Final 100% Remedial Design - Northern Impoundment

San Jacinto River Waste Pits Site
Harris County, Texas

International Paper Company &
McGinnes Industrial Maintenance Corporation

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List of Acronyms

AASHTO	-	American Association of State Highway and Transportation Officials
ACBM	-	Articulated Concrete Block Mat
AISC	-	American Institute of Steel Construction
AMSL	-	Average Mean Sea Level
AOC	-	Administrative Settlement Agreement and Order on Consent for Remedial Design
ARAR	-	Applicable or Relevant and Appropriate Requirements
ASCE	-	American Society of Civil Engineers
ASTM	-	American Society for Testing and Materials
ABM	-	Articulating Block Mat
BBL	-	Barrel, measurement unit for barges, equivalent to 42 gallons of liquid
bgs	-	Below Ground Surface
BHHRA	-	Baseline Human Health Risk Assessment
BMP	-	Best Management Practice
^{137}Cs	-	Cesium-137
CFR	-	Code of Federal Regulations
cm	-	Centimeter
cm/s	-	Centimeters per Second
cm/year	-	Centimeters per Year
CME	-	Central Mine Equipment
COD	-	Chemical Oxygen Demand
COPC	-	Constituent of Potential Concern
CPT	-	Cone Penetrometer Test
CQA/QCP	-	Construction Quality Assurance/Quality Control Plan
CU	-	Consolidated Undrained
CWA	-	Coastal Water Authority
CY	-	Cubic Yard
D	-	Dead Load
DI	-	Deionized
DPT	-	Direct Push Technology
DU	-	Decision Unit
EM	-	Engineer Manual by United States Army Corps of Engineers
EPA	-	Environmental Protection Agency
ERP	-	Emergency Response Plan
FSP	-	Field Sampling Plan
Evoqua	-	Evoqua Water Technologies LLC
F	-	Fluid Load
FEMA	-	Federal Emergency Management Agency
FHWA		Federal Highway Administration
FRP		Fiberglass Reinforced Polymer
FS	-	Feasibility Study
ft	-	Feet, measurement unit for length, height, or distance
ft^2	-	Square Feet
ft^3	-	Cubic Feet
ft/day	-	Feet per Day
ft/s	-	Feet per Second
F_y	-	Yield Stress
GAC	-	Granular Activated Carbon

GCV - Generalized Cross Validation
GHD - GHD Services Inc.
GHG - Greenhouse Gas
gpd - Gallons per Day
gpm - Gallons per Minute
GPS - Global Positioning System
H - Lateral Earth Pressure
HASP - Health and Safety Plan
HCFCD - Harris County Flood Control District
HDPE - High-Density Polyethylene
HWPP - High-Water Preparedness Plan
I - Barge Impact
I-10 - Interstate Highway-10
IBC - Intermediate Bulk Containers
IC - Institutional Control
ICIAP - Institutional Controls Implementation and Assurance Plan
IPC - International Paper Company
K_d - Wind Directionality
K_e - Ground Elevation Factor
kip - Kilopound
kip/ft - Kilopound per Foot
ksi - Kilopound per Square Inch
K_z - Velocity Pressure Exposure Coefficient
K_{zt} - Topographic Factor
lb - Pound
lb/ft^2 - Pounds per Square Foot
lb/ft^3 - Pounds per Cubic Foot
LC - Load Combination
$L_{SH,t}$ - Rising or Falling Limb of the Hydrograph at the Sheldon Gage at Time, t
MARS - Multivariate Adaptive Regression Splines
MIMC - McGinnes Industrial Maintenance Corporation
mg/L - Milligrams per Liter
ML - Minimum Level
MNR - Monitored Natural Recovery
mph - Miles per Hour
MRI - Maximum Recurrence Interval
N - Number of Observations
N_e - Effective Number of Parameters
NAVD88 - North American Vertical Datum of 1988
NI Northern Impoundment
ng/kg - Nanograms per Kilogram
NTU - Nephelometric Turbidity Units
O&M - Operations and Maintenance
Pa - Pascal
^{210}Pb - Lead-210
PBR - Permit By Rule
PCBs - Polychlorinated Biphenyls
PCF - Pounds per Cubic Foot

PDI	-	Pre-Design Investigation
PDI-1	-	First Phase Pre-Design Investigation
PDI-2	-	Second Phase Pre-Design Investigation
PFD	-	Process Flow Diagram
pg/L	-	Picograms per Liter
PMT	-	Pressuremeter Test
POHA	-	Port of Houston Authority
PPV		Peak Particle Velocity
psi	-	Pounds per Square Inch
PTW	-	Principal Threat Waste
PVC	-	Polyvinyl Chloride
QAPP	-	Quality Assurance Project Plan
q_z	-	Velocity Pressure
RA	-	Remedial Action
RAO	-	Remedial Action Objective
RC	-	Remedial Contractor
RCRA	-	Resource Conservation and Recovery Act
RD	-	Remedial Design
RDWP	-	Remedial Design Work Plan
RI	-	Remedial Investigation
RI/FS	-	Remedial Investigation/Feasibility Study
RML		Residual Management Layer
ROD	-	Record of Decision
ROW	-	Right-of-Way
RTK	-	Real-Time Kinetic
RPD	-	Relative Percent Difference
RSS	-	Residual Sum of Squares
SSA	-	Sand Separation Area
SDI	-	Supplemental Design Investigation
SF	-	Safety Factor
SM	-	Standard Method
SOW	-	Statement of Work
SPT	-	Standard Penetration Test
SVOC	-	Semi-volatile Organic Compound
SWMP	-	Site Wide Monitoring Plan
SWPPP	-	Stormwater Pollution Prevention Plan
TAC	-	Texas Administrative Code
TCDD	-	2,3,7,8-tetrachlorinated dibenzo-p-dioxin
TCEQ	-	Texas Commission on Environmental Quality
TCLP	-	Toxicity Characteristic Leaching Procedure
TCRA	-	Time Critical Removal Action
TDS	-	Total Dissolved Solids
$TEQ_{DF,M}$	-	TCDD Toxicity Equivalent for Mammals
TexTox	-	Texas Toxicity Screening
TOC	-	Total Organic Carbon
TODP	-	Transportation and Off-Site Disposal Plan
TSS	-	Total Suspended Solids
TSWP	-	Treatability Study Work Plan

TSWQS	-	Texas Surface Water Quality Standard
TWG	-	Technical Working Group
TxDOT	-	Texas Department of Transportation
USACE	-	United States Army Corps of Engineers
UCS	-	Unconfined Compressive Strength
USGS	-	United States Geological Survey
USCS	-	Unified Soil Classification System
UU	-	Unconsolidated Undrained
V_{100}	-	Design wind velocity with MRI of 100 years
V_{3000}	-	Design wind velocity with MRI of 3000 years
VOC	-	Volatile Organic Compound
WQBEL	-	Water Quality-Based Effluent Limitation
WEAP		Wave Equation Analysis of Pile Driving
W	-	Wind Load
W_e	-	Wind Load, Exterior
W_i	-	Wind Load, Interior
$WSE_{SH,t}$	-	Water Surface Elevation at the Sheldon Gage at Time, t
$WSE_{SJ,t}$	-	Water Surface Elevation at the Northern Impoundment at Time, t
WTS	-	Water Treatment System
µm	-	Micron
µg/L	-	Micrograms per Liter

1. Introduction

GHD Services Inc. (GHD), on behalf of International Paper Company (IPC) and McGinnes Industrial Maintenance Corporation (MIMC; collectively referred to herein as the Respondents), submits to the United States Environmental Protection Agency (EPA) this *Final 100% Remedial Design - Northern Impoundment* (100% RD) for the Northern Impoundment (NI) of the San Jacinto River Waste Pits Site in Harris County, Texas (Site). References in this 100% RD to the "work site" are to the Northern Impoundment, the Texas Department of Transportation (TxDOT) right of way (ROW) that provides the only means of land access to the Northern Impoundment, and the associated locations to be used for staging, office trailers and activities such as wastewater treatment. This 100% RD was prepared pursuant to the requirements of the Administrative Settlement Agreement and Order on Consent for Remedial Design (AOC), Docket No. 06-02-18, with an effective date of April 11, 2018 (EPA, 2018a). The AOC includes a Statement of Work (SOW) that provides for a 100% RD for the Northern Impoundment to be submitted to the EPA. The *Preliminary 90% Remedial Design - Northern Impoundment* (90% RD) was submitted on June 27, 2022 (GHD, 2022f) and the *Preliminary 90% Remedial Design - Northern Impoundment (Northwest Corner Component)* (NW Corner Addendum) (GHD, 2022g) was submitted on November 8, 2022. Comments on the 90% RD (Comments) were received in a letter dated April 18, 2024 (April 18 Letter; EPA, 2024b), and have been addressed in this 100% RD and in accordance with the schedule contained in the April 18 Letter.

In a January 5, 2024 letter (January 5 Letter; EPA 2024a) titled Notification of Serious Deficiency, the EPA notified Respondents that it deemed there to be deficiencies in the 90% RD and requested that they submit a plan within 20 days to address such deficiencies. The Respondents, while disputing EPA's claims of deficiencies in the 90% RD, submitted a plan in response to the January 5 Letter in a letter dated January 25, 2024 (January 25 Letter; IPC and MIMC 2024a), which they supplemented with additional submissions dated March 28, 2024, and April 3, 2024.

The EPA then provided the Comments in its April 18 Letter. The Comments also included EPA's comments on the 90% RD, comments from all relevant stakeholders and agencies. In the April 18 Letter, the EPA established a deliverable schedule of 30-days, 60-days, and 90-days for the Respondents' submissions to the EPA of a 100% RD. The Respondents subsequently made the 30-day and 60-day submissions to EPA, as required by the April 18 Letter.

The Respondents are submitting this 100% RD in response to the Comments in the April 18 Letter and on the basis of the January 25 Letter, as supplemented, and the 30-day and 60-day submissions.

1.1 Background

The Site is located in Harris County, Texas, east of the City of Houston, between two unincorporated areas known as Channelview and Highlands. The vicinity of the Site is shown on Figure 1-1. In 1965 and 1966, pulp and paper mill waste was reportedly transported by barge from the Champion Paper, Inc. paper mill in Pasadena, Texas, and deposited in the Northern Impoundment. The Preliminary Site Perimeter established by EPA for the remedial investigation (RI) encompasses this impoundment and the surrounding in-water and upland areas of the San Jacinto River and is depicted on Figure 1-1. The Northern Impoundment is located immediately north of the I-10 Bridge over the San Jacinto River. An area referred to in the AOC as the Sand Separation Area (SSA; Figure 1-2) is located to the northwest of the Northern Impoundment.

The Northern Impoundment is shown on Figure 1-2. Beginning in 2010, a Time Critical Removal Action (TCRA) was implemented by the Respondents under an Administrative Order on Consent with EPA (Docket No. 06-12-10, April 2010; EPA, 2010). Construction elements of the TCRA included placement of a stabilizing geotextile barrier over the eastern side of the Northern Impoundment, construction of a low-permeability geomembrane and geotextile barrier on the western side of the Northern Impoundment, and placement of armored cap material over the entire Northern Impoundment. Additional background information regarding the Northern Impoundment is contained in the *Remedial Investigation Report* (RI Report; Integral and Anchor QEA, 2013b). In June 2019, approximately 40,000 square feet of articulated concrete block mat (ACBM) were installed along the northwestern submerged slope of the armored cap, as described in the *Northwest Slope Enhancement Completion Report*, submitted to the EPA on August 13, 2019 (Integral and Anchor QEA, 2019).

The remedy selected by the EPA for the Northern Impoundment described in the ROD (EPA, 2017) includes the following:

– Removal of a portion of the existing armored cap material installed as part of the TCRA armored cap.
– Removal of approximately 162,000 cubic yards (CY) of waste material exceeding the clean-up level of 30 nanograms per kilogram (ng/kg) 2,3,7,8-tetrachlorinated dibenzo-*p*-dioxin (TCDD) toxicity equivalent ($TEQ_{DF,M}$) that is located beneath the armored cap and its stabilization, as necessary to meet the appropriate requirements for acceptance at a permitted disposal facility.

The ROD also specifies that Institutional Controls (ICs) will be used to prevent disturbance (dredging and anchoring) in the SSA and that monitored natural recovery (MNR) will be the remedy used for the SSA.

The Remedial Action Objectives (RAOs) for the Site, as identified in the ROD, include:

RAO 1: Prevent releases of dioxins and furans above clean-up levels from the former waste impoundments to sediments and surface water of the San Jacinto River.

RAO 2: Reduce human exposure to dioxins and furans from ingestion of fish by remediating sediments to appropriate clean-up levels.

RAO 3: Reduce human exposure to dioxins and furans from direct contact with or ingestion of paper mill waste, soil, and sediment by remediating affected media to appropriate clean-up levels.

RAO 4: Reduce exposures of benthic invertebrates, birds, and mammals to paper mill waste derived dioxins and furans by remediating affected media to appropriate clean-up levels.

The potential exposure of a future young recreational fisher to dioxin and dioxin-like compounds in sediment, as detailed in the *Baseline Human Health Risk Assessment* (BHHRA; Integral and Anchor QEA, 2013a), was considered in selecting a risk-based clean-up level for the Northern Impoundment. The BHHRA assumed that the young recreational fisher could be exposed through chronic (39 days per year for 6 years) incidental ingestion and dermal contact of impacted sediment and through ingestion of fish collected in areas with impacted sediment. The risk-based clean-up level for the Northern Impoundment was calculated to be 30 ng/kg $TEQ_{DF,M}$.

1.2 Remedial Design Approach

As an introductory note, the EPA has required Respondents to develop a RD based on the remedy selected in the 2017 ROD for the Northern Impoundment. Prior to and during the RD process, the Respondents have raised with the EPA the magnitude of the risks associated with the selected remedy, including the fact that the remedy requires excavation on a “no release” basis to more than 28 feet below the river surface in a complex riverine environment subject to extreme high-water events during which overtopping of the BMP wall might occur. In light of that risk, the Respondents, after discussions with the EPA, proposed in their 30% RD and 90% RD submissions that work be limited to a six-month season that did not include the hurricane season. The Comments ask that the Respondents commit to extend the excavation season well into the hurricane season. The Respondents are prepared to extend the excavation season on the basis set forth below in Section 5.3.2, if directed by the EPA to do so.

In accordance with the AOC, the remedial design (RD) process includes the use of a Technical Working Group (TWG) to provide technical expertise in the development and evaluation of the RD plans. The TWG has considered the pre-design investigation (PDI), Supplemental Design Investigation (SDI), Treatability Study results, and Northern Impoundment RD elements presented in this document. The TWG consists of representatives from the EPA, Texas Commission on Environmental Quality (TCEQ), the United States Army Corps of Engineers (USACE), GHD, and other technical subject matter experts, as needed. TWG Meetings have been conducted a total of 25 times since the RD was initiated, including on April 30, 2018, May 14 to 15, 2018, May 30, 2018, June 13, 2018, May 3, 2019, December 17, 2019, January 27 to 28, 2020, February 19, 2020, March 25, 2020, April 22, 2020, July 29, 2020, November 12, 2020, December 15, 2020, February 4, 2021, March 10, 2021, April 19, 2021, June 4, 2021, August 5, 2021, August 30, 2021, October 19, 2021, November 16, 2021, December 14, 2021, March 10, 2022, March 25, 2022, and April 14, 2022.

In addition, during certain portions of the RD process, representatives from GHD and EPA conducted weekly meetings to discuss the ongoing design progress, key technical items, and decisions associated with these items.

With the exception of Monthly Progress Reports, a summary of the deliverables associated with the RD to-date are listed below:

- On June 8, 2018, the *Draft First Phase Pre-Design Investigation Work Plan* (Integral and Anchor QEA, 2018a) was submitted to the EPA. The EPA provided comments and the *First Phase Pre-Design Investigation Work Plan* (Integral and Anchor QEA, 2018b) was submitted to the EPA on August 24, 2018. It was approved by the EPA on September 12, 2018 (EPA, 2018b). An Addendum to the First Phase Pre-Design Investigation Work Plan (Integral and Anchor QEA, 2018d) was submitted on October 18, 2018.
- On September 10, 2018, the *Draft Remedial Design Work Plan* (RDWP, Integral and Anchor QEA, 2018c) was submitted to the EPA and outlined plans for implementing the RD activities identified in the SOW. The EPA provided comments on the Draft RDWP on October 24, 2018. The *Remedial Design Work Plan* (Integral and Anchor QEA, 2018e) was submitted to the EPA on December 24, 2018.
- On December 7, 2018, a letter was submitted to the EPA (GHD, 2018) requesting a 48-day extension of the deadline for submittal of the *Draft Second Phase Pre-Design Investigation Work Plan* to allow time for the results from the First Phase Pre-Design Investigation (PDI-1) to be evaluated and incorporated. This extension request was approved by the EPA on December 18, 2018 (EPA, 2018c), effectively extending the date for all subsequent RD submittals.
- On February 11, 2019, the *Draft Second Phase Pre-Design Investigation Work Plan* (GHD, 2019a) was submitted to the EPA. The EPA provided comments to the work plan on April 18, 2019 (EPA, 2019a). On June 3, 2019, the *Final Second Phase Pre-Design Investigation Work Plan* (GHD, 2019d) was submitted to the EPA and approved by the EPA in written correspondence dated August 8, 2019 (EPA, 2019c).
- On February 11, 2019, the *Draft Treatability Study Work Plan* (GHD, 2019b) was submitted to the EPA. The EPA provided comments to the work plan on April 18, 2019 (EPA, 2019b). On May 20, 2019, the *Final Treatability Study Work Plan,* (GHD, 2019c) was submitted to the EPA and approved in written correspondence dated August 27, 2019 (EPA, 2019d).
- On September 27, 2019, a letter was submitted to the EPA (GHD, 2019e) requesting an extension to the deadline for both the 30% RD for the Northern and Southern Impoundments in response to a *force majeure* event caused by Tropical Storm Imelda, which caused significant flooding at the Northern Impoundment and the surrounding area beginning on September 17, 2019, and delayed the completion of field work related to the Second Phase PDI (PDI-2) from September 17 to October 7, 2019. In a letter dated October 30, 2019 (EPA, 2019f), the EPA approved a 24-day delay due to the *force majeure* event and an extension to the deadlines for submittal of the 30% RD for both the Northern Impoundment and the Southern Impoundment.
- On May 28, 2020, the 30% RD was submitted to the EPA. The EPA provided Comments on July 16, 2020 (EPA, 2020f).
- On August 21, 2020, a letter was submitted to the EPA (GHD, 2020e) requesting a 160-day extension of the November 13, 2020, deadline for submitting the 90% RD to April 22, 2021, to allow time to determine if significant constructability concerns raised in the 30% RD could be resolved and to obtain additional information about plans being developed by other agencies. The extension was approved by the EPA in a letter dated September 10, 2020 (EPA, 2020g).
- On February 3, 2021, a letter was submitted to the EPA (GHD, 2021a) requesting a 270-day extension of the deadline for the 90% RD to January 17, 2022, to allow time to conduct the SDI to better delineate the extent of the impacted material for removal and to better understand geotechnical conditions to support the design. The extension was approved by the EPA in a letter dated March 29, 2021 (EPA, 2021a).
- On February 19, 2021, the *Supplemental Design Investigation Sampling Plan* (SDI Work Plan) (GHD, 2021b) was submitted to the EPA. EPA provided comments on the SDI Work Plan on March 29, 2021 (EPA, 2021b). On

May 21, 2021, the *Supplemental Design Investigation Sampling Plan - Rev. 1* (Revised SDI Work Plan) (GHD, 2021c) was submitted to the EPA and approved by the EPA in written correspondence dated June 4, 2021 (EPA, 2021c).

– On October 1, 2021, a letter was submitted to the EPA (GHD, 2021f) requesting a 160-day extension of the deadline for the 90% RD to June 26, 2022, to allow for receipt, evaluation, and incorporation of the analytical, geotechnical, and supporting data from the SDI. As requested in an e-mail from the EPA dated October 28, 2021, a Request for Northern Impoundment Schedule Extension - Addendum (GHD, 2021h) was submitted on November 9, 2021, that included a revised schedule that provided for the staged submittal of all RD components required by the SOW to be included in the 90% RD. This extension request was approved by the EPA in a letter dated January 12, 2022 (EPA, 2022a). A further extension request specifically with respect to the northwest corner was submitted to the EPA on June 21, 2022 (IPC and MIMC, 2022b).
– On June 27, 2022, the 90% RD was submitted to the EPA (GHD, 2022f), to which the EPA provided Comments in the April 18 Letter. Responses to these Comments are summarized in Table 1-1 and these Comments have been addressed throughout this 100% RD.
– On November 8, 2022, the 90% RD - Northwest Corner Addendum was submitted to the EPA (GHD, 2022g), to which the EPA provided Comments in the April 18 Letter. Responses to these Comments are summarized in Table 1-1 and these Comments have been addressed throughout this 100% RD.
– On January 25, 2024, the Respondents submitted in the January 25 Letter a plan in response to the EPA's January 5 Letter and subsequently supplemented that plan in submissions dated March 28, 2024 and April 3, 2024. EPA collectively provided comments from other stakeholders on these submissions as part of the Comments.

1.3 Objective

The objective of this 100% RD is to present a summary, consistent with the SOW, of the RD for the Northern Impoundment.

This 100% RD includes a summary of the results from the PDI-1, PDI-2, SDI, and Treatability Studies. This 100% RD also includes a description of the primary design elements for the remedy selected in the ROD for the Northern Impoundment, including those related to the design and installation of the BMP wall, waste material removal methodology, and water treatment. Associated design drawings, specifications, and supplemental plans are also included in this 100% RD.

1.4 Document Organization and Supporting Deliverables

The remaining sections of this 100% RD are organized as follows:

– ***Section 2*** includes descriptions of the phased PDI and SDI for the Northern Impoundment that were performed and a summary of the results and conclusions from these events.
– ***Section 3*** includes a description of Treatability Studies performed for the Northern Impoundment and results.
– ***Section 4*** addresses the Applicable or Relevant and Appropriate Requirements (ARARs) that may be applicable to the Northern Impoundment remedial action (RA) work.
– ***Section 5*** details the design criteria assumptions that are the basis for the current BMP wall design, waste material removal and solidification methodology, transportation and disposal, and water treatment process elements of the Northern Impoundment RD.
– ***Section 6*** includes a description of the investigation activities conducted in the SSA during PDI-2 and the implications of the results of that investigation for MNR.
– ***Section 7*** includes a description of how the RA for the Northern Impoundment may be implemented in a manner that minimizes environmental impacts in accordance with the EPA's *Principles for Greener Clean-Ups* (EPA, 2009).

- ***Section 8*** includes a list of the drawings and associated technical specifications developed to date for this 100% RD.
- ***Section 9*** includes descriptions of the supporting deliverables identified in the SOW: Health and Safety Plan (HASP), Emergency Response Plan (ERP), Field Sampling Plan (FSP), Quality Assurance Project Plan (QAPP), Site-Wide Monitoring Plan (SWMP), Construction Quality Assurance/Quality Control Plan (CQA/QCP), Institutional Controls Implementation and Assurance Plan (ICIAP), Transportation and Off-Site Disposal Plan (TODP), Monitored Natural Recovery (MNR) Plan, and High-Water Preparedness Plan (HWPP).
- ***Section 10*** includes references to cited reports, correspondence and other documents.

This 100% RD includes supporting figures and tables that are referenced throughout the document. This 100% RD also includes the following appendices:

- **Appendix A** - PDI and SDI Supporting Documents (including aquifer test results for the PDI-1, and analytical laboratory reports, data validation reports, and a photographic log for PDI-1, PDI-2, and SDI).
- **Appendix B** - Geotechnical Engineering Report, including a SDI Geotechnical Data Report and the Updated Hydraulic Heave Analysis Report dated May 20, 2024 (GHD, 2024a; Updated Hydraulic Heave Report).
- **Appendix C** - Treatability Testing Supporting Documents (including water and waste material analytical laboratory reports, data validation reports, and a photographic log).
- **Appendix D** - ARAR Support Documents.
- **Appendix E** - SSA Supporting Documents (including analytical lab reports and data validation reports).
- **Appendix F -** Hydrodynamic Modelling Report.
- **Appendix G** - Design Drawing Package.
- **Appendix H** - Design Specifications.
- **Appendix I** - BMP Structural Design Report.
- **Appendix J -** Supporting Deliverables (including HASP, ERP, FSP, QAPP, SWMP, CQA/QCP, ICIAP, TODP, MNR Plan, and HWPP).

2. Design Investigations

In March 2011 and May 2012, the Respondents completed investigations at the Northern Impoundment as part of the RI. A summary and the results of these investigations are included in the RI Report. The RI included installation of eight borings to total depths ranging from 7.5 to 12.5 feet (ft) below ground surface (bgs) to characterize waste material chemistry, the results of which provided the basis for the remedial alternative selected in the ROD.

The main objective of the Northern Impoundment PDI and the SDI was to delineate and refine the depth and volume of materials likely requiring removal, as well as to obtain site-specific geotechnical data to inform the design of the BMP, specified in the ROD.

The PDI for the Northern Impoundment was conducted in two phases (in 2018 and 2019) and the SDI was conducted in 2021, as described below.

2.1 First Phase Pre-Design Investigation (PDI-1)

PDI-1 activities in the Northern Impoundment were completed by Integral Consulting and Anchor QEA between November 5 and December 9, 2018, in accordance with the *First Phase Pre-Design Investigation Work Plan* (Integral and Anchor QEA, 2018b), dated August 24, 2018, and approved by the EPA on September 12, 2018 (EPA, 2018b), and the *Addendum to the First Phase Pre-Design Investigation Work Plan*, dated October 18, 2018 (Integral and Anchor QEA, 2018d).

The purpose of the PDI-1 for the Northern Impoundment was to:

- Characterize the waste material in the Northern Impoundment that contains concentrations of dioxins and furans greater than 30 ng/kg $TEQ_{DF,M}$.
- Evaluate the concentrations of dioxins and furans within the historic central berm separating the eastern and western sides of the Northern Impoundment, as well as the perimeter berm located at the southern edge of the Northern Impoundment.
- Evaluate geotechnical characteristics of the material contained within the Northern Impoundment to inform RD engineering controls.
- Assess the specific yield of the waste material in the Northern Impoundment and hydraulic conductivity and specific yield of the unconsolidated riverine deposits below the Northern Impoundment and above the Beaumont Clay formation, in order to evaluate permeability of the soils and the expected infiltration/seepage of water during excavation activities.

Northern Impoundment PDI-1 field activities included waste material sampling for chemistry, waste characterization, and geotechnical analyses at 17 boring locations (Figure 2-1). Soil borings were advanced from the surface to 18 ft bgs for dioxins and furans analysis, from the surface to 10 ft bgs for waste characterization analysis, and from the surface to the Beaumont Clay (to a maximum depth of 62 ft bgs) for geotechnical sampling and testing. Four monitoring wells were also installed and an aquifer test was conducted.

Upland soil borings were installed from November 5 to 19, 2018 at 10 locations (SJSB028 to SJSB037), from which analytical, geotechnical, and waste characterization samples were collected. Four of these borings were completed as monitoring wells to utilize for aquifer testing. Six geotechnical borings (SJGB018 to SJGB023) were installed outside the perimeter of the armored cap from November 28 to December 5, 2018. Finally, on December 9, 2018, boring SJSB038 was installed for analytical, geotechnical, and waste characterization sampling.

A photographic log documenting the PDI-1 field event is included as part of Appendix A.

2.1.1 PDI-1 Drilling Methodology

PDI-1 boring locations were placed in areas that could be accessed from either a barge secured outside the extent of the armored cap or from a land-based drilling rig.

A roto-sonic drilling rig was utilized to install the 17 geotechnical borings. Six geotechnical boring locations (SJGB018, SJGB019, SJGB020, SJGB021, SJGB022, and SJGB023) were located under water, outside the extent of the armored cap. For these locations, a barge-mounted roto-sonic drilling rig was used. A track-mounted Direct Push Technology (DPT) drilling rig was utilized for the analytical borings. All analytical borings were located on the upland portions of the Northern Impoundment. Boring SJSB038 was located in an area of the Northern Impoundment that is covered with water that fluctuates from 0 to 2 ft of water, depending upon the season and the tide. To ensure that the boring at this location could be completed with the terrestrial drilling equipment, road-base aggregate was brought in and placed to establish access to the boring location.

At locations accessible by standard terrestrial equipment, armored cap material was removed, and the geotextile and/or geomembrane liner was cut prior to drilling activities. At the conclusion of drilling, the borings were grouted to the top, the geotextile and/or geomembrane liner was repaired, and the armored cap material was replaced.

2.1.2 PDI-1 Analytical Sampling

A total of 11 borings were installed at locations in the Northern Impoundment for chemical sampling to fill in data gaps from the RI, as shown on Figure 2-1. Borings were generally installed to a depth of 18 ft bgs, with three borings (SJSB036, SJSB037, and SJSB038) installed to maximum depth of 12 to 13 ft bgs.

Discrete waste material samples were collected via DPT methodology and submitted for analysis consistent with the *First Phase Pre-Design Investigation Work Plan* (Integral and Anchor QEA, 2018b), with the exception of boring location SJS038 which was sampled with the use of a 7-inch diameter sonic core method, due to low recovery with the

DPT methodology. With the exception of boring locations SJSB036, SJSB037, and SJSB038, all samples were collected in two-foot intervals. Borings SJSB036, SJSB037, and SJSB038 were used to determine a potential contact point differentiating waste from underlying soil. Samples for these borings were collected above and below the identified waste contact point.

All samples were analyzed by ALS Laboratories for dioxins and furans using EPA approved Method 1613B. Sample data validation was completed by a third-party validation firm (EcoChem, Inc.).

2.1.3 PDI-1 Geotechnical Sampling

A total of 17 geotechnical borings were installed in the Northern Impoundment to total depths ranging from 22 to 62 ft bgs to fill data gaps from the RI and to evaluate the geotechnical properties of the soil around the perimeter of the Northern Impoundment. PDI-1 geotechnical boring locations are shown on Figure 2-1. Disturbed samples were collected from standard penetration test (SPT) split-spoon samplers and analyzed for moisture content, plasticity (Atterberg limits), specific gravity, and grain size distribution. Undisturbed samples were collected using Shelby tube samplers and analyzed for consolidated undrained (CU) triaxial shear strength, direct shear strength testing, one-dimensional consolidation testing, and bulk density. All tests were performed in a laboratory setting, with the exception of blow counts that were conducted in the field. Geotechnical samples were analyzed by GeoTesting Express.

2.1.4 PDI-1 Waste Characterization Sampling

To support waste disposal planning, three composite samples were collected for waste characterization sampling, as depicted on Figure 2-1. Samples were collected from depths of 0 to 10 ft bgs. Samples were analyzed by ALS Laboratories for toxicity characteristic leaching procedure (TCLP) parameters (EPA Method 1311 [SW-846]), ignitability (Flashpoint - SW-846 1010A), corrosivity (pH - EPA 9040), and reactivity (Reactive cyanide - SW-846 7.3.3.2 and Reactive sulfides - SW-846 9034). All waste characterization samples indicate that the waste material did not exhibit any of the four characteristics of hazardous waste (ignitability, corrosivity, reactivity, or toxicity) and, therefore, can be disposed of as non-hazardous waste.

2.1.5 PDI-1 Aquifer Testing

As part of PDI-1 field activities, four 4-inch diameter temporary monitoring wells (SJTW014, SJTW015, SJTW016, and SJTW017) were installed to total depths ranging from 36 to 42 ft bgs and screened from 10 to 15 ft bgs to total depth. Locations of the monitoring wells are shown on Figure 2-1. The monitoring wells were developed and utilized for an *in-situ* hydraulic aquifer test (i.e., constant rate discharge pumping tests).

Aquifer testing was conducted on each monitoring well from December 4 through December 7, 2018. Each test was run for approximately 3 hours, with a downhole transducer in the pumping well and periodic water level gauging at the other three monitoring wells being used as observation wells. Monitoring wells SJTW-015, SJTW-016, and SJTW-017 all yielded high pumping rates ranging from 16 to 26 gallons per minute (gpm). Each well had a relatively stable drawdown ranging from 7 to 11 ft from the starting water level. After each test, recovery water level readings were collected and each well displayed a relatively rapid well recovery. Only well SJTW-014, in the southeast corner, exhibited slow recovery and supported a pumping rate of 0.2 gpm.

2.1.6 Summary of PDI-1 Results

2.1.6.1 PDI-1 Analytical Results

Of the 11 borings analyzed, 5 borings (SJSB029, SJSB030, SJSB031, SJSB034, and SJSB035) had dioxin and furan concentrations below 30 ng/kg $TEQ_{DF,M}$, in all intervals as seen on Figure 2-2. These borings were located within the historic central berm separating the eastern and western sides of the Northern Impoundment, as well as the berm located at the southern edge of the Northern Impoundment. This is consistent with the understood construction of the historic impoundment whereby native soil was used to create the central and southern berms.

Six boring locations (SJSB028, SJSB032, SJSB033, SJSB036, SJSB037, and SJSB038) had concentrations greater than 30 ng/kg $TEQ_{DF,M}$ in one or more intervals. Boring location SJSB028, installed on the far eastern edge of the southern berm, had concentrations above 30 ng/kg $TEQ_{DF,M}$, at a maximum depth of 6 ft bgs. Boring locations SJSB032 and SJSB033 were installed to 18 ft bgs along the western edge of the Northern Impoundment. Results from these boring locations indicated concentrations above 30 ng/kg $TEQ_{DF,M}$, to depths of 10 and 12 ft bgs, respectively. Borings SJSB036 and SJSB037 were installed to terminal depths of approximately 13 ft bgs. Concentrations above 30 ng/kg $TEQ_{DF,M}$, at these locations near the center of the western side were identified at a maximum depth of approximately 11 ft bgs at both borings. Boring SJSB038 on the eastern side of the Northern Impoundment was installed to a depth of 12 ft bgs and showed concentrations above 30 ng/kg $TEQ_{DF,M}$ at a depth of 11 ft bgs.

PDI-1 analytical results are shown on Figure 2-2. The validated analytical data, shown in Table 2-1, provides quality assurance that the data collected are usable. The analytical laboratory reports and data validation report are included as part of Appendix A.

2.1.6.2 PDI-1 Geotechnical Results

The PDI-1 geotechnical results identified the presence of interbedded clay, silt, and sand in the areas of the Northern Impoundment in which the geotechnical samples were collected. Soils down to 6 to 10 ft bgs have a high moisture content, with moisture content decreasing as depth increases. Atterberg classification of clay soils indicated that most of the clays are high plasticity, fat clays, with a slightly fewer number of samples classified as low plasticity, lean clays. Interspersed within these clays were samples showing high gravel/sand content. The PDI-1 geotechnical results are included in Appendix B and are further discussed in Section 5.3.3, as they relate to the Northern Impoundment RD.

2.1.6.3 PDI-1 Waste Characterization Results

Waste characterization results indicate that the Northern Impoundment waste material did not exhibit any of the four characteristics of hazardous waste (ignitability, corrosivity, reactivity, or toxicity) and are not Listed Wastes, as defined in Title 40 of the Code of Federal Regulations (CFR) Part 261, Subpart C. As a non-hazardous waste, the waste material would meet the definition of Class I or Class II industrial waste under the regulations governing classification of non-hazardous industrial solid waste in Texas (30 Texas Administrative Code [TAC] §335.505, 335.506, and 335.508).

Validated waste characterization data, shown in Table 2-2, provides quality assurance that the data collected are usable. The analytical laboratory reports and data validation report are included as part of Appendix A.

Additional waste characterization testing of Northern Impoundment waste material was performed as part of the 2019 Treatability Study, conducted concurrently with PDI-2, and as part of the 2021 SDI activities. See Section 3.3 for a summary of the Treatability Study waste characterization results. See Section 2.3.7.2 for a summary of the SDI waste characterization results.

2.1.6.4 PDI-1 Aquifer Testing Results

Analysis of the transducer and gauging data from the PDI-1 aquifer tests indicated that there was no meaningful connectivity between the observation wells and the temporary monitoring wells (SJTW014, SJTW015, SJTW016, and SJTW017) and that there is no influence on the water levels of nearby wells that is not also matched by the tidal fluctuations of the river. Results indicated that there is a strong hydrological connection between the river and the shallow sand/silt layer underlying the Northern Impoundment. The data show that the shallow groundwater system is controlled by the hydrological influence of the river. The BMP included in the design will cut off the interconnection between the shallow groundwater and the river within the areas of removal. The only groundwater infiltration to be considered in the design is local seepage of stored groundwater near the excavations. Aquifer test results are included as part of Appendix A.

2.2 Second Phase Pre-Design Investigation (PDI-2)

The PDI-2 fieldwork on the Northern Impoundment was conducted by GHD from September 4 through December 13, 2019, in accordance with the *Final Second Phase Pre-Design Investigation Work Plan* (PDI-2 Work Plan; GHD, 2019d), dated June 3, 2019, and approved by the EPA on August 8, 2019 (EPA, 2019c). On September 17, 2019, Tropical Storm Imelda caused significant flooding at the Northern Impoundment, forcing all field activities to be suspended from September 17 to October 7, 2019. This event resulted in a *force majeure* event that delayed the completion of PDI-2 field activities. EPA approved a 24-day schedule extension due to the *force majeure* event on October 30, 2019 (EPA, 2019f),

The purpose of the PDI-2 was to:

- Fill data gaps identified in PDI-1 by refining the horizontal and vertical extent of the waste material with a $TEQ_{DF,M}$ greater than 30 ng/kg to quantify the volume of waste material requiring removal, and to inform the alignment of the BMP during removal activities.
- Fill geotechnical data gaps identified in PDI-1 by collecting geotechnical data to support evaluation of slope stability and inform the BMP design.
- Conduct topographic, bathymetric, and utility surveys to support design of access, staging, and excavation.
- Collect hydrographic data to inform engineering of the BMP.

The Northern Impoundment PDI-2 field activities included installation of 25 analytical sample borings and 9 geotechnical borings at a total of 29 locations, as shown on Figure 2-3. Cuttings from the geotechnical borings were also collected as composite samples for treatability testing, further discussed in Section 3. Borings were advanced from the surface to a maximum depth of either 18 or 30 ft bgs for analytical borings, and to a maximum depth ranging from 20 to 100 ft bgs for geotechnical borings.

A photographic log documenting the Northern Impoundment PDI-2 field event is included in Appendix A.

2.2.1 Drilling Methodology

Due to the location of the Northern Impoundment, portions of the impoundment are heavily influenced by tides and inclement weather. The water level across the Northern Impoundment can vary several feet in the course of one day, providing unique challenges to the use of the drilling methodologies implemented during the PDI-2. Boring installation and sampling were conducted by one of the following methodologies:

- Track mounted drilling rig (DPT and hollow-stem auger).
- Airboat-mounted drilling rig (DPT).
- Barge-mounted drilling rig (hollow stem auger).

Of the 29 boring locations selected for PDI-2, all but six were located in areas that were under water. The appropriate drilling equipment and methodology was selected specifically for each boring location as required by the site conditions and water level of the San Jacinto River at the time each boring was advanced. PDI-2 boring locations are shown on Figure 2-3.

At locations accessible by standard terrestrial equipment, a mini-excavator was used to remove armored cap rock, then the geotextile and/or geomembrane liner was cut prior to drilling activities. At boring locations that were submerged under water, accessible only by airboat or barge-mounted drilling equipment, certified divers hand cleared the cap rock from each boring location, precisely cut the geotextile and/or geomembrane liner, and then installed a short surface casing (4 feet diameter High-Density Polyethylene [HDPE] pipe or 18-inch diameter steel pipe) to protect against sloughing of the surrounding surface cap materials during drilling. For underwater borings, a wider-diameter casing was first pushed through the extent of the impacted material (approximately 18 to 20 ft bgs) and then the drill rod was advanced through the casing to prevent the potential release of any impacted material to the river during drilling activities.

At the conclusion of drilling at all boring locations, the borings were grouted, the casing was pushed to the mudline (for underwater borings), the geotextile and/or geomembrane liner was repaired, and the armored cap rock was replaced.

2.2.2 PDI-2 Analytical Sampling

In accordance with the PDI-2 Work Plan (GHD, 2019d), the sampling program was designed to better define the placement of the outer BMP. To that end, 14 non-contingent, analytical borings (SJSB045 to SJSB058) were initially installed primarily along the outer perimeter of the Northern Impoundment, just inside the limits of the armored cap. Samples from these locations were analyzed and if the concentrations of dioxins and furans in a boring were found to be below 30 ng/kg $TEQ_{DF,M}$, the associated contingent boring location (located interior to the non-contingent boring) was installed and sampled. This methodology was repeated until a boring was found to have concentrations above 30 ng/kg $TEQ_{DF,M}$.

Nine contingent sample locations (SJSB046-C1, SJSB047-C1, SJSB049-C1, SJSB050-C1, SJSB052-C1, SJSB055-C1, SJSB055-C2, SJSB056-C1, and SJSB057-C1) were originally planned, as seen on Figure 2-3, but based upon the results of the 14 non-contingent analytical borings, only six out of the nine contingent borings (SJSB046-C1, SJSB047-C1, SJSB050-C1, SJSB052-C1, SJSB055-C1, SJSB056-C1) were installed and sampled. All borings were installed using DPT methodology to a depth of 18 ft bgs and samples were collected on two-foot intervals.

Several modifications were made to the original PDI-2 scope of work based upon field conditions and analytical data results. A *Work Plan Refinement Notice* (GHD, 2019f) was submitted to the EPA on October 11, 2019, and approved on October 22, 2019 (EPA, 2019e). Per this notice, sample location SJSB050-C1 was relocated approximately 100 ft to the east to better delineate the horizontal and vertical extent of the waste material on the eastern boundary of the Northern Impoundment. Also, per this notice, sample location SJSB058 was moved approximately 60 ft to the southeast to allow the boring to be completed as a land-based boring.

There were several instances where one of the perimeter non-contingent borings had results below the clean-up level, and the next interior boring location from that clean boring had results that exceeded the clean-up level at, or almost at, total depth. To better delineate the horizontal and vertical extent of waste material, borings were added between the clean boring and the impacted boring. An *Additional Work Plan Refinement Notice* (GHD, 2019g) was submitted to the EPA on November 1, 2019, and was approved on November 8, 2019 (EPA, 2019g*).* Per this notice, three borings (SJSB045-C1, SJSB048-C1, and SJSB053-C1) were added between clean and impacted borings as described above. In addition, two samples were taken at locations SJSB070 and SJSB071 along the southern boundary of the ACBM panels on the western side of the Northern Impoundment (see Figure 2-3). The five additional borings were sampled and analyzed at two-foot intervals from zero to 18 ft bgs.

A *Fourth Work Plan Refinement Notice* (GHD, 2019h) was submitted to the EPA on December 4, 2019, requesting to relocate boring location SJSB046-C1 approximately 45 ft to the north to better delineate the horizontal and vertical extent of waste material on the eastern side of the Northern Impoundment. The request was approved by the EPA on December 9, 2019 (EPA, 2019h).

Analytical results obtained during the initial PDI-2 sample data analysis indicated concentrations of dioxins and furans greater than 30 ng/kg $TEQ_{DF,M}$, at the terminal depth of 18 ft bgs at 3 locations (SJSB046, SJSB058, and SJSB048-C1). To fully delineate the vertical extent of impacted material, duplicate borings were installed directly adjacent to the original borings at these locations, as outlined in the *Additional Work Plan Refinement Notice* (GHD, 2019f) and the *Fourth Work Plan Refinement Notice* (GHD, 2019h). Each duplicate boring was installed directly adjacent to the original borings to a depth of 30 ft bgs. Discrete samples were collected for every two-foot interval between 18 and 30 ft bgs, for a total of six samples per boring. The 18 to 20 ft bgs interval at each duplicate boring was analyzed, while the remaining five samples were held by the lab pending results of the first depth interval. Analytical results indicated that concentrations of dioxins and furans were below 30 ng/kg $TEQ_{DF,M}$ at the 18 to 20 ft bgs depth interval for all three locations; thus, the remaining samples for subsequent depth intervals were not analyzed.

In summary, 25 analytical borings were completed. Three were completed as land-based borings and 22 were completed as water-based borings. Three of the 25 borings were drilled to 30 ft bgs. All others were drilled to 18 ft bgs.

All analytical samples were analyzed by Eurofins TestAmerica Laboratory for dioxins and furans using EPA Method 1613B and percent moisture using Standard Method (SM) 2540G. Data validation was completed by GHD.

2.2.3 PDI-2 Geotechnical Sampling

Upon review of the geotechnical data obtained during the PDI-1, data gaps were identified and documented in the PDI-2 Work Plan (GHD, 2019d). Additional geotechnical data was needed on the interior of the Northern Impoundment boundary on the eastern side of the central berm to inform the design of possible internal BMPs (being considered at the time) for a multi-cell remediation approach. The geotechnical analyses performed during the RI and PDI-1 were determined to be insufficient to inform BMP design. Specifically, there was no unconsolidated-undrained (UU) triaxial compression data to evaluate shear strength. As such, a total of nine geotechnical borings (SJGB024 through SJGB027, SJSB047, SJSB050, SJSB053, SJSB057, and SJSB058) were installed during the PDI-2. The geotechnical boring locations are shown on Figure 2-3.

Geotechnical borings were installed using a Central Mine Equipment (CME) mud-rotary drilling rig. Samples were collected and analyzed for moisture content (per American Society for Testing and Materials [ASTM] D2216), grain size with hydrometer (per ASTM D6913 and ASTM D7928), plasticity (Atterberg limits; per ASTM D4318), torvane shear (per ASTM D2537), and UU triaxial shear strength (per ASTM D2850) to depths ranging from 20 to 100 ft bgs. Geotechnical samples were sent to Tolunay-Wong Engineers, Inc. for analysis.

2.2.4 Sand Separation Area Sampling

Samples were collected during the PDI-2 sampling event to establish current conditions in the SSA. The samples were collected from nine locations shown on Figure 2-4 using Vibracore sampling devices and a dive team. At each location, samples were collected at depth intervals of 0 to 1 ft, 1 to 2 ft, 2 to 4 ft, and 4 to 6 ft below the sediment/surface water interface and analyzed for dioxins and furans. Eurofins TestAmerica analyzed the samples by EPA Method 8290 and percent solids. Samples were also collected at depth intervals of 2.5 centimeters (cm) (0.98 inches) from the sediment/surface water interface to a depth of 82.5 cm (32.5 inches) and analyzed for cesium-137 (^{137}Cs) and lead-210 (^{210}Pb) using EPA Method 901.1 by Teledyne Brown Engineering, Inc.

A detailed summary of sampling activities and results is included in Section 6.

2.2.5 Transducer Installation

On July 22, 2019, two transducers were installed on the west side of the Northern Impoundment to evaluate the hydrological conductivity of the shallow sand and silt zone beneath the Northern Impoundment and the river. One transducer was installed in monitoring well SJTW-016 and the other was installed in a piezometer that was manually driven into the river sediment just off the shore to the west of SJTW-016. Each was fitted with a telemetry device and transmits data that can be remotely accessed. The locations of the transducers are shown on Figure 2-3.

2.2.6 PDI-2 Topographic, Bathymetric, and Utility Survey

To support design elements related to access, staging, and excavation, a topographic and bathymetric survey was completed on the Northern Impoundment from July 8 through August 2, 2019. The survey was conducted by a surveyor (Morrison Surveying, Inc.) licensed in the state of Texas. Field data were collected using conventional surveying equipment, including a Trimble R8 GNSS, Trimble R10 global positioning system (GPS), and Geometrics 882 marine magnetometer using Hypack software to collect geophysical data, CEE Scope Fathometer using Hypack software to collect bathymetric data, and a Trimble SX10 scan station to collect topographic data. Surveying was completed on a 50-feet grid over the Northern Impoundment boundaries. Above-ground utilities were also noted during survey activities. Survey data was utilized to develop a topographical digital elevation map of the Northern

Impoundment. This surface and all identified above and below-ground utilities have been incorporated into the design drawings.

2.2.7 Summary of PDI-2 Results

2.2.7.1 PDI-2 Analytical Results

A total of 25 analytical borings were sampled and analyzed for dioxins and furans during the PDI-2 activities. Of the 25 borings, 12 had concentrations above 30 ng/kg $TEQ_{DF,M}$ to depths ranging from 4 to 18 ft bgs and the remaining borings were all below 30 ng/kg $TEQ_{DF,M}$ down to 18 ft bgs, as shown on Figure 2-5. Consistent with the objectives of the PDI-2 investigation, borings along the northeastern and eastern sides of the Northern Impoundment exhibiting $TEQ_{DF,M}$ concentrations below 30 ng/kg are to be used in the RD to define the extent of the excavation and the alignment of the outer BMP. This is further discussed in Section 5.2.

All subsurface analytical results from the RI, PDI-1, and PDI-2 are shown in Table 2-6 and on Figure 2-9. The data bars on Figure 2-9 show the interval results as elevations, adjusted to account for the depth of surface water atop each boring location, giving an indication of the total depth of waste material to be excavated during the RA. Two borings locations (SJSB046-12 and SJSB071) had samples above 30 ng/kg $TEQ_{DF,M}$ in the deepest sample interval collected. These locations were further investigated in the 2021 SDI event.

The validated analytical PDI-2 data, shown in Table 2-3, provides quality assurance that the data collected are usable. The PDI-2 analytical laboratory reports and data validation reports are included as part of Appendix A.

2.2.7.2 PDI-2 Geotechnical Results

During the RI and PDI-1, the Northern Impoundment soil lithology was characterized as interbedded Recent Alluvial Sediments (silts, sands, and clays) to an approximate depth of -30 ft North American Vertical Datum of 1988 (NAVD88), which was confirmed during the PDI-2. The previous investigations also indicated that the Beaumont Clay formation extended below this reference elevation (-30 ft NAVD88) to a minimum elevation of -60 ft NAVD88 on the western side of the Northern Impoundment and to approximately -50 ft NAVD88 on the eastern side of the Northern Impoundment. Additional geotechnical borings installed during PDI-2 (specifically boring SJSB057) encountered the Beaumont Clay formation at approximately -80 ft NAVD88 (an additional 20 ft of thickness) on the western side and at approximately -50 to -65 ft NAVD88 (up to an additional 15 ft of thickness) on the eastern side. Additionally, the investigations prior to PDI-2 indicated a sand formation extending below the clay formation across the Northern Impoundment to approximately -80 ft NAVD88. These sands, although encountered in the PDI-2, were not found to be consistent across the Northern Impoundment.

The PDI-2 geotechnical results are included in Appendix B. Further analysis and discussion of the geotechnical data as it relates to the RD of the BMP are included in Section 5.2.3.

2.2.7.3 Transducer Results

Consistent with the results of the PDI-1 aquifer tests, data from the transducers indicated that there is a strong hydrological connection between the river and the shallow sand/silt layer underlying the Northern Impoundment. The water levels are nearly identical in all observed data, with a slightly dampened response time observed in the monitoring well data that matches pressure changes in soils versus a free-flowing river. As part of the RD, water pressure heads from the shallow permeable layer have been correlated with fluctuations in the river water levels and accounted for, as such.

2.3 Supplemental Design Investigation (SDI)

The BMP design detailed in the 30% RD was subsequently deemed to be infeasible and following submittal of the 30% RD, a new design approach for the BMP (a double wall BMP system) was developed, the alignment of the BMP was changed, and new approach to the excavation methodology was developed. Based on the changes in BMP design and alignment and changes in excavation methodology, data gaps were identified in the available analytical delineation and geotechnical data.

As discussed during a TWG Meeting on December 15, 2020, an additional field investigation was deemed necessary to address these data gaps in the analytical and geotechnical data and better inform the RD. A proposed plan to collect additional analytical and geotechnical data was presented in a TWG Meeting on February 5, 2021, and then formalized in the SDI Work Plan, submitted to the EPA on February 19, 2021 (GHD, 2021b). A TWG Meeting was held to discuss the details of the SDI Work Plan on March 10, 2021, and the EPA provided comments on the SDI Work Plan (EPA, 2021b) on March 29, 2021. On April 15, 2021, a draft Response to Comments table and figures were sent to the EPA in response to the EPA's comments and were then discussed in detail during a TWG Meeting that took place on April 19, 2021. After further discussion with the EPA regarding the SDI scope of work and other significant modifications to it, a revised SDI Work Plan (Revised SDI Work Plan) was submitted to the EPA on May 21, 2021 (GHD, 2021c). The EPA approved the Revised SDI Work Plan on June 4, 2021 (EPA, 2021c). Between the February submittal of the SDI Work Plan and the June approval of the Revised Work Plan, the scope of the SDI event grew substantially. Most notably, seven analytical boring locations were added, with six of those additional borings being located in very challenging water-based locations. The original 10-week schedule for field work thus expanded to more than 12 weeks. The SDI fieldwork was conducted by GHD from June 28, 2021, to September 16, 2021.

The objectives of the SDI included the following:

- Further delineate the vertical extent of the waste material exceeding the ROD clean-up level around the perimeter of the excavation area to support the BMP design, elements of the anticipated excavation methodology, and other aspects of the RD.
- Address data gaps for the vertical and horizontal extent of waste material exceeding the ROD clean-up level across the area anticipated to be excavated to better refine the estimated excavation bottom elevations and the volume of material to be removed (which had already increased due to the depths of the waste material encountered during the PDI).
- Collect additional geotechnical data along the conceptual alignment of the BMP to inform the BMP design.
- Collect additional hydraulic conductivity data of the material to be excavated to better estimate the amount of seepage water that will require management during the RA.
- Collect additional hydraulic conductivity and pore pressure data to evaluate the risk of hydraulic heave during the RA.

The SDI field activities included installation of 35 analytical sample borings and 17 geotechnical soundings (13 Cone Penetrometer Test [CPT] soundings and 4 instrumented boreholes), as shown on Figure 2-6. Borings were advanced from the surface to a maximum depth of 24 ft bgs for analytical borings, and to a maximum depth ranging from 24 to 75 ft bgs for geotechnical soundings.

A photographic log documenting the SDI field event is included in Appendix A.

2.3.1 SDI Drilling Methodology

Similar to the PDI-2 event, several drilling methodologies were employed to account for variable water levels at the Northern Impoundment. Boring installation and sampling were conducted using the following methodologies:

- Track mounted drilling rig (DPT).
- Airboat-mounted drilling rig (DPT).
- Track-mounted drilling rig (mud rotary).
- Truck-mounted CPT drilling rig.
- Truck-mounted CPT drilling rig secured to a floating modular barge.

Of the 35 analytical boring locations selected for SDI, all but 11 of them were located in areas that were under water. All water-based analytical borings were installed utilizing an airboat-mounted DPT rig and all land-based analytical borings were installed utilizing a track-mounted DPT rig. The three land-based piezometers were installed using a track-mounted mud-rotary rig and the land-based CPT soundings were performed using a truck-mounted CPT drilling rig. The water-based CPT soundings were taken using a truck-mounted CPT drilling rig secured to a floating modular barge. SDI boring and CPT locations are shown on Figure 2-6.

At locations accessible by standard terrestrial equipment, a mini-excavator was used to remove armored cap rock, then the geotextile and/or geomembrane was cut prior to drilling activities. At boring locations that were submerged but were accessible by airboat-mounted drilling equipment, certified divers hand cleared the cap rock from each boring location, precisely cut the geotextile liner, and marked the location with a buoy. The drilling rig then installed a short surface casing (4 ft diameter HDPE pipe or 18-inch diameter steel pipe) to protect against sloughing of the surrounding surface cap materials during drilling. For underwater borings, a wider-diameter casing was first pushed until refusal was encountered (approximately 5 to 7 ft bgs on the shallower locations and approximately 5 to 10 ft bgs on the deeper locations) and then the drill rod was advanced through the casing to prevent the potential release of any impacted material to the river during drilling activities. At the conclusion of drilling at all boring locations, the borings were grouted, the casing was pushed to the mudline (for underwater borings), the geotextile and/or geomembrane was repaired, and the armored cap rock was replaced.

As required by the Revised SDI Work Plan (GHD, 2021c), turbidity curtains were deployed around the northwest corner of the Northern Impoundment during the installation of the four soil borings in that area. The initial plan utilized curtains that spanned the full extent of the water column, but due to higher-than-expected water velocities in that area, it was not possible to maintain that configuration and the curtains were realigned to allow for shorter curtains across the deeper areas. The timeline of activities and the significant challenges encountered were detailed in a letter to the EPA dated September 28, 2021 (GHD, 2021e).

2.3.2 SDI Analytical Sampling

In accordance with the Revised SDI Work Plan (GHD, 2021c), the sampling program was designed to further delineate the vertical and horizontal extent of material exceeding the ROD clean-up level. To that end, a total of 373 discrete samples (including 61 field and lab duplicate samples) were collected from 35 locations across the Northern Impoundment. Discrete samples were collected from two-foot intervals, to a total depth of 24 ft bgs. The sample intervals from 0 to 18 ft bgs were analyzed by the analytical laboratory, and the sample intervals from 18 to 24 ft bgs were archived by the laboratory pending the results of the 16 to 18 ft bgs sample interval. Analysis of the 16 to 18 ft bgs interval from each location was prioritized to expedite the determination as to whether the samples from the deeper sample intervals should be analyzed. If the 16 to 18 ft interval yielded an analytical result with $TEQ_{D,F,M}$ levels above 30 ng/kg, one or more of the three deeper intervals from 18 to 24 ft were also analyzed.

There were five boring locations (SJSB072, SJSB075, SJSB077, SJSB083, and SJSB101) that were co-located with historical boring locations in which a sample interval below the clean-up standard was not observed at the bottom of the boring (SJGB010, SJGB012, SJSB036, SJSB046-C1, and SJSB071). Three of the five locations were in upland areas (SJSB072, SJSB075, SJSB077), and the other two locations (SJSB083 and SJSB101) were in areas that are normally covered in water.

For the co-located borings adjacent to historical borings with $TEQ_{D,F,M}$ levels above 30 ng/kg, with the exception of SJSB083 and SJSB101 which were analyzed for waste characterization purposes, only sample intervals in the co-located borings that were deeper than the terminal depth of each historical boring with $TEQ_{D,F,M}$ levels above 30 ng/kg were analyzed. For example, at proposed boring location SJSB072, the first sample interval analyzed was 8 to 10 ft bgs, because co-located historical boring SJGB012 had a $TEQ_{D,F,M}$ level above 30 ng/kg at its terminal depth of 8 ft bgs.

All analytical samples were analyzed by Eurofins TestAmerica Laboratory for dioxins and furans using EPA Method 1613B and percent moisture using SM 2540G. Data validation was completed by GHD.

2.3.3 SDI Geotechnical Sampling

To delineate the subsurface stratigraphy along or in reasonable proximity to the conceptual BMP alignment, thirteen CPT soundings were taken.

Twelve of these CPT soundings (SJCPT-001 through SJCPT-010, SJCPT-002A, and SJCPT-006A) were taken along or in reasonable proximity to the conceptual BMP alignment. The initial contractor engaged to complete the water-based CPT borings was unable to successfully reach terminal depth due to the insufficient capacity through resistive force of its CPT drill rig and associated vessel. After multiple attempts by the initial contractor to successfully anchor and reach terminal depth, the initial CPT contractor and CPT drill rig demobilized and a second contractor with a larger capacity truck-mounted CPT drilling rig secured to a floating modular barge was retained to complete the CPT soundings.

A thirteenth CPT sounding (SJCPT-011) was taken adjacent to piezometer location, SJMW-016, as a “calibration sounding” to provide both CPT data and geotechnical laboratory test data for comparison with the newly-collected CPT data from the other 12 CPT soundings.

To provide the corresponding laboratory test data for comparison, geotechnical samples were collected at different locations (depths) during borehole SJMW-16 advancement and sent to Thompson Engineering Geotechnical Laboratory for laboratory analysis. The samples were collected along the entire length of this deep boring, including from the surficial alluvium, Beaumont Clay and Beaumont Sand layers (historical investigations gathered limited data from these lower geological strata).

In addition, nine vane shear tests were performed near CPT locations SJCPT-01 to SJCPT-03, and SJCPT-05 to SJCPT-10 using manual equipment. Vane shear tests were conducted in approximately 1.5 ft increments and progressed up to 24 ft bgs or until refusal, in order to define shear strength values within the surficial alluvions and calibrate the CPT results. The locations of the CPT soundings are shown on Figure 2-6.

Using the common set of information and well-defined relationships for various parameters available, the CPT results obtained from the 12 soundings along the current conceptual BMP alignment were calibrated against data from SJMW-016 and correlated to vane shear tests and existing geotechnical laboratory test data from past investigations. Physical geotechnical samples were collected and analyzed from SJMW-017 as supplemental geotechnical data.

2.3.4 Waste Characterization Sampling

Six waste characterization samples were collected from three analytical borings (SJSB083, SJSB101, and SJSB102). The original plan, as detailed in the Revised SDI Work Plan (GHD, 2021c), had been to collect duplicate samples from each planned 2-ft interval from 0 to 24 ft bgs in soil borings SJSB083 and SJSB101 and to archive the duplicates for potential waste characterization, pending dioxins analytical results. Upon receipt of the dioxins analytical results, the two samples in each boring with the highest dioxins concentration would have been identified and the duplicate samples from each of those intervals would have been analyzed for Resource Conservation and Recovery Act (RCRA) hazardous waste characteristics per EPA-required test methodology in 40 CFR Part 261. As detailed in SDI Sampling Plan Refinement Notice - 1, submitted to the EPA on July 26, 2021 (GHD, 2021d) and approved by the EPA on August 4, 2021 (EPA, 2021d), due to short analytical hold times for some of the RCRA hazardous waste characteristics parameters, the plan was revised to pre-select the intervals for analysis based upon historic dioxins data from nearby soil borings. Based upon data from historic soil boring SJSB046-C1, the 8 to 10 ft bgs and 10 to 12 ft bgs intervals were selected for waste characterization analysis from SJSB083. Based upon historic soil boring SJSB071, the 0 to 2 ft bgs and 2 to 4 ft bgs intervals were selected for waste characterization analysis from SJSB101.

Due to shipping delays, the waste characterization samples for SJSB083 were delivered to the analytical laboratory outside of the approved temperature range. The samples were analyzed, but in order to bolster the dataset for waste characterization, a third location was selected to collect waste characterization samples. Duplicate samples from two, 2-ft intervals (8 to 10 ft bgs and 10 to 12 ft bgs) were collected from SJSB102 to analyze for waste characterization parameters. Waste characterization data is included in Table 2-5 and Appendix A.

All waste characterization samples indicate that the waste material did not exhibit any of the four characteristics of hazardous waste (ignitability, corrosivity, reactivity, or toxicity) and, therefore, can be disposed of as non-hazardous waste.

2.3.5 Supplemental Data Collection

In addition to the sampling described above, supplemental data was collected to support the design of turbidity control measures for use during installation and removal of the BMP during the RA. These data collection activities focused on thicknesses of surface materials, geotechnical characteristics of surficial sediment, and velocity measurements in locations outside the proposed BMP alignment. Each of these data collection activities is described below.

2.3.5.1 Sediment and Rock Thickness

The extent and thickness of armored rock cap along the conceptual alignment of the BMP was investigated, together with the thickness of any sediment deposited on top of the armored rock cap. The information was collected by diver-assisted probing at specific intervals and further verified by examining past quarterly bathymetry surveys. The sediment and rock thicknesses varied across the Site with an average rock thickness of approximately 1.5 ft.

2.3.5.2 Surficial Sediments Geotechnical Properties

Ten samples of river sediment that had deposited on top of the armored rock cap were collected in Lexan® tubes that were hand driven into the sediment to collect a minimum 6-inch thick sample. The sediment within each tube was composited to form a single sample for geotechnical analyses. Samples were collected in proximity to corresponding CPT locations (SJCPT001 through SJCPT010, not including SJCPT-002A and SJCPT-006A) as shown on Figure 2-6.

Divers were required to clear surficial rock at six locations (SJCPT005 through SJCPT010) prior to driving each of the performed CPTs. At the time of clearing the CPT locations, the nearby six surficial sediment samples were collected at these six locations. An additional four locations (SJCPT001 through SJCPT004) were also sampled in a similar manner though the removal of rock at these locations was not necessary. Some boring locations were adjusted based on field conditions.

Both sets of samples were shipped under chain of custody procedures to a geotechnical laboratory for testing. Each sample was tested for water content (ASTM D2216), dry density (ASTM D2937), Atterberg limits (ASTM D4318), specific gravity (ASTM D854), particle size distribution (ASTM D422) and organic carbon content (ASTM D2974). The samples were also tested for consistency/stickiness using the Natural Resources Conservation Service method. The results are presented in the geotechnical report included as Appendix B.

2.3.5.3 Water Velocity and Turbidity Measurements

During the week of November 8, 2021, two velocity meters (e.g., acoustic doppler current profiler) were deployed in locations outside of the conceptual BMP alignment, in accordance with the Revised SDI Work Plan (GHD, 2021c). Four turbidity monitors were deployed at the same time in accordance with the *Revised Ambient Turbidity Measurements Plan*, submitted to the EPA on October 6, 2021 (GHD, 2021g) and approved by the EPA on October 15, 2021 (EPA, 2021e). The four turbidity monitors and one of the two velocity monitors (Velocity Monitor A to the northwest) were removed from the river during the week of June 7, 2022. Velocity Monitor B is currently still deployed. The locations of the meters are shown on Figure 2-8. Data from the velocity and turbidity monitors will be used to inform the turbidity monitoring and controls plan to be implemented during installation and removal of the BMP during the RA. Data from December 2021 through June 2022 is summarized in the SWMP (Appendix J).

2.3.6 Piezometer Installation

Four piezometers were installed using mud-rotary drilling equipment during the SDI to better understand the hydraulic conductivity and subsurface hydrostatic pressure of the groundwater bearing units below the Northern Impoundment. The locations of the piezometers are shown on Figure 2-6.

A shallow piezometer was installed and screened from the ground surface to -8 ft NAVD88 at boring SJMW-014 to get a better understanding of the hydraulic conductivity of the waste material itself. An intermediate piezometer was installed and screened from approximately -15 to -25 ft NAVD88 at boring SJMW-015 to obtain a better understanding of the hydraulic conductivity of the zone directly below the waste material. Deep piezometers were installed at borings SJMW-016 and SJMW-017 to better evaluate the potential for hydraulic heave during excavation activities. These piezometers extend into the sand layer below the Beaumont Clay Formation. SJMW-016 was screened from approximately -60 to -70 ft NAVD88, and SJMW-017 was screened from approximately -65 to -75 ft NAVD88, each representing the top ten feet of the lower sand layer below the Beaumont Clay.

During the installation of deep piezometers (SJMW-016 and SJMW-017), split spoon and Shelby Tube samples were collected as explained in Section 2.3.3. The samples were shipped under chain of custody procedures to the Thompson Engineering geotechnical laboratory for testing. Selected samples were analyzed for Unconsolidated Undrained Compression Test (ASTM D2850), Atterberg limits (ASTM D4318), moisture content (ASTM D2216), grain size (ASTM D6913/D7928), and #200 wash (ASTM D1140).

All four piezometers were constructed of 2-inch diameter Schedule 40 polyvinyl chloride (PVC) threaded casing. After development, a transducer was installed in each, and a slug test was performed to evaluate the lateral hydraulic conductivity of the strata through which each piezometer was screened. The locations of piezometers SJMW-014 and SJMW-015 were selected from adjacent boring log data to capture the highest representative conductivity values to inform choices on peak excavation seepage rates and water volumes. The hydraulic head in the lower sand was measured after development of the two deep piezometers (piezometer locations SJMW-016 and SJMW-017) to determine the confined hydrostatic pressure.

Pressuremeter Tests (PMT) were also performed by Braun Intertec at multiple intervals in the two deep piezometer boreholes using Texam Pressuremeter equipment. The tests were performed to evaluate the pressuremeter modulus, the limit pressure, and the at-rest horizontal pressures of the surficial alluvium and Beaumont Clay Formation.

2.3.7 Summary of SDI Results

2.3.7.1 SDI Analytical Results

A total of 35 analytical borings were sampled and analyzed for dioxins and furans during the SDI activities. Of the 35 borings, 30 borings had concentrations above 30 ng/kg $TEQ_{DF,M}$ to depths ranging from 0 to 22 ft bgs and the remaining borings were all below 30 ng/kg $TEQ_{DF,M}$ at a depth of 18 ft bgs, as shown on Figure 2-7. Consistent with the objectives of the SDI, an interval below 30 ng/kg $TEQ_{DF,M}$ was encountered at the terminal depth of every soil boring, establishing vertical delineation of the waste material. Data from the SDI also identified waste material exceeding 30 ng/kg $TEQ_{DF,M}$ at elevations deeper than previously encountered (-28.36 ft NAVD88 at SJSB098).

Due to the apparent variability of the SDI results in some borings (which often include an interval with results above 30 ng/kg $TEQ_{DF,M}$ below several feet of material with results below 30 ng/kg $TEQ_{DF,M}$), a subset of data consisting of 36 selected sample intervals from the full SDI dataset was selected to be re-extracted and reanalyzed by the analytical laboratory. These re-extractions are identified in Table 2-4 as Laboratory Duplicates and the results from these samples are in addition to the 19 field duplicates that were collected and analyzed as a part of project quality assurance procedures. To evaluate the data, the relative percent difference (RPD) was calculated for each set of duplicates. Consistent with the criteria listed in the QAPP for sediment field duplicate samples, the RPD was compared to an acceptance criteria of 100% or less. Using this criteria, analysis of the duplicate data found there to be 8 of the 36 sets of data in the lab duplicate set that were above the 100% RPD threshold and four of the 19 sets above the threshold for the field duplicate sets. Given the small sample extraction amount required for the analysis and the notoriously high variability of sediment samples, this amount of variation in the duplicate datasets was deemed realistic and within normal ranges of variability for sediments. The data presented on Figures 2-7 and 2-9 and in Table 2-6 represents the highest value obtained from either the parent, field duplicate, or laboratory duplicate samples for each sample interval.

All subsurface analytical results from the RI, PDI-1, PDI-2, and SDI are shown on Figure 2-9. The data bars in this figure show the interval results as elevations, adjusted to account for the depth of water atop each boring location. Table 2-6 also presents all subsurface analytical results as elevations.

The validated analytical SDI data, shown in Tables 2-4 and 2-6, provides quality assurance that the data collected are usable. The SDI analytical laboratory reports and data validation reports are included as part of Appendix A.

2.3.7.2 SDI Waste Characterization Sampling

Consistent with the results from waste characterization sampling performed as part of the PDI-1 and PDI-2 Treatability Testing, all six samples collected during the SDI for analysis of waste characterization parameters were below the thresholds to be classified as RCRA hazardous waste. Notably, the dioxins results from three of the six samples were significantly elevated (4,400 ng/kg $TEQ_{DF,M}$ at SJSB083 [8 to 10 ft bgs], 52,000 ng/kg $TEQ_{DF,M}$ at SJSB101 [0 to 2 ft bgs], and 47,000 ng/kg $TEQ_{DF,M}$ at SJSB101 [2 to 4 ft bgs]) indicating that these samples targeted locations with high dioxins concentrations. Waste characterization results are included in Table 2-5. Analytical laboratory reports and data validation reports are included as part of Appendix A. Conclusions of the waste characterization testing are further discussed in Section 3.3.

2.3.7.3 SDI Geotechnical and Hydrogeological Sampling

Additional geotechnical sampling was conducted during the SDI, including Shelby tube and SPT testing at SJMW-016 and SJMW-017. PMT was also completed at these locations. Results were within expected ranges, with alluvium being underlain by the Beaumont Clay, which was underlain by the deep Beaumont Sand. The CPT soundings indicated that the compressible clay strata consisted predominantly of one layer on the west side of the Northern Impoundment but on the east side, this layer may be interlayered by thin occasional granular lenses. The CPTs also provided a continuous profile of the undrained shear strength of the Beaumont Clay to the termination depth of the tests. The SDI geotechnical results are included in Appendix B. Further analysis and discussion of the geotechnical data as it relates to the RD of the BMP are included in Section 5.3.3.

Single well response aquifer tests (slug tests) were conducted at the newly installed piezometers at SJMW-014, SJMW-015, SJMW-016, and SJMW-017 on August 13, 2021. The test results were evaluated with the aquifer testing software AQTESOLV version 4.50 and can be viewed in Appendix A.

The shallow alluvium piezometer SJMW-014, which was screened through the waste material, yielded a hydraulic conductivity value of 0.000127 centimeters per second (cm/s), which is appropriate for a silty material. The deeper alluvium piezometer SJSMW-015 screened in the more permeable zone directly below the waste material, yielded a hydraulic conductivity value of 0.001175 cm/s, which is within expectations for a fine-grained sand.

The deep Beaumont Sand piezometers SJMW-016 and SJMW-017 were installed and screened in the ten-foot interval below the Beaumont Clay. The confined Beaumont Sand was found to have a relatively gradual hydraulic gradient sloping to the east. The two measurement points obtained from SJMW-016 and SJMW-017 were compared to each other and available historical well measurements to confirm the gradual hydraulic gradient. This low gradient allowed the water levels taken at SJMW-016 and SJMW-017 to be extrapolated to approximate water levels across the entire excavation area. The two deep piezometers yielded hydraulic conductivity values of 0.000170 cm/s and 0.000313 cm/s, which are appropriate for a silty sand.

Hydraulic conductivity data was used to verify and refine assumptions for water storage and treatment during the RA, as further described in Section 5.2.

2.3.7.4 SDI Surficial Sediments Geotechnical Properties Sampling

Surficial sediments/alluvium deposits consisting of clay, silt and sand with organic matter contents ranging from 0.7 percent to 9.7 percent were encountered at the surface at all boreholes and CPT locations. The alluvium deposit is black to grey in color with specific gravity ranging from 2.58 to 2.79 and dry bulk density ranging from 45.3 pounds per cubic foot (PCF) to 95.0 PCF. Further details regarding geotechnical conditions are included in Appendix B.

2.4 PDI and SDI Conclusions and Recommendations

When the ROD was issued, only eight subsurface borings had been installed in the Northern Impoundment. As part of PDI and SDI activities, an additional 71 subsurface borings were installed, providing additional horizontal and vertical (to as deep as -36 ft NAVD88) characterization. Analytical results from these samples indicate that the vertical impact of material with $TEQ_{DF,M}$ exceeding 30 ng/kg extends much deeper than initially determined. As shown in Table 2-6 and on Figure 2-9, data from the PDI and SDI indicate that the excavation elevations during the RA range up to an elevation of -28.36 ft NAVD88 with an average elevation of -12.8 ft NAVD88. The average depth of waste referenced in the ROD was -8 ft NAVD88. The corresponding volume of waste material was found to be approximately 50 percent greater than what was known at the time of the ROD. The horizontal and vertical waste extents were used as part of this RD to determine the type of BMP necessary to implement the selected remedy and the appropriate removal methodology. The data from the PDI and SDI was also used to determine the area of the Northern Impoundment that will require remediation and the alignment of the BMP. Data analysis, civil excavation contouring, and BMP design are further discussed in Section 5.

Understanding the geotechnical characteristics of the soils beneath the Northern Impoundment is a critical component of the RD. Given the significantly deep elevations of waste material encountered during the SDI, a detailed evaluation was conducted to examine the potential for hydraulic heave during excavation activities. The evaluation examined the thicknesses of the underlying strata beneath the Northern Impoundment including the alluvium and underlying Beaumont Clay and the interface between the Beaumont Clay and Beaumont Sand. The evaluation also examined the pore pressures of the Beaumont Sand, as measured by the deep piezometers to determine the hydraulic head level. Finally, the evaluation examined the properties of the soils including the unit weight of the clay and overlying alluvium and the presence of sand lenses in some parts of the clay layer. This evaluation was intended to assess whether the pore pressures within the Beaumont Sand and/or sand layers within the clay would be sufficient to overcome the weight of the overburden considering the planned excavation depths and water drawdown.

Based on this evaluation, it was determined that there are several areas across the Northern Impoundment (primarily in and throughout the northwest corner) in which there would be significant risk of hydraulic heave if material is removed to the currently known elevations presented in this document (See Table 5-1). The evaluation indicated a total stress analysis safety factor (SF) below 1.25 for removal of material to the depths of deepest impact in these areas. A total stress analysis SF of 1.25 is considered protective of hydraulic heave and is in accordance with USACE guidance. Based upon the results of this evaluation, it was determined that it would be unsafe to excavate the material in the northwest corner to the currently known depths in the manner required by the ROD. The results of this evaluation were detailed in a Hydraulic Heave Analysis Report submitted to the EPA on December 9, 2021, (GHD, 2021i) and in a follow-up letter submitted to the EPA on December 22, 2021 (GHD, 2021j). Based upon this evaluation, excavation of the northwest corner is technically impracticable as prescribed by the ROD (i.e., “in the dry”) and that area will be addressed with mechanical dredging to mitigate the hydraulic heave risk and based on the Updated Hydraulic Heave Analysis Report submitted as part of this 100% RD.

A detailed analysis of the geotechnical conditions at the Northern Impoundment, as they relate to the RD, are included in Appendix B and are discussed in Section 5. The Updated Hydraulic Heave Analysis Report is also included as an attachment to the Geotechnical Engineering Report included in Appendix B.

3. Treatability Studies

3.1 2019 Treatability Study Overview

As part of the PDI-2 field activities in October 2019, waste material, porewater, and armored cap material samples were collected and contact water was generated from the Northern Impoundment for treatability testing, as specified in the *Treatability Study Work Plan* (TSWP) (GHD, 2019c) submitted to the EPA on May 20, 2019, and approved on

August 27, 2019 (EPA, 2019d). Treatability testing was conducted in the GHD Treatability Laboratory in Niagara Falls, New York (GHD Treatability Lab). Analytical testing was completed by Eurofins TestAmerica Laboratories.

Four composite waste material samples were collected from the four quadrants of the Northern Impoundment for additional waste characterization sampling to determine eligibility for Texas Class I and/or Class II non-hazardous industrial waste disposal and evaluation of solidification mix design, as necessary. Three composite samples of armored cap material were collected for characterization and evaluation for reuse.

As described in the TSWP, two water management approaches were evaluated, as part of the Treatability Study: traditional treatment through clarification and filtration, and thermal evaporation.

To assess the traditional treatment approach, contact water was generated in an excavation on the southwest quadrant of the Northern Impoundment and a field pilot test which involved on-site clarification and filtration was performed. Effluent from the on-site treatment was also utilized in bench-scale treatability testing at the GHD Treatability Lab, to evaluate particle size and the effectiveness of filtration to remove Constituents of Potential Concern (COPCs) for water discharge criteria.

Concurrently, a pilot study was conducted to evaluate the proposed thermal evaporation treatment approach using the clarified contact water. The fate of dioxins and furans was evaluated at different steps of the evaporation treatment process.

3.2 2019 Treatability Study Objectives

As outlined in the TSWP, the objectives of the Northern Impoundment treatability testing included:

- Evaluation of optimum solidification mix designs to solidify the waste material for off-site transportation and disposal.
- Evaluation of optimum solidification mix designs to meet requirements for Texas Class I and/or Class II non-hazardous industrial waste disposal, in accordance with 30 TAC 335.505-506 and 335.508.
- Evaluation of evaporation technology, including processing capacities, fuel consumption, evaluation of the characteristics of the brine produced by the evaporation process, and air emissions.
- Evaluation of traditional water treatment technology.
- Determination of optimum treatment alternatives for contact water to comply with ARARs.
- Evaluation of the armored cap materials at the Northern Impoundment to determine whether such materials can be reused on-site during or post-remedy implementation.

3.3 2019 Waste Material Treatability Testing

Based on the origin of waste material in the Northern Impoundment, the waste material is not listed as hazardous under 40 CFR Part 261, Subpart D. Further, waste characterization samples collected during the PDI-1 were analyzed for ignitability, corrosivity, reactivity, and toxicity, as defined in Title 40 of CFR Part 261, Subpart C, to determine if the material is characteristically hazardous. The results indicate that the material is not a characteristic hazardous waste under RCRA or EPA or TCEQ regulations. Validated PDI-1 waste characterization data are included in Table 2-2.

Additional testing was conducted during the Treatability Study to further classify the non-hazardous waste under applicable Title 30 of the TAC, (Industrial Solid Waste and Municipal Hazardous Waste) (30 TAC 335). The material was also tested in accordance with EPA Method SW-846 Test Method 9095B (i.e., paint filter test), to determine whether free liquids were present which would prevent the material from being disposed of without solidification. Solidification tests were also performed on the waste material to determine the level of solidification necessary to achieve a target unconfined compressive strength (UCS) that may be required for off-site disposal.

Additional waste characterization testing was also performed on six samples collected during the 2021 SDI to supplement the previous dataset.

3.3.1 Treatability Testing Sample Collection

As part of the Northern Impoundment PDI-2 activities conducted from September to December 2019, four approximately 30-gallon composite samples of waste material were collected from the southwest, northwest, northeast, and southeast quadrants of the Northern Impoundment to utilize for treatability testing, as shown on Figure 3-1. Composite Sample 1 in the southwest quadrant was composited from waste material removed from the excavation to create contact water for water treatability testing. The samples were containerized in 5-gallon buckets, sealed, and transported via freight to the GHD Treatability Lab on September 19, 2019. The remaining three samples were composited from cuttings in the first 20 feet from the geotechnical borings in each quadrant (Composite Sample 2 from the northwest quadrant, Composite Sample 3 from the northeast quadrant, and Composite Sample 4 from the southeast quadrant). The samples were containerized in 5-gallon buckets and transported via freight to the GHD Treatability Lab on December 17, 2019.

3.3.2 Baseline Characterization

An initial baseline characterization was performed to determine if there was significant variation of the chemical and physical properties between the four quadrant waste material samples collected within the Northern Impoundment and to provide data for further waste characterization.

Each waste material sample was analyzed for the following parameters to determine whether it met TCEQ Class I or Class II non-hazardous waste landfill disposal requirements:

- Percent Solids - SM for the Examination of Water and Wastewater 2540G.
- TCLP Dioxins and Furans - EPA 1613B.
- TCLP Volatile Organic Compounds (VOCs) - EPA 8260C.
- TCLP Semi-volatile Organic Compounds (SVOCs) - EPA 8270D.
- TCLP Organochlorine Pesticides - EPA 8081B.
- TCLP Polychlorinated Biphenyls (PCBs) - EPA 8082A.
- TCLP Herbicides - EPA 8151A.
- TCLP Glycols - EPA 8015D Direct Injection.
- TCLP Metals - EPA 6010C.
- TCLP Mercury - EPA 7470A.
- TCLP Methomyl - EPA 8321A.
- Total Cyanide - EPA 9014.
- Sulfide - EPA 9034.
- Ignitability - EPA 1020B.
- pH - EPA 9045D.
- Paint Filter - EPA 9095B.

3.3.3 Waste Material Treatability Results and Conclusions

Consistent with the results obtained during PDI-1 and PDI-2, results from the SDI testing characterization indicated that all waste material samples are expected to meet disposal criteria for a Class II landfill and that the material is a non-hazardous waste under RCRA. The basis for this classification is discussed in the sections below.

The results from the PDI-1 waste characterization testing are shown in Table 2-2, the results of the SDI waste characterization testing are shown in Table 2-5, and the results from the PDI-2 Treatability waste characterization testing are shown in Table 3-1. Analytical laboratory reports for the PDI-1 and SDI testing are included as part of Appendix A and analytical laboratory reports for the PDI-2 Treatability Testing are included as part of Appendix C.

3.3.4 Waste Characterization Conclusions

The EPA's guidance regarding the management of remediation waste states that "contaminated environmental media, of itself, is not hazardous waste and, generally, is not subject to regulation under RCRA." (*Management of Remediation Waste under RCRA*, EPA, 1998). The material to be excavated during the Northern Impoundment RA for disposal off-site is the environmental media to be evaluated, and it is subject to regulation under RCRA as hazardous waste only if one of the following two conditions exists:

1. The media is impacted with a listed hazardous waste at concentrations that are above the health-based risk levels.
2. Any constituent in the media exhibits one of the characteristics of hazardous waste.

GHD submitted a waste characterization evaluation for the Northern Impoundment to the EPA on October 20, 2020 (Waste Characterization Letter; GHD, 2020g). The purpose of the evaluation was to describe how pulp and paper mill waste, proposed to be excavated as part of the Northern Impoundment RA, has been characterized and classified in accordance with the RCRA regulations as non-hazardous waste. EPA subsequently concurred with the conclusions contained in the Waste Characterization Letter in a letter to GHD dated November 19, 2020 (EPA, 2020h).

As part of this evaluation, the following sections of Title 40 of the CFR Part 261 - *Identification and Listing of Hazardous Waste*, were evaluated:

- Subpart A - Definition of Solid Waste, Hazardous Waste & Exclusions (261.1-.9).
- Subpart B - Criteria for Identifying the Characteristics and Listing of Hazardous Wastes (261.10-.11).
- Subpart C - Characteristics of Hazardous Waste (261.20-.24).
- Subpart D - Lists of Hazardous Wastes (261.30-.33).

3.3.4.1 Listed Waste Evaluation

The listed waste evaluation involved determining whether the material contains a "listed" hazardous waste at concentrations above regulatory thresholds. The categories of listed hazardous wastes, using the codes assigned to each category, are:

- "F" codes = Non-Specific Sources.
- "K" codes = Specific Sources.
- "P" codes = Commercial Chemical Products (acutely hazardous).
- "U" codes = Commercial Chemical Products (non-acutely hazardous).

According to EPA guidance, information about the source of the waste is to be used in making the determination. Information about the waste material was summarized in the Waste Characterization Letter. The evaluation concluded that the material did not meet any of the listed descriptions.

3.3.4.2 Characteristic Waste Evaluation

Under RCRA, a solid waste is a hazardous waste if it exhibits any of the following characteristics:

- Ignitability (D001).
- Corrosivity (D002).
- Reactivity (D003).
- Toxicity (D004 - D043).

The evaluation involved a review of available waste characterization data from PDI-1 and PDI-2 and information from the RI about the material deposited in the Northern Impoundment. It concluded that the excavated material at the point of generation (when it is excavated) would not exhibit the characteristics of a RCRA hazardous waste (i.e., ignitability, corrosivity, reactivity, or toxicity).

In its letter to GHD dated November 19, 2020, the EPA stated that “based upon information provided in the October 20, 2020 evaluation, EPA agrees with GHD’s determination that the initially generated waste would not be a listed hazardous waste meeting the current definitions of an F, K, P or U waste. From review of the analytical testing results, the samples are all non-hazardous” (EPA, 2020h). Additional waste characterization sampling was conducted during the 2021 SDI, the results of which further support the conclusions summarized in GHD’s October 2020 letter. Additional sampling may be required to further characterize excavated material to determine whether it meets the definition of Class 1 or Class 2 non-hazardous waste under the regulations governing classification of non-hazardous industrial solid waste in Texas. If additional characterization is conducted it will be done so in accordance with the guidance provided in Chapter Nine “Sampling Plan” of the *Test Methods for Evaluating Solid Waste, Physical/Chemical Methods* (EPA, 1986) and in *RCRA Waste Sampling Draft Technical Guidance* (EPA, 2002). If at any time a hazardous waste, as defined in 40 CFR Part 261, is identified, it will be managed and disposed of in accordance with RCRA regulations.

3.3.5 Solidification Testing

Solidification testing was conducted to determine the appropriate reagent dosages to solidify the waste material for transportation to an off-site disposal facility. Off-site disposal facilities typically require incoming waste to pass paint filter testing (an indicator of moisture content) and meet a minimum UCS criteria. A series of tests were performed on material with various levels of the following parameters:

1. Moisture content - to simulate a wide range of site conditions.
2. Reagent concentration - to develop optimal dosage percentage to address paint filter and UCS disposal requirements.
3. Reagent mix - to develop optimal reagent blend for cost analysis.

The solidification testing methodology and results are summarized in the sections to follow.

3.3.5.1 Solidification Testing Methodology

Waste material composite Sample 3 and composite Sample 4 from the Northern Impoundment were utilized for solidification testing. The testing mixtures were prepared by placing 400 grams (g) of waste material with the predetermined amount of reagent in a mechanical mixer. Waste material and reagent were mechanically mixed for five minutes and then placed into a mold for curing. Reagent doses and blends tested are summarized in Table 3-A, as follows:

Table 3.A Solidification Testing Parameter Matrix

Percent Solids Tested (%)	Reagent Type Tested	Reagent Dosage(s) Tested (%)
35 ,45, 55, 70	Portland Cement	2, 5, 10, 20
	Lime	5, 10, 20
	Portland / Lime	5/5, 10/10, 10/20, 15/20

Notes:
(1) Portland/Lime reagent blends were utilized to evaluate cost effective substitutes.
(2) "5/5" indicates percentage of Portland cement and lime used (i.e., 5% Portland + 5% lime).

Curing was monitored using a pocket penetrometer and samples were monitored for the presence of free water which would be a leading indicator of not passing a Paint Filter Test. Pocket penetrometer testing was conducted on molds starting from two days after mixing up to 14 days. Results of solidification testing is summarized in Section 3.3.5.2.

3.3.5.2 Solidification Results and Conclusions

The results of the solidification testing indicated that free water (Paint Filter testing) and UCS requirements of an off-site disposal facility can be met across a range of waste material percent solid scenarios (35 to 70 percent) utilizing

Portland cement and/or lime. In general, Portland cement was more effective at achieving both disposal requirements. Lime dosages did not result in significant strength (UCS) or free water reduction. In addition, combining lime with Portland cement did not result in the ability to lower the percentage of Portland cement utilized.

Based on these solidification tests, the required dose of Portland cement increases with decreasing percent solids and ranges from a dose of two percent for waste material with 70 percent solids to 10 to 20 percent (depending on potential landfill strength requirements) for material with 35 percent solids. Material with 45 percent solids or less has the potential to fail the Paint Filter test without adequate treatment. The selected Remedial Contractor (RC) may perform their own testing at the time of the RA. The specifics of the off-site disposal facility requirements will be worked out between the RC and the selected off-site disposal facility at the time of the RA. The results for these solidification treatability tests are presented in Appendix C.

3.4 2019 Water Treatability Testing

During the RA, as specified in the ROD, as sections of the armored cap are removed, water will come into contact with the waste material through seepage or stormwater and will require management. Additionally, water generated from equipment decontamination and the water treatment system (WTS) containment area will need to be managed. Water treatability testing was performed to evaluate two water management options: (1) traditional treatment and (2) discharge using clarification and filtration and thermal evaporation.

To generate a sufficient quantity of representative contact water for all necessary testing, an open excavation area was constructed in the waste material in the southwestern quadrant, as shown on Figure 3-1, and filled with potable water to simulate potential stormwater or seepage that may come into contact with the impacted waste material. A sample of the raw contact water was collected and sent to the GHD Treatability Lab for baseline characterization and filtration testing.

The remaining generated contact water was processed on-site through a modular filtration treatment system, including polymer addition with inline mixing followed by clarification, sand filtration, and bag filtration. Samples were collected at each step of the treatment process to evaluate the concentration of dioxins and furans. Additional focused filtration testing was performed on a sample of the final clarified and filtered effluent to further evaluate dioxin and furan concentrations using different filter sizes. Treatability testing was also conducted on the clarifier underflow (solids that settle out during the clarification process) to evaluate the level of settling and solidification necessary to prepare the waste stream for off-site disposal.

A batch of clarified water, prior to filtration, was sent to the Purestream pilot test facility in Logan, Utah for a thermal evaporation pilot test to evaluate air emissions.

All water testing results were evaluated against calculated water discharge criteria, as discussed below.

3.4.1 Water Discharge Concentrations

So that discharge of treated water during the RA meets water quality standards, COPC discharge concentrations were developed by conducting a water quality-based effluent limitation (WQBEL) assessment. The Texas Surface Water Quality Standards (TSWQS) are specific to water bodies, not to discharges, so WQBELs take into account the load that the site-specific discharge would add to the water body as a whole to determine the necessary limits to maintain protection of human health and aquatic life.

The TCEQ utilizes the Texas Toxicity Screening (TexTox) Menus to determine WQBELs. TexTox Menus include all relevant formulas and inputs found in the *Procedures to Implement the Texas Surface Water Quality Standards* (Implementation Procedures), June 2010 (TCEQ, 2010). Depending on the type of receiving water body, different TexTox Menus would be assigned. During the RA, treated water from the Northern Impoundment will discharge to either Segment 1005 (Houston Ship Channel/San Jacinto River Tidal, south of I-10) or Segment 1001 (San Jacinto River Tidal, north of I-10) of the San Jacinto River, which is classified as a bay/wide tidal river.

For discharges into Segments 1005 or 1001, TCEQ would assign the TexTox Menu #5 to calculate WQBELs. This TexTox Menu requires inputs for Total Suspended Solids (TSS), effluent flow, and effluent fractions for chronic and acute aquatic life and human health. Based on the planned location of the outfall and the type of water body, the following default dilution fractions were used, per TCEQ guidance: 30 percent for Zone of Initial Dilution (Acute), eight percent for Aquatic Life Mixing Zone (Chronic), and four percent for Human Health Mixing Zone. Since Segments 1005 and 1001 are tidal water bodies, they are dominated by the ebb and flow of tides rather than from upstream flow. These effluent fractions, along with an estimated effluent flow, serve as main inputs for the discharge information required by the TexTox Menu to calculate WQBELs. The estimated discharge flow rate for the RA ranges from 300 to 1,000 gpm (0.432 to 1.44 million gallons per day [gpd]). The default dilution factors are recommended for any discharge into a bay/tidal river greater than 400 ft wide with a flow rate less than 10 million gpd.

Using default dilution factors, river segment specific inputs, and expected TSS and discharge flow rates from the Northern Impoundment WTS discharge, preliminary discharge concentrations were determined. These preliminary calculated discharge concentrations were used to evaluate water treatability testing results and can be found in Table 3-2.

3.4.1.1 Compliance with the Texas Surface Water Quality Standard - Dioxins and Furans

The EPA has made a determination regarding compliance with the TSWQS for dioxins and furans as an ARAR, based on the substantive requirements of the TCEQ's regulation for surface water discharge, as detailed in e-mail correspondence dated February 18, 2020 (EPA, 2020b; included in Appendix D).

EPA has determined that compliance with the TSWQS ARAR will be attained as follows:

- *The state surface water quality standard for Dioxins/Furans is 7.97 x 10^{-8} micrograms per liter (µg/L)[1] [0.0797 picograms per liter (pg/L)[2]] (as TCDD equivalents).*
- *Compliance with the TSWQS will be determined using the minimum level of the EPA approved method (1613B), cited in 40 CFR Part 136 (Guidelines Establishing Test Procedures for the Analysis of Pollutants), in sampling of surface water discharges during the site remedial action.*
- *If an effluent sample analyzed for dioxin is below the Minimum Level (ML) using the EPA approved method, the sample result would be identified as non-detect and the discharge would be determined to be in compliance with the ARAR.*
- *The ML for each analyte is defined as the level at which the entire analytical system must give a recognizable signal and acceptable calibration point. It is equivalent to the concentration of the lowest calibration standard, assuming that all method-specified sample weights, volumes, and clean-up procedures have been employed.*
- *This approach is consistent with the state's guidance and other permits issued by the TCEQ. EPA's determination is contingent on the water treatment facility using a 1-micron final filtration step in the water treatment process*.

3.4.2 Contact Water Pilot Testing

3.4.2.1 Contact Water Creation

Contact water for pilot testing was generated from the Northern Impoundment by creating an open excavation in the southwestern portion of the Northern Impoundment, with approximate dimensions of 20 ft by 20 ft and a depth of 10 ft. The excavated material was temporarily stored in roll-off containers. The excavation remained open overnight, and water that seeped into the excavation was collected and submitted for analysis. Approximately 20,000 gallons of potable water was then transferred into the excavation and mixed using an excavator bucket to generate a worst-case sediment and water mixture that may be encountered during the RA. This simulated contact water was then pumped into two storage tanks and the contents of the two tanks were homogenized prior to treatment.

3.4.2.2 Pilot Test Overview

Once the contact water was created and removed for treatment testing, as described above, the excavation was backfilled with the stockpiled waste material, the geomembrane cover was replaced and sealed, and the armored cap material was replaced. A sample of contact water created from the on-site excavation was shipped to Evoqua Water Technologies LLC (Evoqua), to determine the optimum polymers for addition during the on-site field filtration pilot testing. The modular filtration treatment system included polymer addition with inline mixing followed by clarification, sand filtration, and bag filtration, as depicted on Process Flow Diagram (PFD) shown on Figure 3-2. During the treatment system operations, the storage tanks were continuously mixed, while the water was recirculated between the two tanks to homogenize the feed to the treatment system.

One batch of contact water was treated through clarification only, and one batch was treated through both clarification and sand filtration. The batch of clarification-only water was sent to the Purestream pilot test facility in Logan, Utah, and used to evaluate thermal evaporation technology for water management. The batch of clarified and filtered water was sampled and used to evaluate traditional pump-and-treat technology through on-site field and bench-scale testing, as described in the subsequent sections.

The pilot test treatment system was operated at a flow rate of approximately 30 gpm. The system was initially flooded with contact water, which was directed to an off-specification wastewater storage tank. Clarifier effluent turbidity was monitored as the polymer dosage rates were adjusted. Once the clarifier effluent turbidity dropped below 10 Nephelometric Turbidity Units (NTUs), the clarified water was directed to a separate holding tank. After 7,500 gallons were collected, the clarified effluent was directed to the sand and bag filters, and the effluent to the off-specification tank. Once turbidity levels remained at a consistent value of 10 NTUs in the effluent out of the clarifier, and at approximately one NTU in the filtrate from the filters, the filtered effluent water was discharged to a separate holding tank. Clarifier underflow solids were discharged to a holding tank and allowed to further settle. Photographs from the water treatment pilot test activities are included in the photographic log included in Appendix C.

3.4.2.3 Filtration Pilot Test Water Samples

As discussed previously, contact water was generated in the southwestern part of the Northern Impoundment by placing potable water in an open excavation. This simulated contact water was then processed through an on-site pilot treatment system which included polymer addition with inline mixing followed by clarification, sand filtration, and bag filtration. Water samples were collected and analyzed at different steps in the process, as depicted in the PFD included as Figure 3-2.

A contact water sample taken from the storage tank prior to homogenization was sent to the GHD Treatability Lab for bench-scale testing. This sample and the excavation seepage water were analyzed for the following parameters:

– Total and Dissolved Dioxins and Furans - EPA Method 1613B.
– VOCs - EPA Method 8260C.
– SVOCs - EPA Method 8270D.
– Organochlorine Pesticides - EPA Method 8081B.
– Herbicides - EPA Method 8151A.
– PCBs - EPA Method 8082A.
– Anions - EPA Method 300.0R2.1.
– Total Metals - EPA Method 6010C.
– Total Mercury - EPA Method 7470A.
– Alkalinity - SM 2320B.
– Ammonia Nitrogen - EPA Method 350.1.
– Biochemical Oxygen Demand - SM 5210B.
– Chemical Oxygen Demand (COD) - EPA Method 410.4.
– Cyanide - EPA Method 9012B.

- Ferrous iron - SM 3500.
- Hydrogen sulfide - EPA Method 15.
- pH - EPA Method 9040C.
- Phosphorus - EPA Method 6010C.
- Sulfide - EPA Method 9034.
- Total Dissolved Solids (TDS) - SM 2540C.
- Total Organic Carbon (TOC) - SM 5310C.
- TSS - SM 2540D.

The two homogenized contact water samples, the clarified effluent sample, and the filtered effluent sample were analyzed for any COPC that had a detection in the results of the previous non-homogenized contact water sample. Based on those results, these samples were analyzed for all of the same constituents listed above, except the following which were found to be non-detect: VOCs, SVOCs, Organochlorine Pesticides, Herbicides, and PCBs.

In addition, samples were collected from the clarifier underflow and settling tank for treatability testing and TSS analysis.

3.4.2.3.1 Filtration Pilot Test Results

Results of the water samples from each step of the on-site pilot testing are summarized in Table 3-2 and were compared to the estimated discharge criteria established by the EPA (ML), as described in Section 3.4.1. Analytical laboratory reports are included as part of Appendix C.

The homogenized contact water initially exhibited levels of dioxins and furans, TSS, and some metals (including copper, lead, and zinc) above the estimated discharge criteria. Following clarification, the metal concentrations in the clarified effluent sample were below the estimated discharge criteria. Following filtration, dioxins and furans concentrations were also below the ML. The table on Figure 3-2 shows the stepwise decrease in dioxins, metals, and TSS levels at each step in the treatment process. This treatment process is being used as the basis for the RD with additional proposed unit processes, as discussed in Section 5.9.

Turbidity was monitored online at both the clarifier effluent and the filtered effluent. Turbidity results are presented on Figure 3-3. Clarifier turbidity was typically at 10 NTUs or less, while filtered effluent turbidity was typically at one NTU or below. The clarifier effluent TSS concentration was 10 milligrams per liter (mg/L), while the filtered/clarified effluent TSS was 2 mg/L. Based on the observed relationship between turbidity and TSS (see Figure 3-A), turbidity levels can be used as an indication of the TSS concentration. One dioxin congener was above the ML in the clarified effluent, but below the ML in the filtered effluent. For the RA, due to the strong correlation between TSS and dioxan and furan level, TSS and turbidity levels could potentially be used to indicate if the dioxin and furan level is below the ML based on these pilot testing results, as well as the bench-scale filtration results. However, further field testing will be required during the operations of the treatment system.

A turbidity spike occurred at the 19:30 hour mark during the filtration pilot test as a result of the loss of polymer feed. Once this issue was observed, the polymer feed was changed from automatic to manual then restarted, and turbidity dropped to the pre-spike levels. This result supports the benefit of polymer, as well as the ability to monitor performance using turbidity as an indicator

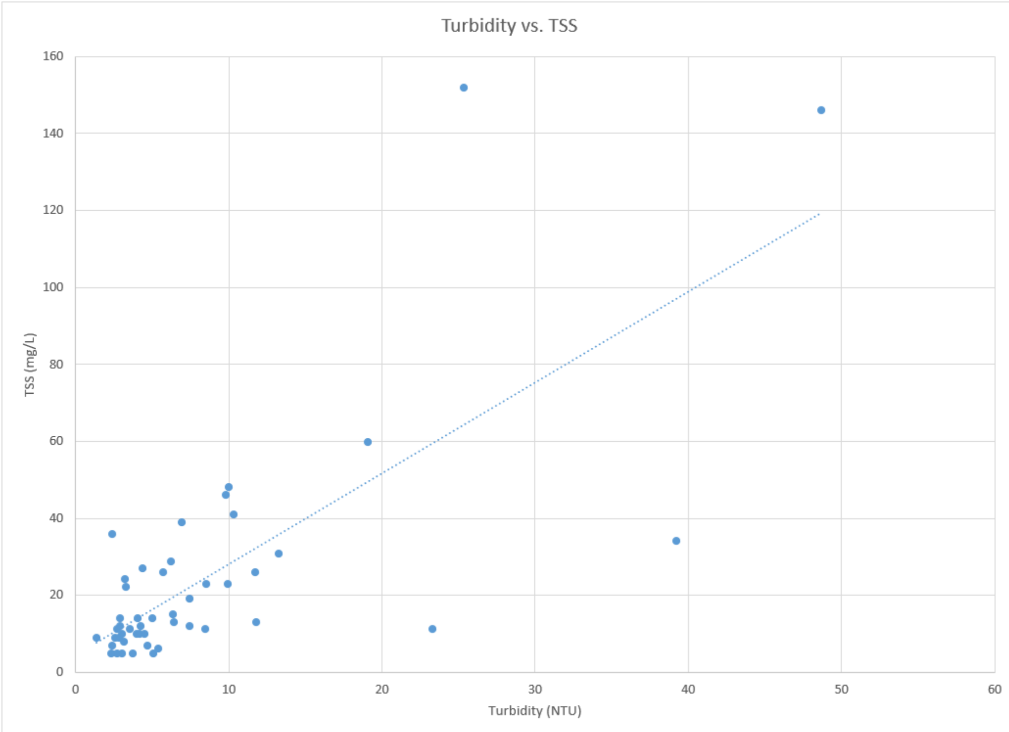


Figure 3-A *Turbidity vs. TSS*

3.4.2.4 Thermal Evaporation Pilot Test

For the thermal evaporation evaluation, approximately 5,000 gallons of clarified contact water were transported to the Purestream pilot test facility in Logan, Utah, for a three-day pilot test. The pilot test facility utilized a 1/10 scale replica pilot test model of a Flash thermal evaporation unit, which utilizes a direct flame to evaporate influent water to the atmosphere, creating a brine byproduct only (that would need to be disposed) with no effluent water stream for river discharge. The pilot test included three days of stack testing to evaluate emissions of COPCs. Results of the stack testing indicated that none of the COPC emissions were above the levels of the applicable air emissions ARAR (the Permit by Rule [PBR] 30 TAC §106.261(a)(3)). This indicates that most of the COPCs remain in the brine byproduct generated by thermal evaporation.

As part of the RD evaluation, water treatment rates and storage requirements were evaluated for both water management alternatives. The treatment flowrate for the traditional pump-and-treat option is 300 gpm. In order to achieve a 300-gpm flowrate using the thermal evaporation option, 25 thermal evaporation units would be needed. It was determined that it would not be feasible to stage and operate this large a number of units at the Northern Impoundment during the RA. As a result, contact water would need to be stored and evaporated at a lower flow rate, resulting in storage of larger volumes of water over a longer duration as compared to the treat-and-discharge option. As a result, traditional treatment through clarification and filtration was selected for use in the 90% RD and thermal evaporation was not further evaluated. Thus, results of the thermal evaporation evaluation are not included in this 100% RD.

3.4.3 GHD Treatability Bench-Scale Testing

The bench-scale testing of the non-homogenized contact water is described in Section 3.4.2.3. In addition to the initial analysis and characterization of the contact water, bench-scale filtration tests were performed on the generated contact water (Section 3.4.3.1, below). Bench-scale testing was also performed on the clarified and filtered effluent from the pilot test (Section 3.4.3.2, below) to evaluate additional filtration steps.

As part of the clarification process, solids settle out of the water into a sludge. This clarifier underflow sludge will be disposed off-site as a separate waste stream. Because the sludge will have a very high moisture content, it may need to be solidified prior to off-site transport. Treatability testing was performed to evaluate options for solidification of the sludge. To optimize the amount of reagent necessary for solidification, additional settling treatability testing was performed to evaluate the effectiveness prior to solidification (Section 3.4.3.3, below).

3.4.3.1 Contact Water Filtration Testing

A serial filtration test was performed on the non-homogenized contact water during the bench-scale testing in order to determine the size distribution of the particles present in the contact water and any relationship between particle size and the concentration of dioxins and furans in the sample.

The test was performed on a 7-liter sample of non-homogenized contact water. The entire sample was filtered through a pre-weighed 100-micron (µm) filter paper. A one-liter sample of the filtrate was then collected for analysis of dioxins and furans. This process was repeated using the remaining filtrate water and pre-weighed 10, 1, 0.45 and 0.1 µm filter papers, with collection of a filtrate sample after each filtration. After the filtration test was complete, each filter paper was dried and then weighed to determine the amount of particulate captured on the filter, and the filtrate samples were analyzed for dioxins and furans.

Testing of other water treatment technologies identified in the TSWP, such as those for metals and ammonia removal, were not required as these compounds did not exceed discharge criteria in the baseline characterization.

Contact Water Filtration Test Results

The results of the filtration test showed more than 90 percent of the particulates were larger than 10 µm in size. Concentrations of dioxins and furans that exceeded the MLs were observed in the filtrate that had passed through the 100 µm and 10 µm filters; however, after filtration with a 1 µm filter, concentrations of all dioxins and furans were below their MLs. These results are summarized in Table 3-3 and shown graphically on Figure 3-4. Analytical laboratory reports are included as part of Appendix C.

3.4.3.2 Focused Filtration Testing

The on-site filtration pilot test water treatment included clarification, followed by sand filtration and nominal bag filtration. In order to determine the effect of additional filtration on the already filtered effluent from the pilot study, the pilot study filtrate water was filtered through 1 µm, 0.45 µm, 0.1 µm, 0.05 µm and 0.025 µm filters. The filtrate from each filter was collected and analyzed for dioxins and furans.

Further testing on the effluent included coagulation/flocculation testing and testing of granular activated carbon (GAC) for polishing.

Focused Filtration Testing Results

The filtrate from the 1 µm, 0.45 µm, 0.1 µm, 0.05 µm and 0.025 µm filters was analyzed for dioxins and furans. These results are summarized in Table 3-4 and shown graphically on Figure 3-4. Analytical laboratory reports are included as part of Appendix C. Consistent with the results obtained from the initial effluent bench-scale filtration testing, none of the filtrate samples contained dioxins and furans above the MLs. This confirms that a 1 µm filter is sufficient for removal of the dioxins and furans from the water. This and the contact water filtration testing data (Section 3.4.3.1) were presented and discussed with members of the TWG on January 27, 2020. Based upon the results and the TWG discussion, the EPA sent correspondence to the Respondents on February 18, 2020 (EPA, 2020b), stating that “compliance with the TSWQS will be determined using the minimum level of the EPA approved method (1613B).” The correspondence further specified that this determination would be “contingent on the water treatment facility using a 1 µm final filtration step in the water treatment process.”

Coagulation/flocculation jar testing was performed on the non-homogenized contact water by Evoqua, and the results were used to inform the polymer dose utilized during the pilot test discussed in Section 3.4.2.

Further testing of the effluent included polishing with GAC. As dioxins and furans were not present above their MLs prior to GAC treatment, removal of dioxins and furans by GAC could not be quantified. However, GAC treatment will be included in the RD to provide a final polishing step to the effluent discharge.

3.4.3.3 Clarifier Underflow Solids Testing

As previously discussed, bench-scale treatability testing was performed to evaluate the effectiveness of additional settling of the clarifier underflow prior to solidification for off-site disposal. As part of the settling test, a sample of the clarifier underflow was agitated to resuspend solids and an initial sample was analyzed for TSS. A subsample of the material was poured into a 500 mL graduated cylinder and allowed to settle. The height of the sediment/water interface was recorded every five minutes and a sample of the supernatant was analyzed for turbidity every ten minutes. After settling was complete (i.e., no change in the sediment/water interface was observed), a sample of the supernatant was analyzed for TSS.

Solidification tests were also performed on both the raw clarifier underflow and the clarifier settled solid samples that were generated, as described above. The solidification tests were conducted by placing 400 grams of waste material with the amounts of solidification agent, stated below, and water in a mechanical mixer. The waste, water, and solidification agent were mixed for five minutes and then placed in a plastic mold. The samples were allowed to cure for two weeks. During curing, the hardness of the sample was evaluated using a pocket penetrometer three times per week. After curing, the samples were analyzed for UCS.

For the raw clarifier underflow sample, solidification was tested using the sample alone and the sample mixed in a 1:1 ratio with a sample of waste material composite. Cement doses between 15 percent and 85 percent were tested with and without the addition of lime at doses between 20 percent and 70 percent.

For the settled solids sample, solidification was tested using the sample alone and the sample mixed in a 1:1 ratio with a sample of waste material composite. Cement doses between 10 percent and 30 percent were tested with and without the addition of lime at doses between 20 percent and 30 percent.

Similar solidification testing was performed with the brine from the evaporation pilot test. Since evaporation is no longer being considered as an option for water treatment, these results will not be discussed in this 100% RD.

Clarifier Underflow Solids Test Results

Settling of the clarifier underflow solids occurred quickly; the bulk of the solids settled within four minutes and the supernatant gradually cleared to produce a low turbidity, low TSS liquid within two hours. These results indicate that settling is useful in removing suspended solids. Photographs of the settling tests are shown in the photographic log included in Appendix C.

For the raw clarifier underflow solidification tests in which lower Portland cement and lime doses were used, even though good solidification of the solids was achieved, standing water remained on top of the solidified mass. This showed that the water had not been incorporated into the solidified material.

To eliminate standing water in the samples, a dose of 35 percent Portland cement and 60 percent lime was required for the raw clarifier underflow sample and a dose of 70 percent Portland cement was required for the clarifier underflow sample mixed at a 1:1 ratio. A pocket penetrometer hardness of >64 pounds per square inch (psi) was achieved for these samples.

These data show that a large dose of Portland cement and lime would be required to solidify the clarifier underflow on its own and that mixing with the waste material at a ratio of less than one part underflow per part of waste material would be recommended in order to minimize the reagent dose for solidification.

For the solidification test using the settled solids, standing water was observed initially in some tests with lower doses of cement and lime. However, after two days, the standing water had been absorbed by the solidified solids. The minimum reagent doses to achieve a pocket penetrometer hardness of >64 psi and a UCS of >50 psi were 25 percent Portland cement with 30 percent lime or 20 percent Portland cement with a 1:1 mixture of waste material and settled solids.

These data show that the settled solids can be solidified on their own but that mixing with waste material at a 1:1 ratio can reduce the required reagent dose. The selected RC may perform its own testing at the time of the RA. The specifics of the off-site disposal facility requirements will be worked out between the RC and the selected off-site disposal facility at the time of the RA. More detailed data for these solidification treatability tests can be made available upon request.

3.5 2019 Armored Cap Material Treatability Testing

The TSWP scope of work included generation and testing of an elutriate to characterize the armored cap material and evaluate the potential for reuse as part of the RA. During the December 17, 2019 TWG Meeting, the EPA requested that the scope be revised to include additional analyses of the sediment that is generated from the rinsing of the armored cap material, as well as analysis of the crushed rock itself. The revised scope was documented in a *Treatability Study Work Plan Refinement Notice*, submitted January 10, 2020, (GHD, 2020a) and approved by the EPA on January 17, 2020 (EPA, 2020a).

Composite samples of the armored cap material were collected from three different locations in the Northern Impoundment (the west side of the impoundment, the east side of the impoundment and the bermed areas). The sample locations included submerged and non-submerged areas, and the samples were collected only from areas in which a geotextile and/or geosynthetic liner separates the rock from the waste material. Two five-gallon buckets of armored cap material were collected per composite sample area. All treatability activities were performed at the GHD Treatability Lab. Approximate locations of the armored cap material samples are shown on Figure 3-5.

The elutriate was generated by mixing the armor rock with deionized (DI) water at a ratio of 1:5, agitating the mix for 30 minutes before removal of rock, settling the solids in the supernatant water for one hour, and finally, centrifugation of the supernatant water. The resulting elutriate water was then analyzed for dioxins and furans using EPA Method 1613B.

The settled solids from the containers comprising the same armored cap material sample, as well as any solids that resulted from centrifugation of the respective rock water, were combined and sent to the laboratory for analysis of dioxins and furans.

The armored cap material that was washed during the elutriate testing was crushed using a rock crusher and the crushed material from the three separate armored cap locations was analyzed for dioxins and furans.

Armored Cap Treatability Testing Results

No dioxins or furans were detected in any of the elutriate samples above their MLs. Similarly, all $TEQ_{DF, M}$ results from the solids that were washed from the rocks and of the crushed rocks, themselves were below the 30 ng/kg clean-up level. These data are shown in Table 3-5. Analytical laboratory reports are included as part of Appendix C.

3.6 Additional Treatability Testing

Treatability activities performed prior to the submittal of the 30% RD and summarized in the previous sections of this 100% RD, were designed to evaluate the water treatment process for the pump-and-treat approach where water generated from the RA would be stored in aboveground tank(s) and then treated. The 30% RD described an alternate remediation approach (Approach B) that was being considered for the Northern Impoundment. Water treatment under this approach would have included water treatment technology similar to that of the pump-and-treat approach except that water would be treated in-situ in a flooded excavation cell via a recirculation and filtration process. The feasibility of the Approach B excavation methodology hinged on the success of the Approach B water treatment methodology. As described in the 30% RD, additional treatability testing was proposed to evaluate the effectiveness of the Approach B water treatment methodology. In addition, a field filtration test was proposed to evaluate operation of an absolute filter for the reduction of dioxin and furan concentrations in the clarified and sand-filtered contact water that remained on-site following the 2019 field pilot testing.

The planned treatability testing was summarized in an *Additional Treatability Testing Notice* submitted to the EPA on April 16, 2020 (GHD, 2020b). Comments were received from the EPA on May 5, 2020 (EPA, 2020c). The EPA's comments were addressed in the *Revised Additional Treatability Testing Notice* (Revised Notice; GHD, 2020c), submitted to the EPA on June 4, 2020. The Revised Notice was approved by the EPA on June 11, 2020 (EPA, 2020d). In response to revisions that were requested by the EPA during a call on October 9, 2020, a *Refinement Notice - Revised Additional Treatability Testing Notice* was submitted to the EPA on October 15, 2020 (GHD, 2020f)

The two treatability testing scopes included in the Revised Notice were conducted in 2020. In addition, some supplemental filtration confirmation testing was performed in October 2021. The results of these three treatability scopes are presented in the following sections.

3.6.1 Field Filtration Testing

As described in the Revised Notice, a field filtration testing was conducted on May 28, 2020, at the Northern Impoundment to further refine the filtration design requirements (specifically the use of nominal versus absolute filters) evaluated in the initial October 2019 field pilot testing. Absolute filters provide a higher removal efficiency than nominal filters at the same pore size. Therefore, the use of absolute filters was expected to provide more efficient removal of dioxins and furans than the nominal filters.

The May 2020 field filtration testing consisted of filtration of contact water that had previously been clarified and sand filtered during the October 2019 field pilot testing through absolute filters.

The primary objectives of the field filtration testing were to:

– Evaluate water quality using 1 μm and 0.5 μm absolute filters.
– Evaluate the operating costs of 1 μm and 0.5 μm absolute filters.
– Evaluate which pore size filter is more appropriate for the application, based on operational efficiency.

