.63 mg/kg-day was determined by EPA (2005c) and is based on a single study (Edens and Garlich, 1983) with reproduction as the endpoint. A LOAEL of 3.26 mg/kg-day was reported by Edens and Garlich (1983). The value of 3.26 mg/kg-day was used as the avian LOAEL TRV.

The mammalian NOAEL of 4.70 mg/kg-day was determined by EPA (2005c) and is based on a single study (Kimmel et al., 1980) using growth as the study endpoint. A LOAEL of 8.90 mg/kg-day was reported from Kimmel et al. (1980). The value of 8.90 mg/kg-day was used as the mammalian LOAEL TRV.

5.0 RISK CHARACTERIZATION

Predictions of the likelihood for adverse effects, if any, for the food web modeling are based on hazard quotients (HQs) (EPA, 1997). The HQs were calculated by dividing the estimated dose by the TRVs for each of the COCs for each of the upper trophic-level receptors.

NOAEL – HQ = Exposure Dose/ NOAEL-TRV
LOAEL – HQ = Exposure Dose/LOAEL-TRV

The HQ value of 1 is considered the threshold for indicating that adverse effects may occur. An HQ less than or equal to a value of 1 (to one significant figure) indicates that adverse impacts to wildlife are considered unlikely (EPA, 1997). An HQ greater than 1 is an indication that further evaluation may be necessary to evaluate the potential for adverse impacts to wildlife.

5.1 Hazard Quotient Analyses

For the initial conservative analysis as described in TCEQ (2014), HQs were calculated using no adverse effect or NOAEL-based TRVs, assumptions of 100 % bioavailability and no exposure modifying factors (Required Element #6) (TCEQ, 2014). Appendix D shows the risk calculations for the SLERA, with the HQs summarized on Table 10, for the initial conservative assessment. As outlined in the TCEQ guidance, if the HQ is greater than one in the initial conservative analysis, then the refined (less conservative) analysis is completed.

TCEQ's Ecological Risk Assessment Required Element #7 requires that the exposure parameters remain as in the initial conservative analysis (e.g., body weight, ingestion rates, and the exposure point concentration), but other factors such as the exposure modifying factor can be modified, depending on the species and site conditions. The HQ is calculated with the same NOAEL used in the initial conservative analysis, but a LOAEL-based TRV is added and the exposure is modified using the receptor's home range in relation to the exposure area size. Table 11 shows the HQs for the refined (less conservative) assessment. Each exposure area is discussed below.

5.1.1 Potential Risks to Aquatic Life Organisms in Surface Water

Risk to organisms in the water column are assessed by comparison of concentrations measured in the surface water to aquatic life criteria. The Texas surface water quality standard for arsenic, cadmium and lead are based on the dissolved portion in water (TCEQ, 2011); therefore, the dissolved samples were

used for this comparison. Additionally, the criteria for cadmium and lead have been adjusted to account to the Lake Lewisville segment water hardness of 106 mg/L. Note that the surface water value for arsenic is not adjusted for hardness (TCEQ, 2012; TCEQ, 2014). Risks are discussed by ecological exposure area below. Additional discussion on selenium as it pertains to the groundwater to surface water pathway is also presented.

Stewart Creek Upstream – Table 1 shows the surface water data for arsenic, cadmium and lead in surface water samples collected directly upstream of the FOP on the Exide Undeveloped Buffer Property. Stewart Creek is classified as a perennial stream by the TCEQ (2013c) and therefore chronic criteria are applicable for this assessment. There are two detections of dissolved lead which are below the chronic aquatic life criteria. There are no detections of arsenic or cadmium (total or dissolved). Detection limits using the more sensitive EPA Method 6020A are all below the chronic screening criteria indicating acceptable data quality. Thus, per TCEQ (2014), the ecological risk assessment process of the upstream exposure area for water column receptors is complete and no further evaluation is necessary.

North Tributary - The North Tributary is classified as an intermittent stream by the TCEQ (2013b) and therefore acute criteria are used for the assessment. Table 1 shows the surface water data. There was one detection of cadmium (0.00044 mg/L) which is below the cadmium acute surface water standard of 0.00908 mg/L. There were no detections of lead in surface water from the North Tributary and the detection limit for lead of 0.0029 mg/L is below the acute criterion of 0.0688 mg/L. Arsenic data are not available for the North Tributary surface water. According to TCEQ (2014), the ecological risk assessment for water column receptors in the North Tributary for cadmium and lead exposures is complete and no further evaluation is necessary.

Stewart Creek On-Site – Surface water data collected from the FOP contains EPA Method 6010B analytical results for samples collected in 2012 and EPA Method 6020A analytical results for samples collected in 2014 (Table 1). Reviewing the more recent and more sensitive data set developed using EPA Method 6020A, there are four detections of lead, but all are below the chronic surface water criteria. There are no detections of cadmium or arsenic in the 2014 data and all of the detection limits generated using the more sensitive method are below the chronic screening criteria. Thus, per TCEQ (2014), the ecological risk assessment of Stewart Creek on-Site exposure area for water column receptors is complete and no further evaluation is necessary.

Selenium in Uppermost Groundwater-Bearing Unit - As discussed in Section 3.1.2, the groundwater to surface water pathway is potentially complete for the uppermost groundwater bearing unit. Selenium was carried forward for evaluation for this pathway because it is considered bioaccumulative. Of the uppermost groundwater bearing unit monitoring wells that represent the groundwater to surface water pathway to Stewart Creek, there are two detections of dissolved selenium in groundwater (see Table 6; MW-37 and MW-38). There are also two detections from the monitoring wells that represent groundwater that could potentially discharge to the North Tributary (LMW-8). Selenium is considered bioaccumulative in water (TCEQ, 2014) and therefore was carried forward for further analysis. One of the samples (MW-38, sample collected on January 16, 2014) was analyzed using EPA Method 6010B and when this sample was re-analyzed with EPA Method 6020A, selenium was not detected above the detection limit. In any event, the four dissolved detections and all of the detection limits are below the aquatic life criteria (unadjusted with a dilution factor). There are no selenium data for surface water or for sediment from the on-Site portion of Stewart Creek or the North Tributary. The Uncertainty Section provides additional discussion about selenium in the project data set. The only other selenium data are for sediment from Stewart Creek downstream of the FOP collected in 2011 (see Table 3). There were no detections of selenium in the sediment with a maximum detection limit of 1.26 mg/kg. As described in Section 3.1.2.2, background soil concentrations of selenium ranged from 0.21 mg/kg to 3.5 mg/kg indicating that the detection limits of the available sediment data are within the background soil range. As such, the assessment of selenium in this SLERA is considered complete given:

- The concentrations detected of selenium in the groundwater are below appropriate surface water criteria (unadjusted for dilution) indicating that the water column receptors are not at risk.
- Selenium was not detected in any sediment sample and sediment sample detection limits are within the range of background soil concentrations.
- While selenium is considered bioaccumulative, the possible exposure point concentrations for upper trophic level organisms are low (i.e., below detection limits for sediment and below chronic criterion for surface water) and therefore this pathway is not evaluated further in the SLERA.

Stewart Creek Downstream of the FOP - Surface water data collected from downstream of the FOP consisted of EPA Method 6010B and EPA Method 6020A analytical results for samples taken in 2014 for lead, cadmium and arsenic (Table 1). Reviewing the more sensitive data set developed using EPA method 6020A, all of the detections and detection limits are below the chronic surface water criteria. Thus, per TCEQ (2014), the ecological risk assessment for the Stewart Creek downstream of the FOP exposure area for water column receptors is complete and no further evaluation is necessary.

5.1.2 Potential Risks to Benthic Invertebrates in Sediment

Risks to the benthic invertebrate community were evaluated using the midpoint of the sediment benchmark and the second effects level. The use of this midpoint is considered the default sediment PCL protective of benthic organisms (TCEQ, 2014).

Stewart Creek Upstream – Table 2 shows the concentrations of arsenic, cadmium and lead in sediment taken from directly upstream of the FOP on the Exide Undeveloped Buffer Property. There are no exceedances of the conservative screening benthic benchmarks or the benthic PCLs for cadmium or lead. All of the arsenic concentration are below the benthic PCL (21.4 mg/kg), except for one (2014-SED-035 at 42.7 mg/kg) which is the most upstream sample (Figure 3). As described in Section 3.1.3.1, extensive cotton farming operations in the area are a potential off-Site source of arsenic to Stewart Creek. This single upstream exceedance of arsenic in the sediment is not co-located with elevated cadmium or lead concentrations indicating that the source of the arsenic is not associated with the source of the lead and cadmium. The 95% UCL for arsenic in the upstream exposure area is 21.71 mg/kg, which is slightly greater than the benthic PCL of 21.4 mg/kg. Appendix B contains the ProUCL output and the statistics are summarized on Table 8.

North Tributary On-Site – Similar to the Stewart Creek Upstream analsyis, there are no exceedances of the conservative screening benthic benchmarks or the benthic PCLs for cadmium or lead. Arsenic data are not available for the North Tributary sediment. Further discussion of the overall arsenic data set is provided in the Uncertainty Section of this SLERA (Section 6). The North Tributary is classified as intermittent (TCEQ, 2013b) and "conditions exist where the benthic invertebrate community may be diminished for reasons unrelated to releases of COCS from an affected property" as described in Section 3.2.1 of TCEQ's *Determining Representative Concentrations of Chemicals of Concern for Ecological Receptors* (TCEQ, 2013d). In accordance with TCEQ (2014), the ecological risk assessment process of the North Tributary on-Site exposure area for the benthic invertebrates is complete and no further evaluation is necessary.

Stewart Creek On-Site – On-Site Sediment data collected in 2012 (see Table 2) indicated no exceedances of the conservative screening benthic benchmarks or benthic PCLs for cadmium or lead. Arsenic data are not available for the on-Site sediment. Further discussion of the overall arsenic data set is provided in the Uncertainty Section of this SLERA (Section 6). In accordance with TCEQ (2014), the ecological risk assessment of the Stewart Creek on-Site exposure area for the benthic invertebrates is complete and no further evaluation is necessary.

Stewart Creek Downstream of the FOP – Table 3 summarizes the sediment data collected downstream of the FOP from 2010 to 2013. Table 4 summarizes the downstream 2014 sediment data. Exceedances of the benthic PCLs are shaded in these tables. As shown on Table 3, there are six exceedances of the lead benthic PCL of 82 mg/kg and four exceedances of the cadmium benthic PCL of 3 mg/kg. Table 4 shows the most recent 2014 sediment data and there are no exceedances of the lead benthic PCL and three exceedances of the cadmium benthic PCL. The 95 % UCL for this exposure area for lead is 58.28 mg/kg and for cadmium is 1.46 mg/kg (Table 8). Both of these 95% UCL values are below the respective benthic PCLs. There are multiple exceedances of the benthic PCL for arsenic as indicated in Tables 3 and 4. The exposure area 95 % UCL for arsenic is 32.35 mg/kg which is greater than the arsenic benthic PCL of 21.4 mg/kg. The higher detections of arsenic do not generally correspond to the elevated detections of cadmium or lead indicating that the sources of cadmium and lead are not consistent with the sources of arsenic.

5.1.3 Potential Risks to Fish from Exposure to Sediment

The fish community is a key component of the freshwater ecosystem. Fish represent an important component of aquatic food webs by processing energy from aquatic plants and benthic macroinvertebrate species. Fish also represent important prey species for piscivorous wildlife. In TCEQ's *Determining Representative Concentrations of Chemicals of Concern for Ecological Receptors* (TCEQ, 2013d), the sediment-to-fish pathway is recognized. An initial screen for evaluating the sediment-to-fish pathway is the use of the midpoint value between the primary benchmark and second effects level for benthic invertebrates. As in screening for the sediment-to-benthic invertebrate pathway, bioaccumulative compounds are retained for further evaluation whereas non-bioaccumulative compounds detected below the midpoint PCL for benthos can be removed from further consideration for the sediment-to-fish pathway. Beyond screening, the sediment-to-fish pathway is typically evaluated using estimated tissue residue concentrations based on sediment concentrations coupled with bioaccumulation factors.

For Stewart Creek, bottom-feeding fish and upper trophic level fish are evaluated for the sediment-to-fish pathway. Examples of bottom feeding fish which may be present in Stewart Creek include blue catfish (*Ictalurus furcatus*), channel catfish (*Ictalurus punctatus*) flathead catfish (*Pylodictis olivaris*), black catfish (*Ameiurus melas*) and yellow bullhead (*Ameiurus natalis*), freshwater drum (*Aplodinotus grunniens*), smallmouth buffalo (*Ictibus bubalus*), and common carp (*Cyprinus carpio*). Examples of upper trophic level fish that may be present in Stewart Creek include largemouth bass (*Micropterus salmoides*), striped bass (*Morone saxatilis*), blue catfish, longnose gar (*Lepisosteus osseus*), and alligator gar (*Aractosteus spatula*). Given the conditions of Stewart Creek, larger fish would be found in the lower

portions of the creek nearer Lake Lewisville. Few large fish would be found in the isolated pools immediately downstream of the FOP.

This SLERA evaluated the sediment-to-fish pathway using biosediment accumulation factors (BSAFs) from the open literature. Rzmski et al. (2014) studied accumulation of cadmium and lead in water, sediment and three bivalve species (*Anodonta anatine, Anodonta cygnea,* and *Unio tumidus*). The geometric mean of the reported BSAFs was determined to be 0.53 for cadmium and 0.07 for lead. A BSAF value of 0.162 for arsenic was taken from EPA (2000) *Bioaccumulation Testing and Interpretation for the Purpose of Sediment Quality Assessment – Status and Trends*. The 95% UCL for each exposure area was used as the exposure point concentration to estimate tissue residue concentrations. A comparison of the estimated fish tissue concentrations with published tissue effects data was used to evaluate the potential risk to the fish population.

There are limited published studies of toxicity related to tissue burdens for freshwater fish; however, in order to evaluate the sediment to fish pathway, the most relevant available studies were chosen and presented below. Of the species/studies available, rainbow trout (*Oncorhynchusmykiss)* and brook trout (*Salvelinusfontinalis*) were chosen to assess the tissue burden from the available studies listed in Jarvinen and Ankley (1999) (recognizing that these species would not be present in Stewart Creek). Further analysis of the limitations of this assessment is presented in the Uncertainty Section (Section 6).

- **Arsenic -**Jarvinen and Ankley (1999) report a dry weight tissue concentration of 27 mg/kg (whole body) for reduced survival of rainbow trout exposed to sodium arsenate – study was lab based, flow-through but the exposure was via water.

- **Cadmium -**Jarvinen and Ankley (1999) report a dry weight tissue concentration of 4.8 mg/kg (whole body) for reduced growth of rainbow trout – study was lab based, flow-through but the exposure was via water.

- **Lead -**Jarvinen and Ankley (1999) report a dry weight tissue concentration of 20 - 44 mg/kg (whole body) for reduced growth of brook trout – study was lab based, flow-through but the exposure was via water.

Stewart Creek Upstream – There are no exceedances of the conservative screening benthic benchmarks or benthic PCLs for cadmium or lead. All of the arsenic concentrations are below the benthic PCL (21.4 mg/kg), except for one (2014-SED-035 at 42.7 mg/kg). The evaluation of the sediment-to-fish pathway for lead is complete with this comparison because "the TCEQ believes that the sediment benchmarks for non-bioaccumulative COCs are generally protective of the sediment-to-fish pathway (even sensitive life stages

such as eggs and larvae)" (TCEQ, 2013d). The sediment-to-fish evaluation for arsenic is carried forward because there is a detection that exceeds the sediment benthic PCL. The evaluation of cadmium is also carried forward because cadmium is considered bioaccumulative in sediment. Fish tissue concentrations were estimated using the BSAFs and are presented in Table 9. As shown in Table 9, the estimated fish tissue concentrations are well below the literature effects concentrations for both arsenic and cadmium. In addition, the exposure of fish to sediment in the upstream exposure area would likely be limited to small forage fish because the small pools found in the upstream portion of the study area would not provide sufficient food, water temperature and dissolved oxygen for larger species, especially predator fish.

North Tributary On-Site – The North Tribuatry is classified as intermittent by the TCEQ (2013b) and therefore evaluation of the sediment-to-fish pathway is not applicable. See Section 3.4.1.1 of TCEQ's *Determining Representative Concentrations of Chemicals of Concern for Ecological Receptors* (TCEQ, 2013d).

Stewart Creek On-Site – Sediment data collected on-Site in 2012 (see Table 2) indicate no exceedances of the conservative screening benthic benchmarks or benthic PCLs for cadmium or lead. Arsenic data are not available for the on-Site sediment. Similar to the evaluation of the upstream exposure area, the evaluation of lead is complete because it is not bioaccumulative in sediment and was not detected at concentrations greater than the benchmark. The evaluation of cadmium is was carried forward because cadmium is considered bioaccumulative in sediment. Tissue concentrations were estimated using the BSAFs and are presented in Table 9. As shown in Table 9, the estimated fish tissue concentration for cadmium in on-Site sediments is well below the literature effects concentrations for cadmium.

Stewart Creek Downstream of the FOP – Arsenic, cadmium and lead were all carried forward for an evaluation of the sediment-to-fish pathway because there are detected concentrations greater than the benthic PCLs. Table 9 shows the evaluation. As shown in Table 9, the estimated fish tissue concentrations for arsenic, cadmium and lead in downstream sediments are well below the literature based tissue values.

5.1.4 Potential Risks to Upper Trophic Level Receptors

Stewart Creek Upstream – Sediment and surface water in Stewart Creek upstream of the FOP were sampled in 2014. There were two detections of lead in the surface water and neither concentration exceeded the chronic surface water criteria. For the sediment, only one sample for arsenic exceeded the benthic PCL. There were no exceedances of the benchmark for cadmium or lead; however, cadmium was retained for trophic analysis because of its bioaccumulative properties. Appendix D (Table D-6 and D-7) show the HQ calculations for arsenic and cadmium for the snowy egret and the raccoon. These upper trophic level

species for this evaluation were presented in the TCEQ-approved Work Plan (PBW, 2012a). The conservative NOAEL-based HQs are summarized on Table 10. None of the HQs listed in this table are above one indicating that the trophic analysis of the upstream exposure area is complete and no adverse risk is indicated. The less-conservative evaluation was not necessary for the evaluation of arsenic and cadmium in upstream sediment.

North Tributary On-Site – The North Tribuatry is classified as intermittent by the TCEQ (2013b) and the risk to aquatic water column receptors was evaluated with acute criteria. Surface water data were collected in 2013 and there was one detection of cadmium which is well below the acute criteria. Sediment samples were collected in 2012 and there are no detections of cadmium or lead greater than their benchmarks or benthic PCLs. Sediments from the North Tributary were not analyzed for arsenic. Cadmium was retained for analysis in the trophic evaluation because of its bioaccumulative properties. Appendix D (Table D-8 and D-9) shows the HQ calculations for cadmium for the snowy egret and the raccoon. The NOAEL-based HQs are summarized on Table 10. None of the HQs listed in this table are above one indicating that the trophic analysis of the North Tributary exposure area is complete and no adverse risk is indicated. As such, a less-conservative evaluation was not necessary for the evaluation of cadmium in North Tributary sediment.

Stewart Creek On-Site – Surface water data collected in 2014 using the most sensitive analytical method (EPA Method 6020A) from Stewart Creek in the FOP showed no exceedances of the chronic surface water criteria for arsenic, cadmium or lead. Arsenic was not detected in surface water. On-Site sediment data collected in 2012 indicated no exceedances of the conservative screening benthic benchmarks or benthic PCLs for cadmium or lead. Arsenic data are not available for the on-Site sediment. Similar to the evaluation of the upstream exposure area, the evaluation of lead in on-Site sediment is complete because it is not bioaccumulative in sediment and was not detected at concentrations greater than the benchmark. The evaluation of cadmium continued because cadmium is considered bioaccumulative in sediment. Appendix D (Table D-10 and D-11) show the HQ calculations for cadmium for the snowy egret and the raccoon. The NOAEL-based HQs are summarized on Table 10. None of the HQs listed in this table are above one indicating that the trophic analysis of the On-Site Stewart Creek exposure area is complete and no adverse risk is indicated. As such, a less-conservative evaluation was not necessary for the evaluation of cadmium in on-Site sediment.

Stewart Creek Downstream of the FOP – Surface water data collected in 2014 using the most sensitive analytical method (EPA Method 6020A) from Stewart Creek downstream of the FOP showed no exceedances of the chronic surface water criteria. Arsenic, cadmium and lead in sediment were carried forward into the trophic evaluation because there were detected concentrations greater than the benthic

PCLs. Appendix D (Table D-12 and D-14) show the HQ calculations for arsenic, cadmium and lead for the snowy egret and the raccoon. The NOAEL-based HQs are summarized on Table 10. As shown in this table, the NOAEL-based HQs for the raccoon were below one. Similarly, the NOAEL-based HQs for arsenic and cadmium for the snowy egret were also less than one; however, the NOAEL-based HQ for lead was estimated to be greater than one for the snowy egret. As per the TCEQ guidance, a less-conservative assessment using LOAEL-based TRVs was completed (Table D-13). The less-conservative assessment maintains conservative assumptions such as assuming that the snowy egret forages 100% of the time from the downstream portion of Stewart Creek and 100% of the exposure point concentration is bioavailable to the snowy egret. The LOAEL-based HQs are summarized on Table 11. As shown on this table, the LOAEL-based HQ for the snowy egret exposure scenario was determined to be less than one (0.61). Based on this less-conservative evaluation for lead and the snowy egret, the trophic analysis for the downstream sediment is complete and there is no adverse risk indicated.

Stewart Creek On-Site + Downstream of the FOP – This 7.5 mile exposure unit was evaluated to address wide ranging receptors that may forage along the Stewart Creek from On-Site to Downstream. The trophic analsyis was similar to the Stewart Creek Downstream exposure area analysis with the snowy egret having a NOAEL-based HQ greater than one (Table D-15), but when a LOAEL-TRV was added to the assessment, the LOAEL-based HQ was determined to be less than one. The raccoon did not have any NOAEL-based HQs greater than one. Following the less-conservative evaluation for lead and the snowy egret, the trophic analysis was complete and no adverse risk is indicated.

Stewart Creek On-Site + Downstream of the FOP (with Hot Spots Removed) – As previously discussed, two hot spots were identified in the downstream portion of Stewart Creek primarily based on the 2010, 2011 and 2013 data. The hot spots are generally associated with samples of chips, slag and potential slag sampled in 2013. Figures 4 and 5 show the locations associated with these hot spots. If the hot spot data are removed from the On-Site + Downstream data set, the exposure point concentrations (95% UCLs) for cadmium and lead are below their screening benchmarks. Nonetheless, these metals were retained for trophic analysis because the maximum detected values are greater than the screening benchmarks. Appendix D (Table D-18 and D-19) show the HQ calculations for arsenic, cadmium and lead for the snowy egret and the raccoon. The NOAEL-based HQs are summarized on Table 10. As shown in this table, none of the HQs are above one indicating that the trophic analysis of the On-Site + Downstream (without Hot Spots) Stewart Creek exposure area is complete and no adverse risk is indicated. As such, the less-conservative evaluation was not necessary.

5.2 Risk Summary

This section evaluates the SLERA by analyte for all receptors (water column, benthic invertebrate, fish, bird or mammal). Arsenic, cadmium and lead are discussed individually.

5.2.1 Arsenic

Arsenic data are available for surface water and sediment from areas upstream and downstream of the FOP. On-Site surface water data are available for 2014 data, but there are no North Tributary arsenic surface water or on-Site arsenic surface water data and there are no sediment arsenic data from On-Site or the North Tributary.

Of the available surface water data, arsenic was detected in two samples taken on the Army Corps of Engineer property (2014-SW-026 and 2014-SW-028) and in two of the samples taken in side tributaries (2014-SW-027 amd 2014-SW-029) that feed into the Army Corps of Engineer property. Arsenic was not detected in surface water in the ten samples taken upstream of the FOP or any of the samples between the Army Corps of Engineer property and the FOP. All of the detections are well below the chronic surface water criteria of 0.15 mg/L. Arsenic was sampled for and detected in a few of uppermost water-bearing unit monitoring wells used to assess the groundwater-to-surface water pathway, but all detections and detection limits were below the chronic surface water criteria.

Sediments sampled upstream of the FOP showed one detection of arsenic (42.7 mg/kg) greater than the benthic benchmark (21.4 mg/kg) (Table 2). The location of this detection (2014-SED-035) is the most upstream location sampled (Figure 3). The 95% UCL for arsenic for the upstream data set is 21.71 mg/kg which is slightly greater than the benthic PCL of 21.4 mg/kg. Data from sediment samples taken downstream of the FOP are shown in Tables 3 and 4 with the individual concentrations which exceeded the benthic PCL shaded. The 95% UCL for the downstream arsenic sediment data was 32.35 mg/kg and 21.89 mg/kg when the hot spots were removed (Table 8). When the data from the hot spots (as defined in Section 3.1.3) are removed, the 95% UCL of 21.89 mg/kg is similar to the 95% UCL calculated for the upstream data set (21.71 mg/kg). According to TCEQ (2014) the benthic invertebrate population in areas upstream and downstream of the FOP could be at risk from exposure to arsenic based on the data comparisons to the benthic PCL.

The estimated fish tissue arsenic concentrations (Table 9) did not exceed the literature-based adverse effects tissue values indicating that the sediment-to-fish pathway does not result in unacceptable risk. Using the 95% UCLs as the exposure point concentration, there were no NOAEL-based HQs greater than

one for the snowy egret or the raccoon as shown in Table 10. As such, the SLERA trophic analysis does not indicate an adverse risk to upper trophic level species from exposures to arsenic in sediment.

As discussed in Section 3.1.3.1 in this SLERA and in Sections 1.2.1.1 and 3.1.3 in the APAR, arsenic was used extensively in agricultural products. Appendix 22 of the APAR shows historical aerial photographs of the area around the FOP and shows large tracts of land used for agriculture. It is probable that products containing arsenic were used in the area around the FOP and that the arsenic detected in the Stewart Creek sediments is sourced from agricultural products. Additionally, arsenic exceedances in sediment are not always co-located with lead and cadmium exceedances suggesting that the source of the arsenic is not associated with the source of the lead and cadmium.

5.2.2 Cadmium

Cadmium data are available for surface water and sediment throughout the study area. In surface water there are no exceedances of the chronic criteria for samples analyzed using the more sensitive EPA Method 6020A data is considered. Cadmium was detected in some of the groundwater samples from the uppermost water-bearing unit monitoring wells in the vicinity of Stewart Creek and the North Tributary, but there were no exceedances of the groundwater to surface water PCL (Table 6). In sediment there were no exceedances of the benthic PCL in the Upstream Stewart Creek, On-Site Stewart Creek or North Tributary data sets. In the downstream samples there were 7 detections out of 118 samples greater than the 3 mg/kg benthic PCL (5.9%) (Tables 3 and 4). The 95% UCL for the downstream portion of the study area was 1.46 mg/kg (Table 8) which is well below the benthic PCL of 3 mg/kg. Because special status mollusk species (Louisiana pigtoe or Texas heelsplitter) or special status alligator snapping turtles were not observed and are not believed to be present in Stewart Creek (Appendix C), the use of the 95% UCL as the exposure point concentration compared to the benthic PCL based on the midpoint is consistent with TCEQ guidance.

The estimated fish tissue cadmium concentrations (Table 9) did not exceed the literature-based adverse effects tissue values found in the open literature indicating that the sediment-to-fish pathway does not result in unacceptable risk. Cadmium is considered bioaccumulative and therefore cadmium was assessed in every exposure area for trophic risk. As shown on Table 10, when the 95% UCL was used as the exposure point concentration, there were no NOAEL-based HQs greater than one for the snowy egret or the raccoon. As such, the SLERA trophic analysis does not indicate an adverse risk to the upper trophic level species from exposures to cadmium in sediment.

5.2.3 Lead

Lead data are available for surface water and sediment throughout the study area. In surface water (Table 1), there are no exceedances of the chronic criteria for samples analyzed using the more sensitive EPA Method 6020A. Lead was detected in some of the groundwater samples from the uppermost water-bearing unit monitoring wells in the vicinity of Stewart Creek and the North Tributary, but the sole exceedance of the groundwater to surface water PCL in these samples was not confirmed by re-sampling (Table 6). In sediment there were no exceedances of the benthic PCL in the Upstream Stewart Creek, On-Site Stewart Creek or North Tributary data sets. In the downstream samples collected by SWG in 2010, 2011 and 2013 (Table 3) there were 6 detections greater than the 82 mg/kg benthic PCL. There were no exceedances of the lead benthic PCL in the 2014 sediment data (Table 4). The 95% UCL using all of the data from 2010 to the present for the downstream portion of the study area was 58.28 mg/kg (Table 8) which is well below the benthic PCL of 82 mg/kg. Because special status mollusk species (Louisiana pigtoe or Texas heelsplitter) or special status alligator snapping turtles were not observed and are not believed to be present in Stewart Creek (Appendix C), the use of the 95% UCL as the exposure point concentration compared to the benthic PCL based on the midpoint is appropriate.

The estimated fish tissue lead concentrations (Table 9) did not exceed the literature-based adverse effects tissue values indicating that the sediment-to-fish pathway does not result in unacceptable risk. As shown on Table 10, when the 95% UCL was used as the exposure point concentration, there were NOAEL-based HQs greater than one for the snowy egret, but not for the raccoon. When a LOAEL-TRV was used in the trophic analysis, there were no HQs greater than one. As such, the SLERA trophic analysis does not indicate an adverse risk to upper trophic level species from exposures to lead in sediment.

6.0 UNCERTAINTY ANALYSIS

The characterization of uncertainty is a component of the ERA process (EPA, 1997) and is Required Element #8 in the TCEQ process (TCEQ, 2014). Due to the multiplicity of potential receptor species and general lack of detailed knowledge and/or variability surrounding their life cycles, feeding habits, and relative toxicological sensitivity, the uncertainty surrounding estimates of ecological hazard can be substantial. The criteria used in this assessment are intended to provide a conservative assessment of potential ecological hazards. This SLERA did not account for site-specific factors such as chemical bioavailability, adaptive tolerance, reproductive potential, or use of similar nearby ecosystems. Such factors would most likely tend to mitigate the estimated degree and ecological significance of loss or impairment of a portion of some ecological population(s) due to both chemical and physical stressors in the area. The approach used in this assessment does develop protective (conservative) estimates of exposure, which likely indicate a potential for hazard that is greater than actually encountered by organisms.

The criteria used in this assessment are all chemical-specific and as such, cannot address the additive, antagonistic, or synergistic effects of the mixtures of chemicals typically present in the environment, nor does this assessment address mechanisms of action. Furthermore, SLERAs do not typically take into account the nature and constitution of the specific ecosystem present at a Site, the potential toxicity of other constituents (naturally occurring) that were not quantified, or the pervasive influence of physical stressors associated with the disruptions caused by human activities. Uncertainties applicable to this SLERA are described below:

6.1 Hot Spot Analysis

As discussed in Section 3.1.3, two hot spots were identified in the downstream portion of Stewart Creek primarily based on the 2010, 2011 and 2013 data. The portion of Stewart Creek directly downstream of the FOP to the Dallas North Tollway is defined as Hot Spot #1. Hot Spot #1 includes the area near the FSCWWTP and several locations where slag was noted in 2013. Hot Spot #2 is tied to locations where potential slag was found in 2013 and is located east of Legacy Drive and south of Stonebrook Parkway if it extended east across Legacy Drive. Figures 4 and 5 shows the locations. Table 8 presents a revised 95% UCL for the On-Site + Downstream with the hot spot data removed. The arsenic 95 % UCL of this modified data set is 21.89 mg/kg which is slightly above the benthic PCL of 21.4 mg/kg. This arsenic concentration of 21.89 mg/kg is very similar to the upstream arsenic 95% UCL of 21.71 mg/kg. The 95% UCLs from this modified data set (i.e., the on-Site + downstream data with hot spots removed) are 1.32 mg/kg for cadmium and 23.13 mg/kg for lead which are both below their respective benthic PCLs. Note that the 95% UCLs for cadmium and lead when all the data are used (hot spot data included) are also below

the benthic PCLs. The hot spot analysis in this SLERA shows that conclusions of risk are identical when the data sets (with and without hot spot data) are evaluated. As described by TCEQ (2013d) "the initial goal of the hot-spot evaluation will be to ensure that a statistical presentation of the sampling data (e.g., 95 % UCL) will not mask or dilute areas of elevated sediment concentrations that may otherwise pose a potential risk to the benthic community or cause risk from the remaining portions of the exposure areas to be overestimated." In this SLERA, the statistics calculated to represent the downstream sediment data set were determined with and without the data associated with the samples from the hot spots. This evaluation is described in Section 3.2.2 (Risk Management for Benthic Hot Spots) in TCEQ 2013d and states "by definition, hot spots present an unacceptable risk to the benthic community. Therefore, if hot spots are identified within the benthic expsoure area, persons should recommend appropriate risk management practices. Where hot spots are identified and will be separately addressed with a remedy (e.g., removal), these data points should be removed from the 95% UCL determiniation and the resulting 95 % UCL should be used as the exposure point concentration."

6.2 Exposure Concentrations

Risk may be overestimated in the exposure assessment because the selected EPCs are either the maximum detected (in the benchmark screening) or the 95 % UCL (in the food web modeling) concentrations. The TCEQ has selected the 95 % UCL as the preferred EPC for the benthic invertebrate community and wildlife since the goal is to protect benthic organisms and wildlife at a community level, rather than individually (TCEQ, 2013d). As described in Appendix C, there were no special status species found in Stewart Creek and therefore protection of the overall benthic and wildlife population is warranted. The 95 % UCL is a conservative estimate of the true mean and accounts for uncertainty in concentrations throughout an exposure area. The EPC term, according to EPA guidance, represents the average exposure experienced by a receptor over an exposure area during an extended period of time. Therefore, the EPC should be a conservative estimate of the true average value and not the highest observed concentration (TCEQ, 2013d). The use of the 95 % UCL as the EPC for evaluation of risk to the benthic community and wildlife receptors likely overestimates the potential risk.

6.3 Data Coverage

Arsenic, cadmium and lead are the primary constituents of interest for this SLERA. Selenium in groundwater is also evaluated for the groundwater to surface water pathway because of its bioaccumulative potential. For surface water, there are no arsenic data for the North Tributary and there are no data for selenium for any of the exposure areas. For sediment, there are no arsenic data for the on-Site sediments in Stewart Creek or the North Tributary. Arsenic data are available for areas upstream and downstream of the

FOP. There are limited sediment data for selenium. These data (all below detection limits) were collected by SWG in 2011 and only from areas downstream of the FOP. Because arsenic and selenium data are not available from the entire study area in all media, there is uncertainty with the conclusions of the SLERA for these two inorganic analytes; however, based on the information available, the overall SLERA conclusions are appropriate.

6.4 Presence of Special Status Species

A habitat evaluation with special emphasis on the potential presence of special status species was completed in January and March of 2014 (see Appendix C). No threatened or endangered species, listed by federal or state agencies, were found while conducting the surveys along Stewart Creek. There is low uncertainty that the Texas threatened freshwater mussels (Texas heelspliter or Louisiana pigtoe) would be present because the investigators waded the entire Stewart Creek study area and conducted benthic surveys finding other mussel species (pondhorn, Asian clams and giant floater), but no evidence (e.g., shells) of the Texas threatened species. There is also low uncertainty that the Texas threatened alligator snapping turtle would be present in Stewart Creek. Stewart Creek has high flow conditions and does not provide the deep muddy bottomed pools and submerged structures that attract alligator snapping turtles. The investigators did identify three species of turtle in Stewart Creek: red-eared slider, box turtle and soft shell. It is also unlikely that the special status bird species (e.g., white-faced ibis) would utilize Stewart Creek for foraging. Although the survey was completed in the winter; the white-faced ibis breed and winter along the Gulf Coast and may occur as migrants in the Panhandle and west Texas. The inland populations of white-faced ibises prefer to breed in shallow freshwater marshes with islands of emergent vegetation such as cattails or bulrushes. The Louisiana and Texas populations also breed in estuarine marshes (Farrand, 1983). In 2012, the total population size of the white-faced ibis was estimated to be 1.2 million individuals and increasing (IUCN, 2012). The investigators concluded that the white faced ibis is not a resident of the area around Stewart Creek; however, riparian habitat adjacent to the perennial pools and Lake Lewisville might be used for resting and feeding by migrating birds. Based on the habitat survey, there is low uncertainty that special status species should be represented in the SLERA.

6.5 Selection of Wildlife Species Subject to Evaluation

The snowy egret and raccoon were selected to represent all bird and mammal species that may contact arsenic, cadmium and lead in Stewart Creek sediment directly during foraging as well as indirectly via the food chain. The selection of these species to represent mammals and birds was based on site observations, their potential to contact sediment or soil directly or indirectly, and professional judgment. The snowy egret has not been observed in Stewart Creek but is likely found in the area has feeding habits that increase the

likelihood that this species might contact sediment in Stewart Creek. Raccoon tracks were commonly noted during the January and March 2014 habitat evaluation of Stewart Creek (Appendix C). The myriad of factors that influence animal and bird behavior, the small size of the creek, the variable water flow in the creek, and the industrial/residential/commercial nature of the area and nearby vicinity limits the ecological productivity of the area and, therefore, the exposure to birds and mammals is likely overestimated in this SLERA. Amphibians and reptiles are present in Stewart Creek; however, assessment of amphibians and reptiles in ecological risk assessment in highly uncertain. The following sections address the assessment of amphibians and reptiles.

6.5.1 Amphibians

Research has shown that amphibians, such as frogs and salamanders, tend to be sensitive indicators of environmental stress from contaminant exposure as a result of their unique life history and physiology (Alford, 2010). Amphibians commonly travel between aquatic and terrestrial habitats and life-history requirements potentially expose this group of vertebrates to contaminants in surface water, sediments and soils at various intensities, depending on developmental stage and the life history unique to each species. In addition to their unique life history, the physiological properties of amphibians heighten their exposure to contaminants in the environment. Amphibians are exposed to contaminants through the direct uptake from water and substrate as well as the ingestion of sediments, soils and food items. The skin of amphibians is thin and highly permeable serving as part of the respiratory system. This permeability maintains the organisms balance in nature, but also creates a route for the potential for uptake and intensifies the risk of contaminant exposure to amphibians by permitting chemical transport across membranes. Amphibian toxicity is generally under-represented in the literature (ENSR, 2004) when compared to other classes of animals and as such is highly uncertain. A summary of the available amphibian aquatic toxicity data for lead and cadmium is presented below.

Endpoint	**Cadmium Concentration (µg/L)**	**Number of Studies**	**Lead Concentration (µg/L)**	**Number of Studies**
Behavioral	1 - 1.3	2	750 – 1,000	4
Biochemical/Cellular	1.1 - 4,000	5	500 – 1,000	2
Developmental	< 2 – 505	12	70 – 10,000	7
Growth	30 - 106	3	NA	NA
Mortality	9920 – 11,648	48	470 – 105,000	13
Reproductive	1.34	1	NA	NA
Other	1 – 77	27	4 – 16,000	12

Source: Table 3-4 in ENSR, 2004. No information presented for arsenic in Table 3-4 (ENSR, 2004).

All of these reported toxicity values are greater than the chronic surface water criteria used for the evaluation of Stewart Creek: cadmium = 0.256 µg/L and lead = 2.68 µg/L. As shown on Table 1, there are no detections of arsenic in any of the surface water samples. Therefore, based on the available toxicity data, the application of the surface water criteria are protective of amphibians found in Stewart Creek.

6.5.2 Reptiles

During the past decades, reptilian toxicology has made up a disproportionately small percentage of toxicological studies of vertebrates. Characteristics of some reptile species make them difficult to study, including long life span and generation time, low fecundity, and incompatibility with laboratory handling techniques. Reptile species are linked by a number of traits (e.g., ectothermia, pulmonary respiration, epidermal scales, and internal fertility), yet possess a diverse array of life history characteristics and inter-species differences (e.g., population distributions, migration patterns, diets, and metabolic processes) (Gardner and Oberdorster, 2006). Turtles such as the alligator snapping turtle (*Macrochelys temminckii*), red-eared slider (*Trachemys scripta elegans*) and soft shell turtle (*Apalone spinifera*) are of particular interest for this Stewart Creek SLERA because the alligator snapping turtle is considered a Texas threatened species in Collin County and the red-eared slider and soft shell turtle were found in Stewart Creek in 2014; however the alligator snapping turtle was not found nor is this species expected to be present due to the high low conditions that are common in the creek and the small number of shallow pooling areas. Stewart Creek does not provide the deep muddy bottomed pools and submerged structure that attract alligator snapping turtles. The assessment of risk to these species from exposure to the arsenic, cadmium and lead is highly uncertain. The open literature was reviewed for information on toxicity to turtles from arsenic, cadmium and lead. These publications are summarized below.

- Clark et al. (2000) collected red-eared sliders in 1994 and 1995 from the Municipal Lake system in Bryan, Texas which had received **arsenic** wastes from 1940-1993. The study investigated nondestructive assay techniques by collecting and analyzing blood samples. Arsenic was not found (detection limit 0.1 ppm) in any blood samples from the red-eared sliders taken from Municipal Lake where arsenic is a known contamiant. No evidence was found in the body condition data (total body mass to carapace length) that red-eared sliders were being harmed. Red-eared sliders at Municipal Lake showed greater body weights which may have been caused by daily feeding by humans.

- Guirlet and Das (2012) studied the accumulation, path and effects of exposure to **cadmium** through diet in female red eared slider turtles In the first phase of the experiment, turtles underwent an acclimatization period during which they were fed a control diet. In the second phase, the turtles were exposed to cadmium through a $CdCl_2$ supplemented diet for 13 weeks. The three dosage turtle groups exposed to the diet Cd treatments received: 0.4 mg/kg (low dosage

group), 0.58 mg/kg (medium dosage group) and 0.95 mg/kg (high dosage group). Following this, the turtles went through a third phase, a recovery phase of 3 weeks during which they were fed uncontaminated food. Blood and feces were collected during the three phases of the experiment. The turtles were euthanized at the end of the experiment and organ samples collected. The Cd-concentrations in blood remained stable over the course of the experiment while Cd-concentrations in feces increased with time and the amount of Cd ingested. In terms of burden in the organs, the Cd-burden was the highest in liver followed by kidney and pancreas. The proportional accumulation decreased as Cd ingestion increased, suggesting that a higher dose of Cd, assimilation decreased. Accumulation of Cd had no effect on survival, food consumption, growth, weight or length suggesting no effect on the female turtle body condition. The study did not identify any toxicity endpoints.

- Burger et al (1998) studied the effects of **lead** on behavioral developments of hatchling slider turtles (*Trachemys scripta*) from the Savannah River Site, near Aiken, SC. Hatchlings from 1995 showed no significant differences in growth, survival, or behavior between control and lead-injected animals at a dose of 0.05 and 0.1 mg/g. In 1996, 48 hatchlings were divided into four groups and injected with 0 (control), 0.25, 1, or 2.5 mg/g lead. Few significant differences occurred in growth or size as a function of lead treatment at 4 months of age, but survival declined markedly as a function of lead dose. Righting response was significantly impaired by lead; time to right was directly related to lead dose. Size also affected behavior; larger hatchlings turned over more quickly and reached cover sooner than did smaller hatchlings. These experiments indicate that lead affects survival and behavior in hatchling turtles at doses in the range of 0.25 to 2.5 mg/g. Thus, these researchers indicate that the no effect level is 0.1 mg/g (100 mg/kg). The survival differences were dramatic in the experiments. At control and low levels of lead, nearly all of the hatchlings survived at 4 months, whereas at medium and high levels survival was low (25% and 0%), yielding an LD_{50} of 0.5 mg/g. Although significant, the behavioral differences were not large for the righting response test, and were nonexistent for the seeking cover test. Taken together, these experiments suggest that hatchling turtles are vulnerable to lead exposure, but that the threshold for behavioral effects in on the same order of magnitude as the LD_{50}. Weight was a significant contributor to the variations in righting and seeking cover behavior observed in these experiments. Larger animals responded sooner and were able to right themselves quicker than were smaller animals. Lead dose correlated negatively with weight, carapace length, and plastron length, indicating that with increased lead, animals grew more slowly. Taken altogether, the data suggest that lead at > 1 mg/g has a major effect on survival, a lesser effect on growth and a small but significant effect on the righting response (Burger et al., 1998).

- Overmann and Krajicek (1995) investigated the common snapping turtle (*Chelydra serpentine*) as a biomonitor of **lead** in a freshwater aquatic ecosystem. Snapping turtles are omnivorous and ingest a wide variety of food items. The benthic habitats of the turtles suggest that they would frequent areas of metal-rich sediments in lead-contaminated aquatic ecosystems. The snapping turtle is mobile, but relatively sedentary which would facilitate relation of tissue contaminant levels with a relatively localized area. Thirty-seven snapping turtles were collected from three sites on the Big River, an Ozarkian stream contaminated with lead mine tailings. Morphometric

measurements, tissue lead concentrations, δ-aminolevulinic acid dehydratase (δ-ALAD) activity, hematocrit, hemoglobin, plasma glucose, osmolality and chloride ion content was measured. δ-ALAD is an enzyme of the heme synthesis pathway and a sensitive indicator of lead exposure. The data showed no effects of lead contamination on capture success or morphological measurements. Tissue lead concentrations were related to capture location. Most hematological parameters were not different with respect to capture location. The δ-ALAD activity was decreased in turtles taken from contaminated sites. Lead levels in the Big River do not appear to be adversely affecting the snapping turtles of the river. The mean concentration of lead in tailings range from 1,000 to 3,000 mg/kg and the tailings vary in consistency from course sand to fine powder.

From the information available in the open literature, determination of a no effect level and low effect level via ingestion is not possible for arsenic, cadmium and lead. The following table saummarizes the available studies discussed for arsenic, cadmium and lead.

Test Species	Study Endpoint(s)	Dose	Reference
Arsenic			
Red Eared Slider Turtles	No effect on total body mass to carapace length and no arsenic detected in blood	None given	Clark, D.R, et al., 2000
Cadmium			
Red Eared Slider Turtles	No effect on survival, food consumption, growth, weight or length	0.95 mg/kg in food	Guirlet and Das, 2012
Lead			
Slider Turtles	Lowest value showing survival and behavior changes	250 mg/kg injection in leg muscle	Burger, 1998
Slider Turtles	No effects on survival or behavior	100 mg/kg injection in leg muscle	Burger, 1998
Common Snapping Turtle	Reduced δ-ALAD activity	1000 mg/kg in mine tailings in sediment	Overmann and Krajicek, 1995

The study for arsenic did not provide any dose or endpoint information. The study on cadmium recommends a no effect value of 0.95 mg/kg in food. This value could be modified as a dose but this value is similar to the benthic invertebrate sediment benchmark of 0.99 mg.kg. The applicability of a value in food when compared to a sediment value protective of benthics is unknown. The two studies for lead did not develop a no effect dose level in food.

The toxicity data are not available in the open literature for quantitative assessment of turtles in Stewart Creek. However, snapping turtles (*Chrlydra serpentine*), although primarily aquatic, are omnivorous eating vegetation, insects, crustacenas, clams, snails, fish, frogs salamanders, small turtles and algae (EPA, 1993). This diet is similar to the omnivorous diet of the raccoon assessed in this SLERA and given the uncertainties in an exposure model and in the toxicity data, the raccoon could be considered a

representative speices for snapping turtles. The red-eared slider and soft shell turtle eats aquatic plants, small fish, invertebrates and decaying material (TPWD, 2014, Herps of Texas, 2014). The use of the snowy egret which is modeled to eat benthic invertebrates and fish is adequatetly representative of aquatic turtles. This SLERA assumes that the benthic invertebrate PCL, water quality criteria assessments and risk analysis of the raccoon and egret will be protective of the reptiles found or potentially found in Stewart Creek.

6.6 Fish Tissue Analysis

The studies from Jarvinen and Ankley (1999) used to evaluate the sediment to fish pathway were chosen because they were flow-through and the analysis was of the whole body and not specific organs and would therefore be more relevant to conditions in Stewart Creek. However it is recognized that the fish species (i.e., rainbow trout and brook trout) are not the same species that would be found in Stewart Creek. Although neither rainbow nor brook trout would be present in Stewart Creek, no other species and studies that would provide an indication of toxicity that might be native in the North Texas are listed in Jarvinen and Ankley (1999). As such, these studies of trout were used in order to evaluate this pathway. It is not known how these tissue residue values used as indices of toxicity compare to native fish species that might reside in Stewart Creek. The BSAF values used to estimate the fish tissue concentations for lead and cadmium are based on bivalves and not on freshwater fish. Because bivalves would be more sedentary within the sediment and not mobile like a fish, the BSAF values are likely conservative. A BSAF of 0.162 was estimated for arsenic from EPA (2000). The geometric mean of BSAF values reported for a variety of fish species was calculated. The average and maximum measured sediment to fish accumulation factors for lead measured in the Calcasieu Estuary as part of an EPA Remedial Investigation was 0.006 to 0.02, respectively (CDM, 2002) indicating that the BSAF of 0.162 is likely conservative. Other sources of information, besides Jarvinen and Ankley (1999) on tissue concentrations are available, for instance, the Oregon Department of Environmental Quality (ODEQ) reports acceptable tissue levels for lead in fish tissue for the protection of birds ranges from 46.5 mg/kg dry weight to 230 mg/kg dry weight and for the protection of mammals ranges from 170 mg/kg dry weight to 850 mg/kg dry weight. The ODEQ lists the biota to sediment accumulation factor for lead to fish to be not applicable (ODEQ, 2007), which likely reflects the lack of accumulation potential for most metals, as well as the difficulty and variability when estimating the relationship between sediment and tissue concentrations for inorganic compounds. It is generally believed that the sediment to fish pathway is incomplete or not significant for lead because of the physio-chemical properties of inorganic lead (ATSDR, 2007). Based on the conditions of the creek, exposures to small forage fish may occur, but it is unlikely that significant populations of large predator fish

will be present in Stewart Creek particularly in the area of the creek near the FOP. As such, the sediment-to-fish pathway analysis likely overestimates risk to fish in Stewart Creek.

6.7 Simultaneous Exposure to Multiple Constituents

Another source of uncertainty originated from the use of toxicity values reported in the open literature that were derived from single-species, single-constituent laboratory studies. Prediction of ecosystem effects from laboratory studies is difficult. Laboratory studies cannot take into account the effects of environmental factors that may add to the effects of chemical stress. TRVs were selected from studies using single-constituent exposure scenarios. The endpoint species selected to represent the wildlife expected to occur within the exposure area were exposed to a variety of constituents, and it is not known whether the individual constituents in this mixture are synergistic, additive, or antagonistic. Therefore, the magnitude of this uncertainty is not measurable and risk could be overestimated or underestimated. Interactive effects were also not addressed and this could increase or decrease risk.

6.8 TRVs

TRVs are designed to be conservative estimates of potential toxicity based on a variety of measurement endpoints for various ecological receptors, typically in a laboratory setting using standard species that are commercially available. In the initial phase of the SLERA, NOAEL-based TRVs are used while in the refined less conservative HQ calculation of TCEQ Ecological Risk Assessment Required Element #7, LOAEL-based TRVs are used. It is important to evaluate the adequacy and validity of the TRV during the SLERA process since sometimes the conservatism built into the TRV-derivation process limits the usefulness of the value. For example, the avian TRV for lead results in an Eco-SSL that is near background levels of lead in soil. This limitation is discussed by EPA (2005b): “The eco SSL for avian wildlife is however lower than the 50th percentile for reported background concentrations in eastern and western U.S. soils.” If the data used in the evaluation (EPA, 2005b) are inspected closer, the variability in the numerous studies and the conservative assumptions used to select the TRV result in a value that is not representative of the majority of the NOAELs for the compound. Again, using lead as an example, the range of TRVs looking at all NOAEL endpoints and species is from 0.0584 mg/kg-day to 304 mg/kg-day, which is a 10,000-fold difference. Often the geometric mean of the dataset is used to estimate the TRV but, in the case of lead, the lowest LOAEL value was lower than the geometric mean for the NOAEL (10.9 mg/kg-day) so the NOAEL-based TRV was set at a lower value which was more than 1/10th of the geometric mean. It should be noted that the range of LOAELs were highly variable as well, from 0.111 to 625 mg/kg-day, and the LOAEL-based TRV used in this risk assessment of 3.6 mg/kg-day is lower than the geometric mean of the NOAELs. Because the TRV is very influential in the calculation of HQs, it is extremely important to

evaluate sources of uncertainty and variability in these values. It is likely that the conservative nature of the TRV selected for use in the SLERA will overestimate potential risk to birds and mammals.

6.9 Benthic PCLs

The benthic PCLs are the midpoint between the benchmark and the second effects levels presented in TCEQ, 2014. The benchmarks and second effects levels correspond to threshold effect concentrations and probable effects concentrations developed by MacDonald et al, (2000) and Ingersoll et al, (2000). These researchers developed a database from 92 published reports for sediment toxicity and reviewed the various studies for sediment chemistry, toxicity test used, species tested and endpoint. The threshold effect concentrations and probable effects concentrations were calculated by determining a geometeric mean of the published sediment quality guidelines for each category once the review had been completed . Although the researchers designated the toxicty thresholds for arsenic, cadmium and lead as “reliable” because there were more than 20 samples used to determine the effect concentrations, the values are not specific to Stewart Creek and there is some uncertainty about applying these look up criteria to a specific aquatic system.

6.10 Bioavailability and Absorption

The bioavailability and absorption of arsenic, cadmium and lead was conservatively assumed to be 100 % in the SLERA. There were no adjustment factors to account for arsenic, cadmium or lead binding irreversibly onto sediment particles, for being present in a form that is not biologically available or active, or to account for the differences in the absorption between the test material that serves as the basis for the TRV for soil and Site sediment. Sediment geochemical parameters such as the quantity and type/quality of organic carbon, the presence of acid volatile sulfides, the redox state of the sediment, salinity or pH can influence whether a constituent is tightly bound within the sediment and unavailable for uptake or whether it is freely dissolved and can be absorbed into organisms (ITRC, 2011).

The TOC of the North Tributary and on-site Stewart Creek is low (< 1 % to 9 %) (Table 2) and is generally lower downstream of the FOP (Tables 3 and 4). The grain size of the sediment tends toward larger sizes such as gravel and sand and not the silt or clay (Table 5). The influence of the organic carbon, grain size and other site specific conditions in the North Tributary and Stewart Creek on arsenic, cadmium and lead availability is not known, but the presence of organic carbon in sediments suggests that Site conditions would likely result in less than 100% bioavailability of arsenic, cadmium and lead to ecological receptors. Thus the assumption of 100 % bioavailability will result in the overestimation of risk in this SLERA. The influence of organic carbon or sulfide is unknown and the presence of these factors could further reduce the bioavailability of the arsenic, cadmium and lead in Stewart Creek sediments.

6.11 Surface Water Exposure

This SLERA assumes that sediment exposure is the primary exposure pathway and does not include a surface water exposure component. The detected concentrations of the dissolved arsenic, cadmium and lead in surface water collected in 2014 and using the most sensitive analytical method were below the aquatic criteria. The raccoon diet was adjusted to 60 % benthic invertebrates, 30 % fish and 10 % plants to focus on sediment exposure and does not include an aquatic insect or amphibian exposure component (i.e., modeled tissue concentrations from surface water). Because the detections of arsenic, cadmium and in the surface water are consistently below the chronic criteria, ecological risks from exposure to surface water is believed to be within acceptable ranges.

6.12 Availablility of Nearby Aquatic Resources

Stewart Creek is one of several freshwater urban creeks in Collin and Denton Counties that provides aquatic habitat. Figure 4 in Appendix C shows where the special status mussel species the Texas healsplitter has been noted to occur in relation to Stewart Creek and Lake Lewisville. This figures shows numerous coves and channels which feed into Lake Lewisville and provide aquatic habitat for a variety of species. Based on the habitat evaluation presented in Appendix C, Stewart Creek does not provide any unique or specialized habitat. The proximity of Lake Lewisville and associated wetlands provides significant and nearby aquatic habitat to Stewart Creek.

7.0 PCL CALCULATIONS AND SLERA RECOMMENDATIONS

TCEQ's Ecological Risk Assessment Required Element #9 is the calculation of medium-specific PCLs bounded by the NOAEL and LOAEL (i.e., comparative PCLs) for those COCs that are not eliminated as a result of the HQ analysis or uncertainty analysis.

In accordance with the evaluation described herein based on TCEQ guidance, this SLERA does not indicate adverse risk due to ecological exposures of cadmium and lead in sediment, groundwater or surface water at the FOP and downstream. This conclusion is based on the overall low HQs estimated for the various receptors and media at the Site. Arsenic is present at a concentration slightly greater than the benthic PCL when the 95% UCL is used to represent the exposure point concentration for upstream of the FOP and downstream of the FOP. According to TCEQ (2014) the benthic invertebrate population in areas upstream and downstream of the FOP could be at risk from exposure to arsenic based on the data comparisons to the benthic PCL. As discussed previously, it is probable that products containing arsenic were used in the area around the FOP and that the arsenic detected in the Stewart Creek sediments is sourced from agricultural products. Additionally, arsenic exceedances in sediment are not always co-located with lead and cadmium exceedances suggesting that the source of the arsenic is not associated with the source of the lead and cadmium.

TCEQ's Ecological Risk Assessment Required Element #10 is the recommendation for managing ecological risk if it is determined that there is unacceptable risk and ecological PCLs are developed in the SLERA. The only ecologically based sediment PCL based on this SLERA would be the benthic PCL of 21.4 mg/kg for arsenic for the protection of the benthic population.

This SLERA included evaluation of two hot spots which were associated with chip and slag material. As described in Section 3.2.2 (Risk Management for Benthic Hot Spots) in TCEQ 2013d "by definition, hot spots present an unacceptable risk to the benthic community. Therefore, if hot spots are identified within the benthic expsoure area, persons should recommend appropriate risk management practices." The Response Action Plan for Stewart Creek will utilize the data presented in this SLERA, but also additional data recently collected, but not available for evaluation in this SLERA. Note that the slag documented by W&M (2011) on the banks of the western reach of Stewart Creek will be removed as part of the Site remediation. Additionally slag, battery chips and potential slag will be removed from Stewart Creek downstream of the FOP.

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TABLES

Table 1. Summary of Surface Water Data for Stewart Creek and North Tributary
Screening Level Ecological Risk Assessment

Sample I.D.	Analytical Method	Sample Date	Total Metals			Dissolved Metals		
			Arsenic (mg/L)	Cadmium (mg/L)	Lead (mg/L)	Arsenic (mg/L)	Cadmium (mg/L)	Lead (mg/L)
Stewart Creek								
Chronic Aquatic Life RBEL[1]			**NA**	**NA**	**NA**	**0.15**	**0.000256**	**0.00268**
Upstream of the Former Operating Plant								
2014-SW-002	SW6010B	1/29/2014	< 0.00328 U	< 0.000350 U	< 0.00290 U	< 0.00328 U	< 0.000350 U	< 0.00290 U
2014-SW-002	SW6020A	1/29/2014	< 0.00130 U	< 0.0000950 U	< 0.000200 U	< 0.00130 U	< 0.0000950 U	< 0.000200 U
2014-SW-007	SW6010B	1/31/2014	< 0.00328 U	< 0.000350 U	< 0.00290 U	< 0.00328 U	< 0.000350 U	< 0.00290 U
2014-SW-007	SW6020A	1/31/2014	< 0.00130 U	< 0.0000950 U	**0.000240 J**	< 0.00130 U	< 0.0000950 U	< 0.000200 U
2014-SW-008	SW6010B	1/31/2014	< 0.00328 U	< 0.000350 U	< 0.00290 U	< 0.00328 U	< 0.000350 U	< 0.00290 U
2014-SW-008	SW6020A	1/31/2014	< 0.00130 U	< 0.0000950 U	**0.000365 J**	< 0.00130 U	< 0.0000950 U	< 0.000200 U
2014-SW-009	SW6010B	1/31/2014	< 0.00328 U	< 0.000350 U	< 0.00290 U	< 0.00328 U	< 0.000350 U	< 0.00290 U
2014-SW-009	SW6020A	1/31/2014	< 0.00130 U	< 0.0000950 U	< 0.000200 U	< 0.00130 U	< 0.0000950 U	< 0.000200 U
2014-SW-010	SW6010B	1/31/2014	< 0.00328 U	< 0.000350 U	< 0.00290 U	< 0.00328 U	< 0.000350 U	< 0.00290 U
2014-SW-010	SW6020A	1/31/2014	< 0.00130 U	< 0.0000950 U	**0.000420 J**	< 0.00130 U	< 0.0000950 U	**0.000235 J**
2014-SW-011	SW6010B	1/31/2014	< 0.00328 U	< 0.000350 U	< 0.00290 U	< 0.00328 U	< 0.000350 U	< 0.00290 U
2014-SW-011	SW6020A	1/31/2014	< 0.00130 U	< 0.0000950 U	< 0.000200 U	< 0.00130 U	< 0.0000950 U	< 0.000200 U
2014-SW-012	SW6010B	1/31/2014	< 0.00328 U	< 0.000350 U	< 0.00290 U	< 0.00328 U	< 0.000350 U	< 0.00290 U
2014-SW-012	SW6020A	1/31/2014	< 0.00130 U	< 0.0000950 U	< 0.000200 U	< 0.00130 U	< 0.0000950 U	< 0.000200 U
2014-SW-013	SW6010B	1/31/2014	< 0.00328 U	< 0.000350 U	< 0.00290 U	< 0.00328 U	< 0.000350 U	< 0.00290 U
2014-SW-013	SW6020A	1/31/2014	< 0.00130 U	< 0.0000950 U	**0.000390 J**	< 0.00130 U	< 0.0000950 U	< 0.000200 U
2014-SW-014	SW6010B	1/31/2014	< 0.00328 U	< 0.000350 U	< 0.00290 U	< 0.00328 U	< 0.000350 U	< 0.00290 U
2014-SW-014	SW6020A	1/31/2014	< 0.00130 U	< 0.0000950 U	**0.000450 J**	< 0.00130 U	< 0.0000950 U	**0.000315 J**
2014-SW-015	SW6010B	1/31/2014	< 0.00328 U	< 0.000350 U	< 0.00290 U	< 0.00328 U	< 0.000350 U	< 0.00290 U
2014-SW-015	SW6020A	1/31/2014	< 0.00130 U	< 0.0000950 U	**0.000325 J**	< 0.00130 U	< 0.0000950 U	< 0.000200 U
On-Site								
2012-SW-1	SW6010B	1/17/2012	--	**0.001J**	< 0.00290 U	--	**0.0019J**	**0.0046J**
2012-SW-2	SW6010B	1/17/2012	--	**0.0009J**	< 0.00290 U	--	**0.002J**	**0.0037J**
2012-SW-3	SW6010B	1/17/2012	--	< 0.000350 U	< 0.00290 U	--	< 0.000350 U	< 0.00290 U
2012-SW-4	SW6010B	1/17/2012	--	< 0.000350 U	< 0.00290 U	--	< 0.000350 U	< 0.00290 U
2012-SW-5	SW6010B	1/17/2012	--	< 0.000350 U	< 0.00290 U	--	< 0.000350 U	< 0.00290 U
2012-SW-6	SW6010B	1/17/2012	--	< 0.000350 U	< 0.00290 U	--	< 0.000350 U	< 0.00290 U
2012-SW-7	SW6010B	1/17/2012	--	< 0.000350 U	**0.0032J**	--	< 0.000350 U	< 0.00290 U
2012-SW-8	SW6010B	1/17/2012	--	< 0.000350 U	**0.0036J**	--	< 0.000350 U	< 0.00290 U
2012-SW-9	SW6010B	1/17/2012	--	< 0.000350 U	< 0.00290 U	--	< 0.000350 U	< 0.00290 U
2012-SW-10	SW6010B	1/17/2012	--	< 0.000350 U	< 0.00290 U	--	< 0.000350 U	< 0.00290 U
2012-SW-11	SW6010B	1/17/2012	--	< 0.000350 U	< 0.00290 U	--	**0.0006J**	< 0.00290 U
2012-SW-12	SW6010B	1/17/2012	--	< 0.000350 U	< 0.00290 U	--	< 0.000350 U	< 0.00290 U
2012-SW-13	SW6010B	1/17/2012	--	< 0.000350 U	< 0.00290 U	--	< 0.000350 U	< 0.00290 U
2014-SW-016	SW6010B	1/31/2014	< 0.00328 U	< 0.000350 U	< 0.00290 U	< 0.00328 U	< 0.000350 U	< 0.00290 U
2014-SW-016	SW6020A	1/31/2014	< 0.00130 U	< 0.0000950 U	< 0.000200 U	< 0.00130 U	< 0.0000950 U	< 0.000200 U
2014-SW-017	SW6010B	1/31/2014	< 0.00328 U	< 0.000350 U	< 0.00290 U	< 0.00328 U	< 0.000350 U	< 0.00290 U
2014-SW-017	SW6020A	1/31/2014	< 0.00130 U	< 0.0000950 U	**0.000990 J**	< 0.00130 U	< 0.0000950 U	**0.000350 J**
2014-SW-018	SW6010B	1/31/2014	< 0.00328 U	< 0.000350 U	< 0.00290 U	< 0.00328 U	< 0.000350 U	< 0.00290 U
2014-SW-018	SW6020A	1/31/2014	< 0.00130 U	< 0.0000950 U	**0.000585 J**	< 0.00130 U	< 0.0000950 U	**0.000255 J**
2014-SW-019	SW6010B	1/31/2014	< 0.00328 U	< 0.000350 U	< 0.00290 U	< 0.00328 U	< 0.000350 U	< 0.00290 U
2014-SW-019	SW6020A	1/31/2014	< 0.00130 U	< 0.0000950 U	**0.00133 J**	< 0.00130 U	< 0.0000950 U	< 0.000200 U
2014-SW-020	SW6010B	1/31/2014	< 0.00328 U	< 0.000350 U	< 0.00290 U	< 0.00328 U	< 0.000350 U	< 0.00290 U
2014-SW-020	SW6020A	1/31/2014	< 0.00130 U	< 0.0000950 U	**0.00174**	< 0.00130 U	< 0.0000950 U	**0.000310 J**
2014-SW-021	SW6010B	1/31/2014	< 0.00328 U	< 0.000350 U	< 0.00290 U	< 0.00328 U	< 0.000350 U	< 0.00290 U
2014-SW-021	SW6020A	1/31/2014	< 0.00130 U	< 0.0000950 U	**0.000635 J**	< 0.00130 U	< 0.0000950 U	**0.000850 J**
Downstream of the Former Operating Plant								
2014-SW-001	SW6010B	1/28/2014	< 0.00328 U	< 0.000350 U	< 0.00290 U	< 0.00328 U	< 0.000350 U	< 0.00290 U
2014-SW-001	SW6020A	1/28/2014	< 0.00130 U	< 0.0000950 U	**0.000310 J**	< 0.00130 U	< 0.0000950 U	**0.000205 J**
2014-SW-003	SW6010B	1/29/2014	< 0.00328 U	< 0.000350 U	< 0.00290 U	< 0.00328 U	< 0.000350 U	< 0.00290 U
2014-SW-003	SW6020A	1/29/2014	< 0.00130 U	< 0.0000950 U	**0.00142 J**	< 0.00130 U	< 0.0000950 U	**0.000250 J**
2014-SW-004	SW6010B	1/29/2014	< 0.00328 U	< 0.000350 U	< 0.00290 U	< 0.00328 U	< 0.000350 U	< 0.00290 U
2014-SW-004	SW6020A	1/29/2014	< 0.00130 U	< 0.0000950 U	**0.000655 J**	< 0.00130 U	< 0.0000950 U	< 0.000200 U
2014-SW-005	SW6010B	1/29/2014	< 0.00328 U	< 0.000350 U	< 0.00290 U	< 0.00328 U	< 0.000350 U	< 0.00290 U
2014-SW-005	SW6020A	1/29/2014	< 0.00130 U	< 0.0000950 U	**0.00103 J**	< 0.00130 U	< 0.0000950 U	**0.000205 J**
2014-SW-006	SW6010B	1/30/2014	< 0.00328 U	< 0.000350 U	< 0.00290 U	< 0.00328 U	< 0.000350 U	< 0.00290 U
2014-SW-006	SW6020A	1/30/2014	< 0.00130 U	< 0.0000950 U	**0.000440 J**	< 0.00130 U	< 0.0000950 U	**0.000240 J**
2014-SW-023	SW6020A	3/18/2014	< 0.00130 U	< 0.0004775 U *	< 0.000200 U	< 0.00130 U	**0.000204 J**	**0.000247 J**

Table 1. Summary of Surface Water Data for Stewart Creek and North Tributary
Screening Level Ecological Risk Assessment

Sample I.D.	Analytical Method	Sample Date	Total Metals			Dissolved Metals		
			Arsenic (mg/L)	Cadmium (mg/L)	Lead (mg/L)	Arsenic (mg/L)	Cadmium (mg/L)	Lead (mg/L)
2014-SW-026	SW6020A	4/15/2014	**0.00168 J**	**0.000107 J**	**0.000530 J**	**0.00171 J**	**0.0000998 J**	< 0.000200 U
2014-SW-028	SW6020A	4/16/2014	**0.00130 J**	**0.000136 J**	**0.000324 J**	**0.00151 J**	< 0.0000950 U	< 0.000200 U
Downstream Tributaries								
2014-SW-022	SW6020A	3/18/2014	< 0.00130 U	< 0.0004775 U *	**0.000812 J**	< 0.00130 U	**0.000217 J**	< 0.000200 U
2014-SW-024	SW6020A	3/19/2014	< 0.00130 U	< 0.0000950 U	**0.000286 J**	< 0.00130 U	< 0.0000950 U	< 0.000200 U
2014-SW-025	SW6020A	3/19/2014	< 0.00130 U	< 0.0000950 U	**0.000421 J**	< 0.00130 U	< 0.0000950 U	< 0.000200 U
2014-SW-027	SW6020A	4/15/2014	**0.00393**	< 0.0000950 U	**0.00105 J**	**0.00311**	< 0.0000950 U	< 0.000200 U
2014-SW-029	SW6020A	4/16/2014	**0.00185 J**	< 0.0000950 U	**0.000279 J**	**0.00194 J**	< 0.0000950 U	**0.000475 J**
North Tributary								
Acute Aquatic Life RBEL[1]			**NA**	**NA**	**NA**	**0.34**	**0.00908**	**0.0688**
SW-NT-1	SW6010B	3/20/2013	--	<0.00035	<0.0029	--	<0.00035	<0.0029
SW-NT-2	SW6010B	3/20/2013	--	<0.00035	<0.0029	--	<0.00035	<0.0029
SW-NT-3	SW6010B	3/20/2013	--	<0.00035	<0.0029	--	<0.00035	<0.0029
SW-NT-4	SW6010B	3/20/2013	--	<0.00035	<0.0029	--	<0.00035	<0.0029
SW-NT-5	SW6010B	3/20/2013	--	<0.00035	<0.0029	--	<0.00035	<0.0029
SW-NT-6	SW6010B	3/20/2013	--	<0.00035	<0.0029	--	<0.00035	<0.0029
SW-NT-7	SW6010B	3/20/2013	--	<0.00035	<0.0029	--	<0.00035	<0.0029
SW-NT-8	SW6010B	3/20/2013	--	<0.00035	<0.0029	--	<0.00035	<0.0029
SW-NT-9	SW6010B	3/20/2013	--	<0.00035	<0.0029	--	**0.00044J**	<0.0029
SW-NT-10	SW6010B	3/20/2013	--	<0.00035	<0.0029	--	<0.00035	<0.0029

Notes:

1. RBELs for cadmium and lead calculated based on a hardness value of 106 mg/L for Lake Lewisville Segment 0823 per Implementation Guidance (TCEQ, 2012).
2. RBEL - Risk Based Exposure Limit. The RBEL is used as the benchmark.
3. Acute and chronic freshwater benchmarks from TCEQ, 2011.
4. mg/L - milligrams/Liter
5. Data Qualifiers: J = estimated concentration. U = Analyte not detected. * analyte detected in field blank; sample result became non-detect at less than five times the field blank concentration.
6. < - Indicates analyte not detected above sample detection limit (SDL).
7. NA - Not Applicable
8. "--" - Not Analyzed
9. Detected analytes are bolded. No exceedances of aquatic criteria.

Table 2. Summary of Upstream and On-Site Sediment Data for Stewart Creek and North Tributary
Screening Level Ecological Risk Assessment

Sample I.D.	Sample Date	Metals (mg/Kg)			Total Organic Carbon (%)
		Arsenic	Cadmium	Lead	
Freshwater Sediment Benchmark		**9.79**	**0.99**	**35.8**	**NA**
Freshwater Sediment Benthic PCL		**21.4**	**3**	**82**	**NA**
Stewart Creek					
Upstream of the Former Operating Plant					
2014-SED-026	1/31/2014	8.55	0.358	11.5	1.07
2014-SED-027	1/31/2014	14.3	0.281 J	16.4	1.57
2014-SED-028	1/31/2014	10.3	0.392 J	13.5	4.44
2014-SED-029	1/31/2014	13.4	0.260 J	12.0	1.04
2014-SED-030	1/31/2014	20.3	0.691 J	14.0	0.834
2014-SED-031	1/31/2014	12.5	0.588	11.3	0.806
2014-SED-032	1/31/2014	15.2	0.386	8.99	0.736
2014-SED-033	1/31/2014	10.5	0.331	6.56	0.959
2014-SED-034	1/31/2014	11.7	0.488	9.35	0.986
2014-SED-035	1/31/2014	42.7	0.612	19.8	1.52
On-Site					
2012-SED-1	1/11/2012	--	0.34 J	7.09 J-	0.48
2012-SED-2	1/11/2012	--	0.79 J-	15.10 J-	0.53
2012-SED-3	1/11/2012	--	1.40 J-	17.10 J-	0.74
2012-SED-4	1/11/2012	--	2.08 J-	14.90 J-	1.32
2012-SED-5	1/11/2012	--	1.43 J-	10.90 J-	9.23
2012-SED-6	1/11/2012	--	1.03 J-	10.40 J-	7.14
2012-SED-7	1/11/2012	--	0.84 J-	10.40 J-	6.93
2012-SED-8	1/11/2012	--	0.86 J-	8.99 J-	7.15
2012-SED-9	1/11/2012	--	0.79 J-	11.50 J-	8.98
2012-SED-10	1/12/2012	--	0.90 J-	6.57 J	0.70
2012-SED-11	1/12/2012	--	0.77 J-	8.82 J	1.00
2012-SED-12	1/12/2012	--	0.72 J-	17.70 J	1.07
2012-SED-13	1/12/2012	--	1.05 J-	19.20 J	0.378 J
North Tributary					
2012-SED-16	1/12/2012	--	1.19 J-	17.80 J	0.96
2012-SED-17	1/12/2012	--	0.78 J-	28.20 J	1.39
2012-SED-18	1/12/2012	--	0.82 J-	20.10 J	--
2012-SED-19	1/12/2012	--	0.98 J-	23.40 J	1.51
2012-SED-20	1/12/2012	--	0.69 J-	12.10 J	2.21
2012-SED-21	1/12/2012	--	1.10 J-	10.40 J	3.26
2012-SED-22	1/12/2012	--	1.06 J-	10.40 J	2.65
2012-SED-23	1/12/2012	--	0.99 J-	11.10 J	4.24
2012-SED-24	1/12/2012	--	0.74 J-	19.70 J	0.87
2012-SED-25	1/12/2012	--	0.83 J-	11.90 J	3.55

Notes:

1. mg/Kg - milligrams/Kilogram
2. Data Qualifiers: J = estimated concentration; J- = estimated, biased low.
3. NA - Not Applicable
4. "--" - Not Analyzed
5. Freshwater benchmarks and midpoint benthic PCLs from TCEQ (2014).
6. Shading indicates concentration greater than benthic PCL.

Table 3. Summary of Downstream Sediment Data for Stewart Creek Collected in 2010, 2011 and 2013
Screening Level Ecological Risk Assessment

Sample I.D.	Hot Spot	Sample Date	Metals (mg/Kg)			Selenium	Total Organic Carbon (%)
			Arsenic	Cadmium	Lead		
Freshwater Sediment Benchmark			**9.79**	**0.99**	**35.80**	**NA**	**NA**
Freshwater Sediment Benthic PCL			**21.4**	**3**	**82**	**NA**	**NA**
CS-1	1	10/27/2010	25.2	6.96	34.6	--	--
CS-2	1	10/27/2010	23.2	<0.87	32.3	--	--
CS-3	1	10/27/2010	23.2	<1.03	175	--	--
CS-4	1	10/27/2010	17.8	<0.99	43.7	--	--
CS-5	1	10/27/2010	13	<1.00	14	--	--
CS-8	1	10/27/2010	26.5	2.52	--	--	--
SC-Sed 1	1	11/18/2011	11.9	0.61	38.2	<1.09	--
SC-Sed 2	1	11/18/2011	11.2	0.75	46.9	<1.15	--
SC-Sed 3	1	11/18/2011	18.6	2.01	63.8	<1.06	--
SC-Sed 4	1	11/18/2011	12.0	0.95	39.1	<1.09	--
SC-Sed 5	1	11/17/2011	14.4	0.9	397	<1.20	--
SC-Sed 6	1	11/17/2011	16.2	1.05	307	<1.08	--
SC-Sed 7	1	11/17/2011	16.1	0.54	35.6	<1.07	--
SC-Sed 8	1	11/17/2011	47.2	0.96	35.2	<1.10	--
SC-Sed 9	1	11/17/2011	20.5	4.16	162	<1.06	--
SC-Sed 10	1	11/17/2011	12.3	0.72	22.5	<1.01	--
SC-Sed 11	1	11/17/2011	29.4	1.11	46.8	<1.02	--
SC-Sed 12	NA	11/18/2011	11.3	0.79	56.7	<1.26	--
SC-Sed 13	NA	11/18/2011	31.1	0.84	33.7	<1.00	--
SC-Sed 14	NA	11/18/2011	12.7	0.79	27.7	<0.97	--
SC-Sed 15	NA	11/18/2011	12.9	1.54	35.3	<1.01	--
SC-Sed 16	NA	11/18/2011	14.6	1.49	59	<1.00	--
SC-Sed 17	NA	11/18/2011	18.3	1.19	43.1	<0.97	--
SC-Sed 18	NA	11/18/2011	8.1	0.43	20.5	<0.91	--
SC-Sed 19	NA	11/18/2011	19.5	1.47	37.6	<1.18	--
SC-Sed 20	NA	11/18/2011	17.4	1.07	38.5	<1.03	--
SC-Sed 21	NA	11/18/2011	18.0	2.19	49.5	<0.96	--
SC-Sed 22	NA	11/18/2011	19.2	2.01	53.2	<0.93	--
SC-Sed 23	NA	11/18/2011	16.1	3.69	34.2	<1.15	--
SC-Sed 24	NA	11/18/2011	32.1	2.00	49.5	<1.03	--
SC-Sed 25	NA	11/18/2011	15.1	1.03	21.6	<1.07	--
SC-Sed 26	NA	11/18/2011	16.5	0.87	30.1	<1.07	--
SC-Sed 27	NA	11/18/2011	14.3	1.09	31.8	<1.00	--
SC-Sed 28	NA	11/18/2011	14.1	1.23	29	<0.96	--
SC-Sed 29	NA	11/18/2011	18.2	1.75	35.9	<1.00	--
SC-Sed 30	NA	11/18/2011	18.5	2.41	31.3	<0.98	--
SC-Sed-31	NA	6/12/2013	19.2	0.38	12.7	--	0.0033
SC-Sed-32	NA	6/12/2013	19.3	0.64	12.3	--	0.00187
SC-Sed-33	NA	6/12/2013	18.5	0.42	14.6	--	0.00343
SC-Sed-34	NA	6/12/2013	16	0.67	14.3	--	0.00201
SC-Sed-35	NA	6/12/2013	17.8	0.45	13	--	0.00219
SC-Sed-36	NA	6/12/2013	17.7	0.61	11.5	--	0.00628
SC-Sed-37	NA	6/12/2013	16.2	0.57	12.1	--	0.00286
SC-Sed-38	NA	6/12/2013	12.7	0.33	9.7	--	0.00258
SC-Sed-39	NA	6/12/2013	11.6	0.47	10.6	--	0.00511
SC-Sed-40	NA	6/12/2013	7.0	0.16	12.9	--	0.00384
SC-Sed-41	NA	6/19/2013	24.9	0.35	13.1	--	0.00405
SC-Sed-42	NA	6/19/2013	10.8	0.35	8.6	--	0.00326
SC-Sed-43	NA	6/19/2013	20.1	1.5	14.3	--	0.00175
SC-Sed-44	2	6/19/2013	12.8	0.39	12.1	--	0.00119
SC-Sed-45	2	6/19/2013	14.0	1.7	11.4	--	0.00128
SC-Sed-46	2	6/19/2013	26.1	1.1	11.8	--	0.00196
SC-Sed-47	2	6/19/2013	16.9	1.2	19.6	--	0.00176
SC-Sed-48	2	6/19/2013	24.8	2.4	13.8	--	0.00156

Table 3. Summary of Downstream Sediment Data for Stewart Creek Collected in 2010, 2011 and 2013
Screening Level Ecological Risk Assessment

Sample I.D.	Hot Spot	Sample Date	Metals (mg/Kg)			Selenium	Total Organic Carbon (%)
			Arsenic	Cadmium	Lead		
Freshwater Sediment Benchmark			**9.79**	**0.99**	**35.80**	**NA**	**NA**
Freshwater Sediment Benthic PCL			**21.4**	**3**	**82**	**NA**	**NA**
Samples Associated with Chips, Potential Slag or Slag (see notes 9 - 12)							
Chip (6-21)-1 Base Comp	2	6/21/2013	17.7	0.87	13.3	--	--
Chip (6-21)-2 Base Comp	2	6/21/2013	12.3	0.54	9.5	--	--
PS (6-21)-1 Base Comp	2	6/21/2013	25.2	4.2	89	--	--
PS (6-21)-2 Base Comp	2	6/21/2013	44.6	0.52	9.7	--	--
Chip (6-20)-2 Base Comp	NA	6/20/2013	10.6	0.62	8.2	--	--
Chip (6-24)-3 Base Comp	NA	6/24/2013	9.2	1.1	27.7	--	--
Chip (6-24)-3 Comp	NA	6/24/2013	11.5	1.4	32.6	--	--
Chip (6-24)-3 SED	NA	6/24/2013	10.4	0.79	39.3	--	--
Chip (6-24)-3 Wall Base	NA	6/24/2013	8.1	0.92	15.7	--	--
Chip (6-24)-4 Base Comp	NA	6/24/2013	9.2	0.63	15.3	--	--
Chip (6-24)-5 Base Comp	1	6/24/2013	8.9	0.63	76.7	--	--
PS (6-24)-3 Base Comp	NA	6/24/2013	11.8	0.82	13.6	--	--
Slag (6-24)-1 Base	1	6/24/2013	16.4	0.56	17.8	--	--
Slag (6-24)-2 Base	1	6/24/2013	279	< 0.040	459	--	--

Notes:
1. Samples SC-Sed 1 through SC-Sed 11 located north of the Dallas North Tollway and are considered part of Hot Spot #1.
2. 2010 data collected by Pastor, Behling and Wheeler in support of FSCWWTP investigation.
3. 2011 data collected by Southwest Geoscience (SWG, 2013a).
4. 2013 data collected by Southwest Geoscience (SWG, 2014).
5. mg/kg - milligrams/kilogram (all values in dry weight)
6. NA = Not Applicable.
7. "--" - Not Analyzed
8. Freshwater benchmarks and midpoint benthic PCLs from TCEQ (2014).
9. Base - discrete sample collected directly beneath the Chip. Slag or Potential Slag (SWG, 2014).
10. Comp - composite sample collected from beneath Chips, Slag or Potential Slag or contained multiple chips (SWG, 2014).
11. SED - discrete sample collected from sediment beneath the base at the water interface (SWG, 2014).
12. Wall - discrete sample collected futher down the feature beneath the base but above the SED sample (SWG, 2014).
13. Two hot spots are identified in Stewart Creek and those data points included in one of the two hot spots are noted by a #1 or #2. (See Figure 4 for locations of hot spots)
14. Shading indicates concentration greater than benthic PCL.

Table 4. Summary of Downstream Sediment Data for Stewart Creek Collected in 2014
Screening Level Ecological Risk Assessment

Sample I.D.	Hot Spot	Sample Date	Metals (mg/Kg)			Total Organic Carbon (%)
			Arsenic	Cadmium	Lead	
Freshwater Sediment Benchmark			**9.79**	**0.99**	**35.8**	**NA**
Freshwater Sediment Benthic PCL			**21.4**	**3**	**82**	**NA**
Stewart Creek						
2014-SED-001	NA	1/28/2014	10.2 J	0.298 J	15.8	2.26
2014-SED-002	NA	1/28/2014	8.31 J	0.503	20.5	3.22
2014-SED-003	NA	1/28/2014	57.7 J	0.956	19.5	0.568
2014-SED-004	NA	1/28/2014	29.7 J	1.03	28.2	0.473
2014-SED-005	NA	1/28/2014	27.2 J	0.981	25.3	0.806
2014-SED-006	NA	1/28/2014	11.2 J	0.371	11.3	0.496
2014-SED-007	NA	1/28/2014	20.4 J	0.892	16.0	0.854
2014-SED-008	NA	1/28/2014	47.5 J	1.05	23.8	0.600
2014-SED-009	NA	1/28/2014	42.9 J	0.920	20.5	0.357
2014-SED-010	NA	1/28/2014	31.1 J	1.00	16.3	0.959
2014-SED-011	NA	1/28/2014	37.4 J	2.42	17.0	0.611
2014-SED-012	NA	1/28/2014	22.0 J	1.03	15.9	0.591
2014-SED-013	NA	1/28/2014	12.0 J	0.510	16.0	1.18
2014-SED-014	1	1/29/2014	12.0 J	0.439 J	25.0	0.825
2014-SED-015	1	1/29/2014	22.0	0.522	32.9	0.684
2014-SED-016	1	1/29/2014	29.6	0.458	26.2	0.406
2014-SED-017	1	1/29/2014	20.6	0.660	30.1	0.532
2014-SED-018	1	1/29/2014	20.2	0.556	59.8	1.28
2014-SED-019	NA	1/30/2014	10.0 J	1.25	47.3	1.34
2014-SED-020	NA	1/30/2014	15.0	1.77	26.0	0.355
2014-SED-021	NA	1/30/2014	25.6	4.09	40.6	0.412
2014-SED-022	NA	1/30/2014	11.6	0.301 J	11.7	0.910
2014-SED-023	NA	1/30/2014	31.2	1.64	24.6	0.269
2014-SED-024	NA	1/30/2014	25.4	1.28	15.7	0.246
2014-SED-025	NA	1/30/2014	14.8	3.03	15.1	0.874
2014-SED-036	NA	3/18/2014	42.8	0.690	34.2	3.02
2014-SED-038	NA	3/18/2014	11.6	0.378	21.4	0.894
2014-SED-039	NA	3/18/2014	25.0	1.90	18.7	0.231
2014-SED-040	NA	3/18/2014	49.2	1.01	17.5	0.401
2014-SED-041	NA	3/18/2014	41.8	1.13	19.0	0.287
2014-SED-042	NA	3/18/2014	31.4	0.870	20.7	0.193
2014-SED-043	NA	3/18/2014	28.2	0.895	28.6	0.556
2014-SED-044	NA	3/18/2014	11.3	0.501	24.8	1.79
2014-SED-045	NA	3/18/2014	19.2	1.01	19.1	0.433
2014-SED-046	NA	3/18/2014	26.6	4.47	19.6	0.273
2014-SED-048	2	3/19/2014	26.6	1.61	31.8	0.441
2014-SED-050	NA	4/15/2014	29.6	1.07	21.2 b	0.357

Table 4. Summary of Downstream Sediment Data for Stewart Creek Collected in 2014
Screening Level Ecological Risk Assessment

Sample I.D.	Hot Spot	Sample Date	Metals (mg/Kg)			Total Organic Carbon (%)
			Arsenic	Cadmium	Lead	
Freshwater Sediment Benchmark			**9.79**	**0.99**	**35.8**	**NA**
Freshwater Sediment Benthic PCL			**21.4**	**3**	**82**	**NA**
2014-SED-051	NA	4/15/2014	49.9	0.273 J	18.5 b	0.409
2014-SED-053	NA	4/15/2014	41.4	0.351	16.3 b	0.514
2014-SED-054	NA	4/15/2014	22.3	0.824	21.0 b	0.547
2014-SED-055	NA	4/15/2014	15.1	0.344 J	20.8 b	0.876
2014-SED-056	NA	4/16/2014	9.81	0.464	21.6	2.09
2014-SED-057	NA	4/16/2014	17.2	0.534	17.7	0.170
2014-SED-058	NA	4/16/2014	18.6	0.785	15.0	0.486
2014-SED-059	NA	4/16/2014	13.2	0.377	19.6	0.919
2014-SED-061	NA	4/16/2014	13.2	0.421	17.9	0.566
2014-SED-062	NA	4/16/2014	18.0	0.612	21.2	0.497
2014-SED-063	NA	4/16/2014	19.6	0.630	29.0	0.677
Downstream Tributaries						
2014-SED-037	NA	3/18/2014	10.6	0.246 J	17.3	1.86
2014-SED-047	NA	3/19/2014	15.4	0.239 J	15.4	1.39
2014-SED-049	NA	3/19/2014	12.7	0.166 J	17.2 J	2.37 J
2014-SED-052	NA	4/15/2014	8.02	0.774	22.2 b	5.19
2014-SED-060	NA	4/16/2014	9.12	0.161 J	11.6	1.26

Notes:

1. mg/Kg - milligrams/Kilogram
2. Data Qualifiers: J = estimated concentration; J- = estimated, biased low, b = detected in method blank.
3. NA - Not Applicable
4. "--" - Not Analyzed
5. Freshwater benchmarks and midpoint benthic PCLs from TCEQ (2014).
6. Two hot spots are identified in Stewart Creek and those data points included in one of the two hot spots are noted by a #1 or #2. (See Figure 4 for locations of hot spots.)
7. Blue highlighting indicates concentration greater than benthic PCL.

Table 5. Summary of Sediment Particle Size
Screening Level Ecological Risk Assessment

Sample ID	Sample Date	Gravel (%)	Sand (%)	Silt (%)	Clay (%)
Upstream					
2014-SED-026	1/31/2014	46.4	31.2	8.9	13.5
2014-SED-027	1/31/2014	1.1	16.6	28.1	54.2
2014-SED-028	1/31/2014	1.9	43.9	32.0	22.2
2014-SED-029	1/31/2014	37.7	11.2	12.8	38.3
2014-SED-030	1/31/2014	29.7	46.6	18.5	5.2
2014-SED-031	1/31/2014	49.9	38.0	7.3	4.8
2014-SED-032	1/31/2014	47.9	33.6	12.9	5.6
2014-SED-033	1/31/2014	34.1	40.7	21.4	3.8
2014-SED-034	1/31/2014	23.5	50.3	15.1	11.1
2014-SED-035	1/31/2014	21.7	46.5	19.3	12.5
On Site Stewart Creek					
2012-SED-1	1/11/2012	13.10	21.40	34.70	30.80
2012-SED-2	1/11/2012	42.60	41.40	8.00	8.10
2012-SED-3	1/11/2012	61.00	19.10	12.40	7.50
2012-SED-4	1/11/2012	35.20	35.20	19.90	9.70
2012-SED-5	1/11/2012	50.20	34.70	12.50	2.60
2012-SED-6	1/11/2012	49.10	36.30	10.20	4.40
2012-SED-7	1/11/2012	37.30	42.10	13.70	7.00
2012-SED-8	1/11/2012	52.40	28.40	14.80	4.40
2012-SED-9	1/11/2012	39.00	40.40	12.00	8.60
2012-SED-10	1/12/2012	42.20	42.70	10.70	4.40
2012-SED-11	1/12/2012	53.20	40.60	0.90	5.30
2012-SED-12	1/12/2012	35.20	19.80	21.50	23.50
2012-SED-13	1/12/2012	41.40	45.90	7.90	4.80
North Tributary					
2012-SED-16	1/12/2012	30.90	50.50	9.60	9.00
2012-SED-17	1/12/2012	38.40	44.00	6.90	10.70
2012-SED-18	1/12/2012	34.80	49.50	9.50	6.20
2012-SED-19	1/12/2012	30.80	57.40	4.80	7.00
2012-SED-20	1/12/2012	39.40	44.10	11.30	5.20
2012-SED-21	1/12/2012	67.60	24.50	5.40	2.50
2012-SED-22	1/12/2012	42.50	38.70	15.20	3.60
2012-SED-23	1/12/2012	52.40	36.10	7.90	3.60
2012-SED-24	1/12/2012	28.50	53.20	9.70	8.60
2012-SED-25	1/12/2012	34.10	46.20	15.50	4.20
Downstream of Former Operating Plant					
2014-SED-001	1/28/2014	0.0	14.5	24.2	61.3
2014-SED-002	1/28/2014	2.6	21.3	54.9	21.2
2014-SED-003	1/28/2014	25.3	57.1	12.0	5.6
2014-SED-004	1/28/2014	35.4	54.0	10.0	0.6
2014-SED-005	1/28/2014	21.3	57.1	15.0	6.6
2014-SED-006	1/28/2014	47.0	45.2	7.3	0.6
2014-SED-007	1/28/2014	40.8	48.5	8.9	1.8
2014-SED-008	1/28/2014	39.1	51.6	8.6	0.7
2014-SED-009	1/28/2014	42.6	44.2	8.1	5.1
2014-SED-010	1/28/2014	40.0	47.7	8.8	3.5

Table 5. Summary of Sediment Particle Size
Screening Level Ecological Risk Assessment

Sample ID	Sample Date	Gravel (%)	Sand (%)	Silt (%)	Clay (%)
2014-SED-011	1/28/2014	36.6	34.9	25.1	3.4
2014-SED-012	1/28/2014	37.4	34.2	18.9	9.5
2014-SED-013	1/28/2014	21.2	28.0	26.2	24.6
2014-SED-014	1/29/2014	46.9	26.0	11.8	15.3
2014-SED-015	1/29/2014	56.2	22.0	16.5	5.3
2014-SED-016	1/29/2014	25.3	42.9	19.6	12.2
2014-SED-017	1/29/2014	22.4	44.4	18.2	15.0
2014-SED-018	1/29/2014	1.5	44.0	25.3	29.2
2014-SED-019	1/30/2014	0.0	35.8	31.7	32.5
2014-SED-020	1/30/2014	38.0	46.1	5.9	10.0
2014-SED-021	1/30/2014	18.0	63.1	12.1	6.8
2014-SED-022	1/30/2014	0.0	21.7	30.0	48.3
2014-SED-023	1/30/2014	60.8	25.7	12.1	1.4
2014-SED-024	1/30/2014	48.9	38.6	7.6	4.9
2014-SED-025	1/30/2014	40.3	43.5	10.7	5.5
2014-SED-036	3/18/2014	12.8	21.0	27.7	38.5
2014-SED-037	3/18/2014	1.4	23.1	27.6	47.9
2014-SED-038	3/18/2014	11.2	28.1	35.1	25.6
2014-SED-039	3/18/2014	42.0	49.5	7.5	1.1
2014-SED-040	3/18/2014	39.5	32.3	7.6	20.6
2014-SED-041	3/18/2014	19.0	53.0	26.0	2.0
2014-SED-042	3/18/2014	46.6	42.6	9.0	1.8
2014-SED-043	3/18/2014	2.9	63.9	9.1	24.1
2014-SED-044	3/18/2014	0.6	25.2	30.8	43.4
2014-SED-045	3/18/2014	20.4	51.3	19.6	8.7
2014-SED-046	3/18/2014	37.0	32.8	25.8	4.4
2014-SED-047	3/19/2014	6.0	20.0	30.5	43.5
2014-SED-048	3/19/2014	37.4	52.5	6.2	3.9
2014-SED-049	3/19/2014	4.4	11.4	49.5	34.7
2014-SED-050	4/15/2014	56.1	39.2	3.8	0.9
2014-SED-051	4/15/2014	42.5	45.5	9.0	3.0
2014-SED-052	4/15/2014	0	15.3	61.4	23.3
2014-SED-053	4/15/2014	51.6	34.4	9.3	4.7
2014-SED-054	4/15/2014	21.0	61.0	7.3	10.7
2014-SED-055	4/15/2014	7.9	52.9	18.5	20.7
2014-SED-056	4/16/2014	0.6	9.0	42.4	48.0
2014-SED-057	4/16/2014	32.1	58.5	4.4	5.0
2014-SED-058	4/16/2014	27.7	58.2	6.3	7.8
2014-SED-059	4/16/2014	5.1	57.6	18.7	18.6
2014-SED-060	4/16/2014	0	48.1	20.6	31.3
2014-SED-061	4/16/2014	7.8	58.0	13.8	20.4
2014-SED-062	4/16/2014	19.8	64.1	7.7	8.4
2014-SED-063	4/16/2014	11.2	67.8	7.6	13.4

Table 5. Summary of Sediment Particle Size
Screening Level Ecological Risk Assessment

Sample ID	Sample Date	Gravel (%)	Sand (%)	Silt (%)	Clay (%)
		Gravel (%)	Sand (%)	Silt, Clay, Colloids (%)	
SC-Sed-31	6/12/2013	0.67	87.0	12.3	
SC-Sed-32	6/12/2013	26.8	69.4	3.8	
SC-Sed-33	6/12/2013	8.4	85.0	6.7	
SC-Sed-34	6/12/2013	2.4	88.9	8.7	
SC-Sed-35	6/12/2013	33.1	65.2	1.8	
SC-Sed-36	6/12/2013	10.4	75.4	14.2	
SC-Sed-37	6/12/2013	7.9	84.3	7.8	
SC-Sed-38	6/12/2013	9.0	79.9	11.2	
SC-Sed-39	6/12/2013	28.4	55.1	16.5	
SC-Sed-40	6/12/2013	5.4	29.9	64.8	
SC-Sed-41	6/19/2013	16.5	49.4	34.1	
SC-Sed-42	6/19/2013	23.7	57.8	18.5	
SC-Sed-43	6/19/2013	4.0	90.0	6.0	
SC-Sed-44	6/19/2013	16.4	47.4	36.2	
SC-Sed-45	6/19/2013	9.4	58.1	32.5	
SC-Sed-46	6/19/2013	21.4	67.0	11.5	
SC-Sed-47	6/19/2013	17.9	71.3	10.8	
SC-Sed-48	6/19/2013	18.2	70.2	11.7	

Table 6. Summary of Upper Groundwater Bearing Unit Data from Monitoring Wells in Vicinity of Stewart Creek and North Tributary
Screening Level Ecological Risk Assessment

				Total				Dissolved			
			Analyte	**Arsenic**	**Cadmium**	**Lead**	**Selenium**	**Arsenic**	**Cadmium**	**Lead**	**Selenium**
			[SW]GW PCL (SW RBEL based on chronic aquatic life criteria, no dilution factor)	**NA**	**NA**	**NA**	**NA**	**0.15**	**0.000256**	**0.00268**	**0.005**
			[SW]GW PCL (SW RBEL, with 0.15 dilution factor)	**NA**	**NA**	**NA**	**NA**	**--**	**0.0017**	**0.018**	**0.033**
			Units	**mg/L**	**mg/L**	**mg/L**	**mg/L**	**mg/L**	**mg/L**	**mg/L**	**mg/L**
Location ID	**GWBU/Location Information**	**Date Sampled**	**Method**								
Stewart Creek											
B5N	Upper GWBU/NW corner of Battery Storage Building	1/17/2012	6010	--	< 0.000350 U	< 0.00290 U	--	--	< 0.000350 U	< 0.00290 U	--
		3/22/2013	6010	--	< 0.000350 U	< 0.00290 U	--	--	< 0.000350 U	< 0.00290 U	--
MW-11	Upper GWBU/Adjacent to RR Tracks/Downstream Property Boundary	4/9/2013	6010	--	< 0.000350 U	< 0.00290 U	--	--	< 0.000350 U	< 0.00290 U	--
		3/28/2014	6020	--	--	--	--	--	< 0.0000950 U	--	--
MW-12	Upper GWBU/SE of Chrystallizer unit	1/16/2012	6010	--	< 0.000350 U	< 0.00290 U	--	--	< 0.000350 U	< 0.00290 U	--
		3/13/2013	6010	--	**0.00103 J**	**0.0029 J**	--	--	< 0.000350 U	< 0.00290 U	--
MW-13	Upper GWBU/East of Storm Water Retention Pond	1/16/2012	6010	--	< 0.000350 U	< 0.00290 U	--	--	< 0.000350 U	< 0.00290 U	--
		3/13/2013	6010	--	< 0.000350 U	< 0.00290 U	--	--	< 0.000350 U	< 0.00290 U	--
MW-14	Upper GWBU/Along Stewart Creek	1/16/2012	6010	--	< 0.000350 U	**0.00311J**	--	--	< 0.000350 U	< 0.00290 U	
		3/13/2013	6010	--	< 0.000350 U	< 0.00290 U	--	--	**0.0007J**	< 0.00290 U	
		2/17/2014	6020	--	<0.0000950 U	**0.000302 J**	--	--	**0.000120 J**	**0.00433**	--
MW-16S	Upper GWBU/Along Stewart Creek	1/17/2012	6010	--	< 0.000350 U	< 0.00290 U	--	--	< 0.000350 U	**0.00299J**	--
		4/9/2013	6010	--	**0.0012J**	**0.005J**	--	--	**0.0007J**	**0.0041J**	--
		2/14/2014	6020	--	**0.00240**	**0.00602**	--	--	< 0.0000950 U	**0.000430 J**	--
MW-17	Upper GWBU/Along Stewart Creek	1/18/2012	6010	--	< 0.000350 U	**0.00411J**	--	--	< 0.000350 U	**0.0029 UJ**	--
		3/22/2013	6010	--	**0.0004J**	< 0.00290 U	--	--	< 0.000350 U	< 0.00290 U	--
		2/17/2014	6020	--	**0.000182 J**	< 0.000200 U	--	--	**0.000130 J**	< 0.000200 U	--
MW-24	Upper GWBU/Near B5N and MW-17	3/18/2013	6010	--	< 0.000350 U	**0.0038J**	--	--	< 0.000350 U	**0.0054J**	--
MW-26	Upper GWBU/Along Stewart Creek	4/9/2013	6010	--	**0.0006J**	< 0.00290 U	--	--	**0.0004J**	< 0.00290 U	--
		2/17/2014	6020	--	**0.000311 J**	**0.000287 J**	--	--	**0.000302 J**	**0.000327 J**	--
MW-27	Upper GWBU/Along Stewart Creek	4/9/2013	6010	--	**0.001J**	**0.0029J**	--	--	**0.0009J**	**0.0035J**	--
		2/17/2014	6020	--	**0.000354 J**	**0.000718 J**	--	--	**0.000410 J**	**0.000743 J**	--
MW-29	Upper GWBU/Along Stewart Creek	4/9/2013	6010	--	**0.0015J**	< 0.00290 U	--	--	**0.0014J**	< 0.00290 U	--
		2/17/2014	6020	--	**0.000765**	**0.000433 J**	--	--	**0.000865**	**0.000937 J**	--
MW-31	Upper GWBU/Along Stewart Creek, across creek from MW-14	5/13/2013	6010	--	< 0.00035 U	< 0.0029 U	--	--	< 0.000350 U	< 0.00290 U	--
P-2	Upper GWBU/In South Wooded Area	3/19/2013	6010	--	**0.0012 J**	**0.005 J**	--	--	**0.0014 J**	**0.005 J**	--
MW-37	Upper GWBU/NW of Stormwater Pond	1/21/2014	NA	NS	NS	NS	NS	NS	NS	NS	NS
		2/13/2014	6020	< 0.00130 U	**0.000375 J**	**0.00173**	< 0.00100 U	**0.00132 J**	**0.000350 J**	**0.00132 J**	**0.00193 J**
		3/28/2014	6020	--	--	--	--	--	< 0.0000950 U	--	--
MW-38	Upper GWBU/Stormwater Pond	1/16/2014	6010	< 0.00328 U	< 0.000350 U	< 0.00290 U	**0.00603 J**	< 0.00328 U	< 0.000350 U	< 0.00290 U	**0.00470 J**
		1/16/2014	6020	--	--	--	--	**0.00165 J**	**0.000150 J**	**0.000281 J**	< 0.00100 U
MW-44	Upper GWBU/Truck Wash	1/22/2014	6010	--	R	R	--	--	**0.00100 J**	< 0.00290 U	--
		1/22/2014	6020	--	--	--	--	--	**0.000495 J**	**0.00148 J**	--
		2/17/2014	6020	--	**0.000109 J**	**0.00611**	--	--	**0.000131 J**	**0.00192**	--
MW-46	Upper GWBU/adjacent to perched well MW-32	1/22/2014	6010	--	R	R	--	--	**0.00190 J**	**0.0259**	--
		2/17/2014	6020	--	**0.000812**	**0.00185**	--	--	**0.000834**	**0.00488**	--
		3/27/2014	6020	--	**0.000794**	**0.00546**	--	-	**0.000797**	**0.00302 J**	--

				Total				Dissolved			
			Analyte	**Arsenic**	**Cadmium**	**Lead**	**Selenium**	**Arsenic**	**Cadmium**	**Lead**	**Selenium**
North Tributary											
^{SW}GW PCL (SW RBEL based on acute aquatic life criteria, no dilution factor)				**NA**	**NA**	**NA**	**NA**	**0.34**	**0.00908**	**0.0688**	**0.02**
			Units	**mg/L**	**mg/L**	**mg/L**	**mg/L**	**mg/L**	**mg/L**	**mg/L**	**mg/L**
B7N	Upper GWBU/North Wooded Area	3/18/2013	6010	--	< 0.000350 U	< 0.00290 U	--	--	< 0.000350 U	< 0.00290 U	--
B9N	Upper GWBU/North Wooded Area	4/10/2013	6010	--	< 0.000350 U	< 0.00290 U	--	--	< 0.000350 U	< 0.00290 U	--
		4/10/2013	6010	--	< 0.000350 U	< 0.00290 U	--	--	< 0.000350 U	< 0.00290 U	--
P-1	Upper GWBU/North Wooded Area	4/9/2013	6010	--	< 0.000350 U	< 0.00290 U	--	--	< 0.000350 U	< 0.00290 U	--
LMW-5	Upper GWBU/Class 2 landfill	3/13/2013	6010	< 0.00328 U	< 0.000350 U	< 0.00290 U	< 0.00417 U	< 0.00328 U	< 0.000350 U	< 0.00290 U	< 0.00417 U
LMW-8	Upper GWBU/Class 2 landfill	3/13/2013	6010	< 0.00328 U	< 0.000350 U	< 0.00290 U	**0.0104 J**	< 0.00328 U	< 0.000350 U	< 0.00290 U	**0.0057 J**
		4/12/2013	6010	--	--	--	**0.0055 J**	--	--	--	**0.0056 J**
LMW17	Upper GWBU/Class 2 landfill	3/12/2013	6010	< 0.00328 U	< 0.000350 U	< 0.00290 U	< 0.00417 U	< 0.00328 U	< 0.000350 U	< 0.00290 U	< 0.00417 U
LMW-22	Upper GWBU/Class 2 landfill	3/13/2013	6010	< 0.00328 U	< 0.000350 U	< 0.00290 U	< 0.00417 U	< 0.00328 U	< 0.000350 U	< 0.00290 U	< 0.00417 U
MW-18	Upper GWBU/W of Slag Landfill	1/17/2012	3010		< 0.000350 U	< 0.00290 U			< 0.000350 U	< 0.00290 U	
		3/18/2013	6010	--	< 0.000350 U	< 0.00290 U	--	--	< 0.000350 U	< 0.00290 U	--
MW-21	Upper GWBU/North Wooded Area	4/9/2013	6010	--	**0.0005J**	< 0.00290 U	--	--	**0.0005J**	< 0.00290 U	--
MW-22	Upper GWBU/North Wooded Area	4/9/2013	6010	--	**0.0029J**	**0.0063J**	--	--	**0.0029J**	**0.004J**	--
MW-39	Upper GWBU/Slag Landfill	1/17/2014	6010	--	< 0.000350 U	< 0.00290 U	--	--	< 0.000350 U	**0.00440 J**	--
MW-40	Upper GWBU/Slag Landfill	1/17/2014	6010	--	< 0.000350 U	< 0.00290 U	--	--	< 0.000350 U	< 0.00290 U	--
MW-41	Upper GWBU/North Tributary	1/17/2014	6010	--	< 0.000350 U	**0.00699 J**	--	NS	NS	NS	NS
		1/17/2014	6020	--	--	**0.00207**	--	--	--	--	--
		2/14/2014	6010	--	--	NA	--	< 0.00328 U	< 0.000350 U	< 0.00290 U	< 0.00417 U
MW-42	Upper GWBU/North Tributary	1/17/2014	6010	--	< 0.000350 U	**0.00369 J**	--	NS	NS	NS	NS
		1/17/2014	6020	--	--	< 0.000200 U	--	--	--	--	--
		2/14/2014	6010	--	--	--	--	< 0.00328 U	< 0.000350 U	< 0.00290 U	< 0.00417 U

Notes:
1. < - Indicates analyte not detected above method detection limit (MDL).
2. NA - Not Applicable
3. J - Analyte concentration estimated. U - Analyte not detected.
4. R - Indicates data rejection due to sample collection error (not properly filtered).
5. "--" - Not Analyzed
6. NS - Not sampled. Well was dry or there was insuffient volume available for sample collection.
7. Cadmium and lead criteria based on hardness value of 106 mg/L for Segment 0823.
8. Monitoring wells along Stewart Creek considered a potential point of exposure where the ^{SW}GW PCL (chronic) applies.
9. Monitoring wells along the North Tributary of Stewart Creek considered potential point of exposure wells where the ^{SW}GW PCL (acute) applies.
10. Dissolved samples filtered with a 0.45 micron filter.
11. Detections are bolded and the exceedance is shaded.

Table 7. Threatened and Endangered Species - Collin and Denton Counties
Screening Level Ecological Risk Assessment

Common Name[1]	Scientific Name	Status[2] Federal	Status[2] Texas	Description	Signficant Presence Terrestrial	Signficant Presence Aquatic	Comment
Birds							
American Peregrine Falcon	*Falco peregrinus anatum*	DL	T	Year-round resident and local breeder in west Texas, nests in tall cliff eyries; also, migrant across state from more northern breeding areas in US and Canada, winters along coast and farther south; occupies wide range of habitats during migration, including urban, concentrations along coast and barrier islands; low-altitude migrant, stopovers at leading landscape edges such as lake shores, coastlines, and barrier islands.	N	N	Unlikely to feed on local prey in urban area; possible rare fly-overs.
Arctic Peregrine Falcon	*Falco peregrinus tundrius*	DL		migrant throughout state from subspecies' far northern breeding range, winters along coast and farther south; occupies wide range of habitats during migration, including urban, concentrations along coast and barrier islands; low-altitude migrant, stopovers at leading landscape edges such as lake shores, coastlines, and barrier islands.	N	N	May occur as infrequent transient.
Bald Eagle	*Haliaeetus leucocephalus*	DL	T	Found primarily near rivers and large lakes; nests in tall trees or on cliffs near water; communally roosts, especially in winter; hunts live prey, scavenges, and pirates food from other birds.	N	N	May occur as infrequent transient.
Interior Least Tern	*Sterna antillarum athalassos*	LE	E	Subspecies is listed only when inland (more than 50 miles from a coastline); nests along sand and gravel bars within braided streams, rivers; also know to nest on man-made structures (inland beaches, wastewater treatment plants, gravel mines, etc); eats small fish and crustaceans, when breeding forages within a few hundred feet of colony.	N	N	May occur as infrequent transient.
Peregrine Falcon	*Falco peregrinus tundrius*	DL	T	Migrates across the state from more northern breeding areas in US and Canada to winter along coast and farther south; no longer listed in Texas, but because the subspecies are not easily distinguishable at a distance, reference is generally made only to the species level.	N	N	Unlikely to feed on local prey; possible rare fly-overs.
Piping Plover	*Charadrius melodus*	LT	T	Wintering migrant along the Texas Gulf Coast; beaches and bayside mud or salt flats.	N	N	May occur as infrequent transient.
Sprague's Pipit	*Anthus spragueii*	C		Only in Texas during migration and winter, mid September to early April; short to medium distance, diurnal migrant; strongly tied to native upland prairie, can be locally common in coastal grasslands, uncommon to rare further west; sensitive to patch size and avoids edges.	N	N	Unlikely to feed on local prey in urban area; possible rare fly-overs.
White-faced Ibis	*Plegadis chihi*		T	Prefers freshwater marshes, sloughs, and irrigated rice fields, but will attend brackish and saltwater habitats; nests in marshes, in low trees, on the ground in bulrushes or reeds, or on floating mats. The white-faced ibis seems to prefer freshwater marshes, where it can find insects, newts, leeches, earthworms, snails and especially crayfish, frogs and fish. They roost on low platforms of dead reed stems or on mud banks. In Texas, they breed and winter along the Gulf Coast and may occur as migrants in the Panhandle and West Texas (TPWD, 2013).	N	N	The white-faced ibis prefers freshwater marshes. They roost on low platforms of dead reed stems or on mud banks. In Texas, they breed and winter along the Gulf Coast and may occur as migrants in the Panhandle and West Texas (TPWD, 2013a). Prefered habitat is not found in Stewart Creek and its presence is unlikely. See Appendix C.
Whooping Crane	*Grus americana*	LE	E	Potential migrant via plains throughout most of state to coast; winters in coastal marshes of Aransas, Calhoun, and Refugio counties.	N	N	Unlikely to feed on local prey; possible rare fly-overs.
Wood Stork	*Mycteria americana*		T	Forages in prairie ponds, flooded pastures or fields, ditches, and other shallow standing water, including salt-water; usually roosts communally in tall snags, sometimes in association with other wading birds (i.e. active heronries); breeds in Mexico and birds move into Gulf States in search of mud flats and other wetlands, even those associated with forested areas; formerly nested in Texas, but no breeding records since 1960.	N	N	Unlikely to feed on local prey; possible rare fly-overs.
Mammals							
Red wolf	*Canis rufus*	LE	E	Extirpated; formerly known throughout eastern half of Texas in brushy and forested areas, as well as coastal prairies.	N	N	Considered extirpated from region.
Mollusks							
Louisiana Pigtoe	*Pleurobe mariddellii*		T	Found in streams and moderate-size rivers, usually flowing water on substrates of mud, sand, and gravel; not generally known from impoundments; Sabine, Neches, and Trinity (historic) River basins. Ranged from eastern Texas drainages into Louisiana, but has been exceptionally rare in recent decades. Since the mid-1990s, small numbers of living specimens have been found in the Neches River and some of its tributaries and the Angelina River (TPWD, 2009).	N	N	No evidence that these species are present in Stewart Creek follwing 2014 habitat assessment. See Appendix C.
Texas heelsplitter	*Potamilus amphichaenus*		T	Found in quiet waters in mud or sand and also in reservoirs. Sabine, Neches, and Trinity River basins	N	N	
Reptiles							
Alligator snapping turtle	*Macrochelys temminckii*		T	Perennial water bodies; deep water of rivers, canals, lakes, and oxbows; also swamps, bayous, and ponds near deep running water; sometimes enters brackish coastal waters; usually in water with mud bottom and abundant aquatic vegetation; may migrate several miles along rivers.	N	N	Unlikely to be present in Stewart Creek due to high flow conditions and small number of shallow pooling areas found in Stewart Creek. Deep muddy bottom pools with adequate vegetationn are not present, broad sandy flood plain preferred by females is uncommon along Stewart Creek. See Appendix C.
Timber/Canebrake rattlesnake	*Crotalus horridus*		T	Swamps, floodplains, upland pine and deciduous woodlands, riparian zones, abandoned farmland; limestone bluffs, sandy soil or black clay; prefers dense ground cover, i.e. grapevines or palmetto.	N	N	Not expected in study area due to limited and fragmented habitat. Surrounding areas are dominated by urban development and active agricultural fields. Continuous undisturbed scrub shrub and forested habitat is required. See Appendix C.
Texas horned lizard	*Phrynosoma cornutum*		T	Open, arid and semi-arid regions with sparse vegetation, including grass, cactus, scattered brush or scrubby trees; soil may vary in texture from sandy to rocky; burrows into soil, enters rodent burrows, or hides under rock when inactive.	N	N	Diet is primarily harvester ants. No harvester ant nests were noted on site. Unlikely to be present.

Notes:

1 - Taxa provided in the Texas Parks and Wildlife Departments Rare, Threatened, and Endangered Species of Texas List for Denton and Collin Counties.

http://www.tpwd.state.tx.us/gis/ris/es/ Only taxa listed as threatened or endangered on either the federal or state list are included.

2 - T = Threatened; E = Endangered; C = Candidate for Listing; LT = Listed Threatened; LE = Listed Endangered; DL = De-Listed.

TPWD 2009, 15 Texas Freshwater Mussels Placed on State Threatened List. November 5, 2009. http://www.texashuntfish.com/app/view/Post/27233/15-Texas-Freshwater-Mussels-Placed-on-State-Threatened-List

TPWD 2013, On Line Species Information on White Faced Ibis: http://www.tpwd.state.tx.us/huntwild/wild/species/ibis/

Table 8. Sediment Data Summary Statistics
Screening Level Ecological Risk Assessment

Exposure Area	Average (mg/kg)	Minimum Detection (mg/kg)	Maximum Detection (mg/kg)	95% UCL (mg/kg)	Statistic Used
Stewart Creek Upstream					
Arsenic	15.95	8.55	42.70	21.71	95% Student's-t UCL
Cadmium	0.44	0.26	0.69	0.53	95% Student's-t UCL
Lead	12.34	6.56	19.8	14.56	95% Student's-t UCL
North Tributary On-Site					
Arsenic	ND	ND	ND	ND	ND
Cadmium	0.92	0.69	1.19	1.02	95% Student's-t UCL
Lead	16.51	10.4	28.2	20.14	95% Student's-t UCL
Stewart Creek On-Site					
Arsenic	ND	ND	ND	ND	ND
Cadmium	1.00	0.34	2.08	1.21	95% Student's-t UCL
Lead	12.21	6.57	19.20	14.26	95% Student's-t UCL
Stewart Creek Downstream of FOP					
Arsenic	22.16	7	279	32.35	95% Chebyshev
Cadmium	1.09	0.04	6.96	1.46	95% Chebyshev
Lead	35.48	8.20	459	58.28	95% Chebyshev
Stewart Creek On-Site and Downstream (with Hot Spots included)					
Arsenic	22.16	7	279	32.35	95% Chebyshev
Cadmium	1.08	0.04	6.96	1.42	95% Chebyshev
Lead	33.37	6.57	459	54.24	95% Chebyshev
Stewart Creek On-Site and Downstream (without Hot Spots)					
Arsenic	19.91	7	57.7	21.89	95% Student's-t UCL
Cadmium	1.01	0.16	4.47	1.32	95% Chebyshev
Lead	21.36	6.57	59	23.13	95% Student's-t UCL

Notes:
1. UCL - upper confidence limit
2. ND - no data; arsenic data not available for on-Site Stewart Creek and the North Tributary.
3. ProUCL output presented in Appendix B.

Table 9. Sediment-To-Fish Evaluation
Screening Level Ecological Risk Assessment

Exposure Area	BSAF	95% UCL (mg/kg)	Estimated Fish Tissue Concentration (mg/kg)	Literature Based Tissue Concentration (mg/kg)	Rationale
Stewart Creek Upstream					
Arsenic	0.162	21.71	3.52	27	Evaluated because one detection > benthic PCL. Estimated tissue concentration well below literature estimate.
Cadmium	0.53	0.53	0.28	4.8	All detections less than benchmark but considered bioaccumulative in sediment. Estimated tissue concentration well below literature estimate.
Lead	NE	NE	NE	NE	All detections less than benchmark and lead is not bioaccumulative in sediment.
Stewart Creek On-Site					
Arsenic	0.162	NE	NE	NE	Arsenic sediment data not available.
Cadmium	0.53	1.02	0.54	4.8	All detections less than benchmark but considered bioaccumulative in sediment. Estimated tissue concentration well below literature estimate.
Lead	0.07	NE	NE	NE	All detections less than benchmark and lead is not bioaccumulative in sediment.
Stewart Creek Downstream of the FOP					
Arsenic	0.162	32.35	5.24	27	Evaluated because at least one detection > benthic PCL. Estimated tissue concentration well below literature estimate.
Cadmium	0.53	1.46	0.77	4.8	Evaluated because at least one detection > benthic PCL and bioaccumulative . Estimated tissue concentration well below literature estimate.
Lead	0.07	58.28	4.08	20-44	Evaluated because at least one detection > benthic PCL. Estimated tissue concentration well below literature estimate.

Notes:
NE - Not Evaluated, see text for further discussion.
North Tributary is classified as intermittent and is therefore not evaluated.

Table 10. NOAEL Based HQ Summary: Initial Conservative Assessment
Screening Level Ecological Risk Assessment

	Snowy Egret	Raccoon
	NOAEL-HQ	
Stewart Creek Upstream		
Arsenic	0.45	0.26
Cadmium	0.047	0.08
Lead	Lead removed in screening process. Max < benchmark and not bioaccumulative in sediment or water.	
North Tributary		
Arsenic	Arsenic data not available.	
Cadmium	0.09	0.15
Lead	Lead removed in screening process. Max < benchmark and not bioaccumulative in sediment or water.	
Stewart Creek On-Site		
Arsenic	Arsenic data not available.	
Cadmium	0.11	0.18
Lead	Lead removed in screening process. Max < benchmark and not bioaccumulative in sediment or water.	
Stewart Creek Downstream of the FOP		
Arsenic	0.67	0.39
Cadmium	0.13	0.22
Lead	**1.2**	0.31
Stewart Creek On-Site + Downstream of the FOP		
Arsenic	0.67	0.39
Cadmium	0.13	0.21
Lead	**1.1**	0.29
Stewart Creek On-Site + Downstream of the FOP (with Hot Spots Removed)		
Arsenic	0.45	0.27
Cadmium	0.12	0.20
Lead	0.48	0.12

Notes:

NOAEL - No Observed Adverse Effect Level

HQ - Hazard Quotient

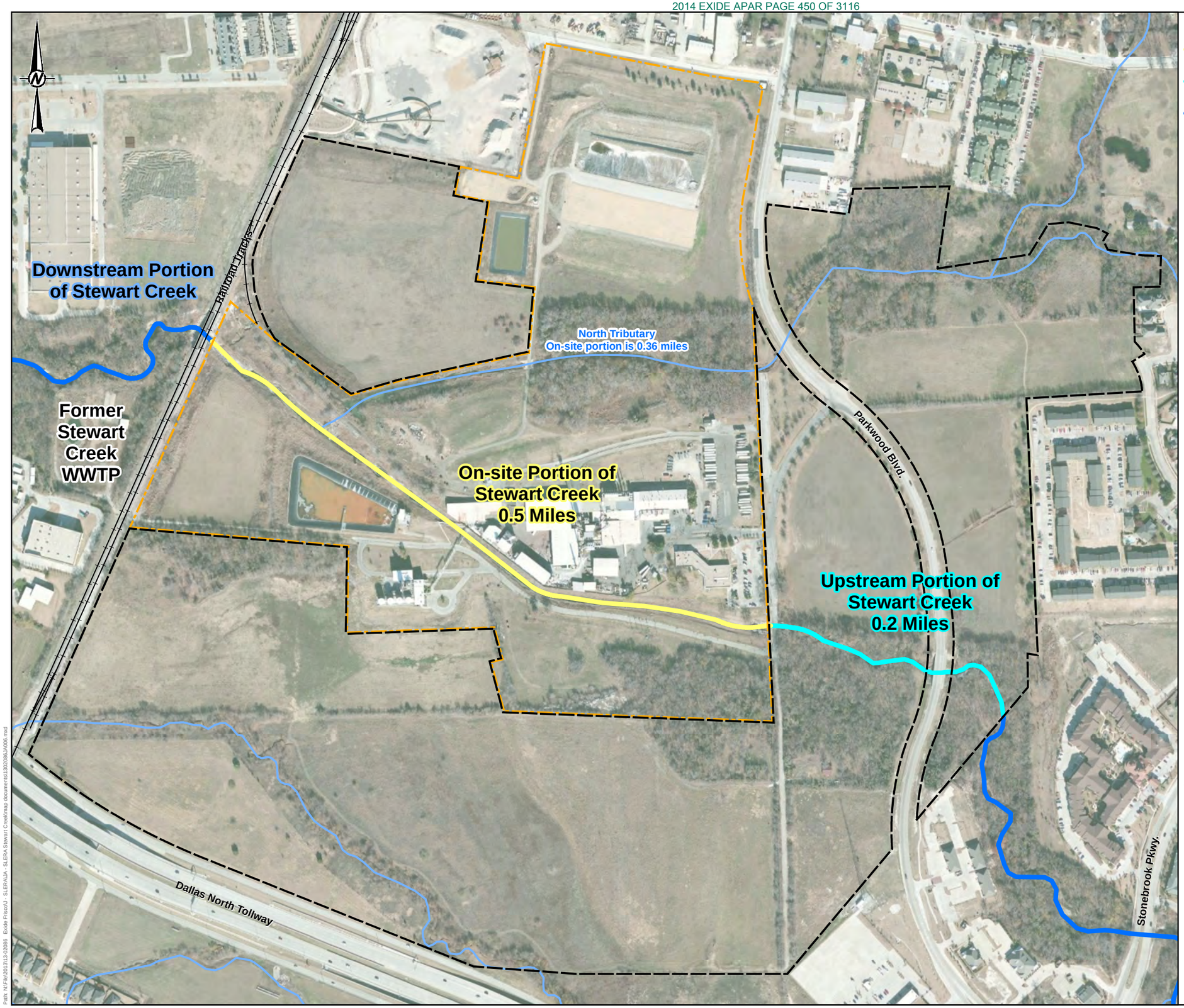
According to Section 3.10 of TCEQ 2014; if the HQ is ≤ 1 for a given COC, then the COC is not considered further. Therefore only those COCs and receptors with HQ > 1 are carried forward to the refined or less-conservative assessment (see Table 11).