3.6.1.1 Field Filtration Testing Process

The field filtration tests were conducted in May 2020.

ProAct, a subsidiary to Evoqua, provided a modular filtration system containing both 1 μm and 0.5 μm absolute filters with a design flow of 80 to 100 gpm. Filtration tests were conducted in one day over the course of ten hours. Prior to filtration, turbidity was measured in the filter feed tank while mixing until readings stabilized, indicating that tank contents were sufficiently mixed and solids were adequately suspended. Flow was then passed through the filter housing with no bag filters so that influent samples could be collected.

The 0.5 μm absolute bag filter was placed inside the housing and then flow was passed through the filter, during which time flow and differential pressure across the filter were continuously monitored. After approximately 35 minutes, flow through the 0.5 μm filter was stopped, and the test was repeated with the 1 μm absolute filter. Again flow and differential pressure were continuously monitoring across the filter. The 1 μm filter test ran for approximately 25 minutes before the volume of water available was expended.

Samples of influent (i.e., the previously sand filtered and clarified contact water), filtrate through 0.5 μm filter, and filtrate through 1.0 μm filter were analyzed for water quality parameters. Parameters of interest were total dioxins and furans, TSS, total metals, and dissolved metals (field filtered).

3.6.1.2 Field Filtration Test Results

Flow and differential pressure measurements for the 0.5 μm and 1 μm absolute filters were plotted versus time and then extrapolated over a longer duration as shown on Figure 3-6.

Figure 3-6 shows that flow decreased rapidly, especially through the 0.5 μm filter, which dropped to nearly 0 gpm after 40 minutes of operation. Flow through the 1 μm filter was projected to drop by almost 20 percent after operating for

50 minutes, although this is based on limited data (due to only a limited volume of water being available to use in the testing). Differential pressure variations appear to correlate with flow variations, increasing significantly even after short operational durations. Differential pressures through the 0.5 µm filter were projected to increase to almost 30 psi after only 40 minutes of operation. Differential pressures through the 1 µm filter show a more gradual increase, but projections are based on fewer data points.

Analytical results from the influent, 1 µm filtrate, and 0.5 µm filtrate samples for parameters of interest are presented in Table 3-6.

Results show that concentrations of TSS and dioxins and furans were low in the influent water, with TCDD levels already below the MLs. As expected, filtration further reduced TSS and dioxins and furans to levels below the MLs after the 1 µm filter, with additional reduction after the 0.5 µm filter. Both filters achieved dioxins and furans concentrations below MLs. Finally, results for both total and dissolved metals showed no concentrations above the discharge criteria.

3.6.1.3 Field Filtration Testing Conclusions

Analytical results indicate that the 0.5 µm and 1 µm absolute filters achieve concentrations of dioxins and furans below the MLs however, the data shown on Figure 3.6 indicate that operations using absolute filters at the small pore sizes evaluated (0.5 µm and 1 µm) may cause operational difficulties, such as rapid increase in differential pressures due to filter fouling, that would require frequent filter changeout. These difficulties are addressed in the WTS design by providing a two-step filtration process after the media filters using a 10-µm filter system before the 1 µm filter system. In addition, the WTS design includes redundant 10 µm and 1 µm filtration systems in parallel, which will allow rapid change over from the duty to the standby system to reduce downtime. Subsequent filtration tests (summarized in Section 3.6.3) indicate that filters provide effective removal of dioxins and furans to below the MLs; therefore, the WTS described in this 100% RD prescribes the use of 95% efficient 10 µm and 1 µm filter cartridges or bags. Actual filtration during treatment may improve based on refining chemical addition and filter feed rates during operation.

3.6.2 Approach B Water Filtration Testing

Approach B excavation methodology considered in the 30% RD included removal of soils through a water column. Approach B in-situ water treatment would have involved adding chemicals to the water column within the barrier wall and then sending the water through a recirculating filtration system (with filter pore sizes down to 1 µm) to reduce TSS concentrations below the target level which is also expected to remove dioxins and furans.

The primary objectives of the Approach B water filtration testing were to:

- Quantify volume of soil particles that become suspended in the water after excavation.
- Determine particle size distribution and dioxin load of the suspended soil particles.
- Determine settling properties of the suspended soil particles.
- Determine time needed for the filtration system to reduce TSS of the water column to acceptable levels.
- Evaluate effects of adding polymer to the water column containing suspended soil particles.
- Evaluate polymer/coagulant mix required to condition soil for filtration and the design parameters for this filtration.

3.6.2.1 Approach B Water Filtration Testing Process

The Approach B water filtration tests were conducted in the GHD Treatability Lab in Niagara Falls, New York from October 2020 through January 2021. Test activities included the following steps:

- Two (2) tanks with sampling ports were constructed to simulate the water column in the excavation cell. The two tanks were used to run parallel tests as follows:
  - Tank #1 tests evaluated treatment effectiveness with the addition of coagulant and polymer.
  - Tank #2 tests evaluated treatment effectiveness without any chemical addition.

- A slurry was prepared with simulated river water and waste materials collected from the Site.
- The slurry was added to each tank and then solids were allowed to settle to mimic an in-situ water column.
- Excavation was simulated in the tanks to reagitate the solids.
- Chemicals, including coagulant and polymer, were added to facilitate setting and filtration.
- After chemical addition, solids were allowed to settle in the tank. Supernatant was sampled for TSS.
- Solids were resuspended then recirculated through a series of filters with decreasing pore sizes down to 1 µm. For this test, Geotube® fabric was used for initial filtration to remove larger particles of TSS and mitigate clogging of the subsequent finer filters.
- Filtrate was then collected for analysis of general chemistry parameters, specifically dioxins and furans.

3.6.2.2 Approach B Water Filtration Testing Results

After simulating the excavation within the water column in the tanks, settling tests showed that the chemical addition increased the rate of solids settling, reaching low levels of TSS and turbidity within three hours of settling as compared to more than 24 hours of settling that was required without chemical addition. However, results from both tests produced supernatant with dioxins and furans still above the MLs.

Geotube filtration tests showed that chemical addition improved TSS removal, reducing TSS in settled supernatant by 90 percent as compared to 50 percent without chemical addition. Recirculation filtration of Geotube filtrate did not remove TSS as much as expected based on calculations using Geotube filtrate particle size distribution. Figure 3-7 shows the actual versus expected TSS values over the time of the recirculation filtration.

After recirculation tests were completed, the solids were mixed to simulate the full-scale operation excavation that would be conducted while recirculating the water column through filters. Particle size distribution was evaluated on samples from both tanks after completion of the recirculation tests and after simulating excavation.

Results showed that there was some decrease in solids particle sizes after excavation simulation, suggesting that excavation activities along with recirculation breaks down particles to sizes that may pass through filtration, even after chemical addition. Additionally, larger particle sizes were observed in the tank where chemicals were added, indicating that chemical addition effectively increases particle sizes of the solids.

Water in the tanks after recirculation testing was analyzed for dioxins and furans. Data show that a series of recirculating filters did not reduce dioxins and furans as expected/calculated. Analysis of dioxins and furans in the filtrate water from each filter size showed significant reduction in dioxin/furan concentrations. However, filtrate through even the smallest 0.1 µm filter did not achieve dioxins and furans below the MLs, compared with previous tests on the pump-and-treat methodology that achieved dioxins and furans below the MLs after a 1 µm filter (Section 3.4.3.). Analytical results from these tests are shown in Table 3-7.

Further review of the particle size distribution test results showed that the majority of particulates containing dioxins and furans are between the sizes of 10 and 41 µm; therefore, it was expected that the filtration through the 10 µm should have produced filtrate with dioxins and furans close to or below the MLs. Inadequate removal of dioxins and furans observed during recirculation testing suggests that the mixing energy imparted from recirculation may break down solids into smaller sizes that can pass through a 0.1 µm filter and allow breakthrough of dioxins and furans in the filtrate.

3.6.2.3 Approach B Water Filtration Testing Conclusions

Treatability testing showed that the Approach B in-situ water treatment approach is not effective. This is due to challenges in mixing in order to keep solids in suspension to allow for effective removal via filtration.

Based on these results, this approach was eliminated as an option for the WTS and was not carried forward in this 100% RD.

3.6.3 Additional WTS Treatability Testing

Following the Approach B water filtration testing which demonstrated that in-situ filtration methodology was not effective, the design shifted to focus on a dry excavation and pump-and-treat aboveground WTS.

The WTS design included herein includes pumping contact water from the excavation area to a separate aboveground WTS utilizing chemical treatment (i.e., coagulation/flocculation) followed by filtration and activated carbon treatment to reduce the TSS below the target level, which would be expected to also remove dioxins and furans. Previous filtration testing of contact water from the site showed that filtration through a 1 µm filter reduced solids to achieve dioxins and furans concentrations below MLs (Section 3.4.3).

Certain tests that had been conducted in previous testing (including polymer addition and settling) were not applicable to the design of the WTS process, as they had been conducted to evaluate the Approach B methodology. As such, to verify the effectiveness of the treatment process included in this 100% RD and to evaluate its operational feasibility, additional WTS treatability testing was conducted.

The primary objectives of the additional WTS treatability testing were:

- Determine particle size distribution and dioxin load of the suspended soil particles.
- Determine settling properties of the suspended soil particles.
- Evaluate polymer/coagulant dosages required for effective setting and filtration.
- Develop design parameters for the chemical addition and filtration processes.

3.6.3.1 Additional WTS Treatability Testing Process

The additional WTS treatability testing was conducted at the GHD Treatability Lab in Niagara Falls, New York in October 2021. Test activities included the following steps:

- Contact water was prepared using simulated precipitation water and waste material collected from the site during the SDI activities.
- The contact water was added to a tank and then solids were allowed to settle.
- Chemicals were added to facilitate setting and filtration.
- After chemical addition, solids were allowed to settle in the tank. Supernatant was pumped to a separate tank and sampled for TSS.
- Supernatant was then sent through a series of filters with decreasing pore sizes to simulate the filtration included in the design of the WTS.
- Filtrate was then collected for analysis of general chemistry parameters, specifically dioxins and furans.

3.6.3.2 Additional WTS Treatability Testing Results

Supernatant from initial one-hour settling tests had high TSS and concentrations of dioxins and furans well above the MLs. Chemicals were added to facilitate solids settling; 100 mg/L of polyaluminum chloride coagulant and 25 mg/L of polymer were added. After chemical addition, settling times decreased, with the majority of solids settling after five minutes. Supernatant from settling after chemical addition was then filtered through 5 µm and 1 µm filters. TSS and dioxins and furans were analyzed after each treatment step with results shown in Table 3-8.

Results showed that filtration achieves very low concentrations of dioxins and furans, with concentrations of all congeners below the MLs, using a 5 µm filter with chemical addition.

Because dioxins and furans are organic compounds, GAC is being included in the treatment process downstream of the 1 µm filter to remove residual dioxins and furans prior to discharge. TOC concentrations were measured in the 5 µm and 1 µm filtrates at 21 mg/L and 19 mg/L, respectively. These are relatively low concentrations that maintain the ability of the GAC to adsorb residual dioxins and furans prior to discharge.

3.6.3.3 Additional WTS Treatability Testing Conclusions

The additional WTS treatability testing confirmed that the pump-and-treat WTS process included in the RD will successfully remove dioxins and furans to levels below MLs and will meet all TSWQS for discharge. This testing also indicated that chemical addition followed by the use of a 5 µm filter is effective in removing an adequate amount of solids to achieve the target dioxin and furan concentrations, with 1 µm filtration and GAC provided as an additional SF for water treatment prior to discharge. Settling tests indicated that the addition of 100 mg/L of coagulant followed by 25 mg/L of polymer was the most effective at achieving solids settlement prior to filtration.

Based on these results, the design of the optimized WTS is further outlined in Section 5.9.

3.7 Treatability Study Conclusions

Waste Material

– Characterization results for the Northern Impoundment waste material samples collected during PDI-1, PDI-2, and SDI indicate that the waste material is non-hazardous and is not subject to regulation under RCRA. This position was detailed in a Waste Characterization Letter, submitted to the EPA on October 20, 2020 (GHD, 2020g) and approved by the EPA in a letter dated November 19, 2020 (EPA, 2020h). In addition, the characterization results from the SDI suggest that the waste material should meet criteria for disposal in a Texas Class II landfill.

– Solidification testing on waste material samples indicates that an addition of a low dose (2 to 10 percent) of Portland cement will allow the removed waste material to meet landfill paint filter and compressive strength requirements.

Water

– Results of the particle size analysis and filtration testing of both simulated contact water and filtered effluent indicate that dioxins and furans in water are primarily associated with the level of TSS in the water. TSS and turbidity demonstrated potential to serve as an indicator parameter for dioxins and furans that can be measured real-time in the field.

– The results of the 2019 bench-scale testing show that filtration with a 1 µm filter can reduce concentrations of dioxins and furans in the contact water to below the ML. Further testing in the 2021 Additional WTS Treatability Testing suggest that filtration with a 5 µm filter with chemical addition can reduce concentrations of dioxins and furans to levels below the ML. Further evaluation of the use of a 5 µm filter in lieu of a 1 µm filter may be warranted depending upon the long-term operational performance of the 1 µm filter.

– Treatment of simulated contact water by clarification and filtration resulted in an effluent that meets the discharge criteria established by the EPA. The success of the treatment process and methodology was corroborated through the implementation of parallel bench-scale tests conducted in 2019 and 2021. This technology has been selected to be advanced in the RD for water treatment. The treatment process will be designed in accordance with EPA correspondence to Respondents dated February 18, 2020, (EPA, 2020b) which stated that “if an effluent sample analyzed for dioxin is below the ML using the EPA approved method, the sample result would be identified as non-detect and the discharge would be determined to be in compliance with the ARAR.”

– In-situ recirculation water treatment methodology (Approach B) was unsuccessful at achieving an effluent that met the TSWQS. This methodology has not been carried forward in the RD.

– Solids in the clarifier underflow will likely require further settlement to produce a concentrated stream for solidification. The settled solids from the clarifier can be solidified with doses as low as 20 percent Portland cement if mixed with waste material in a 1:1 waste material to settled solids ratio.

Armored Cap Material

– No dioxins or furans were detected in any of the armored cap elutriate samples above their MLs. Similarly, all $TEQ_{DF, M}$ results from the sediment that was washed from the rocks and the crushed rock samples themselves were below the 30 ng/kg $TEQ_{DF, M}$ clean-up level. These results support the proposed reuse of the existing armored cap material during or after execution of the Northern Impoundment RA.

4. Applicable or Relevant and Appropriate Requirements (ARARs)

Compliance with ARARs does not include formal submission of permit applications to the agencies for permits or approvals. Instead, information sufficient to demonstrate compliance at the work site with the relevant ARARs will be presented to the EPA and coordinated with other agencies.

The EPA recognizes the following three types of ARARs:

– ***Chemical-Specific ARARs***: Chemical-specific ARARs include health- or risk-based numeric limits or methods that establish the acceptable amount or concentration of a chemical that may be found in or discharged to the environment.

– ***Location-Specific ARARs***: Location-specific ARARs include limits on allowable concentrations or on activities associated with hazardous substances solely because they occur in special locations.

– ***Action-Specific ARARs***: Action-specific ARARs include technology- or activity-based requirements or limitations on actions involving the management of hazardous substance.

As part of the RD, and since the submittal of the 30% RD and 90% RD, focused efforts have been made to engage with the relevant regulatory stakeholders that may have interest in the Northern Impoundment RA to make them aware of the anticipated scope of the RD and to ensure that all substantive permit requirements are identified for purposes of this 100% RD. These efforts at engagement included meetings between the Respondents and the EPA with the following agencies: TCEQ, USACE, United States Coast Guard (USCG), TxDOT, Port of Houston Authority (POHA), Harris County Flood Control District (HCFCD), Harris County Pollution Control, and the Coastal Water Authority (CWA). Applicable regulatory requirements along with project-specific comments that explain how these regulations apply to the project, and how the RD and RA will comply with the regulations are summarized in Table 4-1. Table 4-1 addresses each of the ARARs identified in the ROD and certain additional ARARs applicable to the Northern Impoundment RD. In addition, several supporting documents are included in Appendix D, as referenced in Table 4-1.

5. Remedial Design

This Section provides an overview of the remedial approach for the Northern Impoundment to implement the remedy selected in the ROD and outlines the corresponding RD components, including the following:

– Excavation (traditional dry excavation and mechanical dredging).

– Engineered Barrier BMP.

– Water Management.

– Transportation and Disposal.

– Monitoring and Controls.

5.1 Remedial Design Background

The remedy selected for the Northern Impoundment, as outlined in the ROD, includes the excavation and off-site disposal of waste material located beneath the TCRA armored cap such that the resulting bottom surface is below the prescribed clean-up concentration of 30 ng/kg $TEQ_{DF,M}$. As described in the ROD, the selected remedy is to utilize a BMP, such as a cofferdam, to isolate the excavation area from the river.

At the time that the remedial alternative was selected, the only subsurface data available had been collected during the RI in 2011 and 2012. At the time the ROD was issued, eight soil borings had been installed from elevations ranging from -7.6 ft to -22.7 ft NAVD88. As part of the RD process, 71 additional subsurface soil borings were installed in the Northern Impoundment at deeper elevations up to -35 ft NAVD88. Analytical results from these borings have further defined the vertical and horizontal extent of material located beneath the TCRA armored cap and have significantly increased the volume of waste material to be excavated from the volume and depth estimates that was the basis for the ROD.

The selected remedial alternative in the ROD was based on an expected excavation with an average depth of approximately -8 ft NAVD88. However, results from the PDI and SDI indicate that the actual excavations necessary to remove materials exceeding 30 ng/kg $TEQ_{DF,M}$ are significantly deeper, ranging up to an elevation of -28 ft NAVD88. Furthermore, based on geological and geotechnical data collected during the SDI and not available at the time the ROD was selected, some of the deeper excavation elevations pose a significant risk of hydraulic heave if the remedy is conducted as stated in the ROD (i.e., in the dry).

The following summary provides context to the transition in the RD from the 30% RD submitted in May 2020 (GHD, 2020d) to the RD included in the 90% RD, prior to the northwest corner being addressed in a subsequent submission.

Approach B Water Treatability Testing

During a TWG Meeting in February 2020, newly obtained PDI-2 data was discussed which showed that material exceeding the ROD clean-up level extended to depths that were significantly deeper than were previously understood. It was further explained that utilizing traditional excavation methodology in dry conditions (referred to as “Approach A” in the 30% RD) would pose significant risk and technical challenges for the deeper areas within the Northern Impoundment, as excavating within the confines of a BMP, to the required depth could undermine the structural integrity of the BMP. Therefore, when the 30% RD was submitted, it included an alternative for excavation (referred to as “Approach B”) in areas of deeper waste depths. This approach included installing the BMP and then removing material exceeding the clean-up level through a column of water using barge-mounted excavation equipment. As described in the 30% RD, this approach would require that prior to the end of an excavation season, the water within the BMP would be recirculated through a treatment system until it achieved the TSWQS (as demonstrated through compliance with the ML). In order to evaluate the practicality and effectiveness of this conceptual approach, additional treatability testing was proposed. This additional treatability testing was summarized in the *Revised Additional Treatability Testing Notice*, submitted to the EPA on June 4, 2020 (GHD, 2020c), and approved by the EPA on June 11, 2020 (EPA, 2020d).

The additional treatability testing, as described in the approved notice, included a bench-scale simulation of the recirculation process through a bench-scale filtration system to determine if the ML could be met. The recirculation testing was conducted by the GHD Treatability Laboratory in Niagara Falls, New York from November 2020 to January 2021. As summarized in Section 3.6.2, treatability data indicated that after 16 days of recirculation the TSS reduction had plateaued at around 500 mg/L and the resulting dioxin and furan concentrations remained above the ML.

As presented during a TWG Meeting in December 2020, based on the results of the recirculation testing, Approach B water treatment was deemed technically infeasible for full-scale application during the RA. Since the water treatment for Approach B was shown to be technically infeasible, Approach B excavation methodology was also deemed technically infeasible. As a result, the design process was again significantly altered to focus on performing all excavation work “in the dry.” As such, additional data, including full vertical delineation and geotechnical data along the revised BMP alignment, was required to evaluate the feasibility of excavating the deeper areas “in the dry.”

Supplemental Design Investigation

A major uncertainty identified in the 30% RD was the constructability of the BMP wall. Even with the assumption that the majority of the Northern Impoundment would be excavated through a column of water, the required BMP design included in the 30% RD was extremely robust and was arguably technically infeasible. The pile types necessary would have been 5.5-ft diameter tubular pipe piles and double I-beam piles, driven to tip depths as deep as -93 ft NAVD88 into Beaumont Sand layer. Significant concerns were identified in the Northern Impoundment 30% RD about the ability to successfully drive and/or remove the piles. Given these concerns and the poor performance of the Approach B water treatability testing, following the submittal of the 30% RD, the design team began evaluating other BMP types and excavation methodologies that could overcome these limitations. An optimized BMP design was identified. The optimized BMP design includes a double wall system that allows for shallower embedment depths than the single cantilever wall proposed in the 30% RD. The double wall in this optimized design is further offset, except in limited circumstances, by a minimum of 30-ft from the area of excavation than the BMP described in the 30% RD to increase the structural stability of the BMP system.

Previous investigations had not included collection of data regarding soil properties and stratigraphy in the areas of the new BMP wall. Given the modified alignment of the BMP, the Respondents and EPA agreed that it was necessary to collect additional analytical data to more fully delineate the waste material and geotechnical data to better understand the soil properties and thickness of the shallow stratigraphy in locations in and near the proposed conceptual BMP alignment. With the change in excavation methodology, an additional risk that needed to be evaluated was the potential for hydraulic heave.

The SDI was performed in the summer of 2021 to supplement the delineation of the vertical extent of material requiring excavation and to provide information to aid in designing a structurally robust BMP, potentially capable of withstanding forces associated with excavation in the deeper areas of the Northern Impoundment.

Risk of Hydraulic Heave

The SDI was conducted from June through September 2021 in accordance with the Revised SDI Work Plan, submitted to the EPA on May 21, 2021 (GHD, 2021c) and approved by the EPA on June 4, 2021 (EPA, 2021c). The investigation included the installation of 35 analytical soil borings and 17 geotechnical borings (13 CPT soundings and four instrumented boreholes). Data from the SDI indicated that impacted material above the clean-up level was at deeper elevations than previously understood, with impacts as deep as -28 ft NAVD88 in the northwest corner. Based on these deeper impacts, a focused evaluation was conducted to assess the potential for hydraulic heave while excavating to target depths of known impact. The technical evaluation regarding hydraulic heave was discussed with the EPA, USACE, and TCEQ in detail during the October 19, 2021; November 16, 2021; and December 14, 2021, TWG Meetings. It was documented in the Hydraulic Heave Analysis Report submitted to the EPA on December 9, 2021, (GHD, 2021i) and written correspondence to EPA dated December 22, 2021 (GHD, 2021j). It also was updated as part of this 100% RD submission in Updated Hydraulic Heave Analysis Report, which is included as part of Appendix B.

Based upon the results of this evaluation, it was determined that it is not technically feasible to excavate the material in the northwest corner to the currently known depths in the dry. An alternative approach using mechanical dredging to mitigate the potential for hydraulic heave in the northwest corner has been incorporated in the 100% RD in Section 5.7.

5.2 Remedial Approach

An overall remedial approach has been developed, in coordination with members of the TWG, and includes several fundamental elements that are described below.

BMP Alignment and Lateral Excavation Extent

The lateral extent of the excavation for purposes of the RD is defined by the lateral extent of waste material above the 30 ng/kg $TEQ_{DF,M}$ dioxin clean-up level underneath the armored cap. The lateral extent of the planned removal is shown in green shading on Figure 5-A, below.

Figure 5-A BMP Alignment and Excavation Extent

The lateral limits of the planned removal area also define the corresponding outer alignment of the BMP. The optimized double wall BMP system includes two parallel single cantilever walls spaced approximately 30-ft apart, connected with tie-rods and walers, and filled with aggregate.

In the 100% BMP wall design, the existing riverbed between the BMP (interior wall) and the excavation area is referred to as the “Soil Buttress.” This Soil Buttress is essential to the stability of the wall and the ability to excavate to the target elevations “in the dry.” In some instances, additional fill material is added to the Soil Buttress to raise the riverbed elevation and reduce the exposed height of the BMP above riverbed elevation. That additional fill is referred to as a “Raised Bench.”

Along the west, north, and east sides of the BMP, the system includes at least a 30-ft wide Soil Buttress between the inner wall and the top edge of any excavation inside the BMP to support the wall system and in one section on the west side, a Raised Bench. Along the south side of the BMP, the Soil Buttress in some locations is less than 30-ft wide, due to space constraints.

This optimized wall system pushed the alignment of the BMP further out from the excavation area than the alignment considered in the 30% RD. The alignment of the BMP is shown on Figure 5-A, above. A conceptual depiction of the BMP and a conceptual cross-section of the BMP system are shown below on Figure 5-B.

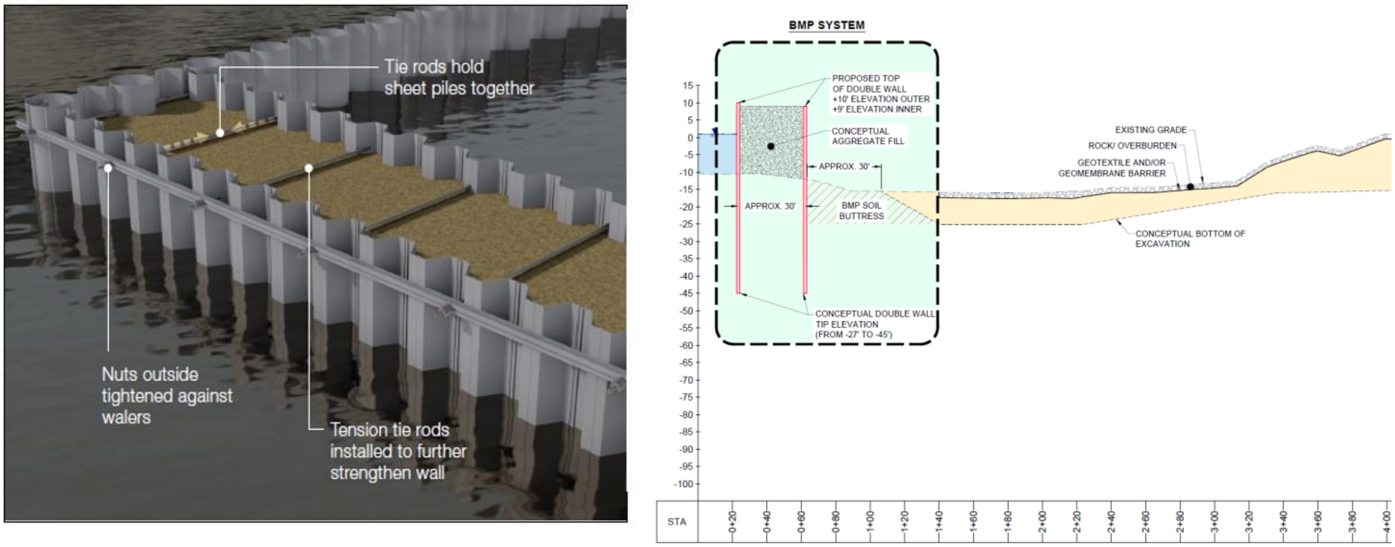


Figure 5-B BMP Alignment and Excavation Extent

Seasonal Excavation and Top of Wall Elevation

The ROD states that performing the removal of the waste material using a BMP would reduce short-term impacts, prevent any material release to the San Jacinto River during removal, and ensure compliance with ARARs. As such, to design the BMP, historical San Jacinto River water surface elevation data, dating back to 1994, was obtained and evaluated. Based upon an evaluation of that historical data, the San Jacinto River seasonally has experienced high water levels between May and October. Therefore, as a risk management measure, an excavation period of November to April was selected for use in the RD and approved by the EPA and members of the TWG during the February 19, 2020 TWG Meeting. This same excavation season had been used as the basis for the 30% RD.

During the non-excavation season and during the first and last year of construction, the RC will perform necessary work activities that do not involve managing impacted material. This work will include, but not be limited to: installing and removing the BMP, developing infrastructure for the project along the TxDOT ROW, constructing and then demobilizing or partially demobilizing the WTS at the end of each excavation season, re-installing the portions of the WTS that were demobilized prior to the next excavation season, dewatering excess water within the BMP and treating and discharging the remaining water in the BMP, water sampling, protecting office trailers and truck laydown equipment from flooding, visual inspections of the BMP and work site properties, importing and staging clean fill material, mobilizing and demobilizing trucks scales and washes, and mobilizing and demobilizing heavy equipment. As discussed in Section 5.3.2, if directed by the EPA, the length of excavation season will be evaluated on a case-by-case basis, as directed by EPA, and potentially extended into the months of May, June, and July, while following the requirements of a High-Water Preparedness Plan prepared for the work site, which is included in Appendix J.

The historical San Jacinto River elevation data were also used to identify a top elevation for the BMP assuming that any high-water events during the planned excavation months of November to April would not exceed historical levels. Based upon the historical data, since 1994 there were no highwater events that exceeded an elevation of +10 ft NAVD88, the top elevation of the exterior wall of the BMP, during the period of November to April. This information is contained on Figure 5-1. Therefore, for design purposes, the top of pile elevation for the BMP was established as +10 ft NAVD88 for the exterior wall. As further detailed in Section 5.12, the use of this design top elevation will not eliminate the risk of overtopping during any of the excavation seasons, and the protectiveness of this design top elevation will need to be confirmed following receipt of modeled flow data from the CWA in relation to its planned improvement project for the Lake Houston Flood Control structure located upriver of the Northern Impoundment.

The excavation of the Northern Impoundment will be approached as seasonal cells - with a single cell being excavated each excavation season. The exact shape and size of the seasonal cells will not be pre-defined but will be based upon production efficiency each season. This is different than the plan proposed in the 30% RD which included pre-defined seasonal cells divided by interior barrier walls. Instead, during an excavation season, only the portion of the TCRA armored cap covering the area targeted for excavation during that season will be removed, with the rest of the TCRA armored cap remaining intact. At the end of each excavation season, the exposed slope between that seasonal cell and the remaining TCRA armored cap will be covered with a cap, consistent with the design used during the TCRA. At the start of the next excavation season, the water inside the Northern Impoundment BMP will be processed and returned to the river and the process will start again.

A conceptual visualization of the overall project sequencing, including a potential seasonal cell layout is included on Figure 5-C, below. This 100% RD has been prepared to be "implementable" as designed. The northwest corner will be completed in the first excavation season due to access issues and bathymetric conditions. If the other areas of the Northern Impoundment were completed first, it would eliminate land access to the northwest corner and make it very difficult to complete a remedy in that area. Completing the northwest corner first will also be appropriate due to the deep bathymetry in that area and the implications of that deep bathymetry on water management.

It is anticipated that the RA excavation activities can be completed in 5 seasons. The planned number, size, and configuration of the cells are flexible and may change based upon the following factors:

– ***Volume and Removal Rates*** -The tentative cell sizes ensure that the volume of planned removal from within each cell could be achieved within the excavation period of November through April (potentially extending to July).
– ***Excavation Depth*** - Depending upon the results of confirmation sampling, the depths of the seasonal excavations could increase, which may, in turn, limit the area effectively excavated in that season.
– ***Access and Implementability*** - The tentative seasonal cells assume sustained access to each area for necessary excavation equipment and trucks.
– ***Transportation and Disposal*** - The target seasonal production rate used to define the tentative cell sizes is dependent on the ability to efficiently and consistently load out waste material and transport it to an offsite landfill, an activity which, as addressed above, requires full access to the TxDOT ROW and I-10.

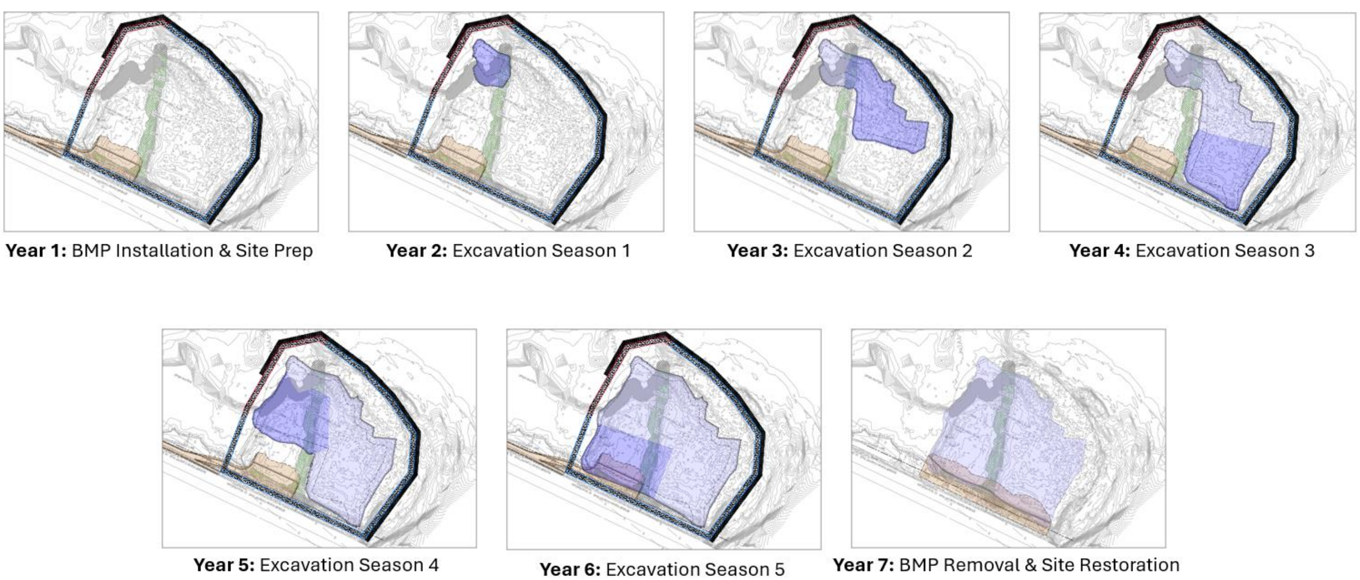
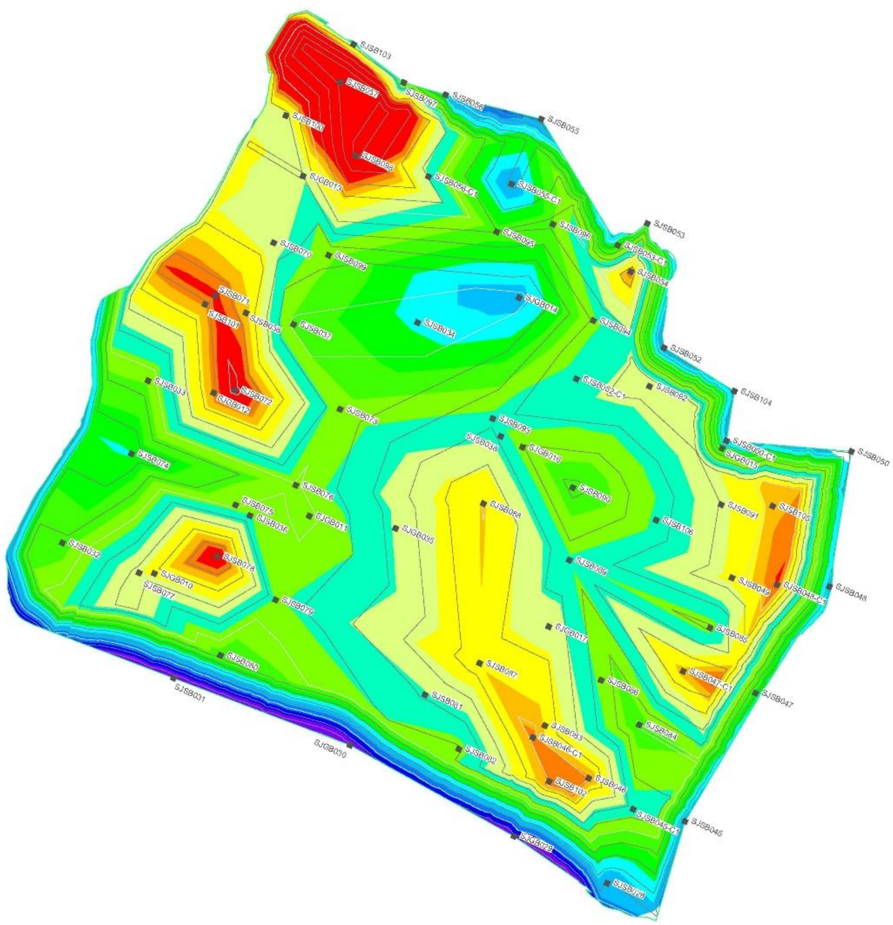


Figure 5-C ***Conceptual Project Sequencing***

Excavation Approach

An excavation approach was developed across the Northern Impoundment that is implementable, mitigates hydraulic heave risk, is protective of human health and the environment, is consistent with the methodology used to develop the clean-up standard outlined in the ROD, and would result in an exposed surface that is below the clean-up level. Figure 5-D, below illustrates the benefits of this excavation approach relative to the risk of hydraulic heave. When the design excavation surface is compared to the hydraulic heave risk elevations, the "hot spots" of hydraulic heave sensitivity are identified and will require local mitigation measures to excavate and offset the hydraulic heave. The entire northwest corner will be excavated by mechanical dredging to mitigate the hydraulic heave risk.



Additional Feet			
Number	Min	Max	Color
1	-26	-22	
2	-22	-20	
3	-20	-18	
4	-18	-16	
5	-16	-14	
6	-14	-12	
7	-12	-10	
8	-10	-8	
9	-8	-6	
10	-6	-4	
11	-4	-2	
12	-2	-1	
13	-1	0	
14	0	11	

Figure 5-D ***Hydraulic Heave Sensitivity***

Table 5-1 presents the design excavation elevations at all the borings. This excavation surface results in approximately 230,000 CY of total volume removed. This excavation surface is intended to provide an indication of where the initial excavation ends (i.e., design elevations); the data collected during the PDI and SDI has been used to inform this. The excavation surface will be refined based on confirmation sampling, which would be used to determine whether the clean-up level has been achieved, as detailed in the FSP (Appendix J, Attachment 3) and in Section 5.6.4.

Excavation Methodology

The approach would include (1) installation of a physical BMP around the perimeter of the Northern Impoundment, (2) processing of river water prior to removal of the TCRA armored cap, (3) removal of the waste material with land-based excavation equipment working within a seasonal cell, removing the TCRA armored cap as work progresses (while leaving in place the portions of the TCRA armored cap not being excavated), and (4) placing an engineered cap over the exposed slope of the seasonal cell excavation at the end of each excavation season. A conceptual illustration of the excavation methodology is shown on Figure 5-E.

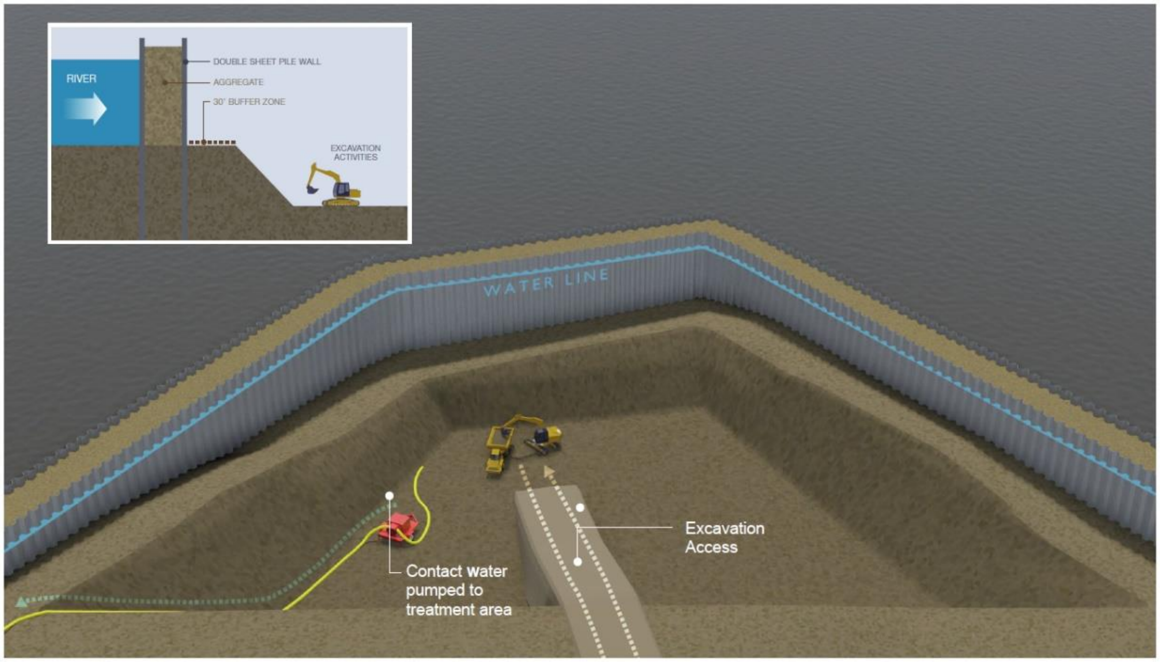


Figure 5-E *Conceptual Excavation Methodology*

Water Management

Following installation of the BMP, and at the beginning of each excavation season, bulk water trapped behind the BMP wall will be treated for solids and returned to the river until the water level is within 2 feet of the lowest point within the BMP. The remaining 2 feet of water and any infiltration or stormwater that accumulates in an open excavation will be pumped to on-site water storage tanks, treated through clarification and filtration, and discharged to the river after compliance with discharge concentration criteria is verified.

Re-Use of TCRA Armored Cap and Historic Berm Material

The Northern Impoundment is currently covered by an armored cap comprised of 6- to12-inch diameter rock on top of a low-permeability geomembrane and/or geotextile barrier, and/or ACBM. As described in Section 3.5, treatability testing was performed on the TCRA armored cap material and results demonstrated that the rock, its elutriate, and sediment generated from its elutriate did not exhibit dioxin concentrations above the ML (as defined in Section 3.4.1) or the clean-up level of 30 ng/kg $TEQ_{DF,M}$.

Prior to removal of the waste material, the TCRA armored cap rock will be removed. The TCRA armored cap rock will be stockpiled at or near the Northern Impoundment for potential reuse or disposal during or after execution of the Northern Impoundment RA. The northwest portion of the TCRA cap, including the ACBM, will not be sampled for re-use and will be removed and sent off-site for disposal.

It is anticipated that during the RA approximately 25,000 CY of unimpacted material from the historic central and southern berms at the Northern Impoundment will be excavated. Based upon characterization data from the PDI (see Figure 2-9), the berm material does not contain dioxin concentrations above the clean-up level. During the RA, this unimpacted material will be considered for reuse for various site activities, construction of site features, cover material, etc. The material will be segregated from the waste material during excavation activities, stockpiled, and sampled prior to reuse, as detailed in the FSP (Appendix J, Attachment 3). Any material not reused will be sent off-site for disposal.

The locations of the historic berm and the TCRA armored cap rock planned for re-use are shown on Figure 3-5.

Preliminary RA Schedule

Based on the current remedial approach, it is anticipated that the implementation of the Northern Impoundment remedy following EPA final approval of the RD will require a period of at least 7 years to complete. This 7-year period will be preceded by an initial period in which parties undertaking the RA will select an RC and engage in steps to procure necessary materials and other resources needed to begin construction of the BMP. Following that initial period, it will then take a minimum of one year to construct the BMP and then to conduct confirmation sampling, followed by an estimated 5 years of waste removal (one cell per excavation season), and concluding with an additional and final year for BMP removal, site restoration, and project demobilization. The estimated five years of waste removal is based on the assumptions described above. This schedule assumes coordinated access to the TxDOT ROW during the implementation period, both to construct the BMP wall and also for purposes of ingress and egress. Limitations on the use of the ROW, which is needed for the approximately 4,600 truck trips required each excavation season to transport the excavated material off-site and reduced production due to traffic and access issues related to an I-10 Bridge replacement project, could extend the overall project schedule.

5.3 Basis of Design

5.3.1 Historic River Level Evaluation

To design the BMP and plan for the RA, all available historical San Jacinto River elevation data dating back to 1994 was evaluated. Data evaluated included continuous monitoring data from the Sheldon gage (described below) and a United States Geological Survey (USGS) Fact Sheet which reported a major flood event in October 1994. The Northern Impoundment is subject to both tidal fluctuations, as well as increases in river level from rainfall and tropical storm events. As such, installation of BMPs requires an understanding of both the vertical range of typical water surface elevations, as well as the temporal variation in water surface elevations, based on available historical data, that would be encountered during the RA.

To evaluate these influences, GHD developed a model to create a history of water surface elevations at the Northern Impoundment by hindcasting historical water level data from an upriver USGS gage in the San Jacinto River near Sheldon, Texas (i.e., Sheldon gage). This was required as historical routine water level readings had not been collected at the Northern Impoundment, whereas the Sheldon gage has a historical record dating back to 1996. This gage is upstream of the Northern Impoundment and is subject to large increases in surface elevation due to major rainfall events in the area. Although the Sheldon gage data are indicative of trends at the Northern Impoundment, the data are not appropriate for understanding the full pattern of water surface elevations at the Northern Impoundment. Historical water surface elevations for the USGS Sheldon gage are shown on Figure 5-1.

To understand the pattern of local variation in water surface elevations, a transducer gage was installed at the Northern Impoundment during the PDI-2 (see Section 2.2.5). Data collected from the transducer provided a direct understanding of water levels at the Northern Impoundment, which could be correlated with the Sheldon gage data thereby allowing for the hindcasting of the long history of data at the Sheldon gage to the Northern Impoundment.

The current hindcasted model utilizes a fixed data set of Sheldon gage inputs compared to site-specific data collected from the transducer at the Northern Impoundment to produce a dataset of calculated site-specific historical river levels dating back to 1996. Northern Impoundment transducer data and Sheldon gage data continue to be collected. As new data become available, the model can then be periodically re-hindcasted to reflect the additional data and provide increased confidence in the outputs.

The original hindcasted data provided in the May 2020 30% RD and the June 2022 90% RD was based on approximately 6 months of site-specific transducer data (July 2019 through December 2019) available at the time of the 30% RD. In connection with the November 2022 NWC, the hindcasted model was updated and rerun with a larger, more recent dataset from both the Sheldon gage and the onsite transducer (July 2019 through December 2021). For purposes of this 100% RD, the hindcasted model has been updated and rerun using available data from February 2023 through February 2024.

To hindcast the Sheldon gage data to the Northern Impoundment, synchronous observations from the Sheldon gage and the Northern Impoundment were subjected to a machine learning model, Multivariate Adaptive Regression Splines (MARS). MARS is an advanced form of linear regression that allows varying relationships between dependent and independent variables across the range of the independent variable. For example, in this case the model has the flexibility to predict different correlations between the Northern Impoundment and Sheldon gage depending on the water surface elevation at the Sheldon gage.

The model selects relationship terms using a generalized cross validation (GCV) method which takes the form of:

$$GCV = RSS/(N \times (1 Ne)/N2)$$

Where RSS is the residual sum of squares of the model, N is the number of observations, and Ne is the effective number of parameters. Thus, the GCV algorithm balances minimization of RSS (which may result in an overfitted model) with parameter number (which allows more flexibility in the model).

The form of the hindcasting model for the Northern Impoundment is:

$$WSESJ,t = WSESH,t \times LSH,t$$

Where, WSESJ,t is the water surface elevation at the Northern Impoundment at time t, WSESH,t is the water surface elevation at the Sheldon gage at time t, and LSH,t is the either rising or falling limb of the hydrograph at the Sheldon gage at time t.

The hindcasted model utilizes a fixed data set of Sheldon gage inputs compared to site specific data collected from the transducer at the Northern Impoundment to produce the hindcasted outputs. When new data becomes available, the model can then be re-hindcasted to reflect the additional data available and allow increased confidence in the hindcasted outputs.

The hindcast model data was provided in the 90% RD and since that time the model has been updated and rerun with a larger, more recent dataset from both the Sheldon gage and the on-site transducer (July 2019 through December 2021 and February 2023 through February 2024). The updated model data was submitted as a technical memo to the EPA in March 2024. On-site data was collected between December 2021 and February 2023; however, there was an issue with the transducer and data cable that ultimately corrupted the entire dataset recorded during this period. During this period the transducer's telemetry was damaged and stopped transmitting data while the transducer continued to log data. The corrupted data was not immediately discovered until months later when the data was retrieved by manually downloading and evaluating the data. Exploration of the time series alignments has revealed how better pre-processing of the time series results in a dataset that more accurately enables comparison between them. Further analysis has also been conducted on how to present extreme events based on the predicted San Jacinto water levels during different months of the year. One way of visualizing these events is by projecting values as boxplots with overlays of different heights, and conducting a flood frequency analysis. In evaluating the hindcasted predictions back to 1996, a maximum level of +8.72 ft NAVD88 was predicted in November 1998 for the planned excavation season (November through April).

The updated river level hindcasted predictions for the full year and the planned excavation season, November through April, are shown on the attached Figures 5-2 and 5-3, respectively. The boxplot in the attached Figure 5-4 also highlights the predicted month-wise river levels at the Northern Impoundment. Figure 5-4 demonstrates that all of the predicted outliers or rare events where water levels exceeded +9 ft NAVD88 occurred outside the planned excavation season.

As stated above, the hindcasted model was updated and rerun with additional river stage data collected since the last modeling run in connection with the modeling report submitted in November 2022. This rerun of the model is based on a dataset that is nearly double the size of the dataset available for purposes of the previous hindcasted modeling report submitted in November 2022. Because of this larger dataset, the hindcasted model has more information to draw on when building and predicting the correlation and relationship between the river stages for the Sheldon gage and on-site.

The hindcasting model was then used to hindcast water surface elevations at the Northern Impoundment using the Sheldon gage record. Figure 5-2 shows the 24-year hydrograph for the Sheldon gage and the 24-year hindcasted water surface elevations for the Northern Impoundment.

Results of the model and surface water elevations were evaluated and discussed during the December 2019, January 2020, and February 2020 TWG Meetings. Based on the evaluations and discussions, the TWG agreed on the need to complete removal activities during a specified “excavation season,” and also agreed on the proposed design elevation of +9 ft NAVD88 for the top of the BMP. The hindcast model data was provided in the 90% RD and since that time the model has been updated to incorporate recent river levels. Based on the latest update to the hindcast model and as a risk mitigation measure, the BMP elevation has been adjusted from +9 ft NAVD88 to +10 ft NAVD88 for the outer wall. These topics as they relate to the 100% RD for the Northern Impoundment are further discussed below.

5.3.2 Excavation Season and BMP Height

Based on the historic river elevations, the San Jacinto River seasonally experiences high water levels between May and October due to rainfall and tropical storm events. Therefore, an excavation season of November to April was selected for the 90% RD. If directed by the EPA, and to increase production and shorten the overall project schedule, the excavation season will be evaluated on a year-by-year basis and possibly extend into the months of May, June, and July based on the conditions and progress of the work. To allow for the removal of waste material during the excavation season, the Northern Impoundment RA work will likely be divided into five cells with a single cell being remediated each excavation season. During the non-excavation season, based on the Respondents’ ability to perform such activities with regards to weather, and during the first and last year of construction, the RC will perform necessary work activities that do not involve managing impacted material. This work will include, but not be limited to: installing and removing the BMP, developing infrastructure for the project along the TxDOT ROW, constructing and then demobilizing or partially demobilizing the WTS at the end of each excavation season, reinstalling the portions of the WTS that were demobilized prior to the next excavation season, dewatering excess water within the BMP and treating and discharging the remaining water in the BMP, water sampling, protecting office trailers and truck laydown equipment from flooding, visual inspections of the BMP and work site properties, importing and staging clean fill material, mobilizing and demobilizing trucks scales and washes, and mobilizing and demobilizing heavy equipment.

The historical San Jacinto River elevation data was also used to determine a top elevation for the BMP that would be protective of high-water events (based on the available historical data) during the planned excavation season (but also during the months of May, June, and July). High-water extreme events that would have overtopped the BMP have historically occurred during the non-excavation season, as shown on Figures 5-1 and 5-2. For example, in August 2017, Hurricane Harvey made landfall in the Galveston Bay area. During this event, water surface elevation peaked at 14.28 ft NAVD88 at the Northern Impoundment. More recently, Tropical Storm Imelda caused significant flooding in September 2019, with water surface elevation peaking at 8.9 ft NAVD88 at the Northern Impoundment. For reference, the typical river stage for September at the Northern Impoundment fluctuates between 1 to 3 ft NAVD88.

Comparison of the Sheldon gage and Northern Impoundment hydrographs for both the full year (shown on Figure 5-2) and for the excavation season (shown on Figure 5-3) show that excluding the months of May to October would substantially reduce the number of high-water events that could be expected, based on the available historical data. These data were reviewed with the members of the TWG during the February 19, 2020 TWG Meeting and it was agreed that excavation activities should only take place between November and April.

A comparison of the Sheldon gage and Northern Impoundment hydrographs from 1996 through 2024 show that there were no high-water events that exceeded an elevation of +9 ft NAVD88 during the proposed excavation season. The members of the TWG agreed that an excavation season of November through April each year and a top of BMP elevation of +9 ft NAVD88 would reduce the risks of water overtopping and should be protective of all events in the hydrographic record dating back to 1996 and the October 1994 flood event. After further evaluation of the hindcast data and as an additional protective measure, the outer wall of the BMP has been raised to +10 ft NAVD88. In addition, the excavation season will be evaluated on a year-by-year basis and may be extended into the months of May, June, and July. As further detailed in Section 5.12, the protectiveness of this design top elevation will need to be confirmed following receipt of modeled flow data from the CWA in relation to the CWA's planned improvement project involving the Lake Houston Flood Control structure located upriver of the work site.

The WTS is sized to treat, in the case of an overtopping event, both contact and non-contact water generated.

5.3.3 Geotechnical Conditions

A primary objective of the SDI was to collect additional geotechnical data to provide a better understanding of the geotechnical properties of the underlying substrata to support the design of the double wall BMP system. A Geotechnical Engineering Report was prepared by Ardaman & Associates Inc. and GHD, and is included as Appendix B. A brief summary of the geotechnical subsoil conditions and the BMP design is presented, below.

The results of the SDI CPT investigation confirmed PDI-2 results and showed that the subsoils in the Northern impoundment, and particularly along the BMP footprint, are principally composed of the three following stratigraphic units:

1. Fairly heterogenous alluvium sediments consisting of a mixture of sand, silt, and clay in varying proportions, present from the riverbed to elevations ranging from -20 to -35 ft NAVD88.
2. Stiff-to-very-stiff high plasticity clay formation (Beaumont Clay) encountered starting at elevations ranging between -20 to -35 ft NAVD88.
3. Compact-to-dense sandy formation (Beaumont Sand) encountered beneath the Beaumont Clay deposit at elevations ranging between -50 to -70 ft NAVD88.

Continuous profiles of different geotechnical parameters were defined from the CPT results using robust published correlations (undrained shear strength, the pre-consolidation pressure, undrained modulus, hydraulic conductivity, friction angles etc.). All CPT defined parameters were compared and validated with those measured in previous investigations.

The Northern Impoundment characteristics vary across the impoundment and necessitate evaluation of multiple sections using soil-structure interaction. The presence of the thick cohesive formation that behaves in a drained or undrained state, requires consideration of both quick and slow loading cases (Q and S cases respectively).

The soft heterogeneous alluvium deposit on the riverbed may temporarily develop pore pressure upon backfilling between the sheet piles and will increase the loads against these sheet piles. The design of the BMP wall includes the full extent of the wall encircling the Northern Impoundment, including the portions of the wall surrounding the northwest corner. Due to deeper mudline depth in the northwest corner, dewatering within the BMP causes a large load differential between the interior and exterior sides of the BMP. In order to mitigate these challenges, design features such as additional buttressing on the interior and staged construction of the BMP such as installing fill in multiple layers with intentional delay between layers and selecting appropriate fill height before installing tie-rods, will be required.

Since the BMP will be driven in the alluvium and Beaumont Clay with tip depths at elevations of approximately -40 ft NAVD88, no excessive vibrations and no detrimental impact on the stability of the existing slope on the riverbed are anticipated during installation.

5.3.4 Excavation Extent and BMP Alignment

Analytical data obtained from the RI, the PDI, and the SDI were used to inform the RD and determine excavation extents and volumes and the alignment of the BMP.

Lateral Extent

As described in the EPA-approved PDI-2 Work Plan (GHD, 2019d), the lateral extent of excavation is based on analytical data. Areas with $TEQ_{DF,M}$ levels below the clean-up level of 30 ng/kg will not require excavation, as depicted on Figure 2-9. The historic central and southern berms depicted on Figure 2-9 have been shown to have levels of dioxins and furans below the clean-up level. To allow for efficient waste removal, the berm material may be excavated in conjunction with the waste material. The unimpacted berm material may be disposed of with the waste or segregated and reused on-site, pending analysis, as described in the FSP (Appendix J, Attachment 3).

The double wall BMP design requires a significant lateral footprint, in addition to the 30-ft width of the wall itself. A Soil Buttress with a minimum width of 30 ft is also necessary between the inner wall and the top of the excavation slope to support the wall. To accommodate the footprint of the BMP wall and to avoid installation of the BMP wall through the TCRA armored cap, the alignment of the BMP was moved outward to fully encircle the Northern Impoundment area.

On the south side of the Northern Impoundment, SDI results indicated that waste material was much deeper than previously understood (as deep as -20 ft NAVD88 while the ROD had assumed that area was -5 ft NAVD88). As the south side of the Northern Impoundment abuts the TxDOT ROW property, there is not sufficient space to accommodate a double wall system (including a slope out of the excavation, 30-ft Soil Buttress, and double wall) without encroaching on the TxDOT ROW property. As further detailed in Section 5.5.6, several different wall types and alignments were evaluated as part of an effort to identify a structurally sound wall with a thinner profile than the double wall system. Ultimately, the only wall-type that proved to be structurally sound for installation on the south side of the Northern Impoundment was the double-wall system, the majority of which will need to be placed on the TxDOT ROW property. Figure 5-A shows the alignment of the BMP and the extent of the excavation area.

Vertical Extent

Analytical data from the RI, PDI, and SDI were also utilized to determine the vertical extent of the waste material requiring removal. As previously mentioned, results from the PDI and SDI indicated that waste material is present at elevations significantly deeper than was known at the time the ROD was issued. During the SDI, the elevation of waste material in the Northern Impoundment was found to be as deep as -28.3 ft NAVD88 with an average depth of -12.8 ft NAVD88. The excavation surface was developed by targeting excavation depths/elevations that were identified across the Northern Impoundment such that the resulting surface will meet the clean-up level of 30 ng/kg $TEQ_{DF,M}$. Due to the deeper elevations of waste material and the goal to design a remedy that includes excavation "in the dry," a detailed hydraulic heave evaluation was conducted. This evaluation indicated that there are hydraulic heave risks in certain areas, with the most significant risk in the northwest corner.

Table 5-1 presents the analytical data at all borings based on elevations (rounded to the nearest foot), with concentrations greater than 30 ng/kg $TEQ_{DF,M}$ indicated by bold text. The red line on Table 5-1 identifies the elevation at each boring at which there is a calculated risk of hydraulic heave, with a SF of 1.25. The green line indicates the design excavation elevation at each boring based on the 30 ng/kg $TEQ_{DF,M}$ criterion. Three boring locations (SJGB010, SJGB012, and SJSB046-C1) had results above 30 ng/kg $TEQ_{DF,M}$ in the deepest sample interval collected, as seen on Figure 2-9. At these locations, the design considered the adjacent co-located borings to determine the appropriate excavation elevations to complete the excavation bottom contours. All borings located within the northwest corner, where there is a significant hydraulic heave concern, are marked with a dark grey tone. Based on this evaluation, it was determined that the northwest corner is technically impracticable to excavate in the dry and will be addressed with mechanical dredging to mitigate the hydraulic heave risk.

The design excavation contours can be seen in Design Drawings C-08 through C-12 in Appendix G. As noted in Section 5.2, these design excavation elevations are the initial excavation depths and will be verified through confirmation sampling.

The approximate volume of material to be excavated in the Northern Impoundment is estimated at 230,000 CY. To facilitate a seasonal excavation approach, the total volume of material will be divided into multiple cells, with a single cell excavated each excavation season.

5.4 Pre-RA Activities

5.4.1 Property Access

To implement the RA, it will be necessary to have access to approximately 15 to 20 acres of dry land to utilize for lay-down storage of equipment, water storage and treatment, office trailers and parking. It is preferred that the property(ies) be located as close as possible to the Northern Impoundment to minimize the distance over which water requiring treatment needs to be conveyed. Property access will also need to be secured for the duration of the RA, which is expected to require at least 7 years and additional time to procure and mobilize equipment and personnel. Currently, several properties located in the vicinity of the Northern Impoundment are being evaluated. The general layout of the WTS is depicted in Drawings P-04 and P-08 (Appendix G). These layouts will need to be updated with site-specific detail in future design submittals once access to a property for laydown/staging has been secured.

Implementation of the Northern Impoundment RA will also require access to and utilization of the TxDOT ROW that runs parallel to I-10, as well as properties owned by POHA and Houston Fleeting Services, LLC between the TxDOT ROW and the bank of the San Jacinto River. As previously mentioned, in addition to providing the only land access route to the Northern Impoundment, the southern extent of the BMP will need to be installed on the TxDOT property. Executing the Northern Impoundment RA will require that an agreement be reached with TxDOT to allow for use of the TxDOT ROW both for access and purposes of construction of the BMP. In addition, as is discussed in more detail in Section 5.11.3, TxDOT plans to replace the I-10 Bridge beginning in the next 2 to 3 years. It is currently unknown as to how TxDOT's plans may impact its ability to allow access to its ROW for purposes of the Northern Impoundment RA, but it is expected that significant coordination between the two large construction projects will be required to minimize delays.

As part of RD efforts, the Respondents have engaged with the POHA and the HCFCD to inform these stakeholders about the planned alignment and design of the BMP wall that will be present in the San Jacinto River for at least 7 years. As requested by the HCFCD, a Floodplain Drainage Impact Analysis was conducted to evaluate the effect that the BMP could have on the surrounding floodplain. Water levels in the vicinity of the Northern Impoundment were evaluated with and without the BMP present under 2-year, 10-year,100-year, and 500-year flood scenarios. Modelling results indicated that the effects of the BMP on the surrounding floodplain would not be significant under any of the four scenarios. The evaluation was submitted to the HCFCD in a letter dated March 30, 2022 (GHD, 2022a). Comments were received from the HCFCD via e-mail on April 8, 2022 (HCFCD, 2022) and a revised letter was submitted on May 6, 2022 (GHD, 2022b). This letter is included in Appendix D. The hydrodynamic modeling data was also provided to TxDOT on April 4, 2022, to allow TxDOT to begin evaluating the effects of the BMP on its bridge structures.

Additional comments were received as part of the EPA Review of the 90% RD (EPA, 2024b). The hydrodynamic model was updated to address EPA's comments and is included as Appendix F.

5.4.2 Northern Impoundment Preparation and Layout

In order to facilitate waste material removal, solidification, and water treatment, the RC will be required to complete several activities to prepare to implement the Northern Impoundment RA.

Assuming that access can be obtained to use the existing TxDOT ROW to implement the RA, the existing TxDOT ROW cannot accommodate two-way traffic for haul trucks; therefore, the TxDOT ROW would need to be enhanced/widened in order to make Northern Impoundment RA operations efficient and safe. Widening the ROW may necessitate installation of a bulkhead along the north side of the TxDOT ROW to bolster and protect the roadway. This access road will also need to be built up as it approaches the south side of the Northern Impoundment, such that the elevation of the access road at the entrance of the Northern Impoundment will be at or above the BMP top elevation of +10 ft NAVD88. This access ramp will be constructed to allow truck traffic to traverse in and out of the Northern Impoundment, over the BMP wall, while maintaining a protective BMP height to prevent overtopping during the excavation season. In addition, the elevated roadway would need to be constructed in a manner that will accommodate TxDOT's need for its vehicles to have access to the ROW for purposes of maintenance of the existing I-10 Bridge structure and future construction of a replacement bridge structure. The area immediately north of the TxDOT ROW is owned by a third-party landowner and access to it will be required to improve the access road.

Working and staging areas on the Northern Impoundment are limited due to the existing topography and tidal conditions. On the west side of the impoundment, the existing TCRA armored cap rock creates uneven terrain that is not suitable for truck traffic. The east side of the impoundment is consistently covered in water during high tides. Therefore, access roads to and within the Northern Impoundment may need to be constructed in different areas of the Northern Impoundment, depending on which cell is being addressed, in order to allow for truck access and turnarounds. The exact nature and extents of these access roads will be determined by the RC as part of its initial work plan submittals.

Staging and laydown pads may need to be constructed on the selected off-site property for materials staging and water storage and treatment equipment. The RC will also provide power, communications, and water utilities for the water treatment equipment, as necessary.

The RC will construct mixing areas for soil solidification as shown on the design drawings on Appendix G. These mixing areas will be constructed with berms and will be lined to contain the waste and prevent contamination of the underlying material. The exact location of the mixing areas may vary from excavation season to excavation season. For each excavation season, the RC will determine the exact nature and location of mixing areas to be used during that season. It is anticipated that these mixing areas will be constructed in areas adjacent to active cells to mitigate excessive handling and transport of wet material.

5.5 BMP Wall

The following guidelines, standards, and technical manuals are the primary sources used to develop the design of the BMP:

- American Society of Civil Engineers (ASCE) 7-16, Minimum Design Loads and Associated Criteria for Building and Other Structures.
- USACE Engineer Manual (EM) 1110-2-2504, Design of Sheet Pile Walls by USACE.
- American Institute of Steel Construction (AISC) 360-16, Steel Construction Manual 15th Edition.
- USACE Hurricane and Storm Damage Risk Reduction System Design Guidelines, updated June 2012.
- American Association of State Highway and Transportation Officials (AASHTO) LRFD Bridge Design Specifications.
- Nucor Skyline Technical Product Manual, 2021 Edition.
- Arcelor Mittal Impervious Steel Sheet Pile Walls Design & Practical Approach.

5.5.1 Structural Definitions

ASCE 7-16 categorizes structures into four Risk Categories (I through IV). During an excavation season, the BMP may be considered to be similar to structures or facilities that process, handle, or store toxic substances. ASCE 7-16 categorizes such structures or facilities as being in Risk Category IV, in which the failure of such structures or facilities may pose a significant hazard to the public.

EM 1110-2-2504 defines the following load case conditions based on severity and probability of occurrences during the design life of the structure:

- ***Usual:*** Service level loading experienced frequently such as static earth pressure, hydrostatic pressures after installation of the BMP and during excavation with normal water levels in the river.
- ***Unusual:*** Loads larger than those considered usual and experienced less frequently, such as 100-year probability storm events and flood levels in the river.

– ***Extreme:*** Worst-case scenario loads, rarely experienced during the design life of the structure, such as hurricane level winds and flood levels in the river.

5.5.2 Material

Material grades for the various structural components are summarized below:

– ***Sheet Piles*** ASTM A572 Grade 60 (Yield stress, F_y = 60 kilopounds per square inch [ksi])
– ***Tie rods*** ASTM A615 Grade 80 (F_y = 80 ksi)
– ***Walers*** ASTM A36 Grade 36 (F_y = 36 ksi)

For purposes of the design, the standard sections for sheet pile and tie-rods were selected from the Nucor Skyline Technical Product Manual. The manual also included the section properties used for design calculations. Alternative sections with equivalent properties are available from other manufacturers and may be used in construction.

5.5.3 Design Parameters

5.5.3.1 In-Situ Soil

The soil parameters specific to the Northern Impoundment are discussed in detail in Appendix B and Appendix I. The subsurface soils include fine grained material that is expected to behave differently in drained (long-term) and undrained (short-term) condition. Both drained and undrained loading conditions were considered. The designations for soil parameters are in accordance with the Unified Soil Classification System (USCS).

Drained and undrained clays and silts behave differently under loading and have different strengths with respect to time and duration of the applied load. Submerged clays loaded rapidly and for short duration behave the same as an undrained soil since drainage cannot occur through the clay particles in a short time, a condition which is referred to as the Q-case (EM 1110-2-2504). Over longer time frames, clay will drain, and the apparent strength will change. This condition represents the S-case loading (EM 1110-2-2504). Results of the stability analysis include strength from both cases, Q-case and S-case.

5.5.3.2 River Water Levels

The loading from the river water with a density of 62.4-pound per cubic feet (lb/ft^3) would be applied as hydrostatic pressure to the exterior and interior BMP faces.

Water elevations for various load case conditions are as follows:

– ***Usual*** +5 ft NAVD88
– ***Unusual*** +10 ft NAVD88
– ***Extreme*** +10 ft NAVD88
– *Note: The river water is influenced by the tidal waters from the bay and Gulf of Mexico. The water density will be in the range of 62.4 lb/ft^3 (freshwater) to 64 lb/ft^3(seawater). The maximum difference of 1.6 lb/ft^3 (2.5%) will not have any impact on the design.*

Tide data is available from the NOAA[1] Station 8770613 located is approximately 9 miles south of the Northern Impoundment. The mean higher high water (MHHW) elevation is 1.33 ft with respect to the mean lower low water (MLLW). The daily tide variation is significantly lower than the water levels assumed for the design of the BMP. Hence, tides will not govern the design.

[1] National Oceanic and Atmospheric Administration Station at Morgans Point, Barbours Cut, Texas.

5.5.3.3 Scour at BMP Exterior

The presence of the BMP can affect the natural flow state of the San Jacinto River in the vicinity of the Northern Impoundment. The scour potential of the river flow around the BMP installation was evaluated using the Hydrodynamic Model developed for the Northern Impoundment. The shear stresses determine the capability of the river flow to move the riverbed material (sediment). The analysis method and results are provided in Appendix F.

The model evaluated the changes in water circulation with and without the BMP installation for 2-year, 10-year, 100-year and 500-year flow events in the river. The analysis results show that average flow velocity increases as the river discharge increases, and it decreases with the increase in water surface elevation.

With the measured average sediment size, it is noted that shear stress exceeding 0.15 Pascals (Pa) has the potential to mobilize the sediment in the vicinity of the Northern Impoundment. The analysis results show maximum increase in shear stress of 2.65 Pa, maximum value of shear stress of 4.34 Pa and an average value of 0.24 Pa. The shear stress values are large compared to the critical shear stress value of 0.15 Pa for the sediment in the area, indicating that the soil particles are mobile and there is potential for scour and/or sediment deposition along the outside perimeter of the BMP.

The maximum shear stresses differences were observed in two locations - the southwest corner and the north side of the BMP installation. The elevated shear stresses are due to the increase in the river flow within these areas due to the presence of the BMP. However, the bathymetry in the model does not account for modifications of the access road for purposes of the RA which will elevate the area in the southwest corner, limiting the river flow and in effect, preventing increase in the shear stress reflected in the analysis model.

The relatively small value of the maximum shear stress indicates that, except for the two locations discussed above, the conditions overall remain similar to the existing conditions (without the BMP in place). The pattern is similar for all four modelled storm conditions (2-year, 10-year, 100-year and 500-year flow events) with only small differences in magnitude.

Scour protection measures such as rock or riprap will be required around the majority of the perimeter of the wall.

5.5.3.4 Scour at BMP Interior

Based on the evaluation of the historic data for the water levels and hindcast model (Section 5.3.1), there have been five (5) instances of water level exceeding elevation +10 ft. The BMP is designed for water levels ranging from normal levels (elevation +2 ft) to top of the exterior wall (elevation +10 ft).

For the rare instances where the water level exceeds elevation +10 ft, the plunging water may cause scour at the interior base of the BMP wall. The riverbed elevation within the Northern Impoundment varies between 0 to -5 ft on the interior of the BMP walls, except in the northwest corner where the riverbed elevation is approximately -15 ft. The riverbed elevation will be raised to elevation -4 ft along the northwest corner by installing a 30 ft wide bench (See Section 5.5.6.1).

Based on the calculated flow rate over the height of the BMP, the entire BMP will fill to the top of the wall within 1 to 2 hours when the river level rises only 6 inches above the top of the BMP wall. The water levels in the river may continue to rise for several hours but as the Northern Impoundment starts filling with water, the energy of the water overtopping the structure will be dissipated before it reaches the base of the BMP wall and the potential for scour will be reduced.

Scour protection measures such as rock or riprap will be provided along the entire interior perimeter of the walls for the initial stages of river water overtopping the BMP wall, should this occur.

5.5.3.5 Wind

The 3-second gust design wind speeds and hurricane exposure are defined in ASCE 7-16 Chapter 26. The web-based hazard tool by ASCE (**https://asce7hazardtool.online**) provides site-specific information. The standard design wind speeds relate to a maximum recurrence interval (MRI) of 100-years. The wind speeds for Risk Category

IV structure in hurricane exposure areas correspond to MRI of 3000-years. All wind speeds are defined at 33-ft above ground level.

– Design wind velocity, 3-second gust, MRI 100-years, V_{100} = 116 miles per hour (mph).
    - Equivalent to 77 mph wind sustained over 1 hour
– Design wind velocity, 3-second gust, MRI 3000-years, V_{3000} = 154 mph.
– Exposure Category C.
– Wind directionality, K_d = 0.85 (solid freestanding wall).
– Topographic Factor, K_{zt} = 1.0.
– Ground Elevation Factor, K_e = 1.0.
– Velocity Pressure Exposure Coefficient, K_z = 0.85.

Velocity Pressure, $q_z = 0.00256\ K_z\ K_{zt}\ K_d\ K_e\ V^2$.

Using $V = V_{100}$, qz_{100} = 24.89 pounds per square foot (lb/ft^2) (Unusual load condition).

Using $V = V_{3000}$, qz_{3000} = 43.87 lb/ft^2 (Extreme load condition).

Velocity pressure from wind (q_z) was applied as uniformly distributed load on the exposed exterior of the BMP.

5.5.3.6 Waves

Wind-waves are generated by sustained winds over unobstructed open waters (fetch). The Northern Impoundment is sheltered by land on all sides within 0.2 miles except the north and northwest directions as shown in Figure 5-F. There are barges moored on the north side within 0.3 miles interrupting the open waters and beyond that, the nearest land is 0.5 miles away. The fetch distance perpendicular to the northwest is less than 1.5 mile.

Assuming a wind speed of 77 mph sustained over a 1-hour period (Section 5.5.3.5), and an average water depth of 20 ft over the entire fetch distance, the significant wave heights can be in the order of 2-ft (0.5 mile fetch) to 4.2 ft (1.5 mile fetch). The waves generated in the northwest direction will refract around the landmass on the northwest side and are not expected to have direct contact with the BMP walls.

During storm season, there will be a significant lag between sustained winds and rising water (storm surge) to generate wind-waves at the flood water levels. Therefore, the wind-waves should be combined with the normal water levels in the area (elevation +2 ft to +5 ft). Since the BMP will be designed for water surface elevation at top of the wall (elevation +10 ft), the wind-waves will not govern the BMP design over the loading scenarios with the total hydrostatic pressure applied from top of the wall and barge impact as described in Section 5.5.3.7.

Figure 5-F ***Fetch Distance near Northern Impoundment***

Wake-waves are generated by passing vessels in the area and approach the BMP walls at an angle as the navigation channel flows parallel to the walls. Similar to the wind-waves, wake-waves should also be combined with the normal water levels in the area (elevation +2 ft to +5 ft). Wind-waves are not combined with wake-waves since passing vessels overlapping with a storm event is unlikely. Since the BMP will be designed for water surface elevation at top of the wall (elevation +10 ft), the wake-waves will not govern the BMP design over the loading scenarios with the total hydrostatic pressure applied from top of the wall and barge impact as described in Section 5.5.3.7.

5.5.3.7 Barge Impact

Given the heavy barge traffic in the San Jacinto River, there is a potential for the BMP to be struck by a barge. An impact could be the result of a barge coming off its mooring and drifting toward the BMP during a storm or it could be the result of a towed barge veering off course. The segment of the river around the BMP actively used by barges is shown on Figure 5-G. The barges traveling in the navigational waterway, either empty or loaded, would be likely to make contact with the BMP at an angle. The barges moored directly north of the BMP would be likely to make head-on contact with the BMP. The impact energy from a barge moving at the river flow velocity will be absorbed by the combination of a barrier wall system installed outboard of the BMP and the BMP structure.

Impact Energy

The kinetic energy from impact can be determined as follows, where velocity may be either the flow velocity or the navigation speed. The energy of impact will be lower for any impact angle other than head-on collision.

$$\text{Kinetic Energy of Impact} = 0.5 \times \text{Mass} \times (\text{Velocity} \times \text{cosine}\ (\alpha))^{2}.$$

Where:

Mass = Mass of the vessel

Velocity = Speed of the vessel at impact cosine (α) = directional factor for impact angle relative to the velocity vector

= 1 for Head-on impact, i.e., 0 degrees relative to velocity vector

The kinetic energy will be absorbed by the structures (barrier wall and BMP) but the barge itself will absorb some energy and suffer damage. The AASHTO[2] method to determine impact force absorbed by bridge piers is being used for evaluating the BMP. This method is conservative since the BMP has a larger profile area than the typical bridge piers to absorb impact and distribute the energy.

Figure 5-G Navigational Waterway - Northern Impoundment

USACE developed design guidelines outlining minimum impact forces for hurricane protection structures.[3] These include structures in protected waterways not exposed to tidal surge (Zone 1A), similar to the conditions at the Northern Impoundment. The extreme load condition criterion for Zone 1A corresponds to an impact force of 400 kilopounds (kips) from a light (empty or ballast condition) barge applied at the top of the wall with hydrostatic pressure induced by the 100-year still water level and wind load applied on any exposed portion of the wall. It should be noted that heavier (loaded or laden condition) vessels did not govern the design as the velocities of these vessels were considerably less.

AASHTO requires all bridge piers located in navigable waterway crossings to be designed for ship and barge impact. The required minimum impact load corresponds to a 195-ft long, 35-ft wide and 12-ft tall empty hopper barge (displacement = 200-ton), drifting toward the structure. This barge size is representative of the barges in the area.

TxDOT's design criteria for the dolphin and fender system protecting the I-10 Bridge piers includes impact from a 30,000-barrel (BBL) barge, one of the larger barges in the area. A typical 30,000 BBL barge is 300-ft long, 54-ft wide, and 12-ft tall. In laden condition, the barge is loaded to full capacity and displaces 30,000 BBL equivalent or approximately 168,500 cubic feet (ft^3) of water. Thus, the barge weighs approximately 5,250 US-tons or 10,500 kips in

[2] AASHTO LRFD Bridge Design Specifications, Section 3.14.
[3] USACE Hurricane and Storm Damage Risk Reduction System Design Guidelines, Section 5.2.1.

laden condition. In ballasted condition, the barge carries only fuel and ballast water, and weighs approximately 910 US-tons or 1,820 kips.

The head-on impact from the 54-ft wide, 30,000 BBL barge resulted in impact energy (and force) greater than the values recommended using USACE and AASHTO vessels. Therefore, the 54-ft, 30,000 BBL barge is considered the design barge for evaluating impact. A contact width of 50-ft was assumed to account for variations in barge bow shapes.

Impact Velocity

The hydrodynamic model (Appendix F) evaluated the flow velocities for four storm conditions at 2-year, 10-year, 100-year and 500-year recurrence intervals, both with and without the BMP present. The maximum and average velocities for the river flow from the hydrodynamic analysis report are summarized in Table 5-A.

The maximum flow velocity of 3.14 feet per second (ft/s) will be considered for Barge Impact.

Table 5-A Velocity - Hydrodynamic Model

Velocity (ft/s)	Existing Conditions (No BMP)				With BMP in Place			
	2-Year	**10-Year**	**100-Year**	**500-Year**	**2-Year**	**10-Year**	**100-Year**	**500-Year**
Maximum	2.79	2.68	2.95	2.95	2.68	2.93	3.14	3.14
Average	0.56	0.55	0.66	0.68	0.61	0.60	0.71	0.72

5.5.3.8 Earthquake

The area of the Northern Impoundment is generally considered to have low seismicity. This is also reflected by the following low seismic accelerations noted in the Geotechnical Report (Appendix B).

PGA: 0.034 g

S_S: 0.069 g

S_1: 0.040 g

Typical retaining wall structures are impacted by earthquake loads due to reduction in strength of the foundation soils, fill material and/or the backfill. Structures that are founded on saturated, cohesionless soils or lenses of such soils within the cohesive soils can lose foundation support when subject to earthquake loading.

The seismic accelerations will not affect the alluvium and Beaumont clay layers. There will be impact on Beaumont sand layers or other granular material but as the BMP walls do not extend into the sand layers, the seismic accelerations do not impact the stability of the wall.

5.5.4 Load Combinations

The following load combinations (LC) are appropriate for the structural design in accordance with Allowable Stress Design in ASCE 7-16, Section 2.4.

LC#1 D + H + F

LC#1A D + H + F + I

LC#5 D + H + F + 0.6W

Where:

D = Dead load

F = Fluid load (hydrostatic pressure)

H = Lateral earth pressures (active and passive)

W = Wind Load on exposed surfaces (interior and/or exterior)

I = Barge Impact

LC#1 was evaluated for both Usual and Unusual load conditions. LC#1A was used to evaluate the barge impact as extreme load condition with impact near top of the wall. An impact at lower levels will cause less rotation in the structure.

LC#5 combines wind load with other loads acting on the BMP. It is noted that wind load is applicable only to the exposed height of BMP above ground or water level. At the design water level for Unusual or Extreme conditions (+10 ft NAVD88), the BMP exterior would not be exposed to wind.

A parametric evaluation was performed for the effect of wind loads on the design of BMP using LC#5. The 0.6 reduction factor for wind load was conservatively ignored for the evaluation. The net load ($F + W_{Exterior} - W_{Interior}$) on the BMP, calculated as sum of the hydrostatic load and the wind load applied to both interior (above ground) and exterior (above water level), was compared to the hydrostatic load with water level at +9 ft NAVD88 acting alone. The net load was determined to be lower. Given that D + H are common to both load cases, LC#5 did not govern over LC#1 and was not evaluated further.

ASCE 7-16 recommends reduction in the load factor for resisting (passive) lateral earth pressure to 0.6. The intent of the reduction is to design structures resistant to overturning by reducing the resistance. Since the BMP wall was designed for overturning (rotational) stability with adequate embedment as described in Section 5.5.6, a reduction for lateral earth pressure was not considered.

5.5.5 BMP Design Criteria

5.5.5.1 Failure Modes

EM 1110-2-2504 describes the following three primary failure modes for sheet pile wall systems:

1. The unstable slopes may cause a deep-seated rotational failure of the entire soil mass. The slope failures are independent of the sheet pile embedment and location of the anchor system. This type of failure can be addressed by changing the geometry of the retained material or improving the soil strength.

   The double wall system of the BMP presented in the 100% RD is evaluated using PLAXIS 2D, a finite element software program. The program can model complex soil profiles, structural sections and perform soilstructure interaction analysis to achieve a solution with compatible forces and displacements. The program evaluates the soil stability around the sheet piles to determine if slope failure is a concern.

2. The sheet piles with inadequate embedment depth can be subjected to rigid-body rotational failure due to the lateral pressures exerted by the retained material. The classical design procedures such as the “free earth” Limit Equilibrium Method calculate the sheet pile embedment depths by balancing the active pressures behind the wall against the passive pressures provided by soil in front of the sheet piles. Adequate embedment depth is achieved at depth where the sum of horizontal forces and sum of moments is zero. Rigid-body rotational failure can be prevented, according to EM 1110-2-2504, by incorporating safety factors to decrease the passive pressures as appropriate for different loading conditions.

   The double wall system of the BMP is an atypical sheet pile system. Unlike a cantilever or anchored system, rotational failure is mitigated by the counterbalancing axial forces on the two walls. Instead of increasing the embedment depth of the single wall, the width of the double wall system can be increased to an extent such that it beneficially contributes to resolving the overturning forces into axial components along the length of the wall. Thus, this mode of failure is not applicable to the double wall system.

3. The sheet pile systems with stable slopes and adequate embedment may fail if the sheet pile sections, tie-rods, and/or the anchor components are overstressed or inadequately sized. Such failures can be prevented, according

to EM 1110-2-2504, by incorporating safety factors in the design by limiting the allowable stress as appropriate for different loading conditions.

5.5.5.2 Safety Factors

The following safety factors and allowable stress limits were adopted in the design of the BMP with respect to the failure modes described in Section 5.5.5.1, consistent with EM 111-2-2504.

5.5.5.3 Embedment Depth

EM 1110-2-2504 recommends the minimum safety factors provided in Table 5-B to determine embedment depth for cantilever or anchored sheet pile wall systems. It should be noted that the safety factors are suitable for the “free earth” Limit Equilibrium Method where the sheet pile is considered a rigid body allowed to rotate about a point below ground level, and the active and passive pressures are balanced to determine the embedment depth. Adequate embedment depth is achieved at depth where the sum of horizontal forces and sum of moments is zero. The pressures, and resulting forces in the system, are considered independent of the wall displacement in the Limit Equilibrium Method.

The BMP design evaluated with the finite element analyses using soil structure interaction incorporates the nonlinear behavior of the soil, wall displacements and flexibility of the sheet pile and anchors. The active and passive pressures vary as the system flexes to achieve a solution by balancing the forces and displacements in the entire system. By inherently balancing the forces and displacements, the system achieves a larger safety factor against rotational failure than the Limit Equilibrium Method. Thus, the safety factors are not applied to determine effective soil parameters for calculating passive pressures.

The cantilever wall BMP presented in the 30% RD acted as both a floodwall and a retaining wall by maintaining differential water (higher water in the river) and soil elevations (excavation below riverbed elevation). However, the current BMP system in the new alignment primarily serves as a floodwall by maintaining a different water elevation between the excavation area and the San Jacinto River. The sheet piles are terminated in the fine grain soils of the Beaumont Clay layer. Hence, both the undrained (Q-Case) and drained (S-Case) conditions were evaluated to determine the stability of the BMP.

Table 5-B Safety Factors for Passive Pressures - EM 1110-2-2504

Loading Case	Floodwalls		Retaining Walls	
	Fine-Grain Soils	**Free-Draining Soils**	**Fine-Grain Soils**	**Free-Draining Soils**
Usual	1.50 Q-Case 1.10 S-Case	1.50 S-Case	2.00 Q-Case 1.50 S-Case	1.50 S-Case
Unusual	1.25 Q-Case 1.10 S-Case	1.25 S-Case	1.75 Q-Case 1.25 S-Case	1.25 S-Case
Extreme	1.10 Q-Case 1.10 S-Case	1.10 S-Case	1.50 Q-Case 1.10 S-Case	1.10 S-Case

Sheet Pile Sections

EM 1110-2-2504 recommends the maximum allowable stresses provided in Table 5-C for the sheet piles subject to different load case conditions. By definition of the various load case conditions (Section 5.5.3), the BMP is subject to Unusual and Extreme load case conditions less frequently than the Usual load case conditions. Hence, the allowable stresses are relatively higher for the more severe loading scenarios to provide design solutions appropriate for Unusual and Extreme load case conditions.

Table 5-C *Allowable Stresses for Sheet Piles - EM 1110-2-2504*

Load Case Conditions	Combined Bending and Axial Stress	Shear Stress
Usual	0.50 F_y	0.33 F_y
Unusual	0.67 F_y	0.44 F_y
Extreme	0.88 F_y	0.58 F_y

Tie-Rod Sections

The tie-rod sections, included in Table 5-D, are designed using allowable stress design methods in accordance with AISC 360. The tie-rods are critical to balance the forces and displacements of the BMP.

Table 5-D *Allowable Stresses for Tie Rod Sections - AISC 360*

Limit State	Overstrength Factors
Tensile Yielding	1.67
Tensile Rupture	2.00
Tensile Rupture of Threaded Parts	2.00

If one tie-rod fails, the loads will be redistributed to the adjacent tie-rods. The individual tie-rods are designed for 150 percent of the demand loads, accounting for a tie-rod failure event where the loads are redistributed to adjacent tie-rods and preventing progressive failure and thereby, increasing the safety factor.

Walers

The walers are longitudinal beams connected to the tie-rods on the exterior face of the sheet piles. The walers distribute the loads from the sheet piles to the tie-rods and minimize variations in displacement along the BMP. In order to provide a continuous longitudinal beam, the individual waler beams will be spliced using bolted connections.

The waler are evaluated as simply supported multi-span beams with tie-rods providing the support reactions. The walers are also evaluated for condition with a longer span (150 percent) accounting for a tie-rod failure thus able to redistribute loads to the adjacent tie-rods. The walers are designed using allowable stress design method in

Table 5-E *Overstrength Factor for Walers - AISC 360*

Limit State	Overstrength Factors
Flexure or Bending Stress	1.67
Shear	1.67

5.5.5.4 Deflection

Total system displacement comprised of structural steel deformation, rotation and translation of the entire BMP and soil system was evaluated for the proposed BMP.

Neither EM 1110-2-2504 nor ASCE 7-16 provide guidance on limiting system deflection. For a cantilever sheet pile system, structural steel can deform significantly before structural failure occurs; hence, structural steel deformation could not be used as a limiting parameter in the previous submittal (30% RD).

The combination of tie-rod anchors and adequate embedment of sheet piles restrain the deflection in the sheet piles. The deflection at the top of the sheet pile translates to local deformations in the structure. These deformations are accounted for by the bending stress in the sheet piles and tensile stress in the tie-rods. The stresses will be limited to the allowable stress (Section 5.5.5.2) and within the elastic range (less than F_y) to avoid structural failure of the BMP.

5.5.5.5 Corrosion Protection & Maintenance

The Northern Impoundment BMP structures were designed for temporary, short-term use. It was assumed that the sheet piles would remain in place for a period of approximately 7 years after installation. Figure 5-H shows the five exposure zones typically considered for corrosion. It also shows a schematic for varying thickness loss along the height of the steel sheet piles exposed to a marine environment.

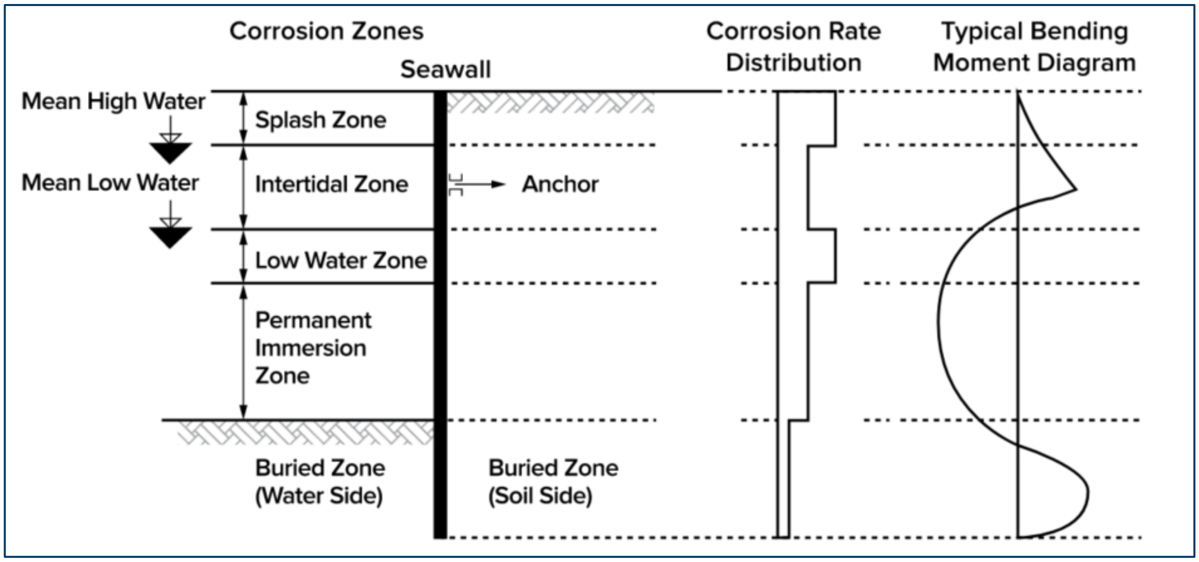


Figure 5-H Typical Thickness Loss - Nucor Skyline Catalog, Ports & Marine Construction

The loss of thickness due to corrosion relative to different exposure conditions are listed in Table 5-F. The corrosion rates are representative of industry-wide accepted rates where site-specific data is unavailable. Since the Northern Impoundment is located in brackish water, an average of total thickness loss for river (0.008 inches) and seawater (0.027 inches) exposure is appropriate (these two values are indicated in bold font in Table 5-F, below). The duration of exposure to each zone varies significantly on the exterior and interior face of the BMP. It is conservative to assume the same thickness loss on both sides of the sheet pile. A uniform sacrificial thickness of 0.035-inches (2 x 0.0175 inches) was included for each side of the sheet pile for the entire height of the wall. No additional maintenance should be required for the assumed 7-year RA period.

Table 5-F Loss of Thickness due to Corrosion

Description of Exposure[1]	Loss in 5 Years[1] (inches)	Loss in 25 Years[1] (inches)	Loss in 7 Years[2] (inches)
Common fresh water (river, ship canal) in the zone of high attack (water line).	0.006	0.022	**0.008**
Very polluted fresh water (sewage, industrial effluent) in the zone of high attack (water line).	0.012	0.051	0.016
Sea water in temperate climate in the zone of high attack (low water and splash zone).	0.022	0.074	**0.027**
Sea water in temperate climate in the zone of permanent immersion or in the intertidal zone.	0.010	0.035	0.013

Notes:
1 Eurocode 3 - Design of Steel Structures, Part 5: Piling, BS EN 1993-5:2007.
2 Interpolated between 5 Years and 25 Years.

5.5.6 BMP Wall Analysis

The BMP cross-sections were analyzed for stability and determining stress in the structural components using Plaxis 2D, a finite element software program developed by Bentley Systems, Inc. The program can model complex soil profiles, structural sections and perform soil-structure interaction analysis to achieve a solution with compatible forces and displacements. The analysis also incorporates a time variable simulating the various stages of construction, such as end of sheet pile installation, adding fill between the walls, installing tie-rods, dewatering the excavation area after BMP is installed, and excavation to allow for consolidation or dissipation of porewater pressures. Additional details of the analyses for all cross-sections are provided in Appendix I.

The finite element analyses using soil-structure interaction incorporate the non-linear behavior of the soil, wall displacements and flexibility of the sheet pile and anchors. The active and passive pressures vary as the system flexes to achieve a solution by balancing the forces and displacements in the entire system. By inherently balancing the forces and displacements, the system achieves a larger safety factor against rotational failure than the “free earth” Limit Equilibrium Method. Thus, the safety factors (Section 5.5.5.2) are not applied to determine effective soil parameters for calculating passive pressures.

The behavior of the BMP varies with the height of the sheet piles above riverbed and the subsurface strata. Hence, multiple cross-sections were evaluated to account for the variations in riverbed elevations, cross-slope of the riverbed along the BMP alignment, thickness of Alluvium Sediments, anticipated top of Beaumont Clay layers, and distance from the BMP to the excavation. Figure 5-I, below, shows the approximate extent of each cross-section selected for the analyses and the summary of results are provided in Table 5-H. These extents are approximate and may change in the final design to accommodate design optimizations, and other considerations related to standardizing construction practices.

Additional considerations were applied to Cross-Sections C2, C6, and C7 due to reasons described, below.

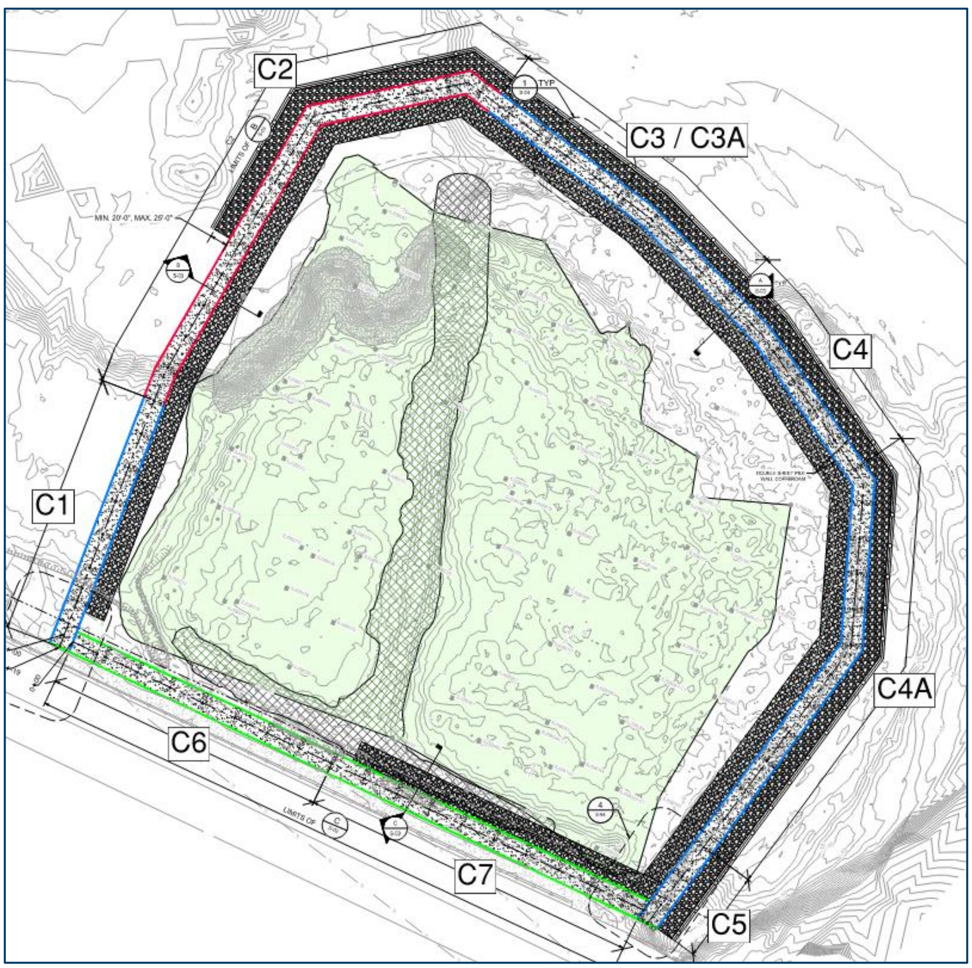


Figure 5-I BMP - Limits of Cross-Sections C1 to C7

5.5.6.1 Cross-Section C2

Cross-Section C2 represents the extent of the tallest height of the BMP above riverbed elevation (approximately -15 ft NAVD88). The approximate wall height on both the exterior and interior sides is 24 ft. The large height above the riverbed overstressed the sheet piles and tie-rods. Hence, a 30 ft wide Raised Bench (imported fill material) constructed above the Soil Buttress, to elevation -4 ft NAVD88 is required on the interior side to reduce the stresses. The sheet piles and tie-rods required to meet the demand loads are the among the largest standard sections available. The tie-rods are required to be installed at elevation +3 ft NAVD88.

This cross-section was analyzed and determined to be adequately designed assuming use of excavation methodology similar to that used in other areas in the Northern Impoundment as well as for other remedial alternatives. However, it should be noted that the areas in the northwest corner are subject to pronounced risk of hydraulic heave as described in the Geotechnical Engineering Report (Appendix B), and hence a different excavation methodology as described in Section 5.7 will be deployed in this area. The change in excavation method does not impact the design of the BMP structure.

5.5.6.2 Cross-Sections C6 and C7

Cross-Sections C6 and C7 represent the BMP along the alignment parallel to the I-10 Bridge. In the alignment previously presented in 30% RD, the BMP was placed directly at the edge of the existing berm and excavation limits extended to the sheet pile. The existing ground elevation varies between elevation 0 ft and Elevation +5 ft NAVD8S. The BMP design elevation at bottom of excavation is -14 ft NAVD88 and -20 ft NAVD88 for Cross-Section C6 and Cross-Section C7, respectively. The TxDOT ROW runs between the elevated portion of the freeway and the southern boundary of the Northern Impoundment.

Several concepts for the BMP, as described in the BMP Design Structural Report (Appendix I), were evaluated to determine if there an implementable solution along the original alignment. The significantly large height retained above the anticipated excavation bottom, the inability due to space constraints to include a Soil Buttress, and the need for active excavation along the face of the BMP resulted in the BMP (and the anchor system, where applicable) extending into the deeper sand layers. Due to concerns with pile driveability and associated vibrations in the vicinity of the I-10 Bridge, the ExxonMobil pipeline assets, and other underground utilities and other considerations, these concepts were considered unfeasible.

The only workable solution was a double-wall system, approximately 30-ft wide, similar to the double-wall around the balance of the Northern Impoundment. This required moving the BMP alignment farther south into the TxDOT ROW to allow for a sloped Soil Buttress beginning at Elevation 0 ft NAVD88 and extending into the excavation area. This placed the double wall within the TxDOT ROW, with the outer wall being approximately 20 ft from the I-10 Bridge guardrails on the TxDOT ROW.

Additional details are provided in Appendix I.

5.5.7 Barge Impact

The impact energy from a barge moving at the river flow velocity will be absorbed in the following two stages -

1. Primary or first contact will be with a barrier wall system comprising of fiberglass reinforced polymer (FRP) composite piles. The barrier wall is designed to absorb impact energy corresponding to velocity of up to 2.2 ft/s (95^{th} percentile river velocity).
2. As the barge damages the barrier wall and breaks through, it will lose energy. The BMP will be subjected to the remaining energy i.e., energy corresponding to velocity of 3.14 ft/s (maximum) - 2.2 ft/s (barrier wall) = 0.94 ft/s (excess energy). In the 90% RD, the BMP was evaluated for impact velocity of 2.2 ft/s. The analysis results are valid for this evaluation.

5.5.7.1 Barrier Wall

A FRP barrier wall will be installed at approximately 20 to 25 ft beyond the exterior wall of the BMP along the north and east side to provide increased protection in areas exposed to potential barge impacts. See Figure 5-F. The barrier wall will be comprised of 18-inch diameter FRP composite piles spaced at 8 ft on center. Four rows of 12-inch x 12-inch reinforced high-density polyethylene (HDPE) walers will be installed horizontally on the exterior side of the FRP piles, evenly spaced between Elevation +2 and +12 ft above mean water level (Figure 5Figure 5-J).

The barge will contact the walers and in turn, multiple FRP piles will be engaged, and the barrier wall system will deflect to absorb the impact energy. The system is designed to absorb impact from the design barge up to a velocity of 2.2 ft/s. The largest moment demands on the pile sections are seen when the barge impact is at or near the top of the barrier wall. At lower elevations of impact, the moment demands are lower and do not govern the design.

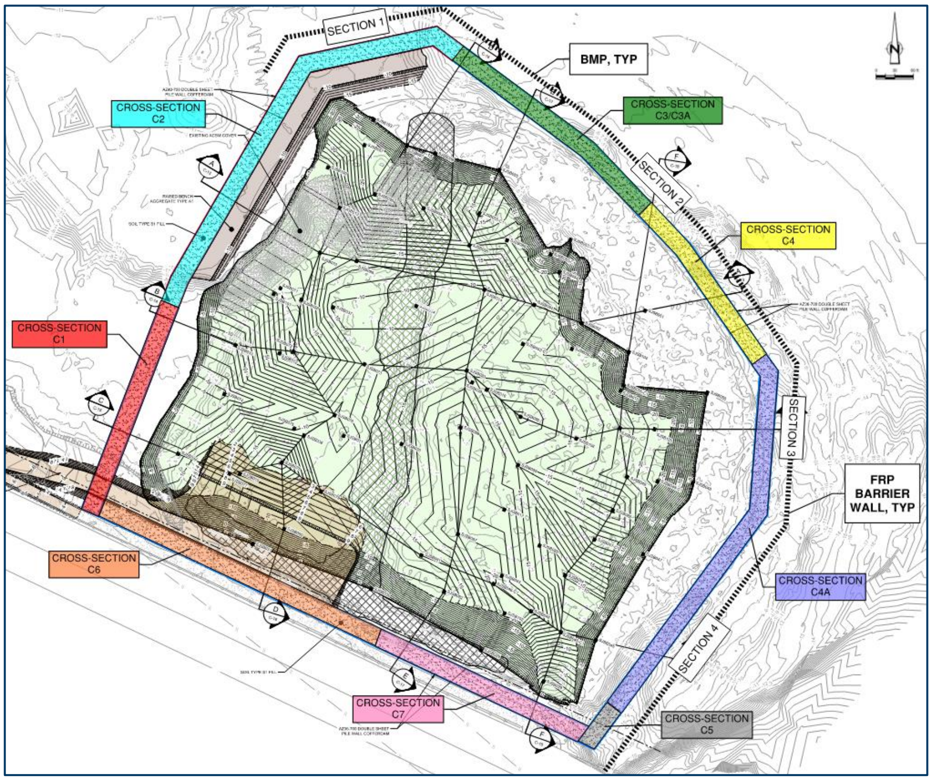


Figure 5-J FRP Barrier Wall - Alignment

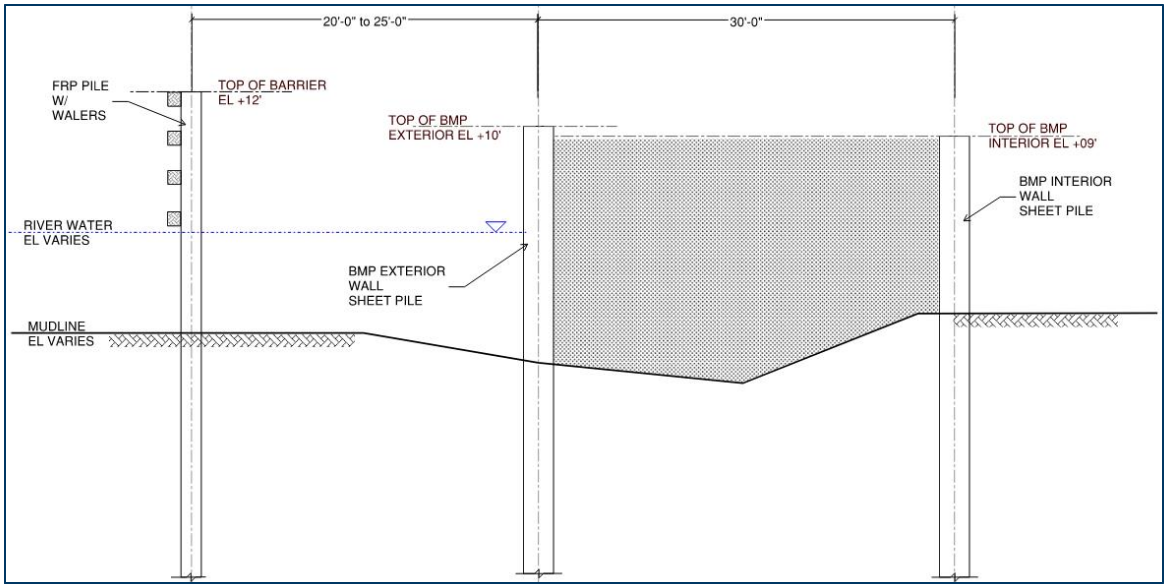


Figure 5-K FRP Barrier Wall - Typical Section

The details of the analysis and results are provided in Appendix I.

5.5.7.2 BMP Impact

The BMP was analyzed for barge impact near the top of the wall (exterior sheet pile). With the FRP barrier wall system as the primary protection, the BMP will absorb the excess impact energy equivalent to an impact from the design barge at velocity of 0.94 ft/s (See Section 5.5.7).

In the 90% RD, the BMP was evaluated for impact at a higher velocity, so the same analysis results (demand loads on BMP sheet pile) are valid for the current evaluation of impact at lower velocity.

Two Cross-Sections, C2 and C4 were analyzed with barge impact loads in Plaxis. These Cross-Sections have the largest retained height above the riverbed and are expected to be the most critical Cross-Sections for evaluating a potential impact at the top of the wall. A 400 feet long three-dimensional model was created with the same stratigraphy, material properties and stages as the analysis sections described in Section 5.5.6. The linear elastic plates representing the sheet piles were assigned orthotropic parameters to capture the difference in stiffness of the vertical and horizontal directions.

The barge impact load was applied as a static uniformly distributed load over a 50-ft x 1-ft area at top of the wall. Due to the instantaneous nature of the impact, the loads are evaluated using the undrained soil parameters and considered an Extreme load condition, with the impact near top of the wall with the water levels at +9 ft NAVD88.

The following two loading scenarios, considering a combination of multiple impact velocities and barge displacement conditions (ballasted or laden), were evaluated. The loads correspond to higher velocities of flow for impact, than as summarized in Table 5-A, with a barge in ballasted condition, hence conservative for the analysis. However, for the laden condition, the loads represent the limiting loads for the BMP.

Case 1: 20 kip/ft x 50 ft = 1000 kip

– Corresponds to contact with 54 ft barge in ballasted condition at impact velocity of 3.8 ft/s (greater than the maximum velocity of 3.14 ft/s) or,

– Contact with 54 ft barge in laden condition at impact velocity of 1.6 ft/s (greater than the excess energy from velocity of 0.94 ft/s).

Case 2: 28 kip/ft x 50 ft = 1400 kip

- Corresponds to contact with 54 ft barge in ballasted condition at impact velocity of 5.3 ft/s (greater than the maximum velocity of 3.14 ft/s) or,
- Contact with 54 ft barge in laden condition at impact velocity of 2.2 ft/s (greater than the excess energy from velocity of 0.94 ft/s).

As Cross-Section C2 is not near the navigational waterway, any impact on the west and northwest portion of the BMP will likely be from barges moored on the north side of the BMP that may come off the mooring in a storm event. Thus, Cross-Section C2 is only evaluated for Case 1 loading scenario. The results from Cross-Section C4 are applicable to all other locations, except C2.

The barge impact loads caused localized deformation of the wall along with increase in soil shear strains. However, the strains did not indicate a global failure would occur. In this scenario, there would be localized damage to the BMP due to limiting flexural capacity. The analysis results are summarized in Table 5-G. The section stresses from demand loads are compared to the allowable stresses in the sheet piles for extreme event loading i.e., 0.88 Fy (combined bending moment and axial stress) and 0.58 Fy (shear stress).

Table 5-G Barge Impact Analysis Output

Analysis Cross-Sections	Analysis Demands per LF			Sheet Pile Capacity (Extreme Load Condition)		Demand to Capacity Ratio	
	Moment (kip-ft)	Shear (kip)	Deflection (ft)	Moment (kip-ft)	Shear (kip)	Moment	Shear
C2, AZ 42-700N (Case 1)	342.4	64.5	1.4	325	351	1.05	0.18
C4, AZ 36-700N (Case 1)	159.6	39.6	0.8	275	276	0.58	0.14
C4, AZ 36-700N (Case 2)	251.2	39.6	1.6	275	276	0.91	0.14

The results show a 5% overstress in the sheet piles at Cross-Section C2 for impact with a ballasted barge at 3.8 ft/s. Impact forces are directly proportional to the impact velocity squared (Section 5.5.3.6). Therefore, the stresses in Cross-Section C2 will be lower for impact at 3.14 ft/s as the impact force will reduce by 17%. Considering the low probability of impact in the area of Cross-Section C2, reduction in impact force at lower velocity and engineering judgement, the 5% overstress for condition evaluated is considered acceptable for design.

The Cross-Sections closer to the navigational waterway would be expected to potentially encounter impact with barges, ballasted or laden, as they are towed. Results from Cross-Section C4 show that the BMP is adequate for impact with barges in ballasted and laden condition at velocity 2.2 ft/s even without the FRP barrier wall system.

It should be noted that the barges and tugboats typically slow down as the width of the navigational waterway reduces closer to the I-10 Bridge. Navigational signs can be posted on the exterior face of the BMP to require marine vessels to reduce speeds along the eastern side of the BMP.

Additional details of the analyses, results, and plots are provided in Appendix I.

5.5.8 Scour Protection at BMP Exterior

Scour protection countermeasures for the BMP exterior are developed based on Federal Highway Administration (FHWA) guidance provided in Hydraulic Engineering Circular No. 23 (HEC-23), Bridge Scour and Stream Instability Countermeasures (Publication No. FHWA-NHI-09-111, September 2009) which provides design guidelines for use of rock riprap to mitigate scour at bridge abutments. Although the BMP is not a bridge abutment, its influence on floodplain hydraulics is similar in that overbank flows are concentrated through a narrower section of the river resulting in localized increase in shear stress.

Design Guideline 14 was applied to the design of the rock riprap scour protection concepts. The median stone diameter for riprap scour protection is calculated based on depth, velocity and abutment geometry using the Isbash equation. The results from the Hydrodynamic Analysis (Appendix F) indicate maximum peak velocities would be approximately 3.14 ft/s. To account for uncertainties related to complex hydrodynamics and potential for localized flow accelerations along the BMP, an additional safety factor was applied to the predicted maximum velocity. The median rock size for the riprap was designed for a velocity of 6 ft/s.

Based on this approach, the riprap scour protection apron will consist of a median stone diameter of 10 inches and an overall layer thickness of 1.5 ft.

As noted in Section 5.5.3.3, scour protection is required around the majority of the perimeter of the wall, including the east side of the BMP as the channel narrows near the I-10 Bridge. A 25 ft wide riprap apron will provide sufficient stability along the exterior perimeter of the BMP.

5.5.9 Scour Protection at BMP Interior

Scour protection countermeasures for the BMP interior are designed by calculating the velocity of water reaching the base of the wall, resulting impact pressure, length of the turbulent flow at the base of the wall and potential for flow jump where the soil slopes away from the wall.

The most critical scour can occur in the initial stages where the river water level rises over the top of the BMP wall. When water rises 6 inches above the BMP wall, it can fill the entire area to the top of the wall within 1-2 hours. As the river water level continues to rise in the initial hours, the BMP will fill faster and reduce the time where the soils at the base of the BMP are directly exposed to the overtopping water.

Additional details of the analysis for a wide range of river water levels between elevation +10.1 ft to +14.0 ft are provided in Appendix I. However, only the initial stages where water level reaches elevation +10.5 ft is considered critical for interior wall scour.

Based on this approach, the interior riprap scour protection will consist of median stone diameter of 18 inches and an overall layer thickness of 3 ft. As an added measure, the riprap will be grouted with flowable concrete of 3000 psi strength to withstand the plunging water flow over the BMP wall. The riprap apron will be extended to 25 ft from the base of the BMP wall.

At the northwest corner of the BMP, the raised bench is required for stability of the wall. Due to limited space available without encroaching into the excavation area, the riprap will be incorporated into the bench to protect the entire 30-ft width of the raised bench. All the interior scour protection will be monitored routinely and maintained for the duration of the project.

5.5.10 Summary of Results

The summary of the structural sections required for the BMP is provided in Table 5-H. As extents of Cross-Sections 3 and 3A overlap, the BMP will be conservatively built as evaluated for Cross-Section 3.

Table 5-H Summary of Analysis Results

Analysis Section	Sheet Pile Section		Tie Rod Section		Waler Section
	Nucor Skyline	Length (ft)	Diameter (inches)	Spacing (ft)	
C1, C3, C3A, C4, C4A	AZ36-700N	50	2.25	5	MC 12X35
C2	AZ40-700N	55	3.00	5	MC 18X45.8
C5	AZ36-700N	60	2.25	5	MC 12X35
C6, C7	AZ26-700	60	2.25	5	MC 12X35

5.5.11 Pile Driveability and Vibration Analysis

During the March 25, 2020 TWG Meeting, the design team was asked to perform an evaluation to quantify the risks associated with pile driving-induced vibrations and potential releases from the Northern Impoundment that may result from these vibrations. A vibration analysis for driving large diameter steel pipe piles into deep sands was performed and included in the 30% RD. Since the submittal of the 30% RD, the BMP concept has changed from cantilever (large diameter pipe piles) to a double wall system with Z-shaped steel sheet piles. The alignment of the BMP has been revised to install the sheet piles outside the perimeter of the TCRA armored cap and beyond the edges of the steep slopes present near both the northwest corner and east side adjacent to the I-10 Bridge.

The Z-shaped sheet piles will be installed using a press-in method of installation. The first few pairs of sheet piles need to be installed using a vibratory hammer to set up the press-in equipment. Then a reaction-based press-in system will use these installed sheet piles to press-in the next pair of sheet piles and move forward to continue installing the remaining length of the BMP using the press-in method. As the press-in piling system uses hydraulic force without the use of percussion (impact hammer) or vibration to install piles, the noise and vibration impact on nearby structures can be diminished. The sheet piles will also be terminated in the Beaumont Clay layer instead of driving into the stiffer sand layers, thereby reducing the potential for vibrations significantly even while using a vibratory hammer for the initial set of sheet piles.

Pile driveability and vibrations resulting from the installation procedure are a function of the equipment selected by the RC. Since information on actual equipment is unavailable at this time, pile driveability and corresponding vibrations were evaluated for one impact hammer and one vibratory hammer. The Wave Equation Analysis of Pile Driving (WEAP) showed that both equipment types can install the sheet piles to required depth. WEAP output for PACO Model 36-5000 (impact hammer) and APE Model 100 (vibratory hammer) are provided in Appendix I.

Caltrans[4] provides guidance on calculating vibration amplitudes in terms of peak particle velocity (PPV) and threshold criteria for damage potential for various type of pile installation equipment. The equations used in the manual are based on several data points collected at various distances from the location of pile installation and for various installation equipment.

For Impact Hammers,

$$PPV_{Impact} = PPV_{Ref}\ (25/D)^n\ (E_{Equip}/E_{Ref})^{0.5}$$

Where:

PPV_{Impact} = Vibration amplitude for the pile installation equipment at distance D from the location of installation.

PPV_{Ref} = Vibration amplitude for a reference impact hammer at 25 ft from the location of installation (0.65 in/sec).

D = Distance from pile installation equipment to the receiver in ft.

n = Constant related to the vibration attenuation rate through ground (maximum suggested value of 1.4).

E_{Ref} = Rated energy of the reference pile installation equipment (36,000 ft-lb).

E_{Equip} = Rated energy of the impact hammer to be used for pile installation (PACO Model 36-5000: 15,000 ft-lb).

For Vibratory Hammers,

$$PPV_{Vibro} = PPV_{Ref}\ (25/D)^n$$

Where:

PPV_{Vibro} = Vibration amplitude for the pile installation equipment at distance D from the location of installation.

[4] Transportation and Construction Vibration Guidance Manual, April 2020, California Department of Transportation

PPV_{Ref} = Vibration amplitude for a reference impact hammer at 25 ft from the location of installation (0.65 in/sec).

D = Distance from pile installation equipment to the receiver in ft.

n = Constant related to the vibration attenuation rate through ground (maximum suggested value of 1.4).

The calculated PPV for the impact and vibratory hammer are shown in Figure 5-L. The threshold for damage to new residential structures, modern industrial or commercial building type structures due to vibrations from continuous or frequent intermittent sources such as the pile installation procedure is 0.5 in/sec (Table 19[4]). This threshold is considered appropriate for the structures near the BMP, including the I-10 Bridge. The anticipated vibration from the vibratory hammer is below the acceptable threshold at 25 ft or farther from the sheet pile installation. The vibration reduces significantly with the distance. Thus, no significant impact to the I-10 bridge or other industrial structures is anticipated due to the sheet pile installation.

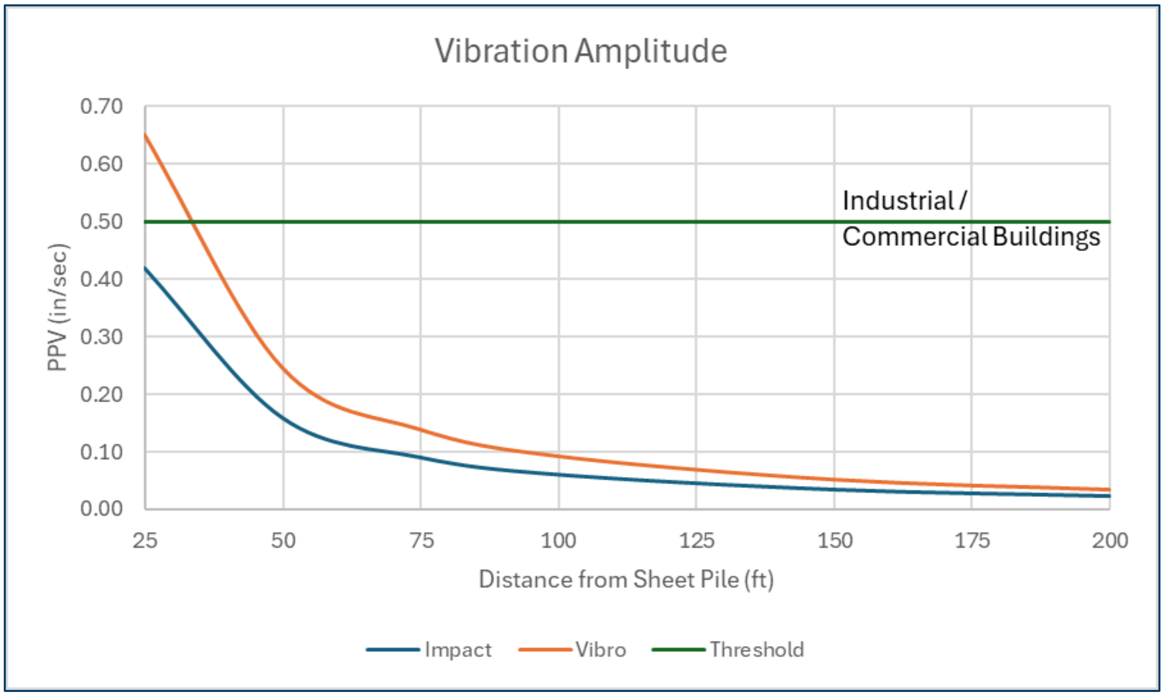


Figure 5-L ***Vibration Amplitude (PPV) for Pile Installation Equipment***

The RC will be required to update the pile driveability and vibration analysis for the equipment to be used during the RA and for allowed use of a vibratory hammer at a minimum distance of 25 ft from the nearest structures.

5.6 Excavation Procedures

5.6.1 Confirmation Sampling

In order to minimize stand-by time during excavation activities, confirmation sampling will be completed after installation of the BMP wall is completed but prior to the commencement of excavation and mechanical dredging activities. Based upon confirmation sampling results, design elevations will be revised prior to excavation, if needed.

As detailed in the FSP (Appendix J, Attachment 3), Decision Units (DUs) were developed by overlaying a grid system on the NI and Northwest Corner. Given that the NI and the Northwest Corner are not a uniform size and shape, this resulted in some variability in the size and shape of DUs. Within each DU, nine discrete samples will be collected from sample locations 0 to 1 feet below the initial excavation elevation and from 1 to 2 ft below the initial excavation elevation as evenly spaced across the DU as possible, given the irregular shape of some of the DUs. A composite sample of these (9) discrete samples will be prepared for each DU for laboratory analysis. A portion of each discrete sample will also be held by the laboratory pending the results of the composite sample analysis.

Prior to sampling, the sample locations will be surveyed by a licensed surveyor and the depth of the confirmation sample will be based upon the initial excavation elevation. A drill rig will be used to collect a sample from each surveyed location. In order to minimize the potential for soil from a shallower depth to slough into the boring, an outer casing will be set to the depth of the initial excavation elevation.

Following laboratory analysis of the 0 to 1 ft composite sample, the result will be compared to the clean-up level. Results will be evaluated, as described below.

– If the result of the composite sample for a DU from 0 to 1 ft below the initial excavation elevation is below the clean-up level, the remedial action objective has been met and the DU will be excavated to the initial excavation elevation.
– If the result of the composite sample for a DU from 0 to 1 ft below the initial excavation elevation is above the clean-up level, the composite sample for the DU from the 1 to 2 ft interval below the initial excavation elevation will be analyzed by the Approved Laboratory.
– If the result of the 1 to 2 ft composite sample from the DU is below the clean-up level, the remedial action objective will be met by either:
    - The discrete samples from the 0 to 1 ft interval for the DU will be analyzed by the Approved Laboratory and discrete locations above the clean-up level will be excavated; OR
    - The DU will be excavated to 1 ft below the initial excavation elevation.
– If the result of the 1 to 2 ft composite sample from the DU is above clean-up level:
    - Analysis of the discrete samples from the 1 to 2 ft interval will be evaluated for the DU; and
    - The path-forward for that DU will be determined pending risk management evaluation with the EPA. The path-forward will consider if additional excavation may compromise the BMP, excavation integrity, or poses a worker safety risk.
– For the northwest corner, a 6-inch overcut will be performed in that DU to serve as a final pass and remove any settled residuals.

5.6.2 Excavation Sequencing

To allow for the removal of waste material during the excavation season, the Northern Impoundment RA work will likely be divided into five cells, one of which would include the northwest corner which will be mechanically dredged. A single cell will be remediated each excavation season. Prior to commencing any excavation activities, the initial season will involve site preparation activities and installation of the BMP around the entire excavation area, as detailed in Section 5.5. The order of cell excavation will likely include a sequence that allows the cell containing the northwest corner to be remedied first and the cell containing the upland working area (southwest corner) to be excavated last, although the excavation volume for each season will be determined by the RC and optimized based on weather conditions and productivity achieved during each season. The conceptual project sequencing is shown on Figure 5-C.

5.6.3 Excavation Methodology

Following BMP installation and water removal, the material in a seasonal cell will be excavated. For the cells other than the one encompassing the northwest corner, excavation will be performed utilizing standard track-mounted excavators located on dry land. The excavator will be positioned where it can reach into the excavation and swing around to load trucks or place material directly into a mixing pad. Where required, the excavator could track down to a ledge or bench to reach deeper or further, but generally, the excavator would operate from upland locations. Excavation methodology is detailed below. The details provided below are for excavation of the cells other than the cell encompassing the northwest corner.

5.6.3.1 Pre-Excavation Dewatering

Following the installation of the BMP around the entire excavation area, river water will become trapped behind the BMP. At the beginning of each excavation season (and prior to removal of any portion of the TCRA armored cap to be removed during that excavation season), the river water located behind the BMP would be pumped out to allow waste material removal activities within each cell to be conducted using land-based equipment in relatively dry conditions. At the end of each excavation season, the exposed slope of the excavation will be capped. At the start of the next excavation season, water trapped behind the BMP will again be pumped out to allow the seasonal excavation to be reinitiated. Management of the pumped-out water is discussed in Section 5.9.

5.6.3.2 TCRA Armored Cap Removal

During each excavation season, after the cell to be excavated during that season is dewatered, the portions of the TCRA armored cap within that cell will be removed to expose the waste material for excavation. Areas where the TCRA cap may be re-used are underlain by liner that segregates the rock from the underlying waste material. The RC will be directed to remove the rock in a manner that does not compromise the underlying liner as not to mix waste material with rock. Rock removal above the liner will be visually inspected to confirm that the liner has not been compromised. If any rock has been mixed with the waste material it will be sent off-site for disposal. It is anticipated that only the portion of the TCRA armored cap in the specific area in which waste material is being excavated will be removed (and the waste material exposed) at any given time. The rock may be salvaged for re-use or disposed of with the waste material. Depending on the space available on the Northern Impoundment, the rock removed during each excavation season may be stockpiled on the impoundment itself or at a nearby location. As part of TCRA armored cap removal, the geotextile and geomembrane barrier of the TCRA armored cap will be disposed of off-site.

5.6.3.3 Excavation Procedures

For each area in which the TCRA armored cap has been removed, excavation of the waste material to the target excavation elevations will take place using excavators. Any waste material that does not contain free liquids and/or does not require solidification may be loaded directly in haul trucks for off-site disposal. Waste material that contains free liquids and/or requires solidification will not be directly loaded into the haul trucks for off-site disposal and may be managed as described in Section 5.6.4.

As excavation activities advance below grade, dewatering sumps may be required to remove water in advance so the waste material can be dried out as much as possible prior to it being excavated. Following dewatering, the waste material may still be too wet (i.e., would not pass the paint filter test based on visual inspection) to be directly loaded into haul trucks. This material would need to be temporarily staged and allowed to dry naturally and/or be solidified for off-site disposal. An earthen ramp will be constructed over the lip of the BMP to allow truck traffic into and out of the Northern Impoundment. Interior berms will be constructed seasonally to convey stormwater such that non-contact stormwater that falls directly onto the TCRA armored cap or areas of the excavation that have been confirmed clean can be segregated from contact stormwater that falls directly onto waste material. Non-contact water will be pumped off and handled as described in Section 5.8. Contact water that accumulates in the excavation area during the excavation season will be pumped out, as needed to maintain excavation operations, to a WTS where it will be treated and discharged to the river, as described in Section 5.8. Waste handling or waste management areas will not be conducted on surfaces that have been determined to be clean, without a barrier system, such as a liner. Contact water will be segregated from non-contact water by constructed berms or other stormwater controls as best management practices.

At the end of an excavation season, the transition areas between clean surfaces and impacted material and any other potentially contaminated surfaces that are exposed will be secured. These areas will be graded to less than 2:1 slope and covered with a 40-mil synthetic liner and non-woven geotextile that will be anchored into the soils. The liner will be covered with rip rap, which will be either imported or on-site rock that has been sampled and determined to be clean. The heave condition will be evaluated for the excavated surfaces using the data from the Pre-Excavation Stratigraphic Borings and Piezometers described in Attachment B of the design specifications. Areas susceptible to heave will be backfilled to elevations protective of the river reaching the top of the BMP at +10 NAVD88.

5.6.3.4 Excavation Season Production Rates

The approximate volume of material removal within the Northern Impoundment is estimated at 230,000 CY. To facilitate a seasonal excavation approach, the total volume of material would be divided into multiple cells, with a single cell excavated during each excavation season. Seasonal cell sizes will not be prescribed, but instead a target production rate will be maintained that should accomplish the full excavation over the course of five excavation seasons (including the northwest corner). The volume of waste that can be removed, transported, and disposed of during an excavation season (i.e., production rate) is based upon the following factors, and will continue to be analyzed/optimized throughout the RA:

– ***Volume and Removal Rates*** -The tentative cell sizes have been established so that the volume of planned removal from within each cell could be achieved within the excavation period.
– ***Excavation Depth*** - Depending upon the results of confirmation sampling, the depths of the seasonal excavations could increase, which may, in turn, limit the area that can excavated in that season.
– ***Access and Implementability*** - The tentative seasonal cells assume sustained access to each area for necessary excavation equipment and trucks.
– ***Transportation and Disposal*** - The target seasonal production rate that the tentative cell sizes are based on is dependent on the ability to efficiently and consistently load out and transport waste material to an off-site landfill.

The assumptions and limitations of waste transport and disposal as a basis of the design are further discussed in Section 5.8.2.

5.6.4 Solidification and Load-Out

If the waste material does not pass the paint filter test for direct load out, it may need to be solidified prior to transport to the off-site disposal facility. This may be achieved by mixing in drier material, either from the excavation or using a solidifying reagent, such as Portland cement or lime. Solidification activities will likely be conducted on a designated mixing pad inside the confines of the BMP, or at a nearby location as space becomes limited within the BMP, prior to load out in the haul trucks. Water collected within the mixing pad will be collected and pumped to a temporary storage tank and then to the WTS, or pumped directly to the WTS.

5.6.5 Excavation Area Restoration

There are no post-excavation restoration measures identified or required as part of the ROD. However, restoration activities may utilize the recycled TCRA armored cap rock, clean berm material, and/or clean imported sand or aggregate for restoration activities in lieu of disposing of these clean materials. These post-excavation restoration measures may be employed during the work, at the end of a working season, or after the completion of all excavation activities. After excavation along the south edge of the impoundment has been completed, a soil embankment would be constructed at an approximate 4-foot horizontal to one-foot vertical (4:1) slope along the vertical excavation face to support the exposed bank. Rip rap will be placed on top of the soil embankment for erosion control. At the conclusion of the RA, the BMP will be removed from the waterway and will not require maintenance.

5.7 Northwest Corner

5.7.1 Background

The northwest corner design was initially submitted, in the November 2022 NW Corner Addendum, as a separate document from the June 2022 90% RD for other areas of the impoundment (*GHD, 2022f*). Below is a summary of correspondence, submissions, and meetings held between the Respondents and the EPA pertaining to the northwest corner and additional information developed regarding conditions in the northwest corner.

– On June 8, 2022, an in-person meeting between the EPA and the Respondents took place at which the concerns and risks associated with the RD in the northwest corner were discussed. These concerns were further outlined in a letter to the EPA dated June 21, 2022 (IPC & MIMC, 2022b).

An in-person meeting between Respondents, GHD, and EPA was scheduled for August 4, 2022, to discuss a path forward for the northwest corner design. On the day prior to the meeting, EPA provided to the Respondents a Memorandum to the File dated August 3, 2022, (Memo to File) in which the EPA provided clarification of the phrase "in the dry" used in the Record of Decision (ROD [EPA, 2017b]) in describing the selected remedy for the Northern Impoundment (EPA,2022c).

During the August 4, 2022, meeting, the Respondents expressed the need to perform an updated hydraulic heave evaluation specifically focused on the northwest corner to confirm the conclusions of the previous investigation and to evaluate the level of water that would need to be maintained to overcome the risk of hydraulic heave in a dredging scenario.

Following the August 4, 2022, meeting, the Respondents began the focused hydraulic heave evaluation, which resulted in a reduction of the area defined as the "northwest corner" and in a refinement of the assumptions for the river elevation used in the hydraulic heave calculations. The hydraulic heave evaulaion has been further updated and is discussed in Section 5.12.3, and as updated, is attached Appendix B1.

Based upon the information provided in the August 3, 2022, EPA Memo to File, and the Respondents' discussions with the EPA during the August 4, 2022, meeting, the Respondents submitted a Request for Schedule Extension Northwest Corner Component to the EPA on August 18, 2022 (GHD, 2022d). The EPA sent a letter to the Respondents dated August 31, 2022 (EPA, 2022d) which extended the deadline for the 90% RD Northwest Corner Component to November 8, 2022.

The EPA subsequently sent a letter to GHD dated September 14, 2022 (EPA, 2022e) that addressed, among other things, certain aspects of the 90% RD Northwest Corner Component and a second letter to GHD dated September 28, 2022, (EPA, 2022f) regarding options for residuals management in a dredging scenario.

The Respondents submitted a letter to EPA dated October 7, 2022, (IPC & MIMC, 2022c) with respect to their understanding of the Memo to File and to which EPA responded in a letter dated October 13, 2022 (EPA, 2022g). GHD submitted a letter to EPA dated October 27, 2022, (GHD, 2022e) regarding certain aspects of the September 14, 2022, letter, and Respondents also submitted a letter to EPA on that date regarding the September 14, 2022, letter (IPC & MIMC, 2022d).

5.7.2 Remedial Evaluation

5.7.2.1 Overview

The northwest corner of the Northern Impoundment excavation area contains approximately 15,000 cubic yards (CY) of impacted material. Following issuance of the ROD, during the RD phase, three design investigations were conducted (as summarized in Section 2) which resulted in a much larger dataset, a clear vertical and horizontal delineation of the Northern Impoundment, and other newly-identified information that significantly changed the characterization and understanding of the Northern Impoundment.

5.7.2.2 Northwest Corner Basis of Design

It was determined that design of excavation in the dry in the northwest corner was technically impractical due the potential for hydraulic heave to occur as the waste is removed. To support a design for the northwest corner that addresses and controls the potential for hydraulic heave, a more focused evaluation of the conditions in the northwest corner was performed.

Hydraulic heave is a mechanism that can occur when the downward forces associated with the weight of material (water, waste material, soil, etc.) are not great enough to overcome the upward forces exerted by an aquifer under pressure, as is the case with the Beaumont Sand underlying the Beaumont Clay. Magnifying this potential risk in the northwest corner is that previous geotechnical evaluations have identified the presence of a sand lens in the

Beaumont Clay approximately 50 ft below ground surface (ft bgs). The pressure in the sand lens and potential connectivity to the river were evaluated based on potentiometric data from piezometers and historic river stage data. Safe levels for dry excavation and the required water elevation to be maintained in order to overcome hydraulic heave risk under a dredging scenario were then developed, taking into consideration these upward pressures and the soil conditions in the northwest corner.

5.7.2.3 Piezometric Pressure Evaluation

The sand lens within the Beaumont Clay plays a critical role in evaluating the potential for hydraulic heave in the northwest corner. The sand lens was observed in area borings and based on potentiometric data from the underlying Beaumont Sand, is assumed to be hydraulically connected to the river. Beginning in August 2020, water level data were collected from on-site transducers placed both in the San Jacinto River and in a piezometer installed in the Beaumont Sand. These data showed that there was a direct correlation between the Beaumont Sand and the water level in the river, with the river elevation being approximately 4.2 ft higher than the piezometer elevation. Assuming that there is a dampening effect that is proportional to the clay thickness, the piezometric head gradient between the river and the Beaumont Sand was calculated to be approximately 0.11 ft per foot of clay. When this factor is applied to the upper sand lens where there are approximately 16 ft of clay, the estimated piezometric head in the sand lens would be 1.7 ft lower than the river elevation. Based on this evaluation, the upward pressure in the sand lens in the northwest corner for the hydraulic heave evaluation was estimated to be the river stage elevation minus the 1.7 ft differential. For example, when the river stage is at +5 ft NAVD88, the piezometric head in the sand lens is estimated to be +3.3 ft NAVD88. The conceptual dampening effect of the piezometric head is shown on Figure 5-M, below.

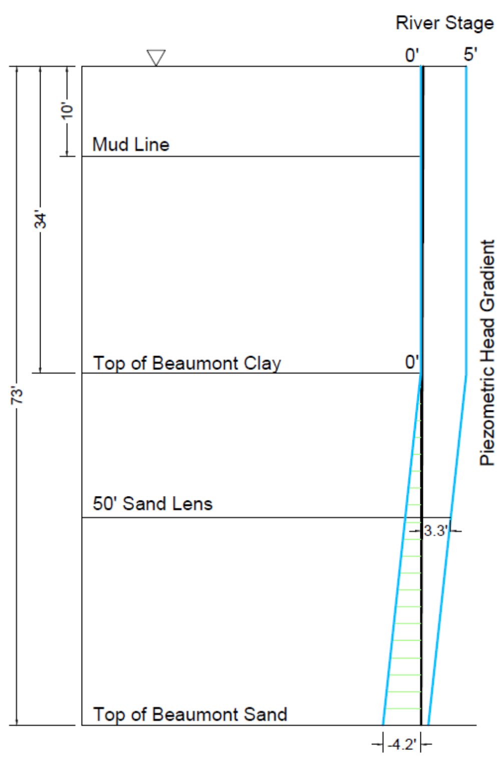


Figure 5-M *Conceptual Dampening Effect*

The upward presssure from the piezometric head level in this 50-foot sand lens and the the weight of the overlying materials are the basis for the hydrauic heave evaluation in the northwest corner.

5.7.2.4 Hydraulic Heave Evaluation

Since submittal of the 90% RD - Northwest Corner Component, the Respondents have continued to evaluate the hydyraulic heave conditions at the work site and specifically in the northwest corner. The Updated Hydraulic Heave Analysis is included as Attachment E in Appendix B. The following assumptions are used is the updated analysis and provide the basis for the removal approach in the northwest corner:

– The San Jacinto River stage is assumed be at +5 ft NAVD88. At higher river stages, there would not be access to the work site and no removal activitities would be occurring.
– The Beaumont Sand is hydraulically connected to the San Jacinto River.
– The 50-ft sand lenses detected in the Beaumont Clay layer is hydraulically connected to the Beaumont Sand.
– The piezometric head in the 50-foot sand lens is assumed to be the San Jacinto River stage at + 5 ft NAVD88 dampened by 1.7 ft head loss, or +3.3 ft NAVD88.
– Conditions after removal and sand placement are to be protective of an overtopping event at river elevation +10 ft NAVD88 and +8.3 ft NAVD88 in the 50-foot sand lens.
– The hydraulic heave was evaluated by analyzing total stress.

The approach for the northwest corner described in this 100% RD includes adjusting water levels and placing sand to specific elevations to offset heave considering the assumptions listed above and the Updated Hydraulic Heave Anaysis. The approach also assumes that removal will be to the design elevations. Following BMP installation in the RA, the RC is required to complete stratigraphic borings in the area and install piezometers in the sand zone(s) that are encountered to measure potentiometric elevations prior to excavation commencing. In addition, preconstruction sampling will be conducted to define the final removal elevations. The specified water and sand elevations to manage the heave will be adjusted during the RA based on the updated potentiometric data from the RA borings and piezometers and the actual removal depths defined by the preconstruction sampling.

5.7.3 Mechanical Dredging

The approach for the northwest corner is to remove the material in the dry that can be performed without the potential for hydraulic heave, and then remove the remaining material by mechanical dredging techniques while maintaining sufficient water in the excavation to off-set the heave. Under this approach, the water level in the northwest corner will be lowered to -15 ft NAVD88; the impacted material above -15 ft NAVD88 will be excavated in the dry, and the remainder of the material to the target removal elevations will be removed via mechanical dredging. The following sections describe the procedures planned for the northwest corner.

Section 35 24 00 (the dredging specification in Appendix H) provides the RC requirements for dredging the northwest corner. Attachment A to the design specifications is a Residual Managment Plan that describes best management practices, dredging procedures and water management procedures for the RC to follow in the northwest corner to minimize dredging residuals and to control the residuals that are generated.

5.7.3.1 Site Preparation Activities

Prior to disturbing ground in the northwest corner, erosion control structures will be installed in conformance with the SWPPP. The site preparation activities will also include constructing roads and truck loading area(s) for the dry excavation. A mixing pad will be constructed adjacent to the northwest corner at the loading area to solidify the excavated material, as necessary, prior to its transport off-site. For the dredging operation, a staging area will be constructed adjacent to the dredging location to support a crane that will assist with assembling the dredging equipment and placing the dredging equipment into the water. The size of the pad will be determined by the RC and is expected to be constructed of crushed concrete or similar over the top of geotextile fabric spread and rolled to provide a base to support the crane. The RC will provide a plan that describes the details of the excavation and dredging operations and associated roads and support facilities. The work in the northwest corner will take place prior to work in other areas so that access for vehicles and a mixing pad is available.

5.7.3.2 Excavation and Dredging Procedures

5.7.3.2.1 Cell Dewatering

Following the installation of the BMP, river water will be trapped within the Northern Impoundment. Based on historical river stage data, it is assumed that the water elevation will be at approximately +/- 0 ft NAVD88 on both sides of the BMP wall prior to any waste removal. The bulk water located inside the BMP wall will be pumped out to achieve an elevation of -15 ft NAVD88 in the northwest corner. Removal and treatment of the bulk water within the BMP are discussed in Section 5.9. Once the water is pumped to -15 ft NAVD88, the existing bathymetry in the northwest corner will effectively form a natural bowl that will contain the water in this low spot and prevent it from flooding out into the surrounding areas of the Northern Impoundment. This is only possible if the northwest corner is addressed prior to the remainder of the Northern Impoundment. At -15 ft NAVD88, approximately 0.67 acres of the northwest corner will be exposed for excavation using land-based equipment in relatively dry conditions. The remaining 0.33 acres, where the mudline is deeper, will remain flooded to off-set the potential for heave. Figure 5-N, below shows the water extent within the northwest corner at a water elevation of -15 ft NAVD88 before and after the dry excavation work.

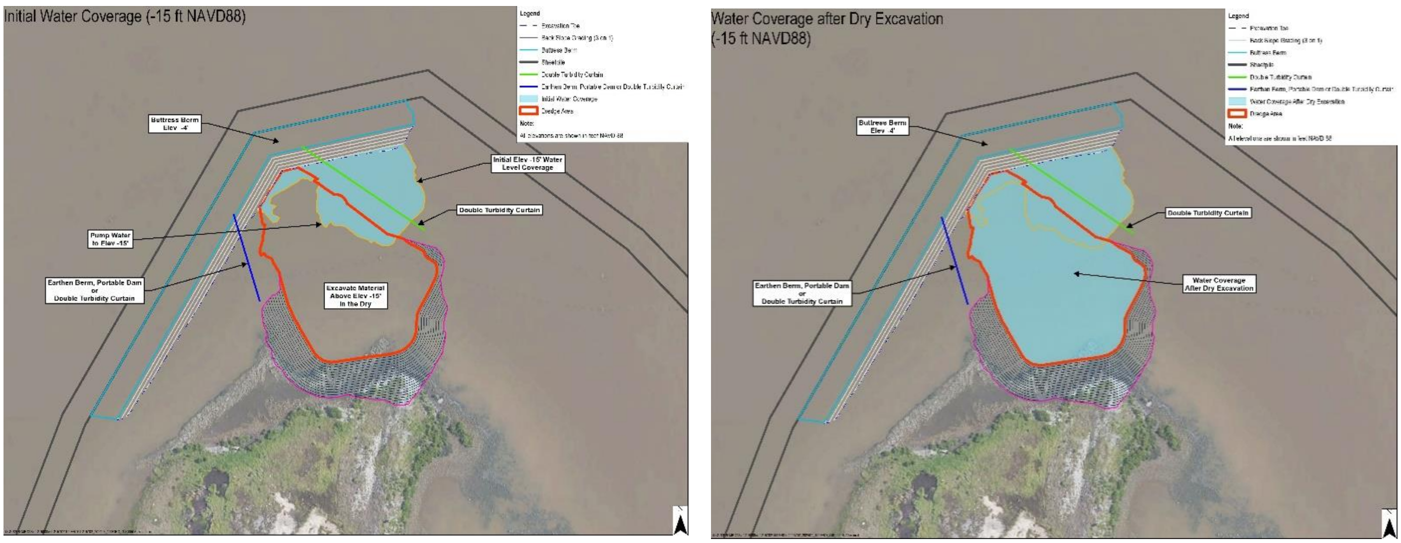


Figure 5-N Mechanical Dredging Area Flooded to - 15 ft NAVD88 (Before and After Dry Excavation)

5.7.3.2.2 TCRA Armored Cap Removal Above -15 ft NAVD88

After pumping the water down to -15 ft NAVD88, and prior to excavation activities, the TCRA armored cap atop the exposed 0.67 acres will be removed using standard land-based excavation equipment to access the underlying waste material for excavation. The rock suitable for potential reuse will be staged on the Northern Impoundment or at a nearby location. Any geotextile and/or geomembrane barrier of the TCRA armored cap will be removed and disposed of off-site with the excavated waste material.

5.7.3.2.3 Dry Excavation

After removal of the TCRA armored cap, excavation of approximately 8,000 CY of waste material to an elevation of -15 ft NAVD88 will take place in the dry using land-based excavation equipment. The excavator will be positioned so it can reach into the excavation and swing around to load trucks or place material directly into a mixing pad. Any waste material that does not contain free liquids and/or does not require solidification will be loaded directly into haul trucks for off-site disposal. Excavated material that is too wet (i.e., will not pass the paint filter test) to be directly loaded into haul trucks will be temporarily staged and allowed to drain by gravity and/or be solidified on the mixing pad prior to loading for off-site disposal. An earthen ramp will be constructed over the lip of the BMP wall (at a location adjoining the TxDOT right-of-way) to allow truck traffic into and out of the work area (see Drawing C-07 in Appendix G).

Containment features will be installed within the northwest corner to control run-on and run-off from the excavation surface, as described in Section 5.7.3.3. Any water that contacts the excavation surface will be pumped out, as needed to maintain excavation operations, to the WTS where it will be treated and discharged as described in Section 5.9 Dredging Procedures**.**

After completion of the dry excavation, the northwest corner will be prepared for mechanical dredging by raising the water to a minimum elevation of -10 ft NAVD88. The water will be pumped into the northwest corner directly from the river and/or pumped to the area from the clean WTS effluent. During dredging, additional water will need to be added to account for the volume of dredge material that has been removed.

The higher water elevation is necessary to offset the heave potential when removing material to the deeper target depths in this area and to provide sufficient draft to float the dredge. Features to contain the residuals during dredging are described in Section 5.7.3.6.

Figure 5-O, below, shows the limits of the flooded area at elevation -10 ft NAVD88, as contained by the natural bathymetry of the land around the northwest corner. It also shows the approximate locations of the containment features to control the spread of generated residuals that are described in Section 5.7.3.6.

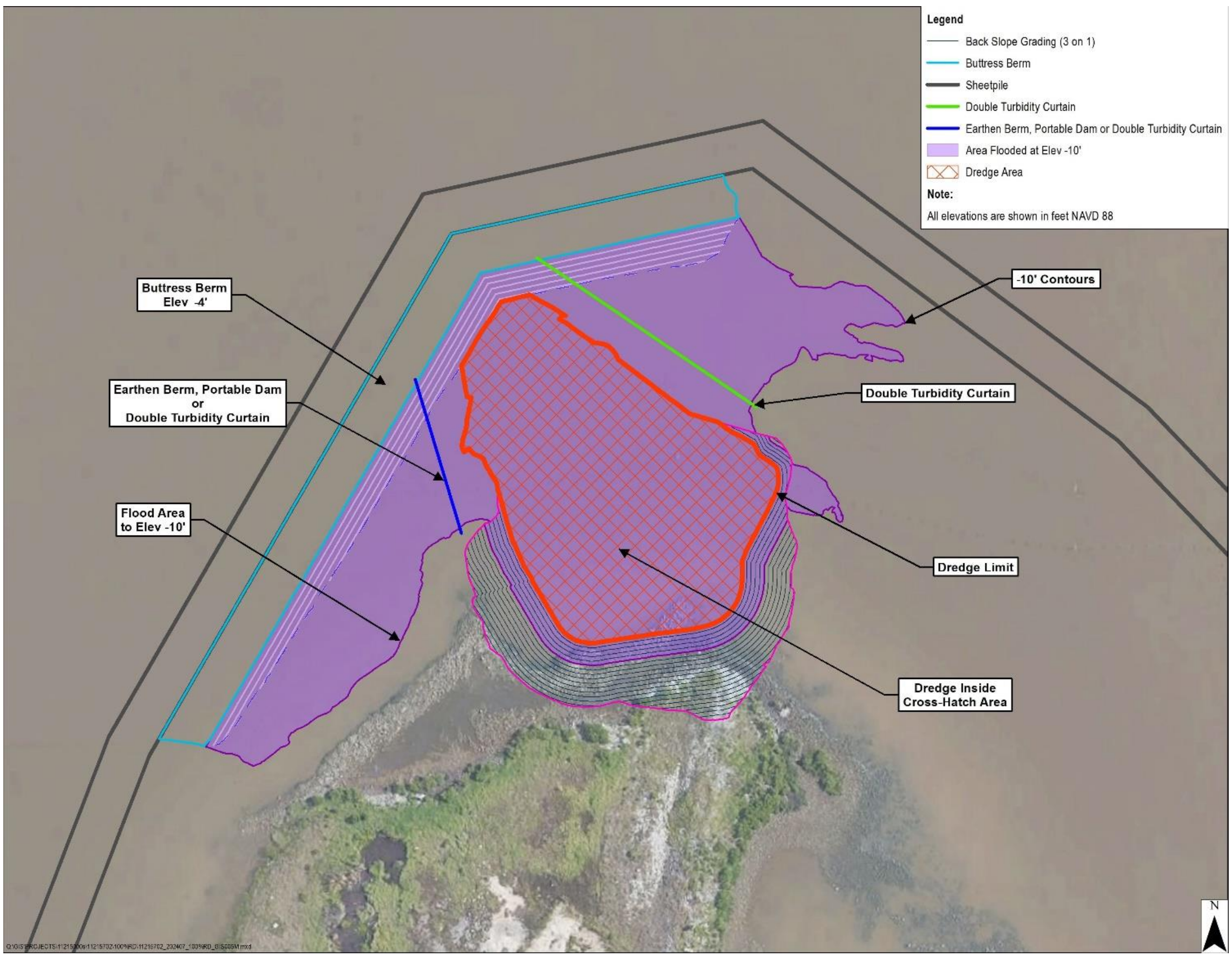


Figure 5-O ***Mechanical Dredging Area Flooded to - 10 ft NAVD88***

5.7.3.2.4 Dredging and Processing Equipment

Mobilization for the dredging operation will occur after construction of the staging area and concurrent with the dry excavation activities. Any equipment requiring assembly will likely require the assistance of a crane. It is expected that the dredge platform will be constructed of FlexiFloat sectional barges or similar and spuds will be installed on the platform for positioning purposes. After assembly of the FlexiFloat dredge platform, the mechanical dredging excavator will be tracked onto the barge or placed onto the barge with the crane. Material barges will be placed into the water and assembled for the purpose of managing the dredge spoils and transporting the spoils to a location at the edge of the dredge area and within the northwest corner as shown on Drawing C-45 in Appendix G for processing.

An aboveground solidification containment area will be constructed adjacent to the shore and will be sized, subject to space limitations, to manage at least 2 days of dredged materials based on the RC's planned production rate. The solidification containment area will be designed to manage both the solidification and loading operations. The containment area will be lined and it will be constructed within a larger bermed area that will also be lined to contain any spillage from the material management and loading operations. The containment area will be equipped with a sump to capture the water draining from the dredge spoil pile. If the TSS in the water from the containment sump is too high to treat in the WTS, additional solids removal methods will be required by the RC. For the purpose of the 100% RD, it is assumed that if TSS removal is necessary, the water will be pumped to a geotextile tube that will drain directly back to the removal area. However, the RC will have the option to use another solids removal technology that can be demonstrated to be effective. Section 35 24 00 of the design specifications require that the RC provide a proposed method for solids removal from the containment sump water using either geotextile tubes or another proposed method.

The barge-mounted excavator will first remove the remaining TCRA armored cap material over the submerged portion of the northwest corner. The TCRA armored cap material will be loaded onto barges and transported to the edge of the dredge area for offloading and transportation off-site.

For the dredging operation, the excavator will be outfitted with an environmental bucket designed to minimize turbidity and resuspension of sediment. Managing resuspension and residuals is discussed further in Section 5.7.3.6. The dredged sediment will be removed and placed into sealed hopper barges, which will be moored to the dredge platform while they are being loaded. Once full, the hopper barges will be transported to the edge of the dredge area for offloading at the stabilization containment area.

5.7.3.2.5 Dredging and Verification Procedures

A pre-dredge bathymetric survey will be performed to develop the pre-dredge surface. The information from the survey, in combination with the CAD surface of the target remediation limits, will provide the basis for the dredge prisms and target volumes for the dredging production passes. Additional bathymetric surveys will be performed during the dredging to provide project operational data for routine evaluation of dredging operations and to allow for analysis of daily production, measurement of removal accuracy, and process adjustments.

For positioning and accuracy purposes, the dredge excavator will be equipped with real-time kinematic global positioning system (RTK-GPS) that will confirm that the removal activities met the horizontal and vertical requirements of the project. The RTK-GPS signals will be combined with various sensors located on the excavator to incorporate the numerous variables of an excavator's operation, including real-time adjustments for water fluctuations. The excavator includes sensors that will measure the angle of the stick and the boom, and the rotation of the bucket, as well as the pitch and roll of the machine itself. The desired design depths within the dredge prism will be displayed in real-time on a screen located on the dredge to assist the operator in determining target depths while operating the equipment. The information generated from the GPS system and the sensors will be processed in real-time using Hypack, Inc. Dredgepack® software or similar.

The dredging operation will require the addition of makeup water to maintain the -10 ft NAVD88 water elevation. The make-up water will either be pumped into the northwest corner directly from the river and/or pumped to the area from the clean WTS effluent.

5.7.3.3 Solidification and Loading

After loading material into hopper barges and pushing the barges to the staging area with work boats, the material will be allowed to gravity drain. Water that accumulates in the hopper barges will be pumped to a settling tank where the sediments will settle out. The water will then be removed and pumped to the WTS, as described in Section 5.8. The accumulated sediments will be periodically removed from the settling tanks and incorporated in with the dredge spoils for solidification. If the TSS in the water from the settling tanks is too high to treat in the WTS, solids will be removed using the method as planned for the water from the containment sump described in Section 5.7.3.2.5

After the water is pumped from the hopper barges, a material handler or similar equipment, will be used to offload the dredge spoils from the hopper to the solidification containment area. The material will be mixed with a solidification agent in the stabilization containment area and allowed to cure, as needed, to meet the paint filter test. Section 3.3.5 provides the result of solidification treatability testing performed on the waste material; however, the RC will be required to perform its own treatability testing to define the reagents and mix ratios prior to the RA. After curing, the solidified material will be removed from the solidification containment area, loaded into haul trucks, and transported to the off-site landfill.

5.7.3.4 Clean-up Pass

After the production pass the residuals will be allowed to settle as described below in Section 5.7.3.6. A clean-up pass will be conducted to remove generated residuals that have settled (to the extent practicable). The depth of dredging for the clean-up pass will be a minimum of 6 inches below the base of the residual layer. A bathymetric survey will be performed to define the top of the residuals. The base of the residuals will be defined by the original dredged elevation, as measured by the operational data collected during dredging as described in Section 5.7.3.2.6, and then confirmed by the RC by probing.

Prior to the clean-up pass, a thin sand layer will be placed across the dredged area using a sprayer barge or similar subaqueous capping equipment. The purpose of the thin sand layer is to stabilize the residuals so they can be effectively captured by mechanical dredging techniques.

The clean-up pass will use the same general procedures for minimizing residuals described in below in Section 5.7.3.6 for the production pass with the addition of a shallow, level bottom cutting bucket to capture the residuals.

5.7.3.5 Residual Management Layer

After the clean-up pass, the suspended sediments in the water column will again be allowed to settle. The Residual Management Layer (RML) will not be placed until the turbidity is below 100 NTUs at three locations generally spaced equally across dredged area. The turbidity measurements will be taken with a hand-held turbidity meter within two feet of the mudline. The RC will have the option of waiting to allow the material to settle to the specified NTUs, or using polymers, coagulants and/or other additives to promote settling.

Granular material will then be placed over the dredged area to achieve the following:

– Provide weight to offset the heave potential as the weight from the water is removed.
– Facilitate complete removal of contact water at the surface.
– Provide a cover for the small mass of any remaining generated dredging residuals.

Initially, subaqueous capping techniques will be utilized to distribute the granular material in thin lifts to evenly cover the dredged surface while minimizing disturbance at the mudline. Bathymetric surveys will be performed during the placement of this initial cover layer to confirm that the appropriate thickness has been achieved throughout the dredging area. Once the initial two feet of granular material has been placed and confirmed by the bathymetric surveys, the RC may install the remaining granular material for the RML at a more rapid pace, while limiting the disturbance of the underlying RML that has already been placed.

During RML placement, the water will be maintained above the elevation of the granular material to continue to offset the heave potential. When the RML reaches -17 ft NAVD88, the water level can be lowered below the sand level, exposing the upper slope of the excavation. Any remaining residuals on the upper slopes will be excavated in the dry and the RML will then be raised to the target elevation of -14 NAVD88. The water that is displaced by the granular material will be captured and pumped to the WTS for treatment. Figure 5-P, below, shows the limits of the granular material after placement.

Granular material will also be placed in a low area located to the northeast of the dredging area where there is a risk of hydraulic heave, as shown in green shading on Figure 5-P, below. The heave calculations indicate that, for this area, the heave potential at a river level of +5 ft NAVD88 and a SF of 1.25 is within the level defined as acceptable for purposes of the RD, but there may be a potential for heave if the river would reach the top of the BMP at +10 ft NAVD88. Considering that this area may be dewatered for up to 7 years during construction across the Northern Impoundment, granular material will be added to elevation -14 ft NAVD88 to protect against heave during a potential high-water event.

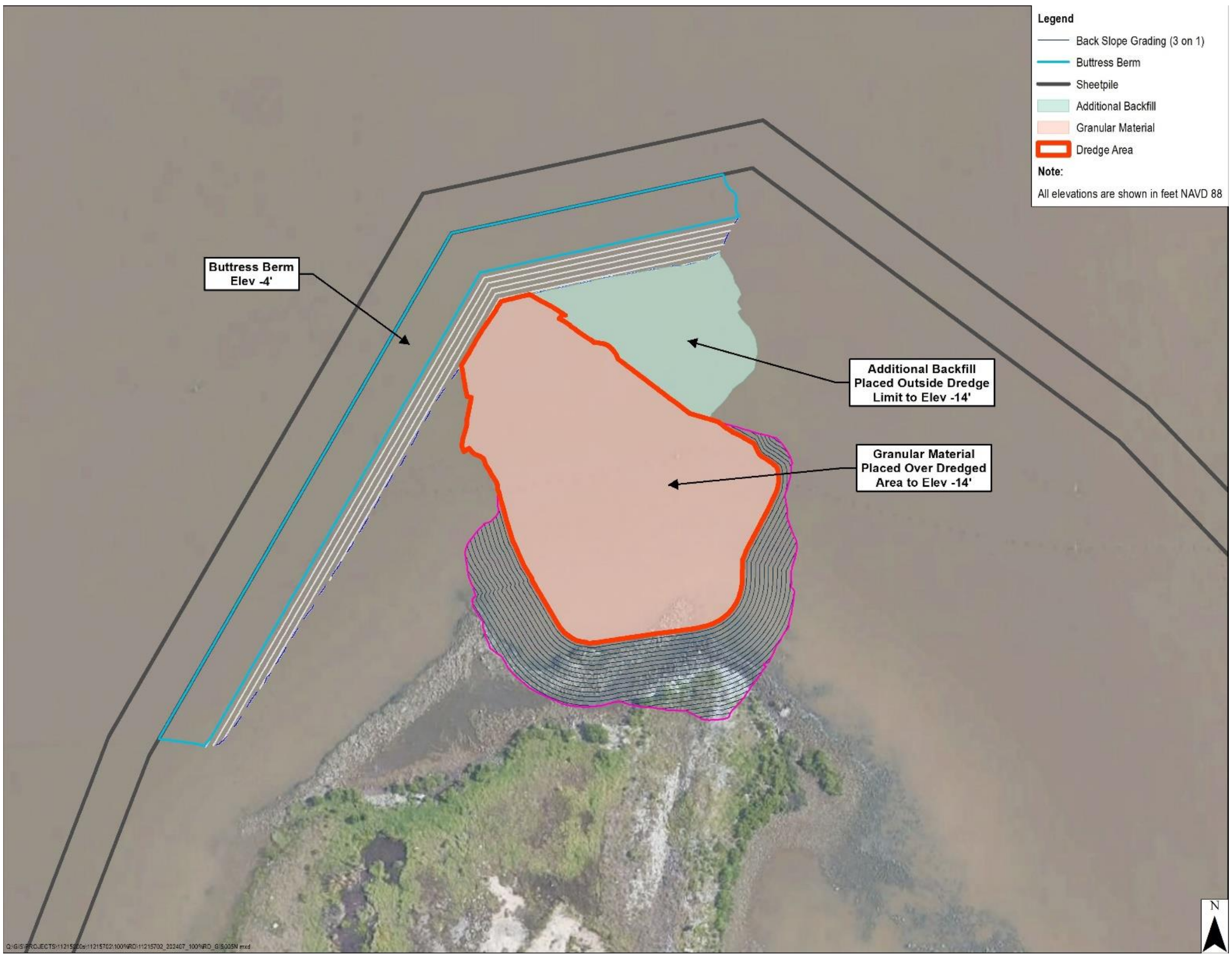


Figure 5-P *Post-Dredging Fill Placement to -14 ft NAVD88*

5.7.3.6 Residuals Management and Controls

Section 35-24-00 is the dredging specification in Appendix H and provides the RC requirements for dredging the northwest corner. Attachment A to the specifications is a Residual Management Plan that describes best management practices, dredging procedures and water management procedures for the RC to follow in the northwest corner to minimize dredging residuals and to control the residuals that are generated. The residual management procedures required by the RC are summarized below.

Construction of BMPs to Control Residuals

The existing bathymetry in the NWC effectively forms a natural bowl to contain water and migration of dredging residuals within the general vicinity of the NWC. Containment features will be constructed as best management practices (BMPs) along the northeast and southwest boundaries of the removal area to further contain the residuals to within the removal limits during the dredging and water management phases to the work in the NWC. The BMPs will extend to a minimum top elevation of -8 ft NAVD88. Several BMP types were considered including sheet piles, impermeable turbidity curtains, earthen dams, and portable dams (e.g. AquaDams®). Considering that the entire area will already be protected by sheet piles and the significant effort and cost to install additional internal piles around the NWC, other BMP options were considered more favorable as described below.

The river bottom surface topography on the northeast side of the dredging limits varies significantly from elevation -10 ft NAVD88 to -17 ft NAVD88. Earthen berms with sufficient slope to be stable during dredging are not feasible, and portable dams are not suitable due to the steep slopes of the river bottom profile. Therefore, a double-wall impermeable turbidity curtain will be constructed along this northeast boundary of the dredging area. The inner curtain will be anchored approximately 10 ft outside the outer limits of the dredge area. The outer curtain will be positioned just outside the inner curtain. Both curtains will be weighted at the bottom and extend the full length of the water column into the mudline and anchored in place. The RC will conduct daily visual inspections of the turbidity curtain to confirm its effectiveness in the field and make any adjustment or repairs as necessary.

On the southwest side of the dredging area, the river bottom topography is shallower with a maximum depth of about -15 ft NAVD88. An earthen berm with a top elevation of -8 ft NAVD88 is more feasible to construct in this area. The RC will have the option to use the double turbidity curtains, construct an earthen berm or use portable dams to contain the residuals on this southwest boundary.

The top elevation of the buttress berm on the north side of the excavation will be at -7 ft NAVD88 with approximately a 3-foot layer of rip rap on top, bringing the top elevation of the buttress to -4 ft NAVD88, which will provide effective containment in this area. Figure 5-M shows the northwest corner, the limits of the water at -10 ft NAVD88, and the BMP components to contain the residuals during dredging.

Dredging Procedures - The RC will be required to perform the mechanical dredging using an environmental dredging bucket that is specifically designed to reduce the release of sediments during closure and retrieval to minimize resuspension. Additional measures required during dredging to minimize resuspension and the generation of residuals include:

- Setting and sequencing production cuts to reduce concentrations in residuals.
- Placing bucket accurately so as not to allow missed sediments between bucket placement.
- Controlling bucket overpenetration and overfilling.
- Overdredging - a six-inch overdredge will be used for the clean-up pass.

Settling of Residuals - After completion of the initial production pass, the residuals in the water column will be allowed to settle. The clean-up pass described in Section 5.7.3.4 will not be allowed to start until the turbidity is below 100 NTUs at three locations generally spaced equally across dredged area. The measurements will be taken with a hand-held turbidity meter within two feet of the mudline.

The RC will have the option of waiting to allow the material to settle to the specified NTUs, or using polymers, coagulants and/or other additives to promote settling based on treatability testing performed by the RC. A settling test treatability study was performed as part of the 2020 Approach B Water Filtration Testing (see Section 3.6.2 of the 100% RD). Polymer and coagulant were added to a tank with suspended solids from the Northern Impoundment simulating conditions in a dredging scenario. Using 250 parts per million (ppm) polyaluminum chloride and 25 ppm Nalco polymer 7194, the turbidity in the tank dropped quickly from 4,060 NTUs to below 40 NTU after 30 minutes of settling. Final turbidity values after 3 hours of settling were between 4 and 5 NTUs. These results were compared to a control test performed without the addition of polymers or coagulants, where the turbidity was above 75 NTUs after

60 hours (with an initial turbidity of 9,190 NTUs). Although results of the laboratory settling tests using polymers and coagulants were favorable, application of these additives in an area much larger than a laboratory setting could prove difficult to provide consistent application and proper mixing. The RC is required by the specifications to evaluate the GHD treatability data and perform its own testing to develop a plan for application and mixing of polymers, coagulants and/or other additives, and be prepared to implement this technology in the event it is necessary to accelerate the settling. Attachment C of the specifications provide the requirements for the testing.

Sand to Stabilize Residuals - Prior to the clean-up pass, a thin sand layer will be placed across the entire northwest corner using a sprayer barge or similar subaqueous capping equipment. The purpose of the thin sand layer is to stabilize the residuals so they can be effectively captured by mechanical dredging techniques.

Clean-up Pass - A clean-up pass will be conducted after completion of production passes to remove the settled residuals to the extent practicable as described above in Section 5.7.3.4.

Residual Management Layer - To overcome the potential for hydraulic heave in the northwest corner while pumping out the contact water, imported granular material will be placed atop the dredged area to an elevation of -14 ft NAVD88. This fill material will also serve as a residuals management layer to cover the remaining residuals. The initial layers will be placed using subaqueous capping techniques that distribute the material in thin lifts to effectively cover any residuals while minimizing sediment resuspension. The residual management layer will be constructed to -14 ft NAVD88, which will protect from hydraulic heave up to the top of the BMP (a river level of +10 ft NAVD88) and will provide as much as 11 ft of imported granular material over the dredged area.

Dry Excavation of Residuals on Slope - During RML placement, the water will be maintained above the elevation of the granular material as it is placed to continue to offset the heave potential. The water that is displaced by the granular material will be captured and pumped to the WTS for treatment. At elevation -17 ft NAVD88, the area can be pumped dry, exposing the upper slope of the excavation. Any remaining residuals on the upper slopes will be excavated in the dry and the RML will then be raised to the target elevation of -14 ft NAVD88, effectively covering any residuals.

5.7.3.7 Stormwater Pollution Prevention Plan and Controls (SWPPP) and Controls

After pumping the water down, and prior to beginning construction activities in the northwest corner, soil erosion and sediment controls will be implemented. When removing waste material during the dry excavation phase, the area will need to be maintained to be free of water, as much as practicable. Measures that may be taken to keep water out of the open excavation include grading the excavation to drain stormwater away from the excavation and/or berm construction to prevent water from entering the excavation. The effectiveness of these water management procedures depends in large part on the northwest corner being addressed prior to the other portions of the Northern Impoundment. To the extent practicable, measures will be put in place to segregate non-contact water (water that falls on the TCRA armored cap, BMP wall soil buttress area, and/or areas that have been confirmed clean) from contact water (water that has come into direct contact with waste material) to control the spread of impacted sediments. The RC will be required to develop a SWPPP for the Northern Impoundment prior to the start of the RA.

5.8 Characterization, Loading, Transportation, and Disposal

The RD elements related to the loading, transportation and off-site disposal of waste material from the Northern Impoundment are outlined in the TODP, included as Appendix J Attachment 8 to this 100% RD.

5.8.1 Waste Characterization

As summarized in Section 3.3, the waste material in the Northern Impoundment is not a listed hazardous waste under 40 CFR Part 261, Subpart D. Furthermore, waste characterization samples collected during the PDI-1, PDI-2, and SDI were analyzed for ignitability, corrosivity, reactivity, and toxicity, as defined in Title 40 of CFR Part 261, Subpart C, to determine if the material was a characteristically hazardous waste. The results indicated that the material is not a characteristic hazardous waste under RCRA or TCEQ regulations.

GHD submitted a Waste Characterization Letter for the Northern Impoundment to the EPA on October 20, 2020 (GHD, 2020g). The evaluation described the detailed characterization evaluation and concluded that the waste has been characterized and classified in accordance with the RCRA regulations as non-hazardous waste. EPA concurred with the conclusions in a letter to GHD dated November 19, 2020 (EPA, 2020h). Additional testing was conducted during the Treatability Study to further classify the non-hazardous waste under applicable TCEQ regulations, 30 TAC §335.505, 335.506, and 335.508. The material was tested for leachability using TCLP. The results of the treatability testing indicate that the waste material from the Northern Impoundment is non-hazardous and is eligible for disposal as a Class II non-hazardous waste per 30 TAC §335.505, 335.506, and 335.508.

Solidification testing, in accordance with EPA Method SW-846 Test Method 9095B (i.e., paint filter test), was also conducted to determine the appropriate reagent dosages to solidify the waste material for transportation to an off-site disposal facility. Off-site disposal facilities typically require incoming waste to pass paint filter testing and sometimes meet a minimum UCS criteria. The results of the solidification testing indicated that these criteria can be met across a range of waste material percent solid scenarios utilizing Portland cement and/or lime with doses typically ranging from 0 to 20 percent solidification reagent depending on the actual percent solids present. The RC may conduct additional tests to determine the appropriate reagent dose at the time of the RA.

5.8.2 Loading, Transportation, and Disposal

5.8.2.1 Transportation Alternatives Evaluation

During the early phases of the RD, Respondents completed a transportation alternative evaluation, including barging. An RAO for the Site, as stated in the ROD, is to "*Prevent releases of dioxins and furans above cleanup levels from the former waste impoundments to sediments and surface water of the San Jacinto River*." Barging significantly increases the risk of a potential release to the river as compared to trucking due to multiple handling operations from loading and offloading material over the water. Specifically, waste material would have to be lifted up and over the BMP and over the FRP barge protection (for a significant portion of the BMP perimeter) and then placed in a barge moored in the river. This would entail waste being lifted approximately 60-feet laterally over the BMP at elevation 10 ft and over the FRP barrier at elevation 12 ft. With trucking, all loading operations would take place within the confined limits of the BMP and protected from the river. There is also the potential for a release while managing a barge that contains waste on the river, including releases during a flood event and during decontamination of the barge. A barging alternative also does not relieve the need for trucking as the evaluation determined that nearby landfills could not accommodate barge traffic directly. Barging would require an additional handling and transportation step by barging the waste material to a transfer station, offloading over the water into trucks, and then transporting waste material to a landfill by truck; consequentially increasing the impacts of greenhouse gas emissions. Moreover, the local community of Channelview has long expressed concern and objection to increased barge traffic on both the north and south sides of the I-10 bridge.

In addition, hydraulic pipelines were considered as another possible transportation alternative during the RD. The removal method presented in the 100% RD is excavation in the dry for most of the impoundment and excavation through the water column by means of mechanical dredging in the Northwest Corner. Hydraulic pipelines are typically used in projects where hydraulic dredging is the removal method, not mechanical dredging. In order to move material via a hydraulic pipeline, the excavated material would have to be slurried by adding a significant amount of water. Once the material is transported via pipeline, the slurry would have to be dewatered prior to off-site disposal. This dewatering process would require significant property, would drastically increase the amount of contact water that would require treatment, would increase the chance of a release occurring should an overtopping event occur during dredging activities, and would likely extend the overall duration of the project. Therefore, hydraulic dredging is not considered a viable alternative for this project.

Based on further evaluation since the submittal of the 90% RD, Respondents still believe trucking to be the safest and most effective transportation method. After submittal of the 90% RD, there were additional meetings (July 28, 2022, November 15, 2022, March 22, 2023, August 16, 2023, and April 22, 2024) between the Respondents, EPA, GHD, and TxDOT regarding access to the right-of-way. In those meetings, TxDOT stated that with proper planning, access could be provided to the TxDOT right-of-way for transporting the material by truck, including during periods when the I-10 bridge replacement project was underway. With respect to the I-10 project, TxDOT has specifically and publicly expressed concern regarding barge traffic in the area of the site, and the risk of barge strikes. Specific plans will need to be developed and commitments from TxDOT will need to be obtained as details regarding the I-10 bridge replacement project become known. Further, the work on the Southern Impoundment RA has demonstrated that trucking is a safe and effective way to move material from the Site to a landfill at production rates similar to those planned for the Northern Impoundment.

5.8.2.2 Waste Material Transportation and Disposal

The total in-ground volume of material anticipated to be removed from the Northern Impoundment is approximately 230,000 CY. Removal will likely be completed over a minimum of five excavation seasons. Approximately 15,000 CY of material from the northwest corner during the first excavation season and approximately 53,000 to 55,000 CY of material will be excavated, transported, and handled over the course of each subsequent excavation season. The tentative seasonal cells have been sized based on the amount of waste material that could reasonably be excavated and transported for disposal during one excavation season, although there will be many factors during implementation, including weather and access issues involving the TxDOT ROW, that will determine the actual productivity rate and volumes removed during each excavation season. It should also be noted that the actual volume sent for disposal may be larger due to the addition of solidification reagent if the waste material is too wet (i.e., cannot pass the paint filter test) for transport to the disposal facilities. Based on solidification testing discussed in Section 3.3.5, it is estimated that the use of reagent could increase the total volume for disposal by approximately 10 percent or 23,000 CY. This could increase the total volume for disposal to approximately 253,000 CY.

Because of limited access and staging area at the Northern Impoundment, the transportation and off-site disposal of waste material may be a limiting factor to the overall volume that can be successfully removed in an excavation season. The single-entry point onto the Northern Impoundment is the existing road within the shared TxDOT ROW. An agreement will need to be reached with TxDOT for the use of that road during the Northern Impoundment RA. TxDOT currently uses that road to access the San Jacinto River I-10 Bridge for maintenance, but as previously referenced in Section 5.4 and discussed in detail in Section 5.11.3, TxDOT is planning to replace the bridge within the next two to three years. The 100% RD assumes that there would be land access to the Northern Impoundment using the TxDOT ROW and that TxDOT will permit improvements to the existing access road, such as grading and widening, to allow for two-way traffic on that road. Even with these improvements, there will still be only a single land access point to the Northern Impoundment. The limited working areas, both on and adjacent to the Northern Impoundment, restrict the space available for truck staging, loading, and turnarounds.

One of the major factors influencing cell sizing is the ability to successfully transport and dispose of all removed waste material within an excavation season. Several off-site disposal facilities are currently under evaluation as disposal sites for the RA waste. These facilities are varying distances from the Northern Impoundment, ranging from 60 to 120 miles away. The transport distance to the furthest of these facilities was used as the design basis to influence the target cell size and excavation volume that can be completed in one excavation season. Based on the longest expected distance (120 miles, one way), it is estimated that haul trucks could complete a maximum of two roundtrips, or “turns,” per working day. Additional factors that were considered when determining the anticipated transportation production rates and cell sizing were based on experience with similar projects, and included anticipated downtime related to mechanical issues, traffic delays, bridge or roadway closures, and other factors. The limited number of truck turns, limited area for staging and loading haul trucks, and anticipated delays all influence the estimated volume of waste material that can be transported and disposed of during an excavation season.

5.9 Water Management

This section describes the basis of design and process design for the WTS that is proposed to treat water generated during the remediation of the site. The process design is based on the successful processes used during the remediation of the South Impoundment. The processes include a lamella filter, multimedia filters, 10 µm bag/cartridge filters, and 1 µm bag/cartridge filters to remove suspended solids and associated adsorbed dioxins and furans. In addition, granular activated carbon (GAC) is included to remove residual/dissolved dioxins and furans. Like the South Impoundment remediation, treated water will be held in the effluent tanks and analyzed for the contaminants of concern. The water will only be discharged to the San Jacinto River if it is verified to meet the ARARs. The system has provisions to retreat water that does not meet the ARARs, however, all treated effluent generated during the remediation of the South Impoundment complied with the limits established in the ARARs.

Following installation of the BMP, river water behind the BMP down to 2 ft above the lowest elevation at the time of dewatering will be processed for TSS removal and returned to the river as described below and in the attached design drawings. Water in the excavation 2 ft above the lowest elevation at the time of the dewatering activity and any other contact water generated during construction will be treated by the WTS as described below and in attached design documents. At the conclusion of each excavation season, the exposed areas of the excavation will be covered.

During excavation activities, measures will be taken to segregate stormwater that comes into contact with waste material from clean stormwater that falls on the TCRA armored cap or confirmed clean excavation areas. Non-contact water will be processed for TSS removal and then discharged to the river. Contact water will be treated through the WTS.

The contact water treatment process will include removal, treatment, and discharge of contact water generated during the RA to allow excavation to continue. The water will be pumped from the excavation area to storage tank(s), treated to remove dioxins and metals below discharge criteria, and then discharged to the river. This section describes the basis of design and design elements for the WTS.

5.9.1 WTS Basis of Design

5.9.1.1 Contact Water Characterization

As described in Section 3.4, water treatability testing was performed in accordance with the TSWP (GHD, 2019b) to inform the RD of the WTS. The results from treatability testing indicated that the average TSS concentration for the simulated Northern Impoundment contact water sample could be as high as 4,600 mg/L. This represents a maximum expected value since waste solids were actively mixed with water in the pilot test excavation to increase TSS concentrations to create this contact water. This worst-case TSS value was used as the basis of design for water treatment.

Treatability testing results indicated that the majority of metals and dioxins found in contact water were associated with the suspended solids and were not found in the dissolved phase.

Seepage water that entered the pilot test excavation during the PDI-2 was characterized to determine the required treatment if a sufficient volume accumulates in the excavation during the RA.

Water characterization results from PDI-2 are presented in Table 3-2.

5.9.1.2 Parameters Requiring Treatment

As described in Section 3.4, discharge criteria were estimated for COPCs in the Northern Impoundment; those discharge limits are presented in Table 3-2. Dioxins and several metals, including copper, lead, and zinc, were detected in the simulated contact water sample above estimated discharge criteria. Dioxins were detected in the seepage water at levels above the ML, but no other COPCs were above discharge criteria. Treatability test results indicate that metals and dioxins are primarily associated with solids, demonstrating that a treatment system that removes solids should reduce COPCs to levels below the discharge criteria.

5.9.1.3 Treatment Process

The WTS is proposed to treat contact water generated during the RA at the Northern Impoundment. Contact water may be generated from the excavation, stormwater, seepage, overburden stockpiles, dewatering activities, WTS containment, and equipment decontamination. Contact water will be pumped to large, aboveground storage tanks.

Water from the storage tanks will be processed through the WTS. WTS treatment processes will include chemically enhanced solids precipitation/flocculation, gravity settling, multimedia filtration, cartridge/bag filtration, and GAC adsorption. Treated water will be stored in large effluent tanks and tested before discharging to the river. Based upon water treatability testing results, described in Sections 3.4 and 3.6, the process described herein has been proven effective in laboratory and pilot testing at reducing concentrations of COPCs in water to levels below their respective discharge limits.

5.9.1.4 Water Volume and Storage

For the Northern Impoundment, contact water may be generated from the following sources:

1. ***Stormwater:*** water from storm events that will accumulate in the excavation and containment areas (e.g., WTS, overburden storage, dewatering) during a rain event, and will be the vast majority of contact water generated and treated during the RA.
2. ***Bulk Contact Water:*** Water in excavation 2 ft above the lowest elevation at the time of the dewatering activity.
3. ***Bulk Non-Contact Water*****:** water removed from the BMP start of construction and water in the excavation from an Overtopping Event that does not come in contact with contaminated surfaces to an excavation water level of 2 feet above the lowest elevation at the time of the dewatering activity.
4. ***Equipment Decontamination Water:*** water that will be associated with the washing/rinsing of equipment (e.g., truck wash).
5. ***Mounded Water:*** water that will drain into an excavation from surrounding soils when the bottom of the excavation is lower than the groundwater level.
6. ***Persistent Infiltration:*** water that infiltrates through the soil from the river when the base of the excavation is below the average mean sea level of the river (i.e., 1.5 ft NAVD88), however since the BMP wall will be driven into the underlying Beaumont Clay, such persistent infiltration is assumed to be insignificant.
7. ***Miscellaneous Contact Water:*** other water that comes into contact with waste material not associated with water types listed above. This includes water from an Overtopping Event that contacts contaminated surfaces.

Contact Water generated by each of the abovementioned contact water sources was estimated by the following methods:

1. **Rainfall:**
   a. Rainfall will comprise a majority of the contact water that will be generated.
   b. Although measures will be taken to segregate contact water from non-contact water, the storage and treatment capacities included herein were designed to account for a worst-case assumption that all stormwater that falls within the BMP area is considered to be contact water. The area inside the BMP is ~730,000 square feet (ft^2).
   c. All rainfall collected inside the WTS containment areas will be treated by the WTS system. The WTS containment area is ~250,000 ft^2.
   d. Each area is multiplied by the 99th Percentile for a 24-hour storm event during the period from November through July of 9.3 inches/day.
   e. The predicted contact water generated from the 99th Percentile for a 24-hour storm event is ~759,000 ft^3 or ~5.68 million gallons.
   f. The estimated volume of contact water generated by rainfall during the period from November through July is 22 million gallons. This based on the average total rainfall during the that period from 1880 to the present.
2. **Bulk Non-Contact Water**
   a. Bulk water is considered the water trapped behind the BMP to 2 feet above the lowest elevation at the time of the dewatering activity during the first year of construction or if the BMP is overtopped in subsequent years of construction and is considered contact water.

   b. The estimated volume of bulk water generated during the first year of construction is ~19.4 million gallons. Assuming the BMP is closed at low water level (~1.5 ft NAVD88)
   c. The Bulk Non-Contact Water will be processed to remove solids. See Bulk Water process drawings in Appendix G.

3. **Bulk Contact Water**
   a. Water in excavation below 2 ft of the lowest elevation at the time of the dewatering activity at the start of construction or after an overtopping event.
   b. During the first year of construction, contact water generated from bulk water is estimated to be ~3.9 million gallons

4. **Mechanical Dredge Water**
   a. During the first excavation season, a mechanical dredge shall be used for part of the excavation.
   b. Contact water will be generated by the dredging process and the clean-up pass.
   c. The estimated volume of water generated by mechanical dredging is ~240,000 ft^3 or ~1.8 million gallons.

5. **Mounded Water:**
   a. This is assumed to be primarily an issue at the start of each excavation season.
   b. Mounded water will primarily be generated at the start of the season as the mounded water drains into the excavation.
   c. Flowrate of mounded water into the excavation will decline over time as soil is dewatered.
   d. The following assumptions were used to model the steady state flow of mounded water into the excavation.
      – Mounded Water is in a cube/block above the low point of the excavation (-15 ft NAVD88)
      – Groundwater level is assumed to start at 1.5 ft NAVD88 across the block
      – Block is 750 ft long, 600 ft wide, and has 16.5 ft of water column height above the river bottom
      – All water will flow to the side of the cubic block facing this low point
      – No base flow from stored water below the river (i.e., cofferdam is watertight)
      – Homogeneous hydraulic conductivity of 3 ft per day (ft/day) across the block
   e. Modelling predicts the highest flowrate of mounded water into the excavation will be ~90,000 gpd.
   f. The estimated volume of mounded water that will flow into excavation during excavation from November through July is 18 million gallons.
   g. Daily and annual mounded water discharge will be reevaluated after the first excavation season.

6. **Persistent Infiltration:**
   a. The BMP is assumed to be watertight and is keyed into the Beaumont Clay.
   b. Therefore, persistent infiltration is assumed to be insignificant.

7. **Equipment Decontamination Water:**
   a. This area is assumed to be within the BMP and is accounted for in the above rainfall assumptions.

8. **Miscellaneous Contact Water:**
   a. Excavated materials storage, dewatering areas, and other minor sources are assumed to be insignificant compared to other sources of contact water.

A summary of the maximum expected contact water generated, shown in gpd, from each source is provided in Table 5-I, below.

Table 5-I   Summary of Maximum Expected Contact Water Generated

Influent Sources	Estimated Water Generation	Notes
Contact Rainfall in BMP	5.5 million gallons after a 9.3 inch 24-hour rain event.	Assumes all rain that falls within the BMP could be contact water. Area = 730,000 ft^2. The 99^{th} percentile 24-hour rain event (1930 to 2019) = 9.3 inches
Rain Collection - WTS and Effluent Containment Areas	1.3 million gallons after a 9.3 inch 24-hour rain event.	Assumes all rain that falls within the Containment area could be contact water. Combined area = 95,000 ft^2. The 99^{th} percentile 24-hour rain event (1930 to 2019) = 9.3 inches
Bulk Contact Water (at start of construction)	3.9 million gallons	Contact water generated from bulk water will be generated at the start of the project when the area behind the BMP is being dewatered
Bulk Non-Contact Water	19.4 million gallons	Bulk water is considered the water trapped behind the BMP to 2 ft of liquid elevation during the first year of construction or if the BMP is flooded in subsequent years of construction and is considered non-contact water.
Mechanical Dredge Water	1.8 million gallons	During the first year of excavation, a mechanical dredge shall be used.
Mounded Water (gpd)	90,000 GPD	See assumption above
Truck Wash	Minimal volume	Assumed to be accounted for in the BMP-area contact water

Design Treatment Capacity of WTS

The design treatment rate for the WTS is 300 GPM with an influent storage capacity of 2.1 million gallons. The WTS was designed with treatment and storage capacity to dewater, store, and/or treat the contact water from the entire BMP area in approximately 8-15 days after a 99^{th} percentile 24-hour rain event (1930 to 2019) = 9.3 inches. Dewatering time will be dependent on treatment flowrate and hours of operation or the WTS. The dewatering time assumes a laboratory turnaround time of 7 days. Since the 90^{th} percentile 24-hour rain events will be less than two inches, the contact water accumulated in the entire BMP area can dewatered, stored, and/or treated in less than 24 hours for most rain events.

At the start of construction, the Bulk Non-Contact Water (~19.4 million gallons) will be treated with the Bulk Water Treatment system at a high treatment rate (3000 to 4000 GPM). Depending on the treatment flowrate and hours of operation, the Bulk Non-Contact water is expected to be removed from within the BMP in 2-3 weeks.

At the start of construction, the Bulk Contact Water (~3.9 million gallons) will be treated by the WTS at design rate of ~300 GPM. Depending on the treatment flowrate and hours of operation the Bulk Contact water is expected to be removed from within the BMP in 1-2 weeks. The dewatering time assumes a laboratory turnaround time of 7 days.

5.9.2 Treatment System Design

A treatment system with multiple processes will be employed to reduce concentrations of suspended solids, dioxins and furans, and metals in the contact water to meet discharge criteria.

– ***Bulk Non-Contact Water Treatment*** - The treatment system will use pumps, influent storage tanks, multimedia filters, and bag/cartridge filters to treat Bulk Non-Contact Water generated during the RA by reducing TSS concentration before discharging the treated water back to the river via a diffuser.

– ***Contact Water Treatment*** **-** The treatment system will use pumps, influent storage tanks, inclined plate clarifier, multimedia filters, bag/cartridge filters, and GAC to treat Contact Water generated during the RA. The treated water will be stored in effluent storage tanks and tested for compliance with discharge criteria. Treated water that meets discharge criteria will be discharged to the river via a diffuser. If treated water does not meet discharge criteria, the water will be retreated.

The treatment process is anticipated to include the following unit processes:

– ***Influent Storage*** - Two (2) B-31 Lake Tanks (1.33 million gallons of working capacity each) are proposed to store water prior to treatment. Storage tanks will allow for water to be removed from the excavation area and stored prior to treatment. No mixing is proposed for these tanks. Some TSS settling will occur in these tanks and will be removed as needed.
– ***Chemical Addition*** - Coagulant and flocculant will be used to precipitate and flocculate TSS and contaminants of concern. Organosulfide, acid and/or caustic may be used if needed for metals removal. Chemicals will be added to mixing tanks using metering pumps. The mixing tanks will have adequate residence time to allow for adequate solids and floc formation.
– ***Bulk Solids Removal Using an Inclined Plate Clarifier*** - Conditioned solids out of the flocculation tank will be settled in an inclined plate clarifier. An inclined plate clarifier is a vessel which includes multiple parallel plates at an angle greater than 45 degrees. As solid particles settle and contact the plates, the particles will be directed by gravity to the bottom of the clarifier, where the solids stream will be continuously removed. Because of the high surface area provided by the plates, an inclined plate clarifier requires a smaller footprint compared to a circular clarifier.
– ***Sludge Dewatering*** **-** Settled solids from the inclined plate clarification (underflow) will be pumped into a sludge dewatering box where solids will be dewatered by gravity. The liquid that drains out of the solids will be pumped back to the storage tank for reprocessing. The dewatered solids will be moved to the excavation solids dewatering area, solidified, and disposed of with other solids from the excavation.
– ***Multimedia Filtration*** - Clarified water from the inclined plate clarifier (overflow) will be pumped through the multimedia filtration system, which is a series of pressure vessels filled with media of different densities and particle sizes. Typically, anthracite, sand, and garnet are used. Larger solids will be captured by the largest media (anthracite). Smaller particles will be captured further into the bed by intermediate media (sand), with the smallest solids captured by the smallest media (garnet). As solids build up in the filter, the pressure across the filter will increase, which requires backwashing to remove the collected particles. The backwashing process will use a forward feed process that does not require a backwash tank or backwash pump.
– ***Bag/Cartridge Filtration*** - Filtrate from multimedia filters will then enter bag filters to remove residual solids. Bag filters use fabric to collect solids as water is pumped through the filter. The filter is designed to collect particles larger than the specified opening in the filter. Filtrate will enter the two sets of filters, the first with a filtration size of 10 µm, followed by the second with a filtration size of 1 µm. Both filters will be specified to have a minimum of 95% removal efficiency for particles at the given micron rating. Higher removal efficiencies are obtained for larger sized particles.
– ***GAC Filtration*** - GAC is a form of carbon that is processed to have small pores that increase the surface area available for adsorption. Residual organic compounds (e.g., dioxins, furans) in the filtrate from the bag filters will be removed with GAC.
– ***Effluent Storage*** - Four (4) B-36 Lake Tanks (1.51 million gallons of working capacity each) are proposed to store water after treatment. Storage tanks will allow for water to be stored while test results are pending.

Details of the basis of design of the WTS are provided below. Note, that the WTS design is subject to changes based on field performance.

5.9.2.1 Major Equipment List and Sizing Basis

The major WTS components and basis of sizing are detailed in Table 5-2. This includes sizing criteria assumptions, design value, and notes for each major equipment and process component.

5.9.2.2 Water Treatment Equipment Layout

The WTS, including the two (2) 1.33 million-gallon water storage tanks, water treatment equipment, and space for a second treatment system, will be staged within a lined containment area of approximately 100,000 ft^2. The effluent storage includes four (4), B-36 Lake Tanks (1.51 million gallons) and return pumping system. The WTS and effluent storage tank containment areas will be surrounded by an earthen berm covered with an impermeable geomembrane. The top of containment berms will be above 10 ft NAVD88. The layout of WTS and Effluent Storage Areas are provided in the attached design drawings.

At the time of the 100% RD submittal, property access negotiations are ongoing, so the location of the WTS has not yet been determined.

5.9.2.3 Specification and Equipment Data Sheet List

Detailed design drawings associated with the WTS, technical specifications detailing the potential water treatment equipment, consumables, staging/sequencing, and operation are included in Appendices G and H, respectively.

5.9.3 Operations and Maintenance Requirements

The WTS associated with the Northern Impoundment RA will operate intermittently primarily based on the need to treat contact water resulting from precipitation. A preliminary discussion of the Operations and Maintenance (O&M) requirements (including consumables and utilities) associated with the WTS is provided, below. In addition, the water treatment system operations include the following:

- The contractor operating the WTS, which may also be the RC (WTS Contractor) shall be a licensed operator as required.
- The WTS Contractor shall include provisions for back-up generator(s) as needed.
- The WTS Contractor shall provide a plan to protect equipment if a severe storm is predicted. Preparation may include provisions such as draining equipment, extra heaters, and/or moving equipment offsite until the storm passes.

5.9.3.1 Consumables

Effective treatment of contact water will require the use of several water treatment chemicals to facilitate solids separation, metals precipitation, and pH adjustment. A brief discussion of the water treatment chemicals is provided, below.

Coagulant - Coagulants (poly aluminum chloride or equivalent) will be dosed to facilitate enhanced removal of metals (through co-precipitation) and suspended solids in the inclined plate clarifier of the WTS. Required type and dosages will be confirmed based on on-site jar testing. It is anticipated that coagulant will be delivered to the work site in intermediate bulk container (IBC) totes (~300 gallons).

Polymer - It is anticipated that liquid polymers will be utilized to enhance the settling of suspended solids and precipitated metals in the inclined plate clarifier of the WTS. Polymer may also be required to enhance the dewatering of chemical sludge in the sludge dewatering boxes. Polymer will be activated/diluted prior to dosing into the water treatment process. Required type and dosages will be confirmed based on on-site jar testing. It is anticipated that polymer will be delivered to the work site in drums or IBC totes.

Organosulfide - Organosulfide is a flocculant that is a commonly used water treatment additive for removal of metals (via sulfide precipitation). Organosulfide may be added if influent soluble metals concentrations exceed the discharge criteria. Precipitated metals may be removed in the inclined plate clarifier and filtration processes of the WTS. It is anticipated that organosulfide would be delivered to the work site in IBC totes (~300 gallons).

Acid/Caustic - Acid and/or caustic may be added to the water to adjust the water pH to optimize metals removal, enhance the effectiveness of the added coagulants, and/or return the treated water pH to within the discharge criteria range. It is anticipated that acid/caustic would be delivered to the work site in IBC totes (~300 gallons).

Bag/Cartridge Filters - Bag and cartridge filters with minimum 95% removal efficiency will be used. As the bag and cartridge filters are fouled (with captured solids), they will need to be removed and replaced.

GAC - The proposed GAC treatment vessels will be filled with bitumen-based GAC media. The GAC vessels will be configured in a lead- lag arrangement. Effluent quality of the lead GAC vessel will be monitored for chemical breakthrough (i.e., detection of COPCs in effluent) to identify the need for media replacement.

5.9.3.2 Power

The WTS (in addition to the other facilities) in the Northern Impoundment will require temporary source(s) of electricity for operation. The power requirements will be confirmed by the selected RC and will be obtained by temporary power connections from the local utility and/or by portable generators.

5.9.3.3 Labor

The WTS is expected to operate in a semi-automatic mode on an intermittent basis (i.e., after a rain event). The WTS will operate primarily during the initial phase of an excavation season to dewater the excavation cell and during precipitation events; thus, there may be periods of time in which the WTS is idle and treatment system operators are not required. Key process decisions and operations will be executed with oversight by the RC's treatment system operators. When the system is being operated, it is expected to require one to three operators, depending on the activities being performed.

5.9.3.4 Residuals

The operation of the WTS will result in the generation of a number of residuals.

Tank Liners: The liners from the Lake Tanks will need to be disposed of at the conclusion of each excavation season. The liners will be characterized and disposed of as indicated in the TODP (Appendix J, Attachment 8), which references the applicable federal and state requirements.

Solids in Lake Tanks: Solids that collect in the Lake Tanks will need to be disposed of at the conclusion of each excavation season. The solids will be characterized and disposed of as indicated in the TODP, which references the applicable federal and state requirements.

Chemical Sludge: The contact water is expected to contain solids from the waste material in the excavation. It is anticipated that coagulants, organosulfide, and/or polymers will result in the precipitation of metals and removal of suspended solids. The resulting sludge will be withdrawn as the underflow of the inclined plate clarifier. The settled solids will be directed to sludge dewatering boxes where it is estimated that it will be gravity-thickened to a solids concentration of up to 6 to 8 percent (mass basis). Treatability testing showed that the clarifier underflow can be thickened easily. However, provisions for polymer addition are being included in the design to provide enhanced thickening. During operation of the WTS, thickened chemical sludge may be generated at a rate of almost 700 pounds (lbs) per hour (dry solids basis). Once dewatered, the sludge dewatering boxes will be transported to the impacted solids dewatering pad for solidification and off-site disposal.

Spent Filter Bags/Cartridges: Filter bags/cartridges will become fouled with solids as the treatment system operates. These fouled filters will need to be removed and replaced. The spent filter bags will be characterized and disposed of as indicated in the TODP, which references the applicable federal and state requirements.

Exhausted GAC Media: GAC media has a finite capacity to remove dissolved constituents (including metals and dioxins and furans) from water. As previously noted, the GAC vessels will be operated in a lead-lag configuration. The discharges of both the lead and lag GAC vessels will be monitored to identify when the GAC media is exhausted. When concentrations of COPCs are detected at elevated levels in the water in the lead GAC vessel, the media in this vessel will be removed and replaced. Once back in service, this vessel will become the lag vessel, and the previous lag vessel will be operated as the lead vessel. The spent media will either be regenerated or will be characterized and disposed of as indicated in the TODP, which references the applicable federal and state requirements.

5.9.4 Compliance Monitoring

Routine effluent compliance monitoring requirements associated with the WTS are expected to include pH, TSS, metals, and dioxins and furans. Treated effluent samples from the WTS will need to be collected from a specified compliance monitoring point on the effluent line to the San Jacinto River. In accordance with 30 TAC Part 1 Chapter 319 Subchapter A Rule 319.5, Section A, (30 TAC 319.5 (a)), samples and measurements of the effluent will be taken at a location following the last treatment unit. Monitoring frequencies and sample types from 30 TAC 319.9 (c) Table 3 (for treatment units with effluent flow from 0.50 million gpd to less than 2.00 million gpd) are identified in Table 5-J, below:

Table 5-J Monitoring Frequencies and Sample Type

Parameter	Minimum Frequency of Measurement [1]	Standard Analytical TAT (business days)[2]	Sample Type
Flow	1 per operating shift	---	Instantaneous
pH	1 when effluent storage tank is ready for discharge	---	Grab
TSS[1]	1 when effluent storage tank is ready for discharge	3-5 days	Composite
Metals[1]	1 when effluent storage tank is ready for discharge	3-5 days	Composite
Dioxin/Furans[1]	1 when effluent storage tank is ready for discharge	7 days	Composite

Notes:

1 Samples will be collected from effluent storage tanks.

2 Flow rate and pH data will be collected on-site using real-time in-line monitors.

Process monitoring samples will also be collected within the treatment process to inform necessary operational adjustments, such as chemical dose refinement. During pilot testing, clarifier effluent and filter effluent turbidity were measured to evaluate performance of the system and adjust chemical dosage rates. In addition, a direct correlation was established between turbidity, TSS, and $TEQ_{DF,M}$ concentrations. Based on the strong correlation between turbidity and dioxin and furan concentrations (See Treatability Section for graph), it is anticipated that during the RA, real-time turbidity readings (post clarifier, post filtration, post GAC) will be used as an indicator for operational performance as related to TSS and dioxin and furans. TSS may also be used as a performance indicator. The WTS Contractor will be required to establish a relationship between turbidity and TSS during the start-up and operations of the WTS. In addition, process monitoring samples will be collected within the treatment process (e.g., influent, post clarifier, post filtration, post lead GAC column) to inform necessary operational adjustments, such as chemical dose optimization and GAC change out. As discussed, turbidity will be monitored through online instrumentation to evaluate treatment system performance and adjust operations as needed. Actions to be taken in response to operational parameter monitoring may be incorporated into a future treatment system monitoring plan. Actions may include turning off pumps upon high turbidity.

Determination of discharge criteria is discussed in Section 3.4.1, with specific criteria specified in Table 3-2.

5.10 Monitoring and Controls

Monitoring and controls may be implemented during the RA at the Northern Impoundment to prevent releases of impacted material to the surrounding land, water, or air. The specific controls will be developed and/or refined in conjunction with the RC and will be included in revisions or modifications to the SWMP (Appendix J; Attachment 5) and CQA/QCP (Appendix J; Attachment 6). A summary is included in the following sections.

5.10.1 Dust Control

During implementation, the RC will be required to use methods that minimize production of dust from construction operations. The RC may be instructed to use potable water for potential misting operations to prevent airborne dust from dispersing into the atmosphere. Further detail is included in the SWMP (Appendix J; Attachment 5).

5.10.2 Stormwater Pollution Prevention Plan and Controls (SWPPP) and BMPs

Prior to beginning construction activities on the Northern Impoundment, soil erosion and sediment controls may be implemented. These structures would either be put and remain in place and be maintained throughout the implementation of the RA or may be put in place and maintained for a given work season.

When removing waste material, the excavation will need to be maintained to be free of water as much as possible. Within the confines of the BMP around the seasonal cell, measures that may be taken to keep water out of the open excavation include grading the excavation to drain stormwater away from the excavation and/or berm construction to prevent water from entering the excavation. To the extent possible, measures will be put in place to segregate non-contact water (water that falls on the TCRA armored cap, BMP Soil Buttress area, and/or areas that have been confirmed clean) from contact water (water that has come into direct contact with waste material). In addition to stormwater controls outside of the excavation limits, the RC will provide, operate, and maintain dewatering equipment appropriately sized to maintain an excavation to be free of water, to the extent possible. The RC may be required to ensure that the pumping equipment, machinery, and tankage be in good working condition for potential emergencies, including power outages, and that appropriately trained workers be employed to operate the pumping equipment. All contact water will be pumped to the water storage tanks for eventual treatment and discharge.

The RC will also be responsible for managing any stormwater that may come into contact with temporarily staged and stockpiled excavated material. The dewatering pads and decontamination pads will be maintained by the RC to contain, collect, and transfer contact water to the water storage tanks for treatment. Stormwater that has not been in contact with impacted material would be discharged in accordance with the SWPPP that the RC will be required to develop. Details of the dewatering pads, overburden stockpiles, and decontamination pads are shown on Drawings C-24 through C-26 in Appendix G.

Excavation dewatering may employ methods such as sheeting and shoring; groundwater control systems; surface or free water control systems employing ditches, diversions, drains, pipes and/or pumps; and any other measures necessary to enable the removal of waste material in as dry of a condition, as possible. The RC will be required to use best management practices for the provision of all dewatering and water removal activities. A SWPPP will be developed for the Northern Impoundment excavation program prior to commencement of any waste material removal work. Further detail is included in the SWMP (Appendix J; Attachment 5)

5.10.3 Odors

There is potential for odors resulting from the Northern Impoundment RA or associated activities. Odors are most likely to occur during excavation activities when previously buried material are unearthed and exposed to air. As needed, the RC will implement odor mitigation and suppression measures during the implementation of the Northern Impoundment RA. Further detail is included in the SWMP (Appendix J; Attachment 5)

5.10.4 Turbidity Controls and Monitoring

The BMP and FRP barrier wall will be placed outside the TCRA armored cap, and thus will not be installed through waste material. Turbidity controls (e.g., turbidity curtains) are planned to be utilized during installation and removal of the BMP and FRP barrier walls as a construction best practice to limit the potential for off-site migration of turbidity. Turbidity monitoring is also planned to be utilized during installation and removal of the sheet and FRP piles as a construction best practice to compare downstream turbidity values with upstream values to monitor any significant contribution from BMP and FRP barrier wall installation and removal to downstream turbidity.

It is anticipated that BMP and FRP barrier wall installation would proceed incrementally in segments from upstream to downstream locations so that vessel movement is aided by the downstream currents. The turbidity curtains would be employed at locations where water flow is away from the work and has the potential for turbidity to be transported with the flow away from the work site. This would be the case for much of the area around the Northern Impoundment, from the northwest corner, along the north and down on the eastern side. On the western side of the Northern Impoundment, flow appears to be towards the impoundment at the corner furthest from I-10. Flow then decreases in location closer to I-10 where water depths are low and a backwater condition exists. The configuration of the turbidity curtain would be such that turbidity migration is mitigated and flow is parallel to the curtain to the extent possible.

During the SDI, and as required by the EPA, turbidity curtains were deployed in the northwest corner of the Northern Impoundment while soil borings were being installed. The initial plan was to utilize impermeable curtains that spanned the full extent of the water column (6 to 14 ft), but due to higher-than-expected water velocities in that area, it was not possible to maintain that configuration and the curtains had to be realigned to use shorter curtains across the deeper areas (ones that did not extend to the river bottom). In light of these challenges, a double layer, permeable Type III curtain extending to one-half the water column depth is being proposed for use during BMP and FRP barrier wall installation and removal. The Type III silt curtain is the most robust class that is commercially available. The use of a permeable curtain of manageable length is expected to help maintain placement and alignment of the curtain.

In addition to the use of silt curtains, monitoring will be performed to confirm that elevated levels of turbidity are not being generated during installation and removal of the sheet piles. Details of this monitoring are provided in the SWMP (Appendix J; Attachment 5). The turbidity monitoring equipment will consist of a buoy with solar charging capabilities, a water quality sonde for collecting turbidity readings, and a dual anchor to the riverbed. Turbidity measurements will be collected in NTUs using a data logger and transmitted in intervals to a database using cellular telemetry. The equipment will also contain a built-in GPS to record and transmit its location.

One turbidity monitoring buoy would be placed upstream of the work to collect background turbidity levels and another one would be placed downstream. Turbidity levels from both monitors would be compared to determine whether the downstream values exceed the upstream by a set threshold. If levels above the thresholds persist, the RC will investigate the source of the turbidity and address it as appropriate (if within RC's control). Another monitor would be utilized as an early warning monitor that will be maintained in close proximity to the work as it progresses. The data will be used internally by the RC to provide an early indication of changes in typical turbidity readings as part of an adaptive management approach. Turbidity monitoring data would be collected twice per day at the start of work. if turbidity levels are below the thresholds included in the SWMP (Appendix J; Attachment 5), the monitoring frequency will be reduced to once per day thereafter.

5.11 Site Restoration

5.11.1 Removal of the BMP

In all areas, except for the southern wall, the BMP wall will be attempted to be removed once all waste has been excavated. The BMP will be disassembled in a similar but inverse sequence to how it was installed.

The recently excavated and exposed bank along the southern extent of the impoundment will need to be supported. Therefore, the BMP sheet piles in this area will be left in place but cut down to existing grade. A soil embankment will be placed along the southern edge of the excavation limit by sloping back into the river at an approximate 4:1 slope. Once the buttress is established to elevation 0 ft, the fill within the BMP walls will be removed to elevation 0 ft along with the tie-rods connecting the two walls. The BMP sheet piles will be cut from top of wall to the lowest of elevation +2 ft or at approximately 1 ft depth below the final grade. The fill material between the walls will be reinstalled to the new established top of wall elevation.

Erosion and scour protection (i.e., rip rap) will be placed at specified locations to protect the buttressed shoreline and prevent washout. Hydrodynamic modelling was performed to evaluate the potential scour along the end-state southern edge of the excavation to support the design of the armament of the backfilled slope. The results of the modelling are included in the Hydrodynamic Modelling Report, included as Appendix F.

5.11.2 TxDOT Access Road

Upon completion of the RA activities and removal of the BMP, the TxDOT access road would be restored to pre-construction conditions. This would include removing the access ramp over the BMP, removing additional aggregate fill used to raise the grade of the access road, and grading areas adjacent to the access road. Any modifications to the end-state of the access road will be coordinated through TxDOT.

5.12 Technical Challenges Associated with Design and Implementation

The remedial alternative for the Northern Impoundment outlined in the ROD was based upon data collected during the RI in 2011 and 2012. At the time the ROD was issued in 2017, a limited amount of subsurface data had been collected from the Northern Impoundment. Subsequent analytical results from the post-ROD PDI and SDI demonstrate that the remedial alternatives considered in the Feasibility Study (FS) and the ROD were not informed by the actual conditions that have since been determined to exist at the Northern Impoundment. The actual conditions have in turn had a significant impact on a number of elements of the RD, including: (1) the type and alignment of the BMP wall required to enclose the Northern Impoundment; (2) the safe excavation of impacted material “in the dry” without the risk of hydraulic heave in locations across the Northern Impoundment particularly in the Northwest Corner (3) the safe excavation of impacted material “in the dry” without the BMP being overtopped by the San Jacinto River during a weather event; and (4) a significant extension of the time required to implement the RD.

In addition, the ROD outlines the need to prevent releases to the San Jacinto River from the Northern Impoundment during construction; however, due to the sheer nature and location of the remedial alternative being imposed by the ROD, there is inherent risk associated with its undertaking causing a release to the river during construction that cannot be entirely eliminated during the design. The below section is intended to identify these technical implementation challenges that will impose risks for this project for all parties planning to undertake its construction.

5.12.1 Use of TxDOT ROW

There are two aspects of site access involving the TxDOT ROW that create technical challenges with respect to the implementation of the 100% RD. One involves whether the TxDOT ROW road that borders the Northern Impoundment to the south and is essential to the execution of the RA, will be available to provide access for vehicles into the Northern Impoundment. The second involves whether TxDOT will allow the southern extent of the BMP wall to be constructed within its ROW.

Use of TxDOT ROW to Access the Site

The TxDOT ROW road is the only route to access the Northern Impoundment by land. During the RA, thousands of haul trucks will be required to drive onto the Northern Impoundment to transport the waste material offsite for disposal. This is in addition to access and egress of general site equipment and personnel. To support these activities, the TxDOT ROW road will need to be widened, and the elevation will be increased such that the road will serve as a ramp up over the +10 ft NAVD88 BMP wall into the Northern Impoundment to allow trucks to drive in and out.

Plans by TxDOT to replace and widen the I10 Bridge were not known or addressed in the ROD. TxDOT has not yet completed its design of the replacement bridge or established a construction schedule. Over the course of the RD, the Respondents have been in regular contact with TxDOT about plans for the Northern Impoundment RD, and learned from TxDOT that construction of a replacement bridge could begin as soon as 2025 and could last up to 5 years. Given the time period for the RA, the implementation of the two projects will overlap. The concurrent construction of these two major infrastructure projects in the same location is a technical challenge for the implementation of the RA that will remain once this 100% RD is finalized. This challenge will necessarily result in changes to the design and intended plans for the remedial alternative during construction to accommodate the TxDOT project. The preliminary schedule for implementation would necessarily be impacted to the extent there are periods of time during which TxDOT is unwilling to allow use of the ROW for ingress and egress to the Northern Impoundment.

Further, this design relies on TxDOT approving use of its ROW for construction and installation of the BMP, a portion of the BMP wall will be constructed on the ROW and will need to remain there throughout the period of implementation of the RD.

The Respondents have been informed by the EPA that TxDOT has committed to work with the Respondents to provide access. TxDOT has not been in a position, however, to engage in discussions regarding the specific timing and terms under which it will allow the Respondents to use the ROW for purposes of the RA. As Respondents are still working to obtain TxDOT's approval to use the ROW; the need for access therefore remains an uncertainty.

5.12.2 Excavation Limits

Effects of Undefined Excavation Limits on BMP Design

The absence of a predefined excavation bottom elevation remains a technical challenge in relation to the BMP design. The elevation (or depth) of the required excavation has a direct effect on the design of the BMP and dictates the type, size, and tip elevations of the pilings. While the double wall system included in the 100% RD can accommodate limited variable excavation elevations, there remains a limit to how many feet of additional excavation it can support without creating conditions that could impair the structural integrity of the BMP. To accommodate this unknown, the entire BMP has been designed to accommodate at least two feet of overexcavation, though overexcavation will remain technically challenging in many places due to the risk of hydraulic heave. In addition, to further reduce the risk from this challenge, the FSP will enable confirmation of excavation bottoms prior to excavation.

Effects of Undefined Excavation Limits on Schedule

The absence of a predefined excavation bottom elevation also presents a challenge in relation to the schedule for the RA. If during the RA, additional volume of material is identified the above 30 ng/kg $TEQ_{DF,M}$, then the schedule for the RA construction will be longer as more material will be removed and there could also be delays as confirmation sampling results are obtained. This would impose the many challenges (e.g., risk of flooding) on the project to be sustained over longer time periods, compounding the risk. Therefore, to further reduce the risk from this challenge and critical to the successful implementation of the 100% RD, the FSP has been developed to enable the confirmation of excavation bottoms prior to excavation.

Risk of Hydraulic Heave

Based on data from the SDI (combined with RI and PDI data), it was found that waste material extends to much deeper depths than was known at the time of the ROD. Considering these deeper impacts, significant geotechnical evaluation work was conducted to better understand the stratigraphy and geological conditions and how they could affect implementation of the remedy during excavation in the dry, as it is prescribed by the ROD. The potential for hydraulic heave during excavation in the dry was evaluated across the entire Northern Impoundment during this design and determined to exist in several areas of the Northern Impoundment. This potential for hydraulic heave will remain a risk for the project during construction, however measures have been developed (as outlined in the Updated Hydraulic Heave Analysis Report) in an attempt to minimize its likelihood during construction.

5.12.3 Uncontrollable Weather Events

Risk of Overtopping and Release During Excavation

The proposed top elevation of the BMP is +10 ft NAVD88 (exterior wall), an elevation which exceeds historical water levels since 1994 during the excavation season proposed. Although the top elevation for the BMP is +10 ft NAVD88 (exterior wall), there is an inherent risk of a flooding event during excavation for the ROD selected remedy which could cause overtopping of the BMP and result in a release of waste material into the river and/or potentially put worker safety at risk. Moreover, when digging in and working below the river surface, the dynamics of the weather and associated river levels create an inherent risk of releases to the river, and there is no guarantee that future river levels during the excavation season will not exceed historical levels. Furthermore, it is not feasible or constructable to simply build a taller cofferdam that can protect against any possible weather event and river elevation while also accommodating equipment and personnel entry into and out of the cofferdam for excavation and waste material removal from below the river; limitations to enable both of these measures exist.

Schedule Interruptions Due to Weather Events

Over the course of the RA construction, the possibility for significant weather events and flooding exists at the work site. A HWPP has been developed to provide guidance on what measure will be undertaken to mitigate the potential consequences of high river levels and flooding at the work site. However, even if the measures in the HWPP are undertaken during RA construction, inevitably there will be an unknown number of demobilizations and remobilizations over the span of the RA construction in attempts to limit the consequences of flooding events. The timing, number, frequency and duration of these demobilizations and remobilizations will be unknown and remain a challenge throughout the RA. This represents a technical challenge inherent in the construction of the remedy selected in the ROD in order to attempt to meet the RAO that prevents releases from the Northern Impoundment to the river and will result in schedule challenges that will most likely lengthen the overall schedule for construction.

5.12.4 Water Treatment

Access to Property for Water Treatment System

Due to lack of usable land in the vicinity of the Northern Impoundment, the WTS will have to be located offsite on a separate piece of property. Approximately 15-20 acres of upland property will be necessary to support RA activities, including water storage and treatment, materials storage, office trailers and parking, truck staging and scales, and sheet pile loadout to marine vessels. Though several properties are being evaluated for long-term access and extensive discussions with property owners have occurred, an agreement for use of such an upland property has not yet been secured. Ideally, the offsite property would be located as close to RA activities as possible (and north of the I-10 Bridge), to minimize the distance that contact water would need to be conveyed for treatment and to minimize the travel distance between the Northern Impoundment and the WTS for site personnel. The details of the future TxDOT bridge replacement project will also affect the options available, as TxDOT's use of its ROW may cut off access to properties located to the west and TxDOT's bridge construction activities could eliminate any option of conveying impacted water to the south under the I-10 Bridge.

6. Sand Separation Area (SSA)

6.1 2019 Sediment Sampling Program

The ROD identifies MNR as the preferred remedial alternative for San Jacinto River sediments in the SSA. The rationale for selection of MNR as the preferred alternative was that the $TEQ_{DF,M}$ concentrations in the SSA are relatively low and there are data indicating that the area is subject to sediment deposition. Modelling of hydrodynamics and sediment transport conducted as part of the Remedial Investigation/Feasibility Study (RI/FS) suggests that the reach of the river adjacent to the SSA is an area of sediment deposition.

In accordance with the PDI-2 Work Plan (GHD, 2019d), sediment samples were collected during PDI-2 field activities from the SSA to meet the following objectives:

– Provide further characterization of the dioxin and furan concentrations in sediment of the SSA.

– Provide a radioisotope analysis of ^{210}Pb and ^{137}Cs to estimate the natural rate of sediment deposition.

^{137}Cs was released into the environment as a result of atmospheric testing of nuclear devices beginning in 1954 with a peak in 1963. Because natural occurrence is extremely rare and its presence can be related to a specific period of time, ^{137}Cs detections are useful in dating sediments. ^{210}Pb is used to calculate deposition rates because it occurs naturally.

Samples were collected from the locations shown on Figure 2-4 using Vibracore sampling devices and a dive team. Collection and analysis of samples were carried out in accordance with the PDI-2 Work Plan (GHD, 2019d).

6.1.1 SSA Analytical Sampling

Thirty-six sediment samples were collected for analysis of dioxins and furans. Samples were collected at the nine locations identified on Figure 2-4. At each location, samples were collected at depth intervals of 0 to 1 foot, 1 to 2 ft, 2 to 4 ft, and 4 to 6 ft below the sediment/surface water interface. Eurofins TestAmerica analyzed the samples for dioxins and furans by EPA Method 1613B and for percent solids by ASTM D2216.

6.1.2 SSA Isotope Sampling

Ninety-nine sediment samples were collected for analysis of ^{137}Cs and ^{210}Pb. Samples were collected at the same nine locations sampled for analysis of dioxins and furans. Samples were collected at depth intervals of 2.5 cm (0.98 inches) from the sediment/surface water interface to a depth of 82.5 cm (32.5 inches). Eleven intervals were sampled at each location. Teledyne Brown Engineering, Inc. analyzed all of the sediment samples for ^{137}Cs and ^{210}Pb by EPA Method 901.1.

6.1.3 SSA Investigation Results

6.1.3.1 SSA Analytical Results

Concentrations of $TEQ_{DF, M}$ are below the risk-based protective level of 30 ng/kg (as determined by the EPA in the ROD) in the top 24 inches of all but one of the SSA sampling locations - SJSSA06 (see Table 6-1 and Figure 2-4).

The laboratory report and data validation report for dioxins and furans are provided in Appendix E.

6.1.3.2 SSA Isotope Results

Cesium-137

^{137}Cs was not detected in any of the 99 samples. Because it was not detected, it can be concluded that sediment to a depth of 82.5 cm (2.71 ft) has been deposited in all areas of the SSA since the mid-1960s. This corresponds to an overall deposition rate of approximately 1.5 cm per year (cm/year).

The laboratory report and data validation report for ^{137}Cs are provided in Appendix E.

Lead-210

Radioactivity of ^{210}Pb decreases with depth at SJSSA01, SJSSA04, SJSSA07, and SJSSA02. The decrease in activity indicates that deposition is occurring at estimated rates ranging from 0.77 cm/year to 3.5 cm/year.

Radioactivity of ^{210}Pb at near shore location SJSSA05 increases with depth, indicating that erosion has occurred at this location. Radioactivity of ^{210}Pb at SJSSA08, SJSSA03, SJSSA06, and SJSSA09 is variable. This variability could be due to alternating periods of erosion and deposition caused by boat traffic, storm events, and/or natural river flows.

Table 6-1 summarizes the results for ^{210}Pb. The laboratory report and data validation report for ^{210}Pb are provided in Appendix E.

6.1.4 SSA Conclusions

Results of the 2019 sampling event indicate that, due to no radioactivity of ^{137}Cs above detection limits, the SSA has generally been depositional since the mid-1960s. Radioactivity of ^{210}Pb indicates that deposition is occurring in four locations at estimated rates of approximately 0.77 cm/year to 3.5 cm/year but that activities may be occurring in the SSA that are affecting deposition in other locations in the area. Concentrations of $TEQ_{DF, M}$ are below the risk-based protective level of 30 ng/kg (as determined by the EPA in the ROD) in the top 24 inches of all but one of the SSA sampling locations - SJSSA06 (see Table 6-1 and Figure 2-4). Changes in the shoreline are visible in historical aerials provided in Appendix E, Sand Separation Area Supporting Documents. The SSA has been superimposed on the historical aerial images. Many of the changes in the shoreline are due to man-made activities.

6.2 Monitored Natural Recovery

The ROD selected MNR as the remedy for sediments in the SSA. The EPA selected MNR on the basis of the relatively low concentrations of dioxins and furans in sediment, low potential for risk to human and ecological receptors, and evidence of net deposition of sediment. Data generated from the PDI-2 sampling event indicate that varying degrees of deposition are occurring in most of the mid shore and far shore areas. With the exception of the one near shore area (location SJSSA06), concentrations of $TEQ_{DF, M}$ at depths less than 24 inches are at or below the level that EPA identified in the ROD as being protective of human and ecological receptors. In one of the mid shore sample locations (SJSSA05), erosion appears to be occurring, however concentrations of $TEQ_{DF, M}$ at all depths at this location are below EPA's protective level of 30 ng/kg. In summary, eight out of nine total sample locations at depths less than 24 inches have $TEQ_{DF, M}$ concentrations below 30 ng/kg. This is consistent with the results observed during the RI. MNR activities moving forward include additional monitoring at the nine locations sampled for PDI-2 to (1) confirm that concentrations of $TEQ_{DF,M}$ remain below 30 ng/kg at depths less than 24 inches at the eight locations identified in PDI-2 and (2) and further monitoring of concentrations at sample location SJSSA06.

The MNR Plan is included as Attachment 9 in Appendix J. The MNR Plan discusses the processes of MNR as related to dioxins and furans, the site-specific characteristics considered in further development of the plan, parameters for monitoring MNR, sampling frequency, and the decision rule for evaluating the effectiveness of MNR. The implementation of ICs will also be considered for the area around SJSSA06 (Appendix J, Attachment 7).

7. Environmental Footprint (Greener Clean-Ups)

EPA's *Principals for Greener Clean-Ups* (EPA, 2009) have been considered in the development of the Northern Impoundment RD. The EPA and state agencies have developed a framework outlining the desired outcomes of a potential standard for greener clean-ups. The framework focuses on five principals associated with a clean-up project's environmental footprint. These principals are listed below along with the potential methods by which they may be incorporated into the Northern Impoundment RA.

Minimizing Total Energy Use and Maximizing Use of Renewable Energy. This includes reducing total energy use while also identifying means to increase the use of renewable energies throughout the clean-up. The selected RC may incorporate this principle into the RD by:

– Limiting traffic at the Northern Impoundment by requiring workers to carpool.
– Requiring the RC to, if appropriate, to use energy efficient equipment or vehicles.

Minimizing Air Pollutants and Greenhouse Gas Emissions. This includes reducing total air emissions, including emissions of air pollutants and GHGs, throughout the RA. The selected RC may incorporate this principle into the RD by:

- Implementing an Air Monitoring Plan to control dust in and around the Northern Impoundment.
- Requiring air emission control devices on equipment that deliver solidification agents.
- Specifying the use of electricity at the laydown and staging areas, where available, rather than portable diesel generators.

Minimizing Water Use and Impacts to Water Resources. This includes minimizing the use of water and impacts to water resources throughout the RA. The selected RC may incorporate this principle into the RD by:

- Employing best management practices for stormwater, erosion, and sedimentation control, as detailed in a SWPPP to be developed prior to the RA.

Reduce, Reuse, and Recycle Materials and Waste. This includes minimizing the use of virgin materials and generation of waste throughout the RA as well as maximizing the use of recycled materials. The selected RC may incorporate this principle into the RD by:

- Using recycled rock from the TCRA armored cap for restoration of the Northern Impoundment area.
- Using recycled non-impacted material from the historic central and southern berms on-site to construct site features and/or SWPPP controls.
- Using recycled aggregate from inside the two walls of the BMP as cover at the completion of the RA.
- Implementing a recycling program for workers.
- Considering recycled material when purchasing material for the RA.
- Reuse of SWPPP controls, where possible.

Protect Land and the Environment. This includes reducing impacts to land and the environment throughout the clean-up. The selected RC may incorporate this principle into the RD by:

- Minimizing the footprint of disturbed areas at the laydown and support areas, to the extent practicable.

8. Drawings and Specifications

8.1 Design Drawings

The 100% RD design drawings are presented in Appendix G and include the following:

- Drawing G-01 - Cover Sheet.
- Drawing C-01 - Overall Plan.
- Drawing C-02 - Existing Conditions.
- Drawing C-03 - SSA Area and Northern Impoundment Works.
- Drawing C-04 - Soil Erosion and Sediment Control Plan - Overall.
- Drawing C-05 - Soil Erosion and Sediment Control Plan - Seasonal.
- Drawing C-06 - Soil Erosion and Sediment Control Details.
- Drawing C-07 - Project Traffic Control Plan.
- Drawing C-08 - Excavation Plan - Overall.
- Drawing C-09 - Excavation Plan Northwest.
- Drawing C-10 - Excavation Plan Northeast.
- Drawing C-11 - Excavation Plan Southeast.
- Drawing C-12 - Excavation Plan Southwest.
- Drawing C-13 - Excavation Section - 1 of 6.

- Drawing C-14 - Excavation Section - 2 of 6.
- Drawing C-15 - Excavation Section - 3 of 6.
- Drawing C-16 - Excavation Section - 4 of 6.
- Drawing C-17 - Excavation Section - 5 of 6.
- Drawing C-18 - Excavation Section - 6 of 6.
- Drawing C-19 - Typical Seasonal Excavation Sequencing.
- Drawing C-20 - Typical Excavation Sequencing - 1 of 2.
- Drawing C-21 - Typical Excavation Sequencing - 2 of 2.
- Drawing C-22 - Restoration Plan.
- Drawing C-23 - Typical Construction Sequencing - 1 of 2.
- Drawing C-24 - Typical Construction Sequencing - 2 of 2.
- Drawing C-25 - Typical Details - 1 of 3.
- Drawing C-26 - Typical Details - 2 of 3.
- Drawing C-27 - Typical Details - 3 of 3.
- Drawing C-28 - Pile Wall Layout Plan.
- Drawing C-29 - Double Pile Wall Plan and Profile - 1 of 4.
- Drawing C-30 - Double Pile Wall Plan and Profile - 2 of 4.
- Drawing C-31 - Double Pile Wall Plan and Profile - 3 of 4.
- Drawing C-32 - Double Pile Wall Plan and Profile - 4 of 4.
- Drawing C-33 - South Wall Plan and Profile - 1 of 2.
- Drawing C-34 - South Wall Plan and Profile - 2 of 2.
- Drawing C-35 - Double Pile Wall Sections - 1 of 7.
- Drawing C-36 - Double Pile Wall Sections - 2 of 7.
- Drawing C-37 - Double Pile Wall Sections - 3 of 7.
- Drawing C-38 - Double Pile Wall Sections - 4 of 7.
- Drawing C-39 - Double Pile Wall Sections - 5 of 7.
- Drawing C-40 - Double Pile Wall Sections - 6 of 7.
- Drawing C-41 - Double Pile Wall Sections - 7 of 7.
- Drawing C-42 - South Wall Sections - 1 of 3.
- Drawing C-43 - South Wall Sections - 2 of 3.
- Drawing C-44 - South Wall Sections - 3 of 3.
- Drawing C-45 - Dredging Northwest Corner Works Plan.
- Drawing C-46 - Dredging Northwest Corner Dredging Controls.
- Drawing C-47 - Dredging Northwest Corner Dry Excavation.
- Drawing C-48 - Dredging Northwest Corner Wet Excavation.
- Drawing C-49 - Dredging Northwest Corner Sections - 1 of 2.
- Drawing C-50 - Dredging Northwest Corner Sections - 2 of 2.
- Drawing C-51 - Dredging Northwest Corner Sequencing - 1 of 3.
- Drawing C-52 - Dredging Northwest Corner Sequencing - 2 of 3.
- Drawing C-53 - Dredging Northwest Corner Sequencing - 3 of 3.
- Drawing C-54 - Dredging Northwest Corner Final Grade.
- Drawing C-55 - Dredging Northwest Corner Dredging Details.

- Drawing C-56 - Restoration Sections 1 of 2.
- Drawing C-57 - Restoration Sections 2 of 2.
- Drawing S-01 - Structural Notes.
- Drawing S-02 - Structural Layout Plan.
- Drawing S-03 - Structural Sections.
- Drawing S-04 - Structural Details 1 of 2.
- Drawing S-05 - Structural Details 2 of 2.
- Drawing S-06 - FRP Barrier Wall.
- Drawing P-00A - Water Treatment System Process Flow Diagram Symbols.
- Drawing P-00B - Water Treatment System Process Flow Diagram Schedules.
- Drawing P-001 - Water Treatment System Process Flow Diagram (Bulk Water).
- Drawing P-002 - Water Treatment System Process Flow Diagram (Contact Water)
- Drawing P-003 - Water Treatment System P&ID (Bulk Water) (1 of 3).
- Drawing P-004 - Water Treatment System P&ID (Bulk Water) (2 of 3).
- Drawing P-005 - Water Treatment System P&ID (Bulk Water) (3 of 3).
- Drawing P-006 - Water Treatment System P&ID (Contact Water) (1 of 4).
- Drawing P-007 - Water Treatment System P&ID (Contact Water) (2 of 4).
- Drawing P-008 - Water Treatment System P&ID (Contact Water) (3 of 4).
- Drawing P-009 - Water Treatment System P&ID (Contact Water) (4 of 4).
- Drawing P-010 - Water Treatment System Site Plan (Bulk Water).
- Drawing P-011 - Water Treatment System Equipment Layout (Bulk Water).
- Drawing P-012 - Water Treatment System Site Plan (Contact Water).
- Drawing P-013 - Water Treatment System Equipment Layout (Contact Water) (1 of 2).
- Drawing P-014 - Water Treatment System Equipment Layout (Contact Water) (2 of 2).
- Drawing P-015 - Mechanical Details 1 of 1.
- Drawing P-016 - Helical Pile Details.
- Drawing P-017 - Mechanical Schedule.

These drawings, insofar as they reflect use of specific means and methods for carrying out the Northern Impoundment remedy selected in the ROD, may be modified as the means and methods for performing the Northern Impoundment remedy selected in the ROD are further defined.

8.2 Technical Specifications

To supplement the Northern Impoundment 100% RD design drawings, technical specifications are presented in Appendix H and include the following:

- Section 00 01 10 - Table of Contents.
- Section 00 01 20 - Seals.
- Section 01 10 00 - Summary.
- Section 01 30 00 - Administrative Requirements.
- Section 01 33 00 - Submittal Procedures.
- Section 01 35 00 - Temporary Traffic Controls.
- Section 01 35 29 - Health and Safety Requirements.
- Section 01 40 00 - Quality Requirements.

- Section 01 50 00 - Temporary Facilities and Controls.
- Section 01 57 13 - Temporary Soil Erosion and Sediment Controls.
- Section 01 57 19 - Temporary Environmental Controls.
- Section 01 60 00 - Product Requirements.
- Section 01 70 00 - Execution and Closeout Requirements.
- Section 01 91 00 - Water Treatment Consumables.
- Section 01 91 20 - Facility Testing and Commissioning.
- Section 02 55 00 - Waste Material Solidification.
- Section 02 61 14 - Material Handling and Transportation.
- Section 02 61 16 - Off-Site Transportation and Disposal.
- Section 22 05 03 - Pipe Data Sheet-PVDF Tubing and Carrier Piping.
- Section 23 05 53 - Identification for Piping and Equipment.
- Section 31 05 19.13 - Geotextiles for Earthwork.
- Section 31 10 00 - Site Clearing.
- Section 31 23 16 - Excavation.
- Section 31 23 19 - Dewatering.
- Section 31 23 23 - Fill.
- Section 31 35 26.16 - Geomembranes.
- Section 31 37 00 - Riprap.
- Section 31 41 16 - Sheet Piles.
- Section 32 31 13 - Chain Link Fences and Gates.
- Section 32 92 19 - Seeding.
- Section 35 24 00 - Dredging.
- Section 35 49 25 - Turbidity Curtain.
- Section 40 05 13 - Common Work Results for Process Piping.
- Section 40 05 33 - High Density Polyethylene Process Pipe.
- Section 40 05 51 - Common Requirements for Process Valves.
- Section 40 70 00 - Instrumentation for Process Systems.
- Section 46 07 01 - Water Treatment System (WTS).
- Attachment A - Residual Management Plan.
- Attachment B - Pre-Excavation Stratigraphic Borings and Piezometers.
- Attachment C - Treatability Testing to Identify Reagents and Dose for Enhanced Settling.