Table 11. NOAEL and LOAEL Based HQ Summary: Refined Less-Conservative Assessment
Screening Level Ecological Risk Assessment

	Snowy Egret		Raccoon	
	NOAEL-HQ	**LOAEL-HQ**	**NOAEL-HQ**	**LOAEL-HQ**
Stewart Creek Upstream				
Arsenic	--	--	--	--
Cadmium	--	--	--	--
Lead	Lead removed in screening process. Max < benchmark and not bioaccumulative in sediment or water.			
North Tributary				
Arsenic	Arsenic data not available.			
Cadmium	--	--	--	--
Lead	Lead removed in screening process. Max < benchmark and not bioaccumulative in sediment or water.			
Stewart Creek On-Site				
Arsenic	Arsenic data not available.			
Cadmium	--	--	--	--
Lead	Lead removed in screening process. Max < benchmark and not bioaccumulative in sediment or water.			
Stewart Creek Downstream of the FOP				
Arsenic	--	--	--	--
Cadmium	--	--	--	--
Lead	**1.2**	0.61	--	--
Stewart Creek On-Site + Downstream of the FOP				
Arsenic	--	--	--	--
Cadmium	--	--	--	--
Lead	**1.1**	0.57	--	--
Stewart Creek On-Site + Downstream of the FOP (with Hot Spots Removed)				
Arsenic	--	--	--	--
Cadmium	--	--	--	--
Lead	--	--	--	--

Notes:
NOAEL - No Observed Adverse Effect Level
LOAEL - Lowest Observed Adverse Effect Level
HQ - Hazard Quotient
An HQ value less than 1 indicates that risk is minimal.
NA- Not Appplicable, indicating that the HQ < 1 in the initial conservative assessment and further evaluation not necessary in the refined less-conservative assessment.
"--" indcates that the pathway in not applicable.

FIGURES



LEGEND

- Onsite Portion of Stewart Creek
- Upstream Portion of Stewart Creek (On Buffer Property)
- Stewart Creek
- Other Creek / Tributary
- Exide Site
- Undeveloped Buffer Property

NOTES

1. WWTP - WASTE WATER TREATMENT PLANT

REFERENCE

1. SITE FEATURES - GOLDER, 2014
2. AERIAL IMAGERY - SOURCE: ESRI, DIGITALGLOBE, GEOEYE, I-CUBED, USDA, USGS, AEX, GETMAPPING, AEROGRID, IGN, IGP, AND THE GIS USER COMMUNITY

DRAFT

400 200 0 400 Feet

CLIENT
EXIDE TECHNOLOGIES

PROJECT
SCREENING LEVEL ECOLOGICAL RISK ASSESSMENT

TITLE
SITE MAP - UPSTREAM AND ON-SITE STEWART CREEK

CONSULTANT

Golder Associates

YYYY-MM-DD	2014-14-05
PREPARED	JWT
DESIGN	####
REVIEW	####
APPROVED	####

PROJECT No.	CONTROL	Rev.	FIGURE
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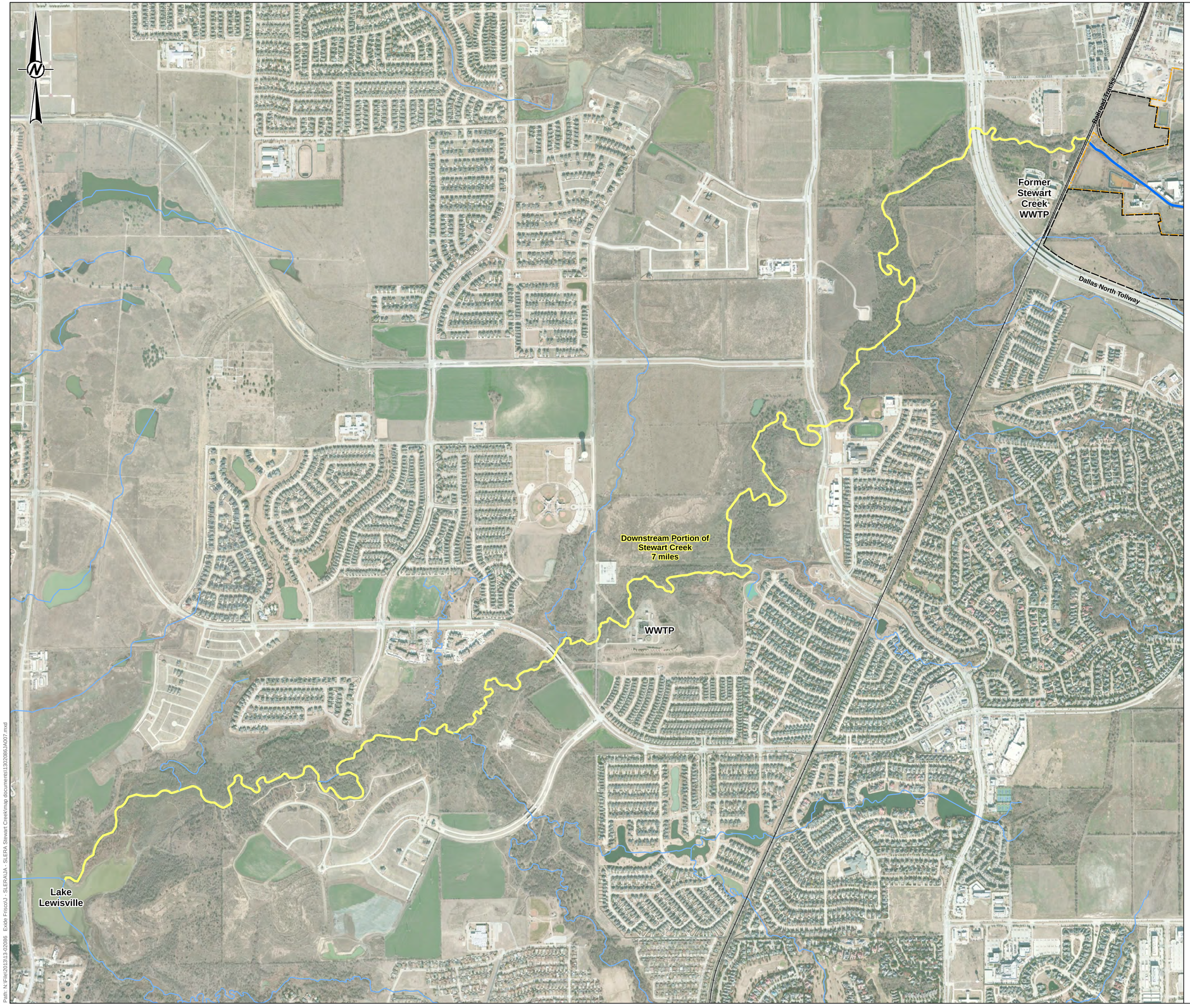

LEGEND

- Downstream Portion of Stewart Creek
- Onsite Portion of Stewart Creek
- Other Creek / Tributary
- Exide Site
- Undeveloped Buffer Property

NOTES

1. USACE - U.S. ARMY CORPS OF ENGINEERS
2. WWTP - WASTE WATER TREATMENT PLANT

REFERENCE

1. IMAGERY - SOURCE: ESRI, DIGITALGLOBE, GEOEYE, I-CUBED, USDA, USGS, AEX, GETMAPPING, AEROGRID, IGN, IGP, AND THE GIS USER COMMUNITY

DRAFT

800 400 0 800 Feet

CLIENT
EXIDE TECHNOLOGIES
FRISCO, TX

PROJECT
SCREENING LEVEL ECOLOGICAL RISK ASSESSMENT

TITLE
SITE MAP - DOWNSTREAM STEWART CREEK

CONSULTANT

Golder Associates

YYYY-MM-DD	2014-14-12
PREPARED	JWT
DESIGN	JWT
REVIEW	AMF
APPROVED	####

PROJECT No.	CONTROL	Rev.	FIGURE
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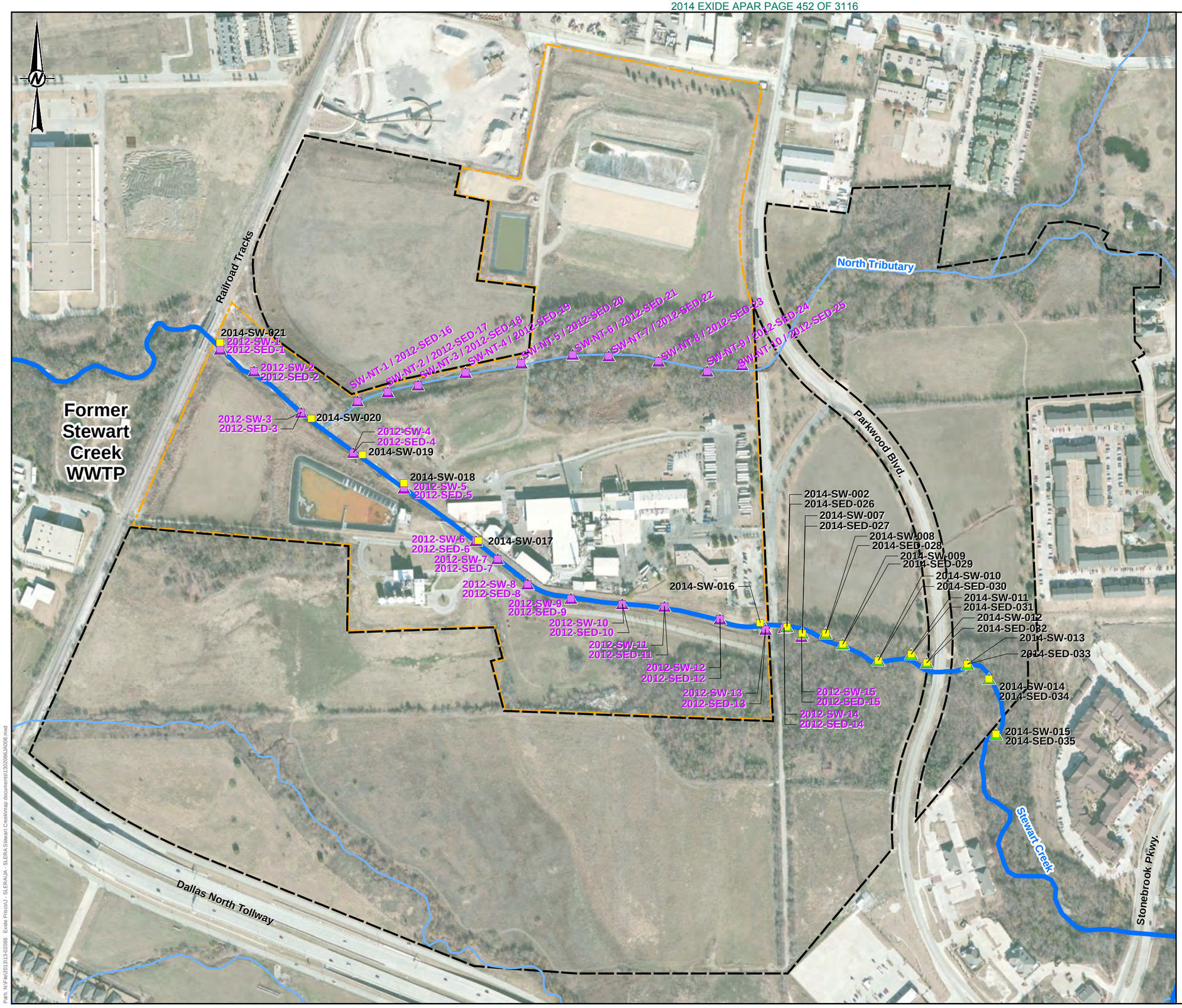

LEGEND

- 2014 Sediment Sample Location
- 2014 Surface Water Sample Location
- Sediment Sample Location
- Surface Water Sample Location
- Former Operating Plant
- Undeveloped Buffer Property

REFERENCE

1. HYDROGRAPHY - TEXAS NATURAL RESOURCES INFORMATION SYSTEM, 2014
2. LOCATIONS - PBW, SOUTHWEST GEOSCIENCES, AND GOLDER
3. AERIAL IMAGERY - SOURCE: ESRI, DIGITALGLOBE, GEOEYE, I-CUBED, USDA, USGS, AEX, GETMAPPING, AEROGRID, IGN, IGP, AND THE GIS USER COMMUNITY

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400 200 0 400 Feet

CLIENT
EXIDE TECHNOLOGIES

PROJECT
SCREENING LEVEL ECOLOGICAL RISK ASSESSMENT

TITLE
UPSTREAM AND ON-SITE SURFACE WATER AND SEDIMENT SAMPLE LOCATIONS

CONSULTANT
Golder Associates

YYYY-MM-DD	2014-14-09
PREPARED	JWT
DESIGN	####
REVIEW	####
APPROVED	####

PROJECT No.	CONTROL	Rev.	FIGURE
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IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET HAS BEEN MODIFIED FROM: ANSI B

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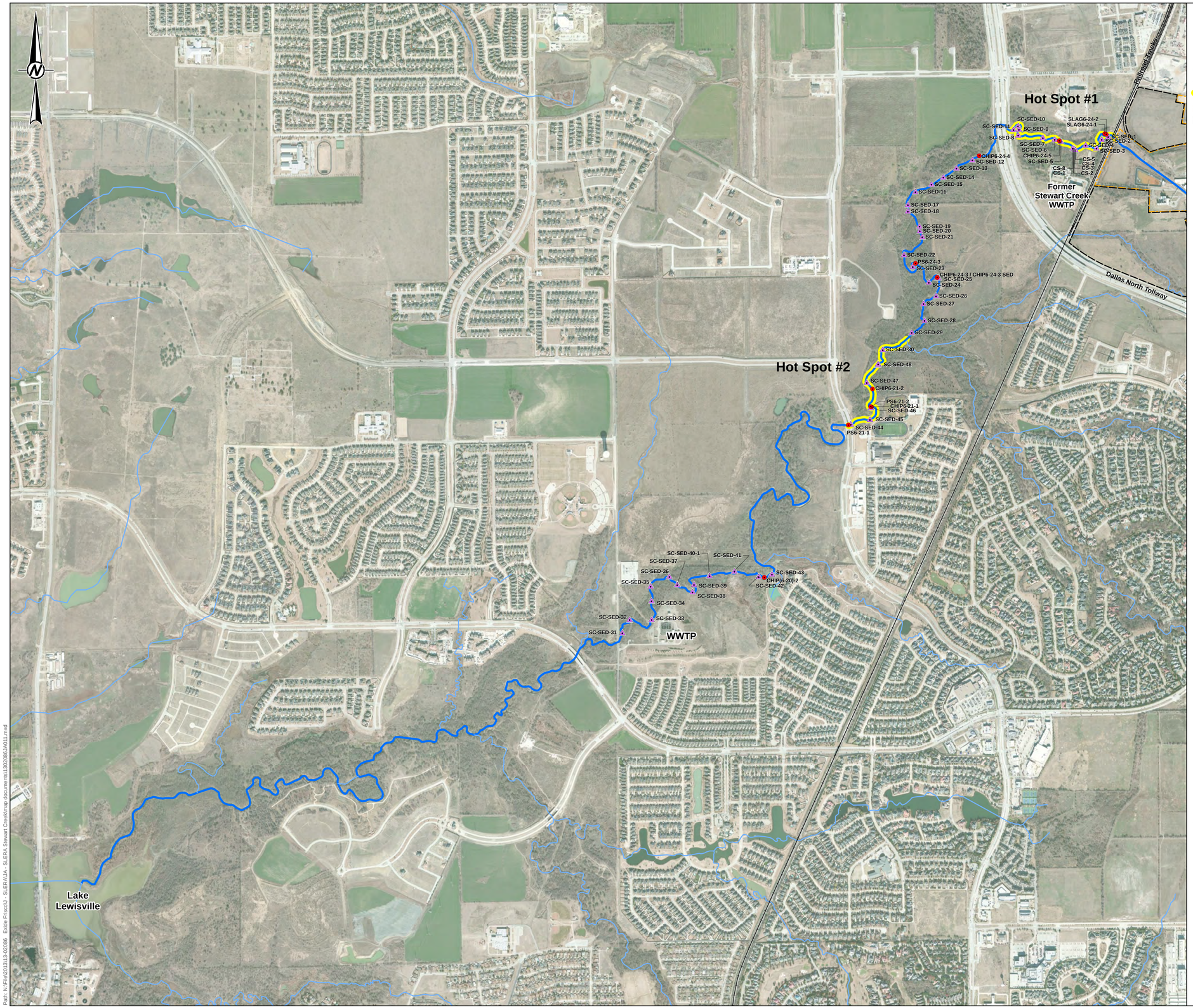


LEGEND

- Sediment Sample Location
- Chip, Slag, or Possible Slag
- Stewart Creek
- Other Creek / Tributary
- Creek Hotspot
- Exide Site
- Undeveloped Buffer Property

NOTES

1. USACE - U.S. ARMY CORPS OF ENGINEERS
2. WWTP - WASTE WATER TREATMENT PLANT

REFERENCE

1. HYDROGRAPHY - TEXAS NATURAL RESOURCES INFORMATION SYSTEM, 2014
2. LOCATIONS - PBW (2010), SOUTHWEST GEOSCIENCE (2011 AND 2013)
3. IMAGERY - SOURCE: ESRI, DIGITALGLOBE, GEOEYE, I-CUBED, USDA, USGS, AEX, GETMAPPING, AEROGRID, IGN, IGP, AND THE GIS USER COMMUNITY

DRAFT

800 400 0 800 Feet

CLIENT
EXIDE TECHNOLOGIES
FRISCO, TX

PROJECT
SCREENING LEVEL ECOLOGICAL RISK ASSESSMENT

TITLE
2010, 2011, AND 2013 DOWNSTREAM SAMPLE LOCATIONS

CONSULTANT

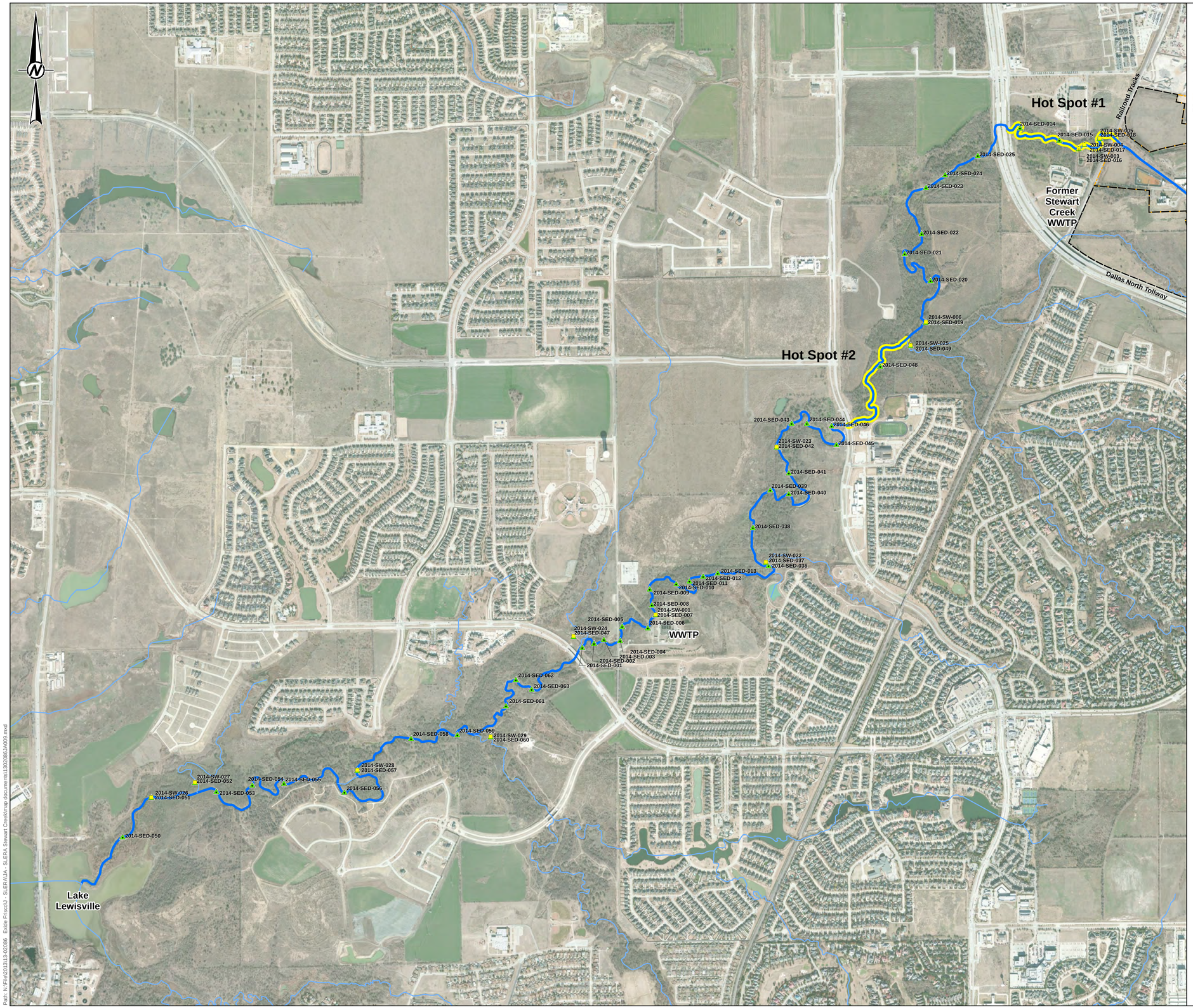
Golder Associates

YYYY-MM-DD	2014-14-12
PREPARED	JWT
DESIGN	JWT
REVIEW	AMF
APPROVED	####

PROJECT No.	CONTROL	Rev.	FIGURE
13-02086	1302086JA011.MXD	0	4

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET HAS BEEN MODIFIED FROM: ANSI D

Path: N:\File\2013\13-02086 Exide Frisco\J - SLERA\JA - SLERA Stewart Creek\map documents\1302086JA011.mxd



LEGEND

- 2014 Sediment Sample Location
- 2014 Surface Water Sample Location
- Stewart Creek
- Other Creek / Tributary
- Former Operating Plant
- Undeveloped Buffer Property

NOTES

1. USACE - U.S. ARMY CORPS OF ENGINEERS
2. WWTP - WASTE WATER TREATMENT PLANT

REFERENCE

1. HYDROGRAPHY - TEXAS NATURAL RESOURCES INFORMATION SYSTEM, 2014
2. LOCATIONS - GOLDER, 2014
3. AERIAL IMAGERY - SOURCE: ESRI, DIGITALGLOBE, GEOEYE, I-CUBED, USDA, USGS, AEX, GETMAPPING, AEROGRID, IGN, IGP, AND THE GIS USER COMMUNITY

DRAFT

800 400 0 800
Feet

CLIENT
EXIDE TECHNOLOGIES
FRISCO, TX

PROJECT
SCREENING LEVEL ECOLOGICAL RISK ASSESSMENT

TITLE
2014 DOWNSTREAM SURFACE WATER AND SEDIMENT SAMPLE LOCATIONS

CONSULTANT

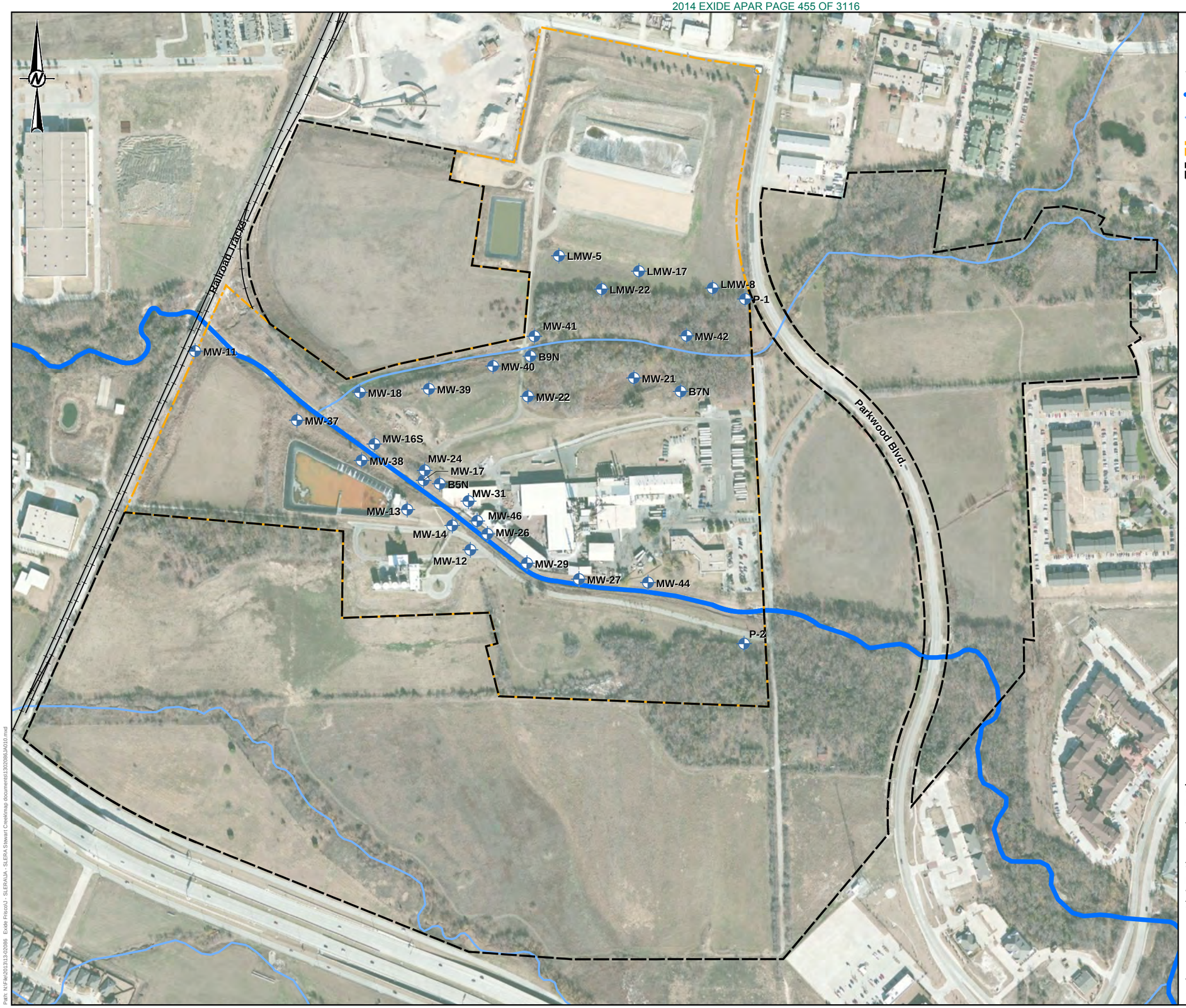
Golder Associates

YYYY-MM-DD	2014-14-12
PREPARED	JWT
DESIGN	JWT
REVIEW	AMF
APPROVED	####

PROJECT No.	CONTROL	Rev.	FIGURE
13-02086	1302086JA009.MXD	0	5

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET HAS BEEN MODIFIED FROM: ANSI D

Path: N:\File\2013\13-02086 Exide Frisco\J - SLERA\JA - SLERA Stewart Creek\map documents\1302086JA009.mxd



LEGEND

- MW
- Railroad
- Stewart Creek
- Other Creek / Tributary
- Former Operating Plant
- Undeveloped Buffer Property

REFERENCE

1. HYDROGRAPHY - TEXAS NATURAL RESOURCES INFORMATION SYSTEM, 2014
2. LOCATIONS - PBW, SOUTHWEST GEOSCIENCES, AND GOLDER
3. AERIAL IMAGERY - SOURCE: ESRI, DIGITALGLOBE, GEOEYE, I-CUBED, USDA, USGS, AEX, GETMAPPING, AEROGRID, IGN, IGP, AND THE GIS USER COMMUNITY

DRAFT

400 200 0 400 Feet

CLIENT
EXIDE TECHNOLOGIES

PROJECT
SCREENING LEVEL ECOLOGICAL RISK ASSESSMENT

TITLE
MONITORING WELL THAT REPRESENT THE GROUNDWATER TO SURFACE WATER PATHWAY

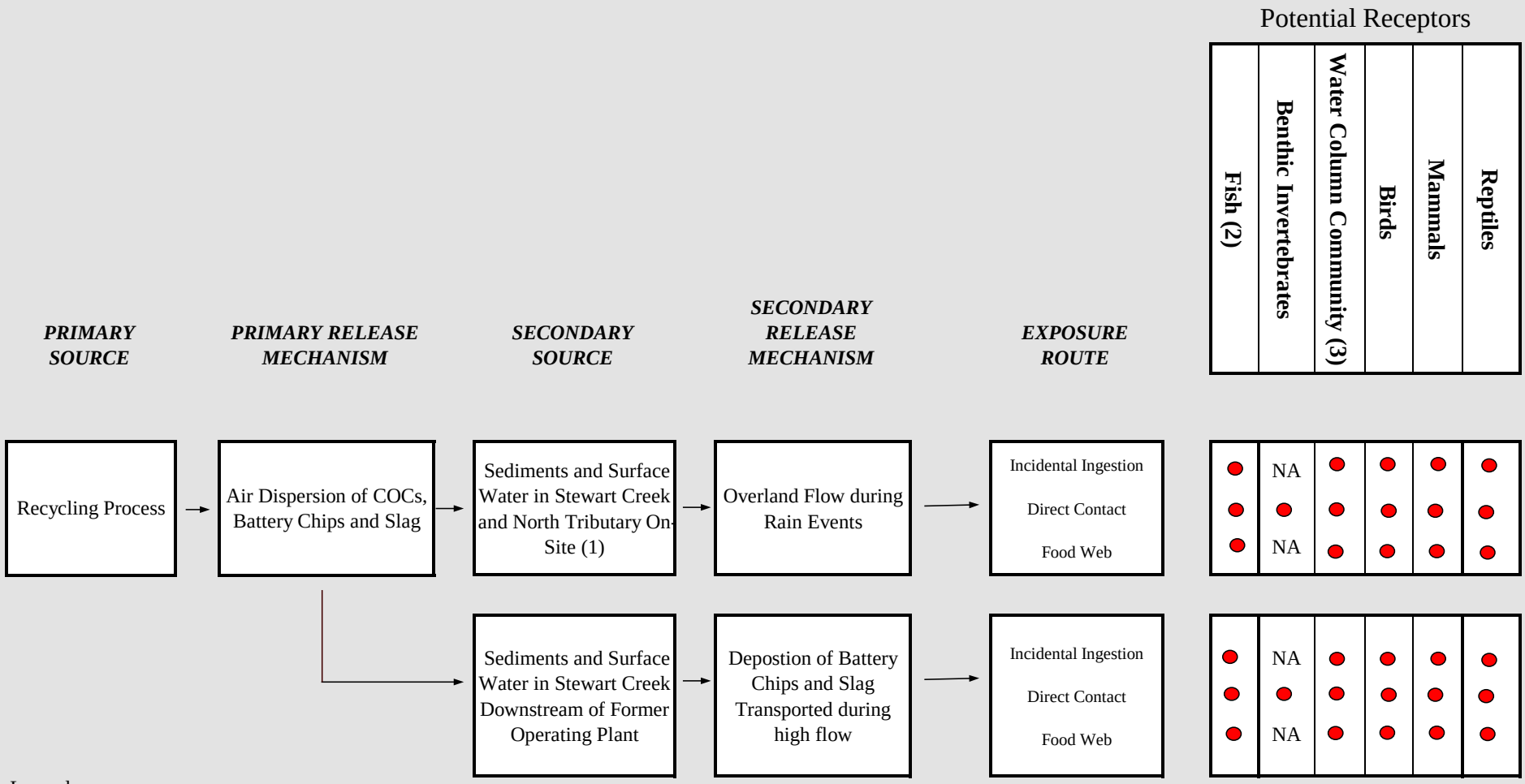
CONSULTANT
Golder Associates

YYYY-MM-DD	2014-14-12
PREPARED	JWT
DESIGN	####
REVIEW	####
APPROVED	####

PROJECT No.	CONTROL	Rev.	FIGURE
13-02086	1302086JA010.mxd	0	6

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET HAS BEEN MODIFIED FROM: ANSI B
1 in
0

Path: N:\File\2013\13-02086 Exide Frisco\1 - SLERA\JA - SLERA Stewart Creek\map documents\1302086JA010.mxd

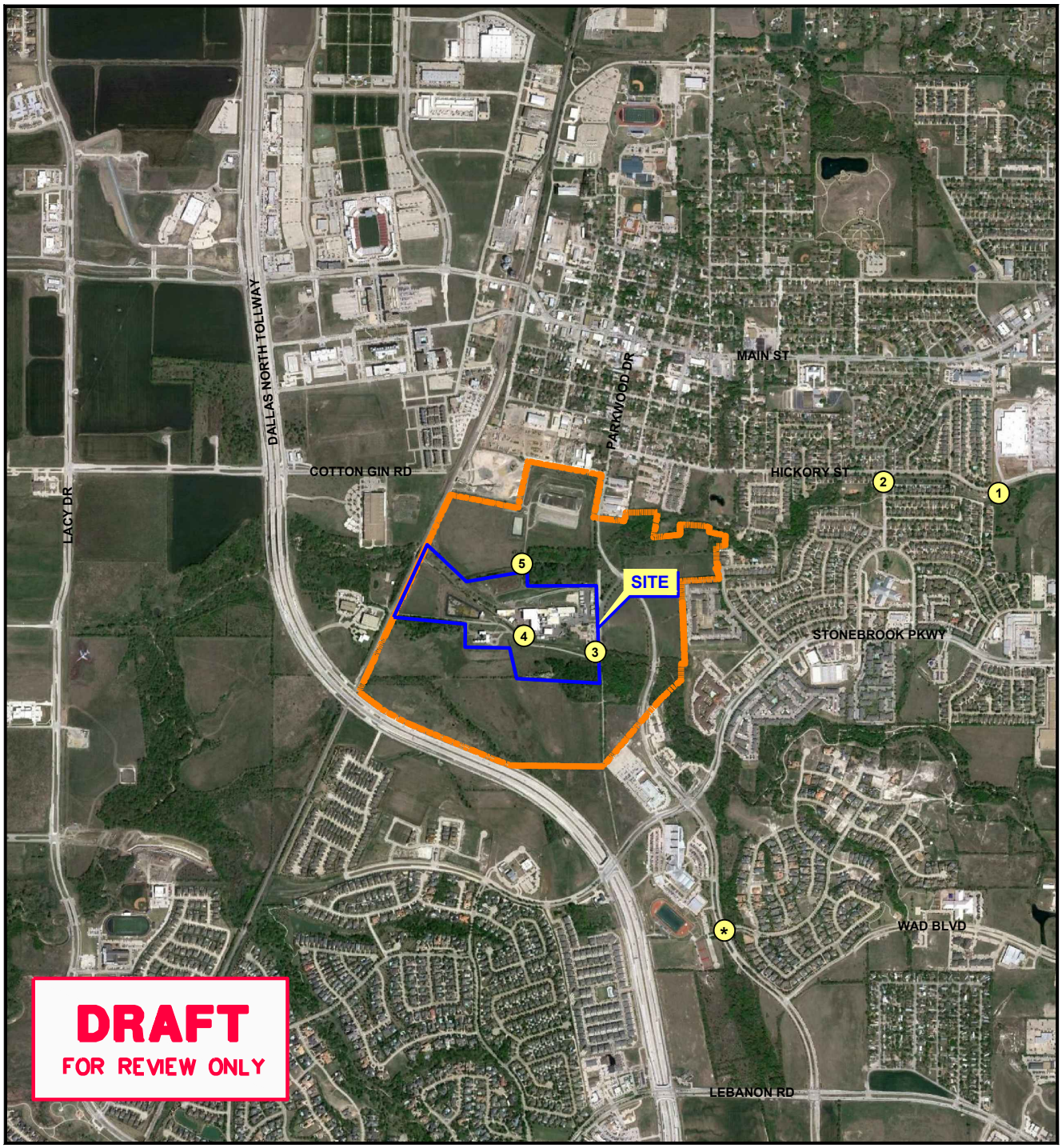


Legend:
● Potentially complete pathway
NA Not an applicable pathway for receptor.
(1) Stewart Creek is considered perennial and North Tributary is considered intermittent.
(2) The sediment-to-fish pathway is evaluated using tissue residue concentrations.
(3) Water column community includes amphibians, fish and invertebrates.

Figure 7. Ecological Conceptual Site Model
Stewart Creek

APPENDIX A

PHOTOGRAPHIC LOG

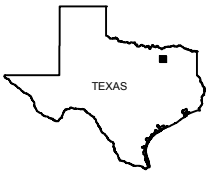


Investigation Area Boundar

Boundar of Propert Owned b Exide

(1) Photograph Location

(*) Entrance to Chapel Cree Estates with Several Fountains in Stewart Cree



QUADRANGLE LOCATIONS

N

Approx. Scale in Feet

0 1000 2000

SOURCE:
Base map from Google Earth, photograph dated 3 31 2011.

EXIDE RECYCLING CENTER
FRISCO, TEXAS

Figure A 1

SITE LOCATION MAP WITH NUMBERED REFERENCES TO PICTURES

PROJECT: 1755	BY: ADJ	REVISIONS
DATE: MARCH, 201	CHECKED: EFP	

PASTOR, BEHLING & WHEELER, LLC
CONSULTING ENGINEERS AND SCIENTISTS

Picture 1a. At apartment complex on E. Hickory, west of Preston Rd. looking toward north tributary of Stewart Creek. This landscaping feature with irrigation pipes visible drains into Stewart Creek.

Picture 1b. Looking upstream at north tributary of Stewart Creek from bridge at apartment complex on E. Hickory St. Irrigation system is visible (associated with apartment complex landscaping).

Picture 1c. Looking downstream at north tributary of Stewart Creek from bridge at apartment complex on E. Hickory St. Streambed is paved until it reaches Oak Creek Park.

Picture 2a. North tributary of Stewart Creek at Oak Creek Park at E. Hickory St. and Woodstream Drive.

Picture 2b. Standing on bridge on Woodstream Dr. looking downstream at the North Tributary of Stewart Creek.

Picture 2c. Looking downstream at the North Tributary of Stewart Creek in Oak Creek Park.

Picture 2d. Looking downstream at the North Tributary of Stewart Creek in Oak Creek Park.

Picture 3a. On-site on bridge on Eagan Dr. looking upstream at Stewart Creek.

Picture 3b. On-site on bridge on Eagan Dr. looking downstream at Stewart Creek as it enters the Site.

Picture 4. Stewart Creek directly behind the main plant at the Site.

Picture 5a. Looking upstream of the relocated North Tributary of Stewart Creek on-site on the road leading from the FRC plant to the landfill to the north of the facility.

Picture 5b. Looking downstream of the relocated North Tributary of Stewart Creek on-site on the road leading from the Site to the landfill to the north of the facility.

APPENDIX B

ProUCL STATISTICAL OUTPUT

APPENDIX B-1

SEDIMENT STEWART CREEK UPSTREAM

UCL Statistics for Uncensored Full Data Sets

User Selected Options	
Date/Time of Computation	5/6/2014 11:04
From File	working file upstream sed.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Arsenic

General Statistics

Total Number of Observations	10	Number of Distinct Observations	10
		Number of Missing Observations	0
Minimum	8.55	Mean	15.95
Maximum	42.7	Median	12.95
SD	9.948	Std. Error of Mean	3.146
Coefficient of Variation	0.624	Skewness	2.589

Normal GOF Test

Shapiro Wilk Test Statistic	0.66	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.842	Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.33	Lilliefors GOF Test
5% Lilliefors Critical Value	0.28	Data Not Normal at 5% Significance Level
Data Not Normal at 5% Significance Level		

Assuming Normal Distribution

95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	21.71	95% Adjusted-CLT UCL (Chen-1995)	23.87
		95% Modified-t UCL (Johnson-1978)	22.14

Gamma GOF Test

A-D Test Statistic	0.891	Anderson-Darling Gamma GOF Test
5% A-D Critical Value	0.729	Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.278	Kolmogrov-Smirnoff Gamma GOF Test
5% K-S Critical Value	0.268	Data Not Gamma Distributed at 5% Significance Level
Data Not Gamma Distributed at 5% Significance Level		

Gamma Statistics

k hat (MLE)	4.565	k star (bias corrected MLE)	3.262
Theta hat (MLE)	3.493	Theta star (bias corrected MLE)	4.888
nu hat (MLE)	91.3	nu star (bias corrected)	65.25
MLE Mean (bias corrected)	15.95	MLE Sd (bias corrected)	8.828
		Approximate Chi Square Value (0.05)	47.66
Adjusted Level of Significance	0.0267	Adjusted Chi Square Value	45.06

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	21.83	95% Adjusted Gamma UCL (use when n<50)	23.09

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.847	Shapiro Wilk Lognormal GOF Test
5% Shapiro Wilk Critical Value	0.842	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.242	Lilliefors Lognormal GOF Test
5% Lilliefors Critical Value	0.28	Data appear Lognormal at 5% Significance Level
Data appear Lognormal at 5% Significance Level		

Lognormal Statistics

Minimum of Logged Data	2.146	Mean of logged Data	2.656
Maximum of Logged Data	3.754	SD of logged Data	0.454

Assuming Lognormal Distribution

95% H-UCL	21.86	90% Chebyshev (MVUE) UCL	22.42
95% Chebyshev (MVUE) UCL	25.51	97.5% Chebyshev (MVUE) UCL	29.8
99% Chebyshev (MVUE) UCL	38.22		

Nonparametric Distribution Free UCL Statistics
Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	21.12	95% Jackknife UCL	21.71
95% Standard Bootstrap UCL	20.71	95% Bootstrap-t UCL	35.23
95% Hall's Bootstrap UCL	45.72	95% Percentile Bootstrap UCL	21.31
95% BCA Bootstrap UCL	23.49		
90% Chebyshev(Mean, Sd) UCL	25.38	95% Chebyshev(Mean, Sd) UCL	29.66
97.5% Chebyshev(Mean, Sd) UCL	35.59	99% Chebyshev(Mean, Sd) UCL	47.24

Suggested UCL to Use

95% Student's-t UCL	**21.71**	**or 95% Modified-t UCL**	**22.14**
or 95% H-UCL	**21.86**		

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002) and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

ProUCL computes and outputs H-statistic based UCLs for historical reasons only.
H-statistic often results in unstable (both high and low) values of UCL95 as shown in examples in the Technical Guide.
It is therefore recommended to avoid the use of H-statistic based 95% UCLs.
Use of nonparametric methods are preferred to compute UCL95 for skewed data sets which do not follow a gamma distribution.

Cadmium

General Statistics

Total Number of Observations	10	Number of Distinct Observations	10
		Number of Missing Observations	0
Minimum	0.26	Mean	0.439
Maximum	0.691	Median	0.389
SD	0.148	Std. Error of Mean	0.0469
Coefficient of Variation	0.338	Skewness	0.555

Normal GOF Test

Shapiro Wilk Test Statistic	0.922	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.842	Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.223	Lilliefors GOF Test
5% Lilliefors Critical Value	0.28	Data appear Normal at 5% Significance Level

Data appear Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	0.525	95% Adjusted-CLT UCL (Chen-1995)	0.525
		95% Modified-t UCL (Johnson-1978)	0.526

Gamma GOF Test

A-D Test Statistic	0.317	Anderson-Darling Gamma GOF Test
5% A-D Critical Value	0.725	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.196	Kolmogrov-Smirnoff Gamma GOF Test
5% K-S Critical Value	0.267	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	10.02	k star (bias corrected MLE)	7.078
Theta hat (MLE)	0.0438	Theta star (bias corrected MLE)	0.062
nu hat (MLE)	200.3	nu star (bias corrected)	141.6
MLE Mean (bias corrected)	0.439	MLE Sd (bias corrected)	0.165
		Approximate Chi Square Value (0.05)	115.1
Adjusted Level of Significance	0.0267	Adjusted Chi Square Value	110.9

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	0.54	95% Adjusted Gamma UCL (use when n<50)	0.56

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.948	Shapiro Wilk Lognormal GOF Test
5% Shapiro Wilk Critical Value	0.842	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.173	Lilliefors Lognormal GOF Test
5% Lilliefors Critical Value	0.28	Data appear Lognormal at 5% Significance Level

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	-1.347	Mean of logged Data	-0.875
Maximum of Logged Data	-0.37	SD of logged Data	0.335

Assuming Lognormal Distribution

95% H-UCL	0.552	90% Chebyshev (MVUE) UCL	0.579
95% Chebyshev (MVUE) UCL	0.643	97.5% Chebyshev (MVUE) UCL	0.731
99% Chebyshev (MVUE) UCL	0.905		

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	0.516	95% Jackknife UCL	0.525
95% Standard Bootstrap UCL	0.512	95% Bootstrap-t UCL	0.549
95% Hall's Bootstrap UCL	0.514	95% Percentile Bootstrap UCL	0.521
95% BCA Bootstrap UCL	0.517		
90% Chebyshev(Mean, Sd) UCL	0.58	95% Chebyshev(Mean, Sd) UCL	0.643
97.5% Chebyshev(Mean, Sd) UCL	0.732	99% Chebyshev(Mean, Sd) UCL	0.906

Suggested UCL to Use

95% Student's-t UCL	**0.525**

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002) and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

Lead

General Statistics

Total Number of Observations	10	Number of Distinct Observations	10
		Number of Missing Observations	0
Minimum	6.56	Mean	12.34
Maximum	19.8	Median	11.75
SD	3.826	Std. Error of Mean	1.21
Coefficient of Variation	0.31	Skewness	0.568

Normal GOF Test

Shapiro Wilk Test Statistic	0.973	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.842	Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.135	Lilliefors GOF Test
5% Lilliefors Critical Value	0.28	Data appear Normal at 5% Significance Level

Data appear Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	14.56	95% Adjusted-CLT UCL (Chen-1995)	14.56
		95% Modified-t UCL (Johnson-1978)	14.59

Gamma GOF Test

A-D Test Statistic	0.151	Anderson-Darling Gamma GOF Test
5% A-D Critical Value	0.725	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.122	Kolmogrov-Smirnoff Gamma GOF Test
5% K-S Critical Value	0.267	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	11.55	k star (bias corrected MLE)	8.15
Theta hat (MLE)	1.069	Theta star (bias corrected MLE)	1.514
nu hat (MLE)	231	nu star (bias corrected)	163
MLE Mean (bias corrected)	12.34	MLE Sd (bias corrected)	4.322
		Approximate Chi Square Value (0.05)	134.5
Adjusted Level of Significance	0.0267	Adjusted Chi Square Value	130

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	14.96	95% Adjusted Gamma UCL (use when n<50)	15.47

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.986	Shapiro Wilk Lognormal GOF Test
5% Shapiro Wilk Critical Value	0.842	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.144	Lilliefors Lognormal GOF Test
5% Lilliefors Critical Value	0.28	Data appear Lognormal at 5% Significance Level

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	1.881	Mean of logged Data	2.469
Maximum of Logged Data	2.986	SD of logged Data	0.316

Assuming Lognormal Distribution

95% H-UCL	15.32	90% Chebyshev (MVUE) UCL	16.08
95% Chebyshev (MVUE) UCL	17.77	97.5% Chebyshev (MVUE) UCL	20.12
99% Chebyshev (MVUE) UCL	24.73		

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	14.33	95% Jackknife UCL	14.56
95% Standard Bootstrap UCL	14.29	95% Bootstrap-t UCL	14.86
95% Hall's Bootstrap UCL	15.58	95% Percentile Bootstrap UCL	14.26
95% BCA Bootstrap UCL	14.22		
90% Chebyshev(Mean, Sd) UCL	15.97	95% Chebyshev(Mean, Sd) UCL	17.61
97.5% Chebyshev(Mean, Sd) UCL	19.89	99% Chebyshev(Mean, Sd) UCL	24.38

Suggested UCL to Use

95% Student's-t UCL	**14.56**

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002) and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

APPENDIX B-2

SEDIMENT NORTH TRIBUTARY (ON-SITE)

UCL Statistics for Uncensored Full Data Sets

User Selected Options	
Date/Time of Computation	5/6/2014 11:00
From File	working file north trib sed.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Cadmium

General Statistics

Total Number of Observations	10	Number of Distinct Observations	10
		Number of Missing Observations	0
Minimum	0.69	Mean	0.918
Maximum	1.19	Median	0.905
SD	0.169	Std. Error of Mean	0.0534
Coefficient of Variation	0.184	Skewness	0.228

Normal GOF Test

Shapiro Wilk Test Statistic	0.945	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.842	Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.199	Lilliefors GOF Test
5% Lilliefors Critical Value	0.28	Data appear Normal at 5% Significance Level

Data appear Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	1.016	95% Adjusted-CLT UCL (Chen-1995)	1.01
		95% Modified-t UCL (Johnson-1978)	1.016

Gamma GOF Test

A-D Test Statistic	0.316	Anderson-Darling Gamma GOF Test
5% A-D Critical Value	0.724	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.195	Kolmogrov-Smirnoff Gamma GOF Test
5% K-S Critical Value	0.266	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	32.94	k star (bias corrected MLE)	23.13
Theta hat (MLE)	0.0279	Theta star (bias corrected MLE)	0.0397
nu hat (MLE)	658.8	nu star (bias corrected)	462.5
MLE Mean (bias corrected)	0.918	MLE Sd (bias corrected)	0.191
		Approximate Chi Square Value (0.05)	413.6
Adjusted Level of Significance	0.0267	Adjusted Chi Square Value	405.6

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	1.026	95% Adjusted Gamma UCL (use when n<50)	1.047

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.949	Shapiro Wilk Lognormal GOF Test
5% Shapiro Wilk Critical Value	0.842	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.179	Lilliefors Lognormal GOF Test
5% Lilliefors Critical Value	0.28	Data appear Lognormal at 5% Significance Level

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	-0.371	Mean of logged Data	-0.101
Maximum of Logged Data	0.174	SD of logged Data	0.184

Assuming Lognormal Distribution

95% H-UCL	1.031	90% Chebyshev (MVUE) UCL	1.079
95% Chebyshev (MVUE) UCL	1.152	97.5% Chebyshev (MVUE) UCL	1.253
99% Chebyshev (MVUE) UCL	1.452		

Nonparametric Distribution Free UCL Statistics
Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	1.006	95% Jackknife UCL	1.016
95% Standard Bootstrap UCL	1	95% Bootstrap-t UCL	1.019
95% Hall's Bootstrap UCL	1.006	95% Percentile Bootstrap UCL	0.999
95% BCA Bootstrap UCL	1.009		
90% Chebyshev(Mean, Sd) UCL	1.078	95% Chebyshev(Mean, Sd) UCL	1.151
97.5% Chebyshev(Mean, Sd) UCL	1.251	99% Chebyshev(Mean, Sd) UCL	1.449

Suggested UCL to Use
95% Student's-t UCL **1.016**

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002) and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

Lead

General Statistics

Total Number of Observations	10	Number of Distinct Observations	9
		Number of Missing Observations	0
Minimum	10.4	Mean	16.51
Maximum	28.2	Median	14.95
SD	6.267	Std. Error of Mean	1.982
Coefficient of Variation	0.38	Skewness	0.681

Normal GOF Test

Shapiro Wilk Test Statistic	0.877	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.842	Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.259	Lilliefors GOF Test
5% Lilliefors Critical Value	0.28	Data appear Normal at 5% Significance Level

Data appear Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	20.14	95% Adjusted-CLT UCL (Chen-1995)	20.23
		95% Modified-t UCL (Johnson-1978)	20.21

Gamma GOF Test

A-D Test Statistic	0.578	Anderson-Darling Gamma GOF Test
5% A-D Critical Value	0.727	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.265	Kolmogrov-Smirnoff Gamma GOF Test
5% K-S Critical Value	0.267	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	8.141	k star (bias corrected MLE)	5.765
Theta hat (MLE)	2.028	Theta star (bias corrected MLE)	2.864
nu hat (MLE)	162.8	nu star (bias corrected)	115.3
MLE Mean (bias corrected)	16.51	MLE Sd (bias corrected)	6.876
		Approximate Chi Square Value (0.05)	91.51
Adjusted Level of Significance	0.0267	Adjusted Chi Square Value	87.83

Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50))	20.8	95% Adjusted Gamma UCL (use when n<50)	21.67

Lognormal GOF Test		
Shapiro Wilk Test Statistic	0.883	Shapiro Wilk Lognormal GOF Test
5% Shapiro Wilk Critical Value	0.842	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.249	Lilliefors Lognormal GOF Test
5% Lilliefors Critical Value	0.28	Data appear Lognormal at 5% Significance Level
Data appear Lognormal at 5% Significance Level		

Lognormal Statistics			
Minimum of Logged Data	2.342	Mean of logged Data	2.741
Maximum of Logged Data	3.339	SD of logged Data	0.37

Assuming Lognormal Distribution			
95% H-UCL	21.4	90% Chebyshev (MVUE) UCL	22.34
95% Chebyshev (MVUE) UCL	24.99	97.5% Chebyshev (MVUE) UCL	28.67
99% Chebyshev (MVUE) UCL	35.89		

Nonparametric Distribution Free UCL Statistics
Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs			
95% CLT UCL	19.77	95% Jackknife UCL	20.14
95% Standard Bootstrap UCL	19.54	95% Bootstrap-t UCL	20.78
95% Hall's Bootstrap UCL	19.97	95% Percentile Bootstrap UCL	19.76
95% BCA Bootstrap UCL	20.04		
90% Chebyshev(Mean, Sd) UCL	22.46	95% Chebyshev(Mean, Sd) UCL	25.15
97.5% Chebyshev(Mean, Sd) UCL	28.89	99% Chebyshev(Mean, Sd) UCL	36.23

Suggested UCL to Use	
95% Student's-t UCL	**20.14**

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

APPENDIX B-3

SEDIMENT STEWART CREEK (ON-SITE)

UCL Statistics for Uncensored Full Data Sets

User Selected Options	
Date/Time of Computation	5/6/2014 11:02
From File	working file on site sed.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Cadmium

General Statistics

Total Number of Observations	13	Number of Distinct Observations	12
		Number of Missing Observations	0
Minimum	0.34	Mean	1
Maximum	2.08	Median	0.86
SD	0.431	Std. Error of Mean	0.119
Coefficient of Variation	0.431	Skewness	1.302

Normal GOF Test

Shapiro Wilk Test Statistic	0.874	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.866	Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.223	Lilliefors GOF Test
5% Lilliefors Critical Value	0.246	Data appear Normal at 5% Significance Level
Data appear Normal at 5% Significance Level		

Assuming Normal Distribution

95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	1.213	95% Adjusted-CLT UCL (Chen-1995)	1.243
		95% Modified-t UCL (Johnson-1978)	1.22

Gamma GOF Test

A-D Test Statistic	0.554	Anderson-Darling Gamma GOF Test
5% A-D Critical Value	0.735	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.183	Kolmogrov-Smirnoff Gamma GOF Test
5% K-S Critical Value	0.237	Detected data appear Gamma Distributed at 5% Significance Level
Detected data appear Gamma Distributed at 5% Significance Level		

Gamma Statistics

k hat (MLE)	6.261	k star (bias corrected MLE)	4.867
Theta hat (MLE)	0.16	Theta star (bias corrected MLE)	0.205
nu hat (MLE)	162.8	nu star (bias corrected)	126.5
MLE Mean (bias corrected)	1	MLE Sd (bias corrected)	0.453
		Approximate Chi Square Value (0.05)	101.6
Adjusted Level of Significance	0.0301	Adjusted Chi Square Value	98.38

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	1.246	95% Adjusted Gamma UCL (use when n<50)	1.286

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.919	Shapiro Wilk Lognormal GOF Test
5% Shapiro Wilk Critical Value	0.866	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.206	Lilliefors Lognormal GOF Test
5% Lilliefors Critical Value	0.246	Data appear Lognormal at 5% Significance Level
Data appear Lognormal at 5% Significance Level		

Lognormal Statistics

Minimum of Logged Data	-1.079	Mean of logged Data	-0.082
Maximum of Logged Data	0.732	SD of logged Data	0.429

Assuming Lognormal Distribution

95% H-UCL	1.299	90% Chebyshev (MVUE) UCL	1.367
95% Chebyshev (MVUE) UCL	1.533	97.5% Chebyshev (MVUE) UCL	1.762
99% Chebyshev (MVUE) UCL	2.213		

Nonparametric Distribution Free UCL Statistics
Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	1.196	95% Jackknife UCL	1.213
95% Standard Bootstrap UCL	1.184	95% Bootstrap-t UCL	1.274
95% Hall's Bootstrap UCL	1.485	95% Percentile Bootstrap UCL	1.202
95% BCA Bootstrap UCL	1.261		
90% Chebyshev(Mean, Sd) UCL	1.358	95% Chebyshev(Mean, Sd) UCL	1.521
97.5% Chebyshev(Mean, Sd) UCL	1.746	99% Chebyshev(Mean, Sd) UCL	2.188

Suggested UCL to Use
95% Student's-t UCL **1.213**

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

Lead

General Statistics

Total Number of Observations	13	Number of Distinct Observations	12
		Number of Missing Observations	0
Minimum	6.57	Mean	12.21
Maximum	19.2	Median	10.9
SD	4.155	Std. Error of Mean	1.152
Coefficient of Variation	0.34	Skewness	0.371

Normal GOF Test

Shapiro Wilk Test Statistic	0.931	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.866	Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.183	Lilliefors GOF Test
5% Lilliefors Critical Value	0.246	Data appear Normal at 5% Significance Level

Data appear Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	14.26	95% Adjusted-CLT UCL (Chen-1995)	14.23
		95% Modified-t UCL (Johnson-1978)	14.28

Gamma GOF Test

A-D Test Statistic	0.336	Anderson-Darling Gamma GOF Test
5% A-D Critical Value	0.734	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.154	Kolmogrov-Smirnoff Gamma GOF Test
5% K-S Critical Value	0.237	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	9.296	k star (bias corrected MLE)	7.202
Theta hat (MLE)	1.313	Theta star (bias corrected MLE)	1.695
nu hat (MLE)	241.7	nu star (bias corrected)	187.3
MLE Mean (bias corrected)	12.21	MLE Sd (bias corrected)	4.548
		Approximate Chi Square Value (0.05)	156.6
Adjusted Level of Significance	0.0301	Adjusted Chi Square Value	152.6

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	14.59	95% Adjusted Gamma UCL (use when n<50)	14.98

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.948	Shapiro Wilk Lognormal GOF Test
5% Shapiro Wilk Critical Value	0.866	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.152	Lilliefors Lognormal GOF Test
5% Lilliefors Critical Value	0.246	Data appear Lognormal at 5% Significance Level

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	1.883	Mean of logged Data	2.447
Maximum of Logged Data	2.955	SD of logged Data	0.347

Assuming Lognormal Distribution

95% H-UCL	14.93	90% Chebyshev (MVUE) UCL	15.79
95% Chebyshev (MVUE) UCL	17.41	97.5% Chebyshev (MVUE) UCL	19.66
99% Chebyshev (MVUE) UCL	24.08		

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	14.1	95% Jackknife UCL	14.26
95% Standard Bootstrap UCL	14.09	95% Bootstrap-t UCL	14.52
95% Hall's Bootstrap UCL	14	95% Percentile Bootstrap UCL	14.03
95% BCA Bootstrap UCL	14.08		
90% Chebyshev(Mean, Sd) UCL	15.66	95% Chebyshev(Mean, Sd) UCL	17.23
97.5% Chebyshev(Mean, Sd) UCL	19.4	99% Chebyshev(Mean, Sd) UCL	23.67

Suggested UCL to Use

95% Student's-t UCL	**14.26**

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002) and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

APPENDIX B-4

SEDIMENT STEWART CREEK FROM FOP AND DOWNSTREAM

UCL Statistics for Uncensored Full Data Sets

User Selected Options	
Date/Time of Computation	5/6/2014 10:54
From File	working file all sed.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Arsenic

General Statistics

Total Number of Observations	121	Number of Distinct Observations	92
		Number of Missing Observations	0
Minimum	7	Mean	22.16
Maximum	279	Median	17.7
SD	25.71	Std. Error of Mean	2.338
Coefficient of Variation	1.16	Skewness	8.497

Normal GOF Test

Shapiro Wilk Test Statistic	0.391	Shapiro Wilk GOF Test
5% Shapiro Wilk P Value	0	Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.283	Lilliefors GOF Test
5% Lilliefors Critical Value	0.0805	Data Not Normal at 5% Significance Level

Data Not Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	26.03	95% Adjusted-CLT UCL (Chen-1995)	27.93
		95% Modified-t UCL (Johnson-1978)	26.33

Gamma GOF Test

A-D Test Statistic	4.091	Anderson-Darling Gamma GOF Test
5% A-D Critical Value	0.76	Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.144	Kolmogrov-Smirnoff Gamma GOF Test
5% K-S Critical Value	0.0847	Data Not Gamma Distributed at 5% Significance Level

Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	2.759	k star (bias corrected MLE)	2.696
Theta hat (MLE)	8.031	Theta star (bias corrected MLE)	8.218
nu hat (MLE)	667.7	nu star (bias corrected)	652.5
MLE Mean (bias corrected)	22.16	MLE Sd (bias corrected)	13.49
		Approximate Chi Square Value (0.05)	594.2
Adjusted Level of Significance	0.048	Adjusted Chi Square Value	593.5

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	24.33	95% Adjusted Gamma UCL (use when n<50)	24.36

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.935	Shapiro Wilk Lognormal GOF Test
5% Shapiro Wilk P Value	6.67E-06	Data Not Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.0882	Lilliefors Lognormal GOF Test
5% Lilliefors Critical Value	0.0805	Data Not Lognormal at 5% Significance Level

Data Not Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	1.946	Mean of logged Data	2.906
Maximum of Logged Data	5.631	SD of logged Data	0.527

Assuming Lognormal Distribution

95% H-UCL	22.95	90% Chebyshev (MVUE) UCL	24.18
95% Chebyshev (MVUE) UCL	25.63	97.5% Chebyshev (MVUE) UCL	27.65
99% Chebyshev (MVUE) UCL	31.6		

Nonparametric Distribution Free UCL Statistics
Data do not follow a Discernible Distribution (0.05)

Nonparametric Distribution Free UCLs

95% CLT UCL	26	95% Jackknife UCL	26.03
95% Standard Bootstrap UCL	25.98	95% Bootstrap-t UCL	30.45
95% Hall's Bootstrap UCL	41.57	95% Percentile Bootstrap UCL	26.77
95% BCA Bootstrap UCL	29.35		
90% Chebyshev(Mean, Sd) UCL	29.17	95% Chebyshev(Mean, Sd) UCL	32.35
97.5% Chebyshev(Mean, Sd) UCL	36.76	99% Chebyshev(Mean, Sd) UCL	45.42

Suggested UCL to Use
95% Chebyshev (Mean, Sd) UCL **32.35**

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

Cadmium

General Statistics

Total Number of Observations	144	Number of Distinct Observations	111
		Number of Missing Observations	0
Minimum	0.04	Mean	1.078
Maximum	6.96	Median	0.87
SD	0.933	Std. Error of Mean	0.0778
Coefficient of Variation	0.866	Skewness	3.11

Normal GOF Test

Shapiro Wilk Test Statistic	0.713	Shapiro Wilk GOF Test
5% Shapiro Wilk P Value	0	Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.236	Lilliefors GOF Test
5% Lilliefors Critical Value	0.0738	Data Not Normal at 5% Significance Level

Data Not Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	1.207	95% Adjusted-CLT UCL (Chen-1995)	1.227
		95% Modified-t UCL (Johnson-1978)	1.21

Gamma GOF Test

A-D Test Statistic	2.532	Anderson-Darling Gamma GOF Test
5% A-D Critical Value	0.765	Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.142	Kolmogrov-Smirnoff Gamma GOF Test
5% K-S Critical Value	0.0791	Data Not Gamma Distributed at 5% Significance Level

Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	2.119	k star (bias corrected MLE)	2.08
Theta hat (MLE)	0.509	Theta star (bias corrected MLE)	0.518
nu hat (MLE)	610.3	nu star (bias corrected)	598.9
MLE Mean (bias corrected)	1.078	MLE Sd (bias corrected)	0.747
		Approximate Chi Square Value (0.05)	543.1

Adjusted Level of Significance	0.0483	Adjusted Chi Square Value	542.6

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	1.189	95% Adjusted Gamma UCL (use when n<50)	1.19

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.978	Shapiro Wilk Lognormal GOF Test
5% Shapiro Wilk P Value	0.316	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.0959	Lilliefors Lognormal GOF Test
5% Lilliefors Critical Value	0.0738	Data Not Lognormal at 5% Significance Level

Data appear Approximate Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	-3.219	Mean of logged Data	-0.179
Maximum of Logged Data	1.94	SD of logged Data	0.715

Assuming Lognormal Distribution

95% H-UCL	1.215	90% Chebyshev (MVUE) UCL	1.292
95% Chebyshev (MVUE) UCL	1.389	97.5% Chebyshev (MVUE) UCL	1.523
99% Chebyshev (MVUE) UCL	1.788		

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	1.206	95% Jackknife UCL	1.207
95% Standard Bootstrap UCL	1.203	95% Bootstrap-t UCL	1.228
95% Hall's Bootstrap UCL	1.236	95% Percentile Bootstrap UCL	1.21
95% BCA Bootstrap UCL	1.227		
90% Chebyshev(Mean, Sd) UCL	1.311	95% Chebyshev(Mean, Sd) UCL	1.417
97.5% Chebyshev(Mean, Sd) UCL	1.564	99% Chebyshev(Mean, Sd) UCL	1.852

Suggested UCL to Use

95% Chebyshev (Mean, Sd) UCL	**1.417**

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

Lead

General Statistics

Total Number of Observations	143	Number of Distinct Observations	116
		Number of Missing Observations	0
Minimum	6.57	Mean	33.37
Maximum	459	Median	19.6
SD	57.25	Std. Error of Mean	4.788
Coefficient of Variation	1.716	Skewness	5.724

Normal GOF Test

Shapiro Wilk Test Statistic	0.375	Shapiro Wilk GOF Test
5% Shapiro Wilk P Value	0	Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.32	Lilliefors GOF Test
5% Lilliefors Critical Value	0.0741	Data Not Normal at 5% Significance Level

Data Not Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	41.29	95% Adjusted-CLT UCL (Chen-1995)	43.69

		95% Modified-t UCL (Johnson-1978)	41.68

Gamma GOF Test			
A-D Test Statistic	10.58	Anderson-Darling Gamma GOF Test	
5% A-D Critical Value	0.773	Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.181	Kolmogrov-Smirnoff Gamma GOF Test	
5% K-S Critical Value	0.08	Data Not Gamma Distributed at 5% Significance Level	
Data Not Gamma Distributed at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	1.4	k star (bias corrected MLE)	1.375
Theta hat (MLE)	23.83	Theta star (bias corrected MLE)	24.26
nu hat (MLE)	400.4	nu star (bias corrected)	393.4
MLE Mean (bias corrected)	33.37	MLE Sd (bias corrected)	28.45
		Approximate Chi Square Value (0.05)	348.4
Adjusted Level of Significance	0.0483	Adjusted Chi Square Value	348
Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50))	37.67	95% Adjusted Gamma UCL (use when n<50)	37.72
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.885	Shapiro Wilk Lognormal GOF Test	
5% Shapiro Wilk P Value	0	Data Not Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.115	Lilliefors Lognormal GOF Test	
5% Lilliefors Critical Value	0.0741	Data Not Lognormal at 5% Significance Level	
Data Not Lognormal at 5% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	1.883	Mean of logged Data	3.11
Maximum of Logged Data	6.129	SD of logged Data	0.712
Assuming Lognormal Distribution			
95% H-UCL	32.49	90% Chebyshev (MVUE) UCL	34.55
95% Chebyshev (MVUE) UCL	37.14	97.5% Chebyshev (MVUE) UCL	40.74
99% Chebyshev (MVUE) UCL	47.81		
Nonparametric Distribution Free UCL Statistics			
Data do not follow a Discernible Distribution (0.05)			
Nonparametric Distribution Free UCLs			
95% CLT UCL	41.24	95% Jackknife UCL	41.29
95% Standard Bootstrap UCL	41.13	95% Bootstrap-t UCL	46.4
95% Hall's Bootstrap UCL	45.59	95% Percentile Bootstrap UCL	42.15
95% BCA Bootstrap UCL	44.28		
90% Chebyshev(Mean, Sd) UCL	47.73	95% Chebyshev(Mean, Sd) UCL	54.24
97.5% Chebyshev(Mean, Sd) UCL	63.27	99% Chebyshev(Mean, Sd) UCL	81
Suggested UCL to Use			
95% Chebyshev (Mean, Sd) UCL	**54.24**		

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

APPENDIX B-5

SEDIMENT STEWART CREEK DOWNSTREAM OF FOP

UCL Statistics for Uncensored Full Data Sets

User Selected Options	
Date/Time of Computation	5/6/2014 13:06
From File	working file all sed past FOP.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Arsenic

General Statistics			
Total Number of Observations	121	Number of Distinct Observations	92
		Number of Missing Observations	0
Minimum	7	Mean	22.16
Maximum	279	Median	17.7
SD	25.71	Std. Error of Mean	2.338
Coefficient of Variation	1.16	Skewness	8.497
Normal GOF Test			
Shapiro Wilk Test Statistic	0.391	Shapiro Wilk GOF Test	
5% Shapiro Wilk P Value	0	Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.283	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.0805	Data Not Normal at 5% Significance Level	
Data Not Normal at 5% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	26.03	95% Adjusted-CLT UCL (Chen-1995)	27.93
		95% Modified-t UCL (Johnson-1978)	26.33
Gamma GOF Test			
A-D Test Statistic	4.091	Anderson-Darling Gamma GOF Test	
5% A-D Critical Value	0.76	Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.144	Kolmogrov-Smirnoff Gamma GOF Test	
5% K-S Critical Value	0.0847	Data Not Gamma Distributed at 5% Significance Level	
Data Not Gamma Distributed at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	2.759	k star (bias corrected MLE)	2.696
Theta hat (MLE)	8.031	Theta star (bias corrected MLE)	8.218
nu hat (MLE)	667.7	nu star (bias corrected)	652.5
MLE Mean (bias corrected)	22.16	MLE Sd (bias corrected)	13.49
		Approximate Chi Square Value (0.05)	594.2
Adjusted Level of Significance	0.048	Adjusted Chi Square Value	593.5
Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50))	24.33	95% Adjusted Gamma UCL (use when n<50)	24.36
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.935	Shapiro Wilk Lognormal GOF Test	
5% Shapiro Wilk P Value	6.67E-06	Data Not Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.0882	Lilliefors Lognormal GOF Test	
5% Lilliefors Critical Value	0.0805	Data Not Lognormal at 5% Significance Level	
Data Not Lognormal at 5% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	1.946	Mean of logged Data	2.906
Maximum of Logged Data	5.631	SD of logged Data	0.527

Assuming Lognormal Distribution

95% H-UCL	22.95	90% Chebyshev (MVUE) UCL	24.18
95% Chebyshev (MVUE) UCL	25.63	97.5% Chebyshev (MVUE) UCL	27.65
99% Chebyshev (MVUE) UCL	31.6		

Nonparametric Distribution Free UCL Statistics
Data do not follow a Discernible Distribution (0.05)

Nonparametric Distribution Free UCLs

95% CLT UCL	26	95% Jackknife UCL	26.03
95% Standard Bootstrap UCL	25.84	95% Bootstrap-t UCL	30.86
95% Hall's Bootstrap UCL	41.74	95% Percentile Bootstrap UCL	26.52
95% BCA Bootstrap UCL	30.31		
90% Chebyshev(Mean, Sd) UCL	29.17	95% Chebyshev(Mean, Sd) UCL	32.35
97.5% Chebyshev(Mean, Sd) UCL	36.76	99% Chebyshev(Mean, Sd) UCL	45.42

Suggested UCL to Use
95% Chebyshev (Mean, Sd) UCL **32.35**

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002) and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

Cadmium

General Statistics

Total Number of Observations	131	Number of Distinct Observations	106
		Number of Missing Observations	0
Minimum	0.04	Mean	1.086
Maximum	6.96	Median	0.87
SD	0.97	Std. Error of Mean	0.0847
Coefficient of Variation	0.893	Skewness	3.025

Normal GOF Test

Shapiro Wilk Test Statistic	0.712	Shapiro Wilk GOF Test
5% Shapiro Wilk P Value	0	Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.238	Lilliefors GOF Test
5% Lilliefors Critical Value	0.0774	Data Not Normal at 5% Significance Level

Data Not Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	1.226	95% Adjusted-CLT UCL (Chen-1995)	1.249
		95% Modified-t UCL (Johnson-1978)	1.23

Gamma GOF Test

A-D Test Statistic	2.333	Anderson-Darling Gamma GOF Test
5% A-D Critical Value	0.765	Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.142	Kolmogrov-Smirnoff Gamma GOF Test
5% K-S Critical Value	0.0825	Data Not Gamma Distributed at 5% Significance Level

Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	1.996	k star (bias corrected MLE)	1.956
Theta hat (MLE)	0.544	Theta star (bias corrected MLE)	0.555
nu hat (MLE)	523	nu star (bias corrected)	512.4
MLE Mean (bias corrected)	1.086	MLE Sd (bias corrected)	0.776

		Approximate Chi Square Value (0.05)	460.9
Adjusted Level of Significance	0.0482	Adjusted Chi Square Value	460.3

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	1.207	95% Adjusted Gamma UCL (use when n<50)	1.208

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.98	Shapiro Wilk Lognormal GOF Test
5% Shapiro Wilk P Value	0.436	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.0937	Lilliefors Lognormal GOF Test
5% Lilliefors Critical Value	0.0774	Data Not Lognormal at 5% Significance Level

Data appear Approximate Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	-3.219	Mean of logged Data	-0.189
Maximum of Logged Data	1.94	SD of logged Data	0.738

Assuming Lognormal Distribution

95% H-UCL	1.236	90% Chebyshev (MVUE) UCL	1.319
95% Chebyshev (MVUE) UCL	1.425	97.5% Chebyshev (MVUE) UCL	1.573
99% Chebyshev (MVUE) UCL	1.862		

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	1.225	95% Jackknife UCL	1.226
95% Standard Bootstrap UCL	1.226	95% Bootstrap-t UCL	1.263
95% Hall's Bootstrap UCL	1.27	95% Percentile Bootstrap UCL	1.238
95% BCA Bootstrap UCL	1.259		
90% Chebyshev(Mean, Sd) UCL	1.34	95% Chebyshev(Mean, Sd) UCL	1.455
97.5% Chebyshev(Mean, Sd) UCL	1.615	99% Chebyshev(Mean, Sd) UCL	1.928

Suggested UCL to Use

95% Chebyshev (Mean, Sd) UCL	**1.455**

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

Lead

General Statistics

Total Number of Observations	130	Number of Distinct Observations	108
		Number of Missing Observations	0
Minimum	8.2	Mean	35.48
Maximum	459	Median	20.75
SD	59.64	Std. Error of Mean	5.231
Coefficient of Variation	1.681	Skewness	5.479

Normal GOF Test

Shapiro Wilk Test Statistic	0.382	Shapiro Wilk GOF Test
5% Shapiro Wilk P Value	0	Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.324	Lilliefors GOF Test
5% Lilliefors Critical Value	0.0777	Data Not Normal at 5% Significance Level

Data Not Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	44.15	95% Adjusted-CLT UCL (Chen-1995)	46.77
		95% Modified-t UCL (Johnson-1978)	44.57

Gamma GOF Test

A-D Test Statistic	10.12	Anderson-Darling Gamma GOF Test
5% A-D Critical Value	0.772	Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.191	Kolmogrov-Smirnoff Gamma GOF Test
5% K-S Critical Value	0.0834	Data Not Gamma Distributed at 5% Significance Level

Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	1.416	k star (bias corrected MLE)	1.388
Theta hat (MLE)	25.06	Theta star (bias corrected MLE)	25.56
nu hat (MLE)	368.1	nu star (bias corrected)	360.9
MLE Mean (bias corrected)	35.48	MLE Sd (bias corrected)	30.12
		Approximate Chi Square Value (0.05)	317.9
Adjusted Level of Significance	0.0482	Adjusted Chi Square Value	317.4

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	40.29	95% Adjusted Gamma UCL (use when n<50)	40.34

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.871	Shapiro Wilk Lognormal GOF Test
5% Shapiro Wilk P Value	0	Data Not Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.112	Lilliefors Lognormal GOF Test
5% Lilliefors Critical Value	0.0777	Data Not Lognormal at 5% Significance Level

Data Not Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	2.104	Mean of logged Data	3.176
Maximum of Logged Data	6.129	SD of logged Data	0.706

Assuming Lognormal Distribution

95% H-UCL	34.7	90% Chebyshev (MVUE) UCL	36.97
95% Chebyshev (MVUE) UCL	39.84	97.5% Chebyshev (MVUE) UCL	43.81
99% Chebyshev (MVUE) UCL	51.61		

Nonparametric Distribution Free UCL Statistics

Data do not follow a Discernible Distribution (0.05)

Nonparametric Distribution Free UCLs

95% CLT UCL	44.09	95% Jackknife UCL	44.15
95% Standard Bootstrap UCL	44.11	95% Bootstrap-t UCL	50.28
95% Hall's Bootstrap UCL	47.93	95% Percentile Bootstrap UCL	44.57
95% BCA Bootstrap UCL	46.84		
90% Chebyshev(Mean, Sd) UCL	51.18	95% Chebyshev(Mean, Sd) UCL	58.28
97.5% Chebyshev(Mean, Sd) UCL	68.15	99% Chebyshev(Mean, Sd) UCL	87.53

Suggested UCL to Use

95% Chebyshev (Mean, Sd) UCL	**58.28**

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

APPENDIX B-6

SEDIMENT STEWART CREEK FROM FOP AND DOWNSTREAM (without hotspots)

UCL Statistics for Uncensored Full Data Sets

User Selected Options	
Date/Time of Computation	5/6/2014 10:57
From File	working file all sed without hotspots.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Arsenic

General Statistics

Total Number of Observations	86	Number of Distinct Observations	71
		Number of Missing Observations	0
Minimum	7	Mean	19.91
Maximum	57.7	Median	17.3
SD	11.02	Std. Error of Mean	1.189
Coefficient of Variation	0.554	Skewness	1.447

Normal GOF Test

Shapiro Wilk Test Statistic	0.844	Shapiro Wilk GOF Test
5% Shapiro Wilk P Value	8.04E-13	Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.197	Lilliefors GOF Test
5% Lilliefors Critical Value	0.0955	Data Not Normal at 5% Significance Level

Data Not Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	21.89	95% Adjusted-CLT UCL (Chen-1995)	22.07
		95% Modified-t UCL (Johnson-1978)	21.92

Gamma GOF Test

A-D Test Statistic	1.574	Anderson-Darling Gamma GOF Test
5% A-D Critical Value	0.756	Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.133	Kolmogrov-Smirnoff Gamma GOF Test
5% K-S Critical Value	0.0968	Data Not Gamma Distributed at 5% Significance Level

Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	4.089	k star (bias corrected MLE)	3.954
Theta hat (MLE)	4.87	Theta star (bias corrected MLE)	5.036
nu hat (MLE)	703.3	nu star (bias corrected)	680.1
MLE Mean (bias corrected)	19.91	MLE Sd (bias corrected)	10.01
		Approximate Chi Square Value (0.05)	620.6
Adjusted Level of Significance	0.0472	Adjusted Chi Square Value	619.6

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	21.82	95% Adjusted Gamma UCL (use when n<50)	21.86

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.956	Shapiro Wilk Lognormal GOF Test
5% Shapiro Wilk P Value	0.0197	Data Not Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.0967	Lilliefors Lognormal GOF Test
5% Lilliefors Critical Value	0.0955	Data Not Lognormal at 5% Significance Level

Data Not Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	1.946	Mean of logged Data	2.864
Maximum of Logged Data	4.055	SD of logged Data	0.493

Assuming Lognormal Distribution

95% H-UCL	21.85	90% Chebyshev (MVUE) UCL	23.09
95% Chebyshev (MVUE) UCL	24.59	97.5% Chebyshev (MVUE) UCL	26.68
99% Chebyshev (MVUE) UCL	30.78		

Nonparametric Distribution Free UCL Statistics
Data do not follow a Discernible Distribution (0.05)

Nonparametric Distribution Free UCLs

95% CLT UCL	21.87	95% Jackknife UCL	21.89
95% Standard Bootstrap UCL	21.93	95% Bootstrap-t UCL	22.14
95% Hall's Bootstrap UCL	21.95	95% Percentile Bootstrap UCL	21.91
95% BCA Bootstrap UCL	22.22		
90% Chebyshev(Mean, Sd) UCL	23.48	95% Chebyshev(Mean, Sd) UCL	25.1
97.5% Chebyshev(Mean, Sd) UCL	27.34	99% Chebyshev(Mean, Sd) UCL	31.74

Suggested UCL to Use

95% Student's-t UCL	**21.89**	**or 95% Modified-t UCL**	**21.92**

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

Cadmium

General Statistics

Total Number of Observations	109	Number of Distinct Observations	89
		Number of Missing Observations	0
Minimum	0.16	Mean	1.006
Maximum	4.47	Median	0.84
SD	0.743	Std. Error of Mean	0.0712
Coefficient of Variation	0.739	Skewness	2.36

Normal GOF Test

Shapiro Wilk Test Statistic	0.783	Shapiro Wilk GOF Test
5% Shapiro Wilk P Value	0	Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.202	Lilliefors GOF Test
5% Lilliefors Critical Value	0.0849	Data Not Normal at 5% Significance Level

Data Not Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	1.124	95% Adjusted-CLT UCL (Chen-1995)	1.141
		95% Modified-t UCL (Johnson-1978)	1.127

Gamma GOF Test

A-D Test Statistic	1.106	Anderson-Darling Gamma GOF Test
5% A-D Critical Value	0.762	Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.114	Kolmogrov-Smirnoff Gamma GOF Test
5% K-S Critical Value	0.088	Data Not Gamma Distributed at 5% Significance Level

Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	2.492	k star (bias corrected MLE)	2.43
Theta hat (MLE)	0.404	Theta star (bias corrected MLE)	0.414
nu hat (MLE)	543.3	nu star (bias corrected)	529.7
MLE Mean (bias corrected)	1.006	MLE Sd (bias corrected)	0.646
		Approximate Chi Square Value (0.05)	477.3
Adjusted Level of Significance	0.0478	Adjusted Chi Square Value	476.7

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	1.117	95% Adjusted Gamma UCL (use when n<50)	1.118

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.974	Shapiro Wilk Lognormal GOF Test
5% Shapiro Wilk P Value	0.244	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.1	Lilliefors Lognormal GOF Test
5% Lilliefors Critical Value	0.0849	Data Not Lognormal at 5% Significance Level

Data appear Approximate Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	-1.833	Mean of logged Data	-0.208
Maximum of Logged Data	1.497	SD of logged Data	0.659

Assuming Lognormal Distribution

95% H-UCL	1.141	90% Chebyshev (MVUE) UCL	1.216
95% Chebyshev (MVUE) UCL	1.31	97.5% Chebyshev (MVUE) UCL	1.441
99% Chebyshev (MVUE) UCL	1.699		

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	1.123	95% Jackknife UCL	1.124
95% Standard Bootstrap UCL	1.126	95% Bootstrap-t UCL	1.149
95% Hall's Bootstrap UCL	1.155	95% Percentile Bootstrap UCL	1.123
95% BCA Bootstrap UCL	1.134		
90% Chebyshev(Mean, Sd) UCL	1.22	95% Chebyshev(Mean, Sd) UCL	1.317
97.5% Chebyshev(Mean, Sd) UCL	1.451	99% Chebyshev(Mean, Sd) UCL	1.715

Suggested UCL to Use

95% Chebyshev (Mean, Sd) UCL	**1.317**

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002) and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

Lead

General Statistics

Total Number of Observations	109	Number of Distinct Observations	88
		Number of Missing Observations	0
Minimum	6.57	Mean	21.36
Maximum	59	Median	18.5
SD	11.12	Std. Error of Mean	1.065
Coefficient of Variation	0.521	Skewness	1.394

Normal GOF Test

Shapiro Wilk Test Statistic	0.865	Shapiro Wilk GOF Test
5% Shapiro Wilk P Value	1.11E-14	Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.179	Lilliefors GOF Test
5% Lilliefors Critical Value	0.0849	Data Not Normal at 5% Significance Level

Data Not Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	23.13	95% Adjusted-CLT UCL (Chen-1995)	23.26
		95% Modified-t UCL (Johnson-1978)	23.15

Gamma GOF Test

A-D Test Statistic	1.25	Anderson-Darling Gamma GOF Test

5% A-D Critical Value	0.756	Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.116	Kolmogrov-Smirnoff Gamma GOF Test	
5% K-S Critical Value	0.0874	Data Not Gamma Distributed at 5% Significance Level	
Data Not Gamma Distributed at 5% Significance Level			

Gamma Statistics

k hat (MLE)	4.454	k star (bias corrected MLE)	4.337
Theta hat (MLE)	4.796	Theta star (bias corrected MLE)	4.925
nu hat (MLE)	971	nu star (bias corrected)	945.6
MLE Mean (bias corrected)	21.36	MLE Sd (bias corrected)	10.26
		Approximate Chi Square Value (0.05)	875.2
Adjusted Level of Significance	0.0478	Adjusted Chi Square Value	874.3

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	23.08	95% Adjusted Gamma UCL (use when n<50)	23.1

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.973	Shapiro Wilk Lognormal GOF Test	
5% Shapiro Wilk P Value	0.185	Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.0825	Lilliefors Lognormal GOF Test	
5% Lilliefors Critical Value	0.0849	Data appear Lognormal at 5% Significance Level	
Data appear Lognormal at 5% Significance Level			

Lognormal Statistics

Minimum of Logged Data	1.883	Mean of logged Data	2.945
Maximum of Logged Data	4.078	SD of logged Data	0.476

Assuming Lognormal Distribution

95% H-UCL	23.15	90% Chebyshev (MVUE) UCL	24.33
95% Chebyshev (MVUE) UCL	25.72	97.5% Chebyshev (MVUE) UCL	27.64
99% Chebyshev (MVUE) UCL	31.42		

Nonparametric Distribution Free UCL Statistics
Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	23.11	95% Jackknife UCL	23.13
95% Standard Bootstrap UCL	23.12	95% Bootstrap-t UCL	23.32
95% Hall's Bootstrap UCL	23.25	95% Percentile Bootstrap UCL	23.14
95% BCA Bootstrap UCL	23.19		
90% Chebyshev(Mean, Sd) UCL	24.56	95% Chebyshev(Mean, Sd) UCL	26
97.5% Chebyshev(Mean, Sd) UCL	28.01	99% Chebyshev(Mean, Sd) UCL	31.96

Suggested UCL to Use			
95% Student's-t UCL	**23.13**	**or 95% Modified-t UCL**	**23.15**
or 95% H-UCL	**23.15**		

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002) and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

ProUCL computes and outputs H-statistic based UCLs for historical reasons only.
H-statistic often results in unstable (both high and low) values of UCL95 as shown in examples in the Technical Guide.
It is therefore recommended to avoid the use of H-statistic based 95% UCLs.
Use of nonparametric methods are preferred to compute UCL95 for skewed data sets which do not follow a gamma distribution.

APPENDIX C

HABITAT ASSESSMENT FIELD SURVEY REPORT

HABITAT ASSESSMENT FIELD SURVEY REPORT

Exide Technologies
Frisco, Collin County, Texas

Prepared For:
Golder Associates, Inc.
St. Charles, Missouri 63301

Prepared By:
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March 2014

TABLE OF CONTENTS

1.0 INTRODUCTION 1
1.1 Purpose and Scope 1
1.2 Site Description 2
2.0 SAMPLING METHODS 3
2.1 Stewart Creek 3
2.2 Former Exide Facility 4
2.3 Data Collection 4
2.3.1 Field Data Log 4
2.3.2 Photographic Log 4
3.0 FIELD SURVEY RESULTS 5
3.1 Stewart Creek 5
3.2 Facility Property 7
3.2.1 Streams 7
3.2.2 Wooded Areas 9
3.2.3 Lake Parcel 11
4.0 DISCUSSION 12
4.1 Stewart Creek 12
4.1.1 Threatened and Endangered Species 12
4.2 Facility Property 14
4.2.1 Threatened and Endangered Species 15
5.0 REFERENCES 18

LIST OF FIGURES

Figure 1. Site Location Map 19

Figure 2. Stewart Creek Area Surveyed..... 20

Figure 3. Former Exide Facility Field Data Points and Transects 21

Figure 4. Threatened and Endangered Species Documented Occurences 22

Figure 5. Stewart Creek Habitat Plots, Benthic Surveys, and Wildlife Observations 23

Figure 6. North Wooded Area..... 28

Figure 7. Land Use Surrounding the Former Exide Facility..... 29

LIST OF ATTACHMENTS

Attachment A ..... Threatened and Endangered Species for Collin and Denton Counties

Attachment B ..... Wildlife Observations Field Data Sheets

Attachment C ..... Representative Photographs

1.0 INTRODUCTION

On July 9, 2013, Exide submitted an Affected Property Assessment Report (APAR) for the former Exide operating plant to the TCEQ. A Screening Level Ecological Risk Assessment (SLERA) was conducted as a part of the APAR and submitted to the agencies with the APAR. The APAR was reviewed by the EPA and TCEQ and comments were received by Exide on October 8, 2013.

Benchmark Ecological Services, Inc. was contracted to collect the ecological information needed to address two comments provided by TCEQ concerning the Exide SLERA. This Habitat Assessment will become part of the APAR for the former Exide Operating Plant. The TCEQ comments that were addressed are presented below.

> *SLERA General Comment #6: Since the assessment of Stewart Creek will continue downstream, the possibility exists that sediment may accumulate in locations that could support mollusks including the threatened Louisiana pigtoe and the Texas heelsplitter. In addition, it is possible that more viable habitat downstream may exist for other protected species, including the threatened White-faced ibis. It is recommended that these species and other protected species known to occur in Collin and Denton Counties be re-evaluated for potential occurrence in downstream Stewart Creek.*

> *SLERA Specific Comment # 13: Figure 9 (Conceptual Site Model). Reptiles and amphibians are likely present at this site and should be reflected in the conceptual site model. In addition, risk to these receptors should be qualitatively evaluated in the SLERA. The risk to reptiles could be tied to the evaluation of the Timber/Canebrake rattlesnake discussed previously and the risk to amphibians could be related to the evaluation of site surface water quality.*

1.1 PURPOSE AND SCOPE

Benchmark was contracted to conduct a wildlife habitat assessment of approximately 7.0 miles of Stewart Creek downstream of the former Exide facility and 36 acres of undeveloped land inside the former Exide facility. The location of the study areas are shown in Figure 1. Benchmark scientists conducted a general habitat assessment with emphasis on habitat that could support the threatened and endangered species listed for Collin and Denton Counties. The habitat assessments were conducted to provide information

needed to support the SLERA that is being conducted at the site.

To address General Comment #6, Benchmark mapped aquatic habitat in Stewart Creek between the former Exide facility and Lake Lewisville in two separate survey events. The initial survey event was conducted on January 15 and 16, 2014, and included all sections of the creek bordered by property owned by the city of Frisco and the United States Corp of Engineers (USACE). Access to sections bordered by private landowners was not granted until March 2014. Benchmark conducted a second survey event on March 18, 2014, in the sections of Stewart Creek not surveyed in January 2014. The creek downstream of the plant is approximately 7.0 miles long (Figure 2).

To address Specific Comment #13, Benchmark mapped wildlife habitat on approximately 36 acres of land within the former Exide facility on January 13 and 14, 2014. Risk calculations for the SLERA being conducted at the site required more information about wildlife utilization of the habitat. Benchmark delineated the habitats to determine if they are being utilized by threatened or endangered wildlife species. The former Exide facility study area is shown in Figure 3.

1.2 SITE DESCRIPTION

The former Exide Facility is located at 7471 South Fifth Street in Collin County, Frisco, Texas. The site, a secondary lead smelter, was active from 1964 through November 2012. It processed used lead-acid batteries and other lead-bearing materials into several lead products. The process produced a slag, which was processed and disposed of in a Class II landfill on-site. The process also produced battery-case chips which were disposed of off-site, and waste acid which was treated through the on-site wastewater-treatment system. The 87 acre former Exide Facility site includes approximately 36 acres of undeveloped land and modified stream channels. The on-site streams, which run east to west across the property, include a segment of Stewart Creek and an unnamed tributary of Stewart Creek (referred to as North Tributary). The streams converge west of the former Exide Facility and flow west toward Lake Lewisville.

Stewart Creek downstream of the former Exide Facility is a perennial stream that receives surface runoff from the former Exide Facility and treated wastewater from the North Texas Municipal Water District wastewater treatment plant. Immediately downstream of the former Exide facility, the stream contains a small number of perennial pools connected by segments of riffles and glides.

2.0 SAMPLING METHODS

2.1 STEWART CREEK

Benchmark conducted a habitat assessment on 7.0 miles of Stewart Creek between Lake Lewisville and the western boundary downstream of the former Exide facility as shown in Figure 2. Prior to conducting the field survey, Benchmark searched existing databases and queried resource agencies to determine if there are known threatened and endangered species occurrences within the study areas and surrounding properties. Figure 4 shows the location of endangered species occurrences identified prior to conducting the field survey. No historical endangered species occurrences were identified within the study areas.

Benchmark scientists walked, waded, and kayaked the sections of the creek shown in Figure 2 to document existing conditions and to locate habitat that could potentially support populations of benthic macro-invertebrates and other wildlife, including threatened or endangered species. Benchmark scientists conducted a general habitat survey noting the physical features of the creek, dominant plant species, and evidence of wildlife utilization.

Stream segments that exhibited favorable conditions for sediment accumulation (pools and glides) are also, in many cases, suitable habitats for benthic and aquatic wildlife. Benthic surveys were conducted within the stream segments that contained accumulated sediment using established stream assessment techniques. The benthic surveys were conducted at the stations shown in Figure 5. The surveys were conducted by first visually examining the sediment surface, and grab samples were collected using a clam rake. Within each transect, scientists waded across the stream or pool using multiple parallel paths perpendicular to the stream centerline. The results of each examination were documented in field notes and in a photographic log. Live specimens were returned to the streambed. Benchmark identified macro-invertebrates observed during the survey and documented sediment type. A photo log was compiled to document the shoreline habitat, sediment type, biological specimens, and general stream conditions. Benchmark scientists used a GPS to record the location of each transect.

During the surveys, Benchmark scientists were especially alert for listed species known to occur in Collin and Denton Counties, as listed in Attachment A. Benchmark scientists used a GPS to record the location of wildlife sightings, changes in stream conditions, and changes in dominant plant species.

2.2 FORMER EXIDE FACILITY

Benchmark Scientists conducted a habitat assessment on approximately 36 acres of undeveloped property within the former Exide Facility shown in Figure 3. The study area consists of two modified streambed areas, the North Wooded area, the South Wooded area, and the Lake Parcel. Benchmark scientists walked the transects shown in Figure 3 and documented the physical characteristics of the habitats, dominant plant species, and wildlife observations. The locations of all field observations were recorded using a sub-meter GPS unit.

Benthic surveys were conducted at the stations shown in Figure 3. The surveys were conducted by first visually examining the sediment surface and grab samples were collected using a clam rake. Within each transect, scientists waded across the stream or pool using multiple parallel paths perpendicular to the stream centerline. The results of each examination were documented in field notes and in a photographic log. A photo log was compiled to document the shoreline habitat, sediment type, and general stream conditions. Benchmark scientists used a GPS to record the location of each transect.

2.3 DATA COLLECTION

2.3.1 Field Data Log

Benchmark scientists recorded all field data on field data sheets and used a GPS to record the location of benthic invertebrate transects, wildlife sightings, stream conditions, and changes in dominant plant species. Copies of the field data sheets are included in Attachment B.

2.3.2 Photographic Log

Benchmark scientists recorded the identification numbers of all photographs taken during the field study on field data sheets. Representative photographs are shown in Attachment C.

3.0 FIELD SURVEY RESULTS

3.1 STEWART CREEK

Benchmark waded through and walked along 7.0 miles of Stewart Creek on January 15 and 16, 2014, and on March 18, 2014, in the areas shown in Figure 2. The streambed that connects the former Exide Plant and Lake Lewisville is typical of a streambed that was formed by rapidly moving water. Most of the creek bottom is dominated by long segments of exposed rock, shale and clay. The elevation of Stewart Creek at the Exide Facility is 640 ft., and the elevation of the water on Lake Lewisville is approximately 515 ft. The distance between the plant and the lake is approximately 4 miles (as the crow flies). The creek bottom downstream of the Exide facility consisted mostly of gravel, shale, and clay and contained few pooling areas. The streambed only included a few segments where measurable amounts of sediment had accumulated. Sediment was only found in the small pools that were scattered along the stream course. The pooling areas were small in size and averaged less than 3 feet deep. The remainder of the streambed consisted of long segments of exposed rock, shale, and clay that had no accumulated sediment. The banks of the creek between the former Exide Facility and Lake Lewisville primarily consisted of steep eroded bluffs 4 to 6 feet high.

Benchmark scientists collected data at 23 habitat plots, conducted 27 benthic surveys, and made over 34 wildlife observations while conducting the surveys along Stewart Creek. The location of the habitat plots, benthic surveys and wildlife observations are shown in Figure 5, and copies of field data sheets are included in Attachment B.

The dominant vegetation on the banks and immediately adjacent to the creek consisted of the following species:

- Green Ash (*Fraxinus pennsylvanica*)
- Hackberry (*Cetlis laevigata*)
- Osage Orange (*Maclura pomifera*)
- Greenbriar (*Smilax bona-nox*)
- Giant Ragweed (*Ambrosia trifida*)
- Canada Wildrye (*Elymus canadensis*)
- Inland Seaoats (*Chasmanthium latifolium*)

Benchmark found three species of mussels (listed below) while conducting the habitat surveys.

- Pondhorn *(Uniomerus tetralasmus)* - shells were found on the banks and on shallow gravel beds throughout the length of creek from the former Exide facility to Lake Lewisville. No live Pondhorn mussels were found when conducting the field surveys.
- Asian Clams (*Corbicula* spp.) – live Asian Clams were collected using a clam rake in the fine gravel of several small pooling areas along the creek downstream of the former Exide facility. Asian Clam shells were abundant on the banks and shallow gravel beds throughout the creek downstream of the former Exide facility.
- Giant Floater (*Pyganodon grandis*) – one shell was found on a shallow gravel bed near Lake Lewisville (Habitat Plot H-74 shown in Figure 5).

Representative photographs of the species listed above are included in Attachment C.

The following turtles were observed when conducting the study;

- Red-eared Slider (*Trachemys scripta elegans*) (Wildlife Plot W-45 and W-101 shown in Figure 5)
- Box Turtle *(Terrapene carolina)* (Wildlife Plots W-42 and W-48 shown in Figure 5*)*
- Soft Shell Turtle *(Apalone spinifera)* (Wildlife Plot W-43 shown in Figure 5*)*

In addition to the species listed above, the following wildlife sightings were recorded when conducting the surveys along Stewart Creek.

- Crow (*Corvus brachyrhynchos*)
- Owl (species unknown)
- Mallard (*Anas platyrhynchos*)
- Turkey Vulture (*Cathartes aura*)
- Northern Cardinal (*Cardinalis cardinalis*)
- Baird's sandpiper (*Calidris bairdii*)
- Carolina Chickadee (*Poecile carolinensis*)
- Tufted Titmouse (*Baeolophus bicolor*)
- Northern Mockingbird (*Mimus polyglottos)*
- Killdeer (*Charadrius vociferous)*
- Beaver (*Castor canadensis*)
- Raccoon (*Procyon lotor*)
- Coyote (*Canis latrans*)
- Bluegill (*Lepomis macrochirus*)
- Green Sunfish (*Lepomis cyanellus*)
- White-tailed Deer (*Odocoileus virginianus*)
- Squirrel Nest (species not identified)

- Minnows (species not identified)

3.2 FACILITY PROPERTY

Benchmark Scientists conducted a habitat assessment on approximately 36 acres of undeveloped property within the former Exide Facility shown in Figure 3. The study area consisted of two modified streambed areas, two wooded areas, and the lake parcel. Copies of the field notes recorded when conducting the habitat surveys area included in Attachment B.

3.2.1 Streams

Benchmark scientists conducted habitat surveys on Stewart Creek and the North Tributary located within the former Exide Facility on January 13 and 14, 2014.

3.2.1.1 Stewart Creek

Stewart Creek runs east to west across the former Exide Facility as shown in Figure 3. The banks on the east end of Stewart Creek averaged approximately 2 feet above the water line. The grasses growing along the banks were maintained and had recently been mowed. The banks along the creek on the west side of the former Exide Facility were greater than 8 ft. tall, and vegetation consisted of shrubs, small trees, and grasses.

Benchmark scientists collected data at 10 habitat plots, conducted 4 benthic surveys, and made over 16 wildlife observations when conducting the surveys along Stewart Creek within the former Exide Facility.

The dominant vegetation along the banks of Stewart Creek consisted of;

- Johnsongrass (*Sorghum halepense*)
- Canada Goldenrod (*Solidago canadensis*)
- Winged Elm (*Ulmus alata*)
- Bermudagrass (*Cynodon dactylon*)
- Giant Ragweed (*Ambrosia trifida*)
- Black Willow (*Salix nigra*)

Wildlife sightings recorded when conducting surveys adjacent to Stewart Creek included the following species;

- European Starling (*Sturnus vulgaris*)
- Crow (*Corvus brachyrhynchos*)

- Turkey Vulture (*Cathartes aura*)
- Pigeon (*Columba livia*)
- Red Tail Hawk (*Buteo jamaicensis*)
- Raccoon (*Procyon lotor*)
- Beaver (*Castor canadensis*)
- Pondhorn (*Uniomerus tetralasmus*)
- Feral hog (*Sus scrofa*)
- Mallard (*Anas platyrhynchos*)

Stewart Creek within the former Exide facility consisted of riffles and a few pooling areas just upstream of small dams located along the creek (one beaver dam and 1 small concrete dam). The creek bed in the riffle areas consisted of gravel, shale, concrete, loose rip/rap, and rip/rap contained within chain link fencing. The creek bed within the pooling areas consisted of gravel, dead vegetation, and small amounts of sand or fine gravel. The gravel sizes vary along the length of the creek bed.

Benchmark conducted benthic surveys in the two pooling areas and in 2 riffle areas within the facility. Benthic survey locations are shown in Figure 3. Several attempts to collect benthic organisms using a clam rake were made at each of the 4 benthic survey stations. No live mussels and no mussel shells were observed when conducting the benthic surveys in Stewart Creek within the former Exide facility.

Benchmark scientists found Pondhorn mussel shells along the bank of the creek just upstream of the Railroad tracks located on the West boundary of the former Exide facility. The weathered condition of the mussel valves indicated that deposition of the shell was not recent. The shells were found approximately 7 feet above the water line on a relatively steep slope.

3.2.1.2 North Tributary

The North Tributary of Stewart Creek runs from east to west. The east end of the North Tributary is located within the North Wooded Area discussed in Section 3.2.2.1. The west end of the North Tributary is bounded by a lake parcel on the north and the former Exide Facility on the south. The North Tributary ends near the west end of the study area where it converges with Stewart Creek. A smaller volume of water flows through the North Tributary compared to Stewart Creek. Small pooling areas less than 5 to 10 square feet were observed when conducting the surveys. The bottom of the creek bed within the riffle areas and pooling areas consisted of gravel, clay and shale.

Along the section of the North Tributary located outside of the North Wooded Area, Benchmark scientists collected data at 8 habitat plots and made over 4 wildlife observations. The dominant vegetation along the stream banks and wildlife observations made in the section of the North Tributary located within the North Wooded Area are listed in Section 3.2.2.1.

The dominant vegetation along the North Tributary outside of the North Wooded Area consisted of:

- Canada Goldenrod (*Solidago canadensis*)
- Bermudagrass (*Cynodon dactylon*)
- Johnsongrass (*Sorghum halepense*)
- Giant Ragweed (*Ambrosia trifida*)

Wildlife sightings recorded when conducting surveys along the North Tributary (outside of the wooded area) included the following species:

- Red Tail Hawk (*Buteo jamaicensis*)
- Raccoon (*Procyon lotor*)
- Active Burrows (unknown species)

3.2.2 Wooded Areas

Benchmark conducted habitat surveys in two wooded areas located within the former Exide Facility. The two wooded areas are labeled North Wooded Area and South Wooded Area in Figure 3.

3.2.2.1 North Wooded Area

Benchmark scientists walked 5 north/south transects within the North Wooded Area as shown in Figure 3. Field data were collected at 16 habitat plots and 13 wildlife observations were made during the surveys in the North Wooded Area. The North Wooded Area was separated into two different habitat types. The north and east sections of the study area consisted of relatively level ground with a higher elevation than the southwest section. The southwest section of the study area was at a lower elevation and exhibited hydrologic features such as drift lines and buttressing at the base of numerous trees. The drift lines and buttressing indicates the area contains standing water part of the year. The approximate boundaries of the two habitat areas listed above are shown in Figure 6.

The dominant vegetation within the wooded area with the higher elevation in the north and east consisted of:

- Greenbrair (*Smilax bona-nox*)
- Osage Orange (*Maclura pomifera*)
- Canada Wildrye (*Elymus canadensis*)
- Hackberry (*Cetlis laevigata*)
- Cedar Elm (*Ulmus crassifolia*)
- American Elm (*Ulmus americana*)
- Honeysuckle (*Lonicera japonica*)

Dominant vegetation within the area at a lower elevation in the southwest consisted of:

- Hackberry (*Cetlis laevigata*)
- Black Willow (*Salix nigra*)
- Mustang Grape (*Vitis mustangensis*)

Wildlife sightings recorded when conducting surveys in the North Wooded area included the following species:

- Robin (*Turdus migratorius*)
- Northern Cardinal (*Cardinalis cardinalis*)
- Mourning Dove (*Zenaida macroura*)
- Raccoon (*Procyon lotor*)
- Tufted Titmouse (*Baeolophus bicolor*)
- Loggerhead Shrike (*Lanius ludovicianus*)

3.2.2.2 South Wooded Area

Benchmark scientists walked 4 north/south transects within the South Wooded Area as shown in Figure 3. Benchmark scientists collected data at 9 habitat plots and made 14 wildlife observations while conducting the surveys in the South Wooded Area. The elevation along the south edge of the wooded area is approximately 680 ft., and the elevation at the north edge of the wooded area is approximately 640 ft. The angle of the slope starting at the south edge and sloping down to north edge is approximately 20 degrees.

The dominant vegetation in the South Wooded Area consisted of:

- Bermudagrass (*Cynodon dactylon*)
- Greenbrair (*Smilax bona-nox*)

- Osage Orange (*Maclura pomifera*)
- Canada Wildrye (*Elymus canadensis*)
- Hackberry (*Cetlis laevigata*)
- Cedar Elm (*Ulmus crassifolia*)

Wildlife sightings recorded when conducting surveys in the South Wooded Area included the following species:

- White-tailed Deer (*Odocoileus virginanus)*
- Tufted Titmouse (*Baeolophus bicolor*)
- Mockingbird (*Mimus polyglottos*)
- Carolina Chickadee (*Poecile carolinensis*)
- Bird nest (unknown species)
- Burrows (unknown species)
- Nest (unknown species)
- Northern Cardinal (*Cardinalis cardinalis*)
- Robin (*Turdrus migratorius*)
- Woodpecker (unknown species)
- Cottontail Rabbit (*Sylvilagus floridanus*)
- Packrat (unknown spieces)
- Cedar Waxwing (*Bombycilla cedrorum*)
- Blue Jay (Cyanocitta cristata)

3.2.3 Lake Parcel

Benchmark scientists walked 1 north/south transect and collected data on 1 habitat plot when conducting the surveys in the Lake Parcel located in the Southwest corner of the former Exide facility (Figure 3). The Lake Parcel was relatively flat and had recently been mowed.

Dominant vegetation in the parcel consisted of;

- Canada Goldenrod (*Solidago canadensis*)
- Bermudagrass (*Cynodon dactylon*)
- Johnsongrass (*Sorghum halepense*)

No wildlife sightings were recorded while conducting surveys in the Lake Parcel.

4.0 DISCUSSION

4.1 STEWART CREEK

No threatened or endangered species, listed by federal or state agencies, were found while conducting the surveys along Stewart Creek.

Benchmark scientists found the following three species of mussels while conducting habitat surveys.

- Pondhorn *(Uniomerus tetralasmus)* - shells were found on the banks and on shallow gravel beds throughout the length of creek from the former Exide Facility to Lake Lewisville. No live Pondhorn mussels were found when conducting the field surveys.
- Asian Clams (*Corbicula spp.*) – live Asian Clams were collected using a clam rake in the fine gravel of several small pooling areas along the creek downstream of the former Exide facility. Asian Clam shells were abundant on the banks and shallow gravel beds throughout the creek downstream of the facility.
- Giant Floater (*Anodonta grandis*) – one shell was found on a shallow gravel bed near Lake Lewisville (Habitat Plot H-74 shown in Figure 5).

Benchmark waded the creek bed and conducted benthic surveys at 20 sample stations. The water was clear along most of the creek, and there were no visible signs of live mussels other than the Asian Clams. The creek bed was comprised of gravel, shale and clay and there were few pooling areas identified during the field study. Based on the results of the visual observations, benthic surveys and the small number of pooling areas with sandy and muddy bottoms, it is unlikely that the Texas Heelsplitter or Louisiana Pigtoe inhabit the sections of Stewart Creek that were surveyed. Three species of turtles were observed when conducting the surveys (Red-eared Slider, Box Turtle, and Soft Shell).

4.1.1 Threatened and Endangered Species

No threatened or endangered species, listed by federal or state agencies, were found while conducting the surveys along Stewart Creek. A list of the threatened and endangered species listed for Collin and Denton Counties is presented in Attachment A. Additional information concerning the habitat requirements of state listed species mentioned in SLERA Comment #6 or by TCEQ Ecological Risk Assessment Program Manager (Alligator snapping turtle and White-faced ibis), are provided below.

Alligator Snapping Turtle (*Macrochelys temminckii*) - No Alligator snapping turtles, which are listed as threatened by the state of Texas, were observed in the creek during the survey. Alligator snapping turtles live in freshwater habitats in the southeastern United States, and are found in most of the river systems that drain into the Gulf of Mexico. They are almost exclusively aquatic and generally live in the deepest water within their habitat. Only females venture on land to build nests and lay their eggs. Alligator snapping turtles prefer the habitat found in large rivers, deep sloughs, oxbow lakes and deep pools connected to large rivers (Ernst, et al., 1994). They prefer areas with submerged cover, fallen logs, overhanging shrubs, and dense overhead canopies. Adult turtles may thermoregulate using differing stream depths seasonally. Adult turtles choose deeper water during midwinter and shallower water in early summer (Riedle, et al., 2006). Hatchlings and juveniles may also inhabit smaller rivers and streams. All stable populations of alligator snapping turtles are found around larger bodies of water (i.e., large rivers and lakes) (Minton Jr., 2001; Conant, et al., 1992; Ernst, et al., 1994).

Alligator snapping turtles are both scavengers and active hunters. They are nocturnal feeders that will eat fish, frogs, snakes, snails, worms, clams, crayfish, aquatic plants, small mammals, and other turtles. During the day, they will lay motionless on the bottom of a pool and use a worm-like lure attached to the back of the mouth to attract fish into their open jaws. The turtles feed year round by taking advantage of warm winter days to search for food along the shoreline (Elsey, 2006; Ernst, et al., 1994; Pritchard, 1979).

Alligator snapping turtles mate in late spring in the western part of their range (i.e., Texas), and the females lay their eggs in a nest about two months later approximately 50 m from a body of water. Nesting success is dependent upon the quality and availability of the adjoining riparian habitat and the abundance of nest predators like raccoons, dogs, cats, and skunks.

It is unlikely that the Alligator snapping turtle would spend time within the survey area due to high flow conditions that are common in the creek and the small number of shallow pooling areas found in the creek. Stewart Creek does not provide the deep muddy bottomed pools and submerged structure that attract alligator snapping turtles. The broad sandy flood plain that is preferred by female snapping turtles for nesting is also uncommon along Stewart Creek. Adult snapping turtles would find it difficult to live and reproduce in the Stewart Creek habitat.

White-Faced Ibis (*Plegadis chihi*) - No White-faced Ibis, which is listed as threatened by the state of Texas, were observed in the creek during the survey. The White-faced Ibis is a medium sized dark brown or maroon wading bird (46-56 cm tall, 450-525 grams) with a long, down-curved bill. It is a member of

the family Threskiornithidae and is similar in appearance and habits to the Glossy Ibis. The White-faced Ibis is distinguished from the Glossy Ibis by the narrow border of white feathers around its bare reddish facial skin (breeding adult). Adult birds have a grey bill, reddish legs, and red eyes year-round (Ryder and Manry, 1994).

The White-faced Ibis prefers freshwater marshes, where it can find insects, newts, leeches, earthworms, snails and especially crayfish, frogs and fish. They roost on low platforms of dead reed stems or on mud banks. Ibises will feed in large flocks of up to 1,000 birds. They utilize both natural wetlands and irrigated and flooded agricultural fields.

The White-faced Ibis is a colonially breeder and usually constructs nests on top of emergent aquatic vegetation or in low shrubs or tree over the water. Locating the nests over water helps protect the eggs and nestlings from mammalian predators such as skunks, raccoons, and cats. Nests are also preyed on by gulls, magpies, ravens, crows, owls, and grackles.. The White-faced Ibis nests in isolated colonies from Oregon to Kansas, but its center of greatest abundance in the US is in Utah, Texas, and Louisiana. In Texas, they breed and winter along the Gulf Coast and may occur as migrants in the Panhandle and West Texas.The inland populations of White-faced Ibises prefer to breed in shallow freshwater marshes with islands of emergent vegetation such as cattails or bulrushes. The Louisiana and Texas populations also breed in estuarine marshes (Farrand, 1983).

Its breeding range extends from the western US south through Mexico to Brazil, Bolivia, Argentina, and Chile (IUCN 2012). Its winter range extends from southern California and Louisiana south to include the rest of its breeding range. In 2012, the total population size was estimated to be 1.2 million individuals, and increasing. The IUCN rates it as a species of "Least Concern" (IUCN 2012).

They migrate from the northern portions of their range in the colder months to winter as far south as northern South America. The breeding populations on the Texas and Louisiana coasts are year round residents.The White-faced Ibis is not a resident of the area around Stewart Creek, but riparian habitat adjacent to the perennial pools and lake shore might be used for resting and feeding by migrating birds. No White-faced Ibis were observed during the habitat survey for this study.

4.2 FACILITY PROPERTY

Benchmark conducted a habitat survey within the former Exide facility on January 13 and 14, 2014, using the methods described in Section 2.2. Benchmark scientists did not find any reptiles or amphibians

while conducting the study. It is likely that reptiles and amphibians live within the study area, but were dormant at the time the habitat surveys were conducted.

4.2.1 Threatened and Endangered Species

No threatened or endangered species, listed by federal or state agencies, were found while conducting the surveys on the facility property. A list of the threatened and endangered species listed for Collin and Denton Counties is presented in Attachment A. Additional information concerning the habitat requirements of state listed species mentioned in SLERA Comment #13 or by TCEQ Ecological Risk Assessment Program Manager (Timber/Canebrake Rattlesnake and Texas Horned Lizard), are provided below.

Timber/Canebrake Rattlesnake (*Crotalus horridus*) - While it is likely that some reptiles do inhabit the study area, it is unlikely that the Timber/Canebrake rattlesnake, which is listed as endangered by the state of Texas, would thrive within the study area. Timber and canebrake rattlesnakes are considered a single species but they may have different habitat preferences and may exhibit different seasonal activity patterns. No subspecies is currently recognized (ITIS, 2014). Timber rattlesnake will be used in the following discussion in reference to both groups. Timber rattlesnakes are found in upland woods and rocky ridges in the eastern United States and the eastern third of Texas.

In Texas, timber rattlesnakes occupy bottomland hardwood forest dominated by oaks, hickories, and sweetgum, and upland forests dominated by oaks, loblolly pine, and shortleaf pine (Rudolph, *et al.*, 2004). They prefer woodlands or thickets near permanent water sources such as rivers, lakes, ponds, streams and swamps where tree stumps, logs and branches provide cover. Timber rattlesnake populations require undisturbed den sites and large contiguous wooded areas to be used during the foraging season (Brown, 1993). This species occurs in a wide variety of terrestrial habitats but their abundance typically declines sharply when urbanization encroaches (Waldron *et al*., 2006).

Timber rattlesnakes usually congregate in dens in rocky areas during cold weather to hibernate. After emergence from the den in spring, males and non-gravid females migrate to lowlands, pasture edges, the banks of streams and rivers, and brushy or wooded sites (Petersen and Fritsch, 1986). Timber rattlesnakes migrate back to the same dens in the fall for hibernation and may retrace the same route used for spring migration (Brown, *et al*., 1982). After migrating to summer habitat, timber rattlesnakes move short

distances within summer ranges to forage and breed. Home range size increases for males during the breeding season compared to the foraging season (Rudolph and Burgdorf, 1997; Waldron *et al*., 2006).

Habitat selection by timber rattlesnakes differs based on gender, reproductive status, and season (Brown, 1993; Reinert and Zappalorti, 1988.). Timber rattlesnakes need 3 types of habitat (e.g., denning, transient, and summer habitats). Denning habitat is used by all timber rattlesnakes for hibernation. Transient habitat is located close to the den and is used by males and non-gravid females for basking before migration to summer habitat. It is also used by gravid females for gestation and parturition. Summer habitat is used by males and nongravid females for foraging, mating, and basking (Brown, 1993).

Timber rattlesnakes feed on rabbits, squirrels, rats, mice, birds, other snakes, lizards, and frogs. Young timber rattlers are eaten by coyotes, bobcats, skunks, foxes, hawks, owls, and snake-eating snakes such as king snakes, indigo snakes and cottonmouths. Timber rattlers are diurnal (active during the day) during spring and fall but become nocturnal (active at night) during summer. Timber rattlesnakes are sometimes slow to defend themselves and rely on their ability to blend into their surroundings to avoid confrontation. They prefer to hide from predators and avoid confrontation.

Mating season is in early spring, only once every two to three years for females. The live young are born in late summer or early fall. After birth, young snakes remain near their mother for seven to ten days, but no parental care is provided. Causes of mortality for newborns include predation, lack of suitable small-sized prey items, and lack of suitable dens (Galligan and Dunson, 1979). Most adult mortality is due to human impacts including hunting, collecting for commercial purposes, habitat loss, and habitat fragmentation (Rudolph and Burgdorf, 1997; Waldron *et al*., 2006).

Timber rattlesnakes would not live in the study area due to the limited and fragmented habitat adjacent to and within the property. An aerial photograph of the property (Figure 7) shows that the surrounding areas are dominated by urban development and active agricultural fields. The continuous undisturbed scrub shrub and wooded habitat that is required to support a population of Timber rattlesnakes was not found at the site.

Texas Horned Lizard (*Phrynosoma cornutum)* - The Texas horned lizard ranges from the south-central United States to northern Mexico (including Texas, Oklahoma, Kansas and New Mexico) and the former Exide Facility is within the range of the species. Texas horned lizards can be found in arid and semiarid habitats in open areas with sparse plant cover. Because horned lizards dig for hibernation, nesting and

insulation purposes, they commonly are found in loose sand or loamy soils (Munger, 1984). The Texas horned lizard currently is listed as a threatened species in Texas (federal category C2).

Texas Horned lizards are most often found near harvester ant mounds. About 70% of the horned lizard's diet is made up of harvester ants and the remainder is composed of termites, beetles, and grasshoppers. The horned lizard requires bright sunlight to produce vitamin D and they are often found in open un-vegetated areas where full sunlight reaches the ground. Without sunlight the lizards are unable to produce vitamin D and will suffer from vitamin deficiency. At night, the lizard buries itself in sand.

Horned lizards can move rapidly if they feel there is a predator in the area, and will dart into thick grass and foliage to escape. Horned lizards are excellent diggers, and can quickly burrow in sandy soil to escape threats (Munger, 1986).

It is unlikely that the Texas Horned lizard is common in the study area due to the lack of suitable habitat. The Texas horned lizard prefers open sandy areas where herbaceous vegetation is scarce. This habitat was not common at the former Exide Facility. The forested areas found at the site are not preferred habitat for the lizards. In addition, Benchmark did not find harvester ants or ant mounds (the preferred prey item of the horned lizard) within the study area.

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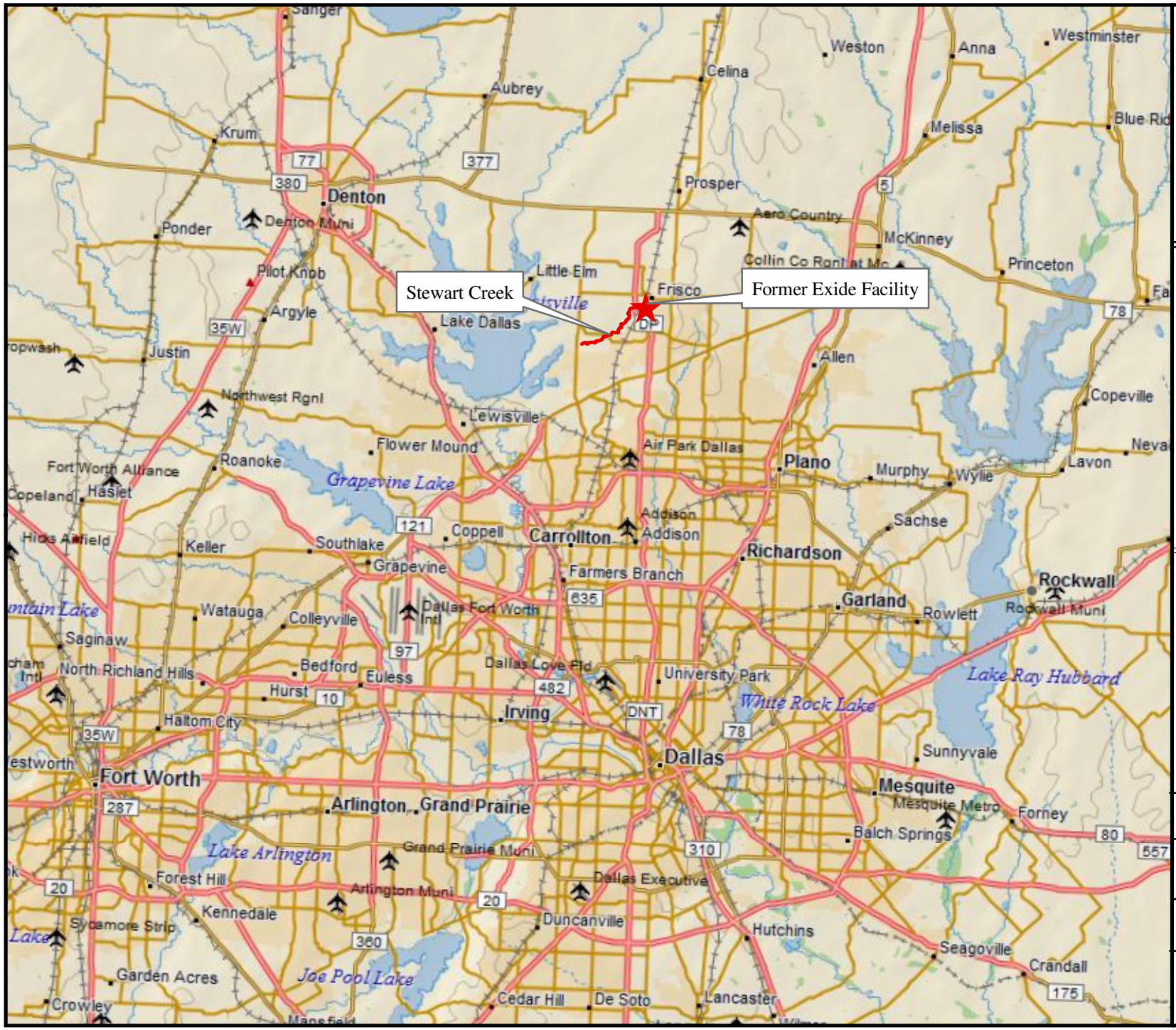
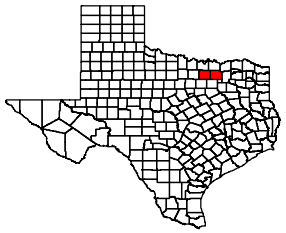
Waldron, Jayme L.; Lanham, Joseph D.; Bennett, Stephen H. 2006. Using behaviorally-based seasons to investigate canebrake rattlesnake (*Crotalus horridus*) movement patterns and habitat selection. Herpetologica. 62(4): 389-398.