9. Supporting Deliverables

Pursuant to the SOW, supporting deliverables have been prepared as part of the 100% RD, as summarized below. As required in the April 18, 2024, letter from the EPA (EPA, 2024b), ten of supporting deliverables (identified below) have already been submitted to the EPA.

- ***HASP*** - submitted to the EPA June 17, 2024.
- ***ERP*** - submitted to the EPA June 17, 2024.
- ***FSP*** - submitted to the EPA July 17, 2024.

– ***QAPP*** - submitted to the EPA July 17, 2024.
– ***SWMP*** - submitted to the EPA July 17, 2024.
– ***CQAQCP*** - submitted to the EPA July 17, 2024.
– ***ICIAP*** - submitted to the EPA June 17, 2024.
– ***TODP*** - submitted to the EPA June 17, 2024.
– ***MNR Plan*** - submitted to the EPA June 17, 2024.
– ***HWPP*** - submitted to the EPA June 17, 2024.

Most of these plans consider that the RC will be required to prepare its own plans that address the topics covered by these plans and detail the means and measures to be implemented to accomplish the objectives of such plans.

9.1 Health and Safety Plan

The Construction HASP (Attachment 1 in Appendix J) has been prepared in accordance with 29 CFR 1910 and 1926 to provide protection of human health and the environment during activities performed to implement the Northern Impoundment RA. It includes all physical, chemical and all other hazards posed by the work required to perform the Northern Impoundment RA.

9.2 Emergency Response Plan

The ERP (Attachment 2 in Appendix J) describes procedures to be used in the event that there is an emergency while work to implement the Northern Impoundment RA is being performed. The ERP includes procedures with respect to the entity(ies) responsible for responding to an emergency, the plan for meeting with those involved in the response, contingency plans for spills, and release reporting and response.

9.3 Field Sampling Plan

The FSP (Attachment 3 in Appendix J) describes the sampling activities for all media to be sampled during work to implement the Northern Impoundment RA. The FSP provides the rationale for sample collection and describes the protocol for sample handling and analysis.

9.4 Quality Assurance Project Plan

The QAPP (Attachment 4 in Appendix J) provides an explanation of the quality assurance and quality control procedures and Chain-of-Custody procedures for all sampling to implement the Northern Impoundment RA. This includes quality assurance during data generation and acquisition and during data validation and review.

9.5 Site-Wide Monitoring Plan

The SWMP (Attachment 5 in Appendix J) describes the procedures for monitoring to prevent the potential spread or off-site migration of contaminated media from the Northern Impoundment during and following implementation of the Northern Impoundment RA.

9.6 Construction Quality Assurance/Quality Control Plan

The CQA/QCP (Attachment 6 in Appendix J) describes the planned and systematic activities that verify that the remedial construction to implement the Northern Impoundment RA will meet requirements consistent with clean-up goals and performance requirements set forth in the ROD.

9.7 Institutional Controls Implementation and Assurance Plan

The ICIAP (Attachment 7 in Appendix J) describes the institutional controls expected to be applicable to the SSA and the process for developing and implementing them.

9.8 Transportation and Off-Site Disposal Plan

The TODP (Attachment 8 in Appendix J) details, for the Northern Impoundment RA, waste characterization activities and disposal options. It addresses the transportation routes for off-site shipments of waste material during implementation of the Northern Impoundment RA, identifies procedures to protect any communities that may be affected by such truck shipments, and describes the procedures for on-site management and loading of the waste materials.

9.9 Monitored Natural Recovery Plan (Operations & Maintenance Plan)

The MNR Plan (Attachment 9 in Appendix J), describes for the SSA the routine monitoring and testing to be conducted and procedures for data collection and evaluation, record keeping and reporting of data to be followed, after completion of the Northern Impoundment RA. As discussed with the EPA on May 7, 2020, the MNR Plan takes the place of the O&M Plan referred to in the SOW.

9.10 High-Water Preparedness Plan

The HWPP (Attachment 10 in Appendix J) describes the specific procedures to be followed during the Northern Impoundment RA for the protection of equipment, employees, and the environment during high-water, flooding, or severe weather events at the work site.

9.11 Operations & Maintenance Manual

Per discussion with the EPA, this plan is not anticipated to be necessary.

10. References

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Table 1-1

Response to EPA Comments on 90% Remedial Design
Final 100% Remedial Design - Northern Impoundment
San Jacinto River Waste Pits Site
Harris County, Texas

Comment Source	Item No.	Reference	Comment	Response to Comment
EPA	1	90% RD - Section 2.3.5.2 Surficial Sediments Geotechnical Properties	A brief explanation of the sampling objectives for the geotechnical analysis of the deposited surficial sediment and how this relates to the Remedial Design (RD) should be provided. This discussion should provide the results of the geotechnical investigation or a clear reference to where the results are available for review.	As stated in the introductory paragraph (Section 2.3.5), the sampling was performed to support design of the turbidity control measures during installation and removal of the BMP. The geotechnical tests listed are classification tests to measure the general material properties of the surficial sediments to be encountered to provide information on how the material will behave during BMP installation/removal.
EPA	2	90% RD - Section 3.3.5.2 Solidification Results and Conclusions	The solidification test results are not presented for the different alternative analysis that were mentioned as being run in the lab. The brief summary of these results needs to be presented to provide the design team and future contractors to assist with their evaluation of possible dewatering, solidification, and stabilization activities.	The 100% RD has been revised per comment and this data has been added to Appendix C.
EPA	3	90% RD - Section 3.3.5.2 Solidification Results and Conclusions	The solidification tests data should be provided as they are needed to show the RC and disposal facilities what strength, permeability, and type of reagent would be coming to their disposal location. This is a baseline test that should be performed in any sediment project that includes removing and transporting wet (potentially impacted) sediments. Also, they provide the contractor with the cost implications if the lower doses did not perform well.	The 100% RD has been revised per comment and this data has been added to Appendix C.
EPA	4	90% RD - Section 2.4 PDI and SDI Conclusions and Recommendations	In the first paragraph of this section the use of the word depth is inappropriate as it appears to indicate that elevation is being referred to, not depth below ground surface or a variable water surface. The wording should be changed so that distances to be excavated or referred to in terms of depth to be excavated and not up to elevations.	The 100% RD has been revised to address this comment.
EPA	5	90% RD - Section 2.4 PDI and SDI Conclusions and Recommendations	At the end of the first full paragraph in this section, add “and water drawdown” after “planned excavation depth”.	The 100% RD has been revised to address this comment.
EPA	6	90% RD - Section 3.4.2.3.1 Filtration Pilot Test Results	This section states that based on the observed relationship between turbidity and TSS, turbidity levels can be used as an indication of the TSS concentration, but no figure or table was provided demonstrating this site-specific correlation. Additionally, the section states that the TSS/turbidity relationship is used to indicate that the dioxin and furan concentrations are below the ML. A better explanation of this relationship needs to be provided and the intended use of this information during filtration pilot testing and RA implementation, as the turbidity/TSS relationship is not an adequate substitute for analysis of dioxins and furans in determining compliance. The text should be clear that an analysis will still be performed on the samples for dioxins and furans.	Additions have been made to the 100% RD, in section 3.4.2.3.1, addressing site-specific data showing the correlation of turbidity to TSS and how turbidity data will be used during filtration pilot testing and RA implementation.
EPA	7	90% RD - Section 5.1 Remedial Design Background	In the 2nd paragraph on Page 38 of this section more clarity is needed. Does Figure 5-A shows area at risk of hydraulic heave if excavated in the dry? Explain this concept. Is the mentioned “additional feet of excavation” the thickness of waste that could be safely excavated below the proposed excavation elevation? Or is it depth below the lowest segment of core identified to be above 30 ng/kg? Also please clarify for the areas shown in white whether the safety factor is less than 1.25 for the proposed removal or is the segment of the core above 30 ng/kg?	Figure 5-A showed the area at risk of hydraulic heave if excavated in the dry by displaying the thickness of waste that could be safely excavated below the proposed excavation elevation. However, Figure 5-A is not included in the 100% RD. The approach for evaluating hydraulic heave has been revised as described in the Updated Hydraulic Heave Analysis provided in Appendix B of the 100 % RD.
EPA	8	90% RD - Section 5.1 Remedial Design Background	In 1st paragraph on Page 38 of this section, three areas of risk for hydraulic heave are identified outside of the northwest corner area of the site. For these areas, what elevation the water level would need to be maintained to prevent hydraulic heave in order to remove or mitigate the risk of hydraulic heave during removal of waste in those small areas? Also, how much backfill would be required to be added to the site if the water level was pumped down for further excavation in the dry after backfilling?	The 100% RD describes the heave conditions based on subsurface stratigraphic data and the potentiometric data that were available during the 100% RD. During the RA, the RC will complete stratigraphic borings in each area in which the potential for hydraulic heave has been identified and install piezometers in the sand zone(s) that are encountered to measure potentiometric elevations at the time of construction. The specified water elevations to manage the heave will be determined during the RA based on the updated potentiometric data and the actual removal depths. The RC will be required to backfill the excavations to elevations that are protective of an overtopping event at river elevation +10 NAV88 as determined by the Engineer from the area-specific stratigraphic and potentiometric data.

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Comment Source	Item No.	Reference	Comment	Response to Comment
EPA	9	90% RD - Section 5.2 Remedial Approach – Seasonal Excavation, and Top of Wall Elevation	There is no discussion or apparent consideration for the effect of wind waves and vessel wakes as potential contributing factors in any overtopping events. Inclusion of discussion of these topics as well as consideration of them in the wall height selection for the design is required for EPA's review.	This comment regarding wind waves and vessel wakes has been addressed within the 100% RD in Section 5.5 with a note that the loads will not govern the design.
EPA	10	90% RD - 5.2 Remedial Approach – BMP Alignment and Lateral Excavation Extent	Will the soil buttress be capped or armored to protect it from erosions should a flooding event occur that results in over-topping of the BMP?	The soil buttress and other areas inside the interior BMP wall will be protected with riprap for certain distance from the wall. Section 5.5 has been updated to discuss scour protection.
EPA	11	90% RD - Section 5.2 Remedial Approach – Season Excavation and Top of Wall Elevations	The design does not present or discuss the ranges of slopes that we will result from the excavation of the waste within the BMP, how these slopes will be managed and what media will be used to cover/cap those exposed, not only upon completion of excavation activities, but also during periods of no site activities.	The text in Section 5.6.3.3 of the 100% RD has been revised to address the comment.
EPA	12	90% RD - Section 5.2 Remedial Approach, Figure 5-4	Clarify what the contours shown on this figure are showing and, if they are proposed excavation contours, the elevations for those contours need to be presented on the figure well.	The contours shown on this figure are representative of the initial bottom of excavation elevations.
EPA	13	90% RD - Section 5.2 Remedial Approach – Excavation Methodology & Water Management	There is a minimum water elevation specified above the soft sediments where the main pumping to the river will cease and the pumping to the proposed water treatment plant will begin. Additionally, the design doesn't address how this minimum water elevation would be determined for areas that have sloped bottoms in which contaminated material is or could be present on the sloped surfaces or excavated side walls.	The 100% RD has been updated in response to this comment. Water in the excavation below 2 ft about the lowest elevation at the time of the dewatering activity and any other contact water generated during construction will be treated by the complete WTS as described in Section 5.9.
EPA	14	90% RD - Section 5.2 Remedial Approach – Re-Use of TCRA Armored Cap and Historic Berm Material	The design states "The locations of the historic berm and the TCRA armored cap rock planned for re-use are shown on Figure 3-5." The 100% should provide a discussion regarding the TCRA cap in the northwest portion of the site where the TCRA cap will not be reused, including the ACBM.	This comment has been addressed within the 100% RD.
EPA	15	90% RD - Section 5.3.2 Excavation Season and BMP	The current design documents appear to show protection against flooding at the top of wall elevation; however, during a severe storm or a hurricane it is expected large waves would spill over the wall and possibly erode the support berm. Have wave fetch and proposed freeboard for wave overtopping been considered in the design storm protection provided by the wall? The quantity of dewatering and water treatment contributed by overtopping should be included in the volume calculations. The design should also include design features that ensure protection of the internal support fill from erosion due to overtopping (i.e. internal ditch system).	Wave fetch and proposed freeboard have been considered in the BMP design. Any water generated by waves overtopping the BMP will be treated as bulk water if all the surfaces are protected or contact water if there are exposed surfaces. This comment was addressed in Section 5.9 of the 100% RD.
EPA	16	90% RD - Section 5.3.2 Excavation Season and BMP Height	The design does not indicate if consideration has been given to measures to keep the wall intact during a severe storm to protect the excavations from river scour and prevent release of contaminated soils from within the barrier.	The 100% RD includes internal and external scour protection intended to address impacts from storm events.
EPA	17	90% RD - Section 5.3.3 Geotechnical Conditions	It is not clearly indicated if the clayey deposits that are discussed in Item 3 on Page 48 are being identified as the Beaumont Clay.	The 100% RD has been revised to address this comment.

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Comment Source	Item No.	Reference	Comment	Response to Comment
EPA	18	90% RD - Section 5.4.2 Northern Impoundment Preparation and Layout	While the EPA understands that the Respondents have not secured access to all property that they feel is required to implement the design, the design is lacking information concerning the total footprint that the design would require for the implementation of the Remedial Action (water treatment equipment, spoils processing, contractor laydown, etc.). This information would allow for evaluation of alternative solutions or mitigation of potential issues that could result in delays and possible redesigns if they are left until contractor selection to be resolved. This would allow for a better evaluation of potential conflicts besides placement of the ROW and multiple use of the ROW for trucking. Furthermore, this would allow identification of potential design limitations that should be reviewed for alternatives to mitigate the impacts to the RA implementation or that would render the design unimplementable, that could allow the design to progress and be implemented.	The design will include dimensioned general arrangement drawings showing proposed locations of WTS equipment (e.g. influent tanks, treatment equipment, effluent storage tanks) located inside designed containment areas.
EPA	19	90% RD - Section 5.5.3.4 Scour	The last paragraph of this section states that modeling results showed decreasing velocities adjacent to the I-10 bridge structure, but then follows in the next sentence with a statement that flows increased. This statement needs to be clarified as to the results of the modeling.	The Hydrodynamic Modelling Report submitted as part of the 100% RD has been updated to reflect this comment. The 100% RD has also been revised to reflect the updating of the Hydrodynamic Modelling Report. Contradicting statement in RD has been removed.
EPA	20	90% RD - Section 5.5.5.1 Failure Modes and Section 5.5.5.2 Safety Factors; Appendix I Section 5.5.5.1 Failure Modes and Section 5.5.5.2 Safety Factors	The review of the design appears to indicate that the wall is susceptible to progressive failure by successive failure of adjacent tie rods due to a material defect, unusual/extreme loading, or a barge strike if unequally distributed to adjacent tie rods. The design should consider the potential for progressive tie rod failure with possible fill loss in the wall design. The design does not present information concerning potential alternative wall structures, such as a cellular cofferdam, that offer greater stability relative to progressive failure if the existing design is suspectable to a progressive failure.	Section 5.5.5.1 of the 100% RD has been updated to note that failure modes are for single-wall systems. The failure modes are not directly applicable for a double-wall system. Exceptions have been noted in item 1 and 2. Section 5.5.5.2 of the 100% RD describes the design methodology for a double wall system, including evaluation for tie-rod failures. As Owner's engineers we are proposing an implementable solution with a double wall system and the analysis shows that the wall is adequate for the different loading scenarios being evaluated. The system is evaluated for tie-rod failure and distributing loads to adjacent tie-rods to avoid progressive collapse. The details of the double wall system have been the subject of detailed discussions with EPA, TWG Meetings, TxDOT, and the Port of Houston. Multiple wall systems have been evaluated through the design process and the double wall system has been found to be the best option given the project and design constraints.
EPA	21	90% RD - Section 5.6.2 Excavation Methodology	With the design is based on excavation occurring in a mostly dewatered area within the BMP, failure of the wall puts working personnel in danger and sufficient plans and observation systems must be in-place to monitor wall movement or impending heave failures. The design does discuss the potential for heave, but no discussion of wall failure. The design should provide a plan or requirements that a remedial contractor will need to incorporate into a plan to protect personnel safety using instrumentation, observations, and emergency action plans to address wall distress, heave failure, seep formation, loose barge alarms, and severe weather.	In the 100% RD, the RC will be required to provide an updated plan for BMP monitoring.
EPA	22	90% RD - Section 5.6.2.1 Cell Dewatering	They should be re-titled **Site Dewatering** to prevent confusion with Cell Dewatering since cells do not appear t be a portion of the current design.	The comment has been addressed within the 100% RD.

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Comment Source	Item No.	Reference	Comment	Response to Comment
EPA	23	90% RD - Section 5.6.2.3 Excavation Procedures	This section in general lacks specific details that are common in a 90% design. Most of the language is more consistent with a design/build project where the selected contractor is expected to propose ways and means on how they intend to accomplish the required activities. In this case, due to the nature of the work and the difficulties that the Respondents have presented it would make it difficult to successfully engage a contractor to implement the RD without extensive additional design development and schedule delays. The 100% should include detail about the construction sequencing, types of equipment being used on site, handling and rehandling of excavated sediments, processes for dewatering/solidification/stabilization before transport, in field testing procedures to ensure quality of sediments being transported, cycle times, demarcation procedures, decontamination procedures, transport quality control and assurance on haul roads and other main roadways.	Additional details have been provided through the 100% RD to assist remedial contractors with bidding the project. Based on discussions with remedial contractors, the detail in the 100% RD is sufficient for procurement.
EPA	24	90% RD - Section 5.6.2.3 Excavation Procedures	Additional information should be provided in this section on how waste material handling onsite will be conducted in a manner to prevent spreading of any contaminated or potentially contaminated materials onto the armored cap or areas of the excavation that have been confirmed clean, where accumulated rainwater would be collected and discharged to the river without treatment. Also, this section states that waste material that does not have free liquids and does not need solidification may be loaded directly to the haul truck for disposal; please add an explanation of how field staff will determine if the waste material needs solidification or not (e.g. paint filter test). In addition, Figure 5-B indicates that some waste materials that require excavation are under the access road and the ramp into the BMP, this portion of the waste was not addressed in the design. Please explain how and when these materials are going to be excavated and removed from the BMP for offsite transport.	The comment has been addressed within the 100% RD.
EPA	25	90% RD - Section 5.6.5 Excavation Area Restoration	While there are "no post-excavation restoration measures identified or required as part of the ROD,", there must be a plan on what the future bathymetry would look like upon completion of excavation and removal of the BMP. Based on this limited section, it seems like the area may be used as a repository of clean materials without a particular plan on how to grade them except for along the south edge, and how to prevent future erosion of any clean materials placed in this area.	As identified in the comment, there is no requirement in the ROD for post-excavation restoration measures. The excavated areas are expected to naturally fill-in over time due to normal deposition of river sediment in the area.
EPA	26	90% RD - Section 5.7.1	The EPA in accordance with RCRA requires that classification of waste occurs at the point of generation (i.e. when the waste is excavated) and before it is mixed or treated with solidification material, which should not be confused with analytical data the receiving facilities requires/requests for the waste after it has been mixed/treated to allow them to have a profile of the material in the state that they would receive it for disposal. It should be clear in the discussion if the additional testing that was conducted during the treatability study was of the primary waste or treated material when it is stated that "results of the treatability testing indicate that the waste material from the Northern Impoundment is non-hazardous" and its eligibility for disposal as a Class-II non-hazardous waste.	The 100% RD has been revised in response to this comment, specifically in the Field Sampling Plan (FSP). Solidification of waste material may be required such that the wetted material would pass the paint filter test prior to offsite shipment to an approved landfill. The solidification of waste material should not alter the chemical composition of the waste and is planned to be used for drying purposes only. The treatability study utilized the primary waste for testing and it was found to be non-hazardous". This would help answer the question at the end of the comment.
EPA	27	90% RD - Section 5.8 Water Management	Based on the discussion in this section as well as information provided in Table 5-3 Water Treatment Basis of Sizing and Section 5.8.2 Treatment System Design the projected 24-hour contact water generation volumes appear to be more than the capacity of the system to handle. Are there other locations for the water to go that are not accounted for in the design that would result in the volume of contact water to be less and more in line with the designed capacity of the treatment system? Please clarify the basis of the calculations as updated for the 100% RD and comparison of projected volumes to the treatment system capacity to clearly show influent sources and volumes, as well as other potential pathways that the contact water could be handled.	Table 5-3 and Section 5.8.3 have been updated based on the extension of the excavation season and updated capacities of the influent and effluent tanks. When the design storage and treatment capacity of the treatment system is exceeded by an extremely large rain event, contact water will be stored in the excavation. Based on analysis of daily rainfall totals at Houston Hobby Airport during the proposed excavation season of November to July, 99.9% of all daily rain events are 4.87 inches or less. The estimated time to dewater the excavation after a 4.87 inch rainstorm ends is approximately 1 day. Table 5-1 in Section 5.8.2 has been updated with new rainfall and treatment estimates.

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EPA	28	90% RD - Section 5.8.1.4 Water Volume and Storage	This section needs to provide additional discussion on the methods that will be taken to segregate contact water from non-contact water. This may be discussed in other sections or an appendix to the design but should be discussed here so that it is clear what the design criteria are and how they will be met to minimize cross contamination.	The 100% RD has been revised in response to this comment to address steps to minimize co-mingling of contact and non-contact water.
EPA	29	90% RD - Section 5.8.2 Treatment System Design-Bag/Cartridge Filtration	Respondents should consider alternate methods or additional steps in the water treatment process so as not to create a hinderance to designing a remedy that meets the requirements of the ROD. Such items for consideration should include, but not be limited to, bulk water removal, storage, chemical addition, bulk solids removal, and sludge dewatering. All of these should have potential alternatives that could provide for less limitations on the water treatment system both in the quality of the water treated, time for treatment, and footprint required. For example, some of these systems (e.g., Del Total Clean SandCat, or 3000+) can get the slurry down to 38 micron at a speed of 3,000 gpm, then the remaining fines can be flocked and sent through smaller dewatering operations. Another example is to use a plate & frame press for dewatering. This method is a bit slower but will remove down to 1 micron all in one step. A potential option for material handling is to stabilize the sediments wet either with an injected slurry Portland or SAP (super absorbent polymer). These will lock in the small fines and prevent future leaching from the material after disposal.	The water treatment process was demonstrated to be effective for the work on the Southern Impoundment and lessons learned from that project have been incorporated into the 100% RD. For the dredging work, the RC is required to add a treatment step to remove solids from the decant water, if necessary, prior to treatment in the WTS. The 100 % RD has geotube bags as the solids removal technology, but the RC has the option to provide another technology, such as those listed in the comment, if it better suits their means and methods and can be demonstrated to be effective.
EPA	30	90% RD - Section 5.8.2 Treatment System Design-Bag/Cartridge Filtration	This section states that during the operation of the water treatment system, 5 micron bag filters may be tested on a side-stream to evaluate if they can be used in place of the 1 micron filters. Please note that EPA's February 18, 2020 correspondence (included in Appendix D-1 of this report) indicated that EPA's determination that the Minimum Level for dioxins/furans could be used to demonstrate compliance with the Texas Surface Water Quality Standards is contingent on the water treatment facility using a 1 micron final filtration step in the water treatment process.	The 100% RD has been updated to provide that all contact and bulk water will be treated through a 1 micron filter prior to discharge.
EPA	31	90% RD - Section 5.8.4 Compliance Monitoring	Modify this section to explain the steps to be taken if analyses at the point of discharge indicate that effluent has not met discharge criteria for a regulated parameter, as laid out in Section 5.5.4 of the Final 100% RD for the Southern Impoundment dated April 19, 2021, which states "If analyses at the point of discharge indicate that effluent has not met discharge criteria for a regulated parameter, the EPA will be notified immediately and the system will then be shut down and/or effluent may be recirculated to the contact water storage tank(s), and additional performance checks may be performed on the treatment system, including but not limited to, check and appropriate modifications with respect to chemical dose, checking to determine whether GAC and/or filter media and bag filters should be replaced, etc. Contingency measures may also include, but are not limited to, increased monitoring and notifications."	Treated effluent will be stored in the effluent tanks. The effluent will be sampled and analyzed for compliance with discharge requirements. If the contents of the tested effluent tank meet the discharge criteria, the contents of the tank will be discharged to the river through a diffuser. If the contents of the effluent tank do not meet the discharge criteria, the contents of the tanks will be pumped back into one of the influent tanks for retreatment.
EPA	32	90% RD - Section 5.9 Monitoring and Controls	The design does not provide supporting calculation(s) used to support the assumption that seepage/infiltration through and under the BMP and upwelling from the bottom of the excavation would be negligible. The design also does not provide specifications or guidance for the use of instrumentation to measure seepage collected to verify this assertion after dewatering and during excavation.	Seepage is discussed in Section 6.8 of Appendix I. That section demonstrates that fully sealed and standard interlocks perform the same under 30-ft of water and seepage is reduced to 25% if a sealant is used. The sheet pile specifications call for a sealant on the inner walls of the BMP.
EPA	33	90% RD - Section 5.11.1.2 Effects of Undefined Excavation Limits on the BMP Design	As the design has progressed, TxDOT has provided updated design drawings that show the TxDOT ROW and TxDOT's planned use and end state for the ROW. The design should be updated to account for this information and steps take to evaluate the impact of these on the design and incorporate changes to the design to mitigate the impacts to the BMP design and implementation.	The most recent information provided by TxDOT regarding the I-10 Bridge design has been incorporated in the 100% RD and steps have been taken to mitigate impacts on the BMP design. The Respondents will continue to engage with TxDOT as the I-10 Bridge design progresses and contemplate that further modifications of the 100% RD may be required as a result.

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Comment Source	Item No.	Reference	Comment	Response to Comment
EPA	34	90% RD - Section 5.11.1.2 Effects of Undefined Excavation Limits on the BMP Design	An analysis of the uncertainty of the depth of contamination and an over-excavation allowance should have been considered in the schedule. This uncertainty in depth of contamination also poses questions regarding the use of area-wide averages for target clean-up levels as well as proposing to leave continuous contamination above the target clean-up level.	The extent of the uncertainties associated with the excavation limits utilizing post-confirmation sampling precluded any detailed assessment of the impact of the uncertainties on the schedule. Both uncertainties and scheduling concerns associated with undefined excavation limits have been addressed by the proposed use of pre-construction excavation sampling, the results of which can be used to refine the schedule.
EPA	35	90% RD - Section 5.11.2 BMP Alignment	Details need to be provided on conditions that could impact the installation of the BMP such as high water or wind conditions, or what steps would be taken to mitigate potential issues to the installation.	There are conditions that could impact/delay installation of the BMP, including repeated high water or wind events, tropical storms, possible materials/equipment issues, etc. It is uncommon to prescribe construction means and methods beyond the details shown in the drawings.
EPA	36	90% RD - Section 5.11.2 BMP Alignment	The design is lacking on requirements for protection of the BMP. Additional information needs to be provided to determine which sides of the BMP need protection and the requirements that the protective structures would need to meet, including any related to the active shipping channel to the east of the site.	An FRP barrier wall has been described in the 100% RD as an additional measure intended to protect the BMP from barges in the navigational waterway.
EPA	37	90% RD - Section 5.11.2.1 Access to Property for Water Treatment System	A potential issue identified by the design is potential lack of space to place and maintain the proposed water treatment system. There appears to be no consideration of alternative locations or placement strategies (such as mounting it on barges) or design changes to the overall operation, as well as the water treatment system design that could result in a smaller or more manageable footprint for the water treatment system.	The 100% RD will include general arrangement drawings showing the approximate sizes of the water treatment equipment and containment areas. The size of the equipment shown on the general arrangement drawings is necessary to accommodate the volumes required to be treated by the WTS. Overall design changes and the use of barge mounted equipment were determined not to be viable options because of the potential impact from high water/storm events and the requirement to have no releases to the San Jacinto River throughout the project.
EPA	38	90% RD - Section 5.11.3.1 Impacts on the Community and Environment	Concerns were raised as part of the design regarding the potential for distractions being created by the Site removal activities for drivers on Interstate 10. It should be noted that there is a high likelihood that the I-10 bridge replacement project would be going on at the same time so the potential for distractions would already be present and not just limited to the removal activities. However, there are several common technologies/design features that can be implemented such as screens to mitigate the potential distractions resulting from the removal activities.	As both projects progress, the Respondents anticipate continuing discussions with TxDOT regarding the I-10 Bridge design and the potential need for changes to the 100% RD as a result of changes to the I-10 Bridge design. Any measures regarding screening to limit driver distraction can be developed as more information regarding details of the I-10 Bridge project are known.
EPA	39	Hydrodynamic Modeling Report - Appendix F – General Comment	The hydrodynamic modeling should include modeling of 500-year flood, given the history of multiple “500-year” floods in the area within the last 10 years, and associated barge strikes and scour from storms. This will require GHD to expand the model grid for EFDC, as well as modeling runoff from the watershed into the San Jacinto River and Houston Ship Channel using a surface water runoff model such as HSPF. The 500-year analysis should be considered as part of the wall design (height of wall/pressure on wall/scour risk, etc.); end-state analysis; evaluating potential impacts from barge strikes; scour; and emergency/contingency plans.	The 500 year flow event was modeled and the results for velocities and shear stress were incorporated in the Hydrodynamic Modelling Report in the 100% RD. For all simulations the flows at the Houston Ship Channel were kept at are normal values since the flows from the Channel create a backup effect on the San Jacinto River at the Northern Impoundment reducing velocities in the area. The San Jacinto River flows are from Lake Houston, and the release flows from the lake are controlled by the dam, not how the flows enter the lake from the watershed. For these reasons a watershed surface water runoff model such as HSPF was not considered necessary for the proper simulation of the flows in the site area.
EPA	40	Hydrodynamic Modeling Report - Appendix F – Section 1.2 Site Description, Figure 2	Add “Light” before “Blue” in the caption of this figure to clearly identify the are in question.	The Hydrodynamic Modelling Report in the 100% RD has been updated to reflect this comment
EPA	41	Hydrodynamic Modeling Report - Appendix F – Section 2.4 Flow Data, Table 2	Which of the sets of streamflow data given in this table were used as the discharge boundary conditions in the RFDC model?	The Hydrodynamic Modelling Report in the 100% RD has been updated to reflect this comment
EPA	42	Hydrodynamic Modeling Report - Appendix F – Section 2.5 Lake Houston Data	How were the Lake Houston waste levels described in this paragraph used in the model? Where any corrections made to them, and if so what were those corrections and how were they applied.	The water levels from Lake Houston were not used in the model. Flows reported at from the dam were used.

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EPA	43	Hydrodynamic Modeling Report - Appendix F – Section 3.2 Model Setup	The report states “the hydrodynamics model uses the parameterization and kinetics from the calibrated (previously developed) models by Anchor QEA.” Hydrodynamic calibrations are specific to the physical dimensions of the model grid, among other things. Since the model grid cell dimensions and bathymetry have been changed, the assumption that the hydrodynamic calibration parameters would hold for the new grid should be verified by direct comparison of water surface elevations and velocities in the calibrated model.	The changes to the model were not considered significant, since the cells dimension were not changed and the bathymetry changes were minimal. Nevertheless, a verification of the model compared to a previously existing HEC-RAS model was conducted as shown in Appendix A of Appendix F.
EPA	44	Hydrodynamic Modeling Report - Appendix F – Section 3.2 Model Setup	In the first paragraph change “Cartesian and orthogonal horizontal grid” to “a combined Cartesian and orthogonal-curvilinear grid.”	The Hydrodynamic Modelling Report in the 100% RD has been updated to reflect this comment
EPA	45	Hydrodynamic Modeling Report - Appendix F – Section 4.1 Cofferdam Effects on the Floodplain	What were the bottom elevations for the two stations that were chosen to compare the results from the model?	The Hydrodynamic Modelling Report in the 100% RD has been updated to reflect this comment
EPA	46	Hydrodynamic Modeling Report - Appendix F – Section 4.2.1 Sedimentation Study with Cofferdam Analysis	The report is not clear on what model output is used to generate the 95th percentile shear stresses and velocities. Are these statistics calculated from all model cells shown in Figure 22 over the full 30-day period? If so, we would recommend focusing on the peak flow period (the peak 1-hr flow period would seem relevant for erosion) at just a few key locations.	The Hydrodynamic Modelling Report in the 100% RD has been updated and the maximum and median velocities and shear stresses at each model cell were used for statistics.
EPA	47	Hydrodynamic Modeling Report - Appendix F – Section 4.2.1 Sedimentation Study with Cofferdam Analysis	In the second paragraph change “Figure 22” to “Figure 23.”	The Hydrodynamic Modelling Report in the 100% RD has been updated to reflect this comment
EPA	48	Hydrodynamic Modeling Report - Appendix F - Section 4.2.1 Sedimentation Study with Cofferdam Analysis	Please explain why the bathymetry model did not take into account the designs specified modifications to the access road to the site. The model should be corrected and re-run to account for the impacts of these changes.	The Hydrodynamic Modelling Report in the 100% RD takes into account the latest design of the cofferdam wall and access road.
EPA	49	Hydrodynamic Modeling Report - Appendix F – Section 4.2.1 Sedimentation Study with Cofferdam Analysis	A more in-depth discussion of the differences in the shear stresses between the “existing conditions” and “with cofferdam” conditions for all three of the modeled storm events should be given.	The Hydrodynamic Modelling Report in the 100% RD has been updated to reflect this comment
EPA	50	Hydrodynamic Modeling Report - Appendix F – Section 4.2.1 Sedimentation Study with Cofferdam Analysis	In the second paragraph on Page 23, change “right next to” to “right next to the”.	The Hydrodynamic Modelling Report in the 100% RD has been updated to reflect this comment
EPA	51	Hydrodynamic Modeling Report - Appendix F – Section 4.2.1 Sedimentation Study with Cofferdam Analysis	Explain why “a sudden large increase” in the velocities “right next to the cofferdam wall itself” occurs.	The Hydrodynamic Modelling Report in the 100% RD has been updated to reflect this comment
EPA	52	Hydrodynamic Modeling Report - Appendix F – Section 4.2.1 Sedimentation Study with Cofferdam Analysis	Explain how the limited sedimentation analysis that was performed in this study has been taken into account form the design of the cofferdam.	Results from the sedimentation analysis were taken into account by the design team on potential scour at the cofferdam wall and the corresponding design of scour protection.

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Comment Source	Item No.	Reference	Comment	Response to Comment
EPA	53	Hydrodynamic Modeling Report - Appendix F – Section 4.2.1 Sedimentation Study with Cofferdam Analysis and Section 4.2.2 End-State Conditions Analysis Tables 8 through 15	It is counter-intuitive that the 95% maximum shear stress and velocities decline as one goes from a 2-year to a 100-year flood event. In the past, sediment erosion in this area has been associated with extreme flood events, and Appendix F does not provide an adequate explanation for the apparent contradiction of documented erosion and the model results. Could this be because the number of active “wet” model cells increases at higher flows? If so, then the 95th percentile is not really the relevant metric to look at, and the comparison needs to be made at specific key locations. Or is it due to backwater effects from Buffalo Bayou flooding? Although a flood event in the San Jacinto watershed is also likely to produce high flows in the Buffalo Bayou watershed, it does not follow that a 100-year flood flow in the San Jacinto would correspond to a 100-year flood flow in Buffalo Bayou. If that assumption was used in the scenario boundary conditions, it would produce unrealistically high backwater conditions and thereby reduce velocities. GHD should perform some sensitivity analysis on boundary conditions, and to simulate actual historical peak flow events.	The Hydrodynamic Modelling Report in the 100% RD has been updated to reflect this comment. Open boundary surge conditions have been adjusted and maximum shear stresses and velocities have been analyzed instead of 95 percentile values for shear stresses and velocities.
EPA	54	Hydrodynamic Modeling Report - Appendix F – Section 4.2.2 End-State Conditions Analysis	This section states that the model simulations were used to analyze the resulting sedimentation, however it does not appear that this was performed. It is stated previously the analysis was limited to a qualitative study. Please clarify whether the analysis was performed, and if so, the results of that analysis and how they are incorporated into the design.	The Hydrodynamic Modelling Report in the 100% RD has been updated to reflect this comment and to clarify that instead of a sedimentation model, only a qualitatively sedimentation analysis was performed based on shear stresses and velocities from the hydrodynamic model.
EPA	55	Hydrodynamic Modeling Report - Appendix F – Section 4.2.2 End-State Conditions Analysis	On page 25, in the second paragraph change “Table 12 and Tables 13” to “Table 12 and Table 13”.	The Hydrodynamic Modelling Report in the 100% RD has been updated to reflect this comment.
EPA	56	Hydrodynamic Modeling Report - Appendix F – Section 4.2.2 End-State Conditions Analysis	Please indicate that on Page 24, in the third paragraph that the maximum values of the shear stress are for the 2-year storm.	The Hydrodynamic Modelling Report in the 100% RD has been updated to reflect this comment.
EPA	57	Hydrodynamic Modeling Report - Appendix F – Section 4.2.2 End-State Conditions Analysis, Figure 30	It is hard to detect the circulation pattern that is supposed to be shown in this figure. Velocity vectors should be added to aid in interpretation. Additionally, the sentence in the fourth line of the second paragraph on page 27 appears to be missing at least one word. Please review and correct.	The Hydrodynamic Modelling Report in the 100% RD has been updated to reflect this comment. Since the figures show maximum speed at each cell, they do not correspond to the same time step for each cell and it was therefore concluded that the addition of velocity vectors would create more confusion rather than aid in interpretation of circulation patterns.
EPA	58	Hydrodynamic Modeling Report - Appendix F – Section 5.2 Sedimentation Analysis - Cofferdam	Explain why the difference (1.84 Pa) in the maximum value of the 95th percentile shear stress is so large.	The Hydrodynamic Modelling Report in the 100% RD has been updated to reflect this comment. Large differences in velocities and shear stresses occur north of the cofferdam since the presence of the cofferdam creates a redistribution of the flow. The flow that previously was distributed along that area and the area of the Northern Impoundment now is all moved to the north.
EPA	59	Appendix I - BMP Structural Design Report - Section 3.0 Design Parameters	The design does not consider the possibility of failure due to waves spilling over the cofferdam and its effect on lowering the actual storm protection provided by the wall. It is recommended that a calculation of wave height and freeboard on BMP be calculated, and the effect of extreme storm protection be updated to evaluate the mechanism.	The 100% RD addresses potential wave loading on the BMP wall. The BMP wall is designed for two water levels, 1) usual condition with water at elevation +5 ft (freeboard of 5 ft) and 2) unusual and extreme condition with water at elevation +10 ft (flood stage, no freeboard).
EPA	60	Appendix I - BMP Structural Design Report - Section 3.1 In-Situ Soil Parameters	The design does not determine if soils at the mudline will lose strength due to cyclic wave action during a hurricane and therefore does not determine if an adjustment to the calculation of cofferdam stability to account for reduced soil strength during extreme events is required.	100% RD describes the limited potential for wind and wake waves in the vicinity of the BMP. It takes a combination of high water level and sustained wind to generate waves in the area. There will be limited interaction of the waves with mudline. The mudline on the interior and exterior of the BMP is protected against scour due to increased flow around the walls.

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EPA	61	Appendix I - BMP Structural Design Report - Attachment 2.1	It is not clear from the provided information what soil properties were estimated and/or laboratory tested to include in the soil properties calculation. This information would help explain selection of fill material source and properties as well as providing an explanation of the reason Young's Modulus is significantly different from Beaumont Sand.	Soil parameters used in the design are provided in Section 2 of the BMP Design report, with additional information in Attachment 1. The same parameters as input in the analysis models are noted in Attachment 2.
EPA	62	Appendix I - BMP Structural Design Report - Attachment 2.2 Section 3.2.1.1.4	It appears that the C1 Drained Model Results were include twice, please clarify and update if required.	This comment is received and noted. Analysis sections have been revised in the 100% RD. The analysis results for each section are tabulated in Attachment 3.
EPA	63	MNR Plan and SSA - 90% RD - Section 6.1.4 SSA Conclusions and All Design Components	The SAA was approximated based on historic photos. However, the results of the remedial design investigation should be used to further define the boundaries of this area. The MNR plan references the “beach area,” and discusses samples taken in this area. The shoreline varies depending on the background map, and the shoreline changes over time, and may not be the same shoreline from historical photos. An additional analysis of shoreline changes in the SSA through time based on historical aerial/satellite images should be conducted and presented in the 100% RD. This information should also be presented in an updated figure that includes the locations of the SSA borings from the RI and PDI-2. Section 6.1.4 SSA Conclusions should be updated to include any additional conclusions about shoreline change as it relates to interpreted erosion/deposition over time in the SSA. The MNR plan should be clear regarding the boundary of the SSA area and whether the area applies to the beach area. Appendix G, Figure C 2 shows the SSA boundary extending past the labeled top of bank. Updates to the revised SSA boundary should be made throughout all design drawing documents.	The aerial extent of the SSA was established in the ROD and is not proposed to be modified. Aerial photos dating back to 1938 are provided in Appendix K-3 of the 100% RD with the SSA overlain; however, it is important to note that significant changes related to the SSA are due to man-made activities. Sampling locations from the RI and PDI-2 have been overlain on the historical aerial images and are provided in Appendix K-4 of the 100% RD. The MNR Plan does not include the Beach Area. Reference to the Beach Area was removed from the MNR Plan so as to avoid any confusion.
EPA	64	MNR Plan - Appendix J - Section 6 – Monitoring Program - Sample Locations and Data Evaluation	The MNR plan proposes an arithmetic mean concentration of the nine composite samples from the entire SSA area be used determine if the remedy is protective. However, of the nine locations sampled, 5 of the samples did not show contamination. These sampling results should inform the area to be sampled as part of ongoing MNR, but not be used for averaging SSA concentration levels. The Feasibility Study report states that MNR would be used to reduce the concentration to sediment PRG (30 ng/kg TEQDF,M) in the SSA area, which suggests that MNR should focus on areas in the SSA with concentrations greater than the PRG considering the fact that the mean TEQDF,M concentration in the SSA has been below 30 ng/kg since 2010 before ROD was issued (Section 6.5 in the plan). The approach proposed in the 30% design focused MNR monitoring on the area around SJSSA06, SJSSA08, and SJNE032 with dioxin concentrations greater than 30 ng/kg TEQDF,M. The polygons on Figure 1 which are already below 30 ng/kg TEQDF,M in all depth intervals may be monitored at lower frequency to ensure that those areas remain below the cleanup level, but those clean areas should not be averaged with the locations of known contamination. The 100% RD should propose a sampling plan consistent with these comments.	The institutional control proposed for the SSA includes the entirety of the SSA; therefore, the composite results from all nine locations within the SSA should be included when calculating the arithmetic mean concentration for the SSA. Selectively including or excluding samples from within the defined SSA will bias the results and effect of the remedy.
EPA	65	MNR Plan - Section 6.3 – Monitoring Program - Sampling Frequency	The 90% RD proposes that monitoring of the SSA will be discontinued if the mean concentration of samples collected in the SSA is below 30 ng/kg TEQ for two consecutive years after submission of the Remedial Action Completion Report for the Northern Impoundment. Two (2) sampling events are proposed in the Plan. EPA does not agree that this sampling will show whether the remedy is protective, and requires sampling to continue until, at a minimum, the first Five Year Review, where EPA can evaluate all sampling results and plans.	The sampling schedule in the MNR Plan has been amended.

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EPA	66	ICIAP - Appendix J - Attachment 7 - Section 2.1 Background	The sentence “Results of the sampling event indicate that the SSA has generally been depositional since the mid-1960s” is not fully supported by the results of the Lead-210 sampling which showed deposition at 4 locations, erosion at one location, and variable erosion/deposition at 4 locations. Please revise to be consistent with Section 6.1.4 of the 90% RD.	This sentence has been struck from the ICIAP submitted as part of the 100% RD..
EPA	67	ICIAP - Appendix J - Attachment 7 – Figures 1 and 2	The 100% RD should include revised Figures 1 and 2, which were not included in the original submission. These figures were provided to EPA for review on December 5, 2024.	Figures 1 and 2 were added to the ICIAP submitted as part of the 100% RD.
EPA	68	90% RD - Section 6.1.4 SSA Conclusions – Sand Separation Area	Was erosion modeling performed on the SSA, in particular the shoreline? Has it has been observed that there is increased fleeting activities in the area of the SSA that could be affecting erosion and deposition?	Erosion modelling was not performed on the SSA. Results of the 2019 sampling event indicate that the SSA has generally been depositional since the mid 1960s. Fleeting activities in the area may have impacted deposition and erosion. Sampling within the SSA under the MNR Plan will evaluate the effectiveness of MNR for the SSA, but cannot account for potential fleeting impacts in the area.
EPA	69	ICIAP - Appendix J - Attachment 7	Include figures 1 and 2 that were not included in this attachment.	Figures 1 and 2 were added to the ICIAP submitted as part of the 100% RD.
EPA	70	90% RD - Additional Figure	The 100% RD should include an updated figure showing the RI and PDI-2 sediment sampling locations in and near the SSA with a visual representation of dioxin concentrations at depth intervals, and a table summarizing the dioxin results from those samples, as provide at EPA’s request during review of the 90% RD.	An updated Figure 2-4 has been provided to address the comment.
EPA	71	Pre-Final 90% Remedial Design - Northwest Corner - 5.12.2.2 Northwest Corner Challenges – Risk from Flooding	The risk from flooding evaluation should consider the same potential for effects on areas using dry excavation versus having the area filled with water during an overtopping of the cofferdam wall. Once an overtopping event occurs, the water should provide a buffer from the potential turbid effects of the impacted sediments. The dry excavation could potentially cause a more turbid environment on the inside of the cofferdam because of the waterfall effect between the high water and lower dry excavation areas. This scour effect could potentially erode the proposed newly placed protective clean fill layer. It may also take a longer period of time to bring in clean fill to cover the exposed sections of excavation areas in the dry versus dropping the suspended sediments out of the water column in areas being dredged.	To address the potential for scour during an overtopping event, scour protection has been added adjacent to the interior of the BMP. The scour protection will include 3 feet of 18-inch rip rap that is grouted with 3,000 psi flowable concrete. The scour protection will extend 30 feet out from the wall. The mechanism of filling the interior of the BMP with water to mitigate the erosional impacts of a potential overtopping was evaluated and the use of scour protection was found to be a more suitable and effective approach. If the interior of the BMP was filled with water, this would create a significant project delay in order to remove and treat the water and would likely require a more robust water treatment system to handle such large volumes of water potentially multiple times each year.
EPA	72	Pre-Final 90% Remedial Design - Northwest Corner - 5.12.2.2 Northwest Corner Challenges – Risk from Flooding	An additional consideration in mitigating the risk of mobilizing sediment in an overtopping event should be the evaluation of the addition of flocking agents to the water. The risk of a release during an overtopping event could be mitigated by quickly dropping the suspended sediments out of the water column, especially if the entire excavation was being performed in a containment that was flooded to average river depths. Once a storm system has been identified, it should not take long to drop the suspended sediments out of the water column and consolidate them on the bottom. This would provide a protective water layer to help prevent the scouring effect during an overtopping event, without the risk of impacted sediments being removed from the cofferdam area.	A High Water Preparedness Plan (HWPP) has been added to the 100% RD. The HWPP includes the option to apply chemical additives (polymer and/or coagulant) to active dredging areas that have not been covered to settle potential suspended solids and/or apply a cover layer to protect the area in the event of a potential major flood that could overtop the BMP. The mechanism of filling the interior of the BMP with water to mitigate the erosional impacts of a potential overtopping was evaluated and the use of scour protection was found to be a more suitable and effective approach. If the interior of the BMP was filled with water, this would create a significant project delay in order to remove and treat the water and would likely require a more robust water treatment system to handle such large volumes of water potentially multiple times each year.

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EPA	73	Pre-Final 90% Remedial Design - Northwest Corner - 5.12.2.2 Northwest Corner Challenges – Working Season	The design specifies that the excavation will occur in seasons (November to April) over approximately 7 years. The changes in the design from the 30% RD submittal to both portions of the 90% RD submittal have either removed features designed to support the excavation season approach (e.g. flood gates) or have gaps in the design that would be required to support this schedule. It should also be noted that this phased approach does not appear to match the industry standard for marine construction in the area where work is conducted year-round. Furthermore, the working season approach appears to be more based on the design as submitted (e.g. wall height, sediment removal methods, potential flooding, etc.).	The Respondents completed a detailed evaluation of the river levels and work schedules to define the approach to effectively complete the project while achieving no release to the river as stated in the ROD should a BMP overtopping event occur. The 100% RD provides the option of possibly extending the excavation season into May, June and July on a case-by- case basis following a HWPP. The HWPP provides the procedures for monitoring the area rainfall and river elevations as a predictive tool to provide clear directions to the Remedial Contractor for managing the work site during high water events. It is acknowledged that the industry standard for marine construction in the area may allow for work year round. However, most marine projects do not have a requirement for "no release" to the environment in an area highly susceptible to flash floods and tropical storms.
EPA	74	Pre-Final 90% Remedial Design - Northwest Corner - 5.12.2.2 Northwest Corner Challenges – Risk from Flooding	The design does not provide clear direction for environmental controls and procedures for the wastewater treatment plant during storm events. The RD should include the basis for design of the plans and procedures to prevent releases from the wastewater treatment plant during storm events, as well as guidance or procedures for treating water in the containment prior to an event.	The 100 % RD includes berms around the WTS to 10 ft NAVD88 to protect against high water events. A HWPP has been added to the 100 % RD to describe the specific actions that will be taken to protect the WTS during a high water event, including the emptying the tanks and treating the water and adding clean ballast water to the tanks, as necessary, to provide stability.
EPA	75	Pre-Final 90% Remedial Design - Northwest Corner - 5.12.2.2 Northwest Corner Challenges – Increased Excavation Depth and Volume	The design as presented does not accommodate the potential need to excavation to a greater depth. The objective of the design is clearly defined by the ROD as the removal off all the contaminated material 30ng/kg, and it has also been discussed that the design should accommodate the ability to perform over-excavation to a greater depth if required based on post confirmation excavation sampling. The design makes no provision for this to be implemented and simply uses the limitations of the design itself as the reasoning for not being able to perform the over excavation.	The design of the BMP allows for a 2-foot overcut from the initial excavation depth which was based on the significant amount of delineation borings installed.
EPA	76	Pre-Final 90% Remedial Design - Northwest Corner - 5.12.3.2 Northwest Corner Challenges – Schedule	This section discusses the potential need to extend the schedule to 7 years or more due to the amount of waste requiring excavation, as well as citing potential access issues due to planned TxDOT bridge update project. Additionally, the section discusses possible delays that could occur due to having to dredge portions of the site, as well as schedule delays that could be caused by the need to cap portions of the site between excavation seasons and having to uncap them for the next season. Finally, treatment of water within the BMP is discussed as a possible source of uncertainty schedule issues and possible cause of schedule delays. The entire premise of this section is based on the concept that the design cannot effectively meet the requirements of the remedy, yet no discussion is made as to possible modifications or considerations that can be made to mitigate these impacts. Several options could have been considered to mitigate these issues from potentially causing scheduling impacts on the project. Consideration could have been given to more extensive use of excavating through the water column and using a marine based approach. Logistically, using a marine based approach could help with the pinch point of the common access road to the site, and simplify the coordination with TxDOT. Alternative sediment handling methodologies should also have been explored.	The schedule risks cannot be completely eliminated, including the timing of access to the TxDOT ROW. As discussed in Section 5.8.2.1 of the 100 % RD, a marine-based approach was considered and evaluated, but was determined to not be the preferable alternative due to infrastructure requirements and multiple handling events of waste over water, increasing the risk of a release However, the 100 % RD has been modified to include other elements that decrease the schedule risks on the project, including: 1) Conducting confirmation sampling prior to excavation to decrease the risk of delay due to sampling, analytical and additional excavation. 2) Increasing the height of the BMP wall to decrease the potential for overtopping and the associated delays. 3) Including a HWPP to provide the procedures for monitoring and contingencies to potentially extend the work that can be done during the non-excavation season and to minimize the impacts and delays from a high water event. 4) Adding barge strike protection to minimize the potential damage to the BMP from a barge strike and the associated delays. 5) Adding interior scour protection to eliminate the need to flood the BMP during the non-excavation season and the associated time it would take to remove and treat that water prior to the next season.

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EPA	77	Pre-Final 90% Remedial Design - Northwest Corner - 5.12.3.2 Northwest Corner Challenges – Water Treatment	The challenges presented by the Respondents do not provide consideration of methods or design modifications that could mitigate the challenges presented. Consider the different solutions to removing suspended sediments from the water column within the BMP after the dredging operation has been completed. The contaminants are mostly adhered to the sediments and not as much in the dissolve phase. Consider the removal of the sediments from the water column by either mechanical or chemical means. These methods are proven in this type of work and should be considered BMPs for any dredging operations. Optimizing treatment of the water by using mechanical and/or chemical means of solidification before going to the WWTP could increase the efficiency of the WWTP. This could not only be used with the turbid waters during dredging, but also handling of water as part of the dredging of the sediments and the remaining water once the sediment removal is complete. Such an example of mechanical means would be the use of something similar to a del total clean, plate frame presses, hydrocyclones, or similar equipment that can quickly dewater the dredged sediments and the suspended sediments remaining. Additionally, controls for use within the BMP to segregate and manage sediment impacted waters resulting from removal activities should have been considered as well. Bubble curtains within the dredge area could be used to provide a mechanical means to drop the sediment out of suspension in the water column and minimize it being spread outside the current excavation area. Another example would be a chemical means to drop the suspended sediments out of the water column such as alum and pelletized activated carbon (PAC). This has been shown in publications to work very quickly and efficiently. Once the sediment has been removed from the water column, the water treatment process then would be more straightforward.	Following submittal of the Northern Impoundment 90% RD, the water treatment process was demonstrated to be effective for the work on the Southern Impoundment and lessons learned from that project have been incorporated into the 100% RD. For the dredging work, the RC is required to add a treatment step to remove solids from the decant water, if necessary, prior to treatment in the WTS. The 100% RD has geotextile tubes as the solids removal technology, but the RC has the option to provide another technology, such as those listed in the comment, if it better suits their means and methods and can be demonstrated to be effective. A Residual Management Plan has also been added to the 100% design, which presents an evaluation of methods to manage the residuals and to control residuals that are suspended in the water column. This includes the application of polymers and/or coagulants, as needed, to promote the settling of suspended solids.
EPA	78	Pre-Final 90% Remedial Design - Northwest Corner - Appendix B-1 Northwest Corner Hydraulic Heave Evaluation - Section 1.3 - Geology	It is unclear how the conclusion of gravelly sand being connected to Beaumont Sands or the Chicot Aquifer was derived. Later in the report it is also indicated that the Beaumont Sands are potentially hydraulically connected to the deeper sand layer. The basis for this statement is unclear.	This comment refers to a report that has been replaced by the Updated Hydraulic Heave Analysis Report submitted as part of the 100% RD. As addressed in the Updated Hydraulic Heave Analysis Report, in general, the gravelly sand has the potential to connect to the Beaumont Sands or the Chicot Aquifer. Refer to Figure 5 of the Geotechnical Report (Appendix B) where the lower gravelly sand (blue) shown is in contact with the upper sand deposit between El. -57 and El. -66. There is also potential that the Beaumont Clay (green) does not act as an aquitard or aquiclude between the gravely sand (blue) and the Beaumont Sands.
EPA	79	Pre-Final 90% Remedial Design - Northwest Corner - Appendix B-1 Northwest Corner Hydraulic Heave Evaluation - Appendix J – Design Drawings	The updated excavation boundary for the NW corner shows that the excavation area near sample location SJSB100 does not extend to the TCRA cap edge. The 100% RD should provide for removal of waste to the boundary of the TCRA cap.	Appendix B-1 is obsoleted. The excavation boundary has been revised as depicted in the Excavation Elevations and Associated Design Drawings provided in Appendix G.

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TxDOT	80	TxDOT - 90% RD General Comments	• TxDOT is concerned regarding the effect of 90% RD bridge alignment on proposed protective structures. TxDOT provided an aerial bridge layout showing the revised cofferdam and access road configurations, which shows an overlap of the revised cofferdam wall and TxDOT bridge protective structures. • TxDOT is concerned regarding the access road in the TxDOT ROW being used by both TxDOT and EPA. TxDOT requested cross sections of the access road to review footprint, side slopes, etc. since they did not see them in 90% RD. • TxDOT is concerned regarding cofferdam/BMP footprint o TxDOT stated 90% RD showed wall was moved further into TxDOT ROW than had previously been discussed. o TxDOT expressed concern that the location of the cofferdam is so close to the existing and proposed bridges, as it may not provide enough room for the demolition of the existing bridge and the construction of the new bridge. o TxDOT asked EPA to look into thinning the footprint up as much as possible. • TxDOT confirmed that their previously shared diagrams showing the locations of the bridge protection structures were still relevant, and there is still an overlap of the protective structures and the cofferdam wall. • TxDOT expressed that the final sloped embankment should be “a permanent slope and not something that can be scoured out.” TxDOT also stated GHD needs to consider loading of the riprap berms on the final slope. • TxDOT agreed that the Southern wall may be cut instead of removed. Details were to be discussed.	These wall types and alignments have been discussed and addressed between GHD, RPs, TxDOT, and EPA during routine meetings. Additional drawings, wall design details, end-state conditions have been provided to TxDOT, and it is the Respondents' understanding that TxDOT's specific technical concerns noted in this comment have been addressed, either in the referenced meetings or in the 100% RD. Respondents are in discussions with TxDOT regarding an agreement that provides for the use of the ROW and it is understood that TxDOT is conducting ongoing "due diligence."

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Comment Source	Item No.	Reference	Comment	Response to Comment
TxDOT	81	90% RD - Southern Cofferdam Wall in TxDOT ROW	• The 90% RD proposes a double sheet pile wall cofferdam with backfill added above existing ground all the way to the top of the sheet pile walls. The distance between sheet piles is 30'. Given that the specific section of the cofferdam is not retaining much earth (or water) behind it, TxDOT is requesting that the footprint of the cofferdam is reduced so that encroachment in TxDOT's ROW is minimized. TxDOT is specifically concerned the wall footprint will not allow them to place the cranes needed for the phase two work (demolition and construction of northernmost bridge within current bridge footprint). Since the 90% RD proposes a shelf on the inside of the wall, TxDOT believes structurally there could be a single •wall, or a double wall with less fill space. Ideally TxDOT would prefer the wall to be a single wall and not in the ROW at all. • EPA Review of Wall Type Evaluation as detailed in in the BMP Design Structural Report (Appendix I): o Combination Wall – The concern in the 90% RD was that it would be too difficult to drive through the hard sand layers and would create vibrations. To address this concern, consider a Giken driving machine that can install tubular walls by applying down force and rotation. A combi-wall with either pipe piles or h-piles may prove to be structurally sound given the revised wall placement. Additionally, consider the updated vibration analysis when reevaluating this wall type. o Cantilever Concrete Secant Pile - This method is robust and requires a lot of coordination. However, the statement of the sheet piles not being watertight for this system needs to be clarified more. Consider seem sealed piles, which are regularly used for dewatering sites and environmental cleanup sites with cofferdams. With the added layer of concrete filled reinforced piles, this option may work for being watertight. Additionally, consider the updated vibration analysis when reevaluating this wall type. o Double wall system – This wall type was selected for the Southern portion of the cofferdam, and is the same as the wall proposed for the remainder of the BMP. However, given the added soil buttress, this wall will now be installed on a peninsula and does not have the same external forces to compete with that the remaining wall does.	These wall types and alignments have been discussed and addressed between GHD, RPs, TxDOT, and EPA during routine meetings. Additional drawings, wall type evaluations, wall design details, end-state conditions have been provided to TxDOT, and it is the Respondents' understanding that TxDOT's specific technical concerns noted in this comment have been addressed, either in the referenced meetings or in the 100% RD. Respondents are in discussions with TxDOT regarding an agreement that provides for the use of the ROW and it is understood that TxDOT is conducting ongoing "due diligence."
TxDOT	82	90% RD - Southern Cofferdam Wall in TxDOT ROW - Section 5.2 - Remedial Approach	The 90% RD proposed a significant change by adding a soil buttress to the inside of the southern portion of the cofferdam to stabilize the wall. Therefore, because of the new wall alignment and added soil buttress, the 100% RD should re-evaluate additional wall types for the Southern portion of the BMP to minimize the necessary encroachment onto the TxDOT ROW. EPA suggests Respondents evaluate various technologies and combinations of options to address this issue. For example, given the addition of a soil buttress on the inside of the cofferdam, a single wall with reinforced stability through either struts, walers, or using a combo wall may address TxDOT's concern regarding the footprint, while adding strength and stability. The updated Vibration Analysis should be considered in the evaluation. The wall types should be evaluated in addition to those presented in Appendix I, such as a single sheet pile wall with tie backs or a berm on existing ground or other seepage barriers/walls that would serve the purpose of flood protection and soil stabilization.	These wall types and alignments have been discussed and addressed between GHD, RPs, TxDOT, and EPA during routine meetings. Additional drawings, wall type evaluations, wall design details, end-state conditions have been provided to TxDOT, and it is the Respondents' understanding that TxDOT's specific technical concerns noted in this comment have been addressed, either in the referenced meetings or in the 100% RD. Respondents are in discussions with TxDOT regarding an agreement that provides for the use of the ROW and it is understood that TxDOT is conducting ongoing "due diligence."
TxDOT	83	90% RD - Southern Cofferdam Wall in TxDOT ROW - Rip-Rap Bridge Protection	Currently the footprint for the proposed protection riprap berms at the vicinity of the North Impoundment overlaps with the proposed cofferdam. The exact limits will be tweaked as TxDOT progresses the design. TxDOT has stated that protecting the bridge sooner rather than later is important. Respondents should further discuss the timing of the installation of the riprap with TxDOT and address this issue in the 100% RD.	These concerns are noted and discussions between GHD, RPs, TxDOT, and EPA will continue.

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Comment Source	Item No.	Reference	Comment	Response to Comment
TxDOT	84	90% RD - Inadequate Consideration of Alternatives to Trucking	Although TxDOT notes transporting excavated soil exclusively by barges may not be feasible, TxDOT suggests that a contingency plan be developed in case schedules overlap. TxDOT cannot guarantee unobstructed use to the access road on the north. TxDOT believes that with coordination both projects can access the ROW, but there will be points in the schedule where they will need 100% access to the ROW. For example, when they are demolishing the old bridge and building new bridge in current bridge footprint (phase 2), they will have equipment and trucks for demo and construction. When they are placing beams, they will have multiple large cranes in the ROW, which may block access for weeks. Although TxDOT can attempt to sequence around the Superfund project, schedules can change. Therefore, TxDOT prefers a contingency plan with an alternate method of transporting the excavated material in place in case schedules coincide.	These concerns are noted and routine discussions between GHD, RPs, TxDOT, and EPA have taken place, including conversations regarding the comments, and will continue. Until the actual schedules and designs for both the Superfund and TxDOT projects are known and finalized, working through potential project/schedule conflicts cannot be addressed.
TxDOT	85	90% RD - Site Restoration	TxDOT noted they had reviewed draft, conceptual sketches provided by GHD after the 90% RD submission, but they have given no written approval. TxDOT requests updated engineer drawings (cross-sections) with back fill grading and rip-rap specs so that they can do their own safety analysis. TxDOT is concerned about slope stabilization protection given the hole that is proposed to be left in place. Engineering drawings should show final end state river bottom elevations.	Restoration cross-sections have been previously provided to TxDOT and are included in the design drawings included as Appendix G.
TxDOT	86	90% RD - Site Restoration	To address the scenario of a double wall in the TxDOT ROW, TxDOT provided a drawing showing a typical section found in GHD's 90% design plans for the south section of the North Impoundment cofferdam with the information for the proposed stone rip rap berm (attached) This drawing also provides the specific gravity and porosity values for the proposed stone rip rap. The RD contractor should estimate the surcharge load coming from the berm for the design of the cofferdam. TxDOT has stated that "given that the south section of the cofferdam is not really retaining much earth behind it, it is very likely that the added surcharge load from the berm will not change GHD's current design. Length of sheet piles appears to be controlled by embedment into an impermeable soil layer below and not from retained earth load requirements."	These concerns have been discussed and addressed between GHD, RPs, TxDOT, and EPA during routine meetings. The sheet piles will be completely buried in the end condition (cut-off at elevation +2 ft or minimum 1 ft below the final grade). The overburden from the rip-rap berm will not impact the wall in the end condition as it will have plenty of soil embankment to provide lateral support. The load will be distributed over soils and the impact to buried BMP can be ignored.
TxDOT	87	90% RD - Site Restoration	TxDOT expects that after cleanup is complete, the sheet pile section of the cofferdam to the North (closest to TxDOT's ROW) can be cut 1ft below existing ground and any added fill used behind it removed as shown in this section. The sheet pile section to the South can be left buried under the proposed protection berm. Outside the footprints of the berms we probably want to have both sheet pile sections cut 1ft below existing ground and all added fill used in between removed."	Based on TxDOT's agreement to allow the BMP walls to remain in place if terminated at least 1 ft below natural grade, the BMP along TxDOT ROW will be terminated below the natural grade.
TxDOT	88	90% RD - Site Restoration	Regarding the design life of the wall, TxDOT has stated that "for the section of the cofferdam within TxDOT's ROW, a marine-grade immersion coating system is applied to both sheet piles (prior to installation) from the top of the sheet pile (EL +9.0) to a depth of 15ft below existing ground (similar to what is specified in TxDOT's Spec Item 407 for steel piles). We also suggest that coating meets the requirements of NORSOK Standard M-501 Coating System No. 7."	TXDOT Spec 447 Type 13 coating is specified in the Sheet Pile Specification 31 41 16 for the southern alignment. This is consistent with TXDOT Spec Item 407 for Steel Piles. NORSOK Standard M-501 was developed for coating structures in the offshore industry. The sheet piles along the southern alignment (TXDOT ROW) will not be exposed to river water on a daily basis during excavation. There will be limited corrosion due to atmospheric exposure for the duration of the excavation project. In the end condition, the sheets will be cut below grade and tie-rods will be removed so there is no structural function of the BMP walls. Any corrosion will not affect any functionality. Hence, the zinc-rich epoxy and glass flake epoxy coating (No 7) system for buried sheet piles is not required for the sheet piles.
TxDOT	89	90% RD - Vibration Analysis	Due to the proximity of the proposed cofferdam to the existing bridge foundation, TxDOT recommends a hydraulic/vibratory hammer is used (instead of an impact hammer) when driving the sheet piles for that section of the cofferdam.	This comment has been received and is noted. Sheet Pile Specification 31 41 16 notes press-in and vibratory pile hammers as the two approved equipment.

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TxDOT	90	90% RD - Vibration Analysis	TxDOT recommends the EPA contractor install instrumentation to monitor any vertical and horizontal movement of any structure(s) that may be affected by the placement of any piles nearby. Although there is no specific guidance, TxDOT states that there have been monitoring systems used in the recent past for TxDOT bridges.	The sheet pile specification has been revised to include language around monitoring during sheet pile activities and excavation.
TxDOT	91	90% RD - Vibration Analysis	As-built drawings of the existing IH 10 WBML bridge foundations should be considered in the vibration analysis.	Updated vibration analysis show insignificant vibrations at 25-ft from the BMP walls. Vibrations will be mitigated based on the required use of silent, press in driver, or similar.
TxDOT	92	90% RD - Vibration Analysis	TxDOT encourages ongoing communication and coordination with stakeholders to ensure a safe design. Elements of the Superfund design (BMP footprint, ROW usage, schedule conflicts, etc.) will require close coordination with TxDOT going forward during both the RD and subsequent RA phases of the project.	Ongoing communication and coordination with TxDOT and stakeholders will continue.
TCEQ	93	90% RD - Section 2.3.5.2 Surficial Sediments Geotechnical Properties	Please add an explanation of the sampling objective for geotechnical analysis of the deposited surficial sediment and how this data will be used in the design.	As stated in the introductory paragraph (Section 2.3.5), the sampling was performed to support design of the turbidity control measures during installation and removal of the BMP. The geotechnical tests listed are classification tests to measure the general material properties of the surficial sediments to be encountered to provide information on how the material will behave during BMP installation/removal.
TCEQ	94	90% RD - Section 2.3.7 Summary of SDI Results	Please briefly summarize the results of the sediment and rock thickness measurement that was presented in section 2.3.5.1.	This comment has been addressed within the 100% RD Section 2.3.5.1.
TCEQ	95	90% RD - Section 3.4.1 Water Discharge Criteria	Please add a clarification of which of the calculated preliminary discharge criteria are going to be used for compliance measurement parameters during the RA, if any? If none will be used for compliance assessment during the RA, please clarify in the text that the calculated preliminary discharge criteria were only used to evaluate water treatability testing results.	100% RD has been revised in response to this comment.
TCEQ	96	90% RD - 3.4.2.3.1 Filtration Pilot Test Results	This section states that based on the observed relationship between turbidity and TSS, turbidity levels can be used as an indication of the TSS concentration. Please add a figure or table demonstrating this site-specific correlation.	The 100% RD, within section 3.4.2.3.1, includes treatability data showing the correlation of turbidity to TSS.
TCEQ	97	90% RD - Figure 5-B BMP Alignment and Excavation Extent	Please mark the Best Management Practice (BMP) sections with raised bench or less than 30-ft soil buttress on Figure 5-B that are described in the accompanying text. This figure should be included at higher resolution such that the symbols display clearly.	The raised bench can be found in the design drawings within Appendix G.
TCEQ	98	90% RD - Section 5.2 Remedial Approach, Top of Wall Elevation	This section states that the +9 design top elevation will not eliminate the risk of overtopping and the protectiveness will be verified following receipt of modeled data from the Coastal Water Authority; please explain when the data is expected to be available and what corrective actions are planned if this design top elevation is determined to not be adequately protective during excavation season. Also, it is stated that intentionally flooding the Northern Impoundment would off-set the forces acting on the BMP and prevent uncontrolled overtopping during the off-season. Please clarify if flooding would be limited to the already excavated area or to the whole northern impoundment within the BMP, and what is the targeted flooding water level inside the BMP?	The 100% RD was completed without the Coastal Water Authority Data. The Respondents do not know when that data may become available. There is no longer a plan to flood the BMP intentionally. The BMP can withstand an overtopping event, and scour protection has been added to protect the area inside the wall from scour during overtopping. In addition, the exterior BMP wall height has been raised to +10 feet to further attempt to mitigate overtopping.

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TCEQ	99	90% RD - Section 5.2 Remedial Approach, Excavation Methodology & Water Management	It is proposed that prior to excavation all the water inside the BMP will be pumped and discharged directly to the river. As previously discussed in Technical Workgroup meetings, the TCEQ is concerned that pumping near the cap surface will withdraw deposited contaminated sediment and recommends that water with high suspended solid (TSS) concentrations potentially associated with high dioxin concentrations should not be treated as river water and should not be discharged to the river without treatment.	This comment is addressed in Section 5.2 of the 100% RD. Following installation of the BMP, and at the beginning of each excavation season, river water trapped behind the BMP wall will be treated for solids and returned to the river until the water level is within 2 feet of the lowest point within the BMP. The remaining 2 feet of water and any infiltration or stormwater that accumulates in an open excavation will be pumped to on site water storage tanks, treated through clarification and filtration, and discharged to the river after compliance with discharge criteria is verified.
TCEQ	100	90% RD - Section 5.2 Re-use of TCRA Armored Cap and Historic Berm Material	This section proposes the reuse of cap rock material at the site during or after the Remedial Action. The TCEQ recommends that additional representative sampling of stockpiled cap rock be conducted prior to reuse to demonstrate that it does not have contaminated sediment or soil adhered to it and has not become contaminated by the process of removing the cap rock from the top of the geotextile or geomembrane. Any stockpiled cap rock that is found to be contaminated with waste material above the cleanup level should be sent for disposal rather than reused at the site. Additionally, the final sentence of this section states that locations of the historic berm and the TCRA armored cap rock planned for re-use are shown on Figure 3-5. Additional information should be added in this section to explain how the boundaries of the historical berm (in blue) and the cap rock reuse area (in green) were derived.	This comment has been addressed within the 100% RD and the Field Sampling Plan.
TCEQ	101	90% RD - Section 5.3.4 Excavation Extent and BMP Alignment, Vertical Extent FSP	This section states that the 90% RD uses an area-based average concentration site-wide approach as the design basis for the excavation contours proposed with a not-to-exceed threshold value of 300 ng/kg. Please clarify in the text that the confirmation sampling Decision Unit (DU) approach presented in the Field Sampling Plan will be followed, including in areas where the excavation target surface leaves material with dioxin/furan concentration greater than 30 ng/kg but less than 300 ng/kg. The composite sample from each ½ acre (or less) DU should include discrete sample material representative of the whole DU, including any polygons where a previous analytical boring has showed contamination over 30 ng/kg at the bottom of excavation. The TCEQ understands that the DUs shown in the Field Sampling Plan in Appendix J are conceptual and requests the opportunity to review and provide comment on the specific updated sampling plans for the DUs established by the Remedial Contractor during each excavation season. • To minimize the risk of re-excavation after confirmation sampling, TCEQ recommends extending the target excavation depth when deepest interval targeted for excavation has very high dioxin concentrations (e.g., borings SJSB073 and SJSB074 where the deepest waste concentrations are 30,000 and 83,000 ng/kg). • For borings where material exceeding the clean-up level is located under the proposed bottom of excavation target surface and clean material (SJSB032, SJSB048-C1, SJSB071, SJSB076, SJSB082, SJSB085, SJSB089, SJSB095, SJSB102), the TCEQ recommends that the target excavation surface be deepened to include all material above the clean-up level, consistent with the 2017 ROD requirement for “removal of all waste material that exceeds the clean-up level of 30 ng/kg regardless of depth”, or demonstrate that a representative composite sample from the affected depth interval(s) within the ½ acre (or less) DU which includes each of these borings meets the clean-up level.	The DU approach will be followed as described in the FSP. The 100% RD has been revised to specify removal of all material in the Northern Impoundment that is greater than the clean-up standard of 30 ng/kg with confirmation sampling prior to excavation. Therefore, the remainder of the comments are not longer applicable.
TCEQ	102	90% RD - Section 5.4.2 Northern Impoundment Preparation and Layout	In the final paragraph of this section, please describe measures that will be taken to ensure contaminated materials stored in the mixing areas do not contact underlying armored cap material or clean post-excavation surfaces or provide reference to the appropriate section or appendix where the information is provided.	This comment has been addressed within the 100% RD.

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TCEQ	103	90% RD - Section 5.5.3.4 Scour	Please clarify in the last paragraph if scour protection will be applied to the whole length of BMP or just at the sections with high potential of scour risk.	The 100% RD has been updated as exterior scour protection will be required around the majority of the perimeter of the BMP, spanning clockwise from the northwest corner to the east side of the BMP as the channel narrows near the I-10 bridge.
TCEQ	104	90% RD - Section 5.6.2.1 Cell Dewatering	Measures should be taken to minimize withdrawal of pore water from within the waste material and minimize fine sediment entrainment as the water within the BMP is pumped out prior to the start of each excavation season as discussed previously in Technical Workgroup (TWG) meetings; please update this section and the design specifications (Appendix H) to describe these measures or best management practices. TCEQ recommends that approximately the last remaining 2 feet of water that accumulates in low areas of the site should be routed through the water treatment system prior to discharge to the river. Please note that the TPDES General Permit No. TXR150000 requires appropriate controls be utilized to minimize the offsite transport of suspended sediments and other pollutants if it is necessary to pump or channel standing water from the site, and that stormwater discharges from basins or impoundments utilize outlet structures that withdraw water from the surface (Part III, Sections F.4.e and G.6).	The 100% RD will be updated to state that only approximately the last remaining 2 feet of water that accumulates in low areas within the BMP wall will be treated by the water treatment system prior to discharge to the river.
TCEQ	105	90% RD - Section 5.6.2.2 TCRA Armored Cap Removal	Additional details should be provided on how the armored cap rock will be removed in a way that minimizes risk of inclusion of any underlying waste material. Please consider requiring field staff to verify and document that the underlying geotextile and/or geomembrane is present and not torn or punctured as cap rock is removed for reuse.	This comment has been addressed within the 100% RD.
TCEQ	106	90% RD - Section 5.6.2.3 Excavation Procedures	Additional information should be provided in this section on how waste material handling onsite will be conducted in a manner to prevent spreading of any contaminated or potentially contaminated materials onto the armored cap or areas of the excavation that have been confirmed clean, where accumulated rainwater would be collected and discharged to the river without treatment. Also, this section states that waste material that does not have free liquids and does not need solidification may be loaded directly to the haul truck for disposal; please add an explanation of how field staff will determine if the waste material needs solidification or not (e.g. paint filter test). In addition, Figure 5-B indicates that some waste materials that require excavation are under the access road and the ramp into the BMP, this portion of the waste was not addressed in the design. Please explain how and when these materials are going to be excavated and removed from the BMP for offsite transport.	These comments are addressed in Section 5.6.3.3. As a general matter, these issues are ones that will be determined by the RC's means and methods.

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TCEQ	107	90% RD - Section 5.8.1.4 Water Volume and Storage	The TCEQ has the following comments about this section. • When the inside of the BMP is dewatered at the start of each excavation season, it is recommended that the mounded water category include pore water from within the armored cap interface with the waste material that drains laterally into surrounding topographic low. • The BMP is expected to cut off the infiltration from river water but will not block the potential upward seepage from groundwater, please ensure that this portion of water is considered in the water volume estimate in addition to the mounded water. • Regarding the subsection for Rainfall (1.e.), based on the BMP area and the maximum 24-hr rainfall level of 6.2 inches, the maximum 24-hr contact water generation should be 377,000 ft3 or 2.8 M gallons, not 415,000 ft3 and 3.1 M gallons (as is stated in Table 5-I). • In the subsection for Equipment Decontamination Water, it is indicated that since the area is within the BMP, it is accounted for by the rainfall assumptions. Please clarify whether the water used on a daily basis to decontaminate trucks and equipment is accounted for in this calculation and provide a justification if it is not included. • The final sentence of this section states that mounded water could be stored and treated on a batch basis. Please clarify if this planned batch discharge would include compliance sampling of the batch prior to discharge.	This comment has been addressed within the 100% RD.
TCEQ	108	90% RD - Section 5.8.2 Treatment System Design-Bag/Cartridge Filtration	This section states that during the operation of the water treatment system, 5 micron bag filters may be tested on a side-stream to evaluate if they can be used in place of the 1 micron filters. Please note that EPA's February 18, 2020 correspondence (included in Appendix D-1 of this report) indicated that EPA's determination that the Minimum Level for dioxins/furans could be used to demonstrate compliance with the Texas Surface Water Quality Standards is contingent on the water treatment facility using a 1 micron final filtration step in the water treatment process.	The 100% RD has been updated to require that all contact water to be treated through a 1 micron filter prior to discharge.
TCEQ	109	90% RD - Section 5.8.4 Compliance Monitoring	Please modify this section to explain the steps to be taken if analyses at the point of discharge indicate that effluent has not met discharge criteria for a regulated parameter, as laid out in Section 5.5.4 of the Final 100% RD for the Southern Impoundment dated April 19, 2021, which states "If analyses at the point of discharge indicate that effluent has not met discharge criteria for a regulated parameter, the EPA will be notified immediately and the system will then be shut down and/or effluent may be recirculated to the contact water storage tank(s), and additional performance checks may be performed on the treatment system, including but not limited to, checks and appropriate modifications with respect to chemical dose, checking to determine whether GAC and/or filter media and bag filters should be replaced, etc. Contingency measures may also include, but are not limited to, increased monitoring and notifications."	Revisions have been made to this section to address these comments. Treated effluent will be stored in the effluent tanks. The effluent will be sampled and analyzed for compliance with discharge requirements. If the contents of the tested effluent tank meet the discharge criteria, the contents of the tank will be discharged to the river. If the contents of the effluent tank do not meet the discharge criteria, the contents of the tanks will be pumped into one of the influent tanks for retreatment.

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TCEQ	110	90% RD - Section 5.8.4 Compliance Monitoring- Table 5-J	It is not clear how Footnote 3 is relevant to the Minimum Frequency of Measurement in this table. Footnote 5 is not referenced in the table and appears to contradict the sample type specified for pH and TSS in the table. Please remove footnotes 3 and 5 or otherwise clarify their purpose. Also, TCEQ's July 15, 2022, comment on Table 5.1 of the Field Sampling Plan also applies to Table 5-J: the standard analytical TAT given in Table 4.4.4 of the Addendum to the Final 100% Remedial Design- Southern Impoundment submitted to EPA on June 2, 2022, is 3-5 business days for TSS, Metals, and Dioxins/Furans. Please update the analytical TAT in Table 5.1 to be consistent or provide an explanation why 3-5 days is available for the Southern Impoundment, but 10-15 days TAT is proposed for the Northern Impoundment water treatment compliance samples. TCEQ suggests that the fastest practicable TAT be chosen to minimize lag in receiving compliance results while discharge is ongoing.	The 100% RD has been revised to address this comment, specifically in the FSP (Appendix J). The analytical TAT has been revised to 3-5 days in Table 5.1.
TCEQ	111	90% RD - Section 5.9.3 Odors SWMP Section 3.6	As TCEQ commented on the Site Wide Management Plan Section 3.6, if the use of odor-suppressing foams is necessary, the TCEQ suggests verifying that the foam is free of PFAS/PFOAs.	The referenced sections have been revised to address the use of PFAS free foams.
TCEQ	112	90% RD - Section 5.9.4 Turbidity Controls and Monitoring	This section states that turbidity monitoring data would be collected twice per day at the start of work, and only once per day thereafter if turbidity thresholds are below the thresholds in the SWMP. Turbidity monitoring should be conducted at a time that is representative of the turbidity generated by the work, not at the commencement of the workday when BMP installation or removal is just beginning for the day. Additionally, turbidity measurements should be taken after any event that results in a disturbance of sediment (such as a boat or barge becoming grounded during site work) or when there are visual observations of increased turbidity outside of turbidity curtains containing the work area. Also, please add a figure to show the flow directions around the Northern Impoundment to support the proposed turbidity control measures in the second paragraph and mark on the figure any sections where turbidity curtain deployment is not planned. It is stated that flow is towards the impoundment at the west side of the impoundment and a turbidity curtain is not needed, will flow direction change in that area as it does in the main channel? If flow direction changes and flow may be away from the impoundment, a turbidity curtain would be needed.	The 100% RD has been revised to address this comment, specifically in the SWMP (Appendix J).
TCEQ	113	90% RD - Section 6.1.3.1 SSA Analytical Results	Please reference or include the figure "Figure 1: Sand Separation Area Analytical Results" submitted to the EPA in March 2022, which is relevant to this section of the 90% RD and should be added to the RD package. In that figure, please correct the vertical depth scale on borings such that the 4-6 ft bgs interval is properly labeled.	The 100% RD has been updated to include this figure with the corrections noted.
TCEQ	114	SSA - 90% RD - Section 6.1.4	The TCEQ recommends additional analysis of shoreline change in the sand separation area through time based on historical aerial/satellite images be conducted and presented on "Figure 1: Sand Separation Area Analytical Results" or in a new figure that also includes the locations of the SSA borings from the RI and PDI-2. TCEQ also suggests updating this section to include any additional conclusions about shoreline change as it relates to interpreted erosion/deposition over time in the SSA.	The aerial extent of the SSA was established in the ROD and is not proposed to be modified. Aerial photos dating back to 1938 are provided in Appendix K-3 of the 100% RD with the SSA overlain; however, it is important to note that significant changes related to the SSA are due to man-made activities. Sampling locations from the RI and PDI-2 have been overlain on the historical aerial images and are provided in Appendix K-4 of the 100% RD. The MNR Plan does not include the Beach Area. Reference to the Beach Area was removed from the MNR Plan so as to avoid any confusion.
TCEQ	115	90% RD - Table 3-2	Please clarify the footnotes 1 and 2 to explain how the dioxins/furans congener concentrations listed in the "Estimated Discharge Criteria" column were calculated, and that compliance with the TSWQS will be determined based on the Minimum Level as directed by EPA. The estimated discharge criteria values in this table for dioxins/furans do not appear to correlate to the Minimum Level.	Footnote 1, is a reference to the February 18, 2020, email from Gary Baumgarten of EPA, which is included in Appendix D, and states that compliance with the TSWQS will be determined using the minimum level of the EPA approved method (1613B), cited in 40 CFR Part 136. The minimum levels are directly from this reference. Footnote 2 refers to the discharge criteria calculations for constituents other than dioxins and furans.

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TCEQ	116	90% RD - Table 5-1	The TCEQ has the following comments about this table: • For borings where very high-concentration waste is located just above the proposed bottom of excavation target surface (such as SJSB073, SJSB074, SJSB088, SJSB092), consider whether slightly deeper excavation should be planned in these polygons (e.g. one foot into presumed clean material) to avoid delays related to re-excavation following a confirmation sample failing to meet the clean-up level. • For borings where material exceeding the clean-up level is located just below the proposed bottom of excavation target surface (SJSB033, SJSB045-C1, SJSB049, SJSB054,SJSB055-C1, SJSB073, SJSB074, SJSB084, SJSB094, SJSB096, SJSB105), the TCEQ recommends that the excavation surface be deepened to include material above the clean-up level to avoid delays related to re-excavation following a confirmation sample failing to meet the clean-up level. • For borings where material exceeding the clean-up level is located below the proposed bottom of excavation target surface and clean material (SJSB032, SJSB048-C1, SJSB071, SJSB076, SJSB082, SJSB085, SJSB089, SJSB095, SJSB102), the TCEQ recommends that the excavation surface be deepened to include all material above the clean-up level, consistent with the 2017 ROD requirement for "removal of all waste material that exceeds the clean-up level of 30 ng/kg regardless of depth", or demonstrate via confirmation sampling that a representative composite sample from the affected depth interval(s) within the ½ acre (or less) DU which includes each of these borings meets the clean-up level.	The 100% RD specifies removal of all material greater than the clean-up standard of 30 ng/kg. Table 5-1 has been revised. Confirmation sampling will be conducted prior to the start of excavation to minimize delays.
TCEQ	117	90% RD - Table 5-2	Please add boring SJSB088 to the list under the "Further excavation would put the area at risk of Hydraulic Heave" rationale since it had a concentration of 1,800 ng/kg at -18 to -20 feet elevation. One row in this section is labeled "4" rather than a typical boring location name (i.e., SJSB0XX), please verify if this is a typographic error and correct.	The 100% RD specifies removal of all material greater than the clean-up standard of 30 ng/kg. As such, Table 5-2 has been removed from the 100% RD.
TCEQ	118	90% RD - Appendix B, Attachment C - Supplemental Design Investigation (SDI) Geotechnical Data Report	In Section 3.1.4, the referenced figure number is not provided. In Section 3.2, the referenced table number is not provided, and the sentence "The laboratory test results are included in Error! Reference source not found.." appears to be a referencing error. Section 4.2 also has two instances of the same referencing error.	Attachment C has been revised per comment.
TCEQ	119	90% RD - Appendix E - Use of Area-based Average Concentration: Section 2.1.2	The TCEQ considers the sediment to fish to human exposure pathway (fish ingestion pathway) to be complete and regardless of the percentage of the total risk contributed by this pathway, does not support a deviation from the clean-up level set in the ROD.	This comment is noted, although the Respondents do not agree that the area-based averages in the 90% RD represented a "deviation from the ROD. The 100% RD specifies removal of all material greater than the clean-up standard of 30 ng/kg.
TCEQ	120	90% RD - Appendix E - Use of Area-based Average Concentration: Section 2.1.3	The TCEQ supports the clean-up level set in the ROD and notes that it is common practice to use default parameters in calculations, unless documented and verifiable site-specific data are provided to deviate from those parameters. Also, as TCEQ has previously commented, the clean-up level of 30 ng/kg results in a fish tissue PRG of 3.1 ng/kg, which is 1.33-fold higher than the DSHS dioxin fish tissue HAC of 2.33 ng/kg. As is, the clean-up level of 30 ng/kg is higher than what would be needed to address the site's contribution to the fishing advisory. Hotspot consideration could be a potential concern for fish tissue if it's a more attractive/prime habitat where they spend significantly more time.	This comment is noted as a statement of TCEQ's position. The 100% RD specifies removal of all material greater than the clean-up standard of 30 ng/kg.
TCEQ	121	ICIAP - 90% RD - Appendix J, Attachment 7 - General Comment	If material known to be above the clean-up level is left in place within the Northern Impoundment due to hydraulic heave risk or the proposed site-wide area-based averaging methodology, the TCEQ recommends that ICs be considered and implemented for the Northern Impoundment.	This comment will be addressed in the 100% RD. No material above the clean-up level will be left in place within the Northern Impoundment; therefore, IC's will not be necessary.

Table 1-1

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Comment Source	Item No.	Reference	Comment	Response to Comment
TCEQ	122	ICIAP - 90% RD - Appendix J, Attachment 7 - Section 2.1 Background	The sentence “Results of the sampling event indicate that the SSA has generally been depositional since the mid-1960s.” is not fully supported by the results of the Lead-210 sampling which showed deposition at 4 locations, erosion at one location, and variable erosion/deposition at 4 locations. Please revise to be consistent with Section 6.1.4 of the 90% RD.	This sentence has been struck from the ICIAP submitted as part of the 100% RD.
TCEQ	123	ICIAP - 90% RD - Appendix J, Attachment 7 - Section 2.4 Key Stakeholders	Please consider whether the Texas General Land Office (GLO) should be included as a stakeholder if the ICs will include areas of riverbed owned by the state.	According to information obtained online from the Harris County Tax Assessor, the submerged area of the SSA belongs to the Port of Houston Authority. No ICs for any other areas of the Northern Impoundment are required.
TCEQ	124	ICIAP - 90% RD - Appendix J, Attachment 7 - Section 3 Planned Remedial Action Institutional Controls	This section does not contain enough detail of the proposed institutional and administrative controls for TCEQ to provide detailed comments on the proposed approach. The plan should be updated following the proposed stakeholder discussions. Additionally, for any property that will be subject to ICs and has its property deed indexed in the county’s property records, the TCEQ recommends filing an IC in the relevant county property records to facilitate notification of future property owners. Figure 1 and 2: The Table of Contents and text of the ICIAP refers to the attached Figure 1 and 2, but those figures are not provided in the ICIAP. Please provide the figures.	If required, the TCEQ’s Restrictive Covenant template will be utilized and, once signed by the relevant parties, recorded in Harris County property records. Figures 1 and 2 were added to the ICIAP.
TxDOT	125	General Comments	The proposed plan to impound the hazardous material site includes a 30 feet wide cofferdam surrounding the site. The proposed cofferdam extends onto TxDOT property next to the bridge. TxDOT had requested that a different, narrower wall design be utilized to minimize impacts on TxDOT property and to allow more space for the adjacent bridge construction. In our last meeting, the consultant for the EPA explained in detail why narrower wall designs were not practical. The current cofferdam wall design is now proposed to run parallel to the access road and right up against it. This creates the following concerns: • The schedule for the cleanup work is based on the following two (2) assumptions: 1) Uninterrupted use of the access road during the months of the cleanup work. 2) Enhancement and widening of the access road to accommodate 2-way truck traffic. The access road will need to be raised in profile as it approaches the south side of the impoundment so that the elevation meets that of the cofferdam at the entrance to the site. That means that the access road will be widened, and an embankment will need to be constructed to raise the profile.	This comment is received and is noted. Access requirements have been, and will continue to be, discussed and addressed between GHD, RPs, TxDOT, and EPA during routine meetings.
TxDOT	126	General Comments	We could not find a layout that shows the limits of the proposed embankment for the enhanced access road. TxDOT is concerned that the proposed embankment is likely to encroach under the existing bridges. We request that the construction of a temporary retaining wall all along the inside of the raised access road be considered to avoid any further encroachment in the TxDOT Right of Way (ROW). Finally, we are concerned about maintenance of the access road due to the heavy truck traffic. Maintenance of the access road from Brookshire Street to the east should be the responsibility of the hazardous material clean up contractor. • There is a stated concern that the simultaneous construction of the bridge will negatively affect the cleanup work schedule. The 2 projects must coordinate construction activities. There will be a need for bridge construction equipment to use the access road.	This comment is received and is noted. Access requirements have been discussed and addressed between GHD, RPs, TxDOT, and EPA during routine meetings. The 100% RD includes design drawings showing the end-state restoration, including the embankment. Pending submission of this 100% RD, construction details with respect to the alignment and improvements of the road on the TxDOT ROW have been provided to TxDOT, as part of ongoing communications with TxDOT regarding access to the ROW.

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Comment Source	Item No.	Reference	Comment	Response to Comment
TxDOT	127	General Comments	TxDOT has the following additional concerns: • There was mention that the existing armored cap on the superfund site will be re-used and that it will be temporarily stored "at or near the North Impoundment". We want to ask if there is intent to store the existing stone armor on TxDOT's ROW and if so where the storage is anticipated. We would prefer that it be stored outside of TxDOT ROW. • There is reference to a Floodplain Drainage Impact Analysis performed with the proposed cofferdam in place that looked at a 2, 10 and 100-year flood event which was submitted to the Harris County Flood Control District (HCFCD) and TxDOT. We have not received this study. • The plan is to remove the cofferdam and restore the site. TxDOT understands that the plan is that if any piles of the cofferdam cannot be removed, they will be either cut or driven below the mudline. However, any piles left in place will likely interfere with the construction of some of the proposed bridge dolphins and with future widening of the I-10 westbound main lane bridge. We insist that all piles on the south side of the cofferdam are removed. We also request that the TxDOT access road be restored to pre-construction condition upon completion of the clean-up project (same limits as previously stated). • The Southwest corner of the proposed cofferdam structure is over one of the Exxon pipelines and less than 25 feet from the other. The top of the sheet pile elevation is shown to be plus 9 feet and length is 60 feet. That means it tips at elevation negative 51 feet which should be able to clear the Exxon pipeline. We recommend that the clearance is confirmed by the wall designer.	These concerns have been discussed and addressed between GHD, RPs, TxDOT, and EPA during routine meetings and are addressed in the 100% RD. 1. The existing cap rock will be staged within the Northern Impoundment. 2. The Floodplain Drainage Impact Analysis is included as part of the ARAR Supporting Documents in Appendix D. 3. Based on recent discussions with TXDOT, the sheet piles within TXDOT right of wall will be cut below final grade and a soil embankment will be installed in the end condition. 4. This comment is received and noted.

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Comment Source	Item No.	Reference	Comment	Response to Comment
TxDOT	128	General Comments	TxDOT has the following additional concerns: • TxDOT has experienced numerous issues with barges hitting the existing I-10 bridge. With the proposed steel girder replacement option, the proposed riprap berms and one of the proposed dolphins now overlap more with the proposed cofferdam structure. TxDOT is concerned that we will not be able to properly protect all the approach bents, the first bent of the steel unit and the second bent (the one in the water) of the steel unit until the cofferdam structure is removed. • TxDOT is concerned that a wider access road to accommodate 2-way truck traffic will result in a need to shift the I-10 westbound main lane bridge enough to miss the proposed wider access road. • For the cable stayed bridge option, the proposed cofferdam overlaps with the foundation, bent and rock island of the proposed I-10 westbound main lane bridge. In addition, the access road will be directly under the proposed bridge. TxDOT is concerned that this will result in a need to considerably shift the I-10 westbound main lane to avoid conflicts. • TxDOT remains concerned that the close proximity to the access road will unavoidably interfere with the bridge construction work with the cleanup work. We are concerned this will become a contested issue down the line. • The schedule for the site remediation includes shutting down during hurricane season. This greatly increases the time to complete the clean-up operation. While worker safety is a concern, hurricanes and tropical storms of any magnitude to potentially affect the site are usually predicted well in advance which would allow the contractor time to evacuate the site. Suggesting allowing the contractor to submit an alternate bid with the ability to work continually on the site. This would tend to help mitigate some of the overlap activities with the adjacent bridge construction and might actually be cost effective due to the costs of mobilizing and demobilizing. • TxDOT is uncertain of the relationship between the EPA and the clean-up activities. Will the contractor work for the EPA or for International Paper? TxDOT would be more amenable with a contractor who worked for the EPA rather than a private entity. • Per previous discussions, you will need a permit to work in TxDOT ROW. We will also require a bond to insure that TxDOT ROW is not left in a damaged state after the clean-up activities.	These concerns are noted and routine discussions between GHD, RPs, TxDOT, and EPA have taken place, including conversations regarding the comments, and will continue. Until the actual schedules and designs for both the Superfund and TxDOT projects are known and finalized, working through potential project/schedule conflicts cannot be completely addressed.

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Comment Source	Item No.	Reference	Comment	Response to Comment
HCPCS (HCTAC)	129	90% RD - Section 3 - Description of Treatability Studies performed and results	• Characterization results indicate waste materials should meet criteria for Class II non-hazardous waste disposal; HCTAC is concerned excavated waste will be disposed of in a Type I landfill that can accept class II non-hazardous waste. The Atascocita landfill is a Type I facility that can accept municipal solid waste, special waste, and Class 2 and 3 non-hazardous industrial wastes. Class 2 waste: Any individual solid waste or combination of industrial solid wastes that are not described as Hazardous, Class 1, or Class 3 per 30 TAC 335.506. Class 3 waste: Inert and essentially insoluble industrial solid waste, usually including, but not limited to, materials such as rock, brick, glass, dirt, and certain plastics and rubber, etc., that are not readily decomposable per 30 TAC 335.507. • Some Type I landfills dispose of leachate via municipal Wastewater Treatment Plants. HCTAC is concerned that any landfills utilized for dioxin contaminated waste disposal, which send leachate to municipal Wastewater Treatment Plants for disposal, could potentially send dioxin contaminated leachate to a municipal facility unable to clean up dioxins and potentially reintroduce dioxins to the environment. • HCTAC is concerned the waste is not hazardous and can possibly be used as cover by the receiving landfill and may impact stormwater runoff and/or transmitted via dust in the area. • HCTAC is concerned with the purpose of the solidification tests if it is dependent on the Remedial Contractor (RC) and disposal facility, which may require their own tests. o HCTAC will recommend excavating all waste with concentrations greater than 30 ng/kg (See Document 1 Section 5, Section 6, and Section 10; and Documents 4, 5, 6, and 9). o HCTAC will recommend EPA not approve averaging of remnant contaminants unless extenuating circumstances exist (See Document 1 Section 5, and Section 10; and Documents 4 and 9). o HCTAC will recommend using the existent geotextile, geomembrane, and cap, be returned to the site, and cover any remaining waste, which may exceed 30 ng/kg due to extenuating circumstances (See Document 1 Section 5, and Document 4, 5, 7 and 9). o HCTAC will request specifics on the proposed reuse for the cap, the geotextile, and the geomembrane. • HCTAC is concerned that the Total Suspended Solids (TSS) and Turbidity will be used instead of testing the water to determine if the dioxin and furan are below the minimum level (ML) (See Document 1 Section 5 and Document 7). • HCTAC is concerned with the actual value used in water testing, which is supposed to be the Texas surface water quality standard (TSWQS) of 7.97 x 10-8 µg/L or 0.0797 pg/l or per the ML of the EPAapproved method 1613B which is 10 pg/l (See Document 3 and 7).	The waste will be sent to a facility(ies) properly permitted to accept the material. These concerns related to the specific operational conditions of the landfills are noted. HCTAC's comments on the operational conditions at such facilities, while noted, are better directed to TCEQ or others with respect to requirements applicable to facilities which accept the waste. As a general matter, the items noted in this comment (to the extent directed to the Respondents) have been considered in preparation of the 100% RD.
HCPCS (HCTAC)	130	90% RD - Section 4 - ARARs	• HCTAC is concerned with the lack of regulatory agency oversite during the performance of work at the site to verify specific actions protective of the environment are being accomplished, which is the function of permits. o HCTAC will request that EPA require a third-party presence during work to verify and ensure the activities performed by the RC protect the environment and human health, including those of the on-site employees.	This comment is directed to the EPA.

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HCPCS (HCTAC)	131	90% RD - Section 5 - Remedial Design	Section 5 details the design criteria assumptions for the current Best Management Practice (BMP) wall design, waste material removal and solidification methodology, transportation and disposal, and water treatment process • HCTAC is concerned access has not been secured to do the proposed work. • HCTAC will request the EPA require the RC to further evaluate the use of barges despite complicated logistics, scarcity of offloading terminals, and risk of loss or release of material during transit. • HCTAC is concerned the congestion of marine vessels in the vicinity due to the Texas Department of Transportation (TxDOT) bridge construction would further preclude barging as an option is a pretext to delay work further. • HCTAC is concerned that the +9 feet only apply from November to April, and the height of the water is higher from April to November (See Document 1 Section 10 and Document 7). • HCTAC is concerned during the return from the off-season, the RC may find the BMP structure compromised due to a highwater situation, such as several barge or tree debris impacts from April to November. o HCTAC will request specifics on how the BMP will be evaluated before work begins in November to determine if it is still structurally sound (See Document 9). o HCTAC will inquire if the 30-foot-wide area between the sheet pile walls of the BMP can be used to support equipment and if barges with equipment can be docked outside the BMP in the San Jacinto River as a way to increase the work area. • HCTAC is concerned concentrations greater than 30 ng/kg will be left in place due to the Safety Factor (SF), heave, or site-based averages (See Document 1 Section 3). • HCTAC is concerned that impacted material, over 30 ng/kg, will be mixed with cleaner material to meet the 30 ng/kg criteria and then be put back in place and used as a fill. o HCTAC will recommend that excavated material be disposed of in a landfill and not be considered for reuse (See Document 7).	These comments, to the extent they are directed to the Respondents and not to EPA or others, were considered in preparing the 100 RD. - The wall has been raised to +10ft NAVD88. - A barge protection impact structure has been incorporated into the 100% RD. During the non-excavation season, non-excavation activities will be ongoing.
HCPCS (HCTAC)	132	90% RD - Section 5 - Remedial Design (Continued)	• HCTAC is concerned the water treatment system (WTS) design is subject to changes based on field performance. o HCTAC will recommend the treated effluent water be stored until sample results verify that the WTS is performing at optimum levels. HCTAC has determined a typical 30,000 BBL barge is one of the larger barges in the area at 300-ft long, 54-ft wide, or 16,200 square feet and could be used as a staging area for the WTS or to store water before or after treatment (See Document 9). • HCTAC is concerned metals analysis will take ten business days and dioxins/furans fifteen days to analyze. o HCTAC will recommend in-field monitoring of TSS or turbidity in the WTS effluent (See Document 1 Section 3). o HCTAC will recommend that a licensed wastewater treatment operator be required to operate the WTS (See Document 7). o HCTAC will recommend a backup generator be available onsite to run the WTS in case of power outages and to prevent project delays due to the WTS not being in operation. o HCTAC will recommend the WTS be weatherized to withstand extreme weather conditions such as winter storm Yuri in February (See Document 7 and 9).	These comments, to the extent they are directed to the Respondents and not to EPA or others, were considered in preparing the 100 RD. As described in the 100% RD, the following applies to the WTS: -The WTS will have four (4), 36,000 barrel, effluent storage tanks. See Response to Comment 109 for discussion of test before release procedures. -The basis of design assumes maximum 7-day turnaround for all analyze which has been confirmed with analytical labs. -The water treatment system will be operated by a licensed operator, to the extent as required. -The 100% RD will include provisions for back-up generator(s) as needed. -The 100% RD will require contractors provide a plan to protect equipment if a severe winter storm (e.g., Yuri) is predicted. Winterization may include provisions such as draining equipment, extra heaters, and/or moving equipment offsite until the storm passes.

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HCPCS (HCTAC)	133	90% RD - Section 5 - Remedial Design (Continued)	• HCTAC is concerned the estimated cy are based on sampling performed during the Pre-Design Investigations (PDI) and Supplemental Design Investigations (SDI). • HCTAC is concerned additional sampling during the excavation may reveal additional information regarding the depth, area, concentration, and volume of contaminants. • HCTAC is concerned the Coastal Water Authority (CWA) has not provided design information for the dam gate and modeled flow data to the EPA and GHD when asked. o HCTAC will recommend both organizations reach out to the board of directors, attend a meeting, or reach out to the governor of Texas and the Mayor of Houston, who appoints the board of directors. o HCTAC will recommend the 30-foot BMP soil buttress or berm adjacent to the inside wall have some cover to prevent erosion during a storm, wind, vibration, etc. events and to protect employees from sliding debris from the berm as they excavate.	HCTAC concerns are received and noted.
HCPCS (HCTAC)	134	90% RD - Section 6 - SSA and MNR	Section 6 description of the investigation activities conducted in the SSA during Pre Design Investigations and the implications of the results for the MNR. • HCTAC is concerned about the concentrations after 2 feet; for example, SJSSA06 (4-6 ft bgs) had a concentration of 3330 ng/kg, which is significantly above the 30 ng/kg concentration (See Document 1 Section 3). • HCTAC is concerned deposit variability could be due to alternating periods of erosion and deposition caused by boat traffic, storm events, and/or natural river flows, with the erosion causing exposure of the contaminants above 30 ng/kg (See Document 1 Section 3).	This comment has been considered as part of the revisions made to the MNR
HCPCS (HCTAC)	135	90% RD - Section 7 - Environmental Footprint (Greener Clean-Ups)	Section 7 description of how the RA may be implemented to minimize environmental impacts in accordance with the EPA's Principles for Greener Clean-Ups (EPA, 2009). • HCTAC is concerned that carpooling is dependent on the location of the workers' homes. • HCTAC is concerned that using a portable generator may be necessary to keep work going during power outages from winter storms. o To limit the footprint, HCTAC recommends consideration of barges for this contingency. • HCTAC is concerned that using the aggregate from inside the BMP to cover the area may make the BMP unstable when trying to complete the work and create an effective cover that doesn't leave a gaping hole in the river.	These comments, to the extent they are directed to the Respondents and not to EPA or others, were considered in preparing the 100 RD. With respect to use of barges, that issue was specifically considered and rejected as described in Section 5.8.2.1 of the 100% RD.
HCPCS (HCTAC)	136	90% RD - Section 9 - Supporting Deliverables	HCTAC is concerned the plans suggested the information to the RC instead of giving more guidance and definitive information, and the information which was supposed to be conveyed was left to a third party that doesn't exist yet.	This comment has been addressed in the 100% RD.

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HCPCS (HCTAC)	137	90% RD - Table 2-6	In Table 2-6, SJSB0088 and SJSB054 show that the concentration decreases to well below 30 ng/kg, and then the concentration increases beyond 30 ng/kg after several feet. There are multiple examples of this in the table (See Document 1 Section 3). • HCTAC is concerned there are instances where the concentration is greater than 30 ng/kg if sampled at further depths. In Table 5-1, the post-excavation surface concentration for sample SJSB073 will be 41.0 ng/kg, for SJSB095 will be 57.0 ng/kg, for SJSB074 will be 87.0 ng/kg, for SJSB047-C-1 will be 327.0 ng/kg, for SJSB096 will be 84.0 ng /kg along with several others at or below the 30 ng/kg range and the area based average concentration is 23.31 ng/kg (See Document 1 Section 3). o HCTAC will recommend at the end of each season, exposed surfaces be covered after excavation with the geomembrane and/or cap (See Document 7).	A pre-construction confirmation sampling program will be conducted to define the removal limits. The 100% RD specifies removal of all material greater than the clean-up standard of 30 ng/kg The 100% RD specifies during excavation seasons, exposed surfaces will be covered.
HCPCS (HCTAC)	138	90% RD - Figure 5-3	Figure 5-3 shows the water surface elevations from November to April from 1996 to 2019. In 1998, 2002, 2003, 2009, and 2016 the water was above the 9 ft elevation proposed for the BMP (See Document 1 Section 5). o HCTAC will recommend the BMP height above water be reconsidered to 10 feet to reduce the risk of water intrusion during the working season.	The outer wall of the BMP has been raised to 10 ft. NAVD88.
HCPCS (HCTAC)	139	90% RD - Appendix B - Geotechnical Engineering Report - Section 3.2	• HCTAC is concerned that section 3.2 is missing information. “The laboratory test results are included in Error! Reference source not found. Results of the laboratory testing were used to confirm site soil logging and are discussed in the relevant subsurface conditions in Section 4.” Section 4.2 is also missing information. “The results for Atterberg Limits determination conducted on five samples of the clay deposit is summarized in Table 5-3 and presented in Error! Reference source not found. Atterberg limit results show a liquid limit in the range of 27 to 55 percent, and a plasticity index of 13 to 38 percent, indicating medium to high plasticity clay.”	This comment has been noted and the SDI report has been updated.
HCPCS (HCTAC)	140	90% RD - Appendix B - Geotechnical Engineering Report - Hydraulic Heave Analysis - Table 1A	• HCTAC is concerned Table 1A, 1B is presented without labeling the different columns for the terms used in the two equations.	Hs is Sediment Thickness, ys is Total Sediment Unit Weight (bottom of table), Hc is BC Thickness, yc is Total Beaumont Clay Unit Weight (bottom of the table), Hw is Water Head, and yw is Water Unit Weight (bottom of the table).

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HCPCS (HCTAC)	141	90% RD - Appendix D - ARAR Supporting Documents	• HCTAC is concerned a 500-year flood event study was not conducted despite HCFCD requesting it to be performed, and the TXDOT may also benefit from this study. • HCTAC is concerned the Environmental Fluid Dynamic Model (EFDC) values don't change across the transect numbers while the HEC-RAS values do. • HCTAC is concerned about a Louisiana-licensed engineer signing off on work performed in Texas. • HCTAC is concerned that this is the 90% design, and there are foreseeable changes in the future since the EFDC for the TXDOT is considered a draft subject to modification in the future. • During the review of the 100% documents for the south impoundment, the documents stated several times that changes to the documents may be made by the RC. HCTAC is concerned this statement will be repeated in the northern impoundment documents causing further delay in the cleanup process. • HCTAC is concerned that the modeling doesn't consider recent environmental climate changes encountered in the last 15 years and encourages more recent data to be used. • Based on the review of the data presented, HCTAC is concerned the velocity, and shear stress differences with and without the cofferdam may cause problems to the I-10 structures.	These comments, to the extent they are directed to the Respondents and not to EPA or others, were considered in preparing the 100 RD. The 500 year flow event was modeled and the results for velocities and shear stress were incorporated in the Hydrodynamic Modelling Report in the 100% RD. For all simulations the flows at the Houston Ship Channel were kept at are normal values since the flows from the Channel create a backup effect on the San Jacinto River at the Northern Impoundment reducing velocities in the area. The San Jacinto River flows are from Lake Houston, and the release flows from the lake are controlled by the dam, not how the flows enter the lake from the watershed. For these reasons a watershed surface water runoff model such as HSPF was not considered necessary for the proper simulation of the flows in the site area.
HCPCS (HCTAC)	142	90% RD - Appendix E - Use of Area-Based Average Concentration to Meet Clean-Up Level (Section 3 - Conclusion)	• HCTAC is concerned the surface weighted average concentration (SWAC) cleanup was accepted by the EPA and Technical Working Group (TWG) on November 16, 2021, instead of the point-by-point method (**See Document 1 Section 3**). • HCTAC is concerned with unforeseen future activities at the site. For instance, right now, exposure is based on the ingestion of fish consuming the sediment; the future exposure may be different. For example, the site was once above the water but is now below the water due to subsidence. • HCTAC is concerned the SWAC doesn't consider higher concentrations below the surface which could potentially be exposed in the future (**See Document 1 Section 3**). • HCTAC is concerned that if the excavated area is not covered, the potential for ingestion remains. Additionally, the incidental ingestion of sediment and sediment direct contact is not eliminated, especially since people who fish drop anchors and fishing lines which may drag along the bottom and, when pulled up, expose recreational fishing children to the sediment and possible ingestion (**See Document 1 Section 3**).	These comments, to the extent they are directed to the Respondents and not to EPA or others, were considered in preparing the 100 RD.
HCPCS (HCTAC)	143	Hydrodynamic Modeling Report - 90% RD - Appendix F	• HCTAC is concerned this will continue to be an exposure pathway by sediment consuming fish which are later eaten by people, contaminated sediment, which is dermally absorbed, or sediment ingested by people (See Document 1 Section 3). o HCTAC will recommend signage be put in place and checked frequently, making the public aware of the presence of the site and the contaminants.	Prior to RA, the RC will implement the appropriate safety precautions in and around the work site.

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HCPCS (HCTAC)	144	Hydrodynamic Modeling Report - 90% RD - Appendix F - Section 2.2 - Water Level Data	• HCTAC is concerned the mean lower low water (MLLW) datum from 1983 to 2001 was used, but the tidal data dates were from 2010 to 2020 and verified from January 6, 1998, to September 16, 2021. o HCTAC will recommend more recent data be used and compared with older data and the more conservative be used for modeling.	The Hydrodynamic Modelling Report in the 100% RD has been updated and sensitivity analysis were conducted to use more conservative modeling conditions.
HCPCS (HCTAC)	145	Hydrodynamic Modeling Report - 90% RD - Appendix F - Section 2.3 - Wind Data	• HCTAC is concerned there was missing wind data from September 18, 2008, to June 8, 2010.	This data gap does not affect the model results.
HCPCS (HCTAC)	146	Hydrodynamic Modeling Report - 90% RD - Appendix F	• HCTAC is concerned floodplain modeling for the 500-year flood event was requested by HCFCD and was not conducted. • HCTAC is concerned the letters and information sent to the HCFCD and TXDOT were presented, but the responses, comments, or concerns from these or other organizations were not presented.	The 500 year flow event was modeled and the results for velocities and shear stress were incorporated in the Hydrodynamic Modelling Report in the 100% RD. For all simulations the flows at the Houston Ship Channel were kept at are normal values since the flows from the Channel create a backup effect on the San Jacinto River at the Northern Impoundment reducing velocities in the area. The San Jacinto River flows are from Lake Houston, and the release flows from the lake are controlled by the dam, not how the flows enter the lake from the watershed. For these reasons a watershed surface water runoff model such as HSPF was not considered necessary for the proper simulation of the flows in the site area.
HCPCS (HCTAC)	147	90% RD - Appendix G - Design Drawings - C-08	• HCTAC is concerned that according to the C-08 drawing, the bench will only be placed on the C-2 section and wonders why a bench is not used in other locations.	C-2 section (Northwest corner) has the deepest mudline on the project site relative to any other section. The raised bench has been to that section to stabilize the wall. Other sections are stable with the presence of existing soils so a bench is not required.
HCPCS (HCTAC)	148	90% RD - Appendix G - Design Drawings - C-22	• HCTAC is concerned that according to drawing C-22, the only areas which will be restored or reseeded are at or near the right-of-way (ROW) in the southern area near I-10.	This comment is received and noted.
HCPCS (HCTAC)	149	90% RD - Appendix G - Design Drawings - P-03, P-04, and P-06	• HCTAC is concerned drawing P-03 shows a clarifier bypass after the influent tanks, and drawing P-04 shows the flow from the clarifier bypass entering the filter feed tank, but the flow from the clarifier has the option to enter the filter feed tank or to go directly to the multimedia filter. Drawing P-06 doesn’t show the clarifier bypass entering the filter feed tank or filter feed pump, and the flow from the clarifier can enter the filter feed tank or the filter feed pump. o HCTAC will recommend specifics on what situations would allow for the clarifier to be bypassed be provided.	The WTS, as described in the 100% RD, does not have a clarifier bypass.
HCPCS (HCTAC)	150	90% RD - Appendix G - Design Drawings - P-03, P-04, and P-06	• HCTAC is concerned there is no direct line from the filter feed tank that is not mixing with the flow from the clarifier via the same pipe. • HCTAC is concerned the filter feed pump is not connected directly to the filter feed tank without using the piping from the clarifier. **See Comments Letter for reference drawings**	The 100% RD will not have a filter feed tank. The discharge pump on the clarifier will pump water through the sand filters, bag filters, and GACs.
HCPCS (HCTAC)	151	90% RD - Appendix H - Specifications - Description of Work	• HCTAC is concerned that the work description doesn’t mention the onsite sampling being done to verify the concentrations of the excavated material and that the field sampling plan is only mentioned for the WTS. o HCTAC will recommend sampling being performed as excavation is being conducted be mentioned in the design specifications documents (See Document 1 Section 3).	These comments, to the extent they are directed to the Respondents and not to EPA or others, were considered in preparing the 100 RD. As reflected in the 100% RD, WTS influent will be tested on an as needed basis to optimize system operation.
HCPCS (HCTAC)	152	90% RD - Appendix H - Specifications - Flood Contingency Plan (01 57 19)	The Flood Contingency Plan (FCP) states to take action if the river is above 10 feet; however, the wall is only 9 feet (See Document 1 Section 5).	The 100% RD includes a High-Water Preparedness Plan (HWPP) which can be found in Appendix J. The BMP outer wall has been raised to +10 ft. NAVD88.