Legend

Notes

Delorme World Base Map
Collin and Denton Counties



Site Location Map

Exide Technologies
Habitat Assessment

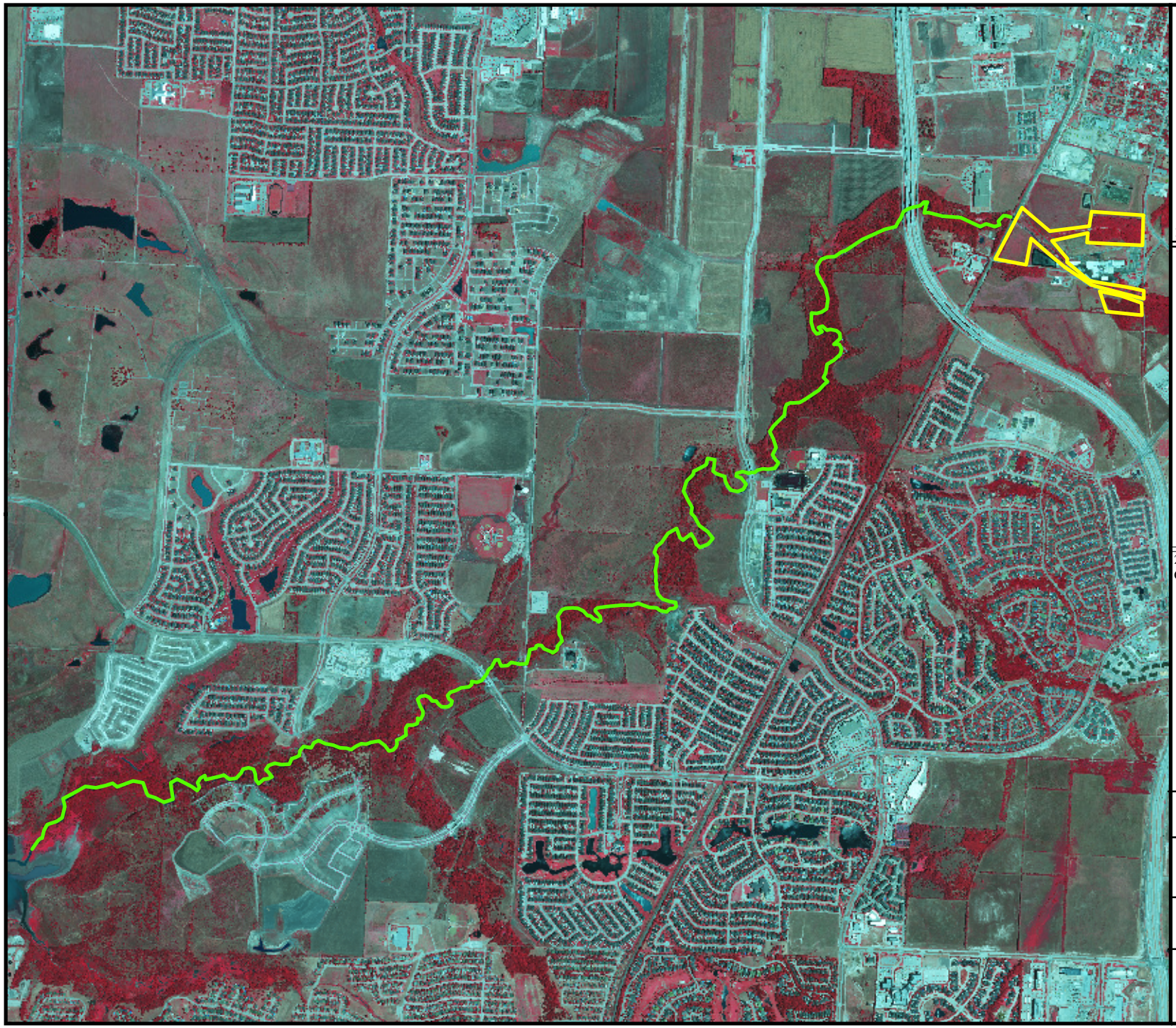
Golder Associates, Inc.

BESI Benchmark Ecological Services, Inc.

Project: 13009-001
Date: 01/02/2014

Figure 1

M:\13009\001\arc\Figure 1_study area.mxd



N

0 1,450 2,900 Feet

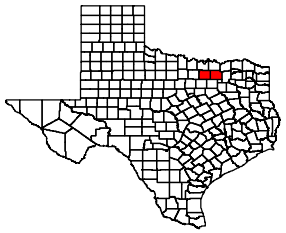
Legend

Stewart Creek (Surveyed)

Former Exide Facility

Notes

2008 DOQQ (Heburn and Frisco) Quad
Collin and Denton County



Stewart Creek
Areas Assessment

Exide Technologies
Habitat Assessments

Golder Associates, Inc.

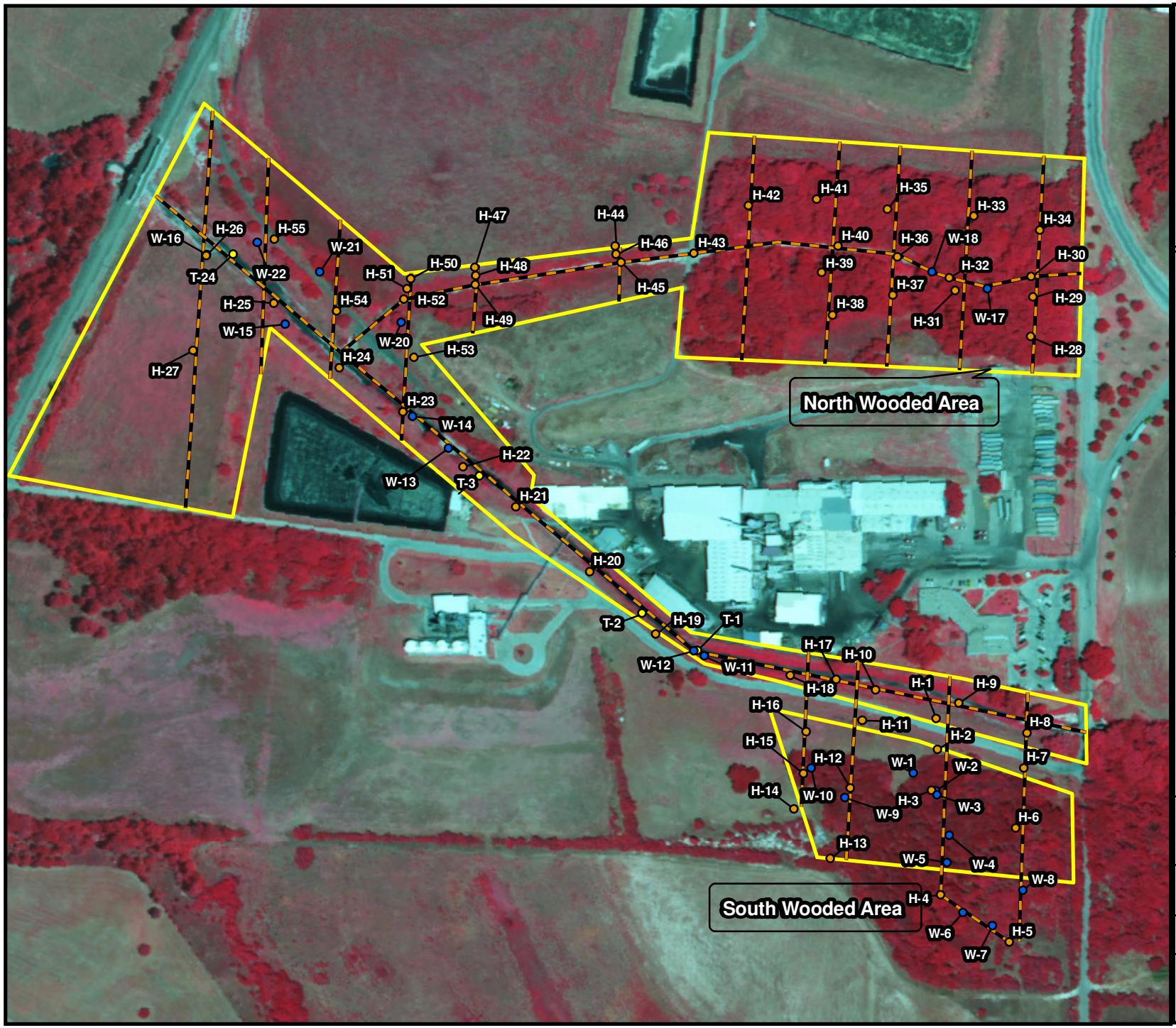
BESI Benchmark Ecological Services, Inc.

Project: 13009-001

Date: 03/19/2014

Figure 2

M:\13009\001\arc\working\Figure 2_creek.mxd



N

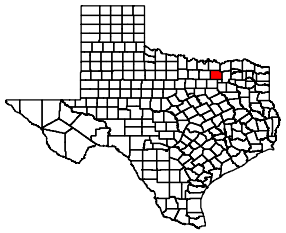
0 260 520 Feet

Legend

- Habitat Plots
- Benthic Surveys
- Wildlife Observations
- Survey Transects
- Former Exide Facility

Notes

2009 DOQQ (Frisco and Heburn Quad)
Collin County



Former Exide Facility
Field Data Points
and Transects

Exide Technologies
Habitat Assessment

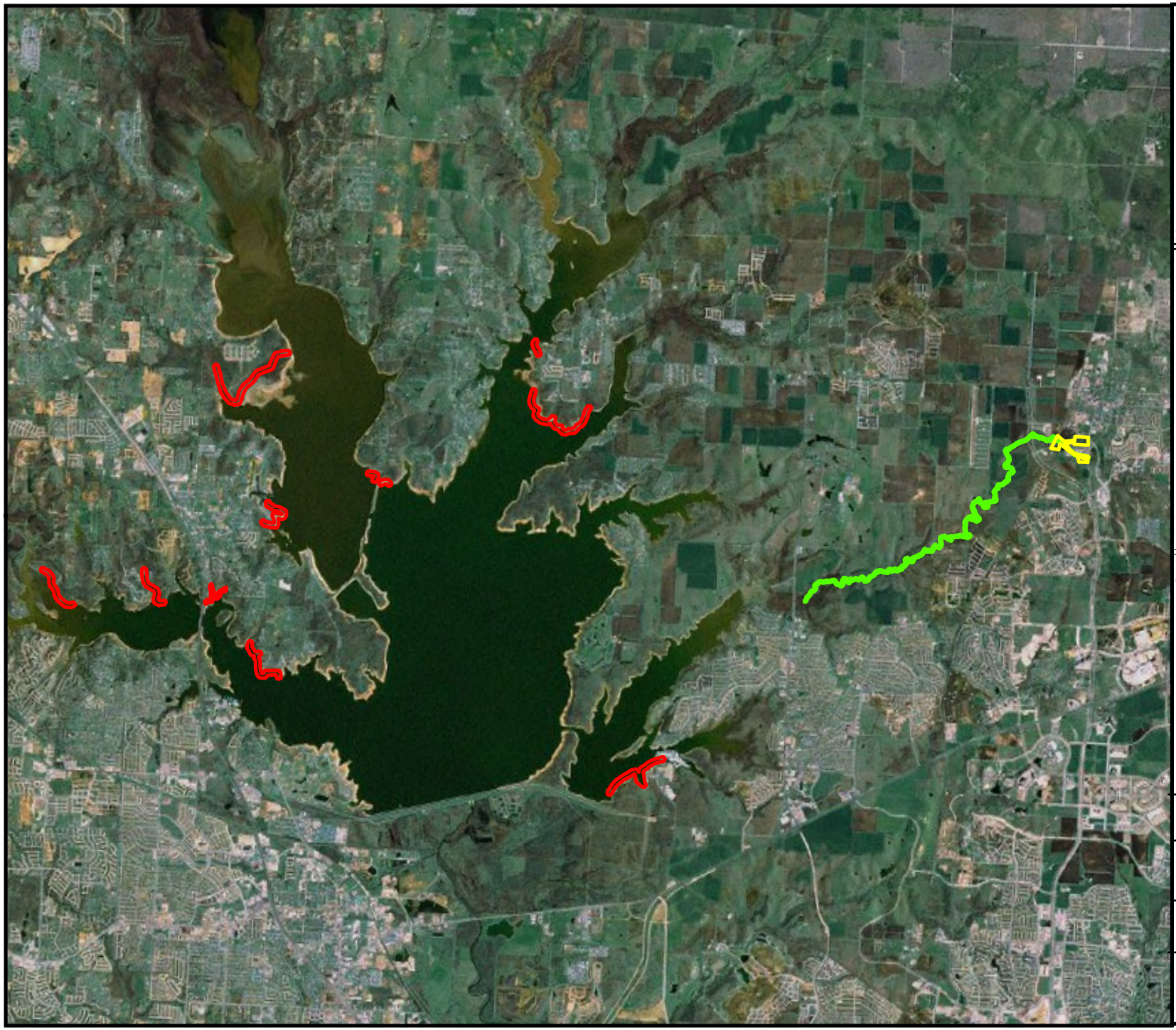
Golder Associates, Inc.

BESI Benchmark Ecological Services, Inc.

Project: 13009-001
Date: 02/11/2014

Figure 3

M:\13009\001\arc\Figure 3_transects_2.mxd



N

0 1 2 Miles

Legend

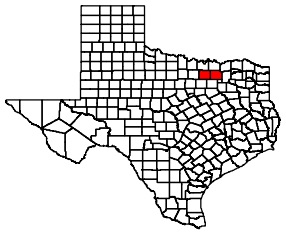
Former Exide Facility

Stewart Creek

Texas Heelsplitter

Notes

ESRI World Imagery, TPWD EO data
Collin and Denton Counties



Threatened and Endanged Species
Documented Occurrences

Exide Technologies
Habitat Surveys

Golder Associates, Inc.

BESI Benchmark Ecological Services, Inc.

Project: 13009-001

Date: 02/11/2014

Figure 4

M:\13009\001\arc\Figure 4 T and E sightings.mxd

N

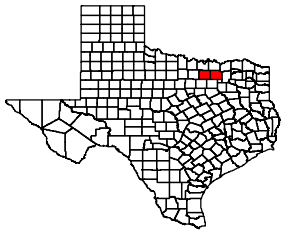
0 435 870 Feet

Legend

- Habitat Plots
- Benthic Surveys
- Wildlife Observations
- Former Exide Facility
- Stewart Creek (Surveyed)

Notes

2008 DOQQ (Frisco, Lewisville East and Heburn Quad) Collin and Denton Counties



Stewart Creek Habitat Plots, Benthic Surveys, and Wildlife Observations.

Exide Technologies
Habitat Assessments

Golder Associates, Inc.

BESI Benchmark Ecological Services, Inc.

Project: 13009-001

Date: 03/19/2014

Figure 5
(Map 1 of 5)

M:\13009\001\arc\working\Figure 5 mapbook of stream_2.mxd

N

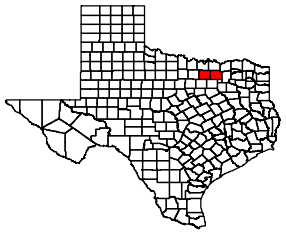
0 437.5 875 Feet

Legend

- Habitat Plots
- Benthic Surveys
- Wildlife Observations
- Former Exide Facility
- Stewart Creek (Surveyed)

Notes

2008 DOQQ (Frisco, Lewisville East and Heburn Quad) Collin and Denton Counties



Stewart Creek Habitat Plots, Benthic Surveys, and Wildlife Observations.

Exide Technologies
Habitat Assessments

Golder Associates, Inc.

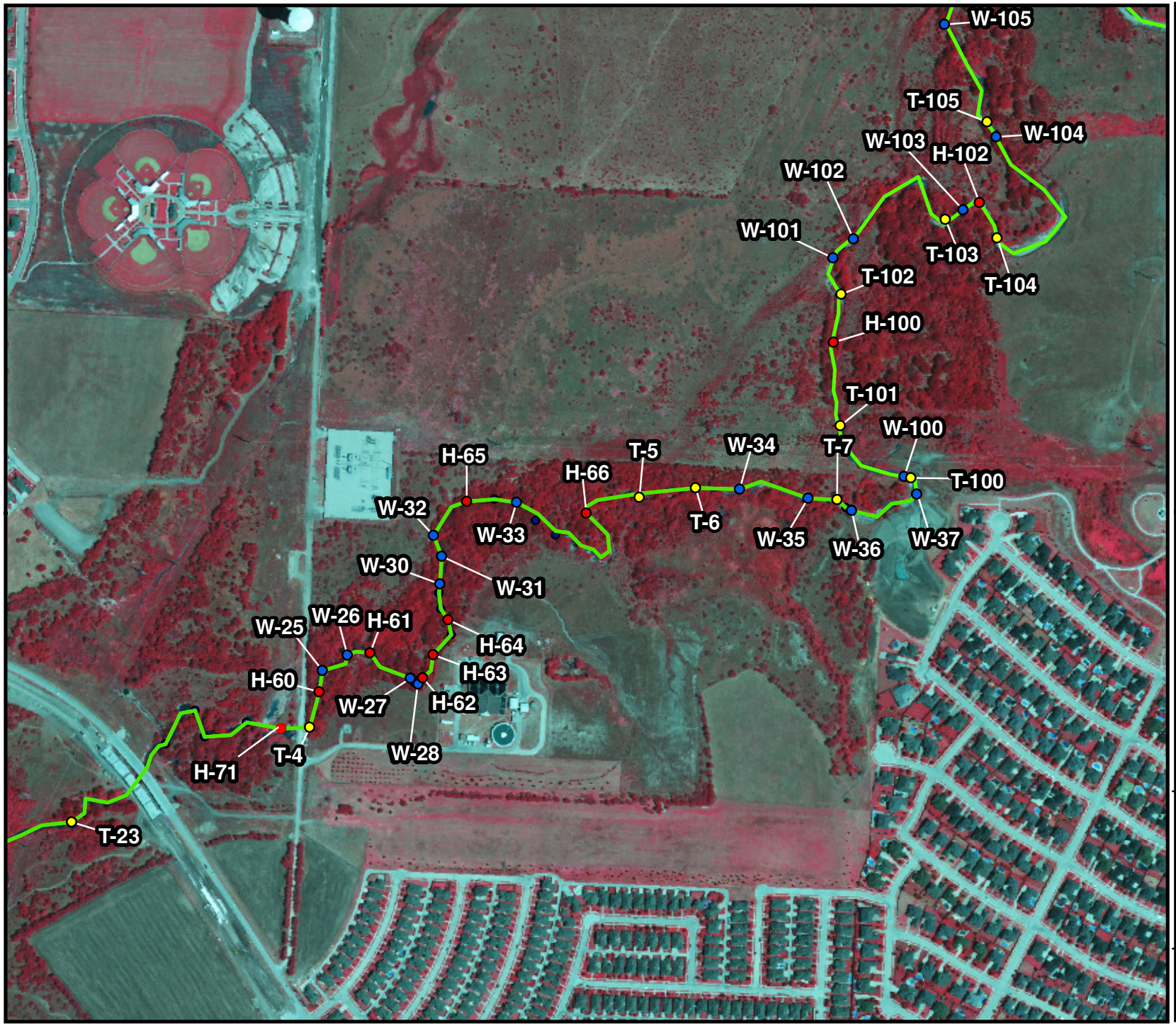
BESI Benchmark Ecological Services, Inc.

Project: 13009-001

Date: 03/19/2014

Figure 5
(Map 2 of 5)

M:\13009\001\arc\working\Figure 5 mapbook of stream_2.mxd



N

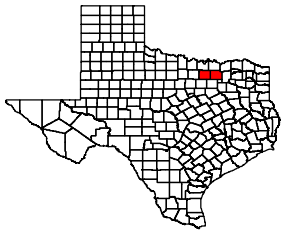
0 437.5 875 Feet

Legend

- Habitat Plots
- Benthic Surveys
- Wildlife Observations
- Former Exide Facility
- Stewart Creek (Surveyed)

Notes

2008 DOQQ (Frisco, Lewisville East and Heburn Quad) Collin and Denton Counties



Stewart Creek Habitat Plots, Benthic Surveys, and Wildlife Observations.

Exide Technologies
Habitat Assessments

Golder Associates, Inc.

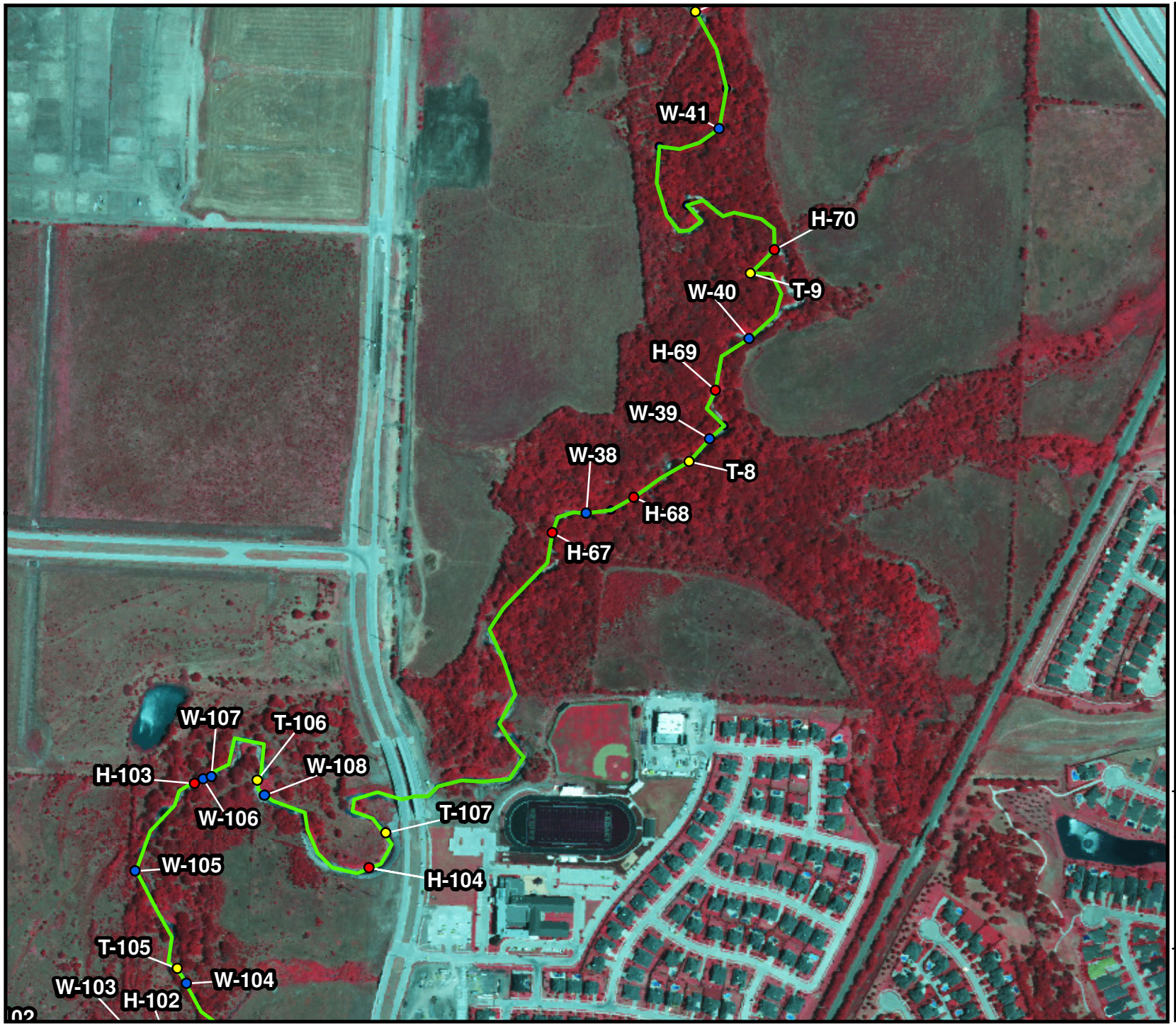
BESI Benchmark Ecological Services, Inc.

Project: 13009-001

Date: 03/19/2014

Figure 5
(Map 3 of 5)

M:\13009\001\arc\working\Figure 5 mapbook of stream_2.mxd



N

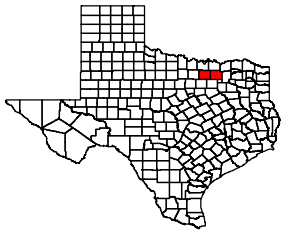
0 437.5 875 Feet

Legend

- Habitat Plots
- Benthic Surveys
- Wildlife Observations
- Former Exide Facility
- Stewart Creek (Surveyed)

Notes

2008 DOQQ (Frisco, Lewisville East and Heburn Quad) Collin and Denton Counties



Stewart Creek Habitat Plots, Benthic Surveys, and Wildlife Observations.

Exide Technologies
Habitat Assessments

Golder Associates, Inc.

BESI Benchmark Ecological Services, Inc.

Project: 13009-001

Date: 03/19/2014

Figure 5
(Map 4 of 5)

M:\13009\001\arc\working\Figure 5 mapbook of stream_2.mxd

N

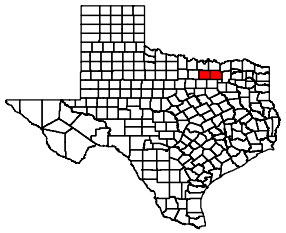
0 437.5 875 Feet

Legend

- Habitat Plots
- Benthic Surveys
- Wildlife Observations
- Former Exide Facility
- Stewart Creek (Surveyed)

Notes

2008 DOQQ (Frisco, Lewisville East and Heburn Quad) Collin and Denton Counties



Stewart Creek Habitat Plots, Benthic Surveys, and Wildlife Observations.

Exide Technologies
Habitat Assessments

Golder Associates, Inc.

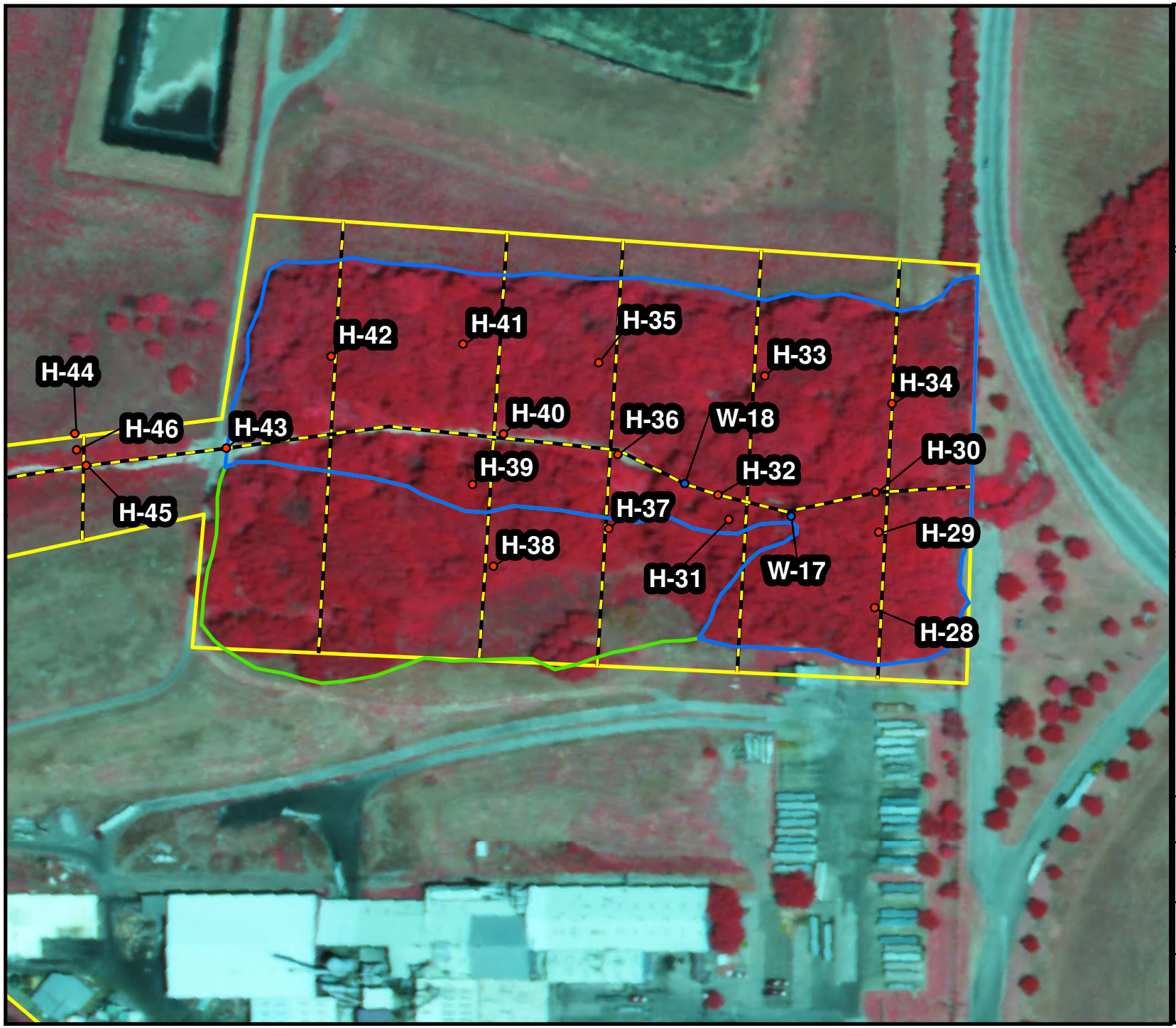
BESI Benchmark Ecological Services, Inc.

Project: 13009-001

Date: 03/19/2014

Figure 5
(Map 5 of 5)

M:\13009\001\arc\working\Figure 5 mapbook of stream_2.mxd



N

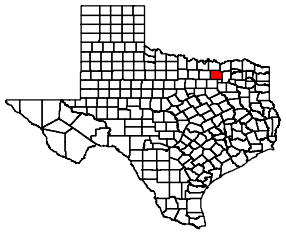
0 125 250 Feet

Legend

- Habitat Plot
- Wildlife Observations
- Wooded Area (Higher Elevation)
- Wooded Area (Lower Elevation)
- Former Exide Facility
- Survey Transects

Notes

2008 DOQQ (Frisco Quad)
Collin County



North Wooded Area

Exide Technologies
Habitat Assessment

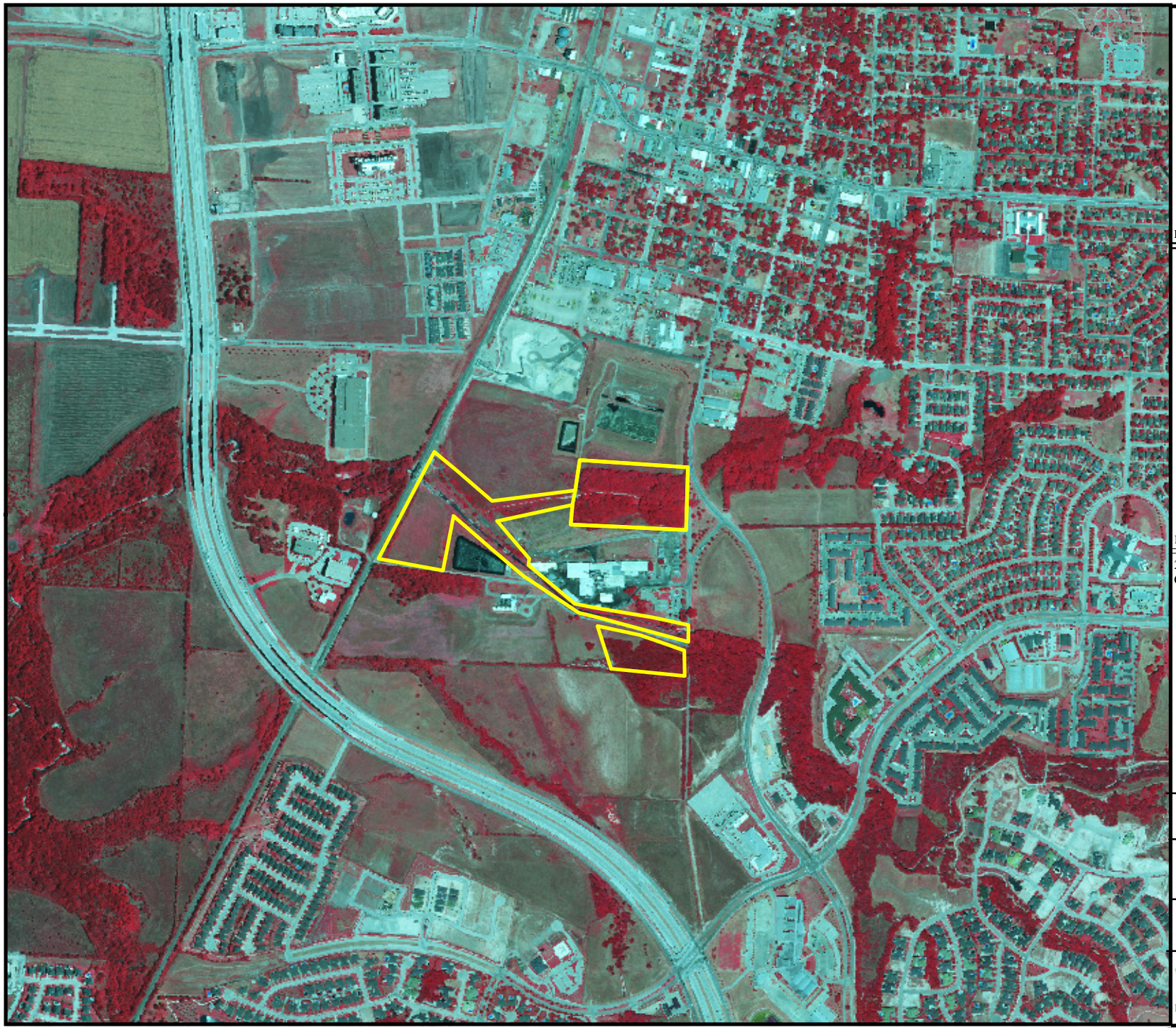
Golder and Associates, Inc.

BESI Benchmark Ecological Services, Inc.

Project: 13009-001
Date: 02/11/2014

Figure 6

M:\13009\001\arc\Figure 6.mxd



N

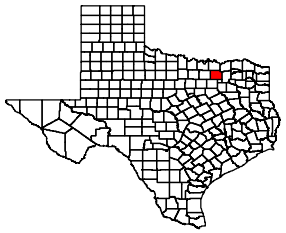
0 385 770 1,540 Feet

Legend

Former Exide Facility

Notes

2008 DOQQ (Frisco Quad)
Collin County



Land Use Surrounding
the Exide Facility

Exide Technologies
Habitat Assessment

Golder and Associates, Inc.

BESI Benchmark Ecological Services, Inc.

Project: 13009-001

Date: 02/12/2014

Figure 7

M:\13009\001\arc\Figure 7 forested areas.mxd

Attachment A

Revised 2/28/2011

COLLIN COUNTY

BIRDS		Federal Status	State Status
American Peregrine Falcon	*Falco peregrinusanatum*	DL	T

year-round resident and local breeder in west Texas, nests in tall cliff eyries; also, migrant across state from more northern breeding areas in US and Canada, winters along coast and farther south; occupies wide range of habitats during migration, including urban, concentrations along coast and barrier islands; low-altitude migrant, stopovers at leading landscape edges such as lake shores, coastlines, and barrier islands.

Arctic Peregrine Falcon	*Falco peregrinustundrius*	DL	

migrant throughout state from subspecies' far northern breeding range, winters along coast and farther south; occupies wide range of habitats during migration, including urban, concentrations along coast and barrier islands; low-altitude migrant, stopovers at leading landscape edges such as lake shores, coastlines, and barrier islands.

Bald Eagle	*Haliaeetusleucocephalus*	DL	T

found primarily near rivers and large lakes; nests in tall trees or on cliffs near water; communally roosts, especially in winter; hunts live prey, scavenges, and pirates food from other birds

Henslow's Sparrow	*Ammodramushenslowii*		

wintering individuals (not flocks) found in weedy fields or cut-over areas where lots of bunch grasses occur along with vines and brambles; a key component is bare ground for running/walking

Interior Least Tern	*Sterna antillarumathalassos*	LE	E

subspecies is listed only when inland (more than 50 miles from a coastline); nests along sand and gravel bars within braided streams, rivers; also know to nest on man-made structures (inland beaches, wastewater treatment plants, gravel mines, etc); eats small fish and crustaceans, when breeding forages within a few hundred feet of colony

Peregrine Falcon	*Falco peregrinus*	DL	T

both subspecies migrate across the state from more northern breeding areas in US and Canada to winter along coast and farther south; subspecies (F. p. anatum) is also a resident breeder in west Texas; the two subspecies' listing statuses differ, F.p. tundrius is no longer listed in Texas; but because the subspecies are not easily distinguishable at a distance, reference is generally made only to the species level; see subspecies for habitat.

Piping Plover *Charadriusmelodus* LT T

wintering migrant along the Texas Gulf Coast; beaches and bayside mud or salt flats

Sprague's Pipit *Anthussprague ii* C

only in Texas during migration and winter, mid September to early April; short to medium distance, diurnal migrant; strongly tied to native upland prairie, can be locally common in coastal grasslands, uncommon to rare further west; sensitive to patch size and avoids edges.

Western Burrowing Owl *Athenecunicularia hypugaea*

open grasslands, especially prairie, plains, and savanna, sometimes in open areas such as vacant lots near human habitation or airports; nests and roosts in abandoned burrows

White-faced Ibis *Plegadischihi* T

prefers freshwater marshes, sloughs, and irrigated rice fields, but will attend brackish and saltwater habitats; nests in marshes, in low trees, on the ground in bulrushes or reeds, or on floating mats

Whooping Crane *Grus Americana* LE E

potential migrant via plains throughout most of state to coast; winters in coastal marshes of Aransas, Calhoun, and Refugio counties

Wood Stork *Mycteria americana* T

forages in prairie ponds, flooded pastures or fields, ditches, and other shallow standing water, including salt-water; usually roosts communally in tall snags, sometimes in association with other wading birds (i.e. active heronries); breeds in Mexico and birds move into Gulf States in search of mud flats and other wetlands, even those associated with forested areas; formerly nested in Texas, but no breeding records since 1960

CRUSTACEANS

Federal Status State Status

A crayfish *Procambarus steigmani*

burrower in long-grass prairie; all animals were collected with traps, thus there is no knowledge of depths of burrows; herbivore; crepuscular, nocturnal

MAMMALS

		Federal Status	State Status
Plains spotted skunk	*Spilogaleputoriusinterrupta*		

catholic; open fields, prairies, croplands, fence rows, farmyards, forest edges, and woodlands; prefers wooded, brushy areas and tallgrass prairie

Red wolf	*Canisrufus*	LE	E

extirpated; formerly known throughout eastern half of Texas in brushy and forested areas, as well as coastal prairies

MOLLUSKS

		Federal Status	State Status
Fawnsfoot	*Truncilladonaciformis*		

small and large rivers especially on sand, mud, rocky mud, and sand and gravel, also silt and cobble bottoms in still to swiftly flowing waters; Red (historic), Cypress (historic), Sabine (historic), Neches, Trinity, and San Jacinto River basins.

Little spectaclecase	*Villosalienosa*		

creeks, rivers, and reservoirs, sandy substrates in slight to moderate current, usually along the banks in slower currents; east Texas, Cypress through San Jacinto River basins

Louisiana pigtoe	*Pleurobemariddellii*		T

streams and moderate-size rivers, usually flowing water on substrates of mud, sand, and gravel; not generally known from impoundments; Sabine, Neches, and Trinity (historic) River basins

Texas heelsplitter	*Potamilusamphichaenus*		T

quiet waters in mud or sand and also in reservoirs. Sabine, Neches, and Trinity River basins

Wabash pigtoe	*Fusconaiaflava*		

creeks to large rivers on mud, sand, and gravel from all habitats except deep shifting sands; found in moderate to swift current velocities; east Texas River basins, Red through San Jacinto River basins; elsewhere occurs in reservoirs and lakes with no flow

REPTILES		Federal Status	State Status
Alligator snapping turtle	*Macrochelystemminckii*		T

perennial water bodies; deep water of rivers, canals, lakes, and oxbows; also swamps, bayous, and ponds near deep running water; sometimes enters brackish coastal waters; usually in water with mud bottom and abundant aquatic vegetation; may migrate several miles along rivers; active March-October; breeds April-October

Texas garter snake *Thamnophissirtalisannectens*

wet or moist microhabitats are conducive to the species occurrence, but is not necessarily restricted to them; hibernates underground or in or under surface cover; breeds March-August

Texas horned lizard *Phrynosomacornutum* T

open, arid and semi-arid regions with sparse vegetation, including grass, cactus, scattered brush or scrubby trees; soil may vary in texture from sandy to rocky; burrows into soil, enters rodent burrows, or hides under rock when inactive; breeds March-September

Timber/Canebrake rattlesnake *Crotalushorridus* T

swamps, floodplains, upland pine and deciduous woodlands, riparian zones, abandoned farmland; limestone bluffs, sandy soil or black clay; prefers dense ground cover, i.e. grapevines or palmetto

Last Updated 2/28/2011

DENTON COUNTY

BIRDS

		Federal Status	State Status
American Peregrine Falcon	*Falco peregrinusanatum*	DL	T

year-round resident and local breeder in west Texas, nests in tall cliff eyries; also, migrant across state from more northern breeding areas in US and Canada, winters along coast and farther south; occupies wide range of habitats during migration, including urban, concentrations along coast and barrier islands; low-altitude migrant, stopovers at leading landscape edges such as lake shores, coastlines, and barrier islands.

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wintering individuals (not flocks) found in weedy fields or cut-over areas where lots of bunch grasses occur along with vines and brambles; a key component is bare ground for running/walking

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Western Burrowing Owl	*Athenecunicularia hypugaea*		

open grasslands, especially prairie, plains, and savanna, sometimes in open areas such as vacant lots near human habitation or airports; nests and roosts in abandoned burrows

White-faced Ibis	*Plegadischihi*		T

prefers freshwater marshes, sloughs, and irrigated rice fields, but will attend brackish and saltwater habitats; nests in marshes, in low trees, on the ground in bulrushes or reeds, or on floating mats

Whooping Crane *Grusamericana* LE E

potential migrant via plains throughout most of state to coast; winters in coastal marshes of Aransas, Calhoun, and Refugio counties

Wood Stork *Mycteriaamericana* T

forages in prairie ponds, flooded pastures or fields, ditches, and other shallow standing water, including salt-water; usually roosts communally in tall snags, sometimes in association with other wading birds (i.e. active heronries); breeds in Mexico and birds move into Gulf States in search of mud flats and other wetlands, even those associated with forested areas; formerly nested in Texas, but no breeding records since 1960

MAMMALS

Federal Status State Status

Plains spotted skunk *Spilogaleputoriusinterrupta*

catholic; open fields, prairies, croplands, fence rows, farmyards, forest edges, and woodlands; prefers wooded, brushy areas and tallgrass prairie

Red wolf *Canisrufus* LE E

extirpated; formerly known throughout eastern half of Texas in brushy and forested areas, as well as coastal prairies

MOLLUSKS

Federal Status State Status

Fawnsfoot *Truncilladonaciformis*

small and large rivers especially on sand, mud, rocky mud, and sand and gravel, also silt and cobble bottoms in still to swiftly flowing waters; Red (historic), Cypress (historic), Sabine (historic), Neches, Trinity, and San Jacinto River basins.

Little spectaclecase *Villosalienosa*

creeks, rivers, and reservoirs, sandy substrates in slight to moderate current, usually along the banks in slower currents; east Texas, Cypress through San Jacinto River basins

Louisiana pigtoe *Pleurobemariddellii* T

streams and moderate-size rivers, usually flowing water on substrates of mud, sand, and gravel; not generally known from impoundments; Sabine, Neches, and Trinity (historic) River basins

Texas heelsplitter *Potamilusamphichaenus* T

quiet waters in mud or sand and also in reservoirs. Sabine, Neches, and Trinity River basins

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REPTILES

		Federal Status	State Status
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wet or moist microhabitats are conducive to the species occurrence, but is not necessarily restricted to them; hibernates underground or in or under surface cover; breeds March-August

Texas horned lizard	*Phrynosomacornutum*		T

open, arid and semi-arid regions with sparse vegetation, including grass, cactus, scattered brush or scrubby trees; soil may vary in texture from sandy to rocky; burrows into soil, enters rodent burrows, or hides under rock when inactive; breeds March-September

Timber/Canebrake rattlesnake	*Crotalushorridus*		T

swamps, floodplains, upland pine and deciduous woodlands, riparian zones, abandoned farmland; limestone bluffs, sandy soil or black clay; prefers dense ground cover, i.e. grapevines or palmetto

PLANTS

		Federal Status	State Status
Glen Rose yucca	*Yucca necopina*		

Texas endemic; grasslands on sandy soils and limestone outcrops; flowering April-June

Attachment B

Exide Technologies Benthic Survey

Date: 1/14/2014

Transect: T-1

Personnel: NH, KH, BS

Camera: Nikon

GPS: B

Time: 8:00

General Location: Stewart Creek, just upstream of beaver dam

Photo IDs	Description
2342	Benthic rake
2343	Contents of the rake

GPS Waypoints	Description
T-1	Stream

Sediment Description

Clay, solid, gravel and small amounts of dead vegetation (leaves), no overlying sediment.

Number of Rakes: 6

Benthic Observations

None

Exide Technologies Benthic Survey

Date: 1/14/2014

Transect: T-2

Personnel: NH, KH, BS

Camera: Nikon

GPS: B

Time: 8:15

General Location: Stewart Creek downstream of beaver dam

Photo IDs	Description
2344	Benthic Rake
2345	Benthic Rake
2346	Contents of rake

GPS Waypoints	Description
T-2	Stream

Sediment Description

Clay, solid, areas with low soft sediment over clay large amounts of gravel

Number of Rakes: 6

Benthic Observations

None

Exide Technologies Benthic Survey

Date: 1/13/2014

Transect: T-3

Personnel: NH, KH, BS

Camera: Nikon

GPS: B

Time: 8:30

General Location: Stewart Creek

Photo IDs	Description
2347	Benthic rake
2348	Contents of rake

GPS Waypoints	Description
T-3	Stream

Sediment Description

Hard clay and gravel, no overlying sediment, dead leaves and vegetation.

Number of Rakes: 8

Benthic Observations

None

Exide Technologies Benthic Survey

Date: 1/15/2014 Transect: T-4

Personnel: (BESI) NH, KH, BS (Golder) AM, MR (Frisco) Tommy Camera: Nikon GPS: B

Time: 8:00

General Location: Stewart Creek up upstream of 4th Army Rd.

Photo IDs	Description
2349	Upstream
2350	Downstream
2351	Contents of rake

GPS Waypoints	Description
T-4	Stream

Sediment Description

Gravel, just upstream of culvert under road.

Number of Rakes: 6

Benthic Observations

None

Exide Technologies Benthic Survey

Date: 1/15/2014 Transect: T-5

Personnel: (BESI) NH, KH, BS (Golder) AM, MR (Frisco) Tommy Camera: Nikon GPS: B

Time: 10:10

General Location: Stewart Creek upstream of wastewater treatment plant

Photo IDs	Description
2407	Benthic rake
2408	Benthic rake
2409	Contents of rake
2410	Site
2411	Contents of rake

GPS Waypoints	Description
T-5	Stream

Sediment Description
Sand, gravel, and rocks

Number of Rakes: 6

Benthic Observations

None

Exide Technologies Benthic Survey

Date: 1/15/2014 Transect: T-6

Personnel: (BESI) NH, KH, BS (Golder) AM, MR (Frisco) Tommy Camera: Nikon GPS: B

Time: 10:20

General Location: Stewart Creek upstream of wastewater treatment facility

Photo IDs	Description
2412-2414	Benthic rake
2415	Benthic rake
2416	Contents of rake
2417	Northern Cardinal
	(Cardinalis cardinalis)

GPS Waypoints	Description
T-6	Stream

Sediment Description
Sand, gravel, and rocks

Number of Rakes: 6

Benthic Observations

Prior to using the benthic rake, Benchmark scientists observed signs of mussel/ clam activity on the surface of the sediment.

Collected live Asian Clams *(Corbicula spp .)* in rake.

Exide Technologies Benthic Survey

Date: 1/15/2014 Transect: T-7

Personnel: (BESI) NH, KH, BS (Golder) AM, MR (Frisco) Tommy Camera: Nikon GPS: B

Time: 11:00

General Location: Stewart Creek upstream of wastewater treatment facility

Photo IDs	Description
2434	Contents of rake
2435	Downstream
2436	Benthic rake
2437	Contents of rake

GPS Waypoints	Description
T-7	Stream

Sediment Description
Sand, gravel, and rocks

Number of Rakes: 6

Benthic Observations :

None

General Observations:

Raccoon (*Procyon lotor*) and canine tracks spotted on bank nearby.

Exide Technologies Benthic Survey

Date: 1/15/2014 Transect: T-8

Personnel: (BESI) NH, KH, BS (Golder) AM, MR (Frisco) Jason Camera: Nikon GPS: B

Time: 14:15

General Location: Stewart Creek upstream of Stonebrook Pkwy

Photo IDs	Description
2465	Contents of rake
2466	Creek
2467	Pondhorn (*Uniomerus tetralasmus*)
	shells found on the surface

GPS Waypoints	Description
T-8	Stream

Sediment Description
Small gravel and sand

Number of Rakes: 6

Benthic Observations

Area has a lot of exposed beds, spotted several of the Pondhorn *(Uniomerus tetralasmus*) shells on the exposed gravel beds.

Exide Technologies Benthic Survey

Date: 1/15/2014

Transect: T-9

Personnel: (BESI) NH, KH, BS (Golder) AM, MR (Frisco) Jason

Camera: Nikon

GPS: B

Time: 15:09

General Location: Stewart Creek upstream of Stonebrook Pkwy.

Photo IDs	Description
2478	Contents of rake
2479	Creek
2480	Gravel bank

GPS Waypoints	Description
T-9	Stream

Sediment Description

Gravel, shall, and clay. Small area of fine gravel in 1 foot deep pool.

Number of Rakes: 6

Benthic Observations

None

Exide Technologies Benthic Survey

Date: 1/15/2014

Transect: T-10

Personnel: (BESI) NH, KH, BS (Golder) AM, MR (Frisco) Jason

Camera: Nikon

GPS: B

Time: 15:45

General Location: Stewart Creek downstream of Dallas Pkwy.

Photo IDs	Description
2490	Worm
2491	Worm
2492	Creek
2493	Worms
2494	Worms

GPS Waypoints	Description
T-10	Stream

Sediment Description

Gravel and sand

Number of Rakes: 5

Benthic Observations

Worms, observed signs of worms on the sediment surface. Captured several worms in rake.

Exide Technologies Benthic Survey

Date: 1/16/2014

Transect: T-11

Personnel: (BESI) BS, KH, (Golder) AM, MR (Frisco) Tommy

Camera: Nikon

GPS: B

Time: 9:01

General Location: Stewart Creek downstream of former Exide Facility

Photo IDs	Description
2522	Contents of rake
2523	Contents of rake
2524	Downstream
2525	Creek
2526	Upstream

GPS Waypoints	Description
T-11	Soft area

Sediment Description

Small gravel, sand, and silt.

Number of Rakes: 6

Benthic Observations

None

General Observations

Nest in nearby tree, and small animal tracks on the bank.

Exide Technologies Benthic Survey

Date: 1/16/2014

Transect: T-12

Personnel: (BESI) BS, KH (Golder) AM, MR (Frisco) Tommy

Camera: Nikon

GPS: B

Time: 10:51

General Location: Stewart Creek upstream of Lake Lewisville

Photo IDs	Description
2527	Contents of rake
2528	Upstream
2529	Creek
2530	Downstream
2531	Asian Clam (*Corbicula spp.*) shells

	Description
T-12	Start transect
T-12b	End transect

Sediment Description

Mix of gravel and silt (1-2" of silt)

Number of Rakes: 7

Benthic Observations

Small rocks, Asian Clams (*Corbicula spp.*) shells.

Exide Technologies Benthic Survey

Date: 1/16/2014

Transect: T-13

Personnel: (BESI) BS, KH (Golder) AM, MR (Frisco) Tommy

Camera: Nikon

GPS: B

Time: 11:08

General Location: Stewart Creek upstream of Lake Lewisville

Photo IDs	Description
2534	Upstream
2535	Downstream
2536	Creek
2537	Content of raking
2538	Asian Clams (*Corbicula spp.*)
2539	Asian Clams (*Corbicula spp.*)

GPS Waypoints	Description
T-13	Start transect
T-13b	End transect

Sediment Description

Sand and silt in middle of channel, clay on sides, steep bank.

Number of Rakes: 6

Benthic Observations

Small rocks, Asian Clams (*Corbicula spp.*), shell pieces and one live clam.

Date: 1/16/2014 Transect: T-14

Personnel: (BESI) BS, KH (Golder) AM, MR (Frisco) Tommy Camera: Nikon GPS: B

Time: 11:35

General Location: Stewart Creek upstream of Lake Lewisville

Photo IDs	Description
2541	Upstream
2542	Downstream
2543	Contents of rake
2544	Asian Clams (*Corbicula spp.*)
2545	Asian Clams (*Corbicula spp.*)

GPS Waypoints	Description
T-14	Start transect
T-14b	End transect

Sediment Description
Soft silt and gravel mix.

Number of Rakes: 8

Benthic Observations

4 Asian Clams (*Corbicula spp.*) (live), 1 Asian Clam (*Corbicula spp* .) shell.

Exide Technologies Benthic Survey

Date: 1/16/2014

Transect: T-15

Personnel: (BESI) BS, KH (Golder) AM, MR (Frisco) Tommy

Camera: Nikon

GPS: B

Time: 11:46

General Location: Stewart Creek upstream of Lake Lewisville

Photo IDs	Description
2546	Contents of rake
2547, 2548	Asian Clams (*Corbicula spp.*), shell, and possibly Pondhorn Mussel shell pieces
2549-2551	Downstream, Creek, Upstream
2552	Asian Clams (*Corbicula spp.*), shell, and Pondhorn (Uniomerus Tetralasmus) shells

GPS Waypoints	Description
T-15	Start transect
T-15b	End transect

Sediment Description

Soft silt and gravel mix

Number of Rakes: 8

Benthic Observations

Asian Clams (*Corbicula spp.*) (live), shell, and Pondhorn (*Uniomerus tetralasmus*) shells.

Exide Technologies Benthic Survey

Date: 1/16/2014

Transect: T-16

Personnel: (BESI) BS, KH (Golder) AM, MR (Frisco) Tommy

Camera: Nikon

GPS: B

Time: 12:11

General Location: Stewart Creek upstream of Lake Lewisville

Photo IDs	Description
2558-2559	Asian Clam (*Corbicula spp* .) shells and Pondhorn (*Uniomerus tetralasmus*) shells
2560	Downstream
2561	Upstream

GPS Waypoints	Description
T-16	Start transect
T-16b	End transect

Sediment Description

Sandy silt and gravel mix, with rocks.

Number of Rakes: 8

Benthic Observations

Asian Clam (*Corbicula spp.*) shells and Pondhorn (*Uniomerus tetralasmus*) shells.

Exide Technologies Benthic Survey

Date: 1/16/2014 Transect: T-17

Personnel: (BESI) BS, KH (Golder) AM, MR (Frisco) Tommy Camera: Nikon GPS: B

Time: 12:33

General Location: Stewart Creek upstream of Lake Lewisville

Photo IDs	Description
2564	Downstream
2565	Upstream
2566	Creek
2567	Asian Clams (*Corbicula spp* .), shells and unidentified snail

GPS Waypoints	Description
T-17	Start transect
T-17b	End transect

Sediment Description

Silt and gravel, small rocks on sides of channel, hard clay in middle of channel.

Number of Rakes: 7

Benthic Observations

Asian Clams (*Corbicula spp.*), shells and unidentified snail.

Exide Technologies Benthic Survey

Date: 1/16/2014

Transect: T-18

Personnel: (BESI) BS, KH (Golder) AM, MR (Frisco) Tommy

Camera: Nikon

GPS: B

Time: 12:50

General Location: Stewart Creek upstream of Lake Lewisville

Photo IDs	Description
2568	Upstream
2569	Creek
2570	Downstream
2571	Contents of rake
2572	Pondhorn (*Uniomerus tetralasmus*) and Asian Clam (*Corbicula spp* .)

GPS Waypoints	Description
T-18	Start transect
T-18b	End transect

Sediment Description

Soft silt.

Number of Rakes: 5

Benthic Observations

Pondhorn (*Uniomerus tetralasmus*) shells and Asian Clam (*Corbicula spp.*) shells.

Exide Technologies Benthic Survey

Date: 1/16/2014

Transect: T-19

Personnel: (BESI) BS, KH (Golder) AM (Frisco) Jason

Camera: Nikon

GPS: B

Time: 14:58

General Location: Stewart Creek upstream of Lake Lewisville

Photo IDs	Description
2580	Downstream
2581	Upstream
2582	Creek
2583	Benthic rake
2584	Contents of rake
2585	Asian Clams (*Corbicula spp.*)

GPS Waypoints	Description
T-19	Stream

Sediment Description
Sand, silt, and gravel.

Number of Rakes : 6

Benthic Observations
Asian Clams (*Corbicula spp.*)

Exide Technologies Benthic Survey

Date: 1/16/2014

Transect: T-20

Personnel: (BESI) BS, KH (Golder) AM (Frisco) Jason

Camera: Nikon

GPS: B

Time: 15:40

General Location: Stewart Creek upstream of Lake Lewisville

Photo IDs	Description
2599	Contents of raking
2600	Asian clams (*Corbicula spp.*)
2601	Upstream
2602	Downstream

GPS Waypoints	Description
T-20	Stream

Sediment Description

Sand and silt with gravel.

Number of Rakes: 6

Benthic Observations

Asian Clams (*Corbicula spp.*) on nearby streambed. Collected live clams and clam shells in rake.

Exide Technologies Benthic Survey

Date: 1/16/2014

Transect: T-22

Personnel: (BESI) BS, KH (Golder) AM (Frisco) Jason

Camera: Nikon

GPS: B

Time: 16:29

General Location: Stewart Creek upstream of Lake Lewisville

Photo IDs	Description
2619	Upstream
2620	Creek
2621	Downstream

GPS Waypoints	Description
T-22	Stream

Sediment Description

Light silt and rocks.

Number of Rakes: 6

Benthic Observations

None

Exide Technologies Benthic Survey

Date: 1/16/2014 Transect: T-23

Personnel: (BESI) BS, KH (Golder) AM, MR (Frisco) Jason Camera: Nikon GPS: B

Time: 16:50

General Location Stewart Creek downstream of Lebanon Rd.

Photo IDs	Description
2622	Upstream
2623	Downstream
2624	Site and contents of rake
2625	Contents of rake
2626	Asian Clam (*Corbicula spp.*)

GPS Waypoints	Description
T-23	Stream

Sediment Description

Gravel and sandy silt mix, soft layer approximately 2 inches.

Number of Rakes: 6

Benthic Observations

1 Asian Clam (*Corbicula spp.*) shell found in rake.

Exide Technologies Benthic Survey

Date: 1/13/2014

Transect: T-24

Personnel: NH, KH, BS, BD

Camera: Sony

GPS: B

Time: 15:30

General Locatio Stewart Creek in Former Exide Facili

GPS Waypoints	Description
Mussel rake site	Stream

Photo IDs	Description
389-391	Benthic rake
392	Bottom of creek
393	Benthic rake near railroad bridge
394-395	Bank where Pondhorn Mussel shells were found
396	Wading bird tracks
397-398	Area where Pondhorn Mussel shells were found
399	Beaver sign on old tree

Sediment Description

Gravel & bedrock/ consolidated clay.

Number of Rakes: 12

Benthic Observations

None

Exide Technologies Benthic Survey

Date: 3/18/2014

Transect: T-100

Personnel: (BESI) KH, RM (Golder) AM, Chris (Frisco) Jason

Camera: Nikon

GPS: A

Time: 9:15

General Location Stewart Creek downstream of Legacy Dr.

Photo IDs	Description
2767	Upstream
2769	Downstream
2770	Site/ Contents of rake
2771	Contents of rake
2772	Asian Clam (*Corbicula spp.*)

GPS Waypoints	Description
T-100	Stream

Sediment Description

Gravel and silt with shale bottom.

Number of Rakes: 3

Benthic Observations

Multiple Asian Clams (*Corbicula spp.*) collected in rake.

Exide Technologies Benthic Survey

Date: 3/18/2014

Transect: T-101

Personnel: KH,RM (BESI) AM,Chris (Golder) Jason (Frisco)

Camera: Nikon

GPS: A

Time: 10:42

General Location Stewart Creek downstream of Legacy Dr.

Photo IDs	Description
2777	Upstream
2775	Downstream
2774	Site/ Contents of rake
2773	Contents of rake
2778	Asian Clam (*Corbicula spp.*)
2776	Bank of creek

GPS Waypoints	Description
T-101	Stream

Sediment Description

Mostly gravel with trace of sand and silt.

Number of Rakes: 5

Benthic Observations

Multiple Asian Clams (*Corbicula spp.*) collected in rake.

Exide Technologies Benthic Survey

Date: 3/18/2014 Transect: T-102

Personnel: KH,RM (BESI) AM, Chris (Golder) Jason (Frisc Camera: Nikon GPS: A

Time: 11:19

General Location Stewart Creek downstream of Legacy Dr.

Photo IDs	Description
2784	Upstream
2785	Downstream
2783	Site/ Contents of rake
2786	Mid Stream
2787/8	Asian Clam (*Corbicula spp.*)

GPS Waypoints	Description
T-102	Stream

Sediment Description

Soft. Silty sand with gravel.

Number of Rakes: 6

Benthic Observations

Asian Clams (*Corbicula spp.*) and various snail species unidentified. Pondhorn (*Uniomerus tetralasmus*) shells observed nearby.

Exide Technologies Benthic Survey

Date: 3/18/2014

Transect: T-103

Personnel: KH,RM (BESI) ; Amy, Chris (Golder), Jason (Frisco)

Camera: Nikon

GPS: A

Time: 12:22

General Location Stewart Creek downstream of Legacy Dr.

Photo IDs	Description
2795	Upstream
2794	Downstream
2793	Contents of rake
2796	Mid Stream
2798/9	Asian Clam (*Corbicula spp.*)
2797	Creek bank

GPS Waypoints	Description
T-103	Stream

Sediment Description

Large and small gravel with silt layer on top.

Number of Rakes: 6

Benthic Observations

Multiple Asian Clams (*Corbicula spp.*) collected in rake.

General Observations

Wading bird print in exposed sediment.

Exide Technologies Benthic Survey

Date: 3/18/2014

Transect: T-104

Personnel: (BESI) KH, RM (Golder) AM, Chris (Frisco) Jason

Camera: Nikon

GPS: A

Time: 13:00

General Location Stewart Creek downstream of Legacy Dr.

Photo IDs	Description
2809	Upstream
2807	Downstream
2805	Contents of rake
2806	Mid Stream
2808	Mid Stream

GPS Waypoints	Description
T-104	Stream

Sediment Description

Soft. Course sand and small amount of silt and gravel - leaves and twigs intermixed.

Number of Rakes: 6

Benthic Observations

None

Exide Technologies Benthic Survey

Date: 3/18/2014 Transect: T-105

Personnel: KH,RM (BESI)AM, Chris (Golder) Jason (Frisco) Camera: Nikon GPS: A

Time: 13:34

General Location Stewart Creek downstream of Legacy Dr.

Photo IDs	Description
2815	Upstream
2813	Downstream
2814	Creek
2816	Contents of rake
2817	Asian Clam (*Corbicula spp.*) and snails

GPS Waypoints	Description
T-105	Stream

Sediment Description

Gravel with silt.

Number of Rakes: 6

Benthic Observations

Multiple Asian Clams (*Corbicula spp.*) and snails (class Gastropoda) collected in rake.

Exide Technologies Benthic Survey

Date: 3/18/2014 Transect: T-106

Personnel: KH,RM (BESI) AM Chris (Golder) Jason (Frisco) Camera: Nikon GPS: A

Time: 15:34

General Location Stewart Creek downstream of Legacy Dr.

Photo IDs	Description
2827	Upstream
2829	Downstream
2828	Contents of rake
2830	Contents of rake
2831	Asian Clam (*Corbicula spp.*)

GPS Waypoints	Description
T-106	Stream

Sediment Description

Sand with gravel with small trace amounts of silt.

Number of Rakes: 6

Benthic Observations

Multiple Asian Clams (*Corbicula spp.*) collected in rake.

Exide Technologies Benthic Survey

Date: 3/18/2014 Transect: T-107

Personnel: KH,RM (BESI) AM, Chris (Golder) Jason (Frisco) Camera: Nikon GPS: A

Time: 16:00

General Location Stewart Creek downstream of Legacy Dr.

GPS Waypoints	Description
T-107	Stream

Photo IDs	Description
2846	Upstream
2843	Downstream
2841/2	Stream Banks
2839	Contents of rake
2844	Asian Clam (*Corbicula spp.*)
2845	Benthic worm
2840	*Corbicula* siphon holes

Sediment Description

Sand with fine gravel. Burrows and siphon holes identified throughout exposed bank on downstream end of inside stream bar.

Number of Rakes: 6

Benthic Observations

Multiple Asian Clams (*Corbicula spp.*) and 1 benthic worm collected in rake.

Exide Technologies Habitat Surveys

Date: 1/13/2014

Plot: H-1

Personnel: NH, KH, BS, BD

Camera: Nikon

GPS: B

Time: 8:30

General Location: Adjacent to Stewart creek

Dominant Vegetation
Cynodon dactylon
Ambrosia trifida

GPS Waypoint	Description
Plot 1	Plot H-1

Photo IDs	Description
2106	North
2107	East
2108	South
2109	West

Comments
None

Exide Technologies Habitat Surveys

Date: 1/13/2014

Plot: H-2

Personnel: NH, KH, BS, BD

Camera: Nikon

GPS: B

Time: 8:35

General Location: Adjacent to south forested area

GPS Waypoints	Description
Plot 2	Plot H-2

Dominant Vegetation
Cynodon dactylon

Photo IDs	Description
2110	North
2111	East
2112	South
2113	West

Comments

None

Exide Technologies Habitat Surveys

Date: 1/13/2014

Plot: H-3

Personnel: NH, KH, BS, BD

Camera: Nikon

GPS: B

Time: 8:50

General Location: South forested area

Dominant Vegetation
Ulmus crassifolia
Ulmus alata
Maclura pomifera
Elymus canadensis
Quercus spp.
Elymus canadensis

GPS Waypoints	Description
Plot 3	On plot H-3
Drainage feature	East of plot

Photo IDs	Description
2224	North
2225	East
2226	South
2227	West
2228	Dry creek

Comments

Dry creek bed running adjacent to Plot H-3.

Exide Technologies Habitat Surveys

Date: 1/13/2014

Plot: H-4

Personnel: NH, KH, BS, BD

Camera: Nikon

GPS: B

Time: 9:00

General Location: South forested area

Dominant Vegetation
Ulmus crassifolia
Ulmus alata
Maclura pomifera
Elymus canadensis
Quercus spp.
Elymus canadensis
Smilax bona-nox

GPS Waypoints	Description
Plot 4	Plot H-4

Photo IDs	Description
2131	North
2132	East
2133	South
2134	West

Comments

Woodpecker, call heard at site.

Northern Cardinal (*Cardinalis cardinalis)* spotted.

Plot at toe of small earthern dam.

American Robins (*Turdus migratorius*) heard near plot.

Date: 1/13/2014

Plot: H-5

Personnel: NH, KH, BS, BD

Camera: Nikon

GPS: B

Time: 9:07

General Location: South forested area

Dominant Vegetation
Celtis occidentalis
Amphiachyris dracunculoides
Gleditsia triacanthos
Cynodon dactylon
Ambrosia psilostachya
Ulmus crassifolia

GPS Waypoints	Description
Plot H-5	Plot H-5

Photo IDs	Description
2136	North
2137	East
2138	South
2139	West

Comments

None

Exide Technologies Habitat Surveys

Date: 1/13/2014

Plot: H-6

Personnel: NH, KH, BS, BD

Camera: Nikon

GPS: B

Time: 9:20

General Location: South forested area

Dominant Vegetation
Ulmus crassifolia
Ulmus alata
Maclura pomifera
Elymus canadensis
Quercus spp.

GPS Waypoints	Description
Plot 6	Plot H-6

Photo IDs	Description
2145	North
2146	East
2147	South
2148	West

Comments

Cottontail rabbit (*Sylvilagus floridanus)* seen near site

Exide Technologies Habitat Surveys

Date: 1/13/2014

Plot: H-7

Personnel: NH, KH, BS, BD

Camera: Nikon

GPS: B

Time: 9:40

General Location: South forested area

Dominant Vegetation
Cynodon dactylon

GPS Waypoints	Description
Plot 7	Plot H-7

Photo IDs	Description
2149	North
2150	East
2151	South
2152	West

Comments

None

Exide Technologies Habitat Surveys

Date: 1/13/2014

Plot: H-8

Personnel: NH, KH, BS, BD

Camera: Nikon

GPS: B

Time: 9:20

General Location: Adjacent to creek

Dominant Vegetation
Cynodon dactylon
Ambrosia trifida

GPS Waypoints	Description
Plot 8	Plot H-8

Photo IDs	Description
2153	North
2154	East
2155	South
2156	West

Comments

None

Exide Technologies Habitat Surveys

Date: 1/13/2014

Plot: H-9

Personnel: NH, KH, BS, BD

Camera: Nikon

GPS: B

Time: 9:46

General Location: Adjacent to creek

GPS Waypoints	Description
Plot 9	Plot H-9

Dominant Vegetation
Sorghum halepense
Ambrosia psilostachya
Ambrosia trifida

Photo IDs	Description
2153	North/creek
2154	East
2155	South
2156	West
2158	Creekbed
2159	Creekbed

Comments

Steep bank, rocky bottom clear water high flow area.

Exide Technologies Habitat Surveys

Date: 1/13/2014

Plot: H-10

Personnel: NH, KH, BS, BD

Camera: Nikon

GPS: B

Time: 9:42

General Location: Adjacent to creek

Dominant Vegetation
Cynodon dactylon
Ambrosia trifida

GPS Waypoints	Description
Plot 10	Plot H-10

Photo IDs	Description
2159	European Starling (*Sturnus vulgaris*)
2161	North
2162	East
2163	South
2164	West

Comments

None

Exide Technologies Habitat Surveys

Date: 1/13/2014

Plot: H-11

Personnel: NH, KH, BS, BD

Camera: Nikon

GPS: B

Time: 9:45

General Location: Clearing north of south forested area

Dominant Vegetation
Cynodon dactylon
Setaria geniculata

GPS Waypoints	Description
Plot 11	Plot H-11

Photo IDs	Description
2164	North
2165	East
2166	South
2167	West

Comments

Cottontail Rabbit (*Sylvilagus floridanus*) spotted adjacent to site.

Exide Technologies Habitat Surveys

Date: 1/13/2014

Plot: H-12

Personnel: NH, KH, BS, BD

Camera: Nikon

GPS: B

Time: 9:50

General Location: South forested area

Dominant Vegetation
Ulmus crassifolia
Ulmus alata
Maclura pomifera
Elymus canadensis
Quercus spp.

GPS Waypoints	Description
Plot 12	Plot H-12

Photo IDs	Description
2168	North
2169	East
2170	South
2171	West

Comments

Steep slope.

Exide Technologies Habitat Surveys

Date: 1/13/2014

Plot: H-13

Personnel: NH, KH, BS, BD

Camera: Nikon

GPS: B

Time: 10:00

General Location: South forested area

Dominant Vegetation
Celtis laevigata
Smilax bona-nox
Melia azederach

GPS Waypoints	Description
Plot 13	Plot H-13

Photo IDs	Description
2174	North
2175	East
2176	South
2177	West
2178	Rock outcrop

Comments

Rock and concrete at plot.

Exide Technologies Habitat Surveys

Date: 1/13/2014

Plot: H-14

Personnel: NH, KH, BS, BD

Camera: Nikon

GPS: B

Time: 10:01

General Location: South forested area

Dominant Vegetation
Cynodon dactylon

GPS Waypoints	Description
Plot 14	Plot H-14

Photo IDs	Description
2179	North
2180	East
2181	South
2182	West

Comments

None

Exide Technologies Habitat Surveys

Date: 1/13/2014

Plot: H-15

Personnel: NH, KH, BS, BD

Camera: Nikon

GPS: B

Time: 10:07

General Location: South forested area

Dominant Vegetation
Ulmus crassifolia
Ulmus alata
Maclura pomifera
Elymus canadensis
Quercus spp.

GPS Waypoints	Description
Plot 15	Plot H-15

Photo IDs	Description
2186	North
2187	East
2188	South
2189	West
2190	Packrat burrows

Comments

Cedar Waxwing (*Bombycilla cedrorum*) heard over at site.

Packrat burrows observed.

Exide Technologies Habitat Surveys

Date: 1/13/2014

Plot: H-16

Personnel: NH, KH, BS, BD

Camera: Nikon

GPS: B

Time: 10:09

General Location: Clearing north of south forested area

GPS Waypoints	Description
Plot 16	Plot H-16

Dominant Vegetation

Cynodon dactylon

Photo IDs	Description
2191	North
2192	East
2193	South
2194	West

Comments

None

Exide Technologies Habitat Surveys

Date: 1/13/2014

Plot: H-17

Personnel: NH, KH, BS, BD

Camera: Nikon

GPS: B

Time: 10:11

General Location: Adjacent to Stewart Creek

Dominant Vegetation
Cynodon dactylon
Ambrosia trifida

GPS Waypoints	Description
Plot 17	Plot H-17

Photo IDs	Description
2195	North
2196	East
2197	South
2198	West
2199	Creek
2200	Creek
2201	Redtailed Hawks (*Buteo jamaicensis*)

Comments

Spotted American Kestrel (*Falco sparverius*) and 2 Redtailed Hawks (*Buteo jamaicensis*).

Exide Technologies Habitat Surveys

Date: 1/13/2014

Plot: H-18

Personnel: NH, KH, BS, BD

Camera: Nikon

GPS: B

Time: 10:11

General Location: Adjacent to Stewart Creek

Dominant Vegetation
Cynodon dactylon
Ambrosia trifida

GPS Waypoints	Description
Plot 18	Plot H-18

Photo IDs	Description
2202	Footprint
2203	Slide
2204	Slide
2205	North
2206	East
2207	South
2208	West

Comments

Beaver footprints

Potential benthic rake site.

Exide Technologies Habitat Surveys

Date: 1/13/2014

Plot: H-19

Personnel: NH, KH, BS, BD

Camera: Nikon

GPS: B

Time: 10:32

General Location: Adjacent to Stewart Creek

Dominant Vegetation
Ulmus alata
Solidago canadensis

GPS Waypoints	Description
Plot 19	Plot H-19

Photo IDs	Description
2212	North
2213	East
2214	South
2215	West
2216	Turkey vulture (*Cathartes aura*)

Comments

Spotted 2 Crows *(Corvus brachyrhynchos*) and a Turkey Vulture (*Cathartes aura*).

Exide Technologies Habitat Surveys

Date: 1/13/2014 Plot: H-20

Personnel: NH, KH, BS, BD Camera: Nikon GPS: B

Time: 10:35

	GPS Waypoints	Description
General Location: Adjacent to Stewart Creek	Plot 20	Plot H-20
Dominant Vegetation	Man made dam	Man made dam located next to plot
Ulmus alata		
Solidago canadensis		
Rubus trivialis		
Ambrosia trifida		

Photo IDs	Description
2217	North
2218	East
2219	South
2220	West
2221	Dam

Comments
Spotted 3 Rock Doves (*Columba livia).*

Exide Technologies Habitat Surveys

Date: 1/13/2014

Plot: H-21

Personnel: NH, KH, BS, BD

Camera: Nikon

GPS: B

Time: 10:41

General Location: Adjacent to Stewart Creek

Dominant Vegetation
Helianthus annuus
Ulmus alata
Solidago canadensis

GPS Waypoints	Description
Plot 21	Plot H-21
Dam	Man made dam next to plot

Photo IDs	Description
2222	North
2223	East
2224	South
2225	West
2226	Creek

Comments

Rip Rap for creekbed.

2 Red-tailed Hawks (*Buteo jamaicensis)* flew over the site.

Exide Technologies Habitat Surveys

Date: 1/13/2014

Plot: H-22

Personnel: NH, KH, BS, BD

Camera: Nikon

GPS: B

Time: 10:45

General Location: Adjacent to Stewart Creek

Dominant Vegetation
Sorghum halepense
Salix nigra
Solidago canadensis

GPS Waypoints	Description
Plot 22	Plot H-22

Photo IDs	Description
2227	North
2228	East
2229	South
2230	West
2231	Culverts
2232	Creek
2234	Creek
2235	Creek
2236	Dam just downstream of Plot H-22

Comments

4 large culverts on oppsite side of creek.

Concrete dam and large rip rap creek bottom.

Riffle area downstream of dam and concrete.

Exide Technologies Habitat Surveys

Date: 1/13/2014

Plot: H-23

Personnel: NH, KH, BS, BD

Camera: Nikon

GPS: B

Time: 10:55

General Location: Adjacent to Stewart Creek

Dominant Vegetation
Sorghum halepense
Salix nigra

GPS Waypoints	Description
Plot 23	Plot H-23

Photo IDs	Description
2238	North
2239	East
2240	South
2241	West
2242	Canine Tracks

Comments

Tracks in creekbed, canine and raccoon (*Procyon lotor).*

Riffle area in creek.

Exide Technologies Habitat Surveys

Date: 1/13/2014

Plot: H-24

Personnel: NH, KH, BS, BD

Camera: Nikon

GPS: B

Time: 11:00

General Location: Adjacent to Stewart Creek

GPS Waypoints	Description
Plot 24	Plot H-24

Dominant Vegetation
Sorghum halepense
Salix nigra
Solidago canadensis

Photo IDs	Description
2243	North
2244	East
2245	South
2246	West
2247	Culvert
2248	Rock creek bottom
2249	Beaver (*Castor canadensis*) sign
2250	Creek bottom

Comments

Raccoon (*Procyon lotor)* tracks and beaver (*Castor canadensis*) sign along creek.

Rock-clay-shale bottom very hard.

Exide Technologies Habitat Surveys

Date: 1/13/2014

Plot: H-25

Personnel: NH, KH, BS, BD

Camera: KH phone

GPS: B

Time: 11:00

General Location: Adjacent to Stewart Creek

GPS Waypoints	Description
Plot 25	Plot H-25

Dominant Vegetation
Sorghum halepense
Salix nigra
Ambrosia trifida

Photo IDs	Description
111053	North
111057	East
111101	South
111105	West
111417	Creek bottom

Comments

Hard creek bottom, no sediment.

Riffle area.

Exide Technologies Habitat Surveys

Date: 1/13/2014

Plot: H-26

Personnel: NH, KH, BS, BD

Camera: Nikon

GPS: B

Time: 11:20

General Location: Adjacent to Stewart Creek

Dominant Vegetation
Solidago canadensis

GPS Waypoints	Description
Plot 26	Plot H-26

Photo IDs	Description
2258	North
2259	East
2260	South
2261	West
2262	Downstream
2263	Site
2264	Upstream

Comments

None

Exide Technologies Habitat Surveys

Date: 1/13/2014

Plot: H-27

Personnel: NH, KH, BS, BD

Camera: Nikon

GPS: B

Time: 11:27

General Location: Lake Parcel

Dominant Vegetation
Solidago canadensis
Cynodon dactylon
Sorghum halepense

GPS Waypoints	Description
Plot 27	Plot H-27

Photo IDs	Description
2254	North
2255	East
2256	South
2257	West

Comments

Plot was located in a hayfield.

Exide Technologies Habitat Surveys

Date: 1/13/2014

Plot: H-28

Personnel: NH, KH, BS, BD

Camera: Nikon

GPS: B

Time: 12:00

General Location: North of forested area

Dominant Vegetation
Ulmus americana
Smilax bona-nox
Celtis laevigata

GPS Waypoints	Description
Plot 28	Plot H-28

Photo IDs	Description
2265	North
2266	East
2267	South
2268	West

Comments

Exide Technologies Habitat Surveys

Date: 1/13/2014

Plot: H-29

Personnel: NH, KH, BS, BD

Camera: Nikon

GPS: B

Time: 12:00

General Location: North forested area

Dominant Vegetation
Populus deltoides
Lonicera japonica
Diospyros texana
Celtis laevigata

GPS Waypoints	Description
Plot 29	Plot H-29

Photo IDs	Description
2269	North
2270	East
2271	South
2272	West

Comments

American Robin (*Turdus migratorius*) heard in area.

Exide Technologies Habitat Surveys

Date: 1/13/2014

Plot: H-30

Personnel: NH, KH, BS, BD

Camera: Nikon

GPS: B

Time: 12:05

General Location: North tributary in forested area

Dominant Vegetation
Populus deltoides
Lonicera japonica
Diospyros texana
Celtis laevigata

GPS Waypoints	Description
Plot 30	Plot H-30

Photo IDs	Description
2273	Upstream
2274	Site
2275	Downstream
2276	Creek bottom

Comments

Creek bottom consists of gravel.

Spotted Cardinal (*Cardinalis carlinalis)* in area.

Exide Technologies Habitat Surveys

Date: 1/13/2014

Plot: H-31

Personnel: NH, KH, BS, BD

Camera: Nikon

GPS: B

Time: 12:20

General Location: North forested area

Dominant Vegetation
Forestiera acuminata
Maclura pomifera
Juniperus virginana
Celtis laevigata
Smilax bona-nox
Ulmus americana

GPS Waypoints	Description
Plot 31	Plot H-31

Photo IDs	Description
2278	North
2279	East
2280	South
2281	West

Comments

None

Exide Technologies Habitat Surveys

Date: 1/13/2014

Plot: H-32

Personnel: NH, KH, BS, BD

Camera: Nikon

GPS: B

Time: 12:21

General Location: North tributary in north forested area

GPS Waypoints	Description
Plot 32	Plot H-32, middle of creek.

Dominant Vegetation

Forestiera acuminata

Maclura pomifera

Celtis laevigata

Simlax bona-nox

Ulmus americana

Photo IDs	Description
2282	Downstream
2283	Site
2284	Upstream
2285	Creek bed
2286	Creek bed
2287	Creek bed

Comments

Rocky creek bottom.

Riffle area.

Exide Technologies Habitat Surveys

Date: 1/13/2014

Plot: H-33

Personnel: NH, KH, BS, BD

Camera: Nikon

GPS: B

Time: 12:25

General Location: North tributary in north forested area

GPS Waypoints	Description
Plot 33	Plot H-33, middle of creek.

Dominant Vegetation
Lonicera japonica
Maclura pomifera
Celtis laevigata
Smilax bona-nox
Ulmus americana
Vitis mustangensis

Photo IDs	Description
2289	squirrel nest
2290	North
2291	East
2292	South
2293	West

Comments

Rocky creek bottom.

Riffle area.

Exide Technologies Habitat Surveys

Date: 1/13/2014

Plot: H-34

Personnel: NH, KH, BS, BD

Camera: Nikon

GPS: B

Time: 12:30

General Location: North forested area

Dominant Vegetation
Smilax bona-nox
Ulmus americana
Elymus canadensis

GPS Waypoints	Description
Plot 34	Plot H-34

Photo IDs	Description
2294	North
2295	East
2296	South
2297	West

Comments

None

Exide Technologies Habitat Surveys

Date: 1/13/2014

Plot: H-35

Personnel: NH, KH, BS, BD

Camera: Nikon

GPS: B

Time: 12:37

General Location: North forested area

Dominant Vegetation
Smilax bona-nox
Ulmus americana
Elymus canadensis

GPS Waypoints	Description
Plot 35	Plot H-35

Photo IDs	Description
2298	North
2299	East
2300	South
2301	West
2302	Squirrel nest

Comments

American Robin (*Turdus migratorius*) sighted near plot.

Squirrel nest near site.

Mourning Doves (*Zenaida macroura*) spotted near site.

Exide Technologies Habitat Surveys

Date: 1/13/2014

Plot: H-36

Personnel: NH, KH, BS, BD

Camera: Nikon GPS: B

Time: 12:40

General Location: Center of creek, North tributary

GPS Waypoints	Description
Plot 36	Plot H-36

Dominant Vegetation
Smilax bona-nox
Celtis laevigata
Elymus canadensis

Photo IDs	Description
2303	Upstream
2304	Site
2305	Downstream

Comments

Rocky creek bottom, and riffles.

Exide Technologies Habitat Surveys

Date: 1/13/2014

Plot: H-37

Personnel: NH, KH, BS, BD

Camera: Nikon

GPS: B

Time: 12:40

General Location: North forested area

Dominant Vegetation
Salix nigra
Celtis laevigata
Vitis mustangensis

GPS Waypoints	Description
Plot 37	Plot H-37

Photo IDs	Description
2306	North
2307	East
2308	South
2309	West

Comments

None

Exide Technologies Habitat Surveys

Date: 1/13/2014

Plot: H-38

Personnel: NH, KH, BS, BD

Camera: Nikon

GPS: B

Time: 12:50

General Location: North forested area

Dominant Vegetation
Salix nigra

GPS Waypoints	Description
Plot 38	Plot H-38

Photo IDs	Description
2310	North
2311	East
2312	South
2313	West

Comments

Spotted Northern Mockingbird (*Mimus polyglottos*) near plot

Blue Jay (*Cyanocitta cristata*) heard near site.

Exide Technologies Habitat Surveys

Date: 1/13/2014

Plot: H-39

Personnel: NH, KH, BS, BD

Camera: Nikon

GPS: B

Time: 12:53

General Location: North forested area

Dominant Vegetation
Ulmus americana
Smilax bona-nox
Elymus canadensis
Ambrosia trifida

GPS Waypoints	Description
Plot 39	Plot H-39

Photo IDs	Description
2314	North
2315	East
2316	South
2317	West

Comments

Mourning Dove (*Zenaida macroura*) spotted at site.

Exide Technologies Habitat Surveys

Date: 1/13/2014

Plot: H-40

Personnel: NH, KH, BS, BD

Camera: Nikon GPS: B

Time: 13:00

General Location: North tributary of north forested area

GPS Waypoints	Description
Plot 40	Plot H-40

Dominant Vegetation
Ulmus americana
Smilax bona-nox
Elymus canadensis
Ambrosia trifida

Photo IDs	Description
2318	Upstream
2319	Site
2320	Downstream

Comments

Riffle area, small amount (less than 1 cm) of sediment over gravel;

Heard Mourning Dove (*Zenaida macroura*) at the site.

Raccoon (*Procyon lotor*) tracks thoughout creek.

Exide Technologies Habitat Surveys

Date: 1/13/2014

Plot: H-42

Personnel: NH, KH, BS, BD

Camera: Nikon

GPS: B

Time: 13:00

General Location: North forested area

Dominant Vegetation
Celtis laevigata
Maclura pomifera
Smilax bona-nox
Lonicera japonica
Ulmus americana

GPS Waypoints	Description
Plot 42	Plot H-42

Photo IDs	Description
2325	North
2326	East
2327	South
2328	West

Comments

None

Exide Technologies Habitat Surveys

Date: 1/13/2014

Plot: H-41

Personnel: NH, KH, BS, BD

Camera: Nikon

GPS: B

Time: 12:55

General Location: North forested area

Dominant Vegetation
Ulmus americana
Smilax bona-nox
Maclura pomifera

GPS Waypoints	Description
Plot 41	Plot H-41

Photo IDs	Description
2321	North
2322	East
2323	South
2324	West

Comments
None

Exide Technologies Habitat Surveys

Date: 1/13/2014

Plot: H-43

Personnel: NH, KH, BS, BD

Camera: Nikon

GPS: B

Time: 13:05

General Location: North tributary

Dominant Vegetation
Celtis laevigata
Smilax bona-nox
Lonicera japonica
Ulmus americana

GPS Waypoints	Description
Plot 43	Plot H-43

Photo IDs	Description
2329	Upstream
2330	Site
2331	Downstream
2332	Predator scat
2333	Predator scat

Comments

Northern Shrike (*Lanius ludovicianus*) spotted near site.

High flow area, no sediment.

Rocky creek bottom.

Exide Technologies Habitat Surveys

Date: 1/13/2014

Plot: H-44

Personnel: NH, KH, BS, BD

Camera: Nikon

GPS: B

Time: 14:58

General Location: Hayfield adjacent to north tributary

GPS Waypoints	Description
Plot 44	Plot H-44

Dominant Vegetation
Solidago canadensis
Cynodon dactylon
Sorghum halepense
Engelmannia peristenia

Photo IDs	Description
2334	North
2335	East
2336	South
2337	West

Comments

Plot was located in a hayfield that was recently mowed.

Red-tailed Hawk (*Buteo jamaicensis*) sighted.

Exide Technologies Habitat Surveys

Date: 1/13/2014

Plot: H-45

Personnel: NH, KH, BS, BD

Camera: Sony

GPS: B

Time: 15:07

General Location: North tributary

GPS Waypoints	Description
Plot 45	Plot H-45

Dominant Vegetation

Solidago canadensis

Cynodon dactylon

Ambrosia trifida

Photo IDs	Description
353	Upstream
354	Site
355	Downstream

Comments

Gravel bottom, no sediment, and a high flow area.

Exide Technologies Habitat Surveys

Date: 1/13/2014

Plot: H-46

Personnel: NH, KH, BS, BD

Camera: Sony

GPS: B

Time: 15:03

General Location: Adjacent to north tributary

Dominant Vegetation
Solidago canadensis
Salix nigra
Sorghum halepense
Desmanthus illinoensis
Ulmus alata

GPS Waypoints	Description
Plot 46	Plot H-46

Photo IDs	Description
347	North
348	East
349	South
350	West

Comments

None

Exide Technologies Habitat Surveys

Date: 1/13/2014

Plot: H-47

Personnel: NH, KH, BS, BD

Camera: Sony

GPS: B

Time: 16:14

General Location: Hayfield adjacent to north tributary

GPS Waypoints	Description
Plot 47	Plot H-47

Dominant Vegetation
Solidago canadensis
Cynodon dactylon
Sorghum halepense
Engelmannia peristenia

Photo IDs	Description
360	Upstream
361	Site
362	Downstream
363	Raccoon (*Procyon lotor*) skull.

Comments

Raccoon (*Procyon lotor*) skull.

Exide Technologies Habitat Surveys

Date: 1/13/2014

Plot: H-48

Personnel: NH, KH, BS, BD

Camera: Sony

GPS: B

Time: 15:14

General Location: Adjacent to north tributary

Dominant Vegetation
Solidago canadensis
Salix nigra
Sorghum halepense
Desmanthus illinoensis
Ulmus alata
Ambrosia trifida

GPS Waypoints	Description
Plot 48	Plot H-48

Photo IDs	Description
356	North
357	East
358	South
359	West

Comments

None

Exide Technologies Habitat Surveys

Date: 1/13/2014

Plot: H-49

Personnel: NH, KH, BS, BD

Camera: Sony

GPS: B

Time: 15:20

General Location: North tributary

Dominant Vegetation
Solidago canadensis
Cynodon dactylon
Ambrosia trifida

GPS Waypoints	Description
Plot 49	Plot H-49

Photo IDs	Description
360	Upstream
361	Site
362	Downstream

Comments

Gravel creek bottom, no sediment, and a high flow area.

Exide Technologies Habitat Surveys

Date: 1/13/2014

Plot: H-50

Personnel: NH, KH, BS, BD

Camera: Nikon

GPS: B

Time: 14:58

General Location: Hayfield adjacent to north tributary

GPS Waypoints	Description
Plot 50	Plot H-50

Dominant Vegetation
Solidago canadensis
Cynodon dactylon
Sorghum halepense
Engelmannia peristenia

Photo IDs	Description
2334	North
2335	East
2336	South
2337	West

Comments

Plot was located in a hayfield that was recently mowed.

Exide Technologies Habitat Surveys

Date: 1/13/2014

Plot: H-51

Personnel: NH, KH, BS, BD

Camera: Sony

GPS: B

Time: 15:20

General Location: North tributary

Dominant Vegetation
Solidago canadensis
Salix nigra
Sorghum halepense
Desmanthus illinoensis
Ulmus alata

GPS Waypoints	Description
Plot 51	Plot H-51

Photo IDs	Description
364	North
365	East
366	South
367	West

Comments

None

Exide Technologies Habitat Surveys

Date: 1/13/2014

Plot: H-52

Personnel: NH, KH, BS, BD

Camera: Sony

GPS: B

Time: 15:07

General Location: North tributary

Dominant Vegetation
Solidago canadensis
Cynodon dactylon
Ambrosia trifida

GPS Waypoints	Description
Plot 52	Plot H-52

Photo IDs	Description
368	Upstream
369	Site
370	Downstream

Comments

Raccoon (*Procyon lotor*) tracks near site.

Exide Technologies Habitat Surveys

Date: 1/13/2014

Plot: H-53

Personnel: NH, KH, BS, BD

Camera: Sony

GPS: B

Time: 15:40

General Location: Between Stewart Creek and north tributary

Dominant Vegetation
Solidago canadensis
Cynodon dactylon
Sorghum halepense
Engelmannia peristenia

GPS Waypoints	Description
Plot 53	Plot H-53

Photo IDs	Description
367	North
368	East
369	South
370	West

Comments

None

Exide Technologies Habitat Surveys

Date: 1/13/2014

Plot: H-54

Personnel: NH, KH, BS, BD

Camera: Sony

GPS: B

Time: 15:40

General Location: Railroad tracks

Dominant Vegetation
Gleditsia triacanthos
Melia azedarach
Sorghum halepense
Helianthus annuus
Ambrosia trifida
Malus ioensis
Solidago canadensis

GPS Waypoints	Description
Plot 54	Plot H-54

Photo IDs	Description
380	North
381	East
382	South
383	West

Comments

Red-tailed Hawk (*Buteo jamaicensis)* sighted.

Exide Technologies Habitat Surveys

Date: 1/13/2014

Plot: H-55

Personnel: NH, KH, BS, BD

Camera: Sony

GPS: B

Time: 15:43

General Location: Railroad tracks

Dominant Vegetation
Gleditsia triacanthos
Melia azedarach
Sorghum halepense
Helianthus annuus
Ambrosia trifida
Malus ioensis
Solidago canadensis

GPS Waypoints	Description
Plot 55	Plot H-55

Photo IDs	Description
385	Northwest down tracks
386	Southeast down tracks
387	West, big creek
388	East toward field

Comments

Photos taken of an old railroad bed.

Exide Technologies Habitat Surveys

Date: 1/15/2014

Plot: H-60

Personnel: (BESI) NH, KH, BS (Golder) AM, MR, (Frisco) Tommy

Camera: Nikon

GPS: B

Time: 8:15

General Location: Stewart Creek

Dominant Vegetation
Fraxinus pennsylvanica
Smilax bona-nox

GPS Waypoints	Description
Plot 60	Plot H-60

Photo IDs	Description
2352	Pondhorn mussel (*Uniomerus tetralasmus*)
2353	Pondhorn mussel (*Uniomerus tetralasmus*)
2354	Shell fragment
2355	Downstream
2356	Upstream

Comments

Bottom of creek consists of gravel rocks.

2 Pondhorn mussel (*Uniomerus tetralasmus*) shells found.

Located downstream of wastewater treatment facility

Exide Technologies Habitat Surveys

Date: 1/15/2014

Plot: H-61

Personnel: (BESI) NH, KH, BS (Golder) AM, MR, (Frisco) Tommy

Camera: Nikon

GPS: B

Time: 8:35

General Location: Streambed near outfall of water treatment plant.

Dominant Vegetation
Celtis laevigata
Ambrosia trifida

GPS Waypoints	Description
Plot 61	Plot H-61

Photo IDs	Description
2363	Downstream
2364	Upstream
2365	Asian clam (*Corbicula spp.*)
2366	Asian clam (*Corbicula spp.*)
2367	Canine and raccoon (*Procyon lotor*) tracks
2368	Canine and raccoon (*Procyon lotor*) tracks

Comments

Bottom of creek changed to gravel.

Canine and raccoon (*Procyon lotor*) tracks on bank.

2 Asian clam (*Corbicula spp.*) shells.

Exide Technologies Habitat Surveys

Date: 1/15/2014

Plot: H-62

Personnel: (BESI) NH, KH, BS (Golder) AM, MR, (Frisco) Tommy

Camera: Nikon

GPS: B

Time: 8:50

General Location: Stewart Creek near outfall

Dominant Vegetation
Celtis occidentalis
Ambrosia trifida

GPS Waypoints	Description
Plot 62	Plot H-62

Photo IDs	Description
2373	Upstream
2374	Downstream
2375	Outfall

Comments

Creek bed transition to sediment and finer gravel.

Exide Technologies Habitat Surveys

Date: 1/15/2014

Plot: H-63

Personnel: (BESI) NH, KH, BS (Golder) AM, MR, (Frisco) Tommy

Camera: Nikon

GPS: B

Time: 8:57

General Location: Near outfall of wastewater treatment facility

Dominant Vegetation
Celtis laevigata
Ambrosia trifida
Fraxinus pennsylvanica

GPS Waypoints	Description
Plot 63	Plot H-63

Photo IDs	Description

Comments

Creek bottom transitioned to all gravel with no sediment.

Exide Technologies Habitat Surveys

Date: 1/15/2014

Plot: H-64

Personnel: (BESI) NH, KH, BS (Golder) AM, MR, (Frisco) Tommy

Camera: Nikon

GPS: B

Time: 9:00

General Location: Upstream of waste water treatment outfall

Dominant Vegetation
Celtis laevigata
Ambrosia trifida
Fraxinus pennsylvanica

GPS Waypoints	Description
Plot 64	Plot H-64

Photo IDs	Description
2377	Gravel bank with mussel shells
2378	Upstream
2379	Asian clams (*Corbicula spp.*)
2380	Bank of site
2381	Dead Green Sunfish (*Lepomis cyanellus*)

Comments

Large amount of mussel shell on gravel bank.

Just upstream from the outfall of wastewater treatment facility

Sediment, all small gravel.

Green sunfish (*Lepomis cyanellus*), dead.

Exide Technologies Habitat Surveys

Date: 1/15/2014

Plot: H-65

Personnel: (BESI) NH, KH, BS (Golder) AM, MR, (Frisco) Tommy

Camera: Nikon

GPS: B

Time: 9:20

General Location: Upstream of wastewater treatment outfall

Dominant Vegetation
Celtis laevigata
Fraxinus pennsylvanica
Elymus canadensis

GPS Waypoints	Description
Plot 65	Plot H-65

Photo IDs	Description
2393	Downstream
2394	Gravel bank
2395	Asian Clam (*Corbicula spp.*)

Comments

Small round Asian Clam (*Corbicula spp.*) collected.

Snail shells found in area, dead.

Exide Technologies Habitat Surveys

Date: 1/15/2014

Plot: H-66

Personnel: (BESI) NH, KH, BS (Golder) AM, MR, (Frisco) Tommy

Camera: Nikon

GPS: B

Time: 9:50

General Location: Stewart Creek, upstream of wastewater treatment outfall

GPS Waypoints	Description
Plot 66	Plot H-66

Dominant Vegetation
Celtis laevigata
Fraxinus pennsylvanica
Elymus canadensis

Photo IDs	Description
2403	Upstream
2404	Site
2405	Downstream
2406	Asian Clams (*Corbicula spp.*)

Comments

Small pools in bends of creek with riffles in the straight aways.

Small amounts of sedimentation in bends.

Asian Clam (*Corbicula spp.*) shells found all along creek on high surfaces next to water.

Nest spotted over creek.

Exide Technologies Habitat Surveys

Date: 1/15/2014

Plot: H-67

Personnel: (BESI) NH, KH, BS (Golder) AM, MR, (Frisco) Jason

Camera: Nikon

GPS: B

Time: 13:50

General Location: Near bridge at Stonebrook Pkwy

Dominant Vegetation
Fraxinus pennsylvanica
Celtis laevigata
Ambrosia trifida
Smilax bona-nox

GPS Waypoints	Description
Plot 67	Plot H-67

Photo IDs	Description
2450	Upstream
2451	Downstream
2452	Pondhorn mussel (*Uniomerus tetralasmus*) weathered.
2453	Pondhorn mussel (*Uniomerus tetralasmus*) weathered.
2454	Snail
2455	Pondhorn mussel (*Uniomerus tetralasmus*) intact.

Comments

Gravel, sand, and rocks

Exide Technologies Habitat Surveys

Date: 1/15/2014

Plot: H-68

Personnel: (BESI) NH, KH, BS (Golder) AM, MR, (Frisco) Jason

Camera: Nikon

GPS: B

Time: 14:28

General Location: Stewart Creek, upstream of Stonebrook Pkwy.

GPS Waypoints	Description
Plot 68	Plot H-68

Dominant Vegetation
Fraxinus pennsylvanica
Smilax bona-nox
Sorghum halepense

Photo IDs	Description
2460	Upstream
2461	Downstream
2462	Pondhorn (*Uniomerus tetralasmus*)
2463	Upstream
2464	Downstream

Comments

Area has a lot of exposed rock beds.

Spotted several pondhorn mussel shells on the exposed gravel bed

Exide Technologies Habitat Surveys

Date: 1/15/2014

Plot: H-69

Personnel: (BESI) NH, KH, BS (Golder) AM, MR, (Frisco) Jason

Camera: Nikon

GPS: B

Time: 14:35

General Location: Stewart Creek upstream of Stonebrook Pkwy.

GPS Waypoints	Description
Plot 69	Plot H-69

Dominant Vegetation
Fraxinus pennsylvanica
Smilax bona-nox
Sorghum halepense

Photo IDs	Description
2469	Pondhorn mussel (*Uniomerus tetralasmus*)
2470	Downstream
2471	Upstream

Comments

Spotted several pondhorn mussel shells on exposed rock beds.

Stream flow is relatively high to elevation changes.

Spotted small minnows near plot.

Exide Technologies Habitat Surveys

Date: 1/15/2014

Plot: H-70

Personnel: (BESI) NH, KH, BS (Golder) AM, MR, (Frisco) Jason

Camera: Nikon

GPS: B

Time: 15:04

General Location: Stewart Creek, upstream of Stonebrook Pkwy.

GPS Waypoints	Description
Plot 70G15	Plot H-70

Dominant Vegetation
Fraxinus pennsylvanica
Smilax bona-nox
Sorghum halepense

Photo IDs	Description
2475	Upstream
2476	Downstream
2477	Site

Comments

Streambed consists of gravel over clay and shale.

Strong currents compared to lower part of the stream surveyed this morning.

Exide Technologies Habitat Surveys

Date: 1/15/2014

Plot: H-71

Personnel: (BESI) NH, KH, BS (Golder) AM, MR, (Frisco) Jason

Camera: Nikon

GPS: B

Time: 11:00

General Location: Stewart Creek between Lebanon Rd. and 4th Army Dr.

Dominant Vegetation
Fraxinus pennsylvanica
Smilax bona-nox
Ambrosia trifida
Celtis laevigata

GPS Waypoints	Description
Photo 001	Outfall near road.
G-10	Soft spot
G-11	Soft spot
G-12	Soft spot
G-13	Soft spot

Photo IDs	Description
2438-2440	Outfall near road, rocky.
2441-2443	Pool area, soft.
2444-2445	Pool area, soft.
2446-2447	Pool area, soft.
2448-2449	Pool area, soft, tributary nearby.

Comments
None

Exide Technologies Habitat Surveys

Date: 1/16/2014

Plot: H-72

Personnel: (BESI) KH, BS (Golder) AM, MR, (Frisco)Tommy

Camera: Nikon

GPS: B

Time: 8:31

General Location: Stewart Creek directly downstream of Exide Facility

Dominant Vegetation
Fraxinus pennsylvanica
Sorghum halepense
Ambrosia trifida
Celtis laevigata

GPS Waypoints	Description
Plot 72	Plot H-72, stream bed

Photo IDs	Description
2469	Pondhorn mussel (*Uniomerus tetralasmus*)
2470	Downstream
2471	Upstream

Comments

Creek bed composed of rocks, no sediment.

Nest in tree nearby.

Small animal tracks on bank.

Exide Technologies Habitat Surveys

Date: 1/16/2014

Plot: H-73

Personnel: (BESI) KH, BS (Golder) AM, MR, (Frisco) Tommy

Camera: Nikon

GPS: B

Time: 10:55

General Location: Stewart Creek upstream of Lake Lewisville

GPS Waypoints	Description
Plot 73	Plot H-73, stream bed

Dominant Vegetation
Fraxinus pennsylvanica
Sorghum halepense
Ambrosia trifida
Celtis laevigata

Photo IDs	Description
2528	Downstream
2529	Site
2530	Upstream

Comments

Asian clam (*Corbicula spp.*) shell found in rake nearby.

Six Mallard (*Anas platyrhynchos*) ducks sighted.

Turkey Vulture (*Cathartes aura*) sighted.

Numerous animal tracks on the bank.

Exide Technologies Habitat Surveys

Date: 1/16/2014

Plot: H-74

Personnel: (BESI) KH, BS (Golder) AM, MR, (Frisco) Tommy

Camera: Nikon

GPS: B

Time: 12:17

General Location: Stewart Creek upstream of Lake Lewisville

GPS Waypoints	Description
Plot 74	Plot H-74, stream bed

Dominant Vegetation
Fraxinus pennsylvanica
Chasmanthium latifolium

Photo IDs	Description
2560	Downstream
2561	Upstream
2562	Gaint Floater (*Anodonta grandis*) and Pondhorn (*Uniomerus tetralasmus*)
2563	Gaint Floater (*Anodonta grandis*) and Pondhorn (*Uniomerus tetralasmus*)

Comments

Beaver (*Castor canadensis*) signs, cut tree.

Five Mallard (*Anas platyrhynchos*) ducks sighted.

Squrriel (*Sciurus*) sighted.

Numerous animal tracks on the bank.

Exide Technologies Habitat Surveys

Date: 1/16/2014

Plot: H-75

Personnel: (BESI) KH, BS (Golder) AM, MR, (Frisco) Jason

Camera: Nikon

GPS: B

Time: 13:15

General Location: Stewart Creek upstream of Lake Lewisville

GPS Waypoints	Description
Plot 75	Plot H-75, stream bed

Dominant Vegetation
Chasmanthium latifolium
Maclura pomifera
Fraxinus pennsylvanica

Photo IDs	Description
2575	Upstream
2576	Site
2577	Downstream

Comments

Bend in stream.

Exide Technologies Habitat Surveys

Date: 1/16/2014

Plot: H-76

Personnel: (BESI) KH, BS (Golder) AM, MR, (Frisco) Tommy

Camera: Nikon

GPS: B

Time: 13:26

General Location: Stewart Creek upstream of Lake Lewisville

GPS Waypoints	Description
Plot 76	Plot H-76, stream bed

Dominant Vegetation
Sorghum halepense
Maclura pomifera
Ulmus crassifolia
Fraxinus pennsylvanica

Photo IDs	Description
2578	Upsteam
2579	Downstream

Comments

Gravel and sand mix.

2 Mallard (*Anas platyrhynchos*) ducks sighted.

Nest in tree.

Exide Technologies Habitat Surveys

Date: 1/16/2014

Plot: H-77

Personnel: (BESI) KH, BS (Golder) AM, MR, (Frisco) Jason

Camera: Nikon

GPS: B

Time: 15:14

General Location: Stewart Creek downstream of Lebanon Rd.

GPS Waypoints	Description
Plot 77	Plot H-77, stream bed

Dominant Vegetation
Fraxinus pennsylvanica
Maclura pomifera
Panicum virgatum
Chasmanthium latifolium

Photo IDs	Description
2586	Upstream
2587	Site
2588	Downstream

Comments

Asian Clam (*Corbicula spp.*) shells on streambed.

Gravel and silt mix, hard bottom.

Heard owl hooting.

Animal tracks on the bank.

Exide Technologies Habitat Surveys

Date: 1/16/2014

Plot: H-78

Personnel: (BESI) KH, BS (Golder) AM, MR, (Frisco) Jason

Camera: Nikon

GPS: B

Time: 15:24

General Location: Stewart Creek downstream of Lebanon Rd.

GPS Waypoints	Description
Plot 78	Plot H-78, stream bed

Dominant Vegetation
Fraxinus pennsylvanica
Ulmus crassifoila
Ambrosia trifida

Photo IDs	Description
2592	Upstream
2593	Site
2594	Downstream
2595	Streambed
2596	Streambed
2597	Asian Clam (*Corbicula spp.*) shells
2598	Asian Clam (*Corbicula spp.*) shells

Comments

Stream bed with large amounts of Asian Clam (*Corbicula spp.*)shells.

Rocky streambed.

Exide Technologies Habitat Surveys

Date: 3/18/2014

Plot: H-100

Personnel: (BESI) KH, RM (Golder) AM, Chris (Frisco) Jason

Camera: Nikon

GPS: A

Time: 11:00

General Location: Stewart Creek downstream of Legacy Dr.

GPS Waypoints	Description
Plot H100	Plot H-100, stream bed

Dominant Vegetation
Ulmus alata
Celtis occidentalis
Gleditsia triacanthos

Photo IDs	Description
2779	North
2780	East
2781	South
2782	West

Comments

Unknown frog species heard.

Exide Technologies Habitat Surveys

Date: 3/18/2014

Plot: H-102

Personnel: (BESI) KH, RM (Golder) AM, Chris (Frisco) Jason

Camera: Nikon

GPS: A

Time: 12:42

General Location: Stewart Creek downstream of Legacy Dr.

GPS Waypoints	Description
Plot 102	Plot H-102, stream bed

Dominant Vegetation
Ulmus alata
Ambrosia Trifida
Sorghum halepense
Rumex crispus

Photo IDs	Description
2801	North
2802	East
2803	South
2804	West

Comments

4 Spring Peepers (*Pseudacris crucifer*) heard.

Exide Technologies Habitat Surveys

Date: 3/18/2014

Plot: H-103

Personnel: (BESI) KH, RM (Golder) AM, Chris (Frisco) Jason

Camera: Nikon

GPS: A

Time: 14:34

General Location: Stewart Creek downstream of Legacy Dr.

GPS Waypoints	Description
Plot H103	Plot H-103, stream bed

Dominant Vegetation
Fraxinus pennsylvanica
Ulmus alata
Gleditsia triacanthos
Ambrosia trifida
Smilax bona-nox

Photo IDs	Description
2819	North
2820	South
2821	West
2822	East

Comments

None

Exide Technologies Habitat Surveys

Date: 3/18/2014

Plot: H-104

Personnel: (BESI) KH, RM (Golder) AM, Chris (Frisco) Jason

Camera: Nikon

GPS: A

Time: 15:50

General Location: Stewart Creek downstream of Legacy Dr.

GPS Waypoints	Description
Plot H104	Plot H-104, stream bed

Dominant Vegetation
Ambrosia trifida
Ulmus alata
Panicum virgatum

Photo IDs	Description
2834	West
2835	North
2836	East
2837	South
2838	Stream bottom

Comments

Open with very few woody species.

Exide Technologies Wildlife Observations

Initials	Date	Time	ID	Observation	Photo ID
NH	1/13/2014	8:45	W-1	Deer (*Odocoileus virginianus*) rubs	2114-2118
NH	1/13/2014	8:50	W-2	Burrow, unknown species, and active	2119-2121
NH	1/13/2014	8:50	W-3	Burrow and Deer (*Odocoileus virginianus*) tracks	2122-2123
NH	1/13/2014	9:00	W-4	Nests, possibly used by a squirrel.	2129
NH	1/13/2014	9:00	W-5	Nest, large possibly used by a raptor or owl.	2130
NH	1/13/2014	9:05	W-6	Burrow, Tufted Titmouse (*Baeolophus bicolor*) and Carolina Chickadee heard.	2135
NH	1/13/2014	9:06	W-7	Mockingbird (*Minus polyglottos*) sighting	
NH	1/13/2014	9:10	W-8	Burrows, multiple, next to old structure, possibly used by Packrats.	2140-2144
NH	1/13/2014	9:46	W-9	Burrows, multiple in the area.	2172-2173
NH	1/13/2014	9:51	W-10	Blue Jay (*Cyanocitta cristata*) heard.	
NH	1/13/2014	10:21	W-11	Beaver (*Castor canadensis*) slide, Burr oak acorns next to the slide.	2209
NH	1/13/2014	10:22	W-12	Beaver (*Castor canadensis*) dam, pooling behind dam.	2210-2211
NH	1/13/2014	10:46	W-13	Beaver (*Castor canadensis*) sign on log.	2233
NH	1/13/2014	10:50	W-14	Raccoon (*Procyon lotor*) tracks	2237
NH	1/13/2014	11:07	W-15	Hog sign	2251
NH	1/13/2014	11:18	W-16	Dead Pondhorn (*Uniomerus tetralasmus*) shell found approximately 7 feet above the waterline.	
NH	1/13/2014	12:15	W-17	Scat, most likely a Raccoon (*Procyon lotor*) on log over creek and Tufted Titmouse (*Baeolophus bicolor*) was spotted.	2277

Exide Technologies Wildlife Observations

Initials	Date	Time	ID	Observation	Photo ID
NH	1/13/2014	12:20	W-18	Raccoon (Procyon lotor) tracks in creek.	2288
NH	1/13/2014	14:42	W-19	Coyote (*Canis latrans*) spotted from van on the south side of creek.	
NH	1/13/2014	15:30	W-20	Burrows	371-373
NH	1/13/2014	15:40	W-21	Nest	384
NH	1/13/2014	16:10	W-22	Burrows	400
NH	1/14/2014	8:00	W-23	Pair of Mallard Ducks (*Anas platyrhynchos*) spotted below the dam.	2338-2341
NH	1/14/2014	8:00	W-24	Mourning Doves (*Zenaida marcoura*) spotted.	
NH	1/15/2014	8:20	W-25	2 Asian Clams (*Corbicula spp.*) and a pair of Mallard Ducks (*Anas platyrhynchos*) spotted.	2357-2358
NH	1/15/2014	8:21	W-26	2 Asian Clams (*Corbicula spp.*) and Great Blue Heron (*Ardea herodias*) feather.	2359-2362
NH	1/15/2014	8:45	W-27	Asian Clams (*Corbicula spp.*) , Raccoon (*Procyon lotor*) and canine tracks	2369-2370
NH	1/15/2014	8:50	W-28	Mussel shell fragment possibly a Pondhorn (*Uniomerus tetralasmus*)	2371-2372
NH	1/15/2014	8:55	W-29	Mussel shell fragment possibly a Pondhorn (*Uniomerus tetralasmus*)	2376
NH	1/15/2014	9:05	W-30	2 dead Bluegill (*Lepomis macrochirus*) and 1 dead Green Sunfish (*Lepomis cyanellus*) found. Also a Carolina Chickadee (*Poecile carolinensis*) was heard.	2381-2384
NH	1/15/2014	9:15	W-31	Deer (Odocoileus virginianus) tracks and rubings on the south bank. A Pondhorn (*Uniomerus tetralasmus*) shell.	2385-2388
NH	1/15/2014	9:17	W-32	Intact Pondhorn (*Uniomerus tetralasmus*) shell	2389-2398
NH	1/15/2014	9:25	W-33	Pondhorn (*Uniomerus tetralasmus*) shell	2396-2399
NH	1/15/2014	10:30	W-34	Wading bird tracks and fish nests on sediment surface.	2418-2420

Exide Technologies Wildlife Observations

Initials	Date	Time	ID	Observation	Photo ID
NH	1/15/2014	10:40	W-35	Larger Pondhorn (*Uniomerus tetralasmus*) shell, on riffle area, older shell.	2421-2424
NH	1/15/2014	10:50	W-36	Larger Pondhorn (*Uniomerus tetralasmus*) shell, shale bottom, on riffle area, older shell.	2425-2428
NH	1/15/2014	11:00	W-37	Bairds Sandpiper (*Calidris bairdii*) spotted, shale bottom no sediment.	2429-2433
NH	1/15/2014	14:20	W-38	Pondhorn (*Uniomerus tetralasmus*) shell, large, bottom rocky.	2456-2459
NH	1/15/2014	14:30	W-39	Wading bird foot prints in sand.	2468
NH	1/15/2014	14:40	W-40	Large Pondhorn (*Uniomerus tetralasmus*) shell.	2472-2473
NH	1/15/2014	15:38	W-41	Large Pondhorn (*Uniomerus tetralasmus*) shell.	2483-2488
NH	1/15/2014	15:50	W-42	Turtle, recently dead.	2496-2503
NH	1/15/2014	16:05	W-43	Juvenile Soft-shell turtle (*Apalone spinifera*) found live, gravel bottom.	2504-2505
BS	1/16/2014	8:23	W-44	Pondhorn (*Uniomerus tetralasmus*) shell out of water on gravel bank.	2510-2513
BS	1/16/2014	8:44	W-45	Red-eared slider (*Trachemys scripta elegans*), multiple sightings. Northern Cardinal (*Cardinalis cardinalis*) sighted. Pondhorn (*Uniomerus tetralasmus*) shell found.	2517-2519
BS	1/16/2014	11:06	W-46	Two (dead), only shells, possibly Red-eared sliders (*Trachemys scripta elegans*)	2533-2534
BS	1/16/2014	11:34	W-47	Animal tracks on bank possibly Raccoon (*Procyon lotor*) and Coyote (*Canis latrans*)	2540
BS	1/16/2014	12:02	W-48	Small owl, fresh dead, found floating in creek. Large trutle also found in creek.	2553-2557
BS	1/16/2014	13:00	W-49	Dead bird, half decomposed, possibly a raptor or owl.	2573-2574
BS	1/16/2014	15:19	W-50	Mallard Ducks(*Anas platyrhynchos*) spotted in streambed.	2589-2591
BS	1/16/2014	16:28	W-51	Beaver (*Castor canadensis*) dam	2616-2617

Exide Technologies Wildlife Observations

Initials	Date	Time	ID	Observation	Photo ID
KH	3/18/2014	9:10	W100	2 Mallards (*Anas platyrhynchos*), 1 mockingbird (*Mimus polyglottos*) sighted.	2766
KH	3/18/2014	11:30	W101	Red-eared slider (*Trachemys scripta elegans*)	2789-2791
KH	3/18/2014	11:40	W102	2 Mallards (*Anas platyrhynchos*) sighted in creek. Beaver (*Castor canadensis*) sign evident on banks.	2792
KH	3/18/2014	12:30	W103	Beaver (*Castor canadensis*) evidenced.	2800
KH	3/18/2014	13:15	W104	White tailed deer (*Odocoileus virginianus*) tracks and Asian clam (*Corbicula spp.*) shells on bank.	2811
KH	3/18/2014	14:00	W105	Auditory observation of Mockingbird (*Mimus polyglottos*) and Hawk (species unknown).	N/A
KH	3/18/2014	14:43	W106	North American Raccoon (*Procyon lotor*) tracks on sediment bar.	2823
KH	3/18/2014	14:45	W107	Pondhorn (*Uniomerus tetralasmus*) shell out of water on gravel bank.	2825
KH	3/18/2014	15:37	W108	2 Mallard ducks (*Anas platyrhynchos*) on stream. North American Raccoon (*Procyon lotor*) tracks on sediment bar.	2832-2733

Attachment C

Stewart Creek (H-64)

Stewart Creek (H-65)

Stewart Creek (T-6)

Stewart Creek (W-35)

Stewart Creek (W-35)

Stewart Creek (H-72)

Stewart Creek (H-73)

Stewart Creek (T-15)

Stewart Creek (T-10)

Stewart Creek (H-77)

Stewart Creek (H-78)

Clam Rake (T-21)

Clam Rake (T-6)

Clam Rake (T-7)

Clam Rake (T-8)

Clam Rake (T-9)

Clam Rake (T-11)

Clam Rake (T-18)

Asian Clams (H-78)

Asian Clams (T-13)

Clam Rake (T-14)

Asian Clams and Pondhorn (T-15)

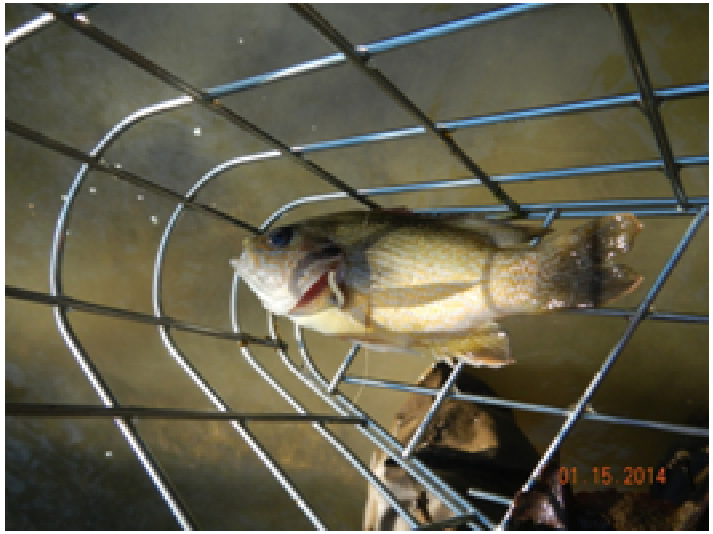
Asian Clams and Pondhorns (T-15)

Pondhorn (W-41)

Pondhorn (W-44)

Pondhorn (W-45)

Soft-shell Turtle (W-43)



Green Sunfish (W-32)

Box Turtle (W-42)

Stewart Creek in Exide Facility (H-18)

Stewart Creek in Exide Facility (H-17)

Stewart Creek in Exide Facility (H-26)

Stewart Creek in Exide Facility (T-24)

Rip-rap in Stewart Creek (W-13)

Concrete Dam in Stewart Creek (H-22)

Stewart Creek in Exide Facility (H-3)

Rip-rap in Stewart Creek (H-22)

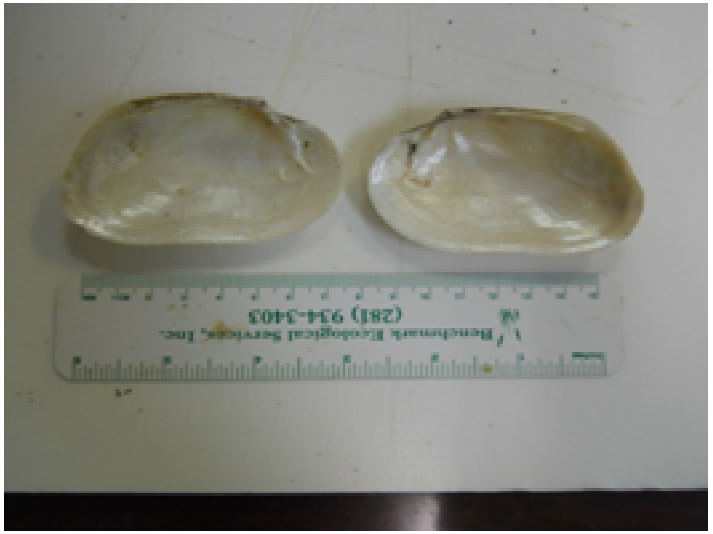
Clam Rakes within the Exide Facility (T-2)

Sediment in the Exide Facility (H-24)

Clam Rakes within the Exide Facility (T-1)

Stewart Creek in the Exide Facility (H-26)

Stewart Creek in the Exide Facility (H-26)



Pondhorn found within the Exide Facility (W-16)

Pondhorn found within the Exide Facility (W-16)

Mallards (W-23)

Northern tributary in NE forested area (H-40)

Northern tributary in NE forested area (H-28)

Northern tributary in NE forested area (H-32)

Northern tributary in NE forested area (H-32)

Northern tributary outside NE forested area (H-49)

Northern tributary outside NE forested area (H-47)

Northern tributary outside NE forested area (H-47)

Northeast Forested Area (H-38)

Northeast Forested Area (H-41)

Northeast Forested Area (H-34)

Northeast Forested Area (H-37)

Southeast Forested Area (H-5)

Southeast Forested Area (H-3)

Southeast Forested Area (H-4)

Southeast Forested Area (H-5)

Deer rub (W-1)

Burrow (W-2)

Packrat burrow (W-8)

Nest (H-33)

Hayfield (H-27)

Hayfield (H-27)

APPENDIX D

ECOLOGICAL RISK ASSESSMENT CALCULATIONS

Calculation Input Parameters for Wildlife Receptors
Stewart Creek SLERA

Screening Level Ecological Risk Assessment
Former Operating Plant
Stewart Creek
Frisco, Texas
May, 2014

Table D-1
Uptake Factors

Analyte	Sediment to Aquatic Plant UF		Sediment to Benthic Invertebrate UF		Sediment to Fish UF	
Arsenic	0.036	a	0.90	a	0.162	b
Cadmium	0.364	a	3.40	a	0.53	c
Lead	0.045	a	0.63	a	0.07	c

Notes:

a. EPA. August 1999. Screening Level Ecological Risk Assessment Protocol for Hazardous Waste Combustion Facilities. Office of Solid Waste and Emergency Response. EPA530-D-99-001.

b. EPA, 2000. Bioaccumulation Testing and Interpretation for the Purpose of Sediment Quality Assessment. Status and Needs. EPA-823-R-00-001.

c. Geometric mean of sediment to fish BSAF values from Rzymski, P., Niedzielski, P., Klimaszyk, P and B. Poniedzialek, 2014. Bioaccumulation of Selected Metals in Bivalves (*Unionidae*) and *Phragmites australis* inhabiting a Municipal Water Reservoir. *Envion. Monit. Assess*. 186:3199-3212.