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HCPCS (HCTAC)	153	90% RD - Appendix H - Specifications - Water Treatment Consumables (01 91 00)	HCTAC is concerned that since the work is to be conducted outside of hurricane season and the possibility of a winter storm can be encountered during the excavation period (See Document 1 Section 5). o HCTAC will recommend acid and caustic be included on page 25.	The 100% RD addresses conditions under which work may be conducted outside the period from November to April and the response to storms, including winter storms during that time period. The list of WTS Consumables has been revised in the 100% RD.
HCPCS (HCTAC)	154	90% RD - Appendix H - Specifications - Excavation (31 23 16)	HCTAC is concerned that over-excavating may cause problems such as hydraulic heave and should be mentioned as a potentially dangerous situation; the only time heave is mentioned is while driving the piles.	Management of the hydraulic heave potential during excavation is described in the Excavation Specification (31 23 16) in Appendix H of the 100% RD.
HCPCS (HCTAC)	155	90% RD - Appendix H - Specifications	HCTAC is concerned about the sampling needed to verify the concentrations of the material removed and left in place during excavation.	The FSP submitted as part of the 100% RD addresses the sampling required to verify concentrations.
HCPCS (HCTAC)	156	90% RD - Appendix H - Specifications - Excavation (31 23 16) and Execution and Closeout Requirements (01 70 00)	HCTAC is concerned that excavated material may be used as part of the berm or in the space between the sheet piles (See Document 1 Section 5). o HCTAC was under the belief a geomembrane would not be placed over the site at the completion of the project with the exception of the area near the ROW (See Document 1 Section 10).	Excavated material will not be used as part of the berm or in the space between the sheet piles. There are no plans for a geomembrane to be placed in locations within the Northern Impoundment.
HCPCS (HCTAC)	157	90% RD - Appendix H - Specifications - Sheet Piles (31 41 16)	HCTAC is concerned the hammer blows to the sheet piles may cause vibrations which could affect the surrounding area.	This comment is received and noted. Only press-in and vibratory hammers are specified for use in pile installation. An updated vibration analysis is included in the BMP Design Report showing minimal vibrations even with an impact hammer.
HCPCS (HCTAC)	158	90% RD - Appendix H - Specifications - Sheet Piles (31 41 16)	The document states the sealant will be the one the factory recommends. HCTAC is concerned the sealant discussed in previous documents said it may be affected by the environment.	This comment is received and noted. Interlock Sealant - WADIT is considered environmentally friendly material - it is non-toxic and made of natural raw materials. It is widely used for sheet piles in contact with ground and surface water use. Datasheet is available at: https://assets.pilepro.com/resources/PPGCatalogWADIT.pdf
HCPCS (HCTAC)	159	90% RD - Appendix H - Specifications - WTS - Water Quality Control Plan	HCTAC is concerned if the WTS is not working correctly, dioxin/furan may be reintroduced into the river. o HCTAC will recommend an alarm system be in place to sound if the turbidity or TSS exceeds a certain amount correlated back to the dioxin/furan concentration (See Document 1 Section 3).	The 100% RD includes batch treatment of the contact water and therefore all contact water will be tested and determined to be compliant with discharge requirement prior to discharging to the river.
HCPCS (HCTAC)	160	90% RD - Appendix H - Specifications - Water Treatment System (47 07 01) Section 1.4 - Sequencing	HCTAC is concerned on page 170 regarding how the following statement is to be accomplished and requests clarification, "Minimize TSS transferred from the excavation to the WTS."	The 100% RD will not have a clarifier bypass. This comment has been addressed within the dewatering design spec.
HCPCS (HCTAC)	161	90% RD - Appendix H - Specifications - General	HCTAC is concerned several times throughout the document the license of the engineer, installer, TSDF, and driver is referenced, but the license of the operator for the WTS is not specified (See Document 1 Section 5).	The water treatment system will be operated by a licensed operator, to the extent required.
HCPCS (HCTAC)	162	90% RD - Appendix I - BMP Structural Report - Section 6.4 - Wind Load Evaluation	HCTAC is concerned if the wind load also considered the effect of the wind on waves since the wind can cause waves. o HCTAC will request clarification on whether wave load was factored in on the calculations.	This comment is received and noted. BMP Design Report has been updated to evaluate and address the impact of wind and wake waves. It concludes that waves will not govern the design of the BMP.

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HCPCS (HCTAC)	163	90% RD - Appendix I - BMP Structural Report - Section 6.5 - Barge Impact	HCTAC is concerned barge impact would occur during a storm where the winds are high and causing waves; therefore, the load from wind, waves, and barges should be calculated.	The 100% RD includes the installation of a barge strike protection system located outside the outer BMP wall.
HCPCS (HCTAC)	164	90% RD - Appendix I - BMP Structural Report - Section 5.2.3 - Tie-Rod Sections	HCTAC is concerned if the SF allows for multiple tie-rods failures.	This comment is received and noted. Potential tie-rod failures were considered in the design. Tie-rods are spaced closer than the maximum spacing determined from evaluating various loading scenarios. Tie-rod capacity is checked against increased demands if an adjacent tie-rod failed to prevent progressive failure. Even with increased loading, demand to capacity ratio is less than 80%.
HCPCS (HCTAC)	165	90% RD - Appendix I - BMP Structural Report - Section 7.2 - Seepage Through Piles	HCTAC is concerned the fill between the two sheet pile walls will retain some water and if the water will be removed at the start of the season.	This comment is received and noted. The interior walls will include an interlock sealant to create a watertight seal, preventing water from entering the Northern Impoundment. Any river or rain water entering the fill area between the BMP walls is expected to be discharged back into the river.
HCPCS (HCTAC)	166	90% RD - Supplemental Deliverables - General Comments	HCTAC is concerned with the purpose of having the 90% HASP, ERP, and other plans if the RC and subcontractors will write their own. HCTAC is concerned the RC and subcontractor will submit a HASP, ERP, and other plans which need to be reviewed, which will further delay the accomplishment of the work.	This comment is noted.
HCPCS (HCTAC)	167	HASP and AMP - 90% RD - Supplemental Deliverables	HCTAC is concerned if air monitors at the site will measure contaminants or just dust, which could potentially carry contaminants. HCTAC is concerned the specifics of the air monitoring plan will be developed by the RC, and the SWMP lists items for the RC to consider. HCTAC is concerned with the exposure of dioxin and furan dust-containing contaminants that the workers may be exposed to and who will be setting the threshold limits, which could be toxic to employees and the public, and HCTAC is questioning if the Permissible exposure limit of 15 mg/cubic 8 hr TWA takes into account the dioxin and furan. HCTAC is concerned with the exposure of dioxin/furan contaminants in the air, which may be released during excavation. Currently, the HASP has recommendations but not requirements. o HCTAC will recommend the workers and community are protected. o HCTAC will recommend more specific and definitive guidance to be included in the HASP.	This comment is noted. Dust monitoring levels take into account dioxins and are protective of works and the public and can be found in The Air Monitoring Plan is included as Attachment 1 of the SWMP submitted as part of the 100% RD.
HCPCS (HCTAC)	168	HASP - 90% RD - Supplemental Deliverables	HCTAC is concerned nutria around the San Jacinto River can also be a rodent of concern.	This comment is noted.
HCPCS (HCTAC)	169	90% RD - Supplemental Deliverables - SWMP	The SWMP describes procedures for monitoring and leaves many items to the discretion of the RC, and HCTAC is concerned without proper guidance, the RC may not fully address the issues such as dust which contains dioxins and furans, adequate stormwater management procedures, turbidity mitigation, and odor control.	Additional direction has been provided to the RC regarding monitoring procedures in the SWMP.
HCPCS (HCTAC)	170	90% RD - Supplemental Deliverables - SWMP	HCTAC is concerned that persons will be designated to perform crucial functions such as stormwater inspections and prefers third-party oversight from organizations who understand the ramifications of contaminated stormwater entering the river.	Qualified personnel will be designated to perform crucial functions such as inspections, and it is the RP's understanding that EPA will provide oversight of RA activities
HCPCS (HCTAC)	171	90% RD - Supplemental Deliverables - SWMP	HCTAC is concerned the manner used to determine the turbidity threshold is not clear and requests specifics regarding investigating and addressing the sources of turbidity.	The turbidity thresholds, described in Section 3.4.3, identify the procedures for investigating the source of turbidity depending upon the specific conditions that are observed.

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HCPCS (HCTAC)	172	90% RD - Supplemental Deliverables - General Comments	HCTAC is concerned some plans seem to offer a lot of guidance while others are lacking. o As part of the TWG, HCTAC will request to be included in the project meetings where the EPA and TCEQ are in attendance. o HCTAC will recommend all meetings, except for the daily progress meetings, have minutes prepared and distributed to all attendees and to the members of the TWG.	This comment is noted.
HCPCS (HCTAC)	173	MNR Sand Separation Area - 90% RD - Supplemental Deliverables	Regarding the SSA, HCTAC is concerned the contaminants are being left in place in an area of sand and being left to chance that deposition is going to keep them in place (See Document 1 Section 3). HCTAC is concerned SSA sampling will be done every few years for 20 years and then determine if MNR has been effective. HCTAC is concerned the remaining contaminants will go downstream and find their way into the environment and humans (See Document 1 Section 3).	MNR is the RA specified in the ROD for the SSA. The sampling schedule in the MNR Plan has been amended.
HCPCS (HCTAC)	174	TODP - 90% RD - Supplemental Deliverables - General	HCTAC is concerned since the waste is not considered hazardous, what kind of DOT signage will be required on the transport vehicle. HCTAC is concerned with the lack of information in the TODP, due to the disposal facility and RC being unknown.	The TODP has been revised to provide additional information on waste characterization and transportation.
HCPCS (HCTAC)	175	20220803 SJRWP Memo to File	HCTAC is concerned that without the presentation of information for the removal of the solid waste and waste suspended in the water column behind a cofferdam, it is difficult to make comments. However, if this method would allow for the removal of all the waste down to 30 ng/kg without leaving hot spots or submerged waste in deeper layers then HCTAC' concerns are addressed. HCTAC is concerned, and as the EPA has stated, based on the dynamic river environment, the danger of repeated storms and associated flooding, the history of cap maintenance and repairs, and the toxicity and persistence of the contamination, leaving contaminants above the 30 ng/kg risks the potential of future exposure to the environment and human health (See Document 9).	The 100% RD specifies removal of all material greater than the clean-up standard of 30 ng/kg in the Northern Impoundment.
HCPCS (Parson)	176	90% RD - Section 3.3.5.2 - Solidification Results and Conclusions	The solidification test results are only briefly summarized, and no data are shown. Because this testing impacts the potential for dioxin dispersal during off-site transport, i.e., liquids leaking from trucks, we believe that solidification is not something that should just be left to be worked out on-the-fly during remedial activities only between the remedial contractor and disposal facility. Please share testing data and provide the procedures that the remedial contractor will follow prior to the RA to verify that wastes are sufficiently stabilized for transportation and disposal without contaminating other media.	The solidification data has been included in Appendix C of the 100% RD. RC will visually inspect waste material to pass paint filter testing prior to be transported off-site for disposal.
HCPCS (Parson)	177	90% RD - Section 5.2 - Remedial Approach	The design is reliant on continuing access via the IH-10 frontage road ROW and an on-site logistical support area. In other sediment remediation projects, such as the Hudson River dredging, it has been necessary to transport excavated sediments by barge to an off-site support area for processing. We suggest that back-up plans be formulated in case this becomes necessary. A similar comment was made previously on the 30% design (Comment 4), but it was dismissed as being impractical with minimal explanation. There should be detailed consideration of this approach. Also, direct input from TxDOT on the design and their plans for bridge update are needed.	Based on further evaluation since the submittal of the 90% RD, Respondents still believe trucking to be the safest and most effective transportation method, as discussed in section 5.8.2.1. The Respondents agree that direct input from TxDOT on plans for the I-10 bridge are needed. The 100 % RD contains information received to date on those plans, but also recognizes that the design of the TxDOT project is ongoing and may necessitate further changes.

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HCPCS (Parson)	178	90% RD - Section 5.2 - Remedial Approach	GHD proposes using a surface weighted average (SWAC) approach rather than point by point to achieve the goal of 30 ng/kg. The selected remedy in the ROD, alternative 6N, is described as follows: “This alternative involves the removal of all waste material that exceeds the cleanup level of 30 ng/kg regardless of depth in the northern waste pits.” There is no provision in the ROD for leaving wastes exceeding that level, either by areal averaging or due to expense or technical difficulty. Several items proposed by GHD in this 90% design would require a ROD amendment.	This comment is no longer applicable, as the 100% RD is not based on use of surface weighted average concentrations.
HCPCS (Parson)	179	90% RD - Section 5.2 - Remedial Approach	We oppose the SWAC approach for several reasons. First, it conflicts with the cleanup standard specified in the ROD. Second, because GHD included in the calculation areas not requiring excavation, such as the historic berm and areas beyond the TCRA cap, they have underestimated the average dioxin concentration of the area requiring remediation. Third, by looking only at the post-excavation surface, it ignores residual contamination exceeding the cleanup level that would be left in place deeper than the proposed post-excavation surface. GHD has not shown that it is impractical to meet the cleanup level throughout the site.	This comment is no longer applicable, as the 100% RD is not based on use of surface weighted average concentrations.
HCPCS (Parson)	180	90% RD - Section 5.2 - Remedial Approach	Even if a site-wide averaging approach is deemed acceptable, we urge that no principal threat waste is allowed to remain. In areas where dioxin levels exceeding 30 ng/kg occur in locations where hydraulic heave risk limits the excavation depth, we believe that the final deepest excavation should be performed by through-water excavation. We believe that that the 30 ng/kg goal should be met on a point-by-point basis to the maximum depth of exceedance.	This comment is no longer applicable, as the 100% RD is not based on use of surface weighted average concentrations.
HCPCS (Parson)	181	90% RD - Sections 5.2 (Remedial Approach) and 5.11 (Uncertainties Associated with Design and Implementation)	GHD identifies numerous ongoing challenges and uncertainties related to the design, such as identification and securing of appropriate property needed for logistical support, interfacing with TxDOT plans, risk of overtopping the BMP, community impacts, etc. These often seem to be presented as impediments to proceeding without providing details on how these issues will be resolved. Additional information should be provided on how these critical issues will be resolved in a timely manner to allow the project to proceed.	The uncertainties section has been revised, and is referred to as "Technical Challenges", which are address to the extent practicable in the 10 % RD.
HCPCS (Parson)	182	90% RD - Table 5-1	The proposed excavation surface is highly irregular, reflecting the high spatial variability in dioxin concentrations. The proposal has adjacent polygons being excavated to more than 10 feet difference in vertical elevation. It places too much confidence in a single core as completely representative of a quarter-acre polygon. We believe it is necessary to over excavate to a greater extent near the periphery of polygons where the uncertainty is highest, to make sure that all waste is removed. Further, post-excavation confirmation sampling should include samples collected near the edges of the excavation polygons and on the side slopes between polygons, not just toward the centers of polygons.	This comment is no longer applicable, as the 100% RD is not based on use of surface weighted average concentrations and the proposed use of pre-construction confirmation sampling to identify excavation depths.
HCPCS (Parson)	183	90% RD - Table 5-1	Core SJSB046-C1 has been paired with core SJSB083 to define the post-excavation surface concentration of 4.8 ng/kg at -20 ft NAVD. Yet there is virtually no similarity between the concentration profiles in the two cores, so the assumption that the concentration at -20-- 22 ft in core SJSB046-C1 is equal to that in core SJSB083 is faulty. The uncertainty in the vertical distribution of dioxins is large here.	This comment is no longer applicable, as the 100% RD is not based on use of surface weighted average concentrations.
HCPCS (Parson)	184	90% RD - Table 5-1	In calculating post-excavation areal average sediment concentrations, it is not appropriate to ignore deeper, more contaminated layers that would be allowed to remain in place. For example, with core SJSB078, the calculation is based on a concentration of 16 ng/kg, but there are deeper intervals at 140 and 260 ng/kg. We revised the area-based average calculations to use the highest concentration that will remain in place and calculated an areally-averaged post-excavation maximum concentration of ~86 ng/kg, almost 3x the cleanup goal of 30 ng/kg.	This comment is no longer applicable, as the 100% RD is not based on use of surface weighted average concentrations.

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HCPCS (Parson)	185	90% RD - Table 5-1	In many places, such as core SJSB096, the proposed excavation surface ignores the cleanup goal of 30 ng/kg even though it could be met without technical difficulty.	This comment is no longer applicable, as the 100% RD is not based on use of surface weighted average concentrations.
HCPCS (Parson)	186	90% RD - Table 5-1	If the historic berm meets the cleanup level, as it appears based on borings, why is it being excavated and hauled to landfill? Borings SJSB029, SJSB030, SJSB031, SJSB034, and SJSB035 together account for 31,000 CY of material included in the total excavation volume. It would seem that material accounts for most of the difference between the current estimate of the volume of waste material to be removed and the ROD estimate.	The historic berm material will be sampled and depending on analytical results may be reused on-site or disposed. The total estimated excavation volume for the 100% RD is approximately 230,000 cubic yards.
HCPCS (Parson)	187	90% RD - Table 5-2	The excavation rationale for soil boring locations SJSB029, SJSB030, SJSB031, SJSB034, and SJSB035 are stated to be based upon removal of all material above 30 ng/kg. But those locations did not have any material above 30 ng/kg at any depth. Please elaborate on the rationale for excavating these locations.	These borings require excavation to provide the appropriate slope to remove material from other areas where material is above 30 ng/kg.
HCPCS (Parson)	188	90% RD - Table 5-2	We note two soil boring locations with excavation elevation rationale stated as “based upon removal of all material above 30 ng/kg TCEQ” that we believe are incorrect: a. SJGB012 only went to -7 feet, and thus was paired with core SJSB072. Core SJSB072 has concentrations exceeding 30 ng/kg below the proposed excavation and thus the rationale listed in the table is incorrect. b. SJSB046-C1 was paired with core SJSB083. However, given the lack of similarity to concentrations in core SJSB083 in the -15 to -20-ft depth interval, we see no evidence that the concentrations should match at -21-ft or that the stated excavation depth would remove all material above 30 ng/kg TCEQ.	This comment is no longer applicable, as the 100% RD is not based on use of surface weighted average concentrations and the excavation surface will be based on confirmation sampling prior to excavation activities.
HCPCS (Parson)	189	90% RD - Table 5-2	The excavation elevation rationale for the polygon represented by borings SJSB072 and SJSB078 state that further excavation would put the area at risk of hydraulic heave. Yet there is waste present at concentrations exceeding the cleanup level between the proposed excavation elevation and the hydraulic heave elevation, so the rationale does not appear to be accurate.	This comment is no longer applicable as Table 5-2 has been removed in the 100% RD. All waste exceeding the cleanup level will be excavated. Mitigations to monitor and control the risk of hydraulic heave are discussed in the 100% RD.
HCPCS (Parson)	190	90% RD - Section 5.6.2.1 Cell Dewatering	The plan states that at the end of each excavation season, the area within the BMP wall will be intentionally flooded to provide support for the BMP wall and prevent scour that could be caused by overtopping the BMP wall during a storm event. We did not find sufficient analysis or rationale for this procedure in the design. Can the benefits be achieved by partial flooding or does it require full flooding to river level? Can the area within the BMP wall be flooded only if and when a large flood or hurricane is approaching?	The 100% RD no longer includes plans to intentionally flood the area within the BMP between excavation seasons, so this comment is no longer applicable.
HCPCS (Parson)	191	90% RD - Section 5.6.2.1 Cell Dewatering	If partial flooding is sufficient, this would reduce the amount of water inside the BMP wall that must be pumped out at the start of excavation season and reduce de-watering time for shallow waste deposits.	The 100% RD no longer includes plans to intentionally flood the area within the BMP between excavation seasons, so this comment is no longer applicable.
HCPCS (Parson)	192	90% RD - Section 5.6.2.1 Cell Dewatering	This section states that “At the end of each excavation season, the exposed slope of the excavation will be capped.” Please provide some detail on what kind of capping measures would be used, as well as how this temporary cap will be removed and managed during the next construction season.	Text has been added to Section 6.6.3.3 of the 100 % RD to describe measures to protect the excavation between seasons.
HCPCS (Parson)	193	90% RD - Section 5.6.2.3 Excavation Procedures	On what basis will the decision be made whether to use natural de-watering or solidification of excavated wastes?	Material that contains free liquids will be solidified.
HCPCS (Parson)	194	90% RD - Section 5.6.2.3 Excavation Procedures	Please describe procedures for collecting and managing the water derived from dewatering wastes after excavation.	Water collected within the mixing pad will be collected and pumped to a temporary storage tank and then to the WTS.

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HCPCS (Parson)	195	90% RD - Section 5.6.2.3 Excavation Procedures	Because waste excavation in the dry may generate particulate (dust) that may spread by wind to surfaces not considered to be in direct contact with wastes, all stormwater discharged to the river should be periodically sampled and analyzed.	This comment has been noted.
HCPCS (Parson)	196	90% RD - Section 5.6.4 - Post-Excavation Confirmation Sampling and FSP	GHD specifies that post-excavation sampling will be done consisting of 6 to 8 samples per ½-acre dredge management unit (DMU). They specify that the samples will be composited and analyzed for compliance with 30 ng/kg criteria. Analysis should be run on each sample collected and the basis for compliance should be 30 ng/kg for each sample, not for a composite of the samples.	The practice of compositing samples within a decision unit for confirmation sampling is a standard practice and appropriate for the Northern Impoundment. In the event a composite sample is above the cleanup level of 30 ng/kg, the associated discrete samples will also be analyzed.
HCPCS (Parson)	197	90% RD - Section 5.6.4 - Post-Excavation Confirmation Sampling and FSP	Upon finding that cleanup goals are not met after excavation, over-excavation should be conservative to ensure that wastes exceeding the cleanup level are removed. Over excavating to only the halfway point between adjacent samples is not conservative because there is no information in the spatial distribution of contamination between the discrete samples. In order to provide confidence that waste materials exceeding the cleanup goal have been removed, and avoid delays associated with additional sampling and dioxin analysis, the over-excavation should be performed over the full area to the nearest discrete sample confirmed to meet the cleanup level, not just to the halfway point between discrete samples.	The excavation sampling has been updated and addressed within the Field Sampling Plan in Appendix J. This comment is no longer applicable, to the extent it was applicable to post-construction confirmation sampling.
HCPCS (Parson)	198	90% RD - Section 5.6.5 Excavation Area Restoration	GHD specifies that there will be no excavation restoration activities, except along the southern boundary to ensure slope stability and if necessary for placement of clean recovered cap material or other clean material. Despite the post-excavation sampling, residual risk and uncertainty remain regarding remaining surface and subsurface levels of dioxins. Therefore, it is suggested that the entire excavation area be restored with at least 6” to 12” of clean material that is resistant to erosion.	The pre-construction confirmation sampling plan, as proposed in the updated FSP in Appendix J, will reduce uncertainty associated with remaining surface and subsurface concentrations with removal of material in the Northern Impoundment to the cleanup level of 30 ng/kg. Further, given the depth of the excavations, these areas are not expected to be subject to erosion, and no placement of "clean material that is resistant to erosion" is deemed to be necessary."
HCPCS (Parson)	199	90% RD - Section 5.7.1 - Waste Characterization	GHD specifies that the waste will not be TCLP hazardous based on waste characterization to date, and do not specify any further TCLP testing. TCLP analysis should be done on excavated material prior to disposal to verify that it is non-hazardous.	The TODP in Appendix J of the 100% RD has been revised. Section 4.2 of this plan includes a description of pre-construction waste sampling and classification activities to be conducted is accordance with the waste disposal facility requirements, including additional TCLP testing.
HCPCS (Parson)	200	90% RD - Section 5.8 Water Management	The 90% design proposes that, at the beginning of excavation season the impounded “river” water will be pumped out of the interior of the BMP and discharged directly to the river without treatment. Evidence suggests that dioxins and furans dissolved in porewater within the wastes (also referred to as mounded groundwater in the 90% design) will be mobile and mix into overlying water. Page 85 of the ROD states “Samples of surface water at the site demonstrate the mobility of dioxin in the San Jacinto River environment; for example, surface water sampling conducted in July 2016 indicated that tetra-dioxin and tetra-furan both more than tripled going over the TCRA cap.” During contact water treatability testing (section 3.4.2.1), a pit was excavated in the southwest quadrant, and pore water that seeped from the waste material into the pit overnight was analyzed. Concentrations of both 2378-TCDD (66 ng/L) and 2378-TCDF (220 ng/L) were significantly elevated relative to their discharge criteria (10 ng/L). Based on the 2378-TCDD (1500 pg/L), 2378-TCDF (3900 pg/L), and TSS (3400 mg/L) concentrations in contact water produced by mixing deionized water into that excavated pit, it is possible to estimate the 2378-TCDD (440 ng/kg) and 2378-TCDF (1150 ng/kg) concentrations in waste materials from that excavation, and from which the pore water seeped into the pit. These levels are roughly 100x lower than the highest dioxin levels observed in the waste materials, suggesting that dioxin concentrations in pore water draining from other waste materials could be 100x higher than those observed in this pit, and exceed discharge criteria by a large factor.	The 100% RD has been revised to include treatment of all the water within the BMP. The bulk non-contact water that is 2’ above the lowest point in the excavation will be treated in the bulk non-contract water treatment system . All other bulk water and contact water will be treated in the contact water treatment system. Refer to Section 5.9.2 of the RD document.

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HCPCS (Parson)	201	90% RD - Section 5.8 Water Management	As the area inside the BMP is pumped out at the beginning of excavation season, the porewater from de-watering waste materials, also called mounded groundwater, will contribute to the water retained inside the BMP wall. As water levels decline, this porewater from wastes will comprise an increasingly large proportion of the water being pumped out to the river. At some unknown point, dioxin levels are very likely to exceed discharge criteria and should not be pumped to the river without treatment.	The 100% RD has been revised to include treatment of all the water within the BMP. The bulk non-contact water that is 2' above the lowest point in the excavation will be treated in the bulk non-contract water treatment system . All other bulk water and contact water will be treated in the contact water treatment system. Refer to Section 5.9.2 of the RD document.
HCPCS (Parson)	202	90% RD - Section 5.8 Water Management	For these reasons, we request that analysis of the impounded water be performed prior to discharge to the river, and that continuing water sampling of discharged waters be performed daily to confirm that the water being pumped to the river is below the minimum level (ML) for dioxin/furan concentrations. At a minimum, this should be done the first two years. If levels are consistently below the ML for dioxins/furans, it may be suitable to reduce or remove this monitoring requirement in future years.	The bulk non-contact water that is 2' above the lowest point in the excavation is considered to have water quality similar to the river and will be treated in the non-contact water treatment system to remove the solids and then discharged without sampling. All other bulk water and contact water will be treated in the contact water treatment system and compliance samples will be collected prior to discharge.
HCPCS (Parson)	203	90% RD - Section 5.8 Water Management	In many places there is a sharp change in dioxin concentrations between depth intervals. For example, in core SJSB073, the concentration of the -7 to -9 ft interval is 83,000 ng/kg, and that of the -9 to -11 ft interval is 41 ng/kg. Given that neither the exact geometry of the waste deposit nor the position of the excavator bucket is seldom precisely known to better than a few inches, it is a typical practice to over-dredge by one-half foot as a safety factor to achieve the required depth. We encourage adoption of this practice.	Confirmation sampling will be conducted prior to the dredge to define the removal limits. A 6 inch overdredge has been added to the dredging specifications for both the production pass and the clean-up pass.
HCPCS (Parson)	204	90% RD - Section 5.8.4 Table 5-J	Note 3 seems to suggest that total suspended solids (TSS) levels will be monitored in place of dioxins and furans. Please confirm that dioxins and furans will still be measured and reported in effluent on at least a weekly basis while discharging. Also, if possible, we suggest that flow be monitored and totalized continuously.	Note 3 has been removed from the 100% RD.
HCPCS (Parson)	205	90% RD - Section 5.9.4 Turbidity Controls and Monitoring and SWMP	GHD specifies that they will monitor for turbidity during BMP installation and removal once or twice per day. This is insufficient to monitor for potential issues that may be associated with specific construction activities and should be revised to include continuous turbidity monitoring with thresholds and specific responses. Also, it is specified that turbidity curtains will only extend to the midpoint of the water column. The curtains should be extended to close to the river bottom, or justification provided regarding why the midpoint is appropriate and sufficient.	The turbidity monitoring requirements have been revised in the 100% RD in light of this and other comments to provide for more frequent monitoring, specifically in the SWMP (Appendix J). Turbidity curtains extending to the midpoint of the water column are appropriate. Turbidity curtains extending beyond the midpoint will be subject to greater stresses from river flow and can potentially increase velocities and agitate sediment if the curtain is too close to the mudline.
HCPCS (Parson)	206	90% RD - Section 5.11.2 BMP Alignment	GHD specifies that, even with the BMP height set to the historic high-water level, the risk of overtopping during high water events remains a significant uncertainty. If this is the case, consideration should be given to increasing the height of the BMP to further reduce this risk.	The BMP outer wall has been raised to +10 ft NAVD88.
HCPCS (Parson)	207	90% RD - Section 5.11.1.2 Effects of Undefined Excavation Limits on the BMP Design	We were unable to reproduce the estimate that excavating to the full depth of remedial target would generate an additional 46,000 cubic yards (CY) of waste material. Our estimate was ~33,000 CY. Please share the calculations for the stated volume.	The volumes in the 100% RD have been revised.

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HCPCS (Parson)	208	90% RD - Section 6.1 2019 Sediment Sampling Program	While most of the Sand Separation Area proved to be near or below the cleanup level, and appropriate for monitored natural recovery, the 4-6 ft interval at Station SJSSA06 was 3330 ng/kg, almost an order of magnitude higher than the highest levels measured prior to the ROD, and an order of magnitude higher than the 300 ng/kg criteria for principal threat waste. Although only present in a small area, this is highly contaminated dioxin waste material that presents ongoing risk. It should be removed after additional sampling to define its vertical and lateral extent. The low levels of Pb-210 indicate this is likely old material, but the dioxin concentrations have apparently not attenuated much, which implies that monitored natural recovery may not work for this deposit.	MNR is the ROD-accepted approach for the SSA and monitoring proposed under the MNR Plan will be completed to document concentrations within the SSA.
HCPCS (Parson)	209	90% RD - Section 6.1 - 2019 Sediment Sampling Program	The radio-isotope data only indicated sediment deposition was occurring at the outer periphery sites (SJSSA-01, -02, -04, and -07) of the sand separation area, where dioxin levels are already low. In samples where the dioxin levels were above cleanup levels, sediment deposition was not evident, implying that MNA may not be effective.	MNR is the ROD-accepted approach for the SSA and monitoring proposed under the MNR Plan will be completed to document concentrations within the SSA.
HCPCS (Parson)	210	90% RD - Appendix E - Use of Area-Based Average Concentration to Meet Clean-Up Level - Section 2	Area-based averages are appropriate when the ROD expresses the cleanup target as an area-based average. Leaving waste above the cleanup level inside the northern impoundment footprint is counter to the remedy selected in the ROD and would appear to require a modification to the ROD.	This comment is no longer applicable, in that the 100% RD does not utilize area-based averages. The 100% RD specifies removal of all material within the Northern Impoundment footprint greater than the clean-up standard of 30 ng/kg.
HCPCS (Parson)	211	90% RD - Appendix E - Use of Area-Based Average Concentration to Meet Clean-Up Level - Section 2	GHD states that “estimates of risk are based on exposures to conservative estimates of the average concentrations of a chemical.” In some cases, this is true, but often it is the maximum or highest concentration exposure that is of greater concern.	The 100% RD specifies removal of all material within the Northern Impoundment footprint greater than the clean-up standard of 30 ng/kg.
HCPCS (Parson)	212	90% RD - Appendix E - Use of Area-Based Average Concentration to Meet Clean-Up Level - Section 2.1.3	While GHD calls EPA’s selected biota-sediment accumulation factor (BSAF) “erroneous”, the BSAF applied in the remedy was actually much lower than values measured in this system. The median BSAFs for 2378-TCDD in the Houston Ship Channel/San Jacinto River system were 0.39 for hardhead catfish filets, and 0.58 for blue crabs (Dean et al, 2009). Although clearly the fish and crabs are mobile organisms, dioxin concentrations in catfish and crab in this system do exhibit strong spatial variations of more than an order of magnitude across the system, and peak spatial tissue concentrations correlated to peak sediment concentrations (Suarez et al, 2005). After lipid content, the sediment concentration at the same site where the fish were caught was the best predictor of 2378-TCDD concentrations in fish tissue (Dean et al, 2009). These observations indicate that these fish and crabs do have a local range where their primary exposure occurs, although the spatial extent of that range is not known.	This comment is not applicable, given that the 100% RD does not utilize area-based average concentrations to meet the clean-up level. The 100% RD specifies removal of all material within the Northern Impoundment footprint greater than the clean-up standard of 30 ng/kg.
HCPCS (Parson)	213	90% RD - Appendix E - Use of Area-Based Average Concentration to Meet Clean-Up Level - Section 2.1.3	We further note that the sediment-based quality target to meet water quality standards calculated for the TCEQ-sponsored Total Maximum Daily Load project addressing dioxins in the Houston Ship Channel system was 115 ng TEQ/kg organic carbon (University of Houston and Parsons, 2007). For sediment with 2% organic carbon, which is typical in this system, this would translate to a concentration of roughly 2 ng TEQ/kg sediment. In other words, to meet Texas water quality standards for protecting public health for consumption of fish tissue would require a concentration more than 10 times lower than the cleanup level. Thus, we do not believe the 30 ng TEQ /kg cleanup level is excessively protective.	This comment is not applicable, given that the 100% RD does not utilize area-based average concentrations to meet the clean-up level. The 100% RD specifies removal of all material within the Northern Impoundment footprint greater than the clean-up standard of 30 ng/kg.

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HCPCS (Parson)	214	90% RD - Appendix E - Use of Area-Based Average Concentration to Meet Clean-Up Level - Section 2.4.1	The excavation strategy says that “a not-to-exceed value lower than 300 ng/kg was applied to the extent practicable.” It implies that excavating below their hydraulic heave safety depth marks the deepest extent that excavation is practicable. If we assume that excavation in the dry may not be practicable below that depth (although we have questions about some of the geotechnical assumptions and calculations related to that safe hydraulic heave depth), they have not considered that excavation of material at greater depths through water could be practicable. This is the same process that will be required in the northwest corner.	This comment is no longer applicable, as the 100% RD is not based on use of surface weighted average concentrations. The 100% RD includes measures in the Excavation Specification (31 23 16) in Appendix H for addressing potential heave, including excavating under a water column.
HCPCS (Parson)	215	Hydrodynamic Modeling Report - 90% RD - Appendix F - Section 3.2 Model Setup	The report states “the hydrodynamics model uses the parameterization and kinetics from the calibrated (previously developed) models by Anchor QEA.” Hydrodynamic calibrations are specific to the physical dimensions of the model grid, among other things. Since the model grid cell dimensions and bathymetry have been changed, the assumption that the hydrodynamic calibration parameters would hold for the new grid should be verified by direct comparison of water surface elevations and velocities in the calibrated model.	The Hydrodynamic Modelling Report in the 100% RD has been updated to reflect this comment
HCPCS (Parson)	216	Hydrodynamic Modeling Report - 90% RD - Appendix F - Section 4.2.1 Sedimentation Study	The report is not clear on what model output is used to generate the 95th percentile shear stresses and velocities. Are these statistics calculated from all model cells shown in Figure 22 over the full 30-day period? If so, we would recommend focusing on the peak flow period (the peak 1-hr flow period would seem relevant for erosion) at just a few key locations.	The Hydrodynamic Modelling Report in the 100% RD has been updated and the maximum and median velocities and shear stresses at each model cell were used for statistics.
HCPCS (Parson)	217	Hydrodynamic Modeling Report - 90% RD - Appendix F - Tables 8-15	It is curious and counter-intuitive that the 95% maximum shear stress and velocities decline as one goes from a 2-year to a 100-year flood event. In the past, sediment erosion in this area has been associated with extreme flood events. Could that be because the number of active “wet” model cells increases at higher flows? If so, then the 95th percentile is not really the relevant metric to look at, and the comparison needs to be made at specific key locations. Or is it due to backwater effects from Buffalo Bayou flooding? Although a flood event in the San Jacinto watershed is also likely to produce high flows in the Buffalo Bayou watershed, it does not follow that a 100-year flood flow in the San Jacinto would correspond to a 100-year flood flow in Buffalo Bayou. If that assumption was used in the scenario boundary conditions, it would produce unrealistically high backwater conditions and thereby reduce velocities. It would be useful to perform some sensitivity analysis on boundary conditions, and to simulate actual historical peak flow events.	The Hydrodynamic Modelling Report in the 100% RD has been updated to reflect this comment. Open boundary surge conditions have been adjusted and maximum shear stresses and velocities have been analyzed instead of 95 percentile values for shear stresses and velocities.
HCPCS (Parson)	218	90% RD - Prior Harris County Comment 2B (Previously Submitted Comments not Addressed)	Previously Harris County commented “The extent of exceedances of cleanup levels on the western side has not been delineated. An assumption has been made that the western extent of the capped area defines the western extent of removal. Consistent with prior comments, further delineation of the extent of contamination, even if it extends beyond the capped area should be completed, or a technical valid discussion regarding why they do not believe there is contamination beyond the extent of the cap should be provided. Data shows some extremely high levels in this area and should be removed.” GHD responded “The remedy, as described in the EPA ROD, only requires excavation of material within the TCRA cap.” Regardless of what is specified in the ROD, this contamination represents an environmental risk. Clarification is requested from USEPA on how this risk will be addressed.	The comment is directed to the EPA.

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HCPCS (Parson)	219	90% RD - Appendix B - Geotechnical Section 5.2.2.1	The report should provide details on how the design unit weights were selected. The unit weight data for the sediment layer shows a quite a bit of scatter. Most of the measured unit weights are above the design value used in the analysis. It may be prudent to have multiple layers within the sediment layer to account for this variation in unit weight – a single value between elevation -10 and -40 and potentially two layers above elevation -10.	Due to the exact reason that the data scattered quite a bit, increasing the number of sediment layers would not guarantee the result produced would increase the accuracy of the design, but rather increase the complexity of the evaluation. The single value for the sediment layer is reasonable and does not need to split into multiple values.
HCPCS (Parson)	220	90% RD - Appendix B - Geotechnical Section 5.2.3	A piezometric water level of +1.5 feet was assumed in many of the cases that did not meet the desirable safety factor. No explanation was provided on why this piezometric elevation was selected versus the -2 feet used in other cases, which was based on measured water levels in SJMW016.	The approach used in calculating the piezometric head was revised, making this comment no longer applicable. The revised approach is discussed in the Updated Hydraulic Heave Analysis submitted as part of the 100% RD.
HCPCS (Parson)	221	90% RD - Appendix B - Geotechnical Section 5.2.3	The assumption that the water level in sand lenses is the same as that at the top of the Beaumont sand layer needs justification. Are the sand lenses assumed to be under artesian pressure? What thickness of sand lenses should be considered to be a concern for bottom heave at the elevation subgrade?	The approach used in calculating the piezometric head was revised, making this comment no longer applicable. The revised approach is discussed in the Updated Hydraulic Heave Analysis submitted as part of the 100% RD.
HCPCS (Parson)	222	90% RD - Appendix B - Geotechnical Section 6 Table 1A	SJSB047 – the presumed Beaumont Sand layer is essentially non-plastic silt with over 90% fines. SJSB057 – this boring does not match the elevations and thicknesses of Beaumont clay and Beaumont sand layers. SJGB019 – boring log describes a very soft moist clayey layer at a depth of 35 feet where the analysis considered to be Beaumont sand. SJGB020 – boring log describes a stiff clay layer at a depth of 32 feet where the analysis considered to be Beaumont sand.	A sitewide stratigraph model was used rather than boring by boring methodology. Refer to the Updated Hydraulic Heave Analysis submitted as part of the 100% RD.
HCFCD	223	90% RD Appendix B - Geotechnical Report - General	Attachment C consists of handwritten boring logs with no supporting laboratory testing data other than soil classifications based on visual observations. Providing handwritten boring logs without supporting laboratory testing data is not considered to be accepted practice and can lead to unsupported conclusions, especially for Geotechnical engineering applications. Harris County is generally considered to be a no-seismic zone. Although interesting, Section 1.5 "Seismic Site Class" does not appear to contribute to any recommendations for the remedial design. The drilling and sampling methods, boring layout/depths, and soil classifications do not comply with HCFCD Geotechnical Guideline requirements. Laboratory testing was not performed per HCFCD Geotechnical Guideline requirements.	Attachment A contains handwritten logs from PDI-1 investigation follows by the supporting laboratory test by other consultants. These information are included to provide a complete picture of all investigation at the site. Attachment B provide information on the PDI-2 investigation and handwritten boring logs was inadvertently included. The typed boring logs is provided following the laboratory data. Attachment C refers to the Supplemental Design Investigation, within this report. Appendix A of Attachment C contains the logs for environmental borings and the objective is to delineate contamination profile. It is understood that Harris County is generally considered a no seismic zone, however it is generally practice to provide a Seismic Site class and seismic parameters. (suggest checking with Satish if seismic site class was used in his analysis). As indicated above, borings SjSB072 to SJSB106 were environmental borings conducted to provide contamination profile. The spacing and depth were selected on the needs of the project. Only SJMW-016 and SJMW-017 were geotechnical borings (Section 3.1.1) and these borings were performed in general industrial acceptable geotechnical guideline.

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HCFCD	224	90% RD Appendix B - Geotechnical Report - General	The drilling and sampling methods, boring layout/depths, and soil classifications do not comply with HCFCD Geotechnical Guideline requirements. Laboratory testing was not performed per HCFCD Geotechnical Guideline requirements. From the information provided, it appears that no sampled borings have been drilled/sampled at the current BMP alignment, and the only data provided at the current BMP alignment is based on CPT's. For a project of this magnitude and significance, it becomes mandatory to base the BMP final design on geotechnical data obtained from geotechnical borings drilled/sampled along the final BMP alignment as per applicable ASTM standards. The report conclusion is that there are portions of the northwest corner of the Northern Impoundment where there is a risk of hydraulic heave occurring when the site is dewatered. However, no recommendation is provided on concepts that may be used to remediate these portions of the site.	Only SJMW-016 and SJMW-017 were geotechnical borings (Section 3.1.1) and these borings were performed in general industrial acceptable geotechnical guideline. Numerous sampled borings have been taken previously to delineate the site sufficiently, in a effort to obtain data along the current proposed BMP alignment only Cone Penetrometer testing (CPT) was performed to obtain necessary parameters for design. In contrast to sampled drilled borings, CPTs provide continuous strength and soil behavior while drilled boring are not continuous and testing is not continuous. The previous drilled sampled borings in combination with the CPTs provided necessary information for design. A new Hydraulic Heave report, dated May 2024, addresses the whole site. Refer to the report for recommendation to reduce the risk of hydraulic heave.
HCFCD	225	90% RD Appendix G - Design Drawings - C-14	Drawing Sheet C-14 shows a 2.3 (H):1.0 (V) slope inclination in the alluvium adjacent to the interior of the BMP. The Reviewer believes that this slope inclination will likely fail in both the rapid drawdown and long-term conditions.	Drawing C-14 has been revised in the 100% RD.
HCFCD	226	90% RD Appendix G - Design Drawings - C-16	Drawing Sheet C-16 shows a 2.5 (H):1.0 (V) slope inclination in the alluvium adjacent to the interior of the BMP. The Reviewer believes that this slope inclination will likely fail in both the rapid drawdown and long-term conditions. Failure of the alluvium slopes noted above may have impact on the overall stability and functional performance of the BMP Wall.	Drawing C-16 has been revised in the 100% RD.
HCFCD	227	90% RD Appendix G - Design Drawings - C-2, C-6, and C-7	The stability of the BMP Wall was evaluated at numerous stations including three cross-sections (C2, C6 and C7) which were deemed to be critical due to their height and/or location. The HCFCD could not identify the results of any global stability analyses of the BMP Wall on either the river side or inland side. The critical cross-section(s) for global stability analyses, particularly on the river side, may be different from those identified as C2, C6 and C7. If such analyses are available, the Reviewer would appreciate an opportunity to review the results and criteria for selection of the cross-section(s).	Drawings have been revised. Stability of the BMP has been evaluated at several sections all around the cofferdam, incorporating varying mudline depths and slopes on both interior and exterior side of the BMP. Information is available in the BMP Design Report.
HCFCD	228	90% RD Appendix I - BMP Structural Design Report - Section 2.4.5	Some of the soil shear strengths shown in Section 2.4.5 are excessively high and should be revised while considering the existing state of engineering practice for Harris County Clays.	The friction angles for alluvium (8 samples) and Beaumont Clay (3 samples) were measured in CIU tests. Friction angle profiles were obtained from CPT correlations.
HCFCD	229	90% RD Appendix I - BMP Structural Design Report - Section 2.4.8	The hydraulic conductivity for the Beaumont Clay presented in Section 2.4.8 is not representative of the hydraulic conductivity generally measured in the Beaumont Clay within Harris County.	The hydraulic conductivity profiles are based on the CPT results and testing for soils on site. The value for Beaumont Clay falls within the determined range. The data is provided in Attachment 1 (Enclosure 6.A).
HCFCD	230	90% RD Appendix I - BMP Structural Design Report - Section 7.2	In Section 7.2, it is stated that the "Beaumont Clay is considered as impervious." The reviewer does not agree with this statement and requests evidence that this statement if correct.	This statement is removed and additional calculation evaluating seepage / piping under the BMP walls is provided in the BMP Design Report.

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HCFCD - Technical Review Team	231	90% RD - Appendix B - Geotechnical Engineering Report - Attachment E - Hydraulic Heave Analysis - Table 1A	A piezometric water level of 1.5 feet was used in 5 out of 6 cases in Table 1A where a less than desirable (1.25) factor of safety was reported. No Explanation was provided on why this piezometric elevation was selected for these cases versus the 2 feet used in many other cases. The rationale for this assumption should be provided.	The approach used in of calculating the piezometric head was revised, making this comment no longer applicable. The revised approach is discussed in the Updated Hydraulic Heave Analysis submitted as part of the 100% RD.
HCFCD - Technical Review Team	232	90% RD - Appendix B - Geotechnical Engineering Report - Attachment E- Hydraulic Heave Analysis	The analysis used water level in the Beaumont Sand (BS) layer as El. -2 based on monitoring data at two piezometer locations. The report should indicated if these piezometers were slotted within the BS layer or the intermediate sand lenses within the Beaumont Clay (BC) layer. Neither of these monitoring wells were located in the vicinity of the NW corner of the impoundment area. Justification should be provided on why the data from these piezometer is representative for conditions within NW area.	The water level was measured at the Beaumont Sand unit. Due to limited data, it was assumed that these data would apply to the entire impoundment. In an effort to confirm these assumptions, the 100% RD specifies that piezometers are to be installed in the vicinity of the NW area as well as other parts of the impoundment where the uppermost Beaumont Sand is encountered to monitor the piezometric head prior to construction.
HCFCD - Technical Review Team	233	90% RD - Appendix B - Geotechnical Engineering Report - Attachment E- Hydraulic Heave Analysis	the assumption that the water level in sand lenses is the same as that at the top of the Beaumont sand layer needs justification. Are the sand lenses assumed to be under artesian pressure? What thickness of these layers should be considered to be a concern for bottom heave at the excavation subgrade?	A sitewide stratigraph model was used is being applied in the Updated Hydraulic Heave Analysis, submitted as part of the 100% RD, which makes these boring specific comments no longer applicable.
HCFCD - Technical Review Team	234	90% RD - Appendix B - Geotechnical Engineering Report - Attachment E- Hydraulic Heave Analysis	The following test borings were reported as locations which would result in a less than desirable factor of safety. However based on a review of these borings the BS layer was not identified at the reported depths. See attached boring logs. Please clarify: a. SJSB047 - The BS layer is essentially non plastic silt with over 90% fines. Not sure if this layer is under artesian pressure b. SJSB057 - Unable to match the elevations and thicknesses of BC and BS layers. c. SJGB019 - Boring described a very soft moist clayey silt layer at a depth of 35 feet where analysis considered BS layer d. SJGB020 - Boring described a stiff clay at a depth of 32 feet where analysis considered BS layer	A sitewide stratigraph model was used in the Updated Hydraulic Heave Analysis, submitted as part of the 100% RD, which makes these boring specific comments no longer applicable.
HCFCD - Technical Review Team	235	90% RD - Appendix B - Geotechnical Engineering Report - Attachment E- Hydraulic Heave Analysis Section 5.2.2.1	The unit weight data for sediment layer shows quite a bit of scatter. The unit weights are well below the design value used in the analysis. It may be prudent to have multiple layers within the sediment layer to account for this variation in unit weight - a single value between El. -10 and El. -40 and potentially two layers above El. -10	Due to the reason that the data scattered quite a bit, increasing the number of sediment layers would not guarantee the result produced would increase the accuracy of the design, but rather increase the complexity of the evaluation. The single value for the sediment layer is reasonable and does not need to split into multiple values.
HCFCD - Technical Review Team	236	90% RD - Appendix B - Geotechnical Engineering Report - Attachment E- Hydraulic Heave Analysis Section 5.2.2.1	The report should provide details on how the design unit weight was selected in comparison with the mean value.	The mean value was utilized in the Updated Hydraulic Heave Analysis submitted as part of the 100% RD.
HCFCD - Technical Review Team	237	90% RD - Appendix B - Geotechnical Engineering Report - Attachment E- Hydraulic Heave Analysis Table 1B	A majority of the cases analyzed meet the desired factor of safety (FS) values. The cases showing less than desired FS value have used a higher piezometric water level in analysis. Additionally, some of the cases can be considered to be OK by observation when we have total FS of 1.18 and effective FS of 1.53 (or total of 1.24 and effective of 1.71.	A revised approach is used in the 100% RD based on a sitewide surface model approach to determine the top of BC and BS. Previous Table 1A calculate the top of BS elevation by adding the BC thickness of a nearby boring to the top of the BC, whereas Table 1B calculate the top of BS to be at the same elevation as a nearby boring. A revised approach is used in the 100% RD based on a sitewide stratigraphic model approach to determine the top of BC and BS and only 1 table is needed to calculate the FS for total stress analysis.
Port of Houston Authority (HDR)	238	90% RD - Section 5.4.2 Northern Impoundment Preparation and Layout	Consider requisite vehicular loading on the segment of the BMP that will support truck/equipment traffic transiting to/from the excavation area	The vehicle access is limited to the areas in the vicinity of the access road. Vehicles do not have access in between the BMP walls in other locations. The areas of the BMP currently designated for truck access and egress will be covered with sufficient fill and rock to support the loads. If larger equipment is to be placed between the two BMP walls by the RC, an additional evaluation would be required specific to that work, and potentially additional means to distribute the loading may be needed (e.g., crane mats).

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Port of Houston Authority (HDR)	239	90% RD - Section 5.4.2 Northern Impoundment Preparation and Layout	Given the BMP is on/touching TxDOT property, TxDOT may require evaluation of the wall using LRFD provisions as provided by AASHTO	This comment regarding possible TxDOT evaluation of BMP wall is noted.
Port of Houston Authority (HDR)	240	90% RD - Section 5.5.2 Material	High strength tie-rods have been observed to undergo/suffer from hydrogen embrittlement. Consider design with lower strength rods	Lower strength rods are specified in 100% RD due to reduced demand loads. Hydrogen embrittlement (HE) is generally associated with high strength rods that are coated or hot-dip galvanized, pre-tensioned and exposed to corrosive environment. The tie-rods are not coated or galvanized, and will not be submerged in sea-water or river water for prolonged period of time.
Port of Houston Authority (HDR)	241	90% RD - Section 5.5.2 Material	36 ksi is notably low for commonly available C/MC shapes. 50ksi material is fairly standard and could present savings to the design.	Noted. Tie-rods revised to 80-ksi due to change in demand loads and this will address the comment from POHA as well. 36-ksi for MC will remain as is. Contractor has option to provide C/MC shapes of 50-ksi tie-rods if they prefer.
Port of Houston Authority (HDR)	242	90% RD - Section 5.5.3.2 River Water	Verify the river water is pure fresh water. Common unit weight of water for design of similar structures is 64 pcf to account for temperature and salinity variation.	Noted. River is influenced by tidal waters from the gulf so density is between 62.4 and 64 pcf. The difference of 2.5% will not affect the design.
Port of Houston Authority (HDR)	243	90% RD - Section 5.5.3.4 Scour	Has a general scour allowance/protection system been considered for the outer side of the BMP? Rip rap/protection scheme should be detailed and shown in the plans if needed	Yes, both are considered. Riprap and a fender protection system has been included in the Updated BMP Structural Report.
Port of Houston Authority (HDR)	244	90% RD - General	It is stated in multiple locations that the success of this project is entirely dependent on accessing/utilizing TxDOT property. There appears to be relatively minimal mention of coordination and agreement with this approach at the 90% level which could severely impact the overall approach.	As both projects progress, the Respondents anticipate continuing discussions with TxDOT regarding the I-10 Bridge design and the potential need for changes to the 100% RD as a result of changes to the I-10 Bridge design.
Port of Houston Authority (HDR)	245	Barge Impact - 90% RD - Section 5.5.7 - Table 5-G	28% overstress for C4 is not insignificant. While it may not cause global instability, this barge strike damage could locally affect the BMP, reducing effectiveness and potentially putting resistance to water levels at risk.	Barge impact protection has been added to the 100% RD and is included in the BMP Structural Design Report (Appendix I).
Port of Houston Authority (HDR)	246	90% RD - Section 5.5.9 Pile Drivability and Vibration Analysis	The revised BMP is substantially closer to TxDOT property compared to the 30% design. Verify the "no impact" assumption.	This comment does not require a response. It should be noted that TxDOT has been engaged during design and are aware of the BMP alignment. From the available drawings from TxDOT, the pile abutment for the westbound bridge nearest to the NI are #24 through #27. Only abutments #26 and #27 use batter piles, with batter in the east-west direction within the footprint of the bridge. Therefore the BMP alignment will not clash with the foundation. The sheet pile walls are specified to be installed using silent press-in method and/or a vibratory hammer preventing potential damage to nearby structures caused by impact hammers.
Port of Houston Authority (HDR)	247	90% RD - Section 5.11.1.2 Northwest Corner - Tie-rods	Has the decision to place tie-rods below water been vetted by a contractor(s) capable of performing this work? The size and weight of the tie rods will be difficult to maneuver and install by divers as they will have to be "threaded" through the holes in the SSP. Further, the tie-rods may have to be installed prior to backfilling the BMP. Aggregate placement on top of the rod without a closely supporting under layer could cause damage to the tierods which would be undetectable underwater.	This comment is no longer applicable, because the tie-rod elevations in the 100% RD are above water.

Table 1-1

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Port of Houston Authority (HDR)	248	90% RD - Section 2.4 PDI and SDI Conclusions and Recommendations - Northwest Corner	"Based upon the results of this evaluation, it is not safe to excavate the material in the northwest corner to the currently known depths in the manner required by the ROD. The results of this evaluation were detailed in a Hydraulic Heave Analysis Report submitted to the EPA on December 9, 2021, (GHD, 2021i) and in a follow-up letter submitted to the EPA on December 22, 2021 (GHD, 2021j). Based upon this evaluation, excavation of the northwest corner is technically impracticable as prescribed by the ROD (i.e., “in the dry”) and that area will have to be addressed using a different remedial approach. Thus, the design for removal of the material in the northwest corner is not included in this 90% RD and will be addressed in a future RD submission." Furthermore, the report indicates that the dredging is not anticipated to happen in the wet, either. What is the current direction of the remediation at the northwest corner and how will it be integrated in with the rest of the project area design?	The 100% RD has been updated to include mechanical dredging of the northwest corner.
Port of Houston Authority (HDR)	249	90% RD - Section 5.2 Remedial Approach - Northwest Corner	"Although the design for the northwest corner is not included in this 90% RD and will be addressed separately, it is important to note that the early completion of the RA in the northwest corner is critical to the overall sequencing of the project. This 90% RD has been prepared to be “implementable” as designed excluding the northwest corner, but in reality, the northwest corner would likely need to be completed in the first excavation season due to access issues and bathymetric conditions." Has there been any discussion relative to delaying excavation of the northwest corner until the end, particularly if it may require a different remediation approach?	The 100% RD has been updated to include mechanical dredging of the northwest corner to occur in the first excavation season.
Port of Houston Authority (HDR)	250	90% RD - Section 5.5.5 - Design Criteria - Wall berms	Section 5.5.5 highlights design of the BMP wall itself, but there is a little discussion of the berm in front of the walls and temporary slopes that will be formed to remove contaminated soils. What is the anticipated geometry for the berm and temporary slopes to remove contaminated material and have the stability of these slopes been evaluated? Given the timeframe for excavation to remove contaminated material and backfill, a short-term (and a long-term analysis in some instances) may be required considering the anticipated slopes and any construction loading. Please clarify.	The berms and temporary slopes to remove contaminated material will be sloped at 1V:3H. The slope were evaluated for a range of excavation depth and found to be adequate.
Port of Houston Authority (HDR)	251	90% RD - Section 5.2 - Remedial Approach - Waste Trucks on BMP	Haul vehicles and other equipment are indicated to have to drive up to and over the BMP. The vertical vehicle pressure will transfer through the BMP fill and potentially apply bending pressure to tie rods. Has this impact been considered or additional structural members added to support this segment of BMP?	Tie-rods are placed significantly lower (EL+3) than the top drivable surface (EL+9). An analysis of vehicle traffic concluded vehicles will not have any significant impact on the tie-rods.
Port of Houston Authority (HDR)	252	90% RD - Section 5.3 - Basis of Design - Water Data	River elevation data back to 1994 was used to determine the top elevation for the BMP, but what years were the most recent data from? Very recent data (past two years) and projected increases based on near-term climate change and sea level rise (next 7 years) should be evaluated to confirm the top elevation of the BMP is sufficient.	The BMP outer wall has been raised to +10 ft. NAVD88.
Port of Houston Authority (HDR)	253	90% RD - BMP Wall	What consideration was given to how increases in flooding the BMP wall may cause issues to the surrounding area by acting as a restriction to flow?	A Floodplain Assessment has been completed and is included in the Hydrodynamic Modelling Report.
Port of Houston Authority (HDR)	254	90% RD - Section 5.7.2 Loading, Transportation, and Disposal	Was moving the material out of the area on barges evaluated as an option (as opposed to trucks), realizing this would pose its own challenges? The estimated 13,200 truck trips seems enough to evaluate alternate modes of transportation.	Alternate mode of transportation were evaluated.

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Port of Houston Authority (HDR)	255	90% RD - Section 5.3.4 Excavation Extent and BMP Alignment, Vertical Extent	Section 5.3.4 vertical delineation was not achieved at 3 boring locations. The design considered the adjacent co located borings to determine the approximate excavation elevations." EPA may consider the requirement to complete the vertical delineation at these 3 locations where results were 194 ng/kg, 17,700 ng/kg and 5690 ng/kg (-20.4 ft.) TEQ, given how important excavation depths are relative to hydraulic heave rather than using nearby borings for vertical delineation. HDR submits that additional vertical delineation - if required - can be accomplished in the future (i.e., prior to the season when those seasonal cells are slated for remediation).	The FSP includes confirmation sampling of the entire northern impoundment to address uncertainty prior to excavation.
Port of Houston Authority (HDR)	256	90% RD - Figure 5-E - Hydraulic Heave Sensitivity	The names of the borings shown on the Hydraulic Heave Sensitivity figure should be adjusted to make more legible.	Individual borings are not depicted on Figure 5 as it is intended to depict sitewide hydraulic heave risk potential.
Port of Houston Authority (HDR)	257	90% RD - Section 5.6.5 Excavation Area Restoration	While there are "no post-excavation restoration measures identified or required as part of the ROD", there must be a plan on what the future bathymetry would look like upon completion of excavation and removal of the BMP. Based on this single paragraph, it seems like the area may be used as a repository of clean materials without a particular plan on how to grade them except for along the south edge, and how to prevent future erosion of any clean materials placed in this area. The letter report should clearly stated the plans for BMP maintenance and removal at the conclusion of the NI remediation.	This comment has been addressed within the 100% RD. Erosion is not of concern because everything below 30 ng/kg will have been removed.
Port of Houston Authority (HDR)	258	90% RD - Section 7 - Environmental Footprint (Greener Clean-Ups)	Section 7 (Environmental Footprint) - alternate means of T&D for removed contamination, other than trucks, may be considered. Limiting idling time of trucks and using equipment operated with low sulfur-containing fuels is also a best practice to consider. Footprint spreadsheets or Green Remediation toolkit outputs may be submitted to further identify ways in which the remedial activities can be made more sustainable.	Alternative means of T&D were considered and found to be not implementable alternate mode of transportation.
Port of Houston Authority (HDR)	259	90% RD - Appendix B - Attachment E - Geotechnical Engineering Report - Section 5.3.1 Complete Removal of Impacted Material	"While the majority of the area outside the northwest corner does not show calculated FS below the target values, much of this area is approaching elevations that would be at risk of heave. This is important to note, given that excavation depths could increase based upon post-confirmation sampling." What is the contingency plan if the post-construction sampling shows additional excavation needs to occur and could induce heave? Will the excavation plan for the northwest corner be adopted?	Refer to Section 7.2 of the Updated Hydraulic Heave Analysis.
Port of Houston Authority (HDR)	260	90% RD - Appendix E - Use of Area Based Average Concentration to Meet Clean-Up Level Section 2.4.1 Excavation Strategy	Appendix E Section 2.4.1 Excavation Strategy - an excavation surface is discussed but no figure is provided. Was not able to locate the November 2021 TWG Meeting presentation. From the description of the approach, it sounds like Theissen polygons were used. Please provide the figures that support this appendix.	The 100% RD specifies removal of all material greater than the clean-up standard of 30 ng/kg.
Port of Houston Authority (HDR)	261	90% RD - Appendix E - Use of Area Based Average Concentration to Meet Clean-Up Level Section 2.4.2 Validity, Protectiveness..	Appendix E Section 2.4.2 - one of the example sites mentions a not-to-exceed value twice that of the site-wide average. For this site, a not-to-exceed value of 10 times the site-wide average is used. Provide the rationale from the methodology (or perhaps discussions with EPA) for selecting the 10x not to- exceed value.	This comment has been received and is noted.
Port of Houston Authority (HDR)	262	90% RD - Appendix G - Design Drawings - C-01	C-01 - Add a tidal Datum Chart	This comment is received and noted. The nearest tidal gauge is 9 miles to south of the project site. MHHW = +1.33 ft (MLLW). There is not much of a tidal change between that gauge and the Northern Impoundment. For that reason, a tidal datum chart is not necessary.

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Port of Houston Authority (HDR)	263	90% RD - Appendix G - Design Drawings - C-09 through C-12	C-09 through C-12 - Within the excavation footprint, consider turning off existing elevations/grading for clarity.	These comments regarding design drawings have been noted and addressed as necessary. As these are the excavation drawings, the existing contours are needed in comparison to the excavation contours to contrast the areas for removal. The revised design drawings are included in the 100% RD as Appendix G.
Port of Houston Authority (HDR)	264	90% RD - Appendix G - Design Drawings - C-13 through C-12	C-13 through C-12 (common) - consider showing Tie-rods in the BMP C-13 through C-12 (common) - recommend expanding the legend to show current/proposed excavation limits for clarity C-13 through C12 (common) - Is the BMP inner fill to the same elevation as the top of wall? C-13 through C-12 (common) - recommend adding a note that the FOS 1.25 maximum line is the maximum permissible depth based on hydraulic heave C-13 through C-12 (common) - recommend adding legend/note what values along boring represent (i.e., concentration of contamination) C-13 through C-12 (common) - Recommend clarifying the BMP soil buttress is existing (to remain) or to be augmented for stability	These comments regarding design drawings have been noted and addressed as deemed appropriate.
Port of Houston Authority (HDR)	265	90% RD - Appendix G - Design Drawings - C-19	C-19 - recommend removing existing/prior grade for clarity once a cell has been excavated	C-19 has been revised in the 100% RD to show existing grade in grayscale once an area has been excavated. The revised design drawings are included in the 100% RD as Appendix G.
Port of Houston Authority (HDR)	266	90% RD - Appendix G - Design Drawings - C-22	C-22 - recommend removing prior grade once excavation has been complete	C-22 has been revised in the 100% RD. The revised design drawings are included in the 100% RD as Appendix G.
Port of Houston Authority (HDR)	267	90% RD - Appendix G - Design Drawings - C-35 through C-44	C-35 through C-44 (common) - recommend showing tie-rods	These comments regarding design drawings have been noted and addressed as deemed appropriate.
Port of Houston Authority (HDR)	268	90% RD - Appendix G - Design Drawings - S-01	S-01 - Recommend adding critical loading criteria (max water elevations, surcharge [if any]) to this sheet. S-01 - Recommend adding notes on the BMP fill / raised bench fill material S-01 - Letter and Structural calculation report indicates tie-rods are 120 ksi S-01 - recommend adding a tidal datum chart S-01 - Specify whether there is a minimum waiting period between initial fill/rod installation to adjust/document any initial consolidation/settlement	These comments regarding design drawings have been noted and addressed as deemed appropriate.
Port of Houston Authority (HDR)	269	90% RD - Appendix G - Design Drawings - S-03	S-03 - Detail C: Add waterline S-03 - the duration of the project poses risk for tie-rods should they become restrained from rotation. Settlement of the supporting fill/pressure from overlying cover could induce bending stresses in the tie-rod. Intermediate supports or adequate FOS should be incorporated into the tie-rod design.	Changes have been made to the design drawings. Water line added. The design of the tie-rods was changed to included spherical nuts, bearing plates and forged eye articulation joint at midspan.

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Port of Houston Authority (HDR)	270	90% RD - Appendix G - Design Drawings - S-04	S-04 - consider shifting tie rod locations equal to the width of one Z sheet to install bolting between waler and sheets. Presently, the waler is not directly connected to the sheets. S-04 - Suggest adding weep holes (~0.5" +/- 10' O.C.) to prevent buildup of water on the upper waler	Tie-rods are spaced to correspond to width of one sheet pile pair. Walers are design as simply supported sections supported only at the tie-rods. This is a typical configuration and walers will bear on the sheet piles sufficiently. Specifications updated to include weep holes for walers.
Port of Houston Authority (HDR)	271	90% RD - Appendix G - Design Drawings - S-05	S-05 - Detail 1: Consider providing a nominal gap between adjacent walers to allow for field adjustment and thermal expansion of the waler. S-05 - Section B: Consider perforating the PVC to release any potential trapped water. S-05 - Section B: consider using spherical washer & dished bearing plate to allow for nominal rotation of tie rod under possible settlement. S-05 - Section C: Consider increasing the gap between walers. Should the tie-rod become "clamped" by the walers or splice plates, the connection will prevent rotation under settlement and could induce bending stress in the rod. S-05 - Recommend adding a table documenting details for "Part 1, Part 2.... etc." S-05 - Consider adding spacers (schedule 80 steel or similar) to splice connections to maintain clearance between walers.	Detail 1 - Revised to include nominal gap Section B - PVC pipe removed. Section B - Detail revised to include spherical nut and bearing plate. Section C - Detail revised to include space between tie rod and walers Table for Parts is shown on S-04 Spacers - note added on drawings.
Port of Houston Authority (HDR)	272	90% RD - Appendix H - Design Specifications Administrative Requirements (01 30 00)	Section 01 30 00 (Administrative Requirements) missing from submittal	These comments regarding design specifications have been noted and addressed as deemed appropriate.
Port of Houston Authority (HDR)	273	90% RD - Appendix H - Design Specifications Submittal Procedures (01 33 00)	Section 01 33 00 (Submittal Procedures) missing from submittal	These comments regarding design specifications have been noted and addressed as deemed appropriate.
Port of Houston Authority (HDR)	274	90% RD - Appendix H - Design Specifications Temporary Traffic Controls (01 35 00)	Section 01 35 00 (Temporary Traffic Controls) missing from submittal. Critical, based on proximity of the site (and proposed location of BMP) to the I- 10 freeway, details of site entry/exit will be critical to PHA, TXDOT, and other stakeholders.	These comments regarding design specifications have been noted and addressed as deemed appropriate.
Port of Houston Authority (HDR)	275	90% RD - Appendix H - Design Specifications Quality Requirements (01 40 00)	Section 01 40 00 (Quality Requirements) missing from submittal	These comments regarding design specifications have been noted and addressed as deemed appropriate.
Port of Houston Authority (HDR)	276	90% RD - Appendix H - Design Specifications Temporary Facilities and Controls (01 50 00)	Section 01 50 00 (Temporary Facilities and Controls) missing from submittal	These comments regarding design specifications have been noted and addressed as deemed appropriate.
Port of Houston Authority (HDR)	277	90% RD - Appendix H - Design Specifications Temporary Soil Erosion and Sediment Controls (01 57 13)	Section 01 57 13 (Temporary Soil Erosion and Sediment Controls) missing from submittal	These comments regarding design specifications have been noted and addressed as deemed appropriate.

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Port of Houston Authority (HDR)	278	90% RD - Appendix I - BMP Structural Design Report - Design Drawings	The design sections (cross-section C-2, for example) indicate significant fill (greater than 10 ft) is being added when constructing the double walled BMP. Additionally, the alluvium sediments are characterized as normally consolidated. While we believe the Plaxis model should incorporate in consolidation settlements and secondary compression (if applicable), no discussion is included regarding the settlement resulting from the fill placement. What magnitude of settlement is anticipated and what impacts are anticipated on the internal tie rods? Additionally, has settlement of the existing (or future) TxDOT bridge foundations adjacent to the project been evaluated?	Drawings include details for placement and consolidation period between fills that accounts for settlement impacts on the BMP and soil buttress adjacent to the walls. The tie-rod details have been revised to allow for vertical articulation to accommodate potential settlements. We have not reviewed or analyzed TXDOT bridge foundations. TXDOT has been included in the discussions and been provided the drawings in the past. In addition, TXDOT was involved in the conversations and decisions for the final restoration plans for the south slope close to the bridge.
Port of Houston Authority (HDR)	279	90% RD - Appendix I - BMP Structural Design Report Section 5.1 Failure Modes	Section 5.1 highlights 3 failure models including "Item 1: The unstable slopes may cause a deep-seated rotational failure of the entire soil mass. The slope failures are independent of the sheet pile embedment and location of the anchor system. This type of failure can be remedied by changing the geometry of the retained material or improving the soil strength." If this failure mechanism has been considered, please provide the corresponding factor of safety. Otherwise, please state why this failure mechanism is not applicable.	The analysis program evaluates soil slope stability around the sheet pile to check this mode of failure. Text in the BMP Design Report updated to note that the analysis program considers the soil profiles, structural sections and performs the soil structure interaction to achieve a solution with compatible forces and displacement.
Port of Houston Authority (HDR)	280	90% RD - Appendix I - BMP Structural Design Report Attachment 3.1 BMP Calculations	Attachment 3.1 - The splice plates have been analyzed for resultant shear from waler moment, however, it is not clear if the direct shear on the waler has been superimposed into this analysis of the splice plate bolt group. The splices are placed at approximately the point of zero moment, which will roughly correspond to the point of maximum shear.	Yes, splice connection is designed for maximum shear in the system.
Port of Houston Authority (HDR)	281	90% RD - Appendix I - BMP Structural Design Report Figure 1-2	What is the basis for the "inner design water elevation" in Figure 1-2? As we understand it, the contaminated materials will generally be excavated in the dry, which we believe means that the water level will temporarily be lowered to or near the bottom of the excavation. As currently shown, the "inner design water elevation" is around El. 5 ft, which is significantly higher than the bottom of the excavation.	Figure 1-2 is revised to show a typical cross-section where, as noted in the Port's comment, the water level will be lowered to accommodate excavation in the dry. Only the NW corner of the Northern Impoundment will be excavated in the wet. Refer to the revised drawings to review the different phases of excavation.
Port of Houston Authority (HDR)	282	90% RD - Appendix J - Supplemental Deliverables	NI "staged" documents were reviewed prior. Many comments on these documents were related to future contractor selection. It is understood that all staged documents in this Appendix will be finalized and incorporated into the 100% RD.	This comment is noted.
NOAA - Natural Resource Trustee	283	90% RD - Table 5-1	The selected remedy in the site's Record of Decision "...involves the removal of all waste material that exceeds the cleanup level of 30 ng/kg regardless of depth in the northern waste pits." (EPA 2017). The proposed excavation surface as described in Table 5-1 of the Subject Document leaves contamination above this cleanup level at approximately one third of sampled locations within the northern impoundment (excluding the northwest corner). In a small number of locations, the proposal to leave contamination in place is likely due to risk of hydraulic heave (e.g., SJSB047-C1, SJSB088), whereas at approximately 70% of locations it's unclear why contamination above the cleanup level is proposed to remain within the impoundment at depth. For example, see samples SJSB033, SJSB048-C1, SJSB049, SJSB076, SJSB082 in Table 5-1. If contamination exceeding the cleanup value will be left in place without backfilling or capping to eliminate the exposure pathway, the Potentially Responsible Party is liable for resulting injuries to natural resources as assessed by a Natural Resource Damage Assessment under CERCLA.	Table 5-1 has been revised for removal of all material above 30 ng/kg.
NOAA - Natural Resource Trustee	284	90% RD - Appendix E	Appendix E of the Subject Document discusses the elimination of the main pathways of exposure for human receptors and the use of a surface-weighted average concentration (SWAC) to demonstrate compliance with the cleanup level. It should be noted that SWACs are not fully protective of all ecological receptors, specifically benthic fauna that do not range over large areas.	The 100% RD specifies removal of all material greater than the clean-up standard of 30 ng/kg.

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NOAA - Natural Resource Trustee	285	90% RD - Section 5.6.2.1	Water behind the BMP wall will be pumped into the river each season to allow excavation activities to take place in a dry environment (as discussed in section 5.6.2.1 of the Subject Document). Best management practices should be used to minimize disturbance of contaminated material during dewatering, therefore, minimizing releases of contaminated water.	This comment is noted. Best management practices will be used.
NOAA - Natural Resource Trustee	286	MNR Plan – Sand Separation Area - 90% RD	While we recognize the site's Record of Decision called for removal of contaminated media solely within the boundaries of the northern and southern impoundments, and we commend EPA's efforts to require removal of this material in the face of significant engineering and logistical challenges, we have concerns about contamination above the cleanup level being left in surface sediments at locations on site adjacent to the impoundments, as well as with the Monitored Natural Recovery plan for the site's Sand Separation Area (see Natural Resource Trustee comment memo dated March 25, 2022). Leaving contamination from the site in place, in some locations one to two orders of magnitude above the cleanup level, may result in unacceptable risks to receptors. We look forward to reviewing how Natural Resource Trustee comments made in the aforementioned memo will be incorporated into the Final 100% Remedial Design.	MNR is the RA specified in the ROD for the SSA. The sampling schedule in the MNR Plan has been amended.
NOAA - Natural Resource Trustee	287	90% RD	Common bottlenose dolphins (Tursiops truncatus) inhabit the waters adjacent to the site; therefore, we recommend the Marine Mammal Protection Act be considered during the Remedial Design process.	This comment is noted and will be considered prior to RA.
NOAA	288	90% RD	Comment #1 in the Natural Resource Trustee comment memo dated September 1, 2022, expresses concern over the subject document's proposal to leave contamination in the Northern Impoundment above the cleanup value established in the site's Record of Decision (ROD; EPA 2017). In areas where excavation can safely be performed without the risk of hydraulic heave, the excavation surface should be designed such that the cleanup value is met without the use of averaging analytical results downcore or between sampling locations. If contamination above the cleanup level established in the ROD is knowingly left in place in the Northern Impoundment, the affected area(s) need to be backfilled appropriately or capped, to provide assurance that contamination left at depth will be isolated from receptors. A long-term monitoring plan will need to be developed to ensure that the remedy will be stable, effective, and protective over the long-term. All areas with contamination remaining above the cleanup value need to be included in the site's long-term monitoring plan. As stated in the ROD "This remedy will result in hazardous substances, pollutants, or contaminants remaining at the site above levels that allow for unlimited use and unrestricted exposure. Pursuant to Section 121(c) of CERCLA, statutory reviews will be conducted no less often than once every five years after the initiation of construction to ensure that the remedy is, or will be, protective of human health and the environment." The ROD section "Five-Year Review Requirements" only discusses monitoring the site's Sand Separation Area and the Southern Impoundment. However, the subject document proposes leaving hazardous substances on site within the Northern Impoundment, making it now subject to CERCLA Section 121(c)'s long term monitoring and review requirement.	The 100% RD specifies removal of all material greater than the clean-up standard of 30 ng/kg.

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TCEQ	289	90% RD - Section 5.12.3.2 Hydraulic Heave Evaluation	It is stated that the design river stage for the Reasonable Maximum Case was calculated based on the safe level of dry excavation calculated for the Extreme Case (+5 ft North American Vertical Datum of 1988 (NAVD88)). However, Section 5.12.3.3.2 Design River Level indicates that the Reasonable Maximum Case value was determined based on the occurrence frequency of various river stages from the hindcasted model using historical data since 1996. Please clarify how the river stage for the Reasonable Maximum Case was derived. It is TCEQ's position that using historical data is a more appropriate estimation method rather than back calculating the reasonable maximum river stage with the calculated dry excavation limit from the Extreme Case. In addition, per Appendix B-1 Section 2.1.2, the safety factor for the Reasonable Maximum Case is 1.25, not 1.15, which is the safety factor for the Extreme Case.	This comment refers to an earlier version of the Hydraulic Heave Analysis. The 100% RD Hydraulic Heave Analysis is based on a river stage of +5 ft NAVD88, which is considered as the maximum river stage that is safe for construction, to calculate the safe level of dry excavation at the northwest corner. At higher levels, the site would be inaccessible due to flooding and excavation activities would be halted. The historical maximum river stage is used in other aspect of the BMP design.
TCEQ	290	90% RD - Section 5.12.3.2 Hydraulic Heave Evaluation	The dry excavation limit of -13 ft NAVD88 in the northwest corner was determined based on the river stage at the extreme case (+9 ft NAVD88). The TCEQ recommends that same calculation be done assuming the river stage at the Reasonable Maximum Case, +5 ft NAVD88. It may not change the decision on the dry excavation limit but will provide additional information when evaluating variances of the excavation limit.	The comment refers to an earlier version of the Hydraulic Heave Analysis and is obsoleted. The design criteria has changed for the 100% RD. Please see response to Item No. 289 for dry excavation limit.
TCEQ	291	90% RD - Section 5.12.5.2.1 Cell Dewatering	Similar to the comments TCEQ made to the 90% RD for the northern impoundment submitted in September 2022, TCEQ recommends that measures be taken to minimize turbidity and resuspension of deposited sediment during pumping. In addition, it is TCEQ's position that water that remains directly on the cap as cell dewatering progresses should not be handled as river water and should be treated in the water treatment system prior to discharge.	The design has been modified and the 100% RD includes treatment of the bulk non-contact water to remove solids prior to discharge. Bulk water is considered the water trapped behind the BMP to 2 feet above the lowest elevation at the time of the dewatering activity All other water during dewatering will be treated in the WTS prior to discharge.
TCEQ	292	90% RD - Section 5.12.5.2.3 Dry Excavation	The TCEQ has the same comment as on Section 5.12.5.2.1 above.	The design has been modified and the 100% RD includes treatment of the bulk non-contact water to remove solids prior to discharge. Bulk water is considered the water trapped behind the BMP to 2 feet above the lowest elevation at the time of the dewatering activity All other water during dewatering will be treated in the WTS prior to discharge.
TCEQ	293	90% RD - Section 5.12.5.2.4 Dredging Procedures	Please explain how the minimum -9 ft water elevation to be maintained during dredging was determined.	The elevation was calculated as the amount of water necessary to offset heave at the maximum depth of removal.
TCEQ	294	90% RD - Section 5.12.5.4 Post Dredging Confirmation Sampling	This section states that a water elevation of -9 ft NAVD88 is sufficient to compensate for removal of waste material to the identified target excavation elevations based on the existing dataset that include a maximum excavation of -28 ft NAVD88 plus an additional 2-ft overcut if necessary. Based on the calculation in Appendix B-1 Figure 6, the -9 ft water elevation may be sufficient for the maximum excavation at -28.4 ft but not sufficient for an additional 2 ft overcut at the maximum excavation or total of -30 ft excavation. Please clarify.	The BMP has been updated to allow for additional 2 foot overcut and raise the outer wall to +10 ft. NAVD88.
TCEQ	295	90% RD Appendix B-1 Northwest Corner Hydraulic Heave Evaluation - Figures 5 and 6	Please explain why safety factors were only applied to soil pressure since safety will be maintained by both overlying soil pressure and water pressure. If safety factors are only applied to a portion of the contributing pressures, the overall safety will be lower than the designated safety factor.	The Northwest corner hydraulic heave report has been replaced by new Hydraulic Heave report for the entire site dated May 2024. The referenced figures do not need to included in the main report.
TCEQ	296	90% RD Appendix B-1 Northwest Corner Hydraulic Heave Evaluation - Figure 5	Please provide the same calculation on the maximum drawdown elevation for the Reasonable Maximum Case (river stage at 5 ft).	This comment refers to an earlier version of the Hydraulic Heave Analysis. The Updated Hydraulic Heave Analysis is based on a maximum river level of +5 ft NAVD88. At higher levels, the site would be inaccessible due to flooding and excavation activities would halt.
TCEQ	297	90% RD Appendix B-1 Northwest Corner Hydraulic Heave Evaluation - Figure 6	Please note that the safe water elevation calculations in Figure 6 were based on the excavation bottom at -27 ft rather than the deepest known excavation bottom at -28.4 ft in SJSB098. Please provide the safe water elevations needed for the excavation bottom at -28.4 ft.	The Updated Hydraulic Heave Analysis is based on a maximum excavation depth of -28.4 ft NAVD88.

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Comment Source	Item No.	Reference	Comment	Response to Comment
TCEQ	298	90% RD Appendix B-1 Northwest Corner Hydraulic Heave Evaluation - Drawing C-49	Consistent with TCEQ's September 2022 comments on the 90% RD, it is recommended that waste material with concentrations greater than 30 ng/kg above the hydraulic heave line be removed. The material around SJSB055-C1 in this cross-section should be shown in light green (material to be excavated).	The 100% RD includes removal of all material greater than the clean-up standard of 30 ng/kg. The drawing has been updated accordingly.
TCEQ	299	90% RD Appendix G-2 - Drawings C-13, C-16, C-17, and C-49	Consistent with TCEQ's September 2022 comments on the 90% RD, it is recommended that waste material with concentrations greater than 30 ng/kg TEQDF,M above the hydraulic heave line be removed. Several borings in these cross-sections should have the light green (material to be excavated) extended downward to target waste material shown in orange.	The 100% RD includes removal of all material greater than the clean-up standard of 30 ng/kg. The drawing has been updated accordingly.
TCEQ	300	90% RD Appendix G-2 - Drawing C-45	TCEQ suggests that either the fill color of the northwest area be changed to light green to be consistent with the color for material to be excavated in other portions of the site or change the legend of "Northwest corner" to "Northwest corner to be excavated".	These comments regarding design drawings have been noted and addressed as necessary. The material to be excavated is shown in a green tone. The Northwest Corner is shown in an additional grey tone that is overlaid on top of the material to be excavated. The revised design drawings are included in the 100% RD as Appendix G.
TCEQ	301	90% RD Appendix G-2 - Drawings C51-53	Please add a title to each phase to indicate major activities that will be conducted in each phase.	These comments regarding design drawings have been noted and addressed as necessary. The major activities for each phase are listed in the phase specific notes for the Design Drawings included in the 100% RD. The revised design drawings are included in the 100% RD as Appendix G.
TCEQ	302	90% RD Appendix J-2, Supporting Deliverables - Field Sampling Plan, Section 2.6 Sampling in Decision Units	Composite samples made from 6 to 8 discrete samples from each ½ acre decision unit (DU) are proposed. As TCEQ commented on the 90% RD, TCEQ recommends collection of additional discrete samples to be included in each composite to be more representative of the full range of concentrations within the DU.	The proposed number of discrete samples from each Decision Unit was increased from 6 to 8 discrete samples to 9 discrete samples from each Decision Unit in Section 2.1.1.
TCEQ	303	90% RD Appendix J-2, Supporting Deliverables - Field Sampling Plan Section 2.6.1.1 Sample Collection and Compositing Procedures:	This section proposes that each sample core will be hand pushed to 2 ft or until refusal is met- will collection of a replacement core from an adjacent location be considered if shallow refusal is met? Representative samples from the 6-12 inch and 12-24 inch intervals at each discrete sample location should be collected.	Section 2.5.1.1 was revised to note that, if refusal is encountered, the sampling location will be off-set within an approximately 10 to 20 ft radius of the original location and advancement of the core will be attempted in the off-set location.
HCTAC	304	90% RD General comments	The ROD was clear in requiring removal of wastes exceeding 30 ng/kg TEQ, and that the long-term risk from leaving dioxins in place in this location was unacceptable. This design shows intent to leave in place sediments with dioxin TEQ concentrations of up to 1,800 ng/kg. We support the mechanical dredging approach to remove waste-impacted materials below depths that can be safely excavated in the dry, though excavating in the dry is preferable to the extent possible.	The 100% RD specifies removal of all material greater than the clean-up standard of 30 ng/kg.
HCTAC	305	90% RD General comments	We continue to question the data interpretation which was the basis of the hydraulic heave evaluation. We have not seen any response to our previous comments on the geotechnical report and hydraulic heave analysis. All previously submitted technical comments with reference to the Northern Impoundment Remedial Design remain a concern.	The 100% RD specifies that the RC will be required to complete stratigraphic borings in the areas identified as having potential hydraulic heave risk and install piezometers in any sand seams/lenses that are identified that could potentially produce hydraulic heave.
HCTAC	306	90% RD General comments	The data obtained and used previously and used for this design, HCFCD believes is inadequate and presents safety issues.	The 100% RD specifies that the RC will be required to complete stratigraphic borings in the areas identified as having potential hydraulic heave risk and install piezometers in any sand seams/lenses that are identified that could potentially produce hydraulic heave.
HCTAC	307	90% RD General comments	Geotechnical Borings, Sampling, Laboratory Testing and results of engineering analysis are not adequate and does not meet the standards of HCFCD, both regulatory and technical.	This comment has been received and is noted.

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HCTAC	308	90% RD General comments	Additional Geotechnical Borings will be needed as noted in HCFCD memo previously provided.	The 100% RD specifies that the RC will be required to complete stratigraphic borings in the areas identified as having potential hydraulic heave risk and install piezometers in any sand seams/lenses that are identified that could potentially produce hydraulic heave.
HCTAC	309	90% RD General comments	Any additional Geotechnical sampling and laboratory testing required to support and verify the design should be performed preferably by an Engineer licensed in Texas and experienced in Harris County Geotechnical issues related to facilities to be installed/repaired within HCFCD ROW.	This comment has been received and is noted.
HCTAC	310	90% RD Section 5.12.2.2	Risk from flooding. The report states that there is a greater risk of release of wastes from inside the BMP wall to the river if the removal is done by dredging through water (to reduce risk of hydraulic heave) than if removal was done by excavation in the dry, because the excavation would be flooded if a storm is approaching. We fail to see why the risk would be more acute under the dredging alternative. The overtopping of the BMP could occur in either circumstance, and it would almost surely release contaminants. If an assumption is being made that by filling the dry excavation from the river just prior to a storm, the level of contaminants in water inside the BMP wall will be lower than under a dredging scenario, we would be interested in seeing the calculations or models that would support that.	Your comment has been received and is noted.
HCTAC	311	90% RD	Was a deeper sheet pile wall considered for the northwest corner? That might reduce risks of hydraulic heave and enable deeper excavation.	Yes. Several concepts were evaluated in the initial stages of the project and considered unfeasible. For various reasons addressed in past submissions and discussions, it was decided to use a double wall system which does not require driving into the sand layers.
HCTAC	312	90% RD Section 2.1.6.4	The BMP included in the design will cut off the interconnection between the shallow groundwater and the river within the areas of removal." Section 2.2.7.2 indicates that the Beaumont Clay formation extends from about -30 feet NAVD88 down to -60 to -80 feet NAVD88 on the western side of the Northern Impoundment. Section 2.3.7.3 says that the compressible clay layer predominantly consisted of one layer on the west side of the northern impoundment but on the east side, this layer may be interlayered by thin occasional granular lenses. Hydraulic heave risk is due to horizontal water migration under the BMP wall through sand lenses. So why the focus on hydraulic heave on the west side when the sand lenses are only present on the east?	This comment is addressed in the Updated Hydraulic Heave Report.
HCTAC	313	90% RD Appendix B-1 Hydraulic Heave Evaluation	Please explain clearly how the stated piezometric head difference of 1.7 feet between the Beaumont Sand and the river was calculated. The actual difference appears to be about 4 feet, based on Figure 3.	As discussed in Section 4.3 of the 100% RD Heave report, when the unit dampening is applied to the upper sand lens where there is approximately 16 ft of clay (in the Northwest Corner), the estimated piezometric head in the sand lens would be 1.7 ft lower than the river elevation. The 1.7 ft dampening effect was conservatively assumed for the entire Northern Impoundment to account for uncertainty as to the occurrence and elevation of sand lenses within the Beaumont Clay.

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HCTAC	314	90% RD Appendix B-1 Hydraulic Heave Evaluation	There is an apparent disconnect between the stated depths of the Beaumont sand described in the report and shown in the geological cross-section (Figure 1) and the actual boring logs and CPT data. Section 1.3 of the report states that the top of the Beaumont sand is at elevation -50 ft NAVD88 in boring SJGB019 and CPT SJSCPT-01, and at -54 ft NAVD88 in boring SJGB018. Yet on page 2 of Appendix B (SDI Cone Penetration Test [CPT] Results) of Appendix B (Geotechnical Engineering Report), CPT SJSCPT-01 shows the sand layer does not begin until -57 ft (datum not provided). In boring SJGB018, the sand layer is not observed until the 40-ft boring depth, which we presume to equate to roughly -60 ft NAVD88 since the top of the boring was 20 ft below the water surface. The log notes that the driller skipped from the 30-ft interval to 40-ft by mistake, skipping the 35-ft (~55-ft NAVD88) interval. In the boring log for SJGB019, the log says that hard, dry reddish-brown clay is present at the 30-32' depth of boring, which should equate to about -50 ft NAVD88 since the top of boring was at 20 ft below water level. In this boring, the sand layer was not hit until the 59-ft boring depth – or ~ 79 ft NAVD88.	Appendix B-1 is in the now obsolete Northwest Corner Heave Analysis, which has been replaced by the May 2024 Heave Analysis which covers the entire site.
HCTAC	315	90% RD Appendix B-1 Hydraulic Heave Evaluation	If the boring logs are correct, and we are interpreting them correctly, the Beaumont sands were observed at elevations of 57 feet NAVD88 or greater. Thus, the thickness of the intervening impervious clay layer (Hc) is apparently being underestimated by at least 7 feet, and the effective head at the top of the sand layer is similarly mis-calculated. This would cause an underestimation of the safe excavation depth.	Appendix B-1 is in the now obsolete Northwest Corner Heave Analysis, which has been replaced by the May 2024 Heave Analysis which covers the entire site.
HCTAC	316	90% RD Appendix B-1 Hydraulic Heave Evaluation	The subsurface profile shown in Figure 1 could not be confirmed with boring logs or Figure 5-1 in the main report. Final boring logs with surface elevation information should be provided for borings SJGB018 and SJGB019. Additional discrepancies that need explanations include: Boring SJB019 did not describe a gravelly sand layer below the soft clay at surface. However, the graphic profile depicts this layer. A layer of silty sand with clay laminations was described at a depth of 13.6 feet followed by a zero-recovery sample. How is this depicted as gravelly sand? Boring log for SJGB019 did not encounter a Beaumont sand layer within the Beaumont clay layer. A very soft clayey silt was encountered between depths of 35 and 40 feet. It is unclear how this layer was identified as Beaumont Sand by designers.	Appendix B-1 is in the now obsolete Northwest Corner Heave Analysis, which has been replaced by the May 2024 Heave Analysis which covers the entire site.
HCTAC	317	90% RD Appendix B-1 Hydraulic Heave Evaluation	The silty fine sand layer encountered between depths of 40 and 50 feet at SJGB018 was described as "dry". It is unclear how this dry layer can result in hydraulic heave.	Appendix B-1 is in the now obsolete Northwest Corner Heave Analysis, which has been replaced by the May 2024Updated Hydraulic Heave Analysis which covers the entire site.
HCTAC	318	90% RD Appendix B-1 Hydraulic Heave Evaluation	It is unclear how the conclusion of gravelly sand being connected to Beaumont Sands or Chicot Aquifer was derived. Later in the report it is also indicated that the Beaumont Sands are potentially hydraulically connected to the deeper sand layer. The basis for this statement is unclear.	This comment is referring to the addendum report concerning the Northwest Corner Hydraulic Heave. This report is obsolete in that it is replaced by a Hydraulic Heave report addressing the entire site dated May 20, 2024. To answer the comment, gravelly sand being connected to Beaumont Sands or the Chicot Aquifer, refer to Figure 3 of the May 2024 Hydraulic Heave report where it can be seen that the gravelly sand (blue) underlays and is in contact with the above sand deposit between El. -57 and El. -66. There is also potential that the Beaumont Clay (green) does not act as an aquitard or aquiclude between the gravelly sand (blue) and the Beaumont Sands.
HCTAC	319	90% RD Appendix B-1 Hydraulic Heave Evaluation	The authors should draw parallels between the subsurface profile at SJMW016 and the borings within NW corner. The profile at SJMW016 looks significantly different from the borings within NW corner. The hydraulic heave analysis assumes the sand layer to be under artesian pressure, but this assumption is not verified within the NW corner. The boring logs either did not encounter or reportedly encountered a dry sand layer. It is difficult to believe that there is an artesian condition existing in this location.	The Northwest corner hydraulic heave report has been replaced by new Hydraulic Heave report for the entire site dated May 2024. The report utilized a sitewide stratigraphic model to determine the top of BC and BS for the entire northern impoundment.

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HCTAC	320	90% RD Appendix B-1 Hydraulic Heave Evaluation	Although Figure 3 indicates that the piezometric head in the Beaumont Sand layer follows the fluctuations in the river water level the difference between two is consistently three to four feet. How was the conclusion of 0.11 feet of dampening per foot of clay made?	This difference in piezometric level (between the San Jacinto River and Beaumont Sand) at SJMW016 indicates the presence of a dampening effect (head loss) in the Beaumont Clay. Assuming that the dampening is proportional to the clay thickness at that location, the piezometric head gradient between the river and the Beaumont Sand was calculated to be approximately 0.11 foot per foot (ft/ft) of clay.
HCTAC	321	90% RD Appendix B-1 Hydraulic Heave Evaluation	It is unclear how the 1.7 feet difference between river stage and piezometric head at EL. - 50 was arrived at. The thickness of clay layer at boring SJGB018 above the sand layer is at least 40 feet. Therefore, using a 0.11 feet of head dampening per foot of clay the head difference should be 4.4 feet. The generalized profile used in Figure 5 also encountered 10 feet of soft sediment and 23 feet of Beaumont Clay.	Refer to responses to Item No. 313 and 320.
HCTAC	322	90% RD Appendix B-1 Hydraulic Heave Evaluation	For the reasonable maximum case in Figure 5, why was the uplift pressure in sand represented as (50+x)*62.4. Why use El. 0 as reference point?	50+x represents the head value of the BS occurs at elevation -50 ft NAVD88 with x being the river stage above or below EL. 0 when referenced to NAVD88. El. 0 is just a point in the vertical datum.
HCTAC	323	90% RD Appendix B-1 Hydraulic Heave Evaluation	The risk of hydraulic heave due to deep sands was not part of this evaluation. Why are the piezometers being recommended to be installed within the deeper sand?	The risk of hydraulic heave is evaluated for the entire northern impoundment on the BS regardless of where the BS occurs. The 100% RD specifies that piezometers are to be installed in the vicinity of the NW corner, as well as other parts of the impoundment to the upper most BS occurrence, as discussed in Attachment B of Appendix H.
HCTAC	324	90% RD Remedial Action Sequencing	The design states that the remediation of the northwest corner will be the most challenging and have the tightest schedule. Therefore, we question the wisdom of addressing the northwest corner in the first removal season. By scheduling it in the second or later season, it would benefit from lessons learned during remediation of the balance of the site. We understand the access issues that would be created if the southwest quadrant was remediated first and left as a partially flooded hole. We believe the southeast quadrant may make more sense to address first. Alternatively, if the southwest quadrant were addressed first and then partially backfilled with clean fill, it might resolve some of the access issues in the remaining areas in following seasons. Additionally, it might ease potential schedule conflicts with IH-10 bridge replacement.	The Northwest Corner will be remediated through mechanical dredging. Section 5.7 of the 100% RD details why the Northwest Corner will need to be addressed during the first excavation season..
HCTAC	325	90% RD Remedial Action Sequencing	Recommend installation of piezometers along the inside periphery of BMP wall to monitor head pressure at the top of the Beaumont sand to serve as warning system for hydraulic heave issues, i.e., if the head approaches the weight of clay and water overlying the piezometer.	Installation of piezometers will be included as part of the RA as discussed in Section XX or Appendix YY
HCTAC	326	90% RD Construction Drawings	The construction drawings indicate an intent to leave waste materials exceeding 30 ng/kg dioxin TEQ in place at a number of points. In some cases, such as boring SJSB088, this would include material with dioxin TEQ of 1800 ng/kg. We oppose the plan to leave these materials in the riverbed.	The 100% RD includes removal of all material greater than the clean-up standard of 30 ng/kg. The drawings have been updated accordingly.
TCEQ	327	ERP - 90% RD Attachment 2 - Section 5	Please clarify at which storm preparation phase excavated waste material awaiting disposal (e.g., on staging pile or pad) will be secured or taken offsite for disposal. For Phase III preparation, please clarify what material (e.g., soil, aggregate, stockpiled armor rock saved from TCRA Cap) will be used to backfill?	Defined preparation phases to address situations involving severe weather, a high water event, a tropical depression, tropical storm, or a hurricane that is anticipated to make landfall in the general vicinity of the work site, is described in the High-Water Preparedness Plan (HWPP) included as Attachment L in the 100% RD.
TCEQ	328	TODP - 90% RD Attachment 8, Section 4.1	The TCEQ suggests that information shared verbally in the Technical Workgroup Meetings about the waste types that can be accepted at the chosen disposal facility be added (i.e., that the selected disposal facility be permitted to receive both Class 1 and Class 2 non-hazardous industrial waste).	The TODP has been revised per comment.

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TCEQ	329	MNR Plan - Sand Separation Area - 90% RD Attachment 9, Section 5.4	The Lavaca Bay site is provided as a case study; but it should be noted that once the performance objective was met, voluntary sediment monitoring has been ongoing since 2006 to verify that MNR is still protective and progressing at the site.	This comment is noted.
TCEQ	330	MNR Plan - Sand Separation Area - 90% RD Attachment 9, Sections 6.4 and 6.5	The TCEQ believes that the MNR monitoring termination based on the arithmetic mean concentration of the nine composite samples from the entire SSA area is not appropriate. The Feasibility Study report states that MNR would be used to reduce the concentration to sediment PRG (30 ng/kg TEQDF,M) in the SSA area, which suggests that MNR should focus on areas in the SSA with concentrations greater than the PRG considering the fact that the mean TEQDF,M concentration in the sand separation area has been below 30 ng/kg since 2010 before ROD was issued (Section 6.5 in the plan). The TCEQ supports the approach proposed in the 30% design focusing MNR monitoring on the area around SJSSA06, SJSSA08, and SJNE032 with dioxin concentrations greater than 30 ng/kg TEQDF,M. The polygons on Figure 1 which are already below 30 ng/kg TEQDF,M in all depth intervals may be monitored at lower frequency to ensure that those areas remain below the cleanup level, but those clean areas should not be averaged with the locations of known contamination.	The institutional control proposed for the SSA includes the entirety of the SSA; therefore, the composite results from all nine locations within the SSA should be included when calculating the arithmetic mean concentration for the SSA. Selectively including or excluding samples from within the defined SSA will bias the results and effect of the remedy.
HCTAC	331	HASP - General comments	Throughout this document, it appears that all active verbs have been replaced with weaker discretionary forms. For example, “will be” has been replaced with “may be”, “shall” by “should”, and “is recommended” for “must”. We expect that this was done to allow the remediation contractors some flexibility, but what results is a plan stating that health and safety activities will be almost entirely discretionary, with the discretion exercised by unnamed persons and unnamed contractors. For example, the plan states “it is recommended that safety equipment be made available for use by Site personnel.” We recommend that the active, non-discretionary verb forms be used and that any required flexibility be obtained through the revision process. The plan needs to identify the specific activities that will be performed and who is going to be responsible for each activity. The project coordinator and site supervisor need to be named.	The HASP has been revised per comment submitted as part of the 100% RD.
HCTAC	332	HASP - General comments	The Emergency Response Plan refers to a “health and safety officer”. Why are they not mentioned here?	Section 1.5 of the HASP submitted as part of the 100% RD has been revised to include a Health and Safety Officer.
HCTAC	333	HASP - General comments	As written, this plan is incomplete as it does not discuss specific hazards.	Additional details have been added to Section 3 of the HASP submitted as part of the 100% RD.
HCTAC	334	HASP - General comments	These plans do not appear to consider potential health and safety or emergency impacts of site activities on nearby business, residents, and recreational activity.	Additional details have been added to Section 3 of the HASP submitted as part of the 100% RD.
HCTAC	335	HASP - Section 1.5	Who has overall responsibility for health and safety?	Section 1.5 of the HASP submitted as part of the 100% RD has been revised to include additional details regarding personnel responsibilities.
HCTAC	336	HASP - Section 1.5	What qualifications are required for the site supervisor?	Section 1.5 of the HASP submitted as part of the 100% RD has been revised to include additional details regarding personnel qualifications.
HCTAC	337	HASP - Section 1.7	The site-specific training should be required.	Section 1.7.1 of the HASP submitted as part of the 100% RD has been revised to require that an initial site specific training session or briefing be conducted by the PC, SS, or HSO prior to commencement of Northern Impoundment RA work activities. During this initial training session, employees will be instructed on topics noted in Section 1.7.1.

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HCTAC	338	HASP - Section 3.1.4	Will secondary containment be required for flammable liquids?	Section 3.1.5 of the HASP submitted as part of the 100% RD has been revised to note that any oil container that is 55 gallons or more in volume will require secondary containment.
HCTAC	339	HASP - Section 3.2.1	Heavy equipment brought to the site should be in clean and working condition Seat belts should be provided and used on heavy equipment All overhead hazards should be identified in the JSAs.	The HASP has been revised accordingly.
HCTAC	340	HASP - Section 3.2.3	Utility one-call phone number should be listed.	The HASP has been revised accordingly.
HCTAC	341	HASP - Section 3.2.10	Is crane operator certification not required?	The HASP has been revised accordingly.
HCTAC	342	HASP - Section 3.2.19	Will lightning detectors be required?	Lightning detectors are not required.
HCTAC	343	HASP - Section 4	The minimum required PPE for the site should be stated.	Minimum required PPE has been specified in Section 4.2 of the HASP submitted as part of the 100% RD.
HCTAC	344	HASP - Section 5	The noise and air monitoring plan needs to be detailed here due to its impact on remediation workers. They should not be expected to consult the site wide monitoring plan.	A summary of the air monitoring program has been provided in Section 5.0 of the HASP submitted as part of the 100% RD.
HCTAC	345	HASP - Section 6.3	Decontamination must be required.	Section 6.5 of the HASP submitted as part of the 100% RD has been revised accordingly.
HCTAC	346	HASP - Table 1	This table is one of the most important of the document, but is incomplete	Table 1 of the HASP submitted as part of the 100% RD has been revised consistent with contaminants that may be encountered based on RI data.
HCTAC	347	ERP - General Comment	In many places, it appears that active verbs have been replaced with weaker discretionary forms. For example, “will be” has been replaced with “may be”, “shall” by “should”, and “is recommended” for “must”. We expect that this was done to allow the remediation contractor(s) some flexibility, but what results is a plan stating that emergency response activities will be largely discretionary, with the discretion exercised by unnamed persons. We recommend that the active, non-discretionary verb forms be used and that any required flexibility be obtained through the revision process. The plan needs to identify the specific activities that will be performed and who is going to be responsible for each activity. The site supervisor and health and safety officer need to be named.	The ERP has been revised per comment submitted as part of the 100% RD.
HCTAC	348	ERP - Section 6	The evacuation routes from each work area need to be specified. These can be revised as the project progresses, but it is not sufficient to decide them at the time of an emergency.	It is anticipated that no single defined route can be identified for evacuation or safe distances due to the nature of the work, and that safe distances will only be determined on an ongoing basis, based on a combination of work site and incident conditions. However, the muster point would likely be at the east end of the East Freeway Service Road in Channelview, Texas, at the entrance gate to the Northern Impoundment. This muster point may be revised in the site-specific HASP that is developed for the RA by the RC. The evacuation route from the work site is the East Freeway Service Road to I-10.
HCTAC	349	ERP - Table 2	It is not clear where this table fits in.	Additional language has been added to clarify the relevance of this table.
HCTAC	350	ERP - Section 6.2	Site compounds with high toxicity should be identified.	Information related to dioxins is provided in the HASP and ERP.
HCTAC	351	ERP - Section 10	Elements of this section also belong in the HASP.	This comment is noted.

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Comment Source	Item No.	Reference	Comment	Response to Comment
HCTAC	352	TODP - General Comments	In many places, it appears that active verbs have been replaced with weaker discretionary forms. For example, “will be” has been replaced with “may be”, “shall” by “should”, and “is recommended” for “must”. We strongly recommend that the active, non-discretionary verb forms be used and that any required changes be handled through the revision process. The plan needs to identify the specific activities that will be performed and who is going to be responsible for each activity. The site supervisor needs to be named.	The TODP has been revised per comment submitted as part of the 100% RD.
HCTAC	353	TODP - Section 1	The TODPs for the RC(s) should be consistent with this overall plan, which may be amended.	This comment is noted.
HCTAC	354	TODP - Section 2	Delegates for the generator’s signatory authority should be identified in an amendment prior to work initiation.	This comment is noted.
HCTAC	355	MNR Plan - General Comments	Given that sediments within the Sand Separation Area already meet the clean-up level of 30 ng/kg TEQDF,M to a depth of 60 cm, the proposed approach of two years of post-remedy-completion monitoring demonstrating compliance is reasonable.	The RPs agree with this comment.
HCTAC	356	MNR Plan - General Comments	The document should reference the specific reports where detailed relevant prior monitoring results can be found.	The 100% RD contains a list of reference reports.
HCTAC	357	MNR Plan - Section 5.2	The relevance of the Beach Area is unclear. The plan says it applies to the Sand Separation Area. However, Section 5.2 discusses samples collected during the RI from the Beach Area, which is adjacent to the Sand Separation Area. Does the plan also include the Beach Area?	The MNR Plan does not include the Beach Area. Reference to the Beach Area was removed from the MNR Plan so as to avoid any confusion.
HCTAC	358	MNR Plan - Section 5.3	Section 5.3 discusses the sampling results from the 2019 Second Phase Pre-Design Investigation, but detailed results are not included. It would be very helpful to include a tag map showing the results from this investigation.	SSA sampling locations are provided on Figure 2-4 and analytical results are reported on Table 6-2 in the 100% RD
HCTAC	359	MNR Plan - Section 6.1	The document references Figure 6.1 but no Figure 6.1 was included in the plan.	The MNR Plan has been revised to include Figure 6.1.
HCTAC	360	MNR Plan - Section 6.5	The report states “Five years is recommended by ESTCP (2009) as the minimum amount of time to document long-term stability of MNR as a remedy. As discussed in Sections 5.2 and 5.3, data from the RI and PDI-2 indicate that mean TEQDF,M concentrations in the SSA have been below the clean-up level of 30 ng/kg TEQDF,M since 2010. With the current schedule for the Northern Impoundment RA, post remediation monitoring is not expected to begin until approximately 2030. The two post-remediation monitoring events will provide over 20 years of sediment data for the SSA.” However, per Sections 5.2 and 5.3, the Sand Separation Area was not sampled until 2019, not 2010. The document should be revised accordingly.	Samples were collected from the SSA during the Remedial Investigation/Feasibility Study in 2010. The sampling schedule in the MNR Plan has been amended.
Port of Houston HDR	361	HASP Section 1 Introduction	HDR notes that updates to responsibilities and personnel will likely be needed at the 100% RD stage. It is understood that when the remedial action is bid, selected subcontractors’ H&S information will be coordinated and assessed by the PRP, including training and safety records (this is acknowledged in the HASP).	This comment is noted.
Port of Houston HDR	362	HASP Section 2 Work Site Operations	It is noted that updates to the scope of work will need to be refined based on the final approved NI remedial design.	This comment is noted.
Port of Houston HDR	363	HASP Section 5 Air Monitoring	It is noted in this HASP section that NI air monitoring requirements are outlined in the Site-Wide Monitoring Plan (SWMP).	This comment is noted.

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Port of Houston HDR	364	HASP Section 9 References	It is recommended that the applicable OSHA statutes noted earlier in the HASP be listed.	Reference to Occupational Safety and Health Administration, United States Department of Labor, 2024. Code of Federal Regulations (CFR) Title 29, Chapter XVII, Parts 1910 and 1926. May 2024 has been added to Section 9 of the HASP submitted as part of the 100% RD.
Port of Houston HDR	365	HASP - General comments	No project specific Contacts have been provided in the Emergency Contact Sheet. It is understood that contacts- and other sections of the HASP - will be populated/updated subsequent to the 100% remedial design being accepted by EPA.	This comment is noted.
Port of Houston HDR	366	HASP - General comments	Table 1 lists chemical / exposure / health criteria for dioxins and furans (main NI COCs). It is recommended that other contaminants that may be encountered (PCBs, metals, SVOCs) also be included based on RI data.	Table 1 has been revised consistent with contaminants that may be encountered based on RI data.
Port of Houston HDR	367	HASP - General comments	Based on the current schedule for remedial action, EPA should confirm if information for COVID-19 should be added, perhaps under Sections 1.4 or 6.	This comment is noted.
Port of Houston HDR	368	HASP - General comments	The HASP is generic and does not at this time provide specific detail to the approved designed which may influence the scope of the remedial action (i.e., site-specific remedial action hazard, worker safety, PPE upgrade threshold, etc.).	Section 2.2 has been revised to note that, upon selection of the RC, the HASP will be updated or one will be developed to address the scope of work in the approved Northern Impoundment RA and the specific hazards associated with that scope of work. The RC will also be expected to develop task specific JSAs for tasks involved in Northern Impoundment RA activities, in accordance with the job hazard analysis requirements of 29 CFR 1910.120(b)(4)(ii)(A) and the workplace hazard assessment requirements of 29 CFR 1910.132(d).
Port of Houston HDR	369	ERP Section 2 - Pre-Emergency Planning	A complete list of current contacts – inclusive of outside agencies and landowner – will need to be compiled and confirmed prior to remedial action.	This comment is noted.
Port of Houston HDR	370	ERP Section 5 – Severe Weather Preparation	Sequencing of NI work around hurricane seasons, as will be included in the final NI RD, can be noted in this section.	This comment is noted. Additional information regarding defined preparation phases to address situations involving severe weather, a high water event, a tropical depression, tropical storm, or a hurricane that is anticipated to make landfall in the general vicinity of the work site, will be described in the High-Water Preparedness Plan (HWPP) included as Attachment L in the 100% RD.
Port of Houston HDR	371	TODP – Section 3 - Compliance with Off-Site Disposal Rule	It is understood that EPA will review and provide comment on this section.	This comment is noted. Additional information regarding defined preparation phases to address situations involving severe weather, a high water event, a tropical depression, tropical storm, or a hurricane that is anticipated to make landfall in the general vicinity of the work site, is described in the High-Water Preparedness Plan (HWPP) included as Attachment L in the 100% RD.
Port of Houston HDR	372	TODP – Section 4 - Waste Classification Procedures	It is noted that the contractors will need to identify in more detail the waste classification procedures and final (selected) disposal options with respect to the different waste streams created from the NI remedial action. This will be finalized subsequent to the final NI RD. It is understood that EPA will review and endorse the final waste profiles for the NI.	This comment is noted.
Port of Houston HDR	373	TODP – Section 5 - On-Site Management and Loading	See above comment, re: plan finalization subsequent to the final NI RD. It is recommended that waste loading / loadout areas and truck staging areas be adequately described in the final NI design. Staging / queuing of trucks waiting loadout should be minimized and kept in accordance with the amount of space available at the NI.	This comment is noted.

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Port of Houston HDR	374	TODP – Section 6 – Transportation	See above comment, re: plan finalization subsequent to the final NI RD.	This comment is noted.
Port of Houston HDR	375	TODP – Section 7 – Document and Reporting	See above comment, re: plan finalization subsequent to the final NI RD. EPA should confirm the requirements for filing, tracking, and electronic data submittals for all waste classification data and waste disposal activities; licenses and qualifications for the transportation firms; and licenses for the selected disposal facilities.	This comment is noted.
Port of Houston HDR	376	TODP – Section 8 – References	It is suggested that TCEQ guidance as related to T&D of contaminated material be considered as an addition to the references.	This comment is noted.
Port of Houston HDR	377	TODP – General Comments	The plan is not highly site-specific at this time and will be updated by the PRP and remedial contractors subsequent to the final NI design.	This comment is noted.
Port of Houston HDR	378	TODP – General Comments	The supporting plans described in Section 1 have not been submitted for review.	This comment is noted.
Port of Houston HDR	379	TODP – General Comments	Document does not define waste disposal facilities; however, it states that EPA approval from EPA region 6 will documented prior to off-site disposal.	This comment is noted.
Port of Houston HDR	380	TODP – General Comments	Numerous plans documented in this submittal will be produced by the remedial contractor and are not available in their entirety for review at this time.	This comment is noted.
Port of Houston HDR	381	TODP – General Comments	Figure 1 should show a detail of waste loading/loadout areas and truck staging / queuing areas. This information will be evaluated further during the NI RD.	The Design Drawings in Appendix G show detail of site works and facilities. Prior to the RA, the RC will specify more detailed layouts of the site works and facilities.
Port of Houston HDR	382	TODP – General Comments	As the NI remedial action may occur over several years, the plan should acknowledge that T&D entities (transportation firms, disposal facilities) and truck routes may need to be modified over time.	The TODP has been revised per comment.
Port of Houston HDR	383	MNR Plan – Sand Separation Area - Section 3 – Regulatory Framework	It is recommended that EPA and TCEQ review these references and provide others if available to reflect the current state of MNR guidance.	This comment is noted.
Port of Houston HDR	384	MNR Plan – Sand Separation Area - Section 5 – Considerations in Developing the Monitoring Program	It is recommended that EPA and TCEQ confirm the following, as presented in the MNRP: - Achievement of an arithmetic mean of 30 ng/kg TEQDF,M for samples collected throughout the SSA will be considered to be protective. - Based on the Operations, Maintenance, and Monitoring Plan (OMMP) for Lavaca Bay (TX) (which provided that monitoring could be discontinued if remedial levels for mercury and polycyclic aromatic hydrocarbons were achieved for two consecutive years), this MNR Plan proposes the same provision. GHD proposes that monitoring of the SSA will be discontinued if the mean concentration of samples collected in the SSA is below 30 ng/kg TEQ for two consecutive years after submission of the Remedial Action Completion Report for the Northern Impoundment. Two (2) sampling events are proposed in the Plan.	The sampling schedule in the MNR Plan has been amended per comment.
Port of Houston HDR	385	MNR Plan – Sand Separation Area - Section 6 – Monitoring Program	Figure 6-1 (polygons) was not included in the document.	The MNR Plan has been revised to include Figure 6.1.
Port of Houston HDR	386	MNR Plan - General Comments	The supporting plans described in Section 1 have not been submitted for review except for the ERP.	This comment is noted.

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Port of Houston HDR	387	MNR Plan - General Comments	Figures of the SSA should be included (location with NI and channel boundaries; polygons with contemplated sample locations).	Figure 6.1 includes polygons with proposed sample locations. Figure 1 of the ICIAP includes the SSA and Northern Impoundment boundaries.
Port of Houston HDR	388	MNR Plan - General Comments	EPA should confirm that dioxins / furans are the only COCs to be included in the SSA MNRP.	This comment is noted.
Port of Houston HDR	389	MNR Plan - General Comments	It is understood that additional data (figures and tables) for the SSA will be provided prior to EPA review of this plan. The proposed approach for sample composting (across locations and depth intervals) should be confirmed.	Figure 6.1 includes polygons with contemplated sample locations. Section 6.1 has been revised to clarify the sampling program for the SSA.
NOAA - Natural Resource Trustee	390	MNR Plan - Sand Separation Area	The proposed Monitored Natural Recovery Plan leaves dioxin contamination in site sediments at concentrations above the site's risk-based cleanup level for dioxin in sediment (30 ng/kg TEQDF,M). These cleanup levels were established in the Subject Document and the Record of Decision (EPA 2017) to be protective of both a recreational fisher and for ecological risk. Leaving the dioxin contamination in place may result in ecological risks to receptors. Surface sediments at locations SJSSA06, SJNE032, and SJNE041 all have dioxin concentrations one order of magnitude above the cleanup level (105, 198, and 121 ng/kg TEQDF,M, respectively). Subsurface sediments at SJNE032 and SJSSA08 are also an order of magnitude above the cleanup level (maximum 349 and 109 ng/kg TEQDF,M respectively), while subsurface sediments at sample SJSSA06 are two orders of magnitude above the cleanup level (maximum 3,330 ng/kg TEQDF,M).	This comment is noted. However, as discussed in Section 4.2, it is important to note that the highest potential for risk occurs in the biologically active zone (BAZ), generally the upper 15 centimeters (cm) of the sediment profile, where benthic organisms can be exposed. As noted in Section 5.3, data for TEQDF,M indicate that, with the exception of one near shore sample location, concentrations of TEQDF,M are below the clean up level of 30 ng/kg TEQDF,M at depth intervals at which exposure pathways are complete (0 to 30 cm). Lastly, as noted in Section 5.6, the RI included baseline human health and ecological risk assessments. Both risk assessments concluded that, excluding the Northern Impoundment, Site wide concentrations of dioxins and furans in sediment pose negligible risk to human health and the aquatic environment.
NOAA - Natural Resource Trustee	391	MNR Plan - Sand Separation Area	The Trustees recommend inclusion of sample SJNE041 in the Sand Separation Area polygon (i.e., the area to be monitored). Based on preliminary mapping that NOAA conducted during the review of the Subject Document, the location of nature and extent sediment sample SJNE041 was left out of the SSA polygon. Sample SJNE041 is known to have elevated surface sediment dioxin concentrations (121 ng/kg TEQDF,M) and the site-specific unmixing analysis indicated it has a significant portion (25.2%) of original waste from the Northern Impoundments (Integral and Anchor 2012). In addition, site documents discuss a surface runoff pathway for dioxin contaminated soils in the upland SSA to the location of around SNJE041: "Hydrological flow paths shown in Figure 3-2 indicate that, at least currently, the topography of the upland sand separation area could generate runoff in the northerly direction in that area, resulting in transfer of waste related particulates to the surface sediments in the area of SJNE041" (Integral and Anchor 2013). The official designation of the polygon should reflect the site's nature and extent sampling.	The location of SNJE041 has been plotted relative to the SSA and is located over 100 ft north of the SSA, as depicted on the figure provided in Appendix K-5 of the 100% RD.
NOAA - Natural Resource Trustee	392	MNR Plan - Sand Separation Area	The river surrounding the Sand Separation Area is too dynamic to classify as "net deposition" and to leave contamination for dispersal or expected burial. Based on aerial imagery over time, statements in site documents, and the known erosional potential of the area, it seems unlikely that the SSA is net-depositional over the long-term. Pre-Design Investigation sediment sampling results for the SSA indicate sediment deposition at 4/9 locations, variable deposition at 4/9 locations, and erosion at 1/9 locations (GHD 2020). These results do not justify a conclusion of "net" or "majority" deposition. Considering site-specific factors including the frequent storm events, hurricanes, planned changes to water control structures upriver, boat traffic, and the adjacent barge operations, the SSA is too dynamic to assume continued sediment deposition and burial of contaminants	This comment is noted.