2014 EXIDE APAR PAGE 676 OF 3116

Screening Level Ecological Risk Assessment
Former Operating Plant
Stewart Creek
Frisco, Texas
May, 2014

Table D-2
NOAEL and LOAEL Toxicity Data

	Avian NOAEL TRV (mg/kg-day)	Avian LOAEL TRV (mg/kg-day)	Mammal NOAEL TRV (mg/kg-day)	Mammal LOAEL TRV (mg/kg-day)
Arsenic	2.24	4.5	2.8	6.9
Cadmium	1.47	6.35	0.77	7.70
Lead	1.63	3.26	4.70	8.90

Notes:

1. Arsenic NOAELs and LOAELs from EPA 2005. Ecological Soil Screening Levels for Arsenic.
2. Cadmium NOAELs and LOAELs from EPA 2005. Ecological Soil Screening Levels for Cadmium.
3. Lead NOAELs and LOAELs from EPA 2005. Ecological Soil Screening Levels for Lead.

Screening Level Ecological Risk Assessment
Former Operating Plant
Stewart Creek
Frisco, Texas
May, 2014

Table D-3
Ingestion-Pathway Exposure Assumptions for Aquatic Wildlife Measurement Receptors

Common Name	Scientific Name	Body Weight (kg)	Food Ingestion Rate (kg/day)	Sediment Ingestion (% of diet)	Sediment Ingestion Rate (kg/day)	Exposure Modifying Factor (EMF)
Bird						
Snowy Egret	*Egretta thula*	0.371 a	0.031 b	17 c	0.0053	1
Mammal						
Raccoon	*Procyon lotor*	5.63 a	0.280 b	9.4 c	0.0263	1

Notes:

a. Geometric mean of raccoon body weights for both sexes from EPA (1993) *Wildlife Exposure Factors Handbook*. Office of Research and Development. EPA/600/R-93/187. December.
To be conservative, the lower of the average male or female body weight was used if available (Dunning, 1993).
Dunning, J.B., Jr., 1993. *CRC Handbook of Avian Body Masses*. CRC Press, Boca Raton, FL. 371 pp.

b. Food ingestion rates for mammals determined using FI (kg/day) = 0.0687 $Wt^{0.822}$ (kg) from EPA 1993 (equation 3-7). Food ingestion rate for all mammals.
Food ingestion rates for birds determined using FI (kg/day) = 0.0582 $Wt^{0.651}$ (g) from EPA 1993 (equation 3-5). Food ingestion rate for all birds.

c. Sediment ingestion taken from Beyer (1994). Beyer, W.N., E. Conner and S. Gould, 1994. Estimates of Soil Ingestion by Wildlife. *J. Wildl Manage.* 58:375-382.

Screening Level Ecological Risk Assessment
Former Operating Plant
Stewart Creek
Frisco, Texas
May, 2014

Table D-4
Fraction of Components in Receptor Diet

Common Name	Aquatic Vascular Plants	Benthic Invertebrates	Fish	Reference
Bird				
Snowy Egret		0.3	0.7	Terres, 1980
Mammal				
Raccoon	0.1	0.6	0.3	EPA 1993

Notes:

1. Terres, J.K. 1980. *The Audubon Society Encyclopedia of North American Birds*. Wing Books. NY.
2. EPA 1993 *Wildlife Exposure Factors Handbook.*

Screening Level Ecological Risk Assessment
Former Operating Plant
Stewart Creek
Frisco, Texas
May, 2014
Table D-5
Sediment Data Summary Statistics

Exposure Area	Minimum Detection (mg/kg)	Maximum Detection (mg/kg)	95% UCL (mg/kg)	Notes for Trophic Analysis
Stewart Creek Upstream				
Arsenic	8.55	42.70	21.71	Arsenic retained for trophic analysis. Max > benchmark.
Cadmium	0.26	0.69	0.53	Cadmium retained for trophic analysis. Max < benchmark, but considered bioaccumulative.
Lead	6.56	19.8	14.56	Lead removed in screening. Max < benchmark and not bioaccumulative.
North Tributary On-Site				
Arsenic	ND	ND	ND	No arsenic data available.
Cadmium	0.69	1.19	1.02	Cadmium retained for trophic analysis. Max < benchmark, but considered bioaccumulative.
Lead	10.4	28.2	20.14	Lead removed in screening. Max < benchmark and not bioaccumulative.
Stewart Creek On-Site				
Arsenic	ND	ND	ND	No arsenic data available.
Cadmium	0.34	2.08	1.21	Cadmium retained for trophic analysis. Max < benchmark, but considered bioaccumulative.
Lead	6.57	19.20	14.26	Lead removed in screening. Max < benchmark and not bioaccumulative.
Stewart Creek Downstream of FOP				
Arsenic	7	279	32.35	Arsenic retained for trophic analysis. Max > benchmark.
Cadmium	0.04	6.96	1.46	Cadmium retained for trophic analysis. Max > benchmark.
Lead	8.20	459	58.28	Lead retained for trophic analysis. Max > benchmark.
Stewart Creek On-Site and Downstream				
Arsenic	7	279	32.35	Arsenic retained for trophic analysis. Max > benchmark.
Cadmium	0.04	6.96	1.42	Cadmium retained for trophic analysis. Max > benchmark.
Lead	6.57	459	54.24	Lead retained for trophic analysis. Max > benchmark.
Stewart Creek On-Site and Downstream (without hotspots)				
Arsenic	7	57.7	21.89	Arsenic retained for trophic analysis. Max > benchmark.
Cadmium	0.16	4.47	1.32	Cadmium retained for trophic analysis. Max > benchmark.
Lead	6.57	59	23.13	Lead retained for trophic analysis. Max > benchmark.

Notes:
1. UCL - upper confidence limit
2. ProUCL output presented in Appendix B.
3. ND - No Data

Hazard Quotient Calculations
Stewart Creek Upstream Exposure Unit

Screening Level Ecological Risk Assessment
Former Operating Plant
Stewart Creek Upstream Exposure Unit
Frisco, Texas
May, 2014
Table D-6
Hazard Quotient Calculations for the Snowy Egret - Initial Conservative Exposure Parameters

Snowy Egret	95% UCL Sediment Conc (mg/kg)	Benthic Invertebrate UF (unitless)	Benthic Invertebrate Conc (mg/kg)	Fish UF (unitless)	Fish Conc (mg/kg)	Total Daily Dose Rate (mg/kg BW-day)	NOAEL Toxicity Reference Value (mg/kg BW-day)	Based on Conservative Exposure Parameters NOAEL Hazard Quotient (unitless)
Arsenic	21.71	9.0E-01	2.0E+01	1.6E-01	3.5E+00	1.0E+00	2.2E+00	4.5E-01
Cadmium	0.53	3.4E+00	1.8E+00	5.3E-01	2.8E-01	6.8E-02	1.5E+00	4.7E-02
Lead	NA	Lead removed in screening						

$$\text{Dose} = [(\text{Conc}_{\text{benthics}} \times \text{IR}_{\text{food}})0.3 + (\text{IR}_{\text{food}} \times \text{Conc}_{\text{fish}})0.7 + (\text{IR}_{\text{sed}} \times \text{Conc}_{\text{Sediment}})]/\text{Body Weight}_{\text{Egret}}$$

Screening Level Ecological Risk Assessment
Former Operating Plant
Stewart Creek Upstream Exposure Unit
Frisco, Texas
May, 2014
Table D-7
Hazard Quotient Calculations for the Raccoon - Initial Conservative Exposure Parameters

Raccoon	95% UCL Sediment Conc (mg/kg)	Aquatic Plant UF (unitless)	Aquatic Plant Conc (mg/kg)	Benthic Invertebrate UF (unitless)	Benthic Invertebrate Conc (mg/kg)	Fish UF (unitless)	Fish Conc (mg/kg)	Total Daily Dose Rate (mg/kg BW-day)	NOAEL Toxicity Reference Value (mg/kg BW-day)	Based on Conservative Exposure Parameters NOAEL Hazard Quotient (unitless)
Arsenic	21.71	3.6E-02	7.8E-01	9.0E-01	2.0E+01	1.6E-01	3.5E+00	7.4E-01	2.8E+00	2.6E-01
Cadmium	0.53	3.6E-01	1.9E-01	3.4E+00	1.8E+00	5.3E-01	2.8E-01	6.1E-02	7.7E-01	7.9E-02
Lead	NA	Lead removed in screening.								

$$\text{Dose} = [(\text{Conc}_{\text{benthics}} \times \text{IR}_{\text{food}})0.6 + (\text{IR}_{\text{food}} \times \text{Conc}_{\text{fish}})0.3 + (\text{IR}_{\text{food}} \times \text{Conc}_{\text{plant}})0.1 + (\text{IR}_{\text{sed}} \times \text{Conc}_{\text{Sediment}})]/\text{Body Weight}_{\text{raccoon}}$$

Hazard Quotient Calculations
North Tributary Exposure Unit

Screening Level Ecological Risk Assessment
Former Operating Plant
North Tributary Exposure Unit
Frisco, Texas
May, 2014
Table D-8
Hazard Quotient Calculations for the Snowy Egret - Initial Conservative Exposure Parameters

Snowy Egret	95% UCL Sediment Conc (mg/kg)	Benthic Invertebrate UF (unitless)	Benthic Invertebrate Conc (mg/kg)	Fish UF (unitless)	Fish Conc (mg/kg)	Total Daily Dose Rate (mg/kg BW-day)	NOAEL Toxicity Reference Value (mg/kg BW-day)	Based on Conservative Exposure Parameters NOAEL Hazard Quotient (unitless)
Arsenic	NA	Arsenic data not available from North Tributary Exposure Unit						
Cadmium	1.02	3.4E+00	3.5E+00	5.3E-01	5.4E-01	1.3E-01	1.5E+00	9.0E-02
Lead	NA	Lead removed in screening						

$$\text{Dose} = [(\text{Conc}_{\text{benthics}} \times \text{IR}_{\text{food}})0.3 + (\text{IR}_{\text{food}} \times \text{Conc}_{\text{fish}})0.7 + (\text{IR}_{\text{sed}} \times \text{Conc}_{\text{Sediment}})]/\text{Body Weight}_{\text{Egret}}$$

2014 EXIDE APAR PAGE 685 OF 3116

Screening Level Ecological Risk Assessment
Former Operating Plant
North Tributary Exposure Unit
Frisco, Texas
May, 2014

Table D-9
Hazard Quotient Calculations for the Raccoon - Initial Conservative Exposure Parameters

Raccoon	95% UCL Sediment Conc (mg/kg)	Aquatic Plant UF (unitless)	Aquatic Plant Conc (mg/kg)	Benthic Invertebrate UF (unitless)	Benthic Invertebrate Conc (mg/kg)	Fish UF (unitless)	Fish Conc (mg/kg)	Total Daily Dose Rate (mg/kg BW-day)	NOAEL Toxicity Reference Value (mg/kg BW-day)	Based on Conservative Exposure Parameters NOAEL Hazard Quotient (unitless)
Arsenic	NA	Arsenic data not available from North Tributary Exposure Unit								
Cadmium	1.02	3.6E-01	3.7E-01	3.4E+00	3.5E+00	5.3E-01	5.4E-01	1.2E-01	7.7E-01	1.5E-01
Lead	NA	Lead removed in screening.								

$$\text{Dose} = [(\text{Conc}_{\text{benthics}} \times \text{IR}_{\text{food}})0.6 + (\text{IR}_{\text{food}} \times \text{Conc}_{\text{fish}})0.3 + (\text{IR}_{\text{food}} \times \text{Conc}_{\text{plant}})0.1 + (\text{IR}_{\text{sed}} \times \text{Conc}_{\text{Sediment}})]/\text{Body Weight}_{\text{raccoon}}$$

Hazard Quotient Calculations
Stewart Creek On-Site Exposure Area

Screening Level Ecological Risk Assessment
Former Operating Plant
Stewart Creek On-Site Exposure Unit
Frisco, Texas
May, 2014
Table D-10
Hazard Quotient Calculations for the Snowy Egret - Initial Conservative Exposure Parameters

Snowy Egret	95% UCL Sediment Conc (mg/kg)	Benthic Invertebrate UF (unitless)	Benthic Invertebrate Conc (mg/kg)	Fish UF (unitless)	Fish Conc (mg/kg)	Total Daily Dose Rate (mg/kg BW-day)	NOAEL Toxicity Reference Value (mg/kg BW-day)	Based on Conservative Exposure Parameters NOAEL Hazard Quotient (unitless)
Arsenic	NA	Arsenic data not available from Stewart Creek On-Site Exposure Unit						
Cadmium	1.21	3.4E+00	4.1E+00	5.3E-01	6.4E-01	1.6E-01	1.5E+00	1.1E-01
Lead	NA	Lead removed in screening						

$$\text{Dose} = [(\text{Conc}_{\text{benthics}} \times \text{IR}_{\text{food}})0.3 + (\text{IR}_{\text{food}} \times \text{Conc}_{\text{fish}})0.7 + (\text{IR}_{\text{sed}} \times \text{Conc}_{\text{Sediment}})]/\text{Body Weight}_{\text{Egret}}$$

Screening Level Ecological Risk Assessment
Former Operating Plant
Stewart Creek On-Site Exposure Unit
Frisco, Texas
May, 2014

Table D-11
Hazard Quotient Calculations for the Raccoon - Initial Conservative Exposure Parameters

Raccoon	95% UCL Sediment Conc (mg/kg)	Aquatic Plant UF (unitless)	Aquatic Plant Conc (mg/kg)	Benthic Invertebrate UF (unitless)	Benthic Invertebrate Conc (mg/kg)	Fish UF (unitless)	Fish Conc (mg/kg)	Total Daily Dose Rate (mg/kg BW-day)	NOAEL Toxicity Reference Value (mg/kg BW-day)	Based on Conservative Exposure Parameters NOAEL Hazard Quotient (unitless)
Arsenic	NA	Arsenic data not available from Stewart Creek On-Site Exposure Unit								
Cadmium	1.21	3.6E-01	4.4E-01	3.4E+00	4.1E+00	5.3E-01	6.4E-01	1.4E-01	7.7E-01	1.8E-01
Lead	NA	Lead removed in screening.								

$$\text{Dose} = [(\text{Conc}_{\text{benthics}} \times \text{IR}_{\text{food}})0.6 + (\text{IR}_{\text{food}} \times \text{Conc}_{\text{fish}})0.3 + (\text{IR}_{\text{food}} \times \text{Conc}_{\text{plant}})0.1 + (\text{IR}_{\text{sed}} \times \text{Conc}_{\text{Sediment}})]/\text{Body Weight}_{\text{raccoon}}$$

2014 EXIDE APAR PAGE 689 OF 3116

Hazard Quotient Calculations
Stewart Creek Downstream of the FOP Exposure Area

Screening Level Ecological Risk Assessment
Former Operating Plant
Stewart Creek Downstream of the FOP Exposure Unit
Frisco, Texas
May, 2014

Table D-12
Hazard Quotient Calculations for the Snowy Egret - Initial Conservative Exposure Parameters

Snowy Egret	95% UCL Sediment Conc (mg/kg)	Benthic Invertebrate UF (unitless)	Benthic Invertebrate Conc (mg/kg)	Fish UF (unitless)	Fish Conc (mg/kg)	Total Daily Dose Rate (mg/kg BW-day)	NOAEL Toxicity Reference Value (mg/kg BW-day)	Based on Conservative Exposure Parameters NOAEL Hazard Quotient (unitless)
Arsenic	32.35	9.0E-01	2.9E+01	1.6E-01	5.2E+00	1.5E+00	2.2E+00	6.7E-01
Cadmium	1.46	3.4E+00	4.9E+00	5.3E-01	7.7E-01	1.9E-01	1.5E+00	1.3E-01
Lead	58.28	6.3E-01	3.7E+01	7.0E-02	4.1E+00	2.0E+00	1.6E+00	**1.2E+00**

$$\text{Dose} = [(\text{Conc}_{\text{benthics}} \times \text{IR}_{\text{food}})0.3 + (\text{IR}_{\text{food}} \times \text{Conc}_{\text{fish}})0.7 + (\text{IR}_{\text{sed}} \times \text{Conc}_{\text{Sediment}})]/\text{Body Weight}_{\text{Egret}}$$

Screening Level Ecological Risk Assessment
Former Operating Plant
Stewart Creek Downstream of the FOP Exposure Unit
Frisco, Texas
May, 2014
Table D-13
Hazard Quotient Calculations for the Snowy Egret - Less Conservative Exposure Parameters

Snowy Egret COC	95% UCL Sediment Conc (mg/kg)	Benthic Invertebrate UF (unitless)	Benthic Invertebrate Conc (mg/kg)	Fish UF (unitless)	Fish Conc (mg/kg)	Total Daily Dose Rate (mg/kg BW-day)	NOAEL Toxicity Reference Value (mg/kg BW-day)	LOAEL Toxicity Reference Value (mg/kg BW-day)	Based on Less-Conservative Exposure Parameters	
									NOAEL Hazard Quotient (unitless)	LOAEL Hazard Quotient (unitless)
Arsenic	32.35	9.0E-01	2.9E+01	1.6E-01	5.2E+00	1.5E+00	2.2E+00	4.5E+00	6.7E-01	3.3E-01
Cadmium	1.46	3.4E+00	4.9E+00	5.3E-01	7.7E-01	1.9E-01	1.5E+00	6.4E+00	1.3E-01	3.0E-02
Lead	58.28	6.3E-01	3.7E+01	7.0E-02	4.1E+00	2.0E+00	1.6E+00	3.3E+00	**1.2E+00**	6.1E-01

Intake = [(Conc benthics x IRfood)0.3 + (IRfood x Conc fish)0.7 + (IRsed x Conc Sediment)]*EMF/Body Weight

Screening Level Ecological Risk Assessment
Former Operating Plant
Stewart Creek Downstream of the FOP Exposure Unit
Frisco, Texas
May, 2014
Table D-14
Hazard Quotient Calculations for the Raccoon - Initial Conservative Exposure Parameters

Raccoon	95% UCL Sediment Conc (mg/kg)	Aquatic Plant UF (unitless)	Aquatic Plant Conc (mg/kg)	Benthic Invertebrate UF (unitless)	Benthic Invertebrate Conc (mg/kg)	Fish UF (unitless)	Fish Conc (mg/kg)	Total Daily Dose Rate (mg/kg BW-day)	NOAEL Toxicity Reference Value (mg/kg BW-day)	Based on Conservative Exposure Parameters NOAEL Hazard Quotient (unitless)
Arsenic	32.35	3.6E-02	1.2E+00	9.0E-01	2.9E+01	1.6E-01	5.2E+00	1.1E+00	2.8E+00	3.9E-01
Cadmium	1.46	3.6E-01	5.3E-01	3.4E+00	4.9E+00	5.3E-01	7.7E-01	1.7E-01	7.7E-01	2.2E-01
Lead	58.28	4.5E-02	2.6E+00	6.3E-01	3.7E+01	7.0E-02	4.1E+00	1.4E+00	4.7E+00	3.1E-01

$$\text{Dose} = [(\text{Conc}_{\text{benthics}} \times \text{IR}_{\text{food}})0.6 + (\text{IR}_{\text{food}} \times \text{Conc}_{\text{fish}})0.3 + (\text{IR}_{\text{food}} \times \text{Conc}_{\text{plant}})0.1 + (\text{IR}_{\text{sed}} \times \text{Conc}_{\text{Sediment}})]/\text{Body Weight}_{\text{raccoon}}$$

Hazard Quotient Calculations
Stewart Creek On-Site and Downstream of the FOP

Screening Level Ecological Risk Assessment
Former Operating Plant
Stewart Creek On-Site and Downstream Exposure Unit
Frisco, Texas
May, 2014

Table D-15
Hazard Quotient Calculations for the Snowy Egret - Initial Conservative Exposure Parameters

Snowy Egret	95% UCL Sediment Conc (mg/kg)	Benthic Invertebrate UF (unitless)	Benthic Invertebrate Conc (mg/kg)	Fish UF (unitless)	Fish Conc (mg/kg)	Total Daily Dose Rate (mg/kg BW-day)	NOAEL Toxicity Reference Value (mg/kg BW-day)	Based on Conservative Exposure Parameters NOAEL Hazard Quotient (unitless)
Arsenic	32.35	9.0E-01	2.9E+01	1.6E-01	5.2E+00	1.5E+00	2.2E+00	6.7E-01
Cadmium	1.42	3.4E+00	4.8E+00	5.3E-01	7.5E-01	1.8E-01	1.5E+00	1.3E-01
Lead	54.24	6.3E-01	3.4E+01	7.0E-02	3.8E+00	1.8E+00	1.6E+00	**1.1E+00**

$$\text{Dose} = [(\text{Conc}_{\text{benthics}} \times \text{IR}_{\text{food}})0.3 + (\text{IR}_{\text{food}} \times \text{Conc}_{\text{fish}})0.7 + (\text{IR}_{\text{sed}} \times \text{Conc}_{\text{Sediment}})]/\text{Body Weight}_{\text{Egret}}$$

Screening Level Ecological Risk Assessment
Former Operating Plant
Stewart Creek On-Site and Downstream Exposure Unit
Frisco, Texas
May, 2014

Table D-16
Hazard Quotient Calculations for the Snowy Egret - Less Conservative Exposure Parameters

Snowy Egret COC	95% UCL Sediment Conc (mg/kg)	Benthic Invertebrate UF (unitless)	Benthic Invertebrate Conc (mg/kg)	Fish UF (unitless)	Fish Conc (mg/kg)	Total Daily Dose Rate (mg/kg BW-day)	NOAEL Toxicity Reference Value (mg/kg BW-day)	LOAEL Toxicity Reference Value (mg/kg BW-day)	Based on Less-Conservative Exposure Parameters	
									NOAEL Hazard Quotient (unitless)	LOAEL Hazard Quotient (unitless)
Arsenic	32.35	9.0E-01	2.9E+01	1.6E-01	5.2E+00	1.5E+00	2.2E+00	4.5E+00	6.7E-01	3.3E-01
Cadmium	1.42	3.4E+00	4.8E+00	5.3E-01	7.5E-01	1.8E-01	1.5E+00	6.4E+00	1.3E-01	2.9E-02
Lead	54.24	6.3E-01	3.4E+01	7.0E-02	3.8E+00	1.8E+00	1.6E+00	3.3E+00	**1.1E+00**	5.7E-01

Intake = [(Conc benthics x IRfood)0.3 + (IRfood x Conc fish)0.7 + (IRsed x Conc Sediment)]*EMF/Body Weight

Screening Level Ecological Risk Assessment
Former Operating Plant
Stewart Creek On-Site and Downstream Exposure Unit
Frisco, Texas
May, 2014

Table D-17
Hazard Quotient Calculations for the Raccoon - Initial Conservative Exposure Parameters

Raccoon	95% UCL Sediment Conc (mg/kg)	Aquatic Plant UF (unitless)	Aquatic Plant Conc (mg/kg)	Benthic Invertebrate UF (unitless)	Benthic Invertebrate Conc (mg/kg)	Fish UF (unitless)	Fish Conc (mg/kg)	Total Daily Dose Rate (mg/kg BW-day)	NOAEL Toxicity Reference Value (mg/kg BW-day)	Based on Conservative Exposure Parameters NOAEL Hazard Quotient (unitless)
Arsenic	32.35	3.6E-02	1.2E+00	9.0E-01	2.9E+01	1.6E-01	5.2E+00	1.1E+00	2.8E+00	3.9E-01
Cadmium	1.42	3.6E-01	5.2E-01	3.4E+00	4.8E+00	5.3E-01	7.5E-01	1.6E-01	7.7E-01	2.1E-01
Lead	54.24	4.5E-02	2.4E+00	6.3E-01	3.4E+01	7.0E-02	3.8E+00	1.3E+00	4.7E+00	2.9E-01

$$\text{Dose} = [(\text{Conc}_{\text{benthics}} \times \text{IR}_{\text{food}})0.6 + (\text{IR}_{\text{food}} \times \text{Conc}_{\text{fish}})0.3 + (\text{IR}_{\text{food}} \times \text{Conc}_{\text{plant}})0.1 + (\text{IR}_{\text{sed}} \times \text{Conc}_{\text{Sediment}})]/\text{Body Weight}_{\text{raccoon}}$$

2014 EXIDE APAR PAGE 697 OF 3116

Hazard Quotient Calculations
Stewart Creek On-Site and Downstream of the FOP
Hot Spots Removed from Data Set

Screening Level Ecological Risk Assessment
Former Operating Plant
Stewart Creek On-Site and Downstream Exposure Unit
Data from Hot Spots Removed
Frisco, Texas
May, 2014

Table D-18
Hazard Quotient Calculations for the Snowy Egret - Initial Conservative Exposure Parameters

Snowy Egret	95% UCL Sediment Conc (mg/kg)	Benthic Invertebrate UF (unitless)	Benthic Invertebrate Conc (mg/kg)	Fish UF (unitless)	Fish Conc (mg/kg)	Total Daily Dose Rate (mg/kg BW-day)	NOAEL Toxicity Reference Value (mg/kg BW-day)	Based on Conservative Exposure Parameters NOAEL Hazard Quotient (unitless)
Arsenic	21.89	9.0E-01	2.0E+01	1.6E-01	3.5E+00	1.0E+00	2.2E+00	4.5E-01
Cadmium	1.32	3.4E+00	4.5E+00	5.3E-01	7.0E-01	1.7E-01	1.5E+00	1.2E-01
Lead	23.13	6.3E-01	1.5E+01	7.0E-02	1.6E+00	7.9E-01	1.6E+00	4.8E-01

$$\text{Dose} = [(\text{Conc}_{\text{benthics}} \times \text{IR}_{\text{food}})0.3 + (\text{IR}_{\text{food}} \times \text{Conc}_{\text{fish}})0.7 + (\text{IR}_{\text{sed}} \times \text{Conc}_{\text{Sediment}})]/\text{Body Weight}_{\text{Egret}}$$

Screening Level Ecological Risk Assessment
Former Operating Plant
Stewart Creek On-Site and Downstream Exposure Unit
Data from Hot Spots Removed
Frisco, Texas
May, 2014
Table D-19
Hazard Quotient Calculations for the Raccoon - Initial Conservative Exposure Parameters

Raccoon	95% UCL Sediment Conc (mg/kg)	Aquatic Plant UF (unitless)	Aquatic Plant Conc (mg/kg)	Benthic Invertebrate UF (unitless)	Benthic Invertebrate Conc (mg/kg)	Fish UF (unitless)	Fish Conc (mg/kg)	Total Daily Dose Rate (mg/kg BW-day)	NOAEL Toxicity Reference Value (mg/kg BW-day)	Based on Conservative Exposure Parameters NOAEL Hazard Quotient (unitless)
Arsenic	21.89	3.6E-02	7.9E-01	9.0E-01	2.0E+01	1.6E-01	3.5E+00	7.5E-01	2.8E+00	2.7E-01
Cadmium	1.32	3.6E-01	4.8E-01	3.4E+00	4.5E+00	5.3E-01	7.0E-01	1.5E-01	7.7E-01	2.0E-01
Lead	23.13	4.5E-02	1.0E+00	6.3E-01	1.5E+01	7.0E-02	1.6E+00	5.7E-01	4.7E+00	1.2E-01

$$\text{Dose} = [(\text{Conc}_{\text{benthics}} \times \text{IR}_{\text{food}})0.6 + (\text{IR}_{\text{food}} \times \text{Conc}_{\text{fish}})0.3 + (\text{IR}_{\text{food}} \times \text{Conc}_{\text{plant}})0.1 + (\text{IR}_{\text{sed}} \times \text{Conc}_{\text{Sediment}})]/\text{Body Weight}_{\text{raccoon}}$$

SCREENING LEVEL ECOLOGICAL RISK ASSESSMENT
TERRESTRIAL EVALUATION

EXIDE TECHNOLOGIES
FORMER OPERATING PLANT
FRISCO, TEXAS

Agreed Order: Docket No. 2011-1712-IHW-E

May 24, 2014

Prepared for:

EXIDE TECHNOLOGIES

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TABLE OF CONTENTS

Page

LIST OF TABLES ..... **iii**

LIST OF FIGURES ..... **iii**

LIST OF APPENDICIES ..... **iii**

LIST OF ACRONYMS ..... **iv**

1.0 INTRODUCTION **1**

2.0 SITE DESCRIPTION AND ENVIRONMENTAL SETTING **3**

2.1 Site History 3

2.2 Current Environmental Setting 4

2.3 Future Environmental Setting 4

3.0 PROBLEM FORMULATION **5**

3.1 Soil COCs 5

3.1.1 Data Summary 5

3.1.2 TCEQ Benchmarks/Initial Screening Comparison 6

3.1.2.1 South Wooded Area 7

3.1.2.2 Lake Parcel 7

3.1.2.3 Stewart Creek Corridor 7

3.1.2.4 North Wooded Area 7

3.1.3 Identification of Soil Hot Spots 8

3.1.4 Fate and Transport and Ecotoxicological Profiles 8

3.1.4.1 Antimony 8

3.1.4.2 Arsenic 9

3.1.4.3 Cadmium 10

3.1.4.4 Lead 10

3.1.4.5 Selenium 11

3.1.4.6 PAHs 11

3.2 Conceptual Site Model 12

3.2.1 Chemical/Physical Properties Governing Transport of Antimony, Arsenic, Cadmium, Lead and Selenium 13

3.2.2 Transport of Antimony, Arsenic, Cadmium, Lead and Selenium in Surface Soil Via Surface Runoff 13

3.3 Assessment Endpoints 14

3.4 Exposure Assessment 14

3.4.1 Food Web Ingestion Modeling 16

3.4.2 COC Uptake into Food Items 17

3.4.3 Exposure Point Concentrations 17

4.0 TOXICITY ASSESSMENT **18**

4.1 Antimony 18
4.2 Arsenic 19
4.3 Cadmium 19
4.4 Lead 19
4.5 Selenium 20

5.0 RISK CHARACTERIZATION 21

5.1 Hazard Quotient Analyses 21
5.1.1 Potential Risks to Plants and Soil Invertebrates – Terrestrial Areas 21
5.1.2 Potential Risks to Upper Trophic Level Receptors 23

5.2 Overall Potential Site Risks 24

6.0 UNCERTAINTY ANALYSIS 25

6.1 Exposure Concentrations 25
6.2 Data Coverage 26
6.3 Selection of Wildlife Species Subject to Evaluation 26
6.3.1 Birds and Mammals 26
6.3.2 Reptiles 26
6.4 Simultaneous Exposure to Multiple Constituents 27
6.5 TRVs 28
6.6 Terrestrial Plant Benchmark 28
6.7 Bioavailability and Absorption 29

7.0 PCL CALCULATIONS AND SLERA RECOMMENDATIONS 30

8.0 REFERENCES 31

LIST OF TABLES

Table	Title
1	Summary of Surface and Subsurface Soil Data for Areas of Ecological Interest
2	Summary of Soil PAH Data for Stewart Creek Corridor and North Wooded Area
3	Soil Data Summary Statistics
4	Threatened and Endangered Species – Collin and Denton Counties
5	NOAEL-Based HQ Summary: Initial Conservative Assessment
6	NOAEL and LOAEL-Based HQ Summary: Refined Less-Conservative Assessment

LIST OF FIGURES

Figure	Title
1	Site Location Map
2	Ecological Exposure Areas
3	Soil Sample Locations in Ecological Exposure Areas
4	Ecological Conceptual Site Model

LIST OF APPENDICIES

Appendix	Title
A	Tier 1 Exclusion Criteria Checklist
B	Photographic Log
C	ProUCL Statistical Output
D	Habitat Assessment Field Survey Report
E	Reptile Exposure and Toxicity
F	Ecological Risk Assessment Calculations

LIST OF ACRONYMS

APAR	Affected Property Assessment Report
bgs	Below Ground Surface
BW	Body Weight
COC	Chemicals of Concern
CSM	Conceptual Site Model
EMF	Exposure Modifying Factor
ERA	Ecological Risk Assessment
EPA	Environmental Protection Agency
EPC	Exposure Point Concentration
FOP	Former Operating Plant
FSCWWTP	Former Stewart Creek Waste Water Treatment Plant
HPAH	High Molecular Weight Polycyclic Aromatic Hydrocarbon
HQ	Hazard Quotient
LOAEL	Lowest Observed Adverse Effect Level
LPAH	Low Molecular Weight Polycyclic Aromatic Hydrocarbon
mg/kg	Milligrams per Kilogram
No.	Number
NOAEL	No Observed Adverse Effect Level
NTMWD	North Texas Municipal Water District
PBW	Pastor, Behling & Wheeler, LLC
PAH	Polycyclic Aromatic Hydrocarbon
PCL	Protective Concentration Level
RAP	Response Action Plan
SLERA	Screening-Level Ecological Risk Assessment
SSL	Soil Screening Level
TCEQ	Texas Commission on Environmental Quality
TPDES	Texas Pollutant Discharge Elimination System
TRV	Toxicity Reference Value
UCL	95th percentile Upper Confidence Limit
W&M	W&M Environmental Group, Inc.

1.0 INTRODUCTION

This report describes the Tier 2 upland terrestrial screening-level ecological risk assessment (SLERA) conducted for the Exide Technologies (Exide) former operating plant in Frisco, Texas. The location of the former plant is shown on the Site Location Map presented on Figure 1. The "Site", as shown on Figure 1, is synonymous with the term "Former Operating Plant (FOP)" used in this SLERA.

The FOP was a lead oxide manufacturing plant and later a lead metal recycling facility (secondary lead smelter) that was in operation in Frisco, Texas since approximately 1964, with recycling operations commencing in 1969 until operations ceased in November 2012. The facility recycled spent lead-acid batteries and other lead-bearing scrap materials.

Data collection and analysis for the SLERA has been based on the Texas Commission on Environmental Quality's (TCEQ's) *Guidance for Conducting Ecological Risk Assessments at Remediation Sites in Texas RG-263 (Revised January 2014)* (TCEQ, 2014) as the primary guidance document. Consistent with the guidance, the SLERA is a conservative assessment that is used to evaluate the likelihood of ecological risk. The SLERA is also used to assess the need for further ecological evaluation.

A SLERA that evaluated ecological habitat areas located on the FOP was submitted to the TCEQ and Environmental Protection Agency (EPA) Region 6 as part of an Affected Property Assessment Report (APAR) for the FOP on July 9, 2013. On October 8, 2013, the TCEQ issued a letter conveying comments on the APAR and SLERA from the TCEQ and EPA Region 6. Responses to those comments were submitted to TCEQ and EPA on October 29, 2013. The TCEQ subsequently conditionally approved the comments responses in a letter dated November 19, 2013 (TCEQ. 2013a). This SLERA includes revisions based on the October 29, 2013 response to comments with the modifications detailed in the TCEQ approval letter and is specific to terrestrial habitat areas on the FOP. A separate SLERA, also included with the FOP APAR, evaluates Stewart Creek aquatic habitat located on the FOP. The methodology for both the aquatic and terrestrial SLERAs was presented in the *Screening Level Ecological Risk Assessment Work Plan for the Exide Frisco Recycling Center, Frisco, Texas* (PBW, 2012) submitted to the TCEQ on December 21, 2012 following discussions with the TCEQ regarding data needs, sampling, and the general approach for the SLERAs. The Work Plan was approved by TCEQ on January 16, 2013.

Agreements put in place between Exide and the City of Frisco pursuant to which the facility ceased operations at the end of November 2012 specified that a significant portion of the Exide-owned undeveloped buffer property surrounding the FOP would become commercial development. Exide will

retain ownership of the FOP, shown on Figure 1, except that the City has an option to acquire the Lake Parcel and the Pond Parcel, shown on Figure 2, at some later time. Exide will remove its current structures, once they are no longer needed. Pending evaluation in the Response Action Plan (RAP) for the Site, Exide will manage and maintain the caps on the disposal areas/landfills within the FOP. This SLERA evaluates potential ecological risks within the FOP. The SLERA incorporates the anticipated future land use for this area when defining the ecological exposure areas. Some areas within the FOP (e.g., former process areas and landfills) are excluded from the SLERA because of a lack of ecological habitat related to the presence of building slabs, asphalt, and other coverings/caps that are currently managed and maintained and will continue to be managed and maintained in the future in accordance with the final remediation and maintenance design to be developed in the RAP. The Tier 1 Exclusion Criteria Checklist is used to document those areas excluded from ecological evaluation in the APAR and SLERA. Appendix A contains the Tier 1 Exclusion Criteria Checklist. Figure 2 provides a diagram of the areas evaluated in the SLERA.

2.0 SITE DESCRIPTION AND ENVIRONMENTAL SETTING

This section provides a summary of the history of the Site, current environmental setting and the anticipated future land use of the Site. The current and future environmental setting information was considered to determine current potentially complete exposure pathways.

2.1 Site History

The Site was a lead oxide manufacturing plant and later a secondary lead smelter (a lead metal recycling facility) that was in operation since approximately 1964 (lead smelting operations began in approximately 1969). The operations ceased at the end of November 2012. Spent lead-acid batteries and other lead-bearing scrap materials were recycled at the Site. The scrap lead was smelted and refined to produce lead, lead alloys and lead oxide.

Process wastewater generated when Site operations were on-going was treated in the on-site Wastewater Treatment Facility (to remove metals) and then through the Crystallization Unit (to remove salts), producing condensate that was then discharged to the North Texas Municipal Water District (NTMWD) sanitary sewer. Prior to construction of the on-site Wastewater Treatment Facility in approximately 1988, wastewater from the Site was treated off-site at the City of Frisco's Former Stewart Creek Waste Water Treatment Plant (FSCWWTP) located west and adjacent to the Site (Figure 2).

Current storm water control features within the former production area include a concrete slab cover located throughout the former production area, the Flood Wall located between the former production area and Stewart Creek (which acts as a flood wall/retaining wall), and a French drain system located on the facility side of the Flood Wall that was constructed as an interim measure to address seepage of storm water and wash water to the exterior of the Flood Wall. These storm water control features route storm water and wash water to a conduit near the western end of the Flood Wall that directs the water to a storm water retention pond located on the south side of Stewart Creek. According to former Exide personnel, the storm water retention pond was constructed in approximately 1987-1988, which corresponds to the timing of the construction of the Flood Wall. Water within the retention pond historically was either treated and discharged to Stewart Creek or was used as make-up water in the plant's process streams. Discharge of water to Stewart Creek is regulated by the TCEQ under Texas Pollutant Discharge Elimination System (TPDES) Permit No. WQ0002964000, but this has not occurred since 2009. Runoff from areas of the Site outside of the former production area flows into either Stewart Creek or the North Tributary. These areas generally have moderate relief and are stabilized with vegetation. The ultimate Site storm water management plan will be designed in conjunction with the final remediation and

maintenance design to be developed in the RAP for the Site. All surface water features within the City of Frisco, including Stewart Creek, are covered under the City's MS4 permit.

W&M Environmental Group, Inc. (W&M) conducted a study in 2011 (W&M, 2011) to evaluate the presence of potential slag in areas within and adjacent to the North and South Disposal Areas. W&M performed additional inspections for these material in 2013 (W&M, 2013a). Several areas within the woods north of the North Disposal Area and within the northernmost portion of the woods to the east of the South Disposal Area were identified that contained isolated occurrences of slag and battery chips. Based on these studies and per a subsequent Interim Action Work Plan (W&M, 2013b), W&M performed certain interim actions to remove and dispose of slag and battery case fragments (W&M, 2013c). Any remaining areas containing visible slag or battery chips will be addressed as part of a response action for the Site.

2.2 Current Environmental Setting

The Site is located within the shallow valley created by the drainages of Stewart Creek and a tributary to Stewart Creek located to the North ("North Tributary") as shown on Figures 1 and 2. Appendix B presents photographs taken during a Site visit on October 22, 2012.

2.3 Future Environmental Setting

Figure 2 shows the Site Land Use Map and identifies areas that will potentially remain as ecological habitat. There are currently no planned future operations at the Site other than maintaining the current buildings and systems until they are no longer needed (the Administrative Building, the on-site Wastewater Treatment Facility, Storm Water Pond, Solar Evaporation Pond, and the Crystallization Unit) and any activities included in the final remediation and maintenance design to be developed in the RAP for the Site. These buildings and systems will be decommissioned and removed when they are no longer needed. Future use of the Site will be restricted to commercial-industrial use only.

Terrestrial areas to be evaluated in the SLERA include the Lake Parcel, the South Wooded Area, the North Wooded Area, and the terrestrial corridor along Stewart Creek (the "Stewart Creek Corridor"). The Lake Parcel was cultivated and harvested for hay as recently as 2008. Currently, the eastern part of the corridor along Stewart Creek in the FOP and the Lake Parcel are routinely mowed and periodically bush hogged, but both could provide terrestrial habitat for mammals and birds. The South Wooded Area and North Wooded Area are overgrown and not maintained; both areas could provide terrestrial habitat for mammals and birds.

3.0 PROBLEM FORMULATION

Per TCEQ guidance (TCEQ, 2014), Problem Formulation is the first phase of the SLERA and establishes the goals, breadth, and focus of the assessment. Therefore, this section identifies the major factors that were considered in the assessment, such as the affected property size and ecology, distribution of chemicals of concern (COCs), and potential ecological receptors.

3.1 Soil COCs

A discussion of FOP COCs is presented in Section 3.1.2 of the FOP APAR. Consistent with that discussion, the soil COCs evaluated in this SLERA for the ecological exposure areas are antimony, arsenic, cadmium, lead and selenium where data for these metals were available.

Additionally, polycyclic aromatic hydrocarbons (PAHs) were analyzed from soil samples along the flood wall by Stewart Creek. During construction of the flood wall along Stewart Creek during the spring of 1988, residual material resulting from an earlier release from a diesel tank was discovered (Lake, 1989). This residual material was remediated and no further action was recommended in the Phase I RFI (Lake, 1993); however, PAHs in soils were included in this SLERA to assess potential ecological risks near this area. Additionally, three soil samples were collected in the North Wooded Area near the former fire training facility (Figure 2) and analyzed for PAHs. These samples are also included in this SLERA.

Lead, cadmium and selenium are considered bioaccumulative in soil. Arsenic and antimony are not considered bioaccumulative in soil (Table 3-1 in TCEQ, 2014). Consistent with TCEQ guidance, the maximum detected concentration in soil from each exposure area was used for media/benchmark screening and the 95 percent upper confidence limit on the mean (95% UCL) was used as the exposure point concentration in the food web analysis. EPA's most recent ProUCL version 5.0 software program was used to calculate the 95% UCL concentrations for the constituents in exposure areas (EPA 2013). Appendix C provides the ProUCL output for soil for the different exposure areas. All data from the exposure areas were used in the statistical calculations.

3.1.1 Data Summary

Multiple investigations have been conducted at the Site, as discussed and presented in greater detail in the FOP APAR. For ecological exposures, TCEQ rules define the soil depth of 0-6 inches as surface soil and the 6 inches to 5 feet depth as subsurface soil [30 TAC 350.4(a)(86, 88)] for ecological exposures. Surface soil and subsurface soil data used in this SLERA for evaluation of risk were collected from 2012 through early April of 2014.

Table 1 shows the data for antimony, arsenic, cadmium, lead and selenium in surface soil and subsurface soil by ecological exposure area. Table 2 shows the PAH data from the aforementioned section of the Stewart Creek Corridor, and the PAH data collected in the North Wooded Area near the former fire training facility. Figure 3 shows the soil sample locations. This SLERA used all of the available data from a soil depth of 5 feet below ground surface (bgs) or less from the four exposure areas. Samples may not have been collected specifically to address ecological risk exposure, but rather may have been collected for nature and extent evaluation purposes; therefore, there are samples from within the 5 foot horizon taken at various depths. The SLERA considered soil sample data as follows:

- Samples collected from 2012 through early April 2014. Historical soil samples collected prior to 2012 were not included in the SLERA.
- Surface soil samples were defined as those samples taken within the top 6 inches of the soil column.
- Subsurface soil samples were defined as those samples taken below 6 inches in depth but above 5 feet bgs.
- All detections of antimony, arsenic, cadmium, lead and selenium from the ecological exposure areas were included (i.e., there was no censoring of the data set).
- Soils analyzed for PAHs from within the Stewart Creek Corridor and from the North Wooded Area near the former fire training facility were included.

PAHs were assessed in this SLERA based on their molecular weight, as defined by EPA (2007b). Low molecular weight PAHs (LPAHs) are defined as having less than four aromatic rings and high molecular weight PAHs (HPAHs) have four aromatic rings or more. The detected LPAHs and HPAHs were summed respectively. PAHs that were not detected, or U-flagged, were not included in the summations; however, estimated, or J-flagged, concentrations were included.

3.1.2 TCEQ Benchmarks/Initial Screening Comparison

Tables 1 and 2 list the TCEQ soil benchmarks (TCEQ, 2014) that were used in this SLERA as an initial screening step. TCEQ Required Element #1 is the comparison of the maximum detected concentration from an exposure area to the benchmark. Note that if a constituent is considered bioaccumulative (e.g., cadmium, lead and selenium) and is detected, then it is automatically retained for further evaluation. If a constituent is not considered bioaccumultive (e.g., antimony and arsenic), but is detected at a concentration in at least one sample from the ecological exposure area greater than the screening level benchmark, then the constituent is retained for further analysis. The screening comparison step for each exposure area is presented below.

3.1.2.1 South Wooded Area

For the South Wooded Area, all of the metals (antimony, arsenic, cadmium, lead and selenium) were carried forward to the next phase of assessment, because the maximum detected concentrations for these metals were above the screening benchmarks.

3.1.2.2 Lake Parcel

The data set for the Lake Parcel does not include any antimony or selenium data. The maximum detection of arsenic (6.74 mg/kg) is below the screening benchmark of 18 mg/kg. Therefore arsenic is not carried forward for further assessment in the Lake Parcel evaluation. Cadmium and lead are retained for further evaluation because they were detected at concentrations greater than their benchmarks and they are considered bioaccumulative in soil.

3.1.2.3 Stewart Creek Corridor

For the Stewart Creek Corridor, all of the metals (antimony, arsenic, cadmium, lead and selenium) move to the next phase of assessment because their maximum detected values are greater than their benchmarks

As shown on Table 2, the detected PAHs from the samples taken in the area of a former diesel spill are at concentrations below the screening value of 18 mg/kg for HPAHs and 29 mg/kg LPAHs. The maximum detected HPAH value is 0.086 mg/kg taken from MW-27C in 2014 and the maximum detected LPAH value is 0.32 mg/kg. Based on this comparison and per TCEQ guidance, PAHs in soil from the Stewart Creek Corridor were not carried forward for further evaluation.

3.1.2.4 North Wooded Area

For the North Wooded Area, all of the metals (antimony, arsenic, cadmium, lead and selenium) were carried forward to the next phase of assessment because their maximum detected values are greater than their benchmarks

Three soil samples from the North Wooded Area associated with the former fire training area were analyzed for PAHs (Table 2). The HPAH and LPAH summations are well below the screening values with the maximum HPAH value of 0.017 mg/kg and the maximum LPAH value of 0.0071 mg/kg. Based on this comparison and per the TCEQ guidance, the PAHs in soil from the North Wooded Area were not carried forward for further evaluation.

3.1.3 Identification of Soil Hot Spots

Following the initial screening evaluation of the data presented in Section 3.1.2 of this SLERA, the characteristics of habitat areas and the detected concentrations of antimony, arsenic, cadmium, lead and selenium in soil were evaluated critically for the identification of hot spots in consideration of overall project objectives and human health protective concentration levels (PCLs). As described in Section 3.9.2.7 of TCEQ, 2014 "a hot spot is a discrete area of substantially elevated COC concentration relative to the surrounding area."

Elevated concentrations of the primary COCs of lead and cadmium are found in numerous soil samples throughout the FOP such that the identification of discrete clusters of soil samples with elevated concentrations of these COCs in the midst of lower concentration sample points is not warranted or appropriate particularly given that the lead concentrations in most samples within the PCL exceedance zone were significantly greater than the human health PCL of 275 mg/kg. As such, a hot spot analysis for this SLERA was not conducted.

3.1.4 Fate and Transport and Ecotoxicological Profiles

Potential fate and transport mechanisms are discussed below for antimony, arsenic, cadmium, lead, selenium and PAHs (TCEQ's Ecological Risk Assessment Required Element #4). Note that following the benchmark screening step, PAHs were removed from further evaluation.

3.1.4.1 Antimony

Antimony is a semi-metallic element that in nature is associated with sulfur. Antimony also occurs in ores with arsenic, and the two metals share similar chemical and physical properties. It is a common component of lead and copper alloys and is used in manufacturing of ceramics, textiles, paints, explosives, batteries and semiconductors (EPA, 2005a). The binding of antimony to soil is determined by the nature of the soil and the form of antimony. Some forms of antimony may bind to inorganic and organic ligands. On the other hand, a mineral form would be unavailable for binding. Since antimony has an anionic character, it is expected to have little affinity for organic carbon. Antimony is known to form co-precipitates with hydrous iron, manganese and aluminum oxides in soil (ATDSR, 1992). Antimony exists in valences of 0, -3, +3 and +5. The tri-and pentavalent forms are the most stable forms of antimony and are of the most interest in biological systems. The toxicokinetics and toxicity of the tri- and pentavalent forms vary, with the trivalent form considered to be more toxic. Ingested antimony is absorbed slowly and many antimony compounds are reported to be gastrointestinal irritants. Trivalent antimony is absorbed more slowly than the pentavalent form. Approximately 15-39 % of trivalent

antimony is reported to be absorbed in the gastrointestinal tract of animals. The toxic effects of antimony in mammals involve cardiovascular changes. Observed changes include degeneration of the myocardium, arterial hypotension, heart dysfunction, arrhythmia and altered electrocardiogram patterns. The mode of action of antimony-induced cardiotoxicity is unknown (EPA, 2005a).

3.1.4.2 Arsenic

Arsenic is an element that occurs naturally in a variety of sulfidic ores. Most anthropogenic releases of arsenic are to land or soil, primarily in the form of pesticides or solid wastes. Arsenic released to land is relatively immobile due to binding to soil particles (ATSDR, 1993). Arsenic is both reactive and mobile and can cycle through both biotic and abiotic components of local terrestrial systems. It can undergo a variety of chemical and biochemical transformations, such as oxidation, reduction, methylation, and demethylation (Environment Canada, 1993). Arsenic can exist in four oxidation states: +5, +3, 0 and -3. In soil, arsenic is a constituent of numerous minerals and is frequently found associated with sulfur, most commonly as arsenopyrite. Inorganic arsenate can also be bound to iron and aluminum cations or any other cation that may be present (e.g., calcium, zinc, magnesium, lead) as well as organic matter in soils (EPA, 2005b). The two primary forms of arsenic are trivalent (+3) arsenic and pentavalent (+5) arsenic. The relative toxicity of the trivalent and pentavalent forms may also be affected by factors such as the water solubility of the compound. Soluble inorganic arsenate (pentavalent state) predominates under normal conditions since it is thermodynamically more stable in water than arsenite (trivalent state). Arsenic toxicity in water is not governed by hardness (Irwin et al., 1997a).

Over the past 100 years, arsenic compounds have had several uses including as a component of animal feed, herbicides and pesticides. Arsenic was used as a defoliant until 1992. Inorganic arsenical products were used as herbicides and insecticides in the first half of the 20th century until banned in 1988. Calcium arsenate was specifically used to fight a cotton pest, the boll weevil. Sodium arsenite was used in sheep and cattle dips. Another inorganic arsenical product, arsenic acid, was pervasively used as a cotton desiccant in Texas from approximately 1965 to 1992, when it was banned by EPA (Bureau of Economic Geology, 2005). Appendix 22 of the APAR shows historical aerial photographs of the area around the FOP and shows large tracts of land used for agriculture. Many of the agricultural tracts were likely used for cotton farming given: 1) cotton was historically identified as the main cash crop in Collin County (USDA, 1969) and 2) the development of the City of Frisco as a hub for area cotton farmers providing cotton gins and grain elevators (CCHC, 2014). Thus, it is probable that products containing arsenic were used in the general vicinity around the FOP and that the arsenic detected in the soils is sourced from agricultural products. See Sections 1.2.1.1 and 3.1.3 in the APAR for additional discussion of arsenic.

3.1.4.3 Cadmium

Cadmium is a naturally occurring element and is typically associated with other metals such as zinc and lead. Cadmium use was infrequent prior to the 20th century; however, recognition of its resistance to corrosion increased its demand, and it is now used in the manufacture of metal alloys, in nickel cadmium batteries, in pigments, metal coatings, and plastics. Cadmium emissions to the atmosphere result from combustion of fossil fuels, industrial emissions, or erosion of soils (Elinder, 1985). In nature, two oxidation states are possible (0 and +2), however, the zero or metallic state is rare. Mobility and bioavailability of cadmium in aquatic systems is enhanced under conditions of low pH, low hardness, low suspended solids, high conductivity, and low salinity (Irwin et al., 1997b). Cadmium in surface water accumulates more rapidly in the sediments than in living organisms. The toxicity of cadmium in sediments is affected by sediment content of acid volatile sulfides and total organic carbon. If released or deposited on soil, cadmium is largely retained in the surface layers of soil and is expected to convert to insoluble forms such as cadmium carbonate (EPA, 2005c). Terrestrial organisms bioaccumulate cadmium (Callahan et al., 1979) and TCEQ considers cadmium bioaccumulative in soil (Table 3-1 in TCEQ, 2014).

3.1.4.4 Lead

Lead, a naturally occurring element, is one of the most ubiquitous contaminants in the developed world because of its long history of a variety of domestic, medicinal and industrial uses. Lead is strongly sorbed in soil and the rate is correlated with grain size and organic content. In the absence of soluble complexing species, lead is almost totally adsorbed to clay particles at pHs greater than 6 (Moore and Ramamoorthy, 1984). In surface water, lead is most soluble and bioavailable under conditions of low pH, low organic content, low levels of suspended solids, and low levels of salts of calcium, iron, manganese, zinc, and cadmium. In surface water, lead exists in three forms, dissolved labile, dissolved bound (e.g., colloids or strong complexes), or as a particulate (Benes et al,. 1985). Most lead in natural waters is precipitated to the sediment as carbonates or hydroxides (Demayo et al,. 1982). Lead in soil is relatively immobile and persistent. Lead forms complexes with organic matter and clay minerals, which limits its mobility (EPA, 2005d).

3.1.4.5 Selenium

Selenium is a naturally occurring element found in all environmental media: air, soil, sediment and water. In nature it is found in the sulfide ores of heavy metals and predominates in approximately 40 minerals. Selenium is found in volcanic rock, sandstone, shale, carbonates, bedrock, coal oil and mineral oil. Selenium can be released to the environment from natural sources such as leaching and weathering of rocks, and volatilization as a result of biomethylation by plants and bacteria. Anthropogenic releases of selenium may result from use in the manufacture and production of glass, pigments, rubber, metal alloys, textiles, petroleum, medical therapeutic agents, anti-dandruff shampoos, veterinary medicines, fungicides, gaseous insulators and photographic emulsions. The burning of coal, oil, and solid waste may also contribute to selenium in the environment. In soils, the chemical form of selenium are largely dependent on pH and oxidation-reduction potentials. Selenium can exist in the -2, 0, +4, and +6 oxidation states. Speciation of selenium in soils is also influenced by the chemical and mineralogical composition of the soil, microbial intervention and nature of adsorbing surfaces. Selenium has a sorptive affinity for hydrous metal oxides, clays and organic materials. Transformation of selenium in soils appear to be microbially mediated. In plants, selenium is essential element for growth. In the environment, uptake and accumulation by plants is influenced by the concentration and form of selenium present in soils. Selenium is an essential trace element in animals and has been shown to be a natural component of the enzyme glutathione peroxidase and other proteins. Selenium toxicity is most likely to occur in animals grazing on seleniferous forage or as a result of including seleniferous grain in their diet. Acute effects in animals following ingestion of plants containing high levels of selenium include abnormal posture and movement, watery diarrhea, labored respiration, abdominal pain, prostration, and death. Chronic effects in animals include alkali disease. In wildlife, elevated selenium concentrations in the diet are associated with adverse reproductive and developmental effects including reduced growth or survival of young (EPA, 2007a).

3.1.4.6 PAHs

PAHs are ubiquitous in nature, detected in sediment, soil, air, surface water, and plant and animal tissues. They are formed as a result of incomplete combustion of organic materials such as wood, coal, and oil and exist in the environment from natural sources. It is estimated that approximately 270,000 metric tons of PAHs reach the environment yearly (Eisler, 1987). The composition of PAHs can vary according to the source and in this case the source is assumed to be petroleum products. Much of the PAHs released into the atmosphere reaches the soil by direct deposition or deposition on vegetation. Plants can adsorb or assimilate PAHs and metabolize and degrade the PAHs. However, if the rate of assimilation exceeds

metabolism, PAHs can accumulate in plants (Edwards 1983). PAHs can be taken into the mammalian body by inhalation, skin contact, or ingestion, although they are poorly absorbed from the gastrointestinal tract. Elimination of PAHs and their metabolites is primarily through the hepatobiliary system and the gastrointestinal tract (Sims and Overcash, 1983). In vertebrates, including fish, there is an enzyme (known by various names like mixed-function oxidases or P450-dependent monooxygenases) system that metabolizes PAHs, limiting bioaccumulation up the food chain (West et al., 1984). An uptake factor of zero is recommended by EPA (2007b) in the derivation of the soil screening levels for the mammalian carnivore. Bioavailability of PAHs to plants is decreased with increasing organic soil content (Greenberg, 2003). Sverdrup, et al. (2003) conducted tests with eight PAHs on seed emergence and early life-stage growth of three terrestrial plants, red clover (*Trifolium pretense*), ryegrass (*Lolium perenne*), and mustard (*Sinap sisalba*). Concentrations estimated to give a 20% reduction (EC_{20}) in seedlings ranged from 140 mg/kg to 650 mg/kg for fluoranthene, 55 mg/kg to 380 mg/kg for fluorene, 37 mg/kg to 300 mg/kg for phenanthrene, and 49 mg/kg to 1,300 mg/kg for pyrene. EC_{20} values demonstrated a large difference in sensitivity between plant species (Sverdrup et al., 2003).

3.2 Conceptual Site Model

Based on the Site history and current and anticipated future land use for the areas with potential ecological habitat, the SLERA is focused on antimony, arsenic, lead, cadmium and selenium in surface soil as the primary release mechanisms and ecological exposure route. This SLERA addresses the exposure pathways related to the introduction of these metals to surface soils, in those areas that will remain ecological habitat for the foreseeable future. Soil invertebrates, birds, and mammals could be exposed directly and indirectly to antimony, arsenic, cadmium, lead, selenium and PAHs in the habitat areas.

A conceptual site model (CSM) for the Site is presented as Figure 9 and illustrates the exposure analysis described above. Development of a CSM is TCEQ's Ecological Risk Assessment Required Element #3. The CSM is a diagram that illustrates the potential contaminant sources, release mechanisms, transport pathways, exposure media, and receptors considered for the SLERA.

The primary release mechanism and associated route of ecological exposure in the habitat areas is through air deposition of metals onto the surfaces and direct exposure to soil. The terrestrial areas have significant amount of ground vegetative litter which is commonly used as surface burrows by native wildlife. Burrows were noted throughout the habitat areas, but were typically only a few inches deep into the leaf litter and soil.

3.2.1 Chemical/Physical Properties Governing Transport of Antimony, Arsenic, Cadmium, Lead and Selenium

Antimony, arsenic, lead, cadmium and selenium, like all compounds, have the potential to move within environmental media (e.g., soil) to some degree. The ability for a compound to be transported within a medium or between media is based on the chemical and physical characteristics of the compound(s) and the source medium as well as the receiving medium. Physical characteristics include parameters such as grain size and moisture content for surface soil particles. Chemical characteristics include parameters such as soil/water distribution coefficients, adsorption potential and degradation characteristics for potential contaminants. These chemical characteristics are specific to each chemical present, and may also be affected by the physical characteristics of the media in which the chemical is present. Antimony, arsenic, lead and cadmium generally tend to remain bound to organic matter, minerals, clays, and silts in soil and, as such, they are relatively immobile. The binding potential of selenium is dependent on the soil type, pH, and aeration in the soil.

3.2.2 Transport of Antimony, Arsenic, Cadmium, Lead and Selenium in Surface Soil Via Surface Runoff

Overland surface runoff from surface soil to Stewart Creek and the North Tributary has the potential to result in these metals bound to soil particles being transported during/after rainfall events into these surface water bodies. The ecological risk evaluation of Stewart Creek and the North Tributary is presented in a separate SLERA submitted with the FOP APAR. Overland flow during runoff events would be expected to occur in the direction of topographic slope and would more likely occur with significant rainfall events when soils are fully saturated and/or precipitation rates are greater than infiltration rates. The Site is relatively flat, with limited elevation changes over the Site, generally less than five to ten feet over the entire Site, with a gradual slope increase in the vicinity of Stewart Creek and lesser so at the North Tributary. Because of the limited topographic slope and vegetative cover, the Site is generally not conducive to high runoff velocities or high sediment loads. In addition, the soils at the Site are predominantly clay, and clay soils have a relatively low erosive potential. There is limited physical evidence of erodible impacts other than a small area of wash-out on the south side of the railroad spur on the western-most portion of the former operations area. Additionally, there are areas of preferential surface water flow in the South Wooded Area that are stabilized by natural vegetation.

3.3 Assessment Endpoints

Per TCEQ's Ecological Risk Assessment Required Element #2, ecological communities and major feeding guilds applicable to the Site were identified. Assessment endpoints are explicit expressions of the actual environmental value to be protected (EPA, 1997). If these endpoints are found to be significantly affected, they can trigger further action. The assessment endpoints for the Site are:

- Protection of birds and mammals with no unacceptable effects on species diversity and abundance (and viable reproduction) due to Site-related antimony, arsenic, cadmium, lead, selenium and PAHs in surface and subsurface soils.
- Protection of soil invertebrate communities with no unacceptable effects on species diversity and abundance due to Site-related related antimony, arsenic, cadmium, lead, selenium and PAHs in the surface and subsurface soils.

Note that PAHs, based in the areas of use, are only applicable to a section of the Stewart Creek Corridor Area and the small area near the Fire Training Facility in the North Wooded Area and do not apply across all of the exposure areas.

Appendix D contains the habitat evaluation conducted to evaluate the potential presence of special status species within the study area. The evaluation concludes that it is unlikely that any of these special status species would be present at the Site. An evaluation of the likelihood of the presence of any of the state or federally listed species is summarized on Table 4.

3.4 Exposure Assessment

The exposure assessment phase expands the problem formulation and defines quantitative inputs for the exposures. A listing of input data available from the literature and exposure assumptions that leads to the calculation of the exposure dose for each receptor is TCEQ's Ecological Risk Assessment Required Element #5. The least shrew, American robin, red-tailed hawk and red fox represent exposures in the terrestrial system and were presented as receptors in the TCEQ-approved Work Plan (PBW, 2012). An assessment of reptiles is presented in Appendix E.

In response to TCEQ and EPA input, subsequent to the Work Plan approval, the nine-banded armadillo (*Daysypus novemcinctus Linnaeus*) was added as a receptor to address exposure to surface and subsurface soils. The armadillo is about the size of a terrier dog. Adult males weigh between 5 and 8 kg and adult females weigh between 4 and 6 kg. It occurs throughout the state, except the western Trans-Pecos. Armadillos are fond of water and prefer small streams and water holes. The armadillo digs cone-shaped

pits about 3 to 4 inches deep, laps up any exposed insects before moving on, then revisits the pits regularly to claim any insects that may have been trapped. In addition to digging for food, an armadillo claws are used to dig burrows. One armadillo may have as many as fifteen burrows located in its 10 acre range – some in use and some abandoned. The armadillo consumes mostly insects and invertebrates, but will consume reptiles, amphibians, bird eggs, plants, berries, fungi and carrion when it is available (Davis and Schmidly, 2009). The armadillo represents mammalian omnivores exposed to surface and subsurface soil in the terrestrial food web via exposure to surface soil from feeding and subsurface soil for incidental ingestion of soil.

As described in Sections 2.2 and 3.1.2 of this SLERA, the terrestrial habitat on the FOP is fragmented. However, to address the potential for wide-ranging receptors to forage among each of these areas, the total potential habitat area was combined into one large exposure area. The exposure areas for the terrestrial assessment include:

- South Wooded Area – 4.83 acres.
- Lake Parcel – 6.76 acres.
- Stewart Creek Corridor – 9.11 acres.
- North Wooded Area – 12.08 acres.
- Site-Wide Area – As described above, this combined habitat area is a theoretical exposure area to address the potential of wide-ranging receptors foraging in each of the individual exposure areas. This is a conservative evaluation because the use of the exposure modifying factor (EMF) with this larger exposure area has less of an impact on the exposure calculation (i.e., the EMF is the ratio between the site size and the receptor's home range and the assumption of a larger site area would result in less attenuation of the receptor's exposure). The red fox and red-tailed hawk are evaluated as wide-ranging receptors with the assumed home range for the fox of 1,845 acres and for the hawk of 1,037 acres. Both of these home range values were developed by calculating the geometric mean of the home range values listed for the red fox and the red-tailed hawk in the EPA's *Wildlife Exposure Factor Handbook* (1993). This theoretical Site-Wide exposure area is considered to be 32.78 acres (i.e., the sum of individual exposure areas).

3.4.1 Food Web Ingestion Modeling

Food web ingestion-based modeling calculations were performed to characterize potential exposures to Site COCs via the food web and to identify potential risks for upper trophic level mammals and birds. Ingestion modeling is based on species-specific exposure parameters and ingestion intake requirements using allometric equations (EPA, 1993). Species-specific ingestion models are presented in Appendix F, but the following general equation (TCEQ, 2014) was used to estimate oral exposure for wildlife receptors:

$$\text{Dose (mg/kg - day)} = \left(\frac{(((\text{IRfood} \times \text{Cfood}) + (IRsoil \times Csoil))EMF)}{\text{BW}} \right)$$

Where:

Dose	=	Estimated dose from ingestion (mg COC/kg body weight/day)
IRfood	=	Ingestion rate of food (prey) (kg/day)
Cfood	=	COC concentration in food (mg/kg)
IRsoil	=	Ingestion rate of soil (kg/day)
Csoil	=	COC concentration in soil (mg/kg)
EMF	=	Exposure modifying factor (unitless)
BW	=	Body weight of the organism (kg)

The purpose of food web modeling is to characterize potential exposures to COCs via the food web and to identify potential risks for upper trophic-level organisms. Through food web modeling, COCs are either retained for or eliminated from further steps of the SLERA. The food web modeling occurs in two phases per TCEQ Required Elements #6 and #7 (TCEQ, 2014): a conservative no observed adverse effect level (NOAEL)- based analysis followed by a less-conservative NOAEL - and lowest observed adverse effect level (LOAEL) - based analysis. As described by TCEQ (2014): “In the risk estimate generated in Required Element #6, an HQ is based on reasonably conservative exposure assumptions and representative NOAEL-based TRV.” These initial or “conservative” assumptions include 100% bioavailability of the COCs and a site foraging factor of 100 % for each of the receptors. TCEQ Required Element #7 provides for calculation of HQs using less conservative exposure assumptions and TRVs based on both the NOAEL and LOAEL data (TCEQ, 2014 Section 3.11). These refined or “less-conservative” assumptions can include changes to exposure modifying factors such as a site foraging factor of less than 100%.

3.4.2 COC Uptake into Food Items

Chemicals in tissues of organisms of the food web are likely to be ingested by the species that feed on them (i.e., those occupying higher trophic levels); the result of which may be the expression of toxicological effects by the higher trophic level species. Chemical-specific uptake factors were taken from the EPA's *Screening Level Ecological Risk Assessment Protocol for Hazardous Waste Combustion Facilities* (EPA, 1999) and were also presented in the TCEQ-approved Work Plan (PBW, 2012).

3.4.3 Exposure Point Concentrations

The basic unit of exposure is the exposure point concentration (EPC), defined as the concentration of a chemical in a specific environmental medium at the point of contact for a receptor. Both the maximum detected concentration and the 95% UCLs were evaluated in the SLERA. The maximum detected concentration was used for comparison to the benchmarks. 95% UCLs were used as the EPC in the food web analysis. EPA's most recent ProUCL software program was used to calculate the 95% UCL concentrations for the constituents in soil, surface water and sediment (EPA 2013).

Appendix C provides the statistical calculations for these data. The EPA's ProUCL Version 5.0 software program (EPA, 2013) was used to test the distributions of the data for each compound and dataset and calculate parametric and distribution-free (i.e., nonparametric) 95% UCL concentrations and summary statistics from data sets including non-detect concentration values.

4.0 TOXICITY ASSESSMENT

Mammal and bird toxicity reference values (TRVs) were taken from the EPA's Soil Screening Level (SSL) documents for antimony (EPA, 2005a), arsenic (EPA, 2005b), cadmium (EPA, 2005c), lead (EPA, 2005d), and selenium (EPA, 2007a) and the open literature. As described in Section 3.1.2 of this SLERA, the evaluation of PAHs in soil was completed at the screening phase and therefore toxicity data are not presented for PAHs.

TRVs are the concentration of chemical exposure from an environmental media below which no significant ecological effects are anticipated. The TRVs used in this evaluation are considered screening level TRVs in that they are generally the lowest value available for that compound and endpoint based on a set of criteria and assumptions developed by EPA when estimating soil screening levels (EPA, 2005e). Because a NOAEL represents a concentration at which no adverse effects are noted, it is the preferred TRV in developing conservative soil screening values. For this SLERA, both NOAELs and LOAELs are required per TCEQ (2014). The LOAELs, or concentration at which the lowest effect was noted, were developed from the EPA SSL documents for each COC. To determine the LOAEL for each COC and receptor, the methodology employed by EPA to determine the NOAEL was replicated. For instance, if a NOAEL was based on the geometric mean of the NOAEL values for the growth endpoint, then the LOAEL was determined by calculating the geometric mean of the LOAEL values presented for the growth endpoint. When the NOAEL TRV recommended by EPA was based on a single study (as is the case for lead) the LOAEL TRV reported by this same study which determined the NOAEL was used. It is preferred to use the same study for both the NOAEL and LOAEL because the variability between study animals, study conditions and study endpoints is minimized. The mammalian and avian TRVs for each of the COCs are discussed below:

4.1 Antimony

No avian TRVs for antimony could be located in the literature and the EPA does not recommend an avian TRV in their *The Ecological Soil Screening Levels for Antimony* (2005a). For mammals, the NOAEL TRV is 0.059 mg/kg-day based on a reproduction endpoint (Rossi et al., 1987). That study listed a LOAEL of 0.590 mg/kg-day. The mammalian antimony LOAEL-TRV used in this assessment was 0.590 mg/kg-day.

4.2 Arsenic

For birds, the TRV is the lowest NOAEL value in EPA, 2005b which is 2.24 mg/kg-day for reproduction, growth, or survival from a study by Holcman and Stibilj (1997). That study does not list a corresponding LOAEL so the geometric mean of the LOAEL values for reproduction, growth and survival of 4.5 mg/kg-day was used in this SLERA.

For mammals, the NOAEL TRVs (growth endpoint) listed by EPA (2005b) range from 0.0859 mg/kg-day to 10.3 mg/kg-day for growth, 0.601 mg/kg-day to 24 mg/kg-day for reproduction, and 0.533 mg/kg-day to 32 mg/kg-day for survival with a geometric mean of 2.8 mg/kg-day. The LOAELs from EPA (2005b) ranged from 0.663 mg/kg-day to 19.7 mg/kg-day for the growth endpoint, 0.0065 mg/kg-day to 48.0 mg/kg-day for the reproduction endpoint and 0.675 mg/kg-day to 43.4 mg/kg-day for the survival endpoint with a geometric mean of 6.9 mg/kg-day. The value of 2.8 mg/kg-day was used as the mammalian NOAEL TRV and 6.9 mg/kg-day was used as the LOAEL TRV for this SLERA.

4.3 Cadmium

The avian NOAEL of 1.47 mg/kg-day is a geometric mean based on growth and reproduction endpoints (EPA, 2005c). LOAELs reported in EPA 2005c ranged from 1.05 mg/kg-day to 37.6 mg/kg-day for growth and 2.37 mg/kg-day to 21.1 mg/kg-day for reproduction. The geometric mean of all of the avian LOAEL values listed in EPA 2005c based on growth and reproduction was 6.35 mg/kg-day. This value of 6.35 mg/kg-day was used as the avian LOAEL TRV for this SLERA.

The mammalian NOAEL of 0.770 mg/kg-day presented in EPA 2005a is based on a study by Yuhas et al. (1979) with a growth endpoint. Yuhas et al (1979) also defines a mammalian LOAEL of 7.70 mg/kg-day. The value of 7.70 mg/kg-day was used as the mammalian LOAEL TRV.

4.4 Lead

The avian NOAEL of 1.63 mg/kg-day was identified by EPA (2005d) based on a single study (Edens and Garlich, 1983) with reproduction as the endpoint. A LOAEL of 3.26 mg/kg-day was reported by Edens and Garlich (1983). The value of 3.26 mg/kg-day was used as the avian LOAEL TRV.

The mammalian NOAEL of 4.70 mg/kg-day was identified by EPA (2005d) based on a single study (Kimmel et al., 1980) using growth as the study endpoint. A LOAEL of 8.90 mg/kg-day was reported from Kimmel et al. (1980). The value of 8.90 mg/kg-day was used as the mammalian LOAEL TRV.

4.5 Selenium

The avian NOAEL of 0.29 mg/kg-day was identified by EPA (2007a) based on a single study (El-Begearmi and Combs, 1982) with survival as the endpoint. A LOAEL of 0.579 mg/kg-day was reported by Begearmi and Combs (1982). The value of 0.579 mg/kg-day was used as the avian LOAEL TRV.

The mammalian NOAEL of 0.143 mg/kg-day was identified by EPA (2007a) based on a single study (Maham and Moxon, 1984) using growth as the study endpoint. A LOAEL of 0.215 mg/kg-day was reported from Maham and Moxon (1984). The value of 0.215 mg/kg-day was used as the mammalian LOAEL TRV.

5.0 RISK CHARACTERIZATION

Predictions of the likelihood for adverse effects, if any, for the food web modeling are based on hazard quotients (HQs) (EPA, 1997). The HQs were calculated by dividing the estimated dose by the TRVs for each of the COCs for each of the upper trophic-level receptors.

NOAEL – HQ = Exposure Dose/ NOAEL-TRV
LOAEL – HQ = Exposure Dose/LOAEL-TRV

The HQ value of 1 is considered the threshold for indicating that adverse effects may occur. An HQ less than or equal to a value of 1 (to one significant figure) indicates that adverse impacts to wildlife are considered unlikely (EPA, 1997). An HQ greater than 1 is an indication that further evaluation may be necessary to evaluate the potential for adverse impacts to wildlife.

5.1 Hazard Quotient Analyses

For the initial conservative analysis as described in TCEQ (2014), HQs were calculated using no adverse effect or NOAEL-based TRVs, assumptions of 100 % bioavailability and no exposure modifying factors (Required Element #6) (TCEQ, 2014). Appendix F shows the risk calculations for the SLERA, with the HQs summarized on Table 5, for the initial conservative assessment. As outlined in the TCEQ guidance, if the HQ is greater than one in the initial conservative analysis, then the refined (less conservative) analysis is completed.

TCEQ's Ecological Risk Assessment Required Element #7 requires that the exposure parameters remain as in the initial conservative analysis (e.g., body weight, ingestion rates, and the exposure point concentration), but other factors can be modified such as the exposure modifying factor, depending on the species and site conditions. The HQ is calculated with the same NOAEL used in the initial conservative analysis, but a LOAEL-based TRV is added and the exposure is modified using the receptor's home range in relation to the exposure area size. Table 6 shows the HQs for the refined(less conservative) assessment. Each exposure area is discussed below.

5.1.1 Potential Risks to Plants and Soil Invertebrates – Terrestrial Areas

For the evaluation of the plant and soil invertebrate communities, the conservative soil benchmark was used. The plant benchmark is more conservative for all of the evaluated metals than the earthworm benchmark. An evaluation of the data sets against each type of benchmark is presented below.

South Wooded Area - Lead concentrations in 19 out of 26 samples exceeded the plant benchmark of 120 mg/kg and concentrations of three samples exceeded the earthworm benchmark of 1,700 mg/kg. There were no exceedances of either the plant or soil invertebrate benchmarks for arsenic or cadmium. There was one exceedance (out of five samples) of the plant benchmark of 5 mg/kg for antimony and one exceedance (again out of five samples) of the plant benchmark for selenium of 0.52 mg/kg. There were no exceedances of the earthworm benchmark for antimony or selenium.

North Wooded Area – Similar to the South Wooded Area, the majority of benchmark exceedances were for lead. Lead concentrations in 37 out of 67 samples exceeded the plant benchmark of 120 mg/kg and concentrations in three samples exceeded the earthworm benchmark of 1,700 mg/kg. There was one exceedance of the plant benchmarks and no exceedances of the invertebrate benchmarks for antimony and cadmium. There were two exceedances of the plant benchmark and one exceedance of the invertebrate benchmark for arsenic. Of the 24 samples from this area analyzed for of selenium, there were 7 exceedances of the plant benchmark and one exceedance of the invertebrate benchmark. Several of the detection limits for selenium are greater than the plant benchmark of 0.52 mg/kg. Sample E-11C had elevated concentrations of all of the metals [antimony (49.8 mg/kg), arsenic (79.8 mg/kg), cadmium (62.8 mg/kg), lead (11,200 mg/kg) and selenium (29.2 mg/kg)]. Other samples located near E-11C (EC-11 and EC-11C-A) did not show similar elevated detections. Note that the assessment of PAHs detected near the former fire training facility were below the screening criteria and the assessment of PAHs ended at the benchmark screening step (Section 3.1.2).

Lake Parcel – Twenty two samples from the Lake Parcel were analyzed for cadmium and lead. Of those 22 samples, there are no exccedances of the benchmarks for cadmium, but 14 exceedances of the plant benchmark for lead. There are no exceedances of the invertebrate benchmark for lead. There was only one sample from this area for which antimony, arsenic and selenium data are available. None of these analyses exceeded the benchmark, although the detection limit for selenium was greater than the plant benchmark.

Stewart Creek Corridor – Lead concentrations in 46 of the 77 samples from this area exceeded the plant benchmark and 12 of the lead results were greater than the invertebrate screening level of 1,700 mg/kg. For cadmium, three of the 59 samples had concentrations that exceeded the plant benchmark, but only one sample exceeded the soil invertebrate benchmark. There were 11 samples of arsenic and the plant benchmark was exceeded three times. There were nine samples for selenium and the plant benchmark was four times. Both arsenic and selenium exceeded their soil invertebrate benchmarks in one sample [2012-FWCS-1A (2-4)]. Note that the assessment of PAHs detected near the flood wall were below the screening criteria and the assessment of PAHs ended at the benchmark screening step (Section 3.1.2).

5.1.2 Potential Risks to Upper Trophic Level Receptors

Four terrestrial areas were evaluated in the SLERA for potential ecological exposure to antimony, arsenic, cadmium, lead and selenium in soils: South Wooded Area, North Wooded Area, Lake Parcel and the Stewart Creek Corridor. In addition, a Site-Wide evaluation was also performed. Table 5 summarizes the NOAEL-based HQs developed in the conservative assessment for all of the exposure areas. Table 6 summarizes the NOAEL-based HQs and the LOAEL-based HQs developed in the less-conservative assessment for those areas, analytes and receptors found to have NOAEL-based HQs in the conservative assessment greater than one. Results of the evaluation for each of these areas are provided below:

South Wooded Area – Using the initial conservative exposure parameters and the assumption that the birds and mammals forage in this area 100 % of the time, the resulting HQ for the armadillo exposed to antimony is greater than one (Table 5). All of the other NOAEL-based HQs were less than one for the robin, hawk, shrew and fox exposed to antimony, arsenic, cadmium, lead and selenium and the armadillo had NOAEL-based HQs less than one for arsenic, cadmium, lead and selenium. In the refined (less conservative) analysis the LOAEL-based TRV is added. Table 6 shows the HQs following the refined (less conservative) assessment. The NOAEL-based HQ for antimony for the armadillo is greater than one, but the corresponding LOAEL-based HQ for antimony for the armadillo is below one. According to TCEQ (2014), if LOAEL-based HQ is less than one in the refined (less conservative) assessment, then no further evaluation is necessary. As such and per TCEQ guidance, no further evaluation for the South Wooded Area is necessary.

North Wooded Area – For the North Wooded Area, the HQs are greater than 1 in the initial conservative assessment for the fox exposed to antimony and for the armadillo exposed to antimony and lead. The other NOAEL-based HQs in this assessment were less than one (Table 5). In the refined (less conservative) analysis, the LOAEL-based HQ is added to the evaluation. As shown in Table 6, the resulting LOAEL-based HQs for antimony exposure to the armadillo and fox and lead exposure to the armadillo are less than 1. As such and per TCEQ guidance, no further evaluation for the North Wooded Area is necessary

Lake Parcel – The trophic analysis of the Lake Parcel did not show any NOAEL-based HQs above 1 for any of the receptors. As such and per TCEQ guidance, no further evaluation of the Lake Parcel is necessary.

Stewart Creek Corridor – The Stewart Creek Corridor exposure area runs the length of Stewart Creek on-Site adjacent to the former operations area (see Figure 3). This area is mowed and maintained up to the edge of Stewart Creek. The trophic assessment of the Stewart Creek Corridor shows NOAEL-based HQs

greater than one for the armadillo from exposure to antimony, cadmium and lead. The fox also showed NOAEL-based HQs greater than one from exposure to antimony (Table 5). The exposure for the armadillo can be modified slightly because the site size is 9.11 acres which is less than the 10 acre home range of the armadillo. The less-conservative assessment shows that there is no risk to the fox or armadillo from exposure to antimony or cadmium, but there is a LOAEL-based HQ greater than one for armadillo exposures to lead. As such and per TCEQ guidance, no further evaluation of antimony, arsenic, cadmium or selenium in the Stewart Creek Corridor is necessary; however, an ecological PCL for armadillo exposure to lead was developed.

Site-Wide Area – As a conservative measure, all of the exposure areas were combined into one theoretical exposure area of 32.78 acres and exposure to the wide ranging receptors (red fox and red-tailed hawk) was determined. In the conservative assessment, the fox and hawk both had a NOAEL-based HQ less and adverse risk (HQs greater than one) was not indicated.

5.2 Overall Potential Site Risks

This SLERA concludes that antimony, arsenic, cadmium, selenium or PAHs in soils do not pose an adverse risk to potential ecological receptors at the FOP. There is unacceptable risk from exposure to lead for the armadillo in the Stewart Creek corridor and development of an ecologically based PCL is required. There are detected concentrations of antimony, arsenic, cadmium, lead and selenium in soil that exceed the community (plants and earthworm) benchmarks in the exposure areas with the exception of the Lake Parcel where only lead detections exceed the benchmarks.

6.0 UNCERTAINTY ANALYSIS

The characterization of uncertainty is a component of the ERA process (EPA, 1997) and is Required Element #8 in the TCEQ process (TCEQ, 2014). Due to the multiplicity of potential receptor species and general lack of detailed knowledge and/or variability surrounding their life cycles, feeding habits, and relative toxicological sensitivity, the uncertainty surrounding estimates of ecological hazard can be substantial. The criteria used in this assessment are intended to provide a conservative assessment of potential ecological hazards. This SLERA did not account for site-specific factors such as chemical bioavailability, adaptive tolerance, reproductive potential, or use of similar nearby ecosystems. Such factors would most likely tend to mitigate the estimated degree and ecological significance of loss or impairment of a portion of some ecological population(s) due to both chemical and physical stressors in the area. The approach used in this assessment does develop protective (conservative) estimates of exposure, which likely indicate a potential for hazard that is greater than actually encountered by organisms that might utilize the Site.

The criteria used in this assessment are all chemical-specific and as such, cannot address the additive, antagonistic, or synergistic effects of the mixtures of chemicals typically present in the environment. Furthermore, SLERAs do not typically take into account the nature and constitution of the specific ecosystem present at a Site, the potential toxicity of other constituents (naturally occurring) that were not quantified, or the pervasive influence of physical stressors associated with the disruptions caused by human activities. Uncertainties applicable to this SLERA are described below:

6.1 Exposure Concentrations

Risk may be overestimated in the exposure assessment because the selected EPCs are either the maximum detected (in the benchmark screening) or the 95 % UCL (in the food web modeling) concentrations. The TCEQ has selected the 95 % UCL as the preferred EPC for the benthic invertebrate community and wildlife since the goal is to protect benthic organisms and wildlife at a community level, rather than individually (TCEQ, 2013b). As described in Appendix D, there were no special status species found in Stewart Creek or on-Site and therefore protection of the wildlife populations, and not individuals within the populations, is warranted. The 95 % UCL is a conservative estimate of the true mean and accounts for uncertainty in concentrations throughout an exposure area. The EPC term, according to EPA guidance, represents the average exposure experienced by a receptor over an exposure area during an extended period of time. Therefore, the EPC should be a conservative estimate of the true average value and not the highest observed concentration (TCEQ, 2013b). The use of the 95 % UCL as the EPC for evaluation of risk to the wildlife receptors likely overestimates the potential risk.

6.2 Data Coverage

Cadmium and lead are the primary constituents of interest for this SLERA; however, antimony, arsenic and selenium in soil is also evaluated in this SLERA. There are fewer samples analyzed for antimony, arsenic and selenium than there are for cadmium and lead in the ecological exposure areas. Because the source of these COCs to on-Site soil is the same for lead and cadmium as it is for antimony, arsenic and selenium, it is unlikely the smaller antimony, arsenic and selenium soil data sets impact the SLERA conclusions. As is common practice and discussed in TCEQ 2014, the maximum detected concentration was used for the wildlife exposure point concentration if data were insufficient in number to reliable calculate a 95% UCL.

Additionally, there is less data coverage for the subsurface exposure than for surface soil. This uncertainty was conservatively addressed in the model by assuming that the surface soil concentration is equal to the subsurface soil concentration for assessment of the nine-banded armadillo when subsurface data were not available. The assessment of the community receptors (plants and terrestrial invertebrates) was completed using the surface and subsurface data and was not limited to just the surface data. The evaluation of both the surface and subsurface data in the SLERA reduces the uncertainty associated with fewer subsurface data points than surface.

6.3 Selection of Wildlife Species Subject to Evaluation

6.3.1 Birds and Mammals

The shrew, red fox, American robin and red-tailed hawk were evaluated as terrestrial receptors exposed to surface soil in the various exposure areas. The armadillo was evaluated as a terrestrial receptor exposed to both surface and subsurface soil. The selection of these species to represent mammals and birds was based on Site observations, their potential to contact soil directly or indirectly, and professional judgment. These species were not directly observed on Site, but based on the habitat, it is reasonable to assume that they would be present. The myriad of factors that influence animal and bird behavior, the fragmented terrestrial areas, water flow in the creek, and the industrial/residential/commercial nature of the area and nearby vicinity limits the ecological productivity of the area and, therefore, the exposure to birds and mammals is likely overestimated in this SLERA.

6.3.2 Reptiles

The evaluation of ecological risk to reptiles, as represented by a terrestrial snake (timber/canebrake rattlesnake) is highly uncertain and was not conducted in this SLERA. Appendix F provides a detailed evaluation of toxicity data available in the open literature and potential snake exposure parameters.

The reptile based toxicity data for the arsenic, lead, cadmium and selenium is limited with the majority of data focused on biological accumulation with no clear demarcation of no or lowest effect levels or even dose response relationships. No information on the reptile toxicity of antimony was found in the literature. The toxicity endpoints of growth and survival traditionally used for mammals and birds may not be the most appropriate endpoints for the rattlesnake; however, endpoints such as lizard sprint speed and turtle righting time are also not applicable to the snake. According to Grillitsch and Schiesari (2010): "the mechanistic understanding of the toxicokinetics of metals in reptiles remains poorly developed and must be addressed in future research to characterize shortcomings for taxa and compounds, and to link toxicodynamics and toxicokinetics (i.e., fate and effect of metals in reptiles)."

For the snake exposure parameters, the information found for the food ingestion rate is based on insectivorous lizards, the soil ingestion rate is based on turtles. The body weight for the adult timber rattlesnake varies from 0.5 kg to 4.5 kg. Additionally, the use of a mammalian and avian intake model may not be applicable to the ecothermic reptiles. According to Linder at al. (2010): "it is not a 'fits-all-sizes' world when dietary routes of exposure are considered for the herpetofauna, particularly within the context of exposure to chemical stressors in the field. For example, 'sit and wait foragers' (e.g., common to some snakes) rely on ingesting a single, frequently large meal followed by extended nonforaging, resting state."

Because neither the exposure model nor the toxicity data are considered acceptable, the use of the snake in a terrestrial ecological risk assessment for antimony, arsenic, cadmium, lead and selenium is too uncertain to be value added information for decision making purposes at the Site. Therefore, the evaluation of reptiles in the ecological risk assessment and calculation of HQs or PCLs based on the snake model could not be determined nor incorporated into the larger affected property assessment.

6.4 Simultaneous Exposure to Multiple Constituents

Another source of uncertainty originated from the use of toxicity values reported in the open literature that were derived from single-species, single-constituent laboratory studies. Prediction of ecosystem effects from laboratory studies is difficult. Laboratory studies cannot take into account the effects of environmental factors that may add to the effects of chemical stress. TRVs were selected from studies using single-constituent exposure scenarios. The endpoint species selected to represent the wildlife expected to occur within the exposure area were exposed to a variety of constituents, and it is not known whether the individual constituents in this mixture are synergistic, additive, or antagonistic. Therefore, the magnitude of this uncertainty is not measurable and risk could be overestimated or underestimated. Interactive effects were also not addressed and this could increase or decrease risk.

6.5 TRVs

TRVs are designed to be conservative estimates of potential toxicity based on a variety of measurement endpoints for various ecological receptors, typically in a laboratory setting using standard species that are commercially available. In the initial phase of the SLERA, NOAEL-based TRVs are used while in the refined less conservative HQ calculation of TCEQ Required Element #7, LOAEL-based TRVs are used. It is important to evaluate the adequacy and validity of the TRV during the SLERA process since sometimes the conservatism built into the TRV-derivation process limits the usefulness of the value. For example, the avian TRV for lead results in an Eco-SSL that is near background levels of lead This is discussed by EPA (2005d): "The eco SSL for avian wildlife is however lower than the 50th percentile for reported background concentrations in eastern and western U.S. soils." If the data used in the evaluation (EPA, 2005d) are inspected closer, the tremendous variability in the numerous studies and the conservative assumptions used to select the TRV result in a value that is not representative of the majority of the NOAELs for the compound. Again, using lead as an example, the range of TRVs looking at all NOAEL endpoints and species is from 0.0584 mg/kg-day to 304 mg/kg-day, which is a 10,000-fold difference. Often the geometric mean of the dataset is used to estimate the TRV but, in the case of lead, the lowest LOAEL value was lower than the geometric mean for the NOAEL (10.9 mg/kg-day) so the NOAEL-based TRV was set at a lower value which was more than 1/10th of the geometric mean. It should be noted that the range of LOAELs were highly variable as well, from 0.111 to 625 mg/kg-day, and the LOAEL-based TRV used in this risk assessment of 3.6 mg/kg-day is lower than the geometric mean of the NOAELs. Because the TRV is very influential in the calculation of HQs, it is extremely important to evaluate sources of uncertainty and variability in these values. It is likely that the conservative nature of the TRV selected for use in the SLERA will overestimate potential risk to birds and mammals.

An avian TRV could not be located for antimony, but the mammalian TRVs from the *EPA's Soil Screening Guidance for Antimony* (EPA, 2005a) were used for assessment of mammalian receptors. It is highly uncertain to apply a mammalian toxicity value to the assessment of birds. The lack of an avian TRV for antimony represents a source of uncertainty in the SLERA.

6.6 Terrestrial Plant Benchmark

There is considerable uncertainty associated with the plant benchmarks. For example, the lead benchmark protective of the terrestrial plant community is from the EPA's Soil Screening Levels for Lead (EPA, 2005d) and is a geometric mean of the maximum acceptable toxicant concentrations values for four test species (loblolly pine, red maple, clover and ryegrass) under three test conditions (pH and percent organic

matter) and is equal to 120 mg/kg dry weight. The individual toxicity values ranged from 22 mg/kg for ryegrass to 316 mg/kg for clover. The EPA chose data from tests performed using soil conditions favoring high bioavailability or upland aerobic soils (low pH and organic matter). The preferred endpoint for plant was biomass production, as it is normally the most sensitive measurement. Other studies listed in EPA (2005d) but not used in the development of the SSL list no effect levels as high as 1,000 mg/kg and low effect levels as low as 50 mg/kg. The variability of the data suggests toxicity to a plant community is difficult to assess based on studies using one plant species under controlled test conditions. The applicability of this benchmark concentrations protective of all terrestrial plants at the FOP is highly uncertain and is most likely overly conservative. TCEQ does not recommend the application of ecologically-based PCLs based on the plant community. As described in Section 3.13 of TCEQ 2014, "The ecological PCL is not directly intended to be protective of on-site receptors with limited mobility or range (e.g., plants, soil invertebrates and small rodents)." Based on the uncertainty in the plant benchmark and TCEQ's recognition of the limitations of the soil benchmarks, an ecologically-based PCL protective of the terrestrial plant community is not recommended.

6.7 Bioavailability and Absorption

The bioavailability and absorption of all of the COCs was conservatively assumed to be 100 % in the SLERA. There were no adjustment factors to account for COCs binding irreversibly onto soil particles, for being present in a form that is not biologically available or active, or to account for the differences in the absorption between the test material that serves as the basis for the TRV for soil. Assumption of 100% bioavailability of COCs will result in the overestimation of risk in this SLERA. Organic carbon or pH could reduce the bioavailability of the COCs in soil; however, a quantitative evaluation of these factors was not performed.

7.0 PCL CALCULATIONS AND SLERA RECOMMENDATIONS

TCEQ's Ecological Risk Assessment Required Element #9 is the calculation of medium-specific PCLs bounded by the NOAEL and LOAEL (i.e., comparative PCLs) for those COCs that are not eliminated as a result of the HQ analysis or uncertainty analysis.

As noted previously, this SLERA concludes ecological exposures to antimony, arsenic, cadmium or PAHs in soils at the FOP do not pose an adverse risk and additional evaluation is not necessary. This evaluation does conclude; however, that an ecological based PCL for lead based on the armadillo exposure is required in the Stewart Creek Corridor. A concentration of 650 mg/kg lead in both surface and subsurface soils is the ecologically derived PCL protective of the armadillo. This value was derived using the exposure parameters for the armadillo used in the HQ calculations and assuming that the HQ was equal to one. Per the guidance, the TRV was assumed to be the midpoint between the mammalian NOAEL and LOAEL so that the PCL represents the midpoint.

Soils concentrations of metals exceed the soil benchmarks protective of terrestrial plant communities and soil invertebrate communities in at least one sample from the five terrestrial exposure areas evaluated in this SLERA. As described in Section 3.13 of TCEQ 2014, "The ecological PCL is not directly intended to be protective of on-site receptors with limited mobility or range (e.g., plants, soil invertebrates and small rodents)." Based on the uncertainty in the plant benchmarks (as discussed in Section 6 6, herein) and consistent with TCEQ's recognition of the limitations of the soil benchmarks, an ecological PCL protective of the terrestrial plant community was not developed.

TCEQ's Ecological Risk Assessment Required Element #10 is the recommendation for managing ecological risk if it is determined that there is unacceptable risk and ecological PCLs are developed in the SLERA. For the FOP, the ecologically-based lead PCL of 650 mg/kg is greater than the human health PCL of 275 mg/kg which will be applied to 5 feet bgs protective of the commercial/industrial land use. In addition to soils being remediated to a lead value of 275 mg/kg, any battery chips or slag material will be removed as part of the remedial measures to be developed in the RAP to address these soils and materials so that the appropriate management of ecological risks can be attained.

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TABLES

Table 1. Summary of Surface and Subsurface Soil Data for Areas of Ecological Interest
Screening Level Ecological Risk Assessment

Sample I.D.	Sample Date	Depth (ft bgs)	Antimony (mg/kg)	Arsenic (mg/kg)	Cadmium (mg/kg)	Lead (mg/kg)	Selenium (mg/kg)
Soil Benchmark (plants)			**5**	**18**	**32**	**120**	**0.52**
Soil Benchmark (earthworms)			**78**	**60**	**140**	**1700**	**4.1**
Lake Parcel							
F-4	3/28/2012	0-0.4	--	--	2.51J	255	--
F-5	3/28/2012	0-0.4	--	--	3.51	367	--
G-4	3/28/2012	0-0.4	--	--	2.17	222	--
G-4 (1 ft)	3/27/2013	1	--	--	< 0.0325	18.2	--
G-5	3/28/2012	0-0.4	--	--	2.61J	273	--
G-5 (1 ft)	3/27/2013	1	--	--	< 0.0346	13.9	--
G-6	3/28/2012	0-0.4	--	--	1.96J	268	--
H-3	3/28/2012	0-0.4	--	--	1.06J	154	--
H-4	3/28/2012	0-0.4	--	--	<1.05	120	--
H-4 (1 ft)	3/27/2013	1	--	--	0.0782 J	17.9	--
H-5	3/28/2012	0-0.4	--	--	1.54J	147	--
H-5 (1 ft)	3/27/2013	1	--	--	< 0.0325	15.9	--
H5-2	2/7/2013	0-0.4	--	--	1.4	154	--
H4-2	2/7/2013	0-0.4	--	--	1.3	145	--
G4-2	2/7/2013	0-0.4	--	--	1.5	166	--
F-5D (0.0-0.25)	1/10/2014	0-0.25	--	--	1.07	101	--
F-5E (0-0.25)	1/10/2014	0-0.25	--	--	2.14	161	--
F-5B (0-0.25)	1/10/2014	0-0.25	--	--	1.3	116	--
F-5A (0-0.25)	1/10/2014	0-0.25	--	--	1.11	60.7	--
F-5A (1 ft.)	1/10/2014	1	--	--	0.275	17.6	--
F-5C (0-0.25)	1/10/2014	0-0.25	--	--	1.55	162	--
2014-CUFT-17 (0-0.5)	4/4/2014	0-0.5	< 2.92	6.74	4.43	172	< 2.34
South Wooded Area							
ECO-1 (0-0.5')	01/15/13	0-0.5	--	--	1.85	431	--
ECO-2 (0-0.5')	01/15/13	0-0.5	--	--	3.19	396	--
ECO-3 (0-0.5')	01/15/13	0-0.5	--	--	10.1	1,740	--
ECO-3 (0.5-2')	03/06/13	0.5-2	--	--	--	43.9	--
ECO-4 (0-0.5')	01/15/13	0-0.5	--	--	2.97	373	--
ECO-5 (0-0.5')	01/15/13	0-0.5	--	--	1.62	221	--
ECO-6 (0-0.5')	01/15/13	0-0.5	--	--	7.92	1,030	--
ECO-6 (0.5-2')	03/04/13	0.5-2	--	--	--	22.7	--
ECO-7 (0-0.5')	01/15/13	0-0.5	--	--	14.6	2,340	--
ECO-7 (0.5-2')	03/06/13	0.5-2	--	--	--	76.5	--
ECO-7A (0-0.5')	03/06/13	0-0.5	--	--	3.61	606	--
ECO-7B (0-0.5')	03/15/13	0-0.5	--	--	2.48	327	--
ECO-8 (0-0.5')	01/15/13	0-0.5	--	--	3.61J	600	--
ECO-8 (0.5-2')	03/04/13	0.5-2	--	--	--	112	--
ECO-9 (0-0.5')	01/15/13	0-0.5	--	--	12.6	2,050	--
ECO-10 (0-0.5')	01/15/13	0-0.5	--	--	3.3	345	--
ECO-1A (0-0.5)	1/9/2014	0-0.5	0.463	12.4	0.692	151	< 2.41
ECO-2A (0-0.5)	1/9/2014	0-0.5	1.46	16.3	3.29	303	0.564
ECO-2A (0.5-2)	1/9/2014	0.5-2	< 3.06	9.87	0.557	26.6	0.41
ECO-8A (0-0.5)	1/9/2014	0-0.5	6.7	13.1	5.65	1090	0.486
ECO-10A (0-0.5)	1/10/2014	0-0.5	--	--	0.409	21.4	--
ECO-4A (0-0.5)	1/10/2014	0-0.5	--	--	1.64	245	--

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Sample I.D.	Sample Date	Depth (ft bgs)	Antimony (mg/kg)	Arsenic (mg/kg)	Cadmium (mg/kg)	Lead (mg/kg)	Selenium (mg/kg)
Soil Benchmark (plants)			**5**	**18**	**32**	**120**	**0.52**
Soil Benchmark (earthworms)			**78**	**60**	**140**	**1700**	**4.1**
ECO-4B (0-0.5)	1/13/2014	0-0.5	--	--	1.21	201	--
ECO-7D (0-0.5)	1/14/2014	0-0.5	0.463	15.1	2.3	192	0.512
ECO-7C (0-0.5)	1/14/2014	0-0.5	--	--	3.35	375	--
ECO-7C (2-3)	1/14/2014	2-3	--	--	< 0.287	12.7	--
Stewart Creek Corridor							
MW-27	03/05/13	0-1	--	--	--	400	--
MW-29	03/06/13	0-0.5	--	--	3.38	455	--
2013-RO-1 (0-0.5')	03/05/13	0-0.5	--	--	2.91	1170	--
2013-RO-2 (0-0.5')	03/05/13	0-0.5	--	--	5.26	811	--
2013-RO-3 (0-0.5')	03/15/13	0-0.5	--	--	0.347	26.1	--
2013-MW-17A (0-0.5')	03/15/13	0-0.5	--	--	0.921	279	--
MW-24 (0-0.5')	03/05/13	0-0.5	--	--	0.0829J	8.82	--
SCC-1 (0-0.5')	01/15/13	0-0.5	--	--	1.21	188.0	--
SCC-2 (0-0.5')	01/15/13	0-0.5	--	--	0.897	99.4	--
SCC-3 (0-0.5')	01/15/13	0-0.5	--	--	33.3	3510	--
SCC-3A (0-0.5')	03/05/13	0-0.5	--	--	--	140	--
SCC-4 (0-0.5')	01/15/13	0-0.5	--	--	0.851	199	--
SCC-5 (0-0.5')	01/15/13	0-0.5	--	--	1.51	443	--
SCC-6 (0-0.5')	01/15/13	0-0.5	--	--	1.04	200	--
SCC-7 (0-0.5')	01/15/13	0-0.5	--	--	0.681	186	--
SCC-8 (0-0.5')	01/15/13	0-0.5	--	--	6.93	4870	--
SCC-9 (0-0.5')	01/15/13	0-0.5	--	--	2.36	149	--
SCC-10 (0-0.5')	01/15/13	0-0.5	--	--	6.55	1510	--
SCC-10A (0-0.5')	03/05/13	0-0.5	--	--	1.40	296	--
SCC-11 (0-0.5')	01/15/13	0-0.5	--	--	106.00	788	--
SCC-11A (0-0.5')	03/06/13	0-0.5	--	--	2.45	268	--
SCC-12 (0-0.5')	01/15/13	0-0.5	--	--	1.44	210	--
SCC-13 (0-0.5')	01/15/13	0-0.5	--	--	0.253J	34.60	--
SCC-14 (0-0.5')	01/15/13	0-0.5	--	--	0.158J	42.7	--
SCC-15 (0-0.5')	01/15/13	0-0.5	--	--	1.62	177	--
2012-FWCS-9	1/18/2012	0-2	--	--	3.07	81.3	--
2012-FWCS-1	1/18/2012	0-2	--	--	10	2240	--
2012-FWCS-8	1/18/2012	0-2	--	--	234	853	--
2012-FWCS-7	1/19/2012	0-2	--	--	0.583	63.9	--
2012-FWCS-5	1/19/2012	0-2	--	--	1.3	224	--
2012-FWCS-4	1/19/2012	0-2	--	--	0.116	158	--
2012-FWCS-3	1/19/2012	0-2	--	--	0.145	35	--
2012-FWCS-2	1/19/2012	0-2	--	--	0.0756	23.6	--
2012-FWCS-1 (2-2.5')	9/4/2012	2-2.5	--	--	--	6270	--
2012-FWCS-12 (0-2')	9/4/2012	0-2	--	--	--	20500	--
2012-FWCS-11 (0-2')	9/4/2012	0-2	--	--	--	217	--
SCC-3 (2-4)	3/5/2013	2-4		8.99	--	1300	< 2.34
SCC-3 (0.5-2)	3/5/2013	0.5-2	--	--	--	535	--
SCC-3 (4-5)	3/5/2013	4-5	--	--	--	15.2	--
2013-FWFS-1A (2-4)	3/5/2013	2-4	--	--	--	15	--
2013-FWFS-1A (4-5)	3/5/2013	4-5	--	--	--	14.9	--

Table 1. Summary of Surface and Subsurface Soil Data for Areas of Ecological Interest
Screening Level Ecological Risk Assessment

Sample I.D.	Sample Date	Depth (ft bgs)	Antimony (mg/kg)	Arsenic (mg/kg)	Cadmium (mg/kg)	Lead (mg/kg)	Selenium (mg/kg)
Soil Benchmark (plants)			**5**	**18**	**32**	**120**	**0.52**
Soil Benchmark (earthworms)			**78**	**60**	**140**	**1700**	**4.1**
MW-29 (2.5-4)	3/5/2013	2.5-4	--	--	1.56	87.3	--
MW-29 (4-5)	3/5/2013	4-5	--	--	< 0.298	8.56	--
2012-FWCS-1 (2.5-4)	3/5/2013	2.5-4	--	--	--	780	--
2012-FWCS-1 (4-5)	3/5/2013	4-5	--	--	--	22	--
2012-FWCS-1A (1-2)	3/5/2013	1-2		115	--	19400	12.6
2012-FWCS-1A (2-4)	3/5/2013	2-4	--	--	--	12.4	--
SCC-10 (0.5-2)	3/5/2013	0.5-2	--	--	--	23.5	--
2013-RO-1 (0.5-1)	3/5/2013	0.5-1	--	--	--	19.8	--
SCC-11 (2-4)	3/6/2013	2-4	--	--	0.538	17.6	--
2013-SL-4 (0-0.5)	3/7/2013	0-0.5	--	--	21.5	82.3	--
2012-FWCS-12 (2-2.7)	3/15/2013	2-2.7	--	--	4.09	31000	--
2012-FWCS-12 (4-5)	3/15/2013	4-5	--	--	--	19.1	--
2013-FWCS-1B (1.1-1.6)	3/15/2013	1.1-1.6	--	--	0.783	80.1	--
2012-FWFS-7A (0-0.5)	5/21/2013	0-0.5	--	--	0.32	44.7	--
2013-SL-02 (0-6)	12/18/2013	0-0.5	--	--	3.32	395	--
2013-SL-02 (6-12)	12/18/2013	0.5-1	--	--	2.13	272	--
MW-27C (0-2)	1/8/2014	0-2	--	--	9.11	1830	--
MW-27B (0-2)	1/9/2014	0-2	6.99	16.8	9.85	2420	0.536
MW-27B (2-4)	1/9/2014	2-4	--	--	0.48	27.6	--
MW-27A (0-2)	1/9/2014	0-2	--	--	12	829	--
MW-27A (2-4)	1/9/2014	2-4	--	--	0.547	51.9	--
MW-44 (0-0.5)	1/9/2014	0-0.5	--	--	0.689	38.6	--
2013-SDA-3B (0-0.5)	1/9/2014	0-0.5	--	--	4.02	1000	--
2013-SDA-4B (0-0.5)	1/10/2014	0-0.5	0.315	11.7	0.671	44.5	0.403
SCC-5B (0-0.5)	1/10/2014	0-0.5	3.11	11.1	2.48	1400	< 2.31
SCC-5A (0-0.5)	1/10/2014	0-0.5	--	--	0.258	29.8	--
MW-27E (0-1)	1/13/2014	0-1	--	--	1.58	298	--
MW-27E (1-2)	1/13/2014	1-2	--	--	15.2	4830	--
MW-29A (0-0.5)	1/13/2014	0-0.5	--	--	1.27	171	--
2013-FWFS-5A (0-2)	1/13/2014	0-2	< 2.97	11.4	0.529	100	< 2.38
2013-FWCS-12A (2-2.7)	1/13/2014	2-2.7	--	--	--	106	--
2013-MW-17B (0-0.5)	1/13/2014	0-0.5	32.4	36.7	5.19	6830	1.35
SCC-10B (0-0.5)	1/13/2014	0-0.5	1.69	14	1.85	333	0.601
ECO-8B (0-0.5)	3/31/2014	0-0.5	4.65	16.4	12.4	1900	--
ECO-8B (0.5-2)	3/31/2014	0.5-2	0.809	2.7	15.5	1860	--
2014-SL-7 (0-0.5)	3/31/2014	0-0.5	< 2.70	9.45	1.28	85.2	< 2.16
North Wooded Area							
MW-21 (0-0.5')	03/05/13	0-0.5	--	--	0.34	8.59	--
MW-22 (0-0.5')	03/05/13	0-0.5	--	--	0.853	84.2	--
ECO-11 (0-0.5')	03/05/13	0-0.5	--	--	0.809	45.3	--
ECO-12 (0-0.5')	03/05/13	0-0.5	--	--	0.953	240	--
D-11	3/28/2012	0-0.5	--	--	3.62	524	--
D-11 (0.5-1')	4/22/2013	0.5-1	--	--	--	312	--
D-12	3/28/2012	0-0.5	--	--	3.71	522	--
D-12 (0.5-1')	4/22/2013	0.5-1	--	--	--	29.7	--
D-13	3/28/2012	0-0.5	--	--	2.98	434	--

Table 1. Summary of Surface and Subsurface Soil Data for Areas of Ecological Interest
Screening Level Ecological Risk Assessment

Sample I.D.	Sample Date	Depth (ft bgs)	Antimony (mg/kg)	Arsenic (mg/kg)	Cadmium (mg/kg)	Lead (mg/kg)	Selenium (mg/kg)
Soil Benchmark (plants)			**5**	**18**	**32**	**120**	**0.52**
Soil Benchmark (earthworms)			**78**	**60**	**140**	**1700**	**4.1**
D-14	3/28/2012	0-0.5	--	--	1.44J	204	--
D-15	3/28/2012	0-0.5	--	--	1.61J	245	--
E-11	3/28/2012	0-0.5	--	--	17.8	2920	--
E-11 (0.5-2')	3/6/2013	0.5-2	--	--	--	109	--
E-11 (2-4')	3/6/2013	2-4	--	--	0.865	46	--
E-11 (4-5')	3/6/2013	4-5	--	--	0.511	5.26	--
E-11A (0-0.5')	03/06/13	0-0.5	--	--	3.89	816	--
E-11A (0.5-1')	04/22/13	0.5-1	--	--	--	285	--
E-12	3/28/2012	0-0.5	--	--	18.3	2610	--
E-12 (0.5-1)	4/22/2013	0.5-1	--	--	--	70	--
E-13	3/28/2012	0-0.5	--	--	10.1	1850	--
E-13 (0.5-1')	4/22/2013	0.5-1	--	--	--	33.6	--
E-14	3/28/2012	0-0.5	--	--	5.64	1090	--
E-14 (0.5-1)	4/22/2013	0.5-1	--	--	--	54.9	--
E-15	3/28/2012	0-0.5	--	--	4.34	893	--
E-15 (0.5-1')	4/22/2013	0.5-1	--	--	--	43.6	--
E-15A (0-0.5')	03/06/13	0-0.5	--	--	1.51	234	--
2013-SL-C16 (0-6)	12/19/2013	0-0.5	--	--	2.13	444	--
2013-SL-C16 (6-12)	12/19/2013	0.5-1	--	--	--	39	--
2013-SL-C15 (0-6)	12/19/2013	0-0.5	0.756	12.1	2.1	476	0.767
2013-SL-C15 (6-12)	12/19/2013	0.5-1	--	--	--	63.6	--
MW-41 (0-0.5)	1/8/2014	0-0.5	--	8	0.474	18.4	< 2.49
MW-41 (0.5-2)	1/8/2014	0.5-2	--	10.1	0.81	92.5	< 2.61
MW-42 (0-0.5)	1/8/2014	0-0.5	--	14.2	1.56	230	0.58
MW-42 (0.5-2)	1/8/2014	0.5-2	< 3.10	13.9	1.82	241	0.502
2013-NDA-1A(2-4)	1/9/2014	2-4	--	--	4.32	946	--
E-11C (0-0.5)	1/9/2014	0-0.5	49.8	79.8	62.8	11200	29.2
D11A (0-0.5)	1/9/2014	0-0.5	1.76	27.2	1.77	257	< 2.73
D12A (0-0.5)	1/9/2014	0-0.5	--	10.9	0.652	80.2	< 2.51
D13A (0-0.5)	1/9/2014	0-0.5	--	--	0.503	67.3	--
E-11D (0-0.5)	1/10/2014	0-0.5	--	--	1.22	152	--
2013-NT-01 (0-0.5)	1/10/2014	0-0.5	--	15.9	0.571	19.5	< 2.54
2013-NT-01 (0.2-2)	1/10/2014	0.2-2	--	14.4	0.618	18.5	0.546
E-12A (0-0.5)	1/10/2014	0-0.5	--	--	1.54	201	--
2013-NT-02 (0-0.5)	1/10/2014	0-0.5	--	14.9	4.89	837	0.654
2013-NT-02 (0.5-2))	1/10/2014	0.5-2	--	14.1	0.354	21.2	0.324
E-13A (0-0.5)	3/31/2014	0-0.5	--	--	0.492	44.4	--
E-14A (0-0.5)	3/31/2014	0-0.5	--	--	1.84	349	--
E-11C-A (0.5-2)	3/31/2014	0.5-2	--	13.8	--	--	--
E-11E- (0-0.5)	3/31/2014	0-0.5	< 3.04	8.75	0.959	126	< 2.43
2014-NT-3 (0-0.5)	3/31/2014	0-0.5	< 2.88	12.3	1.92	353	< 2.30
2014-NT-3 (0.5-2)	3/31/2014	0.5-2	--	--	--	59.3	--
2014-NT-4 (0-0.5)	3/31/2014	0-0.5	< 2.83	10.9	0.402	42.8	< 2.27
2014-SL-5 (0-0.5)	3/31/2014	0-0.5	< 3.08	14.6	1.79	346	0.671
2014-SL-5 (0.5-2)	3/31/2014	0.5-2	--	--	--	10	--
2014-SL-6 (0-0.5)	3/31/2014	0-0.5	< 2.81	9.9	0.736	99.5	< 2.25

Table 1. Summary of Surface and Subsurface Soil Data for Areas of Ecological Interest
Screening Level Ecological Risk Assessment

Sample I.D.	Sample Date	Depth (ft bgs)	Antimony (mg/kg)	Arsenic (mg/kg)	Cadmium (mg/kg)	Lead (mg/kg)	Selenium (mg/kg)
Soil Benchmark (plants)			**5**	**18**	**32**	**120**	**0.52**
Soil Benchmark (earthworms)			**78**	**60**	**140**	**1700**	**4.1**
2014-FFTA-05 (0-0.5)	3/31/2014	0-0.5	< 3.18	9.64	0.909	152	< 2.54
2014-NDA-7 (0-0.5)	4/1/2014	0-0.5	1.98	14.3	4.17	633	0.659
2014-NDA-7 (0.5-2)	4/1/2014	0.5-2	< 2.98	--	--	28	--
2014-FFTA-07 (0-0.5)	4/1/2014	0-0.5	1.97	16.4	4.42	663	0.45
2014-FFTA-07 (0.5-2)	4/1/2014	0.5-2	--	7.11	--	815	--
2014-FFTA-08 (0-0.5)	4/1/2014	0-0.5	2.19	17.4	6.43	566	0.508
2014-FFTA-08 (0.5-2)	4/1/2014	0.5-2	--	11.4	--	108	--
2014-FFTA-06 (0.-0.5)	4/1/2014	0-0.5	1.89	16.9	2.51	736	< 2.29
2014-FFTA-06 (0.5-2)	4/1/2014	0.5-2	--	13.5	--	171	--
2014-NDA-9 (0-0.5)	4/1/2014	0-0.5	< 3.17	12.8	2.26	282	0.412
2014-NDA-9 (0.5-2)	4/1/2014	0.5-2	--	--	--	130	--
2014-NDA-8 (0-0.5)	4/1/2014	0-0.5	< 3.02	11.8	2.97	318	0.338
2014-NDA-8 (0.5-2)	4/1/2014	0.5-2	--	--	--	< 0.554	--

Notes:

Soil benchmarks from TCEQ, 2014 (Table 3-4).

mg/Kg - milligrams/Kilogram

NA - Not Applicable

"--" - Not Analyzed ,

ft - feet

bgs - below ground surface

Table 2. Summary of Soil PAH Data for Stewart Creek Corridor and North Wooded Area
Screening Level Ecological Risk Assessment

Sample I.D.	Sample Date	Depth (ft bgs)	Polycyclic Aromatic Hydrocarbons (mg/kg)													
			Anthracene*	Benzo(a)anthracene**	Benzo(a)pyrene**	Benzo(b)fluoranthene**	Benzo(g,h,i)perylene**	Benzo(k)fluoranthene**	Chrysene**	Dibenz(a,h)anthracene**	Fluoranthene**	Indeno(1,2,3-cd)pyrene**	Phenanthrene*	Pyrene**	HPAH	LPAH
Soil Benchmark (plants)			**not available**												**NA**	**NA**
Soil Benchmark (earthworms)			**not available**												**18**	**29**
Stewart Creek Corridor															--	--
SCC-3 (0-0.5')	01/15/13	0-0.5	0.00203J	0.00903J	0.0245	0.0333J	0.0263	0.00719J	0.0137J	<0.00469	0.0198J	0.0427J	0.00828J	0.0158J	0.01031	0.1923
SCC-6 (0-0.5')	01/15/13	0-0.5	<0.0017	0.00331J	0.0194J	0.0194J	0.0202J	0.00218J	0.00851J	<0.00482	0.0089J	<0.00465	<0.00657	0.0079J	NA	0.0898
SCC-8 (0-0.5')	01/15/13	0-0.5	0.00502J	0.0169J	0.0323	0.0542	0.0336	0.0161J	0.0394	0.0386	0.0239	0.0495	0.0113J	0.0223	0.0163	0.3268
MW-27A (0-2)	1/9/2014	0-2	0.0076	0.0138	< 0.0424	< 0.0424	< 0.0424	< 0.0424	0.0361	< 0.0424	< 0.0424	< 0.0424	0.0148	< 0.0424	0.0499	0.0224
MW-27C (0-2)	1/8/2014	0-2	0.00824	0.0123	0.0138	0.0202	< 0.0424	< 0.0424	0.0297	< 0.0424	< 0.0424	< 0.0424	0.0133	0.0106	0.0866	0.02154
North Wooded Area																
2013-FFTA-03 (0.25-2')	1/7/2014	0.25-2	0.0048	< 0.0435	< 0.0435	< 0.0435	< 0.0435	< 0.0435	< 0.0435	< 0.0435	0.011	< 0.0435	< 0.0435	0.0063	0.0173	0.0048
2014-FFTA-06 (0.-0.5)	4/1/2014	0-0.5	< 0.0199	< 0.0199	< 0.0199	< 0.0199	< 0.0199	< 0.0199	< 0.0199	< 0.0199	< 0.0199	< 0.0199	0.0071	< 0.0199	NA	0.0071
2014-FFTA-08 (0-0.5)	4/1/2014	0-0.5	< 0.0185	< 0.0185	< 0.0185	< 0.0185	< 0.0185	< 0.0185	< 0.0185	< 0.0185	< 0.0185	< 0.0185	< 0.0185	0.00509	0.00509	NA

Notes:

Soil benchmarks from LPAHs and HPAHs from EPA 2007b.

mg/Kg - milligrams/Kilogram

HPAH - High Molecular Weight PAHs (Sum of individual HPAH compounds denoted with **)

LPAH - Low Molecular Weight PAHs (Sum of individual LPAH compounds detnoted with *)

NA - Not Applicable

"--" - Not Analyzed

ft - feet

bgs - below ground surface

Table 3. Soil Data Summary Statistics
Screening Level Ecological Risk Assessment

Chemicals of Concern	Average (mg/kg)	Minimum Detection (mg/kg)	Maximum Detection (mg/kg)	Frequency of Detection	95% UCL (mg/kg)	Statistic Used
Site-Wide Area Surface Soil (0 to 6 inches)						
Antimony	6.98E+00	3.15E-01	4.98E+01	16 of 26	1.85E+01	97.5% KM (Chebyshev) UCL
Arsenic	1.62E+01	6.74E+00	7.98E+01	31 of 31	2.05E+01	95% Modified-t UCL
Cadmium	4.77E+00	8.29E-02	1.06E+02	114 of 115	9.60E+00	95% KM (Chebyshev) UCL
Lead	6.49E+02	8.59E+00	1.12E+04	116 of 116	1.21E+03	95% Chebyshev UCL
Selenium	2.29E+00	3.38E-01	2.92E+01	16 of 30	7.61E+00	97.5% KM (Chebyshev) UCL
Site-Wide Area Sub-Surface Soil (0.5 to 5 feet)						
Antimony	3.90E+00	8.09E-01	6.99E+00	2 of 6	6.99E+00	Maximum
Arsenic	1.88E+01	2.70E+00	1.15E+02	14 of 14	5.13E+01	95% Chebyshev UCL
Cadmium	1.04E+01	7.56E-02	2.34E+02	32 of 37	7.17E+01	99% KM (Chebyshev) UCL
Lead	1.35E+03	5.26E+00	3.10E+04	75 of 76	4.75E+03	97.5% KM (Chebyshev) UCL
Selenium	2.49E+00	3.24E-01	1.26E+01	6 of 9	1.05E+01	97.5% KM (Chebyshev) UCL
South Wooded Area Surface Soil (0 to 6 inches)						
Antimony	2.27E+00	4.63E-01	6.70E+00	3 of 4	5.79E+00	95% Student's-t UCL
Arsenic	1.42E+01	1.24E+01	1.63E+01	4 of 4	1.63E+01	95% Student's-t UCL
Cadmium	4.32E+00	4.09E-01	1.46E+01	20 of 20	6.32E+00	95% Adjusted Gamma UCL
Lead	6.52E+02	2.14E+01	2.34E+03	20 of 20	1.00E+03	95% Adjusted Gamma UCL
Selenium	5.21E-01	4.86E-01	5.64E-01	3 of 4	5.60E-01	Maximum
South Wooded Area Sub-Surface Soil (0.5 to 5 feet)						
Antimony	NA	NA	NA	0 of 1	NA	
Arsenic	NA	9.87E+00	9.87E+00	1 of 1	9.87E+00	Maximum
Cadmium	NA	5.57E-01	5.57E-01	1 of 2	5.57E-01	Maximum
Lead	4.91E+01	1.27E+01	1.12E+02	6 of 6	8.04E+01	95% Student's-t UCL
Selenium	NA	4.10E-01	4.10E-01	1 of 1	4.10E-01	Maximum
Lake Parcel Surface Soil (0 to 6 inches)						
Antimony	NA	NA	NA	0 of 1	NA	
Arsenic	NA	6.74E+00	6.74E+00	1 of 1	NA	
Cadmium	1.95E+00	1.06E+00	4.43E+00	16 of 17	2.46E+00	95% GROS Adjusted Gamma UCL
Lead	1.79E+02	6.07E+01	3.67E+02	17 of 17	2.11E+02	95% Student's-t UCL
Selenium	NA	NA	NA	0 of 1	NA	
Lake Parcel Sub-Surface Soil (0.5 to 5 feet)						
Cadmium	1.77E-01	7.82E-02	2.75E-01	2 of 5	2.80E-01	Maximum
Lead	1.67E+01	1.39E+01	1.82E+01	5 of 5	1.84E+01	95% Student's-t UCL
Stewart Creek Corridor Surface Soil (0 to 6 inches)						
Antimony	8.43E+00	3.15E-01	3.24E+01	5 of 6	3.24E+01	Maximum
Arsenic	1.66E+01	9.45E+00	3.67E+01	6 of 6	2.49E+01	95% Student's-t UCL
Cadmium	6.58E+00	8.29E-02	1.06E+02	36 of 36	1.11E+01	95% H-UCL
Lead	7.68E+02	8.82E+00	6.83E+01	37 of 37	1.79E+03	95% Chebyshev UCL
Selenium	7.85E-01	4.03E-01	1.35E+00	3 of 5	1.40E+00	95% KM (Percentile Bootstrap) UCL
Stewart Creek Corridor Sub-Surface Soil (0.5 to 5 feet)						
Antimony	2.73E+00	8.09E-01	4.65E+00	2 of 3	4.65E+00	Maximum
Arsenic	3.10E+01	2.70E+00	1.15E+02	5 of 5	1.15E+02	Maximum
Cadmium	1.47E+01	7.56E-02	2.34E+02	22 of 23	1.14E+02	99% KM (Chebyshev) UCL
Lead	2.43E+03	8.56E+00	3.10E+04	40 of 40	8.76E+03	97.5% Chebyshev UCL
Selenium	6.57E+00	5.36E-01	1.26E+01	2 of 4	8.63E+00	95% KM (t) UCL
North Wooded Area Surface Soil (0 to 6 inches)						
Antimony	8.62E+00	7.56E-01	4.98E+01	7 of 15	1.16E+01	95% KM (BCA) UCL
Arsenic	1.69E+01	8.00E+00	7.98E+01	20 of 20	2.34E+01	95% Modified-t UCL
Cadmium	4.53E+00	3.40E-01	6.28E+01	42 of 42	1.13E+01	95% Chebyshev UCL
Lead	7.48E+02	8.59E+00	1.12E+04	42 of 42	1.40E+03	95% H-UCL
Selenium	3.42E+00	3.38E-01	2.92E+01	10 of 20	4.89E+00	95% KM (BCA) UCL
North Wooded Area Sub-Surface Soil (0.5 to 5 feet)						
Antimony	NA	NA	NA	0 of 2	NA	
Arsenic	1.23E+01	7.11E+00	1.44E+01	8 of 8	1.40E+01	95% Student's-t UCL
Cadmium	1.33E+00	3.54E-01	4.32E+00	7 of 7	3.66E+00	95% Adjusted Gamma UCL
Lead	1.56E+02	5.26E+00	9.46E+02	24 of 25	3.56E+02	95% KM (Chebyshev) UCL
Selenium	4.57E-01	3.24E-01	5.46E-01	3 of 4	6.17E-01	95% KM (t) UCL

Notes:
NA - Not applicable
UCL - upper confidence limit

Table 4. Threatened and Endangered Species - Collin and Denton Counties
Screening Level Ecological Risk Assessment

Common Name[1]	Scientific Name	Status[2] Federal	Status[2] Texas	Description	Signficant Presence Terrestrial	Signficant Presence Aquatic	Comment
Birds							
American Peregrine Falcon	*Falco peregrinus anatum*	DL	T	Year-round resident and local breeder in west Texas, nests in tall cliff eyries; also, migrant across state from more northern breeding areas in US and Canada, winters along coast and farther south; occupies wide range of habitats during migration, including urban, concentrations along coast and barrier islands; low-altitude migrant, stopovers at leading landscape edges such as lake shores, coastlines, and barrier islands.	N	N	Unlikely to feed on local prey in urban area; possible rare fly-overs.
Arctic Peregrine Falcon	*Falco peregrinus tundrius*	DL		migrant throughout state from subspecies' far northern breeding range, winters along coast and farther south; occupies wide range of habitats during migration, including urban, concentrations along coast and barrier islands; low-altitude migrant, stopovers at leading landscape edges such as lake shores, coastlines, and barrier islands.	N	N	May occur as infrequent transient.
Bald Eagle	*Haliaeetus leucocephalus*	DL	T	Found primarily near rivers and large lakes; nests in tall trees or on cliffs near water; communally roosts, especially in winter; hunts live prey, scavenges, and pirates food from other birds.	N	N	May occur as infrequent transient.
Interior Least Tern	*Sterna antillarum athalassos*	LE	E	Subspecies is listed only when inland (more than 50 miles from a coastline); nests along sand and gravel bars within braided streams, rivers; also know to nest on man-made structures (inland beaches, wastewater treatment plants, gravel mines, etc); eats small fish and crustaceans, when breeding forages within a few hundred feet of colony.	N	N	May occur as infrequent transient.
Peregrine Falcon	*Falco peregrinus tundrius*	DL	T	Migrates across the state from more northern breeding areas in US and Canada to winter along coast and farther south; no longer listed in Texas, but because the subspecies are not easily distinguishable at a distance, reference is generally made only to the species level.	N	N	Unlikely to feed on local prey; possible rare fly-overs.
Piping Plover	*Charadrius melodus*	LT	T	Wintering migrant along the Texas Gulf Coast; beaches and bayside mud or salt flats.	N	N	May occur as infrequent transient.
Sprague's Pipit	*Anthus spragueii*	C		Only in Texas during migration and winter, mid September to early April; short to medium distance, diurnal migrant; strongly tied to native upland prairie, can be locally common in coastal grasslands, uncommon to rare further west; sensitive to patch size and avoids edges.	N	N	Unlikely to feed on local prey in urban area; possible rare fly-overs.
White-faced Ibis	*Plegadis chihi*		T	Prefers freshwater marshes, sloughs, and irrigated rice fields, but will attend brackish and saltwater habitats; nests in marshes, in low trees, on the ground in bulrushes or reeds, or on floating mats. The white-faced ibis seems to prefer freshwater marshes, where it can find insects, newts, leeches, earthworms, snails and especially crayfish, frogs and fish. They roost on low platforms of dead reed stems or on mud banks. In Texas, they breed and winter along the Gulf Coast and may occur as migrants in the Panhandle and West Texas (TPWD, 2013).	N	N	The white-faced ibis prefers freshwater marshes. They roost on low platforms of dead reed stems or on mud banks. In Texas, they breed and winter along the Gulf Coast and may occur as migrants in the Panhandle and West Texas (TPWD, 2013). Prefered habitat is not found in Stewart Creek and its presence is unlikely. See Appendix D.
Whooping Crane	*Grus americana*	LE	E	Potential migrant via plains throughout most of state to coast; winters in coastal marshes of Aransas, Calhoun, and Refugio counties.	N	N	Unlikely to feed on local prey; possible rare fly-overs.
Wood Stork	*Mycteria americana*		T	Forages in prairie ponds, flooded pastures or fields, ditches, and other shallow standing water, including salt-water; usually roosts communally in tall snags, sometimes in association with other wading birds (i.e. active heronries); breeds in Mexico and birds move into Gulf States in search of mud flats and other wetlands, even those associated with forested areas; formerly nested in Texas, but no breeding records since 1960.	N	N	Unlikely to feed on local prey; possible rare fly-overs.
Mammals							
Red wolf	*Canis rufus*	LE	E	Extirpated; formerly known throughout eastern half of Texas in brushy and forested areas, as well as coastal prairies.	N	N	Considered extirpated from region.
Mollusks							
Louisiana Pigtoe	*Pleurobe mariddellii*		T	Found in streams and moderate-size rivers, usually flowing water on substrates of mud, sand, and gravel; not generally known from impoundments; Sabine, Neches, and Trinity (historic) River basins. Ranged from eastern Texas drainages into Louisiana, but has been exceptionally rare in recent decades. Since the mid-1990s, small numbers of living specimens have been found in the Neches River and some of its tributaries and the Angelina River (TPWD, 2009).	N	N	No evidence that these species are present in Stewart Creek follwing 2014 habitat assessment. See Appendix D.
Texas heelsplitter	*Potamilus amphichaenus*		T	Found in quiet waters in mud or sand and also in reservoirs. Sabine, Neches, and Trinity River basins	N	N	
Reptiles							
Alligator snapping turtle	*Macrochelys temminckii*		T	Perennial water bodies; deep water of rivers, canals, lakes, and oxbows; also swamps, bayous, and ponds near deep running water; sometimes enters brackish coastal waters; usually in water with mud bottom and abundant aquatic vegetation; may migrate several miles along rivers.	N	N	Unlikely to be present in Stewart Creek due to high flow conditions and small number of shallow pooling areas found in Stewart Creek. Deep muddy bottom pools with adequate vegetationn are not present, broad sandy flood plain preferred by females is uncommon along Stewart Creek. See Appendix D.
Timber/Canebrake rattlesnake	*Crotalus horridus*		T	Swamps, floodplains, upland pine and deciduous woodlands, riparian zones, abandoned farmland; limestone bluffs, sandy soil or black clay; prefers dense ground cover, i.e. grapevines or palmetto.	N	N	Not expected in study area due to limited and fragmented habitat. Surrounding areas are dominated by urban development and active agricultural fields. Continuous undisturbed scrub shrub and forested habitat is required. See Appendix D.
Texas horned lizard	*Phrynosoma cornutum*		T	Open, arid and semi-arid regions with sparse vegetation, including grass, cactus, scattered brush or scrubby trees; soil may vary in texture from sandy to rocky; burrows into soil, enters rodent burrows, or hides under rock when inactive.	N	N	Diet is primarily harvester ants. No harvester ant nests were noted on site. Unlikely to be present.

Notes:

1 - Taxa provided in the Texas Parks and Wildlife Departments Rare, Threatened, and Endangered Species of Texas List for Denton and Collin Counties.

http://www.tpwd.state.tx.us/gis/ris/es/ Only taxa listed as threatened or endangered on either the federal or state list are included.

2 - T = Threatened; E = Endangered; C = Candidate for Listing; LT = Listed Threatened; LE = Listed Endangered; DL = De-Listed.

TPWD 2009, 15 Texas Freshwater Mussels Placed on State Threatened List. November 5, 2009. http://www.texashuntfish.com/app/view/Post/27233/15-Texas-Freshwater-Mussels-Placed-on-State-Threatened-List

TPWD 2013, On Line Species Information on White Faced Ibis: http://www.tpwd.state.tx.us/huntwild/wild/species/ibis/

Table 5. NOAEL-Based HQ Summary: Initial Conservative Assessment
Screening Level Ecological Risk Assessment

COC	Armadillo NOAEL-Based HQ	American Robin NOAEL-Based HQ	Red-Tailed Hawk NOAEL-Based HQ	Least Shrew NOAEL-Based HQ	Fox NOAEL-Based HQ
Site-Wide Area					
Antimony	NA	NA	NA	NA	2.30E-01
Arsenic	NA	NA	8.60E-05	NA	5.30E-03
Cadmium	NA	NA	6.10E-05	NA	9.10E-03
Lead	NA	NA	7.00E-03	NA	1.90E-01
Selenium	NA	NA	2.50E-04	NA	3.90E-02
South Wooded Area					
Antimony	**2.00E+00**	NA	NA	2.47E-02	5.79E-01
Arsenic	6.30E-02	8.80E-04	4.10E-04	9.00E-04	1.90E-02
Cadmium	4.00E-01	3.22E-03	1.80E-03	6.80E-03	1.91E-01
Lead	5.00E-01	3.94E-02	1.36E-02	2.01E-02	3.05E-01
Selenium	6.74E-02	3.83E-04	1.99E-04	9.26E-04	2.31E-02
Lake Parcel					
Antimony	NA	NA	NA	NA	NA
Arsenic	NA	NA	NA	NA	NA
Cadmium	1.6E-01	1.25E-03	6.99E-04	2.65E-03	7.45E-02
Lead	1.1E-01	8.32E-03	2.87E-03	4.24E-03	6.43E-02
Selenium	NA	NA	NA	NA	NA
Stewart Creek Corridor					
Antimony	**7.03E+00**	NA	NA	1.38E-01	**3.24E+00**
Arsenic	4.22E-01	1.30E-03	6.20E-04	1.40E-03	2.90E-02
Cadmium	**2.02E+00**	5.70E-03	3.20E-03	1.20E-02	3.40E-01
Lead	**1.73E+01**	7.10E-02	2.40E-02	3.64E-02	5.50E-01
Selenium	6.28E-01	9.60E-04	5.00E-04	2.32E-03	5.80E-02
North Wooded Area					
Antimony	**3.99E+00**	NA	NA	4.93E-02	**1.16E+00**
Arsenic	9.00E-02	1.30E-03	5.90E-04	1.30E-03	2.80E-02
Cadmium	7.50E-01	5.76E-03	3.20E-03	1.21E-02	3.41E-01
Lead	**1.20E+00**	5.54E-02	1.91E-02	2.82E-02	4.28E-01
Selenium	4.00E-01	3.34E-03	1.74E-03	8.08E-03	2.02E-01

Notes:

NA - not available

COC - Chemical of Concern

NOAEL - No Observed Adverse Effect Level

HQ - Hazard Quotient

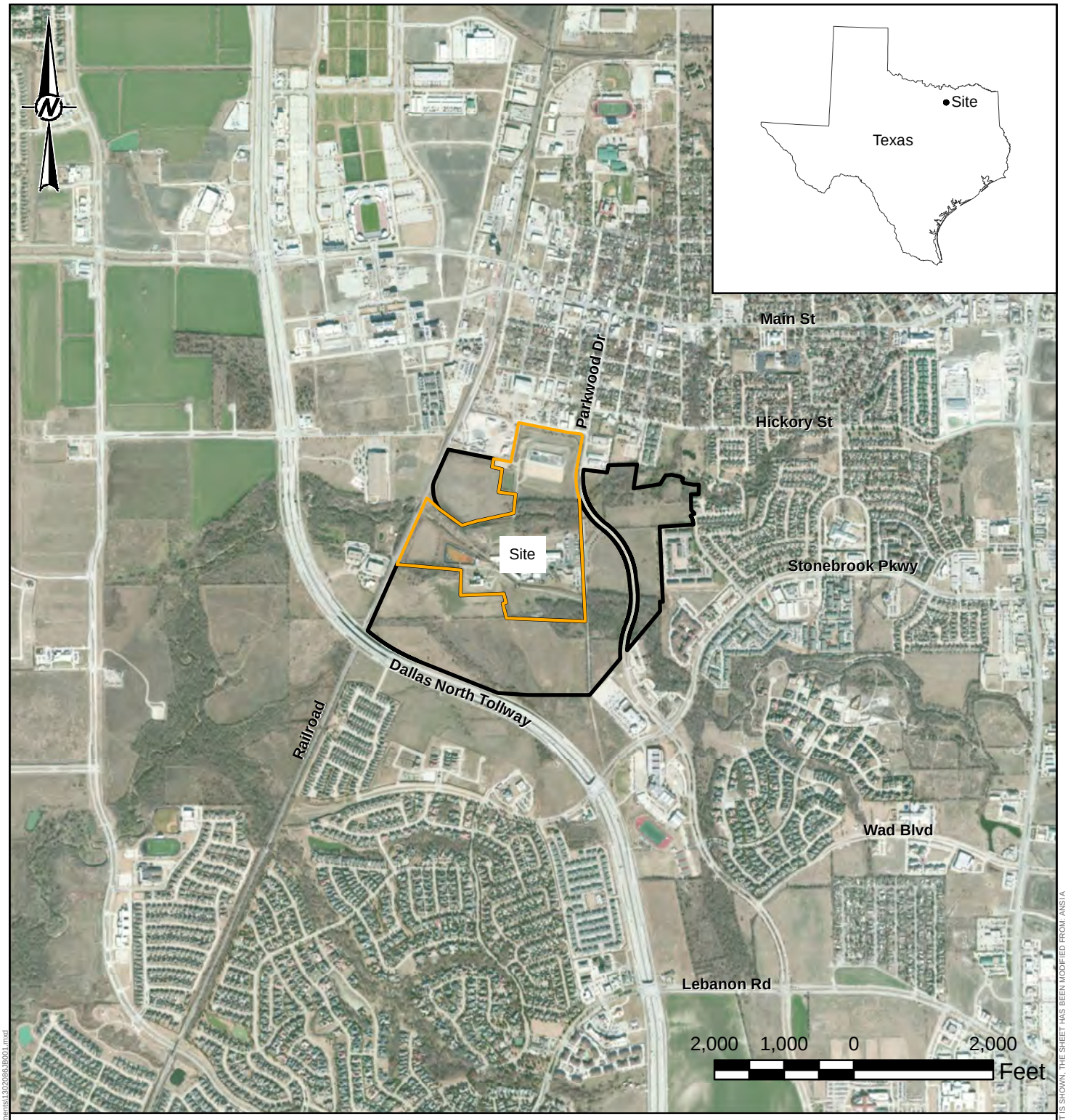
According to Section 3.10 of TCEQ 2014; if the HQ is ≤ 1 for a given COC, then the COC is dropped from further consideration, therefore only those COCs and receptors with HQ > 1 are carried forward to the refined or less-conservative assessment (see Table 6).

Table 6. NOAEL and LOAEL-Based HQ Summary: Refined Less-Conservative Assessment
Screening Level Ecological Risk Assessment

COC	Armadillo NOAEL-Based HQ	Armadillo LOAEL-Based HQ	Fox NOAEL-Based HQ	Fox LOAEL-Based HQ
South Wooded Area				
Antimony	**2.00E+00**	2.00E-01	NA	NA
Stewart Creek Corridor				
Antimony	**6.40E+00**	6.40E-01	**3.20E+00**	3.20E-01
Cadmium	**1.80E+00**	1.80E-01	NA	NA
Lead	**1.60E+01**	**8.30E+00**	NA	NA
North Wooded Area				
Antimony	**3.99E+00**	3.99E-01	**1.16E+00**	1.20E-01
Lead	**1.20E+00**	6.10E-01	NA	NA

Notes:
COC - Chemical of Concern
NOAEL - No Observed Adverse Effect Level
LOAEL - Lowest Observed Adverse Effect Level
HQ - Hazard Quotient
NA- Not Appplicable, indicating that the HQ < 1 in the initial conservative assessment and further evaluation not necessary in the refined less-conservative assessment.
"--" indcates that the pathway in not applicable.

FIGURES



LEGEND

- Exide Investigation Area Boundary
- Exide Undeveloped Buffer Property

REFERENCE

1. AERIAL IMAGERY - SOURCE: ESRI, DIGITALGLOBE, GEOEYE, I-CUBED, USDA, USGS, AEX, GETMAPPING, AEROGRID, IGN, IGP, AND THE GIS USER COMMUNITY

CLIENT
EXIDE TECHNOLOGIES

PROJECT
SCREENING LEVEL ECOLOGICAL RISK ASSESSMENT

TITLE
SITE LOCATION MAP

DRAFT

CONSULTANT
Golder Associates

YYYY-MM-DD	####
PREPARED	####
DESIGN	####
REVIEW	####
APPROVED	####

PROJECT No.	CONTROL	Rev.	FIGURE
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IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET HAS BEEN MODIFIED FROM: ANSI A

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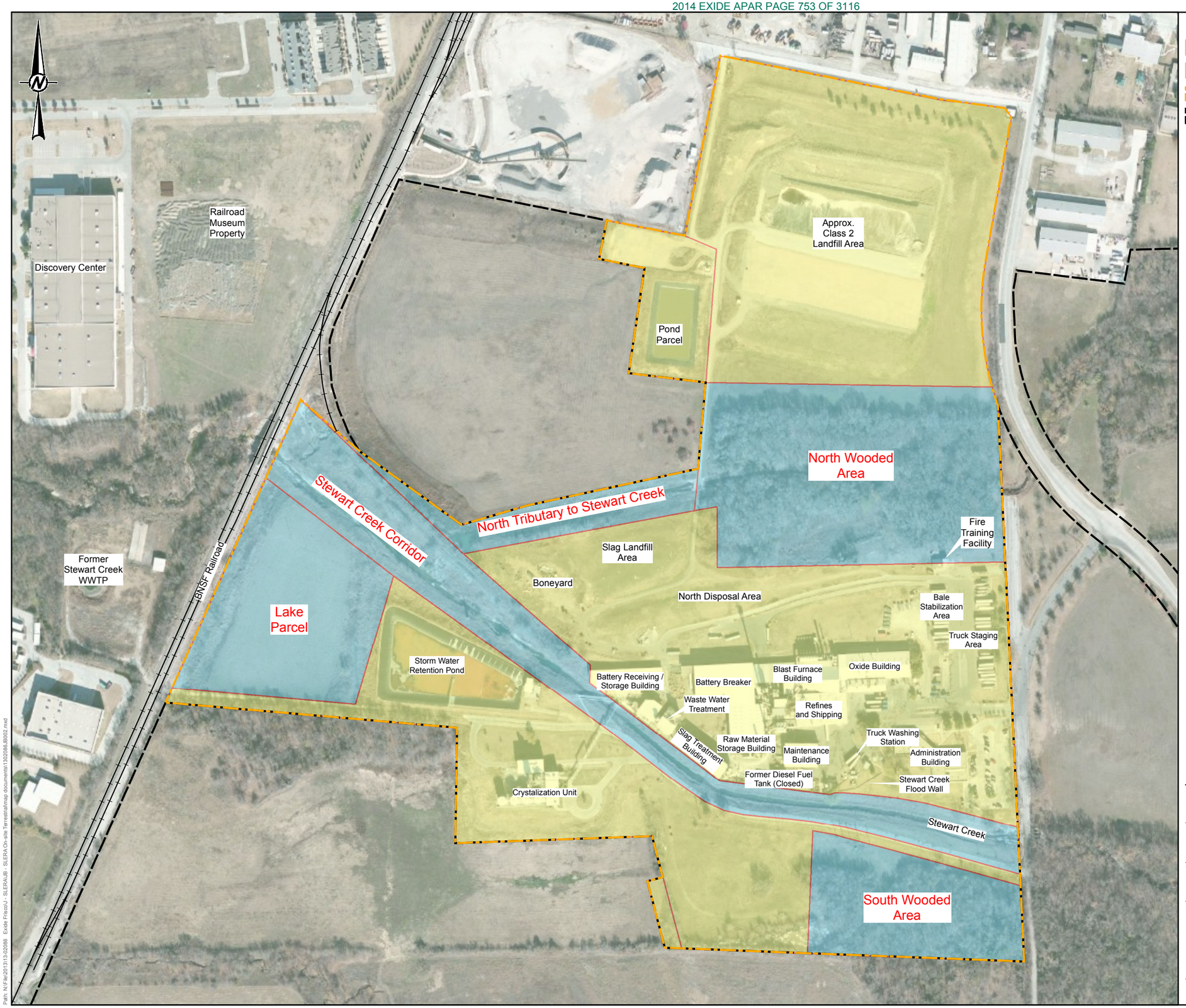

LEGEND

- Operational / Waste Management Area
- Ecological Habitat Area Evaluated in SLERA
- Exide Site
- Undeveloped Buffer Property

NOTES

1. WWTP - WASTE WATER TREATMENT PLANT

REFERENCE

1. SITE FEATURES - PBW AND GOLDER, 2014
2. AERIAL IMAGERY - SOURCE: ESRI, DIGITALGLOBE, GEOEYE, I-CUBED, USDA, USGS, AEX, GETMAPPING, AEROGRID, IGN, IGP, AND THE GIS USER COMMUNITY

DRAFT

300 150 0 300 Feet

CLIENT
EXIDE TECHNOLOGIES

PROJECT
SCREENING LEVEL ECOLOGICAL RISK ASSESSMENT

TITLE
ECOLOGICAL EXPOSURE AREAS

CONSULTANT
Golder Associates

YYYY-MM-DD	2014-14-15
PREPARED	JWT
DESIGN	####
REVIEW	####
APPROVED	####

PROJECT No.	CONTROL	Rev.	FIGURE
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IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET HAS BEEN MODIFIED FROM: ANSI B

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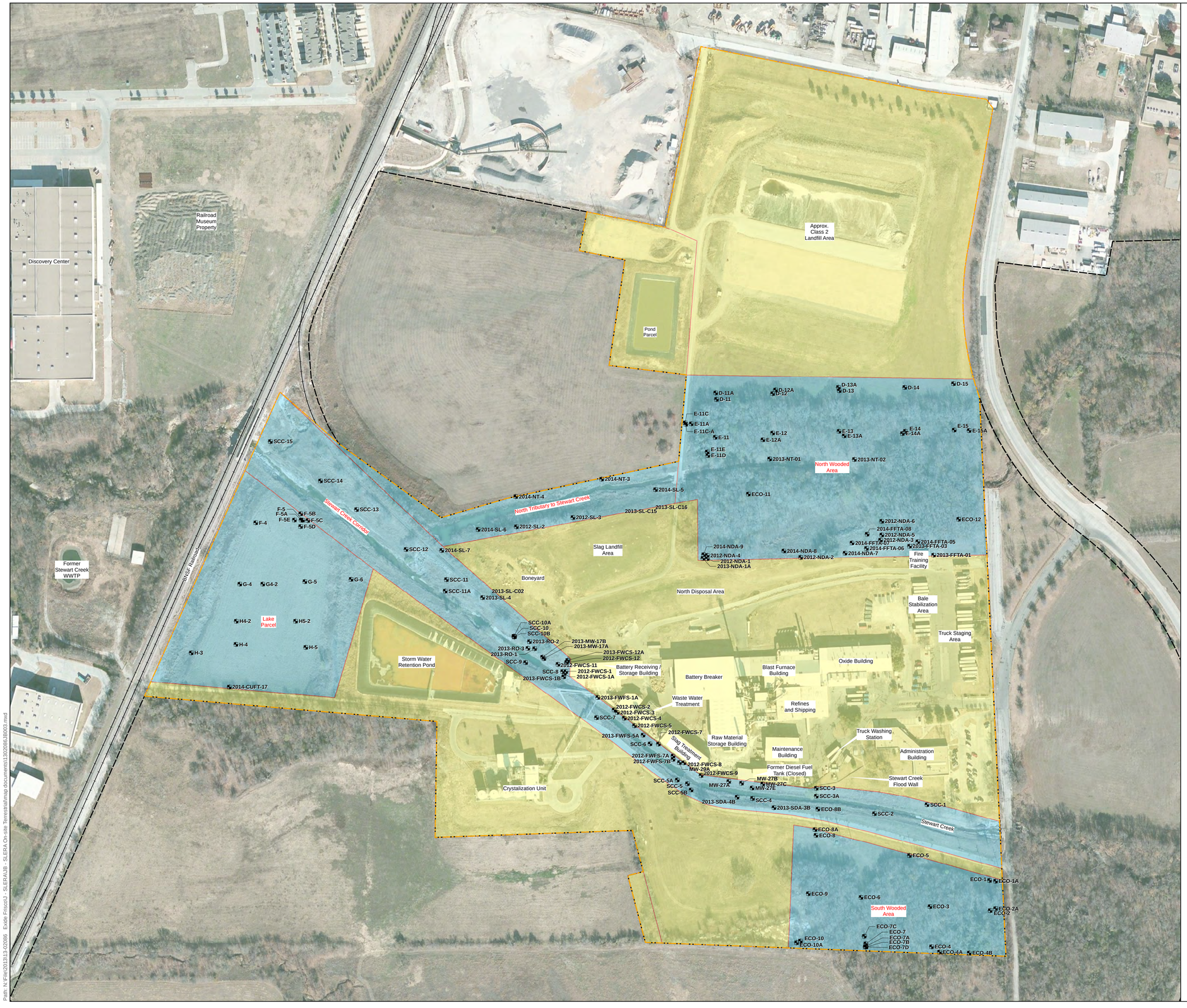

LEGEND

- Soil Boring / Soil Sample Location (2012 - 2014)
- Operational / Waste Management Area
- Ecological Habitat Area Evaluated in SLERA
- Exide Site
- Undeveloped Buffer Property

NOTES

1. WWTP - WASTE WATER TREATMENT PLANT

REFERENCE

1. LOCATIONS - PBW AND GOLDER, 2014
2. IMAGERY - SOURCE: ESRI, DIGITALGLOBE, GEOEYE, I-CUBED, USDA, USGS, AEX, GETMAPPING, AEROGRID, IGN, IGP, AND THE GIS USER COMMUNITY

N

DRAFT

150 75 0 150 Feet

CLIENT
EXIDE TECHNOLOGIES
FRISCO, TX

PROJECT
SCREENING LEVEL ECOLOGICAL RISK ASSESSMENT

TITLE
SOIL SAMPLE LOCATIONS IN ECOLOGICAL EXPOSURE AREAS

CONSULTANT

Golder Associates

YYYY-MM-DD	2014-14-15
PREPARED	JWT
DESIGN	JWT
REVIEW	AMF
APPROVED	####

PROJECT No.	CONTROL	Rev.	FIGURE
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IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET HAS BEEN MODIFIED FROM: ANSI D
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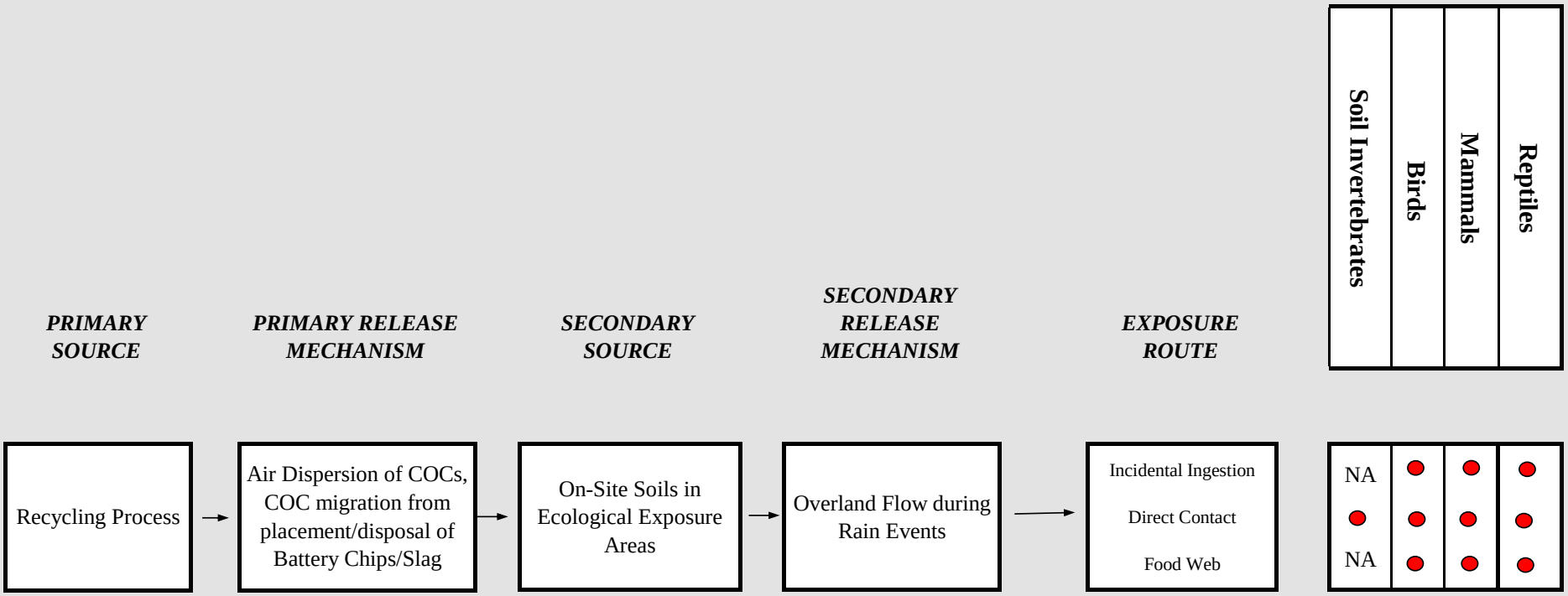

Legend:
● Potentially complete pathway
NA Not an applicable pathway for receptor.

Figure 4. Ecological Conceptual Site Model Former Operating Plant

APPENDIX A
TIER 1 EXCLUSION CRITERIA CHECKLIST

Figure: 30 TAC §350.77(b)

TIER 1: Exclusion Criteria Checklist

This exclusion criteria checklist is intended to aid the person and the TNRCC in determining whether or not further ecological evaluation is necessary at an affected property where a response action is being pursued under the Texas Risk Reduction Program (TRRP). Exclusion criteria refer to those conditions at an affected property which preclude the need *for* a formal ecological risk assessment (ERA) because there are incomplete or insignificant ecological exposure pathways due to the nature of the affected property setting and/or the condition of the affected property media. This checklist (and/or a Tier 2 or 3 ERA or the equivalent) must be completed by the person *for* all affected property subject to the TRRP. The person should be familiar with the affected property but need not be a professional scientist in order to respond, although some questions will likely require contacting a wildlife management agency (Le., Texas Parks and Wildlife Department or *U.S.* Fish and Wildlife Service). The checklist is designed *for* general applicability to all affected property; however, there may be unusual circumstances which require professional judgment in order to determine the need *for* further ecological evaluation (e.g., cave-dwelling receptors). In these cases, the person is strongly encouraged to contact TNRCC before proceeding.

Besides some preliminary information, the checklist consists of three major parts, each of which must be completed unless otherwise instructed. PART I requests affected property identification and background information. PART II contains the actual exclusion criteria and supportive information. PART III is a qualitative summary statement and a certification of the information provided by the person. Answers should reflect existing conditions and should not consider future remedial actions at the affected property. Completion of the checklist should lead to a logical conclusion as to whether further evaluation is warranted. Definitions of terms used in the checklist have been provided and users are strongly encouraged to familiarize themselves with these definitions before beginning the checklist.

Name of Facility:

Exide Frisco Former Operating Plant

Affected Property Location:

7471 South Fifth Street. Frisco, TX. Collin County

PART I. Affected Property Identification and Background Information

1) Provide a description of the specific area of the response action and the nature of the release. Include estimated acreage of the affected property and the facility property, and a description of the type of facility and/or operation associated with the affected property. Also describe the location of the affected property with respect to the facility property boundaries and public roadways.

The location of the Former Operating Plant was a lead oxide manufacturing plant and a lead metal recycling facility (secondary lead smelter) that had been in operation in Frisco, Texas, since approximately 1964, with recycling commencing in 1969 until operations ended in November 2012. The facility recycled spent lead-acid batteries and other lead-bearing scrap materials. The scrap lead was smelted and refined to produce lead, lead alloys and lead oxide.

Figure: 30 TAC §350.77(b) continued

Attach available USGS topographic maps and/or aerial or other affected property photographs to this form to depict the affected property and surrounding area. Indicate attachments:

☐ Topo map ☐ Aerial photo X Other (See Appendix B)

2) Identify environmental media known or suspected to contain chemicals of concern (COCs) at the present time.

Check all that apply:

Known/Suspected COC location based on sampling data?

X Soil < 5 ft below ground	**X Yes**	☐ No
☐Soil > 5 ft below ground surface	☐ Yes	**X** No
☐ Groundwater	☐ Yes	**X** No
X Surface Water/Sediments	**X Yes**	☐ No

Explain (previously submitted information may be referenced):

Based on facility history and current and future land use, surface deposition of lead and cadmium was the primary route of COC distribution into the environment in the areas of ecological concern. Surface soil contamination and potentially runoff of lead and cadmium into Stewart Creek and the North Tributary may have occurred in the past. Slag material was historically used in Stewart Creek for erosion protection. A TCEQ-approved removal action was performed in 2000 to address these materials. The ecological exposure to sediments in Stewart Creek is evaluated in a separate SLERA.

3) Provide the information below for the nearest surface water body which has become or has the potential to become impacted from migrating COCs via surface water runoff, air deposition, groundwater seepage, etc. Exclude wastewater treatment facilities and stormwater conveyances/impoundments authorized by permit. Also exclude conveyances, decorative ponds, and those portions of process facilities which are:

a. Not in contact with surface waters in the State or other surface waters which are ultimately in contact with surface waters in the State; and

b. Not consistently or routinely utilized as valuable habitat for natural communities including birds, mammals, reptiles, etc.

The water body is **Stewart Creek** and is best described as a:

X freshwater stream ____X___perennial (has water all year)

_____intermittent (dries up completely for at least 1 week a year)

_____intermittent with perennial pools

☐ freshwater swamp/marsh/wetland

☐ saltwater or brackish marsh/swamp/wetland

☐ reservoir, lake, or pond; approximate surface acres:

☐ drainage ditch

☐ tidal stream ☐ bay ☐ estuary

☐ other; specify

Figure: 30 TAC §350.77(b) continued

Is the water body listed as a State classified segment in Appendix C of the current Texas Surface Water Quality Standards; §§307.1 - 307.1O?

☐ Yes Segment # Use Classification:

X No

If the water body is not a State classified segment, identify the first downstream classified segment.

Name: **Lake Lewisville**

Segment #: **0823**

Use Classification: **Aquatic Life, Contact Recreation, Fish Consumption**

As necessary, provide further description of surface waters in the vicinity of the affected property:

Stewart Creek crosses Collin and Denton Counties. Stewart Creek is a perennial stream and the North Tributary is an intermittent stream in the Trinity River Basin.

PART II. Exclusion Criteria and Supportive Information

Subpart A. Surface Water/Sediment Exposure

1) Regarding the affected property where a response action is being pursued under the TRRP, have COCs migrated and resulted in a release or imminent threat of release to either surface waters or to their associated sediments via surface water runoff, air deposition, groundwater seepage, etc.? Exclude wastewater treatment facilities and stormwater conveyances/impoundments authorized by permit. Also exclude conveyances, decorative ponds, and those portions of process facilities which are:

    a. Not in contact with surface waters in the State or other surface waters which are ultimately in contact with surface waters in the State; and

    b. Not consistently or routinely utilized as valuable habitat for natural communities including birds, mammals, reptiles, etc.

    X Yes ☐ No

Explain: **Lead and cadmium present in Stewart Creek sediments is from the historical placement of battery chips or slag into the creek for erosion control and due to direct run-off of these materials into the creek. A TCEQ-approved removal action was performed in 2000 to address these materials. The ecological exposure to sediments in Stewart Creek is evaluated in a separate SLERA.**

If the answer is Yes to Subpart A above, the affected property does not meet the exclusion criteria. However, complete the remainder of Part II to determine if there is a complete and/or significant soil exposure pathway, then complete PART III - Qualitative Summary and Certification. If the answer is No, go to Subpart B.

Subpart B. Affected Property Setting

In answering "Yes" to the following question, it is understood that the affected property is not attractive to wildlife or livestock, including threatened or endangered species (i.e., the affected property does not serve as valuable habitat, foraging area, or refuge for ecological communities). (May require consultation with wildlife management agencies.)

1) Is the affected property wholly contained within contiguous land characterized by: pavement, buildings,

Figure: 30 TAC §350.77(b) continued

landscaped area, functioning cap, roadways, equipment storage area, manufacturing or process area, other surface

cover or structure, or otherwise disturbed ground?

☐ Yes **X** No

Explain: **Agreements put in place between Exide and the City of Frisco pursuant to which the facility ceased operations at the end of November 2012 specified that a significant portion of the Exide-owned undeveloped buffer property surrounding the former operating plant would become commercial development. Exide will retain ownership of the former operating plant (the Site), except that the City has an option to acquire the Lake Parcel and Pond Parcel at some later time. Exide will remove its current structures, except for the administration building and the fire training facility. Pending evaluation in the Response Action Plan (RAP) for the Site, Exide will manage and maintain the caps on the disposal areas/landfills within the Site. The SLERA incorporates the future land use for this area when defining the ecological exposure areas. Some areas within the Site (e.g., former process areas and landfills) are excluded from the SLERA because of a lack of ecological habitat related to the presence of building slabs, asphalt, and other coverings/caps that are currently managed and maintained and will continue to be managed and maintained in the future.**

If the answer to Subpart B above is Yes, the affected property meets the exclusion criteria, assuming the answer to Subpart A was No. Skip Subparts C and D and complete PART III - Qualitative Summary and Certification. If the answer to Subpart B above is No, go to Subpart C.

Subpart C. Soil Exposure

1) Are COCs which are in the soil of the affected property solely below the first 5 feet beneath ground surface or does the affected property have a physical barrier present to prevent exposure of receptors to COCs in surface soil?

☐ Yes X No

Explain:

Areas of terrestrial uplands which may remain undeveloped are evaluated in the SLERA.

If the answer to Subpart C above is Yes, the affected property meets the exclusion criteria, assuming the answer to Subpart A was No. Skip Subpart D and complete PART III - Qualitative Summary and Certification.If the answer to Subpart C above is No, proceed to Subpart D.

Subpart D. *De Minimus*Land Area

In answering "Yes" to the question below, it is understood that all of the following conditions apply:

- The affected property is not known to serve as habitat, foraging area, or refuge to threatened/endangered or otherwise protected species. (Will likely require consultation with wildlife management agencies.)
- Similar but unimpacted habitat exists within a half-mile radius.
- The affected property is not known to be located within one-quarter mile of sensitive environmental areas (e.g., rookeries, wildlife management areas, preserves). (Will likely require consultation with wildlife management agencies.)
- There is no reason to suspect that the COCs associated with the affected property will migrate such that the affected property will become larger than one acre.

1) Using human health protective concentration levels as a basis to determine the extent of the COCs, does the affected property consist of one acre or less <u>and</u> does it meet all of the conditions above?

☐ Yes X No

Explain how conditions are met/not met: **The area of interest is greater than one acre and detections of lead and cadmium in soil exceed the benchmarks. Ecological exposure areas are evaluated in this SLERA and an aquatic evaluation is provided under separate cover.**

Figure: 30 TAC §350.77(b) continued

If the answer to Subpart D above is Yes, then no further ecological evaluation is needed at this affected property, assuming the answer to Subpart A was No. Complete PART III - Qualitative Summary and Certification. If the answer to Subpart D above is No, proceed to Tier 2 or 3 or comparable ERA.

PART III. Qualitative Summary and Certification (Complete in all cases.)

Attach a brief statement (not to exceed I page) summarizing the information you have provided in this form. This summary should include sufficient information to verify that the affected property meets or does not meet the exclusion criteria. The person should make the initial decision regarding the need for further ecological evaluation (ie., Tier 2 or 3) based upon the results of this checklist. After review, TNRCC will make a final determination on the need for further assessment. Note that the person has the continuing obligation to reenter the ERA process if changing circumstances result in the affected property not meeting the Tier 1 exclusion criteria.

Completed by:

Margaret Roy

Margaret Roy
Senior Environmental Scientist
May 14, 2014

I believe that the information submitted is true, accurate, and complete, to the best of my knowledge.

Matthew A. Love

Matthew A. Love
Director - Global Environmental Remediation
Exide Technologies
May 14, 2014

Supporting Documentation for Exclusion Criteria Checklist

The Exide Technologies (Exide) Former Operating Plant was a lead oxide manufacturing plant and a lead metal recycling facility (secondary lead smelter) that had been in operation in Frisco, Texas, since approximately 1964 with recycling operations commencing in 1969 until operations ended in November 2012. The facility recycled spent lead-acid batteries and other lead-bearing scrap materials. The scrap lead was smelted and refined to produce lead, lead alloys and lead oxide.

Agreements put in place between Exide and the City of Frisco pursuant to which the facility cease operations by the end of November 2012. There are currently no planned future operations at the Site other than maintaining the current buildings and systems until they are no longer needed (the Administrative Building, the on-site Wastewater Treatment Facility, Storm Water Pond, Solar Evaporation Pond, and the Crystallization Unit) and any activities included in the final remediation and maintenance design to be developed in the RAP for the Site. These buildings and systems will be decommissioned and removed when they are no longer needed. Future use of the Site will be restricted to commercial-industrial use only.

Areas that may provide some ecological resources in the future include the Lake Parcel, North Wooded Area, South Wooded Area, the riparian transitional area of Stewart Creek, Stewart Creek and the North Tributary. The Conceptual Site Model indicated that overland flow/surface water runoff could have been an open exposure pathway from the Site soils to Stewart Creek and the North Tributary.

The Tier 1 Exclusion Criteria Checklist in the APAR documents that exposure pathways to soils and the terrestrial system are complete in selected areas. A Screening Level Ecological Risk Assessment (SLERA) is required for the selected terrestrial areas and Stewart Creek (including the North Tributary). A SLERA will evaluate potential ecological risks within the Site, and incorporates the future land use in defining the ecological exposure areas for the Site. Some areas within the former operating plant (e.g., former process areas and landfills) are excluded from the SLERA due to a lack of habitat. A SLERA specific to Stewart Creek and the North Tributary is presented in the APAR as a separate document from this terrestrial SLERA.

APPENDIX B

PHOTOGRAPHIC LOG

Picture 1. On-site on bridge on Eagan Dr. looking downstream at Stewart Creek as it enters the Site (Stewart Creek Corridor).

Picture 2. Standing on Eagan Dr. just south of Crystallizer Rd. looking at dense shrubs and trees south east of the South Disposal Area.

Picture 3. Standing on Crystallizer Rd. looking south toward South Wooded Area.

Picture 4. Standing near the western side of the hayfield in the Lake Parcel looking toward the storm water retention pond.

Picture 5. Evidence of larger burrowing mammal in the hayfield in the Lake Parcel. This hole was approximately 6 to 8 inches across but did not extend very far into the soil.

Picture 6. Looking upstream of the relocated North Tributary of Stewart Creek on-site on the road leading from the FRC plant to the landfill to the north of the facility.

Picture 7. Looking downstream (toward the confluence with Stewart Creek) of the relocated North Tributary of Stewart Creek on-site on the road leading from the Site to the landfill to the north of the facility.

APPENDIX C

STATISTICAL OUTPUT

APPENDIX C-1

SITE-WIDE SURFACE SOIL

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	5/15/2014 13:00
From File	sitewide surface soil.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Antimony

General Statistics

Total Number of Observations	26	Number of Distinct Observations	25
Number of Detects	16	Number of Non-Detects	10
Number of Distinct Detects	15	Number of Distinct Non-Detects	10
Minimum Detect	0.315	Minimum Non-Detect	2.7
Maximum Detect	49.8	Maximum Non-Detect	3.18
Variance Detects	190.2	Percent Non-Detects	38.46%
Mean Detects	6.975	SD Detects	13.79
Median Detects	1.93	CV Detects	1.977
Skewness Detects	2.698	Kurtosis Detects	6.74
Mean of Logged Detects	0.827	SD of Logged Detects	1.39

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.51	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.887	Detected Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.383	Lilliefors GOF Test
5% Lilliefors Critical Value	0.222	Detected Data Not Normal at 5% Significance Level

Detected Data Not Normal at 5% Significance Level

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs

Mean	4.821	Standard Error of Mean	2.197
SD	10.83	95% KM (BCA) UCL	8.908
95% KM (t) UCL	8.574	95% KM (Percentile Bootstrap) UCL	8.534
95% KM (z) UCL	8.435	95% KM Bootstrap t UCL	28.82
90% KM Chebyshev UCL	11.41	95% KM Chebyshev UCL	14.4
97.5% KM Chebyshev UCL	18.54	99% KM Chebyshev UCL	26.68

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	1.631	Anderson-Darling GOF Test
5% A-D Critical Value	0.791	Detected Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.288	Kolmogrov-Smirnoff GOF
5% K-S Critical Value	0.226	Detected Data Not Gamma Distributed at 5% Significance Level

Detected Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics on Detected Data Only

k hat (MLE)	0.56	k star (bias corrected MLE)	0.497
Theta hat (MLE)	12.46	Theta star (bias corrected MLE)	14.05
nu hat (MLE)	17.91	nu star (bias corrected)	15.89
MLE Mean (bias corrected)	6.975	MLE Sd (bias corrected)	9.898

Gamma Kaplan-Meier (KM) Statistics

k hat (KM)	0.198	nu hat (KM)	10.3
Approximate Chi Square Value (10.30, α)	4.131	Adjusted Chi Square Value (10.30, β)	3.875
95% Gamma Approximate KM-UCL (use when n>=50)	12.02	95% Gamma Adjusted KM-UCL (use when n<50)	12.82

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs

GROS may not be used when kstar of detected data is small such as < 0.1

For such situations, GROS method tends to yield inflated values of UCLs and BTVs

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.01	Mean	4.296
Maximum	49.8	Median	0.61
SD	11.23	CV	2.613
k hat (MLE)	0.26	k star (bias corrected MLE)	0.255
Theta hat (MLE)	16.55	Theta star (bias corrected MLE)	16.83

nu hat (MLE)	13.5	nu star (bias corrected)	13.27
MLE Mean (bias corrected)	4.296	MLE Sd (bias corrected)	8.503
		Adjusted Level of Significance (β)	0.0398
Approximate Chi Square Value (13.27, α)	6.077	Adjusted Chi Square Value (13.27, β)	5.757
95% Gamma Approximate UCL (use when n>=50)	9.383	95% Gamma Adjusted UCL (use when n<50)	9.905

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.907	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.887	Detected Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.2	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.222	Detected Data appear Lognormal at 5% Significance Level	

Detected Data appear Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	4.776	Mean in Log Scale	0.597
SD in Original Scale	11.05	SD in Log Scale	1.117
95% t UCL (assumes normality of ROS data)	8.479	95% Percentile Bootstrap UCL	8.8
95% BCA Bootstrap UCL	10.3	95% Bootstrap t UCL	33.91
95% H-UCL (Log ROS)	6.143		

UCLs using Lognormal Distribution and KM Estimates when Detected data are Lognormally Distributed

KM Mean (logged)	0.558	95% H-UCL (KM -Log)	6.819
KM SD (logged)	1.188	95% Critical H Value (KM-Log)	2.76
KM Standard Error of Mean (logged)	0.268		

DL/2 Statistics

DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	4.862	Mean in Log Scale	0.66
SD in Original Scale	11.02	SD in Log Scale	1.098
95% t UCL (Assumes normality)	8.555	95% H-Stat UCL	6.312

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics
Detected Data appear Lognormal Distributed at 5% Significance Level

Suggested UCL to Use
97.5% KM (Chebyshev) UCL **18.54**

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
Recommendations are based upon data size, data distribution, and skewness.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Arsenic

General Statistics

Total Number of Observations	31	Number of Distinct Observations	29
		Number of Missing Observations	0
Minimum	6.74	Mean	16.18
Maximum	79.8	Median	13.1
SD	13.08	Std. Error of Mean	2.35
Coefficient of Variation	0.809	Skewness	4.198

Normal GOF Test

Shapiro Wilk Test Statistic	0.501	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.929	Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.366	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.159	Data Not Normal at 5% Significance Level	

Data Not Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	20.17	95% Adjusted-CLT UCL (Chen-1995)	21.94
		95% Modified-t UCL (Johnson-1978)	20.47

Gamma GOF Test

A-D Test Statistic	2.679	Anderson-Darling Gamma GOF Test	
5% A-D Critical Value	0.751	Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.28	Kolmogrov-Smirnoff Gamma GOF Test	
5% K-S Critical Value	0.159	Data Not Gamma Distributed at 5% Significance Level	
Data Not Gamma Distributed at 5% Significance Level			

Gamma Statistics			
k hat (MLE)	3.668	k star (bias corrected MLE)	3.334
Theta hat (MLE)	4.412	Theta star (bias corrected MLE)	4.853
nu hat (MLE)	227.4	nu star (bias corrected)	206.7
MLE Mean (bias corrected)	16.18	MLE Sd (bias corrected)	8.862
		Approximate Chi Square Value (0.05)	174.5
Adjusted Level of Significance	0.0413	Adjusted Chi Square Value	172.8

Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50))	19.18	95% Adjusted Gamma UCL (use when n<50)	19.36

Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.828	Shapiro Wilk Lognormal GOF Test	
5% Shapiro Wilk Critical Value	0.929	Data Not Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.224	Lilliefors Lognormal GOF Test	
5% Lilliefors Critical Value	0.159	Data Not Lognormal at 5% Significance Level	
Data Not Lognormal at 5% Significance Level			

Lognormal Statistics			
Minimum of Logged Data	1.908	Mean of logged Data	2.642
Maximum of Logged Data	4.38	SD of logged Data	0.461

Assuming Lognormal Distribution			
95% H-UCL	18.31	90% Chebyshev (MVUE) UCL	19.56
95% Chebyshev (MVUE) UCL	21.37	97.5% Chebyshev (MVUE) UCL	23.89
99% Chebyshev (MVUE) UCL	28.84		

Nonparametric Distribution Free UCL Statistics
Data do not follow a Discernible Distribution (0.05)

Nonparametric Distribution Free UCLs			
95% CLT UCL	20.05	95% Jackknife UCL	20.17
95% Standard Bootstrap UCL	20.03	95% Bootstrap-t UCL	26.63
95% Hall's Bootstrap UCL	35.94	95% Percentile Bootstrap UCL	20.09
95% BCA Bootstrap UCL	23.44		
90% Chebyshev(Mean, Sd) UCL	23.23	95% Chebyshev(Mean, Sd) UCL	26.43
97.5% Chebyshev(Mean, Sd) UCL	30.86	99% Chebyshev(Mean, Sd) UCL	39.57

Suggested UCL to Use			
95% Student's-t UCL	**20.17**	**or 95% Modified-t UCL**	**20.47**

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

Cadmium

General Statistics			
Total Number of Observations	115	Number of Distinct Observations	102
Number of Detects	114	Number of Non-Detects	1
Number of Distinct Detects	101	Number of Distinct Non-Detects	1
Minimum Detect	0.0829	Minimum Non-Detect	1.05
Maximum Detect	106	Maximum Non-Detect	105.00%
Variance Detects	144.3	Percent Non-Detects	0.87%
Mean Detects	4.774	SD Detects	12.01
Median Detects	1.85	CV Detects	2.516
Skewness Detects	6.571	Kurtosis Detects	49.46
Mean of Logged Detects	0.717	SD of Logged Detects	1.148

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.354	Normal GOF Test on Detected Observations Only	
5% Shapiro Wilk P Value	0	Detected Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.348	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.083	Detected Data Not Normal at 5% Significance Level	
Detected Data Not Normal at 5% Significance Level			

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs

Mean	4.738	Standard Error of Mean	1.116
SD	11.91	95% KM (BCA) UCL	6.913
95% KM (t) UCL	6.588	95% KM (Percentile Bootstrap) UCL	6.757
95% KM (z) UCL	6.573	95% KM Bootstrap t UCL	9.122
90% KM Chebyshev UCL	8.085	95% KM Chebyshev UCL	9.601
97.5% KM Chebyshev UCL	11.71	99% KM Chebyshev UCL	15.84

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	6.533	Anderson-Darling GOF Test	
5% A-D Critical Value	0.799	Detected Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.192	Kolmogrov-Smirnoff GOF	
5% K-S Critical Value	0.0894	Detected Data Not Gamma Distributed at 5% Significance Level	
Detected Data Not Gamma Distributed at 5% Significance Level			

Gamma Statistics on Detected Data Only

k hat (MLE)	0.712	k star (bias corrected MLE)	0.699
Theta hat (MLE)	6.704	Theta star (bias corrected MLE)	6.827
nu hat (MLE)	162.4	nu star (bias corrected)	159.4
MLE Mean (bias corrected)	4.774	MLE Sd (bias corrected)	5.709

Gamma Kaplan-Meier (KM) Statistics

k hat (KM)	0.158	nu hat (KM)	36.39
Approximate Chi Square Value (36.39, α)	23.58	Adjusted Chi Square Value (36.39, β)	23.45
95% Gamma Approximate KM-UCL (use when n>=50)	7.311	95% Gamma Adjusted KM-UCL (use when n<50)	7.352

Gamma ROS Statistics using Imputed Non-Detects
GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs
GROS may not be used when kstar of detected data is small such as < 0.1
For such situations, GROS method tends to yield inflated values of UCLs and BTVs
For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.01	Mean	4.733
Maximum	106	Median	1.85
SD	11.97	CV	2.528
k hat (MLE)	0.686	k star (bias corrected MLE)	0.673
Theta hat (MLE)	6.904	Theta star (bias corrected MLE)	7.028
nu hat (MLE)	157.7	nu star (bias corrected)	154.9
MLE Mean (bias corrected)	4.733	MLE Sd (bias corrected)	5.767
		Adjusted Level of Significance (β)	0.0479
Approximate Chi Square Value (154.90, α)	127.1	Adjusted Chi Square Value (154.90, β)	126.8
95% Gamma Approximate UCL (use when n>=50)	5.767	95% Gamma Adjusted UCL (use when n<50)	5.781

Lognormal GOF Test on Detected Observations Only

Lilliefors Test Statistic	0.0753	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.083	Detected Data appear Lognormal at 5% Significance Level	
Detected Data appear Lognormal at 5% Significance Level			

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	4.737	Mean in Log Scale	0.705
SD in Original Scale	11.96	SD in Log Scale	1.15
95% t UCL (assumes normality of ROS data)	6.588	95% Percentile Bootstrap UCL	6.739
95% BCA Bootstrap UCL	7.683	95% Bootstrap t UCL	9.13
95% H-UCL (Log ROS)	5.056		

UCLs using Lognormal Distribution and KM Estimates when Detected data are Lognormally Distributed

KM Mean (logged)	0.705	95% H-UCL (KM -Log)	5.029
KM SD (logged)	1.146	95% Critical H Value (KM-Log)	2.359
KM Standard Error of Mean (logged)	0.107		

DL/2 Statistics

DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	4.737	Mean in Log Scale	0.705
SD in Original Scale	11.96	SD in Log Scale	1.15
95% t UCL (Assumes normality)	6.587	95% H-Stat UCL	5.056

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics
Detected Data appear Lognormal Distributed at 5% Significance Level

Suggested UCL to Use
95% KM (Chebyshev) UCL **9.601**

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
Recommendations are based upon data size, data distribution, and skewness.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Lead

General Statistics

Total Number of Observations	116	Number of Distinct Observations	110
		Number of Missing Observations	0
Minimum	8.59	Mean	654.4
Maximum	11200	Median	250
SD	1366	Std. Error of Mean	126.8
Coefficient of Variation	2.088	Skewness	5.308

Normal GOF Test

Shapiro Wilk Test Statistic	0.457	Shapiro Wilk GOF Test
5% Shapiro Wilk P Value	0	Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.318	Lilliefors GOF Test
5% Lilliefors Critical Value	0.0823	Data Not Normal at 5% Significance Level

Data Not Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	864.7	95% Adjusted-CLT UCL (Chen-1995)	929.8
		95% Modified-t UCL (Johnson-1978)	875.1

Gamma GOF Test

A-D Test Statistic	4.211	Anderson-Darling Gamma GOF Test
5% A-D Critical Value	0.803	Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.168	Kolmogrov-Smirnoff Gamma GOF Test
5% K-S Critical Value	0.0892	Data Not Gamma Distributed at 5% Significance Level

Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	0.666	k star (bias corrected MLE)	0.654
Theta hat (MLE)	982.8	Theta star (bias corrected MLE)	1000
nu hat (MLE)	154.5	nu star (bias corrected)	151.8
MLE Mean (bias corrected)	654.4	MLE Sd (bias corrected)	809
		Approximate Chi Square Value (0.05)	124.3
Adjusted Level of Significance	0.0479	Adjusted Chi Square Value	124

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	799	95% Adjusted Gamma UCL (use when n<50)	801

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.982	Shapiro Wilk Lognormal GOF Test
5% Shapiro Wilk P Value	0.579	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.0857	Lilliefors Lognormal GOF Test
5% Lilliefors Critical Value	0.0823	Data Not Lognormal at 5% Significance Level

Data appear Approximate Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	2.151	Mean of logged Data	5.57
Maximum of Logged Data	9.324	SD of logged Data	1.323

Assuming Lognormal Distribution

95% H-UCL	862	90% Chebyshev (MVUE) UCL	924.4
95% Chebyshev (MVUE) UCL	1062	97.5% Chebyshev (MVUE) UCL	1253
99% Chebyshev (MVUE) UCL	1627		

Nonparametric Distribution Free UCL Statistics
Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	863	95% Jackknife UCL	864.7
95% Standard Bootstrap UCL	865.2	95% Bootstrap-t UCL	988.1
95% Hall's Bootstrap UCL	1226	95% Percentile Bootstrap UCL	888.1
95% BCA Bootstrap UCL	958.3		
90% Chebyshev(Mean, Sd) UCL	1035	95% Chebyshev(Mean, Sd) UCL	1207
97.5% Chebyshev(Mean, Sd) UCL	1447	99% Chebyshev(Mean, Sd) UCL	1917

Suggested UCL to Use
95% Chebyshev (Mean, Sd) UCL **1207**

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002) and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

Selenium

General Statistics

Total Number of Observations	30	Number of Distinct Observations	29
Number of Detects	16	Number of Non-Detects	14
Number of Distinct Detects	16	Number of Distinct Non-Detects	13
Minimum Detect	0.338	Minimum Non-Detect	216.00%
Maximum Detect	29.2	Maximum Non-Detect	2.73
Variance Detects	51.19	Percent Non-Detects	46.67%
Mean Detects	2.385	SD Detects	7.154
Median Detects	0.572	CV Detects	3
Skewness Detects	3.993	Kurtosis Detects	15.96
Mean of Logged Detects	-0.325	SD of Logged Detects	1.036

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.296	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.887	Detected Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.495	Lilliefors GOF Test
5% Lilliefors Critical Value	0.222	Detected Data Not Normal at 5% Significance Level

Detected Data Not Normal at 5% Significance Level

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs

Mean	1.55	Standard Error of Mean	0.97
SD	5.139	95% KM (BCA) UCL	3.459
95% KM (t) UCL	3.199	95% KM (Percentile Bootstrap) UCL	3.443
95% KM (z) UCL	3.146	95% KM Bootstrap t UCL	36.11
90% KM Chebyshev UCL	4.46	95% KM Chebyshev UCL	5.778
97.5% KM Chebyshev UCL	7.608	99% KM Chebyshev UCL	11.2

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	4.333	Anderson-Darling GOF Test
5% A-D Critical Value	0.794	Detected Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.458	Kolmogrov-Smirnoff GOF
5% K-S Critical Value	0.227	Detected Data Not Gamma Distributed at 5% Significance Level

Detected Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics on Detected Data Only

k hat (MLE)	0.527	k star (bias corrected MLE)	0.47
Theta hat (MLE)	4.521	Theta star (bias corrected MLE)	5.072

nu hat (MLE)	16.88	nu star (bias corrected)	15.05
MLE Mean (bias corrected)	2.385	MLE Sd (bias corrected)	3.478

Gamma Kaplan-Meier (KM) Statistics

k hat (KM)	0.091	nu hat (KM)	5.461
Approximate Chi Square Value (5.46, α)	1.371	Adjusted Chi Square Value (5.46, β)	1.257
95% Gamma Approximate KM-UCL (use when n>=50)	6.177	95% Gamma Adjusted KM-UCL (use when n<50)	6.733

Gamma (KM) may not be used when k hat (KM) is < 0.1

Gamma ROS Statistics using Imputed Non-Detects
GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs
GROS may not be used when kstar of detected data is small such as < 0.1
For such situations, GROS method tends to yield inflated values of UCLs and BTVs
For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.01	Mean	1.331
Maximum	29.2	Median	0.408
SD	5.28	CV	3.966
k hat (MLE)	0.285	k star (bias corrected MLE)	0.279
Theta hat (MLE)	4.668	Theta star (bias corrected MLE)	4.773
nu hat (MLE)	17.11	nu star (bias corrected)	16.73
MLE Mean (bias corrected)	1.331	MLE Sd (bias corrected)	2.521
		Adjusted Level of Significance (β)	0.041
Approximate Chi Square Value (16.73, α)	8.48	Adjusted Chi Square Value (16.73, β)	8.142
95% Gamma Approximate UCL (use when n>=50)	2.626	95% Gamma Adjusted UCL (use when n<50)	2.735

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.546	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.887	Detected Data Not Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.352	Lilliefors GOF Test
5% Lilliefors Critical Value	0.222	Detected Data Not Lognormal at 5% Significance Level

Detected Data Not Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	1.58	Mean in Log Scale	-0.371
SD in Original Scale	5.22	SD in Log Scale	0.752
95% t UCL (assumes normality of ROS data)	3.199	95% Percentile Bootstrap UCL	3.484
95% BCA Bootstrap UCL	4.494	95% Bootstrap t UCL	47.85
95% H-UCL (Log ROS)	1.243		

DL/2 Statistics

DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	1.831	Mean in Log Scale	-0.0897
SD in Original Scale	5.181	SD in Log Scale	0.789
95% t UCL (Assumes normality)	3.438	95% H-Stat UCL	1.73

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics
Data do not follow a Discernible Distribution at 5% Significance Level

Suggested UCL to Use
97.5% KM (Chebyshev) UCL **7.608**

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
Recommendations are based upon data size, data distribution, and skewness.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

APPENDIX C-2

SITE-WIDE SUB-SURFACE SOIL

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	5/15/2014 13:10
From File	Site wide subsurface soil.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Antimony

General Statistics

Total Number of Observations	6	Number of Distinct Observations	6
Number of Detects	2	Number of Non-Detects	4
Number of Distinct Detects	2	Number of Distinct Non-Detects	4
Minimum Detect	0.809	Minimum Non-Detect	2.97
Maximum Detect	6.99	Maximum Non-Detect	3.1
Variance Detects	19.1	Percent Non-Detects	67%
Mean Detects	3.9	SD Detects	4.371
Median Detects	3.9	CV Detects	1.121
Skewness Detects	N/A	Kurtosis Detects	N/A
Mean of Logged Detects	0.866	SD of Logged Detects	1.525

Warning: Data set has only 2 Detected Values.
This is not enough to compute meaningful or reliable statistics and estimates.

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.
For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).
Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.0

Normal GOF Test on Detects Only
Not Enough Data to Perform GOF Test

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs

Mean	1.839	Standard Error of Mean	1.33
SD	2.304	95% KM (BCA) UCL	N/A
95% KM (t) UCL	4.519	95% KM (Percentile Bootstrap) UCL	N/A
95% KM (z) UCL	4.027	95% KM Bootstrap t UCL	N/A
90% KM Chebyshev UCL	5.829	95% KM Chebyshev UCL	7.636
97.5% KM Chebyshev UCL	10.14	99% KM Chebyshev UCL	15.07

Gamma GOF Tests on Detected Observations Only
Not Enough Data to Perform GOF Test

Gamma Statistics on Detected Data Only

k hat (MLE)	1.149	k star (bias corrected MLE)	N/A
Theta hat (MLE)	3.394	Theta star (bias corrected MLE)	N/A
nu hat (MLE)	4.596	nu star (bias corrected)	N/A
MLE Mean (bias corrected)	N/A	MLE Sd (bias corrected)	N/A

Gamma Kaplan-Meier (KM) Statistics

k hat (KM)	0.637	nu hat (KM)	7.65
		Adjusted Level of Significance (β)	0.0122
Approximate Chi Square Value (7.65, α)	2.534	Adjusted Chi Square Value (7.65, β)	1.602
95% Gamma Approximate KM-UCL (use when n>=50)	5.552	95% Gamma Adjusted KM-UCL (use when n<50)	8.783

Lognormal GOF Test on Detected Observations Only
Not Enough Data to Perform GOF Test

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	1.839	Mean in Log Scale	0.147
SD in Original Scale	2.523	SD in Log Scale	0.88
95% t UCL (assumes normality of ROS data)	3.915	95% Percentile Bootstrap UCL	N/A
95% BCA Bootstrap UCL	N/A	95% Bootstrap t UCL	N/A

95% H-UCL (Log ROS)	7.365		

DL/2 Statistics

DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	2.309	Mean in Log Scale	0.565
SD in Original Scale	2.311	SD in Log Scale	0.721
95% t UCL (Assumes normality)	4.21	95% H-Stat UCL	6.472

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics
Data do not follow a Discernible Distribution at 5% Significance Level

Suggested UCL to Use
97.5% KM (Chebyshev) UCL 10.14
Warning: Recommended UCL exceeds the maximum observation

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
Recommendations are based upon data size, data distribution, and skewness.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Arsenic

General Statistics

Total Number of Observations	14	Number of Distinct Observations	13
		Number of Missing Observations	0
Minimum	2.7	Mean	18.79
Maximum	115	Median	12.45
SD	27.92	Std. Error of Mean	7.462
Coefficient of Variation	1.486	Skewness	3.633

Normal GOF Test

Shapiro Wilk Test Statistic	0.417	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.874	Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.457	Lilliefors GOF Test
5% Lilliefors Critical Value	0.237	Data Not Normal at 5% Significance Level

Data Not Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	32.01	95% Adjusted-CLT UCL (Chen-1995)	38.81
		95% Modified-t UCL (Johnson-1978)	33.21

Gamma GOF Test

A-D Test Statistic	2.108	Anderson-Darling Gamma GOF Test
5% A-D Critical Value	0.753	Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.364	Kolmogrov-Smirnoff Gamma GOF Test
5% K-S Critical Value	0.233	Data Not Gamma Distributed at 5% Significance Level

Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	1.369	k star (bias corrected MLE)	1.123
Theta hat (MLE)	13.73	Theta star (bias corrected MLE)	16.73
nu hat (MLE)	38.33	nu star (bias corrected)	31.45
MLE Mean (bias corrected)	18.79	MLE Sd (bias corrected)	17.73
		Approximate Chi Square Value (0.05)	19.64
Adjusted Level of Significance	0.0312	Adjusted Chi Square Value	18.41

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	30.09	95% Adjusted Gamma UCL (use when n<50)	32.11

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.78	Shapiro Wilk Lognormal GOF Test
5% Shapiro Wilk Critical Value	0.874	Data Not Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.285	Lilliefors Lognormal GOF Test
5% Lilliefors Critical Value	0.237	Data Not Lognormal at 5% Significance Level

Data Not Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	0.993	Mean of logged Data	2.526
Maximum of Logged Data	4.745	SD of logged Data	0.783

Assuming Lognormal Distribution

95% H-UCL	28.93	90% Chebyshev (MVUE) UCL	27.53
95% Chebyshev (MVUE) UCL	32.51	97.5% Chebyshev (MVUE) UCL	39.42
99% Chebyshev (MVUE) UCL	53.01		

Nonparametric Distribution Free UCL Statistics
Data do not follow a Discernible Distribution (0.05)

Nonparametric Distribution Free UCLs

95% CLT UCL	31.06	95% Jackknife UCL	32.01
95% Standard Bootstrap UCL	30.88	95% Bootstrap-t UCL	94.38
95% Hall's Bootstrap UCL	101.1	95% Percentile Bootstrap UCL	33.47
95% BCA Bootstrap UCL	40.71		
90% Chebyshev(Mean, Sd) UCL	41.18	95% Chebyshev(Mean, Sd) UCL	51.32
97.5% Chebyshev(Mean, Sd) UCL	65.39	99% Chebyshev(Mean, Sd) UCL	93.04

Suggested UCL to Use
95% Chebyshev (Mean, Sd) UCL **51.32**

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002) and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

Cadmium

General Statistics

Total Number of Observations	37	Number of Distinct Observations	36
Number of Detects	32	Number of Non-Detects	5
Number of Distinct Detects	32	Number of Distinct Non-Detects	4
Minimum Detect	0.0756	Minimum Non-Detect	0.0325
Maximum Detect	234	Maximum Non-Detect	29.80%
Variance Detects	1685	Percent Non-Detects	13.51%
Mean Detects	10.42	SD Detects	41.05
Median Detects	0.838	CV Detects	3.94
Skewness Detects	5.549	Kurtosis Detects	31.14
Mean of Logged Detects	0.303	SD of Logged Detects	1.774

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.252	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.93	Detected Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.419	Lilliefors GOF Test
5% Lilliefors Critical Value	0.157	Detected Data Not Normal at 5% Significance Level

Detected Data Not Normal at 5% Significance Level

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs

Mean	9.019	Standard Error of Mean	6.304
SD	37.74	95% KM (BCA) UCL	21.95
95% KM (t) UCL	19.66	95% KM (Percentile Bootstrap) UCL	21.29
95% KM (z) UCL	19.39	95% KM Bootstrap t UCL	89.93
90% KM Chebyshev UCL	27.93	95% KM Chebyshev UCL	36.5
97.5% KM Chebyshev UCL	48.39	99% KM Chebyshev UCL	71.74

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	3.202	Anderson-Darling GOF Test
5% A-D Critical Value	0.848	Detected Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.237	Kolmogrov-Smirnoff GOF
5% K-S Critical Value	0.168	Detected Data Not Gamma Distributed at 5% Significance Level

Detected Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics on Detected Data Only

k hat (MLE)	0.332	k star (bias corrected MLE)	0.322
Theta hat (MLE)	31.35	Theta star (bias corrected MLE)	32.35
nu hat (MLE)	21.27	nu star (bias corrected)	20.61
MLE Mean (bias corrected)	10.42	MLE Sd (bias corrected)	18.36

Gamma Kaplan-Meier (KM) Statistics

k hat (KM)	0.0571	nu hat (KM)	4.225
Approximate Chi Square Value (4.23, α)	0.813	Adjusted Chi Square Value (4.23, β)	0.752
95% Gamma Approximate KM-UCL (use when n>=50)	46.89	95% Gamma Adjusted KM-UCL (use when n<50)	50.66

Gamma (KM) may not be used when k hat (KM) is < 0.1

Gamma ROS Statistics using Imputed Non-Detects
GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs
GROS may not be used when kstar of detected data is small such as < 0.1
For such situations, GROS method tends to yield inflated values of UCLs and BTVs
For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.01	Mean	9.012
Maximum	234	Median	0.618
SD	38.26	CV	4.246
k hat (MLE)	0.274	k star (bias corrected MLE)	0.269
Theta hat (MLE)	32.94	Theta star (bias corrected MLE)	33.45
nu hat (MLE)	20.24	nu star (bias corrected)	19.94
MLE Mean (bias corrected)	9.012	MLE Sd (bias corrected)	17.36
		Adjusted Level of Significance (β)	0.0431
Approximate Chi Square Value (19.94, α)	10.8	Adjusted Chi Square Value (19.94, β)	10.51
95% Gamma Approximate UCL (use when n>=50)	16.63	95% Gamma Adjusted UCL (use when n<50)	17.09

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.949	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.93	Detected Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.131	Lilliefors GOF Test
5% Lilliefors Critical Value	0.157	Detected Data appear Lognormal at 5% Significance Level

Detected Data appear Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	9.016	Mean in Log Scale	-0.191
SD in Original Scale	38.26	SD in Log Scale	2.091
95% t UCL (assumes normality of ROS data)	19.64	95% Percentile Bootstrap UCL	21.23
95% BCA Bootstrap UCL	28.48	95% Bootstrap t UCL	87.59
95% H-UCL (Log ROS)	28.27		

UCLs using Lognormal Distribution and KM Estimates when Detected data are Lognormally Distributed

KM Mean (logged)	-0.156	95% H-UCL (KM -Log)	22.57
KM SD (logged)	2.009	95% Critical H Value (KM-Log)	3.744
KM Standard Error of Mean (logged)	0.337		

DL/2 Statistics

DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	9.02	Mean in Log Scale	-0.174
SD in Original Scale	38.26	SD in Log Scale	2.089
95% t UCL (Assumes normality)	19.64	95% H-Stat UCL	28.59

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics
Detected Data appear Lognormal Distributed at 5% Significance Level

Suggested UCL to Use
99% KM (Chebyshev) UCL **71.74**

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
Recommendations are based upon data size, data distribution, and skewness.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Lead

General Statistics

Total Number of Observations	76	Number of Distinct Observations	75
Number of Detects	75	Number of Non-Detects	1
Number of Distinct Detects	74	Number of Distinct Non-Detects	1
Minimum Detect	5.26	Minimum Non-Detect	0.554
Maximum Detect	31000	Maximum Non-Detect	55.40%
Variance Detects	23080196	Percent Non-Detects	1.32%
Mean Detects	1349	SD Detects	4804
Median Detects	70	CV Detects	3.562
Skewness Detects	4.885	Kurtosis Detects	24.79
Mean of Logged Detects	4.684	SD of Logged Detects	1.98

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.316	Normal GOF Test on Detected Observations Only
5% Shapiro Wilk P Value	0	Detected Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.4	Lilliefors GOF Test
5% Lilliefors Critical Value	0.102	Detected Data Not Normal at 5% Significance Level

Detected Data Not Normal at 5% Significance Level

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs

Mean	1331	Standard Error of Mean	547.7
SD	4743	95% KM (BCA) UCL	2258
95% KM (t) UCL	2243	95% KM (Percentile Bootstrap) UCL	2262
95% KM (z) UCL	2232	95% KM Bootstrap t UCL	3146
90% KM Chebyshev UCL	2974	95% KM Chebyshev UCL	3718
97.5% KM Chebyshev UCL	4751	99% KM Chebyshev UCL	6781

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	8.713	Anderson-Darling GOF Test
5% A-D Critical Value	0.877	Detected Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.262	Kolmogrov-Smirnoff GOF
5% K-S Critical Value	0.113	Detected Data Not Gamma Distributed at 5% Significance Level

Detected Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics on Detected Data Only

k hat (MLE)	0.277	k star (bias corrected MLE)	0.275
Theta hat (MLE)	4871	Theta star (bias corrected MLE)	4910
nu hat (MLE)	41.53	nu star (bias corrected)	41.2
MLE Mean (bias corrected)	1349	MLE Sd (bias corrected)	2573

Gamma Kaplan-Meier (KM) Statistics

k hat (KM)	0.0787	nu hat (KM)	11.97
Approximate Chi Square Value (11.97, α)	5.206	Adjusted Chi Square Value (11.97, β)	5.12
95% Gamma Approximate KM-UCL (use when n>=50)	3060	95% Gamma Adjusted KM-UCL (use when n<50)	3111

Gamma (KM) may not be used when k hat (KM) is < 0.1

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs

GROS may not be used when kstar of detected data is small such as < 0.1

For such situations, GROS method tends to yield inflated values of UCLs and BTVs

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.01	Mean	1331
Maximum	31000	Median	66.95
SD	4775	CV	3.587
k hat (MLE)	0.267	k star (bias corrected MLE)	0.265
Theta hat (MLE)	4985	Theta star (bias corrected MLE)	5018
nu hat (MLE)	40.58	nu star (bias corrected)	40.31
MLE Mean (bias corrected)	1331	MLE Sd (bias corrected)	2584
		Adjusted Level of Significance (β)	0.0468
Approximate Chi Square Value (40.31, α)	26.76	Adjusted Chi Square Value (40.31, β)	26.55
95% Gamma Approximate UCL (use when n>=50)	2005	95% Gamma Adjusted UCL (use when n<50)	2021

Lognormal GOF Test on Detected Observations Only

Lilliefors Test Statistic	0.133	Lilliefors GOF Test
5% Lilliefors Critical Value	0.102	Detected Data Not Lognormal at 5% Significance Level

Detected Data Not Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	1331	Mean in Log Scale	4.616
SD in Original Scale	4775	SD in Log Scale	2.054
95% t UCL (assumes normality of ROS data)	2243	95% Percentile Bootstrap UCL	2299
95% BCA Bootstrap UCL	2733	95% Bootstrap t UCL	3467
95% H-UCL (Log ROS)	1907		

DL/2 Statistics

DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	1331	Mean in Log Scale	4.605
SD in Original Scale	4775	SD in Log Scale	2.082
95% t UCL (Assumes normality)	2243	95% H-Stat UCL	2043

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics
Data do not follow a Discernible Distribution at 5% Significance Level

Suggested UCL to Use
97.5% KM (Chebyshev) UCL **4751**

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
Recommendations are based upon data size, data distribution, and skewness.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Selenium

General Statistics

Total Number of Observations	9	Number of Distinct Observations	9
Number of Detects	6	Number of Non-Detects	3
Number of Distinct Detects	6	Number of Distinct Non-Detects	3
Minimum Detect	0.324	Minimum Non-Detect	2.34
Maximum Detect	12.6	Maximum Non-Detect	261.00%
Variance Detects	24.56	Percent Non-Detects	33.33%
Mean Detects	2.486	SD Detects	4.955
Median Detects	0.519	CV Detects	1.993
Skewness Detects	2.448	Kurtosis Detects	5.994
Mean of Logged Detects	-0.234	SD of Logged Detects	1.37

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use
guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.
For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).
Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.0

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.513	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.788	Detected Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.486	Lilliefors GOF Test
5% Lilliefors Critical Value	0.362	Detected Data Not Normal at 5% Significance Level

Detected Data Not Normal at 5% Significance Level

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs

Mean	1.812	Standard Error of Mean	1.393
SD	3.815	95% KM (BCA) UCL	4.532
95% KM (t) UCL	4.403	95% KM (Percentile Bootstrap) UCL	4.494
95% KM (z) UCL	4.104	95% KM Bootstrap t UCL	78.53
90% KM Chebyshev UCL	5.992	95% KM Chebyshev UCL	7.885
97.5% KM Chebyshev UCL	10.51	99% KM Chebyshev UCL	15.67

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	1.43	Anderson-Darling GOF Test
5% A-D Critical Value	0.733	Detected Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.495	Kolmogrov-Smirnoff GOF
5% K-S Critical Value	0.348	Detected Data Not Gamma Distributed at 5% Significance Level

Detected Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics on Detected Data Only

k hat (MLE)	0.547	k star (bias corrected MLE)	0.385
Theta hat (MLE)	4.543	Theta star (bias corrected MLE)	6.462
nu hat (MLE)	6.567	nu star (bias corrected)	4.617
MLE Mean (bias corrected)	2.486	MLE Sd (bias corrected)	4.008

Gamma Kaplan-Meier (KM) Statistics

k hat (KM)	0.226	nu hat (KM)	4.061
Approximate Chi Square Value (4.06, α)	0.746	Adjusted Chi Square Value (4.06, β)	0.5
95% Gamma Approximate KM-UCL (use when n>=50)	9.865	95% Gamma Adjusted KM-UCL (use when n<50)	14.73

Gamma ROS Statistics using Imputed Non-Detects
GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs
GROS may not be used when kstar of detected data is small such as < 0.1
For such situations, GROS method tends to yield inflated values of UCLs and BTVs
For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.189	Mean	1.721
Maximum	12.6	Median	0.41
SD	4.082	CV	2.373
k hat (MLE)	0.506	k star (bias corrected MLE)	0.411
Theta hat (MLE)	3.402	Theta star (bias corrected MLE)	4.184
nu hat (MLE)	9.104	nu star (bias corrected)	7.403
MLE Mean (bias corrected)	1.721	MLE Sd (bias corrected)	2.683
		Adjusted Level of Significance (β)	0.0231
Approximate Chi Square Value (7.40, α)	2.394	Adjusted Chi Square Value (7.40, β)	1.839
95% Gamma Approximate UCL (use when n>=50)	5.32	95% Gamma Adjusted UCL (use when n<50)	6.928

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.634	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.788	Detected Data Not Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.44	Lilliefors GOF Test
5% Lilliefors Critical Value	0.362	Detected Data Not Lognormal at 5% Significance Level

Detected Data Not Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	1.846	Mean in Log Scale	-0.345
SD in Original Scale	4.033	SD in Log Scale	1.096
95% t UCL (assumes normality of ROS data)	4.347	95% Percentile Bootstrap UCL	4.531
95% BCA Bootstrap UCL	5.874	95% Bootstrap t UCL	102.7
95% H-UCL (Log ROS)	4.927		

DL/2 Statistics

DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	2.065	Mean in Log Scale	-0.0895
SD in Original Scale	3.968	SD in Log Scale	1.105
95% t UCL (Assumes normality)	4.525	95% H-Stat UCL	6.549

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics
Data do not follow a Discernible Distribution at 5% Significance Level

Suggested UCL to Use
97.5% KM (Chebyshev) UCL **10.51**

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
Recommendations are based upon data size, data distribution, and skewness.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

APPENDIX C-3

SOUTH WOODED AREA SURFACE SOIL

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	5/15/2014 10:24
From File	SWA surface.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Antimony

General Statistics

Total Number of Observations	4	Number of Distinct Observations	3
		Number of Missing Observations	0
Minimum	0.463	Mean	2.272
Maximum	6.7	Median	0.962
SD	2.99	Std. Error of Mean	1.495
Coefficient of Variation	1.316	Skewness	1.859

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use
guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.
For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).
Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.0

Normal GOF Test

Shapiro Wilk Test Statistic	0.74	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.748	Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.357	Lilliefors GOF Test
5% Lilliefors Critical Value	0.443	Data appear Normal at 5% Significance Level

Data appear Approximate Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	5.789	95% Adjusted-CLT UCL (Chen-1995)	6.214
		95% Modified-t UCL (Johnson-1978)	6.021

Gamma GOF Test

A-D Test Statistic	0.494	Anderson-Darling Gamma GOF Test
5% A-D Critical Value	0.668	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.297	Kolmogrov-Smirnoff Gamma GOF Test
5% K-S Critical Value	0.403	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	0.918	k star (bias corrected MLE)	0.396
Theta hat (MLE)	2.475	Theta star (bias corrected MLE)	5.734
nu hat (MLE)	7.344	nu star (bias corrected)	3.169
MLE Mean (bias corrected)	2.272	MLE Sd (bias corrected)	3.609
		Approximate Chi Square Value (0.05)	0.424
Adjusted Level of Significance	N/A	Adjusted Chi Square Value	N/A

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	16.97	95% Adjusted Gamma UCL (use when n<50)	N/A

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.856	Shapiro Wilk Lognormal GOF Test
5% Shapiro Wilk Critical Value	0.748	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.275	Lilliefors Lognormal GOF Test
5% Lilliefors Critical Value	0.443	Data appear Lognormal at 5% Significance Level

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	-0.77	Mean of logged Data	0.185
Maximum of Logged Data	1.902	SD of logged Data	1.266

Assuming Lognormal Distribution

95% H-UCL	1218	90% Chebyshev (MVUE) UCL	5.567
95% Chebyshev (MVUE) UCL	7.151	97.5% Chebyshev (MVUE) UCL	9.35
99% Chebyshev (MVUE) UCL	13.67		

Nonparametric Distribution Free UCL Statistics
Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs			
95% CLT UCL	4.73	95% Jackknife UCL	5.789
95% Standard Bootstrap UCL	N/A	95% Bootstrap-t UCL	N/A
95% Hall's Bootstrap UCL	N/A	95% Percentile Bootstrap UCL	N/A
95% BCA Bootstrap UCL	N/A		
90% Chebyshev(Mean, Sd) UCL	6.756	95% Chebyshev(Mean, Sd) UCL	8.787
97.5% Chebyshev(Mean, Sd) UCL	11.61	99% Chebyshev(Mean, Sd) UCL	17.14

Suggested UCL to Use
95% Student's-t UCL **5.789**

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

Arsenic

General Statistics			
Total Number of Observations	4	Number of Distinct Observations	4
		Number of Missing Observations	0
Minimum	12.4	Mean	14.23
Maximum	16.3	Median	14.1
SD	1.795	Std. Error of Mean	0.898
Coefficient of Variation	0.126	Skewness	0.242

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use
guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.
For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).
Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.0

Normal GOF Test			
Shapiro Wilk Test Statistic	0.941	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.748	Data appear Normal at 5% Significance Level	
Lilliefors Test Statistic	0.235	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.443	Data appear Normal at 5% Significance Level	
Data appear Normal at 5% Significance Level			

Assuming Normal Distribution			
95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	16.34	95% Adjusted-CLT UCL (Chen-1995)	15.82
		95% Modified-t UCL (Johnson-1978)	16.36

Gamma GOF Test			
A-D Test Statistic	0.3	Anderson-Darling Gamma GOF Test	
5% A-D Critical Value	0.656	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.261	Kolmogrov-Smirnoff Gamma GOF Test	
5% K-S Critical Value	0.394	Detected data appear Gamma Distributed at 5% Significance Level	
Detected data appear Gamma Distributed at 5% Significance Level			

Gamma Statistics			
k hat (MLE)	84.08	k star (bias corrected MLE)	21.19
Theta hat (MLE)	0.169	Theta star (bias corrected MLE)	0.671
nu hat (MLE)	672.6	nu star (bias corrected)	169.5
MLE Mean (bias corrected)	14.23	MLE Sd (bias corrected)	3.091
		Approximate Chi Square Value (0.05)	140.4
Adjusted Level of Significance	N/A	Adjusted Chi Square Value	N/A

Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50))	17.17	95% Adjusted Gamma UCL (use when n<50)	N/A

Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.942	Shapiro Wilk Lognormal GOF Test	
5% Shapiro Wilk Critical Value	0.748	Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.228	Lilliefors Lognormal GOF Test	
5% Lilliefors Critical Value	0.443	Data appear Lognormal at 5% Significance Level	
Data appear Lognormal at 5% Significance Level			

Lognormal Statistics			
Minimum of Logged Data	2.518	Mean of logged Data	2.649
Maximum of Logged Data	2.791	SD of logged Data	0.126

Assuming Lognormal Distribution			
95% H-UCL	16.82	90% Chebyshev (MVUE) UCL	16.91
95% Chebyshev (MVUE) UCL	18.13	97.5% Chebyshev (MVUE) UCL	19.81
99% Chebyshev (MVUE) UCL	23.13		

Nonparametric Distribution Free UCL Statistics
Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs			
95% CLT UCL	15.7	95% Jackknife UCL	16.34
95% Standard Bootstrap UCL	N/A	95% Bootstrap-t UCL	N/A
95% Hall's Bootstrap UCL	N/A	95% Percentile Bootstrap UCL	N/A
95% BCA Bootstrap UCL	N/A		
90% Chebyshev(Mean, Sd) UCL	**16.92**	**95% Chebyshev(Mean, Sd) UCL**	**18.14**
97.5% Chebyshev(Mean, Sd) UCL	**19.83**	**99% Chebyshev(Mean, Sd) UCL**	**23.16**

Suggested UCL to Use
95% Student's-t UCL **16.34**
Recommended UCL exceeds the maximum observation

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

Cadmium

General Statistics			
Total Number of Observations	20	Number of Distinct Observations	19
		Number of Missing Observations	0
Minimum	0.409	Mean	4.32
Maximum	14.6	Median	3.24
SD	3.945	Std. Error of Mean	0.882
Coefficient of Variation	0.913	Skewness	1.603

Normal GOF Test			
Shapiro Wilk Test Statistic	0.787	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.905	Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.321	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.198	Data Not Normal at 5% Significance Level	
Data Not Normal at 5% Significance Level			

Assuming Normal Distribution			
95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	5.845	95% Adjusted-CLT UCL (Chen-1995)	6.108
		95% Modified-t UCL (Johnson-1978)	5.898

Gamma GOF Test			
A-D Test Statistic	0.554	Anderson-Darling Gamma GOF Test	
5% A-D Critical Value	0.758	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.225	Kolmogrov-Smirnoff Gamma GOF Test	
5% K-S Critical Value	0.197	Data Not Gamma Distributed at 5% Significance Level	
Detected data follow Appr. Gamma Distribution at 5% Significance Level			

Gamma Statistics			
k hat (MLE)	1.522	k star (bias corrected MLE)	1.327
Theta hat (MLE)	2.838	Theta star (bias corrected MLE)	3.255
nu hat (MLE)	60.88	nu star (bias corrected)	53.08
MLE Mean (bias corrected)	4.32	MLE Sd (bias corrected)	3.75
		Approximate Chi Square Value (0.05)	37.35
Adjusted Level of Significance	0.038	Adjusted Chi Square Value	36.3

Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50)	6.14	95% Adjusted Gamma UCL (use when n<50)	6.316

Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.965	Shapiro Wilk Lognormal GOF Test	
5% Shapiro Wilk Critical Value	0.905	Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.169	Lilliefors Lognormal GOF Test	
5% Lilliefors Critical Value	0.198	Data appear Lognormal at 5% Significance Level	
Data appear Lognormal at 5% Significance Level			

Lognormal Statistics			
Minimum of Logged Data	-0.894	Mean of logged Data	1.1
Maximum of Logged Data	2.681	SD of logged Data	0.904
Assuming Lognormal Distribution			
95% H-UCL	7.583	90% Chebyshev (MVUE) UCL	7.335
95% Chebyshev (MVUE) UCL	8.665	97.5% Chebyshev (MVUE) UCL	10.51
99% Chebyshev (MVUE) UCL	14.14		

Nonparametric Distribution Free UCL Statistics
Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs			
95% CLT UCL	5.771	95% Jackknife UCL	5.845
95% Standard Bootstrap UCL	5.734	95% Bootstrap-t UCL	6.484
95% Hall's Bootstrap UCL	6.194	95% Percentile Bootstrap UCL	5.8
95% BCA Bootstrap UCL	5.984		
90% Chebyshev(Mean, Sd) UCL	6.966	95% Chebyshev(Mean, Sd) UCL	8.165
97.5% Chebyshev(Mean, Sd) UCL	9.828	99% Chebyshev(Mean, Sd) UCL	13.1

Suggested UCL to Use
95% Adjusted Gamma UCL **6.316**

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

Lead

General Statistics			
Total Number of Observations	20	Number of Distinct Observations	20
		Number of Missing Observations	0
Minimum	21.4	Mean	651.9
Maximum	2340	Median	374
SD	662.2	Std. Error of Mean	148.1
Coefficient of Variation	1.016	Skewness	1.627
Normal GOF Test			
Shapiro Wilk Test Statistic	0.758	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.905	Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.281	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.198	Data Not Normal at 5% Significance Level	
Data Not Normal at 5% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	907.9	95% Adjusted-CLT UCL (Chen-1995)	953
		95% Modified-t UCL (Johnson-1978)	916.9
Gamma GOF Test			
A-D Test Statistic	0.712	Anderson-Darling Gamma GOF Test	
5% A-D Critical Value	0.763	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.196	Kolmogrov-Smirnoff Gamma GOF Test	
5% K-S Critical Value	0.198	Detected data appear Gamma Distributed at 5% Significance Level	
Detected data appear Gamma Distributed at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	1.223	k star (bias corrected MLE)	1.073
Theta hat (MLE)	533.1	Theta star (bias corrected MLE)	607.6
nu hat (MLE)	48.92	nu star (bias corrected)	42.91
MLE Mean (bias corrected)	651.9	MLE Sd (bias corrected)	629.4
		Approximate Chi Square Value (0.05)	28.89
Adjusted Level of Significance	0.038	Adjusted Chi Square Value	27.98
Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50)	968.2	95% Adjusted Gamma UCL (use when n<50)	999.6
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.924	Shapiro Wilk Lognormal GOF Test	
5% Shapiro Wilk Critical Value	0.905	Data appear Lognormal at 5% Significance Level	

Lilliefors Test Statistic	0.137	Lilliefors Lognormal GOF Test	
5% Lilliefors Critical Value	0.198	Data appear Lognormal at 5% Significance Level	
Data appear Lognormal at 5% Significance Level			

Lognormal Statistics			
Minimum of Logged Data	3.063	Mean of logged Data	6.018
Maximum of Logged Data	7.758	SD of logged Data	1.063

Assuming Lognormal Distribution			
95% H-UCL	1405	90% Chebyshev (MVUE) UCL	1252
95% Chebyshev (MVUE) UCL	1505	97.5% Chebyshev (MVUE) UCL	1856
99% Chebyshev (MVUE) UCL	2546		

Nonparametric Distribution Free UCL Statistics
Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs			
95% CLT UCL	895.4	95% Jackknife UCL	907.9
95% Standard Bootstrap UCL	889.5	95% Bootstrap-t UCL	1017
95% Hall's Bootstrap UCL	934	95% Percentile Bootstrap UCL	903.8
95% BCA Bootstrap UCL	960.1		
90% Chebyshev(Mean, Sd) UCL	1096	95% Chebyshev(Mean, Sd) UCL	1297
97.5% Chebyshev(Mean, Sd) UCL	1577	99% Chebyshev(Mean, Sd) UCL	2125

Suggested UCL to Use	
95% Adjusted Gamma UCL	**999.6**

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

Selenium

General Statistics			
Total Number of Observations	4	Number of Distinct Observations	4
Number of Detects	3	Number of Non-Detects	1
Number of Distinct Detects	3	Number of Distinct Non-Detects	1
Minimum Detect	0.486	Minimum Non-Detect	241%
Maximum Detect	0.564	Maximum Non-Detect	2.41
Variance Detects	0.00158	Percent Non-Detects	25%
Mean Detects	0.521	SD Detects	0.0397
Median Detects	0.512	CV Detects	0.0763
Skewness Detects	0.935	Kurtosis Detects	N/A
Mean of Logged Detects	-0.655	SD of Logged Detects	0.0755

Warning: Data set has only 3 Detected Values.
This is not enough to compute meaningful or reliable statistics and estimates.

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use
guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.
For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).
Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.0

Normal GOF Test on Detects Only			
Shapiro Wilk Test Statistic	0.964	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.767	Detected Data appear Normal at 5% Significance Level	
Lilliefors Test Statistic	0.253	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.512	Detected Data appear Normal at 5% Significance Level	
Detected Data appear Normal at 5% Significance Level			

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs			
Mean	0.521	Standard Error of Mean	0.0229
SD	0.0324	95% KM (BCA) UCL	N/A
95% KM (t) UCL	0.575	95% KM (Percentile Bootstrap) UCL	N/A
95% KM (z) UCL	0.558	95% KM Bootstrap t UCL	N/A
90% KM Chebyshev UCL	0.589	95% KM Chebyshev UCL	0.621
97.5% KM Chebyshev UCL	0.664	99% KM Chebyshev UCL	0.749

Gamma GOF Tests on Detected Observations Only
Not Enough Data to Perform GOF Test

Gamma Statistics on Detected Data Only

k hat (MLE)	261.4	k star (bias corrected MLE)	N/A
Theta hat (MLE)	0.00199	Theta star (bias corrected MLE)	N/A
nu hat (MLE)	1568	nu star (bias corrected)	N/A
MLE Mean (bias corrected)	N/A	MLE Sd (bias corrected)	N/A

Gamma Kaplan-Meier (KM) Statistics

k hat (KM)	257.8	nu hat (KM)	2062
		Adjusted Level of Significance (β)	0.00498
Approximate Chi Square Value (N/A, α)	1958	Adjusted Chi Square Value (N/A, β)	1901
95% Gamma Approximate KM-UCL (use when n>=50)	0.548	95% Gamma Adjusted KM-UCL (use when n<50)	0.565

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.971	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.767	Detected Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.245	Lilliefors GOF Test
5% Lilliefors Critical Value	0.512	Detected Data appear Lognormal at 5% Significance Level

Detected Data appear Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	0.52	Mean in Log Scale	-0.655
SD in Original Scale	0.0324	SD in Log Scale	0.0617
95% t UCL (assumes normality of ROS data)	0.559	95% Percentile Bootstrap UCL	N/A
95% BCA Bootstrap UCL	N/A	95% Bootstrap t UCL	N/A
95% H-UCL (Log ROS)	N/A		

UCLs using Lognormal Distribution and KM Estimates when Detected data are Lognormally Distributed

KM Mean (logged)	-0.655	95% H-UCL (KM -Log)	N/A
KM SD (logged)	0.0617	95% Critical H Value (KM-Log)	N/A
KM Standard Error of Mean (logged)	0.0436		

DL/2 Statistics

DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	0.692	Mean in Log Scale	-0.444
SD in Original Scale	0.344	SD in Log Scale	0.425
95% t UCL (Assumes normality)	1.096	95% H-Stat UCL	1.573

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Detected Data appear Normal Distributed at 5% Significance Level

Suggested UCL to Use

95% KM (t) UCL	**0.575**	**95% KM (Percentile Bootstrap) UCL**	**N/A**

Warning: One or more Recommended UCL(s) not available!

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
Recommendations are based upon data size, data distribution, and skewness.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

APPENDIX C-4

SOUTH WOODED AREA SUB-SURFACE SOIL

UCL Statistics for Uncensored Full Data Sets

User Selected Options	
Date/Time of Computation	5/15/2014 10:14
From File	SWA subsurface.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Lead

General Statistics

Total Number of Observations	6	Number of Distinct Observations	6
		Number of Missing Observations	0
Minimum	12.7	Mean	49.07
Maximum	112	Median	35.25
SD	38.11	Std. Error of Mean	15.56
Coefficient of Variation	0.777	Skewness	1.041

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.
For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).
Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.0

Normal GOF Test

Shapiro Wilk Test Statistic	0.892	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.788	Data appear Normal at 5% Significance Level	
Lilliefors Test Statistic	0.222	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.362	Data appear Normal at 5% Significance Level	

Data appear Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	80.42	95% Adjusted-CLT UCL (Chen-1995)	81.72
		95% Modified-t UCL (Johnson-1978)	81.52

Gamma GOF Test

A-D Test Statistic	0.241	Anderson-Darling Gamma GOF Test	
5% A-D Critical Value	0.704	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.21	Kolmogrov-Smirnoff Gamma GOF Test	
5% K-S Critical Value	0.336	Detected data appear Gamma Distributed at 5% Significance Level	

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	2.054	k star (bias corrected MLE)	1.138
Theta hat (MLE)	23.89	Theta star (bias corrected MLE)	43.11
nu hat (MLE)	24.65	nu star (bias corrected)	13.66
MLE Mean (bias corrected)	49.07	MLE Sd (bias corrected)	45.99
		Approximate Chi Square Value (0.05)	6.338
Adjusted Level of Significance	0.0122	Adjusted Chi Square Value	4.657

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	105.7	95% Adjusted Gamma UCL (use when n<50)	143.9

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.973	Shapiro Wilk Lognormal GOF Test	
5% Shapiro Wilk Critical Value	0.788	Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.167	Lilliefors Lognormal GOF Test	
5% Lilliefors Critical Value	0.362	Data appear Lognormal at 5% Significance Level	

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	2.542	Mean of logged Data	3.63
Maximum of Logged Data	4.718	SD of logged Data	0.809

Assuming Lognormal Distribution

95% H-UCL	185.9	90% Chebyshev (MVUE) UCL	97.3
95% Chebyshev (MVUE) UCL	119.2	97.5% Chebyshev (MVUE) UCL	149.5
99% Chebyshev (MVUE) UCL	209		

Nonparametric Distribution Free UCL Statistics
Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	74.66	95% Jackknife UCL	80.42
95% Standard Bootstrap UCL	72.69	95% Bootstrap-t UCL	118.3
95% Hall's Bootstrap UCL	236.2	95% Percentile Bootstrap UCL	74.58
95% BCA Bootstrap UCL	76.97		
90% Chebyshev(Mean, Sd) UCL	95.74	95% Chebyshev(Mean, Sd) UCL	116.9
97.5% Chebyshev(Mean, Sd) UCL	146.2	99% Chebyshev(Mean, Sd) UCL	203.9

Suggested UCL to Use	
95% Student's-t UCL	**80.42**

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002) and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

APPENDIX C-5

LAKE PARCEL SURFACE SOIL

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	5/13/2014 11:28
From File	lake parcel surface.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Cadmium

General Statistics

Total Number of Observations	17	Number of Distinct Observations	16
Number of Detects	16	Number of Non-Detects	1
Number of Distinct Detects	15	Number of Distinct Non-Detects	1
Minimum Detect	1.06	Minimum Non-Detect	1.05
Maximum Detect	4.43	Maximum Non-Detect	1.05
Variance Detects	0.891	Percent Non-Detects	5.88%
Mean Detects	1.948	SD Detects	0.944
Median Detects	1.545	CV Detects	0.485
Skewness Detects	1.513	Kurtosis Detects	2.122
Mean of Logged Detects	0.575	SD of Logged Detects	0.425

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.838	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.887	Detected Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.226	Lilliefors GOF Test
5% Lilliefors Critical Value	0.222	Detected Data Not Normal at 5% Significance Level
Detected Data Not Normal at 5% Significance Level		

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs

Mean	1.895	Standard Error of Mean	0.228
SD	0.912	95% KM (BCA) UCL	2.271
95% KM (t) UCL	2.293	95% KM (Percentile Bootstrap) UCL	2.263
95% KM (z) UCL	2.27	95% KM Bootstrap t UCL	2.472
90% KM Chebyshev UCL	2.58	95% KM Chebyshev UCL	2.89
97.5% KM Chebyshev UCL	3.321	99% KM Chebyshev UCL	4.167

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	0.541	Anderson-Darling GOF Test
5% A-D Critical Value	0.741	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.21	Kolmogrov-Smirnoff GOF
5% K-S Critical Value	0.216	Detected data appear Gamma Distributed at 5% Significance Level
Detected data appear Gamma Distributed at 5% Significance Level		

Gamma Statistics on Detected Data Only

k hat (MLE)	5.62	k star (bias corrected MLE)	4.608
Theta hat (MLE)	0.347	Theta star (bias corrected MLE)	0.423
nu hat (MLE)	179.8	nu star (bias corrected)	147.4
MLE Mean (bias corrected)	1.948	MLE Sd (bias corrected)	0.907

Gamma Kaplan-Meier (KM) Statistics

k hat (KM)	4.32	nu hat (KM)	146.9
Approximate Chi Square Value (146.89, α)	119.9	Adjusted Chi Square Value (146.89, β)	117.3
95% Gamma Approximate KM-UCL (use when n>=50)	2.322	95% Gamma Adjusted KM-UCL (use when n<50)	2.372

Gamma ROS Statistics using Imputed Non-Detects
GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs
GROS may not be used when kstar of detected data is small such as < 0.1
For such situations, GROS method tends to yield inflated values of UCLs and BTVs
For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.228	Mean	1.846
Maximum	4.43	Median	1.54
SD	1.005	CV	0.544
k hat (MLE)	3.301	k star (bias corrected MLE)	2.757
Theta hat (MLE)	0.559	Theta star (bias corrected MLE)	0.67
nu hat (MLE)	112.2	nu star (bias corrected)	93.75
MLE Mean (bias corrected)	1.846	MLE Sd (bias corrected)	1.112
		Adjusted Level of Significance (β)	0.0346
Approximate Chi Square Value (93.75, α)	72.42	Adjusted Chi Square Value (93.75, β)	70.46
95% Gamma Approximate UCL (use when n>=50)	2.39	95% Gamma Adjusted UCL (use when n<50)	2.457

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.931	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.887	Detected Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.189	Lilliefors GOF Test
5% Lilliefors Critical Value	0.222	Detected Data appear Lognormal at 5% Significance Level
Detected Data appear Lognormal at 5% Significance Level		

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	1.87	Mean in Log Scale	0.514
SD in Original Scale	0.968	SD in Log Scale	0.483
95% t UCL (assumes normality of ROS data)	2.28	95% Percentile Bootstrap UCL	2.286
95% BCA Bootstrap UCL	2.287	95% Bootstrap t UCL	2.459
95% H-UCL (Log ROS)	2.397		

UCLs using Lognormal Distribution and KM Estimates when Detected data are Lognormally Distributed

KM Mean (logged)	0.544	95% H-UCL (KM -Log)	2.308
KM SD (logged)	0.418	95% Critical H Value (KM-Log)	1.958
KM Standard Error of Mean (logged)	0.105		

DL/2 Statistics

DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	1.864	Mean in Log Scale	0.503

SD in Original Scale	0.977	SD in Log Scale	0.507
95% t UCL (Assumes normality)	2.278	95% H-Stat UCL	2.437

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics
Detected Data appear Gamma Distributed at 5% Significance Level

Suggested UCL to Use			
95% KM (BCA) UCL	**2.271**	**95% GROS Adjusted Gamma UCL**	**2.457**
95% Adjusted Gamma KM-UCL	**2.372**		

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
Recommendations are based upon data size, data distribution, and skewness.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Lead

General Statistics

Total Number of Observations	17	Number of Distinct Observations	16
		Number of Missing Observations	0
Minimum	60.7	Mean	179
Maximum	367	Median	######
SD	75.63	Std. Error of Mean	18.34
Coefficient of Variation	0.422	Skewness	0.98

Normal GOF Test

Shapiro Wilk Test Statistic	0.916	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.892	Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.243	Lilliefors GOF Test
5% Lilliefors Critical Value	0.215	Data Not Normal at 5% Significance Level

Data appear Approximate Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	211.1	95% Adjusted-CLT UCL (Chen-1995)	213.9
		95% Modified-t UCL (Johnson-1978)	211.8

Gamma GOF Test

A-D Test Statistic	0.429	Anderson-Darling Gamma GOF Test
5% A-D Critical Value	0.741	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.192	Kolmogrov-Smirnoff Gamma GOF Test
5% K-S Critical Value	0.21	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	6.199	k star (bias corrected MLE)	5.144
Theta hat (MLE)	28.88	Theta star (bias corrected MLE)	34.81
nu hat (MLE)	210.8	nu star (bias corrected)	174.9
MLE Mean (bias corrected)	179	MLE Sd (bias corrected)	78.94
		Approximate Chi Square Value (0.05)	145.3
Adjusted Level of Significance	0.0346	Adjusted Chi Square Value	142.5

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	215.5	95% Adjusted Gamma UCL (use when n<50)	219.8

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.959	Shapiro Wilk Lognormal GOF Test
5% Shapiro Wilk Critical Value	0.892	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.166	Lilliefors Lognormal GOF Test
5% Lilliefors Critical Value	0.215	Data appear Lognormal at 5% Significance Level

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	4.106	Mean of logged Data	5.105
Maximum of Logged Data	5.905	SD of logged Data	0.427

Assuming Lognormal Distribution

95% H-UCL	222.6	90% Chebyshev (MVUE) UCL	236.6
95% Chebyshev (MVUE) UCL	262.5	97.5% Chebyshev (MVUE) UCL	298.4
99% Chebyshev (MVUE) UCL	368.9		

Nonparametric Distribution Free UCL Statistics
Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	209.2	95% Jackknife UCL	211.1
95% Standard Bootstrap UCL	208.5	95% Bootstrap-t UCL	215.4
95% Hall's Bootstrap UCL	223.7	95% Percentile Bootstrap UCL	209.1
95% BCA Bootstrap UCL	213.2		
90% Chebyshev(Mean, Sd) UCL	234.1	95% Chebyshev(Mean, Sd) UCL	259
97.5% Chebyshev(Mean, Sd) UCL	293.6	99% Chebyshev(Mean, Sd) UCL	361.5

Suggested UCL to Use	
95% Student's-t UCL	**211.1**

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

APPENDIX C-6

LAKE PARCEL SUB-SURFACE SOIL

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	5/13/2014 8:46
From File	lake parcel subsurface.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Cadmium

General Statistics

Total Number of Observations	5	Number of Distinct Observations	4
Number of Detects	2	Number of Non-Detects	3
Number of Distinct Detects	2	Number of Distinct Non-Detects	2
Minimum Detect	0.0782	Minimum Non-Detect	0.317
Maximum Detect	0.275	Maximum Non-Detect	0.337
Variance Detects	0.0194	Percent Non-Detects	60%
Mean Detects	0.177	SD Detects	0.139
Median Detects	0.177	CV Detects	0.788
Skewness Detects	N/A	Kurtosis Detects	N/A
Mean of Logged Detects	-1.92	SD of Logged Detects	0.889

Warning: Data set has only 2 Detected Values.
This is not enough to compute meaningful or reliable statistics and estimates.

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.
For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).
Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.0

Normal GOF Test on Detects Only
Not Enough Data to Perform GOF Test

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs

Mean	0.177	Standard Error of Mean	0.0984
SD	0.0984	95% KM (BCA) UCL	N/A
95% KM (t) UCL	0.386	95% KM (Percentile Bootstrap) UCL	N/A
95% KM (z) UCL	0.338	95% KM Bootstrap t UCL	N/A
90% KM Chebyshev UCL	0.472	95% KM Chebyshev UCL	0.606
97.5% KM Chebyshev UCL	0.791	99% KM Chebyshev UCL	1.156

Gamma GOF Tests on Detected Observations Only
Not Enough Data to Perform GOF Test

Gamma Statistics on Detected Data Only

k hat (MLE)	2.846	k star (bias corrected MLE)	N/A
Theta hat (MLE)	0.0621	Theta star (bias corrected MLE)	N/A
nu hat (MLE)	11.38	nu star (bias corrected)	N/A
MLE Mean (bias corrected)	N/A	MLE Sd (bias corrected)	N/A

Gamma Kaplan-Meier (KM) Statistics

k hat (KM)	3.221	nu hat (KM)	32.21
		Adjusted Level of Significance (β)	0.0086
Approximate Chi Square Value (32.21, α)	20.24	Adjusted Chi Square Value (32.21, β)	16.23
95% Gamma Approximate KM-UCL (use when n>=50)	0.281	95% Gamma Adjusted KM-UCL (use when n<50)	0.351

Lognormal GOF Test on Detected Observations Only
Not Enough Data to Perform GOF Test

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	0.171	Mean in Log Scale	-1.92
SD in Original Scale	0.0993	SD in Log Scale	0.629
95% t UCL (assumes normality of ROS data)	0.265	95% Percentile Bootstrap UCL	0.236
95% BCA Bootstrap UCL	0.236	95% Bootstrap t UCL	0.343
95% H-UCL (Log ROS)	0.519		

DL/2 Statistics

DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	0.168	Mean in Log Scale	-1.861
SD in Original Scale	0.0702	SD in Log Scale	0.449
95% t UCL (Assumes normality)	0.235	95% H-Stat UCL	0.321

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics
Data do not follow a Discernible Distribution at 5% Significance Level

Suggested UCL to Use

95% KM (t) UCL	**0.386**	**95% KM (% Bootstrap) UCL**	**N/A**

Warning: One or more Recommended UCL(s) not available!
Warning: Recommended UCL exceeds the maximum observation

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
Recommendations are based upon data size, data distribution, and skewness.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Lead

General Statistics

Total Number of Observations	5	Number of Distinct Observations	5
		Number of Missing Observations	0
Minimum	13.9	Mean	16.7
Maximum	18.2	Median	17.6
SD	1.801	Std. Error of Mean	0.806
Coefficient of Variation	0.108	Skewness	-1.186

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest. For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).
Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.0

Normal GOF Test

Shapiro Wilk Test Statistic	0.86	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.762	Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.291	Lilliefors GOF Test
5% Lilliefors Critical Value	0.396	Data appear Normal at 5% Significance Level

Data appear Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	18.42	95% Adjusted-CLT UCL (Chen-1995)	17.57
		95% Modified-t UCL (Johnson-1978)	18.35

Gamma GOF Test

A-D Test Statistic	0.482	Anderson-Darling Gamma GOF Test
5% A-D Critical Value	0.678	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.314	Kolmogrov-Smirnoff Gamma GOF Test
5% K-S Critical Value	0.357	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	101.3	k star (bias corrected MLE)	40.66
Theta hat (MLE)	0.165	Theta star (bias corrected MLE)	0.411
nu hat (MLE)	1013	nu star (bias corrected)	406.6
MLE Mean (bias corrected)	16.7	MLE Sd (bias corrected)	2.619
		Approximate Chi Square Value (0.05)	360.9
Adjusted Level of Significance	0.0086	Adjusted Chi Square Value	341.8

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	18.82	95% Adjusted Gamma UCL (use when n<50)	19.87

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.847	Shapiro Wilk Lognormal GOF Test
5% Shapiro Wilk Critical Value	0.762	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.295	Lilliefors Lognormal GOF Test
5% Lilliefors Critical Value	0.396	Data appear Lognormal at 5% Significance Level

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	2.632	Mean of logged Data	2.81
Maximum of Logged Data	2.901	SD of logged Data	0.113

Assuming Lognormal Distribution

95% H-UCL	18.78	90% Chebyshev (MVUE) UCL	19.23
95% Chebyshev (MVUE) UCL	20.38	97.5% Chebyshev (MVUE) UCL	21.96
99% Chebyshev (MVUE) UCL	25.09		

Nonparametric Distribution Free UCL Statistics
Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	18.03	95% Jackknife UCL	18.42
95% Standard Bootstrap UCL	17.87	95% Bootstrap-t UCL	17.99
95% Hall's Bootstrap UCL	17.48	95% Percentile Bootstrap UCL	17.84
95% BCA Bootstrap UCL	17.56		
90% Chebyshev(Mean, Sd) UCL	19.12	95% Chebyshev(Mean, Sd) UCL	20.21
97.5% Chebyshev(Mean, Sd) UCL	21.73	99% Chebyshev(Mean, Sd) UCL	24.72

Suggested UCL to Use
95% Student's-t UCL **18.42**

Recommended UCL exceeds the maximum observation

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL. These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002) and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

Note: For highly negatively-skewed data, confidence limits (e.g., Chen, Johnson, Lognormal, and Gamma) may not be reliable. Chen's and Johnson's methods provide adjustments for positvely skewed data sets.

APPENDIX C-7

STEWART CREEK CORRIDOR SURFACE SOIL

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	5/15/2014 10:49
From File	SCC surface soil.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Antimony

General Statistics

Total Number of Observations	6	Number of Distinct Observations	6
Number of Detects	5	Number of Non-Detects	1
Number of Distinct Detects	5	Number of Distinct Non-Detects	1
Minimum Detect	0.315	Minimum Non-Detect	2.7
Maximum Detect	32.4	Maximum Non-Detect	2.7
Variance Detects	182.1	Percent Non-Detects	16.67%
Mean Detects	8.433	SD Detects	13.49
Median Detects	3.11	CV Detects	1.6
Skewness Detects	2.157	Kurtosis Detects	4.716
Mean of Logged Detects	1.104	SD of Logged Detects	1.678

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.
For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).
Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.0

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.667	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.762	Detected Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.41	Lilliefors GOF Test
5% Lilliefors Critical Value	0.396	Detected Data Not Normal at 5% Significance Level

Detected Data Not Normal at 5% Significance Level

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs

Mean	7.195	Standard Error of Mean	5.19
SD	11.36	95% KM (BCA) UCL	17.55
95% KM (t) UCL	17.65	95% KM (Percentile Bootstrap) UCL	17.05
95% KM (z) UCL	15.73	95% KM Bootstrap t UCL	63.59
90% KM Chebyshev UCL	22.76	95% KM Chebyshev UCL	29.82
97.5% KM Chebyshev UCL	39.6	99% KM Chebyshev UCL	58.83

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	0.367	Anderson-Darling GOF Test
5% A-D Critical Value	0.706	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.289	Kolmogrov-Smirnoff GOF
5% K-S Critical Value	0.37	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics on Detected Data Only

k hat (MLE)	0.601	k star (bias corrected MLE)	0.374
Theta hat (MLE)	14.04	Theta star (bias corrected MLE)	22.57
nu hat (MLE)	6.008	nu star (bias corrected)	3.736
MLE Mean (bias corrected)	8.433	MLE Sd (bias corrected)	13.8

Gamma Kaplan-Meier (KM) Statistics

k hat (KM)	0.401	nu hat (KM)	4.809
Approximate Chi Square Value (4.81, α)	1.065	Adjusted Chi Square Value (4.81, β)	0.563
95% Gamma Approximate KM-UCL (use when n>=50)	32.48	95% Gamma Adjusted KM-UCL (use when n<50)	61.48

Gamma ROS Statistics using Imputed Non-Detects
GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs
GROS may not be used when kstar of detected data is small such as < 0.1
For such situations, GROS method tends to yield inflated values of UCLs and BTVs
For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.01	Mean	7.029
Maximum	32.4	Median	2.4
SD	12.55	CV	1.785
k hat (MLE)	0.371	k star (bias corrected MLE)	0.296
Theta hat (MLE)	18.97	Theta star (bias corrected MLE)	23.71
nu hat (MLE)	4.447	nu star (bias corrected)	3.557
MLE Mean (bias corrected)	7.029	MLE Sd (bias corrected)	12.91
		Adjusted Level of Significance (β)	0.0122
Approximate Chi Square Value (3.56, α)	0.555	Adjusted Chi Square Value (3.56, β)	0.259

95% Gamma Approximate UCL (use when n>=50)	45.06	95% Gamma Adjusted UCL (use when n<50)	96.7

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.981	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.762	Detected Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.198	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.396	Detected Data appear Lognormal at 5% Significance Level	

Detected Data appear Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	7.133	Mean in Log Scale	0.844
SD in Original Scale	12.48	SD in Log Scale	1.63
95% t UCL (assumes normality of ROS data)	17.4	95% Percentile Bootstrap UCL	16.82
95% BCA Bootstrap UCL	17.78	95% Bootstrap t UCL	73.9
95% H-UCL (Log ROS)	899.8		

UCLs using Lognormal Distribution and KM Estimates when Detected data are Lognormally Distributed

KM Mean (logged)	0.867	95% H-UCL (KM -Log)	399.6
KM SD (logged)	1.508	95% Critical H Value (KM-Log)	5.909
KM Standard Error of Mean (logged)	0.715		

DL/2 Statistics

DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	7.253	Mean in Log Scale	0.97
SD in Original Scale	12.41	SD in Log Scale	1.536
95% t UCL (Assumes normality)	17.46	95% H-Stat UCL	533.9

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Detected Data appear Gamma Distributed at 5% Significance Level

Suggested UCL to Use			
95% KM (Chebyshev) UCL	**29.82**	**95% GROS Adjusted Gamma UCL**	**96.7**
95% Adjusted Gamma KM-UCL	**61.48**		

Warning: Recommended UCL exceeds the maximum observation

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
Recommendations are based upon data size, data distribution, and skewness.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Arsenic

General Statistics

Total Number of Observations	6	Number of Distinct Observations	6
		Number of Missing Observations	0
Minimum	9.45	Mean	16.56
Maximum	36.7	Median	12.85
SD	10.16	Std. Error of Mean	4.148
Coefficient of Variation	0.614	Skewness	2.15

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use
guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.
For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).
Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.0

Normal GOF Test

Shapiro Wilk Test Statistic	0.715	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.788	Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.34	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.362	Data appear Normal at 5% Significance Level	

Data appear Approximate Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	24.92	95% Adjusted-CLT UCL (Chen-1995)	27.27
		95% Modified-t UCL (Johnson-1978)	25.52

Gamma GOF Test

A-D Test Statistic	0.644	Anderson-Darling Gamma GOF Test
5% A-D Critical Value	0.699	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.279	Kolmogrov-Smirnoff Gamma GOF Test
5% K-S Critical Value	0.333	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics			
k hat (MLE)	4.51	k star (bias corrected MLE)	2.366
Theta hat (MLE)	3.672	Theta star (bias corrected MLE)	6.998
nu hat (MLE)	54.12	nu star (bias corrected)	28.39
MLE Mean (bias corrected)	16.56	MLE Sd (bias corrected)	10.76
		Approximate Chi Square Value (0.05)	17.23
Adjusted Level of Significance	0.0122	Adjusted Chi Square Value	14.19
Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50))	27.28	95% Adjusted Gamma UCL (use when n<50)	33.13
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.845	Shapiro Wilk Lognormal GOF Test	
5% Shapiro Wilk Critical Value	0.788	Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.247	Lilliefors Lognormal GOF Test	
5% Lilliefors Critical Value	0.362	Data appear Lognormal at 5% Significance Level	
Data appear Lognormal at 5% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	2.246	Mean of logged Data	2.692
Maximum of Logged Data	3.603	SD of logged Data	0.485
Assuming Lognormal Distribution			
95% H-UCL	29.21	90% Chebyshev (MVUE) UCL	25.91
95% Chebyshev (MVUE) UCL	30.29	97.5% Chebyshev (MVUE) UCL	36.35
99% Chebyshev (MVUE) UCL	48.28		
Nonparametric Distribution Free UCL Statistics			
Data appear to follow a Discernible Distribution at 5% Significance Level			
Nonparametric Distribution Free UCLs			
95% CLT UCL	23.38	95% Jackknife UCL	24.92
95% Standard Bootstrap UCL	22.65	95% Bootstrap-t UCL	44.46
95% Hall's Bootstrap UCL	52.05	95% Percentile Bootstrap UCL	24
95% BCA Bootstrap UCL	25.37		
90% Chebyshev(Mean, Sd) UCL	29	95% Chebyshev(Mean, Sd) UCL	34.64
97.5% Chebyshev(Mean, Sd) UCL	42.46	99% Chebyshev(Mean, Sd) UCL	57.83
Suggested UCL to Use			
95% Student's-t UCL	**24.92**		

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

Cadmium

General Statistics			
Total Number of Observations	36	Number of Distinct Observations	36
		Number of Missing Observations	0
Minimum	0.0829	Mean	6.578
Maximum	106	Median	1.475
SD	18.23	Std. Error of Mean	3.039
Coefficient of Variation	2.772	Skewness	4.996
Normal GOF Test			
Shapiro Wilk Test Statistic	0.362	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.935	Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.381	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.148	Data Not Normal at 5% Significance Level	
Data Not Normal at 5% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	11.71	95% Adjusted-CLT UCL (Chen-1995)	14.28
		95% Modified-t UCL (Johnson-1978)	12.13
Gamma GOF Test			
A-D Test Statistic	2.579	Anderson-Darling Gamma GOF Test	
5% A-D Critical Value	0.815	Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.219	Kolmogrov-Smirnoff Gamma GOF Test	
5% K-S Critical Value	0.156	Data Not Gamma Distributed at 5% Significance Level	
Data Not Gamma Distributed at 5% Significance Level			

Gamma Statistics			
k hat (MLE)	0.486	k star (bias corrected MLE)	0.464
Theta hat (MLE)	13.53	Theta star (bias corrected MLE)	14.17
nu hat (MLE)	35	nu star (bias corrected)	33.42
MLE Mean (bias corrected)	6.578	MLE Sd (bias corrected)	9.655
		Approximate Chi Square Value (0.05)	21.2
Adjusted Level of Significance	0.0428	Adjusted Chi Square Value	20.76
Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50))	10.37	95% Adjusted Gamma UCL (use when n<50)	10.59
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.977	Shapiro Wilk Lognormal GOF Test	
5% Shapiro Wilk Critical Value	0.935	Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.0892	Lilliefors Lognormal GOF Test	
5% Lilliefors Critical Value	0.148	Data appear Lognormal at 5% Significance Level	
Data appear Lognormal at 5% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	-2.49	Mean of logged Data	0.571
Maximum of Logged Data	4.663	SD of logged Data	1.479
Assuming Lognormal Distribution			
95% H-UCL	11.14	90% Chebyshev (MVUE) UCL	9.712
95% Chebyshev (MVUE) UCL	11.85	97.5% Chebyshev (MVUE) UCL	14.83
99% Chebyshev (MVUE) UCL	20.67		
Nonparametric Distribution Free UCL Statistics			
Data appear to follow a Discernible Distribution at 5% Significance Level			
Nonparametric Distribution Free UCLs			
95% CLT UCL	11.58	95% Jackknife UCL	11.71
95% Standard Bootstrap UCL	11.41	95% Bootstrap-t UCL	25.83
95% Hall's Bootstrap UCL	27.81	95% Percentile Bootstrap UCL	12.1
95% BCA Bootstrap UCL	15.08		
90% Chebyshev(Mean, Sd) UCL	15.69	95% Chebyshev(Mean, Sd) UCL	19.82
97.5% Chebyshev(Mean, Sd) UCL	25.56	99% Chebyshev(Mean, Sd) UCL	36.81
Suggested UCL to Use			
95% H-UCL	**11.14**		

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

ProUCL computes and outputs H-statistic based UCLs for historical reasons only.
H-statistic often results in unstable (both high and low) values of UCL95 as shown in examples in the Technical Guide.
It is therefore recommended to avoid the use of H-statistic based 95% UCLs.