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NOAA - Natural Resource Trustee	393	MNR Plan - Sand Separation Area	The Trustees recommend using the same sampling protocols as developed for the Northern Impoundment at the Sand Separation Areas. The Trustees do not agree with the plan to composite and calculate an arithmetic mean, which would reduce the maximum number of 45 unique samples down to one result for each sampling event to determine success of the remedy across the entire SSA. This is not how samples from the Northern Impoundment Preliminary 30% Remedial Design (GHD 2020) are proposed to be interpreted. If samples must be composited, at a minimum, the nine unique analytical results for the nine locations of the SSA should be reported and interpreted independently.	Section 6.1 clarifies the compositing approach. Within each polygon, samples will be collected from five locations. Four depth intervals will be sampled from each location: 0 to 15 cm, 15 to 30 cm, 30 to 45 cm, and 45 to 60 cm below the sediment/surface water interface. A composite sample consisting of sediment from each of the five locations will be prepared for each sampling interval. Meaning, each of the nine polygons will have a composited sample for the 0 to 15 cm interval, 15 to 30 cm interval, 30 to 45 cm interval, and the 45 to 60 cm interval.
NOAA - Natural Resource Trustee	394	MNR Plan - Sand Separation Area	The Trustees recommend acknowledgement and discussion of the contaminated upland Sand Separation Area as a source of contamination to the submerged Sand Separation Area in Section 5.7 of the Subject Document. Soil sampling has demonstrated contamination of the upland SSA with dioxins (Integral and Anchor 2012). Pre-Design Investigation sampling of the SSA documented exceedances of the cleanup goal in sediment samples at station SJSSA06 (GHD 2020), just offshore of the highest levels of dioxins measured in subsurface soils on the upland SSA (station SJTS018; Integral and Anchor 2012). The Preliminary Site Characterization Report (Integral and Anchor 2012) describes surface water flows from the majority of the upland SSA as discharging into the river, particularly along the eastern section that borders the submerged SSA polygon (see quote above in Comment 2) and aerial imagery indicates a large portion of the northeast corner of the upland SSA has eroded over time. This information, along with statements in the Preliminary Site Characterization Report (Integral and Anchor 2012), suggest a chronic shore-based source of contamination, along with potential for unwanted dispersion downriver.	The RI (2013) presents shore-based data. This comment is noted.
NOAA - Natural Resource Trustee	395	MNR Plan - Sand Separation Area - Request for Figures - 6A	The Trustees request additional figures to interpret the full suite of sampling results from the Sand Separation Area over time. We recommend these figures also be included for clarity in the 100% Remedial Design. Standalone Figure 1, received from EPA on March 8, 2021, was helpful, but does not include the nature and extent samples collected adjacent to the SSA (e.g., SJNE041) and does not aid in visualizing the changing shoreline over time. The Trustees request this figure be updated by adding sediment chemistry results from samples collected adjacent to (not just within) the SSA (i.e., the results presented in Figure 5-5 of the Remedial Investigation Report [Integral and Anchor 2013]).	Aerial photos dating back to 1938 are provided in Appendix K-3 of the 100% RD; however, it is important to note that significant changes related to the SSA are due to man-made activities. Historical analytical data collected from areas outside of the SSA and/or Northern Impoundment are not included in the 100% RD as they are considered outside the scope of the 100% RD as they do not affect the remedial strategies developed for these areas.
NOAA - Natural Resource Trustee	396	MNR Plan - Sand Separation Area - Request for Figures - 6B	The Trustees request additional figures to interpret the full suite of sampling results from the Sand Separation Area over time. We recommend these figures also be included for clarity in the 100% Remedial Design. From the information provided in site documents and the use of different basemaps over time, it is very difficult to determine exactly what area surrounding, and including, the SSA was originally upland and is now submerged. This in turn makes comparing sampling locations over time very difficult. A figure that illustrates changes to the upland SSA footprint over time would help clarify exactly which areas contain dioxins above cleanup levels, both historically and currently, and depict erosional/depositional areas over time.	Aerial photos dating back to 1938 are provided in Appendix K-3 of the 100% RD; however, it is important to note that significant changes related to the SSA are due to man-made activities.
NOAA - Natural Resource Trustee	397	MNR Plan - Sand Separation Area	The Trustees do not agree that Lavaca Bay is a comparable case study due to different environmental settings (riverine vs. open-bay) and contaminants (dioxins vs. mercury) as presented in Sections 5.4 and 6.6 of the Subject Document.	This comment is noted.

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NOAA - Natural Resource Trustee	398	MNR Plan - Sand Separation Area	Section 1.1, sentence two, should read "EPA selected MNR as a remedy for the SSA that would protect the aquatic environment based on the relatively low concentrations of dioxins and furan in sediment in the SSA compared to sediments in the Northern Impoundments…" Concentrations of dioxins and furans are not relatively low when compared to established background as indicated when compared to the site's TEQDF,M Reference Envelope Value (Figure 4-1a; Integral and Anchor 2013).	The MNR was revised per comment.
TCEQ	399	Field Sampling Plan - General Comments	The 90% Remedial Design proposes the reuse of cap rock material at the site during or after the Remedial Action. The TCEQ suggests that additional representative sampling of stockpiled cap rock be conducted prior to reuse to demonstrate that it does not have contaminated sediment or soil adhered to it and has not become contaminated by the process of removing the cap rock from the top of the geotextile or geomembrane. Any stockpiled cap rock that is found to be contaminated with waste material above the cleanup level should be sent for disposal rather than reused at the site.	Handling and sampling of the TCRA cap rock for potential reuse is outlined in the FSP.
TCEQ	400	Field Sampling Plan - Section 2.1.1	It is proposed that 6 to 8 discrete samples will be collected from each Decision Unit (DU), but it is unclear if all the DUs will have the same number of samples from 6 to 8 or if each DU may have a number of samples ranging from 6 to 8. Figure 2.2 indicates that all the DUs may have the same number of samples. The TCEQ recommends that additional discrete samples (more than the proposed 6 to 8) be collected and incorporated into the composite sample from each DU to be more representative of the potentially heterogeneous concentrations at the post-excavation surface.	The proposed number of discrete samples from each Decision Unit was increased from 6 to 8 discrete samples to 9 discrete samples from each Decision Unit in Section 2.1.1.
TCEQ	401	Field Sampling Plan - Figure 2.4	Given the importance of this figure to implementing the FSP, it should be included as a full-page figure, perhaps 11x17" like other maps and design drawings, so it can be viewed at adequate resolution to read the boring location labels. Additionally, please provide a caption or annotation describing the meanings of each column of the inset table "Additional Feet of Excavation" (e.g., what is the meaning of the "Number" column and why are the depth intervals presented as negative numbers?).	Figure 2.4 (Areas Sensitive to Hydraulic Heave) was removed from the Field Sampling Plan as the current confirmation sampling methodology includes pre-excavation sampling instead of post-excavation sampling. An updated figure showing the areas sensitive to hydraulic heave have been included in the Updated Hydraulic Heave Analysis which is included as Attachment E of Appendix B.
TCEQ	402	Field Sampling Plan - Section 3: Historic Berm Material Sampling	The Pre-Design Investigation sampling events had a limited number of borings collected from the approximate centerline of each historical berm and did not finely delineate the boundaries of contaminated material from clean berm material. The TCEQ suggests that berm material identified for reuse rather than disposal be sampled at a greater frequency. Also, the TCEQ requests that the 100% RD include details of how this material will be excavated and stockpiled while waiting for sample results in a manner that keeps it separate from and uncontaminated by waste materials being excavated nearby. Please note that Texas Risk Reduction Rule requirements for reuse of soil containing Chemicals of Concern (COCs) above background concentrations are addressed in 30 TAC §350.36.	The sampling frequency was revised from one composite sample of unimpacted berm material every 1,000 CY to one composite sample of unimpacted berm material every 500 CY in Section 3.2.1 of the FSP. Section 3.4 of the FSP discusses the segregation of material. Additional details for segregating and staging material is included in the 100% RD (specify which document this is included in). It's noted that 30 TAC §350.36 contains Texas Risk Reduction Rule requirements for reuse of soil containing Chemicals of Concern (COCs) above background concentrations.
TCEQ	403	Field Sampling Plan - Section 4.3 Sample Analyses	In addition to the chemical analyses in Table 4.1, please list other analyses of off-site fill soil samples that will be conducted, (e.g. particle size, organic matter, pH) or reference Section 31 23 23 of the Technical Specifications where other soil analyses are described.	Section 4.3 of the FSP has been revised so that it references Section 31 23 23 of the Technical Specifications submitted as part of the 100% RD.

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TCEQ	404	Field Sampling Plan - Table 5.1	The standard analytical TAT given in Table 4.4.4 of the Addendum to the Final 100% Remedial Design- Southern Impoundment submitted to EPA on June 2, 2022, is 3-5 business days for TSS, Metals, and Dioxins/Furans. Please update the standard analytical TAT in Table 5.1 to be consistent or provide an explanation why 3-5 days is available for the Southern Impoundment, but 10-15 days TAT is proposed for the Northern Impoundment water treatment compliance samples. TCEQ suggests that the fastest practicable TAT be chosen to minimize lag in receiving compliance results while discharge is ongoing.	The standard analytical TAT has been updated to 3-5 days in Table 5.1.
TCEQ	405	Site-Wide Monitoring Plan - Figure 3.2	Please provide frequency plots for Ambient A, B, and D in addition to Ambient C as this is relevant to interpretation of the ambient data statistics.	The Frequency of Ambient C turbidity NTU was included only as an example. The additional frequencies are not needed to allow for the interpretation of the ambient data statistics. The intent of the example frequency plot was to show how the data was found to be lognormally distributed to explain the basis of calculations.
TCEQ	406	Site-Wide Monitoring Plan - Section 3.4.1.2 Data Review	The ambient turbidity data herein was collected from December to March, within the planned excavation season, while the BMP installation may occur outside the planned excavation season (i.e., during hurricane season). The natural water conditions and river traffic conditions that impact turbidity may fluctuate seasonally. Please discuss if there is any uncertainty or bias from using the ambient turbidity data collected in the winter/spring to establish the criteria for work that may be conducted in a different season.	The SWMP accounts for potential fluctuations in the background turbidity level and sets thresholds and triggers accordingly. The intent of the thresholds and triggers is to account for any bias or uncertainties in the dataset. In the event of a tropical storm or named weather event, work will likely not take place.
TCEQ	407	Site-Wide Monitoring Plan - Section 3.4.2 Remedial Action Monitoring Locations	The first paragraph states that the data from ambient velocity monitors shows that the flow around the vicinity of the TCRA cap is along the northern edge in a south-easterly direction and along the eastern edge in a southerly direction. Please provide the relevant ambient velocity data collected in a figure or table to support the conclusion. Additionally, Background Location B appears to be very close to the eastern edge of the BMP installation area, within the area of support boat traffic at the site during BMP installation. Please provide the minimum distance expected from Location B to the eastern BMP installation area and provide rationale/justification for the close proximity of this background location to the cap.	Figure 3.3 has been updated to show typical flow direction based on velocity data. Location B is a compliance location for when work is done on the northern edge and east is downgradient. Location B will not be a compliance location when work is done on the eastern side of the BMP. Velocity data is provided is provided in the Hydrodynamic Modelling Report included as Appendix F.
TCEQ	408	Site-Wide Monitoring Plan - Figure 3.3	Add a scale bar and a North arrow to this figure.	Figure 3.3 has been revised to include the north arrow and scale bar.
TCEQ	409	Site-Wide Monitoring Plan - Section 3.6 Odors	The first bullet discusses “deployment of odor suppressing foams.” If the use of these foams is necessary, the TCEQ suggests verifying that the foam is free of PFAS/PFOAs.	Section 3.6 was revised to note that Safety Data Sheets will be evaluated as part of the selection and approval of foams and no foams containing PFAS will be utilized.
HCTAC	410	Field Sampling Plan - Section 2.3	If, in post-excavation confirmation sampling, a composite DU sample exceeds the cleanup level, and one or more discrete samples are identified as the cause of the exceedance, the plan recommends over-excavation of an area only to half the distance to other discrete sample locations. Since there will be no information on COC concentrations between the discrete samples, we recommend over-excavation of the entire distance (not half the distance) between adjacent discrete samples that met the cleanup levels as the only way to verify that the DU-average concentration meets the cleanup level.	Confirmation sampling will be completed prior to excavation activities to minimize stand-by time during excavation and to refine the excavation elevations, as needed.
HCTAC	411	Field Sampling Plan - Section 2.3	We recommend sidewall sampling as part of post-excavation confirmation sampling to ensure that thin sections of waste will not be left in place at the boundaries between the seasonal cells.	The number of discrete samples from each Decision Unit was increased to 9, which will provide greater coverage across each Decision Unit. This will include samples on the sidewalls/slopes.

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HCTAC	412	Field Sampling Plan - Section 3	Because it has not been established that the historic berm material is completely free of contamination exceeding the cleanup level, and it will be used on-site for cover and other purposes, we believe that one sample per 1,000 CY may not be sufficient, and recommend one composite sample for every 500 CY, as in the southern impoundment monitoring plan.	The sampling frequency was revised from one composite sample of unimpacted berm material every 1,000 CY to one composite sample of unimpacted berm material every 500 CY in Section 3.2.1.
HCTAC	413	Field Sampling Plan - Section 5.2	The submittal does not appear to state the discharge criteria that the effluent sampling will be compared to. We note that 30 TAC §319.23 specifies maximum discharge concentrations for metals to tidal waters. Nor does it state what response measures or notifications will be performed if exceedances of discharge criteria are observed, beyond collection of a second sample.	Sections 5.2.2 has been added to the FSP, which discusses frequency of compliance sampling and responses to results under a batch discharge scenario. Discharge criteria are in Table 3 of the Water Treatment System specification (46 07 01).
HCTAC	414	Site-Wide Monitoring Plan - Section 3.4.2	The monitoring stations selected do not appear to account for the fact that the flows reverse in this tidal system. Station C is not a suitable location, as it is unlikely that suspended solids released by construction-related disturbance can travel across the entire channel under any conditions except slack tide. It may be an appropriate reference site under flood tide conditions. We recommend moving C across the channel near to the west bank. Station A would not be an appropriate background site under flood tide conditions.	The monitoring station locations are based on the dominant flow directions. Station C is downgradient of the east side of the BMP and an appropriate monitoring location for work in this area. The west bank is an active operations facility, making it an unsuitable location for Station C.
HCTAC	415	Site-Wide Monitoring Plan - Section 3.4.5	Since the turbidity sondes can be programmed to operate continuously and have telemetry, they should measure, report, and record turbidity every 5 to 15 minutes rather than 2x/day. In addition to absolute turbidity thresholds, the data should be scanned for sudden turbidity increases that may be associated with site actions. The goal here is not to shut down or delay the installation of sheet pile walls, but to optimize practices and controls to minimize sediment resuspension. Particularly during the first week or two of BMP installation, the evaluation should be performed by an independent on-site owner representative who can work with the RC to optimize practices through the adaptive management approach mentioned.	Section 3.4.5 was revised to reflect that turbidity levels will be monitored a minimum of every hour during BMP installation and removal. The monitoring will be completed by the engineer of record who will work with the RC to optimize practices to minimize sediment resuspension.
HCTAC	416	Site-Wide Monitoring Plan - Section 3.4.6	Exceedance of turbidity thresholds should trigger collection of ambient water samples for TSS and COCs, as well as notifications of EPA and TCEQ, and required checks on the proper installation and functioning of the turbidity curtains.	Section 3.4.5 was revised to reflect that turbidity levels will be monitored a minimum of every hour during BMP installation and removal and [add references to other changes to make monitoring more robust; do those procedures includes checks on proper installation and functioning of turbidity curtains]. Any additional requirement for collection of samples for TSS and COCs and notifications to EPA and TCEQ are not warranted because the BMP installation will occur outside the limits of the TCRA cap.

Table 2-1

First Phase Pre-Design Investigation Analytical Results - Northern Impoundment
Final 100% Remedial Design - Northern Impoundment
San Jacinto River Waste Pits Site
Harris County, Texas

Area:	Units	Northern Impoundment - Waste Pits	Northern Impoundment - Waste Pits	Northern Impoundment - Waste Pits	Northern Impoundment - Waste Pits	Northern Impoundment - Waste Pits	Northern Impoundment - Waste Pits	Northern Impoundment - Waste Pits	Northern Impoundment - Waste Pits	Northern Impoundment - Waste Pits	Northern Impoundment - Waste Pits	Northern Impoundment - Waste Pits	Northern Impoundment - Waste Pits	Northern Impoundment - Waste Pits	Northern Impoundment - Waste Pits	Northern Impoundment - Waste Pits
Sample Location:		SJSB028	SJSB028	SJSB028	SJSB028	SJSB028	SJSB028	SJSB028	SJSB028	SJSB028	SJSB028	SJSB029	SJSB029	SJSB029	SJSB029	SJSB029
Sample Identification:		SL0580	SL0581	SL0582	SL0583	SL0584	SL0589	SL0585	SL0586	SL0587	SL0588	SL0500	SL0501	SL0502	SL0503	SL0504
Sample Date:		11/19/2018	11/19/2018	11/19/2018	11/19/2018	11/19/2018	11/19/2018	11/19/2018	11/19/2018	11/19/2018	11/19/2018	11/6/2018	11/6/2018	11/6/2018	11/6/2018	11/6/2018
Sample Type:							Duplicate									
Sample Depth:		(0-2) ft bgs	(2-4) ft bgs	(4-6) ft bgs	(6-8) ft bgs	(8-10) ft bgs	(8-10) ft bgs	(10-12) ft bgs	(12-14) ft bgs	(14-16) ft bgs	(16-18) ft bgs	(0-2) ft bgs	(2-4) ft bgs	(4-6) ft bgs	(6-8) ft bgs	(8-10) ft bgs
Integral Sample ID:		SJSB028-C1	SJSB028-C2	SJSB028-C3	SJSB028-C4	SJSB028-C5	SJSB028-C10	SJSB028-C6	SJSB028-C7	SJSB028-C8	SJSB028-C9	SJSB029-C1	SJSB029-C2	SJSB029-C3	SJSB029-C4	SJSB029-C5
Dioxins/Furans																
1,2,3,4,6,7,8,9-Octachlorodibenzofuran (OCDF)	ng/kg	28.1	1.24 J	64	4.82 J	2.4 J	5.86 J	2.19 J	1.34 U	1.2 U	0.349 U	44.1	5.19 U	2.95 J	1.45 J	2 U
1,2,3,4,6,7,8,9-Octachlorodibenzo-p-dioxin (OCDD)	ng/kg	2130	1680	2570	2260	948	3270	683	1070	856	985	4720	2750	2110	690	791
1,2,3,4,6,7,8-Heptachlorodibenzofuran (HpCDF)	ng/kg	19.2	0.34 J	6.55	1.33 U	0.94 J	2.1 U	0.183 U	0.26 U	0.333 U	0.072 U	9.89	1.25 J	0.39 J	0.349 U	0.46 J
1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin (HpCDD)	ng/kg	46	23.5	38.6	32	13	39.9	9.57	16.8	16.3	20.9	104	42.5	37.5	11.3	20.1
1,2,3,4,7,8,9-Heptachlorodibenzofuran (HpCDF)	ng/kg	2.14 J	3.07 U	0.798 U	0.181 U	0.19 J	0.261 U	3.32 U	3.27 U	3.32 U	3.23 U	0.706 U	3.21 U	3.23 U	3.86 U	3.17 U
1,2,3,4,7,8-Hexachlorodibenzofuran (HxCDF)	ng/kg	5.9 U	0.144 U	3.37 U	0.93 J	0.993 U	1.71 U	0.288 U	0.243 U	0.262 U	3.23 U	1.89 J	0.208 U	3.23 U	0.22 J	3.17 U
1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin (HxCDD)	ng/kg	2.97 U	0.352 U	3.32 U	3.33 U	3.34 U	0.605 U	0.26 J	0.284 U	0.192 U	0.26 J	0.845 U	0.486 U	0.504 U	3.86 U	0.286 U
1,2,3,6,7,8-Hexachlorodibenzofuran (HxCDF)	ng/kg	2.83 J	0.09 J	1.27 U	0.259 U	0.214 U	0.7 J	0.0887 U	3.27 U	0.0543 U	3.23 U	0.78 J	3.21 U	3.23 U	0.137 U	3.17 U
1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin (HxCDD)	ng/kg	1.72 J	0.582 U	0.94 U	0.93 J	3.34 U	1.2 U	0.399 U	0.439 U	0.53 J	0.582 U	2.46 J	0.752 U	0.804 U	3.86 U	0.67 J
1,2,3,7,8,9-Hexachlorodibenzofuran (HxCDF)	ng/kg	0.933 U	0.1 J	0.435 U	0.203 U	0.112 U	0.0976 U	0.075 U	0.0823 U	3.32 U	3.23 U	0.59 J	3.21 U	3.23 U	3.86 U	0.082 U
1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin (HxCDD)	ng/kg	1.47 J	1.08 U	1.31 J	1.48 J	0.358 U	1.89 J	0.6 J	0.766 U	0.71 J	0.674 U	3 J	1.78 U	1.84 J	0.57 J	0.96 J
1,2,3,7,8-Pentachlorodibenzofuran (PeCDF)	ng/kg	3.06	3.07 U	1.87 U	0.62 J	0.495 U	1.26 J	0.21 J	3.27 U	0.16 J	3.23 U	1.09 U	3.21 U	3.23 U	3.86 U	3.17 U
1,2,3,7,8-Pentachlorodibenzo-p-dioxin (PeCDD)	ng/kg	0.75 J	0.28 J	0.384 U	0.39 U	0.23 J	0.229 U	0.164 U	3.27 U	0.0787 U	0.153 U	0.542 U	0.341 U	0.33 J	3.86 U	3.17 U
2,3,4,6,7,8-Hexachlorodibenzofuran (HxCDF)	ng/kg	3.72	3.07 U	0.46 U	0.23 J	0.2 J	0.42 J	3.32 U	3.27 U	3.32 U	3.23 U	1.05 J	3.21 U	3.23 U	3.86 U	3.17 U
2,3,4,7,8-Pentachlorodibenzofuran (PeCDF)	ng/kg	4.55	0.094 U	1.63 U	0.397 U	0.63 J	1.17 U	0.177 U	3.27 U	0.179 U	3.23 U	1.4 U	3.21 U	3.23 U	3.86 U	3.17 U
2,3,7,8-Tetrachlorodibenzofuran (TCDF)	ng/kg	124	4.51	74.1	21.6	16	40.8	4.49	7.04	6.74	1.84	45.9	5.03	1.81 U	2.81 U	2.26
2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ng/kg	41.9	1.64 U	26.3	8.45	4.55	14.9	2.36	2.4 UJ	2.16 U	0.647 U	12.5 U	1.55 U	0.749 U	1.37 U	0.648 U
Octachlorodibenzofuran (OCDF) 13C12	ng/kg	28.1	1.24 J	64	4.82 J	2.4 J	5.86 J	2.19 J	1.34 U	1.2 U	0.349 U	44.1	5.19 U	2.95 J	1.45 J	2 U
Total dioxin/furan	pg/g	2410	1710	2780	2330	986	3380	703	1090	880	1010	4930	2800	2150	704	815
Total dioxin/furan (ND*0.5)	pg/g	2410	1710	2790	2330	987	3380	703	1100	883	1010	4940	2800	2160	707	817
Total dioxin/furan (ND*1)	pg/g	2420	1710	2790	2330	989	3380	704	1100	885	1010	4950	2810	2160	710	819
Total heptachlorodibenzofuran (HpCDF)	ng/kg	36.8	0.71 J	14	1.71 J	2.29 J	3.5	0.31 J	3.27 U	0.66 J	3.23 U	31.2	2.3 J	0.38 J	3.86 U	0.71 J
Total heptachlorodibenzo-p-dioxin (HpCDD)	ng/kg	132	69.4	119	90	38.4	120	27.3	52.3	54	68.7	466	121	106	32.1	68.6
Total hexachlorodibenzofuran (HxCDF)	ng/kg	21.1	0.19 J	4.64	1.68 J	0.66 J	1.91 J	0.19 J	3.27 U	0.16 J	3.23 U	13	0.65 J	3.23 U	0.35 J	0.12 J
Total hexachlorodibenzo-p-dioxin (HxCDD)	ng/kg	27.8	14.6	15	23.3	7.62	19.3	4.85	12.4	15.5	20.5	59.5	15.4	22.4	6.35	18.8
Total pentachlorodibenzofuran (PeCDF)	ng/kg	19.4	3.07 U	1.67 J	0.62 J	0.63 J	4.12	0.21 J	3.27 U	0.16 J	3.23 U	6.09	3.21 U	3.23 U	3.86 U	3.17 U
Total pentachlorodibenzo-p-dioxin (PeCDD)	ng/kg	3.51	1.24 J	1.34 J	3.33 U	0.71 J	1.57 J	0.24 J	3.27 U	0.88 J	2.51 J	3.47	3.16 J	1.74 J	3.86 U	2.72 J
Total TEQ 1998 (Avian) (ND*0.5)	ng/kg	173	6	102	31.1	21.7	57.3	7.21	8.6	8.16	2.45	54.6	6.63	2.22	2.59	3.06
Total TEQ 1998 (Fish) (ND*0.5)	ng/kg	52.9	2	31.4	10.3	6.17	18.2	2.96	1.89	1.69	0.77	10.6	1.79	1.24	1.2	0.829
Total TEQ Dioxin 1998 (Bird) (ND=0)	ng/kg	173	5	101	30.6	21.5	56.5	7.02	7.16	6.93	1.97	47.3	5.36	0.767	0.159	2.47
Total TEQ Dioxin 1998 (Bird) (ND=1)	ng/kg	174	6.9	104	31.5	21.8	58.1	7.41	10	9.39	2.93	61.9	7.9	3.68	5.02	3.64
Total TEQ Dioxin 1998 (Fish) (ND=0)	ng/kg	52.4	0.7	30.4	9.96	6.03	17.5	2.81	0.476	0.459	0.341	3.46	0.582	0.601	0.108	0.233
Total TEQ Dioxin 1998 (Fish) (ND=1)	ng/kg	53.3	3	32.3	10.7	6.3	18.8	3.11	3.31	2.91	1.2	17.7	2.99	1.88	2.29	1.43
Total TEQ Dioxin Texas TEF (ND=0)	ng/kg	58.1	0.6	33.8	11	6.6	19.3	2.91	0.704	0.806	0.21	5.57	0.503	0.349	0.079	0.389
Total TEQ Dioxin Texas TEF (ND=0.5)	ng/kg	58.4	2	34.7	11.2	6.72	19.9	3.03	2.08	1.97	0.657	12.4	1.64	0.969	1.11	0.859
Total TEQ Dioxin Texas TEF (ND=1)	ng/kg	58.8	2.5	35.6	11.4	6.83	20.4	3.16	3.46	3.14	1.1	19.2	2.78	1.59	2.15	1.33
Total tetrachlorodibenzofuran (TCDF)	ng/kg	222	6.2	124	39.2	24.4	70.6	6.89	9.89	8.48	1.84	72.1	6.94	0.647 U	0.771 U	2.74
Total tetrachlorodibenzo-p-dioxin (TCDD)	ng/kg	46.7	0.615 U	29.9	8.45	0.669 U	16.1	2.36	0.779 U	0.56 J	0.647 U	1.22	0.73 U	0.749 U	1.37 U	0.71
Total WHO Dioxin TEQ(Human/Mammal)(ND=0)	ng/kg	58.8	1.5	35.1	12	7.02	20.7	3.2	1.19	1.22	0.714	8.14	1.77	1.53	0.399	0.832
Total WHO Dioxin TEQ(Human/Mammal)(ND=0.5)	ng/kg	59.2	2.4	35.9	12.3	7.13	21.2	3.35	2.59	2.39	1.19	14.9	2.95	2.12	1.48	1.35
Total WHO Dioxin TEQ(Human/Mammal)(ND=1)	ng/kg	59.5	3.4	36.7	12.6	7.24	21.7	3.5	3.99	3.57	1.67	21.7	4.14	2.71	2.56	1.87
Asbestos																
Asbestos	%	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
PCBs																
Aroclor (unspecified)	ug/kg	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Aroclor-1016 (PCB-1016)	ug/kg	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Aroclor-1221 (PCB-1221)	ug/kg	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Aroclor-1232 (PCB-1232)	ug/kg	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Aroclor-1242 (PCB-1242)	ug/kg	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Aroclor-1248 (PCB-1248)	ug/kg	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Aroclor-1254 (PCB-1254)	ug/kg	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Aroclor-1260 (PCB-1260)	ug/kg	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Aroclor-1262 (PCB-1262)	ug/kg	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Aroclor-1268 (PCB-1268)	ug/kg	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Total PCBs	ug/kg	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Total PCBs (7)	ug/kg	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Total PCBs (ND*0)	ug/kg	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Total PCBs (ND*0.5)	ug/kg	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Total Petroleum Hydrocarbons (TPH)																
Total Petroleum Hydrocarbons	mg/kg	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Total Petroleum Hydrocarbons (C12-C28)	mg/kg	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Total Petroleum Hydrocarbons (C25-C36) ORO	mg/kg	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Total Petroleum Hydrocarbons (C28-C35)	mg/kg	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Total Petroleum Hydrocarbons (C6-C12)	mg/kg	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
General Chemistry																
Cyanide (total)	mg/kg	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Flash point (closed cup)	Deg C	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Moisture	%	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Percent solids	%	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
pH, lab	s.u.	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Reactive cyanide	mg/kg	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Sulfate	mg/kg	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Sulfide	mg/kg	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Sulfur	mg/kg	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Total solids	%	80.2	76.6	71.7	69.4	71.6	70.4	72.9	72.2	75.1	72.1	76	72.1	70.7	62.2	75.8

Notes:
- ng/kg - nanograms per kilogram
- ug/kg - microgram per kilogram
- pg/kg - picogram per kilogram
- mg/kg - milligram per kilogram
- Deg C - Degrees in Celsius
- s.u. - standard unit
- U - Not detected at the associated reporting limit.
- J - Estimated concentration.
- UJ - Not detected; associated reporting limit is estimated.
- Dup - indicates the result from a duplicate sample
- -- Data not available

Table 2-1

First Phase Pre-Design Investigation Analytical Results - Northern Impoundment
Final 100% Remedial Design - Northern Impoundment
San Jacinto River Waste Pits Site
Harris County, Texas

Area:	Units	Northern Impoundment - Waste Pits	Northern Impoundment - Waste Pits	Northern Impoundment - Waste Pits	Northern Impoundment - Waste Pits	Northern Impoundment - Waste Pits	Northern Impoundment - Waste Pits	Northern Impoundment - Waste Pits	Northern Impoundment - Waste Pits	Northern Impoundment - Waste Pits	Northern Impoundment - Waste Pits	Northern Impoundment - Waste Pits	Northern Impoundment - Waste Pits	Northern Impoundment - Waste Pits	Northern Impoundment - Waste Pits	Northern Impoundment - Waste Pits
Sample Location:		SJSB029	SJSB029	SJSB029	SJSB029	SJSB030	SJSB030	SJSB030	SJSB030	SJSB030	SJSB030	SJSB030	SJSB030	SJSB030	SJSB031	SJSB031
Sample Identification:		SL0505	SL0506	SL0507	SL0508	SL0571	SL0572	SL0573	SL0574	SL0575	SL0576	SL0577	SL0578	SL0579	SL0509	SL0518
Sample Date:		11/6/2018	11/6/2018	11/6/2018	11/6/2018	11/18/2018	11/18/2018	11/18/2018	11/18/2018	11/18/2018	11/18/2018	11/18/2018	11/18/2018	11/18/2018	11/8/2018	11/8/2018
Sample Type:																Duplicate
Sample Depth:		(10-12) ft bgs	(12-14) ft bgs	(14-16) ft bgs	(16-18) ft bgs	(0-2) ft bgs	(2-4) ft bgs	(4-6) ft bgs	(6-8) ft bgs	(8-10) ft bgs	(10-12) ft bgs	(12-14) ft bgs	(14-16) ft bgs	(16-18) ft bgs	(0-2) ft bgs	(0-2) ft bgs
Integral Sample ID:		SJSB029-C6	SJSB029-C7	SJSB029-C8	SJSB029-C9	SJSB030-C1	SJSB030-C2	SJSB030-C3	SJSB030-C4	SJSB030-C5	SJSB030-C6	SJSB030-C7	SJSB030-C8	SJSB030-C9	SJSB031-C1	SJSB031-C10
Dioxins/Furans																
1,2,3,4,6,7,8,9-Octachlorodibenzofuran (OCDF)	ng/kg	2 J	15.7	0.505 J	13.1	55.7	2.84 U	0.822 J	9.54	5.66 U	0.293 J	9.72	0.976 U	1.27 J	2.98 UJ	8.35
1,2,3,4,6,7,8,9-Octachlorodibenzo-p-dioxin (OCDD)	ng/kg	3470	1040	296	1320	1290	2130	329	744	175	108	163	195	424	155 J	168
1,2,3,4,6,7,8-Heptachlorodibenzofuran (HpCDF)	ng/kg	0.25 J	0.86 J	3.09 U	3.21	9.23	0.71 J	0.154 U	2.06 J	0.0432 U	0.044 U	1.01 J	0.13 U	0.545 U	0.65 J	0.917 U
1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin (HpCDD)	ng/kg	49.3	21.8	12	30.5	68.1	28.2	6.45	15	3.31	2.19 J	2.85 J	5.33	14.5	5.77	6.03
1,2,3,4,7,8,9-Heptachlorodibenzofuran (HpCDF)	ng/kg	3.83 U	3.22 U	3.09 U	0.299 U	0.87 J	2.83 U	3.04 U	0.171 U	2.83 U	2.86 U	0.113 U	3.02 U	0.0813 U	0.102 U	2.7 U
1,2,3,4,7,8-Hexachlorodibenzofuran (HxCDF)	ng/kg	3.83 U	0.125 U	0.0639 U	1.2 U	1.6 J	0.23 U	0.0628 U	0.424 U	0.0231 U	0.03 U	0.34 J	3.02 U	0.26 J	0.66 J	0.45 J
1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin (HxCDD)	ng/kg	0.641 U	0.311 U	3.09 U	3.12 U	0.261 U	2.83 U	3.04 U	0.28 J	0.1 J	0.12 J	0.124 U	0.176 U	0.303 U	2.6 U	0.07 J
1,2,3,6,7,8-Hexachlorodibenzofuran (HxCDF)	ng/kg	3.83 U	0.13 J	3.09 U	0.508 U	0.82 J	0.119 U	0.0429 U	0.124 U	0.0181 U	0.0299 U	0.0872 U	3.02 U	0.0909 U	0.0948 U	0.159 U
1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin (HxCDD)	ng/kg	1.38 J	0.538 U	0.324 U	3.12 U	2.04 J	0.91 J	0.257 U	0.45 J	0.16 J	0.1 J	0.2 U	0.3 U	0.65 J	0.239 U	0.22 J
1,2,3,7,8,9-Hexachlorodibenzofuran (HxCDF)	ng/kg	3.83 U	3.22 U	3.09 U	3.12 U	0.178 U	0.0854 U	0.0674 U	0.135 U	0.0215 U	2.86 U	2.95 U	3.02 U	3.21 U	0.071 U	0.0935 U
1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin (HxCDD)	ng/kg	1.98 J	1.14 J	0.372 U	1.1 J	1.12 J	1.23 U	0.38 J	0.65 J	0.134 U	0.31 J	0.3 J	0.372 U	1.08 J	0.23 J	0.35 J
1,2,3,7,8-Pentachlorodibenzofuran (PeCDF)	ng/kg	3.83 U	3.22 U	3.09 U	0.708 U	1.08 J	0.202 U	3.04 U	0.193 U	2.83 U	2.86 U	2.95 U	3.02 U	3.21 U	0.292 U	0.193 U
1,2,3,7,8-Pentachlorodibenzo-p-dioxin (PeCDD)	ng/kg	3.83 U	0.308 U	3.09 U	0.131 U	0.269 U	0.184 U	3.04 U	0.188 U	2.83 U	2.86 U	2.95 U	3.02 U	0.201 U	0.125 U	0.104 U
2,3,4,6,7,8-Hexachlorodibenzofuran (HxCDF)	ng/kg	3.83 U	3.22 U	3.09 U	0.328 U	0.68 J	0.13 U	0.0353 U	0.16 J	2.83 U	2.86 U	2.95 U	3.02 U	0.109 U	2.6 U	0.0789 U
2,3,4,7,8-Pentachlorodibenzofuran (PeCDF)	ng/kg	3.83 U	3.22 U	3.09 U	0.528 U	1.44 J	2.83 U	3.04 U	0.14 U	2.83 U	2.86 U	0.128 U	3.02 U	3.21 U	0.285 U	0.144 U
2,3,7,8-Tetrachlorodibenzofuran (TCDF)	ng/kg	1.21 U	0.89	0.644 U	21	11.1	2.34	1.13	2.83	0.966 U	0.65	0.59 U	0.604 U	0.641 U	5.34	3.4
2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ng/kg	0.766 U	0.728 U	0.834 U	5.87	4.01 U	0.867 U	0.607 U	1.83	0.453 U	0.59	0.59 U	0.604 U	0.641 U	1.59	1.06
Octachlorodibenzofuran (OCDF) 13C12	ng/kg	2 J	15.7	0.5 J	13.1	55.7	2.84 U	0.82 J	9.54	0.115 U	0.29 J	9.72	0.976 U	1.27 J	2.98 UJ	8.35
Total dioxin/furan	pg/g	3520	1080	308	1390	1440	2160	338	777	200	110	177	200	442	169	188
Total dioxin/furan (ND*0.5)	pg/g	3530	1080	310	1400	1450	2170	339	777	200	110	178	202	443	171	189
Total dioxin/furan (ND*1)	pg/g	3530	1080	311	1400	1450	2170	340	778	200	110	179	204	445	174	190
Total heptachlorodibenzofuran (HpCDF)	ng/kg	0.49 J	0.86 J	3.09 U	9.05	35.5	1.94 J	0.27 J	4.96	2.83 U	0.05 J	1.01 J	3.02 U	0.2 J	0.65 J	1.39 J
Total heptachlorodibenzo-p-dioxin (HpCDD)	ng/kg	139	60.8	25.3	103	160	86.7	24.1	44.6	12.5	8.71	11	24.7	49.6	19.1	19.7
Total hexachlorodibenzofuran (HxCDF)	ng/kg	0.24 J	0.13 J	3.09 U	2.02 J	12.9	0.5 J	3.04 U	1.12 J	2.83 U	2.86 U	0.34 J	3.02 U	0.26 J	0.66 J	0.86 J
Total hexachlorodibenzo-p-dioxin (HxCDD)	ng/kg	28.7	13.8	2.12 J	16.1	20.1	17	7.72	11.1	2.32 J	2.15 J	0.62 J	2.28 J	16.4	3.58	3.89
Total pentachlorodibenzofuran (PeCDF)	ng/kg	3.83 U	3.22 U	3.09 U	2.71 J	7.36	2.83 U	3.04 U	2.82 U	2.83 U	2.86 U	2.95 U	3.02 U	3.21 U	0.39 J	2.7 U
Total pentachlorodibenzo-p-dioxin (PeCDD)	ng/kg	3.08 J	0.78 J	0.72 J	0.73 J	1.43 J	0.53 J	0.63 J	1.29 J	0.08 J	2.86 U	2.95 U	2.27 J	3.21 U	2.6 U	2.7 U
Total TEQ 1998 (Avian) (ND*0.5)	ng/kg	1.77	1.79	0.921	27.7	15.5	3.29	1.66	5.07	0.812	1.4	0.489	0.803	1.05	7.28	4.72
Total TEQ 1998 (Fish) (ND*0.5)	ng/kg	1.12	0.862	0.588	7.56	4.18	1.05	0.545	2.41	0.38	0.762	0.39	0.507	0.673	2.12	1.45
Total TEQ Dioxin 1998 (Bird) (ND=0)	ng/kg	0.611	1.15	0.0416	27.2	13.4	2.6	1.21	4.87	0.027	1.3	0.0942	0.0248	0.198	7.05	4.57
Total TEQ Dioxin 1998 (Bird) (ND=1)	ng/kg	2.93	2.43	1.8	28.1	17.7	3.99	2.12	5.28	1.6	1.46	0.883	1.58	1.91	7.5	4.87
Total TEQ Dioxin 1998 (Fish) (ND=0)	ng/kg	0.433	0.205	0.0416	7.13	1.97	0.374	0.0997	2.25	0.07	0.7	0.0672	0.0248	0.1	1.95	1.34
Total TEQ Dioxin 1998 (Fish) (ND=1)	ng/kg	1.81	1.52	1.13	8	6.39	1.72	0.99	2.58	0.68	0.824	0.713	0.989	1.25	2.29	1.56
Total TEQ Dioxin Texas TEF (ND=0)	ng/kg	0.336	0.216	0	8.08	2.51	0.325	0.151	2.27	0.03	0.7	0.064	0	0.199	2.21	1.51
Total TEQ Dioxin Texas TEF (ND=0.5)	ng/kg	0.899	0.759	1.1	8.41	4.6	0.943	0.55	2.39	0.34	0.8	0.341	0.919	0.675	2.35	1.59
Total TEQ Dioxin Texas TEF (ND=1)	ng/kg	1.46	1.3	1.1	8.75	6.69	1.56	0.948	2.5	0.66	0.8	0.619	0.919	1.15	2.48	1.67
Total tetrachlorodibenzofuran (TCDF)	ng/kg	2.61	0.42 J	0.619 U	31	22.2	3.86	1.6	3.99	0.45 J	0.39 J	0.59 U	0.604 U	0.45 J	7.97	5.57
Total tetrachlorodibenzo-p-dioxin (TCDD)	ng/kg	0.766 U	0.728 U	0.834 U	5.87	0.586 U	0.8	0.607 U	2.38	0.566 U	0.59	0.59 U	3.31	0.641 U	1.95	1.06
Total WHO Dioxin TEQ(Human/Mammal)(ND=0)	ng/kg	1.87	0.759	0.209	8.82	3.39	1.25	0.314	2.66	0.11	0.76	0.154	0.112	0.472	2.32	1.62
Total WHO Dioxin TEQ(Human/Mammal)(ND=0.5)	ng/kg	2.45	1.36	0.769	9.13	5.54	1.9	0.735	2.81	0.44	0.82	0.453	0.592	0.982	2.46	1.72
Total WHO Dioxin TEQ(Human/Mammal)(ND=1)	ng/kg	3.02	1.96	1.33	9.44	7.7	2.55	1.16	2.96	0.77	0.87	0.751	1.07	1.49	2.59	1.81
Asbestos																
Asbestos	%	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
PCBs																
Aroclor (unspecified)	ug/kg	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Aroclor-1016 (PCB-1016)	ug/kg	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Aroclor-1221 (PCB-1221)	ug/kg	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Aroclor-1232 (PCB-1232)	ug/kg	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Aroclor-1242 (PCB-1242)	ug/kg	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Aroclor-1248 (PCB-1248)	ug/kg	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Aroclor-1254 (PCB-1254)	ug/kg	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Aroclor-1260 (PCB-1260)	ug/kg	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Aroclor-1262 (PCB-1262)	ug/kg	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Aroclor-1268 (PCB-1268)	ug/kg	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Total PCBs	ug/kg	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Total PCBs (7)	ug/kg	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Total PCBs (ND*0)	ug/kg	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Total PCBs (ND*0.5)	ug/kg	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Total Petroleum Hydrocarbons (TPH)																
Total Petroleum Hydrocarbons	mg/kg	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Total Petroleum Hydrocarbons (C12-C28)	mg/kg	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Total Petroleum Hydrocarbons (C25-C36) ORO	mg/kg	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Total Petroleum Hydrocarbons (C28-C35)	mg/kg	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Total Petroleum Hydrocarbons (C6-C12)	mg/kg	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
General Chemistry																
Cyanide (total)	mg/kg	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Flash point (closed cup)	Deg C	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Moisture	%	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Percent solids	%	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
pH, lab	s.u.	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Reactive cyanide	mg/kg	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Sulfate	mg/kg	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Sulfide	mg/kg	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Sulfur	mg/kg	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Total solids	%	62.3	74.6	76.8	76.2	85	86.5	81.8	82.9	81.7	82.4	81.1	80.6	74	88.5	88.4

Notes:
- ng/kg - nanograms per kilogram
- ug/kg - microgram per kilogram
- pg/kg - picogram per kilogram
- mg/kg - milligram per kilogram
- Deg C - Degrees in Celsius
- s.u. - standard unit
- U - Not detected at the associated reporting limit.
- J - Estimated concentration.
- UJ - Not detected; associated reporting limit is estimated.
- Dup - indicates the result from a duplicate sample
- -- Data not available

Table 2-1

First Phase Pre-Design Investigation Analytical Results - Northern Impoundment
Final 100% Remedial Design - Northern Impoundment
San Jacinto River Waste Pits Site
Harris County, Texas

Area:	Units	Northern Impoundment - Waste Pits	Northern Impoundment - Waste Pits	Northern Impoundment - Waste Pits	Northern Impoundment - Waste Pits	Northern Impoundment - Waste Pits	Northern Impoundment - Waste Pits	Northern Impoundment - Waste Pits	Northern Impoundment - Waste Pits	Northern Impoundment - Waste Pits	Northern Impoundment - Waste Pits	Northern Impoundment - Waste Pits	Northern Impoundment - Waste Pits	Northern Impoundment - Waste Pits	Northern Impoundment - Waste Pits	Northern Impoundment - Waste Pits
Sample Location:		SJSB031	SJSB031	SJSB031	SJSB031	SJSB031	SJSB031	SJSB031	SJSB031	SJSB032	SJSB032	SJSB032	SJSB032	SJSB032	SJSB032	SJSB032
Sample Identification:		SL0510	SL0511	SL0512	SL0513	SL0514	SL0515	SL0516	SL0517	SL0561	SL0562	SL0563	SL0570	SL0564	SL0565	SL0566
Sample Date:		11/8/2018	11/8/2018	11/8/2018	11/8/2018	11/8/2018	11/9/2018	11/9/2018	11/9/2018	11/17/2018	11/17/2018	11/17/2018	11/17/2018	11/17/2018	11/17/2018	11/17/2018
Sample Type:													Duplicate			
Sample Depth:		(2-4) ft bgs	(4-6) ft bgs	(6-8) ft bgs	(8-10) ft bgs	(10-12) ft bgs	(12-14) ft bgs	(14-16) ft bgs	(16-18) ft bgs	(0-2) ft bgs	(2-4) ft bgs	(4-6) ft bgs	(4-6) ft bgs	(6-8) ft bgs	(8-10) ft bgs	(10-12) ft bgs
Integral Sample ID:		SJSB031-C2	SJSB031-C3	SJSB031-C4	SJSB031-C5	SJSB031-C6	SJSB031-C7	SJSB031-C8	SJSB031-C9	SJSB032-C1	SJSB032-C2	SJSB032-C3	SJSB032-C10	SJSB032-C4	SJSB032-C5	SJSB032-C6
Dioxins/Furans																
1,2,3,4,6,7,8,9-Octachlorodibenzofuran (OCDF)	ng/kg	1.17 U	1.88 U	1.84 U	2.9 U	4.65 J	1.58 J	2.9 J	0.801 J	56.7	102	31.4	21.5	2.21 J	3.22 J	0.521 U
1,2,3,4,6,7,8,9-Octachlorodibenzo-p-dioxin (OCDD)	ng/kg	650	449	331	375	416	113	239	165	1630	2730	1090	839	432	496	97.4
1,2,3,4,6,7,8-Heptachlorodibenzofuran (HpCDF)	ng/kg	0.161 U	0.27 J	0.25 J	0.449 U	1.07 U	0.42 J	0.7 J	0.16 U	79	134	46.7	29.6	0.66 J	2.6 J	0.722 U
1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin (HpCDD)	ng/kg	9.75	7.96	6.85	7.86	11.4	3.98	6.96	6.29	69.6	134	40.8	31.7	9.37	12.1	2.59 J
1,2,3,4,7,8,9-Heptachlorodibenzofuran (HpCDF)	ng/kg	2.76 U	3.01 U	2.88 U	2.89 UJ	3 U	2.83 U	0.136 U	3.25 U	25.4	40.7	16	9.94	0.0833 U	0.81 J	0.26 J
1,2,3,4,7,8-Hexachlorodibenzofuran (HxCDF)	ng/kg	0.1 J	0.0778 U	0.0583 U	2.89 U	0.213 U	0.147 U	0.131 U	3.25 U	236	400	159	87.8	0.6 J	6.84	1.95 U
1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin (HxCDD)	ng/kg	2.76 U	3.01 U	0.21 J	2.89 U	0.188 U	0.0841 U	2.99 U	0.11 J	0.48 J	0.66 J	2.86 UJ	0.24 J	0.151 U	0.4 J	2.93 U
1,2,3,6,7,8-Hexachlorodibenzofuran (HxCDF)	ng/kg	2.76 U	3.01 U	2.88 U	2.89 U	0.143 U	0.0677 U	0.0986 U	3.25 U	57.2	94.9	40.1	21	0.24 J	1.72 J	0.66 J
1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin (HxCDD)	ng/kg	0.43 J	0.23 J	0.243 U	0.262 U	0.53 J	0.139 U	0.26 J	0.32 J	2.58 J	4.16	1.43 J	1.19 J	0.36 U	0.391 U	0.106 U
1,2,3,7,8,9-Hexachlorodibenzofuran (HxCDF)	ng/kg	0.125 U	3.01 U	0.105 U	2.89 U	3 U	2.83 U	0.128 U	0.0837 U	15.7	24.6	14.8	5.72	3.05 U	0.513 U	0.203 U
1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin (HxCDD)	ng/kg	0.431 U	0.342 U	0.42 J	0.62 J	0.449 U	0.199 U	0.29 J	0.374 U	0.813 U	1.25 U	0.701 U	0.578 U	0.418 U	0.69 J	0.101 U
1,2,3,7,8-Pentachlorodibenzofuran (PeCDF)	ng/kg	2.76 U	3.01 U	2.88 U	2.89 U	0.17 J	0.12 U	0.105 U	3.25 U	141	233	92.4	48	0.27 J	3.96	1.28 J
1,2,3,7,8-Pentachlorodibenzo-p-dioxin (PeCDD)	ng/kg	2.76 U	3.01 U	0.13 J	0.177 U	0.152 U	0.0601 U	0.141 U	0.104 U	14.3	28.1	6.72	6.25	0.174 U	0.68 J	0.239 U
2,3,4,6,7,8-Hexachlorodibenzofuran (HxCDF)	ng/kg	2.76 U	3.01 U	0.0634 U	2.89 U	0.11 J	0.0743 U	0.16 J	3.25 U	9.79	16.9	8.72	3.61	0.1 U	0.49 J	0.12 J
2,3,4,7,8-Pentachlorodibenzofuran (PeCDF)	ng/kg	2.76 U	3.01 U	2.88 U	2.89 U	3 U	2.83 U	0.116 U	3.25 U	123	226	79.6	46.6	0.267 U	4.05	1.14 J
2,3,7,8-Tetrachlorodibenzofuran (TCDF)	ng/kg	0.553 U	0.602 U	0.576 U	1.35 U	0.99	0.97	0.546 U	0.65 U	5210	10500	4620	2450	8.96	157	43.9
2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ng/kg	0.553 U	0.602 U	0.576 U	0.501 U	0.41 J	0.163 U	0.598 U	0.65 U	2800	6450	2650 J	1460	4.79	66.7	21.4
Octachlorodibenzofuran (OCDF) 13C12	ng/kg	1.17 U	1.88 U	1.84 U	2.9 U	4.65 J	1.58 J	2.9 J	0.8 J	56.7	102	31.4	21.5	2.21 J	3.22 J	0.52 U
Total dioxin/furan	pg/g	700	457	339	383	434	120	250	173	10500	21100	8900	5060	459	757	169
Total dioxin/furan (ND*0.5)	pg/g	700	460	341	387	436	121	251	173	10500	21100	8900	5060	460	758	171
Total dioxin/furan (ND*1)	pg/g	700	462	343	390	437	121	252	174	10500	21100	8900	5060	461	758	173
Total heptachlorodibenzofuran (HpCDF)	ng/kg	2.76 U	0.46 J	0.46 J	0.4 J	1.96 J	1.16 J	1.91 J	3.25 U	146	245	83.4	53.5	0.66 J	4.94	0.26 J
Total heptachlorodibenzo-p-dioxin (HpCDD)	ng/kg	40.9	31	28.1	33.8	41.1	12.5	24	22.2	156	258	91.2	71.8	30.5	37.4	10.7
Total hexachlorodibenzofuran (HxCDF)	ng/kg	0.1 J	3.01 U	2.88 U	2.89 U	1.07 J	0.12 J	0.61 J	0.05 J	350	589	241	127	1.51 J	9.25	0.96 J
Total hexachlorodibenzo-p-dioxin (HxCDD)	ng/kg	11.6	7.81	7.43	8.94	7.5	2.74 J	4.67	8.36	18.2	27.9	16.6	15.1	6.04	10.7	2.69 J
Total pentachlorodibenzofuran (PeCDF)	ng/kg	2.76 U	3.01 U	2.88 U	2.89 U	0.17 J	2.83 U	2.99 U	3.25 U	388	686	260	2.98 U	0.8 J	12.2	2.42 J
Total pentachlorodibenzo-p-dioxin (PeCDD)	ng/kg	0.71 J	0.62 J	0.44 J	1.01 J	0.56 J	0.06 J	0.49 J	0.95 J	19.9	31.6	7.65	8.48	1.06 J	0.89 J	0.42 J
Total TEQ 1998 (Avian) (ND*0.5)	ng/kg	0.8	0.786	0.864	1.23	1.68	1.17	0.801	0.323	8190	17300	7390	3980	14.2	230	66.9
Total TEQ 1998 (Fish) (ND*0.5)	ng/kg	0.54	0.487	0.623	0.522	0.718	0.235	0.511	0.276	3180	7180	2960	1630	5.59	78.7	24.6
Total TEQ Dioxin 1998 (Bird) (ND=0)	ng/kg	0.09	0.0579	0.225	0.107	1.49	0.99	0.0858	0.0316	8190	17300	7390	3980	13.9	230	66.7
Total TEQ Dioxin 1998 (Bird) (ND=1)	ng/kg	1.51	1.51	1.5	2.35	1.87	1.35	1.52	0.615	8190	17300	7390	3980	14.4	230	67.1
Total TEQ Dioxin 1998 (Fish) (ND=0)	ng/kg	0.09	0.0579	0.282	0.0516	0.538	0.0681	0.0596	0.0811	3180	7180	2960	1630	5.39	78.7	24.3
Total TEQ Dioxin 1998 (Fish) (ND=1)	ng/kg	0.99	0.917	0.965	0.993	0.898	0.403	0.961	0.472	3180	7180	2960	1630	5.79	78.7	24.8
Total TEQ Dioxin Texas TEF (ND=0)	ng/kg	0.05	0.023	0.128	0.062	0.582	0.097	0.071	0.043	3430	7690	3180	1750	5.78	86	26.5
Total TEQ Dioxin Texas TEF (ND=0.5)	ng/kg	0.46	0.437	0.494	0.505	0.702	0.247	0.48	0.232	3430	7690	3180	1750	5.94	86	26.7
Total TEQ Dioxin Texas TEF (ND=1)	ng/kg	0.87	0.851	0.86	0.949	0.823	0.398	0.889	0.421	3430	7690	3180	1750	6.11	86.1	26.9
Total tetrachlorodibenzofuran (TCDF)	ng/kg	0.553 U	0.602 U	0.576 U	0.577 U	0.99	1.38	0.598 U	0.65 U	8180	15500	4270	3300	15.3	282	85.6
Total tetrachlorodibenzo-p-dioxin (TCDD)	ng/kg	0.553 U	0.602 U	0.576 U	0.577 U	0.41 J	0.566 U	0.598 U	0.78	2130	4430	1200	893	4.79	67.9	21.4
Total WHO Dioxin TEQ(Human/Mammal)(ND=0)	ng/kg	0.35	0.24	0.363	0.253	0.818	0.175	0.22	0.156	3410	7660	3170	1740	6.01	85.7	26.3
Total WHO Dioxin TEQ(Human/Mammal)(ND=0.5)	ng/kg	0.77	0.666	0.719	0.726	0.97	0.333	0.653	0.362	3410	7660	3170	1740	6.19	85.8	26.5
Total WHO Dioxin TEQ(Human/Mammal)(ND=1)	ng/kg	1.2	1.09	1.07	1.2	1.12	0.49	1.09	0.568	3410	7660	3170	1740	6.36	85.8	26.8
Asbestos																
Asbestos	%	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
PCBs																
Aroclor (unspecified)	ug/kg	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Aroclor-1016 (PCB-1016)	ug/kg	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Aroclor-1221 (PCB-1221)	ug/kg	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Aroclor-1232 (PCB-1232)	ug/kg	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Aroclor-1242 (PCB-1242)	ug/kg	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Aroclor-1248 (PCB-1248)	ug/kg	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Aroclor-1254 (PCB-1254)	ug/kg	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Aroclor-1260 (PCB-1260)	ug/kg	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Aroclor-1262 (PCB-1262)	ug/kg	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Aroclor-1268 (PCB-1268)	ug/kg	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Total PCBs	ug/kg	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Total PCBs (7)	ug/kg	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Total PCBs (ND*0)	ug/kg	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Total PCBs (ND*0.5)	ug/kg	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Total Petroleum Hydrocarbons (TPH)																
Total Petroleum Hydrocarbons	mg/kg	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Total Petroleum Hydrocarbons (C12-C28)	mg/kg	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Total Petroleum Hydrocarbons (C25-C36) ORO	mg/kg	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Total Petroleum Hydrocarbons (C28-C35)	mg/kg	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Total Petroleum Hydrocarbons (C6-C12)	mg/kg	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
General Chemistry																
Cyanide (total)	mg/kg	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Flash point (closed cup)	Deg C	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Moisture	%	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Percent solids	%	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
pH, lab	s.u.	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Reactive cyanide	mg/kg	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Sulfate	mg/kg	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Sulfide	mg/kg	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Sulfur	mg/kg	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Total solids	%	84.3	79.6	84.4	84.4	82.6	82.2	81.9	75.9	84.4	81.4	82.9	83	77	80.5	82.5

Notes:
- ng/kg - nanograms per kilogram
- ug/kg - microgram per kilogram
- pg/kg - picogram per kilogram
- mg/kg - milligram per kilogram
- Deg C - Degrees in Celsius
- s.u. - standard unit
- U - Not detected at the associated reporting limit.
- J - Estimated concentration.
- UJ - Not detected; associated reporting limit is estimated.
- Dup - indicates the result from a duplicate sample
- -- Data not available

Table 2-1

First Phase Pre-Design Investigation Analytical Results - Northern Impoundment
Final 100% Remedial Design - Northern Impoundment
San Jacinto River Waste Pits Site
Harris County, Texas

Area:	Units	Northern Impoundment - Waste Pits	Northern Impoundment - Waste Pits	Northern Impoundment - Waste Pits	Northern Impoundment - Waste Pits	Northern Impoundment - Waste Pits	Northern Impoundment - Waste Pits	Northern Impoundment - Waste Pits	Northern Impoundment - Waste Pits	Northern Impoundment - Waste Pits	Northern Impoundment - Waste Pits	Northern Impoundment - Waste Pits	Northern Impoundment - Waste Pits	Northern Impoundment - Waste Pits	Northern Impoundment - Waste Pits	Northern Impoundment - Waste Pits
Sample Location:		SJSB032	SJSB032	SJSB032	SJSB033	SJSB033	SJSB033	SJSB033	SJSB033	SJSB033	SJSB033	SJSB033	SJSB033	SJSB034	SJSB034	SJSB034
Sample Identification:		SL0567	SL0568	SL0569	SL0539	SL0540	SL0541	SL0542	SL0543	SL0544	SL0545	SL0546	SL0538	SL0519	SL0520	SL0521
Sample Date:		11/17/2018	11/17/2018	11/17/2018	11/12/2018	11/12/2018	11/12/2018	11/12/2018	11/12/2018	11/12/2018	11/14/2018	11/14/2018	11/15/2018	11/10/2018	11/10/2018	11/10/2018
Sample Type:																
Sample Depth:		(12-14) ft bgs	(14-16) ft bgs	(16-18) ft bgs	(2-4) ft bgs	(4-6) ft bgs	(6-8) ft bgs	(8-10) ft bgs	(10-12) ft bgs	(12-14) ft bgs	(14-16) ft bgs	(16-18) ft bgs	(0-2) ft bgs	(0-2) ft bgs	(2-4) ft bgs	(4-6) ft bgs
Integral Sample ID:		SJSB032-C7	SJSB032-C8	SJSB032-C9	SJSB033-C2	SJSB033-C3	SJSB033-C4	SJSB033-C5	SJSB033-C6	SJSB033-C7	SJSB033-C8	SJSB033-C9	SJSB033-C1	SJSB034-C1	SJSB034-C2	SJSB034-C3
Dioxins/Furans																
1,2,3,4,6,7,8,9-Octachlorodibenzofuran (OCDF)	ng/kg	5.79 U	0.333 J	0.77 U	105	133	112	44.3	5.59	0.815 J	1.23 J	0.583 U	17.4	1.01 U	0.646 J	1.96 U
1,2,3,4,6,7,8,9-Octachlorodibenzo-p-dioxin (OCDD)	ng/kg	80.9	49.2	32.9	481	1720	2180	829	200	90.1	127	109	588	272	319	180
1,2,3,4,6,7,8-Heptachlorodibenzofuran (HpCDF)	ng/kg	0.39 J	0.06 J	0.322 U	41.1	197	201	71.5	7.5	1.05 J	0.92 J	0.51 J	6.85	0.344 U	0.0608 U	0.253 U
1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin (HpCDD)	ng/kg	2.42 J	1.7 J	1.31 J	19.8	62.5	71.5	24.7	5.79	2.19 J	3.87	4.09	22.7	5.69	5.85	4.3
1,2,3,4,7,8,9-Heptachlorodibenzofuran (HpCDF)	ng/kg	0.111 U	3.1 U	0.133 U	17.2	81.3	71.4	31.6	2.92	0.45 J	0.24 J	0.2 J	1.73 J	0.0928 U	0.06 J	2.93 U
1,2,3,4,7,8-Hexachlorodibenzofuran (HxCDF)	ng/kg	1.38 J	0.159 U	1.32 J	109	651	584	241	26.3	3.21	2 J	1.65 J	12.9	0.62 J	0.158 U	0.278 U
1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin (HxCDD)	ng/kg	2.89 U	3.1 U	3.08 U	0.258 U	0.57 J	0.633 U	0.257 U	2.78 U	2.94 U	0.109 U	0.21 J	0.192 U	2.79 U	2.74 U	2.93 U
1,2,3,6,7,8-Hexachlorodibenzofuran (HxCDF)	ng/kg	0.34 J	0.03 J	0.295 U	24.2	144	138	54.8	6	0.743 U	0.57 J	0.361 U	3.33	0.106 U	2.74 U	0.178 U
1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin (HxCDD)	ng/kg	0.0632 U	3.1 U	0.11 J	0.728 U	2.24 U	2.96 J	0.783 U	2.78 U	0.113 U	0.187 U	0.31 J	0.821 U	0.216 U	2.74 U	2.93 U
1,2,3,7,8,9-Hexachlorodibenzofuran (HxCDF)	ng/kg	0.0691 U	0.0388 U	0.0667 U	6.5	41.5	35.5	13.5	2.27 J	0.27 J	0.15 J	0.145 U	1.18 J	2.79 U	0.0571 U	2.93 U
1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin (HxCDD)	ng/kg	0.0782 U	0.201 U	3.08 U	0.487 U	1.03 U	1.7 U	0.717 U	0.238 U	0.13 J	0.34 J	0.26 J	0.58 U	0.279 U	0.4 J	0.19 J
1,2,3,7,8-Pentachlorodibenzofuran (PeCDF)	ng/kg	0.88 J	3.1 U	0.522 U	33.3	268	230	76.8	12.1	1.63 J	1.03 J	0.73 J	8.87	0.46 J	2.74 U	2.93 U
1,2,3,7,8-Pentachlorodibenzo-p-dioxin (PeCDD)	ng/kg	0.156 U	0.133 U	0.17 U	3.5 U	23.8	21.9	6.89	0.975 U	0.179 U	0.3 J	3.02 U	0.805 U	2.79 U	2.74 U	2.93 U
2,3,4,6,7,8-Hexachlorodibenzofuran (HxCDF)	ng/kg	0.0505 U	3.1 U	3.08 U	4.3	26	22.3	7.67 U	1.42 J	0.102 U	2.95 U	3.02 U	0.785 U	0.0489 U	2.74 U	0.07 J
2,3,4,7,8-Pentachlorodibenzofuran (PeCDF)	ng/kg	0.731 U	3.1 U	0.512 U	26.8	214	186	60.7	9.37	1.14 U	0.87 J	0.53 J	6.45	0.32 J	2.74 U	2.93 U
2,3,7,8-Tetrachlorodibenzofuran (TCDF)	ng/kg	27.3	2.98	21.8	1420	10600	8340	2510	274	39.6	26.2	20.2	184	11.8	3.27 UJ	6.07
2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ng/kg	12.7	1.69	10.2 J	879	5870	4740	1390	122	19.3	14	9.83	72.2	3.53	1.35 UJ	2.09
Octachlorodibenzofuran (OCDF) 13C12	ng/kg	0.0841 U	0.33 J	0.77 U	105	133	112	44.3	5.59	0.81 J	1.23 J	0.583 U	17.4	1.01 U	0.646 J	1.96 U
Total dioxin/furan	pg/g	126	56	67.6	3170	20000	16900	5350	675	159	179	148	926	294	326	193
Total dioxin/furan (ND*0.5)	pg/g	127	56.4	69.1	3170	20000	16900	5360	676	160	179	148	927	296	329	195
Total dioxin/furan (ND*1)	pg/g	128	56.9	70.6	3170	20000	16900	5360	677	161	179	149	929	297	332	197
Total heptachlorodibenzofuran (HpCDF)	ng/kg	2.89 U	0.06 J	3.08 U	71.5	338	326	124	12.5	2.94 U	1.17 J	0.71 J	15.9	2.79 U	0.06 J	0.17 J
Total heptachlorodibenzo-p-dioxin (HpCDD)	ng/kg	9.98	6.26	4.14	47.5	147	183	64.1	17.4	8.14	13.2	12.6	56	20.7	22.6	17.3
Total hexachlorodibenzofuran (HxCDF)	ng/kg	1.72 J	0.03 J	1.44 J	148	928	834	330	39.1	3.48	2.74 J	1.65 J	22	0.62 J	2.74 U	0.07 J
Total hexachlorodibenzo-p-dioxin (HxCDD)	ng/kg	3.05	3.19	0.56 J	5.1	20.4	30.8	11.9	4.11	0.13 J	1.93 J	4.05	6.97	0.86 J	3.91	1.15 J
Total pentachlorodibenzofuran (PeCDF)	ng/kg	1.66 J	3.1 U	0.28 J	90.1	727	628	206	30.9	2.29 J	1.9 J	1.27 J	22.8	0.79 J	2.74 U	2.93 U
Total pentachlorodibenzo-p-dioxin (PeCDD)	ng/kg	0.64 J	0.64 J	0.36 J	2.96 U	29.4	28.6	8.2	2.78 U	0.3 J	1.16 J	0.59 J	0.2 J	2.79 U	2.74 U	2.93 U
Total TEQ 1998 (Avian) (ND*0.5)	ng/kg	40.7	4.81	32.5	2350	16800	13400	4010	411	60.1	41.8	31	266	15.9	2.59	8.52
Total TEQ 1998 (Fish) (ND*0.5)	ng/kg	14.6	1.96	11.7	982	6630	5360	1590	145	22.2	16.4	11.5	87.5	4.5	0.984	2.69
Total TEQ Dioxin 1998 (Bird) (ND=0)	ng/kg	40.3	4.68	32.1	2340	16800	13400	4010	410	59.5	41.8	30.9	265	15.8	0.0784	8.21
Total TEQ Dioxin 1998 (Bird) (ND=1)	ng/kg	41.2	4.95	32.9	2350	16800	13400	4010	411	60.8	41.8	31.1	266	16	5.1	8.82
Total TEQ Dioxin 1998 (Fish) (ND=0)	ng/kg	14.3	1.85	11.4	980	6630	5360	1590	145	21.7	16.4	11.4	87	4.4	0.0424	2.42
Total TEQ Dioxin 1998 (Fish) (ND=1)	ng/kg	14.8	2.08	12	984	6630	5360	1590	146	22.6	16.5	11.7	88	4.6	1.93	2.96
Total TEQ Dioxin Texas TEF (ND=0)	ng/kg	15.6	1.99	12.5	1050	7150	5770	1710	158	23.7	17.6	12.4	96	4.96	0.04	2.72
Total TEQ Dioxin Texas TEF (ND=0.5)	ng/kg	15.9	2.07	12.7	1050	7150	5770	1710	159	24.1	17.6	12.5	96.3	5.02	1	2.9
Total TEQ Dioxin Texas TEF (ND=1)	ng/kg	16.1	2.15	12.9	1050	7150	5770	1710	159	24.5	17.6	12.5	96.6	5.09	1.96	3.08
Total tetrachlorodibenzofuran (TCDF)	ng/kg	46.2	3.28	33.5	1620	13300	12100	3430	450	61.8	38	31.7	311	17.7	0.548 U	6.63
Total tetrachlorodibenzo-p-dioxin (TCDD)	ng/kg	18.7	3.44	10.2	517	3660	3450	954	133	19.3	14	9.83	79	3.53	0.761 U	2.09
Total WHO Dioxin TEQ(Human/Mammal)(ND=0)	ng/kg	15.7	2.02	12.5	1050	7120	5740	1700	156	23.7	17.6	12.4	95	5.02	0.195	2.82
Total WHO Dioxin TEQ(Human/Mammal)(ND=0.5)	ng/kg	15.9	2.13	12.7	1050	7120	5740	1700	157	24	17.6	12.5	95.6	5.12	1.17	3.04
Total WHO Dioxin TEQ(Human/Mammal)(ND=1)	ng/kg	16.1	2.23	12.9	1050	7120	5740	1700	157	24.3	17.6	12.6	96.1	5.22	2.15	3.26
Asbestos																
Asbestos	%	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
PCBs																
Aroclor (unspecified)	ug/kg	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Aroclor-1016 (PCB-1016)	ug/kg	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Aroclor-1221 (PCB-1221)	ug/kg	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Aroclor-1232 (PCB-1232)	ug/kg	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Aroclor-1242 (PCB-1242)	ug/kg	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Aroclor-1248 (PCB-1248)	ug/kg	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Aroclor-1254 (PCB-1254)	ug/kg	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Aroclor-1260 (PCB-1260)	ug/kg	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Aroclor-1262 (PCB-1262)	ug/kg	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Aroclor-1268 (PCB-1268)	ug/kg	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Total PCBs	ug/kg	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Total PCBs (7)	ug/kg	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Total PCBs (ND*0)	ug/kg	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Total PCBs (ND*0.5)	ug/kg	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Total Petroleum Hydrocarbons (TPH)																
Total Petroleum Hydrocarbons	mg/kg	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Total Petroleum Hydrocarbons (C12-C28)	mg/kg	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Total Petroleum Hydrocarbons (C25-C36) ORO	mg/kg	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Total Petroleum Hydrocarbons (C28-C35)	mg/kg	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Total Petroleum Hydrocarbons (C6-C12)	mg/kg	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
General Chemistry																
Cyanide (total)	mg/kg	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Flash point (closed cup)	Deg C	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Moisture	%	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Percent solids	%	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
pH, lab	s.u.	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Reactive cyanide	mg/kg	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Sulfate	mg/kg	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Sulfide	mg/kg	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Sulfur	mg/kg	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Total solids	%	80.6	74.5	79.5	81	77	74.6	78.3	82.6	79.1	80.1	80	89.7	86.5	84.2	81.9

Notes:
- ng/kg - nanograms per kilogram
- ug/kg - microgram per kilogram
- pg/kg - picogram per kilogram
- mg/kg - milligram per kilogram
- Deg C - Degrees in Celsius
- s.u. - standard unit
- U - Not detected at the associated reporting limit.
- J - Estimated concentration.
- UJ - Not detected; associated reporting limit is estimated.
- Dup - indicates the result from a duplicate sample
- -- Data not available

Table 2-1

First Phase Pre-Design Investigation Analytical Results - Northern Impoundment
Final 100% Remedial Design - Northern Impoundment
San Jacinto River Waste Pits Site
Harris County, Texas

Area:	Units	Northern Impoundment - Waste Pits	Northern Impoundment - Waste Pits	Northern Impoundment - Waste Pits	Northern Impoundment - Waste Pits	Northern Impoundment - Waste Pits	Northern Impoundment - Waste Pits	Northern Impoundment - Waste Pits	Northern Impoundment - Waste Pits	Northern Impoundment - Waste Pits	Northern Impoundment - Waste Pits	Northern Impoundment - Waste Pits	Northern Impoundment - Waste Pits	Northern Impoundment - Waste Pits	Northern Impoundment - Waste Pits	Northern Impoundment - Waste Pits
Sample Location:		SJSB034	SJSB034	SJSB034	SJSB034	SJSB034	SJSB034	SJSB035	SJSB035	SJSB035	SJSB035	SJSB035	SJSB035	SJSB035	SJSB035	SJSB035
Sample Identification:		SL0522	SL0523	SL0524	SL0525	SL0526	SL0527	SL0528	SL0529	SL0530	SL0531	SL0532	SL0533	SL0534	SL0537	SL0535
Sample Date:		11/10/2018	11/10/2018	11/10/2018	11/10/2018	11/10/2018	11/10/2018	11/11/2018	11/11/2018	11/11/2018	11/11/2018	11/11/2018	11/11/2018	11/11/2018	11/11/2018	11/11/2018
Sample Type:															Duplicate	
Sample Depth:		(6-8) ft bgs	(8-10) ft bgs	(10-12) ft bgs	(12-14) ft bgs	(14-16) ft bgs	(16-18) ft bgs	(0-2) ft bgs	(2-4) ft bgs	(4-6) ft bgs	(6-8) ft bgs	(8-10) ft bgs	(10-12) ft bgs	(12-14) ft bgs	(12-14) ft bgs	(14-16) ft bgs
Integral Sample ID:		SJSB034-C4	SJSB034-C5	SJSB034-C6	SJSB034-C7	SJSB034-C8	SJSB034-C9	SJSB035-C1	SJSB035-C2	SJSB035-C3	SJSB035-C4	SJSB035-C5	SJSB035-C6	SJSB035-C7	SJSB035-C10	SJSB035-C8
Dioxins/Furans																
1,2,3,4,6,7,8,9-Octachlorodibenzofuran (OCDF)	ng/kg	2.73 U	18.8 J	0.729 U	0.441 U	0.377 U	0.362 U	12.1 U	0.564 U	0.337 U	1.46 U	1.18 U	0.299 J	1.08 J	0.544 J	0.789 J
1,2,3,4,6,7,8,9-Octachlorodibenzo-p-dioxin (OCDD)	ng/kg	787	170	159	229	121	315	481	120	141	213	173	99.7	140	144	157
1,2,3,4,6,7,8-Heptachlorodibenzofuran (HpCDF)	ng/kg	0.6 J	2.78 J	0.26 J	0.13 J	0.0427 U	0.11 J	2.9	0.137 U	0.148 U	0.166 U	0.166 U	0.0489 U	0.22 J	0.0688 U	0.09 J
1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin (HpCDD)	ng/kg	12.6	4.77	2.68 J	3.48 U	2.36 J	5.03	20.7	3.54	3.45	5.89	5.92	2.05 J	3.02	2.49 J	3.85
1,2,3,4,7,8,9-Heptachlorodibenzofuran (HpCDF)	ng/kg	3.1 U	0.303 U	0.185 U	3.09 U	2.86 U	2.85 U	2.79 U	2.82 U	2.9 U	2.84 U	2.97 U	2.98 U	2.78 U	0.0462 U	0.07 J
1,2,3,4,7,8-Hexachlorodibenzofuran (HxCDF)	ng/kg	0.166 U	0.42 J	0.145 U	0.0637 U	0.0756 U	0.0751 U	0.546 U	0.137 U	0.104 U	0.0955 U	2.97 U	0.0894 U	0.276 U	2.93 U	0.147 U
1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin (HxCDD)	ng/kg	0.184 U	3.03 U	0.199 U	0.071 U	2.86 U	2.85 U	0.12 J	2.82 U	2.9 U	2.84 U	2.97 U	2.98 U	2.78 U	0.0534 U	0.195 U
1,2,3,6,7,8-Hexachlorodibenzofuran (HxCDF)	ng/kg	0.16 J	0.18 J	0.12 J	3.09 U	2.86 U	0.032 U	0.29 J	2.82 U	2.9 U	0.05 J	2.97 U	2.98 U	2.78 UJ	2.93 U	2.86 U
1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin (HxCDD)	ng/kg	0.393 U	0.152 U	0.116 U	0.121 U	0.177 U	0.21 J	0.65 J	2.82 U	2.9 U	0.28 J	2.97 U	2.98 U	0.0899 U	0.0844 U	0.193 U
1,2,3,7,8,9-Hexachlorodibenzofuran (HxCDF)	ng/kg	0.11 U	0.1 U	0.25 J	3.09 U	2.86 U	2.85 U	0.107 U	2.82 U	2.9 U	2.84 U	2.97 U	2.98 U	2.78 U	0.06 J	2.86 U
1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin (HxCDD)	ng/kg	0.638 U	0.131 U	0.24 U	0.227 U	0.278 U	0.41 J	0.43 J	0.239 U	0.132 U	0.428 U	0.33 J	0.2 J	0.33 U	0.282 U	0.3 J
1,2,3,7,8-Pentachlorodibenzofuran (PeCDF)	ng/kg	3.1 U	0.108 U	0.126 U	3.09 U	0.114 U	2.85 U	0.35 J	2.82 U	2.9 U	2.84 U	2.97 U	2.98 U	0.202 U	2.93 U	2.86 U
1,2,3,7,8-Pentachlorodibenzo-p-dioxin (PeCDD)	ng/kg	3.1 U	3.03 U	2.97 U	3.09 U	2.86 U	2.85 U	2.79 U	2.82 U	2.9 U	0.0834 U	2.97 U	2.98 U	2.78 U	0.0961 U	0.144 U
2,3,4,6,7,8-Hexachlorodibenzofuran (HxCDF)	ng/kg	3.1 U	0.0639 U	0.128 U	0.0537 U	2.86 U	2.85 U	0.108 U	2.82 U	2.9 U	2.84 U	2.97 U	2.98 U	2.78 U	0.0274 U	2.86 U
2,3,4,7,8-Pentachlorodibenzofuran (PeCDF)	ng/kg	3.1 U	3.03 U	0.204 U	3.09 U	2.86 U	2.85 U	2.79 U	2.82 U	2.9 U	2.84 U	2.97 U	2.98 U	2.78 U	2.93 U	2.86 U
2,3,7,8-Tetrachlorodibenzofuran (TCDF)	ng/kg	2.49 U	1.55	1.87	2.01 U	1.97 J	1.34	2.41	2.72 UJ	1.43	2.6 J	1.53	2.3 UJ	3.18 J	0.585 U	2.81
2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ng/kg	0.619 U	0.54 J	0.79 U	0.618 U	1.12 J	0.48 J	0.847 U	0.564 U	0.66	0.778 U	0.511 U	1.07 U	1.49 U	0.585 U	0.882 U
Octachlorodibenzofuran (OCDF) 13C12	ng/kg	2.73 U	18.8 J	0.729 U	0.441 U	0.377 U	0.362 U	12.1 U	0.564 U	0.337 U	1.46 U	1.18 U	0.299 J	1.08 J	0.54 J	0.789 J
Total dioxin/furan	pg/g	800	199	164	229	126	323	509	124	147	222	181	102	148	147	165
Total dioxin/furan (ND*0.5)	pg/g	804	200	166	233	127	323	516	126	147	224	182	104	149	148	166
Total dioxin/furan (ND*1)	pg/g	808	200	167	237	128	324	523	129	148	225	183	106	150	149	167
Total heptachlorodibenzofuran (HpCDF)	ng/kg	1.27 J	5	0.26 J	0.2 J	2.86 U	0.11 J	11.6	2.82 U	2.9 U	0.59 J	2.97 U	2.98 U	0.22 J	2.93 U	0.07 J
Total heptachlorodibenzo-p-dioxin (HpCDD)	ng/kg	41.4	16.4	9.7	11.9	9.44	21.7	56	13.2	13.8	26.3	23	8.48	12.6	10.5	14.3
Total hexachlorodibenzofuran (HxCDF)	ng/kg	0.16 J	1.19 J	0.38 J	0.17 J	2.86 U	2.85 U	3.71	0.13 J	0.03 J	0.16 J	2.97 U	2.98 U	2.78 U	0.06 J	0.14 J
Total hexachlorodibenzo-p-dioxin (HxCDD)	ng/kg	8.22	2.37 J	1.4 J	3.1	0.55 J	7.1	9.06	2.82 U	2.34 J	4.96	4.08	0.2 J	1.92 J	1.61 J	0.37 J
Total pentachlorodibenzofuran (PeCDF)	ng/kg	3.1 U	3.03 U	2.97 U	3.09 U	2.86 U	2.85 U	1.84 J	2.82 U	2.9 U	2.84 U	2.97 U	2.98 U	2.78 U	2.93 U	2.86 U
Total pentachlorodibenzo-p-dioxin (PeCDD)	ng/kg	0.37 J	3.03 U	2.97 U	3.09 U	2.86 U	0.32 J	0.15 J	2.82 U	2.9 U	0.35 J	2.97 U	2.98 U	2.78 U	0.07 J	2.86 U
Total TEQ 1998 (Avian) (ND*0.5)	ng/kg	1.87	2.32	2.5	1.49	3.24	2.02	3.23	1.8	2.27	3.15	1.94	1.83	4.11	0.696	3.45
Total TEQ 1998 (Fish) (ND*0.5)	ng/kg	0.659	0.827	0.706	0.495	1.35	0.701	0.889	0.474	0.884	0.667	0.468	0.708	1.05	0.405	0.768
Total TEQ Dioxin 1998 (Bird) (ND=0)	ng/kg	0.113	2.2	1.93	0.0242	3.1	1.9	2.63	0.0155	2.11	2.63	1.59	0.032	3.2	0.0229	2.86
Total TEQ Dioxin 1998 (Bird) (ND=1)	ng/kg	3.62	2.44	3.08	2.95	3.38	2.14	3.82	3.59	2.43	3.67	2.3	3.63	5.01	1.37	4.03
Total TEQ Dioxin 1998 (Fish) (ND=0)	ng/kg	0.113	0.729	0.152	0.0242	1.23	0.591	0.336	0.0155	0.749	0.165	0.103	0.014	0.178	0.0229	0.165
Total TEQ Dioxin 1998 (Fish) (ND=1)	ng/kg	1.21	0.925	1.26	0.966	1.47	0.811	1.44	0.933	1.02	1.17	0.833	1.4	1.92	0.787	1.37
Total TEQ Dioxin Texas TEF (ND=0)	ng/kg	0.016	0.755	0.224	0	1.32	0.676	0.407	0	0.803	0.293	0.186	0.02	0.318	0.006	0.311
Total TEQ Dioxin Texas TEF (ND=0.5)	ng/kg	0.597	0.829	0.733	0.997	1.41	0.743	0.934	1.01	0.898	0.763	0.505	0.738	1.17	0.386	0.85
Total TEQ Dioxin Texas TEF (ND=1)	ng/kg	1.18	0.903	1.24	0.997	1.5	0.81	1.46	1.01	0.992	1.23	0.824	1.46	2.03	0.766	1.39
Total tetrachlorodibenzofuran (TCDF)	ng/kg	1	2.43	1.87	1.01	1.97	1.34	3.5	0.564 U	1.43	2.6	1.68	1.21	4.57	0.585 U	4.15
Total tetrachlorodibenzo-p-dioxin (TCDD)	ng/kg	0.619 U	0.605 U	0.594 U	0.618 U	1.12	0.57 U	0.559 U	0.564 U	0.66	0.567 U	1.01	0.595 U	0.746 U	0.585 U	0.572 U
Total WHO Dioxin TEQ(Human/Mammal)(ND=0)	ng/kg	0.384	0.887	0.301	0.07	1.38	0.822	0.781	0.0714	0.88	0.416	0.297	0.0705	0.393	0.0743	0.398
Total WHO Dioxin TEQ(Human/Mammal)(ND=0.5)	ng/kg	0.988	0.98	0.812	0.592	1.5	0.897	1.32	0.585	0.995	0.896	0.64	0.801	1.26	0.471	0.962
Total WHO Dioxin TEQ(Human/Mammal)(ND=1)	ng/kg	1.59	1.07	1.32	1.11	1.62	0.972	1.85	1.1	1.11	1.38	0.983	1.53	2.13	0.869	1.53
Asbestos																
Asbestos	%	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
PCBs																
Aroclor (unspecified)	ug/kg	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Aroclor-1016 (PCB-1016)	ug/kg	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Aroclor-1221 (PCB-1221)	ug/kg	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Aroclor-1232 (PCB-1232)	ug/kg	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Aroclor-1242 (PCB-1242)	ug/kg	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Aroclor-1248 (PCB-1248)	ug/kg	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Aroclor-1254 (PCB-1254)	ug/kg	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Aroclor-1260 (PCB-1260)	ug/kg	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Aroclor-1262 (PCB-1262)	ug/kg	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Aroclor-1268 (PCB-1268)	ug/kg	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Total PCBs	ug/kg	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Total PCBs (7)	ug/kg	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Total PCBs (ND*0)	ug/kg	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Total PCBs (ND*0.5)	ug/kg	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Total Petroleum Hydrocarbons (TPH)																
Total Petroleum Hydrocarbons	mg/kg	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Total Petroleum Hydrocarbons (C12-C28)	mg/kg	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Total Petroleum Hydrocarbons (C25-C36) ORO	mg/kg	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Total Petroleum Hydrocarbons (C28-C35)	mg/kg	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Total Petroleum Hydrocarbons (C6-C12)	mg/kg	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
General Chemistry																
Cyanide (total)	mg/kg	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Flash point (closed cup)	Deg C	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Moisture	%	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Percent solids	%	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
pH, lab	s.u.	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Reactive cyanide	mg/kg	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Sulfate	mg/kg	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Sulfide	mg/kg	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Sulfur	mg/kg	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Total solids	%	79.9	77.8	81.2	75.3	84.1	81.8	87.6	85.8	82.1	83	80.3	81.8	83.2	83	81.6

Notes:
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ug/kg - microgram per kilogram
pg/kg - picogram per kilogram
mg/kg - milligram per kilogram
Deg C - Degrees in Celsius
s.u. - standard unit
U - Not detected at the associated reporting limit.
J - Estimated concentration.
UJ - Not detected; associated reporting limit is estimated.
Dup - indicates the result from a duplicate sample
-- Data not available

Table 2-1

First Phase Pre-Design Investigation Analytical Results - Northern Impoundment
Final 100% Remedial Design - Northern Impoundment
San Jacinto River Waste Pits Site
Harris County, Texas

Area:	Units	Northern Impoundment - Waste Pits	Northern Impoundment - Waste Pits	Northern Impoundment - Waste Pits	Northern Impoundment - Waste Pits	Northern Impoundment - Waste Pits	Northern Impoundment - Waste Pits	Northern Impoundment - Waste Pits	Northern Impoundment - Waste Pits	Northern Impoundment - Waste Pits	Northern Impoundment - Waste Pits	Northern Impoundment - Waste Pits	Northern Impoundment - Waste Pits	Northern Impoundment - Waste Pits	Northern Impoundment - Waste Pits	Northern Impoundment - Waste Pits
Sample Location:		SJSB035	SJSB036	SJSB036	SJSB036	SJSB036	SJSB036	SJSB037	SJSB037	SJSB037	SJSB037	SJSB037	SJSB038	SJSB038	SJSB038	SJSB038
Sample Identification:		SL0536	SL0559	SL0560	SL0556	SL0557	SL0558	SL0552	SL0549	SL0550	SL0551	SL0553	SL0590	SL0591	SL0592	SL0593
Sample Date:		11/11/2018	11/16/2018	11/16/2018	11/16/2018	11/16/2018	11/16/2018	11/15/2018	11/15/2018	11/15/2018	11/15/2018	11/16/2018	12/9/2018	12/9/2018	12/9/2018	12/9/2018
Sample Type:																
Sample Depth:		(16-18) ft bgs	(3.5-4.5) ft bgs	(6-8) ft bgs	(10-11) ft bgs	(11-12) ft bgs	(12-13) ft bgs	(6.3-8) ft bgs	(10-11) ft bgs	(11-12) ft bgs	(12-13) ft bgs	(4-5.8) ft bgs	(8-9) ft bgs	(9-10) ft bgs	(10-11) ft bgs	(11-12) ft bgs
Integral Sample ID:		SJSB035-C9	SJSB036-C2	SJSB036-C3	SJSB036-C11	SJSB036-C12	SJSB036-C13	SJSB037-C2	SJSB037-C11	SJSB037-C12	SJSB037-C13	SJSB037-C3	SJSB038-C6	SJSB038-C7	SJSB038-C8	SJSB038-C9
Dioxins/Furans																
1,2,3,4,6,7,8,9-Octachlorodibenzofuran (OCDF)	ng/kg	1.06 U	369	18.4	38.6	0.403 J	2.9 J	1.6 J	14.8	0.841 J	0.769 J	384	1720	2.56 U	2.13 U	1.63 U
1,2,3,4,6,7,8,9-Octachlorodibenzo-p-dioxin (OCDD)	ng/kg	127	5460	357	106 Dup 433	21.1 Dup 86.3	46.2 Dup 221	800	545	163	153	5550	1730	675	793	987
1,2,3,4,6,7,8-Heptachlorodibenzofuran (HpCDF)	ng/kg	0.165 U	654	9.65	22.2 Dup 68.8	0.35 U Dup 0.551 U	4.51 Dup 1.1 J	0.31 U	22.6	0.53 J	0.445 UJ	741	3430	5.46	3.3 J	0.33 J
1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin (HpCDD)	ng/kg	5.25	188	8.23	11.1 Dup 2.78 J	0.6 J Dup 2.2 J	5.54 Dup 1.43 J	10.7	15.2	5.21	6.19	182	97.8	19.4	20.8	25.7
1,2,3,4,7,8,9-Heptachlorodibenzofuran (HpCDF)	ng/kg	0.0912 U	240	3.05 U	8.56 Dup 33.1	0.14 J Dup 0.244 U	1.45 U Dup 0.389 J	2.8 U	9.89	3.26 U	3.01 U	265	972	1.63 U	0.97 J	0.133 U
1,2,3,4,7,8-Hexachlorodibenzofuran (HxCDF)	ng/kg	0.0663 U	2540	29.7	160 Dup 57.2	0.543 J Dup 2.16 J	3.56 Dup 17.3	2.8 U	72.5	0.33 J	0.77 U	2580	10500	15.5	7.77	0.23 J
1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin (HxCDD)	ng/kg	2.96 U	1.97 J	0.135 U	0.0911 U Dup 2.97 U	0.104 U Dup 0.0689 U	0.0435 U Dup 0.19 J	0.155 U	0.4 J	3.26 U	3.01 U	2.12 U	2.6 U	0.44 J	0.49 J	0.408 U
1,2,3,6,7,8-Hexachlorodibenzofuran (HxCDF)	ng/kg	2.96 U	596	7.44	14.1 Dup 28.1	0.141 U Dup 0.428 U	0.801 J Dup 3.97 U	2.8 U	16.5	0.0895 U	0.3 J	628	2590	4.04	2.37 J	0.124 U
1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin (HxCDD)	ng/kg	0.255 U	12.1	0.4 J	0.174 J Dup 0.494 U	0.0765 U Dup 0.0997 U	0.288 U Dup 0.0911 U	0.202 U	0.612 U	0.3 J	3.01 U	11.2	9.86 U	0.692 U	0.71 J	0.668 U
1,2,3,7,8,9-Hexachlorodibenzofuran (HxCDF)	ng/kg	0.07 J	195	2.62 J	4.05 Dup 3.93	0.123 U Dup 0.0568 U	0.307 U Dup 1.18 J	2.8 U	4.45 U	3.26 U	3.01 U	184	611	1.18 U	0.82 J	0.123 U
1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin (HxCDD)	ng/kg	0.33 U	3.91 J	0.442 U	0.197 U Dup 0.47 J	0.0709 U Dup 0.141 U	0.4 J Dup 0.137 U	0.393 U	0.71 J	0.274 U	0.259 U	4.82	5.44	1.09 J	1.04 J	1.32 J
1,2,3,7,8-Pentachlorodibenzofuran (PeCDF)	ng/kg	2.96 U	1510	14.2	25.8 Dup 8.58	1.22 J Dup 0.212 U	1.62 J Dup 10.5	0.088 U	24.3	3.26 U	0.444 U	1430	2660	11.5	6.03	0.23 J
1,2,3,7,8-Pentachlorodibenzo-p-dioxin (PeCDD)	ng/kg	2.96 U	129	1.6 J	2.57 J Dup 0.876 J	0.11 U Dup 0.27 J	0.221 J Dup 1.28 J	0.115 U	3.02	3.26 U	3.01 U	118	284	2.68 J	1.36 U	0.54 J
2,3,4,6,7,8-Hexachlorodibenzofuran (HxCDF)	ng/kg	2.96 U	112	1.19 U	1.92 J Dup 2.38 J	0.139 U Dup 0.176 J	0.134 U Dup 0.683 U	2.8 U	2.86 J	3.26 U	0.0877 U	120	631	0.92 J	0.538 U	0.0816 U
2,3,4,7,8-Pentachlorodibenzofuran (PeCDF)	ng/kg	2.96 U	1240	12.5	22.8 Dup 6.91	0.37 U Dup 0.79 J	9.83 Dup 1.65 J	2.8 U	21	0.174 U	0.314 U	1130	2120	12.2	6.5	0.14 U
2,3,7,8-Tetrachlorodibenzofuran (TCDF)	ng/kg	0.24 J	62400	591	1240 Dup 217	33.2 Dup 5.51	358 Dup 51.7	1.35	2330	3.83	20.9	45500	136000	1210	313	4.88
2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	ng/kg	0.592 U	43400	207	88 Dup 376	14.8 Dup 2.43	146 Dup 20.9	0.559 U	365	1.93	9.1	35000	80600	234	116	2.87
Octachlorodibenzofuran (OCDF) 13C12	ng/kg	1.06 U	369	18.4	14 Dup 38.6	0.4 J Dup 0.523 U	2.9 J Dup 0.881 U	1.6 J	14.8	0.84 J	0.76 J	384	1720	2.56 U	2.13 U	1.63 U
Total dioxin/furan	pg/g	133	119000	1260	2230 Dup 765	30.5 Dup 141	779 Dup 130	814	3440	176	190	93800	244000	2190	1270	1020
Total dioxin/furan (ND*0.5)	pg/g	134	119000	1260	2230 Dup 765	31.5 Dup 142	782 Dup 130	815	3450	177	192	93800	244000	2200	1270	1020
Total dioxin/furan (ND*1)	pg/g	135	119000	1260	2230 Dup 765	32.5 Dup 143	785 Dup 131	816	3450	177	193	93800	244000	2200	1280	1030
Total heptachlorodibenzofuran (HpCDF)	ng/kg	0.17 J	1180	13.6	118 Dup 36.6	2.77 U Dup 0.14 J	6.31 Dup 1.98 J	0.17 J	40	0.96 J	0.41 J	1250	5270	5.52	5.52	0.55 J
Total heptachlorodibenzo-p-dioxin (HpCDD)	ng/kg	20.6	467	27.6	9.41 Dup 36.2	10.3 Dup 2.86 J	4.76 Dup 14.1	32.6	47.4	17.3	17.6	438	227	60.5	73.4	88.9
Total hexachlorodibenzofuran (HxCDF)	ng/kg	0.23 J	3740	42.3	194 Dup 83.1	2.16 J Dup 0.838 J	4.53 Dup 18.5	2.8 U	99.2	0.52 J	0.47 J	3780	11600	22.2	11.1	0.23 J
Total hexachlorodibenzo-p-dioxin (HxCDD)	ng/kg	5.25	55.4	4.77	5.18 Dup 1.5 J	4.15 Dup 0.879 J	5.93 Dup 1.11 J	3.29	9.69	3.12 J	1.71 J	79.5	56.6	19	25.2	33.6
Total pentachlorodibenzofuran (PeCDF)	ng/kg	2.96 U	4080	40	23.6 Dup 72.7	0.37 J Dup 2.52 J	4.03 Dup 25.3	2.8 U	65.5	3.26 U	3.01 U	3760	7320	34.4	16.2	0.23 J
Total pentachlorodibenzo-p-dioxin (PeCDD)	ng/kg	1.19 J	142	1.91 J	3.06 Dup 1.03 J	0.71 J Dup 0.0937 U	0.221 J Dup 1.28 J	0.17 J	3.02	0.12 J	3.01 U	131	323	4.27	1.32 J	4.88
Total TEQ 1998 (Avian) (ND*0.5)	ng/kg	0.676	108000	818	1650 Dup 334	8.28 Dup 49.5	75.1 Dup 518	1.84	2730	5.99	30.4	82300	221000	1460	438	8.7
Total TEQ 1998 (Fish) (ND*0.5)	ng/kg	0.426	47700	249	461 Dup 124	2.96 Dup 17.5	173 Dup 25.1	0.559	506	2.33	10.4	38400	90400	306	137	3.98
Total TEQ Dioxin 1998 (Bird) (ND=0)	ng/kg	0.265	108000	818	334 Dup 1650	8.02 Dup 49.4	518 Dup 75.1	1.44	2730	5.82	30.1	82300	221000	1460	437	8.6
Total TEQ Dioxin 1998 (Bird) (ND=1)	ng/kg	1.09	108000	818	334 Dup 1650	49.5 Dup 8.55	519 Dup 75.2	2.24	2730	6.17	30.7	82300	221000	1460	439	8.8
Total TEQ Dioxin 1998 (Fish) (ND=0)	ng/kg	0.0369	47700	249	124 Dup 461	2.78 Dup 17.4	25.1 Dup 173	0.158	506	2.18	10.2	38400	90400	306	137	3.83
Total TEQ Dioxin 1998 (Fish) (ND=1)	ng/kg	0.815	47700	249	462 Dup 124	17.5 Dup 3.15	25.1 Dup 173	0.96	506	2.48	10.7	38400	90400	306	138	4.14
Total TEQ Dioxin Texas TEF (ND=0)	ng/kg	0.031	50700	278	133 Dup 522	3.05 Dup 18.9	27.5 Dup 190	0.135	621	2.38	11.2	40600	97000	365	152	3.79
Total TEQ Dioxin Texas TEF (ND=0.5)	ng/kg	0.409	50700	278	522 Dup 133	3.2 Dup 19	27.6 Dup 190	0.503	621	2.48	11.4	40600	97000	365	153	3.9
Total TEQ Dioxin Texas TEF (ND=1)	ng/kg	0.788	50700	278	522 Dup 133	19 Dup 3.34	190 Dup 27.6	0.871	621	2.58	11.6	40600	97000	365	153	4
Total tetrachlorodibenzofuran (TCDF)	ng/kg	0.24 J	80400	837	1570 Dup 404	58.2 Dup 9.42	638 Dup 96.7	1.88	1460	3.83	34.5	75800	159000	1220	566	3.3
Total tetrachlorodibenzo-p-dioxin (TCDD)	ng/kg	1.05	22900	230	99.4 Dup 416	2.43 Dup 18.1	23.5 Dup 164	0.559 U	401	3.1	9.1	21900	38000	257	127	4.19
Total WHO Dioxin TEQ(Human/Mammal)(ND=0)	ng/kg	0.122	50500	276	519 Dup 133	3.07 Dup 18.9	188 Dup 27.3	0.482	618	2.48	11.3	40400	96700	364	151	4.62
Total WHO Dioxin TEQ(Human/Mammal)(ND=0.5)	ng/kg	0.516	50500	276	519 Dup 133	3.2 Dup 19	27.3 Dup 189	0.873	618	2.59	11.5	40400	96700	364	152	4.71
Total WHO Dioxin TEQ(Human/Mammal)(ND=1)	ng/kg	0.911	50500	276	519 Dup 133	3.34 Dup 19	189 Dup 27.4	1.26	618	2.71	11.7	40400	96700	365	153	4.8
Asbestos																
Asbestos	%	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
PCBs																
Aroclor (unspecified)	ug/kg	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Aroclor-1016 (PCB-1016)	ug/kg	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Aroclor-1221 (PCB-1221)	ug/kg	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Aroclor-1232 (PCB-1232)	ug/kg	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Aroclor-1242 (PCB-1242)	ug/kg	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Aroclor-1248 (PCB-1248)	ug/kg	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Aroclor-1254 (PCB-1254)	ug/kg	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Aroclor-1260 (PCB-1260)	ug/kg	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Aroclor-1262 (PCB-1262)	ug/kg	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Aroclor-1268 (PCB-1268)	ug/kg	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Total PCBs	ug/kg	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Total PCBs (7)	ug/kg	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Total PCBs (ND*0)	ug/kg	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Total PCBs (ND*0.5)	ug/kg	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Total Petroleum Hydrocarbons (TPH)																
Total Petroleum Hydrocarbons	mg/kg	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Total Petroleum Hydrocarbons (C12-C28)	mg/kg	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Total Petroleum Hydrocarbons (C25-C36) ORO	mg/kg	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Total Petroleum Hydrocarbons (C28-C35)	mg/kg	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Total Petroleum Hydrocarbons (C6-C12)	mg/kg	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
General Chemistry																
Cyanide (total)	mg/kg	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Flash point (closed cup)	Deg C	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Moisture	%	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Percent solids	%	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
pH, lab	s.u.	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Reactive cyanide	mg/kg	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Sulfate	mg/kg	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Sulfide	mg/kg	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Sulfur	mg/kg	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Total solids	%	79.5	58.8	80.5	79.2 Dup 79.3	83 Dup 82.5	80.4 Dup 78.9	83.7	79.2	74.6	75.8	54	47.3 Dup 47.3	71.1 Dup 71.1	63.3 Dup 63.3	70.3 Dup 70.3

Notes:
ng/kg - nanograms per kilogram
ug/kg - microgram per kilogram
pg/kg - picogram per kilogram
mg/kg - milligram per kilogram
Deg C - Degrees in Celsius
s.u. - standard unit
U - Not detected at the associated reporting limit.
J - Estimated concentration.
UJ - Not detected; associated reporting limit is estimated.
Dup - indicates the result from a duplicate sample
-- Data not available

Table 2-2

First Phase Pre-Design Investigation Waste Characterization Results
Final 100% Remedial Design - Northern Impoundment
San Jacinto River Waste Pits Site
Harris County, Texas

Parameters	Units	TCLP Regulatory Levels[1]	Method Detection Limits[2]	Northern Impoundment - East	Northern Impoundment - West	Northern Impoundment - West
			Sample Location:	SJSB038	SJSB037	SJSB036
			Sample Identification:	SL0594	SL0547	SL0554
			Sample Date:	12/18/2018	11/15/18	11/16/18
				-	-	-
TCLP-Volatile Organic Compounds (VOCs)						
1,1-Dichloroethene	mg/L	0.7	0.00008	0.20 U	0.032 U	0.032 U
1,2-Dichloroethane	mg/L	0.5	0.00008	0.20 U	0.032 U	0.032 U
1,4-Dichlorobenzene	mg/L	7.5	0.00032	0.20 U	0.048 U	0.048 U
2-Butanone (Methyl ethyl ketone) (MEK)	mg/L	200.0	0.0019	8.0 U	0.76 U	0.76 U
Benzene	mg/L	0.5	0.000062	0.20 U	0.025 U	0.025 U
Carbon tetrachloride	mg/L	0.5	0.000096	0.20 U	0.039 U	0.039 U
Chlorobenzene	mg/L	100.0	0.00011	0.20 U	0.044 U	0.044 U
Chloroform (Trichloromethane)	mg/L	6.0	0.000072	0.20 U	0.029 U	0.029 U
Tetrachloroethene	mg/L	0.7	0.000099	0.20 U	0.040 U	0.040 U
Trichloroethene	mg/L	0.5	0.0001	0.20 U	0.040 U	0.040 U
Vinyl chloride	mg/L	0.2	0.000075	0.080 U	0.030 U	0.030 U
TCLP-Semi-Volatile Organic Compounds (SVOCs)						
2,4,5-Trichlorophenol	mg/L	400.0	0.000018	0.10 U	0.013 U	0.013 U
2,4,6-Trichlorophenol	mg/L	2.0	0.000014	0.10 U	0.011 U	0.0099 U
2,4-Dinitrotoluene	mg/L	0.13	0.00027	0.10 U	0.020 U	0.019 U
2-Methylphenol	mg/L	200.0	0.00033	0.10 U	0.013 U	0.013 U
4-Methylphenol	mg/L	200.0	0.00048	0.10 U	0.0070 U	0.0067 U
Hexachlorobenzene	mg/L	0.13	0.00063	0.10 U	0.014 U	0.014 U
Hexachlorobutadiene	mg/L	0.5	0.00029	0.10 U	0.0095 U	0.0091 U
Hexachloroethane	mg/L	3.0	0.00029	0.10 U	0.0071 U	0.0068 U
Nitrobenzene	mg/L	2.0	0.00057	0.10 U	0.012 U	0.012 U
Pentachlorophenol	mg/L	100.0	0.0024	0.25 U	0.016 U	0.016 U
Pyridine	mg/L	5.0	0.0075	0.50 U	0.38 U	0.36 U
TCLP-Pesticides						
Chlordane	mg/L	0.03	0.0001	0.0010 U	0.0010 U	0.0010 U
Endrin	mg/L	0.02	0.00000069	0.00010 U	0.00010 U	0.00010 U
gamma-BHC (lindane)	mg/L	0.3	0.00000036	0.00010 U	0.00010 U	0.00010 U
Heptachlor	mg/L	0.008	0.00000068	0.00010 U	0.00010 U	0.00010 U
Heptachlor epoxide	mg/L	0.04	0.00000084	0.00010 U	0.00010 U	0.00010 U
Methoxychlor	mg/L	10.0	0.0000001	0.00010 U	0.00010 U	0.00010 U
Toxaphene	mg/L	0.5	0.0002	0.0020 U	0.0020 U	0.0020 U
TCLP-Metals						
Arsenic	mg/L	5.0	0.005	0.020 U	0.021 J	0.020 U
Barium	mg/L	100.0	0.0006	0.9 J	1.6	1.4
Cadmium	mg/L	1.0	0.0005	0.050 U	0.002 J	0.001 J
Chromium	mg/L	5.0	0.0009	0.050 U	0.010 U	0.010 U
Lead	mg/L	5.0	0.005	0.050 U	0.015 U	0.015 U
Mercury	mg/L	0.2	0.00002	0.0010 U	0.0001 U	0.0001 U
Selenium	mg/L	1.0	0.009	0.10 U	0.02 U	0.02 J
Silver	mg/L	5.0	0.002	0.050 U	0.004 U	0.004 U
TCLP-Herbicides						
2,4,5-TP (Silvex)	mg/L	1.0	0.000036	0.020 U	0.030 U	0.029 U
2,4-Dichlorophenoxyacetic acid (2,4-D)	mg/L	10.0	0.000045	0.100 U	0.150 U	0.150 U
General Chemistry						
Flash point (closed cup)	°C	> 60	NA	> 110	> 110	> 110
Percent solids	%	NA	NA	45.9 J	67.1 J	70.0 J
pH, lab	s.u.	>2 or <12	NA	7.84	8.09 J	8.54 J
Reactive cyanide	mg/kg	NA	17.4	17 U	100 U	100 U
Reactive sulfide	mg/kg	NA	0.2	70 U	48 U	46 U
Sulfur	mg/kg	NA	0.46	---	---	---
Total Petroleum Hydrocarbons (TPH)						
Gasoline Range Organics (GRO)	mg/kg	>1500[3]	0.62	---	---	---
Diesel Range Organics (DRO)	mg/kg	>1500[3]	0.79	---	---	---
Residual Range Organics (RRO)	mg/kg	>1500[3]	2.9	---	---	---
Polychlorinated Biphenyls (PCBs)						
Aroclor 1016	mg/kg	NA	2.1	---	---	---
Aroclor 1221	mg/kg	NA	2.1	---	---	---
Aroclor 1232	mg/kg	NA	2.1	---	---	---
Aroclor 1242	mg/kg	NA	2.1	---	---	---
Aroclor 1248	mg/kg	NA	2.1	---	---	---
Aroclor 1254	mg/kg	NA	2.1	---	---	---
Aroclor 1260	mg/kg	NA	2.1	---	---	---
Aroclor 1262	mg/kg	NA	2.1	---	---	---
Aroclor 1268	mg/kg	NA	2.1	---	---	---

Notes:
TCLP - Toxicity Characteristic Leaching Procedure
mg/L - milligrams per Liter
ug/L - microgram per Liter
mg/kg - milligram per kilogram
Deg C - Degrees in Celsius
TCLP - Toxicity Characteristic Leaching Procedure
NA - Not Applicable
s.u. - standard unit
U - Not detected at the associated reporting limit.
J - Estimated concentration.
UJ - Not detected; associated reporting limit is estimated.
--- - Not analyzed

[1] - TCLP Regulatory Levels from the *Guidelines for the Classification and Coding of Industrial and Hazardous Wastes* , November 2014, and Table 1 - Maximum Concentrations.

[2] - Method Detection Limits were taken from *Table 9 Analyte, Method Reporting Limits, and Method Detection Limits for Waste Characterization Samples* from the First Phase Pre-Design Investigation Report.

[3] - TPH Regulatory Standard is a Total value, not a TCLP.

Table 2-3

Second Phase Pre-Design Investigation Analytical Results
Final 100% Remedial Design - Northern Impoundment
San Jacinto River Waste Pits Site
Harris County, Texas

Sample Location: Sample Identification: Sample Date: Sample Depth: Sample Type:	Units	SJSB045 11187072-090719-SS-SJSB045-S- (8-10) 9/7/2019 (8-10) ft bgs	SJSB045 11187072-090719-SS-SJSB045-S- (10-12) 9/7/2019 (10-12) ft bgs	SJSB045 11187072-090719-SS-SJSB045-S- (12-14) 9/7/2019 (12-14) ft bgs	SJSB045 11187072-090719-SS-SJSB045-S- (14-16) 9/7/2019 (14-16) ft bgs	SJSB045 11187072-090719-SS-SJSB045-S- (16-18) 9/7/2019 (16-18) ft bgs	SJSB045 11187072-091119-SS-SJSB045-S (0-2) 9/11/2019 (0-2) ft bgs	SJSB045 11187072-091119-SS-DUP-2 9/11/2019 (2-4) ft bgs Duplicate
Dioxins/Furans								
1,2,3,4,6,7,8,9-Octachlorodibenzofuran (OCDF)	pg/g	1.6 J	0.28 U	0.30 U	1.4 J	0.93 J	1.8 J	0.87 J
1,2,3,4,6,7,8,9-Octachlorodibenzo-p-dioxin (OCDD)	pg/g	350	240	950	1900	350 J	410	230
1,2,3,4,6,7,8-Heptachlorodibenzofuran (HpCDF)	pg/g	0.57 J	0.37 U	0.38 U	0.44 U	0.37 U	0.26 U	0.23 U
1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin (HpCDD)	pg/g	11	6.9	33	70	11	10	6.1 J
1,2,3,4,7,8,9-Heptachlorodibenzofuran (HpCDF)	pg/g	1.2 J	0.52 J	0.81 J	0.95 J	0.67 J	1.3 U	0.93 U
1,2,3,4,7,8-Hexachlorodibenzofuran (HxCDF)	pg/g	0.37 J	0.19 U	0.22 U	0.25 J	0.27 J	0.53 J	0.38 J
1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin (HxCDD)	pg/g	0.53 J	0.25 U	0.43 U	0.76 U	0.31 U	0.26 U	0.22 U
1,2,3,6,7,8-Hexachlorodibenzofuran (HxCDF)	pg/g	0.32 J	0.20 U	0.23 U	0.22 U	0.20 U	0.27 J	0.26 J
1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin (HxCDD)	pg/g	0.57 J	0.24 U	0.44 U	0.80 U	0.31 U	0.27 U	0.22 U
1,2,3,7,8,9-Hexachlorodibenzofuran (HxCDF)	pg/g	2.3 U	1.6 U	1.7 U	1.8 U	1.7 U	1.9 U	1.9 U
1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin (HxCDD)	pg/g	0.80 J	0.67 J	1.3 J	3.2 J	0.77 J	0.62 J	0.21 U
1,2,3,7,8-Pentachlorodibenzofuran (PeCDF)	pg/g	0.36 U	0.29 U	0.37 U	0.39 U	0.44 J	0.85 U	0.54 U
1,2,3,7,8-Pentachlorodibenzo-p-dioxin (PeCDD)	pg/g	0.49 U	0.36 U	0.61 U	0.51 U	0.46 U	0.37 U	0.36 U
2,3,4,6,7,8-Hexachlorodibenzofuran (HxCDF)	pg/g	0.26 J	0.15 U	0.18 U	0.17 U	0.15 U	0.17 U	0.15 U
2,3,4,7,8-Pentachlorodibenzofuran (PeCDF)	pg/g	0.39 U	0.33 U	0.39 U	0.42 U	0.36 U	0.34 U	0.27 U
2,3,7,8-Tetrachlorodibenzofuran (TCDF)	pg/g	7.1	0.32 J	1.0 J	0.97 J	13 J	31	16
2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	pg/g	1.6	0.21 U	0.27 U	0.25 U	2.9	6.4	3.1
Total heptachlorodibenzofuran (HpCDF)	pg/g	1.8 J	0.52 J	0.81 J	0.95 J	0.67 J	1.3 J	0.93 J
Total heptachlorodibenzo-p-dioxin (HpCDD)	pg/g	36 J	29 J	110 J	250 J	41 J	44 J	22 J
Total hexachlorodibenzofuran (HxCDF)	pg/g	4.4 J	3.0 J	2.1 J	3.6 J	3.0 J	3.4 J	3.4 J
Total hexachlorodibenzo-p-dioxin (HxCDD)	pg/g	8.8 J	7.0 J	20 J	47 J	8.2 J	9.8 J	4.1 J
Total pentachlorodibenzofuran (PeCDF)	pg/g	0.42 U	0.34 U	0.45 U	0.46 U	0.44 J	0.85 J	0.54 J
Total pentachlorodibenzo-p-dioxin (PeCDD)	pg/g	0.64 J	0.55 J	1.9 J	7.9 J	0.66 J	0.37 U	0.36 U
Total tetrachlorodibenzofuran (TCDF)	pg/g	9.0 J	0.32 J	1.6 J	1.9 J	16 J	47 J	25 J
Total tetrachlorodibenzo-p-dioxin (TCDD)	pg/g	2.1 J	0.21 U	1.4 J	4.2 J	3.5 J	6.8 J	3.1 J
Total WHO Dioxin TEQ(Human/Mammal)(ND=0)	pg/g	2.83	0.245	0.853	1.72	4.54	9.87	4.89
Total WHO Dioxin TEQ(Human/Mammal)(ND=0.5)	pg/g	3.25	0.717	1.52	2.36	4.96	10.3	5.26

Notes:
pg/g - picogram per gram
U - Not detected at the associated reporting limit.
J - Estimated concentration.
UJ - Not detected; associated reporting limit is estimated.