Lead

General Statistics			
Total Number of Observations	37	Number of Distinct Observations	37
		Number of Missing Observations	0
Minimum	8.82	Mean	768
Maximum	6830	Median	200
SD	1430	Std. Error of Mean	235.1
Coefficient of Variation	1.862	Skewness	3.095
Normal GOF Test			
Shapiro Wilk Test Statistic	0.556	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.936	Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.316	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.146	Data Not Normal at 5% Significance Level	
Data Not Normal at 5% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	1165	95% Adjusted-CLT UCL (Chen-1995)	1282
		95% Modified-t UCL (Johnson-1978)	1185
Gamma GOF Test			
A-D Test Statistic	1.447	Anderson-Darling Gamma GOF Test	
5% A-D Critical Value	0.808	Data Not Gamma Distributed at 5% Significance Level	

K-S Test Statistic	0.185	Kolmogrov-Smirnoff Gamma GOF Test	
5% K-S Critical Value	0.153	Data Not Gamma Distributed at 5% Significance Level	
Data Not Gamma Distributed at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	0.546	k star (bias corrected MLE)	0.52
Theta hat (MLE)	1407	Theta star (bias corrected MLE)	1478
nu hat (MLE)	40.4	nu star (bias corrected)	38.46
MLE Mean (bias corrected)	768	MLE Sd (bias corrected)	1065
		Approximate Chi Square Value (0.05)	25.26
Adjusted Level of Significance	0.0431	Adjusted Chi Square Value	24.79
Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50))	1169	95% Adjusted Gamma UCL (use when n<50)	1191
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.98	Shapiro Wilk Lognormal GOF Test	
5% Shapiro Wilk Critical Value	0.936	Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.0789	Lilliefors Lognormal GOF Test	
5% Lilliefors Critical Value	0.146	Data appear Lognormal at 5% Significance Level	
Data appear Lognormal at 5% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	2.177	Mean of logged Data	5.496
Maximum of Logged Data	8.829	SD of logged Data	1.552
Assuming Lognormal Distribution			
95% H-UCL	1808	90% Chebyshev (MVUE) UCL	1521
95% Chebyshev (MVUE) UCL	1865	97.5% Chebyshev (MVUE) UCL	2342
99% Chebyshev (MVUE) UCL	3281		
Nonparametric Distribution Free UCL Statistics			
Data appear to follow a Discernible Distribution at 5% Significance Level			
Nonparametric Distribution Free UCLs			
95% CLT UCL	1155	95% Jackknife UCL	1165
95% Standard Bootstrap UCL	1147	95% Bootstrap-t UCL	1568
95% Hall's Bootstrap UCL	1460	95% Percentile Bootstrap UCL	1184
95% BCA Bootstrap UCL	1303		
90% Chebyshev(Mean, Sd) UCL	1473	95% Chebyshev(Mean, Sd) UCL	1793
97.5% Chebyshev(Mean, Sd) UCL	2236	99% Chebyshev(Mean, Sd) UCL	3107
Suggested UCL to Use			
95% Chebyshev (Mean, Sd) UCL	**1793**		

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

Selenium

General Statistics			
Total Number of Observations	5	Number of Distinct Observations	5
Number of Detects	3	Number of Non-Detects	2
Number of Distinct Detects	3	Number of Distinct Non-Detects	2
Minimum Detect	0.403	Minimum Non-Detect	2.16
Maximum Detect	1.35	Maximum Non-Detect	2.31
Variance Detects	0.25	Percent Non-Detects	40%
Mean Detects	0.785	SD Detects	0.5
Median Detects	0.601	CV Detects	0.637
Skewness Detects	1.431	Kurtosis Detects	N/A
Mean of Logged Detects	-0.373	SD of Logged Detects	0.616

Warning: Data set has only 3 Detected Values.
This is not enough to compute meaningful or reliable statistics and estimates.

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use
guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.
For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).
Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.0

Normal GOF Test on Detects Only		
Shapiro Wilk Test Statistic	0.899	Shapiro Wilk GOF Test

5% Shapiro Wilk Critical Value	0.767	Detected Data appear Normal at 5% Significance Level	
Lilliefors Test Statistic	0.31	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.512	Detected Data appear Normal at 5% Significance Level	
Detected Data appear Normal at 5% Significance Level			

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs

Mean	0.785	Standard Error of Mean	0.288
SD	0.408	95% KM (BCA) UCL	N/A
95% KM (t) UCL	1.399	95% KM (Percentile Bootstrap) UCL	N/A
95% KM (z) UCL	1.259	95% KM Bootstrap t UCL	N/A
90% KM Chebyshev UCL	1.65	95% KM Chebyshev UCL	2.042
97.5% KM Chebyshev UCL	2.586	99% KM Chebyshev UCL	3.654

Gamma GOF Tests on Detected Observations Only
Not Enough Data to Perform GOF Test

Gamma Statistics on Detected Data Only

k hat (MLE)	4.001	k star (bias corrected MLE)	N/A
Theta hat (MLE)	0.196	Theta star (bias corrected MLE)	N/A
nu hat (MLE)	24.01	nu star (bias corrected)	N/A
MLE Mean (bias corrected)	N/A	MLE Sd (bias corrected)	N/A

Gamma Kaplan-Meier (KM) Statistics

k hat (KM)	3.702	nu hat (KM)	37.02
		Adjusted Level of Significance (β)	0.0086
Approximate Chi Square Value (37.02, α)	24.09	Adjusted Chi Square Value (37.02, β)	19.66
95% Gamma Approximate KM-UCL (use when n>=50)	1.206	95% Gamma Adjusted KM-UCL (use when n<50)	1.478

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.963	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.767	Detected Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.254	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.512	Detected Data appear Lognormal at 5% Significance Level	
Detected Data appear Lognormal at 5% Significance Level			

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	0.746	Mean in Log Scale	-0.373
SD in Original Scale	0.357	SD in Log Scale	0.436
95% t UCL (assumes normality of ROS data)	1.087	95% Percentile Bootstrap UCL	N/A
95% BCA Bootstrap UCL	N/A	95% Bootstrap t UCL	N/A
95% H-UCL (Log ROS)	1.379		

UCLs using Lognormal Distribution and KM Estimates when Detected data are Lognormally Distributed

KM Mean (logged)	-0.373	95% H-UCL (KM -Log)	1.644
KM SD (logged)	0.503	95% Critical H Value (KM-Log)	2.956
KM Standard Error of Mean (logged)	0.356		

DL/2 Statistics

DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	0.918	Mean in Log Scale	-0.179
SD in Original Scale	0.398	SD in Log Scale	0.51
95% t UCL (Assumes normality)	1.298	95% H-Stat UCL	2.036

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics
Detected Data appear Normal Distributed at 5% Significance Level

Suggested UCL to Use			
95% KM (t) UCL	**1.399**	**95% KM (Percentile Bootstrap) UCL**	**N/A**

Warning: One or more Recommended UCL(s) not available!

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
Recommendations are based upon data size, data distribution, and skewness.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

APPENDIX C-8

STEWART CREEK CORRIDOR SUB-SURFACE SOIL

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	5/15/2014 11:16
From File	SCC subsurface.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Antimony

General Statistics

Total Number of Observations	3	Number of Distinct Observations	3
Number of Detects	2	Number of Non-Detects	1
Number of Distinct Detects	2	Number of Distinct Non-Detects	1
Minimum Detect	0.809	Minimum Non-Detect	2.97
Maximum Detect	4.65	Maximum Non-Detect	2.97
Variance Detects	7.377	Percent Non-Detects	33%
Mean Detects	2.73	SD Detects	2.716
Median Detects	2.73	CV Detects	0.995
Skewness Detects	N/A	Kurtosis Detects	N/A
Mean of Logged Detects	0.662	SD of Logged Detects	1.237

Warning: Data set has only 2 Detected Values.
This is not enough to compute meaningful or reliable statistics and estimates.

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest. For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012). Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.0

Normal GOF Test on Detects Only
Not Enough Data to Perform GOF Test

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs

Mean	2.089	Standard Error of Mean	1.478
SD	1.811	95% KM (BCA) UCL	N/A
95% KM (t) UCL	6.406	95% KM (Percentile Bootstrap) UCL	N/A
95% KM (z) UCL	4.521	95% KM Bootstrap t UCL	N/A
90% KM Chebyshev UCL	6.525	95% KM Chebyshev UCL	8.534
97.5% KM Chebyshev UCL	11.32	99% KM Chebyshev UCL	16.8

Gamma GOF Tests on Detected Observations Only
Not Enough Data to Perform GOF Test

Gamma Statistics on Detected Data Only

k hat (MLE)	1.61	k star (bias corrected MLE)	N/A
Theta hat (MLE)	1.695	Theta star (bias corrected MLE)	N/A
nu hat (MLE)	6.44	nu star (bias corrected)	N/A
MLE Mean (bias corrected)	N/A	MLE Sd (bias corrected)	N/A

Gamma Kaplan-Meier (KM) Statistics

k hat (KM)	1.331	nu hat (KM)	7.989
		Adjusted Level of Significance (β)	0.00136
Approximate Chi Square Value (7.99, α)	2.729	Adjusted Chi Square Value (7.99, β)	0.936
95% Gamma Approximate KM-UCL (use when n>=50)	6.117	95% Gamma Adjusted KM-UCL (use when n<50)	17.83

Lognormal GOF Test on Detected Observations Only
Not Enough Data to Perform GOF Test

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	2.089	Mean in Log Scale	0.371
SD in Original Scale	2.218	SD in Log Scale	1.01
95% t UCL (assumes normality of ROS data)	5.828	95% Percentile Bootstrap UCL	N/A
95% BCA Bootstrap UCL	N/A	95% Bootstrap t UCL	N/A
95% H-UCL (Log ROS)	29391		

DL/2 Statistics

DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	2.315	Mean in Log Scale	0.573
SD in Original Scale	2.051	SD in Log Scale	0.888
95% t UCL (Assumes normality)	5.772	95% H-Stat UCL	3786

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics
Data do not follow a Discernible Distribution at 5% Significance Level

Suggested UCL to Use

97.5% KM (Chebyshev) UCL **11.32**
Warning: Recommended UCL exceeds the maximum observation

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
Recommendations are based upon data size, data distribution, and skewness.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Arsenic

General Statistics

Total Number of Observations	5	Number of Distinct Observations	5
		Number of Missing Observations	0
Minimum	2.7	Mean	30.98
Maximum	115	Median	11.4
SD	47.24	Std. Error of Mean	21.13
Coefficient of Variation	1.525	Skewness	2.172

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use
guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.
For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).
Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.0

Normal GOF Test

Shapiro Wilk Test Statistic	0.656	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.762	Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.418	Lilliefors GOF Test
5% Lilliefors Critical Value	0.396	Data Not Normal at 5% Significance Level
Data Not Normal at 5% Significance Level		

Assuming Normal Distribution

95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	76.02	95% Adjusted-CLT UCL (Chen-1995)	87.66
		95% Modified-t UCL (Johnson-1978)	79.44

Gamma GOF Test

A-D Test Statistic	0.513	Anderson-Darling Gamma GOF Test
5% A-D Critical Value	0.698	Detected data appear Gamma Distributed at 5% Significance Leve
K-S Test Statistic	0.332	Kolmogrov-Smirnoff Gamma GOF Test
5% K-S Critical Value	0.367	Detected data appear Gamma Distributed at 5% Significance Leve
Detected data appear Gamma Distributed at 5% Significance Level		

Gamma Statistics

k hat (MLE)	0.752	k star (bias corrected MLE)	0.434
Theta hat (MLE)	41.18	Theta star (bias corrected MLE)	71.34
nu hat (MLE)	7.523	nu star (bias corrected)	4.342
MLE Mean (bias corrected)	30.98	MLE Sd (bias corrected)	47.01
		Approximate Chi Square Value (0.05)	0.861
Adjusted Level of Significance	0.0086	Adjusted Chi Square Value	0.371

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50)	156.2	95% Adjusted Gamma UCL (use when n<50)	363

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.943	Shapiro Wilk Lognormal GOF Test
5% Shapiro Wilk Critical Value	0.762	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.246	Lilliefors Lognormal GOF Test
5% Lilliefors Critical Value	0.396	Data appear Lognormal at 5% Significance Level
Data appear Lognormal at 5% Significance Level		

Lognormal Statistics

Minimum of Logged Data	0.993	Mean of logged Data	2.638
Maximum of Logged Data	4.745	SD of logged Data	1.362

Assuming Lognormal Distribution

95% H-UCL	2945	90% Chebyshev (MVUE) UCL	73
95% Chebyshev (MVUE) UCL	93.72	97.5% Chebyshev (MVUE) UCL	122.5
99% Chebyshev (MVUE) UCL	179		

Nonparametric Distribution Free UCL Statistics
Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	65.73	95% Jackknife UCL	76.02
95% Standard Bootstrap UCL	62.16	95% Bootstrap-t UCL	326.5
95% Hall's Bootstrap UCL	291.5	95% Percentile Bootstrap UCL	71.82
95% BCA Bootstrap UCL	74.64		
90% Chebyshev(Mean, Sd) UCL	94.36	95% Chebyshev(Mean, Sd) UCL	123.1
97.5% Chebyshev(Mean, Sd) UCL	162.9	99% Chebyshev(Mean, Sd) UCL	241.2

Suggested UCL to Use
95% Adjusted Gamma UCL **363**
Recommended UCL exceeds the maximum observation

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

Cadmium

General Statistics

Total Number of Observations	23	Number of Distinct Observations	23
Number of Detects	22	Number of Non-Detects	1
Number of Distinct Detects	22	Number of Distinct Non-Detects	1
Minimum Detect	0.0756	Minimum Non-Detect	0.298
Maximum Detect	234	Maximum Non-Detect	0.298
Variance Detects	2426	Percent Non-Detects	4.35%
Mean Detects	14.69	SD Detects	49.25
Median Detects	1.57	CV Detects	3.353
Skewness Detects	4.608	Kurtosis Detects	21.45
Mean of Logged Detects	0.664	SD of Logged Detects	1.927

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.297	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.911	Detected Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.448	Lilliefors GOF Test
5% Lilliefors Critical Value	0.189	Detected Data Not Normal at 5% Significance Level

Detected Data Not Normal at 5% Significance Level

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs

Mean	14.06	Standard Error of Mean	10.06
SD	47.16	95% KM (BCA) UCL	34.72
95% KM (t) UCL	31.34	95% KM (Percentile Bootstrap) UCL	33.87
95% KM (z) UCL	30.61	95% KM Bootstrap t UCL	140
90% KM Chebyshev UCL	44.25	95% KM Chebyshev UCL	57.93
97.5% KM Chebyshev UCL	76.91	99% KM Chebyshev UCL	114.2

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	1.82	Anderson-Darling GOF Test
5% A-D Critical Value	0.84	Detected Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.227	Kolmogrov-Smirnoff GOF
5% K-S Critical Value	0.2	Detected Data Not Gamma Distributed at 5% Significance Level

Detected Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics on Detected Data Only

k hat (MLE)	0.335	k star (bias corrected MLE)	0.319
Theta hat (MLE)	43.88	Theta star (bias corrected MLE)	45.99
nu hat (MLE)	14.73	nu star (bias corrected)	14.05
MLE Mean (bias corrected)	14.69	MLE Sd (bias corrected)	25.99

Gamma Kaplan-Meier (KM) Statistics

k hat (KM)	0.0889	nu hat (KM)	4.087
Approximate Chi Square Value (4.09, α)	0.756	Adjusted Chi Square Value (4.09, β)	0.662
95% Gamma Approximate KM-UCL (use when n>=50)	75.95	95% Gamma Adjusted KM-UCL (use when n<50)	86.74

Gamma (KM) may not be used when k hat (KM) is < 0.1

Gamma ROS Statistics using Imputed Non-Detects
GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs
GROS may not be used when kstar of detected data is small such as < 0.1
For such situations, GROS method tends to yield inflated values of UCLs and BTVs
For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.01	Mean	14.05
Maximum	234	Median	1.56
SD	48.22	CV	3.431
k hat (MLE)	0.311	k star (bias corrected MLE)	0.299
Theta hat (MLE)	45.25	Theta star (bias corrected MLE)	46.99
nu hat (MLE)	14.29	nu star (bias corrected)	13.76
MLE Mean (bias corrected)	14.05	MLE Sd (bias corrected)	25.7
		Adjusted Level of Significance (β)	0.0389
Approximate Chi Square Value (13.76, α)	6.404	Adjusted Chi Square Value (13.76, β)	6.043
95% Gamma Approximate UCL (use when n>=50)	30.18	95% Gamma Adjusted UCL (use when n<50)	31.99

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.96	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.911	Detected Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.107	Lilliefors GOF Test
5% Lilliefors Critical Value	0.189	Detected Data appear Lognormal at 5% Significance Level

Detected Data appear Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	14.06	Mean in Log Scale	0.534
SD in Original Scale	48.22	SD in Log Scale	1.983
95% t UCL (assumes normality of ROS data)	31.32	95% Percentile Bootstrap UCL	33.85
95% BCA Bootstrap UCL	44.24	95% Bootstrap t UCL	142.6
95% H-UCL (Log ROS)	66.76		

UCLs using Lognormal Distribution and KM Estimates when Detected data are Lognormally Distributed

KM Mean (logged)	0.538	95% H-UCL (KM -Log)	56.41
KM SD (logged)	1.933	95% Critical H Value (KM-Log)	3.942
KM Standard Error of Mean (logged)	0.413		

DL/2 Statistics

DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	14.06	Mean in Log Scale	0.552
SD in Original Scale	48.22	SD in Log Scale	1.957
95% t UCL (Assumes normality)	31.32	95% H-Stat UCL	62.04

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics
Detected Data appear Lognormal Distributed at 5% Significance Level

Suggested UCL to Use
99% KM (Chebyshev) UCL **114.2**

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
Recommendations are based upon data size, data distribution, and skewness.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Lead

General Statistics

Total Number of Observations	40	Number of Distinct Observations	40
		Number of Missing Observations	0
Minimum	8.56	Mean	2426
Maximum	31000	Median	132
SD	6419	Std. Error of Mean	1015
Coefficient of Variation	2.646	Skewness	3.453

Normal GOF Test

Shapiro Wilk Test Statistic	0.432	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.94	Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.375	Lilliefors GOF Test
5% Lilliefors Critical Value	0.14	Data Not Normal at 5% Significance Level

Data Not Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	4136	95% Adjusted-CLT UCL (Chen-1995)	4688
		95% Modified-t UCL (Johnson-1978)	4228

Gamma GOF Test

A-D Test Statistic	2.901	Anderson-Darling Gamma GOF Test
5% A-D Critical Value	0.867	Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.198	Kolmogrov-Smirnoff Gamma GOF Test
5% K-S Critical Value	0.152	Data Not Gamma Distributed at 5% Significance Level

Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	0.282	k star (bias corrected MLE)	0.278
Theta hat (MLE)	8588	Theta star (bias corrected MLE)	8728
nu hat (MLE)	22.6	nu star (bias corrected)	22.24
MLE Mean (bias corrected)	2426	MLE Sd (bias corrected)	4602
		Approximate Chi Square Value (0.05)	12.52
Adjusted Level of Significance	0.044	Adjusted Chi Square Value	12.24

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	4310	95% Adjusted Gamma UCL (use when n<50)	4407

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.926	Shapiro Wilk Lognormal GOF Test
5% Shapiro Wilk Critical Value	0.94	Data Not Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.114	Lilliefors Lognormal GOF Test
5% Lilliefors Critical Value	0.14	Data appear Lognormal at 5% Significance Level

Data appear Approximate Lognormal at 5% Significance Level

Lognormal Statistics			
Minimum of Logged Data	2.147	Mean of logged Data	5.329
Maximum of Logged Data	10.34	SD of logged Data	2.292

Assuming Lognormal Distribution			
95% H-UCL	13386	90% Chebyshev (MVUE) UCL	5997
95% Chebyshev (MVUE) UCL	7662	97.5% Chebyshev (MVUE) UCL	9973
99% Chebyshev (MVUE) UCL	14511		

Nonparametric Distribution Free UCL Statistics
Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs			
95% CLT UCL	4095	95% Jackknife UCL	4136
95% Standard Bootstrap UCL	4087	95% Bootstrap-t UCL	5607
95% Hall's Bootstrap UCL	4111	95% Percentile Bootstrap UCL	4201
95% BCA Bootstrap UCL	4914		
90% Chebyshev(Mean, Sd) UCL	5471	95% Chebyshev(Mean, Sd) UCL	6850
97.5% Chebyshev(Mean, Sd) UCL	8764	99% Chebyshev(Mean, Sd) UCL	12525

Suggested UCL to Use	
97.5% Chebyshev (Mean, Sd) UCL	**8764**

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

Selenium

General Statistics			
Total Number of Observations	4	Number of Distinct Observations	4
Number of Detects	2	Number of Non-Detects	2
Number of Distinct Detects	2	Number of Distinct Non-Detects	2
Minimum Detect	0.536	Minimum Non-Detect	2.34
Maximum Detect	12.6	Maximum Non-Detect	2.38
Variance Detects	72.77	Percent Non-Detects	50%
Mean Detects	6.568	SD Detects	8.531
Median Detects	6.568	CV Detects	1.299
Skewness Detects	N/A	Kurtosis Detects	N/A
Mean of Logged Detects	0.955	SD of Logged Detects	2.233

Warning: Data set has only 2 Detected Values.
This is not enough to compute meaningful or reliable statistics and estimates.

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use
guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.
For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).
Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.0

Normal GOF Test on Detects Only
Not Enough Data to Perform GOF Test

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs			
Mean	3.552	Standard Error of Mean	3.694
SD	5.224	95% KM (BCA) UCL	N/A
95% KM (t) UCL	12.24	95% KM (Percentile Bootstrap) UCL	N/A
95% KM (z) UCL	9.628	95% KM Bootstrap t UCL	N/A
90% KM Chebyshev UCL	14.63	95% KM Chebyshev UCL	19.65
97.5% KM Chebyshev UCL	26.62	99% KM Chebyshev UCL	40.31

Gamma GOF Tests on Detected Observations Only
Not Enough Data to Perform GOF Test

Gamma Statistics on Detected Data Only			
k hat (MLE)	0.658	k star (bias corrected MLE)	N/A
Theta hat (MLE)	9.988	Theta star (bias corrected MLE)	N/A
nu hat (MLE)	2.63	nu star (bias corrected)	N/A
MLE Mean (bias corrected)	N/A	MLE Sd (bias corrected)	N/A

Gamma Kaplan-Meier (KM) Statistics			
k hat (KM)	0.462	nu hat (KM)	3.699
		Adjusted Level of Significance (β)	0.00498
Approximate Chi Square Value (3.70, α)	0.606	Adjusted Chi Square Value (3.70, β)	0.183
95% Gamma Approximate KM-UCL (use when n>=50)	21.66	95% Gamma Adjusted KM-UCL (use when n<50)	71.78

Lognormal GOF Test on Detected Observations Only
Not Enough Data to Perform GOF Test

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	3.552	Mean in Log Scale	0.166
SD in Original Scale	6.032	SD in Log Scale	1.579
95% t UCL (assumes normality of ROS data)	10.65	95% Percentile Bootstrap UCL	N/A
95% BCA Bootstrap UCL	N/A	95% Bootstrap t UCL	N/A
95% H-UCL (Log ROS)	52790		

DL/2 Statistics

DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	3.874	Mean in Log Scale	0.56
SD in Original Scale	5.825	SD in Log Scale	1.367
95% t UCL (Assumes normality)	10.73	95% H-Stat UCL	5504

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics
Data do not follow a Discernible Distribution at 5% Significance Level

Suggested UCL to Use
99% KM (Chebyshev) UCL 40.31
Warning: Recommended UCL exceeds the maximum observation

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
Recommendations are based upon data size, data distribution, and skewness.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

KM SD (logged)	1.195	95% Critical H Value (KM-Log)	5.756
KM Standard Error of Mean (logged)	0.662		

DL/2 Statistics

DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	3.261	Mean in Log Scale	0.406
SD in Original Scale	5.228	SD in Log Scale	1.233
95% t UCL (Assumes normality)	8.245	95% H-Stat UCL	124.1

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics
Detected Data appear Approximate Normal Distributed at 5% Significance Level

Suggested UCL to Use

95% KM (t) UCL	**8.633**	**95% KM (Percentile Bootstrap) UCL**	**N/A**

Warning: One or more Recommended UCL(s) not available!

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
Recommendations are based upon data size, data distribution, and skewness.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

APPENDIX C-9

NORTH WOODED AREA SURFACE SOIL

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	5/15/2014 11:53
From File	NWA surface.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Antimony

General Statistics			
Total Number of Observations	15	Number of Distinct Observations	15
Number of Detects	7	Number of Non-Detects	8
Number of Distinct Detects	7	Number of Distinct Non-Detects	8
Minimum Detect	0.756	Minimum Non-Detect	2.81
Maximum Detect	49.8	Maximum Non-Detect	3.18
Variance Detects	329.9	Percent Non-Detects	53.33%
Mean Detects	8.621	SD Detects	18.16
Median Detects	1.97	CV Detects	2.107
Skewness Detects	2.642	Kurtosis Detects	6.985
Mean of Logged Detects	0.996	SD of Logged Detects	1.333

Normal GOF Test on Detects Only		
Shapiro Wilk Test Statistic	0.476	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.803	Detected Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.495	Lilliefors GOF Test
5% Lilliefors Critical Value	0.335	Detected Data Not Normal at 5% Significance Level
Detected Data Not Normal at 5% Significance Level		

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs			
Mean	4.96	Standard Error of Mean	3.348
SD	11.99	95% KM (BCA) UCL	11.57
95% KM (t) UCL	10.86	95% KM (Percentile Bootstrap) UCL	11.22
95% KM (z) UCL	10.47	95% KM Bootstrap t UCL	186.3
90% KM Chebyshev UCL	15	95% KM Chebyshev UCL	19.55
97.5% KM Chebyshev UCL	25.87	99% KM Chebyshev UCL	38.27

Gamma GOF Tests on Detected Observations Only		
A-D Test Statistic	1.625	Anderson-Darling GOF Test
5% A-D Critical Value	0.749	Detected Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.491	Kolmogrov-Smirnoff GOF
5% K-S Critical Value	0.326	Detected Data Not Gamma Distributed at 5% Significance Level
Detected Data Not Gamma Distributed at 5% Significance Level		

Gamma Statistics on Detected Data Only			
k hat (MLE)	0.542	k star (bias corrected MLE)	0.405
Theta hat (MLE)	15.91	Theta star (bias corrected MLE)	21.29
nu hat (MLE)	7.587	nu star (bias corrected)	5.669
MLE Mean (bias corrected)	8.621	MLE Sd (bias corrected)	13.55

Gamma Kaplan-Meier (KM) Statistics			
k hat (KM)	0.171	nu hat (KM)	5.133
Approximate Chi Square Value (5.13, α)	1.214	Adjusted Chi Square Value (5.13, β)	0.998
95% Gamma Approximate KM-UCL (use when n>=50)	20.97	95% Gamma Adjusted KM-UCL (use when n<50)	25.5

Gamma ROS Statistics using Imputed Non-Detects
GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs
GROS may not be used when kstar of detected data is small such as < 0.1
For such situations, GROS method tends to yield inflated values of UCLs and BTVs
For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.521	Mean	4.301
Maximum	49.8	Median	0.521
SD	12.61	CV	2.931
k hat (MLE)	0.477	k star (bias corrected MLE)	0.426
Theta hat (MLE)	9.019	Theta star (bias corrected MLE)	10.1
nu hat (MLE)	14.31	nu star (bias corrected)	12.78
MLE Mean (bias corrected)	4.301	MLE Sd (bias corrected)	6.59
		Adjusted Level of Significance (β)	0.0324
Approximate Chi Square Value (12.78, α)	5.744	Adjusted Chi Square Value (12.78, β)	5.174
95% Gamma Approximate UCL (use when n>=50)	9.568	95% Gamma Adjusted UCL (use when n<50)	10.62

Lognormal GOF Test on Detected Observations Only		
Shapiro Wilk Test Statistic	0.675	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.803	Detected Data Not Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.42	Lilliefors GOF Test
5% Lilliefors Critical Value	0.335	Detected Data Not Lognormal at 5% Significance Level

Detected Data Not Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	5.092	Mean in Log Scale	0.836
SD in Original Scale	12.37	SD in Log Scale	0.887
95% t UCL (assumes normality of ROS data)	10.72	95% Percentile Bootstrap UCL	11.48
95% BCA Bootstrap UCL	14.66	95% Bootstrap t UCL	454.3
95% H-UCL (Log ROS)	6.281		

DL/2 Statistics

DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	4.823	Mean in Log Scale	0.681
SD in Original Scale	12.45	SD in Log Scale	0.925
95% t UCL (Assumes normality)	10.48	95% H-Stat UCL	5.807

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics
Data do not follow a Discernible Distribution at 5% Significance Level

Suggested UCL to Use
95% KM (BCA) UCL **11.57**

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
Recommendations are based upon data size, data distribution, and skewness.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Arsenic

General Statistics

Total Number of Observations	20	Number of Distinct Observations	19
		Number of Missing Observations	0
Minimum	8	Mean	16.93
Maximum	79.8	Median	13.5
SD	15.38	Std. Error of Mean	3.439
Coefficient of Variation	0.908	Skewness	3.965

Normal GOF Test

Shapiro Wilk Test Statistic	0.462	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.905	Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.388	Lilliefors GOF Test
5% Lilliefors Critical Value	0.198	Data Not Normal at 5% Significance Level

Data Not Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	22.88	95% Adjusted-CLT UCL (Chen-1995)	25.85
		95% Modified-t UCL (Johnson-1978)	23.39

Gamma GOF Test

A-D Test Statistic	2.191	Anderson-Darling Gamma GOF Test
5% A-D Critical Value	0.747	Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.306	Kolmogrov-Smirnoff Gamma GOF Test
5% K-S Critical Value	0.195	Data Not Gamma Distributed at 5% Significance Level

Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	3.136	k star (bias corrected MLE)	2.699
Theta hat (MLE)	5.399	Theta star (bias corrected MLE)	6.274
nu hat (MLE)	125.5	nu star (bias corrected)	108
MLE Mean (bias corrected)	16.93	MLE Sd (bias corrected)	10.31
		Approximate Chi Square Value (0.05)	84.99
Adjusted Level of Significance	0.038	Adjusted Chi Square Value	83.38

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	21.51	95% Adjusted Gamma UCL (use when n<50)	21.93

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.771	Shapiro Wilk Lognormal GOF Test
5% Shapiro Wilk Critical Value	0.905	Data Not Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.246	Lilliefors Lognormal GOF Test
5% Lilliefors Critical Value	0.198	Data Not Lognormal at 5% Significance Level

Data Not Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	2.079	Mean of logged Data	2.662
Maximum of Logged Data	4.38	SD of logged Data	0.491

Assuming Lognormal Distribution			
95% H-UCL	20.26	90% Chebyshev (MVUE) UCL	21.52
95% Chebyshev (MVUE) UCL	24	97.5% Chebyshev (MVUE) UCL	27.45
99% Chebyshev (MVUE) UCL	34.21		

Nonparametric Distribution Free UCL Statistics
Data do not follow a Discernible Distribution (0.05)

Nonparametric Distribution Free UCLs			
95% CLT UCL	22.59	95% Jackknife UCL	22.88
95% Standard Bootstrap UCL	22.33	95% Bootstrap-t UCL	39.99
95% Hall's Bootstrap UCL	48.4	95% Percentile Bootstrap UCL	23.42
95% BCA Bootstrap UCL	27.55		
90% Chebyshev(Mean, Sd) UCL	27.25	95% Chebyshev(Mean, Sd) UCL	31.92
97.5% Chebyshev(Mean, Sd) UCL	38.41	99% Chebyshev(Mean, Sd) UCL	51.15

Suggested UCL to Use			
95% Student's-t UCL	**22.88**	**or 95% Modified-t UCL**	**23.39**

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

Cadmium

General Statistics			
Total Number of Observations	42	Number of Distinct Observations	42
		Number of Missing Observations	0
Minimum	0.34	Mean	4.522
Maximum	62.8	Median	1.815
SD	10.01	Std. Error of Mean	1.544
Coefficient of Variation	2.213	Skewness	5.165

Normal GOF Test		
Shapiro Wilk Test Statistic	0.392	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.942	Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.342	Lilliefors GOF Test
5% Lilliefors Critical Value	0.137	Data Not Normal at 5% Significance Level
Data Not Normal at 5% Significance Level		

Assuming Normal Distribution			
95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	7.12	95% Adjusted-CLT UCL (Chen-1995)	8.376
		95% Modified-t UCL (Johnson-1978)	7.325

Gamma GOF Test		
A-D Test Statistic	2.508	Anderson-Darling Gamma GOF Test
5% A-D Critical Value	0.789	Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.189	Kolmogrov-Smirnoff Gamma GOF Test
5% K-S Critical Value	0.142	Data Not Gamma Distributed at 5% Significance Level
Data Not Gamma Distributed at 5% Significance Level		

Gamma Statistics			
k hat (MLE)	0.752	k star (bias corrected MLE)	0.714
Theta hat (MLE)	6.017	Theta star (bias corrected MLE)	6.335
nu hat (MLE)	63.13	nu star (bias corrected)	59.95
MLE Mean (bias corrected)	4.522	MLE Sd (bias corrected)	5.352
		Approximate Chi Square Value (0.05)	43.15
Adjusted Level of Significance	0.0443	Adjusted Chi Square Value	42.64

Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50))	6.283	95% Adjusted Gamma UCL (use when n<50)	6.358

Lognormal GOF Test		
Shapiro Wilk Test Statistic	0.917	Shapiro Wilk Lognormal GOF Test
5% Shapiro Wilk Critical Value	0.942	Data Not Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.082	Lilliefors Lognormal GOF Test
5% Lilliefors Critical Value	0.137	Data appear Lognormal at 5% Significance Level
Data appear Approximate Lognormal at 5% Significance Level		

Lognormal Statistics			
Minimum of Logged Data	-1.079	Mean of logged Data	0.713
Maximum of Logged Data	4.14	SD of logged Data	1.106

Assuming Lognormal Distribution

95% H-UCL	5.762	90% Chebyshev (MVUE) UCL	5.926
95% Chebyshev (MVUE) UCL	6.946	97.5% Chebyshev (MVUE) UCL	8.362
99% Chebyshev (MVUE) UCL	11.14		

Nonparametric Distribution Free UCL Statistics
Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	7.061	95% Jackknife UCL	7.12
95% Standard Bootstrap UCL	6.921	95% Bootstrap-t UCL	11.97
95% Hall's Bootstrap UCL	15.28	95% Percentile Bootstrap UCL	7.322
95% BCA Bootstrap UCL	8.668		
90% Chebyshev(Mean, Sd) UCL	9.153	95% Chebyshev(Mean, Sd) UCL	11.25
97.5% Chebyshev(Mean, Sd) UCL	14.16	99% Chebyshev(Mean, Sd) UCL	19.88

Suggested UCL to Use
95% Chebyshev (Mean, Sd) UCL **11.25**

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

Lead

General Statistics

Total Number of Observations	42	Number of Distinct Observations	41
		Number of Missing Observations	0
Minimum	8.59	Mean	747.9
Maximum	11200	Median	300
SD	1766	Std. Error of Mean	272.6
Coefficient of Variation	2.362	Skewness	5.364

Normal GOF Test

Shapiro Wilk Test Statistic	0.382	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.942	Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.348	Lilliefors GOF Test
5% Lilliefors Critical Value	0.137	Data Not Normal at 5% Significance Level

Data Not Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	1207	95% Adjusted-CLT UCL (Chen-1995)	1437
		95% Modified-t UCL (Johnson-1978)	1244

Gamma GOF Test

A-D Test Statistic	1.523	Anderson-Darling Gamma GOF Test
5% A-D Critical Value	0.803	Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.166	Kolmogrov-Smirnoff Gamma GOF Test
5% K-S Critical Value	0.143	Data Not Gamma Distributed at 5% Significance Level

Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	0.611	k star (bias corrected MLE)	0.583
Theta hat (MLE)	1224	Theta star (bias corrected MLE)	1282
nu hat (MLE)	51.34	nu star (bias corrected)	49
MLE Mean (bias corrected)	747.9	MLE Sd (bias corrected)	979.2
		Approximate Chi Square Value (0.05)	33.93
Adjusted Level of Significance	0.0443	Adjusted Chi Square Value	33.49

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	1080	95% Adjusted Gamma UCL (use when n<50)	1095

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.948	Shapiro Wilk Lognormal GOF Test
5% Shapiro Wilk Critical Value	0.942	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.105	Lilliefors Lognormal GOF Test
5% Lilliefors Critical Value	0.137	Data appear Lognormal at 5% Significance Level

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	2.151	Mean of logged Data	5.609
Maximum of Logged Data	9.324	SD of logged Data	1.417

Assuming Lognormal Distribution

95% H-UCL	1402	90% Chebyshev (MVUE) UCL	1312
95% Chebyshev (MVUE) UCL	1584	97.5% Chebyshev (MVUE) UCL	1961

99% Chebyshev (MVUE) UCL	2703

Nonparametric Distribution Free UCL Statistics
Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	1196	95% Jackknife UCL	1207
95% Standard Bootstrap UCL	1191	95% Bootstrap-t UCL	2107
95% Hall's Bootstrap UCL	2699	95% Percentile Bootstrap UCL	1250
95% BCA Bootstrap UCL	1707		
90% Chebyshev(Mean, Sd) UCL	1566	95% Chebyshev(Mean, Sd) UCL	1936
97.5% Chebyshev(Mean, Sd) UCL	2450	99% Chebyshev(Mean, Sd) UCL	3460

Suggested UCL to Use
95% H-UCL **1402**

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

ProUCL computes and outputs H-statistic based UCLs for historical reasons only.
H-statistic often results in unstable (both high and low) values of UCL95 as shown in examples in the Technical Guide.
It is therefore recommended to avoid the use of H-statistic based 95% UCLs.
Use of nonparametric methods are preferred to compute UCL95 for skewed data sets which do not follow a gamma distribution.

Selenium

General Statistics

Total Number of Observations	20	Number of Distinct Observations	19
Number of Detects	10	Number of Non-Detects	10
Number of Distinct Detects	10	Number of Distinct Non-Detects	900%
Minimum Detect	0.338	Minimum Non-Detect	2.25
Maximum Detect	29.2	Maximum Non-Detect	2.73
Variance Detects	82.04	Percent Non-Detects	50%
Mean Detects	3.424	SD Detects	9.058
Median Detects	0.617	CV Detects	2.645
Skewness Detects	3.161	Kurtosis Detects	9.994
Mean of Logged Detects	-0.212	SD of Logged Detects	1.286

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.38	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.842	Detected Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.515	Lilliefors GOF Test
5% Lilliefors Critical Value	0.28	Detected Data Not Normal at 5% Significance Level

Detected Data Not Normal at 5% Significance Level

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs

Mean	1.992	Standard Error of Mean	1.472
SD	6.243	95% KM (BCA) UCL	4.869
95% KM (t) UCL	4.537	95% KM (Percentile Bootstrap) UCL	4.851
95% KM (z) UCL	4.413	95% KM Bootstrap t UCL	64.62
90% KM Chebyshev UCL	6.408	95% KM Chebyshev UCL	8.408
97.5% KM Chebyshev UCL	11.18	99% KM Chebyshev UCL	16.64

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	2.723	Anderson-Darling GOF Test
5% A-D Critical Value	0.787	Detected Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.509	Kolmogrov-Smirnoff GOF
5% K-S Critical Value	0.283	Detected Data Not Gamma Distributed at 5% Significance Level

Detected Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics on Detected Data Only

k hat (MLE)	0.448	k star (bias corrected MLE)	0.38
Theta hat (MLE)	7.646	Theta star (bias corrected MLE)	9.007
nu hat (MLE)	8.956	nu star (bias corrected)	7.603
MLE Mean (bias corrected)	3.424	MLE Sd (bias corrected)	5.553

Gamma Kaplan-Meier (KM) Statistics

k hat (KM)	0.102	nu hat (KM)	4.072
Approximate Chi Square Value (4.07, α)	0.75	Adjusted Chi Square Value (4.07, β)	0.649
95% Gamma Approximate KM-UCL (use when n>=50)	10.81	95% Gamma Adjusted KM-UCL (use when n<50)	12.5

Gamma ROS Statistics using Imputed Non-Detects
GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs
GROS may not be used when kstar of detected data is small such as < 0.1
For such situations, GROS method tends to yield inflated values of UCLs and BTVs

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.01	Mean	1.804
Maximum	29.2	Median	0.375
SD	6.463	CV	3.582
k hat (MLE)	0.258	k star (bias corrected MLE)	0.253
Theta hat (MLE)	6.996	Theta star (bias corrected MLE)	7.144
nu hat (MLE)	10.32	nu star (bias corrected)	10.1
MLE Mean (bias corrected)	1.804	MLE Sd (bias corrected)	3.59
		Adjusted Level of Significance (β)	0.038
Approximate Chi Square Value (10.10, α)	4.005	Adjusted Chi Square Value (10.10, β)	3.706
95% Gamma Approximate UCL (use when n>=50)	4.55	95% Gamma Adjusted UCL (use when n<50)	4.918

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.56	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.842	Detected Data Not Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.416	Lilliefors GOF Test
5% Lilliefors Critical Value	0.28	Detected Data Not Lognormal at 5% Significance Level

Detected Data Not Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	2.051	Mean in Log Scale	-0.31
SD in Original Scale	6.392	SD in Log Scale	0.901
95% t UCL (assumes normality of ROS data)	4.522	95% Percentile Bootstrap UCL	4.89
95% BCA Bootstrap UCL	6.349	95% Bootstrap t UCL	84.78
95% H-UCL (Log ROS)	1.844		

DL/2 Statistics

DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	2.321	Mean in Log Scale	-0.0087
SD in Original Scale	6.336	SD in Log Scale	0.91
95% t UCL (Assumes normality)	4.771	95% H-Stat UCL	2.531

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Data do not follow a Discernible Distribution at 5% Significance Level

Suggested UCL to Use

95% KM (BCA) UCL	**4.869**

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
Recommendations are based upon data size, data distribution, and skewness.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

APPENDIX C-10

NORTH WOODED AREA SUB-SURFACE SOIL

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	5/15/2014 12:15
From File	NWA subsurface.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Arsenic

General Statistics

Total Number of Observations	8	Number of Distinct Observations	8
		Number of Missing Observations	0
Minimum	7.11	Mean	12.29
Maximum	14.4	Median	13.65
SD	2.577	Std. Error of Mean	0.911
Coefficient of Variation	0.21	Skewness	-1.395

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use
guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.
For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).
Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.0

Normal GOF Test

Shapiro Wilk Test Statistic	0.808	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.818	Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.306	Lilliefors GOF Test
5% Lilliefors Critical Value	0.313	Data appear Normal at 5% Significance Level

Data appear Approximate Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	14.01	95% Adjusted-CLT UCL (Chen-1995)	13.31
		95% Modified-t UCL (Johnson-1978)	13.94

Gamma GOF Test

A-D Test Statistic	0.834	Anderson-Darling Gamma GOF Test
5% A-D Critical Value	0.716	Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.321	Kolmogrov-Smirnoff Gamma GOF Test
5% K-S Critical Value	0.294	Data Not Gamma Distributed at 5% Significance Level

Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	21.31	k star (bias corrected MLE)	13.4
Theta hat (MLE)	0.577	Theta star (bias corrected MLE)	0.917
nu hat (MLE)	341	nu star (bias corrected)	214.4
MLE Mean (bias corrected)	12.29	MLE Sd (bias corrected)	3.357
		Approximate Chi Square Value (0.05)	181.5
Adjusted Level of Significance	0.0195	Adjusted Chi Square Value	173.9

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	14.52	95% Adjusted Gamma UCL (use when n<50)	15.16

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.768	Shapiro Wilk Lognormal GOF Test
5% Shapiro Wilk Critical Value	0.818	Data Not Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.309	Lilliefors Lognormal GOF Test
5% Lilliefors Critical Value	0.313	Data appear Lognormal at 5% Significance Level

Data appear Approximate Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	1.962	Mean of logged Data	2.485
Maximum of Logged Data	2.667	SD of logged Data	0.245

Assuming Lognormal Distribution

95% H-UCL	14.87	90% Chebyshev (MVUE) UCL	15.53
95% Chebyshev (MVUE) UCL	16.99	97.5% Chebyshev (MVUE) UCL	19.01
99% Chebyshev (MVUE) UCL	22.97		

Nonparametric Distribution Free UCL Statistics
Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs			
95% CLT UCL	13.79	95% Jackknife UCL	14.01
95% Standard Bootstrap UCL	13.71	95% Bootstrap-t UCL	13.57
95% Hall's Bootstrap UCL	13.4	95% Percentile Bootstrap UCL	13.54
95% BCA Bootstrap UCL	13.36		
90% Chebyshev(Mean, Sd) UCL	15.02	95% Chebyshev(Mean, Sd) UCL	16.26
97.5% Chebyshev(Mean, Sd) UCL	17.98	99% Chebyshev(Mean, Sd) UCL	21.35

Suggested UCL to Use
95% Student's-t UCL **14.01**

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

Note: For highly negatively-skewed data, confidence limits (e.g., Chen, Johnson, Lognormal, and Gamma) may not be
reliable. Chen's and Johnson's methods provide adjustments for positvely skewed data sets.

Cadmium

General Statistics			
Total Number of Observations	7	Number of Distinct Observations	7
		Number of Missing Observations	0
Minimum	0.354	Mean	1.328
Maximum	4.32	Median	0.81
SD	1.402	Std. Error of Mean	0.53
Coefficient of Variation	1.056	Skewness	2.101

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use
guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.
For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).
Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.0

Normal GOF Test			
Shapiro Wilk Test Statistic	0.715	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.803	Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.344	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.335	Data Not Normal at 5% Significance Level	
Data Not Normal at 5% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	2.358	95% Adjusted-CLT UCL (Chen-1995)	2.65
		95% Modified-t UCL (Johnson-1978)	2.428
Gamma GOF Test			
A-D Test Statistic	0.539	Anderson-Darling Gamma GOF Test	
5% A-D Critical Value	0.72	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.302	Kolmogrov-Smirnoff Gamma GOF Test	
5% K-S Critical Value	0.317	Detected data appear Gamma Distributed at 5% Significance Level	
Detected data appear Gamma Distributed at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	1.562	k star (bias corrected MLE)	0.988
Theta hat (MLE)	0.851	Theta star (bias corrected MLE)	1.345
nu hat (MLE)	21.86	nu star (bias corrected)	13.83
MLE Mean (bias corrected)	1.328	MLE Sd (bias corrected)	1.337
		Approximate Chi Square Value (0.05)	6.453
Adjusted Level of Significance	0.0158	Adjusted Chi Square Value	5.013
Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50)	2.846	95% Adjusted Gamma UCL (use when n<50)	3.663
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.924	Shapiro Wilk Lognormal GOF Test	
5% Shapiro Wilk Critical Value	0.803	Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.25	Lilliefors Lognormal GOF Test	
5% Lilliefors Critical Value	0.335	Data appear Lognormal at 5% Significance Level	
Data appear Lognormal at 5% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	-1.038	Mean of logged Data	-0.0693

Maximum of Logged Data	1.463	SD of logged Data	0.846

Assuming Lognormal Distribution

95% H-UCL	4.134	90% Chebyshev (MVUE) UCL	2.465
95% Chebyshev (MVUE) UCL	3.013	97.5% Chebyshev (MVUE) UCL	3.774
99% Chebyshev (MVUE) UCL	5.269		

Nonparametric Distribution Free UCL Statistics
Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	2.2	95% Jackknife UCL	2.358
95% Standard Bootstrap UCL	2.119	95% Bootstrap-t UCL	6.635
95% Hall's Bootstrap UCL	7.097	95% Percentile Bootstrap UCL	2.244
95% BCA Bootstrap UCL	2.716		
90% Chebyshev(Mean, Sd) UCL	2.918	95% Chebyshev(Mean, Sd) UCL	3.638
97.5% Chebyshev(Mean, Sd) UCL	4.638	99% Chebyshev(Mean, Sd) UCL	6.602

Suggested UCL to Use
95% Adjusted Gamma UCL **3.663**

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

Lead

General Statistics

Total Number of Observations	25	Number of Distinct Observations	25
Number of Detects	24	Number of Non-Detects	1
Number of Distinct Detects	24	Number of Distinct Non-Detects	1
Minimum Detect	5.26	Minimum Non-Detect	0.554
Maximum Detect	946	Maximum Non-Detect	0.554
Variance Detects	57322	Percent Non-Detects	4%
Mean Detects	155.5	SD Detects	239.4
Median Detects	61.45	CV Detects	1.54
Skewness Detects	2.634	Kurtosis Detects	6.597
Mean of Logged Detects	4.261	SD of Logged Detects	1.265

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.601	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.916	Detected Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.292	Lilliefors GOF Test
5% Lilliefors Critical Value	0.181	Detected Data Not Normal at 5% Significance Level

Detected Data Not Normal at 5% Significance Level

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs

Mean	149.3	Standard Error of Mean	47.33
SD	231.6	95% KM (BCA) UCL	228.3
95% KM (t) UCL	230.3	95% KM (Percentile Bootstrap) UCL	229.4
95% KM (z) UCL	227.1	95% KM Bootstrap t UCL	352.2
90% KM Chebyshev UCL	291.3	95% KM Chebyshev UCL	355.6
97.5% KM Chebyshev UCL	444.8	99% KM Chebyshev UCL	620.2

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	0.908	Anderson-Darling GOF Test
5% A-D Critical Value	0.782	Detected Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.167	Kolmogrov-Smirnoff GOF
5% K-S Critical Value	0.185	Detected data appear Gamma Distributed at 5% Significance Level

Detected data follow Appr. Gamma Distribution at 5% Significance Level

Gamma Statistics on Detected Data Only

k hat (MLE)	0.761	k star (bias corrected MLE)	0.693
Theta hat (MLE)	204.4	Theta star (bias corrected MLE)	224.3
nu hat (MLE)	36.51	nu star (bias corrected)	33.28
MLE Mean (bias corrected)	155.5	MLE Sd (bias corrected)	186.7

Gamma Kaplan-Meier (KM) Statistics

k hat (KM)	0.415	nu hat (KM)	20.77
Approximate Chi Square Value (20.77, α)	11.42	Adjusted Chi Square Value (20.77, β)	10.95
95% Gamma Approximate KM-UCL (use when n>=50)	271.5	95% Gamma Adjusted KM-UCL (use when n<50)	283.2

Gamma ROS Statistics using Imputed Non-Detects
GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs
GROS may not be used when kstar of detected data is small such as < 0.1
For such situations, GROS method tends to yield inflated values of UCLs and BTVs
For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.01	Mean	149.3
Maximum	946	Median	59.3
SD	236.4	CV	1.584
k hat (MLE)	0.567	k star (bias corrected MLE)	0.526
Theta hat (MLE)	263.3	Theta star (bias corrected MLE)	284.1
nu hat (MLE)	28.34	nu star (bias corrected)	26.28
MLE Mean (bias corrected)	149.3	MLE Sd (bias corrected)	205.9
		Adjusted Level of Significance (β)	0.0395
Approximate Chi Square Value (26.28, α)	15.59	Adjusted Chi Square Value (26.28, β)	15.03
95% Gamma Approximate UCL (use when n>=50)	251.6	95% Gamma Adjusted UCL (use when n<50)	261

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.983	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.916	Detected Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.0874	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.181	Detected Data appear Lognormal at 5% Significance Level	

Detected Data appear Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	149.4	Mean in Log Scale	4.135
SD in Original Scale	236.4	SD in Log Scale	1.391
95% t UCL (assumes normality of ROS data)	230.3	95% Percentile Bootstrap UCL	233.1
95% BCA Bootstrap UCL	259.4	95% Bootstrap t UCL	350.8
95% H-UCL (Log ROS)	388.5		

UCLs using Lognormal Distribution and KM Estimates when Detected data are Lognormally Distributed

KM Mean (logged)	4.067	95% H-UCL (KM -Log)	534.2
KM SD (logged)	1.542	95% Critical H Value (KM-Log)	3.258
KM Standard Error of Mean (logged)	0.315		

DL/2 Statistics

DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	149.3	Mean in Log Scale	4.039
SD in Original Scale	236.4	SD in Log Scale	1.663
95% t UCL (Assumes normality)	230.2	95% H-Stat UCL	727.7

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics
Detected Data appear Approximate Gamma Distributed at 5% Significance Level

Suggested UCL to Use

95% KM (Chebyshev) UCL	**355.6**	**95% GROS Adjusted Gamma UCL**	**261**
95% Adjusted Gamma KM-UCL	**283.2**		

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
Recommendations are based upon data size, data distribution, and skewness.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Selenium

General Statistics

Total Number of Observations	4	Number of Distinct Observations	4
Number of Detects	3	Number of Non-Detects	1
Number of Distinct Detects	3	Number of Distinct Non-Detects	1
Minimum Detect	0.324	Minimum Non-Detect	2.61
Maximum Detect	0.546	Maximum Non-Detect	2.61
Variance Detects	0.0138	Percent Non-Detects	25%
Mean Detects	0.457	SD Detects	0.118
Median Detects	0.502	CV Detects	0.257
Skewness Detects	-1.463	Kurtosis Detects	N/A
Mean of Logged Detects	-0.807	SD of Logged Detects	0.28

Warning: Data set has only 3 Detected Values.
This is not enough to compute meaningful or reliable statistics and estimates.

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use

guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.
For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).
Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.0

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.892	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.767	Detected Data appear Normal at 5% Significance Level	
Lilliefors Test Statistic	0.315	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.512	Detected Data appear Normal at 5% Significance Level	

Detected Data appear Normal at 5% Significance Level

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs

Mean	0.457	Standard Error of Mean	0.0679
SD	0.096	95% KM (BCA) UCL	N/A
95% KM (t) UCL	0.617	95% KM (Percentile Bootstrap) UCL	N/A
95% KM (z) UCL	0.569	95% KM Bootstrap t UCL	N/A
90% KM Chebyshev UCL	0.661	95% KM Chebyshev UCL	0.753
97.5% KM Chebyshev UCL	0.881	99% KM Chebyshev UCL	1.133

Gamma GOF Tests on Detected Observations Only
Not Enough Data to Perform GOF Test

Gamma Statistics on Detected Data Only

k hat (MLE)	20.36	k star (bias corrected MLE)	N/A
Theta hat (MLE)	0.0225	Theta star (bias corrected MLE)	N/A
nu hat (MLE)	122.2	nu star (bias corrected)	N/A
MLE Mean (bias corrected)	N/A	MLE Sd (bias corrected)	N/A

Gamma Kaplan-Meier (KM) Statistics

k hat (KM)	22.71	nu hat (KM)	181.6
		Adjusted Level of Significance (β)	0.00498
Approximate Chi Square Value (181.64, α)	151.5	Adjusted Chi Square Value (181.64, β)	136.3
95% Gamma Approximate KM-UCL (use when n>=50)	0.548	95% Gamma Adjusted KM-UCL (use when n<50)	0.61

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.867	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.767	Detected Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.33	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.512	Detected Data appear Lognormal at 5% Significance Level	

Detected Data appear Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	0.455	Mean in Log Scale	-0.807
SD in Original Scale	0.0961	SD in Log Scale	0.229
95% t UCL (assumes normality of ROS data)	0.568	95% Percentile Bootstrap UCL	N/A
95% BCA Bootstrap UCL	N/A	95% Bootstrap t UCL	N/A
95% H-UCL (Log ROS)	0.641		

UCLs using Lognormal Distribution and KM Estimates when Detected data are Lognormally Distributed

KM Mean (logged)	-0.807	95% H-UCL (KM -Log)	0.641
KM SD (logged)	0.229	95% Critical H Value (KM-Log)	2.546
KM Standard Error of Mean (logged)	0.162		

DL/2 Statistics

DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	0.669	Mean in Log Scale	-0.539
SD in Original Scale	0.435	SD in Log Scale	0.583
95% t UCL (Assumes normality)	1.181	95% H-Stat UCL	2.764

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics
Detected Data appear Normal Distributed at 5% Significance Level

Suggested UCL to Use

95% KM (t) UCL	**0.617**	**95% KM (Percentile Bootstrap) UCL**	**N/A**

Warning: One or more Recommended UCL(s) not available!

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
Recommendations are based upon data size, data distribution, and skewness.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

APPENDIX D

HABITAT ASSESSMENT FIELD SURVEY REPORT

HABITAT ASSESSMENT FIELD SURVEY REPORT

Exide Technologies
Frisco, Collin County, Texas

Prepared For:
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March 2014

TABLE OF CONTENTS

1.0 INTRODUCTION 1
1.1 Purpose and Scope 1
1.2 Site Description 2
2.0 SAMPLING METHODS 3
2.1 Stewart Creek 3
2.2 Former Exide Facility 4
2.3 Data Collection 4
2.3.1 Field Data Log 4
2.3.2 Photographic Log 4
3.0 FIELD SURVEY RESULTS 5
3.1 Stewart Creek 5
3.2 Facility Property 7
3.2.1 Streams 7
3.2.2 Wooded Areas 9
3.2.3 Lake Parcel 11
4.0 DISCUSSION 12
4.1 Stewart Creek 12
4.1.1 Threatened and Endangered Species 12
4.2 Facility Property 14
4.2.1 Threatened and Endangered Species 15
5.0 REFERENCES 18

LIST OF FIGURES

Figure 1. Site Location Map 19

Figure 2. Stewart Creek Area Surveyed..... 20

Figure 3. Former Exide Facility Field Data Points and Transects 21

Figure 4. Threatened and Endangered Species Documented Occurences 22

Figure 5. Stewart Creek Habitat Plots, Benthic Surveys, and Wildlife Observations 23

Figure 6. North Wooded Area..... 28

Figure 7. Land Use Surrounding the Former Exide Facility..... 29

LIST OF ATTACHMENTS

Attachment A ..... Threatened and Endangered Species for Collin and Denton Counties

Attachment B ..... Wildlife Observations Field Data Sheets

Attachment C ..... Representative Photographs

1.0 INTRODUCTION

On July 9, 2013, Exide submitted an Affected Property Assessment Report (APAR) for the former Exide operating plant to the TCEQ. A Screening Level Ecological Risk Assessment (SLERA) was conducted as a part of the APAR and submitted to the agencies with the APAR. The APAR was reviewed by the EPA and TCEQ and comments were received by Exide on October 8, 2013.

Benchmark Ecological Services, Inc. was contracted to collect the ecological information needed to address two comments provided by TCEQ concerning the Exide SLERA. This Habitat Assessment will become part of the APAR for the former Exide Operating Plant. The TCEQ comments that were addressed are presented below.

> *SLERA General Comment #6: Since the assessment of Stewart Creek will continue downstream, the possibility exists that sediment may accumulate in locations that could support mollusks including the threatened Louisiana pigtoe and the Texas heelsplitter. In addition, it is possible that more viable habitat downstream may exist for other protected species, including the threatened White-faced ibis. It is recommended that these species and other protected species known to occur in Collin and Denton Counties be re-evaluated for potential occurrence in downstream Stewart Creek.*
>
> *SLERA Specific Comment # 13: Figure 9 (Conceptual Site Model). Reptiles and amphibians are likely present at this site and should be reflected in the conceptual site model. In addition, risk to these receptors should be qualitatively evaluated in the SLERA. The risk to reptiles could be tied to the evaluation of the Timber/Canebrake rattlesnake discussed previously and the risk to amphibians could be related to the evaluation of site surface water quality.*

1.1 PURPOSE AND SCOPE

Benchmark was contracted to conduct a wildlife habitat assessment of approximately 7.0 miles of Stewart Creek downstream of the former Exide facility and 36 acres of undeveloped land inside the former Exide facility. The location of the study areas are shown in Figure 1. Benchmark scientists conducted a general habitat assessment with emphasis on habitat that could support the threatened and endangered species listed for Collin and Denton Counties. The habitat assessments were conducted to provide information

needed to support the SLERA that is being conducted at the site.

To address General Comment #6, Benchmark mapped aquatic habitat in Stewart Creek between the former Exide facility and Lake Lewisville in two separate survey events. The initial survey event was conducted on January 15 and 16, 2014, and included all sections of the creek bordered by property owned by the city of Frisco and the United States Corp of Engineers (USACE). Access to sections bordered by private landowners was not granted until March 2014. Benchmark conducted a second survey event on March 18, 2014, in the sections of Stewart Creek not surveyed in January 2014. The creek downstream of the plant is approximately 7.0 miles long (Figure 2).

To address Specific Comment #13, Benchmark mapped wildlife habitat on approximately 36 acres of land within the former Exide facility on January 13 and 14, 2014. Risk calculations for the SLERA being conducted at the site required more information about wildlife utilization of the habitat. Benchmark delineated the habitats to determine if they are being utilized by threatened or endangered wildlife species. The former Exide facility study area is shown in Figure 3.

1.2 SITE DESCRIPTION

The former Exide Facility is located at 7471 South Fifth Street in Collin County, Frisco, Texas. The site, a secondary lead smelter, was active from 1964 through November 2012. It processed used lead-acid batteries and other lead-bearing materials into several lead products. The process produced a slag, which was processed and disposed of in a Class II landfill on-site. The process also produced battery-case chips which were disposed of off-site, and waste acid which was treated through the on-site wastewater-treatment system. The 87 acre former Exide Facility site includes approximately 36 acres of undeveloped land and modified stream channels. The on-site streams, which run east to west across the property, include a segment of Stewart Creek and an unnamed tributary of Stewart Creek (referred to as North Tributary). The streams converge west of the former Exide Facility and flow west toward Lake Lewisville.

Stewart Creek downstream of the former Exide Facility is a perennial stream that receives surface runoff from the former Exide Facility and treated wastewater from the North Texas Municipal Water District wastewater treatment plant. Immediately downstream of the former Exide facility, the stream contains a small number of perennial pools connected by segments of riffles and glides.

2.0 SAMPLING METHODS

2.1 STEWART CREEK

Benchmark conducted a habitat assessment on 7.0 miles of Stewart Creek between Lake Lewisville and the western boundary downstream of the former Exide facility as shown in Figure 2. Prior to conducting the field survey, Benchmark searched existing databases and queried resource agencies to determine if there are known threatened and endangered species occurrences within the study areas and surrounding properties. Figure 4 shows the location of endangered species occurrences identified prior to conducting the field survey. No historical endangered species occurrences were identified within the study areas.

Benchmark scientists walked, waded, and kayaked the sections of the creek shown in Figure 2 to document existing conditions and to locate habitat that could potentially support populations of benthic macro-invertebrates and other wildlife, including threatened or endangered species. Benchmark scientists conducted a general habitat survey noting the physical features of the creek, dominant plant species, and evidence of wildlife utilization.

Stream segments that exhibited favorable conditions for sediment accumulation (pools and glides) are also, in many cases, suitable habitats for benthic and aquatic wildlife. Benthic surveys were conducted within the stream segments that contained accumulated sediment using established stream assessment techniques. The benthic surveys were conducted at the stations shown in Figure 5. The surveys were conducted by first visually examining the sediment surface, and grab samples were collected using a clam rake. Within each transect, scientists waded across the stream or pool using multiple parallel paths perpendicular to the stream centerline. The results of each examination were documented in field notes and in a photographic log. Live specimens were returned to the streambed. Benchmark identified macro-invertebrates observed during the survey and documented sediment type. A photo log was compiled to document the shoreline habitat, sediment type, biological specimens, and general stream conditions. Benchmark scientists used a GPS to record the location of each transect.

During the surveys, Benchmark scientists were especially alert for listed species known to occur in Collin and Denton Counties, as listed in Attachment A. Benchmark scientists used a GPS to record the location of wildlife sightings, changes in stream conditions, and changes in dominant plant species.

2.2 FORMER EXIDE FACILITY

Benchmark Scientists conducted a habitat assessment on approximately 36 acres of undeveloped property within the former Exide Facility shown in Figure 3. The study area consists of two modified streambed areas, the North Wooded area, the South Wooded area, and the Lake Parcel. Benchmark scientists walked the transects shown in Figure 3 and documented the physical characteristics of the habitats, dominant plant species, and wildlife observations. The locations of all field observations were recorded using a sub-meter GPS unit.

Benthic surveys were conducted at the stations shown in Figure 3. The surveys were conducted by first visually examining the sediment surface and grab samples were collected using a clam rake. Within each transect, scientists waded across the stream or pool using multiple parallel paths perpendicular to the stream centerline. The results of each examination were documented in field notes and in a photographic log. A photo log was compiled to document the shoreline habitat, sediment type, and general stream conditions. Benchmark scientists used a GPS to record the location of each transect.

2.3 DATA COLLECTION

2.3.1 Field Data Log

Benchmark scientists recorded all field data on field data sheets and used a GPS to record the location of benthic invertebrate transects, wildlife sightings, stream conditions, and changes in dominant plant species. Copies of the field data sheets are included in Attachment B.

2.3.2 Photographic Log

Benchmark scientists recorded the identification numbers of all photographs taken during the field study on field data sheets. Representative photographs are shown in Attachment C.

3.0 FIELD SURVEY RESULTS

3.1 STEWART CREEK

Benchmark waded through and walked along 7.0 miles of Stewart Creek on January 15 and 16, 2014, and on March 18, 2014, in the areas shown in Figure 2. The streambed that connects the former Exide Plant and Lake Lewisville is typical of a streambed that was formed by rapidly moving water. Most of the creek bottom is dominated by long segments of exposed rock, shale and clay. The elevation of Stewart Creek at the Exide Facility is 640 ft., and the elevation of the water on Lake Lewisville is approximately 515 ft. The distance between the plant and the lake is approximately 4 miles (as the crow flies). The creek bottom downstream of the Exide facility consisted mostly of gravel, shale, and clay and contained few pooling areas. The streambed only included a few segments where measurable amounts of sediment had accumulated. Sediment was only found in the small pools that were scattered along the stream course. The pooling areas were small in size and averaged less than 3 feet deep. The remainder of the streambed consisted of long segments of exposed rock, shale, and clay that had no accumulated sediment. The banks of the creek between the former Exide Facility and Lake Lewisville primarily consisted of steep eroded bluffs 4 to 6 feet high.

Benchmark scientists collected data at 23 habitat plots, conducted 27 benthic surveys, and made over 34 wildlife observations while conducting the surveys along Stewart Creek. The location of the habitat plots, benthic surveys and wildlife observations are shown in Figure 5, and copies of field data sheets are included in Attachment B.

The dominant vegetation on the banks and immediately adjacent to the creek consisted of the following species:

- Green Ash (*Fraxinus pennsylvanica*)
- Hackberry (*Cetlis laevigata*)
- Osage Orange (*Maclura pomifera*)
- Greenbriar (*Smilax bona-nox*)
- Giant Ragweed (*Ambrosia trifida*)
- Canada Wildrye (*Elymus canadensis*)
- Inland Seaoats (*Chasmanthium latifolium*)

Benchmark found three species of mussels (listed below) while conducting the habitat surveys.

- Pondhorn *(Uniomerus tetralasmus)* - shells were found on the banks and on shallow gravel beds throughout the length of creek from the former Exide facility to Lake Lewisville. No live Pondhorn mussels were found when conducting the field surveys.
- Asian Clams (*Corbicula* spp.) – live Asian Clams were collected using a clam rake in the fine gravel of several small pooling areas along the creek downstream of the former Exide facility. Asian Clam shells were abundant on the banks and shallow gravel beds throughout the creek downstream of the former Exide facility.
- Giant Floater (*Pyganodon grandis*) – one shell was found on a shallow gravel bed near Lake Lewisville (Habitat Plot H-74 shown in Figure 5).

Representative photographs of the species listed above are included in Attachment C.

The following turtles were observed when conducting the study;

- Red-eared Slider (*Trachemys scripta elegans*) (Wildlife Plot W-45 and W-101 shown in Figure 5)
- Box Turtle *(Terrapene carolina)* (Wildlife Plots W-42 and W-48 shown in Figure 5*)*
- Soft Shell Turtle *(Apalone spinifera)* (Wildlife Plot W-43 shown in Figure 5*)*

In addition to the species listed above, the following wildlife sightings were recorded when conducting the surveys along Stewart Creek.

- Crow (*Corvus brachyrhynchos*)
- Owl (species unknown)
- Mallard (*Anas platyrhynchos*)
- Turkey Vulture (*Cathartes aura*)
- Northern Cardinal (*Cardinalis cardinalis*)
- Baird's sandpiper (*Calidris bairdii*)
- Carolina Chickadee (*Poecile carolinensis*)
- Tufted Titmouse (*Baeolophus bicolor*)
- Northern Mockingbird (*Mimus polyglottos)*
- Killdeer (*Charadrius vociferous)*
- Beaver (*Castor canadensis*)
- Raccoon (*Procyon lotor*)
- Coyote (*Canis latrans*)
- Bluegill (*Lepomis macrochirus*)
- Green Sunfish (*Lepomis cyanellus*)
- White-tailed Deer (*Odocoileus virginianus*)
- Squirrel Nest (species not identified)

- Minnows (species not identified)

3.2 FACILITY PROPERTY

Benchmark Scientists conducted a habitat assessment on approximately 36 acres of undeveloped property within the former Exide Facility shown in Figure 3. The study area consisted of two modified streambed areas, two wooded areas, and the lake parcel. Copies of the field notes recorded when conducting the habitat surveys area included in Attachment B.

3.2.1 Streams

Benchmark scientists conducted habitat surveys on Stewart Creek and the North Tributary located within the former Exide Facility on January 13 and 14, 2014.

3.2.1.1 Stewart Creek

Stewart Creek runs east to west across the former Exide Facility as shown in Figure 3. The banks on the east end of Stewart Creek averaged approximately 2 feet above the water line. The grasses growing along the banks were maintained and had recently been mowed. The banks along the creek on the west side of the former Exide Facility were greater than 8 ft. tall, and vegetation consisted of shrubs, small trees, and grasses.

Benchmark scientists collected data at 10 habitat plots, conducted 4 benthic surveys, and made over 16 wildlife observations when conducting the surveys along Stewart Creek within the former Exide Facility.

The dominant vegetation along the banks of Stewart Creek consisted of;

- Johnsongrass (*Sorghum halepense*)
- Canada Goldenrod (*Solidago canadensis*)
- Winged Elm (*Ulmus alata*)
- Bermudagrass (*Cynodon dactylon*)
- Giant Ragweed (*Ambrosia trifida*)
- Black Willow (*Salix nigra*)

Wildlife sightings recorded when conducting surveys adjacent to Stewart Creek included the following species;

- European Starling (*Sturnus vulgaris*)
- Crow (*Corvus brachyrhynchos*)

- Turkey Vulture (*Cathartes aura*)
- Pigeon (*Columba livia*)
- Red Tail Hawk (*Buteo jamaicensis*)
- Raccoon (*Procyon lotor*)
- Beaver (*Castor canadensis*)
- Pondhorn (*Uniomerus tetralasmus*)
- Feral hog (*Sus scrofa*)
- Mallard (*Anas platyrhynchos*)

Stewart Creek within the former Exide facility consisted of riffles and a few pooling areas just upstream of small dams located along the creek (one beaver dam and 1 small concrete dam). The creek bed in the riffle areas consisted of gravel, shale, concrete, loose rip/rap, and rip/rap contained within chain link fencing. The creek bed within the pooling areas consisted of gravel, dead vegetation, and small amounts of sand or fine gravel. The gravel sizes vary along the length of the creek bed.

Benchmark conducted benthic surveys in the two pooling areas and in 2 riffle areas within the facility. Benthic survey locations are shown in Figure 3. Several attempts to collect benthic organisms using a clam rake were made at each of the 4 benthic survey stations. No live mussels and no mussel shells were observed when conducting the benthic surveys in Stewart Creek within the former Exide facility.

Benchmark scientists found Pondhorn mussel shells along the bank of the creek just upstream of the Railroad tracks located on the West boundary of the former Exide facility. The weathered condition of the mussel valves indicated that deposition of the shell was not recent. The shells were found approximately 7 feet above the water line on a relatively steep slope.

3.2.1.2 North Tributary

The North Tributary of Stewart Creek runs from east to west. The east end of the North Tributary is located within the North Wooded Area discussed in Section 3.2.2.1. The west end of the North Tributary is bounded by a lake parcel on the north and the former Exide Facility on the south. The North Tributary ends near the west end of the study area where it converges with Stewart Creek. A smaller volume of water flows through the North Tributary compared to Stewart Creek. Small pooling areas less than 5 to 10 square feet were observed when conducting the surveys. The bottom of the creek bed within the riffle areas and pooling areas consisted of gravel, clay and shale.

Along the section of the North Tributary located outside of the North Wooded Area, Benchmark scientists collected data at 8 habitat plots and made over 4 wildlife observations. The dominant vegetation along the stream banks and wildlife observations made in the section of the North Tributary located within the North Wooded Area are listed in Section 3.2.2.1.

The dominant vegetation along the North Tributary outside of the North Wooded Area consisted of:

- Canada Goldenrod (*Solidago canadensis*)
- Bermudagrass (*Cynodon dactylon*)
- Johnsongrass (*Sorghum halepense*)
- Giant Ragweed (*Ambrosia trifida*)

Wildlife sightings recorded when conducting surveys along the North Tributary (outside of the wooded area) included the following species:

- Red Tail Hawk (*Buteo jamaicensis*)
- Raccoon (*Procyon lotor*)
- Active Burrows (unknown species)

3.2.2 Wooded Areas

Benchmark conducted habitat surveys in two wooded areas located within the former Exide Facility. The two wooded areas are labeled North Wooded Area and South Wooded Area in Figure 3.

3.2.2.1 North Wooded Area

Benchmark scientists walked 5 north/south transects within the North Wooded Area as shown in Figure 3. Field data were collected at 16 habitat plots and 13 wildlife observations were made during the surveys in the North Wooded Area. The North Wooded Area was separated into two different habitat types. The north and east sections of the study area consisted of relatively level ground with a higher elevation than the southwest section. The southwest section of the study area was at a lower elevation and exhibited hydrologic features such as drift lines and buttressing at the base of numerous trees. The drift lines and buttressing indicates the area contains standing water part of the year. The approximate boundaries of the two habitat areas listed above are shown in Figure 6.

The dominant vegetation within the wooded area with the higher elevation in the north and east consisted of:

- Greenbrair (*Smilax bona-nox*)
- Osage Orange (*Maclura pomifera*)
- Canada Wildrye (*Elymus canadensis*)
- Hackberry (*Cetlis laevigata*)
- Cedar Elm (*Ulmus crassifolia*)
- American Elm (*Ulmus americana*)
- Honeysuckle (*Lonicera japonica*)

Dominant vegetation within the area at a lower elevation in the southwest consisted of:

- Hackberry (*Cetlis laevigata*)
- Black Willow (*Salix nigra*)
- Mustang Grape (*Vitis mustangensis*)

Wildlife sightings recorded when conducting surveys in the North Wooded area included the following species:

- Robin (*Turdus migratorius*)
- Northern Cardinal (*Cardinalis cardinalis*)
- Mourning Dove (*Zenaida macroura*)
- Raccoon (*Procyon lotor*)
- Tufted Titmouse (*Baeolophus bicolor*)
- Loggerhead Shrike (*Lanius ludovicianus*)

3.2.2.2 South Wooded Area

Benchmark scientists walked 4 north/south transects within the South Wooded Area as shown in Figure 3. Benchmark scientists collected data at 9 habitat plots and made 14 wildlife observations while conducting the surveys in the South Wooded Area. The elevation along the south edge of the wooded area is approximately 680 ft., and the elevation at the north edge of the wooded area is approximately 640 ft. The angle of the slope starting at the south edge and sloping down to north edge is approximately 20 degrees.

The dominant vegetation in the South Wooded Area consisted of:

- Bermudagrass (*Cynodon dactylon*)
- Greenbrair (*Smilax bona-nox*)

- Osage Orange (*Maclura pomifera*)
- Canada Wildrye (*Elymus canadensis*)
- Hackberry (*Cetlis laevigata*)
- Cedar Elm (*Ulmus crassifolia*)

Wildlife sightings recorded when conducting surveys in the South Wooded Area included the following species:

- White-tailed Deer (*Odocoileus virginanus)*
- Tufted Titmouse (*Baeolophus bicolor*)
- Mockingbird (*Mimus polyglottos*)
- Carolina Chickadee (*Poecile carolinensis*)
- Bird nest (unknown species)
- Burrows (unknown species)
- Nest (unknown species)
- Northern Cardinal (*Cardinalis cardinalis*)
- Robin (*Turdrus migratorius*)
- Woodpecker (unknown species)
- Cottontail Rabbit (*Sylvilagus floridanus*)
- Packrat (unknown spieces)
- Cedar Waxwing (*Bombycilla cedrorum*)
- Blue Jay (Cyanocitta cristata)

3.2.3 Lake Parcel

Benchmark scientists walked 1 north/south transect and collected data on 1 habitat plot when conducting the surveys in the Lake Parcel located in the Southwest corner of the former Exide facility (Figure 3). The Lake Parcel was relatively flat and had recently been mowed.

Dominant vegetation in the parcel consisted of;

- Canada Goldenrod (*Solidago canadensis*)
- Bermudagrass (*Cynodon dactylon*)
- Johnsongrass (*Sorghum halepense*)

No wildlife sightings were recorded while conducting surveys in the Lake Parcel.

4.0 DISCUSSION

4.1 STEWART CREEK

No threatened or endangered species, listed by federal or state agencies, were found while conducting the surveys along Stewart Creek.

Benchmark scientists found the following three species of mussels while conducting habitat surveys.

- Pondhorn *(Uniomerus tetralasmus)* - shells were found on the banks and on shallow gravel beds throughout the length of creek from the former Exide Facility to Lake Lewisville. No live Pondhorn mussels were found when conducting the field surveys.
- Asian Clams (*Corbicula spp.*) – live Asian Clams were collected using a clam rake in the fine gravel of several small pooling areas along the creek downstream of the former Exide facility. Asian Clam shells were abundant on the banks and shallow gravel beds throughout the creek downstream of the facility.
- Giant Floater (*Anodonta grandis*) – one shell was found on a shallow gravel bed near Lake Lewisville (Habitat Plot H-74 shown in Figure 5).

Benchmark waded the creek bed and conducted benthic surveys at 20 sample stations. The water was clear along most of the creek, and there were no visible signs of live mussels other than the Asian Clams. The creek bed was comprised of gravel, shale and clay and there were few pooling areas identified during the field study. Based on the results of the visual observations, benthic surveys and the small number of pooling areas with sandy and muddy bottoms, it is unlikely that the Texas Heelsplitter or Louisiana Pigtoe inhabit the sections of Stewart Creek that were surveyed. Three species of turtles were observed when conducting the surveys (Red-eared Slider, Box Turtle, and Soft Shell).

4.1.1 Threatened and Endangered Species

No threatened or endangered species, listed by federal or state agencies, were found while conducting the surveys along Stewart Creek. A list of the threatened and endangered species listed for Collin and Denton Counties is presented in Attachment A. Additional information concerning the habitat requirements of state listed species mentioned in SLERA Comment #6 or by TCEQ Ecological Risk Assessment Program Manager (Alligator snapping turtle and White-faced ibis), are provided below.

Alligator Snapping Turtle (*Macrochelys temminckii*) - No Alligator snapping turtles, which are listed as threatened by the state of Texas, were observed in the creek during the survey. Alligator snapping turtles live in freshwater habitats in the southeastern United States, and are found in most of the river systems that drain into the Gulf of Mexico. They are almost exclusively aquatic and generally live in the deepest water within their habitat. Only females venture on land to build nests and lay their eggs. Alligator snapping turtles prefer the habitat found in large rivers, deep sloughs, oxbow lakes and deep pools connected to large rivers (Ernst, et al., 1994). They prefer areas with submerged cover, fallen logs, overhanging shrubs, and dense overhead canopies. Adult turtles may thermoregulate using differing stream depths seasonally. Adult turtles choose deeper water during midwinter and shallower water in early summer (Riedle, et al., 2006). Hatchlings and juveniles may also inhabit smaller rivers and streams. All stable populations of alligator snapping turtles are found around larger bodies of water (i.e., large rivers and lakes) (Minton Jr., 2001; Conant, et al., 1992; Ernst, et al., 1994).

Alligator snapping turtles are both scavengers and active hunters. They are nocturnal feeders that will eat fish, frogs, snakes, snails, worms, clams, crayfish, aquatic plants, small mammals, and other turtles. During the day, they will lay motionless on the bottom of a pool and use a worm-like lure attached to the back of the mouth to attract fish into their open jaws. The turtles feed year round by taking advantage of warm winter days to search for food along the shoreline (Elsey, 2006; Ernst, et al., 1994; Pritchard, 1979).

Alligator snapping turtles mate in late spring in the western part of their range (i.e., Texas), and the females lay their eggs in a nest about two months later approximately 50 m from a body of water. Nesting success is dependent upon the quality and availability of the adjoining riparian habitat and the abundance of nest predators like raccoons, dogs, cats, and skunks.

It is unlikely that the Alligator snapping turtle would spend time within the survey area due to high flow conditions that are common in the creek and the small number of shallow pooling areas found in the creek. Stewart Creek does not provide the deep muddy bottomed pools and submerged structure that attract alligator snapping turtles. The broad sandy flood plain that is preferred by female snapping turtles for nesting is also uncommon along Stewart Creek. Adult snapping turtles would find it difficult to live and reproduce in the Stewart Creek habitat.

White-Faced Ibis (*Plegadis chihi*) - No White-faced Ibis, which is listed as threatened by the state of Texas, were observed in the creek during the survey. The White-faced Ibis is a medium sized dark brown or maroon wading bird (46-56 cm tall, 450-525 grams) with a long, down-curved bill. It is a member of

the family Threskiornithidae and is similar in appearance and habits to the Glossy Ibis. The White-faced Ibis is distinguished from the Glossy Ibis by the narrow border of white feathers around its bare reddish facial skin (breeding adult). Adult birds have a grey bill, reddish legs, and red eyes year-round (Ryder and Manry, 1994).

The White-faced Ibis prefers freshwater marshes, where it can find insects, newts, leeches, earthworms, snails and especially crayfish, frogs and fish. They roost on low platforms of dead reed stems or on mud banks. Ibises will feed in large flocks of up to 1,000 birds. They utilize both natural wetlands and irrigated and flooded agricultural fields.

The White-faced Ibis is a colonially breeder and usually constructs nests on top of emergent aquatic vegetation or in low shrubs or tree over the water. Locating the nests over water helps protect the eggs and nestlings from mammalian predators such as skunks, raccoons, and cats. Nests are also preyed on by gulls, magpies, ravens, crows, owls, and grackles.. The White-faced Ibis nests in isolated colonies from Oregon to Kansas, but its center of greatest abundance in the US is in Utah, Texas, and Louisiana. In Texas, they breed and winter along the Gulf Coast and may occur as migrants in the Panhandle and West Texas.The inland populations of White-faced Ibises prefer to breed in shallow freshwater marshes with islands of emergent vegetation such as cattails or bulrushes. The Louisiana and Texas populations also breed in estuarine marshes (Farrand, 1983).

Its breeding range extends from the western US south through Mexico to Brazil, Bolivia, Argentina, and Chile (IUCN 2012). Its winter range extends from southern California and Louisiana south to include the rest of its breeding range. In 2012, the total population size was estimated to be 1.2 million individuals, and increasing. The IUCN rates it as a species of "Least Concern" (IUCN 2012).

They migrate from the northern portions of their range in the colder months to winter as far south as northern South America. The breeding populations on the Texas and Louisiana coasts are year round residents.The White-faced Ibis is not a resident of the area around Stewart Creek, but riparian habitat adjacent to the perennial pools and lake shore might be used for resting and feeding by migrating birds. No White-faced Ibis were observed during the habitat survey for this study.

4.2 FACILITY PROPERTY

Benchmark conducted a habitat survey within the former Exide facility on January 13 and 14, 2014, using the methods described in Section 2.2. Benchmark scientists did not find any reptiles or amphibians

while conducting the study. It is likely that reptiles and amphibians live within the study area, but were dormant at the time the habitat surveys were conducted.

4.2.1 Threatened and Endangered Species

No threatened or endangered species, listed by federal or state agencies, were found while conducting the surveys on the facility property. A list of the threatened and endangered species listed for Collin and Denton Counties is presented in Attachment A. Additional information concerning the habitat requirements of state listed species mentioned in SLERA Comment #13 or by TCEQ Ecological Risk Assessment Program Manager (Timber/Canebrake Rattlesnake and Texas Horned Lizard), are provided below.

Timber/Canebrake Rattlesnake (*Crotalus horridus*) - While it is likely that some reptiles do inhabit the study area, it is unlikely that the Timber/Canebrake rattlesnake, which is listed as endangered by the state of Texas, would thrive within the study area. Timber and canebrake rattlesnakes are considered a single species but they may have different habitat preferences and may exhibit different seasonal activity patterns. No subspecies is currently recognized (ITIS, 2014). Timber rattlesnake will be used in the following discussion in reference to both groups. Timber rattlesnakes are found in upland woods and rocky ridges in the eastern United States and the eastern third of Texas.

In Texas, timber rattlesnakes occupy bottomland hardwood forest dominated by oaks, hickories, and sweetgum, and upland forests dominated by oaks, loblolly pine, and shortleaf pine (Rudolph, *et al.*, 2004). They prefer woodlands or thickets near permanent water sources such as rivers, lakes, ponds, streams and swamps where tree stumps, logs and branches provide cover. Timber rattlesnake populations require undisturbed den sites and large contiguous wooded areas to be used during the foraging season (Brown, 1993). This species occurs in a wide variety of terrestrial habitats but their abundance typically declines sharply when urbanization encroaches (Waldron *et al*., 2006).

Timber rattlesnakes usually congregate in dens in rocky areas during cold weather to hibernate. After emergence from the den in spring, males and non-gravid females migrate to lowlands, pasture edges, the banks of streams and rivers, and brushy or wooded sites (Petersen and Fritsch, 1986). Timber rattlesnakes migrate back to the same dens in the fall for hibernation and may retrace the same route used for spring migration (Brown, *et al*., 1982). After migrating to summer habitat, timber rattlesnakes move short

distances within summer ranges to forage and breed. Home range size increases for males during the breeding season compared to the foraging season (Rudolph and Burgdorf, 1997; Waldron *et al*., 2006).

Habitat selection by timber rattlesnakes differs based on gender, reproductive status, and season (Brown, 1993; Reinert and Zappalorti, 1988.). Timber rattlesnakes need 3 types of habitat (e.g., denning, transient, and summer habitats). Denning habitat is used by all timber rattlesnakes for hibernation. Transient habitat is located close to the den and is used by males and non-gravid females for basking before migration to summer habitat. It is also used by gravid females for gestation and parturition. Summer habitat is used by males and nongravid females for foraging, mating, and basking (Brown, 1993).

Timber rattlesnakes feed on rabbits, squirrels, rats, mice, birds, other snakes, lizards, and frogs. Young timber rattlers are eaten by coyotes, bobcats, skunks, foxes, hawks, owls, and snake-eating snakes such as king snakes, indigo snakes and cottonmouths. Timber rattlers are diurnal (active during the day) during spring and fall but become nocturnal (active at night) during summer. Timber rattlesnakes are sometimes slow to defend themselves and rely on their ability to blend into their surroundings to avoid confrontation. They prefer to hide from predators and avoid confrontation.

Mating season is in early spring, only once every two to three years for females. The live young are born in late summer or early fall. After birth, young snakes remain near their mother for seven to ten days, but no parental care is provided. Causes of mortality for newborns include predation, lack of suitable small-sized prey items, and lack of suitable dens (Galligan and Dunson, 1979). Most adult mortality is due to human impacts including hunting, collecting for commercial purposes, habitat loss, and habitat fragmentation (Rudolph and Burgdorf, 1997; Waldron *et al*., 2006).

Timber rattlesnakes would not live in the study area due to the limited and fragmented habitat adjacent to and within the property. An aerial photograph of the property (Figure 7) shows that the surrounding areas are dominated by urban development and active agricultural fields. The continuous undisturbed scrub shrub and wooded habitat that is required to support a population of Timber rattlesnakes was not found at the site.

Texas Horned Lizard (*Phrynosoma cornutum)* - The Texas horned lizard ranges from the south-central United States to northern Mexico (including Texas, Oklahoma, Kansas and New Mexico) and the former Exide Facility is within the range of the species. Texas horned lizards can be found in arid and semiarid habitats in open areas with sparse plant cover. Because horned lizards dig for hibernation, nesting and

insulation purposes, they commonly are found in loose sand or loamy soils (Munger, 1984). The Texas horned lizard currently is listed as a threatened species in Texas (federal category C2).

Texas Horned lizards are most often found near harvester ant mounds. About 70% of the horned lizard's diet is made up of harvester ants and the remainder is composed of termites, beetles, and grasshoppers. The horned lizard requires bright sunlight to produce vitamin D and they are often found in open un-vegetated areas where full sunlight reaches the ground. Without sunlight the lizards are unable to produce vitamin D and will suffer from vitamin deficiency. At night, the lizard buries itself in sand.

Horned lizards can move rapidly if they feel there is a predator in the area, and will dart into thick grass and foliage to escape. Horned lizards are excellent diggers, and can quickly burrow in sandy soil to escape threats (Munger, 1986).

It is unlikely that the Texas Horned lizard is common in the study area due to the lack of suitable habitat. The Texas horned lizard prefers open sandy areas where herbaceous vegetation is scarce. This habitat was not common at the former Exide Facility. The forested areas found at the site are not preferred habitat for the lizards. In addition, Benchmark did not find harvester ants or ant mounds (the preferred prey item of the horned lizard) within the study area.

5.0 REFERENCES

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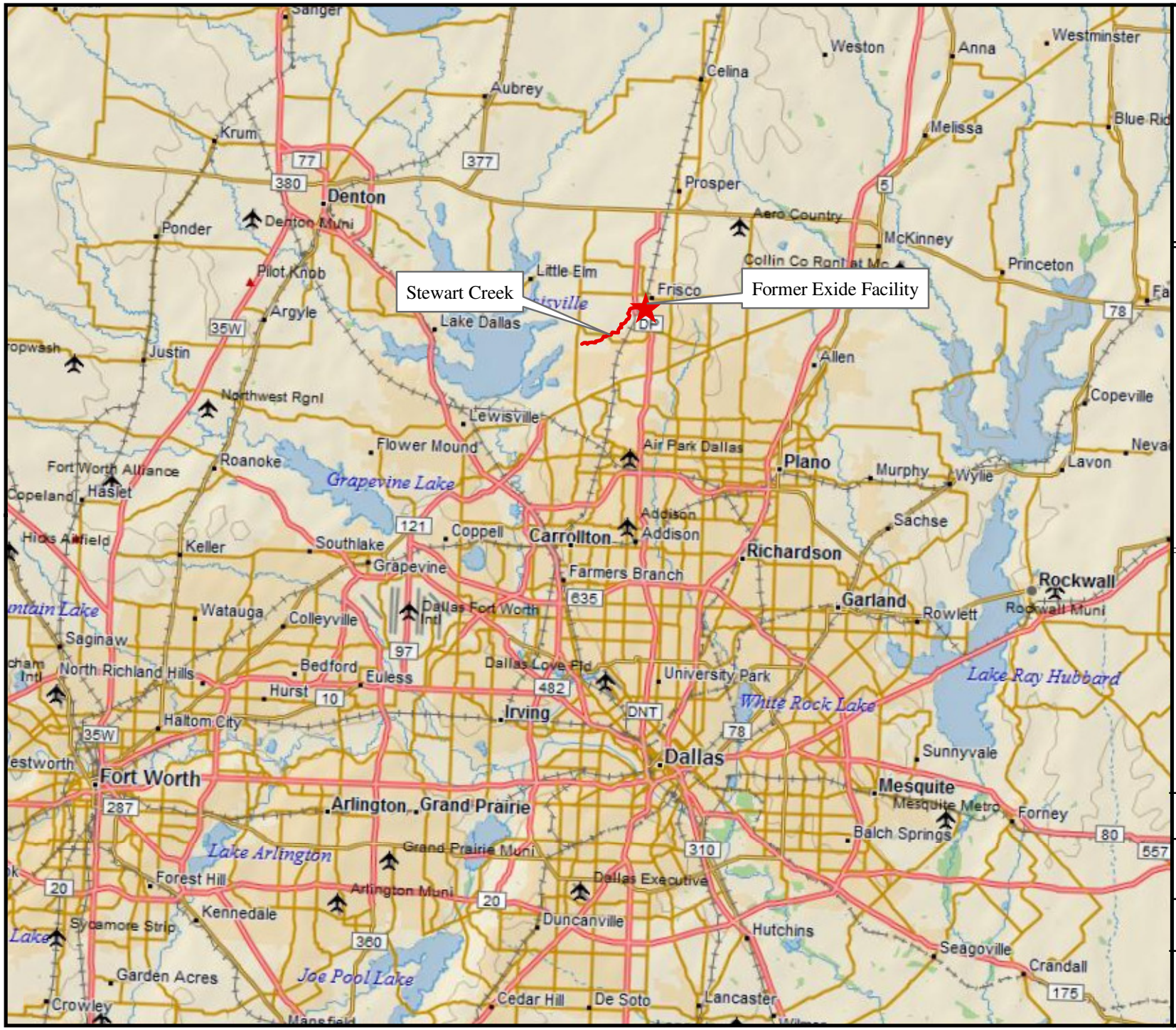
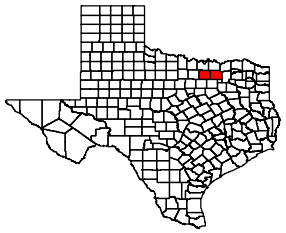


Legend

Notes

Delorme World Base Map
Collin and Denton Counties



Site Location Map

Exide Technologies
Habitat Assessment

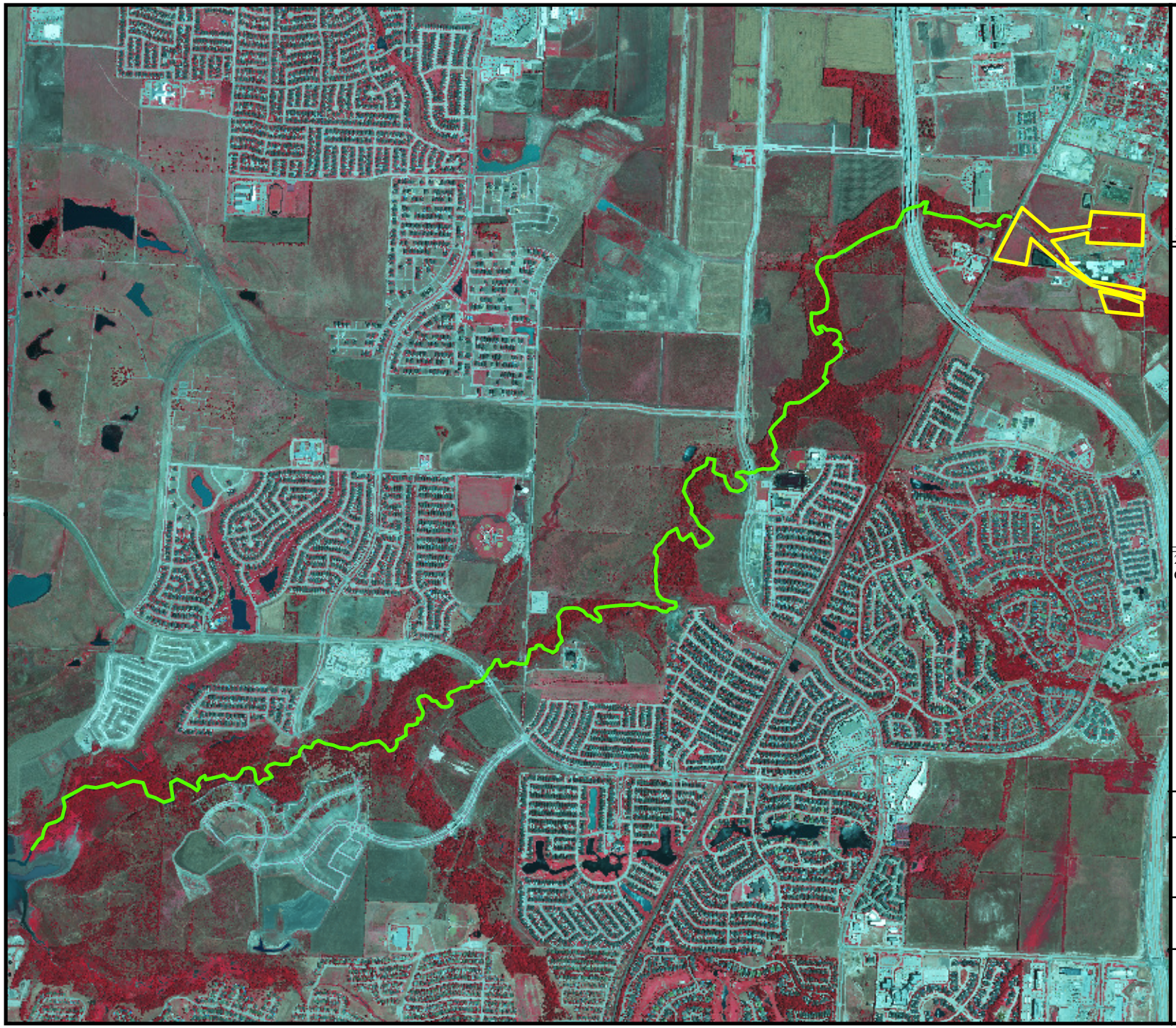
Golder Associates, Inc.

BESI Benchmark Ecological Services, Inc.

Project: 13009-001
Date: 01/02/2014

Figure 1

M:\13009\001\arc\Figure 1_study area.mxd



N

0 1,450 2,900 Feet

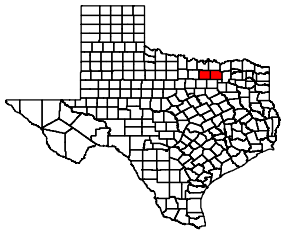
Legend

Stewart Creek (Surveyed)

Former Exide Facility

Notes

2008 DOQQ (Heburn and Frisco) Quad
Collin and Denton County



Stewart Creek
Areas Assessment

Exide Technologies
Habitat Assessments

Golder Associates, Inc.

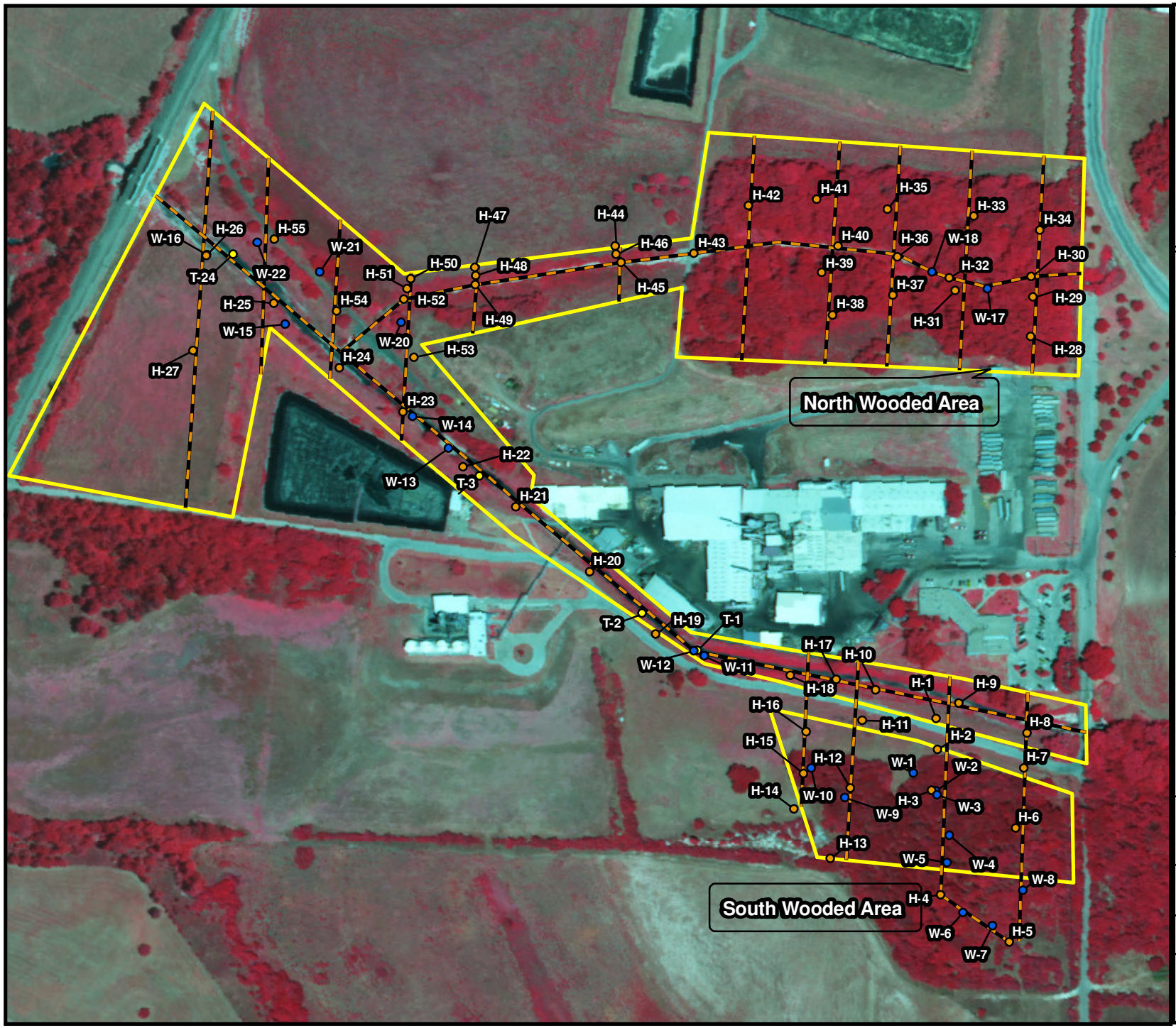
BESI Benchmark Ecological Services, Inc.

Project: 13009-001

Date: 03/19/2014

Figure 2

M:\13009\001\arc\working\Figure 2_creek.mxd



N

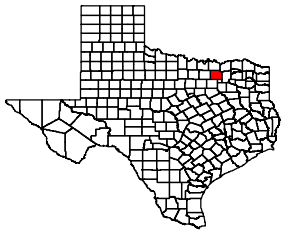
0 260 520 Feet

Legend

- Habitat Plots
- Benthic Surveys
- Wildlife Observations
- Survey Transects
- Former Exide Facility

Notes

2009 DOQQ (Frisco and Heburn Quad)
Collin County



Former Exide Facility
Field Data Points
and Transects

Exide Technologies
Habitat Assessment

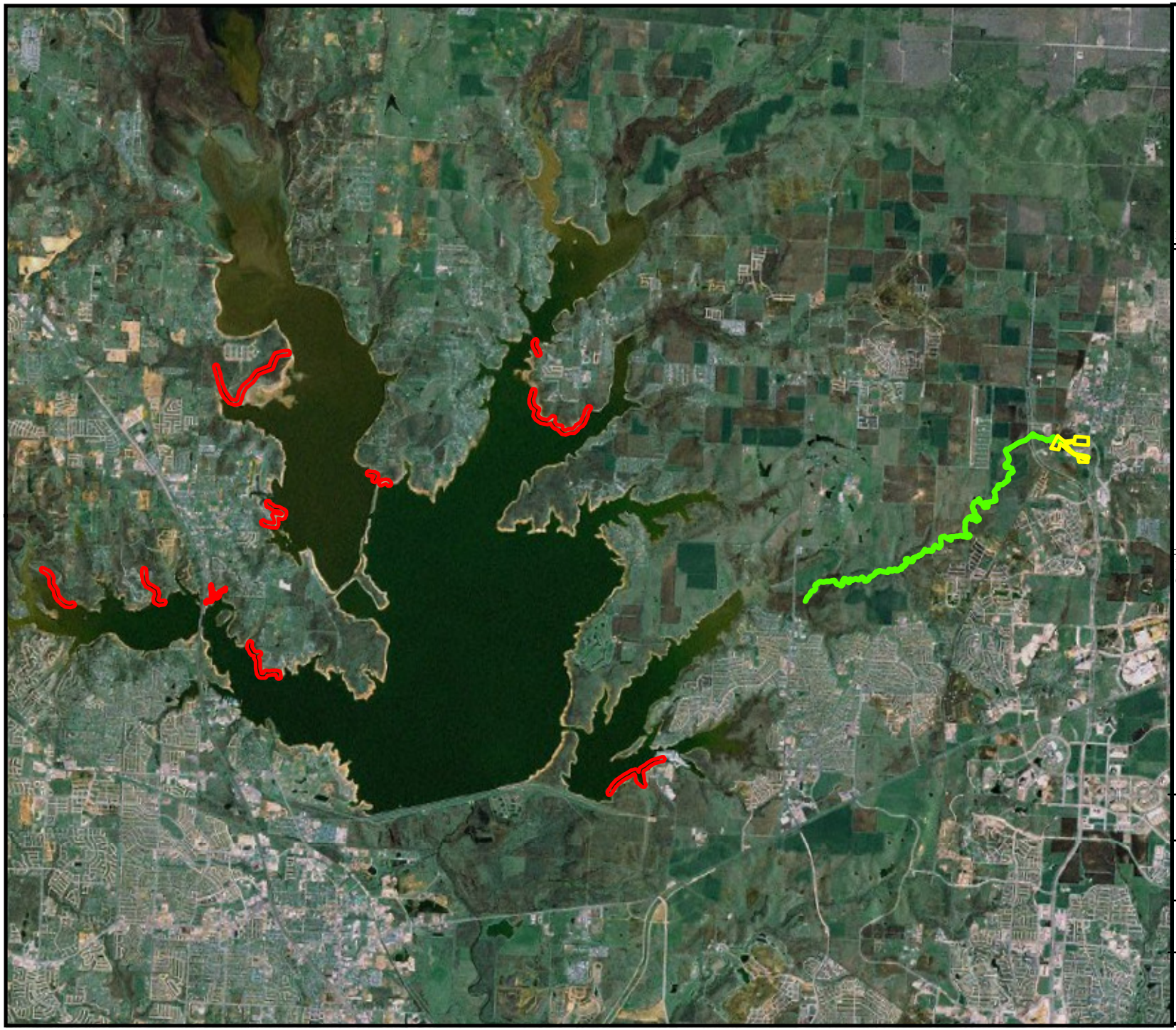
Golder Associates, Inc.

BESI Benchmark Ecological Services, Inc.

Project: 13009-001
Date: 02/11/2014

Figure 3

M:\13009\001\arc\Figure 3_transects_2.mxd



N

0 1 2 Miles

Legend

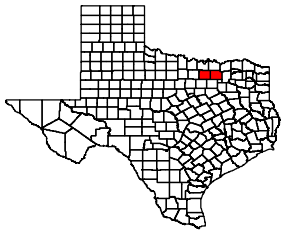
Former Exide Facility

Stewart Creek

Texas Heelsplitter

Notes

ESRI World Imagery, TPWD EO data
Collin and Denton Counties



Threatened and Endanged Species
Documented Occurrences

Exide Technologies
Habitat Surveys

Golder Associates, Inc.

BESI Benchmark Ecological Services, Inc.

Project: 13009-001

Date: 02/11/2014

Figure 4

M:\13009\001\arc\Figure 4 T and E sightings.mxd

N

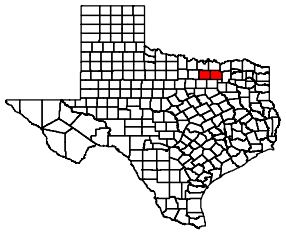
0 435 870 Feet

Legend

- Habitat Plots
- Benthic Surveys
- Wildlife Observations
- Former Exide Facility
- Stewart Creek (Surveyed)

Notes

2008 DOQQ (Frisco, Lewisville East and Heburn Quad) Collin and Denton Counties



Stewart Creek Habitat Plots, Benthic Surveys, and Wildlife Observations.

Exide Technologies
Habitat Assessments

Golder Associates, Inc.

BESI Benchmark Ecological Services, Inc.

Project: 13009-001

Date: 03/19/2014

Figure 5
(Map 1 of 5)

M:\13009\001\arc\working\Figure 5 mapbook of stream_2.mxd

N

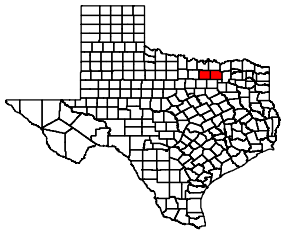
0 437.5 875 Feet

Legend

- Habitat Plots
- Benthic Surveys
- Wildlife Observations
- Former Exide Facility
- Stewart Creek (Surveyed)

Notes

2008 DOQQ (Frisco, Lewisville East and Heburn Quad) Collin and Denton Counties



Stewart Creek Habitat Plots, Benthic Surveys, and Wildlife Observations.

Exide Technologies
Habitat Assessments

Golder Associates, Inc.

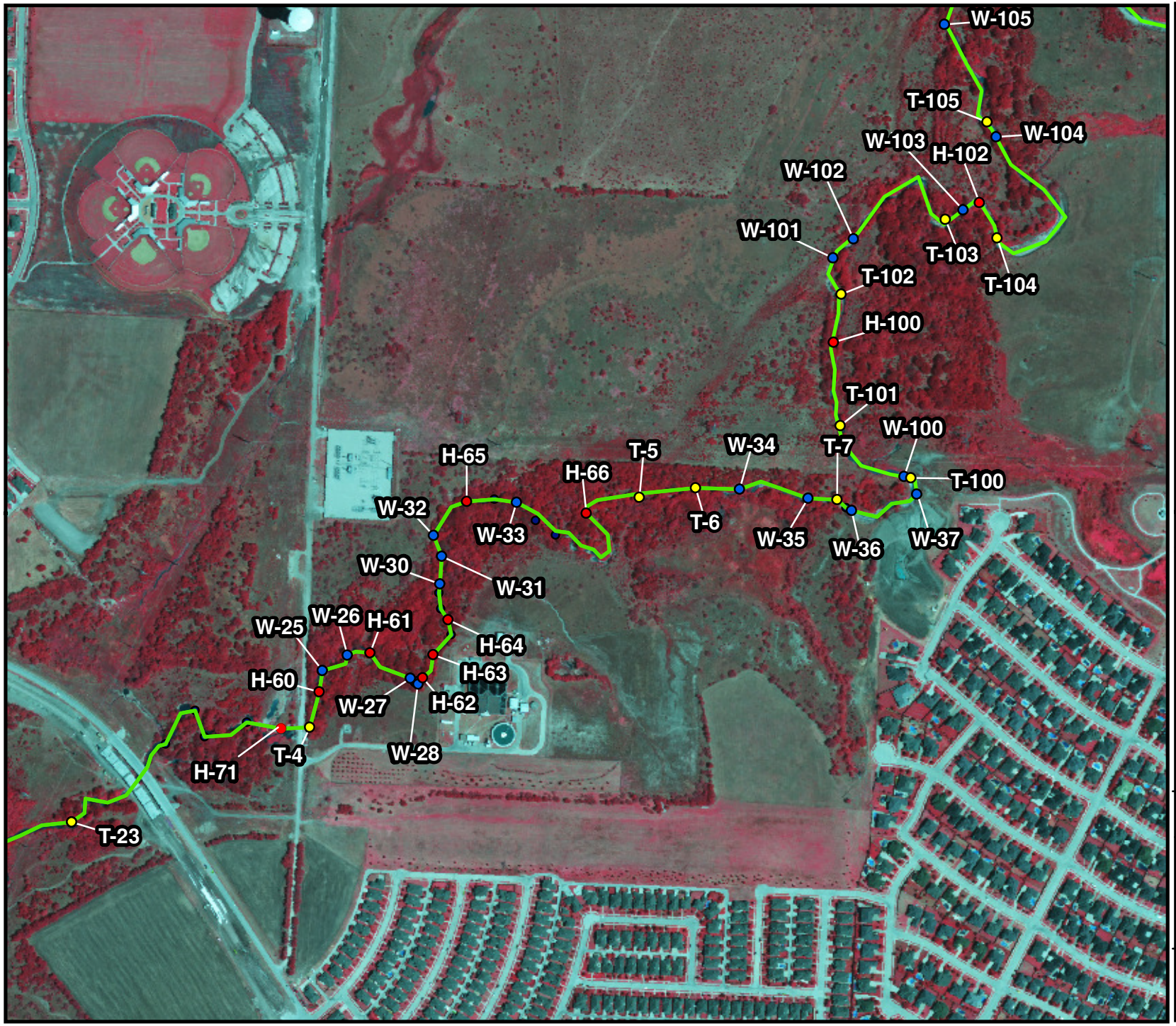
BESI Benchmark Ecological Services, Inc.

Project: 13009-001

Date: 03/19/2014

Figure 5
(Map 2 of 5)

M:\13009\001\arc\working\Figure 5 mapbook of stream_2.mxd



N

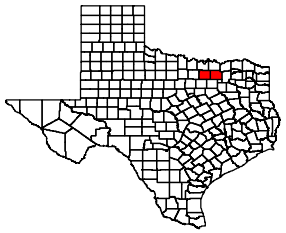
0 437.5 875 Feet

Legend

- Habitat Plots
- Benthic Surveys
- Wildlife Observations
- Former Exide Facility
- Stewart Creek (Surveyed)

Notes

2008 DOQQ (Frisco, Lewisville East and Heburn Quad) Collin and Denton Counties



Stewart Creek Habitat Plots, Benthic Surveys, and Wildlife Observations.

Exide Technologies
Habitat Assessments

Golder Associates, Inc.

BESI Benchmark Ecological Services, Inc.

Project: 13009-001

Date: 03/19/2014

Figure 5
(Map 3 of 5)

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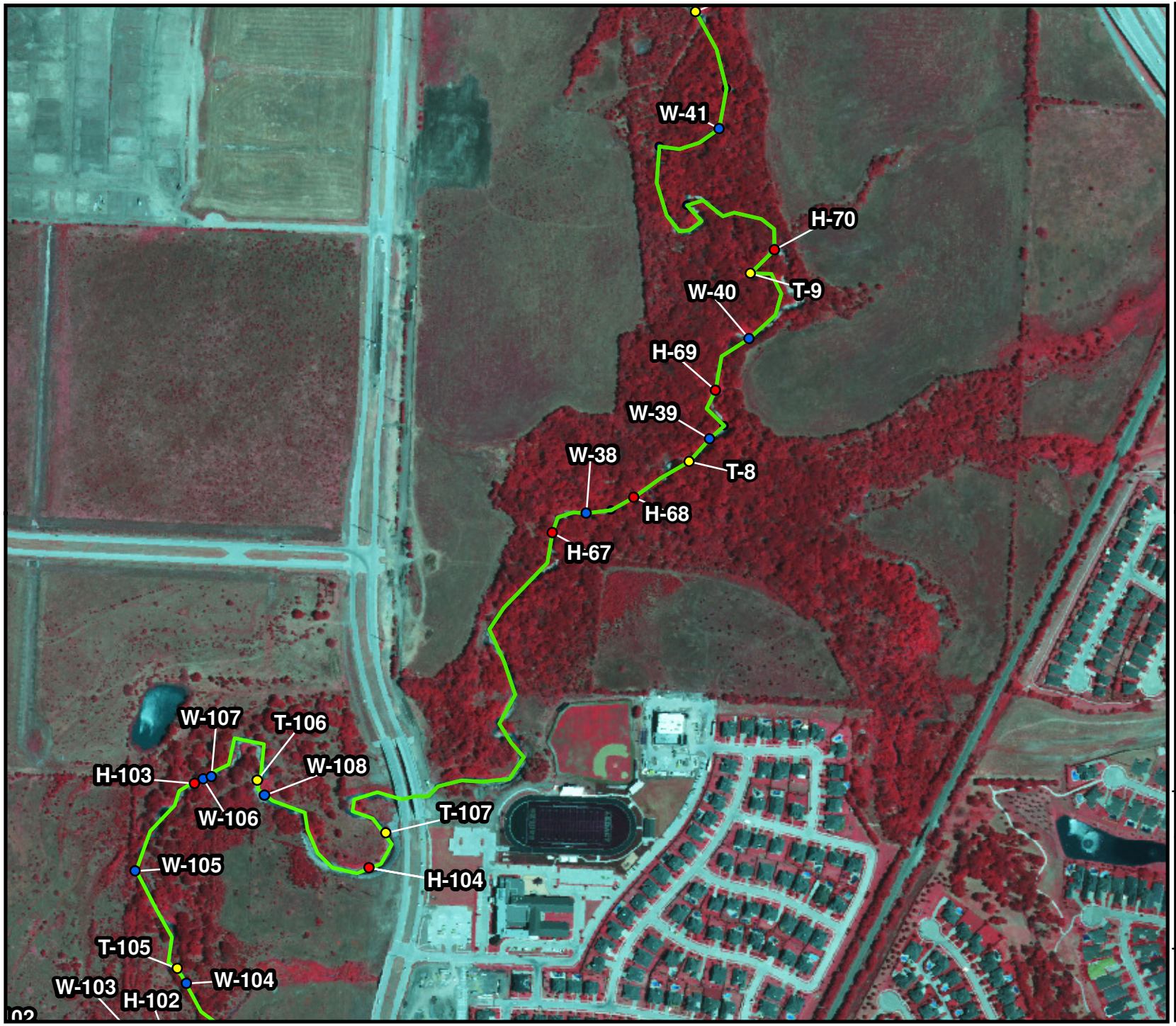


N

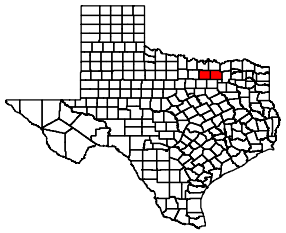
0 437.5 875 Feet

Legend

- Habitat Plots
- Benthic Surveys
- Wildlife Observations
- Former Exide Facility
- Stewart Creek (Surveyed)

Notes

2008 DOQQ (Frisco, Lewisville East and Heburn Quad) Collin and Denton Counties



Stewart Creek Habitat Plots, Benthic Surveys, and Wildlife Observations.

Exide Technologies
Habitat Assessments

Golder Associates, Inc.

BESI Benchmark Ecological Services, Inc.

Project: 13009-001

Date: 03/19/2014

Figure 5
(Map 4 of 5)

M:\13009\001\arc\working\Figure 5 mapbook of stream_2.mxd

N

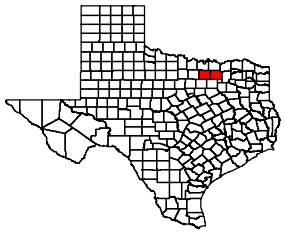
0 437.5 875 Feet

Legend

- Habitat Plots
- Benthic Surveys
- Wildlife Observations
- Former Exide Facility
- Stewart Creek (Surveyed)

Notes

2008 DOQQ (Frisco, Lewisville East and Heburn Quad) Collin and Denton Counties



Stewart Creek Habitat Plots, Benthic Surveys, and Wildlife Observations.

Exide Technologies
Habitat Assessments

Golder Associates, Inc.