Table 2-3

Second Phase Pre-Design Investigation Analytical Results
Final 100% Remedial Design - Northern Impoundment
San Jacinto River Waste Pits Site
Harris County, Texas

Sample Location: Sample Identification: Sample Date: Sample Depth: Sample Type:	Units	SJSB045 11187072-091119-SS-SJSB045-S (2-4) 9/11/2019 (2-4) ft bgs	SJSB045 11187072-091119-SS-SJSB045-S (4-6) 9/11/2019 (4-6) ft bgs	SJSB045 11187072-091119-SS-DUP-3 9/11/2019 (6-8) ft bgs Duplicate	SJSB045 11187072-091119-SS-SJSB045-S (6-8) 9/11/2019 (6-8) ft bgs	SJSB045-C1 11187072-11719-KW-SJSB045-C1-S (0-2) 11/9/2019 (0-2) ft bgs	SJSB045-C1 11187072-11719-KW-SJSB045-C1-S (2-4) 11/9/2019 (2-4) ft bgs	SJSB045-C1 11187072-11719-KW-SJSB045-C1-S (4-6) 11/9/2019 (4-6) ft bgs
Dioxins/Furans								
1,2,3,4,6,7,8,9-Octachlorodibenzofuran (OCDF)	pg/g	0.29 U	0.89 J	0.38 U	0.28 U	9.7 J	7.4 J	11 J
1,2,3,4,6,7,8,9-Octachlorodibenzo-p-dioxin (OCDD)	pg/g	120	170	350	740	360	250	1000
1,2,3,4,6,7,8-Heptachlorodibenzofuran (HpCDF)	pg/g	0.25 U	0.26 U	0.27 U	0.19 U	7.6	5.6	9.8
1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin (HpCDD)	pg/g	3.3 J	5.3 J	11	23	13	10	34
1,2,3,4,7,8,9-Heptachlorodibenzofuran (HpCDF)	pg/g	0.79 U	1.1 U	0.99 U	0.95 U	3.3 J	2.0 J	3.3 J
1,2,3,4,7,8-Hexachlorodibenzofuran (HxCDF)	pg/g	0.27 J	0.21 U	0.20 U	0.37 J	27	17	27
1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin (HxCDD)	pg/g	0.22 U	0.25 U	0.24 U	0.47 J	0.26 J	0.15 J	0.62 J
1,2,3,6,7,8-Hexachlorodibenzofuran (HxCDF)	pg/g	0.18 U	0.34 J	0.21 U	0.16 U	6.8	3.8 J	7.1
1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin (HxCDD)	pg/g	0.23 U	0.26 U	0.25 U	0.49 J	0.38 J	0.31 J	0.84 J
1,2,3,7,8,9-Hexachlorodibenzofuran (HxCDF)	pg/g	1.5 U	2.2 U	1.9 U	1.9 U	0.64 J	0.37 J	0.52 J
1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin (HxCDD)	pg/g	0.21 U	0.24 U	0.70 J	1.0 J	0.62 J	0.44 J	1.9 J
1,2,3,7,8-Pentachlorodibenzofuran (PeCDF)	pg/g	0.29 U	0.28 U	0.32 U	0.21 U	17	10	17
1,2,3,7,8-Pentachlorodibenzo-p-dioxin (PeCDD)	pg/g	0.31 U	0.44 U	0.36 U	0.32 U	2.0 J	1.2 J	2.5 J
2,3,4,6,7,8-Hexachlorodibenzofuran (HxCDF)	pg/g	0.14 U	0.17 U	0.16 U	0.12 U	0.75 J	0.46 J	0.94 J
2,3,4,7,8-Pentachlorodibenzofuran (PeCDF)	pg/g	0.31 U	0.31 U	0.34 U	0.22 U	13	9.2	13
2,3,7,8-Tetrachlorodibenzofuran (TCDF)	pg/g	8.9	18	12 J	2.8 J	760	530	740
2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	pg/g	2.1	3.2	3.0	0.88 J	200	130	200
Total heptachlorodibenzofuran (HpCDF)	pg/g	0.79 J	1.1 J	0.99 J	0.95 J	14 J	9.9 J	16 J
Total heptachlorodibenzo-p-dioxin (HpCDD)	pg/g	12 J	18 J	35 J	63 J	40 J	30 J	97 J
Total hexachlorodibenzofuran (HxCDF)	pg/g	2.3 J	3.3 J	2.5 J	2.9 J	42 J	26 J	42 J
Total hexachlorodibenzo-p-dioxin (HxCDD)	pg/g	2.7 J	4.0 J	6.9 J	11 J	9.1 J	6.8 J	20 J
Total pentachlorodibenzofuran (PeCDF)	pg/g	0.31 U	0.31 U	0.34 U	0.27 U	52 J	34 J	53 J
Total pentachlorodibenzo-p-dioxin (PeCDD)	pg/g	0.31 U	0.44 U	0.36 U	0.32 U	3.7 J	1.5 J	3.2 J
Total tetrachlorodibenzofuran (TCDF)	pg/g	12 J	33 J	18 J	4.0 J	1600 J	1100 J	1500 J
Total tetrachlorodibenzo-p-dioxin (TCDD)	pg/g	2.1 J	3.2 J	3.5 J	1.5 J	220 J	150 J	220 J
Total WHO Dioxin TEQ(Human/Mammal)(ND=0)	pg/g	3.09	5.14	4.49	1.85	286	190	286
Total WHO Dioxin TEQ(Human/Mammal)(ND=0.5)	pg/g	3.42	5.58	4.88	2.16	286	190	286

Notes:
pg/g - picogram per gram
U - Not detected at the associated reporting limit.
J - Estimated concentration.
UJ - Not detected; associated reporting limit is estimated

Table 2-3

Second Phase Pre-Design Investigation Analytical Results
Final 100% Remedial Design - Northern Impoundment
San Jacinto River Waste Pits Site
Harris County, Texas

Sample Location: Sample Identification: Sample Date: Sample Depth: Sample Type:	Units	SJSB045-C1 11187072-11719-KW-SJSB045-C1-S (6-8) 11/9/2019 (6-8) ft bgs	SJSB045-C1 11187072-11719-KW-SJSB045-C1-S (8-10) 11/9/2019 (8-10) ft bgs	SJSB045-C1 11187072-11719-KW-SJSB045-C1-S (10-12) 11/9/2019 (10-12) ft bgs	SJSB045-C1 11187072-11719-KW-SJSB045-C1-S (12-14) 11/9/2019 (12-14) ft bgs	SJSB045-C1 11187072-11719-KW-SJSB045-C1-S (14-16) 11/9/2019 (14-16) ft bgs	SJSB045-C1 11187072-11719-KW-SJSB045-C1-S (16-18) 11/9/2019 (16-18) ft bgs
Dioxins/Furans							
1,2,3,4,6,7,8,9-Octachlorodibenzofuran (OCDF)	pg/g	3.4 U	2.4 U	1.6 U	0.20 U	0.83 U	0.25 U
1,2,3,4,6,7,8,9-Octachlorodibenzo-p-dioxin (OCDD)	pg/g	1200	590	1600	2400	2900	3400
1,2,3,4,6,7,8-Heptachlorodibenzofuran (HpCDF)	pg/g	1.6 J	1.6 J	1.5 J	0.072 U	0.46 U	0.087 U
1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin (HpCDD)	pg/g	40	21	64	100	110	130
1,2,3,4,7,8,9-Heptachlorodibenzofuran (HpCDF)	pg/g	0.50 J	0.56 J	0.32 U	0.033 U	0.24 U	0.040 U
1,2,3,4,7,8-Hexachlorodibenzofuran (HxCDF)	pg/g	4.1 J	5.4 J	3.6 J	0.059 U	1.6 J	0.17 J
1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin (HxCDD)	pg/g	0.46 J	0.31 J	0.67 J	1.4 J	1.1 J	1.3 J
1,2,3,6,7,8-Hexachlorodibenzofuran (HxCDF)	pg/g	0.94 J	1.3 J	0.89 J	0.056 U	0.45 J	0.091 J
1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin (HxCDD)	pg/g	0.80 J	0.38 J	1.6 J	3.0 J	2.2 J	3.3 J
1,2,3,7,8,9-Hexachlorodibenzofuran (HxCDF)	pg/g	0.096 U	0.15 J	0.16 U	0.077 U	0.14 U	0.096 U
1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin (HxCDD)	pg/g	1.8 J	1.0 J	2.9 J	5.1 J	5.2 J	6.5 J
1,2,3,7,8-Pentachlorodibenzofuran (PeCDF)	pg/g	2.4 J	4.1 J	2.3 J	0.094 J	0.84 J	0.17 J
1,2,3,7,8-Pentachlorodibenzo-p-dioxin (PeCDD)	pg/g	0.51 J	0.32 J	0.58 J	0.37 J	0.46 J	0.58 J
2,3,4,6,7,8-Hexachlorodibenzofuran (HxCDF)	pg/g	0.079 U	0.17 J	0.13 U	0.064 U	0.11 U	0.078 U
2,3,4,7,8-Pentachlorodibenzofuran (PeCDF)	pg/g	2.1 J	2.9 J	2.2 J	0.030 U	0.89 J	0.098 J
2,3,7,8-Tetrachlorodibenzofuran (TCDF)	pg/g	130	110	150	1.6	56	4.3
2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	pg/g	31	41	32	0.56 J	13	1.3 J
Total heptachlorodibenzofuran (HpCDF)	pg/g	2.8 J	2.8 J	2.2 J	0.15 J	0.93 J	0.17 J
Total heptachlorodibenzo-p-dioxin (HpCDD)	pg/g	100 J	69 J	200 J	300 J	330 J	380 J
Total hexachlorodibenzofuran (HxCDF)	pg/g	5.5 J	8.3 J	4.9 J	0.077 U	2.1 J	0.26 J
Total hexachlorodibenzo-p-dioxin (HxCDD)	pg/g	20 J	16 J	48 J	72 J	82 J	93 J
Total pentachlorodibenzofuran (PeCDF)	pg/g	7.8 J	10 J	7.2 J	0.19 J	2.9 J	0.26 J
Total pentachlorodibenzo-p-dioxin (PeCDD)	pg/g	3.3 J	2.2 J	6.6 J	12 J	14 J	17 J
Total tetrachlorodibenzofuran (TCDF)	pg/g	230 J	330 J	270 J	5.2 J	100 J	9.8 J
Total tetrachlorodibenzo-p-dioxin (TCDD)	pg/g	36 J	47 J	39 J	7.0 J	23 J	12 J
Total WHO Dioxin TEQ(Human/Mammal)(ND=0)	pg/g	46.8	54.6	50.4	3.76	22.4	5.80
Total WHO Dioxin TEQ(Human/Mammal)(ND=0.5)	pg/g	46.8	54.6	50.4	3.79	22.4	5.81

Notes:
pg/g - picogram per gram
U - Not detected at the associated reporting limit.
J - Estimated concentration.
UJ - Not detected; associated reporting limit is estimated

Table 2-3

Second Phase Pre-Design Investigation Analytical Results
Final 100% Remedial Design - Northern Impoundment
San Jacinto River Waste Pits Site
Harris County, Texas

Sample Location: Sample Identification: Sample Date: Sample Depth: Sample Type:	Units	SJSB046 11187072-100719-SS-SJSB046 (0-2) 10/7/2019 (0-2) ft bgs	SJSB046 11187072-100719-SS-SJSB046 (2-4) 10/7/2019 (2-4) ft bgs	SJSB046 11187072-100719-SS-SJSB046 (4-6) 10/7/2019 (4-6) ft bgs	SJSB046 11187072-100719-SS-SJSB046 (6-8) 10/7/2019 (6-8) ft bgs	SJSB046 11187072-100719-SS-SJSB046 (8-10) 10/7/2019 (8-10) ft bgs	SJSB046 11187072-100719-SS-SJSB046 (10-12) 10/7/2019 (10-12) ft bgs	SJSB046 11187072-100719-DUP-6 10/7/2019 (12-14) ft bgs Duplicate
Dioxins/Furans								
1,2,3,4,6,7,8,9-Octachlorodibenzofuran (OCDF)	pg/g	9.7 J	98	470	780	410	6.4 J	290
1,2,3,4,6,7,8,9-Octachlorodibenzo-p-dioxin (OCDD)	pg/g	400	3800	4900	2900	5100	800	3300
1,2,3,4,6,7,8-Heptachlorodibenzofuran (HpCDF)	pg/g	8.7	78	240	1800	180	3.5 J	130
1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin (HpCDD)	pg/g	22	130	190	190 J	210	29	120
1,2,3,4,7,8,9-Heptachlorodibenzofuran (HpCDF)	pg/g	2.4 J	23	85	660	61	1.7 J	38
1,2,3,4,7,8-Hexachlorodibenzofuran (HxCDF)	pg/g	31	210	820	5700	600	12	340
1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin (HxCDD)	pg/g	0.44 U	1.9 J	2.7 J	4.5 U	3.1 J	0.67 U	1.6 J
1,2,3,6,7,8-Hexachlorodibenzofuran (HxCDF)	pg/g	7.8	54	210	1400	150	3.1 J	87
1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin (HxCDD)	pg/g	0.80 J	3.7 J	7.2 J	13 J	7.4 J	0.79 J	4.0 J
1,2,3,7,8,9-Hexachlorodibenzofuran (HxCDF)	pg/g	0.53 J	3.5 J	14	76 J	11	0.44 J	5.8 J
1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin (HxCDD)	pg/g	0.76 J	4.8 J	7.1 J	7.5 J	7.1 J	1.8 J	4.0 J
1,2,3,7,8-Pentachlorodibenzofuran (PeCDF)	pg/g	28	160	590	2800	450	7.6	230
1,2,3,7,8-Pentachlorodibenzo-p-dioxin (PeCDD)	pg/g	3.4 J	17	62	200 J	46	0.94 J	23
2,3,4,6,7,8-Hexachlorodibenzofuran (HxCDF)	pg/g	1.2 J	6.6 J	24	140 J	18	0.61 J	10
2,3,4,7,8-Pentachlorodibenzofuran (PeCDF)	pg/g	25	110	380	1500	290	4.4 J	140
2,3,7,8-Tetrachlorodibenzofuran (TCDF)	pg/g	2600	8700	19000	30000	18000	310	8500
2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	pg/g	360	1700	6400	24000 J	4900	75	2400
Total heptachlorodibenzofuran (HpCDF)	pg/g	15 J	130 J	410 J	2800 J	310 J	6.5 J	210 J
Total heptachlorodibenzo-p-dioxin (HpCDD)	pg/g	63 J	380 J	520 J	470 J	590 J	110 J	330 J
Total hexachlorodibenzofuran (HxCDF)	pg/g	48 J	320 J	1200 J	8300 J	920 J	19 J	520 J
Total hexachlorodibenzo-p-dioxin (HxCDD)	pg/g	13 J	68 J	92 J	90 J	100 J	30 J	56 J
Total pentachlorodibenzofuran (PeCDF)	pg/g	88 J	450 J	1600 J	6800 J	1200 J	19 J	600 J
Total pentachlorodibenzo-p-dioxin (PeCDD)	pg/g	9.2 J	30 J	83 J	230 J	67 J	7.7 J	34 J
Total tetrachlorodibenzofuran (TCDF)	pg/g	4100 J	14000 J	41000 J	140000 J	31000 J	490 J	15000 J
Total tetrachlorodibenzo-p-dioxin (TCDD)	pg/g	420 J	1900 J	7000 J	27000 J	5300 J	84 J	2600 J
Total WHO Dioxin TEQ(Human/Mammal)(ND=0)	pg/g	636	2660	8610	28500	6930	111	3370
Total WHO Dioxin TEQ(Human/Mammal)(ND=0.5)	pg/g	636	2660	8610	28500	6930	111	3370

Notes:
pg/g - picogram per gram
U - Not detected at the associated reporting limit.
J - Estimated concentration.
UJ - Not detected; associated reporting limit is estimated

Table 2-3

Second Phase Pre-Design Investigation Analytical Results
Final 100% Remedial Design - Northern Impoundment
San Jacinto River Waste Pits Site
Harris County, Texas

Sample Location: Sample Identification: Sample Date: Sample Depth: Sample Type:	Units	SJSB046 11187072-100719-SS-SJSB046 (12-14) 10/7/2019 (12-14) ft bgs	SJSB046 11187072-100719-SS-SJSB046 (14-16) 10/7/2019 (14-16) ft bgs	SJSB046 11187072-100719-SS-SJSB046 (16-18) 10/7/2019 (16-18) ft bgs	SJSB046 11187072-111119-KW-SJSB046-S(18-20) 11/11/2019 (18-20) ft bgs	SJSB046-C1 11187072-120919-BN-SJSB046-C1(0-2) 12/9/2019 (0-2) ft bgs	SJSB046-C1 11187072-120919-BN-SJSB046-C1(2-4) 12/9/2019 (2-4) ft bgs	SJSB046-C1 11187072-120919-BN-SJSB046-C1(4-6) 12/9/2019 (4-6) ft bgs
Dioxins/Furans								
1,2,3,4,6,7,8,9-Octachlorodibenzofuran (OCDF)	pg/g	320	270	230	1.9 J	30	45	65
1,2,3,4,6,7,8,9-Octachlorodibenzo-p-dioxin (OCDD)	pg/g	2000	1800	2500	1800	1000 J	1600 J	1900 J
1,2,3,4,6,7,8-Heptachlorodibenzofuran (HpCDF)	pg/g	110	59	98	0.44 U	26	54	55
1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin (HpCDD)	pg/g	74	63	95	76	38	49	69
1,2,3,4,7,8,9-Heptachlorodibenzofuran (HpCDF)	pg/g	35	18	31	0.17 U	8.1	16	17
1,2,3,4,7,8-Hexachlorodibenzofuran (HxCDF)	pg/g	360	170	310	0.35 U	100	200	180
1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin (HxCDD)	pg/g	1.3 J	0.99 U	1.3 J	1.3 U	0.66 U	0.97 J	1.2 U
1,2,3,6,7,8-Hexachlorodibenzofuran (HxCDF)	pg/g	91	41	77	0.34 U	25	48	45
1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin (HxCDD)	pg/g	2.9 J	2.2 J	3.2 J	2.2 J	1.2 J	1.7 J	2.4 J
1,2,3,7,8,9-Hexachlorodibenzofuran (HxCDF)	pg/g	6.1 J	2.6 J	5.0 J	0.39 J	1.7 J	2.9 J	3.0 J
1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin (HxCDD)	pg/g	2.8 J	2.4 J	3.5 J	4.0 J	1.2 J	1.9 J	2.6 J
1,2,3,7,8-Pentachlorodibenzofuran (PeCDF)	pg/g	260	110	220	0.59 U	85	170	150
1,2,3,7,8-Pentachlorodibenzo-p-dioxin (PeCDD)	pg/g	22	11	22	0.44 J	7.4	18	14
2,3,4,6,7,8-Hexachlorodibenzofuran (HxCDF)	pg/g	12	4.9 J	9.1	0.24 U	3.2 J	5.7 J	5.4 J
2,3,4,7,8-Pentachlorodibenzofuran (PeCDF)	pg/g	150	70	140	0.28 J	61	130	110
2,3,7,8-Tetrachlorodibenzofuran (TCDF)	pg/g	7900	4500	8900	9.1	5100	8600	8400
2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	pg/g	2500	1200	2400	2.6 U	1000	2400	1900
Total heptachlorodibenzofuran (HpCDF)	pg/g	180 J	97 J	160 J	0.44 J	44 J	84 J	96 J
Total heptachlorodibenzo-p-dioxin (HpCDD)	pg/g	200 J	180 J	260 J	220 J	130 J	150 J	200 J
Total hexachlorodibenzofuran (HxCDF)	pg/g	540 J	250 J	460 J	0.39 J	150 J	280 J	270 J
Total hexachlorodibenzo-p-dioxin (HxCDD)	pg/g	40 J	37 J	48 J	54 J	21 J	29 J	38 J
Total pentachlorodibenzofuran (PeCDF)	pg/g	660 J	300 J	580 J	0.88 J	240 J	480 J	420 J
Total pentachlorodibenzo-p-dioxin (PeCDD)	pg/g	30 J	17 J	31 J	11 J	12 J	24 J	23 J
Total tetrachlorodibenzofuran (TCDF)	pg/g	14000 J	7300 J	15000 J	15 J	11000 J	25000 J	19000 J
Total tetrachlorodibenzo-p-dioxin (TCDD)	pg/g	2600 J	1200 J	2500 J	8.8 J	1100 J	2700 J	2200 J
Total WHO Dioxin TEQ(Human/Mammal)(ND=0)	pg/g	3420	1710	3400	3.39	1550	3350	2820
Total WHO Dioxin TEQ(Human/Mammal)(ND=0.5)	pg/g	3420	1710	3400	4.82	1550	3350	2820

Notes:
pg/g - picogram per gram
U - Not detected at the associated reporting limit.
J - Estimated concentration.
UJ - Not detected; associated reporting limit is estimated

Table 2-3

Second Phase Pre-Design Investigation Analytical Results
Final 100% Remedial Design - Northern Impoundment
San Jacinto River Waste Pits Site
Harris County, Texas

Sample Location:	Units	SJSB046-C1	SJSB046-C1	SJSB046-C1	SJSB046-C1	SJSB046-C1	SJSB046-C1	SJSB046-C1
Sample Identification:		11187072-120919-BN-SJSB046-C1(6-8)	11187072-120919-BN-SJSB046-C1(8-10)	11187072-120919-BN-SJSB046-C1(10-12)	11187072-120919-BN-SJSB046-C1(12-14)	11187072-120919-BN-SJSB046-C1(14-16)	11187072-120919-BN-DUP3	11187072-120919-BN-SJSB046-C1(16-18)
Sample Date:		12/9/2019	12/9/2019	12/9/2019	12/9/2019	12/9/2019	12/9/2019	12/9/2019
Sample Depth:		(6-8) ft bgs	(8-10) ft bgs	(10-12) ft bgs	(12-14) ft bgs	(14-16) ft bgs	(16-18) ft bgs	(16-18) ft bgs
Sample Type:							Duplicate	
Dioxins/Furans								
1,2,3,4,6,7,8,9-Octachlorodibenzofuran (OCDF)	pg/g	370	270	2.6 U	50	4.9 U	180	93
1,2,3,4,6,7,8,9-Octachlorodibenzo-p-dioxin (OCDD)	pg/g	2400 J	2100 J	1200 J	1800 J	1600 J	4100 J	1600 J
1,2,3,4,6,7,8-Heptachlorodibenzofuran (HpCDF)	pg/g	290	540	1.5 J	60	3.2 J	120	160
1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin (HpCDD)	pg/g	130	120	41	72	68	150	67
1,2,3,4,7,8,9-Heptachlorodibenzofuran (HpCDF)	pg/g	120	180	0.56 J	24	1.4 J	38	45
1,2,3,4,7,8-Hexachlorodibenzofuran (HxCDF)	pg/g	1400	2000	4.7 J	180	10	390	470
1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin (HxCDD)	pg/g	2.4 J	2.3 J	0.64 U	3.5 J	0.93 U	2.0 J	1.1 J
1,2,3,6,7,8-Hexachlorodibenzofuran (HxCDF)	pg/g	390	510	1.6 J	46	3.1 J	94	120
1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin (HxCDD)	pg/g	6.2 J	6.6 J	0.92 J	4.6 J	2.0 J	4.7 J	2.8 J
1,2,3,7,8,9-Hexachlorodibenzofuran (HxCDF)	pg/g	25	34	0.28 U	6.2 J	0.56 U	5.6 J	7.8
1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin (HxCDD)	pg/g	5.6 J	4.6 J	2.2 J	6.3 J	3.7 J	4.6 J	2.3 J
1,2,3,7,8-Pentachlorodibenzofuran (PeCDF)	pg/g	1100	1400	3.7 J	140	9.5	280	340
1,2,3,7,8-Pentachlorodibenzo-p-dioxin (PeCDD)	pg/g	70	89	0.48 J	13	1.3 J	25	39
2,3,4,6,7,8-Hexachlorodibenzofuran (HxCDF)	pg/g	46	56	0.24 J	7.4 J	0.59 J	11	13
2,3,4,7,8-Pentachlorodibenzofuran (PeCDF)	pg/g	590	710	2.3 J	93	7.3 J	180	240
2,3,7,8-Tetrachlorodibenzofuran (TCDF)	pg/g	21000	13000	160	5600	680	8400	12000
2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	pg/g	9100	13000	36	1600	130	3000	4300
Total heptachlorodibenzofuran (HpCDF)	pg/g	500 J	850 J	2.8 J	98 J	5.8 J	210 J	240 J
Total heptachlorodibenzo-p-dioxin (HpCDD)	pg/g	350 J	250 J	140 J	210 J	190 J	420 J	170 J
Total hexachlorodibenzofuran (HxCDF)	pg/g	2200 J	2900 J	7.2 J	270 J	17 J	570 J	680 J
Total hexachlorodibenzo-p-dioxin (HxCDD)	pg/g	77 J	56 J	37 J	60 J	49 J	71 J	34 J
Total pentachlorodibenzofuran (PeCDF)	pg/g	2700 J	3300 J	9.4 J	370 J	28 J	710 J	910 J
Total pentachlorodibenzo-p-dioxin (PeCDD)	pg/g	89 J	100 J	6.6 J	20 J	9.7 J	35 J	84 J
Total tetrachlorodibenzofuran (TCDF)	pg/g	70000 J	74000 J	270 J	12000 J	1300 J	24000 J	35000 J
Total tetrachlorodibenzo-p-dioxin (TCDD)	pg/g	9900 J	15000 J	43 J	1800 J	150 J	3300 J	4800 J
Total WHO Dioxin TEQ(Human/Mammal)(ND=0)	pg/g	11700	14900	55.0	2230	205	3980	5690
Total WHO Dioxin TEQ(Human/Mammal)(ND=0.5)	pg/g	11700	14900	55.1	2230	205	3980	5690

Notes:
pg/g - picogram per gram
U - Not detected at the associated reporting limit.
J - Estimated concentration.
UJ - Not detected; associated reporting limit is estimated

Table 2-3

Second Phase Pre-Design Investigation Analytical Results
Final 100% Remedial Design - Northern Impoundment
San Jacinto River Waste Pits Site
Harris County, Texas

Sample Location: Sample Identification: Sample Date: Sample Depth: Sample Type:	Units	SJSB047 11187072-100919-SS-SJSB047(8-10) 10/9/2019 (8-10) ft bgs	SJSB047 11187072-100919-SS-SJSB047(10-12) 10/9/2019 (10-12) ft bgs	SJSB047 11187072-100919-SS-SJSB047(12-14) 10/9/2019 (12-14) ft bgs	SJSB047 11187072-100919-SS-SJSB047(14-16) 10/9/2019 (14-16) ft bgs	SJSB047 11187072-100919-SS-SJSB047(16-18) 10/9/2019 (16-18) ft bgs	SJSB047 11187072-101019-SS-SJSB047(0-2) 10/10/2019 (0-2) ft bgs	SJSB047 11187072-101019-SS-SJSB047(2-4) 10/10/2019 (2-4) ft bgs
Dioxins/Furans								
1,2,3,4,6,7,8,9-Octachlorodibenzofuran (OCDF)	pg/g	0.83 U	1.4 U	1.5 U	0.33 U	0.29 U	2.5 U	0.91 U
1,2,3,4,6,7,8,9-Octachlorodibenzo-p-dioxin (OCDD)	pg/g	1700	930	1000	1400	1100	500	1100
1,2,3,4,6,7,8-Heptachlorodibenzofuran (HpCDF)	pg/g	0.29 U	0.22 U	0.65 J	0.27 U	0.29 U	0.57 J	0.17 J
1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin (HpCDD)	pg/g	49	34	48	65	46	22	43
1,2,3,4,7,8,9-Heptachlorodibenzofuran (HpCDF)	pg/g	0.052 U	0.22 J	0.33 U	0.29 U	0.34 U	0.13 J	0.16 J
1,2,3,4,7,8-Hexachlorodibenzofuran (HxCDF)	pg/g	0.20 J	0.084 U	0.24 U	0.21 U	0.25 U	0.11 J	0.098 J
1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin (HxCDD)	pg/g	0.62 U	0.60 U	0.75 U	0.70 U	0.82 U	0.38 J	0.47 J
1,2,3,6,7,8-Hexachlorodibenzofuran (HxCDF)	pg/g	0.10 J	0.083 U	0.26 U	0.22 U	0.27 U	0.064 U	0.11 J
1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin (HxCDD)	pg/g	1.1 J	0.81 J	1.3 J	1.5 J	1.2 J	0.65 J	0.95 J
1,2,3,7,8,9-Hexachlorodibenzofuran (HxCDF)	pg/g	0.19 J	0.21 J	0.23 J	0.11 U	0.27 J	0.13 J	0.24 J
1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin (HxCDD)	pg/g	2.6 J	1.8 J	3.0 J	3.2 J	2.7 J	1.6 J	2.1 J
1,2,3,7,8-Pentachlorodibenzofuran (PeCDF)	pg/g	0.17 J	0.070 U	0.23 U	0.20 U	0.18 U	0.054 U	0.043 U
1,2,3,7,8-Pentachlorodibenzo-p-dioxin (PeCDD)	pg/g	0.25 J	0.20 J	0.36 U	0.38 U	0.39 U	0.11 U	0.097 U
2,3,4,6,7,8-Hexachlorodibenzofuran (HxCDF)	pg/g	0.059 U	0.066 U	0.16 U	0.14 U	0.16 U	0.048 U	0.094 J
2,3,4,7,8-Pentachlorodibenzofuran (PeCDF)	pg/g	0.067 U	0.077 U	0.24 U	0.22 U	0.19 U	0.056 U	0.043 U
2,3,7,8-Tetrachlorodibenzofuran (TCDF)	pg/g	0.42 J	0.31 J	0.27 J	0.13 U	0.20 J	1.0 J	0.27 J
2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	pg/g	0.27 J	0.22 J	0.27 U	0.28 U	0.28 U	0.36 J	0.10 J
Total heptachlorodibenzofuran (HpCDF)	pg/g	0.29 J	0.44 J	0.65 J	0.29 U	0.34 U	1.6 J	0.52 J
Total heptachlorodibenzo-p-dioxin (HpCDD)	pg/g	210 J	120 J	160 J	200 J	160 J	85 J	150 J
Total hexachlorodibenzofuran (HxCDF)	pg/g	0.48 J	0.28 J	0.23 J	0.22 U	0.27 J	0.24 J	0.55 J
Total hexachlorodibenzo-p-dioxin (HxCDD)	pg/g	47 J	30 J	43 J	47 J	45 J	17 J	35 J
Total pentachlorodibenzofuran (PeCDF)	pg/g	0.31 J	0.10 U	0.24 U	0.22 U	0.20 U	0.066 U	0.053 U
Total pentachlorodibenzo-p-dioxin (PeCDD)	pg/g	7.9 J	5.6 J	9.5 J	7.6 J	9.3 J	1.9 J	6.6 J
Total tetrachlorodibenzofuran (TCDF)	pg/g	1.0 J	1.1 J	0.96 J	0.50 J	0.82 J	1.8 J	0.93 J
Total tetrachlorodibenzo-p-dioxin (TCDD)	pg/g	4.0 J	2.9 J	5.1 J	4.3 J	5.2 J	2.0 J	4.1 J
Total WHO Dioxin TEQ(Human/Mammal)(ND=0)	pg/g	1.99	1.35	1.27	1.54	1.23	1.12	1.30
Total WHO Dioxin TEQ(Human/Mammal)(ND=0.5)	pg/g	2.03	1.41	1.69	1.98	1.67	1.19	1.35

Notes:
pg/g - picogram per gram
U - Not detected at the associated reporting limit.
J - Estimated concentration.
UJ - Not detected; associated reporting limit is estimated

Table 2-3

Second Phase Pre-Design Investigation Analytical Results
Final 100% Remedial Design - Northern Impoundment
San Jacinto River Waste Pits Site
Harris County, Texas

Sample Location:	Units	SJSB047	SJSB047	SJSB047-C1	SJSB047-C1	SJSB047-C1	SJSB047-C1	SJSB047-C1
Sample Identification:		11187072-101019-SS-SJSB047(4-6)	11187072-101019-SS-SJSB047(6-8)	11187072-101719-SS-SJSB047-C1-(0-2)	11187072-101719-SS-SJSB047-C1-(2-4)	11187072-101719-SS-SJSB047-C1-(4-6)	11187072-101719-SS-SJSB047-C1-(6-8)	11187072-101719-SS-SJSB047-C1-(8-10)
Sample Date:		10/10/2019	10/10/2019	10/17/2019	10/17/2019	10/17/2019	10/17/2019	10/17/2019
Sample Depth:		(4-6) ft bgs	(6-8) ft bgs	(0-2) ft bgs	(2-4) ft bgs	(4-6) ft bgs	(6-8) ft bgs	(8-10) ft bgs
Sample Type:								
Dioxins/Furans								
1,2,3,4,6,7,8,9-Octachlorodibenzofuran (OCDF)	pg/g	0.48 U	27	390	410	5.5 J	1.8 U	45
1,2,3,4,6,7,8,9-Octachlorodibenzo-p-dioxin (OCDD)	pg/g	830	2300	4300	2400	1300	1200	1200
1,2,3,4,6,7,8-Heptachlorodibenzofuran (HpCDF)	pg/g	0.14 J	3.5 J	190	150	3.6 J	0.83 J	25
1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin (HpCDD)	pg/g	27	79	190	110	50	53	44
1,2,3,4,7,8,9-Heptachlorodibenzofuran (HpCDF)	pg/g	0.15 J	0.33 J	63	52	1.2 J	0.27 J	7.3
1,2,3,4,7,8-Hexachlorodibenzofuran (HxCDF)	pg/g	0.085 J	0.067 U	690	530	11	1.8 J	75
1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin (HxCDD)	pg/g	0.50 J	0.86 J	3.4 J	2.1 J	0.79 U	0.71 U	0.62 U
1,2,3,6,7,8-Hexachlorodibenzofuran (HxCDF)	pg/g	0.075 J	0.16 J	180	140	3.1 J	0.57 J	19
1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin (HxCDD)	pg/g	0.60 J	1.6 J	7.6 J	5.4 J	1.2 J	1.4 J	1.2 J
1,2,3,7,8,9-Hexachlorodibenzofuran (HxCDF)	pg/g	0.18 J	0.15 J	11	8.8 J	0.26 J	0.18 J	1.2 J
1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin (HxCDD)	pg/g	1.5 J	3.6 J	7.3 J	5.4 J	2.7 J	3.1 J	1.8 J
1,2,3,7,8-Pentachlorodibenzofuran (PeCDF)	pg/g	0.14 J	0.064 U	510	400	8.2 J	1.8 J	51
1,2,3,7,8-Pentachlorodibenzo-p-dioxin (PeCDD)	pg/g	0.18 J	0.30 J	58	49	1.3 J	0.26 U	6.3 J
2,3,4,6,7,8-Hexachlorodibenzofuran (HxCDF)	pg/g	0.063 J	0.055 U	20	16	0.43 J	0.095 U	2.2 J
2,3,4,7,8-Pentachlorodibenzofuran (PeCDF)	pg/g	0.047 U	0.066 U	330	260	5.5 J	1.1 J	34
2,3,7,8-Tetrachlorodibenzofuran (TCDF)	pg/g	1.7	0.17 J	14000 J	13000	380	82	2000
2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	pg/g	0.35 J	0.23 J	5800	4800	95	19	540
Total heptachlorodibenzofuran (HpCDF)	pg/g	0.43 J	12 J	330 J	260 J	6.0 J	1.3 J	40 J
Total heptachlorodibenzo-p-dioxin (HpCDD)	pg/g	110 J	250 J	550 J	330 J	180 J	170 J	140 J
Total hexachlorodibenzofuran (HxCDF)	pg/g	0.40 J	1.3 J	1000 J	780 J	17 J	2.7 J	110 J
Total hexachlorodibenzo-p-dioxin (HxCDD)	pg/g	28 J	52 J	95 J	70 J	43 J	48 J	28 J
Total pentachlorodibenzofuran (PeCDF)	pg/g	0.14 J	0.080 U	1300 J	1000 J	22 J	4.1 J	130 J
Total pentachlorodibenzo-p-dioxin (PeCDD)	pg/g	5.8 J	11 J	64 J	54 J	10 J	12 J	10 J
Total tetrachlorodibenzofuran (TCDF)	pg/g	3.2 J	0.93 J	39000 J	30000 J	630 J	130 J	3900 J
Total tetrachlorodibenzo-p-dioxin (TCDD)	pg/g	4.1 J	5.0 J	6300 J	5300 J	110 J	26 J	590 J
Total WHO Dioxin TEQ(Human/Mammal)(ND=0)	pg/g	1.53	2.71	7470	6310	139	29.2	769
Total WHO Dioxin TEQ(Human/Mammal)(ND=0.5)	pg/g	1.53	2.73	7470	6310	139	29.4	769

Notes:
- pg/g - picogram per gram
- U - Not detected at the associated reporting limit.
- J - Estimated concentration.
- UJ - Not detected; associated reporting limit is estimated

Table 2-3

Second Phase Pre-Design Investigation Analytical Results
Final 100% Remedial Design - Northern Impoundment
San Jacinto River Waste Pits Site
Harris County, Texas

Sample Location: / Sample Identification: / Sample Date: / Sample Depth: / Sample Type:	Units	SJSB047-C1 11187072-101719-SS-SJSB047-C1-(10-12) 10/17/2019 (10-12) ft bgs	SJSB047-C1 11187072-101719-SS-SJSB047-C1-(12-14) 10/17/2019 (12-14) ft bgs	SJSB047-C1 11187072-101719-SS-SJSB047-C1-(14-16) 10/17/2019 (14-16) ft bgs	SJSB047-C1 11187072-101719-SS-SJSB047-C1-(16-18) 10/17/2019 (16-18) ft bgs	SJSB048 11187072-090819-SS-SJSB048-S- (0-2) 9/8/2019 (0-2) ft bgs	SJSB048 11187072-090819-SS-SJSB048-S- (2-4) 9/8/2019 (2-4) ft bgs	SJSB048 11187072-090819-SS-SJSB048-S- (4-6) 9/8/2019 (4-6) ft bgs
Dioxins/Furans								
1,2,3,4,6,7,8,9-Octachlorodibenzofuran (OCDF)	pg/g	31	17	9.0 J	1.1 U	1.4 J	1.5 J	0.35 U
1,2,3,4,6,7,8,9-Octachlorodibenzo-p-dioxin (OCDD)	pg/g	1300	1100	930	1400	400	280	1100
1,2,3,4,6,7,8-Heptachlorodibenzofuran (HpCDF)	pg/g	19	25	9.4	0.27 J	0.45 U	0.94 J	0.41 U
1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin (HpCDD)	pg/g	43	40	34	60	9.5	8.0	42
1,2,3,4,7,8,9-Heptachlorodibenzofuran (HpCDF)	pg/g	6.1 J	7.6	3.1 J	0.093 U	1.1 J	0.73 J	0.71 J
1,2,3,4,7,8-Hexachlorodibenzofuran (HxCDF)	pg/g	61	76	29	0.49 J	0.37 J	0.53 J	0.23 U
1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin (HxCDD)	pg/g	0.59 U	0.68 U	0.52 U	1.0 U	0.31 U	0.27 U	0.61 J
1,2,3,6,7,8-Hexachlorodibenzofuran (HxCDF)	pg/g	16	20	7.6	0.15 U	0.34 J	0.16 U	0.24 U
1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin (HxCDD)	pg/g	1.2 J	1.0 J	0.74 J	1.3 J	0.32 U	0.29 U	1.3 J
1,2,3,7,8,9-Hexachlorodibenzofuran (HxCDF)	pg/g	0.95 J	1.2 J	0.53 J	0.10 U	1.9 U	1.4 U	1.4 U
1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin (HxCDD)	pg/g	1.8 J	1.6 J	1.5 J	4.1 J	1.0 J	0.91 J	2.1 J
1,2,3,7,8-Pentachlorodibenzofuran (PeCDF)	pg/g	43	50	19	0.46 J	0.39 U	0.30 U	0.41 U
1,2,3,7,8-Pentachlorodibenzo-p-dioxin (PeCDD)	pg/g	5.5 J	7.3	2.7 J	0.47 J	0.57 U	0.46 U	0.47 U
2,3,4,6,7,8-Hexachlorodibenzofuran (HxCDF)	pg/g	2.0 J	2.3 J	0.97 J	0.10 U	0.17 U	0.13 U	0.18 U
2,3,4,7,8-Pentachlorodibenzofuran (PeCDF)	pg/g	30	37	13	0.29 J	0.43 U	0.34 U	0.43 U
2,3,7,8-Tetrachlorodibenzofuran (TCDF)	pg/g	1700	1900	950	16	1.7	1.8	0.26 J
2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	pg/g	490	600	220	3.5	0.64 J	0.24 U	0.26 U
Total heptachlorodibenzofuran (HpCDF)	pg/g	32 J	39 J	15 J	0.27 J	1.1 J	2.2 J	0.71 J
Total heptachlorodibenzo-p-dioxin (HpCDD)	pg/g	140 J	120 J	100 J	220 J	33 J	27 J	120 J
Total hexachlorodibenzofuran (HxCDF)	pg/g	91 J	110 J	42 J	0.49 J	4.2 J	3.5 J	2.0 J
Total hexachlorodibenzo-p-dioxin (HxCDD)	pg/g	31 J	25 J	22 J	55 J	6.9 J	6.2 J	21 J
Total pentachlorodibenzofuran (PeCDF)	pg/g	120 J	140 J	51 J	0.95 J	0.51 U	0.34 U	0.43 U
Total pentachlorodibenzo-p-dioxin (PeCDD)	pg/g	10 J	11 J	6.5 J	13 J	0.57 U	0.46 U	2.0 J
Total tetrachlorodibenzofuran (TCDF)	pg/g	3500 J	4300 J	1500 J	23 J	2.7 J	2.6 J	0.84 J
Total tetrachlorodibenzo-p-dioxin (TCDD)	pg/g	530 J	650 J	240 J	10 J	0.64 J	0.31 J	2.5 J
Total WHO Dioxin TEQ(Human/Mammal)(ND=0)	pg/g	685	821	327	7.28	1.21	0.505	1.18
Total WHO Dioxin TEQ(Human/Mammal)(ND=0.5)	pg/g	685	821	327	7.35	1.70	1.02	1.72

Notes:
pg/g - picogram per gram
U - Not detected at the associated reporting limit.
J - Estimated concentration.
UJ - Not detected; associated reporting limit is estimated

Table 2-3

Second Phase Pre-Design Investigation Analytical Results
Final 100% Remedial Design - Northern Impoundment
San Jacinto River Waste Pits Site
Harris County, Texas

Sample Location: Sample Identification: Sample Date: Sample Depth: Sample Type:	Units	SJSB048 11187072-090819-SS-SJSB048-S- (6-8) 9/8/2019 (6-8) ft bgs	SJSB048 11187072-090819-SS-SJSB048-S- (8-10) 9/8/2019 (8-10) ft bgs	SJSB048 11187072-090819-SS-SJSB048-S- (10-12) 9/8/2019 (10-12) ft bgs	SJSB048 11187072-090819-SS-SJSB048-S- (12-14) 9/8/2019 (12-14) ft bgs	SJSB048 11187072-090819-SS-SJSB048-S- (14-16) 9/8/2019 (14-16) ft bgs	SJSB048 11187072-090819-SS-SJSB048-S- (16-18) 9/8/2019 (106-18) ft bgs	SJSB048-C1 11187072-11719-KW-SJSB048-C1-S (0-2) 11/7/2019 (0-2) ft bgs
Dioxins/Furans								
1,2,3,4,6,7,8,9-Octachlorodibenzofuran (OCDF)	pg/g	1.3 J	1.2 J	0.34 U	1.2 J	0.31 U	1.3 J	7.9 J
1,2,3,4,6,7,8,9-Octachlorodibenzo-p-dioxin (OCDD)	pg/g	1800	1700	1200	1300	920	1900	780
1,2,3,4,6,7,8-Heptachlorodibenzofuran (HpCDF)	pg/g	0.75 J	0.45 U	0.41 U	0.40 U	0.62 J	0.38 U	16
1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin (HpCDD)	pg/g	74	66	44	45	36	69	35
1,2,3,4,7,8,9-Heptachlorodibenzofuran (HpCDF)	pg/g	0.51 U	0.79 J	0.69 J	0.41 U	0.45 U	0.55 J	5.4 J
1,2,3,4,7,8-Hexachlorodibenzofuran (HxCDF)	pg/g	0.20 U	0.22 U	0.22 U	0.17 U	0.21 U	0.25 U	53
1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin (HxCDD)	pg/g	0.77 J	0.86 J	0.60 J	0.63 J	0.56 J	0.83 J	0.40 J
1,2,3,6,7,8-Hexachlorodibenzofuran (HxCDF)	pg/g	0.22 U	0.24 U	0.24 U	0.18 U	0.23 U	0.27 U	13
1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin (HxCDD)	pg/g	1.7 J	1.7 J	1.2 J	1.0 J	0.93 J	1.6 J	1.0 J
1,2,3,7,8,9-Hexachlorodibenzofuran (HxCDF)	pg/g	1.5 U	2.0 U	1.3 U	0.90 U	1.3 U	1.4 U	1.1 J
1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin (HxCDD)	pg/g	3.4 J	3.5 J	2.4 J	2.1 J	2.2 J	3.6 J	1.9 J
1,2,3,7,8-Pentachlorodibenzofuran (PeCDF)	pg/g	0.38 U	0.43 U	0.36 U	0.35 U	0.38 U	0.38 U	35
1,2,3,7,8-Pentachlorodibenzo-p-dioxin (PeCDD)	pg/g	0.55 U	0.63 U	0.49 U	0.48 U	0.58 U	0.58 U	5.4 J
2,3,4,6,7,8-Hexachlorodibenzofuran (HxCDF)	pg/g	0.18 U	0.18 U	0.19 U	0.14 U	0.18 U	0.20 U	1.8 J
2,3,4,7,8-Pentachlorodibenzofuran (PeCDF)	pg/g	0.42 U	0.46 U	0.39 U	0.36 U	0.41 U	0.42 U	30
2,3,7,8-Tetrachlorodibenzofuran (TCDF)	pg/g	0.17 U	0.42 J	0.16 U	0.59 J	0.65 J	0.62 J	1400
2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	pg/g	0.25 U	0.34 U	0.26 U	0.38 J	0.26 U	0.32 U	460
Total heptachlorodibenzofuran (HpCDF)	pg/g	0.75 J	0.79 J	0.69 J	0.41 U	0.62 J	0.55 J	26 J
Total heptachlorodibenzo-p-dioxin (HpCDD)	pg/g	210 J	280 J	160 J	150 J	130 J	250 J	89 J
Total hexachlorodibenzofuran (HxCDF)	pg/g	2.0 J	2.5 J	2.2 J	0.90 J	1.8 J	1.4 J	80 J
Total hexachlorodibenzo-p-dioxin (HxCDD)	pg/g	40 J	60 J	35 J	30 J	32 J	53 J	20 J
Total pentachlorodibenzofuran (PeCDF)	pg/g	0.50 U	0.47 U	0.39 U	0.36 U	0.41 U	0.45 U	110 J
Total pentachlorodibenzo-p-dioxin (PeCDD)	pg/g	6.3 J	9.1 J	5.1 J	5.9 J	6.8 J	8.2 J	5.4 J
Total tetrachlorodibenzofuran (TCDF)	pg/g	0.52 J	1.1 J	0.66 J	1.4 J	1.7 J	1.6 J	3300 J
Total tetrachlorodibenzo-p-dioxin (TCDD)	pg/g	3.8 J	2.6 J	3.9 J	3.7 J	4.7 J	5.8 J	510 J
Total WHO Dioxin TEQ(Human/Mammal)(ND=0)	pg/g	1.87	1.83	1.23	1.65	1.08	1.93	623
Total WHO Dioxin TEQ(Human/Mammal)(ND=0.5)	pg/g	2.46	2.52	1.77	2.03	1.66	2.56	623

Notes:
pg/g - picogram per gram
U - Not detected at the associated reporting limit.
J - Estimated concentration.
UJ - Not detected; associated reporting limit is estimated

Table 2-3

Second Phase Pre-Design Investigation Analytical Results
Final 100% Remedial Design - Northern Impoundment
San Jacinto River Waste Pits Site
Harris County, Texas

Sample Location:	Units	SJSB048-C1	SJSB048-C1	SJSB048-C1	SJSB048-C1	SJSB048-C1	SJSB048-C1
Sample Identification:		11187072-11719-KW-SJSB048-C1-S (2-4)	11187072-11719-KW-SJSB048-C1-S (4-6)	11187072-11719-KW-SJSB048-C1-S (6-8)	11187072-11719-KW-SJSB048-C1-S (8-10)	11187072-11719-KW-SJSB048-C1-S (10-12)	11187072-11719-KW-SJSB048-C1-S (12-14)
Sample Date:		11/7/2019	11/7/2019	11/7/2019	11/7/2019	11/7/2019	11/7/2019
Sample Depth:		(2-4) ft bgs	(4-6) ft bgs	(6-8) ft bgs	(8-10) ft bgs	(10-12) ft bgs	(12-14) ft bgs
Sample Type:							
Dioxins/Furans							
1,2,3,4,6,7,8,9-Octachlorodibenzofuran (OCDF)	pg/g	1.1 U	9.2 J	0.37 U	3.4 U	0.24 U	1.5 U
1,2,3,4,6,7,8,9-Octachlorodibenzo-p-dioxin (OCDD)	pg/g	490	380	1300	150	2000	2200
1,2,3,4,6,7,8-Heptachlorodibenzofuran (HpCDF)	pg/g	2.0 J	20	0.33 U	7.2	0.25 U	3.1 J
1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin (HpCDD)	pg/g	19	16	48	6.4	91	98
1,2,3,4,7,8,9-Heptachlorodibenzofuran (HpCDF)	pg/g	0.70 J	7.8	0.22 U	2.6 J	0.031 U	1.3 J
1,2,3,4,7,8-Hexachlorodibenzofuran (HxCDF)	pg/g	5.7 J	55	0.63 J	25	0.41 J	11
1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin (HxCDD)	pg/g	0.23 J	0.28 J	0.51 J	0.13 J	0.86 J	1.1 J
1,2,3,6,7,8-Hexachlorodibenzofuran (HxCDF)	pg/g	1.5 J	13	0.15 J	6.1	0.18 J	2.6 J
1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin (HxCDD)	pg/g	0.54 J	0.38 J	0.93 J	0.22 J	2.2 J	2.5 J
1,2,3,7,8,9-Hexachlorodibenzofuran (HxCDF)	pg/g	0.16 J	1.0 J	0.069 U	0.44 J	0.073 U	0.25 J
1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin (HxCDD)	pg/g	1.1 J	0.96 J	2.8 J	0.36 J	4.9 J	5.3 J
1,2,3,7,8-Pentachlorodibenzofuran (PeCDF)	pg/g	3.5 J	33	0.26 J	16	0.31 J	6.8 J
1,2,3,7,8-Pentachlorodibenzo-p-dioxin (PeCDD)	pg/g	0.59 J	5.3 J	0.24 J	2.8 J	0.33 J	1.4 J
2,3,4,6,7,8-Hexachlorodibenzofuran (HxCDF)	pg/g	0.13 J	1.6 J	0.058 U	0.86 J	0.062 U	0.35 J
2,3,4,7,8-Pentachlorodibenzofuran (PeCDF)	pg/g	3.1 J	28	0.24 J	15	0.26 J	6.4 J
2,3,7,8-Tetrachlorodibenzofuran (TCDF)	pg/g	42	1400	5.5	820	6.6	390
2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	pg/g	48	430	2.7	230	2.9	100
Total heptachlorodibenzofuran (HpCDF)	pg/g	3.2 J	32 J	0.55 J	12 J	0.34 J	5.1 J
Total heptachlorodibenzo-p-dioxin (HpCDD)	pg/g	53 J	42 J	150 J	20 J	290 J	300 J
Total hexachlorodibenzofuran (HxCDF)	pg/g	8.4 J	81 J	0.78 J	37 J	0.60 J	16 J
Total hexachlorodibenzo-p-dioxin (HxCDD)	pg/g	13 J	11 J	39 J	5.7 J	66 J	78 J
Total pentachlorodibenzofuran (PeCDF)	pg/g	11 J	93 J	0.50 J	49 J	0.67 J	23 J
Total pentachlorodibenzo-p-dioxin (PeCDD)	pg/g	2.3 J	7.9 J	6.5 J	3.0 J	10 J	13 J
Total tetrachlorodibenzofuran (TCDF)	pg/g	340 J	3000 J	21 J	1700 J	22 J	790 J
Total tetrachlorodibenzo-p-dioxin (TCDD)	pg/g	54 J	480 J	7.0 J	260 J	9.6 J	120 J
Total WHO Dioxin TEQ(Human/Mammal)(ND=0)	pg/g	55.1	592	4.94	323	6.34	147
Total WHO Dioxin TEQ(Human/Mammal)(ND=0.5)	pg/g	55.1	592	4.95	323	6.35	147

Notes:
pg/g - picogram per gram
U - Not detected at the associated reporting limit.
J - Estimated concentration.
UJ - Not detected; associated reporting limit is estimated.

Table 2-3

Second Phase Pre-Design Investigation Analytical Results
Final 100% Remedial Design - Northern Impoundment
San Jacinto River Waste Pits Site
Harris County, Texas

Sample Location: Sample Identification: Sample Date: Sample Depth: Sample Type:	Units	SJSB048-C1 11187072-11719-KW-SJSB048-C1-S (14-16) 11/7/2019 (14-16) ft bgs	SJSB048-C1 11187072-11719-KW-SJSB048-C1-S (16-18) 11/7/2019 (16-18) ft bgs	SJSB048-C1 1187072-120519-SS-SJSB048-C1(18-20) 12/5/2019 (18-20) ft bgs	SJSB048-C1 1187072-120519-SS-DUP-1 12/5/2019 (20-22) ft bgs	SJSB049 11187072-091119-SS-SJSB049-S (0-2) 9/11/2019 (0-2) ft bgs	SJSB049 11187072-091119-SS-SJSB049-S (2-4) 9/11/2019 (2-4) ft bgs	SJSB049 11187072-091119-SS-SJSB049-S (4-6) 9/11/2019 (4-6) ft bgs
Dioxins/Furans								
1,2,3,4,6,7,8,9-Octachlorodibenzofuran (OCDF)	pg/g	1.5 U	2.3 U	2.5 U	1.9 U	490	240	82
1,2,3,4,6,7,8,9-Octachlorodibenzo-p-dioxin (OCDD)	pg/g	2600	710	1200 J	62	5200	3200	1600
1,2,3,4,6,7,8-Heptachlorodibenzofuran (HpCDF)	pg/g	3.2 J	5.3 J	0.63 J	0.13 U	830	190	94
1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin (HpCDD)	pg/g	87	30	47	2.3 J	260	120	60
1,2,3,4,7,8,9-Heptachlorodibenzofuran (HpCDF)	pg/g	1.1 J	1.9 J	0.20 U	0.17 U	260	56	30
1,2,3,4,7,8-Hexachlorodibenzofuran (HxCDF)	pg/g	9.7	18	0.92 J	0.19 J	2400	550	240
1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin (HxCDD)	pg/g	0.86 J	0.30 J	0.86 J	0.32 J	3.2 J	1.7 J	0.94 J
1,2,3,6,7,8-Hexachlorodibenzofuran (HxCDF)	pg/g	2.4 J	4.3 J	0.44 J	0.14 J	680	150	65
1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin (HxCDD)	pg/g	1.9 J	0.67 J	1.3 J	0.27 J	14	4.6 J	1.7 J
1,2,3,7,8,9-Hexachlorodibenzofuran (HxCDF)	pg/g	0.30 J	0.39 J	0.55 J	0.28 J	43	10 U	5.6 U
1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin (HxCDD)	pg/g	3.9 J	1.3 J	4.0 J	0.42 J	7.7 J	4.3 J	2.5 J
1,2,3,7,8-Pentachlorodibenzofuran (PeCDF)	pg/g	6.6 J	11	0.20 U	0.11 U	1600	430	150
1,2,3,7,8-Pentachlorodibenzo-p-dioxin (PeCDD)	pg/g	1.5 J	2.0 J	0.60 J	0.17 U	150	46	12 J
2,3,4,6,7,8-Hexachlorodibenzofuran (HxCDF)	pg/g	0.38 J	0.49 J	0.23 J	0.11 J	76	16	6.1 J
2,3,4,7,8-Pentachlorodibenzofuran (PeCDF)	pg/g	6.0 J	9.9	0.47 J	0.11 U	1100	330	100
2,3,7,8-Tetrachlorodibenzofuran (TCDF)	pg/g	400	510	25 J	1.9	27000 J	14000 J	5700 J
2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	pg/g	96	160	6.9	0.56 J	20000 J	5000 J	1700 J
Total heptachlorodibenzofuran (HpCDF)	pg/g	5.1 J	8.6 J	0.63 J	0.17 U	1400 J	300 J	140 J
Total heptachlorodibenzo-p-dioxin (HpCDD)	pg/g	240 J	77 J	170 J	6.6 J	620 J	320 J	180 J
Total hexachlorodibenzofuran (HxCDF)	pg/g	15 J	26 J	2.1 J	0.73 J	3600 J	820 J	350 J
Total hexachlorodibenzo-p-dioxin (HxCDD)	pg/g	54 J	19 J	47 J	2.9 J	110 J	61 J	33 J
Total pentachlorodibenzofuran (PeCDF)	pg/g	22 J	36 J	0.47 J	0.12 U	4400 J	1200 J	380 J
Total pentachlorodibenzo-p-dioxin (PeCDD)	pg/g	8.9 J	3.0 J	7.9 J	0.17 U	160 J	61 J	14 J
Total tetrachlorodibenzofuran (TCDF)	pg/g	750 J	1100 J	44 J	2.1 J	100000 J	35000 J	11000 J
Total tetrachlorodibenzo-p-dioxin (TCDD)	pg/g	110 J	170 J	11 J	1.1 J	21000 J	5500 J	1800 J
Total WHO Dioxin TEQ(Human/Mammal)(ND=0)	pg/g	143	219	11.8	0.965	23600	6640	2350
Total WHO Dioxin TEQ(Human/Mammal)(ND=0.5)	pg/g	143	219	11.8	1.07	23600	6640	2350

Notes:
pg/g - picogram per gram
U - Not detected at the associated reporting limit.
J - Estimated concentration.
UJ - Not detected; associated reporting limit is estimated

Table 2-3

Second Phase Pre-Design Investigation Analytical Results
Final 100% Remedial Design - Northern Impoundment
San Jacinto River Waste Pits Site
Harris County, Texas

Sample Location:	Units	SJSB049	SJSB049	SJSB049	SJSB049	SJSB049	SJSB049	SJSB050
Sample Identification:		11187072-091119-SS-SJSB049-S (6-8)	11187072-091119-SS-SJSB049-S (8-10)	11187072-091119-SS-SJSB049-S (10-12)	11187072-091119-SS-SJSB049-S (12-14)	11187072-091119-SS-SJSB049-S (14-16)	11187072-091119-SS-SJSB049-S (16-18)	11187072-091619-SS-SJSB050-(0-2)
Sample Date:		9/11/2019	9/11/2019	9/11/2019	9/11/2019	9/11/2019	9/11/2019	9/16/2019
Sample Depth:		(6-8) ft bgs	(8-10) ft bgs	(10-12) ft bgs	(12-14) ft bgs	(14-16) ft bgs	(16-18) ft bgs	(0-2) ft bgs
Sample Type:								
Dioxins/Furans								
1,2,3,4,6,7,8,9-Octachlorodibenzofuran (OCDF)	pg/g	5.1 J	9.7 J	3.2 J	4.5 J	1.8 J	0.47 U	7.2 J
1,2,3,4,6,7,8,9-Octachlorodibenzo-p-dioxin (OCDD)	pg/g	1700	1600	1700	2600	2000	2000	2600
1,2,3,4,6,7,8-Heptachlorodibenzofuran (HpCDF)	pg/g	3.0 J	6.6 J	2.2 J	2.8 J	0.49 U	0.37 U	1.1 J
1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin (HpCDD)	pg/g	64	59	75	99	75	77	91
1,2,3,4,7,8,9-Heptachlorodibenzofuran (HpCDF)	pg/g	2.9 U	3.6 U	2.5 U	3.0 U	1.5 U	1.6 U	0.42 U
1,2,3,4,7,8-Hexachlorodibenzofuran (HxCDF)	pg/g	8.1	18	6.5 J	8.4	1.7 J	0.24 U	0.27 U
1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin (HxCDD)	pg/g	0.57 J	0.62 J	1.0 J	1.0 J	1.4 J	0.83 J	1.1 J
1,2,3,6,7,8-Hexachlorodibenzofuran (HxCDF)	pg/g	2.4 J	4.6 J	2.1 J	2.6 J	0.67 J	0.25 U	0.27 U
1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin (HxCDD)	pg/g	1.3 J	1.4 J	2.0 J	2.3 J	2.2 J	1.5 J	2.5 J
1,2,3,7,8,9-Hexachlorodibenzofuran (HxCDF)	pg/g	3.6 U	3.1 U	2.4 U	3.5 U	2.8 U	3.2 U	0.70 U
1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin (HxCDD)	pg/g	2.8 J	2.6 J	4.1 J	5.5 J	6.3 J	5.0 J	4.7 J
1,2,3,7,8-Pentachlorodibenzofuran (PeCDF)	pg/g	6.4 J	14	5.8 J	7.4 J	1.9 J	0.39 U	0.38 U
1,2,3,7,8-Pentachlorodibenzo-p-dioxin (PeCDD)	pg/g	1.1 J	1.6 J	1.1 J	0.89 J	0.52 U	0.60 U	0.47 U
2,3,4,6,7,8-Hexachlorodibenzofuran (HxCDF)	pg/g	0.22 U	0.63 J	0.19 U	0.48 J	0.18 U	0.20 U	0.21 U
2,3,4,7,8-Pentachlorodibenzofuran (PeCDF)	pg/g	4.2 J	9.4	4.1 J	4.5 J	1.1 J	0.41 U	0.42 U
2,3,7,8-Tetrachlorodibenzofuran (TCDF)	pg/g	320	720 J	330	340	77	11 J	11
2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	pg/g	73	170	74	77	17	2.1 J	3.4
Total heptachlorodibenzofuran (HpCDF)	pg/g	5.9 J	12 J	4.7 J	7.0 J	1.5 J	1.6 J	1.1 J
Total heptachlorodibenzo-p-dioxin (HpCDD)	pg/g	190 J	190 J	220 J	290 J	260 J	240 J	220 J
Total hexachlorodibenzofuran (HxCDF)	pg/g	18 J	31 J	13 J	18 J	6.5 J	4.7 J	0.70 J
Total hexachlorodibenzo-p-dioxin (HxCDD)	pg/g	39 J	42 J	58 J	68 J	67 J	62 J	44 J
Total pentachlorodibenzofuran (PeCDF)	pg/g	17 J	37 J	16 J	19 J	2.9 J	0.41 U	0.42 U
Total pentachlorodibenzo-p-dioxin (PeCDD)	pg/g	6.3 J	7.9 J	15 J	10 J	5.5 J	9.6 J	6.1 J
Total tetrachlorodibenzofuran (TCDF)	pg/g	520 J	1200 J	530 J	530 J	110 J	17 J	13 J
Total tetrachlorodibenzo-p-dioxin (TCDD)	pg/g	80 J	190 J	84 J	88 J	22 J	7.5 J	6.4 J
Total WHO Dioxin TEQ(Human/Mammal)(ND=0)	pg/g	110	251	112	117	27.7	5.30	7.03
Total WHO Dioxin TEQ(Human/Mammal)(ND=0.5)	pg/g	110	251	112	117	28.1	5.87	7.41

Notes:
pg/g - picogram per gram
U - Not detected at the associated reporting limit.
J - Estimated concentration.
UJ - Not detected; associated reporting limit is estimated

Table 2-3

Second Phase Pre-Design Investigation Analytical Results
Final 100% Remedial Design - Northern Impoundment
San Jacinto River Waste Pits Site
Harris County, Texas

Sample Location: Sample Identification: Sample Date: Sample Depth: Sample Type:	Units	SJSB050 11187072-091619-SS-DUP-5 9/16/2019 (2-4) ft bgs Duplicate	SJSB050 11187072-091619-SS-SJSB050-(2-4) 9/16/2019 (2-4) ft bgs	SJSB050 11187072-091619-SS-SJSB050-(4-6) 9/16/2019 (4-6) ft bgs	SJSB050 11187072-091619-SS-SJSB050-(6-8) 9/16/2019 (6-8) ft bgs	SJSB050 11187072-091619-SS-SJSB050-(8-10) 9/16/2019 (8-10) ft bgs	SJSB050 11187072-091619-SS-SJSB050-(10-12) 9/16/2019 (10-12) ft bgs	SJSB050 11187072-091619-SS-SJSB050-(12-14) 9/16/2019 (12-14) ft bgs
Dioxins/Furans								
1,2,3,4,6,7,8,9-Octachlorodibenzofuran (OCDF)	pg/g	1.8 J	1.7 J	0.46 U	0.39 U	1.0 J	0.45 U	0.34 U
1,2,3,4,6,7,8,9-Octachlorodibenzo-p-dioxin (OCDD)	pg/g	1400	2300	850	1300	2500	2000	1400
1,2,3,4,6,7,8-Heptachlorodibenzofuran (HpCDF)	pg/g	0.27 U	0.34 U	0.27 U	0.23 U	0.22 U	0.24 U	0.19 U
1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin (HpCDD)	pg/g	50	62	31	38	110	85	50
1,2,3,4,7,8,9-Heptachlorodibenzofuran (HpCDF)	pg/g	0.32 U	0.38 U	0.32 U	0.26 U	0.24 U	0.28 U	0.20 U
1,2,3,4,7,8-Hexachlorodibenzofuran (HxCDF)	pg/g	0.20 U	0.20 U	0.17 U	0.16 U	0.18 U	0.15 U	0.13 U
1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin (HxCDD)	pg/g	0.76 J	1.2 J	0.51 J	0.42 J	1.1 J	1.0 J	0.44 J
1,2,3,6,7,8-Hexachlorodibenzofuran (HxCDF)	pg/g	0.20 U	0.21 U	0.18 U	0.17 U	0.18 U	0.16 U	0.14 U
1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin (HxCDD)	pg/g	1.3 J	1.3 J	0.62 J	0.78 J	2.4 J	2.1 J	0.97 J
1,2,3,7,8,9-Hexachlorodibenzofuran (HxCDF)	pg/g	0.53 U	0.30 U	0.23 U	0.23 U	0.35 U	0.32 U	0.27 U
1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin (HxCDD)	pg/g	2.7 J	3.1 J	1.9 J	2.0 J	5.6 J	4.7 J	2.4 J
1,2,3,7,8-Pentachlorodibenzofuran (PeCDF)	pg/g	0.30 U	0.54 J	0.23 U	0.23 U	0.24 U	0.22 U	0.20 U
1,2,3,7,8-Pentachlorodibenzo-p-dioxin (PeCDD)	pg/g	0.48 U	0.52 U	0.48 U	0.41 U	0.45 U	0.47 U	0.36 U
2,3,4,6,7,8-Hexachlorodibenzofuran (HxCDF)	pg/g	0.16 U	0.16 U	0.14 U	0.12 U	0.14 U	0.12 U	0.10 U
2,3,4,7,8-Pentachlorodibenzofuran (PeCDF)	pg/g	0.31 U	0.36 U	0.25 U	0.25 U	0.26 U	0.25 U	0.22 U
2,3,7,8-Tetrachlorodibenzofuran (TCDF)	pg/g	3.9	0.97 J	0.20 U	0.14 U	0.19 U	0.21 U	0.15 U
2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	pg/g	1.0 J	0.71 J	0.27 U	0.21 U	0.30 J	0.31 U	0.25 J
Total heptachlorodibenzofuran (HpCDF)	pg/g	0.32 U	0.38 U	0.32 U	0.26 U	0.24 U	0.28 U	0.20 U
Total heptachlorodibenzo-p-dioxin (HpCDD)	pg/g	120 J	160 J	120 J	150 J	280 J	230 J	140 J
Total hexachlorodibenzofuran (HxCDF)	pg/g	0.53 J	0.30 J	0.23 J	0.23 J	0.35 J	0.32 J	0.27 J
Total hexachlorodibenzo-p-dioxin (HxCDD)	pg/g	24 J	30 J	34 J	36 J	78 J	66 J	33 J
Total pentachlorodibenzofuran (PeCDF)	pg/g	0.36 U	1.5 J	0.28 U	0.25 U	0.26 U	0.26 U	0.22 U
Total pentachlorodibenzo-p-dioxin (PeCDD)	pg/g	4.2 J	5.4 J	7.3 J	6.2 J	17 J	13 J	5.6 J
Total tetrachlorodibenzofuran (TCDF)	pg/g	5.9 J	2.8 J	0.20 U	0.14 U	0.47 J	1.4 J	0.37 J
Total tetrachlorodibenzo-p-dioxin (TCDD)	pg/g	2.0 J	4.1 J	3.2 J	1.6 J	8.4 J	8.1 J	2.8 J
Total WHO Dioxin TEQ(Human/Mammal)(ND=0)	pg/g	2.79	2.69	0.868	1.09	3.06	2.23	1.55
Total WHO Dioxin TEQ(Human/Mammal)(ND=0.5)	pg/g	3.13	3.05	1.33	1.48	3.38	2.71	1.81

Notes:
pg/g - picogram per gram
U - Not detected at the associated reporting limit.
J - Estimated concentration.
UJ - Not detected; associated reporting limit is estimated

Table 2-3

Second Phase Pre-Design Investigation Analytical Results
Final 100% Remedial Design - Northern Impoundment
San Jacinto River Waste Pits Site
Harris County, Texas

Sample Location:	Units	SJSB050	SJSB050	SJSB050-C1	SJSB050-C1	SJSB050-C1	SJSB050-C1	SJSB050-C1
Sample Identification:		11187072-091619-SS-SJSB050-(14-16)	11187072-091619-SS-SJSB050-(16-18)	11187072-100919-SS-SJSB050C1(0-2)	11187072-100919-SS-SJSB050C1(2-4)	11187072-100919-SS-SJSB050C1(4-6)	11187072-100919-SS-SJSB050C1(6-8)	11187072-100919-SS-SJSB050C1(8-10)
Sample Date:		9/16/2019	9/16/2019	10/10/2019	10/10/2019	10/10/2019	10/10/2019	10/10/2019
Sample Depth:		(14-16) ft bgs	(16-18) ft bgs	(0-2) ft bgs	(2-4) ft bgs	(4-6) ft bgs	(6-8) ft bgs	(8-10) ft bgs
Sample Type:								
Dioxins/Furans								
1,2,3,4,6,7,8,9-Octachlorodibenzofuran (OCDF)	pg/g	0.41 U	0.31 U	0.18 U	0.83 U	0.26 U	1.4 U	0.52 U
1,2,3,4,6,7,8,9-Octachlorodibenzo-p-dioxin (OCDD)	pg/g	1200	40	450	750	1500	2300	130
1,2,3,4,6,7,8-Heptachlorodibenzofuran (HpCDF)	pg/g	0.23 U	0.16 U	0.17 U	0.20 U	0.24 U	0.22 U	0.15 U
1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin (HpCDD)	pg/g	45	0.94 J	16	33	58	97	6.0 J
1,2,3,4,7,8,9-Heptachlorodibenzofuran (HpCDF)	pg/g	0.26 U	0.20 U	0.20 U	0.23 U	0.25 U	0.26 U	0.18 U
1,2,3,4,7,8-Hexachlorodibenzofuran (HxCDF)	pg/g	0.21 U	0.13 U	0.14 U	0.18 U	0.17 U	0.19 U	0.14 U
1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin (HxCDD)	pg/g	0.61 J	0.15 U	0.33 U	0.44 U	0.62 U	1.0 U	0.15 U
1,2,3,6,7,8-Hexachlorodibenzofuran (HxCDF)	pg/g	0.21 U	0.13 U	0.15 U	0.20 U	0.18 U	0.22 U	0.15 U
1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin (HxCDD)	pg/g	1.3 J	0.16 U	0.39 J	0.77 J	1.2 J	2.0 J	0.16 U
1,2,3,7,8,9-Hexachlorodibenzofuran (HxCDF)	pg/g	0.36 U	0.26 U	0.11 J	0.25 J	0.094 U	0.27 J	0.076 U
1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin (HxCDD)	pg/g	2.9 J	0.14 U	0.79 J	1.5 J	2.6 J	4.5 J	0.34 J
1,2,3,7,8-Pentachlorodibenzofuran (PeCDF)	pg/g	0.27 U	0.22 U	0.16 U	0.16 U	0.17 U	0.17 U	0.22 J
1,2,3,7,8-Pentachlorodibenzo-p-dioxin (PeCDD)	pg/g	0.48 U	0.29 U	0.27 U	0.29 U	0.33 U	0.36 U	0.21 U
2,3,4,6,7,8-Hexachlorodibenzofuran (HxCDF)	pg/g	0.16 U	0.098 U	0.092 U	0.12 U	0.11 U	0.13 U	0.090 U
2,3,4,7,8-Pentachlorodibenzofuran (PeCDF)	pg/g	0.29 U	0.23 U	0.17 U	0.17 U	0.18 U	0.18 U	0.14 U
2,3,7,8-Tetrachlorodibenzofuran (TCDF)	pg/g	0.19 U	0.13 U	3.5	0.86 J	0.44 J	0.31 J	3.0
2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	pg/g	0.27 U	0.17 U	1.3 J	0.85 J	0.51 J	0.44 J	0.70 J
Total heptachlorodibenzofuran (HpCDF)	pg/g	0.26 U	0.20 U	0.20 U	0.23 U	0.25 U	0.26 U	0.18 U
Total heptachlorodibenzo-p-dioxin (HpCDD)	pg/g	130 J	3.8 J	51 J	110 J	180 J	320 J	15 J
Total hexachlorodibenzofuran (HxCDF)	pg/g	0.36 J	0.26 J	0.11 U	0.25 J	0.18 U	0.27 J	0.15 U
Total hexachlorodibenzo-p-dioxin (HxCDD)	pg/g	38 J	0.78 J	9.2 J	20 J	40 J	72 J	2.2 J
Total pentachlorodibenzofuran (PeCDF)	pg/g	0.29 U	0.23 U	0.17 U	0.19 U	0.18 U	0.18 U	0.22 J
Total pentachlorodibenzo-p-dioxin (PeCDD)	pg/g	7.5 J	0.29 U	0.49 J	1.5 J	6.6 J	12 J	0.21 U
Total tetrachlorodibenzofuran (TCDF)	pg/g	0.80 J	0.13 U	4.6 J	1.7 J	0.88 J	0.89 J	4.4 J
Total tetrachlorodibenzo-p-dioxin (TCDD)	pg/g	4.1 J	0.17 U	2.1 J	3.1 J	4.1 J	7.5 J	0.91 J
Total WHO Dioxin TEQ(Human/Mammal)(ND=0)	pg/g	1.29	0.0214	2.07	1.74	1.96	2.81	1.14
Total WHO Dioxin TEQ(Human/Mammal)(ND=0.5)	pg/g	1.77	0.351	2.27	1.97	2.22	3.10	1.31

Notes:
pg/g - picogram per gram
U - Not detected at the associated reporting limit.
J - Estimated concentration.
UJ - Not detected; associated reporting limit is estimated

Table 2-3

Second Phase Pre-Design Investigation Analytical Results
Final 100% Remedial Design - Northern Impoundment
San Jacinto River Waste Pits Site
Harris County, Texas

Sample Location: / Sample Identification: / Sample Date: / Sample Depth: / Sample Type:	Units	SJSB050-C1 11187072-100919-SS-SJSB050C1(10-12) 10/10/2019 (10-12) ft bgs	SJSB050-C1 11187072-100919-SS-SJSB050C1(12-14) 10/10/2019 (12-14) ft bgs	SJSB050-C1 11187072-100919-SS-SJSB050C1(14-16) 10/10/2019 (14-16) ft bgs	SJSB050-C1 11187072-100919-SS-SJSB050C1(16-18) 10/10/2019 (16-18) ft bgs	SJSB050-C1 11187072-101019-SS-DUP-7 10/10/2019 (16-18) ft bgs Duplicate	SJSB051 11187072-091019-SS-SJSB051-S (0-2) 9/10/2019 (0-2) ft bgs	SJSB051 11187072-091019-SS-SJSB051-S (2-4) 9/10/2019 (2-4) ft bgs
Dioxins/Furans								
1,2,3,4,6,7,8,9-Octachlorodibenzofuran (OCDF)	pg/g	0.24 U	0.32 U	1.1 U	0.24 U	0.19 U	2.5 J	4.0 J
1,2,3,4,6,7,8,9-Octachlorodibenzo-p-dioxin (OCDD)	pg/g	340	2000	1800	960 J	250 J	2300	5500
1,2,3,4,6,7,8-Heptachlorodibenzofuran (HpCDF)	pg/g	0.19 U	0.24 U	0.21 U	0.19 U	0.13 U	0.28 U	0.53 U
1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin (HpCDD)	pg/g	14	100	96	41 J	8.7 J	60	130
1,2,3,4,7,8,9-Heptachlorodibenzofuran (HpCDF)	pg/g	0.21 U	0.27 U	0.24 U	0.21 U	0.16 U	0.35 U	0.67 U
1,2,3,4,7,8-Hexachlorodibenzofuran (HxCDF)	pg/g	0.15 U	0.21 U	0.19 U	0.16 U	0.13 U	0.19 U	0.33 U
1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin (HxCDD)	pg/g	0.38 U	0.97 U	0.88 U	0.51 U	0.17 U	0.62 J	1.3 J
1,2,3,6,7,8-Hexachlorodibenzofuran (HxCDF)	pg/g	0.17 U	0.23 U	0.21 U	0.18 U	0.14 U	0.19 U	0.32 U
1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin (HxCDD)	pg/g	0.35 J	2.6 J	2.7 J	0.92 J	0.17 U	1.4 J	3.1 J
1,2,3,7,8,9-Hexachlorodibenzofuran (HxCDF)	pg/g	0.085 U	0.33 J	0.24 J	0.088 U	0.11 J	1.5 U	2.3 U
1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin (HxCDD)	pg/g	0.71 J	5.7 J	5.4 J	2.0 J	0.39 J	3.2 J	6.1 J
1,2,3,7,8-Pentachlorodibenzofuran (PeCDF)	pg/g	0.15 U	0.18 U	0.19 U	0.18 U	0.11 U	0.29 U	0.58 U
1,2,3,7,8-Pentachlorodibenzo-p-dioxin (PeCDD)	pg/g	0.24 U	0.41 U	0.38 U	0.30 U	0.23 U	0.45 U	0.94 U
2,3,4,6,7,8-Hexachlorodibenzofuran (HxCDF)	pg/g	0.10 U	0.15 U	0.13 U	0.11 U	0.087 U	0.15 U	0.25 U
2,3,4,7,8-Pentachlorodibenzofuran (PeCDF)	pg/g	0.17 U	0.20 U	0.21 U	0.18 U	0.12 U	0.33 U	0.67 U
2,3,7,8-Tetrachlorodibenzofuran (TCDF)	pg/g	2.4	0.15 U	0.12 U	0.14 U	0.097 U	1.4 J	0.30 U
2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	pg/g	0.76 J	0.59 J	0.24 J	0.19 U	0.17 U	0.67 J	0.43 U
Total heptachlorodibenzofuran (HpCDF)	pg/g	0.21 U	0.27 U	0.24 U	0.21 U	0.16 U	0.35 U	0.67 U
Total heptachlorodibenzo-p-dioxin (HpCDD)	pg/g	40 J	260 J	240 J	110 J	25 J	160 J	330 J
Total hexachlorodibenzofuran (HxCDF)	pg/g	0.17 U	0.33 J	0.24 J	0.18 U	0.11 U	1.9 J	2.6 J
Total hexachlorodibenzo-p-dioxin (HxCDD)	pg/g	8.1 J	67 J	59 J	22 J	5.2 J	31 J	53 J
Total pentachlorodibenzofuran (PeCDF)	pg/g	0.17 U	0.20 U	0.21 U	0.18 U	0.15 U	0.33 U	0.67 U
Total pentachlorodibenzo-p-dioxin (PeCDD)	pg/g	0.57 J	9.7 J	8.8 J	2.2 J	0.46 J	2.4 J	1.8 J
Total tetrachlorodibenzofuran (TCDF)	pg/g	2.7 J	0.70 J	0.99 J	0.14 U	0.097 U	2.6 J	1.2 J
Total tetrachlorodibenzo-p-dioxin (TCDD)	pg/g	1.2 J	6.4 J	5.3 J	1.2 J	0.18 J	2.4 J	3.1 J
Total WHO Dioxin TEQ(Human/Mammal)(ND=0)	pg/g	1.35	3.05	2.57	0.99	0.212	2.62	4.00
Total WHO Dioxin TEQ(Human/Mammal)(ND=0.5)	pg/g	1.54	3.38	2.88	1.33	0.473	3.02	4.98

Notes:
pg/g - picogram per gram
U - Not detected at the associated reporting limit.
J - Estimated concentration.
UJ - Not detected; associated reporting limit is estimated

Table 2-3

Second Phase Pre-Design Investigation Analytical Results
Final 100% Remedial Design - Northern Impoundment
San Jacinto River Waste Pits Site
Harris County, Texas

Sample Location: / Sample Identification: / Sample Date: / Sample Depth: / Sample Type:	Units	SJSB051 11187072-091019-SS-SJSB051-S (4-6) 9/10/2019 (4-6) ft bgs	SJSB051 11187072-091019-SS-SJSB051-S (6-8) 9/10/2019 (6-8) ft bgs	SJSB051 11187072-091019-SS-SJSB051-S (8-10) 9/10/2019 (8-10) ft bgs	SJSB051 11187072-091019-SS-SJSB051-S (10-12) 9/10/2019 (10-12) ft bgs	SJSB051 11187072-091019-SS-SJSB051-S (12-14) 9/10/2019 (12-14) ft bgs	SJSB051 11187072-091019-SS-SJSB051-S (14-16) 9/10/2019 (14-16) ft bgs	SJSB051 11187072-091019-SS-DUP-1 9/10/2019 (16-18) ft bgs Duplicate
Dioxins/Furans								
1,2,3,4,6,7,8,9-Octachlorodibenzofuran (OCDF)	pg/g	0.38 U	1.2 J	2.6 J	0.58 J	0.85 J	0.74 J	0.61 J
1,2,3,4,6,7,8,9-Octachlorodibenzo-p-dioxin (OCDD)	pg/g	1600	2200	1400	1400	2600	1500	850
1,2,3,4,6,7,8-Heptachlorodibenzofuran (HpCDF)	pg/g	0.40 U	0.34 J	0.50 J	0.14 J	0.25 J	0.22 J	0.15 J
1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin (HpCDD)	pg/g	62	81	49	51	70	66	40
1,2,3,4,7,8,9-Heptachlorodibenzofuran (HpCDF)	pg/g	0.48 U	0.76 J	0.76 J	0.71 J	0.75 J	0.74 J	0.56 J
1,2,3,4,7,8-Hexachlorodibenzofuran (HxCDF)	pg/g	0.23 U	0.24 J	0.17 J	0.15 J	0.27 J	0.18 J	0.19 J
1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin (HxCDD)	pg/g	0.73 J	1.2 J	0.95 J	0.79 J	1.1 J	0.90 J	0.74 J
1,2,3,6,7,8-Hexachlorodibenzofuran (HxCDF)	pg/g	0.22 U	0.17 J	0.15 J	0.12 J	0.17 J	0.14 J	0.032 U
1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin (HxCDD)	pg/g	1.3 J	1.5 J	1.2 J	1.0 J	1.5 J	1.3 J	1.1 J
1,2,3,7,8,9-Hexachlorodibenzofuran (HxCDF)	pg/g	1.5 U	1.6 U	1.5 U	1.4 U	1.5 U	1.5 U	1.3 U
1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin (HxCDD)	pg/g	3.6 J	4.4 J	2.9 J	2.7 J	3.1 J	3.6 J	3.3 J
1,2,3,7,8-Pentachlorodibenzofuran (PeCDF)	pg/g	0.32 U	0.29 J	0.28 J	0.22 J	0.28 J	0.17 J	0.19 J
1,2,3,7,8-Pentachlorodibenzo-p-dioxin (PeCDD)	pg/g	0.60 U	0.080 U	0.28 J	0.060 U	0.37 J	0.33 J	0.24 J
2,3,4,6,7,8-Hexachlorodibenzofuran (HxCDF)	pg/g	0.17 U	0.024 U	0.021 U	0.019 U	0.026 U	0.019 U	0.027 U
2,3,4,7,8-Pentachlorodibenzofuran (PeCDF)	pg/g	0.34 U	0.13 J	0.18 J	0.13 J	0.15 J	0.083 J	0.058 U
2,3,7,8-Tetrachlorodibenzofuran (TCDF)	pg/g	0.21 U	0.13 J	2.2	0.11 J	0.56 J	0.11 J	0.096 J
2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	pg/g	0.34 J	0.23 J	0.93 J	0.14 J	0.25 J	0.17 J	0.17 J
Total heptachlorodibenzofuran (HpCDF)	pg/g	0.48 U	1.5 J	1.9 J	1.1 J	1.3 J	1.3 J	0.98 J
Total heptachlorodibenzo-p-dioxin (HpCDD)	pg/g	220 J	290 J	150 J	180 J	210 J	220 J	140 J
Total hexachlorodibenzofuran (HxCDF)	pg/g	1.5 J	2.9 J	3.1 J	2.5 J	2.9 J	2.7 J	2.4 J
Total hexachlorodibenzo-p-dioxin (HxCDD)	pg/g	49 J	76 J	44 J	51 J	42 J	65 J	41 J
Total pentachlorodibenzofuran (PeCDF)	pg/g	0.34 U	0.92 J	1.3 J	0.86 J	1.1 J	0.69 J	0.82 J
Total pentachlorodibenzo-p-dioxin (PeCDD)	pg/g	7.9 J	13 J	9.2 J	7.6 J	8.0 J	12 J	6.9 J
Total tetrachlorodibenzofuran (TCDF)	pg/g	0.21 U	0.92 J	3.9 J	0.49 J	3.0 J	1.0 J	1.2 J
Total tetrachlorodibenzo-p-dioxin (TCDD)	pg/g	4.2 J	8.2 J	5.8 J	4.1 J	6.0 J	5.5 J	3.9 J
Total WHO Dioxin TEQ(Human/Mammal)(ND=0)	pg/g	2.00	2.52	2.95	1.61	2.83	2.27	1.62
Total WHO Dioxin TEQ(Human/Mammal)(ND=0.5)	pg/g	2.48	2.64	3.03	1.71	2.91	2.35	1.70

Notes:
pg/g - picogram per gram
U - Not detected at the associated reporting limit.
J - Estimated concentration.
UJ - Not detected; associated reporting limit is estimated

Table 2-3

Second Phase Pre-Design Investigation Analytical Results
Final 100% Remedial Design - Northern Impoundment
San Jacinto River Waste Pits Site
Harris County, Texas

Sample Location:	Units	SJSB051	SJSB052	SJSB052	SJSB052	SJSB052	SJSB052	SJSB052
Sample Identification:		11187072-091019-SS-SJSB051-S (16-18)	11187072-091219-SS-SJSB052-S (0-2)	11187072-091219-SS-SJSB052-S (2-4)	11187072-091219-SS-SJSB052-S (4-6)	11187072-091219-SS-SJSB052-S (6-8)	11187072-091219-SS-SJSB052-S (8-10)	11187072-091219-SS-SJSB052-S (10-12)
Sample Date:		9/10/2019	9/12/2019	9/12/2019	9/12/2019	9/12/2019	9/12/2019	9/12/2019
Sample Depth:		(16-18) ft bgs	(0-2) ft bgs	(2-4) ft bgs	(4-6) ft bgs	(6-8) ft bgs	(8-10) ft bgs	(10-12) ft bgs
Sample Type:								
Dioxins/Furans								
1,2,3,4,6,7,8,9-Octachlorodibenzofuran (OCDF)	pg/g	0.75 J	1.3 J	0.33 U	0.30 U	0.58 U	0.46 U	1.6 J
1,2,3,4,6,7,8,9-Octachlorodibenzo-p-dioxin (OCDD)	pg/g	1500	440	280	610	1200	640	1700
1,2,3,4,6,7,8-Heptachlorodibenzofuran (HpCDF)	pg/g	0.19 J	0.29 U	0.25 U	0.26 U	0.38 U	0.33 U	0.25 U
1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin (HpCDD)	pg/g	67	31	13	23	48	29	74
1,2,3,4,7,8,9-Heptachlorodibenzofuran (HpCDF)	pg/g	0.67 J	2.0 U	1.6 U	1.5 U	1.6 U	1.7 U	2.1 U
1,2,3,4,7,8-Hexachlorodibenzofuran (HxCDF)	pg/g	0.11 J	0.44 J	0.26 J	0.16 U	0.20 U	0.23 U	0.22 J
1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin (HxCDD)	pg/g	1.1 J	0.70 J	0.25 U	0.25 U	0.67 J	0.62 J	0.97 J
1,2,3,6,7,8-Hexachlorodibenzofuran (HxCDF)	pg/g	0.15 J	0.33 J	0.38 J	0.17 U	0.22 U	0.23 U	0.38 J
1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin (HxCDD)	pg/g	1.5 J	0.90 J	0.26 U	0.46 J	1.1 J	0.66 J	1.6 J
1,2,3,7,8,9-Hexachlorodibenzofuran (HxCDF)	pg/g	1.4 U	2.6 U	2.7 U	2.1 U	3.4 U	3.0 U	3.2 U
1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin (HxCDD)	pg/g	4.5 J	1.5 J	0.72 J	1.0 J	2.7 J	1.8 J	3.7 J
1,2,3,7,8-Pentachlorodibenzofuran (PeCDF)	pg/g	0.25 J	0.57 J	0.76 J	0.23 U	0.36 U	0.28 U	0.28 U
1,2,3,7,8-Pentachlorodibenzo-p-dioxin (PeCDD)	pg/g	0.33 J	0.36 U	0.38 U	0.33 U	0.47 U	0.48 U	0.37 U
2,3,4,6,7,8-Hexachlorodibenzofuran (HxCDF)	pg/g	0.023 U	0.13 U	0.16 U	0.13 U	0.16 U	0.19 U	0.14 U
2,3,4,7,8-Pentachlorodibenzofuran (PeCDF)	pg/g	0.045 U	0.25 U	0.29 U	0.25 U	0.38 U	0.31 U	0.32 U
2,3,7,8-Tetrachlorodibenzofuran (TCDF)	pg/g	0.11 J	2.8	3.8	3.2	0.43 J	1.8	0.46 J
2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	pg/g	0.19 J	0.58 J	0.78 J	0.76 J	0.30 U	0.56 J	0.40 J
Total heptachlorodibenzofuran (HpCDF)	pg/g	1.3 J	2.0 J	1.6 J	1.5 J	1.6 J	1.7 J	2.1 J
Total heptachlorodibenzo-p-dioxin (HpCDD)	pg/g	240 J	58 J	38 J	79 J	170 J	100 J	210 J
Total hexachlorodibenzofuran (HxCDF)	pg/g	2.1 J	4.4 J	4.5 J	2.9 J	4.7 J	4.2 J	5.1 J
Total hexachlorodibenzo-p-dioxin (HxCDD)	pg/g	66 J	11 J	7.6 J	17 J	41 J	30 J	48 J
Total pentachlorodibenzofuran (PeCDF)	pg/g	0.68 J	0.57 J	0.76 J	0.25 U	0.38 U	0.31 U	0.32 U
Total pentachlorodibenzo-p-dioxin (PeCDD)	pg/g	9.7 J	0.39 J	0.38 U	0.95 J	4.6 J	4.7 J	8.7 J
Total tetrachlorodibenzofuran (TCDF)	pg/g	0.70 J	3.8 J	4.3 J	4.6 J	0.43 J	2.6 J	1.2 J
Total tetrachlorodibenzo-p-dioxin (TCDD)	pg/g	5.2 J	0.80 J	0.78 J	1.3 J	1.9 J	2.3 J	5.2 J
Total WHO Dioxin TEQ(Human/Mammal)(ND=0)	pg/g	2.40	1.71	1.53	1.64	1.33	1.53	2.38
Total WHO Dioxin TEQ(Human/Mammal)(ND=0.5)	pg/g	2.48	2.07	1.94	1.99	1.99	2.01	2.80

Notes:
pg/g - picogram per gram
U - Not detected at the associated reporting limit.
J - Estimated concentration.
UJ - Not detected; associated reporting limit is estimated

Table 2-3

Second Phase Pre-Design Investigation Analytical Results
Final 100% Remedial Design - Northern Impoundment
San Jacinto River Waste Pits Site
Harris County, Texas

Sample Location: Sample Identification: Sample Date: Sample Depth: Sample Type:	Units	SJSB052 11187072-091219-SS-SJSB052-S (12-14) 9/12/2019 (12-14) ft bgs	SJSB052 11187072-091219-SS-SJSB052-S (14-16) 9/12/2019 (14-16) ft bgs	SJSB052 11187072-091219-SS-DUP-4 9/12/2019 (16-18) ft bgs Duplicate	SJSB052 11187072-091219-SS-SJSB052-S (16-18) 9/12/2019 (16-18) ft bgs	SJSB052-C1 11187072-100819-SS-SJSB052-C1 (0-2) 10/8/2019 (0-2) ft bgs	SJSB052-C1 11187072-100819-SS-SJSB052-C1 (2-4) 10/8/2019 (2-4) ft bgs	SJSB052-C1 11187072-100819-SS-SJSB052-C1 (4-6) 10/8/2019 (4-6) ft bgs
Dioxins/Furans								
1,2,3,4,6,7,8,9-Octachlorodibenzofuran (OCDF)	pg/g	0.30 U	0.32 U	0.34 U	0.38 U	1.4 J	0.31 J	0.53 J
1,2,3,4,6,7,8,9-Octachlorodibenzo-p-dioxin (OCDD)	pg/g	1500	140	1400	1000	1300	460	100
1,2,3,4,6,7,8-Heptachlorodibenzofuran (HpCDF)	pg/g	0.25 U	0.27 U	0.32 U	0.31 U	0.47 J	0.12 J	0.12 J
1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin (HpCDD)	pg/g	53	4.4 J	55	46	39	33	3.0 J
1,2,3,4,7,8,9-Heptachlorodibenzofuran (HpCDF)	pg/g	1.7 U	2.5 U	2.0 U	2.5 U	0.26 J	0.075 J	0.027 U
1,2,3,4,7,8-Hexachlorodibenzofuran (HxCDF)	pg/g	0.20 U	0.21 U	0.21 U	0.25 U	0.75 J	0.066 J	0.10 J
1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin (HxCDD)	pg/g	0.61 J	0.25 U	0.90 J	0.59 J	0.86 U	0.51 U	0.22 U
1,2,3,6,7,8-Hexachlorodibenzofuran (HxCDF)	pg/g	0.19 U	0.44 J	0.23 U	0.26 U	0.28 J	0.040 J	0.038 U
1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin (HxCDD)	pg/g	1.1 J	0.26 U	2.2 J	1.1 J	1.1 J	0.98 J	0.13 J
1,2,3,7,8,9-Hexachlorodibenzofuran (HxCDF)	pg/g	3.0 U	3.8 U	3.0 U	4.1 U	0.30 J	0.15 J	0.088 J
1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin (HxCDD)	pg/g	3.1 J	0.24 U	3.1 J	3.0 J	2.3 J	2.0 J	0.18 J
1,2,3,7,8-Pentachlorodibenzofuran (PeCDF)	pg/g	0.24 U	0.67 U	0.54 U	1.1 U	0.75 J	0.15 J	0.041 U
1,2,3,7,8-Pentachlorodibenzo-p-dioxin (PeCDD)	pg/g	0.36 U	0.29 U	5.2 J	0.39 U	0.44 J	0.21 J	0.071 U
2,3,4,6,7,8-Hexachlorodibenzofuran (HxCDF)	pg/g	0.16 U	0.17 U	0.18 U	0.20 U	0.13 J	0.044 J	0.030 U
2,3,4,7,8-Pentachlorodibenzofuran (PeCDF)	pg/g	0.26 U	0.31 U	0.31 U	0.33 U	0.47 J	0.043 U	0.042 U
2,3,7,8-Tetrachlorodibenzofuran (TCDF)	pg/g	0.44 J	0.15 U	1.0 J	49 J	23	0.41 J	0.85 J
2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	pg/g	0.33 J	0.19 U	3.0	5.5	5.0	0.11 J	0.24 J
Total heptachlorodibenzofuran (HpCDF)	pg/g	1.7 J	2.5 J	2.0 J	2.5 J	0.96 J	0.25 J	0.16 J
Total heptachlorodibenzo-p-dioxin (HpCDD)	pg/g	170 J	14 J	170 J	140 J	120 J	68 J	8.4 J
Total hexachlorodibenzofuran (HxCDF)	pg/g	4.7 J	6.3 J	5.7 J	6.1 J	1.5 J	0.30 J	0.19 J
Total hexachlorodibenzo-p-dioxin (HxCDD)	pg/g	38 J	2.8 J	52 J	37 J	21 J	15 J	1.7 J
Total pentachlorodibenzofuran (PeCDF)	pg/g	0.27 U	0.67 J	7.7 J	1.9 J	2.8 J	0.33 J	0.061 U
Total pentachlorodibenzo-p-dioxin (PeCDD)	pg/g	3.0 J	0.29 U	19 J	5.9 J	10 J	2.8 J	0.29 J
Total tetrachlorodibenzofuran (TCDF)	pg/g	0.93 J	0.15 U	1.9 J	88 J	47 J	1.8 J	1.7 J
Total tetrachlorodibenzo-p-dioxin (TCDD)	pg/g	2.3 J	0.19 U	8.0 J	8.5 J	13 J	1.8 J	0.57 J
Total WHO Dioxin TEQ(Human/Mammal)(ND=0)	pg/g	1.84	0.130	9.89	11.6	9.18	1.16	0.436
Total WHO Dioxin TEQ(Human/Mammal)(ND=0.5)	pg/g	2.24	0.694	10.1	12.1	9.22	1.20	0.493

Notes:
pg/g - picogram per gram
U - Not detected at the associated reporting limit.
J - Estimated concentration.
UJ - Not detected; associated reporting limit is estimated

Table 2-3

Second Phase Pre-Design Investigation Analytical Results
Final 100% Remedial Design - Northern Impoundment
San Jacinto River Waste Pits Site
Harris County, Texas

Sample Location:	Units	SJSB052-C1	SJSB052-C1	SJSB052-C1	SJSB052-C1	SJSB052-C1	SJSB052-C1	SJSB053
Sample Identification:		11187072-100819-SS-SJSB052-C1 (6-8)	11187072-100819-SS-SJSB052-C1 (8-10)	11187072-100819-SS-SJSB052-C1 (10-12)	11187072-100819-SS-SJSB052-C1 (12-14)	11187072-100819-SS-SJSB052-C1 (14-16)	11187072-100819-SS-SJSB052-C1 (16-18)	11187072-101319-SS-SJSB053 (0-2)
Sample Date:		10/8/2019	10/8/2019	10/8/2019	10/8/2019	10/8/2019	10/8/2019	10/13/2019
Sample Depth:		(6-8) ft bgs	(8-10) ft bgs	(10-12) ft bgs	(12-14) ft bgs	(14-16) ft bgs	(16-18) ft bgs	(0-2) ft bgs
Sample Type:								
Dioxins/Furans								
1,2,3,4,6,7,8,9-Octachlorodibenzofuran (OCDF)	pg/g	0.25 J	0.37 U	0.17 U	0.69 U	0.26 U	0.24 U	10 U
1,2,3,4,6,7,8,9-Octachlorodibenzo-p-dioxin (OCDD)	pg/g	790	1400	740 J	1100	900	1300	720
1,2,3,4,6,7,8-Heptachlorodibenzofuran (HpCDF)	pg/g	0.13 J	0.13 U	0.079 U	0.25 U	0.13 U	0.13 U	2.1 J
1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin (HpCDD)	pg/g	31	60	31	43	39	56	36
1,2,3,4,7,8,9-Heptachlorodibenzofuran (HpCDF)	pg/g	0.072 J	0.12 J	0.037 U	0.055 U	0.076 J	0.087 J	0.32 U
1,2,3,4,7,8-Hexachlorodibenzofuran (HxCDF)	pg/g	0.035 U	0.12 J	0.059 U	0.057 U	0.088 J	0.048 U	0.27 U
1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin (HxCDD)	pg/g	0.50 U	0.73 U	0.67 U	0.72 U	0.83 U	0.78 U	0.57 J
1,2,3,6,7,8-Hexachlorodibenzofuran (HxCDF)	pg/g	0.093 J	0.13 J	0.060 U	0.099 J	0.092 J	0.087 J	0.32 U
1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin (HxCDD)	pg/g	0.83 J	1.5 J	0.91 J	1.1 J	1.1 J	1.5 J	1.1 J
1,2,3,7,8,9-Hexachlorodibenzofuran (HxCDF)	pg/g	0.17 J	0.26 U	0.13 U	0.21 U	0.17 U	0.18 U	0.17 U
1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin (HxCDD)	pg/g	2.0 J	3.8 J	2.1 J	3.0 J	3.2 J	4.0 J	2.1 J
1,2,3,7,8-Pentachlorodibenzofuran (PeCDF)	pg/g	0.11 J	0.077 U	0.055 U	0.060 U	0.058 U	0.051 U	0.16 U
1,2,3,7,8-Pentachlorodibenzo-p-dioxin (PeCDD)	pg/g	0.20 J	0.33 J	0.24 J	0.31 J	0.42 J	0.33 J	0.34 U
2,3,4,6,7,8-Hexachlorodibenzofuran (HxCDF)	pg/g	0.028 U	0.049 U	0.047 U	0.078 J	0.083 J	0.065 J	0.18 U
2,3,4,7,8-Pentachlorodibenzofuran (PeCDF)	pg/g	0.041 U	0.081 U	0.059 U	0.064 U	0.059 U	0.052 U	0.18 U
2,3,7,8-Tetrachlorodibenzofuran (TCDF)	pg/g	0.74 J	0.28 J	0.11 J	0.056 U	0.22 J	0.044 U	0.33 J
2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	pg/g	0.30 J	0.32 J	0.25 J	0.15 J	0.17 J	0.17 J	0.53 J
Total heptachlorodibenzofuran (HpCDF)	pg/g	0.20 J	0.25 J	0.079 J	0.25 J	0.21 J	0.22 J	5.8 J
Total heptachlorodibenzo-p-dioxin (HpCDD)	pg/g	100 J	180 J	120 J	150 J	140 J	180 J	120 J
Total hexachlorodibenzofuran (HxCDF)	pg/g	0.26 J	0.51 J	0.13 J	0.39 J	0.43 J	0.33 J	0.55 J
Total hexachlorodibenzo-p-dioxin (HxCDD)	pg/g	26 J	40 J	29 J	44 J	43 J	49 J	26 J
Total pentachlorodibenzofuran (PeCDF)	pg/g	0.11 J	0.094 U	0.073 U	0.071 U	0.067 U	0.059 U	0.18 U
Total pentachlorodibenzo-p-dioxin (PeCDD)	pg/g	6.2 J	7.0 J	5.0 J	10 J	9.0 J	11 J	3.7 J
Total tetrachlorodibenzofuran (TCDF)	pg/g	2.1 J	1.4 J	1.3 J	0.85 J	1.1 J	1.5 J	0.76 J
Total tetrachlorodibenzo-p-dioxin (TCDD)	pg/g	3.9 J	4.4 J	3.6 J	5.4 J	3.9 J	6.6 J	2.8 J
Total WHO Dioxin TEQ(Human/Mammal)(ND=0)	pg/g	1.44	2.25	1.33	1.65	1.73	2.02	1.54
Total WHO Dioxin TEQ(Human/Mammal)(ND=0.5)	pg/g	1.47	2.32	1.39	1.71	1.79	2.08	1.79

Notes:
pg/g - picogram per gram
U - Not detected at the associated reporting limit.
J - Estimated concentration.
UJ - Not detected; associated reporting limit is estimated

Table 2-3

Second Phase Pre-Design Investigation Analytical Results
Final 100% Remedial Design - Northern Impoundment
San Jacinto River Waste Pits Site
Harris County, Texas

Sample Location:	Units	SJSB053	SJSB053	SJSB053	SJSB053	SJSB053	SJSB053	SJSB053
Sample Identification:		11187072-101319-SS-SJSB053 (2-4)	11187072-101319-SS-SJSB053 (4-6)	11187072-101319-SS-SJSB053 (6-8)	11187072-101319-SS-SJSB053 (8-10)	11187072-101319-SS-SJSB053 (10-12)	11187072-101319-SS-SJSB053 (12-14)	11187072-101319-SS-SJSB053 (14-15)
Sample Date:		10/13/2019	10/13/2019	10/13/2019	10/13/2019	10/13/2019	10/13/2019	10/13/2019
Sample Depth:		(2-4) ft bgs	(4-6) ft bgs	(6-8) ft bgs	(8-10) ft bgs	(10-12) ft bgs	(12-14) ft bgs	(14-15) ft bgs
Sample Type:								
Dioxins/Furans								
1,2,3,4,6,7,8,9-Octachlorodibenzofuran (OCDF)	pg/g	0.57 U	1.1 U	2.0 U	2.8 U	0.50 U	0.29 U	120
1,2,3,4,6,7,8,9-Octachlorodibenzo-p-dioxin (OCDD)	pg/g	570	640	800	810	1300	21 U	2100
1,2,3,4,6,7,8-Heptachlorodibenzofuran (HpCDF)	pg/g	0.050 U	0.15 J	0.43 J	0.69 J	0.11 J	0.14 J	17
1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin (HpCDD)	pg/g	22	22	32	34	53	0.97 J	110 J
1,2,3,4,7,8,9-Heptachlorodibenzofuran (HpCDF)	pg/g	0.053 U	0.050 U	0.073 U	0.067 U	0.060 U	0.048 U	1.4 J
1,2,3,4,7,8-Hexachlorodibenzofuran (HxCDF)	pg/g	0.096 U	0.095 U	0.096 U	0.12 U	0.086 U	0.10 U	0.28 J
1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin (HxCDD)	pg/g	0.42 J	0.42 J	0.62 J	0.42 J	0.51 J	0.25 J	0.75 J
1,2,3,6,7,8-Hexachlorodibenzofuran (HxCDF)	pg/g	0.097 U	0.093 U	0.095 U	0.12 U	0.087 U	0.099 U	0.44 J
1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin (HxCDD)	pg/g	0.52 J	0.54 J	0.79 J	0.80 J	1.1 J	0.12 J	2.3 J
1,2,3,7,8,9-Hexachlorodibenzofuran (HxCDF)	pg/g	0.10 J	0.067 U	0.094 J	0.089 U	0.16 J	0.077 U	0.14 J
1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin (HxCDD)	pg/g	1.3 J	1.3 J	2.1 J	2.3 J	3.3 J	0.18 J	5.1 J
1,2,3,7,8-Pentachlorodibenzofuran (PeCDF)	pg/g	0.063 U	0.087 U	0.099 U	0.093 U	0.088 U	0.066 U	0.062 U
1,2,3,7,8-Pentachlorodibenzo-p-dioxin (PeCDD)	pg/g	0.13 U	0.17 U	0.19 U	0.14 U	0.25 J	0.12 U	0.21 J
2,3,4,6,7,8-Hexachlorodibenzofuran (HxCDF)	pg/g	0.075 U	0.074 U	0.072 U	0.099 U	0.071 U	0.081 U	0.19 J
2,3,4,7,8-Pentachlorodibenzofuran (PeCDF)	pg/g	0.065 U	0.088 U	0.099 U	0.096 U	0.087 U	0.068 U	0.063 U
2,3,7,8-Tetrachlorodibenzofuran (TCDF)	pg/g	0.22 J	1.3 J	0.98 J	0.23 J	0.14 U	0.13 U	0.057 U
2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	pg/g	0.18 J	0.55 J	0.29 J	0.21 J	0.15 U	0.11 U	0.24 J
Total heptachlorodibenzofuran (HpCDF)	pg/g	0.053 U	0.33 J	1.0 J	1.7 J	0.11 J	0.14 J	58 J
Total heptachlorodibenzo-p-dioxin (HpCDD)	pg/g	81 J	79 J	110 J	130 J	180 J	3.2 J	250 J
Total hexachlorodibenzofuran (HxCDF)	pg/g	0.10 J	0.095 U	0.094 J	0.12 U	0.16 J	0.10 U	6.3 J
Total hexachlorodibenzo-p-dioxin (HxCDD)	pg/g	20 J	18 J	28 J	31 J	38 J	1.2 J	41 J
Total pentachlorodibenzofuran (PeCDF)	pg/g	0.086 U	0.11 U	0.13 U	0.14 U	0.097 U	0.092 U	0.19 J
Total pentachlorodibenzo-p-dioxin (PeCDD)	pg/g	3.8 J	3.2 J	4.0 J	4.7 J	5.7 J	0.12 U	8.3 J
Total tetrachlorodibenzofuran (TCDF)	pg/g	0.55 J	1.7 J	1.7 J	0.64 J	0.55 J	0.13 U	0.18 J
Total tetrachlorodibenzo-p-dioxin (TCDD)	pg/g	2.3 J	1.7 J	2.6 J	2.9 J	2.6 J	0.11 U	2.9 J
Total WHO Dioxin TEQ(Human/Mammal)(ND=0)	pg/g	0.827	1.32	1.31	1.17	1.68	0.0660	3.32
Total WHO Dioxin TEQ(Human/Mammal)(ND=0.5)	pg/g	0.917	1.44	1.44	1.28	1.79	0.220	3.33

Notes:
- pg/g - picogram per gram
- U - Not detected at the associated reporting limit.
- J - Estimated concentration.
- UJ - Not detected; associated reporting limit is estimated

Table 2-3

Second Phase Pre-Design Investigation Analytical Results
Final 100% Remedial Design - Northern Impoundment
San Jacinto River Waste Pits Site
Harris County, Texas

Sample Location: Sample Identification: Sample Date: Sample Depth: Sample Type:	Units	SJSB053 11187072-111019-KW-SJSB053-S(14-16) 11/10/2019 (14-16) ft bgs	SJSB053 11187072-111019-KW-SJSB053-S(16-18) 11/10/2019 (16-18) ft bgs	SJSB053-C1 11187072-110919-KW-SJSB053-C1-S (0-2) 11/9/2019 (0-2) ft bgs	SJSB053-C1 11187072-110919-KW-SJSB053-C1-S (2-4) 11/9/2019 (2-4) ft bgs	SJSB053-C1 11187072-110919-KW-SJSB053-C1-S (4-6) 11/9/2019 (4-6) ft bgs	SJSB053-C1 11187072-110919-KW-SJSB053-C1-S (6-8) 11/9/2019 (6-8) ft bgs
Dioxins/Furans							
1,2,3,4,6,7,8,9-Octachlorodibenzofuran (OCDF)	pg/g	1.5 U	0.59 U	1.8 U	3.4 U	3.3 U	9.3 U
1,2,3,4,6,7,8,9-Octachlorodibenzo-p-dioxin (OCDD)	pg/g	92	130	150	600	940	1000
1,2,3,4,6,7,8-Heptachlorodibenzofuran (HpCDF)	pg/g	0.25 U	0.14 U	0.19 U	0.40 U	0.47 U	0.71 U
1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin (HpCDD)	pg/g	2.8 J	4.0 J	7.1	24	38	42
1,2,3,4,7,8,9-Heptachlorodibenzofuran (HpCDF)	pg/g	0.12 U	0.073 U	0.12 U	0.21 U	0.25 U	0.35 U
1,2,3,4,7,8-Hexachlorodibenzofuran (HxCDF)	pg/g	0.068 U	0.059 U	0.066 U	0.074 U	0.15 U	0.14 J
1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin (HxCDD)	pg/g	0.31 U	0.27 U	0.31 U	0.41 U	0.57 U	0.60 U
1,2,3,6,7,8-Hexachlorodibenzofuran (HxCDF)	pg/g	0.067 U	0.058 U	0.063 U	0.070 U	0.15 U	0.14 J
1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin (HxCDD)	pg/g	0.25 J	0.19 J	0.22 J	0.65 J	0.80 J	1.0 J
1,2,3,7,8,9-Hexachlorodibenzofuran (HxCDF)	pg/g	0.13 U	0.12 U	0.14 U	0.054 U	0.20 U	0.27 U
1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin (HxCDD)	pg/g	0.33 U	0.41 U	0.35 U	1.5 J	1.9 J	2.4 J
1,2,3,7,8-Pentachlorodibenzofuran (PeCDF)	pg/g	0.13 U	0.14 U	0.047 U	0.16 U	0.17 U	0.14 U
1,2,3,7,8-Pentachlorodibenzo-p-dioxin (PeCDD)	pg/g	0.16 J	0.16 J	0.13 J	0.099 U	0.23 J	0.14 U
2,3,4,6,7,8-Hexachlorodibenzofuran (HxCDF)	pg/g	0.049 U	0.069 J	0.048 U	0.052 U	0.11 U	0.074 J
2,3,4,7,8-Pentachlorodibenzofuran (PeCDF)	pg/g	0.058 U	0.050 U	0.047 U	0.050 U	0.061 U	0.084 J
2,3,7,8-Tetrachlorodibenzofuran (TCDF)	pg/g	0.068 J	0.057 J	1.1 J	0.14 J	0.15 J	0.094 J
2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	pg/g	0.062 U	0.046 U	0.37 J	0.11 J	0.092 J	0.15 J
Total heptachlorodibenzofuran (HpCDF)	pg/g	0.37 J	0.21 J	0.39 J	0.77 J	0.72 J	1.5 J
Total heptachlorodibenzo-p-dioxin (HpCDD)	pg/g	10 J	17 J	26 J	86 J	130 J	160 J
Total hexachlorodibenzofuran (HxCDF)	pg/g	0.13 J	0.19 J	0.14 J	0.074 U	0.20 J	0.63 J
Total hexachlorodibenzo-p-dioxin (HxCDD)	pg/g	3.5 J	6.6 J	5.8 J	21 J	29 J	39 J
Total pentachlorodibenzofuran (PeCDF)	pg/g	0.13 J	0.14 J	0.048 U	0.16 J	0.17 J	0.31 J
Total pentachlorodibenzo-p-dioxin (PeCDD)	pg/g	0.67 J	2.0 J	0.84 J	4.8 J	5.4 J	6.0 J
Total tetrachlorodibenzofuran (TCDF)	pg/g	0.068 J	0.12 J	1.8 J	0.34 J	0.44 J	0.27 J
Total tetrachlorodibenzo-p-dioxin (TCDD)	pg/g	1.1 J	2.6 J	0.83 J	2.9 J	2.9 J	3.3 J
Total WHO Dioxin TEQ(Human/Mammal)(ND=0)	pg/g	0.247	0.271	0.748	0.759	1.27	1.28
Total WHO Dioxin TEQ(Human/Mammal)(ND=0.5)	pg/g	0.339	0.350	0.806	0.855	1.34	1.40

Notes:
pg/g - picogram per gram
U - Not detected at the associated reporting limit.
J - Estimated concentration.
UJ - Not detected; associated reporting limit is estimated.