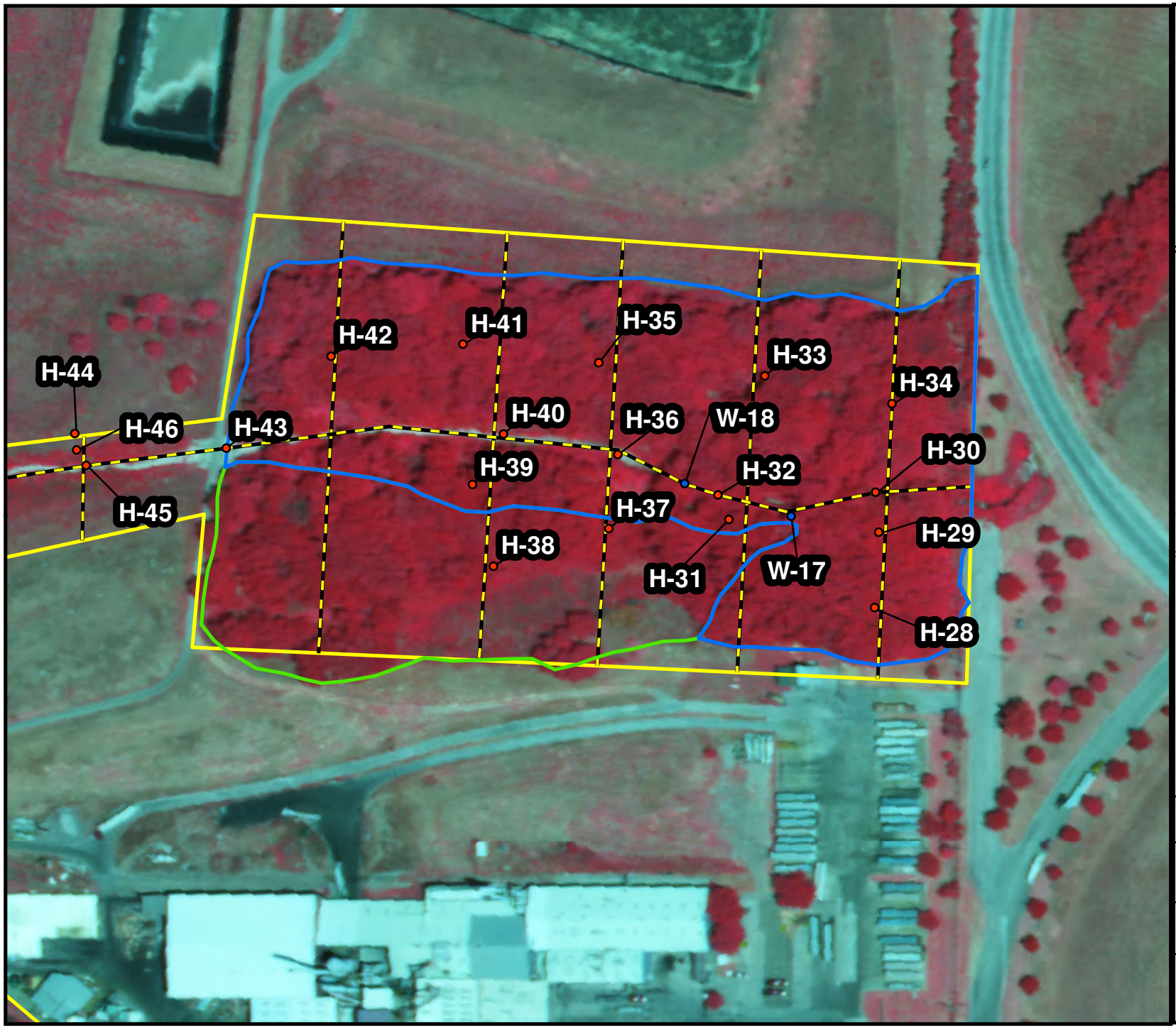
BESI Benchmark Ecological Services, Inc.

Project: 13009-001

Date: 03/19/2014

Figure 5
(Map 5 of 5)

M:\13009\001\arc\working\Figure 5 mapbook of stream_2.mxd



N

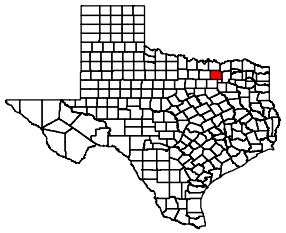
0 125 250 Feet

Legend

- Habitat Plot
- Wildlife Observations
- Wooded Area (Higher Elevation)
- Wooded Area (Lower Elevation)
- Former Exide Facility
- Survey Transects

Notes

2008 DOQQ (Frisco Quad)
Collin County



North Wooded Area

Exide Technologies
Habitat Assessment

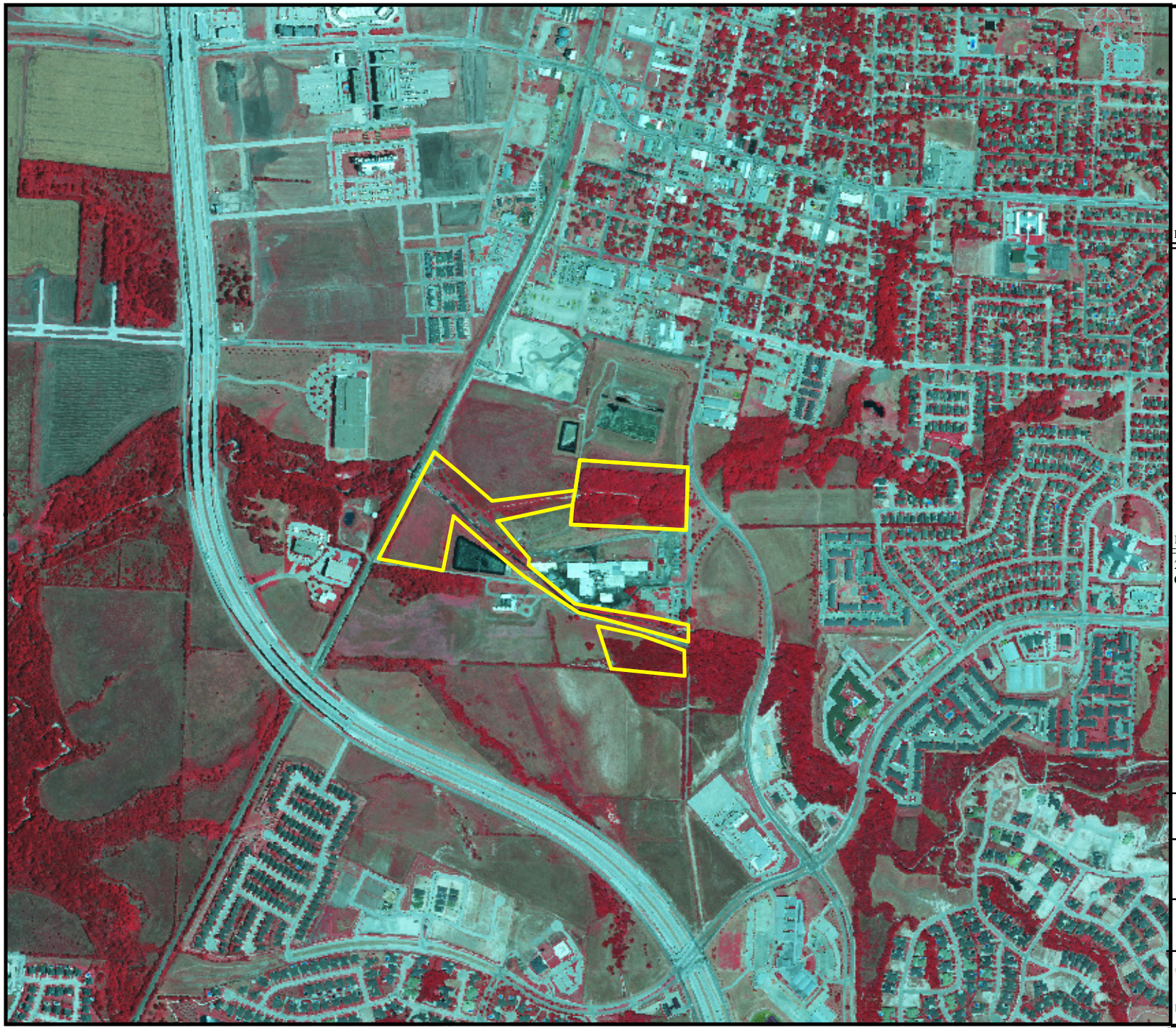
Golder and Associates, Inc.

BESI Benchmark Ecological Services, Inc.

Project: 13009-001
Date: 02/11/2014

Figure 6

M:\13009\001\arc\Figure 6.mxd



N

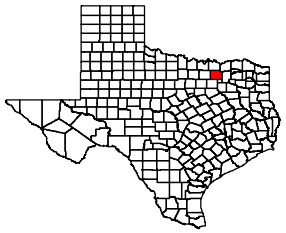
0 385 770 1,540 Feet

Legend

Former Exide Facility

Notes

2008 DOQQ (Frisco Quad)
Collin County



Land Use Surrounding
the Exide Facility

Exide Technologies
Habitat Assessment

Golder and Associates, Inc.

BESI Benchmark Ecological Services, Inc.

Project: 13009-001

Date: 02/12/2014

Figure 7

M:\13009\001\arc\Figure 7 forested areas.mxd

Attachment A

Revised 2/28/2011

COLLIN COUNTY

BIRDS		Federal Status	State Status
American Peregrine Falcon	*Falco peregrinusanatum*	DL	T

year-round resident and local breeder in west Texas, nests in tall cliff eyries; also, migrant across state from more northern breeding areas in US and Canada, winters along coast and farther south; occupies wide range of habitats during migration, including urban, concentrations along coast and barrier islands; low-altitude migrant, stopovers at leading landscape edges such as lake shores, coastlines, and barrier islands.

Arctic Peregrine Falcon	*Falco peregrinustundrius*	DL	

migrant throughout state from subspecies' far northern breeding range, winters along coast and farther south; occupies wide range of habitats during migration, including urban, concentrations along coast and barrier islands; low-altitude migrant, stopovers at leading landscape edges such as lake shores, coastlines, and barrier islands.

Bald Eagle	*Haliaeetusleucocephalus*	DL	T

found primarily near rivers and large lakes; nests in tall trees or on cliffs near water; communally roosts, especially in winter; hunts live prey, scavenges, and pirates food from other birds

Henslow's Sparrow	*Ammodramushenslowii*		

wintering individuals (not flocks) found in weedy fields or cut-over areas where lots of bunch grasses occur along with vines and brambles; a key component is bare ground for running/walking

Interior Least Tern	*Sterna antillarumathalassos*	LE	E

subspecies is listed only when inland (more than 50 miles from a coastline); nests along sand and gravel bars within braided streams, rivers; also know to nest on man-made structures (inland beaches, wastewater treatment plants, gravel mines, etc); eats small fish and crustaceans, when breeding forages within a few hundred feet of colony

Peregrine Falcon	*Falco peregrinus*	DL	T

both subspecies migrate across the state from more northern breeding areas in US and Canada to winter along coast and farther south; subspecies (F. p. anatum) is also a resident breeder in west Texas; the two subspecies' listing statuses differ, F.p. tundrius is no longer listed in Texas; but because the subspecies are not easily distinguishable at a distance, reference is generally made only to the species level; see subspecies for habitat.

Piping Plover *Charadriusmelodus* LT T

wintering migrant along the Texas Gulf Coast; beaches and bayside mud or salt flats

Sprague's Pipit *Anthussprague ii* C

only in Texas during migration and winter, mid September to early April; short to medium distance, diurnal migrant; strongly tied to native upland prairie, can be locally common in coastal grasslands, uncommon to rare further west; sensitive to patch size and avoids edges.

Western Burrowing Owl *Athenecunicularia hypugaea*

open grasslands, especially prairie, plains, and savanna, sometimes in open areas such as vacant lots near human habitation or airports; nests and roosts in abandoned burrows

White-faced Ibis *Plegadischihi* T

prefers freshwater marshes, sloughs, and irrigated rice fields, but will attend brackish and saltwater habitats; nests in marshes, in low trees, on the ground in bulrushes or reeds, or on floating mats

Whooping Crane *Grus Americana* LE E

potential migrant via plains throughout most of state to coast; winters in coastal marshes of Aransas, Calhoun, and Refugio counties

Wood Stork *Mycteria americana* T

forages in prairie ponds, flooded pastures or fields, ditches, and other shallow standing water, including salt-water; usually roosts communally in tall snags, sometimes in association with other wading birds (i.e. active heronries); breeds in Mexico and birds move into Gulf States in search of mud flats and other wetlands, even those associated with forested areas; formerly nested in Texas, but no breeding records since 1960

CRUSTACEANS

Federal Status State Status

A crayfish *Procambarus steigmani*

burrower in long-grass prairie; all animals were collected with traps, thus there is no knowledge of depths of burrows; herbivore; crepuscular, nocturnal

MAMMALS

		Federal Status	State Status
Plains spotted skunk	*Spilogaleputoriusinterrupta*		

catholic; open fields, prairies, croplands, fence rows, farmyards, forest edges, and woodlands; prefers wooded, brushy areas and tallgrass prairie

Red wolf	*Canisrufus*	LE	E

extirpated; formerly known throughout eastern half of Texas in brushy and forested areas, as well as coastal prairies

MOLLUSKS

		Federal Status	State Status
Fawnsfoot	*Truncilladonaciformis*		

small and large rivers especially on sand, mud, rocky mud, and sand and gravel, also silt and cobble bottoms in still to swiftly flowing waters; Red (historic), Cypress (historic), Sabine (historic), Neches, Trinity, and San Jacinto River basins.

Little spectaclecase	*Villosalienosa*		

creeks, rivers, and reservoirs, sandy substrates in slight to moderate current, usually along the banks in slower currents; east Texas, Cypress through San Jacinto River basins

Louisiana pigtoe	*Pleurobemariddellii*		T

streams and moderate-size rivers, usually flowing water on substrates of mud, sand, and gravel; not generally known from impoundments; Sabine, Neches, and Trinity (historic) River basins

Texas heelsplitter	*Potamilusamphichaenus*		T

quiet waters in mud or sand and also in reservoirs. Sabine, Neches, and Trinity River basins

Wabash pigtoe	*Fusconaiaflava*		

creeks to large rivers on mud, sand, and gravel from all habitats except deep shifting sands; found in moderate to swift current velocities; east Texas River basins, Red through San Jacinto River basins; elsewhere occurs in reservoirs and lakes with no flow

REPTILES		Federal Status	State Status
Alligator snapping turtle	*Macrochelystemminckii*		T

perennial water bodies; deep water of rivers, canals, lakes, and oxbows; also swamps, bayous, and ponds near deep running water; sometimes enters brackish coastal waters; usually in water with mud bottom and abundant aquatic vegetation; may migrate several miles along rivers; active March-October; breeds April-October

Texas garter snake *Thamnophissirtalisannectens*

wet or moist microhabitats are conducive to the species occurrence, but is not necessarily restricted to them; hibernates underground or in or under surface cover; breeds March-August

Texas horned lizard *Phrynosomacornutum* T

open, arid and semi-arid regions with sparse vegetation, including grass, cactus, scattered brush or scrubby trees; soil may vary in texture from sandy to rocky; burrows into soil, enters rodent burrows, or hides under rock when inactive; breeds March-September

Timber/Canebrake rattlesnake *Crotalushorridus* T

swamps, floodplains, upland pine and deciduous woodlands, riparian zones, abandoned farmland; limestone bluffs, sandy soil or black clay; prefers dense ground cover, i.e. grapevines or palmetto

Last Updated 2/28/2011

DENTON COUNTY

BIRDS

		Federal Status	State Status
American Peregrine Falcon	*Falco peregrinusanatum*	DL	T

year-round resident and local breeder in west Texas, nests in tall cliff eyries; also, migrant across state from more northern breeding areas in US and Canada, winters along coast and farther south; occupies wide range of habitats during migration, including urban, concentrations along coast and barrier islands; low-altitude migrant, stopovers at leading landscape edges such as lake shores, coastlines, and barrier islands.

Arctic Peregrine Falcon	*Falco peregrinustundrius*	DL	

migrant throughout state from subspecies' far northern breeding range, winters along coast and farther south; occupies wide range of habitats during migration, including urban, concentrations along coast and barrier islands; low-altitude migrant, stopovers at leading landscape edges such as lake shores, coastlines, and barrier islands.

Bald Eagle	*Haliaeetusleucocephalus*	DL	T

found primarily near rivers and large lakes; nests in tall trees or on cliffs near water; communally roosts, especially in winter; hunts live prey, scavenges, and pirates food from other birds

Henslow's Sparrow	*Ammodramushenslowii*		

wintering individuals (not flocks) found in weedy fields or cut-over areas where lots of bunch grasses occur along with vines and brambles; a key component is bare ground for running/walking

Peregrine Falcon	*Falco peregrinus*	DL	T

both subspecies migrate across the state from more northern breeding areas in US and Canada to winter along coast and farther south; subspecies (F. p. anatum) is also a resident breeder in west Texas; the two subspecies' listing statuses differ, F.p. tundrius is no longer listed in Texas; but because the subspecies are not easily distinguishable at a distance, reference is generally made only to the species level; see subspecies for habitat.

Sprague's Pipit	*Anthussprague**ii***	C	

only in Texas during migration and winter, mid September to early April; short to medium distance, diurnal migrant; strongly tied to native upland prairie, can be locally common in coastal grasslands, uncommon to rare further west; sensitive to patch size and avoids edges.

Western Burrowing Owl	*Athenecunicularia**hypugaea***		

open grasslands, especially prairie, plains, and savanna, sometimes in open areas such as vacant lots near human habitation or airports; nests and roosts in abandoned burrows

White-faced Ibis	*Plegadischihi*		T

prefers freshwater marshes, sloughs, and irrigated rice fields, but will attend brackish and saltwater habitats; nests in marshes, in low trees, on the ground in bulrushes or reeds, or on floating mats

Whooping Crane *Grusamericana* LE E

potential migrant via plains throughout most of state to coast; winters in coastal marshes of Aransas, Calhoun, and Refugio counties

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MAMMALS

Federal Status State Status

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catholic; open fields, prairies, croplands, fence rows, farmyards, forest edges, and woodlands; prefers wooded, brushy areas and tallgrass prairie

Red wolf *Canisrufus* LE E

extirpated; formerly known throughout eastern half of Texas in brushy and forested areas, as well as coastal prairies

MOLLUSKS

Federal Status State Status

Fawnsfoot *Truncilladonaciformis*

small and large rivers especially on sand, mud, rocky mud, and sand and gravel, also silt and cobble bottoms in still to swiftly flowing waters; Red (historic), Cypress (historic), Sabine (historic), Neches, Trinity, and San Jacinto River basins.

Little spectaclecase *Villosalienosa*

creeks, rivers, and reservoirs, sandy substrates in slight to moderate current, usually along the banks in slower currents; east Texas, Cypress through San Jacinto River basins

Louisiana pigtoe *Pleurobemariddellii* T

streams and moderate-size rivers, usually flowing water on substrates of mud, sand, and gravel; not generally known from impoundments; Sabine, Neches, and Trinity (historic) River basins

Texas heelsplitter *Potamilusamphichaenus* T

quiet waters in mud or sand and also in reservoirs. Sabine, Neches, and Trinity River basins

Wabash pigtoe *Fusconaiaflava*

creeks to large rivers on mud, sand, and gravel from all habitats except deep shifting sands; found in moderate to swift current velocities; east Texas River basins, Red through San Jacinto River basins; elsewhere occurs in reservoirs and lakes with no flow

REPTILES

		Federal Status	State Status
Texas garter snake	*Thamnophissirtalisannectens*		

wet or moist microhabitats are conducive to the species occurrence, but is not necessarily restricted to them; hibernates underground or in or under surface cover; breeds March-August

Texas horned lizard	*Phrynosomacornutum*		T

open, arid and semi-arid regions with sparse vegetation, including grass, cactus, scattered brush or scrubby trees; soil may vary in texture from sandy to rocky; burrows into soil, enters rodent burrows, or hides under rock when inactive; breeds March-September

Timber/Canebrake rattlesnake	*Crotalushorridus*		T

swamps, floodplains, upland pine and deciduous woodlands, riparian zones, abandoned farmland; limestone bluffs, sandy soil or black clay; prefers dense ground cover, i.e. grapevines or palmetto

PLANTS

		Federal Status	State Status
Glen Rose yucca	*Yucca necopina*		

Texas endemic; grasslands on sandy soils and limestone outcrops; flowering April-June

Attachment B

Exide Technologies Benthic Survey

Date: 1/14/2014

Transect: T-1

Personnel: NH, KH, BS

Camera: Nikon

GPS: B

Time: 8:00

General Location: Stewart Creek, just upstream of beaver dam

Photo IDs	Description
2342	Benthic rake
2343	Contents of the rake

GPS Waypoints	Description
T-1	Stream

Sediment Description

Clay, solid, gravel and small amounts of dead vegetation (leaves), no overlying sediment.

Number of Rakes: 6

Benthic Observations

None

Exide Technologies Benthic Survey

Date: 1/14/2014

Transect: T-2

Personnel: NH, KH, BS

Camera: Nikon

GPS: B

Time: 8:15

General Location: Stewart Creek downstream of beaver dam

Photo IDs	Description
2344	Benthic Rake
2345	Benthic Rake
2346	Contents of rake

GPS Waypoints	Description
T-2	Stream

Sediment Description

Clay, solid, areas with low soft sediment over clay large amounts of gravel

Number of Rakes: 6

Benthic Observations

None

Exide Technologies Benthic Survey

Date: 1/13/2014

Transect: T-3

Personnel: NH, KH, BS

Camera: Nikon

GPS: B

Time: 8:30

General Location: Stewart Creek

Photo IDs	Description
2347	Benthic rake
2348	Contents of rake

GPS Waypoints	Description
T-3	Stream

Sediment Description

Hard clay and gravel, no overlying sediment, dead leaves and vegetation.

Number of Rakes: 8

Benthic Observations

None

Exide Technologies Benthic Survey

Date: 1/15/2014 Transect: T-4

Personnel: (BESI) NH, KH, BS (Golder) AM, MR (Frisco) Tommy Camera: Nikon GPS: B

Time: 8:00

General Location: Stewart Creek up upstream of 4th Army Rd.

Photo IDs	Description
2349	Upstream
2350	Downstream
2351	Contents of rake

GPS Waypoints	Description
T-4	Stream

Sediment Description

Gravel, just upstream of culvert under road.

Number of Rakes: 6

Benthic Observations

None

Exide Technologies Benthic Survey

Date: 1/15/2014 Transect: T-5

Personnel: (BESI) NH, KH, BS (Golder) AM, MR (Frisco) Tommy Camera: Nikon GPS: B

Time: 10:10

General Location: Stewart Creek upstream of wastewater treatment plant

Photo IDs	Description
2407	Benthic rake
2408	Benthic rake
2409	Contents of rake
2410	Site
2411	Contents of rake

GPS Waypoints	Description
T-5	Stream

Sediment Description
Sand, gravel, and rocks

Number of Rakes: 6

Benthic Observations

None

Exide Technologies Benthic Survey

Date: 1/15/2014 Transect: T-6

Personnel: (BESI) NH, KH, BS (Golder) AM, MR (Frisco) Tommy Camera: Nikon GPS: B

Time: 10:20

General Location: Stewart Creek upstream of wastewater treatment facility

Photo IDs	Description
2412-2414	Benthic rake
2415	Benthic rake
2416	Contents of rake
2417	Northern Cardinal
	(Cardinalis cardinalis)

GPS Waypoints	Description
T-6	Stream

Sediment Description
Sand, gravel, and rocks

Number of Rakes: 6

Benthic Observations

Prior to using the benthic rake, Benchmark scientists observed signs of mussel/ clam activity on the surface of the sediment.

Collected live Asian Clams *(Corbicula spp .)* in rake.

Exide Technologies Benthic Survey

Date: 1/15/2014 Transect: T-7

Personnel: (BESI) NH, KH, BS (Golder) AM, MR (Frisco) Tommy Camera: Nikon GPS: B

Time: 11:00

General Location: Stewart Creek upstream of wastewater treatment facility

Photo IDs	Description
2434	Contents of rake
2435	Downstream
2436	Benthic rake
2437	Contents of rake

GPS Waypoints	Description
T-7	Stream

Sediment Description
Sand, gravel, and rocks

Number of Rakes: 6

Benthic Observations :

None

General Observations:

Raccoon (*Procyon lotor*) and canine tracks spotted on bank nearby.

Exide Technologies Benthic Survey

Date: 1/15/2014 Transect: T-8

Personnel: (BESI) NH, KH, BS (Golder) AM, MR (Frisco) Jason Camera: Nikon GPS: B

Time: 14:15

General Location: Stewart Creek upstream of Stonebrook Pkwy

Photo IDs	Description
2465	Contents of rake
2466	Creek
2467	Pondhorn (*Uniomerus tetralasmus*)
	shells found on the surface

GPS Waypoints	Description
T-8	Stream

Sediment Description
Small gravel and sand

Number of Rakes: 6

Benthic Observations

Area has a lot of exposed beds, spotted several of the Pondhorn *(Uniomerus tetralasmus*) shells on the exposed gravel beds.

Exide Technologies Benthic Survey

Date: 1/15/2014

Transect: T-9

Personnel: (BESI) NH, KH, BS (Golder) AM, MR (Frisco) Jason

Camera: Nikon

GPS: B

Time: 15:09

General Location: Stewart Creek upstream of Stonebrook Pkwy.

Photo IDs	Description
2478	Contents of rake
2479	Creek
2480	Gravel bank

GPS Waypoints	Description
T-9	Stream

Sediment Description

Gravel, shall, and clay. Small area of fine gravel in 1 foot deep pool.

Number of Rakes: 6

Benthic Observations

None

Exide Technologies Benthic Survey

Date: 1/15/2014

Transect: T-10

Personnel: (BESI) NH, KH, BS (Golder) AM, MR (Frisco) Jason

Camera: Nikon

GPS: B

Time: 15:45

General Location: Stewart Creek downstream of Dallas Pkwy.

Photo IDs	Description
2490	Worm
2491	Worm
2492	Creek
2493	Worms
2494	Worms

GPS Waypoints	Description
T-10	Stream

Sediment Description

Gravel and sand

Number of Rakes: 5

Benthic Observations

Worms, observed signs of worms on the sediment surface. Captured several worms in rake.

Exide Technologies Benthic Survey

Date: 1/16/2014

Transect: T-11

Personnel: (BESI) BS, KH, (Golder) AM, MR (Frisco) Tommy

Camera: Nikon

GPS: B

Time: 9:01

General Location: Stewart Creek downstream of former Exide Facility

Photo IDs	Description
2522	Contents of rake
2523	Contents of rake
2524	Downstream
2525	Creek
2526	Upstream

GPS Waypoints	Description
T-11	Soft area

Sediment Description

Small gravel, sand, and silt.

Number of Rakes: 6

Benthic Observations

None

General Observations

Nest in nearby tree, and small animal tracks on the bank.

Exide Technologies Benthic Survey

Date: 1/16/2014

Transect: T-12

Personnel: (BESI) BS, KH (Golder) AM, MR (Frisco) Tommy

Camera: Nikon

GPS: B

Time: 10:51

General Location: Stewart Creek upstream of Lake Lewisville

Photo IDs	Description
2527	Contents of rake
2528	Upstream
2529	Creek
2530	Downstream
2531	Asian Clam (*Corbicula spp.*) shells

	Description
T-12	Start transect
T-12b	End transect

Sediment Description

Mix of gravel and silt (1-2" of silt)

Number of Rakes: 7

Benthic Observations

Small rocks, Asian Clams (*Corbicula spp.*) shells.

Exide Technologies Benthic Survey

Date: 1/16/2014 Transect: T-13

Personnel: (BESI) BS, KH (Golder) AM, MR (Frisco) Tommy Camera: Nikon GPS: B

Time: 11:08

General Location: Stewart Creek upstream of Lake Lewisville

Photo IDs	Description
2534	Upstream
2535	Downstream
2536	Creek
2537	Content of raking
2538	Asian Clams (*Corbicula spp.*)
2539	Asian Clams (*Corbicula spp.*)

GPS Waypoints	Description
T-13	Start transect
T-13b	End transect

Sediment Description

Sand and silt in middle of channel, clay on sides, steep bank.

Number of Rakes: 6

Benthic Observations

Small rocks, Asian Clams (*Corbicula spp.*), shell pieces and one live clam.

Date: 1/16/2014 Transect: T-14

Personnel: (BESI) BS, KH (Golder) AM, MR (Frisco) Tommy Camera: Nikon GPS: B

Time: 11:35

General Location: Stewart Creek upstream of Lake Lewisville

Photo IDs	Description
2541	Upstream
2542	Downstream
2543	Contents of rake
2544	Asian Clams (*Corbicula spp.*)
2545	Asian Clams (*Corbicula spp.*)

GPS Waypoints	Description
T-14	Start transect
T-14b	End transect

Sediment Description
Soft silt and gravel mix.

Number of Rakes: 8

Benthic Observations

4 Asian Clams (*Corbicula spp.*) (live), 1 Asian Clam (*Corbicula spp* .) shell.

Exide Technologies Benthic Survey

Date: 1/16/2014

Transect: T-15

Personnel: (BESI) BS, KH (Golder) AM, MR (Frisco) Tommy

Camera: Nikon

GPS: B

Time: 11:46

General Location: Stewart Creek upstream of Lake Lewisville

Photo IDs	Description
2546	Contents of rake
2547, 2548	Asian Clams (*Corbicula spp.*), shell, and possibly Pondhorn Mussel shell pieces
2549-2551	Downstream, Creek, Upstream
2552	Asian Clams (*Corbicula spp.*), shell, and Pondhorn (Uniomerus Tetralasmus) shells

GPS Waypoints	Description
T-15	Start transect
T-15b	End transect

Sediment Description

Soft silt and gravel mix

Number of Rakes: 8

Benthic Observations

Asian Clams (*Corbicula spp.*) (live), shell, and Pondhorn (*Uniomerus tetralasmus*) shells.

Exide Technologies Benthic Survey

Date: 1/16/2014

Transect: T-16

Personnel: (BESI) BS, KH (Golder) AM, MR (Frisco) Tommy

Camera: Nikon

GPS: B

Time: 12:11

General Location: Stewart Creek upstream of Lake Lewisville

Photo IDs	Description
2558-2559	Asian Clam (*Corbicula spp* .) shells and Pondhorn (*Uniomerus tetralasmus*) shells
2560	Downstream
2561	Upstream

GPS Waypoints	Description
T-16	Start transect
T-16b	End transect

Sediment Description

Sandy silt and gravel mix, with rocks.

Number of Rakes: 8

Benthic Observations

Asian Clam (*Corbicula spp.*) shells and Pondhorn (*Uniomerus tetralasmus*) shells.

Exide Technologies Benthic Survey

Date: 1/16/2014 Transect: T-17

Personnel: (BESI) BS, KH (Golder) AM, MR (Frisco) Tommy Camera: Nikon GPS: B

Time: 12:33

General Location: Stewart Creek upstream of Lake Lewisville

Photo IDs	Description
2564	Downstream
2565	Upstream
2566	Creek
2567	Asian Clams (*Corbicula spp* .), shells and unidentified snail

GPS Waypoints	Description
T-17	Start transect
T-17b	End transect

Sediment Description

Silt and gravel, small rocks on sides of channel, hard clay in middle of channel.

Number of Rakes: 7

Benthic Observations

Asian Clams (*Corbicula spp.*), shells and unidentified snail.

Exide Technologies Benthic Survey

Date: 1/16/2014

Transect: T-18

Personnel: (BESI) BS, KH (Golder) AM, MR (Frisco) Tommy

Camera: Nikon

GPS: B

Time: 12:50

General Location: Stewart Creek upstream of Lake Lewisville

Photo IDs	Description
2568	Upstream
2569	Creek
2570	Downstream
2571	Contents of rake
2572	Pondhorn (*Uniomerus tetralasmus*) and Asian Clam (*Corbicula spp* .)

GPS Waypoints	Description
T-18	Start transect
T-18b	End transect

Sediment Description

Soft silt.

Number of Rakes: 5

Benthic Observations

Pondhorn (*Uniomerus tetralasmus*) shells and Asian Clam (*Corbicula spp.*) shells.

Exide Technologies Benthic Survey

Date: 1/16/2014

Transect: T-19

Personnel: (BESI) BS, KH (Golder) AM (Frisco) Jason

Camera: Nikon

GPS: B

Time: 14:58

General Location: Stewart Creek upstream of Lake Lewisville

Photo IDs	Description
2580	Downstream
2581	Upstream
2582	Creek
2583	Benthic rake
2584	Contents of rake
2585	Asian Clams (*Corbicula spp.*)

GPS Waypoints	Description
T-19	Stream

Sediment Description
Sand, silt, and gravel.

Number of Rakes : 6

Benthic Observations
Asian Clams (*Corbicula spp.*)

Exide Technologies Benthic Survey

Date: 1/16/2014

Transect: T-20

Personnel: (BESI) BS, KH (Golder) AM (Frisco) Jason

Camera: Nikon

GPS: B

Time: 15:40

General Location: Stewart Creek upstream of Lake Lewisville

Photo IDs	Description
2599	Contents of raking
2600	Asian clams (*Corbicula spp.*)
2601	Upstream
2602	Downstream

GPS Waypoints	Description
T-20	Stream

Sediment Description

Sand and silt with gravel.

Number of Rakes: 6

Benthic Observations

Asian Clams (*Corbicula spp.*) on nearby streambed. Collected live clams and clam shells in rake.

Exide Technologies Benthic Survey

Date: 1/16/2014

Transect: T-22

Personnel: (BESI) BS, KH (Golder) AM (Frisco) Jason

Camera: Nikon

GPS: B

Time: 16:29

General Location: Stewart Creek upstream of Lake Lewisville

Photo IDs	Description
2619	Upstream
2620	Creek
2621	Downstream

GPS Waypoints	Description
T-22	Stream

Sediment Description

Light silt and rocks.

Number of Rakes: 6

Benthic Observations

None

Exide Technologies Benthic Survey

Date: 1/16/2014 Transect: T-23

Personnel: (BESI) BS, KH (Golder) AM, MR (Frisco) Jason Camera: Nikon GPS: B

Time: 16:50

General Location Stewart Creek downstream of Lebanon Rd.

Photo IDs	Description
2622	Upstream
2623	Downstream
2624	Site and contents of rake
2625	Contents of rake
2626	Asian Clam (*Corbicula spp.*)

GPS Waypoints	Description
T-23	Stream

Sediment Description

Gravel and sandy silt mix, soft layer approximately 2 inches.

Number of Rakes: 6

Benthic Observations

1 Asian Clam (*Corbicula spp.*) shell found in rake.

Exide Technologies Benthic Survey

Date: 1/13/2014

Transect: T-24

Personnel: NH, KH, BS, BD

Camera: Sony

GPS: B

Time: 15:30

General Locatio Stewart Creek in Former Exide Facili

GPS Waypoints	Description
Mussel rake site	Stream

Photo IDs	Description
389-391	Benthic rake
392	Bottom of creek
393	Benthic rake near railroad bridge
394-395	Bank where Pondhorn Mussel shells were found
396	Wading bird tracks
397-398	Area where Pondhorn Mussel shells were found
399	Beaver sign on old tree

Sediment Description

Gravel & bedrock/ consolidated clay.

Number of Rakes: 12

Benthic Observations

None

Exide Technologies Benthic Survey

Date: 3/18/2014

Transect: T-100

Personnel: (BESI) KH, RM (Golder) AM, Chris (Frisco) Jason

Camera: Nikon

GPS: A

Time: 9:15

General Location Stewart Creek downstream of Legacy Dr.

Photo IDs	Description
2767	Upstream
2769	Downstream
2770	Site/ Contents of rake
2771	Contents of rake
2772	Asian Clam (*Corbicula spp.*)

GPS Waypoints	Description
T-100	Stream

Sediment Description

Gravel and silt with shale bottom.

Number of Rakes: 3

Benthic Observations

Multiple Asian Clams (*Corbicula spp.*) collected in rake.

Exide Technologies Benthic Survey

Date: 3/18/2014

Transect: T-101

Personnel: KH,RM (BESI) AM,Chris (Golder) Jason (Frisco)

Camera: Nikon

GPS: A

Time: 10:42

General Location Stewart Creek downstream of Legacy Dr.

Photo IDs	Description
2777	Upstream
2775	Downstream
2774	Site/ Contents of rake
2773	Contents of rake
2778	Asian Clam (*Corbicula spp.*)
2776	Bank of creek

GPS Waypoints	Description
T-101	Stream

Sediment Description

Mostly gravel with trace of sand and silt.

Number of Rakes: 5

Benthic Observations

Multiple Asian Clams (*Corbicula spp.*) collected in rake.

Exide Technologies Benthic Survey

Date: 3/18/2014 Transect: T-102

Personnel: KH,RM (BESI) AM, Chris (Golder) Jason (Frisc Camera: Nikon GPS: A

Time: 11:19

General Location Stewart Creek downstream of Legacy Dr.

Photo IDs	Description
2784	Upstream
2785	Downstream
2783	Site/ Contents of rake
2786	Mid Stream
2787/8	Asian Clam (*Corbicula spp.*)

GPS Waypoints	Description
T-102	Stream

Sediment Description

Soft. Silty sand with gravel.

Number of Rakes: 6

Benthic Observations

Asian Clams (*Corbicula spp.*) and various snail species unidentified. Pondhorn (*Uniomerus tetralasmus*) shells observed nearby.

Exide Technologies Benthic Survey

Date: 3/18/2014

Transect: T-103

Personnel: KH,RM (BESI) ; Amy, Chris (Golder), Jason (Frisco)

Camera: Nikon

GPS: A

Time: 12:22

General Location Stewart Creek downstream of Legacy Dr.

Photo IDs	Description
2795	Upstream
2794	Downstream
2793	Contents of rake
2796	Mid Stream
2798/9	Asian Clam (*Corbicula spp.*)
2797	Creek bank

GPS Waypoints	Description
T-103	Stream

Sediment Description

Large and small gravel with silt layer on top.

Number of Rakes: 6

Benthic Observations

Multiple Asian Clams (*Corbicula spp.*) collected in rake.

General Observations

Wading bird print in exposed sediment.

Exide Technologies Benthic Survey

Date: 3/18/2014

Transect: T-104

Personnel: (BESI) KH, RM (Golder) AM, Chris (Frisco) Jason

Camera: Nikon

GPS: A

Time: 13:00

General Location Stewart Creek downstream of Legacy Dr.

Photo IDs	Description
2809	Upstream
2807	Downstream
2805	Contents of rake
2806	Mid Stream
2808	Mid Stream

GPS Waypoints	Description
T-104	Stream

Sediment Description

Soft. Course sand and small amount of silt and gravel - leaves and twigs intermixed.

Number of Rakes: 6

Benthic Observations

None

Exide Technologies Benthic Survey

Date: 3/18/2014 Transect: T-105

Personnel: KH,RM (BESI)AM, Chris (Golder) Jason (Frisco) Camera: Nikon GPS: A

Time: 13:34

General Location Stewart Creek downstream of Legacy Dr.

Photo IDs	Description
2815	Upstream
2813	Downstream
2814	Creek
2816	Contents of rake
2817	Asian Clam (*Corbicula spp.*) and snails

GPS Waypoints	Description
T-105	Stream

Sediment Description

Gravel with silt.

Number of Rakes: 6

Benthic Observations

Multiple Asian Clams (*Corbicula spp.*) and snails (class Gastropoda) collected in rake.

Exide Technologies Benthic Survey

Date: 3/18/2014 Transect: T-106

Personnel: KH,RM (BESI) AM Chris (Golder) Jason (Frisco) Camera: Nikon GPS: A

Time: 15:34

General Location Stewart Creek downstream of Legacy Dr.

Photo IDs	Description
2827	Upstream
2829	Downstream
2828	Contents of rake
2830	Contents of rake
2831	Asian Clam (*Corbicula spp.*)

GPS Waypoints	Description
T-106	Stream

Sediment Description

Sand with gravel with small trace amounts of silt.

Number of Rakes: 6

Benthic Observations

Multiple Asian Clams (*Corbicula spp.*) collected in rake.

Exide Technologies Benthic Survey

Date: 3/18/2014 Transect: T-107

Personnel: KH,RM (BESI) AM, Chris (Golder) Jason (Frisco) Camera: Nikon GPS: A

Time: 16:00

General Location Stewart Creek downstream of Legacy Dr.

GPS Waypoints	Description
T-107	Stream

Photo IDs	Description
2846	Upstream
2843	Downstream
2841/2	Stream Banks
2839	Contents of rake
2844	Asian Clam (*Corbicula spp.*)
2845	Benthic worm
2840	*Corbicula* siphon holes

Sediment Description

Sand with fine gravel. Burrows and siphon holes identified throughout exposed bank on downstream end of inside stream bar.

Number of Rakes: 6

Benthic Observations

Multiple Asian Clams (*Corbicula spp.*) and 1 benthic worm collected in rake.

Exide Technologies Habitat Surveys

Date: 1/13/2014

Plot: H-1

Personnel: NH, KH, BS, BD

Camera: Nikon

GPS: B

Time: 8:30

General Location: Adjacent to Stewart creek

Dominant Vegetation
Cynodon dactylon
Ambrosia trifida

GPS Waypoint	Description
Plot 1	Plot H-1

Photo IDs	Description
2106	North
2107	East
2108	South
2109	West

Comments
None

Exide Technologies Habitat Surveys

Date: 1/13/2014

Plot: H-2

Personnel: NH, KH, BS, BD

Camera: Nikon

GPS: B

Time: 8:35

General Location: Adjacent to south forested area

Dominant Vegetation
Cynodon dactylon

GPS Waypoints	Description
Plot 2	Plot H-2

Photo IDs	Description
2110	North
2111	East
2112	South
2113	West

Comments

None

Exide Technologies Habitat Surveys

Date: 1/13/2014

Plot: H-3

Personnel: NH, KH, BS, BD

Camera: Nikon

GPS: B

Time: 8:50

General Location: South forested area

Dominant Vegetation
Ulmus crassifolia
Ulmus alata
Maclura pomifera
Elymus canadensis
Quercus spp.
Elymus canadensis

GPS Waypoints	Description
Plot 3	On plot H-3
Drainage feature	East of plot

Photo IDs	Description
2224	North
2225	East
2226	South
2227	West
2228	Dry creek

Comments

Dry creek bed running adjacent to Plot H-3.

Exide Technologies Habitat Surveys

Date: 1/13/2014

Plot: H-4

Personnel: NH, KH, BS, BD

Camera: Nikon

GPS: B

Time: 9:00

General Location: South forested area

Dominant Vegetation
Ulmus crassifolia
Ulmus alata
Maclura pomifera
Elymus canadensis
Quercus spp.
Elymus canadensis
Smilax bona-nox

GPS Waypoints	Description
Plot 4	Plot H-4

Photo IDs	Description
2131	North
2132	East
2133	South
2134	West

Comments

Woodpecker, call heard at site.

Northern Cardinal (*Cardinalis cardinalis)* spotted.

Plot at toe of small earthern dam.

American Robins (*Turdus migratorius*) heard near plot.

Date: 1/13/2014

Plot: H-5

Personnel: NH, KH, BS, BD

Camera: Nikon

GPS: B

Time: 9:07

General Location: South forested area

Dominant Vegetation
Celtis occidentalis
Amphiachyris dracunculoides
Gleditsia triacanthos
Cynodon dactylon
Ambrosia psilostachya
Ulmus crassifolia

GPS Waypoints	Description
Plot H-5	Plot H-5

Photo IDs	Description
2136	North
2137	East
2138	South
2139	West

Comments

None

Exide Technologies Habitat Surveys

Date: 1/13/2014

Plot: H-6

Personnel: NH, KH, BS, BD

Camera: Nikon

GPS: B

Time: 9:20

General Location: South forested area

Dominant Vegetation
Ulmus crassifolia
Ulmus alata
Maclura pomifera
Elymus canadensis
Quercus spp.

GPS Waypoints	Description
Plot 6	Plot H-6

Photo IDs	Description
2145	North
2146	East
2147	South
2148	West

Comments

Cottontail rabbit (*Sylvilagus floridanus)* seen near site

Exide Technologies Habitat Surveys

Date: 1/13/2014

Plot: H-7

Personnel: NH, KH, BS, BD

Camera: Nikon

GPS: B

Time: 9:40

General Location: South forested area

Dominant Vegetation
Cynodon dactylon

GPS Waypoints	Description
Plot 7	Plot H-7

Photo IDs	Description
2149	North
2150	East
2151	South
2152	West

Comments

None

Exide Technologies Habitat Surveys

Date: 1/13/2014

Plot: H-8

Personnel: NH, KH, BS, BD

Camera: Nikon

GPS: B

Time: 9:20

General Location: Adjacent to creek

Dominant Vegetation
Cynodon dactylon
Ambrosia trifida

GPS Waypoints	Description
Plot 8	Plot H-8

Photo IDs	Description
2153	North
2154	East
2155	South
2156	West

Comments

None

Exide Technologies Habitat Surveys

Date: 1/13/2014

Plot: H-9

Personnel: NH, KH, BS, BD

Camera: Nikon

GPS: B

Time: 9:46

General Location: Adjacent to creek

GPS Waypoints	Description
Plot 9	Plot H-9

Dominant Vegetation
Sorghum halepense
Ambrosia psilostachya
Ambrosia trifida

Photo IDs	Description
2153	North/creek
2154	East
2155	South
2156	West
2158	Creekbed
2159	Creekbed

Comments

Steep bank, rocky bottom clear water high flow area.

Exide Technologies Habitat Surveys

Date: 1/13/2014

Plot: H-10

Personnel: NH, KH, BS, BD

Camera: Nikon

GPS: B

Time: 9:42

General Location: Adjacent to creek

Dominant Vegetation
Cynodon dactylon
Ambrosia trifida

GPS Waypoints	Description
Plot 10	Plot H-10

Photo IDs	Description
2159	European Starling (*Sturnus vulgaris*)
2161	North
2162	East
2163	South
2164	West

Comments

None

Exide Technologies Habitat Surveys

Date: 1/13/2014

Plot: H-11

Personnel: NH, KH, BS, BD

Camera: Nikon

GPS: B

Time: 9:45

General Location: Clearing north of south forested area

Dominant Vegetation
Cynodon dactylon
Setaria geniculata

GPS Waypoints	Description
Plot 11	Plot H-11

Photo IDs	Description
2164	North
2165	East
2166	South
2167	West

Comments

Cottontail Rabbit (*Sylvilagus floridanus*) spotted adjacent to site.

Exide Technologies Habitat Surveys

Date: 1/13/2014

Plot: H-12

Personnel: NH, KH, BS, BD

Camera: Nikon

GPS: B

Time: 9:50

General Location: South forested area

Dominant Vegetation
Ulmus crassifolia
Ulmus alata
Maclura pomifera
Elymus canadensis
Quercus spp.

GPS Waypoints	Description
Plot 12	Plot H-12

Photo IDs	Description
2168	North
2169	East
2170	South
2171	West

Comments

Steep slope.

Exide Technologies Habitat Surveys

Date: 1/13/2014

Plot: H-13

Personnel: NH, KH, BS, BD

Camera: Nikon

GPS: B

Time: 10:00

General Location: South forested area

Dominant Vegetation
Celtis laevigata
Smilax bona-nox
Melia azederach

GPS Waypoints	Description
Plot 13	Plot H-13

Photo IDs	Description
2174	North
2175	East
2176	South
2177	West
2178	Rock outcrop

Comments

Rock and concrete at plot.

Exide Technologies Habitat Surveys

Date: 1/13/2014

Plot: H-14

Personnel: NH, KH, BS, BD

Camera: Nikon

GPS: B

Time: 10:01

General Location: South forested area

Dominant Vegetation
Cynodon dactylon

GPS Waypoints	Description
Plot 14	Plot H-14

Photo IDs	Description
2179	North
2180	East
2181	South
2182	West

Comments

None

Exide Technologies Habitat Surveys

Date: 1/13/2014

Plot: H-15

Personnel: NH, KH, BS, BD

Camera: Nikon

GPS: B

Time: 10:07

General Location: South forested area

Dominant Vegetation
Ulmus crassifolia
Ulmus alata
Maclura pomifera
Elymus canadensis
Quercus spp.

GPS Waypoints	Description
Plot 15	Plot H-15

Photo IDs	Description
2186	North
2187	East
2188	South
2189	West
2190	Packrat burrows

Comments

Cedar Waxwing (*Bombycilla cedrorum*) heard over at site.

Packrat burrows observed.

Exide Technologies Habitat Surveys

Date: 1/13/2014

Plot: H-16

Personnel: NH, KH, BS, BD

Camera: Nikon

GPS: B

Time: 10:09

General Location: Clearing north of south forested area

GPS Waypoints	Description
Plot 16	Plot H-16

Dominant Vegetation

Cynodon dactylon

Photo IDs	Description
2191	North
2192	East
2193	South
2194	West

Comments

None

Exide Technologies Habitat Surveys

Date: 1/13/2014

Plot: H-17

Personnel: NH, KH, BS, BD

Camera: Nikon

GPS: B

Time: 10:11

General Location: Adjacent to Stewart Creek

Dominant Vegetation
Cynodon dactylon
Ambrosia trifida

GPS Waypoints	Description
Plot 17	Plot H-17

Photo IDs	Description
2195	North
2196	East
2197	South
2198	West
2199	Creek
2200	Creek
2201	Redtailed Hawks (*Buteo jamaicensis*)

Comments

Spotted American Kestrel (*Falco sparverius*) and 2 Redtailed Hawks (*Buteo jamaicensis*).

Exide Technologies Habitat Surveys

Date: 1/13/2014

Plot: H-18

Personnel: NH, KH, BS, BD

Camera: Nikon

GPS: B

Time: 10:11

General Location: Adjacent to Stewart Creek

Dominant Vegetation
Cynodon dactylon
Ambrosia trifida

GPS Waypoints	Description
Plot 18	Plot H-18

Photo IDs	Description
2202	Footprint
2203	Slide
2204	Slide
2205	North
2206	East
2207	South
2208	West

Comments

Beaver footprints

Potential benthic rake site.

Exide Technologies Habitat Surveys

Date: 1/13/2014

Plot: H-19

Personnel: NH, KH, BS, BD

Camera: Nikon

GPS: B

Time: 10:32

General Location: Adjacent to Stewart Creek

Dominant Vegetation
Ulmus alata
Solidago canadensis

GPS Waypoints	Description
Plot 19	Plot H-19

Photo IDs	Description
2212	North
2213	East
2214	South
2215	West
2216	Turkey vulture (*Cathartes aura*)

Comments

Spotted 2 Crows *(Corvus brachyrhynchos*) and a Turkey Vulture (*Cathartes aura*).

Exide Technologies Habitat Surveys

Date: 1/13/2014 Plot: H-20

Personnel: NH, KH, BS, BD Camera: Nikon GPS: B

Time: 10:35

	GPS Waypoints	Description
General Location: Adjacent to Stewart Creek	Plot 20	Plot H-20
Dominant Vegetation	Man made dam	Man made dam located next to plot
Ulmus alata		
Solidago canadensis		
Rubus trivialis		
Ambrosia trifida		

Photo IDs	Description
2217	North
2218	East
2219	South
2220	West
2221	Dam

Comments
Spotted 3 Rock Doves (*Columba livia).*

Exide Technologies Habitat Surveys

Date: 1/13/2014

Plot: H-21

Personnel: NH, KH, BS, BD

Camera: Nikon

GPS: B

Time: 10:41

General Location: Adjacent to Stewart Creek

Dominant Vegetation
Helianthus annuus
Ulmus alata
Solidago canadensis

GPS Waypoints	Description
Plot 21	Plot H-21
Dam	Man made dam next to plot

Photo IDs	Description
2222	North
2223	East
2224	South
2225	West
2226	Creek

Comments

Rip Rap for creekbed.

2 Red-tailed Hawks (*Buteo jamaicensis)* flew over the site.

Exide Technologies Habitat Surveys

Date: 1/13/2014

Plot: H-22

Personnel: NH, KH, BS, BD

Camera: Nikon

GPS: B

Time: 10:45

General Location: Adjacent to Stewart Creek

Dominant Vegetation
Sorghum halepense
Salix nigra
Solidago canadensis

GPS Waypoints	Description
Plot 22	Plot H-22

Photo IDs	Description
2227	North
2228	East
2229	South
2230	West
2231	Culverts
2232	Creek
2234	Creek
2235	Creek
2236	Dam just downstream of Plot H-22

Comments

4 large culverts on oppsite side of creek.

Concrete dam and large rip rap creek bottom.

Riffle area downstream of dam and concrete.

Exide Technologies Habitat Surveys

Date: 1/13/2014

Plot: H-23

Personnel: NH, KH, BS, BD

Camera: Nikon

GPS: B

Time: 10:55

General Location: Adjacent to Stewart Creek

Dominant Vegetation
Sorghum halepense
Salix nigra

GPS Waypoints	Description
Plot 23	Plot H-23

Photo IDs	Description
2238	North
2239	East
2240	South
2241	West
2242	Canine Tracks

Comments

Tracks in creekbed, canine and raccoon (*Procyon lotor).*

Riffle area in creek.

Exide Technologies Habitat Surveys

Date: 1/13/2014

Plot: H-24

Personnel: NH, KH, BS, BD

Camera: Nikon

GPS: B

Time: 11:00

General Location: Adjacent to Stewart Creek

Dominant Vegetation
Sorghum halepense
Salix nigra
Solidago canadensis

GPS Waypoints	Description
Plot 24	Plot H-24

Photo IDs	Description
2243	North
2244	East
2245	South
2246	West
2247	Culvert
2248	Rock creek bottom
2249	Beaver (*Castor canadensis*) sign
2250	Creek bottom

Comments

Raccoon (*Procyon lotor)* tracks and beaver (*Castor canadensis*) sign along creek.

Rock-clay-shale bottom very hard.

Exide Technologies Habitat Surveys

Date: 1/13/2014

Plot: H-25

Personnel: NH, KH, BS, BD

Camera: KH phone

GPS: B

Time: 11:00

General Location: Adjacent to Stewart Creek

GPS Waypoints	Description
Plot 25	Plot H-25

Dominant Vegetation
Sorghum halepense
Salix nigra
Ambrosia trifida

Photo IDs	Description
111053	North
111057	East
111101	South
111105	West
111417	Creek bottom

Comments

Hard creek bottom, no sediment.

Riffle area.

Exide Technologies Habitat Surveys

Date: 1/13/2014

Plot: H-26

Personnel: NH, KH, BS, BD

Camera: Nikon

GPS: B

Time: 11:20

General Location: Adjacent to Stewart Creek

Dominant Vegetation
Solidago canadensis

GPS Waypoints	Description
Plot 26	Plot H-26

Photo IDs	Description
2258	North
2259	East
2260	South
2261	West
2262	Downstream
2263	Site
2264	Upstream

Comments

None

Exide Technologies Habitat Surveys

Date: 1/13/2014

Plot: H-27

Personnel: NH, KH, BS, BD

Camera: Nikon

GPS: B

Time: 11:27

General Location: Lake Parcel

Dominant Vegetation
Solidago canadensis
Cynodon dactylon
Sorghum halepense

GPS Waypoints	Description
Plot 27	Plot H-27

Photo IDs	Description
2254	North
2255	East
2256	South
2257	West

Comments

Plot was located in a hayfield.

Exide Technologies Habitat Surveys

Date: 1/13/2014

Plot: H-28

Personnel: NH, KH, BS, BD

Camera: Nikon

GPS: B

Time: 12:00

General Location: North of forested area

Dominant Vegetation
Ulmus americana
Smilax bona-nox
Celtis laevigata

GPS Waypoints	Description
Plot 28	Plot H-28

Photo IDs	Description
2265	North
2266	East
2267	South
2268	West

Comments

Exide Technologies Habitat Surveys

Date: 1/13/2014

Plot: H-29

Personnel: NH, KH, BS, BD

Camera: Nikon

GPS: B

Time: 12:00

General Location: North forested area

Dominant Vegetation
Populus deltoides
Lonicera japonica
Diospyros texana
Celtis laevigata

GPS Waypoints	Description
Plot 29	Plot H-29

Photo IDs	Description
2269	North
2270	East
2271	South
2272	West

Comments

American Robin (*Turdus migratorius*) heard in area.

Exide Technologies Habitat Surveys

Date: 1/13/2014

Plot: H-30

Personnel: NH, KH, BS, BD

Camera: Nikon

GPS: B

Time: 12:05

General Location: North tributary in forested area

Dominant Vegetation
Populus deltoides
Lonicera japonica
Diospyros texana
Celtis laevigata

GPS Waypoints	Description
Plot 30	Plot H-30

Photo IDs	Description
2273	Upstream
2274	Site
2275	Downstream
2276	Creek bottom

Comments

Creek bottom consists of gravel.

Spotted Cardinal (*Cardinalis carlinalis)* in area.

Exide Technologies Habitat Surveys

Date: 1/13/2014

Plot: H-31

Personnel: NH, KH, BS, BD

Camera: Nikon

GPS: B

Time: 12:20

General Location: North forested area

Dominant Vegetation
Forestiera acuminata
Maclura pomifera
Juniperus virginana
Celtis laevigata
Smilax bona-nox
Ulmus americana

GPS Waypoints	Description
Plot 31	Plot H-31

Photo IDs	Description
2278	North
2279	East
2280	South
2281	West

Comments

None

Exide Technologies Habitat Surveys

Date: 1/13/2014

Plot: H-32

Personnel: NH, KH, BS, BD

Camera: Nikon

GPS: B

Time: 12:21

General Location: North tributary in north forested area

GPS Waypoints	Description
Plot 32	Plot H-32, middle of creek.

Dominant Vegetation

Forestiera acuminata

Maclura pomifera

Celtis laevigata

Simlax bona-nox

Ulmus americana

Photo IDs	Description
2282	Downstream
2283	Site
2284	Upstream
2285	Creek bed
2286	Creek bed
2287	Creek bed

Comments

Rocky creek bottom.

Riffle area.

Exide Technologies Habitat Surveys

Date: 1/13/2014

Plot: H-33

Personnel: NH, KH, BS, BD

Camera: Nikon

GPS: B

Time: 12:25

General Location: North tributary in north forested area

GPS Waypoints	Description
Plot 33	Plot H-33, middle of creek.

Dominant Vegetation
Lonicera japonica
Maclura pomifera
Celtis laevigata
Smilax bona-nox
Ulmus americana
Vitis mustangensis

Photo IDs	Description
2289	squirrel nest
2290	North
2291	East
2292	South
2293	West

Comments

Rocky creek bottom.

Riffle area.

Exide Technologies Habitat Surveys

Date: 1/13/2014

Plot: H-34

Personnel: NH, KH, BS, BD

Camera: Nikon

GPS: B

Time: 12:30

General Location: North forested area

Dominant Vegetation
Smilax bona-nox
Ulmus americana
Elymus canadensis

GPS Waypoints	Description
Plot 34	Plot H-34

Photo IDs	Description
2294	North
2295	East
2296	South
2297	West

Comments

None

Exide Technologies Habitat Surveys

Date: 1/13/2014

Plot: H-35

Personnel: NH, KH, BS, BD

Camera: Nikon

GPS: B

Time: 12:37

General Location: North forested area

Dominant Vegetation
Smilax bona-nox
Ulmus americana
Elymus canadensis

GPS Waypoints	Description
Plot 35	Plot H-35

Photo IDs	Description
2298	North
2299	East
2300	South
2301	West
2302	Squirrel nest

Comments

American Robin (*Turdus migratorius*) sighted near plot.

Squirrel nest near site.

Mourning Doves (*Zenaida macroura*) spotted near site.

Exide Technologies Habitat Surveys

Date: 1/13/2014

Plot: H-36

Personnel: NH, KH, BS, BD

Camera: Nikon GPS: B

Time: 12:40

General Location: Center of creek, North tributary

GPS Waypoints	Description
Plot 36	Plot H-36

Dominant Vegetation
Smilax bona-nox
Celtis laevigata
Elymus canadensis

Photo IDs	Description
2303	Upstream
2304	Site
2305	Downstream

Comments

Rocky creek bottom, and riffles.

Exide Technologies Habitat Surveys

Date: 1/13/2014

Plot: H-37

Personnel: NH, KH, BS, BD

Camera: Nikon

GPS: B

Time: 12:40

General Location: North forested area

Dominant Vegetation
Salix nigra
Celtis laevigata
Vitis mustangensis

GPS Waypoints	Description
Plot 37	Plot H-37

Photo IDs	Description
2306	North
2307	East
2308	South
2309	West

Comments

None

Exide Technologies Habitat Surveys

Date: 1/13/2014

Plot: H-38

Personnel: NH, KH, BS, BD

Camera: Nikon

GPS: B

Time: 12:50

General Location: North forested area

Dominant Vegetation
Salix nigra

GPS Waypoints	Description
Plot 38	Plot H-38

Photo IDs	Description
2310	North
2311	East
2312	South
2313	West

Comments

Spotted Northern Mockingbird (*Mimus polyglottos*) near plot

Blue Jay (*Cyanocitta cristata*) heard near site.

Exide Technologies Habitat Surveys

Date: 1/13/2014

Plot: H-39

Personnel: NH, KH, BS, BD

Camera: Nikon

GPS: B

Time: 12:53

General Location: North forested area

Dominant Vegetation
Ulmus americana
Smilax bona-nox
Elymus canadensis
Ambrosia trifida

GPS Waypoints	Description
Plot 39	Plot H-39

Photo IDs	Description
2314	North
2315	East
2316	South
2317	West

Comments

Mourning Dove (*Zenaida macroura*) spotted at site.

Exide Technologies Habitat Surveys

Date: 1/13/2014

Plot: H-40

Personnel: NH, KH, BS, BD

Camera: Nikon GPS: B

Time: 13:00

General Location: North tributary of north forested area

GPS Waypoints	Description
Plot 40	Plot H-40

Dominant Vegetation
Ulmus americana
Smilax bona-nox
Elymus canadensis
Ambrosia trifida

Photo IDs	Description
2318	Upstream
2319	Site
2320	Downstream

Comments

Riffle area, small amount (less than 1 cm) of sediment over gravel;

Heard Mourning Dove (*Zenaida macroura*) at the site.

Raccoon (*Procyon lotor*) tracks thoughout creek.

Exide Technologies Habitat Surveys

Date: 1/13/2014

Plot: H-42

Personnel: NH, KH, BS, BD

Camera: Nikon

GPS: B

Time: 13:00

General Location: North forested area

Dominant Vegetation
Celtis laevigata
Maclura pomifera
Smilax bona-nox
Lonicera japonica
Ulmus americana

GPS Waypoints	Description
Plot 42	Plot H-42

Photo IDs	Description
2325	North
2326	East
2327	South
2328	West

Comments

None

Exide Technologies Habitat Surveys

Date: 1/13/2014

Plot: H-41

Personnel: NH, KH, BS, BD

Camera: Nikon

GPS: B

Time: 12:55

General Location: North forested area

Dominant Vegetation
Ulmus americana
Smilax bona-nox
Maclura pomifera

GPS Waypoints	Description
Plot 41	Plot H-41

Photo IDs	Description
2321	North
2322	East
2323	South
2324	West

Comments
None

Exide Technologies Habitat Surveys

Date: 1/13/2014

Plot: H-43

Personnel: NH, KH, BS, BD

Camera: Nikon

GPS: B

Time: 13:05

General Location: North tributary

Dominant Vegetation
Celtis laevigata
Smilax bona-nox
Lonicera japonica
Ulmus americana

GPS Waypoints	Description
Plot 43	Plot H-43

Photo IDs	Description
2329	Upstream
2330	Site
2331	Downstream
2332	Predator scat
2333	Predator scat

Comments

Northern Shrike (*Lanius ludovicianus*) spotted near site.

High flow area, no sediment.

Rocky creek bottom.

Exide Technologies Habitat Surveys

Date: 1/13/2014

Plot: H-44

Personnel: NH, KH, BS, BD

Camera: Nikon

GPS: B

Time: 14:58

General Location: Hayfield adjacent to north tributary

GPS Waypoints	Description
Plot 44	Plot H-44

Dominant Vegetation
Solidago canadensis
Cynodon dactylon
Sorghum halepense
Engelmannia peristenia

Photo IDs	Description
2334	North
2335	East
2336	South
2337	West

Comments

Plot was located in a hayfield that was recently mowed.

Red-tailed Hawk (*Buteo jamaicensis*) sighted.

Exide Technologies Habitat Surveys

Date: 1/13/2014

Plot: H-45

Personnel: NH, KH, BS, BD

Camera: Sony

GPS: B

Time: 15:07

General Location: North tributary

GPS Waypoints	Description
Plot 45	Plot H-45

Dominant Vegetation

Solidago canadensis

Cynodon dactylon

Ambrosia trifida

Photo IDs	Description
353	Upstream
354	Site
355	Downstream

Comments

Gravel bottom, no sediment, and a high flow area.

Exide Technologies Habitat Surveys

Date: 1/13/2014

Plot: H-46

Personnel: NH, KH, BS, BD

Camera: Sony

GPS: B

Time: 15:03

General Location: Adjacent to north tributary

Dominant Vegetation
Solidago canadensis
Salix nigra
Sorghum halepense
Desmanthus illinoensis
Ulmus alata

GPS Waypoints	Description
Plot 46	Plot H-46

Photo IDs	Description
347	North
348	East
349	South
350	West

Comments

None

Exide Technologies Habitat Surveys

Date: 1/13/2014

Plot: H-47

Personnel: NH, KH, BS, BD

Camera: Sony

GPS: B

Time: 16:14

General Location: Hayfield adjacent to north tributary

GPS Waypoints	Description
Plot 47	Plot H-47

Dominant Vegetation
Solidago canadensis
Cynodon dactylon
Sorghum halepense
Engelmannia peristenia

Photo IDs	Description
360	Upstream
361	Site
362	Downstream
363	Raccoon (*Procyon lotor*) skull.

Comments

Raccoon (*Procyon lotor*) skull.

Exide Technologies Habitat Surveys

Date: 1/13/2014

Plot: H-48

Personnel: NH, KH, BS, BD

Camera: Sony

GPS: B

Time: 15:14

General Location: Adjacent to north tributary

Dominant Vegetation
Solidago canadensis
Salix nigra
Sorghum halepense
Desmanthus illinoensis
Ulmus alata
Ambrosia trifida

GPS Waypoints	Description
Plot 48	Plot H-48

Photo IDs	Description
356	North
357	East
358	South
359	West

Comments

None

Exide Technologies Habitat Surveys

Date: 1/13/2014

Plot: H-49

Personnel: NH, KH, BS, BD

Camera: Sony

GPS: B

Time: 15:20

General Location: North tributary

Dominant Vegetation
Solidago canadensis
Cynodon dactylon
Ambrosia trifida

GPS Waypoints	Description
Plot 49	Plot H-49

Photo IDs	Description
360	Upstream
361	Site
362	Downstream

Comments

Gravel creek bottom, no sediment, and a high flow area.

Exide Technologies Habitat Surveys

Date: 1/13/2014

Plot: H-50

Personnel: NH, KH, BS, BD

Camera: Nikon

GPS: B

Time: 14:58

General Location: Hayfield adjacent to north tributary

GPS Waypoints	Description
Plot 50	Plot H-50

Dominant Vegetation
Solidago canadensis
Cynodon dactylon
Sorghum halepense
Engelmannia peristenia

Photo IDs	Description
2334	North
2335	East
2336	South
2337	West

Comments

Plot was located in a hayfield that was recently mowed.

Exide Technologies Habitat Surveys

Date: 1/13/2014

Plot: H-51

Personnel: NH, KH, BS, BD

Camera: Sony

GPS: B

Time: 15:20

General Location: North tributary

Dominant Vegetation
Solidago canadensis
Salix nigra
Sorghum halepense
Desmanthus illinoensis
Ulmus alata

GPS Waypoints	Description
Plot 51	Plot H-51

Photo IDs	Description
364	North
365	East
366	South
367	West

Comments

None

Exide Technologies Habitat Surveys

Date: 1/13/2014

Plot: H-52

Personnel: NH, KH, BS, BD

Camera: Sony

GPS: B

Time: 15:07

General Location: North tributary

Dominant Vegetation
Solidago canadensis
Cynodon dactylon
Ambrosia trifida

GPS Waypoints	Description
Plot 52	Plot H-52

Photo IDs	Description
368	Upstream
369	Site
370	Downstream

Comments

Raccoon (*Procyon lotor*) tracks near site.

Exide Technologies Habitat Surveys

Date: 1/13/2014

Plot: H-53

Personnel: NH, KH, BS, BD

Camera: Sony

GPS: B

Time: 15:40

General Location: Between Stewart Creek and north tributary

GPS Waypoints	Description
Plot 53	Plot H-53

Dominant Vegetation
Solidago canadensis
Cynodon dactylon
Sorghum halepense
Engelmannia peristenia

Photo IDs	Description
367	North
368	East
369	South
370	West

Comments

None

Exide Technologies Habitat Surveys

Date: 1/13/2014

Plot: H-54

Personnel: NH, KH, BS, BD

Camera: Sony

GPS: B

Time: 15:40

General Location: Railroad tracks

Dominant Vegetation
Gleditsia triacanthos
Melia azedarach
Sorghum halepense
Helianthus annuus
Ambrosia trifida
Malus ioensis
Solidago canadensis

GPS Waypoints	Description
Plot 54	Plot H-54

Photo IDs	Description
380	North
381	East
382	South
383	West

Comments

Red-tailed Hawk (*Buteo jamaicensis)* sighted.

Exide Technologies Habitat Surveys

Date: 1/13/2014

Plot: H-55

Personnel: NH, KH, BS, BD

Camera: Sony

GPS: B

Time: 15:43

General Location: Railroad tracks

Dominant Vegetation
Gleditsia triacanthos
Melia azedarach
Sorghum halepense
Helianthus annuus
Ambrosia trifida
Malus ioensis
Solidago canadensis

GPS Waypoints	Description
Plot 55	Plot H-55

Photo IDs	Description
385	Northwest down tracks
386	Southeast down tracks
387	West, big creek
388	East toward field

Comments

Photos taken of an old railroad bed.

Exide Technologies Habitat Surveys

Date: 1/15/2014

Plot: H-60

Personnel: (BESI) NH, KH, BS (Golder) AM, MR, (Frisco) Tommy

Camera: Nikon

GPS: B

Time: 8:15

General Location: Stewart Creek

Dominant Vegetation
Fraxinus pennsylvanica
Smilax bona-nox

GPS Waypoints	Description
Plot 60	Plot H-60

Photo IDs	Description
2352	Pondhorn mussel (*Uniomerus tetralasmus*)
2353	Pondhorn mussel (*Uniomerus tetralasmus*)
2354	Shell fragment
2355	Downstream
2356	Upstream

Comments

Bottom of creek consists of gravel rocks.

2 Pondhorn mussel (*Uniomerus tetralasmus*) shells found.

Located downstream of wastewater treatment facility

Exide Technologies Habitat Surveys

Date: 1/15/2014

Plot: H-61

Personnel: (BESI) NH, KH, BS (Golder) AM, MR, (Frisco) Tommy

Camera: Nikon

GPS: B

Time: 8:35

General Location: Streambed near outfall of water treatment plant.

GPS Waypoints	Description
Plot 61	Plot H-61

Dominant Vegetation
Celtis laevigata
Ambrosia trifida

Photo IDs	Description
2363	Downstream
2364	Upstream
2365	Asian clam (*Corbicula spp.*)
2366	Asian clam (*Corbicula spp.*)
2367	Canine and raccoon (*Procyon lotor*) tracks
2368	Canine and raccoon (*Procyon lotor*) tracks

Comments

Bottom of creek changed to gravel.

Canine and raccoon (*Procyon lotor*) tracks on bank.

2 Asian clam (*Corbicula spp.*) shells.

Exide Technologies Habitat Surveys

Date: 1/15/2014

Plot: H-62

Personnel: (BESI) NH, KH, BS (Golder) AM, MR, (Frisco) Tommy

Camera: Nikon

GPS: B

Time: 8:50

General Location: Stewart Creek near outfall

Dominant Vegetation
Celtis occidentalis
Ambrosia trifida

GPS Waypoints	Description
Plot 62	Plot H-62

Photo IDs	Description
2373	Upstream
2374	Downstream
2375	Outfall

Comments

Creek bed transition to sediment and finer gravel.

Exide Technologies Habitat Surveys

Date: 1/15/2014

Plot: H-63

Personnel: (BESI) NH, KH, BS (Golder) AM, MR, (Frisco) Tommy

Camera: Nikon

GPS: B

Time: 8:57

General Location: Near outfall of wastewater treatment facility

Dominant Vegetation
Celtis laevigata
Ambrosia trifida
Fraxinus pennsylvanica

GPS Waypoints	Description
Plot 63	Plot H-63

Photo IDs	Description

Comments

Creek bottom transitioned to all gravel with no sediment.

Exide Technologies Habitat Surveys

Date: 1/15/2014

Plot: H-64

Personnel: (BESI) NH, KH, BS (Golder) AM, MR, (Frisco) Tommy

Camera: Nikon

GPS: B

Time: 9:00

General Location: Upstream of waste water treatment outfall

Dominant Vegetation
Celtis laevigata
Ambrosia trifida
Fraxinus pennsylvanica

GPS Waypoints	Description
Plot 64	Plot H-64

Photo IDs	Description
2377	Gravel bank with mussel shells
2378	Upstream
2379	Asian clams (*Corbicula spp.*)
2380	Bank of site
2381	Dead Green Sunfish (*Lepomis cyanellus*)

Comments

Large amount of mussel shell on gravel bank.

Just upstream from the outfall of wastewater treatment facility

Sediment, all small gravel.

Green sunfish (*Lepomis cyanellus*), dead.

Exide Technologies Habitat Surveys

Date: 1/15/2014

Plot: H-65

Personnel: (BESI) NH, KH, BS (Golder) AM, MR, (Frisco) Tommy

Camera: Nikon

GPS: B

Time: 9:20

General Location: Upstream of wastewater treatment outfall

Dominant Vegetation
Celtis laevigata
Fraxinus pennsylvanica
Elymus canadensis

GPS Waypoints	Description
Plot 65	Plot H-65

Photo IDs	Description
2393	Downstream
2394	Gravel bank
2395	Asian Clam (*Corbicula spp.*)

Comments

Small round Asian Clam (*Corbicula spp.*) collected.

Snail shells found in area, dead.

Exide Technologies Habitat Surveys

Date: 1/15/2014

Plot: H-66

Personnel: (BESI) NH, KH, BS (Golder) AM, MR, (Frisco) Tommy

Camera: Nikon

GPS: B

Time: 9:50

General Location: Stewart Creek, upstream of wastewater treatment outfall

GPS Waypoints	Description
Plot 66	Plot H-66

Dominant Vegetation
Celtis laevigata
Fraxinus pennsylvanica
Elymus canadensis

Photo IDs	Description
2403	Upstream
2404	Site
2405	Downstream
2406	Asian Clams (*Corbicula spp.*)

Comments

Small pools in bends of creek with riffles in the straight aways.

Small amounts of sedimentation in bends.

Asian Clam (*Corbicula spp.*) shells found all along creek on high surfaces next to water.

Nest spotted over creek.

Exide Technologies Habitat Surveys

Date: 1/15/2014

Plot: H-67

Personnel: (BESI) NH, KH, BS (Golder) AM, MR, (Frisco) Jason

Camera: Nikon

GPS: B

Time: 13:50

General Location: Near bridge at Stonebrook Pkwy

Dominant Vegetation
Fraxinus pennsylvanica
Celtis laevigata
Ambrosia trifida
Smilax bona-nox

GPS Waypoints	Description
Plot 67	Plot H-67

Photo IDs	Description
2450	Upstream
2451	Downstream
2452	Pondhorn mussel (*Uniomerus tetralasmus*) weathered.
2453	Pondhorn mussel (*Uniomerus tetralasmus*) weathered.
2454	Snail
2455	Pondhorn mussel (*Uniomerus tetralasmus*) intact.

Comments

Gravel, sand, and rocks

Exide Technologies Habitat Surveys

Date: 1/15/2014

Plot: H-68

Personnel: (BESI) NH, KH, BS (Golder) AM, MR, (Frisco) Jason

Camera: Nikon

GPS: B

Time: 14:28

General Location: Stewart Creek, upstream of Stonebrook Pkwy.

GPS Waypoints	Description
Plot 68	Plot H-68

Dominant Vegetation
Fraxinus pennsylvanica
Smilax bona-nox
Sorghum halepense

Photo IDs	Description
2460	Upstream
2461	Downstream
2462	Pondhorn (*Uniomerus tetralasmus*)
2463	Upstream
2464	Downstream

Comments

Area has a lot of exposed rock beds.

Spotted several pondhorn mussel shells on the exposed gravel bed

Exide Technologies Habitat Surveys

Date: 1/15/2014

Plot: H-69

Personnel: (BESI) NH, KH, BS (Golder) AM, MR, (Frisco) Jason

Camera: Nikon

GPS: B

Time: 14:35

General Location: Stewart Creek upstream of Stonebrook Pkwy.

GPS Waypoints	Description
Plot 69	Plot H-69

Dominant Vegetation
Fraxinus pennsylvanica
Smilax bona-nox
Sorghum halepense

Photo IDs	Description
2469	Pondhorn mussel (*Uniomerus tetralasmus*)
2470	Downstream
2471	Upstream

Comments

Spotted several pondhorn mussel shells on exposed rock beds.

Stream flow is relatively high to elevation changes.

Spotted small minnows near plot.

Exide Technologies Habitat Surveys

Date: 1/15/2014

Plot: H-70

Personnel: (BESI) NH, KH, BS (Golder) AM, MR, (Frisco) Jason

Camera: Nikon

GPS: B

Time: 15:04

General Location: Stewart Creek, upstream of Stonebrook Pkwy.

GPS Waypoints	Description
Plot 70G15	Plot H-70

Dominant Vegetation
Fraxinus pennsylvanica
Smilax bona-nox
Sorghum halepense

Photo IDs	Description
2475	Upstream
2476	Downstream
2477	Site

Comments

Streambed consists of gravel over clay and shale.

Strong currents compared to lower part of the stream surveyed this morning.

Exide Technologies Habitat Surveys

Date: 1/15/2014

Plot: H-71

Personnel: (BESI) NH, KH, BS (Golder) AM, MR, (Frisco) Jason

Camera: Nikon

GPS: B

Time: 11:00

General Location: Stewart Creek between Lebanon Rd. and 4th Army Dr.

Dominant Vegetation
Fraxinus pennsylvanica
Smilax bona-nox
Ambrosia trifida
Celtis laevigata

GPS Waypoints	Description
Photo 001	Outfall near road.
G-10	Soft spot
G-11	Soft spot
G-12	Soft spot
G-13	Soft spot

Photo IDs	Description
2438-2440	Outfall near road, rocky.
2441-2443	Pool area, soft.
2444-2445	Pool area, soft.
2446-2447	Pool area, soft.
2448-2449	Pool area, soft, tributary nearby.

Comments
None

Exide Technologies Habitat Surveys

Date: 1/16/2014

Plot: H-72

Personnel: (BESI) KH, BS (Golder) AM, MR, (Frisco)Tommy

Camera: Nikon

GPS: B

Time: 8:31

General Location: Stewart Creek directly downstream of Exide Facility

Dominant Vegetation
Fraxinus pennsylvanica
Sorghum halepense
Ambrosia trifida
Celtis laevigata

GPS Waypoints	Description
Plot 72	Plot H-72, stream bed

Photo IDs	Description
2469	Pondhorn mussel (*Uniomerus tetralasmus*)
2470	Downstream
2471	Upstream

Comments

Creek bed composed of rocks, no sediment.

Nest in tree nearby.

Small animal tracks on bank.

Exide Technologies Habitat Surveys

Date: 1/16/2014

Plot: H-73

Personnel: (BESI) KH, BS (Golder) AM, MR, (Frisco) Tommy

Camera: Nikon

GPS: B

Time: 10:55

General Location: Stewart Creek upstream of Lake Lewisville

GPS Waypoints	Description
Plot 73	Plot H-73, stream bed

Dominant Vegetation
Fraxinus pennsylvanica
Sorghum halepense
Ambrosia trifida
Celtis laevigata

Photo IDs	Description
2528	Downstream
2529	Site
2530	Upstream

Comments

Asian clam (*Corbicula spp.*) shell found in rake nearby.

Six Mallard (*Anas platyrhynchos*) ducks sighted.

Turkey Vulture (*Cathartes aura*) sighted.

Numerous animal tracks on the bank.

Exide Technologies Habitat Surveys

Date: 1/16/2014

Plot: H-74

Personnel: (BESI) KH, BS (Golder) AM, MR, (Frisco) Tommy

Camera: Nikon

GPS: B

Time: 12:17

General Location: Stewart Creek upstream of Lake Lewisville

GPS Waypoints	Description
Plot 74	Plot H-74, stream bed

Dominant Vegetation
Fraxinus pennsylvanica
Chasmanthium latifolium

Photo IDs	Description
2560	Downstream
2561	Upstream
2562	Gaint Floater (*Anodonta grandis*) and Pondhorn (*Uniomerus tetralasmus*)
2563	Gaint Floater (*Anodonta grandis*) and Pondhorn (*Uniomerus tetralasmus*)

Comments

Beaver (*Castor canadensis*) signs, cut tree.

Five Mallard (*Anas platyrhynchos*) ducks sighted.

Squrriel (*Sciurus*) sighted.

Numerous animal tracks on the bank.

Exide Technologies Habitat Surveys

Date: 1/16/2014

Plot: H-75

Personnel: (BESI) KH, BS (Golder) AM, MR, (Frisco) Jason

Camera: Nikon

GPS: B

Time: 13:15

General Location: Stewart Creek upstream of Lake Lewisville

GPS Waypoints	Description
Plot 75	Plot H-75, stream bed

Dominant Vegetation
Chasmanthium latifolium
Maclura pomifera
Fraxinus pennsylvanica

Photo IDs	Description
2575	Upstream
2576	Site
2577	Downstream

Comments

Bend in stream.

Exide Technologies Habitat Surveys

Date: 1/16/2014

Plot: H-76

Personnel: (BESI) KH, BS (Golder) AM, MR, (Frisco) Tommy

Camera: Nikon

GPS: B

Time: 13:26

General Location: Stewart Creek upstream of Lake Lewisville

GPS Waypoints	Description
Plot 76	Plot H-76, stream bed

Dominant Vegetation
Sorghum halepense
Maclura pomifera
Ulmus crassifolia
Fraxinus pennsylvanica

Photo IDs	Description
2578	Upsteam
2579	Downstream

Comments

Gravel and sand mix.

2 Mallard (*Anas platyrhynchos*) ducks sighted.

Nest in tree.

Exide Technologies Habitat Surveys

Date: 1/16/2014

Plot: H-77

Personnel: (BESI) KH, BS (Golder) AM, MR, (Frisco) Jason

Camera: Nikon

GPS: B

Time: 15:14

General Location: Stewart Creek downstream of Lebanon Rd.

GPS Waypoints	Description
Plot 77	Plot H-77, stream bed

Dominant Vegetation
Fraxinus pennsylvanica
Maclura pomifera
Panicum virgatum
Chasmanthium latifolium

Photo IDs	Description
2586	Upstream
2587	Site
2588	Downstream

Comments

Asian Clam (*Corbicula spp.*) shells on streambed.

Gravel and silt mix, hard bottom.

Heard owl hooting.

Animal tracks on the bank.

Exide Technologies Habitat Surveys

Date: 1/16/2014

Plot: H-78

Personnel: (BESI) KH, BS (Golder) AM, MR, (Frisco) Jason

Camera: Nikon

GPS: B

Time: 15:24

General Location: Stewart Creek downstream of Lebanon Rd.

GPS Waypoints	Description
Plot 78	Plot H-78, stream bed

Dominant Vegetation
Fraxinus pennsylvanica
Ulmus crassifoila
Ambrosia trifida

Photo IDs	Description
2592	Upstream
2593	Site
2594	Downstream
2595	Streambed
2596	Streambed
2597	Asian Clam (*Corbicula spp.*) shells
2598	Asian Clam (*Corbicula spp.*) shells

Comments

Stream bed with large amounts of Asian Clam (*Corbicula spp.*)shells.

Rocky streambed.

Exide Technologies Habitat Surveys

Date: 3/18/2014

Plot: H-100

Personnel: (BESI) KH, RM (Golder) AM, Chris (Frisco) Jason

Camera: Nikon

GPS: A

Time: 11:00

General Location: Stewart Creek downstream of Legacy Dr.

GPS Waypoints	Description
Plot H100	Plot H-100, stream bed

Dominant Vegetation
Ulmus alata
Celtis occidentalis
Gleditsia triacanthos

Photo IDs	Description
2779	North
2780	East
2781	South
2782	West

Comments

Unknown frog species heard.

Exide Technologies Habitat Surveys

Date: 3/18/2014

Plot: H-102

Personnel: (BESI) KH, RM (Golder) AM, Chris (Frisco) Jason

Camera: Nikon

GPS: A

Time: 12:42

General Location: Stewart Creek downstream of Legacy Dr.

GPS Waypoints	Description
Plot 102	Plot H-102, stream bed

Dominant Vegetation
Ulmus alata
Ambrosia Trifida
Sorghum halepense
Rumex crispus

Photo IDs	Description
2801	North
2802	East
2803	South
2804	West

Comments

4 Spring Peepers (*Pseudacris crucifer*) heard.

Exide Technologies Habitat Surveys

Date: 3/18/2014

Plot: H-103

Personnel: (BESI) KH, RM (Golder) AM, Chris (Frisco) Jason

Camera: Nikon

GPS: A

Time: 14:34

General Location: Stewart Creek downstream of Legacy Dr.

GPS Waypoints	Description
Plot H103	Plot H-103, stream bed

Dominant Vegetation
Fraxinus pennsylvanica
Ulmus alata
Gleditsia triacanthos
Ambrosia trifida
Smilax bona-nox

Photo IDs	Description
2819	North
2820	South
2821	West
2822	East

Comments

None

Exide Technologies Habitat Surveys

Date: 3/18/2014

Plot: H-104

Personnel: (BESI) KH, RM (Golder) AM, Chris (Frisco) Jason

Camera: Nikon

GPS: A

Time: 15:50

General Location: Stewart Creek downstream of Legacy Dr.

GPS Waypoints	Description
Plot H104	Plot H-104, stream bed

Dominant Vegetation
Ambrosia trifida
Ulmus alata
Panicum virgatum

Photo IDs	Description
2834	West
2835	North
2836	East
2837	South
2838	Stream bottom

Comments

Open with very few woody species.

Exide Technologies Wildlife Observations

Initials	Date	Time	ID	Observation	Photo ID
NH	1/13/2014	8:45	W-1	Deer (*Odocoileus virginianus*) rubs	2114-2118
NH	1/13/2014	8:50	W-2	Burrow, unknown species, and active	2119-2121
NH	1/13/2014	8:50	W-3	Burrow and Deer (*Odocoileus virginianus*) tracks	2122-2123
NH	1/13/2014	9:00	W-4	Nests, possibly used by a squirrel.	2129
NH	1/13/2014	9:00	W-5	Nest, large possibly used by a raptor or owl.	2130
NH	1/13/2014	9:05	W-6	Burrow, Tufted Titmouse (*Baeolophus bicolor*) and Carolina Chickadee heard.	2135
NH	1/13/2014	9:06	W-7	Mockingbird (*Minus polyglottos*) sighting	
NH	1/13/2014	9:10	W-8	Burrows, multiple, next to old structure, possibly used by Packrats.	2140-2144
NH	1/13/2014	9:46	W-9	Burrows, multiple in the area.	2172-2173
NH	1/13/2014	9:51	W-10	Blue Jay (*Cyanocitta cristata*) heard.	
NH	1/13/2014	10:21	W-11	Beaver (*Castor canadensis*) slide, Burr oak acorns next to the slide.	2209
NH	1/13/2014	10:22	W-12	Beaver (*Castor canadensis*) dam, pooling behind dam.	2210-2211
NH	1/13/2014	10:46	W-13	Beaver (*Castor canadensis*) sign on log.	2233
NH	1/13/2014	10:50	W-14	Raccoon (*Procyon lotor*) tracks	2237
NH	1/13/2014	11:07	W-15	Hog sign	2251
NH	1/13/2014	11:18	W-16	Dead Pondhorn (*Uniomerus tetralasmus*) shell found approximately 7 feet above the waterline.	
NH	1/13/2014	12:15	W-17	Scat, most likely a Raccoon (*Procyon lotor*) on log over creek and Tufted Titmouse (*Baeolophus bicolor*) was spotted.	2277

Exide Technologies Wildlife Observations

Initials	Date	Time	ID	Observation	Photo ID
NH	1/13/2014	12:20	W-18	Raccoon (Procyon lotor) tracks in creek.	2288
NH	1/13/2014	14:42	W-19	Coyote (*Canis latrans*) spotted from van on the south side of creek.	
NH	1/13/2014	15:30	W-20	Burrows	371-373
NH	1/13/2014	15:40	W-21	Nest	384
NH	1/13/2014	16:10	W-22	Burrows	400
NH	1/14/2014	8:00	W-23	Pair of Mallard Ducks (*Anas platyrhynchos*) spotted below the dam.	2338-2341
NH	1/14/2014	8:00	W-24	Mourning Doves (*Zenaida marcoura*) spotted.	
NH	1/15/2014	8:20	W-25	2 Asian Clams (*Corbicula spp.*) and a pair of Mallard Ducks (*Anas platyrhynchos*) spotted.	2357-2358
NH	1/15/2014	8:21	W-26	2 Asian Clams (*Corbicula spp.*) and Great Blue Heron (*Ardea herodias*) feather.	2359-2362
NH	1/15/2014	8:45	W-27	Asian Clams (*Corbicula spp.*) , Raccoon (*Procyon lotor*) and canine tracks	2369-2370
NH	1/15/2014	8:50	W-28	Mussel shell fragment possibly a Pondhorn (*Uniomerus tetralasmus*)	2371-2372
NH	1/15/2014	8:55	W-29	Mussel shell fragment possibly a Pondhorn (*Uniomerus tetralasmus*)	2376
NH	1/15/2014	9:05	W-30	2 dead Bluegill (*Lepomis macrochirus*) and 1 dead Green Sunfish (*Lepomis cyanellus*) found. Also a Carolina Chickadee (*Poecile carolinensis*) was heard.	2381-2384
NH	1/15/2014	9:15	W-31	Deer (Odocoileus virginianus) tracks and rubings on the south bank. A Pondhorn (*Uniomerus tetralasmus*) shell.	2385-2388
NH	1/15/2014	9:17	W-32	Intact Pondhorn (*Uniomerus tetralasmus*) shell	2389-2398
NH	1/15/2014	9:25	W-33	Pondhorn (*Uniomerus tetralasmus*) shell	2396-2399
NH	1/15/2014	10:30	W-34	Wading bird tracks and fish nests on sediment surface.	2418-2420

Exide Technologies Wildlife Observations

Initials	Date	Time	ID	Observation	Photo ID
NH	1/15/2014	10:40	W-35	Larger Pondhorn (*Uniomerus tetralasmus*) shell, on riffle area, older shell.	2421-2424
NH	1/15/2014	10:50	W-36	Larger Pondhorn (*Uniomerus tetralasmus*) shell, shale bottom, on riffle area, older shell.	2425-2428
NH	1/15/2014	11:00	W-37	Bairds Sandpiper (*Calidris bairdii*) spotted, shale bottom no sediment.	2429-2433
NH	1/15/2014	14:20	W-38	Pondhorn (*Uniomerus tetralasmus*) shell, large, bottom rocky.	2456-2459
NH	1/15/2014	14:30	W-39	Wading bird foot prints in sand.	2468
NH	1/15/2014	14:40	W-40	Large Pondhorn (*Uniomerus tetralasmus*) shell.	2472-2473
NH	1/15/2014	15:38	W-41	Large Pondhorn (*Uniomerus tetralasmus*) shell.	2483-2488
NH	1/15/2014	15:50	W-42	Turtle, recently dead.	2496-2503
NH	1/15/2014	16:05	W-43	Juvenile Soft-shell turtle (*Apalone spinifera*) found live, gravel bottom.	2504-2505
BS	1/16/2014	8:23	W-44	Pondhorn (*Uniomerus tetralasmus*) shell out of water on gravel bank.	2510-2513
BS	1/16/2014	8:44	W-45	Red-eared slider (*Trachemys scripta elegans*), multiple sightings. Northern Cardinal (*Cardinalis cardinalis*) sighted. Pondhorn (*Uniomerus tetralasmus*) shell found.	2517-2519
BS	1/16/2014	11:06	W-46	Two (dead), only shells, possibly Red-eared sliders (*Trachemys scripta elegans*)	2533-2534
BS	1/16/2014	11:34	W-47	Animal tracks on bank possibly Raccoon (*Procyon lotor*) and Coyote (*Canis latrans*)	2540
BS	1/16/2014	12:02	W-48	Small owl, fresh dead, found floating in creek. Large trutle also found in creek.	2553-2557
BS	1/16/2014	13:00	W-49	Dead bird, half decomposed, possibly a raptor or owl.	2573-2574
BS	1/16/2014	15:19	W-50	Mallard Ducks(*Anas platyrhynchos*) spotted in streambed.	2589-2591
BS	1/16/2014	16:28	W-51	Beaver (*Castor canadensis*) dam	2616-2617

Exide Technologies Wildlife Observations

Initials	Date	Time	ID	Observation	Photo ID
KH	3/18/2014	9:10	W100	2 Mallards (*Anas platyrhynchos*), 1 mockingbird (*Mimus polyglottos*) sighted.	2766
KH	3/18/2014	11:30	W101	Red-eared slider (*Trachemys scripta elegans*)	2789-2791
KH	3/18/2014	11:40	W102	2 Mallards (*Anas platyrhynchos*) sighted in creek. Beaver (*Castor canadensis*) sign evident on banks.	2792
KH	3/18/2014	12:30	W103	Beaver (*Castor canadensis*) evidenced.	2800
KH	3/18/2014	13:15	W104	White tailed deer (*Odocoileus virginianus*) tracks and Asian clam (*Corbicula spp.*) shells on bank.	2811
KH	3/18/2014	14:00	W105	Auditory observation of Mockingbird (*Mimus polyglottos*) and Hawk (species unknown).	N/A
KH	3/18/2014	14:43	W106	North American Raccoon (*Procyon lotor*) tracks on sediment bar.	2823
KH	3/18/2014	14:45	W107	Pondhorn (*Uniomerus tetralasmus*) shell out of water on gravel bank.	2825
KH	3/18/2014	15:37	W108	2 Mallard ducks (*Anas platyrhynchos*) on stream. North American Raccoon (*Procyon lotor*) tracks on sediment bar.	2832-2733

Attachment C

Stewart Creek (H-64)

Stewart Creek (H-65)

Stewart Creek (T-6)

Stewart Creek (W-35)

Stewart Creek (W-35)

Stewart Creek (H-72)

Stewart Creek (H-73)

Stewart Creek (T-15)

Stewart Creek (T-10)

Stewart Creek (H-77)

Stewart Creek (H-78)

Clam Rake (T-21)

Clam Rake (T-6)

Clam Rake (T-7)

Clam Rake (T-8)

Clam Rake (T-9)

Clam Rake (T-11)

Clam Rake (T-18)

Asian Clams (H-78)

Asian Clams (T-13)

Clam Rake (T-14)

Asian Clams and Pondhorn (T-15)

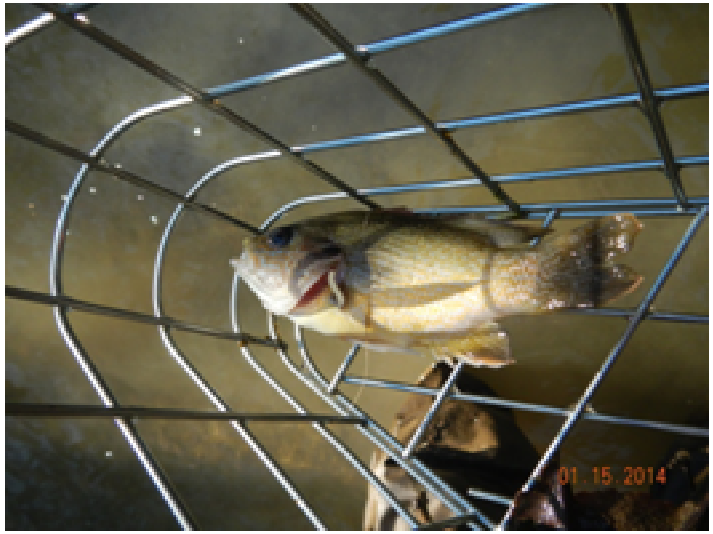
Asian Clams and Pondhorns (T-15)

Pondhorn (W-41)

Pondhorn (W-44)

Pondhorn (W-45)

Soft-shell Turtle (W-43)



Green Sunfish (W-32)

Box Turtle (W-42)

Stewart Creek in Exide Facility (H-18)

Stewart Creek in Exide Facility (H-17)

Stewart Creek in Exide Facility (H-26)

Stewart Creek in Exide Facility (T-24)

Rip-rap in Stewart Creek (W-13)

Concrete Dam in Stewart Creek (H-22)

Stewart Creek in Exide Facility (H-3)

Rip-rap in Stewart Creek (H-22)

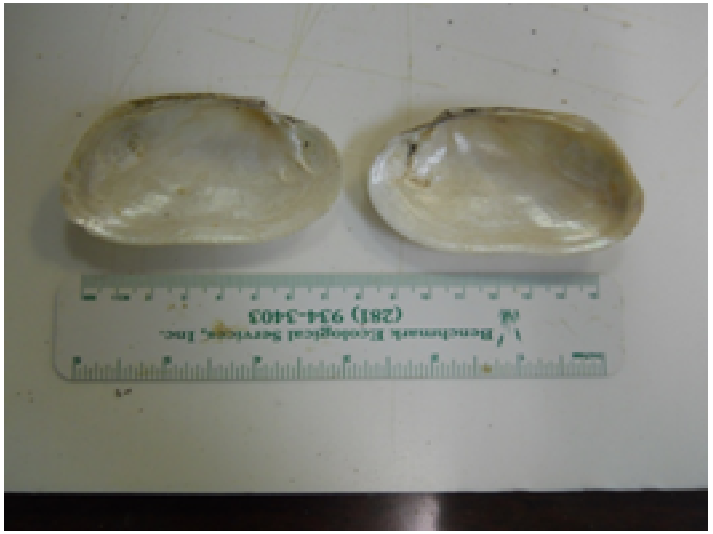
Clam Rakes within the Exide Facility (T-2)

Sediment in the Exide Facility (H-24)

Clam Rakes within the Exide Facility (T-1)

Stewart Creek in the Exide Facility (H-26)

Stewart Creek in the Exide Facility (H-26)



Pondhorn found within the Exide Facility (W-16)

Pondhorn found within the Exide Facility (W-16)

Mallards (W-23)

Northern tributary in NE forested area (H-40)

Northern tributary in NE forested area (H-28)

Northern tributary in NE forested area (H-32)

Northern tributary in NE forested area (H-32)

Northern tributary outside NE forested area (H-49)

Northern tributary outside NE forested area (H-47)

Northern tributary outside NE forested area (H-47)

Northeast Forested Area (H-38)

Northeast Forested Area (H-41)

Northeast Forested Area (H-34)

Northeast Forested Area (H-37)

Southeast Forested Area (H-5)

Southeast Forested Area (H-3)

Southeast Forested Area (H-4)

Southeast Forested Area (H-5)

Deer rub (W-1)

Burrow (W-2)

Packrat burrow (W-8)

Nest (H-33)

Hayfield (H-27)

Hayfield (H-27)

APPENDIX E

REPTILE EXPOSURE AND TOXICITY

E1.0 Introduction

A detailed evaluation on reptilian exposure and toxicity to antimony, arsenic, cadmium, lead and selenium was developed to support this SLERA. The timber (canebrake) rattlesnake (*Crotalus horridus)* is listed as a Texas threatened species for both Collin and Denton Counties and therefore the SLERA is required to assess the potential that this species may be present on Site. To help determine if this rattlesnake species may utilize the FOP, a habitat assessment was completed and presented in Appendix D. In support of potentially estimating risk to a terrestrial snake, toxicity data and exposure parameters were researched. This appendix presents the findings of the literature evaluation for the assessment of a terrestrial snake in an ecological risk assessment.

E2.0 Background

During the past decades, reptilian toxicology has made up a disproportionately small percentage of toxicological studies of vertebrates. Characteristics of some reptile species make them difficult to study, including long life span and generation time, low fecundity, and incompatibility with laboratory handling techniques. Reptile species are linked by a number of traits (e.g., ectothermia, pulmonary respiration, epidermal scales, and internal fertility), yet possess a diverse array of life history characteristics and inter-species differences (e.g., population distributions, migration patterns, diets, and metabolic processes) (Gardner and Oberdorster, 2006).

Reptiles are considered a globally declining taxon. Hypotheses for reptile decline include: habitat loss and degradation, invasive species, disease, parasitism, global climate change, and environmental pollution (Gibbons et al., 2000). Detecting population declines in reptile populations is inherently difficult as a result of their cryptic or secretive nature, large home range size, low population densities and lack of rarity of congregational behavior (Irwin and Irwin, 2006).

Currently, much less is known about the accumulation and effects of COCs in reptiles than in any other vertebrate class, making prediction of COC impacts on reptiles difficult. Risk predictions based on toxicity thresholds established for other vertebrates (e.g., birds and fish) may be inappropriate for many reptiles because of their unique combination of physiological and life history characteristics (e.g., long life span, relatively small home ranges, high trophic position and ecotothermic physiology) (Hopkins et al., 2002). As such, the quantitative differences between reptiles, birds and mammals is unknown and therefore uncertain. Reptiles may respond differently than birds and mammals to some environmental contaminants because their metabolic rates may slow the elimination and detoxification of toxic substances. Reptiles may maintain higher body burdens of COCs. Many reptile species are known to store significant amounts of body fat, which may serve to bioaccumulate lipophilic COCs. A number of

reptiles are predators or scavengers that occupy high positions in trophic food chains potentially resulting in an increased exposure to persistent contaminants as a result of biomagnification (Selcer, 2006).

E2.1 Life Cycle

According to Herps of Texas (http://www.herpsoftexas.org/view/snakes), Collin and Denton Counties are home to a variety of snakes from the families Leptopyphlopidae, Colubridae and Crotalidae. All of the species from the family Crotalidae are venomous and are also viviparous (females give live birth). These snakes include the copperhead (*Agkistrodon contortrix*), cottonmouth (*Agkistrodon piscivrous*), western diamondback rattlesnake (*Crotalus atrox*) and the timber rattlesnake (*Crotalus horridus*). Species from the family Colubridae include both egg laying such as the eastern ratsnake (*Pantherophis obsoletus*) and viviparous such as, the western ribbonsnake (*Thamnophis proximus*).

For the viviparous snakes, their young are born in late summer to early fall and are capable of delivering a venomous bit hours after their birth. For egg-laying snakes, the young can emerge five weeks to 2 months after the eggs are deposited. Juvenile snakes are opportunistic feeders consuming earthworms to small lizards. In general, snakes can live 10 – 25 years.

Snakes can be found in the wooded forests, as well as vegetated lowlands. The copperhead lives in leaf piles, or alongside logs and stones in wooded forests, using camouflage to elude predators. The timber rattlesnake can be found associated with heavily vegetated riparian waterways in the eastern part of Texas. The prairie kingsnake (*Lampropeltis calligaster*) spends most of its life underground in burrows and under rocks. It is commonly found in cultivated fields and pastures, mixed woodlands and open meadows; however, it is also found on rocky ledges and bottom lands. Coachwhips (*Masticophis flagellum*) frequently climb trees to eat nestling birds or to escape predators (Herps of Texas, 2013).

Many of the snakes found in northeastern Texas are nocturnal, such as the Chihuahuan nightsnake (*Hypsiglena jani*). The copperhead is nocturnal during the hotter summer months and is active during the day in the cooler spring and fall months. The western diamondback rattlesnake is usually inactive between later October and early March, although it might be seen sunning itself on warm winter days. The timber rattlesnake often congregates in large numbers in den sites for winter hibernation (Herps of Texas, 2013).

Snakes feed on a variety of prey ranging from lizards and other snakes to small mammals and birds. The plain-bellied watersnake (*Nerodia erythrogaster*) feeds on fish and amphibians with its juveniles feeding on tadpoles, small fish and invertebrates. The gopher snake (*Pituophis catenifer*) is a common snake and is highly beneficial feeding on mice in areas of agriculture or areas where rodents are viewed as pests.

The rough earthsnake (*Virginia striatula*) consumes only earthworms and is frequently seen in backyards and open lots of eastern Texas often found when overturning logs and stones (Herps of Texas, 2013).

E2.2 Exposure

Reptiles can be exposed to COCs by several routes, including ingesting contaminated material, contact with skin, maternal transfer into eggs and embryos, and uptake from the nest materials by incubating eggs. Although ingestion of contaminated food is probably one of the most important routes for COCs to enter reptiles and other terrestrial vertebrates, ingestion of soil could also be an important route for the uptake of soil COCs (Rich and Talent, 2009).

As described above, the snakes identified in Collin and Denton Counties represent a variety of snakes, venomous and nonvenomous, viviparous and egg laying, preferring aquatic habitat or terrestrial; however, all snakes are ectothermic and therefore hibernate in the coldest months and manage heat exposure in the summer months by being nocturnal. Exposure to media based COCs is influenced by preferred food type, for instance the eastern ratsnake (*Pantherophis obsoletus*) is considered arboreal, as they seek food and refuge inside hollow limbs as well as on exposed branches (Herps of Texas, 2013), thereby, limiting any exposure to COCs in soil for his particular snake.

E3.0 Toxicology

Of the types of reptiles, turtles appear to have been studied more frequently than crocodilians, lizards or snakes and most of the studies have focused on organic contaminants (Hopkins et al., 2002). In general, past reptile studies have focused on measuring body burdens of various pollutants from samples collected in the field. While these data are useful for understanding historical exposures of given populations, the actual risks and population-level effects of pollution on reptiles is still largely unknown and generally understudied (Wier et al., 2010).

Relatively few laboratory studies have been conducted on the dose-response of toxicants and no standardized tests involving reptile models are in use (Talent et al., 2002). Campbell and Campbell (2000, 2002) reviewed the open literature for metals data for reptiles and reported one study using snakes in their 2000 publication and three effects studies for lizards and five for snakes in their 2002 publication. Campbell and Campbell (2000) states: “The available data on reptiles were too scanty to allow for meaningful analysis of levels or effects.” Fryday and Thompson (2009) collated toxicity data of chemicals to reptiles available in the scientific literature. Few values for toxicity were found and most studies did not calculate LD_{50} or LC_{50} values, but only reported mortality or symptoms. The lack of standard dose-response toxicity testing makes determining a toxicity reference virtually impossible or very imprecise.

Researchers are considering various reptile species as environmental indicators (Heinz et al, 1980; Clark et al., 2000); although to date there is not a consensus on test species or testing protocol for determination of environmental toxicity. Maintenance of breeding populations of most reptile species under laboratory conditions is not practical because of their size and maturation rate. Talent et al. (2002) proposes that the western fence lizard is an excellent candidate for a laboratory reptile model because a complete life cycle can be completed under laboratory conditions in less than a year and each stage in the life cycle can provide several endpoints for evaluating the effects on environmental toxicants, for example, they bury their eggs in moist substrate and water-soluble contaminants could be transported into the egg. Selcer (2006) evaluated candidate test species for turtles, lizards, snakes and crocodylia. For snakes, the genus *Thamnophis*, which includes garter and ribbon snakes, was proposed because of their broad range from Canada to Mexico, common distribution including urban settings, use of a variety of habitats, and opportunistic diet. The garter snake has been studied extensively from the standpoint of reproductive ecology and physiology, although no toxicity studies on metals were found in the literature. Selcer (2006) also recommended water snakes (*Nerodia spp*.) as a good toxicology model because they are primarily aquatic, widely distributed and reasonably abundant.

E3.1 Specific Toxicity and Uptake Studies (arsenic, cadmium, lead and selenium)

The following text describes the published papers located in the open literature relevant to ecological exposures of reptiles to the COCs (arsenic, cadmium, lead and selenium). No information was found on antimony. Preference was given to chronic, oral studies using snakes as a test species and ecologically relevant endpoints (e.g., survival and reproduction); however, because of the limited information available, all of the methods of exposure and study endpoints are described below. Table 1 summarizes the toxicity data taken from these studies.

In a two year study, Hopkins et al. (2002) fed contaminated food to juvenile banded water snakes (*Nerodia fasciata*). Prey items were collected from a coal ash-contaminated site that contained elevated levels of **arsenic, cadmium**, copper, **selenium**, strontium, and vanadium. Concentrations of arsenic in prey ranged from 0.69 µg/g to 1.28 µg/g, for cadmium ranged from 0.14 µg/g to 0.23 µg/g and for selenium ranged from 11.36 µg/g to 22.7 µg/g. With the exception of copper, snakes accumulated significant concentrations of the elements, usually in a dose-dependent manner. Accumulation, varied significantly among liver, kidney and gonads and in most cases between the sexes. Selenium accumulation was most notable, greatly exceeding established toxicity thresholds of other vertebrates. Despite the high concentrations of pollutants accumulated, snakes exposed to the contaminated diet survived through the study and exhibited normal food consumption, growth, condition factor, overwinter

survival and mass loss, metabolic rate and gonadosomatic index. The results of the study confirm that diet can be a significant route of exposure in snakes, but the study did not define toxicity endpoints.

Marco et al (2004) tested whether **arsenic** present in the nest material could cross through the flexible eggshell of the Iberian rock lizard (*Lacerta monticola cyrenni*) and affect the embryos. The study endpoints were embryo survival, incubation duration, hatchling size, and hatchling running speed. Arsenic was added to the soil substrate at concentrations of 50, 100, 250, 400 and 500 parts per billion (ppb) as arsenic. The tested levels of arsenic had no effect on embryo survival, incubation duration and hatchling size. There was a strong negative relationship between the average hatchling running speed for each treatment with the lowest effect level at 100 ppb. Escape using fast movements is an important defensive behavior for many lizards and may be considered as an indicator of fitness. Moreover, most reptiles have an intensive foraging strategy and they travel considerable distances often at a high running speed. Decreased locomotor ability and increased energetic costs of locomotion due to the egg incubation on contaminated substrates may influence survival or success of juveniles.

Guirlet and Das (2012) studied the accumulation, path and effects of exposure to **cadmium** through diet in female red eared slider turtles (*Trachemys scripta elegans*). In the first phase of the experiment, turtles underwent an acclimatization period during which they were fed a control diet. In the second phase, the turtles were exposed to cadmium through a $CdCl_2$ supplemented diet for 13 weeks. The three dosage turtle groups exposed to the diet Cd treatments received: 0.4 mg/kg (low dosage group), 0.58 mg/kg (medium dosage group) and 0.95 mg/kg (high dosage group). Following this, the turtles went through a third phase, a recovery phase of 3 weeks during which they were fed uncontaminated food. Blood and feces were collected during the three phases of the experiment. The turtles were euthanized at the end of the experiment and organ samples collected. The Cd-concentrations in blood remained stable over the course of the experiment while Cd-concentrations in feces increased with time and the amount of Cd ingested. In terms of burden in the organs, the Cd-burden was the highest in liver followed by kidney and pancreas. The proportional accumulation decreased as Cd ingestion increased, suggesting that at a higher dose of Cd, assimilation decreased. Accumulation of Cd had no effect on survival, food consumption, growth, weight or length suggesting no effect on the female turtle body condition, although the study did not identify any toxicity endpoints.

Brasfield et al (2004) investigated developing lizard embryos as a terrestrial vertebrate model. Lizard eggs may be particularly susceptible to soil contamination and exposure may affect hatchling size and mortality. Fertilized eastern fence lizard (*Sceloporus undulatus*) eggs were placed in **cadmium**-spiked expanded perlite (0, 1.48, 14.8, 148, 1,480, 14,800 mg/kg), artificially incubated, and examined daily for

mortality. Whole lizard hatchlings as well as failed hatches were homogenized in ethanol and the homogenate was divided for cadmium body residue analysis. Acute mortality was observed in the two highest doses (1,480 and 14,800 mg/kg). Cadmium body residues showed a higher internal concentration with increasing exposure concentration indicating uptake of cadmium. There were no differences observed in hatchling size measured as weight and snout-vent length, or in whole body thyroid hormone levels. In summary, this study has shown cadmium amended to a solid phase representing soil (perlite) can traverse the thin, parchment-like shell membrane of the fence lizard egg and bioaccumulate in lizard embryos. This study did not identify a toxicity endpoint.

Burger et al (1998) studied the effects of **lead** on behavioral developments of hatchling slider turtles (*Trachemys scripta*) from the Savannah River Site, near Aiken, SC. Hatchlings from 1995 showed no significant differences in growth, survival, or behavior between control and lead-injected animals at a dose of 0.05 and 0.1 mg/g. In 1996, 48 hatchlings were divided into four groups and injected with 0 (control), 0.25, 1, or 2.5 mg/g lead. Few significant differences occurred in growth or size as a function of lead treatment at 4 months of age, but survival declined markedly as a function of lead dose. Righting response was significantly impaired by lead; time to right was directly related to lead dose. Size also affected behavior; larger hatchlings turned over more quickly and reached cover sooner than did smaller hatchlings. These experiments indicate that lead affects survival and behavior in hatchling turtles at doses in the range of 0.25 to 2.5 mg/g. Thus, these researchers indicate that the no effect level of 0.1 mg/g. The survival differences were dramatic in the experiments. At control and low levels of lead, nearly all of the hatchlings survived at 4 months, whereas at medium and high levels survival was low (25% and 0%), yielding an LD_{50} of 0.5 mg/g. Although significant, the behavioral differences were not large for the righting response test, and were nonexistent for the seeking cover test. Taken together, these experiments suggest that hatchling turtles are vulnerable to lead exposure, but that the threshold for behavioral effects in on the same order of magnitude as the LD_{50}. Weight was a significant contributor to the variations in righting and seeking cover behavior observed in these experiments. Larger animals responded sooner and were able to right themselves quicker than were smaller animals. Lead dose correlated negatively with weight, carapace length, and plastron length, indicating that with increased lead, animals grew more slowly. Taken altogether, the data suggest that lead at > 1 mg/g (1,000 mg/kg) has a major effect on survival, a lesser effect on growth and a small but significant effect on the righting response (Burger et al., 1998).

Salice et al. (2009) evaluated the toxicity of **lead** acetate to the western fence lizard (*Sceloporus occidentalis*). The acute lethal dose and sub-acute (14-day) toxicity studies were used to narrow exposure concentrations for a sub-chronic (60-day) study. In the sub-chronic study, adult and juvenile male lizards

were dosed via gavage with 0, 1, 10 and 20 mg/kg-day. Mortality was limited and occurred only at the highest dose (20 mg/kg-day). There were statistically significant sub-lethal effects of 10 and 20 mg/kg-day on body weight, cricket consumption, organ weight, hematological parameters and post-dose behaviors. Of these, lead-induced changes in body weight are most useful for ecological risk assessment because it is linked to fitness in wild lizard populations.

Ciliberti et al (2013) evaluated how juvenile savannah monitor lizards (*Varanus exanthematicus*) absorb and accumulate pollutants and how they are affected. Savannah monitors were orally exposed during 6 months to a mixture of **lead**, 4,4,-DDT and chlorpyrifos-ethyl (CPF). Monitors received 20 then 10 mg/kg lead, 2 then 0.5 mg/kg CPF and 4 mg/kg 4,4-DDT. Individuals surviving contamination were euthanized after 4 or 6 months. Exposed monitors absorbed all three pollutants but only lead (in bone, tail tips and phalanxes) and 4,4-DDT plus its main metabolites (in fat and liver) accumulated. High individual levels were measured among the specimens that were exposed for the longest duration: DDT maximum reached 638.7 mg/kg in adipose tissue, lead reached 80 mg/kg in bone, 13.6 mg/kg renal concentration and 11 mg/L in blood. CPF killed ten individuals. The critically poisoned monitors showed typical symptoms of cholinesterasic activity inhibition, i.e., tremors, head twitching, tongue flicking, poor locomotion, loss of balance and abundant lachrymal secretion. Tail tips and skin samples are recommended as non-destructive indicators for lead and organochlorine pesticides contamination. Lead and total DDT concentrations in the exposed monitors reached levels rarely observed in reptiles, including lizards, snake and crocodilians. Among previous studies, the most noticeable data (Kaur, 1988) relate lead concentrations as high as 160 mg/kg in scales of common wall lizards (*Podarcis muralis*) and 220 mg/kg in shed skins of Indian cobras (*Naja naja*). These results suggested that far higher concentrations may occur in target tissues, and would mean that squamates may withstand very high lead levels. Squamate taxa in the family Lacertidae and in the infra-order Serpentes can withstand very high loads of lead tends to indicate that this resistance may well be a general feature of squamates. Considering the high lead and total DDT concentrations measured in some exposed yet apparently healthy specimens, it is unlikely that lead or DDT were directly involved in the death of the ten prematurely deceased monitors.

Overmann and Krajicek (1995) investigated the common snapping turtle (*Chelydra serpentine*) as a biomonitor of **lead** in a freshwater aquatic ecosystem. Snapping turtles are omnivorous and ingest a wide variety of food items. The benthic habitats of the turtles suggest that they would frequent areas of metal-rich sediments in lead-contaminated aquatic ecosystems. The snapping turtle is mobile, but relatively sedentary which would facilitate relation of tissue contaminant levels with a relatively localized area. Thirty-seven snapping turtles were collected from three sites on the Big River, an Ozarkian stream

contaminated with lead mine tailings. Morphometric measurements, tissue lead concentrations, δ-aminolevulinic acid dehydratase (δ-ALAD) activity, hematocrit, hemoglobin, plasma glucose, osmolality and chloride ion content was measured. δ-ALAD is an enzyme of the heme synthesis pathway and a sensitive indicator of lead exposure. The data showed no effects of lead contamination on capture success or morphological measurements. Tissue lead concentrations were related to capture location. Most hematological parameters were not different with respect to capture location. The δ-ALAD activity was decreased in turtles taken from contaminated sites. Lead levels in the Big River do not appear to be adversely affecting the snapping turtles of the river. The mean concentration of lead in tailings range from 1,000 to 3,000 mg/kg and the tailings vary in consistency from course sand to fine powder.

Holem et al. (2006) hypothesized that acute exposure to neurotoxic metals and pesticides could influence locomotor performance of reptiles. To test this hypothesis, western fence lizards (*Sceloporus occidentalis*) were exposed to malathion and **lead**. Single doses were administered via oral gavage at order-of-magnitude levels ranging from 0.2 to 200 and 1.0 to 1,000 mg/kg (body weight basis) for malathion and Pb, respectively. Lizard sprint velocity was determined using a 2.3-meter sprint track interfaced with a laptop computer 24 hours prior to dosing and again at 4, 24, 120, and 312 hours post-dose. Twenty percent and 30% mortality occurred at the highest malathion and lead dose levels (200 and 1000 mg/kg) and 70% of the lizards exposed to 200 mg/kg malathion exhibited clinical symptoms of organophosphate poisoning. Contrary to the hypothesis, exposure to lead had no effect on locomotor performance, and exposure to the highest concentration of malathion increased sprint velocity.

Hopkins et al (2004) studied the trophic and maternal transfer of **selenium** in reptiles by feeding selenium injected prey (10 and 20 mg/kg of seleno-D-L-methionine) to female brown house snakes (*Lamrophis fuliginosus*) for 10 months and measured selenium accumulation as well as survival, food consumption, growth and body conditions. Additionally, the researchers paired females with untreated males and quantified the number of females that reproduced, reproductive output of each female (number of clutches, total number of eggs and total mass of combined clutches), and maternal transfer of selenium to eggs. Snakes were fed meals equaling 25% of their body mass 2-3 times a month for 10 months. The study found that the snakes accumulated significant concentrations of selenium in kidney, liver and ovarian tissue, but accumulation had no effect on female survival, food consumption, growth or body condition. Selenium was transferred in significant concentrations to the eggs and in the 20 mg/kg treatment, maternal transfer resulted in selenium concentrations that surpassed all suggested reproductive thresholds for birds and mammals. The study concludes that additional studies are needed to determine whether maternal transfer of selenium decreased the overall reproductive success of snakes and the health of their offspring.

In 2005, Hopkins et al. studied the trophic transfer of **selenium** from a selenium-laden commercial feed to crickets (*Acheta domestica*), which were then preyed upon by juvenile western fence lizards (*Sceloporus occidentalis*). A diet of 30 mg/kg for 5-7 days produced whole body cricket selenium concentrations ranging from 1.8 to 10 mg/kg with minimal effect on growth and survival. Despite the elevated concentrations of selenium accumulated by lizards, no adverse biological effects were documented. Lizards with high selenium tissue burdens survived to the end of the study and exhibited normal food consumption and growth. In general, the findings of this study are consistent with most studies on birds that indicate dietary organoselenium concentrations greater than 40 mg/kg are required to adversely affect growth and survival.

Table E-1. Summary of Reptile Toxicity Data for Arsenic, Cadmium, Lead and Selenium

Test Species	Study Endpoint(s)	Dose	Reference
Arsenic			
Banded Water Snake	No effects on food consumption, growth, overwinter survival, mass loss, metabolic rate, gonadosomatic index	0.69 to 1.28 mg/kg in food	Hopkins et al., 2002
Iberian rock lizard	Reduced hatchling running speed	100 ppb on egg substrate	Marco et al., 2004
Iberian rock lizard	No effect on embryo survival, incubation duration and hatchling size	500 ppb on egg substrate	Marco et al., 2004
Cadmium			
Banded Water Snake	No effects on food consumption, growth, overwinter survival, mass loss, metabolic rate, gonadosomatic index	0.14 to 0.23 mg/kg in food	Hopkins et al., 2002
Red Eared Slider Turtles	No effect on survival, food consumption, growth, weight or length	0.95 mg/kg in food	Guirlet and Das, 2012
Fence Lizard	Acute mortality	1,480 mg/kg in egg substrate	Brasfield et al, 2004
Fence Lizard	No effects on hatchling size measured as weight and snout-vent length, or in whole body thyroid hormone levels	148 mg/kg in egg substrate	Brasfield et al, 2004
Lead			
Slider Turtles	Lowest value showing survival and behavior changes	250 mg/kg injection in leg muscle	Burger, 1998
Slider Turtles	No effects on survival or behavior	100 mg/kg injection in leg muscle	Burger, 1998
Savannah Monitor	No effect on mortality	20 mg/kg orally	Ciliberti et al., 2013
Common Snapping Turtle	Reduced δ-ALAD activity	1000 mg/kg in mine tailings in sediment	Overmann and Krajicek, 1995
Fence Lizard	Effect on body weight	10 mg/kg-day gavage	Salice et al., 2009
Fence Lizard	30% Mortality	1000 mg/kg oral gavage	Holem et al., 2006
Fence Lizard	No effect on sprint performance	1000 mg/kg oral gavage	Holem et al., 2006
Selenium			
Banded Water Snake	No effects on food consumption, growth, overwinter survival, mass loss, metabolic rate, gonadosomatic index	11.36 to 22.7 mg/kg in food	Hopkins et al., 2002
Brown house snake	Accumulation in tissues, but no effects on survival, food consumption, growth, body condition or reproduction.	20 mg/kg in food	Hopkins et al., 2004
Fence Lizard	No effect on food consumption or growth	30 mg/kg in food to crickets and 14.8 – 16 mg/kg in cricket tissue	Hopkins et al., 2005

E3.2 Derivation of TRVs for Snake Exposure

Using the available data, toxicity reference values (TRVs) were determined when possible. The timber/canebrake rattlesnake was chosen as a representative snake because it is known to be present in Denton and Collin Counties according to the Herps of Texas (2013) and it is a Texas listed threatened species. In order to calculate the dose to the timber canebrake rattlesnake the following assumptions were made:

Body weight of an adult timber/canebrake rattlesnake in Texas is assumed to be 0.9 kg. According to <www.tpwd.state.tx.us/huntwild/wild/species/timberrattlesnake/> timber rattlers are the second largest venomous snake in Texas and third largest in the United States. Adult timber rattlesnakes reach a length of 36 to 40 inches (91 to 101 cm), and weigh 1.3 to 2 pounds (0.58 to 0.9 kg). The upper end of the body weight range was used because other references list the average weight of 2.3 kg with a maximum weight of 4.5 kg (<seaworld.org/AnimalInfo/Animal-Info/Animal-Bytes/Reptiles/Canebrake-Rattlesnake>).

Food ingestion rate is determined from Nagy (1987) as presented in EPA (1993). Information was only available for iguanid lizards and not carnivorous snakes. Equations for herbivores and insectivores are listed and the equation for insectivores was used to determine a food ingestion rate of 0.0025 kg/day.

Arsenic, Cadmium and Selenium – Of the papers reviewed, only one study was conducted on snakes for arsenic and cadmium (banded water snake) and two papers for selenium (banded water snake and brown house snake). Note, no information could be located for antimony.

Hopkins et al (2002) conducted a two year study and determined that arsenic, cadmium and selenium concentrations in prey did not impact food consumption, growth, condition factor, overwinter survival and mass loss, metabolic rate and gonadosomic index. The study did not define a level of toxicity, but focused on tissue residue measurements and the no effect information was presented as a study observation. Hopkins et al (2002) states: “Despite the high concentrations of pollutants accumulated, snakes exposed to the contaminated diet survived through the study and exhibited normal food consumption, grown, condition factor, overwinter survival and mass loss, metabolic rate and gonadosomatic index. The results of this study confirm that diet can be a significant route of exposure to trace elements in snakes and indicate that further studies on snakes are warranted to better understand their response to contaminants.”

Guirlet and Das (2012) studied the bioaccumulation and toxicokinetics of cadmium through the diet in female red eared slider turtles, but the study did not define any toxicity endpoints. Guirlet and Das (2012) state: “Further studies are needed to investigate the deleterious effects of environmental contamination on

reptiles at the individual and population level so that prediction of the impact of contaminants on reptiles and conservation efforts can be effective."

Hopkins et al (2004) studied the trophic and maternal transfer of selenium in brown house snakes for 10 months and found that the snakes accumulated significant concentrations of selenium in kidney, liver and ovarian tissue, but accumulation had no effect on female survival, food consumption, growth or body condition. The study concludes that additional studies are needed to determine whether maternal transfer of selenium decreased the overall reproductive success of snakes and the health of their offspring. In 2005, Hopkins et al. studied the trophic transfer of selenium from a selenium-laden commercial feed to crickets, which were then preyed upon by juvenile western fence lizards. Despite the elevated concentrations of selenium accumulated by lizards, no adverse biological effects were documented.

Because none of these studies determined an effect level the "true" no effect level could be significantly greater than the maximum reported intake; therefore, snake-TRVs for arsenic, cadmium and selenium could not be developed.

Lead – No dose response studies using snakes as the test species were found in the literature search; but Burger (1998) determined a no effect concentration of 100 mg/kg when lead was injected into the muscle of a turtle and a lowest observed effect of 250 mg/kg. The study from Salice et al (2009) used oral gavage as the method of exposure, but the study does not define a no effect or lowest effect values based on the same endpoint.

Using the body weight of 0.9 kg and the food ingestion rate of 0.0025 kg/day, the calculated no effect level is 0.28 mg/kg day and the lowest effect level is 0.69 mg/kg day using the Burger (1998) findings:

- 100 mg/kg dose × 0.0025 kg/day ÷ 0.9 kg = 0.28 mg/kg day (No effect dose)
- 250 mg/kg dose × 0.0025 kg/day ÷ 0.9 kg = 0.69 mg/kg day (Lowest effect dose)

E4.0 Uncertainties

Test Exposure - Several studies exposed the test species via food (Hopkins et al., 2002; 2004; 2005 and Guirlet and Das, 2012) or via oral gavage (Salice et al., 2009 and Holem et al., 2006); but Marco et al. (2004) and Brasfield et al. (2004) exposed reptile eggs to a substrate which was dosed with the COC. The exposure of eggs to a substrate is not a relevant exposure to the timber/canebrake rattlesnake, or other viviparous snake species present in Collin and Denton Counties. The timber/canebrake rattlesnake gives birth to live snakes every three to five years (NYDEC, 2013). The studies which used the substrate as the exposure medium were not considered in the development of the TRV. The exposure method used by

Burger (1998) was injection of lead into the leg muscle of slider turtle. The use of injection as the exposure method is not a reasonable exposure route since it doesn't allow for gut metabolism or excretion. Note that all available toxicity studies on reptiles for these COCs were presented and the diversity of the exposure mechanisms is another obstacle in determination of a toxicity value.

Study Endpoints – The study endpoints varied from the "traditional" such as food consumption, growth, survival, weight, length, hatchling size and mortality, but also included species specific endpoints such as behavior (e.g., time for turtles to right themselves) or locomotion (e.g., sprint speed or sprint performance for lizards). Another study (Overmann and Krajicek, 1995) measured enzyme activity, hematocrit, hemoglobin, plasma glucose and osmolality and chloride ion content in snapping turtles. Studies with traditional and ecologically relevant endpoints were chosen for the TRV development, but it is uncertain if the species specific endpoints may be more or less conservative and more or less relevant to terrestrial snake exposures.

Test Species – For arsenic, cadmium and selenium, a study on the aquatic banded water snake (Hopkins et al., 2009) was reviewed for development of a snake-based TRV to be applied to terrestrial exposures. This study did expose the juvenile banded water snakes via food and the endpoints were the ecologically relevant (e.g., food consumption, growth), but the exposures may not include incidental soil ingestion or dermal exposures on soils containing COCs. For lead, the TRVs are based on a study of behavioral developments of hatchling slider turtles. This study (Burger et al., 1998) also evaluated ecologically relevant endpoints (survival and righting response); however, the applicability of turtle righting response to a terrestrial snake is unknown.

Snake Body Weight – The body weight of the timber/canebrake rattlesnake is assumed to be 0.9 kg, but other sources indicate that the adult body weight of a timber/canebrake rattlesnake may be greater. It is uncertain if the body weight of 0.9 kg is a conservative assumption for terrestrial snakes in Texas.

Food Ingestion Rate – The information found to determine the food ingestion rate for the timber/canebrake rattlesnake results in a range of 0.13 kg/day to 0.0025 kg/day. The value of 0.0025 kg/day was determined using the Nagy (1987) equations listed in EPA, 1993. Nagy states that information was only available for iguanid lizards and not for carnivorous snakes. The Cal/EcoTox database uses an assumption from Petersen et al (1998) which evaluated a garter snakes and says that the food ingestion rate is 14% of the body weight, resulting in a food ingestion rate of 0.013 kg/day. The concept of a kilogram per day ingestion rate may be incorrect for reptiles, for instance, Hopkins et al (2004) exposed female brown house snakes to selenium in prey by offering meals equal to 25% of the snakes body mass 2-3 times a month. In Hopkins (2005), the western fence lizard was fed 5% of their body mass, 4 days a

week and on the fifth day, a ration equaling of 10% of its body mass. Thus, the feeding regime resulted in a weekly ration of 30% of each lizard's body mass. The assumption of a daily intake is not applicable to snakes, but this impact of this uncertainty is unknown. Additionally the reptilian metabolic processes during food digestion are different than the mammalian model and the effect on COC exposure is unknown.

Temperature – Because reptiles are poikilothermic (i.e., body temperature that varies with the temperature of the surroundings) and their metabolic rates vary with body temperature, the sensitivity of reptiles to a dose level of a COC might vary with temperature. The body temperature and metabolic rates of reptiles can vary greatly, both during the day and throughout the year. As a result, because of the differences in enzymatic activity necessary to break down toxicants, cellular processes and other metabolic-dependent physiological processes, the toxicity of different COCs may vary with temperature. Talent (2005) investigated the effects of temperature on the toxicity of the green anole lizard (*Anolis carolinensis*) of a single concentration of a natural pyrethrin pesticide via percutaneous exposure. Talent found that lizards maintained at the lower study temperature (15 and 20°C) has significantly higher mortality than those lizards maintained at the higher temperature (35 and 38°C). The relationship of body temperature and sensitivity to contaminants has been poorly investigated in reptiles. The influence of temperature on the toxicity of arsenic, cadmium, lead, selenium and antimony on terrestrial snakes is unknown.

Sensitive Life Stage – It is assumed that the most sensitive life stage for the timber/canebrake rattlesnake is the juvenile stage; however, the exposure model is based on an adult (0.9 kg body weight). Juvenile timber/canebrake rattlesnakes most likely have a diet different than adult rattlesnakes and may not have the same type of trophic exposure as adults. Juveniles are opportunistic feeders and would consume earthworms, small lizards, baby mice and the model may or may not be adequately representative of juvenile exposure. According to the New Jersey Endangered and Threatened Species Field Guide (2013), baby rattlesnakes eat young shrews and moles.

Population Impacts – The exposure of the timber/canebrake rattlesnake to COCs in soil and prey may or may not impact the population of rattlesnakes, if present at the Site. Every state inhabited by timber/canebrake rattlesnakes has laws protecting the species (TPWD, 2013). Timber/canebrake rattlesnakes reproduce at a low rate, making for slow population growth. Factors such as development, illegal collecting and the continual disturbance of forests by recreational users will prevent or hinder population recovery for many years (NYDEC, 2013). New Jersey (2013) states that "the primary threats

to timber rattlesnakes come from human-related factors. These include malicious killing, illegal collecting, human incursions into rattlesnake range, and behavioral disturbances by people."

E5.0 Conclusion

The evaluation of ecological risk to reptiles, as represented by a terrestrial snake (timber/canebrake rattlesnake) is highly uncertain. The exposure parameters such as food ingestion rate, incidental soil ingestion and body weight are developed using a variety of species. The food ingestion rate is based on insectivorous lizards, the soil ingestion rate is based on turtles and the body weight for the adult rattlesnake varies from 0.5 kg to 4.5 kg. Additionally, the use of a mammalian and avian intake model may not be applicable to the ecothermic reptiles. According to Linder at al. (2010): "it is not a 'fits-all-sizes' world when dietary routes of exposure are considered for the herpetofauna, particularly within the context of exposure to chemical stressors in the field. For example, 'sit and wait foragers' (e.g., common to some snakes) rely on ingesting a single, frequently large meal followed by extended nonforaging, resting state."

The reptile based toxicity data for the COCs is limited with the majority of data focused on biological accumulation with no clear demarcation of no or lowest effect levels or even dose response relationships. The toxicity endpoints of growth and survival traditionally used for mammals and birds may not be the most appropriate endpoints for the rattlesnake; however, endpoints such as lizard sprint speed and turtle righting time are also not applicable to the snake. According to Grillitsch and Schiesari (2010): "the mechanistic understanding of the toxicokinetics of metals in reptiles remains poorly developed and must be addressed in future research to characterize shortcomings for taxa and compounds, and to link toxicodynamics and toxicokinetics (i.e., fate and effect of metals in reptiles)."

Because neither the exposure model nor the toxicity data are considered acceptable, the use of the snake in a terrestrial ecological risk assessment for arsenic, cadmium, lead and selenium is too uncertain to be considered value added information for decision making purposes at the Site. Therefore, the evaluation of reptiles in the ecological risk assessment is discussed herein in the uncertainty section of the document and calculation of hazard quotients or protective concentration levels based on the snake model could not be determined or incorporated into the larger affected property assessment.

E6.0 References

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APPENDIX F

ECOLOGICAL RISK ASSESSMENT CALCULATIONS

Calculation Input Parameters for Wildlife Receptors
Former Operating Plant - Terrestrial

Screening Level Ecological Risk Assessment
Former Operating Plant
All Terrestrial Exposure Areas
Frisco, Texas
May 2014

Table F-1
Exposure Point Concentrations

Data: 95% UCL COCs	South Wooded Area Soil (0-6 inches bgs) (mg/kg)	North Wooded Area Soil (0-6 inches bgs) (mg/kg)	Lake Parcel Soil (0-6 inches bgs) (mg/kg)	Stewart Creek Corridor Soil (0-6 inches bgs) (mg/kg)	Site-Wide Expsoure Area Soil (0-6 inches bgs) (mg/kg)
Antimony	5.79	11.55	NA	32.40	18.50
Arsenic	16.30	23.40	Screened Out	24.90	20.50
Cadmium	6.32	11.26	2.46	11.10	9.60
Lead	1000	1400	211.1	1790.0	1210.0
Selenium	0.56	4.89	NA	1.4	7.6

Data: 95% UCL COCs	South Wooded Area Soil (6 inches - 5 ft bgs) (mg/kg)	North Wooded Area Soil (6 inches - 5 ft bgs) (mg/kg)	Lake Parcel Soil (6 inches - 5 ft bgs) (mg/kg)	Stewart Creek Corridor Soil (6 inches - 5 ft bgs) (mg/kg)	Site-Wide Exposure Area Soil (6 inches - 5 ft bgs) (mg/kg)
Antimony	NA	NA	NA	4.65	6.99
Arsenic	9.87	14.0	NA	115.0	51.3
Cadmium	0.56	3.66	0.28	114.0	71.7
Lead	80.4	356	18.4	8760.0	4750.0
Selenium	0.41	0.546	NA	8.63	10.50

Notes:
NA - Not Applicable
bgs - below ground surface
Lower of 95 % UCL or maximum detected concentration used as EPC.
The Site-Wide Exposure Area is a combination of all of the data from the ecological expsoure area for evaluation of wide ranging receptors.

Screening Level Ecological Risk Assessment
Former Operating Plant
Frisco, Texas
May 2014

Table F-2
Fraction of Components in Receptor Diet

Common Name	Small Mammals	Small Birds	Arthropods	Plants, Seeds, Vegetation	Earthworms
Birds					
American Robin			0.46	0.08	0.46
Red-Tailed Hawk	0.785	0.215			
Mammals					
Armadillo				0.1	0.9
Red Fox	1				
Least Shrew			0.90	0.10	
Reptiles					
Timber/canebrake rattlesnake	1				

Notes:

1. Dietary Fractions from EPA, 1993 for robin, hawk, fox and shrew.
2. EPA, 1993. Wildlife Exposure Factors Handbook. Office of Research and Development. EPA/600/R-93/187. December.
3. Dietary Fractions for armadillo from Layne, 2003.
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5. Dietary fraction for rattlesnake from http://www.herpsoftexas.org/content/timber-rattlesnake.

Screening Level Ecological Risk Assessment
Former Operating Plant
Frisco, Texas
May 2014

Table F-3
NOAEL and LOAEL Toxicity Data

COC	Avian NOAEL TRV (mg/kg-day)	Avian LOAEL TRV (mg/kg-day)	Mammalian NOAEL TRV (mg/kg-day)	Mammalian LOAEL TRV (mg/kg-day)
Antimony	NA	NA	0.059	0.590
Arsenic	2.24	4.5	2.8	6.9
Cadmium	1.47	6.35	0.770	7.7
Lead	1.63	3.26	4.7	8.9
Selenium	0.29	0.579	0.143	0.215
High MW PAHs	2	20	0.62	3.07
Low MW PAHs	210	228	66	328

Notes:

1. Arsenic NOAELs and LOAELs for birds and mammals from EPA 2005b. Ecological Soil Screening Levels for Arsenic.
2. Cadmium NOAELs and LOAELs or birds and mammals from EPA 2005c. Ecological Soil Screening Levels for Cadmium.
3. Lead NOAELs and LOAELs for birds and mammals from EPA 2005d. Ecological Soil Screening Levels for Lead.
4. Antimony NOAELs and LOAELs for birds and mammals from EPA 2005a. Ecological Soil Screening Levels for Antimony.
5. Selenium NOAELs and LOAELs for birds and mammals from EPA 2007a. Ecological Soil Screening Levels for Selenium.
6. PAHs NOAELs and LOAELs from EPA 2007b. Ecological Soil Screening Levels for PAHs.

Screening Level Ecological Risk Assessment
Former Operating Plant
Frisco, Texas
May 2014

Table F-4
Uptake Factors for Terrestrial Assessment

Analyte	Soil to Plant UF	Soil to Earthworm or Arthropod UF	Plant to Wildlife UF	Soil to Wildlife UF	Plant to Bird UF	Soil to Bird UF
Antimony	0.2	0.22	6.20E-04	1.36E-05	NS	NS
Arsenic	0.036	0.11	1.20E-03	2.70E-05	NS	NS
Cadmium	0.364	0.96	7.44E-05	1.64E-06	4.71E-02	1.51E-03
Lead	0.045	0.03	1.86E-04	4.09E-06	NS	NS
Selenium	0.016	0.22	1.41E-03	3.10E-05	5.02E-01	1.35E-02

Notes:

1. EPA. August 1999. Screening Level Ecological Risk Assessment Protocol for Hazardous Waste Combustion Facilities. Office of Solid Waste and Emergency Response. EPA530-D-99-001.
2. NS - EPA, 1999 indicates insufficient data to determine value.

2014 EXIDE APAR PAGE 1028 OF 3116

South Wooded Area
Terrestrial HQ Calculations

Screening Level Ecological Risk Assessment
Former Operating Plant
South Wooded Area
Frisco, Texas
May 2014

Table F-5
Ingestion-Pathway Exposure Assumptions for Terrestrial Wildlife Measurement Receptors

Common Name	Body Weight (kg)	Food Ingestion Rate (kg/day)	Soil Ingestion (% of diet)	Soil Ingestion Rate (kg/day)	Exposure Modifying Factor (EMF)	Site Area (Acres)	Home Range (Acres)
Birds							
Red Tailed Hawk	9.57E-01	4.5E-04	2	8.97E-06	0.005	4.83	1037
American Robin	6.30E-02	4.9E-05	5.2	2.52E-06	1	4.83	1.12
Mammals							
Armadillo	4.00E+00	2.10E-01	17	3.57E-02	0.48	4.83	10
Red Fox	4.13E+00	1.08E-01	2.7	3.00E-03	0.003	4.83	1845
Least Shrew	4.00E-03	3.38E-06	8	2.71E-07	1	4.83	1
Reptiles							
Timber/Canebrake Rattlesnake	9.00E-01	2.50E-03	5.2	1.30E-04	0.044	4.83	110

Notes:

1. Factors from EPA, 1993 unless noted otherwise.
2. EPA, 1993. Wildlife Exposure Factors Handbook. Office of Research and Development. EPA/600/R-93/187. December
3. Least Shrew and Armadillo Body Weight from: Davis and Schmidley, 2009. The Mammals of Texas, online edition. www.nrsl.ttu.edu/tmot1/ .
4. Fox and Armadillo Soil ingestion rate from: Beyer, W.N. E.Cnner, and S. Gerould 1994. Estimates of Soil Ingestion by Wildlife. J. Wildl. Manage. 58:375-382.
5. EMF of 1 used for all initial conservative calculations. If a value less than 1 was used, it is noted in the text.
6. EMF for red-tailed hawk and red fox for less-conservative assessment based on ratio of site area to home range.
7. Home range for red-tailed hawk and red fox from EPA 1993. Geometric mean of all values listed.
8. Home range for armadillo from Davis and Schmidley, 2009.
9. Body weight from http://www.tpwd.state.tx.us/huntwild/wild/species/timberrattlesnake/
10. Food ingestion rate for snake taken from EPA 1993. Equation for insectivore iguanids.
11. Soil ingestion for snake from Beyer, 1994. Average soil ingestion by box turtle and eastern painted turtle.
12. Snake home range from Adams, J.P., 2005. Home Range and Behavior of the Timber Rattlesnake. Thesis - Marshall University. October.

Screening Level Ecological Risk Assessment
Former Operating Plant
South Wooded Area
Frisco, Texas
May 2014

Table F-6
Hazard Quotient Calculations for the American Robin - Initial Conservative Exposure Parameters

American Robin COC	95% UCL Soil Conc (mg/kg)	Soil to Earthworm or Arthropod UF	Earthworm/ Arthropod Conc (mg/kg)	Soil to Plant UF	Plant Conc (mg/kg)	Total Daily Dose Rate (mg/kg BW-day)	NOAEL Toxicity Reference Value (mg/kg BW-day)	Based on Conservative Exposure Parameters NOAEL Hazard Quotient (unitless)
Antimony	5.8E+00	2.2E-01	1.3E+00	2.0E-01	1.2E+00	1.2E-03	NA	NA
Arsenic	1.6E+01	1.1E-01	1.8E+00	3.6E-02	5.9E-01	2.0E-03	2.24E+00	8.8E-04
Cadmium	6.3E+00	9.6E-01	6.1E+00	3.6E-01	2.3E+00	4.7E-03	1.47E+00	3.2E-03
Lead	1.0E+03	3.0E-02	3.0E+01	4.5E-02	4.5E+01	6.4E-02	1.63E+00	3.9E-02
Selenium	5.6E-01	2.2E-01	1.2E-01	1.6E-02	9.0E-03	1.1E-04	2.90E-01	3.8E-04

$$\text{Dose} = [(\text{Conc}_{\text{Earthworm/Arthropod}}\text{s} \times \text{IR}_{\text{food}})0.92 + (\text{IR}_{\text{food}} \times \text{Conc}_{\text{Plants}})0.08 + (\text{IR}_{\text{soil}} \times \text{Conc}_{\text{Soil}})] / \text{Body Weight}_{\text{robin}}$$

Toxicity data not available for antimony.

2014 EXIDE APAR PAGE 1031 OF 3116

Screening Level Ecological Risk Assessment
Former Operating Plant
South Wooded Area
Frisco, Texas
May 2014

Table F-7
Hazard Quotient Calculations for the Red-Tailed Hawk - Initial Conservative Exposure Parameters

Red-Tailed Hawk COC	95% UCL Soil Conc (mg/kg)	Soil to Wildlife Mammal UF - Least Shrew	Plant to Wildlife Mammal UF - Least Shrew	FCM - Arthropod	FCM - Least Shrew	Small Mammal Conc (mg/kg)	Soil to Wildlife Bird UF - American Robin	Plant to Wildlife Bird UF - American Robin	FCM - American Robin	Small Bird Conc (mg/kg)	Total Daily Dose Rate (mg/kg BW-day)	NOAEL Toxicity Reference Value (mg/kg BW-day)	Based on Conservative Exposure Parameters NOAEL Hazard Quotient (unitless)
Antimony	5.8E+00	1.4E-05	6.2E-04	1.0E+00	1.0E+00	1.1E+00	NS	NS	1.0E+00	1.2E+00	6.0E-04	NA	NA
Arsenic	1.6E+01	2.7E-05	1.2E-03	1.0E+00	1.0E+00	1.6E+00	NS	NS	1.0E+00	1.6E+00	9.2E-04	2.24E+00	4.1E-04
Cadmium	6.3E+00	1.6E-06	7.4E-05	1.0E+00	1.0E+00	5.5E+00	1.5E-03	4.7E-02	1.0E+00	5.6E+00	2.6E-03	1.47E+00	1.8E-03
Lead	1.0E+03	4.1E-06	1.9E-04	1.0E+00	1.0E+00	2.7E+01	NS	NS	1.0E+00	2.8E+01	2.2E-02	1.63E+00	1.4E-02
Selenium	5.6E-01	3.1E-05	1.4E-03	1.0E+00	1.0E+00	1.1E-01	1.4E-02	5.0E-01	1.0E+00	1.1E-01	5.8E-05	2.90E-01	2.0E-04

$Dose = (Conc_{Small\ Mammals} \times IR_{food})0.785 + (IR_{food} \times Conc_{Birds})0.215 + (IR_{soil} \times Conc_{Soil})/Body\ Weight_{hawk}$

$Conc_{small\ mammal} = Conc_{least\ shrew}$ (mg/kg BW) = $[(Conc_{soil} \times UF_{soil\text{-}small\ mammal}) + (Conc_{plant} \times UF_{plant\text{-}small\ mammal} \times DF_{plant}) + (Conc_{arthropod} \times [FCM_{small\ mammal}/FCM_{arthropod}] \times DF_{arthropod})]$

$Conc_{small\ bird} = Conc_{robin}$ (mg/kg BW) = $[(Conc_{soil} \times UF_{soil\text{-}small\ bird}) + (Conc_{plant} \times UF_{plant\text{-}small\ bird} \times DF_{plant}) + (Conc_{arthropod} \times [FCM_{small\ bird}/FCM_{arthropod}] \times DF_{arthropod})]$

where DF = dietary fraction of food item, FCM=Food Chain Multiplier. Equation adapted from Equation 5-12 in EPA, 1999

NS - EPA, 1999 indicates insufficient data to determine value.

Toxicity data not available for antimony.

2014 EXIDE APAR PAGE 1032 OF 3116

Screening Level Ecological Risk Assessment
Former Operating Plant
South Wooded Area
Frisco, Texas
May 2014

Table F-8
Hazard Quotient Calculations for the Red Fox - Initial Conservative Exposure Parameters

Red Fox COC	95% UCL Soil Conc (mg/kg)	Soil to Wildlife Mammal UF - Least Shrew	Plant to Wildlife Mammal UF - Least Shrew	FCM - Arthropod	FCM - Least Shrew	Small Mammal Conc (mg/kg)	Total Daily Dose Rate (mg/kg BW-day)	NOAEL Toxicity Reference Value (mg/kg BW-day)	Based on Conservative Exposure Parameters NOAEL Hazard Quotient (unitless)
Antimony	5.8E+00	1.4E-05	6.2E-04	1.0E+00	1.0E+00	1.1E+00	3.4E-02	5.9E-02	5.8E-01
Arsenic	1.6E+01	2.7E-05	1.2E-03	1.0E+00	1.0E+00	1.6E+00	5.4E-02	2.8E+00	1.9E-02
Cadmium	6.3E+00	1.6E-06	7.4E-05	1.0E+00	1.0E+00	5.5E+00	1.5E-01	7.7E-01	1.9E-01
Lead	1.0E+03	4.1E-06	1.9E-04	1.0E+00	1.0E+00	2.7E+01	1.4E+00	4.7E+00	3.0E-01
Selenium	5.6E-01	3.1E-05	1.4E-03	1.0E+00	1.0E+00	1.1E-01	3.3E-03	1.4E-01	2.3E-02

$Dose = (Conc_{Small\ Mammals} \times IR_{food})1 + (IR_{soil} \times Conc_{Soil})/Body\ Weight_{fox}$

$Conc_{small\ mammal} = Conc_{least\ shrew}$ (mg/kg BW) $= [(Conc_{soil} \times UF_{soil\text{-}small\ mammal}) + (Conc_{plant} \times UF_{plant\text{-}small\ mammal} \times DF_{plant}) + (Conc_{arthropod} \times [FCM_{small\ mammal}/FCM_{arthropod}] \times DF_{arthropod})]$

where DF = dietary fraction of food item, FCM = Food Chain Multiplier. Equation adapted from Equation 5-12 in EPA, 1999

2014 EXIDE APAR PAGE 1033 OF 3116

Screening Level Ecological Risk Assessment
Former Operating Plant
South Wooded Area
Frisco, Texas
May 2014

Table F-9
Hazard Quotient Calculations for the Least Shrew - Initial Conservative Exposure Parameters

Least Shrew COC	95% UCL Soil Conc (mg/kg)	Soil to Earthworm or Arthropod UF	Earthworm/ Arthropod Conc (mg/kg)	Soil to Plant UF	Plant Conc (mg/kg)	Total Daily Dose Rate (mg/kg BW-day)	NOAEL Toxicity Reference Value (mg/kg BW-day)	Based on Conservative Exposure Parameters NOAEL Hazard Quotient (unitless)
Antimony	5.8E+00	2.2E-01	1.3E+00	2.0E-01	1.2E+00	1.5E-03	5.9E-02	2.5E-02
Arsenic	1.6E+01	1.1E-01	1.8E+00	3.6E-02	5.9E-01	2.5E-03	2.8E+00	9.0E-04
Cadmium	6.3E+00	9.6E-01	6.1E+00	3.6E-01	2.3E+00	5.2E-03	7.7E-01	6.8E-03
Lead	1.0E+03	3.0E-02	3.0E+01	4.5E-02	4.5E+01	9.4E-02	4.7E+00	2.0E-02
Selenium	5.6E-01	2.2E-01	1.2E-01	1.6E-02	9.0E-03	1.3E-04	1.4E-01	9.3E-04

$$\text{Dose} = (\text{Conc}_{\text{Earthworm/Arthropod}} \times \text{IR}_{\text{food}})0.9 + (\text{IR}_{\text{food}} \times \text{Conc}_{\text{Plants}})0.1 + (\text{IR}_{\text{soil}} \times \text{Conc}_{\text{Soil}})/\text{Body Weight}_{\text{shrew}}$$

2014 EXIDE APAR PAGE 1034 OF 3116

Screening Level Ecological Risk Assessment
Former Operating Plant
South Wooded Area
Frisco, Texas
May 2014

Table F-10
Hazard Quotient Calculations for the Armadillo - Initial Conservative Exposure Parameters

Armadillo COC	Surface 95% UCL Soil Conc (mg/kg)	Subsurface 95% UCL Soil Conc (mg/kg)	Soil to Earthworm or Arthropod UF	Earthworm/ Arthropod Conc (mg/kg)	Soil to Plant UF	Plant Conc (mg/kg)	Total Daily Dose Rate (mg/kg BW-day)	NOAEL Toxicity Reference Value (mg/kg BW-day)	Based on Conservative Exposure Parameters NOAEL Hazard Quotient (unitless)
Antimony	5.8E+00	NA	2.2E-01	1.3E+00	2.0E-01	1.2E+00	1.2E-01	5.9E-02	**2.0E+00**
Arsenic	1.6E+01	9.9E+00	1.1E-01	1.8E+00	3.6E-02	5.9E-01	1.8E-01	2.8E+00	6.3E-02
Cadmium	6.3E+00	5.6E-01	9.6E-01	6.1E+00	3.6E-01	2.3E+00	3.1E-01	7.7E-01	4.0E-01
Lead	1.0E+03	8.0E+01	3.0E-02	3.0E+01	4.5E-02	4.5E+01	2.4E+00	4.7E+00	5.0E-01
Selenium	5.6E-01	4.1E-01	2.2E-01	1.2E-01	1.6E-02	9.0E-03	9.6E-03	1.4E-01	6.7E-02

$$\text{Dose} = [(\text{Conc}_{\text{Earthworm/Arthropod}} \times \text{IR}_{\text{food}})0.9 + (\text{IR}_{\text{food}} \times \text{Conc}_{\text{Plants}})0.1 + (\text{IR}_{\text{soil}} \times \text{Subsurface Conc}_{\text{Soil}})] / \text{Body Weight}_{\text{armadillo}}$$

The surface soil concentration for antimony was used for subsurface expsoure.

2014 EXIDE APAR PAGE 1035 OF 3116

Screening Level Ecological Risk Assessment
Former Operating Plant
South Wooded Area
Frisco, Texas
May 2014

Table F-11
Hazard Quotient Calculations for the Armadillo - Refined Less-Conservative Exposure Parameters

Armadillo COC	Surface 95% UCL Soil Conc (mg/kg)	Subsurface 95% UCL Soil Conc (mg/kg)	Soil to Earthworm or Arthropod UF	Earthworm/ Arthropod Conc (mg/kg)	Soil to Plant UF	Plant Conc (mg/kg)	Total Daily Dose Rate (mg/kg BW-day)	NOAEL Toxicity Reference Value (mg/kg BW-day)	LOAEL Toxicity Reference Value (mg/kg BW-day)	NOAEL Hazard Quotient (unitless)	LOAEL Hazard Quotient (unitless)
Antimony	5.8E+00	NA	2.2E-01	1.3E+00	2.0E-01	1.2E+00	1.2E-01	5.9E-02	5.9E-01	**2.0E+00**	2.0E-01
Arsenic	1.6E+01	9.9E+00	1.1E-01	1.8E+00	3.6E-02	5.9E-01	1.8E-01	2.8E+00	6.9E+00	6.3E-02	2.6E-02
Cadmium	6.3E+00	5.6E-01	9.6E-01	6.1E+00	3.6E-01	2.3E+00	3.1E-01	7.7E-01	7.7E+00	4.0E-01	4.0E-02
Lead	1.0E+03	8.0E+01	3.0E-02	3.0E+01	4.5E-02	4.5E+01	2.4E+00	4.7E+00	8.9E+00	5.0E-01	2.6E-01
Selenium	5.6E-01	4.1E-01	2.2E-01	1.2E-01	1.6E-02	9.0E-03	9.6E-03	1.4E-01	2.2E-01	6.7E-02	4.5E-02

$$\text{Dose} = [(\text{Conc}_{\text{Earthworm/Arthropod}} \times \text{IR}_{\text{food}})0.9 + (\text{IR}_{\text{food}} \times \text{Conc}_{\text{Plants}})0.1 + (\text{IR}_{\text{soil}} \times \text{Subsurface Conc}_{\text{Soil}})] / \text{Body Weight}_{\text{armadillo}}$$

The surface soil concentration for antimony was used for subsurface expsoure.
Exposure modifying factors **not** applied to exposure.

North Wooded Area
Terrestrial HQ Calculations

Screening Level Ecological Risk Assessment
Former Operating Plant
North Wooded Area
Frisco, Texas
May 2014

Table F-12
Ingestion-Pathway Exposure Assumptions for Terrestrial Wildlife Measurement Receptors

Common Name	Body Weight (kg)	Food Ingestion Rate (kg/day)	Soil Ingestion (% of diet)	Soil Ingestion Rate (kg/day)	Exposure Modifying Factor (EMF)	Site Area (Acres)	Home Range (Acres)
Birds							
Red Tailed Hawk	9.57E-01	4.5E-04	2	8.97E-06	0.012	12.08	1037
American Robin	6.30E-02	4.9E-05	5.2	2.52E-06	1	12.08	1.12
Mammals							
Armadillo	4.00E+00	2.10E-01	17	3.57E-02	1	12.08	10
Red Fox	4.13E+00	1.08E-01	2.7	3.00E-03	0.007	12.08	1845
Least Shrew	4.00E-03	3.38E-06	8	2.71E-07	1	12.08	1
Reptiles							
Timber/Canebrake Rattlesnake	9.00E-01	2.50E-03	5.2	1.30E-04	0.110	12.08	110

Notes:

1. Factors from EPA, 1993 unless noted otherwise.
2. EPA, 1993. Wildlife Exposure Factors Handbook. Office of Research and Development. EPA/600/R-93/187. December
3. Least Shrew and Armadillo Body Weight from: Davis and Schmidley, 2009. The Mammals of Texas, online edition. www.nrsl.ttu.edu/tmot1/ .
4. Fox and Armadillo Soil ingestion rate from: Beyer, W.N. E.Cnner, and S. Gerould 1994. Estimates of Soil Ingestion by Wildlife. J. Wildl. Manage. 58:375-382.
5. EMF of 1 used for all initial conservative calculations. If a value less than 1 was used, it is noted in the text.
6. EMF for red-tailed hawk and red fox for less-conservative assessment based on ratio of site area to home range.
7. Home range for red-tailed hawk and red fox from EPA 1993. Geometric mean of all values listed.
8. Home range for armadillo from Davis and Schmidley, 2009.
9. Body weight from http://www.tpwd.state.tx.us/huntwild/wild/species/timberrattlesnake/
10. Food ingestion rate for snake taken from EPA 1993. Equation for insectivore iguanids.
11. Soil ingestion for snake from Beyer, 1994. Average soil ingestion by box turtle and eastern painted turtle.
12. Snake home range from Adams, J.P., 2005. Home Range and Behavior of the Timber Rattlesnake. Thesis - Marshall University. October.

Screening Level Ecological Risk Assessment
Former Operating Plant
North Wooded Area
Frisco, Texas
May 2014

Table F-13
Hazard Quotient Calculations for the American Robin - Initial Conservative Exposure Parameters

American Robin COC	95% UCL Soil Conc (mg/kg)	Soil to Earthworm or Arthropod UF	Earthworm/ Arthropod Conc (mg/kg)	Soil to Plant UF	Plant Conc (mg/kg)	Total Daily Dose Rate (mg/kg BW-day)	NOAEL Toxicity Reference Value (mg/kg BW-day)	Based on Conservative Exposure Parameters NOAEL Hazard Quotient (unitless)
Antimony	1.2E+01	2.2E-01	2.5E+00	2.0E-01	2.3E+00	2.4E-03	NA	NA
Arsenic	2.3E+01	1.1E-01	2.6E+00	3.6E-02	8.4E-01	2.8E-03	2.24E+00	1.3E-03
Cadmium	1.1E+01	9.6E-01	1.1E+01	3.6E-01	4.1E+00	8.5E-03	1.47E+00	5.8E-03
Lead	1.4E+03	3.0E-02	4.2E+01	4.5E-02	6.3E+01	9.0E-02	1.63E+00	5.5E-02
Selenium	4.9E+00	2.2E-01	1.1E+00	1.6E-02	7.8E-02	9.7E-04	2.90E-01	3.3E-03

$$\text{Dose} = [(\text{Conc}_{\text{Earthworm/Arthropod}}\text{s} \times \text{IR}_{\text{food}})0.92 + (\text{IR}_{\text{food}} \times \text{Conc}_{\text{Plants}})0.08 + (\text{IR}_{\text{soil}} \times \text{Conc}_{\text{Soil}})] / \text{Body Weight}_{\text{robin}}$$

Toxicity data not available for antimony.

2014 EXIDE APAR PAGE 1039 OF 3116

Screening Level Ecological Risk Assessment
Former Operating Plant
North Wooded Area
Frisco, Texas
May 2014

Table F-14
Hazard Quotient Calculations for the Red-Tailed Hawk - Initial Conservative Exposure Parameters

Red-Tailed Hawk COC	95% UCL Soil Conc (mg/kg)	Soil to Wildlife Mammal UF - Least Shrew	Plant to Wildlife Mammal UF - Least Shrew	FCM - Arthropod	FCM - Least Shrew	Small Mammal Conc (mg/kg)	Soil to Wildlife Bird UF - American Robin	Plant to Wildlife Bird UF - American Robin	FCM - American Robin	Small Bird Conc (mg/kg)	Total Daily Dose Rate (mg/kg BW-day)	NOAEL Toxicity Reference Value (mg/kg BW-day)	Based on Conservative Exposure Parameters NOAEL Hazard Quotient (unitless)
Antimony	1.2E+01	1.4E-05	6.2E-04	1.0E+00	1.0E+00	2.3E+00	NS	NS	1.0E+00	2.3E+00	1.2E-03	NA	NA
Arsenic	2.3E+01	2.7E-05	1.2E-03	1.0E+00	1.0E+00	2.3E+00	NS	NS	1.0E+00	2.4E+00	1.3E-03	2.24E+00	5.9E-04
Cadmium	1.1E+01	1.6E-06	7.4E-05	1.0E+00	1.0E+00	9.8E+00	1.5E-03	4.7E-02	1.0E+00	1.0E+01	4.7E-03	1.47E+00	3.2E-03
Lead	1.4E+03	4.1E-06	1.9E-04	1.0E+00	1.0E+00	3.8E+01	NS	NS	1.0E+00	3.9E+01	3.1E-02	1.63E+00	1.9E-02
Selenium	4.9E+00	3.1E-05	1.4E-03	1.0E+00	1.0E+00	9.7E-01	1.4E-02	5.0E-01	1.0E+00	9.9E-01	5.0E-04	2.90E-01	1.7E-03

$Dose = (Conc_{Small\ Mammals} \times IR_{food})0.785 + (IR_{food} \times Conc_{Birds})0.215 + (IR_{soil} \times Conc_{Soil})/Body\ Weight_{hawk}$

$Conc_{small\ mammal} = Conc_{least\ shrew}$ (mg/kg BW) = $[(Conc_{soil} \times UF_{soil\text{-}small\ mammal}) + (Conc_{plant} \times UF_{plant\text{-}small\ mammal} \times DF_{plant}) + (Conc_{arthropod} \times [FCM_{small\ mammal}/FCM_{arthropod}] \times DF_{arthropod})]$

$Conc_{small\ bird} = Conc_{robin}$ (mg/kg BW) = $[(Conc_{soil} \times UF_{soil\text{-}small\ bird}) + (Conc_{plant} \times UF_{plant\text{-}small\ bird} \times DF_{plant}) + (Conc_{arthropod} \times [FCM_{small\ bird}/FCM_{arthropod}] \times DF_{arthropod})]$

where DF = dietary fraction of food item, FCM=Food Chain Multiplier. Equation adapted from Equation 5-12 in EPA, 1999

NS - EPA, 1999 indicates insufficient data to determine value.

Toxicity data not available for antimony.

2014 EXIDE APAR PAGE 1040 OF 3116

Screening Level Ecological Risk Assessment
Former Operating Plant
North Wooded Area
Frisco, Texas
May 2014

Table F-15
Hazard Quotient Calculations for the Red Fox - Initial Conservative Exposure Parameters

Red Fox COC	95% UCL Soil Conc (mg/kg)	Soil to Wildlife Mammal UF - Least Shrew	Plant to Wildlife Mammal UF - Least Shrew	FCM - Arthropod	FCM - Least Shrew	Small Mammal Conc (mg/kg)	Total Daily Dose Rate (mg/kg BW-day)	NOAEL Toxicity Reference Value (mg/kg BW-day)	Based on Conservative Exposure Parameters NOAEL Hazard Quotient (unitless)
Antimony	1.2E+01	1.4E-05	6.2E-04	1.0E+00	1.0E+00	2.3E+00	6.8E-02	5.9E-02	**1.2E+00**
Arsenic	2.3E+01	2.7E-05	1.2E-03	1.0E+00	1.0E+00	2.3E+00	7.8E-02	2.8E+00	2.8E-02
Cadmium	1.1E+01	1.6E-06	7.4E-05	1.0E+00	1.0E+00	9.8E+00	2.6E-01	7.7E-01	3.4E-01
Lead	1.4E+03	4.1E-06	1.9E-04	1.0E+00	1.0E+00	3.8E+01	2.0E+00	4.7E+00	4.3E-01
Selenium	4.9E+00	3.1E-05	1.4E-03	1.0E+00	1.0E+00	9.7E-01	2.9E-02	1.4E-01	2.0E-01

$Dose = (Conc_{Small\ Mammals} \times IR_{food})1 + (IR_{soil} \times Conc_{Soil})/Body\ Weight_{fox}$

$Conc_{small\ mammal} = Conc_{least\ shrew}$ (mg/kg BW) = $[(Conc_{soil} \times UF_{soil\text{-}small\ mammal}) + (Conc_{plant} \times UF_{plant\text{-}small\ mammal} \times DF_{plant}) + (Conc_{arthropod} \times [FCM_{small\ mammal}/FCM_{arthropod}] \times DF_{arthropod})]$

where DF = dietary fraction of food item, FCM = Food Chain Multiplier. Equation adapted from Equation 5-12 in EPA, 1999

2014 EXIDE APAR PAGE 1041 OF 3116

Screening Level Ecological Risk Assessment
Former Operating Plant
North Wooded Area
Frisco, Texas
May 2014

Table F-16
Hazard Quotient Calculations for the Red Fox - Refined Less-Conservative Exposure Parameters

Red Fox COC	95% UCL Soil Conc (mg/kg)	Soil to Wildlife Mammal UF - Least Shrew	Plant to Wildlife Mammal UF - Least Shrew	FCM - Arthropod	FCM - Least Shrew	Small Mammal Conc (mg/kg)	Total Daily Dose Rate (mg/kg BW-day)	NOAEL Toxicity Reference Value (mg/kg BW-day)	LOAEL Toxicity Reference Value (mg/kg BW-day)	NOAEL Hazard Quotient (unitless)	LOAEL Hazard Quotient (unitless)
Antimony	1.2E+01	1.4E-05	6.2E-04	1.0E+00	1.0E+00	2.3E+00	6.8E-02	5.9E-02	5.9E-01	**1.2E+00**	1.2E-01

$Dose = EMF*(Conc_{Small\ Mammals} \times IR_{food})1 + (IR_{soil} \times Conc_{Soil})/Body\ Weight_{fox}$

$Conc_{small\ mammal} = Conc_{least\ shrew}\ (mg/kg\ BW) = [(Conc_{soil} \times UF_{soil\text{-}small\ mammal}) + (Conc_{plant} \times UF_{plant\text{-}small\ mammal} \times DF_{plant}) + (Conc_{arthropod} \times [FCM_{small\ mammal}/FCM_{arthropod}] \times DF_{arthropod})]$

where DF = dietary fraction of food item, FCM = Food Chain Multiplier. Equation adapted from Equation 5-12 in EPA, 1999

Screening Level Ecological Risk Assessment
Former Operating Plant
North Wooded Area
Frisco, Texas
May 2014

Table F-17
Hazard Quotient Calculations for the Least Shrew - Initial Conservative Exposure Parameters

Least Shrew COC	95% UCL Soil Conc (mg/kg)	Soil to Earthworm or Arthropod UF	Earthworm/ Arthropod Conc (mg/kg)	Soil to Plant UF	Plant Conc (mg/kg)	Total Daily Dose Rate (mg/kg BW-day)	NOAEL Toxicity Reference Value (mg/kg BW-day)	Based on Conservative Exposure Parameters NOAEL Hazard Quotient (unitless)
Antimony	1.2E+01	2.2E-01	2.5E+00	2.0E-01	2.3E+00	2.9E-03	5.9E-02	4.9E-02
Arsenic	2.3E+01	1.1E-01	2.6E+00	3.6E-02	8.4E-01	3.6E-03	2.8E+00	1.3E-03
Cadmium	1.1E+01	9.6E-01	1.1E+01	3.6E-01	4.1E+00	9.4E-03	7.7E-01	1.2E-02
Lead	1.4E+03	3.0E-02	4.2E+01	4.5E-02	6.3E+01	1.3E-01	4.7E+00	2.8E-02
Selenium	4.9E+00	2.2E-01	1.1E+00	1.6E-02	7.8E-02	1.2E-03	1.4E-01	8.1E-03

$$\text{Dose} = (\text{Conc}_{\text{Earthworm/Arthropod}} \times \text{IR}_{\text{food}})0.9 + (\text{IR}_{\text{food}} \times \text{Conc}_{\text{Plants}})0.1 + (\text{IR}_{\text{soil}} \times \text{Conc}_{\text{Soil}})/\text{Body Weight}_{\text{shrew}}$$

2014 EXIDE APAR PAGE 1043 OF 3116

Screening Level Ecological Risk Assessment
Former Operating Plant
North Wooded Area
Frisco, Texas
May 2014

Table F-18
Hazard Quotient Calculations for the Armadillo - Initial Conservative Exposure Parameters

Armadillo COC	Surface 95% UCL Soil Conc (mg/kg)	Subsurface 95% UCL Soil Conc (mg/kg)	Soil to Earthworm or Arthropod UF	Earthworm/ Arthropod Conc (mg/kg)	Soil to Plant UF	Plant Conc (mg/kg)	Total Daily Dose Rate (mg/kg BW-day)	NOAEL Toxicity Reference Value (mg/kg BW-day)	Based on Conservative Exposure Parameters NOAEL Hazard Quotient (unitless)
Antimony	1.2E+01	NA	2.2E-01	2.5E+00	2.0E-01	2.3E+00	2.4E-01	5.9E-02	**4.0E+00**
Arsenic	2.3E+01	1.4E+01	1.1E-01	2.6E+00	3.6E-02	8.4E-01	2.5E-01	2.8E+00	9.0E-02
Cadmium	1.1E+01	3.7E+00	9.6E-01	1.1E+01	3.6E-01	4.1E+00	5.7E-01	7.7E-01	7.5E-01
Lead	1.4E+03	3.6E+02	3.0E-02	4.2E+01	4.5E-02	6.3E+01	5.5E+00	4.7E+00	**1.2E+00**
Selenium	4.9E+00	5.5E-01	2.2E-01	1.1E+00	1.6E-02	7.8E-02	5.7E-02	1.4E-01	4.0E-01

$$\text{Dose} = [(\text{Conc}_{\text{Earthworm/Arthropod}} \times \text{IR}_{\text{food}})0.9 + (\text{IR}_{\text{food}} \times \text{Conc}_{\text{Plants}})0.1 + (\text{IR}_{\text{soil}} \times \text{Subsurface Conc}_{\text{Soil}})] / \text{Body Weight}_{\text{armadillo}}$$

The surface soil concentration for antimony was used for subsurface expsoure.

2014 EXIDE APAR PAGE 1044 OF 3116

Screening Level Ecological Risk Assessment
Former Operating Plant
North Wooded Area
Frisco, Texas
May 2014

Table F-19
Hazard Quotient Calculations for the Armadillo - Refined Less-Conservative Exposure Parameters

Armadillo COC	Surface 95% UCL Soil Conc (mg/kg)	Subsurface 95% UCL Soil Conc (mg/kg)	Soil to Earthworm or Arthropod UF	Earthworm/ Arthropod Conc (mg/kg)	Soil to Plant UF	Plant Conc (mg/kg)	Total Daily Dose Rate (mg/kg BW-day)	NOAEL Toxicity Reference Value (mg/kg BW-day)	LOAEL Toxicity Reference Value (mg/kg BW-day)	NOAEL Hazard Quotient (unitless)	LOAEL Hazard Quotient (unitless)
Antimony	1.2E+01	NA	2.2E-01	2.5E+00	2.0E-01	2.3E+00	2.4E-01	5.9E-02	5.9E-01	**4.0E+00**	4.0E-01
Lead	1.4E+03	3.6E+02	3.0E-02	4.2E+01	4.5E-02	6.3E+01	5.5E+00	4.7E+00	8.9E+00	**1.2E+00**	6.1E-01

$$\text{Dose} = [(\text{Conc}_{\text{Earthworm/Arthropod}} \times \text{IR}_{\text{food}})0.9 + (\text{IR}_{\text{food}} \times \text{Conc}_{\text{Plants}})0.1 + (\text{IR}_{\text{soil}} \times \text{Subsurface Conc}_{\text{Soil}})] / \text{Body Weight}_{\text{armadillo}}$$

The surface soil concentration for antimony was used for subsurface expsoure.

2014 EXIDE APAR PAGE 1045 OF 3116

Lake Parcel Area
Terrestrial HQ Calculations

Screening Level Ecological Risk Assessment
Former Operating Plant
Lake Parcel Area
Frisco, Texas
May 2014

Table F-20
Ingestion-Pathway Exposure Assumptions for Terrestrial Wildlife Measurement Receptors

Common Name	Body Weight (kg)	Food Ingestion Rate (kg/day)	Soil Ingestion (% of diet)	Soil Ingestion Rate (kg/day)	Exposure Modifying Factor (EMF)	Site Area (Acres)	Home Range (Acres)
Birds							
Red Tailed Hawk	9.57E-01	4.5E-04	2	8.97E-06	0.007	6.76	1037
American Robin	6.30E-02	4.9E-05	5.2	2.52E-06	1	6.76	1.12
Mammals							
Armadillo	4.00E+00	2.10E-01	17	3.57E-02	1	6.76	10
Red Fox	4.13E+00	1.08E-01	2.7	3.00E-03	0.004	6.76	1845
Least Shrew	4.00E-03	3.38E-06	8	2.71E-07	1	6.76	1
Reptiles							
Timber/Canebrake Rattlesnake	9.00E-01	2.50E-03	5.2	1.30E-04	0.061	6.76	110

Notes:

1. Factors from EPA, 1993 unless noted otherwise.
2. EPA, 1993. Wildlife Exposure Factors Handbook. Office of Research and Development. EPA/600/R-93/187. December
3. Least Shrew and Armadillo Body Weight from: Davis and Schmidley, 2009. The Mammals of Texas, online edition. www.nrsl.ttu.edu/tmot1/ .
4. Fox and Armadillo Soil ingestion rate from: Beyer, W.N. E.Cnner, and S. Gerould 1994. Estimates of Soil Ingestion by Wildlife. J. Wildl. Manage. 58:375-382.
5. EMF of 1 used for all initial conservative calculations. If a value less than 1 was used, it is noted in the text.
6. EMF for red-tailed hawk and red fox for less-conservative assessment based on ratio of site area to home range.
7. Home range for red-tailed hawk and red fox from EPA 1993. Geometric mean of all values listed.
8. Home range for armadillo from Davis and Schmidley, 2009.
9. Body weight from http://www.tpwd.state.tx.us/huntwild/wild/species/timberrattlesnake/
10. Food ingestion rate for snake taken from EPA 1993. Equation for insectivore iguanids.
11. Soil ingestion for snake from Beyer, 1994. Average soil ingestion by box turtle and eastern painted turtle.
12. Snake home range from Adams, J.P., 2005. Home Range and Behavior of the Timber Rattlesnake. Thesis - Marshall University. October.

Screening Level Ecological Risk Assessment
Former Operating Plant
Lake Parcel Area
Frisco, Texas
May 2014

Table F-21
Hazard Quotient Calculations for the American Robin - Initial Conservative Exposure Parameters

American Robin COC	95% UCL Soil Conc (mg/kg)	Soil to Earthworm or Arthropod UF	Earthworm/ Arthropod Conc (mg/kg)	Soil to Plant UF	Plant Conc (mg/kg)	Total Daily Dose Rate (mg/kg BW-day)	NOAEL Toxicity Reference Value (mg/kg BW-day)	Based on Conservative Exposure Parameters NOAEL Hazard Quotient (unitless)
Antimony	NA	2.2E-01	NA	2.0E-01	NA	NA	NA	NA
Arsenic	NA	NA	NA	NA	NA	NA	NA	NA
Cadmium	2.5E+00	9.6E-01	2.4E+00	3.6E-01	9.0E-01	1.8E-03	1.47E+00	1.3E-03
Lead	2.1E+02	3.0E-02	6.3E+00	4.5E-02	9.5E+00	1.4E-02	1.63E+00	8.3E-03
Selenium	NA	2.2E-01	NA	1.6E-02	NA	NA	2.90E-01	NA

$$\text{Dose} = [(\text{Conc}_{\text{Earthworm/Arthropod}}\text{s} \times \text{IR}_{\text{food}})0.92 + (\text{IR}_{\text{food}} \times \text{Conc}_{\text{Plants}})0.08 + (\text{IR}_{\text{soil}} \times \text{Conc}_{\text{Soil}})] / \text{Body Weight}_{\text{robin}}$$

Toxicity data not available for antimony.
Arsenic removed at screening step.

2014 EXIDE APAR PAGE 1048 OF 3116

Screening Level Ecological Risk Assessment
Former Operating Plant
Lake Parcel Area
Frisco, Texas
May 2014

Table F-22
Hazard Quotient Calculations for the Red-Tailed Hawk - Initial Conservative Exposure Parameters

Red-Tailed Hawk COC	95% UCL Soil Conc (mg/kg)	Soil to Wildlife Mammal UF - Least Shrew	Plant to Wildlife Mammal UF - Least Shrew	FCM - Arthropod	FCM - Least Shrew	Small Mammal Conc (mg/kg)	Soil to Wildlife Bird UF - American Robin	Plant to Wildlife Bird UF - American Robin	FCM - American Robin	Small Bird Conc (mg/kg)	Total Daily Dose Rate (mg/kg BW-day)	NOAEL Toxicity Reference Value (mg/kg BW-day)	Based on Conservative Exposure Parameters NOAEL Hazard Quotient (unitless)
Antimony	NA	1.4E-05	6.2E-04	1.0E+00	1.0E+00	NA	NS	NS	1.0E+00	NA	NA	NA	NA
Arsenic	NA	2.7E-05	1.2E-03	1.0E+00	1.0E+00	NA	NS	NS	1.0E+00	NA	NA	NA	NA
Cadmium	2.5E+00	1.6E-06	7.4E-05	1.0E+00	1.0E+00	2.1E+00	1.5E-03	4.7E-02	1.0E+00	2.2E+00	1.0E-03	1.47E+00	7.0E-04
Lead	2.1E+02	4.1E-06	1.9E-04	1.0E+00	1.0E+00	5.7E+00	NS	NS	1.0E+00	5.8E+00	4.7E-03	1.63E+00	2.9E-03
Selenium	NA	3.1E-05	1.4E-03	1.0E+00	1.0E+00	NA	1.4E-02	5.0E-01	1.0E+00	NA	NA	2.90E-01	NA

$Dose = (Conc_{Small\ Mammals} \times IR_{food})0.785 + (IR_{food} \times Conc_{Birds})0.215 + (IR_{soil} \times Conc_{Soil})/Body\ Weight_{hawk}$

$Conc_{small\ mammal} = Conc_{least\ shrew}$ (mg/kg BW) = $[(Conc_{soil} \times UF_{soil\text{-}small\ mammal}) + (Conc_{plant} \times UF_{plant\text{-}small\ mammal} \times DF_{plant}) + (Conc_{arthropod} \times [FCM_{small\ mammal}/FCM_{arthropod}] \times DF_{arthropod})]$

$Conc_{small\ bird} = Conc_{robin}$ (mg/kg BW) = $[(Conc_{soil} \times UF_{soil\text{-}small\ bird}) + (Conc_{plant} \times UF_{plant\text{-}small\ bird} \times DF_{plant}) + (Conc_{arthropod} \times [FCM_{small\ bird}/FCM_{arthropod}] \times DF_{arthropod})]$

where DF = dietary fraction of food item, FCM=Food Chain Multiplier. Equation adapted from Equation 5-12 in EPA, 1999

NS - EPA, 1999 indicates insufficient data to determine value.

Toxicity data not available for antimony.

Arsenic removed at screening step.

Screening Level Ecological Risk Assessment
Former Operating Plant
Lake Parcel Area
Frisco, Texas
May 2014

Table F-23
Hazard Quotient Calculations for the Red Fox - Initial Conservative Exposure Parameters

Red Fox COC	95% UCL Soil Conc (mg/kg)	Soil to Wildlife Mammal UF - Least Shrew	Plant to Wildlife Mammal UF - Least Shrew	FCM - Arthropod	FCM - Least Shrew	Small Mammal Conc (mg/kg)	Total Daily Dose Rate (mg/kg BW-day)	NOAEL Toxicity Reference Value (mg/kg BW-day)	Based on Conservative Exposure Parameters NOAEL Hazard Quotient (unitless)
Antimony	NA	1.4E-05	6.2E-04	1.0E+00	1.0E+00	NA	NA	5.9E-02	NA
Arsenic	NA	2.7E-05	1.2E-03	1.0E+00	1.0E+00	NA	NA	2.8E+00	NA
Cadmium	2.5E+00	1.6E-06	7.4E-05	1.0E+00	1.0E+00	2.1E+00	5.7E-02	7.7E-01	7.5E-02
Lead	2.1E+02	4.1E-06	1.9E-04	1.0E+00	1.0E+00	5.7E+00	3.0E-01	4.7E+00	6.4E-02
Selenium	NA	3.1E-05	1.4E-03	1.0E+00	1.0E+00	NA	NA	1.4E-01	NA

$Dose = (Conc_{Small\ Mammals} \times IR_{food})1 + (IR_{soil} \times Conc_{Soil})/Body\ Weight_{fox}$

$Conc_{small\ mammal} = Conc_{least\ shrew}$ (mg/kg BW) $= [(Conc_{soil} \times UF_{soil\text{-}small\ mammal}) + (Conc_{plant} \times UF_{plant\text{-}small\ mammal} \times DF_{plant}) + (Conc_{arthropod} \times [FCM_{small\ mammal}/FCM_{arthropod}] \times DF_{arthropod})]$

where DF = dietary fraction of food item, FCM = Food Chain Multiplier. Equation adapted from Equation 5-12 in EPA, 1999

Arsenic removed at screening step.

2014 EXIDE APAR PAGE 1050 OF 3116

Screening Level Ecological Risk Assessment
Former Operating Plant
Lake Parcel Area
Frisco, Texas
May 2014

Table F-24
Hazard Quotient Calculations for the Least Shrew - Initial Conservative Exposure Parameters

Least Shrew COC	95% UCL Soil Conc (mg/kg)	Soil to Earthworm or Arthropod UF	Earthworm/ Arthropod Conc (mg/kg)	Soil to Plant UF	Plant Conc (mg/kg)	Total Daily Dose Rate (mg/kg BW-day)	NOAEL Toxicity Reference Value (mg/kg BW-day)	Based on Conservative Exposure Parameters NOAEL Hazard Quotient (unitless)
Antimony	NA	2.2E-01	NA	2.0E-01	NA	NA	5.9E-02	NA
Arsenic	NA	1.1E-01	NA	3.6E-02	NA	NA	2.8E+00	NA
Cadmium	2.5E+00	9.6E-01	2.4E+00	3.6E-01	9.0E-01	2.0E-03	7.7E-01	2.6E-03
Lead	2.1E+02	3.0E-02	6.3E+00	4.5E-02	9.5E+00	2.0E-02	4.7E+00	4.2E-03
Selenium	NA	2.2E-01	NA	1.6E-02	NA	NA	1.4E-01	NA

$$\text{Dose} = (\text{Conc}_{\text{Earthworm/Arthropod}} \times \text{IR}_{\text{food}})0.9 + (\text{IR}_{\text{food}} \times \text{Conc}_{\text{Plants}})0.1 + (\text{IR}_{\text{soil}} \times \text{Conc}_{\text{Soil}})/\text{Body Weight}_{\text{shrew}}$$

Arsenic removed at screening step.

2014 EXIDE APAR PAGE 1051 OF 3116

Screening Level Ecological Risk Assessment
Former Operating Plant
Lake Parcel Area
Frisco, Texas
May 2014

Table F-25
Hazard Quotient Calculations for the Armadillo - Initial Conservative Exposure Parameters

Armadillo COC	Surface 95% UCL Soil Conc (mg/kg)	Subsurface 95% UCL Soil Conc (mg/kg)	Soil to Earthworm or Arthropod UF	Earthworm/ Arthropod Conc (mg/kg)	Soil to Plant UF	Plant Conc (mg/kg)	Total Daily Dose Rate (mg/kg BW-day)	NOAEL Toxicity Reference Value (mg/kg BW-day)	Based on Conservative Exposure Parameters NOAEL Hazard Quotient (unitless)
Antimony	NA	NA	2.2E-01	NA	2.0E-01	NA	NA	5.9E-02	NA
Arsenic	NA	NA	1.1E-01	NA	3.6E-02	NA	NA	2.8E+00	NA
Cadmium	2.5E+00	2.8E-01	9.6E-01	2.4E+00	3.6E-01	9.0E-01	1.2E-01	7.7E-01	1.6E-01
Lead	2.1E+02	1.8E+01	3.0E-02	6.3E+00	4.5E-02	9.5E+00	5.1E-01	4.7E+00	1.1E-01
Selenium	NA	NA	2.2E-01	NA	1.6E-02	NA	NA	1.4E-01	NA

$$\text{Dose} = [(\text{Conc}_{\text{Earthworm/Arthropod}} \times \text{IR}_{\text{food}})0.9 + (\text{IR}_{\text{food}} \times \text{Conc}_{\text{Plants}})0.1 + (\text{IR}_{\text{soil}} \times \text{Subsurface Conc}_{\text{Soil}})] / \text{Body Weight}_{\text{armadillo}}$$

The surface soil concentration for arsenic was used for subsurface expsoure.
Arsenic removed at screening step.

2014 EXIDE APAR PAGE 1052 OF 3116

Stewart Creek Corridor Area
Terrestrial HQ Calculations

2014 EXIDE APAR PAGE 1053 OF 3116

Table F-26
Ingestion-Pathway Exposure Assumptions for Terrestrial Wildlife Measurement Receptors

Common Name	Body Weight (kg)	Food Ingestion Rate (kg/day)	Soil Ingestion (% of diet)	Soil Ingestion Rate (kg/day)	Exposure Modifying Factor (EMF)	Site Area (Acres)	Home Range (Acres)
Birds							
Red Tailed Hawk	9.57E-01	4.5E-04	2	8.97E-06	0.009	9.11	1037
American Robin	6.30E-02	4.9E-05	5.2	2.52E-06	1	9.11	1.12
Mammals							
Armadillo	4.00E+00	2.10E-01	17	3.57E-02	0.9	9.11	10
Red Fox	4.13E+00	1.08E-01	2.7	3.00E-03	0.005	9.11	1845
Least Shrew	4.00E-03	3.38E-06	8	2.71E-07	1	9.11	1
Reptiles							
Timber/Canebrake Rattlesnake	9.00E-01	2.50E-03	5.2	1.30E-04	0.083	9.11	110

Notes:

1. Factors from EPA, 1993 unless noted otherwise.
2. EPA, 1993. Wildlife Exposure Factors Handbook. Office of Research and Development. EPA/600/R-93/187. December
3. Least Shrew and Armadillo Body Weight from: Davis and Schmidley, 2009. The Mammals of Texas, online edition. www.nrsl.ttu.edu/tmot1/ .
4. Fox and Armadillo Soil ingestion rate from: Beyer, W.N. E.Cnner, and S. Gerould 1994. Estimates of Soil Ingestion by Wildlife. J. Wildl. Manage. 58:375-382.
5. EMF of 1 used for all initial conservative calculations. If a value less than 1 was used, it is noted in the text.
6. EMF for red-tailed hawk and red fox for less-conservative assessment based on ratio of site area to home range.
7. Home range for red-tailed hawk and red fox from EPA 1993. Geometric mean of all values listed.
8. Home range for armadillo from Davis and Schmidley, 2009.
9. Body weight from http://www.tpwd.state.tx.us/huntwild/wild/species/timberrattlesnake/
10. Food ingestion rate for snake taken from EPA 1993. Equation for insectivore iguanids.
11. Soil ingestion for snake from Beyer, 1994. Average soil ingestion by box turtle and eastern painted turtle.
12. Snake home range from Adams, J.P., 2005. Home Range and Behavior of the Timber Rattlesnake. Thesis - Marshall University. October.

Screening Level Ecological Risk Assessment
Former Operating Plant
Stewart Creek Corridor
Frisco, Texas
May 2014

Table F-27
Hazard Quotient Calculations for the American Robin - Initial Conservative Exposure Parameters

American Robin COC	95% UCL Soil Conc (mg/kg)	Soil to Earthworm or Arthropod UF	Earthworm/ Arthropod Conc (mg/kg)	Soil to Plant UF	Plant Conc (mg/kg)	Total Daily Dose Rate (mg/kg BW-day)	NOAEL Toxicity Reference Value (mg/kg BW-day)	Based on Conservative Exposure Parameters NOAEL Hazard Quotient (unitless)
Antimony	3.2E+01	2.2E-01	7.1E+00	2.0E-01	6.5E+00	6.8E-03	NA	NA
Arsenic	2.5E+01	1.1E-01	2.7E+00	3.6E-02	9.0E-01	3.0E-03	2.24E+00	1.3E-03
Cadmium	1.1E+01	9.6E-01	1.1E+01	3.6E-01	4.0E+00	8.3E-03	1.47E+00	5.7E-03
Lead	1.8E+03	3.0E-02	5.4E+01	4.5E-02	8.1E+01	1.2E-01	1.63E+00	7.1E-02
Selenium	1.4E+00	2.2E-01	3.1E-01	1.6E-02	2.2E-02	2.8E-04	2.90E-01	9.6E-04

$$\text{Dose} = [(\text{Conc}_{\text{Earthworm/Arthropod}}\text{s} \times \text{IR}_{\text{food}})0.92 + (\text{IR}_{\text{food}} \times \text{Conc}_{\text{Plants}})0.08 + (\text{IR}_{\text{soil}} \times \text{Conc}_{\text{Soil}})] / \text{Body Weight}_{\text{robin}}$$

Toxicity data not available for antimony.

2014 EXIDE APAR PAGE 1055 OF 3116

Screening Level Ecological Risk Assessment
Former Operating Plant
Stewart Creek Corridor
Frisco, Texas
May 2014

Table F-28
Hazard Quotient Calculations for the Red-Tailed Hawk - Initial Conservative Exposure Parameters

Red-Tailed Hawk COC	95% UCL Soil Conc (mg/kg)	Soil to Wildlife Mammal UF - Least Shrew	Plant to Wildlife Mammal UF - Least Shrew	FCM - Arthropod	FCM - Least Shrew	Small Mammal Conc (mg/kg)	Soil to Wildlife Bird UF - American Robin	Plant to Wildlife Bird UF - American Robin	FCM - American Robin	Small Bird Conc (mg/kg)	Total Daily Dose Rate (mg/kg BW-day)	NOAEL Toxicity Reference Value (mg/kg BW-day)	Based on Conservative Exposure Parameters NOAEL Hazard Quotient (unitless)
Antimony	3.2E+01	1.4E-05	6.2E-04	1.0E+00	1.0E+00	6.4E+00	NS	NS	1.0E+00	6.6E+00	3.3E-03	NA	NA
Arsenic	2.5E+01	2.7E-05	1.2E-03	1.0E+00	1.0E+00	2.5E+00	NS	NS	1.0E+00	2.5E+00	1.4E-03	2.24E+00	6.2E-04
Cadmium	1.1E+01	1.6E-06	7.4E-05	1.0E+00	1.0E+00	9.6E+00	1.5E-03	4.7E-02	1.0E+00	9.8E+00	4.6E-03	1.47E+00	3.2E-03
Lead	1.8E+03	4.1E-06	1.9E-04	1.0E+00	1.0E+00	4.8E+01	NS	NS	1.0E+00	4.9E+01	4.0E-02	1.63E+00	2.4E-02
Selenium	1.4E+00	3.1E-05	1.4E-03	1.0E+00	1.0E+00	2.8E-01	1.4E-02	5.0E-01	1.0E+00	2.8E-01	1.4E-04	2.90E-01	5.0E-04

$Dose = (Conc_{Small\ Mammals} \times IR_{food})0.785 + (IR_{food} \times Conc_{Birds})0.215 + (IR_{soil} \times Conc_{Soil})/Body\ Weight_{hawk}$

$Conc_{small\ mammal} = Conc_{least\ shrew}$ (mg/kg BW) = $[(Conc_{soil} \times UF_{soil\text{-}small\ mammal}) + (Conc_{plant} \times UF_{plant\text{-}small\ mammal} \times DF_{plant}) + (Conc_{arthropod} \times [FCM_{small\ mammal}/FCM_{arthropod}] \times DF_{arthropod})]$

$Conc_{small\ bird} = Conc_{robin}$ (mg/kg BW) = $[(Conc_{soil} \times UF_{soil\text{-}small\ bird}) + (Conc_{plant} \times UF_{plant\text{-}small\ bird} \times DF_{plant}) + (Conc_{arthropod} \times [FCM_{small\ bird}/FCM_{arthropod}] \times DF_{arthropod})]$

where DF = dietary fraction of food item, FCM=Food Chain Multiplier. Equation adapted from Equation 5-12 in EPA, 1999

NS - EPA, 1999 indicates insufficient data to determine value.

Toxicity data not available for antimony.

2014 EXIDE APAR PAGE 1056 OF 3116

Screening Level Ecological Risk Assessment
Former Operating Plant
Stewart Creek Corridor
Frisco, Texas
May 2014

Table F-29
Hazard Quotient Calculations for the Red Fox - Initial Conservative Exposure Parameters

Red Fox COC	95% UCL Soil Conc (mg/kg)	Soil to Wildlife Mammal UF - Least Shrew	Plant to Wildlife Mammal UF - Least Shrew	FCM - Arthropod	FCM - Least Shrew	Small Mammal Conc (mg/kg)	Total Daily Dose Rate (mg/kg BW-day)	NOAEL Toxicity Reference Value (mg/kg BW-day)	Based on Conservative Exposure Parameters NOAEL Hazard Quotient (unitless)
Antimony	3.2E+01	1.4E-05	6.2E-04	1.0E+00	1.0E+00	6.4E+00	1.9E-01	5.9E-02	**3.2E+00**
Arsenic	2.5E+01	2.7E-05	1.2E-03	1.0E+00	1.0E+00	2.5E+00	8.3E-02	2.8E+00	2.9E-02
Cadmium	1.1E+01	1.6E-06	7.4E-05	1.0E+00	1.0E+00	9.6E+00	2.6E-01	7.7E-01	3.4E-01
Lead	1.8E+03	4.1E-06	1.9E-04	1.0E+00	1.0E+00	4.8E+01	2.6E+00	4.7E+00	5.5E-01
Selenium	1.4E+00	3.1E-05	1.4E-03	1.0E+00	1.0E+00	2.8E-01	8.3E-03	1.4E-01	5.8E-02

$Dose = (Conc_{Small\ Mammals} \times IR_{food})1 + (IR_{soil} \times Conc_{Soil})/Body\ Weight_{fox}$

$Conc_{small\ mammal} = Conc_{least\ shrew}$ (mg/kg BW) $= [(Conc_{soil} \times UF_{soil\text{-}small\ mammal}) + (Conc_{plant} \times UF_{plant\text{-}small\ mammal} \times DF_{plant}) + (Conc_{arthropod} \times [FCM_{small\ mammal}/FCM_{arthropod}] \times DF_{arthropod})]$

where DF = dietary fraction of food item, FCM = Food Chain Multiplier. Equation adapted from Equation 5-12 in EPA, 1999

2014 EXIDE APAR PAGE 1057 OF 3116

Screening Level Ecological Risk Assessment
Former Operating Plant
Stewart Creek Corridor
Frisco, Texas
May 2014

Table F-30
Hazard Quotient Calculations for the Red Fox - Refined Less-Conservative Exposure Parameters

Red Fox COC	95% UCL Soil Conc (mg/kg)	Soil to Wildlife Mammal UF - Least Shrew	Plant to Wildlife Mammal UF - Least Shrew	FCM - Arthropod	FCM - Least Shrew	Small Mammal Conc (mg/kg)	Total Daily Dose Rate (mg/kg BW-day)	NOAEL Toxicity Reference Value (mg/kg BW-day)	LOAEL Toxicity Reference Value (mg/kg BW-day)	NOAEL Hazard Quotient (unitless)	LOAEL Hazard Quotient (unitless)
Antimony	3.2E+01	1.4E-05	6.2E-04	1.0E+00	1.0E+00	6.4E+00	1.9E-01	5.9E-02	5.9E-01	**3.2E+00**	3.2E-01

$Dose = EMF*(Conc_{Small\ Mammals} \times IR_{food})1 + (IR_{soil} \times Conc_{Soil})/Body\ Weight_{fox}$

$Conc_{small\ mammal} = Conc_{least\ shrew}\ (mg/kg\ BW) = [(Conc_{soil} \times UF_{soil\text{-}small\ mammal}) + (Conc_{plant} \times UF_{plant\text{-}small\ mammal} \times DF_{plant}) + (Conc_{arthropod} \times [FCM_{small\ mammal}/FCM_{arthropod}] \times DF_{arthropod})]$

where DF = dietary fraction of food item, FCM = Food Chain Multiplier. Equation adapted from Equation 5-12 in EPA, 1999

Screening Level Ecological Risk Assessment
Former Operating Plant
Stewart Creek Corridor
Frisco, Texas
May 2014

Table F-31
Hazard Quotient Calculations for the Least Shrew - Initial Conservative Exposure Parameters

Least Shrew COC	95% UCL Soil Conc (mg/kg)	Soil to Earthworm or Arthropod UF	Earthworm/ Arthropod Conc (mg/kg)	Soil to Plant UF	Plant Conc (mg/kg)	Total Daily Dose Rate (mg/kg BW-day)	NOAEL Toxicity Reference Value (mg/kg BW-day)	Based on Conservative Exposure Parameters NOAEL Hazard Quotient (unitless)
Antimony	3.2E+01	2.2E-01	7.1E+00	2.0E-01	6.5E+00	8.2E-03	5.9E-02	1.4E-01
Arsenic	2.5E+01	1.1E-01	2.7E+00	3.6E-02	9.0E-01	3.8E-03	2.8E+00	1.4E-03
Cadmium	1.1E+01	9.6E-01	1.1E+01	3.6E-01	4.0E+00	9.2E-03	7.7E-01	1.2E-02
Lead	1.8E+03	3.0E-02	5.4E+01	4.5E-02	8.1E+01	1.7E-01	4.7E+00	3.6E-02
Selenium	1.4E+00	2.2E-01	3.1E-01	1.6E-02	2.2E-02	3.3E-04	1.4E-01	2.3E-03

$$\text{Dose} = (\text{Conc}_{\text{Earthworm/Arthropod}} \times \text{IR}_{\text{food}})0.9 + (\text{IR}_{\text{food}} \times \text{Conc}_{\text{Plants}})0.1 + (\text{IR}_{\text{soil}} \times \text{Conc}_{\text{Soil}})/\text{Body Weight}_{\text{shrew}}$$

2014 EXIDE APAR PAGE 1059 OF 3116

Screening Level Ecological Risk Assessment
Former Operating Plant
Stewart Creek Corridor
Frisco, Texas
May 2014

Table F-32
Hazard Quotient Calculations for the Armadillo - Initial Conservative Exposure Parameters

Armadillo COC	Surface 95% UCL Soil Conc (mg/kg)	Subsurface 95% UCL Soil Conc (mg/kg)	Soil to Earthworm or Arthropod UF	Earthworm/ Arthropod Conc (mg/kg)	Soil to Plant UF	Plant Conc (mg/kg)	Total Daily Dose Rate (mg/kg BW-day)	NOAEL Toxicity Reference Value (mg/kg BW-day)	Based on Conservative Exposure Parameters NOAEL Hazard Quotient (unitless)
Antimony	3.2E+01	4.7E+00	2.2E-01	7.1E+00	2.0E-01	6.5E+00	4.1E-01	5.9E-02	**7.0E+00**
Arsenic	2.5E+01	1.2E+02	1.1E-01	2.7E+00	3.6E-02	9.0E-01	1.2E+00	2.8E+00	4.2E-01
Cadmium	1.1E+01	1.1E+02	9.6E-01	1.1E+01	3.6E-01	4.0E+00	1.5E+00	7.7E-01	**2.0E+00**
Lead	1.8E+03	8.8E+03	3.0E-02	5.4E+01	4.5E-02	8.1E+01	8.1E+01	4.7E+00	**1.7E+01**
Selenium	1.4E+00	8.6E+00	2.2E-01	3.1E-01	1.6E-02	2.2E-02	9.2E-02	1.4E-01	6.4E-01

$$\text{Dose} = [(\text{Conc}_{\text{Earthworm/Arthropod}} \times \text{IR}_{\text{food}})0.9 + (\text{IR}_{\text{food}} \times \text{Conc}_{\text{Plants}})0.1 + (\text{IR}_{\text{soil}} \times \text{Subsurface Conc}_{\text{Soil}})] / \text{Body Weight}_{\text{armadillo}}$$

2014 EXIDE APAR PAGE 1060 OF 3116

Screening Level Ecological Risk Assessment
Former Operating Plant
Stewart Creek Corridor
Frisco, Texas
May 2014

Table F-33
Hazard Quotient Calculations for the Armadillo - Refined Less-Conservative Exposure Parameters

Armadillo COC	Surface 95% UCL Soil Conc (mg/kg)	Subsurface 95% UCL Soil Conc (mg/kg)	Soil to Earthworm or Arthropod UF	Earthworm/ Arthropod Conc (mg/kg)	Soil to Plant UF	Plant Conc (mg/kg)	Total Daily Dose Rate (mg/kg BW-day)	NOAEL Toxicity Reference Value (mg/kg BW-day)	LOAEL Toxicity Reference Value (mg/kg BW-day)	Based on Conservative Exposure Parameters NOAEL Hazard Quotient (unitless)	Based on Conservative Exposure Parameters LOAEL Hazard Quotient (unitless)
Antimony	3.2E+01	4.7E+00	2.2E-01	7.1E+00	2.0E-01	6.5E+00	3.8E-01	5.9E-02	5.9E-01	**6.4E+00**	6.4E-01
Arsenic	2.5E+01	1.2E+02	1.1E-01	2.7E+00	3.6E-02	9.0E-01	1.1E+00	2.8E+00	6.9E+00	3.8E-01	1.5E-01
Cadmium	1.1E+01	1.1E+02	9.6E-01	1.1E+01	3.6E-01	4.0E+00	1.4E+00	7.7E-01	7.7E+00	**1.8E+00**	1.8E-01
Lead	1.8E+03	8.8E+03	3.0E-02	5.4E+01	4.5E-02	8.1E+01	7.4E+01	4.7E+00	8.9E+00	**1.6E+01**	**8.3E+00**
Selenium	1.4E+00	8.6E+00	2.2E-01	3.1E-01	1.6E-02	2.2E-02	8.4E-02	1.4E-01	2.2E-01	5.9E-01	3.9E-01

$$\text{Dose} = [(\text{Conc}_{\text{Earthworm/Arthropod}} \times \text{IR}_{\text{food}})0.9 + (\text{IR}_{\text{food}} \times \text{Conc}_{\text{Plants}})0.1 + (\text{IR}_{\text{soil}} \times \text{Subsurface Conc}_{\text{Soil}})] / \text{Body Weight}_{\text{armadillo}}$$

2014 EXIDE APAR PAGE 1061 OF 3116

Site-Wide
Terrestrial HQ Calculations

Screening Level Ecological Risk Assessment
Former Operating Plant
Site-Wide
Frisco, Texas
May 2014

Table F-34
Ingestion-Pathway Exposure Assumptions for Terrestrial Wildlife Measurement Receptors

Common Name	Body Weight (kg)	Food Ingestion Rate (kg/day)	Soil Ingestion (% of diet)	Soil Ingestion Rate (kg/day)	Exposure Modifying Factor (EMF)	Site Area (Acres)	Home Range (Acres)
Birds							
Red Tailed Hawk	9.57E-01	4.5E-04	2	8.97E-06	0.032	32.78	1037
Mammals							
Red Fox	4.13E+00	1.08E-01	2.7	3.00E-03	0.018	32.78	1845

Notes:

1. Factors from EPA, 1993 unless noted otherwise.
2. EPA, 1993. Wildlife Exposure Factors Handbook. Office of Research and Development. EPA/600/R-93/187. December
3. Fox and Armadillo Soil ingestion rate from: Beyer, W.N. E.Cnner, and S. Gerould 1994. Estimates of Soil Ingestion by Wildlife. J. Wildl. Manage. 58:375-382.
4. EMF of 1 used for all initial conservative calculations. If a value less than 1 was used, it is noted in the text.
5. EMF for red-tailed hawk and red fox for less-conservative assessment based on ratio of site area to home range.
6. Home range for red-tailed hawk and red fox from EPA 1993. Geometric mean of all values listed.

Screening Level Ecological Risk Assessment
Former Operating Plant
Site-Wide
Frisco, Texas
May 2014

Table F-35
Hazard Quotient Calculations for the Red-Tailed Hawk - Initial Conservative Exposure Parameters

Red-Tailed Hawk COC	95% UCL Soil Conc (mg/kg)	Soil to Wildlife Mammal UF - Least Shrew	Plant to Wildlife Mammal UF - Least Shrew	FCM - Arthropod	FCM - Least Shrew	Small Mammal Conc (mg/kg)	Soil to Wildlife Bird UF - American Robin	Plant to Wildlife Bird UF - American Robin	FCM - American Robin	Small Bird Conc (mg/kg)	Total Daily Dose Rate (mg/kg BW-day)	NOAEL Toxicity Reference Value (mg/kg BW-day)	Based on Conservative Exposure Parameters NOAEL Hazard Quotient (unitless)
Antimony	1.9E+01	1.4E-05	6.2E-04	1.0E+00	1.0E+00	2.5E-04	NS	NS	1.0E+00	0.0E+00	1.7E-04	NA	NA
Arsenic	2.1E+01	2.7E-05	1.2E-03	1.0E+00	1.0E+00	5.5E-04	NS	NS	1.0E+00	0.0E+00	1.9E-04	2.24E+00	8.6E-05
Cadmium	9.6E+00	1.6E-06	7.4E-05	1.0E+00	1.0E+00	1.6E-05	1.5E-03	4.7E-02	1.0E+00	0.0E+00	9.0E-05	1.47E+00	6.1E-05
Lead	1.2E+03	4.1E-06	1.9E-04	1.0E+00	1.0E+00	4.9E-03	NS	NS	1.0E+00	0.0E+00	1.1E-02	1.63E+00	7.0E-03
Selenium	7.6E+00	3.1E-05	1.4E-03	1.0E+00	1.0E+00	2.4E-04	1.4E-02	5.0E-01	1.0E+00	0.0E+00	7.1E-05	2.90E-01	2.5E-04

$Dose = (Conc_{Small\ Mammals} \times IR_{food})0.785 + (IR_{food} \times Conc_{Birds})0.215 + (IR_{soil} \times Conc_{Soil})/Body\ Weight_{hawk}$

$Conc_{small\ mammal} = Conc_{least\ shrew}$ (mg/kg BW) = $[(Conc_{soil} \times UF_{soil\text{-}small\ mammal}) + (Conc_{plant} \times UF_{plant\text{-}small\ mammal} \times DF_{plant}) + (Conc_{arthropod} \times [FCM_{small\ mammal}/FCM_{arthropod}] \times DF_{arthropod})]$

$Conc_{small\ bird} = Conc_{robin}$ (mg/kg BW) = $[(Conc_{soil} \times UF_{soil\text{-}small\ bird}) + (Conc_{plant} \times UF_{plant\text{-}small\ bird} \times DF_{plant}) + (Conc_{arthropod} \times [FCM_{small\ bird}/FCM_{arthropod}] \times DF_{arthropod})]$

where DF = dietary fraction of food item, FCM=Food Chain Multiplier. Equation adapted from Equation 5-12 in EPA, 1999

NS - EPA, 1999 indicates insufficient data to determine value.

Toxicity data not available for antimony.

2014 EXIDE APAR PAGE 1064 OF 3116

Screening Level Ecological Risk Assessment
Former Operating Plant
Site-Wide
Frisco, Texas
May 2014

Table F-36
Hazard Quotient Calculations for the Red Fox - Initial Conservative Exposure Parameters

Red Fox COC	95% UCL Soil Conc (mg/kg)	Soil to Wildlife Mammal UF - Least Shrew	Plant to Wildlife Mammal UF - Least Shrew	FCM - Arthropod	FCM - Least Shrew	Small Mammal Conc (mg/kg)	Total Daily Dose Rate (mg/kg BW-day)	NOAEL Toxicity Reference Value (mg/kg BW-day)	Based on Conservative Exposure Parameters NOAEL Hazard Quotient (unitless)
Antimony	1.9E+01	1.4E-05	6.2E-04	1.0E+00	1.0E+00	2.5E-04	1.3E-02	5.9E-02	2.3E-01
Arsenic	2.1E+01	2.7E-05	1.2E-03	1.0E+00	1.0E+00	5.5E-04	1.5E-02	2.8E+00	5.3E-03
Cadmium	9.6E+00	1.6E-06	7.4E-05	1.0E+00	1.0E+00	1.6E-05	7.0E-03	7.7E-01	9.1E-03
Lead	1.2E+03	4.1E-06	1.9E-04	1.0E+00	1.0E+00	4.9E-03	8.8E-01	4.7E+00	1.9E-01
Selenium	7.6E+00	3.1E-05	1.4E-03	1.0E+00	1.0E+00	2.4E-04	5.5E-03	1.4E-01	3.9E-02

$Dose = (Conc_{Small\ Mammals} \times IR_{food})1 + (IR_{soil} \times Conc_{Soil})/Body\ Weight_{fox}$

$Conc_{small\ mammal} = Conc_{least\ shrew}$ (mg/kg BW) $= [(Conc_{soil} \times UF_{soil\text{-}small\ mammal}) + (Conc_{plant} \times UF_{plant\text{-}small\ mammal} \times DF_{plant}) + (Conc_{arthropod} \times [FCM_{small\ mammal}/FCM_{arthropod}] \times DF_{arthropod})]$

where DF = dietary fraction of food item, FCM = Food Chain Multiplier. Equation adapted from Equation 5-12 in EPA, 1999

2014 EXIDE APAR PAGE 1065 OF 3116

10.0 COC SCREENING

TRRP Rules 30 TAC §350.71(k)(1) and §350.71(k)(3) specify that a COC may be screened from critical PCL development if all detected COC concentrations and sample detection limits (SDLs) are less than applicable RALs or if all SDLs for analytes not detected are less than applicable RALs. All COCs sampled in all media were screened from critical PCL development based on these criteria, with the exception of antimony, arsenic, cadmium, lead, and selenium in soil and the two SVOCs discussed in Section 10.4 below.

10.1 Frequency of Detection

A COC can be screened from critical PCL development if more than 20 samples of the media were collected and the COC was detected in less than five percent of the samples (30 TAC §350.71(k)(2)(A)). No COCs at the Site were screened out based on frequency of detection.

10.2 Lab Contaminant or Blank Contaminant

A COC can be screened from critical PCL development if it is a common laboratory contaminant, as long as the concentration of the COC detected in each sample for that environmental medium does not exceed 10 times the maximum amount detected in any associated blank and the COC is not anticipated to be present based on knowledge of on-site historical operations including consideration of companion and daughter products (30 TAC §350.71(k)(2)(B)). No COCs at the Site were screened out based on lab contaminants or blank contaminants, except for butyl benzyl phthalate, diethyl phthalate, and di-n-butyl phthalate. Methylene chloride is a known laboratory contaminant; however evidence of associated laboratory blank contamination was not observed in all occurrences, so this constituent was not screened from PCL development.

10.3 COC Not Sourced On-site

A COC can be screened from critical PCL development if it can be demonstrated that the COC did not result from activity at the on-site property based on appropriate evidence, including, but not limited to, the concentration and distribution of the COC in environmental media, source area information, consideration of companion and daughter products, and knowledge of on-site historical operations (30 TAC §350.71(k)(2)(E)). This exclusion is applicable to COCs with SDLs exceeding the assessment levels (See Section 10.4). No COCs at the Site were screened out based on off-site sources. Arsenic in sediment is believed to be attributable to anthropogenic background and not associated with on-site sources.

10.4 Appropriate Sample Quantitation Limits

Several SVOCs (see Table 10A) were screened from critical PCL development had soil sample SDLs greater than the applicable RALs (Tables 4A and 4C). These compounds were analyzed by appropriate EPA methods (see Section 3.3.1 and Appendix 10) that represent the best available technology. There is no indication that the presence of these compounds should be expected at the Site based on knowledge of the Site history and operations. These compounds are not considered daughter or companion products of any parent COCs that cannot be screened from critical PCL development.

10.5 Screened COCs Expected to be Present Dropped from Future Sampling

No screened COCs are expected to be present at the Site.

Table 10A
COC Screening Summary Table

1	2	3	4	5	6	7	8	SQL Justifications 9	SQL Justifications 10
Chemical of Concern	**All detected concentrations and SQLs < residential assessment level in all sampled media §350.71(k)(1)**	**COC not detected in any sample in the medium §350.71(k)(3)**	**Frequency of detects <5% of the >20 samples in this medium §350.71(k)(2)(A)(i) through (iii)**	**Common lab contaminant §350.71(k)(2)(B)**	**Blank contaminant §350.71(k)(2)(C)**	**Max conc < background §350.71(k)(2)(D)**	**COC not sourced on-site §350.71(k)(2)(E)**	**All SQLs < RAL §350.71(k)(3)(A)**	**SQL > RAL but justified §350.71(k)(3)(B)**
Metals									
Antimony		soil >15 ft						soil >15 ft	
Arsenic	sw	gw					sed	gw	
Barium	soil 0-15 ft								
Beryllium	soil 0-15 ft								
Cadmium	soil >15 ft, gw							soil >15 ft, gw	
Chromium	soil 0-15 ft								
Lead									
Mercury	soil 0-15 ft								
Nickel	soil 0-15 ft								
Selenium	soil >15 ft, gw								
Silver		soil 0-15 ft						soil 0-15 ft	
Zinc	soil 0-15 ft								
Total Petroleum Hydrocarbons (TPH) by TX1005									
T/R Hydrocarbons: C6-C12	soil 0-15 ft	gw						gw	
T/R Hydrocarbons: >C12-C28	soil 0-15 ft	gw						gw	
T/R Hydrocarbons: >C28-C35	soil 0-15 ft	gw						gw	
T/R Hydrocarbons: C6-C35	soil 0-15 ft	gw						gw	
Total Petroleum Hydrocarbons (TPH) by TX1006									
nC6 Aliphatics		soil 0-15 ft						soil 0-15 ft	
<C6-C8 Aliphatics		soil 0-15 ft						soil 0-15 ft	
>C8-C10 Aliphatics	soil 0-15 ft								
>C10-C12 Aliphatics	soil 0-15 ft								
>C12-C16 Aliphatics	soil 0-15 ft								
>C16-C21 Aliphatics	soil 0-15 ft								
>C21-C35 Aliphatics	soil 0-15 ft								
>C7-C8 Aromatics	soil 0-15 ft								
>C8-C10 Aromatics	soil 0-15 ft								
>C10-C12 Aromatics	soil 0-15 ft								
>C12-C16 Aromatics	soil 0-15 ft								
>C16-C21 Aromatics	soil 0-15 ft								
>C21-C35 Aromatics	soil 0-15 ft								
>C6-C35	soil 0-15 ft								
Polychlorinated Biphenyls (PCBs)									
Aroclor 1016	soil 0-15 ft								
Aroclor 1221	soil 0-15 ft								
Aroclor 1232	soil 0-15 ft								
Aroclor 1242	soil 0-15 ft								
Aroclor 1248	soil 0-15 ft								
Aroclor 1254	soil 0-15 ft								
Aroclor 1260	soil 0-15 ft								
Perfluorinated Compounds (PFCs)									
Perfluoro-1-Octanesulfonate (PFOS)	soil 0-15 ft	gw							
Perfluorobutane Sulfonate		soil 0-15 ft, gw							
Perfluorobutyric acid		soil 0-15 ft, gw							
Perfluorodecane Sulfonate		soil 0-15 ft, gw							
Perfluorodecanoic acid		soil 0-15 ft, gw							
Perfluorododecanoic acid		soil 0-15 ft, gw							
Perfluoroheptanoic acid	soil 0-15 ft	gw							
Perfluorohexane Sulfonate	soil 0-15 ft	gw							
Perfluorohexanoic acid	soil 0-15 ft	gw							
Perfluoro-n-octanoic acid (PFOA)	soil 0-15 ft	gw							
Perfluorononanoic acid	soil 0-15 ft	gw							
Perfluorooctane Sulfonamide		soil 0-15 ft, gw							
Perfluoropentanoic acid	soil 0-15 ft	gw							
Perfluorotetradecanoic acid		soil 0-15 ft, gw							
Perfluorotridecanoic acid		soil 0-15 ft, gw							
Perfluoroundecanoic acid		soil 0-15 ft, gw							

Table 10A
COC Screening Summary Table

1	2	3	4	5	6	7	8	SQL Justifications 9	SQL Justifications 10
Chemical of Concern	**All detected concentrations and SQLs < residential assessment level in all sampled media §350.71(k)(1)**	**COC not detected in any sample in the medium §350.71(k)(3)**	**Frequency of detects <5% of the >20 samples in this medium §350.71(k)(2)(A)(i) through (iii)**	**Common lab contaminant §350.71(k)(2)(B)**	**Blank contaminant §350.71(k)(2)(C)**	**Max conc < background §350.71(k)(2)(D)**	**COC not sourced on-site §350.71(k)(2)(E)**	**All SQLs < RAL §350.71(k)(3)(A)**	**SQL > RAL but justified §350.71(k)(3)(B)**
Volatile Organic Compounds (VOCs)									
1,1,1-Trichloroethane		soil 0-15 ft, soil>15 ft, gw						soil 0-15 ft, soil>15 ft, gw	
1,1,2,2-Tetrachloroethane		soil 0-15 ft, soil>15 ft, gw						soil 0-15 ft, soil>15 ft, gw	
1,1,2-Trichloroethane		soil 0-15 ft, soil>15 ft, gw						soil 0-15 ft, soil>15 ft, gw	
1,1-Dichloroethane		soil 0-15 ft, soil>15 ft, gw						soil 0-15 ft, soil>15 ft, gw	
1,1-Dichloroethene		soil 0-15 ft, soil>15 ft, gw						soil 0-15 ft, soil>15 ft, gw	
1,2-Dichloroethane		soil 0-15 ft, soil>15 ft, gw						soil 0-15 ft, soil>15 ft, gw	
1,2-Dichloroethene, Total		soil 0-15 ft, soil>15 ft, gw						soil 0-15 ft, soil>15 ft, gw	
1,2-Dichloropropane		soil 0-15 ft, soil>15 ft, gw						soil 0-15 ft, soil>15 ft, gw	
2-Butanone (MEK)	soil 0-15 ft	soil >15 ft, gw						soil >15 ft, gw	
2-Hexanone		soil 0-15 ft, soil>15 ft, gw						soil 0-15 ft, soil>15 ft, gw	
4-Methyl-2-pentanone (MIBK)		soil 0-15 ft, soil>15 ft, gw						soil 0-15 ft, soil>15 ft, gw	
Acetone	soil 0-15 ft, soil > 15 ft	gw						gw	
Benzene		soil>15 ft, gw						soil>15 ft, gw	
Bromochloromethane		soil 0-15 ft, soil > 15 feet, gw						soil 0-15 ft, soil > 15 feet, gw	
Bromodichloromethane		soil 0-15 ft, soil > 15 feet, gw						soil 0-15 ft, soil > 15 feet, gw	
Bromoform		soil 0-15 ft, soil > 15 feet, gw						soil 0-15 ft, soil > 15 feet, gw	
Bromomethane		soil 0-15 ft, soil > 15 feet, gw						soil 0-15 ft, soil > 15 feet, gw	
Carbon disulfide	soil 0-15 ft								
Carbon tetrachloride		soil 0-15 ft, soil >15 ft, gw						soil 0-15 ft, soil >15 ft, gw	
Chlorobenzene		soil 0-15 ft, soil >15 ft, gw						soil 0-15 ft, soil >15 ft, gw	
Chlorobromomethane		soil 0-15 ft, soil> 15 ft, gw						soil 0-15 ft, soil> 15 ft, gw	
Volatile Organic Compounds (VOCs) (Continued)									
Chloroethane		soil 0-15 ft, soil >15 ft, gw						soil 0-15 ft, soil >15 ft, gw	
Chloroform	soil 0-15 ft	soil >15 ft, gw						soil >15 ft, gw	
Chloromethane		soil 0-15 ft, soil >15 ft, gw						soil 0-15 ft, soil >15 ft, gw	
cis-1,2-Dichloroethene		soil 0-15 ft, soil >15 ft, gw						soil 0-15 ft, soil >15 ft, gw	
cis-1,3-Dichloropropene		soil 0-15 ft, soil >15 ft, gw						soil 0-15 ft, soil >15 ft, gw	
Dibromochloromethane		soil 0-15 ft, soil >15 ft, gw						soil 0-15 ft, soil >15 ft, gw	
Ethylbenzene	soil 0-15 ft	soil >15 ft, gw						soil >15 ft, gw	
Methyl tert-butyl ether	soil 0-15 ft	soil >15 ft, gw						soil >15 ft, gw	
Methylene Chloride	soil >15 ft	gw						gw	
m-Xylene and p-Xylene		soil >15 ft, gw						soil >15 ft, gw	
o-Xylene	soil 0-15 ft	soil >15 ft, gw						soil >15 ft, gw	
Styrene		soil 0-15 ft, gw						soil 0-15 ft, gw	
Tetrachloroethene	soil 0-15 ft	soil > 15 ft, gw						soil > 15 ft, gw	
Toluene	soil 0-15 ft	soil > 15 ft, gw						soil > 15 ft, gw	
trans-1,2-Dichloroethene		soil > 15 ft, gw						soil > 15 ft, gw	
trans-1,3-Dichloropropene		soil > 15 ft, gw						soil > 15 ft, gw	
Trichloroethene		soil > 15 ft, gw						soil > 15 ft, gw	
Vinyl acetate		soil > 15 ft, gw						soil > 15 ft, gw	
Vinyl chloride		soil > 15 ft, gw						soil > 15 ft, gw	
Xylenes, Total	soil 0-15 ft	soil > 15 ft, gw						soil > 15 ft, gw	
Semivolatile Organic Compounds (SVOCs)									
1,2,4-Trichlorobenzene		soil 0-15 ft, soil >15 ft, gw						soil 0-15 ft, soil >15 ft, gw	
1,2-Dichlorobenzene		soil 0-15 ft, soil >15 ft, gw						soil 0-15 ft, soil >15 ft, gw	
1,3-Dichlorobenzene		soil 0-15 ft, soil >15 ft, gw						soil 0-15 ft, soil >15 ft, gw	
1,4-Dichlorobenzene		soil 0-15 ft, soil >15 ft, gw						soil 0-15 ft, soil >15 ft, gw	
1-Methylnaphthalene	soil 0-15 ft, gw	soil > 15 ft						soil > 15 ft	
2,4,5-Trichlorophenol		soil 0-15 ft, soil >15 ft, gw						soil 0-15 ft, soil >15 ft, gw	
2,4,6-Trichlorophenol		soil 0-15 ft, soil >15 ft, gw						soil 0-15 ft, soil >15 ft, gw	
2,4-Dichlorophenol		soil 0-15 ft, soil >15 ft, gw						soil 0-15 ft, soil >15 ft, gw	
2,4-Dimethylphenol		soil 0-15 ft, soil >15 ft, gw						soil 0-15 ft, soil >15 ft, gw	
2,4-Dinitrophenol		soil 0-15 ft, soil >15 ft, gw						soil >15 ft	soil 0-15 ft, gw
2,4-Dinitrotoluene		soil 0-15 ft, soil >15 ft, gw							soil 0-15 ft, soil > 15 ft, gw
2,6-Dinitrotoluene		soil 0-15 ft, soil >15 ft, gw							soil 0-15 ft, soil > 15 ft, gw
2-Chloronaphthalene		soil 0-15 ft, soil >15 ft, gw						soil 0-15 ft, soil >15 ft, gw	
2-Chlorophenol		soil 0-15 ft, soil >15 ft, gw						soil 0-15 ft, soil >15 ft, gw	
2-Methylnaphthalene	soil 0-15 ft, gw								
2-Methylphenol		soil 0-15 ft, soil >15 ft, gw						soil 0-15 ft, soil >15 ft, gw	

Table 10A
COC Screening Summary Table

1	2	3	4	5	6	7	8	SQL Justifications 9	SQL Justifications 10
Chemical of Concern	**All detected concentrations and SQLs < residential assessment level in all sampled media §350.71(k)(1)**	**COC not detected in any sample in the medium §350.71(k)(3)**	**Frequency of detects <5% of the >20 samples in this medium §350.71(k)(2)(A)(i) through (iii)**	**Common lab contaminant §350.71(k)(2)(B)**	**Blank contaminant §350.71(k)(2)(C)**	**Max conc < background §350.71(k)(2)(D)**	**COC not sourced on-site §350.71(k)(2)(E)**	**All SQLs < RAL §350.71(k)(3)(A)**	**SQL > RAL but justified §350.71(k)(3)(B)**
2-Nitroaniline		soil 0-15 ft, soil >15 ft, gw						soil >15 ft, gw	soil 0-15 ft
Semivolatile Organic Compounds (SVOCs) (Continued)									
2-Nitrophenol		soil 0-15 ft, soil >15 ft, gw						soil >15 ft, gw	soil 0-15 ft
3 & 4 Methylphenol	soil 0-15 ft, soil > 15 ft	gw						gw	
3,3'-Dichlorobenzidine		soil 0-15 ft, soil >15 ft, gw						soil >15 ft, gw	soil 0-15 ft
3-Nitroaniline		soil 0-15 ft, soil >15 ft, gw						soil >15 ft, gw	soil 0-15 ft
4,6-Dinitro-2-methylphenol		soil 0-15 ft, soil >15 ft, gw						gw	soil 0-15 ft, soil >15 ft,
4-Bromophenyl phenyl ether		soil 0-15 ft, soil >15 ft, gw						soil 0-15 ft, soil >15 ft	gw
4-Chloro-3-methylphenol		soil 0-15 ft, soil >15 ft, gw						soil 0-15 ft, soil >15 ft, gw	
4-Chloroaniline		soil 0-15 ft, soil >15 ft, gw						soil >15 ft, gw	soil 0-15 ft
4-Chlorophenyl phenyl ether		soil 0-15 ft, soil >15 ft, gw						soil 0-15 ft, soil >15 ft	gw
4-Nitroaniline		soil 0-15 ft, soil >15 ft, gw						soil 0-15 ft, soil >15 ft, gw	
4-Nitrophenol		soil 0-15 ft, soil >15 ft, gw						soil 0-15 ft, soil >15 ft, gw	
Acenaphthene	gw	soil 0-15 ft, soil > 15 ft						soil 0-15 ft, soil > 15 ft	
Acenaphthylene		soil 0-15 ft, soil > 15 ft, gw						soil 0-15 ft, soil > 15 ft, gw	
Anthracene	soil 0-15 ft	soil > 15 ft, gw						soil > 15 ft, gw	
Benzidine		soil 0-15 ft, soil >15 ft, gw							soil 0-15 ft, soil >15 ft
Benzo[a]anthracene	soil 0-15 ft	soil > 15 ft, gw						soil > 15 ft, gw	
Benzo[a]pyrene	soil 0-15 ft	soil > 15 ft, gw						soil > 15 ft, gw	
Benzo[b]fluoranthene	soil 0-15 ft	soil > 15 ft, gw						soil > 15 ft, gw	
Benzo[g,h,i]perylene	soil 0-15 ft	soil > 15 ft, gw						soil > 15 ft, gw	
Benzo[k]fluoranthene	soil 0-15 ft	soil > 15 ft, gw						soil > 15 ft, gw	
Benzyl alcohol		soil 0-15 ft, soil >15 ft, gw						soil 0-15 ft, soil >15 ft, gw	
bis (2-Chloroisopropyl) ether		soil 0-15 ft, soil >15 ft, gw						soil 0-15 ft, soil >15 ft, gw	
Bis(2-chloroethoxy)methane		soil 0-15 ft, soil >15 ft, gw						soil >15 ft, gw	soil 0-15 ft
Bis(2-chloroethyl)ether		gw						gw	
Bis(2-ethylhexyl) phthalate	soil 0-15 ft, soil > 15 feet	gw						gw	
Butyl benzyl phthalate		gw			soil 0-15 ft, soil > 15 ft			gw	
Carbazole		soil 0-15 ft, soil > 15 feet, gw						soil 0-15 ft, soil > 15 feet, gw	
Chrysene	soil 0-15 ft	soil > 15 feet, gw						soil > 15 feet, gw	
Dibenz(a,h)anthracene	soil 0-15 ft	soil > 15 feet, gw						soil > 15 feet	gw
Dibenzofuran	soil 0-15 ft	soil > 15 feet, gw						soil > 15 feet, gw	
Diethyl phthalate		gw			soil 0-15 ft, soil > 15 ft			gw	
Dimethyl phthalate	soil 0-15 ft, soil > 15 feet	gw						gw	
Di-n-butyl phthalate		gw			soil 0-15 ft, soil > 15 ft			gw	
Di-n-octyl phthalate		soil 0-15 ft, soil > 15 feet, gw						soil 0-15 ft, soil > 15 feet, gw	
Fluoranthene	soil 0-15 ft	soil > 15 ft, gw						soil > 15 ft, gw	
Fluorene	soil 0-15 ft, gw	soil > 15 ft						soil > 15 ft	
Hexachlorobenzene		soil 0-15 ft, soil > 15 ft, gw						soil 0-15 ft, soil > 15 ft, gw	
Hexachlorobutadiene		soil 0-15 ft, soil > 15 ft, gw						soil 0-15 ft, soil > 15 ft, gw	
Hexachlorocyclopentadiene		soil 0-15 ft, soil > 15 ft, gw						soil 0-15 ft, soil > 15 ft, gw	
Hexachloroethane		soil 0-15 ft, soil > 15 ft, gw						soil 0-15 ft, soil > 15 ft, gw	
Indeno[1,2,3-cd]pyrene	soil 0-15 ft	soil > 15 ft, gw						soil > 15 ft, gw	
Isophorone	soil 0-15 ft, soil > 15 ft	gw						gw	
Naphthalene	soil 0-15 ft, soil >15 ft, gw								
Nitrobenzene		soil 0-15 ft, soil > 15 ft, gw						soil 0-15 ft, soil > 15 ft, gw	
N-Nitrosodimethylamine		soil 0-15 ft, soil > 15 ft, gw							soil 0-15 ft, soil > 15 ft, gw
N-Nitrosodi-n-propylamine		soil 0-15 ft, soil > 15 ft, gw							soil 0-15 ft, soil > 15 ft, gw
N-Nitrosodiphenylamine		soil 0-15 ft, soil > 15 ft, gw						soil 0-15 ft, soil > 15 ft, gw	
Pentachlorophenol		soil 0-15 ft, soil > 15 ft, gw						soil > 15 ft, gw	soil 0-15 ft
Phenanthrene	soil 0-15 ft	soil >15 ft, gw						soil >15 ft, gw	
Phenol		soil 0-15 ft, soil > 15 ft, gw						soil 0-15 ft, soil > 15 ft, gw	
Pyrene	soil 0-15 ft	soil > 15 ft, gw						soil > 15 ft, gw	

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11.0 SOIL CRITICAL PCL DEVELOPMENT

11.1 Tier 2 or 3 PCL Development and Non-Default Parameters

As presented in Section 10, antimony, arsenic, lead, cadmium, and selenium were the only inorganic constituents analyzed in soil samples from the Site that were not screened from critical PCL development. In accordance with 30 TAC §350.75(c)(1), Tier 2 $^{GW}Soil_{Ing}$ PCLs were developed for lead, cadmium, arsenic, and selenium using site-specific data and equations provided in TRRP Figure 30 TAC §350.75(b)(1). The Tier 2 PCLs are used as the RALs (see Section 4) and critical PCLs for lead, cadmium and selenium. Documentation for the development of the Tier 2 critical PCLs is provided in Appendix 9. The site-specific background soil concentration for arsenic (15.9 mg/kg) as presented in Appendix 8 is substituted as the critical PCL since it was higher than the calculated Tier 2 PCL.

The only organic constituents not screened from PCL development include benzene, methylene chloride, and bis(2-chloroethyl ether). The critical PCLs for these constituents are the commercial/industrial Tier 1 $^{GW}Soil_{Ing}$ PCLs.

<u>Non-Default Affected Property Parameters</u>

Site-specific pH soil sample results were used to determine soil-water partition coefficient (Kd) values for calculating Tier 2 PCLs in accordance with 30 TAC §350.73(f)(1). Sixty-five soil samples were evaluated for pH; the results are presented in Table 4F. The average pH value for soils was 7.5, with corresponding Kd values being 1,830 L/kg for lead, 590 L/kg for cadmium, 3.1 L/kg for selenium, and 30 L/kg for arsenic.

11.2 Soil PCL Adjustments

No residual saturation, cumulative risk, hazard index or other adjustments were made to PCLs for COCs detected at the Site.

11.3 Soil Critical PCLs

The Site will be deed recorded to commercial-industrial land use. Based on this proposed future land use, soil critical PCLs were established using commercial-industrial Tier 1 and Tier 2 $^{GW}Soil_{Ing}$ PCLs. The $^{Air}Soil_{Inh-V}$ exposure pathway is not applicable for inorganics and was not used to develop soil critical PCLs. Development of the critical PCLs for these constituents in surface soil and subsurface soil is summarized in Tables 11A and 11B, respectively. As described in Section 4, lead and cadmium concentrations in soil samples exceeded critical PCLs within all affected property zones identified at the Site. As discussed in Section 4.2, nearly all exceedances of other metals (antimony, arsenic and selenium) correlate with elevated lead concentrations. The anticipated response action for on-site soils.

will address all inorganic and organic constituents. Figure 4A depicts the critical PCL exceedance (PCLE) zone for lead and cross sections showing the PCLE zone are provided in Section 4.

Table 11A
Surface Soil Critical PCLs

COC	Source Area Size (acres)	$^{Tot}Soil_{Comb}$ PCL (mg/kg)	$^{GW}Soil_{Ing}$ PCL (mg/kg)	Tier	cPCL[1] (mg/kg)	MQL (mg/kg)	Site-specific Background[2] (mg/kg)	Maximum Concentration				Remedy or NFA (mg/kg)
								Sample ID	Sample Depth (feet bgs)	Sample Date	Conc (mg/kg)	
Antimony	30	1.5E+01	**2.7E+00**	1	2.70E+00	2.50E+00	1.00E+00	2014-SDA-7-(0-0.5)	0-0.5	3/31/2014	**102**	Remedy
Arsenic	30	2.0E+02	3.1E+00	2	1.59E+01	1.00E+00	**1.59E+01**	2012-FWCS-1A (1-2')	1-2*	03/05/13	**115**	Remedy
Cadmium	30	8.5E+02	**3.0E+01**	2	3.00E+01	2.50E-01	--	2012-FWFS-9 (Floor)	2.4	09/04/12	**984**	Remedy
Lead	30	1.6E+03	**2.7E+02**	2	2.75E+02	5.00E-01	3.15E+01	2013-WMU14-1 (0.9-2)	0.9-2*	05/07/13	**95000**	Remedy
Selenium	30	2.9E+01	**1.6E+00**	2	1.60E+00	2.00E+00	3.00E-01	E-11C (0-0.5)	0-0.5	01/09/14	**29.2**	Remedy
Benzene	0.5	1.2E+02	**2.6E-02**	1	2.60E-02	5.00E-03	--	2013-STB-6 (0.5-1.1')	0.5-1.1	03/14/13	**0.0406**	Remedy
Methylene Chloride	0.5	4.8E+02	**1.3E-02**	1	1.30E-02	1.00E-02	--	DUP-4 (2014-NDA-7)	0-0.5	4/1/2014	**0.0183**	Remedy
Bis(2-chloroethyl)ether	0.5	2.2E+00	**2.1E-03**	1	2.1E-03	1.7E-02	--	2014-FFTA-08 (0-0.5)	0-0.5	04/01/14	**0.0371**	Remedy

Notes:

1. The critical PCL (cPCL) is the lower of the TRRP commercial-industrial Tier 1 $^{Tot}Soil_{Comb}$ and Tier 2 $^{GW}Soil_{Ing}$ PCLs for a 30-acre source area, or background if higher. Documentation of development of Tier 2 PCLs is provided in Appendix 9. The minimum applicable PCL is bolded.
2. Background values for arsenic and lead are site-specific background values (see Appendix 8).
3. Background results that exceed the critical PCL are bolded.
4. NA - Not applicable.
5. * - Sub-slab or sub-gabion basket sample; top depth represents the approximate top of soil.

Subsurface Soil Critical PCLs

COC	Source Area Size (acres)	$^{Tot}Soil_{Comb}$ PCL (mg/kg)	$^{GW}Soil_{Ing}$ PCL (mg/kg)	$^{GW}Soil_{Ing}$ PCL Tier	cPCL[1] (mg/kg)	MQL (mg/kg)	Site-specific Background[2] (mg/kg)	Maximum Concentration Sample ID	Maximum Concentration Sample Depth (feet bgs)	Maximum Concentration Sample Date	Maximum Concentration Conc (mg/kg)	Remedy or NFA (mg/kg)
Arsenic	30	NA	3.1.E+00	2	1.6E+01	1.00E+00	**1.6E+01**	2013-RMSB-5 (5-7)	5-7	05/07/13	44.5	Remedy
Cadmium	30	NA	**3.0.E+01**	2	3.0E+01	2.50E-01	--	2013-RMSB-5 (5-7)	5-7	05/07/13	60.7	Remedy
Lead	30	NA	**2.7.E+02**	2	2.7E+02	5.00E-01	3.2E+01	2013-BSB-8 (8-10)	8-10	04/10/13	54600	Remedy

Notes:

1. [1] - The $^{Air}Soil_{Inh-V}$ pathway is not applicable for arsenic, cadmium, or lead; therefore, the critical PCL (cPCL) for each of these constituents is equal to the TRRP commercial-industrial Tier 2 $^{GW}Soil_{Ing}$ PCL, or background if higher. Documentation on the development of Tier 2 PCLs is provided in Appendix 9.
2. Background values for arsenic and lead are site-specific background values (see Appendix 8).
3. Background results that exceed the critical PCL are bolded.
4. NA - Not applicable.

12.0 GROUNDWATER CRITICAL PCL DEVELOPMENT

12.1 Tier 2 or 3 PCL Development and Non-Default Parameters

Tier 2 or Tier 3 PCLs were not developed for groundwater COCs; therefore, this section is not applicable.

12.2 Groundwater PCL Adjustments

Groundwater PCL adjustments were not made for groundwater COCs; therefore, this section is not applicable.

12.3 Groundwater Critical PCLs

As discussed in Section 10, TRRP Rules 30 TAC §350.71(k)(1) and §350.71(k)(3) specify that a COC may be screened from critical PCL development if all detected COC concentrations and SDLs are less than applicable RALs or if all SDLs for analytes not detected are less than applicable RALs. As discussed in Section 5, concentrations of all organic COCs in all groundwater samples collected as part of this affected property assessment were less than applicable RALs and were therefore screened from critical PCL development.

Groundwater critical PCLs were developed for selenium, lead, arsenic and cadmium and are equivalent to the Tier 1 $^{GW}GW_{Ing}$ PCLs (see Section 5) for wells screened in the upper GWBU that are not considered potential point of exposure wells. Groundwater critical PCLs for dissolved lead and dissolved cadmium were also developed for potential point of exposure wells located along Stewart Creek and the north tributary of Stewart Creek. The lowest PCL among applicable pathways was selected as the critical groundwater PCL. The critical PCL for lead (Stewart Creek and North Tributary) and cadmium (North Tributary) is the groundwater ingestion PCL. The critical PCL for cadmium (Stewart Creek) is based on chronic aquatic life criteria. The most recent sampling data indicated no applicable PCL exceedances for total or dissolved lead or cadmium, and the selenium exceedance is believed to be associated with gypsum. Therefore, a PCLE zone figure is not presented and a response action for groundwater is not anticipated.

Table 12
Groundwater Critical PCLs

COC	$^{GW}GW_{Ing}$ PCL		$^{Air}GW_{Inh-V}$ PCL		MQL (mg/L)	Back-ground (mg/L)	Sample ID	Conc (mg/L)		Remedy or NFA
	(mg/L)	Tier	(mg/L)	Tier				Max	Rep	
Cadmium	0.005	1	NA	1	0.005	NA	MW-25	0.0031J	-	NFA (2)
Lead	0.015	1	NA	1	0.01	NA	B4R	0.076 J-	-	NFA(1,2)
Selenium	0.05	1	NA	1	0.04	NA	LMW-9	0.944	-	NFA(3)

Note:
1. B4R was resampled on 3/19/2013 for lead and was found to be below RALs/critical PCLs.
2. While MW-25 and B4R represent the maxmimum detected concentrations for cadmium and lead respectively, it is noted that cadmium does not exceed critical PCLs, and B4R was resampled and found to be below critical PCLs. Additionally, MW-46 which initially exceeded critical PCLs was resampled twice (2/17/2014 and 3/27/2014) and found to be within critical PCLs.
3. Believed to be attributable to naturally occurring in the Eagle Ford Shale and its residual soils.

13.0 NOTIFICATIONS

13.1 Section 13.1 Notification of Actual or Probable Exposure

In accordance with 30 TAC §350.55, Exide has provided notifications to property owners of areas of Stewart Creek downstream of the Site where surface water and sediment samples were collected. The notifications include the media sampled, analytical parameters, human health PCLs, and that these results and historical information are available, and how such information can be obtained. In some instances, arsenic concentrations in sediments exceeded the Tier 1 human health PCL. In those instances, notification letters included a statement that the arsenic PCL was exceeded as well as a statement regarding potential exposure. The notification letters are included in Appendix 1. A notification summary is included in Table 13A and a property map is shown in Figure 13A. The notification summary table includes the property ID, property owner name, property location, property owner mailing address, phone number, contact information (if different from owner), and the reason for notification.

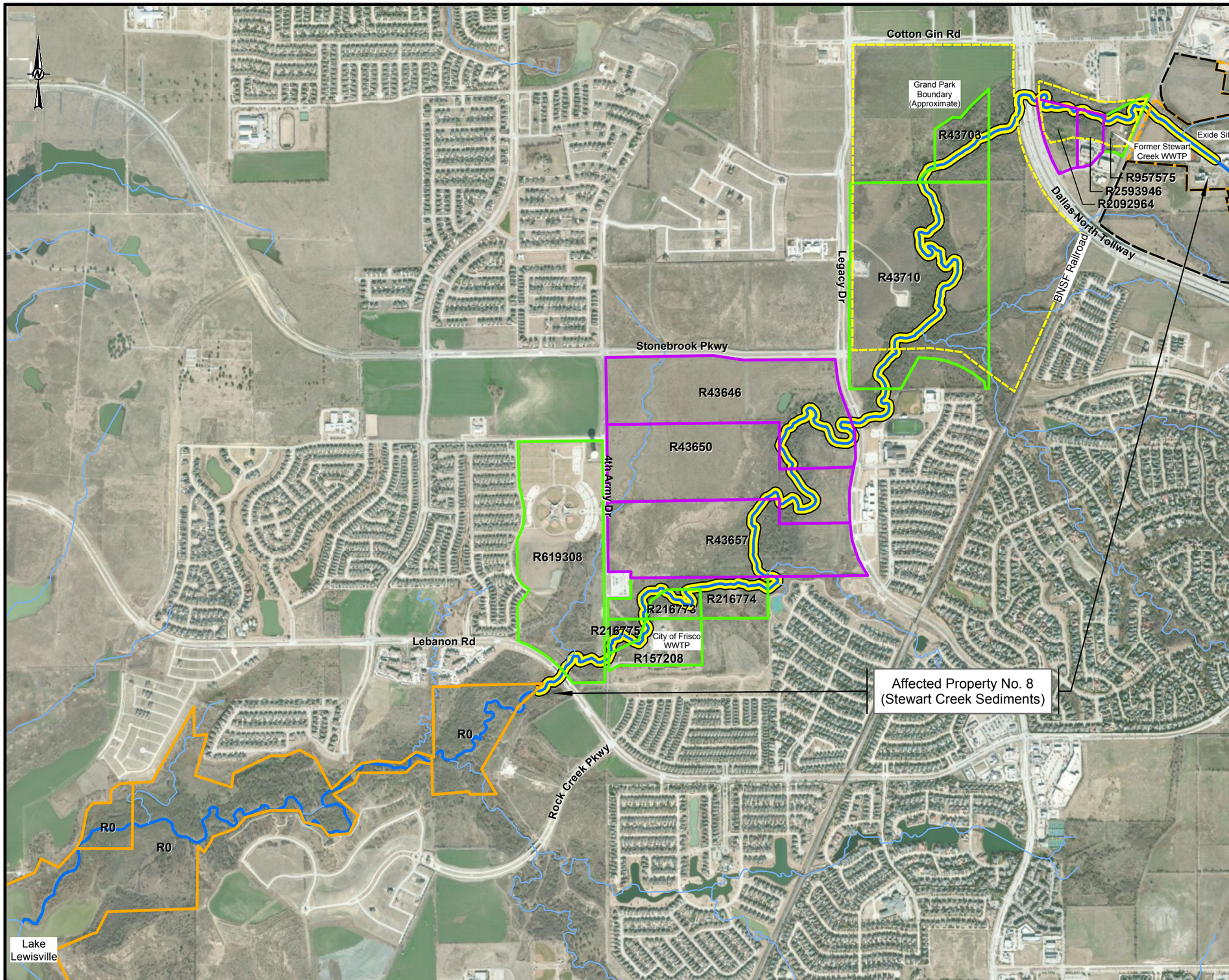
13.2 Section 13.2 Other Notifications

No other notifications were performed as a part of this Affected Property Assessment.

Table 13A
Notification Summary

Property ID (Lot No.)	Property Owner Name	Physical Property Address	Property Owner Mailing Address	Property Owner Phone Number	Contact Name, Mailing Address, City, State, Zip (if different from owner)	Reason for Notification
R957575	City of Frisco/Frisco Community Development Corporation	NA - undeveloped property	6101 Frisco Square Boulevard; Frisco, TX 75034	(972) 292-5127	Mr. Mack Borchardt	Property sampled; arsenic concentrations in sediment; historic information
R43703						
R43710						
R216774						
R216773						
R157208						
R216775						
R619308						
R2593946	Stewart Creek International Investments LP	NA - undeveloped property	5750 Genesis Court, Suite 105; Frisco, TX 75034-4163	(972) 241-5959	Mr. Terry Lowrey	Property sampled; arsenic concentrations in sediment; historic information
R2092964	Bellevue Partners Ltd.	NA - undeveloped property	111518 Reeder Road; Dallas, TX 75229-2114	(972) 241-5959	Mr. L. Bradley Camp	Property sampled; arsenic concentrations in sediment; historic information
R43646	Bert Fields Jr.	NA - undeveloped property	11835 Preston Road; Dallas, TX 75230-2708	(972) 661-3330	Peter Wahl, Esq.; Jackson Walker LLP; 901 Main Street, Suite 6000; Dallas, TX 75202	Property sampled; arsenic concentrations in sediment; historic information
R43650						
R43657						
R0	United States Army Corps of Engineers	NA - undeveloped property	1801 N. Mill Street; Lewisville, TX 75057	(469) 645-9100	Mr. Rob Jordan	Property sampled; arsenic concentrations in sediment; historic information

NOTES
NA - Not Applicable



Legend

- Grand Park Boundary (Approximate)
- Private Owner Property
- City of Frisco or City of Frisco Entity Property
- USACE Property
- Former Operating Plant
- Undeveloped Buffer Property
- Stewart Creek (Appoximate Creek Centerline)
- Creek Tributary (Appoximate Creek Centerline)
- Stewart Creek PCLE Zone

Notes:
1. PCLE Zone Boundary is based on sediment data and/or visual observations of slag or battery case fragments.

Source:
1. Aerial Imagery: Source: Esri, DigitalGlobe, GeoEye, i-cubed, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, and the GIS User Community

1,500 750 0 1,500 Feet

Scale: AS SHOWN
File No. 1302086-B027 FIG 13A.mxd

FORMER OPERATING PLANT
FRISCO RECYCLING CENTER
FRISCO, TEXAS

FIGURE 13A

NOTIFICATION MAP

PROJECT NO. 13-02086	BY: JWT	REVISIONS
DATE: 5/22/2014	CHECKED: - - -	

GOLDER ASSOCIATES INC.

Map Document: N:\File\2013\13-02086 Exide Frisco\B - APAR Phase II\map documents\1302086-B027 FIG 13A.mxd / Modified 5/22/2014 12:45:26 PM by jthomas / Exported 5/22/2014 12:45:43 PM by jthomas

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