Table 2-3

Second Phase Pre-Design Investigation Analytical Results
Final 100% Remedial Design - Northern Impoundment
San Jacinto River Waste Pits Site
Harris County, Texas

Sample Location:	Units	SJSB053-C1	SJSB053-C1	SJSB053-C1	SJSB053-C1	SJSB054	SJSB054	SJSB054
Sample Identification:		11187072-110919-KW-SJSB053-C1-S (8-10)	11187072-110919-KW-SJSB053-C1-S (10-12)	11187072-110919-KW-SJSB053-C1-S (12-14)	11187072-110919-KW-SJSB053-C1-S (14-16)	11187072-101319-SS-SJSB054 (0-2)	11187072-101319-SS-SJSB054 (2-4)	11187072-101319-SS-SJSB054 (4-6)
Sample Date:		11/9/2019	11/9/2019	11/9/2019	11/9/2019	10/13/2019	10/13/2019	10/13/2019
Sample Depth:		(8-10) ft bgs	(10-12) ft bgs	(12-14) ft bgs	(14-16) ft bgs	(0-2) ft bgs	(2-4) ft bgs	(4-6) ft bgs
Sample Type:								
Dioxins/Furans								
1,2,3,4,6,7,8,9-Octachlorodibenzofuran (OCDF)	pg/g	0.82 U	0.80 U	0.82 U	1.1 U	130 J	29 U	0.36 U
1,2,3,4,6,7,8,9-Octachlorodibenzo-p-dioxin (OCDD)	pg/g	510	1300	410	1300	690	310	1400
1,2,3,4,6,7,8-Heptachlorodibenzofuran (HpCDF)	pg/g	0.13 U	0.13 U	0.12 U	0.23 U	370	66 J	0.23 U
1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin (HpCDD)	pg/g	18	50	15	57	49 J	15 J	53
1,2,3,4,7,8,9-Heptachlorodibenzofuran (HpCDF)	pg/g	0.033 U	0.087 U	0.028 U	0.053 U	150 J	29 J	0.092 U
1,2,3,4,7,8-Hexachlorodibenzofuran (HxCDF)	pg/g	0.056 U	0.062 U	0.067 J	0.091 U	1300	180	0.59 J
1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin (HxCDD)	pg/g	0.35 U	0.76 U	0.35 U	0.80 U	1.5 U	0.51 UJ	0.57 J
1,2,3,6,7,8-Hexachlorodibenzofuran (HxCDF)	pg/g	0.055 U	0.060 U	0.050 U	0.090 U	340	47 J	0.17 J
1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin (HxCDD)	pg/g	0.35 J	1.0 J	0.35 J	1.6 J	4.6 J	1.5 J	1.0 J
1,2,3,7,8,9-Hexachlorodibenzofuran (HxCDF)	pg/g	0.12 U	0.22 U	0.14 U	0.24 U	20 J	2.5 J	0.081 U
1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin (HxCDD)	pg/g	0.91 J	2.6 J	0.87 J	4.5 J	1.5 U	0.48 U	3.1 J
1,2,3,7,8-Pentachlorodibenzofuran (PeCDF)	pg/g	0.15 U	0.14 U	0.042 U	0.20 U	850	88	0.28 J
1,2,3,7,8-Pentachlorodibenzo-p-dioxin (PeCDD)	pg/g	0.097 U	0.25 J	0.14 J	0.31 J	140 J	13 J	0.35 J
2,3,4,6,7,8-Hexachlorodibenzofuran (HxCDF)	pg/g	0.068 J	0.048 J	0.056 J	0.062 U	42 J	5.1 J	0.064 U
2,3,4,7,8-Pentachlorodibenzofuran (PeCDF)	pg/g	0.047 U	0.047 U	0.078 J	0.056 U	730	78	0.24 J
2,3,7,8-Tetrachlorodibenzofuran (TCDF)	pg/g	0.92 J	0.10 J	1.6	0.18 J	50000 J	2900	13
2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	pg/g	0.29 J	0.18 J	0.39 J	0.22 J	11000	1200	3.2
Total heptachlorodibenzofuran (HpCDF)	pg/g	0.13 J	0.29 J	0.12 J	0.23 J	620 J	110 J	0.38 J
Total heptachlorodibenzo-p-dioxin (HpCDD)	pg/g	61 J	170 J	53 J	190 J	110 J	50 J	180 J
Total hexachlorodibenzofuran (HxCDF)	pg/g	0.19 J	0.27 J	0.26 J	0.24 J	1900 J	260 J	0.76 J
Total hexachlorodibenzo-p-dioxin (HxCDD)	pg/g	14 J	39 J	12 J	49 J	26 J	15 J	49 J
Total pentachlorodibenzofuran (PeCDF)	pg/g	0.15 J	0.14 J	0.078 J	0.20 J	2600 J	280 J	0.52 J
Total pentachlorodibenzo-p-dioxin (PeCDD)	pg/g	2.2 J	6.8 J	2.4 J	10 J	140 J	15 J	9.8 J
Total tetrachlorodibenzofuran (TCDF)	pg/g	1.6 J	0.25 J	2.2 J	0.92 J	89000 J	8800 J	24 J
Total tetrachlorodibenzo-p-dioxin (TCDD)	pg/g	1.7 J	3.4 J	1.6 J	6.7 J	12000 J	1300 J	10 J
Total WHO Dioxin TEQ(Human/Mammal)(ND=0)	pg/g	0.848	1.69	1.12	2.12	16600	1550	6.42
Total WHO Dioxin TEQ(Human/Mammal)(ND=0.5)	pg/g	0.936	1.76	1.15	2.20	16600	1550	6.43

Notes:
pg/g - picogram per gram
U - Not detected at the associated reporting limit.
J - Estimated concentration.
UJ - Not detected; associated reporting limit is estimated

Table 2-3

Second Phase Pre-Design Investigation Analytical Results
Final 100% Remedial Design - Northern Impoundment
San Jacinto River Waste Pits Site
Harris County, Texas

Sample Location:	Units	SJSB054	SJSB054	SJSB054	SJSB054	SJSB054	SJSB054	SJSB055
Sample Identification:		11187072-101319-SS-SJSB054 (6-8)	11187072-101319-SS-SJSB054 (8-10)	11187072-101319-SS-SJSB054 (10-12)	11187072-101319-SS-SJSB054 (12-14)	11187072-101319-SS-SJSB054 (14-16)	11187072-101319-SS-SJSB054 (16-18)	11187072-091019-SS-SJSB055-S (0-2)
Sample Date:		10/13/2019	10/13/2019	10/13/2019	10/13/2019	10/13/2019	10/13/2019	9/10/2019
Sample Depth:		(6-8) ft bgs	(8-10) ft bgs	(10-12) ft bgs	(12-14) ft bgs	(14-16) ft bgs	(16-18) ft bgs	(0-2) ft bgs
Sample Type:								
Dioxins/Furans								
1,2,3,4,6,7,8,9-Octachlorodibenzofuran (OCDF)	pg/g	0.24 U	0.28 U	0.19 U	4.2 U	0.63 U	0.25 U	0.61 J
1,2,3,4,6,7,8,9-Octachlorodibenzo-p-dioxin (OCDD)	pg/g	1900	1700	1300	550	310	2000	410 J
1,2,3,4,6,7,8-Heptachlorodibenzofuran (HpCDF)	pg/g	0.19 U	0.52 U	0.15 U	8.0	0.98 J	0.18 U	0.25 J
1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin (HpCDD)	pg/g	70	67	61	25	12	82	20
1,2,3,4,7,8,9-Heptachlorodibenzofuran (HpCDF)	pg/g	0.052 U	0.15 U	0.061 U	3.0 J	0.52 J	0.097 U	0.70 J
1,2,3,4,7,8-Hexachlorodibenzofuran (HxCDF)	pg/g	0.38 J	1.0 J	0.27 J	29	3.0 J	0.34 J	0.23 J
1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin (HxCDD)	pg/g	0.93 J	0.56 J	0.68 J	0.44 J	0.15 J	0.90 J	0.85 J
1,2,3,6,7,8-Hexachlorodibenzofuran (HxCDF)	pg/g	0.068 U	0.29 J	0.058 U	7.5	0.80 J	0.21 J	0.15 J
1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin (HxCDD)	pg/g	1.4 J	1.5 J	1.3 J	0.69 J	0.21 J	1.7 J	0.037 U
1,2,3,7,8,9-Hexachlorodibenzofuran (HxCDF)	pg/g	0.14 J	0.086 U	0.074 U	0.56 J	0.099 U	0.087 U	1.5 U
1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin (HxCDD)	pg/g	3.5 J	4.0 J	3.3 J	1.3 J	0.12 U	5.8 J	1.7 J
1,2,3,7,8-Pentachlorodibenzofuran (PeCDF)	pg/g	0.24 J	1.0 J	0.18 J	19	1.8 J	0.12 J	0.63 J
1,2,3,7,8-Pentachlorodibenzo-p-dioxin (PeCDD)	pg/g	0.27 J	0.47 J	0.38 J	3.4 J	0.30 J	0.43 J	0.30 J
2,3,4,6,7,8-Hexachlorodibenzofuran (HxCDF)	pg/g	0.071 U	0.066 U	0.059 U	1.0 J	0.079 U	0.070 U	0.020 U
2,3,4,7,8-Pentachlorodibenzofuran (PeCDF)	pg/g	0.087 U	0.78 J	0.072 U	17	1.6 J	0.20 J	0.051 U
2,3,7,8-Tetrachlorodibenzofuran (TCDF)	pg/g	9.4	39	9.2	850	82	11	1.1 J
2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	pg/g	2.8 J	11	2.4	270	23	2.6	0.22 J
Total heptachlorodibenzofuran (HpCDF)	pg/g	0.33 J	0.84 J	0.15 J	13 J	1.7 J	0.28 J	1.2 J
Total heptachlorodibenzo-p-dioxin (HpCDD)	pg/g	230 J	200 J	210 J	81 J	43 J	250 J	63 J
Total hexachlorodibenzofuran (HxCDF)	pg/g	0.52 J	1.3 J	0.27 J	43 J	4.3 J	0.55 J	2.9 J
Total hexachlorodibenzo-p-dioxin (HxCDD)	pg/g	55 J	43 J	53 J	21 J	11 J	68 J	20 J
Total pentachlorodibenzofuran (PeCDF)	pg/g	0.24 J	2.6 J	0.18 J	58 J	5.1 J	0.32 J	3.4 J
Total pentachlorodibenzo-p-dioxin (PeCDD)	pg/g	9.1 J	7.3 J	8.2 J	6.3 J	2.0 J	13 J	7.5 J
Total tetrachlorodibenzofuran (TCDF)	pg/g	21 J	79 J	18 J	2000 J	160 J	19 J	7.0 J
Total tetrachlorodibenzo-p-dioxin (TCDD)	pg/g	10 J	16 J	8.2 J	300 J	27 J	9.6 J	8.8 J
Total WHO Dioxin TEQ(Human/Mammal)(ND=0)	pg/g	5.92	17.5	5.26	369	32.7	6.51	1.27
Total WHO Dioxin TEQ(Human/Mammal)(ND=0.5)	pg/g	5.94	17.6	5.28	369	32.7	6.52	1.36

Notes:
pg/g - picogram per gram
U - Not detected at the associated reporting limit.
J - Estimated concentration.
UJ - Not detected; associated reporting limit is estimated

Table 2-3

Second Phase Pre-Design Investigation Analytical Results
Final 100% Remedial Design - Northern Impoundment
San Jacinto River Waste Pits Site
Harris County, Texas

Sample Location: Sample Identification: Sample Date: Sample Depth: Sample Type:	Units	SJSB055 11187072-091019-SS-SJSB055-S (2-4) 9/10/2019 (2-4) ft bgs	SJSB055 11187072-091019-SS-SJSB055-S (4-6) 9/10/2019 (4-6) ft bgs	SJSB055 11187072-091019-SS-SJSB055-S (6-8) 9/10/2019 (6-8) ft bgs	SJSB055 11187072-091019-SS-SJSB055-S (8-10) 9/10/2019 (8-10) ft bgs	SJSB055 11187072-091019-SS-SJSB055-S (10-12) 9/10/2019 (10-12) ft bgs	SJSB055 11187072-091019-SS-SJSB055-S (12-14) 9/10/2019 (12-14) ft bgs	SJSB055 11187072-091019-SS-SJSB055-S (14-16) 9/10/2019 (14-16) ft bgs
Dioxins/Furans								
1,2,3,4,6,7,8,9-Octachlorodibenzofuran (OCDF)	pg/g	0.72 J	0.57 J	0.79 J	1.4 J	1.5 J	0.72 J	1.6 J
1,2,3,4,6,7,8,9-Octachlorodibenzo-p-dioxin (OCDD)	pg/g	280	240	720	260	110	300	630
1,2,3,4,6,7,8-Heptachlorodibenzofuran (HpCDF)	pg/g	0.26 J	0.19 J	0.29 J	0.28 J	0.32 J	0.21 J	0.41 J
1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin (HpCDD)	pg/g	24	11	27	9.0	4.3 J	16	29
1,2,3,4,7,8,9-Heptachlorodibenzofuran (HpCDF)	pg/g	0.69 J	0.79 J	0.83 J	0.69 J	0.88 J	0.61 J	1.2 J
1,2,3,4,7,8-Hexachlorodibenzofuran (HxCDF)	pg/g	0.16 J	0.16 J	0.17 J	0.29 J	0.28 J	0.17 J	0.25 J
1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin (HxCDD)	pg/g	0.51 J	0.31 J	0.62 J	0.37 J	0.41 J	0.46 J	0.84 J
1,2,3,6,7,8-Hexachlorodibenzofuran (HxCDF)	pg/g	0.15 J	0.022 U	0.14 J	0.15 J	0.25 J	0.15 J	0.20 J
1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin (HxCDD)	pg/g	0.63 J	0.35 J	0.64 J	0.32 J	0.33 J	0.41 J	0.63 J
1,2,3,7,8,9-Hexachlorodibenzofuran (HxCDF)	pg/g	1.2 U	1.4 U	1.8 U	1.4 U	1.4 U	1.1 U	2.0 U
1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin (HxCDD)	pg/g	1.2 J	0.74 J	1.7 J	0.57 J	0.45 J	1.3 J	2.3 J
1,2,3,7,8-Pentachlorodibenzofuran (PeCDF)	pg/g	0.22 J	0.24 J	0.27 J	0.43 J	0.30 J	0.25 J	0.29 J
1,2,3,7,8-Pentachlorodibenzo-p-dioxin (PeCDD)	pg/g	0.21 J	0.12 J	0.17 J	0.12 J	0.17 J	0.16 J	0.26 J
2,3,4,6,7,8-Hexachlorodibenzofuran (HxCDF)	pg/g	0.13 J	0.019 U	0.019 U	0.020 U	0.016 U	0.015 U	0.021 U
2,3,4,7,8-Pentachlorodibenzofuran (PeCDF)	pg/g	0.089 J	0.091 J	0.14 J	0.21 J	0.17 J	0.11 J	0.15 J
2,3,7,8-Tetrachlorodibenzofuran (TCDF)	pg/g	0.38 J	0.19 J	0.13 J	5.1	0.69 J	0.79 J	0.15 J
2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	pg/g	0.12 J	0.22 J	0.13 J	1.4	0.26 J	0.25 J	0.075 J
Total heptachlorodibenzofuran (HpCDF)	pg/g	1.2 J	1.2 J	1.6 J	1.4 J	1.6 J	1.0 J	2.0 J
Total heptachlorodibenzo-p-dioxin (HpCDD)	pg/g	58 J	44 J	110 J	30 J	13 J	70 J	130 J
Total hexachlorodibenzofuran (HxCDF)	pg/g	2.3 J	2.4 J	3.3 J	2.7 J	2.9 J	2.0 J	3.9 J
Total hexachlorodibenzo-p-dioxin (HxCDD)	pg/g	13 J	11 J	29 J	8.3 J	3.5 J	22 J	36 J
Total pentachlorodibenzofuran (PeCDF)	pg/g	0.66 J	0.85 J	1.1 J	1.5 J	0.88 J	0.75 J	1.3 J
Total pentachlorodibenzo-p-dioxin (PeCDD)	pg/g	1.9 J	1.2 J	5.1 J	1.6 J	0.76 J	4.3 J	6.0 J
Total tetrachlorodibenzofuran (TCDF)	pg/g	1.0 J	0.69 J	0.83 J	9.2 J	1.3 J	1.8 J	0.56 J
Total tetrachlorodibenzo-p-dioxin (TCDD)	pg/g	1.5 J	2.0 J	4.0 J	2.8 J	0.86 J	3.1 J	3.5 J
Total WHO Dioxin TEQ(Human/Mammal)(ND=0)	pg/g	1.01	0.741	1.19	2.45	0.819	1.04	1.32
Total WHO Dioxin TEQ(Human/Mammal)(ND=0.5)	pg/g	1.07	0.814	1.28	2.53	0.890	1.09	1.42

Notes:
pg/g - picogram per gram
U - Not detected at the associated reporting limit.
J - Estimated concentration.
UJ - Not detected; associated reporting limit is estimated.

Table 2-3

Second Phase Pre-Design Investigation Analytical Results
Final 100% Remedial Design - Northern Impoundment
San Jacinto River Waste Pits Site
Harris County, Texas

Sample Location: / Sample Identification: / Sample Date: / Sample Depth: / Sample Type:	Units	SJSB055 / 11187072-091019-SS-SJSB055-S (16-18) / 9/10/2019 / (16-18) ft bgs	SJSB055 / 11187072-101419-SS-SJSB055 C1 (0-2) / 10/14/2019 / (0-2) ft bgs	SJSB055 / 11187072-101419-SS-SJSB055 C1 (2-4) / 10/14/2019 / (2-4) ft bgs	SJSB055 / 11187072-101419-SS-SJSB055 C1 (4-6) / 10/14/2019 / (4-6) ft bgs	SJSB055 / 11187072-101419-SS-SJSB055 C1 (6-8) / 10/14/2019 / (6-8) ft bgs	SJSB055 / 11187072-101419-SS-SJSB055 C1 (8-10) / 10/14/2019 / (8-10) ft bgs	SJSB055 / 11187072-101419-SS-SJSB055 C1 (10-12) / 10/14/2019 / (10-12) ft bgs
Dioxins/Furans								
1,2,3,4,6,7,8,9-Octachlorodibenzofuran (OCDF)	pg/g	0.60 J	2.7 J	1.3 J	0.14 U	0.35 J	0.43 J	0.50 J
1,2,3,4,6,7,8,9-Octachlorodibenzo-p-dioxin (OCDD)	pg/g	400	860	600	430	250	670	500
1,2,3,4,6,7,8-Heptachlorodibenzofuran (HpCDF)	pg/g	0.16 J	1.2 J	0.61 U	0.12 U	0.12 U	0.12 U	0.068 U
1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin (HpCDD)	pg/g	19	34	24	19	12	31	23
1,2,3,4,7,8,9-Heptachlorodibenzofuran (HpCDF)	pg/g	0.58 J	0.48 J	0.33 J	0.071 J	0.094 J	0.044 U	0.083 J
1,2,3,4,7,8-Hexachlorodibenzofuran (HxCDF)	pg/g	0.12 J	1.9 J	1.6 J	0.11 U	0.075 U	0.088 U	0.078 U
1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin (HxCDD)	pg/g	0.49 J	0.77 U	0.49 U	0.33 U	0.35 U	0.54 U	0.44 U
1,2,3,6,7,8-Hexachlorodibenzofuran (HxCDF)	pg/g	0.12 J	0.58 J	0.58 J	0.10 U	0.070 U	0.083 U	0.073 U
1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin (HxCDD)	pg/g	0.47 J	0.88 J	0.65 J	0.48 J	0.31 J	0.59 J	0.41 J
1,2,3,7,8,9-Hexachlorodibenzofuran (HxCDF)	pg/g	1.4 U	0.24 J	0.17 J	0.067 U	0.092 J	0.15 J	0.12 J
1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin (HxCDD)	pg/g	1.9 J	2.3 J	1.7 J	1.5 J	1.3 J	2.7 J	1.9 J
1,2,3,7,8-Pentachlorodibenzofuran (PeCDF)	pg/g	0.19 J	1.4 J	1.3 J	0.062 U	0.052 U	0.078 U	0.052 U
1,2,3,7,8-Pentachlorodibenzo-p-dioxin (PeCDD)	pg/g	0.17 J	0.61 J	0.43 J	0.15 U	0.13 U	0.15 U	0.21 J
2,3,4,6,7,8-Hexachlorodibenzofuran (HxCDF)	pg/g	0.018 U	0.25 J	0.098 J	0.072 U	0.045 U	0.058 U	0.048 U
2,3,4,7,8-Pentachlorodibenzofuran (PeCDF)	pg/g	0.085 J	1.3 J	1.2 J	0.064 U	0.055 U	0.084 U	0.053 U
2,3,7,8-Tetrachlorodibenzofuran (TCDF)	pg/g	0.12 J	110	93	2.1	0.39 J	0.26 J	0.62 J
2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	pg/g	0.025 U	21	20	0.49 J	0.19 J	0.12 U	0.22 J
Total heptachlorodibenzofuran (HpCDF)	pg/g	0.97 J	2.5 J	1.3 J	0.20 J	0.21 J	0.12 J	0.15 J
Total heptachlorodibenzo-p-dioxin (HpCDD)	pg/g	89 J	140 J	100 J	84 J	55 J	150 J	110 J
Total hexachlorodibenzofuran (HxCDF)	pg/g	2.5 J	3.3 J	2.7 J	0.11 U	0.092 J	0.15 J	0.12 J
Total hexachlorodibenzo-p-dioxin (HxCDD)	pg/g	29 J	29 J	24 J	21 J	18 J	35 J	29 J
Total pentachlorodibenzofuran (PeCDF)	pg/g	0.81 J	3.3 J	3.9 J	0.064 U	0.055 U	0.084 U	0.061 U
Total pentachlorodibenzo-p-dioxin (PeCDD)	pg/g	5.4 J	4.7 J	4.0 J	3.9 J	3.6 J	6.4 J	5.8 J
Total tetrachlorodibenzofuran (TCDF)	pg/g	0.55 J	190 J	160 J	3.7 J	0.71 J	0.81 J	1.1 J
Total tetrachlorodibenzo-p-dioxin (TCDD)	pg/g	3.7 J	26 J	23 J	2.4 J	2.2 J	3.0 J	3.1 J
Total WHO Dioxin TEQ(Human/Mammal)(ND=0)	pg/g	0.841	34.3	31.0	1.22	0.595	0.881	1.12
Total WHO Dioxin TEQ(Human/Mammal)(ND=0.5)	pg/g	0.920	34.3	31.1	1.34	0.697	1.07	1.16

Notes:
pg/g - picogram per gram
U - Not detected at the associated reporting limit.
J - Estimated concentration.
UJ - Not detected; associated reporting limit is estimated.

Table 2-3

Second Phase Pre-Design Investigation Analytical Results
Final 100% Remedial Design - Northern Impoundment
San Jacinto River Waste Pits Site
Harris County, Texas

Sample Location: Sample Identification: Sample Date: Sample Depth: Sample Type:	Units	SJSB055 11187072-101419-SS-SJSB055 C1 (12-14) 10/14/2019 (12-14) ft bgs	SJSB055 11187072-101419-SS-SJSB055 C1 (14-16) 10/14/2019 (14-16) ft bgs	SJSB055 11187072-101419-SS-SJSB055 C1 (16-18) 10/14/2019 (16-18) ft bgs	SJSB056 11187072-111119-SS-SJSB056 (0-2) 11/11/2019 (0-2) ft bgs	SJSB056 11187072-111119-SS-SJSB056 (2-4) 11/11/2019 (2-4) ft bgs	SJSB056 11187072-111119-SS-SJSB056 (4-6) 11/11/2019 (4-6) ft bgs	SJSB056 11187072-111119-SS-SJSB056 (6-8) 11/11/2019 (6-8) ft bgs
Dioxins/Furans								
1,2,3,4,6,7,8,9-Octachlorodibenzofuran (OCDF)	pg/g	0.092 U	0.49 J	0.42 J	2.5 J	0.83 J	0.19 U	0.19 U
1,2,3,4,6,7,8,9-Octachlorodibenzo-p-dioxin (OCDD)	pg/g	210	500	51	480	340	220	390
1,2,3,4,6,7,8-Heptachlorodibenzofuran (HpCDF)	pg/g	0.031 U	0.058 U	0.18 U	0.47 J	0.14 U	0.13 U	0.13 U
1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin (HpCDD)	pg/g	11	24	2.7 J	24	14	10	17
1,2,3,4,7,8,9-Heptachlorodibenzofuran (HpCDF)	pg/g	0.036 U	0.056 J	0.073 J	0.16 U	0.14 U	0.14 U	0.14 U
1,2,3,4,7,8-Hexachlorodibenzofuran (HxCDF)	pg/g	0.066 U	0.092 U	0.35 J	0.17 U	0.15 U	0.12 U	0.14 U
1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin (HxCDD)	pg/g	0.37 U	0.54 U	0.25 U	0.62 J	0.36 J	0.33 J	0.37 J
1,2,3,6,7,8-Hexachlorodibenzofuran (HxCDF)	pg/g	0.060 U	0.086 U	0.11 J	0.20 U	0.17 U	0.14 U	0.16 U
1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin (HxCDD)	pg/g	0.36 J	0.56 J	0.14 J	0.87 J	0.45 J	0.39 J	0.32 J
1,2,3,7,8,9-Hexachlorodibenzofuran (HxCDF)	pg/g	0.074 J	0.18 J	0.078 J	0.35 J	0.14 J	0.14 J	0.081 U
1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin (HxCDD)	pg/g	0.67 J	2.4 J	0.26 J	1.9 J	1.1 J	0.92 J	1.4 J
1,2,3,7,8-Pentachlorodibenzofuran (PeCDF)	pg/g	0.050 U	0.075 U	0.28 J	0.19 U	0.14 U	0.14 U	0.13 U
1,2,3,7,8-Pentachlorodibenzo-p-dioxin (PeCDD)	pg/g	0.12 U	0.17 U	0.11 U	0.56 J	0.26 U	0.27 J	0.23 U
2,3,4,6,7,8-Hexachlorodibenzofuran (HxCDF)	pg/g	0.040 U	0.057 U	0.037 U	0.13 U	0.11 U	0.087 U	0.11 U
2,3,4,7,8-Pentachlorodibenzofuran (PeCDF)	pg/g	0.052 U	0.079 U	0.26 J	0.21 U	0.15 U	0.15 U	0.14 U
2,3,7,8-Tetrachlorodibenzofuran (TCDF)	pg/g	0.52 J	0.55 J	15	4.7	2.2	0.46 J	0.32 J
2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	pg/g	0.24 J	0.22 J	3.7	1.5	0.81 J	0.20 U	0.18 U
Total heptachlorodibenzofuran (HpCDF)	pg/g	0.036 U	0.11 J	0.33 J	0.47 J	0.14 U	0.14 U	0.14 U
Total heptachlorodibenzo-p-dioxin (HpCDD)	pg/g	52 J	140 J	10 J	96 J	65 J	45 J	72 J
Total hexachlorodibenzofuran (HxCDF)	pg/g	0.074 J	0.18 J	0.58 J	0.35 J	0.14 J	0.14 J	0.16 U
Total hexachlorodibenzo-p-dioxin (HxCDD)	pg/g	19 J	41 J	2.7 J	27 J	16 J	13 J	20 J
Total pentachlorodibenzofuran (PeCDF)	pg/g	0.085 U	0.079 U	0.75 J	0.21 U	0.15 U	0.15 U	0.16 U
Total pentachlorodibenzo-p-dioxin (PeCDD)	pg/g	4.9 J	8.6 J	0.28 J	4.9 J	1.6 J	3.1 J	2.9 J
Total tetrachlorodibenzofuran (TCDF)	pg/g	0.90 J	1.2 J	28 J	6.8 J	2.7 J	0.46 J	0.32 J
Total tetrachlorodibenzo-p-dioxin (TCDD)	pg/g	2.9 J	5.9 J	4.4 J	3.8 J	2.1 J	0.49 J	0.18 U
Total WHO Dioxin TEQ(Human/Mammal)(ND=0)	pg/g	0.575	0.980	5.42	3.29	1.48	0.660	0.528
Total WHO Dioxin TEQ(Human/Mammal)(ND=0.5)	pg/g	0.671	1.12	5.49	3.35	1.65	0.803	0.782

Notes:
pg/g - picogram per gram
U - Not detected at the associated reporting limit.
J - Estimated concentration.
UJ - Not detected; associated reporting limit is estimated

Table 2-3

Second Phase Pre-Design Investigation Analytical Results
Final 100% Remedial Design - Northern Impoundment
San Jacinto River Waste Pits Site
Harris County, Texas

Sample Location: Sample Identification: Sample Date: Sample Depth: Sample Type:	Units	SJSB056 11187072-111119-SS-SJSB056 (8-10) 11/11/2019 (8-10) ft bgs	SJSB056 11187072-111119-SS-SJSB056 (10-12) 11/11/2019 (10-12) ft bgs	SJSB056 11187072-111119-SS-SJSB056 (12-14) 11/11/2019 (12-14) ft bgs	SJSB056 11187072-111119-SS-SJSB056 (14-16) 11/11/2019 (14-16) ft bgs	SJSB056 11187072-111119-SS-SJSB056 (16-18) 11/11/2019 (16-18) ft bgs	SJSB056-C1 11187072-120319-SS-SJSB056-C1(0-2) 12/3/2019 (0-0) ft bgs	SJSB056-C1 11187072-120319-SS-SJSB056-C1(2-4) 12/3/2019 (2-4) ft bgs
Dioxins/Furans								
1,2,3,4,6,7,8,9-Octachlorodibenzofuran (OCDF)	pg/g	1.0 J	0.35 J	4.0 J	1.5 J	1.1 J	7.1 U	11 U
1,2,3,4,6,7,8,9-Octachlorodibenzo-p-dioxin (OCDD)	pg/g	81	17	350	190	59	140 U	150 U
1,2,3,4,6,7,8-Heptachlorodibenzofuran (HpCDF)	pg/g	0.15 U	0.13 U	0.53 J	0.14 U	0.55 J	0.17 U	0.98 U
1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin (HpCDD)	pg/g	2.9 J	0.89 J	14	8.2	3.0 J	2.5 U	4.8 J
1,2,3,4,7,8,9-Heptachlorodibenzofuran (HpCDF)	pg/g	0.15 U	0.14 U	0.54 J	0.13 U	0.14 U	0.11 U	0.31 J
1,2,3,4,7,8-Hexachlorodibenzofuran (HxCDF)	pg/g	0.36 J	0.12 U	0.31 J	0.13 U	0.31 J	0.10 U	0.12 U
1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin (HxCDD)	pg/g	0.16 U	0.30 J	0.48 J	0.32 J	0.43 J	0.25 U	0.27 U
1,2,3,6,7,8-Hexachlorodibenzofuran (HxCDF)	pg/g	0.15 U	0.14 U	0.17 U	0.15 U	0.16 U	0.11 U	0.13 U
1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin (HxCDD)	pg/g	0.17 U	0.14 U	0.25 U	0.26 J	0.28 J	0.14 J	0.15 J
1,2,3,7,8,9-Hexachlorodibenzofuran (HxCDF)	pg/g	0.075 U	0.12 J	0.24 J	0.074 U	0.078 U	0.15 U	0.14 U
1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin (HxCDD)	pg/g	0.16 U	0.13 U	1.2 J	0.71 J	0.45 J	0.22 J	0.33 J
1,2,3,7,8-Pentachlorodibenzofuran (PeCDF)	pg/g	0.15 U	0.10 U	0.14 U	0.34 J	0.14 U	0.094 U	0.11 U
1,2,3,7,8-Pentachlorodibenzo-p-dioxin (PeCDD)	pg/g	0.20 U	0.20 U	0.27 U	0.17 U	0.25 U	0.16 U	0.15 U
2,3,4,6,7,8-Hexachlorodibenzofuran (HxCDF)	pg/g	0.10 U	0.093 U	0.29 J	0.093 U	0.10 U	0.086 U	0.11 U
2,3,4,7,8-Pentachlorodibenzofuran (PeCDF)	pg/g	0.16 U	0.12 U	0.16 U	0.19 J	0.16 U	0.094 U	0.11 U
2,3,7,8-Tetrachlorodibenzofuran (TCDF)	pg/g	10	1.5	5.2	11	0.16 U	1.1 J	1.6
2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	pg/g	2.5 J	0.57 J	1.7	2.9	0.16 U	0.48 J	0.72 J
Total heptachlorodibenzofuran (HpCDF)	pg/g	0.15 U	0.14 U	1.1 J	0.14 U	0.55 J	0.45 J	2.6 J
Total heptachlorodibenzo-p-dioxin (HpCDD)	pg/g	11 J	2.7 J	64 J	33 J	8.8 J	10 J	13 J
Total hexachlorodibenzofuran (HxCDF)	pg/g	0.36 J	0.12 J	0.84 J	0.15 U	0.31 J	0.15 J	0.14 J
Total hexachlorodibenzo-p-dioxin (HxCDD)	pg/g	1.9 J	0.30 J	15 J	9.4 J	1.9 J	2.3 J	2.4 J
Total pentachlorodibenzofuran (PeCDF)	pg/g	0.16 U	0.15 U	0.18 U	0.53 J	0.24 U	0.094 U	0.11 U
Total pentachlorodibenzo-p-dioxin (PeCDD)	pg/g	0.20 U	0.20 U	2.1 J	1.2 J	0.25 U	0.16 U	0.15 U
Total tetrachlorodibenzofuran (TCDF)	pg/g	16 J	2.1 J	9.1 J	18 J	0.16 U	1.6 J	2.2 J
Total tetrachlorodibenzo-p-dioxin (TCDD)	pg/g	2.5 J	0.57 J	2.4 J	2.9 J	0.19 J	0.48 J	0.72 J
Total WHO Dioxin TEQ(Human/Mammal)(ND=0)	pg/g	3.59	0.776	2.73	4.34	0.201	0.626	0.980
Total WHO Dioxin TEQ(Human/Mammal)(ND=0.5)	pg/g	3.76	0.928	2.91	4.44	0.457	0.792	1.14

Notes:
pg/g - picogram per gram
U - Not detected at the associated reporting limit.
J - Estimated concentration.
UJ - Not detected; associated reporting limit is estimated

Table 2-3

Second Phase Pre-Design Investigation Analytical Results
Final 100% Remedial Design - Northern Impoundment
San Jacinto River Waste Pits Site
Harris County, Texas

Sample Location: Sample Identification: Sample Date: Sample Depth: Sample Type:	Units	SJSB056-C1 11187072-120319-SS-SJSB056-C1(4-6) 12/3/2019 (4-6) ft bgs	SJSB056-C1 11187072-120319-SS-SJSB056-C1(6-8) 12/3/2019 (6-8) ft bgs	SJSB056-C1 11187072-120319-SS-SJSB056-C1(8-10) 12/3/2019 (8-10) ft bgs	SJSB056-C1 11187072-120319-SS-SJSB056-C1(10-12) 12/3/2019 (10-12) ft bgs	SJSB056-C1 11187072-120319-SS-SJSB056-C1(12-14) 12/3/2019 (12-14) ft bgs	SJSB056-C1 11187072-120319-SS-DUP-1 12/3/2019 (14-16) ft bgs Duplicate	SJSB056-C1 11187072-120319-SS-SJSB056-C1(14-16) 12/3/2019 (14-16) ft bgs
Dioxins/Furans								
1,2,3,4,6,7,8,9-Octachlorodibenzofuran (OCDF)	pg/g	4.8 U	35	2.4 U	3.3 U	2.5 U	4.3 U	2.6 U
1,2,3,4,6,7,8,9-Octachlorodibenzo-p-dioxin (OCDD)	pg/g	120 U	260	88 U	160 U	320	370	270
1,2,3,4,6,7,8-Heptachlorodibenzofuran (HpCDF)	pg/g	0.19 U	1.9 J	0.33 U	0.94 U	0.31 U	0.55 U	0.62 U
1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin (HpCDD)	pg/g	3.3 U	14	2.7 U	6.8	15	17	10
1,2,3,4,7,8,9-Heptachlorodibenzofuran (HpCDF)	pg/g	0.087 U	0.20 J	0.16 J	0.90 J	0.13 J	0.064 U	0.10 J
1,2,3,4,7,8-Hexachlorodibenzofuran (HxCDF)	pg/g	0.12 U	0.094 U	0.11 U	0.53 J	0.064 U	0.075 U	0.34 J
1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin (HxCDD)	pg/g	0.079 U	0.23 U	0.25 U	0.83 J	0.40 U	0.44 U	0.26 U
1,2,3,6,7,8-Hexachlorodibenzofuran (HxCDF)	pg/g	0.14 U	0.11 U	0.11 U	0.60 J	0.068 U	0.078 U	0.13 J
1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin (HxCDD)	pg/g	0.082 U	0.30 J	0.18 J	0.79 J	0.46 J	0.46 J	0.26 J
1,2,3,7,8,9-Hexachlorodibenzofuran (HxCDF)	pg/g	0.090 U	0.13 U	0.081 U	0.81 U	0.16 U	0.13 U	0.16 U
1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin (HxCDD)	pg/g	0.26 J	0.40 J	0.36 J	1.1 J	1.3 J	1.3 J	0.98 J
1,2,3,7,8-Pentachlorodibenzofuran (PeCDF)	pg/g	0.094 U	0.17 U	0.13 U	0.36 U	0.067 U	0.067 U	0.054 U
1,2,3,7,8-Pentachlorodibenzo-p-dioxin (PeCDD)	pg/g	0.16 U	0.18 U	0.12 U	0.39 J	0.12 U	0.12 U	0.097 U
2,3,4,6,7,8-Hexachlorodibenzofuran (HxCDF)	pg/g	0.10 U	0.081 U	0.088 U	0.61 J	0.050 U	0.063 U	0.070 U
2,3,4,7,8-Pentachlorodibenzofuran (PeCDF)	pg/g	0.091 U	0.080 U	0.081 U	0.35 J	0.070 U	0.067 U	0.055 U
2,3,7,8-Tetrachlorodibenzofuran (TCDF)	pg/g	0.45 U	0.86 J	2.9	0.20 U	0.14 U	0.050 U	0.086 U
2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	pg/g	0.099 U	0.11 U	0.92 J	0.23 J	0.11 U	0.10 U	0.15 J
Total heptachlorodibenzofuran (HpCDF)	pg/g	0.47 J	11 J	0.77 J	2.0 J	0.73 J	1.2 J	0.93 J
Total heptachlorodibenzo-p-dioxin (HpCDD)	pg/g	11 J	29 J	8.9 J	24 J	62 J	69 J	45 J
Total hexachlorodibenzofuran (HxCDF)	pg/g	0.14 U	0.13 J	0.11 U	2.6 J	0.16 J	0.13 J	0.63 J
Total hexachlorodibenzo-p-dioxin (HxCDD)	pg/g	1.8 J	5.1 J	2.7 J	8.0 J	19 J	20 J	14 J
Total pentachlorodibenzofuran (PeCDF)	pg/g	0.094 U	0.17 J	0.13 J	0.72 J	0.087 U	0.067 U	0.063 U
Total pentachlorodibenzo-p-dioxin (PeCDD)	pg/g	0.16 U	0.29 J	0.29 J	1.3 J	3.2 J	3.4 J	2.2 J
Total tetrachlorodibenzofuran (TCDF)	pg/g	0.63 J	1.4 J	4.0 J	0.41 J	0.59 J	0.31 J	0.16 J
Total tetrachlorodibenzo-p-dioxin (TCDD)	pg/g	0.099 U	0.91 J	1.1 J	0.55 J	2.3 J	2.3 J	1.4 J
Total WHO Dioxin TEQ(Human/Mammal)(ND=0)	pg/g	0.0260	0.406	1.27	1.25	0.423	0.457	0.503
Total WHO Dioxin TEQ(Human/Mammal)(ND=0.5)	pg/g	0.260	0.597	1.40	1.33	0.596	0.624	0.593

Notes:
pg/g - picogram per gram
U - Not detected at the associated reporting limit.
J - Estimated concentration.
UJ - Not detected; associated reporting limit is estimated

Table 2-3

Second Phase Pre-Design Investigation Analytical Results
Final 100% Remedial Design - Northern Impoundment
San Jacinto River Waste Pits Site
Harris County, Texas

Sample Location: Sample Identification: Sample Date: Sample Depth: Sample Type:	Units	SJSB056-C1 11187072-120319-SS-SJSB056-C1(16-18) 12/3/2019 (16-18) ft bgs	SJSB057 11187072-110519-SS-SJSB057 (0-2) 11/5/2019 (0-2) ft bgs	SJSB057 11187072-110519-SS-SJSB057 (2-4) 11/5/2019 (2-4) ft bgs	SJSB057 11187072-110519-SS-SJSB057 (4-6) 11/5/2019 (4-6) ft bgs	SJSB057 11187072-110519-SS-SJSB057 (6-8) 11/5/2019 (6-8) ft bgs	SJSB057 11187072-110519-SS-SJSB057 (8-10) 11/5/2019 (8-10) ft bgs	SJSB057 11187072-110519-SS-SJSB057 (10-12) 11/5/2019 (10-12) ft bgs
Dioxins/Furans								
1,2,3,4,6,7,8,9-Octachlorodibenzofuran (OCDF)	pg/g	3.2 U	490 J	520 J	55	6.8 J	0.94 U	6.1 J
1,2,3,4,6,7,8,9-Octachlorodibenzo-p-dioxin (OCDD)	pg/g	440	5200	2400	670	94	48	85
1,2,3,4,6,7,8-Heptachlorodibenzofuran (HpCDF)	pg/g	0.45 U	990	1300	110	13	0.36 U	2.0 J
1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin (HpCDD)	pg/g	18	310	190 J	43	4.7 J	4.0 J	6.1
1,2,3,4,7,8,9-Heptachlorodibenzofuran (HpCDF)	pg/g	0.058 U	300	410 J	34	4.0 J	0.27 U	1.9 J
1,2,3,4,7,8-Hexachlorodibenzofuran (HxCDF)	pg/g	0.090 U	3000	4400	350	39	0.71 J	0.75 J
1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin (HxCDD)	pg/g	0.41 U	3.6 U	5.6 U	0.64 U	0.25 U	0.35 U	1.2 J
1,2,3,6,7,8-Hexachlorodibenzofuran (HxCDF)	pg/g	0.097 U	740	1100	92	10	0.25 U	0.59 J
1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin (HxCDD)	pg/g	0.44 J	21 J	16 U	1.9 J	0.27 U	0.28 U	1.3 J
1,2,3,7,8,9-Hexachlorodibenzofuran (HxCDF)	pg/g	0.21 U	45 J	56 J	5.0 J	0.64 J	0.21 U	1.1 J
1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin (HxCDD)	pg/g	1.7 J	8.7 J	9.0 J	1.1 J	0.25 J	0.42 J	1.5 J
1,2,3,7,8-Pentachlorodibenzofuran (PeCDF)	pg/g	0.069 U	2000	2900	230	26	0.53 J	0.21 J
1,2,3,7,8-Pentachlorodibenzo-p-dioxin (PeCDD)	pg/g	0.19 J	200 J	300 J	21	2.3 J	0.26 J	0.45 J
2,3,4,6,7,8-Hexachlorodibenzofuran (HxCDF)	pg/g	0.076 U	90 J	120 J	9.1	1.1 J	0.15 U	1.2 J
2,3,4,7,8-Pentachlorodibenzofuran (PeCDF)	pg/g	0.071 U	1300	1900	140	15	0.31 J	0.32 J
2,3,7,8-Tetrachlorodibenzofuran (TCDF)	pg/g	0.15 U	31000 J	51000 J	8200	890	18	2.9
2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	pg/g	0.18 J	20000	31000	2600	270	5.2	1.2
Total heptachlorodibenzofuran (HpCDF)	pg/g	1.5 J	1600 J	2100 J	180 J	20 J	0.63 J	4.1 J
Total heptachlorodibenzo-p-dioxin (HpCDD)	pg/g	80 J	700 J	410 J	99 J	13 J	11 J	13 J
Total hexachlorodibenzofuran (HxCDF)	pg/g	0.44 J	4400 J	6400 J	510 J	58 J	1.3 J	3.6 J
Total hexachlorodibenzo-p-dioxin (HxCDD)	pg/g	24 J	110 J	83 J	18 J	3.0 J	3.3 J	6.1 J
Total pentachlorodibenzofuran (PeCDF)	pg/g	0.073 U	5200 J	7400 J	570 J	64 J	1.1 J	0.53 J
Total pentachlorodibenzo-p-dioxin (PeCDD)	pg/g	4.5 J	230 J	330 J	27 J	2.7 J	0.71 J	0.91 J
Total tetrachlorodibenzofuran (TCDF)	pg/g	0.44 J	130000 J	210000 J	13000 J	1500 J	29 J	5.0 J
Total tetrachlorodibenzo-p-dioxin (TCDD)	pg/g	2.5 J	22000 J	34000 J	2800 J	290 J	5.8 J	1.5 J
Total WHO Dioxin TEQ(Human/Mammal)(ND=0)	pg/g	0.896	24200	37600	3540	372	7.54	2.93
Total WHO Dioxin TEQ(Human/Mammal)(ND=0.5)	pg/g	0.962	24200	37600	3540	372	7.60	2.93

Notes:
pg/g - picogram per gram
U - Not detected at the associated reporting limit.
J - Estimated concentration.
UJ - Not detected; associated reporting limit is estimated

Table 2-3

Second Phase Pre-Design Investigation Analytical Results
Final 100% Remedial Design - Northern Impoundment
San Jacinto River Waste Pits Site
Harris County, Texas

Sample Location:	Units	SJSB057	SJSB057	SJSB057	SJSB058	SJSB058	SJSB058	SJSB058
Sample Identification:		11187072-110519-SS-SJSB057 (12-14)	11187072-110519-SS-SJSB057 (14-16)	11187072-110519-SS-SJSB057 (16-18)	11187072-101419-BN-SJSB058-S (0-2)	11187072-101419-BN-SJSB058-S (2-4)	11187072-101419-BN-SJSB058-S (4-6)	11187072-101419-BN-SJSB058-S (6-8)
Sample Date:		11/5/2019	11/5/2019	11/5/2019	10/14/2019	10/14/2019	10/14/2019	10/14/2019
Sample Depth:		(12-14) ft bgs	(14-16) ft bgs	(16-18) ft bgs	(0-2) ft bgs	(2-4) ft bgs	(4-6) ft bgs	(6-8) ft bgs
Sample Type:								
Dioxins/Furans								
1,2,3,4,6,7,8,9-Octachlorodibenzofuran (OCDF)	pg/g	2.2 U	0.53 U	0.34 U	13	690	1100	8.4 J
1,2,3,4,6,7,8,9-Octachlorodibenzo-p-dioxin (OCDD)	pg/g	99	85	69	520	6600	13000	400
1,2,3,4,6,7,8-Heptachlorodibenzofuran (HpCDF)	pg/g	0.65 U	0.11 U	0.096 U	4.7 J	1900	2100	14
1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin (HpCDD)	pg/g	4.0 J	3.5 J	3.1 J	35	540	620	18
1,2,3,4,7,8,9-Heptachlorodibenzofuran (HpCDF)	pg/g	0.36 U	0.081 U	0.032 U	0.62 J	780	820	5.6 J
1,2,3,4,7,8-Hexachlorodibenzofuran (HxCDF)	pg/g	1.4 J	0.15 J	0.12 J	2.2 J	8200	7200	44
1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin (HxCDD)	pg/g	0.27 U	0.33 U	0.25 U	0.25 J	6.3 J	6.3 J	0.38 J
1,2,3,6,7,8-Hexachlorodibenzofuran (HxCDF)	pg/g	0.42 J	0.083 U	0.062 U	0.78 J	2000 J	1800 J	11
1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin (HxCDD)	pg/g	0.26 U	0.21 U	0.23 U	0.83 J	30 J	41 J	0.62 J
1,2,3,7,8,9-Hexachlorodibenzofuran (HxCDF)	pg/g	0.26 U	0.077 U	0.091 U	0.15 U	110 J	120 J	0.90 J
1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin (HxCDD)	pg/g	0.47 J	0.36 J	0.32 J	0.92 J	11 J	14 J	1.7 J
1,2,3,7,8-Pentachlorodibenzofuran (PeCDF)	pg/g	1.1 J	0.13 J	0.098 J	1.4 J	4200	3900	23
1,2,3,7,8-Pentachlorodibenzo-p-dioxin (PeCDD)	pg/g	0.19 J	0.21 J	0.24 J	0.28 U	260	430	2.6 J
2,3,4,6,7,8-Hexachlorodibenzofuran (HxCDF)	pg/g	0.18 U	0.040 U	0.047 U	0.32 J	200 J	210 J	1.4 J
2,3,4,7,8-Pentachlorodibenzofuran (PeCDF)	pg/g	0.64 J	0.11 J	0.058 U	0.87 J	2200	2900	15
2,3,7,8-Tetrachlorodibenzofuran (TCDF)	pg/g	41	2.7	2.5	25	100000 J	150000 J	800
2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	pg/g	11	0.92 J	0.87 J	8.0	24000 J	31000 J	230
Total heptachlorodibenzofuran (HpCDF)	pg/g	1.2 J	0.23 J	0.096 J	14 J	3200 J	3800 J	24 J
Total heptachlorodibenzo-p-dioxin (HpCDD)	pg/g	13 J	10 J	8.6 J	83 J	1100 J	1400 J	67 J
Total hexachlorodibenzofuran (HxCDF)	pg/g	2.4 J	0.35 J	0.21 J	9.9 J	12000 J	11000 J	66 J
Total hexachlorodibenzo-p-dioxin (HxCDD)	pg/g	3.8 J	2.8 J	2.5 J	11 J	220 J	230 J	17 J
Total pentachlorodibenzofuran (PeCDF)	pg/g	2.6 J	0.29 J	0.098 J	9.2 J	10000 J	11000 J	60 J
Total pentachlorodibenzo-p-dioxin (PeCDD)	pg/g	0.86 J	0.73 J	0.58 J	1.0 J	310 J	510 J	3.4 J
Total tetrachlorodibenzofuran (TCDF)	pg/g	66 J	5.2 J	3.8 J	55 J	180000 J	270000 J	1400 J
Total tetrachlorodibenzo-p-dioxin (TCDD)	pg/g	13 J	1.4 J	1.2 J	9.4 J	27000 J	34000 J	250 J
Total WHO Dioxin TEQ(Human/Mammal)(ND=0)	pg/g	15.8	1.55	1.46	11.9	36100	48400	324
Total WHO Dioxin TEQ(Human/Mammal)(ND=0.5)	pg/g	15.9	1.59	1.50	12.0	36100	48400	324

Notes:
pg/g - picogram per gram
U - Not detected at the associated reporting limit.
J - Estimated concentration.
UJ - Not detected; associated reporting limit is estimated

Table 2-3

Second Phase Pre-Design Investigation Analytical Results
Final 100% Remedial Design - Northern Impoundment
San Jacinto River Waste Pits Site
Harris County, Texas

Sample Location:	Units	SJSB058	SJSB058	SJSB058	SJSB058	SJSB058	SJSB058	SJSB070
Sample Identification:		11187072-101419-BN-SJSB058-S (8-10)	11187072-101419-BN-SJSB058-S (10-12)	11187072-101419-BN-SJSB058-S (12-14)	11187072-101419-BN-SJSB058-S (14-16)	11187072-101419-BN-SJSB058-S (16-18)	11187072-111219-SS-SJSB058 (18-20)	11187072-111219-SS-SJSB070 (0-2)
Sample Date:		10/14/2019	10/14/2019	10/14/2019	10/14/2019	10/14/2019	11/12/2019	11/12/2019
Sample Depth:		(8-10) ft bgs	(10-12) ft bgs	(12-14) ft bgs	(14-16) ft bgs	(16-18) ft bgs	(18-20) ft bgs	(0-2) ft bgs
Sample Type:								
Dioxins/Furans								
1,2,3,4,6,7,8,9-Octachlorodibenzofuran (OCDF)	pg/g	25 J	6.4 J	270 J	3.0 U	20 U	0.37 U	710
1,2,3,4,6,7,8,9-Octachlorodibenzo-p-dioxin (OCDD)	pg/g	670	360	3400	140	410	120	2000
1,2,3,4,6,7,8-Heptachlorodibenzofuran (HpCDF)	pg/g	47	14	590	5.7 J	35	0.15 U	1900
1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin (HpCDD)	pg/g	28 J	20	160	8.0	22 J	5.6 J	190
1,2,3,4,7,8,9-Heptachlorodibenzofuran (HpCDF)	pg/g	17 J	5.3 J	200	2.1 J	15 J	0.16 U	610
1,2,3,4,7,8-Hexachlorodibenzofuran (HxCDF)	pg/g	150	50	1700	18	120	0.12 U	6700
1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin (HxCDD)	pg/g	0.18 U	0.55 J	0.82 U	0.13 J	0.40 J	0.16 U	4.7 J
1,2,3,6,7,8-Hexachlorodibenzofuran (HxCDF)	pg/g	37	13	440	4.9 J	31 J	0.14 U	1700
1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin (HxCDD)	pg/g	0.95 J	0.94 J	9.0 J	0.23 J	0.94 J	0.17 U	14
1,2,3,7,8,9-Hexachlorodibenzofuran (HxCDF)	pg/g	3.0 J	0.92 J	26 J	0.30 J	1.7 J	0.23 J	46 J
1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin (HxCDD)	pg/g	0.17 U	2.0 J	3.2 J	0.38 J	1.2 J	0.38 J	5.9 J
1,2,3,7,8-Pentachlorodibenzofuran (PeCDF)	pg/g	88	29	940	9.2	70	0.18 U	4200
1,2,3,7,8-Pentachlorodibenzo-p-dioxin (PeCDD)	pg/g	8.7 J	3.0 J	96 J	0.66 J	6.2 J	0.35 U	390
2,3,4,6,7,8-Hexachlorodibenzofuran (HxCDF)	pg/g	4.3 J	1.6 J	51 J	0.61 J	3.3 J	0.10 U	170 J
2,3,4,7,8-Pentachlorodibenzofuran (PeCDF)	pg/g	59	19	630	6.7	42	0.18 U	2700
2,3,7,8-Tetrachlorodibenzofuran (TCDF)	pg/g	1900	790	6400	310	1500	0.60 U	27000 J
2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	pg/g	920	280	8700	99	600	0.20 U	39000 J
Total heptachlorodibenzofuran (HpCDF)	pg/g	81 J	24 J	990 J	9.9 J	61 J	0.16 U	2900 J
Total heptachlorodibenzo-p-dioxin (HpCDD)	pg/g	80 J	77 J	370 J	27 J	68 J	23 J	370 J
Total hexachlorodibenzofuran (HxCDF)	pg/g	220 J	74 J	2500 J	28 J	180 J	0.23 J	9600 J
Total hexachlorodibenzo-p-dioxin (HxCDD)	pg/g	14 J	23 J	60 J	9.1 J	16 J	6.9 J	98 J
Total pentachlorodibenzofuran (PeCDF)	pg/g	240 J	78 J	2600 J	26 J	180 J	0.18 U	11000 J
Total pentachlorodibenzo-p-dioxin (PeCDD)	pg/g	8.7 J	5.4 J	96 J	1.8 J	6.2 J	0.35 U	410 J
Total tetrachlorodibenzofuran (TCDF)	pg/g	5800 J	1600 J	62000 J	630 J	3800 J	0.96 J	300000 J
Total tetrachlorodibenzo-p-dioxin (TCDD)	pg/g	1000 J	310 J	9700 J	110 J	670 J	0.70 J	44000 J
Total WHO Dioxin TEQ(Human/Mammal)(ND=0)	pg/g	1160	376	9890	136	788	0.153	43900
Total WHO Dioxin TEQ(Human/Mammal)(ND=0.5)	pg/g	1160	376	9890	136	788	0.524	43900

Notes:
pg/g - picogram per gram
U - Not detected at the associated reporting limit.
J - Estimated concentration.
UJ - Not detected; associated reporting limit is estimated

Table 2-3

Second Phase Pre-Design Investigation Analytical Results
Final 100% Remedial Design - Northern Impoundment
San Jacinto River Waste Pits Site
Harris County, Texas

Sample Location: Sample Identification: Sample Date: Sample Depth: Sample Type:	Units	SJSB070 11187072-111219-SS-SJSB070 (2-4) 11/12/2019 (2-4) ft bgs	SJSB070 11187072-111219-SS-SJSB070 (4-6) 11/12/2019 (4-6) ft bgs	SJSB070 11187072-111219-SS-SJSB070 (6-8) 11/12/2019 (6-8) ft bgs	SJSB070 11187072-111219-SS-SJSB070 (8-10) 11/12/2019 (8-10) ft bgs	SJSB070 11187072-111219-SS-SJSB070 (10-12) 11/12/2019 (10-12) ft bgs	SJSB070 11187072-111219-SS-SJSB070 (12-14) 11/12/2019 (12-14) ft bgs
Dioxins/Furans							
1,2,3,4,6,7,8,9-Octachlorodibenzofuran (OCDF)	pg/g	1400	920	480	370	14	7.8 J
1,2,3,4,6,7,8,9-Octachlorodibenzo-p-dioxin (OCDD)	pg/g	15000 J	11000 J	6000 J	4500	300	410 J
1,2,3,4,6,7,8-Heptachlorodibenzofuran (HpCDF)	pg/g	2800	1900	980	790	29	16
1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin (HpCDD)	pg/g	960	630	330	260	15	19
1,2,3,4,7,8,9-Heptachlorodibenzofuran (HpCDF)	pg/g	860	550	290	240	9.6	5.2 J
1,2,3,4,7,8-Hexachlorodibenzofuran (HxCDF)	pg/g	9100	5800	3100	2200	97	51
1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin (HxCDD)	pg/g	7.8 J	6.1 J	3.2 J	2.0 J	0.38 U	0.47 U
1,2,3,6,7,8-Hexachlorodibenzofuran (HxCDF)	pg/g	2300	1500	780	570	24	13
1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin (HxCDD)	pg/g	55	39	20	14	0.61 U	0.72 J
1,2,3,7,8,9-Hexachlorodibenzofuran (HxCDF)	pg/g	110 J	61 J	37 J	33	0.45 J	0.85 J
1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin (HxCDD)	pg/g	15	11 J	6.1	4.4 J	0.73 J	1.0 J
1,2,3,7,8-Pentachlorodibenzofuran (PeCDF)	pg/g	6500	4300	2100	1400	65	36
1,2,3,7,8-Pentachlorodibenzo-p-dioxin (PeCDD)	pg/g	550	410	200	130	6.0 J	3.6 J
2,3,4,6,7,8-Hexachlorodibenzofuran (HxCDF)	pg/g	250 J	170 J	78 J	57	2.8 J	1.6 J
2,3,4,7,8-Pentachlorodibenzofuran (PeCDF)	pg/g	3800	2800	1500	920	40	23
2,3,7,8-Tetrachlorodibenzofuran (TCDF)	pg/g	35000 J	24000	12000	9700	2400	1600
2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	pg/g	62000 J	41000 J	22000 J	15000 J	730	430
Total heptachlorodibenzofuran (HpCDF)	pg/g	4900 J	3200 J	1700 J	1300 J	48 J	26 J
Total heptachlorodibenzo-p-dioxin (HpCDD)	pg/g	2000 J	1300 J	710 J	560 J	44 J	63 J
Total hexachlorodibenzofuran (HxCDF)	pg/g	13000 J	8600 J	4300 J	3200 J	140 J	75 J
Total hexachlorodibenzo-p-dioxin (HxCDD)	pg/g	320 J	220 J	110 J	75 J	8.8 J	14 J
Total pentachlorodibenzofuran (PeCDF)	pg/g	17000 J	12000 J	5600 J	3800 J	170 J	94 J
Total pentachlorodibenzo-p-dioxin (PeCDD)	pg/g	640 J	410 J	230 J	150 J	6.4 J	5.1 J
Total tetrachlorodibenzofuran (TCDF)	pg/g	350000 J	280000 J	130000 J	86000 J	5100 J	2600 J
Total tetrachlorodibenzo-p-dioxin (TCDD)	pg/g	70000 J	45000 J	25000 J	17000 J	800 J	470 J
Total WHO Dioxin TEQ(Human/Mammal)(ND=0)	pg/g	68600	45600	24300	16700	1000	609
Total WHO Dioxin TEQ(Human/Mammal)(ND=0.5)	pg/g	68600	45600	24300	16700	1000	609

Notes:
pg/g - picogram per gram
U - Not detected at the associated reporting limit.
J - Estimated concentration.
UJ - Not detected; associated reporting limit is estimated

Table 2-3

Second Phase Pre-Design Investigation Analytical Results
Final 100% Remedial Design - Northern Impoundment
San Jacinto River Waste Pits Site
Harris County, Texas

Sample Location:	Units	SJSB070	SJSB070	SJSB071	SJSB071	SJSB071	SJSB071	SJSB071
Sample Identification:		11187072-111219-SS-SJSB070 (14-16)	11187072-111219-SS-SJSB070 (16-18)	11187072-111219-SS-SJSB071 (0-2)	11187072-111219-SS-SJSB071 (2-4)	11187072-111219-SS-SJSB071 (4-6)	11187072-111219-SS-SJSB071 (6-8)	11187072-111219-SS-SJSB071 (8-10)
Sample Date:		11/12/2019	11/12/2019	11/12/2019	11/12/2019	11/12/2019	11/12/2019	11/12/2019
Sample Depth:		(14-16) ft bgs	(16-18) ft bgs	(0-2) ft bgs	(2-4) ft bgs	(4-6) ft bgs	(6-8) ft bgs	(8-10) ft bgs
Sample Type:								
Dioxins/Furans								
1,2,3,4,6,7,8,9-Octachlorodibenzofuran (OCDF)	pg/g	0.52 J	0.41 J	820 J	1200 J	1.2 J	1.1 J	0.39 J
1,2,3,4,6,7,8,9-Octachlorodibenzo-p-dioxin (OCDD)	pg/g	110 J	310 J	8100 J	11000 J	110 J	38 J	46 J
1,2,3,4,6,7,8-Heptachlorodibenzofuran (HpCDF)	pg/g	0.35 U	0.22 U	1600	2500	0.97 U	0.70 U	0.20 U
1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin (HpCDD)	pg/g	5.0 J	13	460	650	3.5 J	1.7 J	1.7 J
1,2,3,4,7,8,9-Heptachlorodibenzofuran (HpCDF)	pg/g	0.094 J	0.054 U	460	770	0.37 J	0.15 J	0.089 J
1,2,3,4,7,8-Hexachlorodibenzofuran (HxCDF)	pg/g	0.81 J	0.52 J	4200	8300	2.7 J	0.73 J	0.089 U
1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin (HxCDD)	pg/g	0.30 U	0.37 U	5.3 U	6.6 J	0.24 U	0.24 U	0.20 U
1,2,3,6,7,8-Hexachlorodibenzofuran (HxCDF)	pg/g	0.065 U	0.090 U	1100	2100	1.0 J	0.19 U	0.085 U
1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin (HxCDD)	pg/g	0.19 U	0.39 U	32 J	36	0.20 U	0.12 U	0.13 U
1,2,3,7,8,9-Hexachlorodibenzofuran (HxCDF)	pg/g	0.12 J	0.19 J	56	100 J	0.10 U	0.13 U	0.16 J
1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin (HxCDD)	pg/g	0.41 J	1.0 J	10 J	13	0.23 J	0.20 J	0.23 J
1,2,3,7,8-Pentachlorodibenzofuran (PeCDF)	pg/g	0.64 U	0.65 U	3200	5000	1.8 J	0.38 U	0.24 U
1,2,3,7,8-Pentachlorodibenzo-p-dioxin (PeCDD)	pg/g	0.13 J	0.11 U	320 J	380 J	0.24 J	0.13 U	0.098 U
2,3,4,6,7,8-Hexachlorodibenzofuran (HxCDF)	pg/g	0.047 U	0.072 U	120	200 J	0.11 U	0.14 U	0.063 U
2,3,4,7,8-Pentachlorodibenzofuran (PeCDF)	pg/g	0.38 J	0.29 J	2200	3000	1.1 J	0.090 U	0.058 U
2,3,7,8-Tetrachlorodibenzofuran (TCDF)	pg/g	17	11	20000	24000	67	7.9	3.3 U
2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	pg/g	4.7	3.0	31000 J	41000 J	19	2.4 U	1.4 U
Total heptachlorodibenzofuran (HpCDF)	pg/g	0.54 J	0.22 J	2600 J	4200 J	1.8 J	0.85 J	0.29 J
Total heptachlorodibenzo-p-dioxin (HpCDD)	pg/g	22 J	61 J	1000 J	1400 J	12 J	5.3 J	6.6 J
Total hexachlorodibenzofuran (HxCDF)	pg/g	0.93 J	0.70 J	6300 J	14000 J	3.7 J	0.73 J	0.16 J
Total hexachlorodibenzo-p-dioxin (HxCDD)	pg/g	6.4 J	16 J	140 J	220 J	2.3 J	2.4 J	4.4 J
Total pentachlorodibenzofuran (PeCDF)	pg/g	1.2 J	1.1 J	8500 J	13000 J	4.5 J	0.56 J	0.24 J
Total pentachlorodibenzo-p-dioxin (PeCDD)	pg/g	1.2 J	2.7 J	320 J	400 J	0.24 J	0.28 J	0.91 J
Total tetrachlorodibenzofuran (TCDF)	pg/g	31 J	20 J	220000 J	260000 J	110 J	14 J	5.0 J
Total tetrachlorodibenzo-p-dioxin (TCDD)	pg/g	5.6 J	4.8 J	34000 J	46000 J	21 J	3.6 J	3.4 J
Total WHO Dioxin TEQ(Human/Mammal)(ND=0)	pg/g	6.86	4.58	34700	45900	26.8	0.913	0.0710
Total WHO Dioxin TEQ(Human/Mammal)(ND=0.5)	pg/g	6.90	4.69	34700	45900	26.8	2.24	1.03

Notes:
pg/g - picogram per gram
U - Not detected at the associated reporting limit.
J - Estimated concentration.
UJ - Not detected; associated reporting limit is estimated

Table 2-3

Second Phase Pre-Design Investigation Analytical Results
Final 100% Remedial Design - Northern Impoundment
San Jacinto River Waste Pits Site
Harris County, Texas

Sample Location: / Sample Identification: / Sample Date: / Sample Depth: / Sample Type:	Units	SJSB071 / 11187072-111219-SS-SJSB071 (10-12) / 11/12/2019 / (10-12) ft bgs	SJSB071 / 11187072-111219-SS-SJSB071 (12-14) / 11/12/2019 / (12-14) ft bgs	SJSB071 / 11187072-111219-SS-SJSB071 (14-16) / 11/12/2019 / (14-16) ft bgs	SJSB071 / 11187072-111219-SS-SJSB071 (16-18) / 11/12/2019 / (16-18) ft bgs
Dioxins/Furans					
1,2,3,4,6,7,8,9-Octachlorodibenzofuran (OCDF)	pg/g	0.11 UJ	0.24 J	1.7 J	1.8 J
1,2,3,4,6,7,8,9-Octachlorodibenzo-p-dioxin (OCDD)	pg/g	98 J	130 J	59	63
1,2,3,4,6,7,8-Heptachlorodibenzofuran (HpCDF)	pg/g	0.23 U	0.11 U	1.9 J	1.7 J
1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin (HpCDD)	pg/g	5.7 J	5.9 J	3.0 J	2.6 J
1,2,3,4,7,8,9-Heptachlorodibenzofuran (HpCDF)	pg/g	0.053 U	0.038 U	0.52 J	0.47 J
1,2,3,4,7,8-Hexachlorodibenzofuran (HxCDF)	pg/g	0.30 J	0.071 U	4.6 J	4.6 J
1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin (HxCDD)	pg/g	0.30 U	0.32 U	0.14 U	0.14 U
1,2,3,6,7,8-Hexachlorodibenzofuran (HxCDF)	pg/g	0.095 U	0.067 U	1.3 J	1.3 J
1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin (HxCDD)	pg/g	0.29 U	0.24 U	0.14 U	0.15 U
1,2,3,7,8,9-Hexachlorodibenzofuran (HxCDF)	pg/g	0.23 J	0.089 J	0.27 J	0.43 J
1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin (HxCDD)	pg/g	0.38 J	0.48 J	0.13 U	0.14 U
1,2,3,7,8-Pentachlorodibenzofuran (PeCDF)	pg/g	0.30 U	0.23 U	3.3 J	2.4 J
1,2,3,7,8-Pentachlorodibenzo-p-dioxin (PeCDD)	pg/g	0.12 U	0.094 U	0.35 U	0.31 U
2,3,4,6,7,8-Hexachlorodibenzofuran (HxCDF)	pg/g	0.079 U	0.051 U	0.21 J	0.12 U
2,3,4,7,8-Pentachlorodibenzofuran (PeCDF)	pg/g	0.15 J	0.063 U	2.0 J	1.6 J
2,3,7,8-Tetrachlorodibenzofuran (TCDF)	pg/g	6.1 U	1.1 U	110	110
2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	pg/g	1.7 U	0.43 U	32	33
Total heptachlorodibenzofuran (HpCDF)	pg/g	0.23 J	0.11 J	3.0 J	2.8 J
Total heptachlorodibenzo-p-dioxin (HpCDD)	pg/g	17 J	21 J	8.5 J	7.3 J
Total hexachlorodibenzofuran (HxCDF)	pg/g	0.53 J	0.089 J	6.8 J	6.3 J
Total hexachlorodibenzo-p-dioxin (HxCDD)	pg/g	7.2 J	7.0 J	1.6 J	1.4 J
Total pentachlorodibenzofuran (PeCDF)	pg/g	0.45 J	0.23 J	8.5 J	6.4 J
Total pentachlorodibenzo-p-dioxin (PeCDD)	pg/g	1.6 J	1.3 J	0.35 U	0.31 U
Total tetrachlorodibenzofuran (TCDF)	pg/g	10 J	1.8 J	190 J	180 J
Total tetrachlorodibenzo-p-dioxin (TCDD)	pg/g	2.7 J	1.2 J	34 J	35 J
Total WHO Dioxin TEQ(Human/Mammal)(ND=0)	pg/g	0.222	0.155	44.4	45.3
Total WHO Dioxin TEQ(Human/Mammal)(ND=0.5)	pg/g	1.48	0.523	44.6	45.4

Notes:
pg/g - picogram per gram
U - Not detected at the associated reporting limit.
J - Estimated concentration.
UJ - Not detected; associated reporting limit is estimated

Table 2-4

Supplemental Design Investigation Analytical Results - Northern Impoundment
Final 100% Remedial Design - Northern Impoundment
San Jacinto River Waste Pits Site
Harris County, Texas

Sample Location: Sample Identification: Sample Date: Sample Depth: Parameters	Units	SJSB072 11215702-072021-SS-SJSB072(8-10) 07/20/2021 (8-10) ft bgs	SJSB072 11215702-072021-SS-SJSB072(10-12) 07/20/2021 (10-12) ft bgs	SJSB072 11215702-072021-SS-SJSB072(12-14) 07/20/2021 (12-14) ft bgs	SJSB072 11215702-072021-SS-SJSB072(14-16) 07/20/2021 (14-16) ft bgs	SJSB072 11215702-072021-SS-SJSB072(16-18) 07/20/2021 (16-18) ft bgs	SJSB072 11215702-072021-SS-SJSB072(18-20) 07/20/2021 (18-20) ft bgs	SJSB072 11215702-072021-SS-SJSB072(20-22) 07/20/2021 (20-22) ft bgs	SJSB072 11215702-072021-SS-SJSB072 (20-22)-R 07/20/2021 (20-22) ft bgs Lab Duplicate	SJSB072 11215702-072021-SS-SJSB072(22-24) 07/20/2021 (22-24) ft bgs	SJSB073 11215702-072021-SS-SJSB073(0-2) 07/20/2021 (0-2) ft bgs	SJSB073 11215702-072021-SS-SJSB073(2-4) 07/20/2021 (2-4) ft bgs
Dioxins/Furans												
1,2,3,4,6,7,8,9-Octachlorodibenzofuran (OCDF)	pg/g	0.49 U	5.3 U	0.046 U	0.49 U	2.3 U	0.88 U	1.3 U	2.6 U	0.88 U	20	440
1,2,3,4,6,7,8,9-Octachlorodibenzo-p-dioxin (OCDD)	pg/g	72	190	42	38	89	190	120	130	43	550	3500
1,2,3,4,6,7,8-Heptachlorodibenzofuran (HpCDF)	pg/g	0.32 J	10	0.050 U	0.11 U	1.7 J	0.35 U	2.7 J	4.1 J	0.032 U	6.4 J	1000
1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin (HpCDD)	pg/g	2.6 J	8.2	1.8 J	1.9 J	4.1 J	8.4	7.7	5.5 J	1.8 U	33	260
1,2,3,4,7,8,9-Heptachlorodibenzofuran (HpCDF)	pg/g	0.14 J	3.4 J	0.056 U	0.13 U	0.85 J	0.033 U	0.92 U	1.3 U	0.037 U	1.5 U	330
1,2,3,4,7,8-Hexachlorodibenzofuran (HxCDF)	pg/g	0.96 J	33	0.083 J	0.16 J	5.0 J	0.024 U	8.3	12	0.072 J	16	3300
1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin (HxCDD)	pg/g	0.22 J	0.26 J	0.20 J	0.16 U	0.32 J	0.31 U	0.31 U	0.25 U	0.31 U	0.092 U	2.7 J
1,2,3,6,7,8-Hexachlorodibenzofuran (HxCDF)	pg/g	0.29 J	8.7	0.039 U	0.081 U	1.4 J	0.025 U	2.1 J	3.3 J	0.036 J	3.4 J	820
1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin (HxCDD)	pg/g	0.14 J	0.36 J	0.088 U	0.16 U	0.28 J	0.27 J	0.18 J	0.26 U	0.088 J	1.1 J	12
1,2,3,7,8,9-Hexachlorodibenzofuran (HxCDF)	pg/g	0.89 U	1.3 U	0.85 U	0.77 U	0.84 U	0.050 J	0.039 U	0.25 U	0.053 J	2.8 U	57
1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin (HxCDD)	pg/g	0.28 J	0.21 J	0.17 J	0.14 U	0.44 J	0.70 J	0.32 J	0.32 U	0.21 J	0.56 U	5.1 J
1,2,3,7,8-Pentachlorodibenzofuran (PeCDF)	pg/g	1.1 J	24	0.30 J	0.41 J	3.1 J	0.028 U	5.6 J	8.8	0.081 J	7.0	1900
1,2,3,7,8-Pentachlorodibenzo-p-dioxin (PeCDD)	pg/g	0.13 J	1.9 J	0.061 U	0.12 U	0.075 U	0.057 U	0.44 J	0.70 J	0.050 U	0.068 U	190
2,3,4,6,7,8-Hexachlorodibenzofuran (HxCDF)	pg/g	0.049 J	0.98 J	0.030 U	0.063 U	0.20 J	0.019 U	0.26 U	0.45 J	0.11 U	0.44 J	83
2,3,4,7,8-Pentachlorodibenzofuran (PeCDF)	pg/g	0.50 J	14	0.073 J	0.10 U	1.5 J	0.028 U	3.1 J	4.7 J	0.035 U	0.98 J	1200
2,3,7,8-Tetrachlorodibenzofuran (TCDF)	pg/g	25	710	2.7	2.6	70	0.40 J	180	270	1.7	13	77000
2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	pg/g	8.4	260	0.85 J	1.2	25	0.18 J	53	87	0.52 J	4.9	22000
Total heptachlorodibenzofuran (HpCDF)	pg/g	0.57 J	17 J	0.056 U	0.13 U	3.1 J	0.091 J	4.5 J	7.0 J	0.037 U	19 J	1600 J
Total heptachlorodibenzo-p-dioxin (HpCDD)	pg/g	11 J	28 J	8.0 J	6.5 J	15 J	38 J	21 J	18 J	7.3 J	88 J	550 J
Total hexachlorodibenzofuran (HxCDF)	pg/g	2.3 J	51 J	0.94 J	0.94 J	8.2 J	0.050 J	12 J	18 J	0.19 J	29 J	4700 J
Total hexachlorodibenzo-p-dioxin (HxCDD)	pg/g	2.6 J	3.9 J	5.3 J	2.2 J	5.6 J	13 J	5.7 J	5.7 J	3.1 J	8.7 J	68 J
Total pentachlorodibenzofuran (PeCDF)	pg/g	2.3 J	60 J	0.38 J	0.41 J	7.0 J	0.031 U	14 J	22 J	0.081 J	13 J	4700 J
Total pentachlorodibenzo-p-dioxin (PeCDD)	pg/g	0.39 J	2.2 J	2.0 J	0.19 U	0.82 J	2.4 J	1.7 J	1.8 J	0.56 J	0.52 J	220 J
Total tetrachlorodibenzofuran (TCDF)	pg/g	50 J	1400 J	5.4 J	4.9 J	140 J	0.66 J	320 J	510 J	2.4 J	30 J	120000 J
Total tetrachlorodibenzo-p-dioxin (TCDD)	pg/g	9.4 J	280 J	4.1 J	1.2 J	28 J	1.8 J	59 J	96 J	0.96 J	4.9 J	24000 J
TEQ												
Total WHO Dioxin TEQ(Human/Mammal)(ND=0)	pg/g	12 J	340 J	1.2 J	1.5 J	33 J	0.46 J	74 J	120 J	0.75 J	9.4 J	31000 J
Total WHO Dioxin TEQ(Human/Mammal)(ND=0.5)	pg/g	12 J	340 J	1.3 J	1.7 J	34 J	0.52 J	74 J	120 J	0.81 J	9.6 J	31000 J

Notes:
- U - Not detected at the associated reporting limit
- J - Estimated concentration
- UJ - Not detected; associated reporting limit is estimated
- J- - Estimated concentration, result may be biased low
- J+ - Estimated concentration, result may be biased high
- TEQ - Toxicity Equivalent Quotient
- ft bgs - Feet below ground surface
- pg/g - picogram per grams

Table 2-4

Supplemental Design Investigation Analytical Results - Northern Impoundment
Final 100% Remedial Design - Northern Impoundment
San Jacinto River Waste Pits Site
Harris County, Texas

Sample Location: Sample Identification: Sample Date: Sample Depth: Parameters	Units	SJSB073 11215702-072021-SS-SJSB073(4-6) 07/20/2021 (4-6) ft bgs	SJSB073 11215702-072021-SS-SJSB073(6-8) 07/20/2021 (6-8) ft bgs	SJSB073 11215702-072021-SS-SJSB073(8-10) 07/20/2021 (8-10) ft bgs	SJSB073 11215702-072021-SS-SJSB073(10-12) 07/20/2021 (10-12) ft bgs	SJSB073 11215702-072021-SS-SJSB073(12-14) 07/20/2021 (12-14) ft bgs	SJSB073 11215702-072021-SS-SJSB073(14-16) 07/20/2021 (14-16) ft bgs	SJSB073 11215702-072021-SS-SJSB073(16-18) 07/20/2021 (16-18) ft bgs	SJSB074 11215702-072221-SS-SJSB074(0-2) 07/22/2021 (0-2) ft bgs	SJSB074 11215702-072221-SS-SJSB074(2-4) 07/22/2021 (2-4) ft bgs	SJSB074 11215702-072221-DUP-5 07/22/2021 (2-4) ft bgs Field Duplicate	SJSB074 11215702-072221-SS-SJSB074(4-6) 07/22/2021 (4-6) ft bgs
Dioxins/Furans												
1,2,3,4,6,7,8,9-Octachlorodibenzofuran (OCDF)	pg/g	350	780 J	1300 J	1.8 U	0.32 U	1.5 U	0.15 U	140	1600	950	600
1,2,3,4,6,7,8,9-Octachlorodibenzo-p-dioxin (OCDD)	pg/g	2400	10000	19000	160 U	200 U	390	220	2200	41000 J	21000 J	17000 J
1,2,3,4,6,7,8-Heptachlorodibenzofuran (HpCDF)	pg/g	770	1700	2800 J+	2.2 U	0.64 U	0.92 U	0.11 U	280	4200 J	1900	1200
1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin (HpCDD)	pg/g	170	590 J	950 J	9.4	19	24	11	110	4000 J	1800	1700
1,2,3,4,7,8,9-Heptachlorodibenzofuran (HpCDF)	pg/g	240	520 J	850 J	0.85 U	0.17 U	0.51 U	0.13 U	85	1100	610	420
1,2,3,4,7,8-Hexachlorodibenzofuran (HxCDF)	pg/g	2400	5600	8400	6.0	0.82 J	1.8 J	0.97 J	910	9900 J	5900 J	5100 J
1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin (HxCDD)	pg/g	2.2 J	5.4 U	12 U	0.30 U	0.19 U	0.21 U	0.17 U	1.3 J	8.7 J	6.5 J	4.0 J
1,2,3,6,7,8-Hexachlorodibenzofuran (HxCDF)	pg/g	620	1500	2200	1.3 J	0.46 U	0.64 U	0.38 U	240	2700	1600	1400
1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin (HxCDD)	pg/g	7.2 J	41 J	52 J	0.30 U	0.23 U	0.24 U	0.20 U	3.6 J	80	45	32
1,2,3,7,8,9-Hexachlorodibenzofuran (HxCDF)	pg/g	42	100 U	140 U	3.0 U	2.3 U	2.5 U	2.3 U	13	130	86	110
1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin (HxCDD)	pg/g	4.2 J	17 U	10 U	0.28 U	1.3 U	1.9 U	0.17 U	2.7 J	25	16	8.6 J
1,2,3,7,8-Pentachlorodibenzofuran (PeCDF)	pg/g	1400	4500	5000	4.5 U	1.9 U	2.7 U	1.6 U	680	5300 J	3900 J	3600 J
1,2,3,7,8-Pentachlorodibenzo-p-dioxin (PeCDD)	pg/g	130	400 J	460 J	0.24 U	0.25 U	0.15 U	0.13 U	49	480	390	190
2,3,4,6,7,8-Hexachlorodibenzofuran (HxCDF)	pg/g	66	170 J	210 J	0.37 U	0.16 U	0.11 U	0.093 U	28	250	160	160
2,3,4,7,8-Pentachlorodibenzofuran (PeCDF)	pg/g	820	2700	2900	2.2 J	0.14 U	0.99 J	0.13 U	370	3300	2600	1500
2,3,7,8-Tetrachlorodibenzofuran (TCDF)	pg/g	91000	160000	200000	90	3.4	28	5.9	19000 J	180000 J	160000 J	63000 J
2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	pg/g	16000	50000	60000	30	4.1	11	4.5	5600 J	49000 J	41000 J	22000 J
Total heptachlorodibenzofuran (HpCDF)	pg/g	1200 J	2800 J	4600 J	3.0 J	1.1 J	2.4 J	0.13 U	440 J	6300 J	3200 J	2000 J
Total heptachlorodibenzo-p-dioxin (HpCDD)	pg/g	350 J	1300 J	2100 J	60 J	77 J	82 J	48 J	230 J	6600 J	3200 J	2700 J
Total hexachlorodibenzofuran (HxCDF)	pg/g	3500 J	8500 J	12000 J	10 J	3.6 J	4.9 J	3.6 J	1300 J	15000 J	8800 J	7800 J
Total hexachlorodibenzo-p-dioxin (HxCDD)	pg/g	49 J	160 J	210 J	19 J	20 J	23 J	14 J	32 J	450 J	250 J	350 J
Total pentachlorodibenzofuran (PeCDF)	pg/g	3300 J	11000 J	13000 J	7.9 J	1.9 J	3.7 J	1.6 J	1600 J	13000 J	10000 J	7600 J
Total pentachlorodibenzo-p-dioxin (PeCDD)	pg/g	150 J	400 J	460 J	0.45 U	0.25 U	0.15 U	0.13 U	52 J	600 J	480 J	240 J
Total tetrachlorodibenzofuran (TCDF)	pg/g	78000 J	290000 J	350000 J	210 J	24 J	63 J	24 J	34000 J	210000 J	160000 J	110000 J
Total tetrachlorodibenzo-p-dioxin (TCDD)	pg/g	17000 J	55000 J	66000 J	36 J	5.1 J	11 J	4.5 J	6100 J	54000 J	46000 J	24000 J
TEQ												
Total WHO Dioxin TEQ(Human/Mammal)(ND=0)	pg/g	26000 J	68000 J	83000 J	41 J	4.7 J	15 J	5.4 J	7800 J	70000 J	59000 J	30000 J
Total WHO Dioxin TEQ(Human/Mammal)(ND=0.5)	pg/g	26000 J	68000 J	83000 J	41 J	5.2 J	15 J	5.6 J	7800 J	70000 J	59000 J	30000 J

Notes:
- U - Not detected at the associated reporting limit
- J - Estimated concentration
- UJ - Not detected; associated reporting limit is estimated
- J- - Estimated concentration, result may be biased low
- J+ - Estimated concentration, result may be biased high
- TEQ - Toxicity Equivalent Quotient
- ft bgs - Feet below ground surface
- pg/g - picogram per grams

Table 2-4

Supplemental Design Investigation Analytical Results - Northern Impoundment
Final 100% Remedial Design - Northern Impoundment
San Jacinto River Waste Pits Site
Harris County, Texas

Sample Location: Sample Identification: Sample Date: Sample Depth: Parameters	Units	SJSB074 11215702-072221-SS-SJSB074(6-8) 07/22/2021 (6-8) ft bgs	SJSB074 11215702-072221-SS-SJSB074(8-10) 07/22/2021 (8-10) ft bgs	SJSB074 11215702-072221-SS-SJSB074(10-12) 07/22/2021 (10-12) ft bgs	SJSB074 11215702-072221-SS-SJSB074(12-14) 07/22/2021 (12-14) ft bgs	SJSB074 11215702-072221-SS-SJSB074(14-16) 07/22/2021 (14-16) ft bgs	SJSB074 11215702-072221-SS-SJSB074(16-18) 07/22/2021 (16-18) ft bgs	SJSB075 11215702-072021-SS-SJSB075(4-6) 07/20/2021 (4-6) ft bgs	SJSB075 11215702-072021-SS-SJSB075(10-12) 07/20/2021 (10-12) ft bgs	SJSB075 11215702-072021-SS-SJSB075(12-14) 07/20/2021 (12-14) ft bgs	SJSB075 11215702-072021-SS-SJSB075(14-16) 07/20/2021 (14-16) ft bgs	SJSB075 11215702-072021-SS-SJSB075(16-18) 07/20/2021 (16-18) ft bgs
Dioxins/Furans												
1,2,3,4,6,7,8,9-Octachlorodibenzofuran (OCDF)	pg/g	7.1 J	0.38 U	0.32 U	0.32 U	0.34 U	0.14 U	970 U	3.0 U	0.11 U	1.1 U	0.10 U
1,2,3,4,6,7,8,9-Octachlorodibenzo-p-dioxin (OCDD)	pg/g	1200	82	58	55	51	200	11000 U	130 U	52 U	240 U	190 U
1,2,3,4,6,7,8-Heptachlorodibenzofuran (HpCDF)	pg/g	4.3 J	0.22 U	0.16 U	0.13 U	0.42 U	0.14 U	2300	5.4 J	0.096 U	0.48 U	0.48 U
1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin (HpCDD)	pg/g	34	2.9 J	1.8 J	2.2 J	2.2 J	9.6	660	7.0 U	1.9 U	15 U	10
1,2,3,4,7,8,9-Heptachlorodibenzofuran (HpCDF)	pg/g	0.87 J	0.063 U	0.059 U	0.099 U	0.12 U	0.027 U	710	2.5 J	0.10 U	0.19 U	0.30 U
1,2,3,4,7,8-Hexachlorodibenzofuran (HxCDF)	pg/g	7.8	0.44 J	0.28 U	0.13 U	0.38 J	0.067 J	8400	25	0.33 J	0.41 J	0.90 J
1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin (HxCDD)	pg/g	0.55 U	0.20 U	0.19 U	0.11 U	0.25 U	0.26 U	6.3 U	0.30 U	0.25 U	0.28 U	0.37 U
1,2,3,6,7,8-Hexachlorodibenzofuran (HxCDF)	pg/g	2.3 J	0.12 U	0.13 U	0.054 U	0.20 U	0.019 U	2100	6.3	0.32 U	0.14 U	0.34 U
1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin (HxCDD)	pg/g	0.98 J	0.082 U	0.074 J	0.11 U	0.19 J	0.27 J	34 J	0.39 J	0.10 U	0.62 J	0.43 J
1,2,3,7,8,9-Hexachlorodibenzofuran (HxCDF)	pg/g	0.085 U	0.036 U	0.11 U	0.11 U	0.19 U	0.22 U	110 U	2.1 U	2.9 U	1.9 U	1.9 U
1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin (HxCDD)	pg/g	1.4 J	0.19 U	0.061 U	0.22 U	0.24 U	0.67 J	9.6 U	0.43 U	0.36 U	1.1 U	0.72 U
1,2,3,7,8-Pentachlorodibenzofuran (PeCDF)	pg/g	5.6 J	0.33 J	0.17 J	0.033 U	0.30 J	0.18 J	5500	22	1.7 U	1.4 U	1.4 U
1,2,3,7,8-Pentachlorodibenzo-p-dioxin (PeCDD)	pg/g	0.64 J	0.065 U	0.043 U	0.11 J	0.054 U	0.12 J	330 J	1.8 J	0.069 U	0.23 U	0.066 U
2,3,4,6,7,8-Hexachlorodibenzofuran (HxCDF)	pg/g	0.32 J	0.035 U	0.024 U	0.056 J	0.10 J	0.016 U	230 J	1.0 J	0.065 U	0.11 U	0.12 U
2,3,4,7,8-Pentachlorodibenzofuran (PeCDF)	pg/g	3.6 J	0.20 J	0.12 J	0.032 U	0.16 J	0.056 J	2800	12	0.065 U	0.19 U	0.33 J
2,3,7,8-Tetrachlorodibenzofuran (TCDF)	pg/g	200	12	6.2	0.76 U	5.7	0.66 U	130000	690	1.3 U	5.9 U	13
2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	pg/g	63	3.7	2.3	0.26 U	1.8	0.38 J	40000	190	0.98 U	1.8 U	5.0
Total heptachlorodibenzofuran (HpCDF)	pg/g	7.3 J	0.35 J	0.16 J	0.34 J	0.74 J	0.096 J	3800 J	10 J	0.10 U	0.28 J	0.56 J
Total heptachlorodibenzo-p-dioxin (HpCDD)	pg/g	110 J	13 J	7.1 J	9.6 J	7.6 J	37 J	1500 J	18 J	11 J	43 J	36 J
Total hexachlorodibenzofuran (HxCDF)	pg/g	14 J	0.56 J	0.47 J	0.35 J	0.88 J	0.28 J	12000 J	40 J	4.2 J	2.3 J	3.5 J
Total hexachlorodibenzo-p-dioxin (HxCDD)	pg/g	21 J	2.7 J	1.4 J	7.9 J	6.8 J	11 J	170 J	5.1 J	4.8 J	15 J	13 J
Total pentachlorodibenzofuran (PeCDF)	pg/g	17 J	0.69 J	0.36 J	0.033 U	0.55 J	0.29 J	13000 J	55 J	2.2 J	1.4 J	2.6 J
Total pentachlorodibenzo-p-dioxin (PeCDD)	pg/g	4.1 J	0.17 J	0.18 J	2.9 J	1.8 J	2.4 J	350 J	1.8 J	0.71 J	3.1 J	2.4 J
Total tetrachlorodibenzofuran (TCDF)	pg/g	370 J	22 J	10 J	1.1 J	7.7 J	1.3 J	230000 J	1300 J	5.0 J	10 J	29 J
Total tetrachlorodibenzo-p-dioxin (TCDD)	pg/g	69 J	4.0 J	2.7 J	7.9 J	4.6 J	2.0 J	44000 J	220 J	3.7 J	3.2 J	6.6 J
TEQ												
Total WHO Dioxin TEQ(Human/Mammal)(ND=0)	pg/g	87 J	5.1 J	3.0 J	0.15 J	2.5 J	0.78 J	55000 J	270 J	0.033 J	0.10 J	6.6 J
Total WHO Dioxin TEQ(Human/Mammal)(ND=0.5)	pg/g	87 J	5.1 J	3.1 J	0.37 J	2.6 J	0.84 J	55000 J	270 J	0.88 J	1.8 J	6.7 J

Notes:
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- TEQ - Toxicity Equivalent Quotient
- ft bgs - Feet below ground surface
- pg/g - picogram per grams

Table 2-4

Supplemental Design Investigation Analytical Results - Northern Impoundment
Final 100% Remedial Design - Northern Impoundment
San Jacinto River Waste Pits Site
Harris County, Texas

Sample Location: Sample Identification: Sample Date: Sample Depth: Parameters	Units	SJSB076 11215702-072221-SS-SJSB076(0-2) 07/22/2021 (0-2) ft bgs	SJSB076 11215702-072221-SS-SJSB076(2-4) 07/22/2021 (2-4) ft bgs	SJSB076 11215702-072221-SS-SJSB076(4-6) 07/22/2021 (4-6) ft bgs	SJSB076 11215702-072221-SS-SJSB076(6-8) 07/22/2021 (6-8) ft bgs	SJSB076 11215702-072221-SS-SJSB076(8-10) 07/22/2021 (8-10) ft bgs	SJSB076 11215702-072221-SS-SJSB076(10-12) 07/22/2021 (10-12) ft bgs	SJSB076 11215702-072221-SS-SJSB076 (10-12)-R 07/22/2021 (10-12) ft bgs Lab Duplicate	SJSB076 11215702-072221-SS-SJSB076(12-14) 07/22/2021 (12-14) ft bgs	SJSB076 11215702-072221-SS-SJSB076(14-16) 07/22/2021 (14-16) ft bgs	SJSB076 11215702-072221-SS-SJSB076(16-18) 07/22/2021 (16-18) ft bgs	SJSB077 11215702-072121-SS-SJSB077(6-8) 07/21/2021 (6-8) ft bgs
Dioxins/Furans												
1,2,3,4,6,7,8,9-Octachlorodibenzofuran (OCDF)	pg/g	72	910	1400	3.6 J	0.35 J	2.7 J	1.7 U	0.58 J	0.81 J	0.24 U	1300
1,2,3,4,6,7,8,9-Octachlorodibenzo-p-dioxin (OCDD)	pg/g	1200	4500	16000 J	150	84	200	170	350	130	400	8900
1,2,3,4,6,7,8-Heptachlorodibenzofuran (HpCDF)	pg/g	150	2300	2900	6.6 J	0.43 J	5.2 J	3.1 J	1.0 J	0.70 J	0.21 U	2400
1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin (HpCDD)	pg/g	51 J	350	1200	6.4 J	3.4 J	8.9	8.7	19	10	18	550
1,2,3,4,7,8,9-Heptachlorodibenzofuran (HpCDF)	pg/g	46	780	1000	2.5 J	0.16 J	1.8 J	0.96 U	0.42 J	0.084 J	0.027 U	770
1,2,3,4,7,8-Hexachlorodibenzofuran (HxCDF)	pg/g	500	8400 J	11000 J	24	1.1 J	19	11	3.0 J	1.1 J	0.39 J	7100
1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin (HxCDD)	pg/g	0.96 J	3.6 J	7.0 J	0.051 U	0.28 J	0.071 U	0.24 U	0.61 J	0.31 J	0.45 U	7.4 J
1,2,3,6,7,8-Hexachlorodibenzofuran (HxCDF)	pg/g	130	2300	3000	6.8	0.30 J	4.4 J	3.0 J	0.87 J	0.31 J	0.13 J	1800
1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin (HxCDD)	pg/g	1.8 J	18	35	0.054 U	0.19 J	0.082 U	0.24 U	0.85 J	0.34 J	0.53 J	41 J
1,2,3,7,8,9-Hexachlorodibenzofuran (HxCDF)	pg/g	8.1	140	210	0.14 U	0.13 J	0.35 J	0.26 U	0.046 U	0.065 J	0.23 U	120
1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin (HxCDD)	pg/g	2.0 J	9.1 J	13	0.24 J	0.28 J	0.29 J	0.35 U	1.5 J	0.56 J	1.4 J	18 J
1,2,3,7,8-Pentachlorodibenzofuran (PeCDF)	pg/g	310	6000 J	6400 J	17	0.96 J	14	13	2.1 J	0.72 J	0.41 J	4600
1,2,3,7,8-Pentachlorodibenzo-p-dioxin (PeCDD)	pg/g	20	270	420	1.5 J	0.19 J	0.98 J	0.61 J	0.21 U	0.15 J	0.22 J	400
2,3,4,6,7,8-Hexachlorodibenzofuran (HxCDF)	pg/g	16	260	360	0.15 U	0.073 U	0.59 J	0.51 J	0.044 U	0.029 U	0.019 U	220
2,3,4,7,8-Pentachlorodibenzofuran (PeCDF)	pg/g	160	2600	3200	9.7	0.54 J	7.5	6.4	0.95 J	0.31 J	0.16 J	2800
2,3,7,8-Tetrachlorodibenzofuran (TCDF)	pg/g	7600 J	110000 J	150000 J	540	28	360	260	43	9.8	6.5	170000 J
2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	pg/g	2100 J	36000 J	45000 J	150	7.9	110	82	15	3.5	2.2	44000 J
Total heptachlorodibenzofuran (HpCDF)	pg/g	230 J	3600 J	4600 J	11 J	0.72 J	8.5 J	5.1 J	1.7 J	0.90 J	0.32 J	3900 J
Total heptachlorodibenzo-p-dioxin (HpCDD)	pg/g	120 J	690 J	2200 J	19 J	12 J	24 J	22 J	69 J	26 J	77 J	1100 J
Total hexachlorodibenzofuran (HxCDF)	pg/g	740 J	13000 J	16000 J	31 J	1.5 J	27 J	17 J	3.8 J	1.7 J	0.76 J	10000 J
Total hexachlorodibenzo-p-dioxin (HxCDD)	pg/g	22 J	110 J	260 J	3.6 J	3.9 J	3.4 J	3.7 J	17 J	7.5 J	21 J	190 J
Total pentachlorodibenzofuran (PeCDF)	pg/g	720 J	13000 J	16000 J	38 J	2.1 J	32 J	33 J	4.0 J	1.5 J	0.81 J	11000 J
Total pentachlorodibenzo-p-dioxin (PeCDD)	pg/g	22 J	300 J	420 J	1.5 J	0.40 J	0.98 J	0.87 J	0.68 J	0.66 J	4.2 J	400 J
Total tetrachlorodibenzofuran (TCDF)	pg/g	13000 J	160000 J	230000 J	930 J	51 J	640 J	490 J	78 J	19 J	11 J	240000 J
Total tetrachlorodibenzo-p-dioxin (TCDD)	pg/g	2300 J	40000 J	50000 J	160 J	8.8 J	120 J	92 J	17 J	4.5 J	5.7 J	48000 J
TEQ												
Total WHO Dioxin TEQ(Human/Mammal)(ND=0)	pg/g	3000 J	49000 J	63000 J	210 J	11 J	150 J	110 J	21 J	5.2 J	3.7 J	63000 J
Total WHO Dioxin TEQ(Human/Mammal)(ND=0.5)	pg/g	3000 J	49000 J	63000 J	210 J	11 J	150 J	110 J	21 J	5.2 J	3.7 J	63000 J

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- TEQ - Toxicity Equivalent Quotient
- ft bgs - Feet below ground surface
- pg/g - picogram per grams

Table 2-4

Supplemental Design Investigation Analytical Results - Northern Impoundment
Final 100% Remedial Design - Northern Impoundment
San Jacinto River Waste Pits Site
Harris County, Texas

Sample Location: Sample Identification: Sample Date: Sample Depth: Parameters	Units	SJSB077 11215702-072121-DUP-3 07/21/2021 (6-8) ft bgs Field Duplicate	SJSB077 11215702-072121-SS-SJSB077(8-10) 07/21/2021 (8-10) ft bgs	SJSB077 11215702-072121-SS-SJSB077(10-12) 07/21/2021 (10-12) ft bgs	SJSB077 11215702-072121-SS-SJSB077 (10-12)-R 07/21/2021 (10-12) ft bgs Lab Duplicate	SJSB077 11215702-072121-SS-SJSB077(12-14) 07/21/2021 (12-14) ft bgs	SJSB077 11215702-072121-SS-SJSB077 (12-14)-R 07/21/2021 (12-14) ft bgs Lab Duplicate	SJSB077 11215702-072121-SS-SJSB077(14-16) 07/21/2021 (14-16) ft bgs	SJSB077 11215702-072121-SS-SJSB077 (14-16)-R 07/21/2021 (14-16) ft bgs Lab Duplicate	SJSB077 11215702-072121-SS-SJSB077(16-18) 07/21/2021 (16-18) ft bgs	SJSB078 11215702-072121-SS-SJSB078(0-2) 07/21/2021 (0-2) ft bgs	SJSB078 11215702-072121-SS-SJSB078(2-4) 07/21/2021 (2-4) ft bgs
Dioxins/Furans												
1,2,3,4,6,7,8,9-Octachlorodibenzofuran (OCDF)	pg/g	1400	1700	1.4 J	2.0 U	0.95 J	0.87 U	8.3 J	5.4 J	0.83 J	560 J	1100 J
1,2,3,4,6,7,8,9-Octachlorodibenzo-p-dioxin (OCDD)	pg/g	9700	10000	100	150	73	120	480	480	89	5600	15000
1,2,3,4,6,7,8-Heptachlorodibenzofuran (HpCDF)	pg/g	2500	3900	2.1 J	3.4 J	0.84 J	1.0 U	14	11	0.32 J	1300	2300
1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin (HpCDD)	pg/g	610	720	4.4 J	8.7	2.7 J	5.7 J	21	27	3.9 J	440 J	1100
1,2,3,4,7,8,9-Heptachlorodibenzofuran (HpCDF)	pg/g	760	1000	0.67 J	1.3 U	0.33 J	0.41 U	4.5 J	3.6 J	0.18 J	480 J	730 J
1,2,3,4,7,8-Hexachlorodibenzofuran (HxCDF)	pg/g	8700	9800	6.9	14	2.2 J	3.5 J	41	36	0.033 U	4700	7100
1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin (HxCDD)	pg/g	4.6 J	5.2 J	0.32 J	0.31 U	0.17 U	0.26 U	0.24 U	0.41 U	0.077 U	38 J	5.8 U
1,2,3,6,7,8-Hexachlorodibenzofuran (HxCDF)	pg/g	2300	2500	1.8 J	3.3 J	0.74 J	0.98 J	11	8.1	0.032 U	1200	1800
1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin (HxCDD)	pg/g	48 J	37 J	0.13 U	0.20 U	0.18 U	0.15 U	0.27 U	0.48 J	0.088 U	4.5 U	6.4 U
1,2,3,7,8,9-Hexachlorodibenzofuran (HxCDF)	pg/g	140	160	0.075 U	0.31 U	0.050 U	0.14 U	0.25 U	0.57 J	0.031 U	22 U	37 U
1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin (HxCDD)	pg/g	13 J	12 J	0.11 U	0.27 U	0.16 U	0.21 U	0.24 U	0.39 U	0.076 U	4.0 U	5.7 U
1,2,3,7,8-Pentachlorodibenzofuran (PeCDF)	pg/g	5400	5900	5.1 J	9.5	1.6 J	2.1 J	27	22	0.038 U	3100	3300
1,2,3,7,8-Pentachlorodibenzo-p-dioxin (PeCDD)	pg/g	460	530	0.091 U	0.98 J	0.077 U	0.23 J	2.4 J	1.9 J	0.069 U	170 J	260 J
2,3,4,6,7,8-Hexachlorodibenzofuran (HxCDF)	pg/g	280	280	0.077 U	0.42 J	0.050 U	0.18 U	1.4 J	1.0 J	0.031 U	170 J	170 J
2,3,4,7,8-Pentachlorodibenzofuran (PeCDF)	pg/g	3200	3500	2.5 J	6.4	1.1 J	1.2 J	16	15	0.040 U	1700	1800
2,3,7,8-Tetrachlorodibenzofuran (TCDF)	pg/g	140000 J	200000 J	100	340	48	51	730 J	690 J	1.0 U	80000	190000 J
2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	pg/g	44000 J	54000 J	38	110	18	17	260	250	0.058 U	24000	26000
Total heptachlorodibenzofuran (HpCDF)	pg/g	4000 J	5900 J	3.3 J	6.1 J	1.2 J	1.8 J	23 J	18 J	0.65 J	2100 J	3700 J
Total heptachlorodibenzo-p-dioxin (HpCDD)	pg/g	1300 J	1500 J	17 J	23 J	9.9 J	19 J	74 J	66 J	16 J	820 J	2300 J
Total hexachlorodibenzofuran (HxCDF)	pg/g	13000 J	14000 J	8.7 J	21 J	3.0 J	5.6 J	58 J	51 J	0.033 U	6500 J	9500 J
Total hexachlorodibenzo-p-dioxin (HxCDD)	pg/g	200 J	190 J	8.4 J	9.6 J	3.3 J	5.9 J	23 J	14 J	5.2 J	93 J	150 J
Total pentachlorodibenzofuran (PeCDF)	pg/g	13000 J	14000 J	7.6 J	25 J	2.7 J	5.0 J	62 J	56 J	0.072 U	7600 J	7800 J
Total pentachlorodibenzo-p-dioxin (PeCDD)	pg/g	460 J	530 J	0.14 U	3.9 J	0.077 U	1.5 J	6.0 J	4.2 J	0.34 U	170 J	260 J
Total tetrachlorodibenzofuran (TCDF)	pg/g	250000 J	300000 J	200 J	640 J	100 J	96 J	1400 J	1300 J	1.0 J	160000 J	160000 J
Total tetrachlorodibenzo-p-dioxin (TCDD)	pg/g	48000 J	59000 J	43 J	130 J	20 J	22 J	290 J	270 J	0.74 U	27000 J	28000 J
TEQ												
Total WHO Dioxin TEQ(Human/Mammal)(ND=0)	pg/g	61000 J	77000 J	50 J	150 J	24 J	23 J	350 J	330 J	0.071 J	33000 J	47000 J
Total WHO Dioxin TEQ(Human/Mammal)(ND=0.5)	pg/g	61000 J	77000 J	50 J	150 J	24 J	23 J	350 J	330 J	0.21 J	33000 J	47000 J

Notes:
U - Not detected at the associated reporting limit
J - Estimated concentration
UJ - Not detected; associated reporting limit is estimated
J- - Estimated concentration, result may be biased low
J+ - Estimated concentration, result may be biased high
TEQ - Toxicity Equivalent Quotient
ft bgs - Feet below ground surface
pg/g - picogram per grams

Table 2-4

Supplemental Design Investigation Analytical Results - Northern Impoundment
Final 100% Remedial Design - Northern Impoundment
San Jacinto River Waste Pits Site
Harris County, Texas

Sample Location: Sample Identification: Sample Date: Sample Depth: Parameters	Units	SJSB078 11215702-072121-SS-SJSB078(4-6) 07/21/2021 (4-6) ft bgs	SJSB078 11215702-072121-SS-SJSB078(6-8) 07/21/2021 (6-8) ft bgs	SJSB078 11215702-072121-SS-SJSB078 (6-8)-R 07/21/2021 (6-8) ft bgs Lab Duplicate	SJSB078 11215702-072121-SS-SJSB078(8-10) 07/21/2021 (8-10) ft bgs	SJSB078 11215702-072121-SS-SJSB078 (8-10)-R 07/21/2021 (8-10) ft bgs Lab Duplicate	SJSB078 11215702-072121-SS-SJSB078(10-12) 07/21/2021 (10-12) ft bgs	SJSB078 11215702-072121-SS-SJSB078 (10-12)-R 07/21/2021 (10-12) ft bgs Lab Duplicate	SJSB078 11215702-072121-SS-SJSB078(12-14) 07/21/2021 (12-14) ft bgs	SJSB078 11215702-072121-SS-SJSB078(14-16) 07/21/2021 (14-16) ft bgs	SJSB078 11215702-072121-DUP-2 07/21/2021 (14-16) ft bgs Field Duplicate	SJSB078 11215702-072121-SS-SJSB078(16-18) 07/21/2021 (16-18) ft bgs
Dioxins/Furans												
1,2,3,4,6,7,8,9-Octachlorodibenzofuran (OCDF)	pg/g	1200	0.74 J	2.1 U	1.7 J	1.5 U	3.1 J	1.5 U	0.073 U	0.069 U	0.33 U	4.4 J
1,2,3,4,6,7,8,9-Octachlorodibenzo-p-dioxin (OCDD)	pg/g	12000	91 J	200 J	92	130	320	280	89	100	130	240
1,2,3,4,6,7,8-Heptachlorodibenzofuran (HpCDF)	pg/g	2300	0.33 J	3.3 J	1.6 J	2.2 U	2.5 J	2.0 U	0.69 J	0.21 J	0.19 U	4.5 J
1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin (HpCDD)	pg/g	710	3.1 J	6.4 J	4.4 J	8.0	9.1	9.4	2.7 J	4.9 J	6.3	10
1,2,3,4,7,8,9-Heptachlorodibenzofuran (HpCDF)	pg/g	730	0.050 U	0.85 U	0.64 J	0.65 U	0.94 J	0.73 U	0.21 J	0.047 U	0.18 U	1.1 J
1,2,3,4,7,8-Hexachlorodibenzofuran (HxCDF)	pg/g	8200	1.6 J	8.8	5.1 J	6.2	9.9	7.6	1.7 J	0.58 J	0.89 J	13
1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin (HxCDD)	pg/g	6.2 J	0.093 U	0.35 U	0.056 U	0.22 U	0.17 U	0.28 U	0.090 U	0.081 U	0.28 U	0.10 U
1,2,3,6,7,8-Hexachlorodibenzofuran (HxCDF)	pg/g	2100	0.50 J	2.7 J	1.5 J	1.8 J	2.3 J	2.3 J	0.52 J	0.030 U	0.12 U	3.4 J
1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin (HxCDD)	pg/g	45 J	0.11 U	0.29 U	0.065 U	0.26 U	0.20 U	0.29 U	0.11 U	0.088 U	0.29 U	0.11 U
1,2,3,7,8,9-Hexachlorodibenzofuran (HxCDF)	pg/g	160	0.033 U	0.27 U	0.063 U	0.13 U	0.092 U	0.19 U	0.033 U	0.029 U	0.11 U	0.38 J
1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin (HxCDD)	pg/g	14 J	0.093 U	0.45 U	0.056 U	0.26 U	0.17 U	0.37 U	0.090 U	0.078 U	0.26 U	0.098 U
1,2,3,7,8-Pentachlorodibenzofuran (PeCDF)	pg/g	5300	1.8 J	8.0	4.4 J	5.6 J	7.1	7.4	1.3 J	0.48 J	0.17 U	8.1
1,2,3,7,8-Pentachlorodibenzo-p-dioxin (PeCDD)	pg/g	440	0.071 U	0.97 J	0.51 J	0.56 J	0.076 U	0.62 J	0.068 U	0.089 U	0.41 UJ	1.1 J
2,3,4,6,7,8-Hexachlorodibenzofuran (HxCDF)	pg/g	270	0.029 U	0.42 J	0.061 U	0.21 J	0.082 U	0.28 J	0.031 U	0.028 U	0.11 U	0.32 J
2,3,4,7,8-Pentachlorodibenzofuran (PeCDF)	pg/g	3300	1.0 J	4.8 J	2.6 J	3.4 J	3.7 J	3.8 J	0.071 U	0.032 U	0.17 U	4.8 J
2,3,7,8-Tetrachlorodibenzofuran (TCDF)	pg/g	250000	66 J	290 J	150	250	200	250	32	15	22	230
2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	pg/g	58000	25 J	110 J	47	74	68	83	12	5.6	9.6	92
Total heptachlorodibenzofuran (HpCDF)	pg/g	4000 J	0.64 J	5.7 J	2.8 J	3.8 J	4.5 J	3.8 J	1.1 J	0.21 J	0.19 U	7.7 J
Total heptachlorodibenzo-p-dioxin (HpCDD)	pg/g	1600 J	13 J	25 J	13 J	22 J	34 J	32 J	15 J	19 J	27 J	31 J
Total hexachlorodibenzofuran (HxCDF)	pg/g	12000 J	2.1 J	14 J	6.6 J	9.3 J	13 J	11 J	2.2 J	0.58 J	0.89 J	20 J
Total hexachlorodibenzo-p-dioxin (HxCDD)	pg/g	220 J	3.0 J	6.4 J	3.5 J	4.8 J	5.8 J	6.8 J	2.0 J	8.8 J	11 J	7.3 J
Total pentachlorodibenzofuran (PeCDF)	pg/g	13000 J	4.4 J	20 J	9.3 J	14 J	15 J	17 J	1.3 J	0.48 J	0.29 U	20 J
Total pentachlorodibenzo-p-dioxin (PeCDD)	pg/g	440 J	0.51 U	2.1 J	0.51 J	1.5 J	0.58 U	1.8 J	0.34 U	2.3 J	0.60 U	2.1 J
Total tetrachlorodibenzofuran (TCDF)	pg/g	320000 J	130 J	570 J	300 J	500 J	380 J	490 J	64 J	26 J	38 J	460 J
Total tetrachlorodibenzo-p-dioxin (TCDD)	pg/g	63000 J	25 J	120 J	47 J	81 J	68 J	92 J	12 J	8.0 J	9.6 J	100 J
TEQ												
Total WHO Dioxin TEQ(Human/Mammal)(ND=0)	pg/g	86000 J	32 J	140 J	64 J	100 J	91 J	110 J	16 J	7.3 J	12 J	120 J
Total WHO Dioxin TEQ(Human/Mammal)(ND=0.5)	pg/g	86000 J	32 J	140 J	64 J	100 J	91 J	110 J	16 J	7.3 J	12 J	120 J

Notes:
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J- - Estimated concentration, result may be biased low
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TEQ - Toxicity Equivalent Quotient
ft bgs - Feet below ground surface
pg/g - picogram per grams

Table 2-4

Supplemental Design Investigation Analytical Results - Northern Impoundment
Final 100% Remedial Design - Northern Impoundment
San Jacinto River Waste Pits Site
Harris County, Texas

Sample Location: Sample Identification: Sample Date: Sample Depth: Parameters	Units	SJSB078 11215702-072121-SS-SJSB078 (16-18)-R 07/21/2021 (16-18) ft bgs Lab Duplicate	SJSB078 11215702-072121-SS-SJSB078(18-20) 07/21/2021 (18-20) ft bgs	SJSB078 11215702-072121-SS-SJSB078(20-22) 07/21/2021 (20-22) ft bgs	SJSB078 11215702-072121-SS-SJSB078 (20-22)-R 07/21/2021 (20-22) ft bgs Lab Duplicate	SJSB078 11215702-072121-SS-SJSB078(22-24) 07/21/2021 (22-24) ft bgs	SJSB079 11215702-072521-SS-SJSB079(0-2) 07/25/2021 (0-2) ft bgs	SJSB079 11215702-072521-SS-SJSB079(2-4) 07/25/2021 (2-4) ft bgs	SJSB079 11215702-072521-SS-SJSB079(4-6) 07/25/2021 (4-6) ft bgs	SJSB079 11215702-072521-SS-SJSB079(6-8) 07/25/2021 (6-8) ft bgs	SJSB079 11215702-072521-SS-SJSB079(8-10) 07/25/2021 (8-10) ft bgs	SJSB079 11215702-072521-DUP-7 07/25/2021 (8-10) ft bgs Field Duplicate
Dioxins/Furans												
1,2,3,4,6,7,8,9-Octachlorodibenzofuran (OCDF)	pg/g	3.7 U	0.88 U	4.5 J	4.1 J	0.88 U	620	1500	950	1200	1200	1700
1,2,3,4,6,7,8,9-Octachlorodibenzo-p-dioxin (OCDD)	pg/g	240	130	240	230	63	5100	12000	5600	6500	9000	11000
1,2,3,4,6,7,8-Heptachlorodibenzofuran (HpCDF)	pg/g	4.1 J	0.35 U	7.3	6.4	0.35 U	1200	2800	1900	2000	2100	2800
1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin (HpCDD)	pg/g	8.8	6.3	12	10	2.6 U	410	880	340	470	570	850
1,2,3,4,7,8,9-Heptachlorodibenzofuran (HpCDF)	pg/g	1.2 U	0.034 U	2.3 J	2.2 U	0.036 U	420	1000	620	650	640	1300
1,2,3,4,7,8-Hexachlorodibenzofuran (HxCDF)	pg/g	10	0.22 J	22	23	0.070 J	4800	10000	6500	6500	7000	20000
1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin (HxCDD)	pg/g	0.25 U	0.31 U	0.31 U	0.32 U	0.045 U	2.0 U	6.4 J	2.2 U	7.0 J	4.9 J	3.8 J
1,2,3,6,7,8-Hexachlorodibenzofuran (HxCDF)	pg/g	3.2 J	0.028 U	5.6 J	5.3 J	0.030 U	1200	2500	1700	1700	1900	4400
1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin (HxCDD)	pg/g	0.30 U	0.25 J	0.37 J	0.34 J	0.049 U	13 J	27 J	15 J	31 J	32 J	39 J
1,2,3,7,8,9-Hexachlorodibenzofuran (HxCDF)	pg/g	0.20 U	0.043 J	0.46 J	0.47 J	0.057 J	84 J	130	87 J	100	97 J	300
1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin (HxCDD)	pg/g	0.39 U	0.51 J	0.41 J	0.39 U	0.27 J	7.9 J	15 J	2.1 U	9.0 J	9.9 J	12 J
1,2,3,7,8-Pentachlorodibenzofuran (PeCDF)	pg/g	9.1	0.19 J	16	13	0.034 U	3600	5200	4100	4200	4500 J	26000 J
1,2,3,7,8-Pentachlorodibenzo-p-dioxin (PeCDD)	pg/g	0.89 J	0.10 J	1.6 J	1.3 J	0.050 U	210	340	200	330	290	320 J
2,3,4,6,7,8-Hexachlorodibenzofuran (HxCDF)	pg/g	0.42 J	0.11 U	0.73 J	0.68 J	0.024 U	170	260	210	190	230 J	780 J
2,3,4,7,8-Pentachlorodibenzofuran (PeCDF)	pg/g	5.1 J	0.096 J	9.5	8.4	0.033 U	2000	2600	1800	2400	2400 J	11000 J
2,3,7,8-Tetrachlorodibenzofuran (TCDF)	pg/g	280	5.0	570 J	450	0.57 J	77000 J	120000 J	70000 J	130000 J	120000 J	120000 J
2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	pg/g	110	1.8	190	150	0.25 J	23000 J	37000 J	19000 J	35000 J	31000 J	31000 J
Total heptachlorodibenzofuran (HpCDF)	pg/g	7.9 J	0.14 J	13 J	11 J	0.10 J	1900 J	4500 J	3000 J	3300 J	3400 J	5300 J
Total heptachlorodibenzo-p-dioxin (HpCDD)	pg/g	28 J	25 J	32 J	32 J	12 J	750 J	1600 J	720 J	1000 J	1200 J	1800 J
Total hexachlorodibenzofuran (HxCDF)	pg/g	16 J	0.28 J	33 J	33 J	0.13 J	7100 J	15000 J	9400 J	9700 J	10000 J	30000 J
Total hexachlorodibenzo-p-dioxin (HxCDD)	pg/g	7.2 J	8.8 J	7.4 J	8.1 J	5.0 J	80 J	160 J	80 J	140 J	140 J	170 J
Total pentachlorodibenzofuran (PeCDF)	pg/g	23 J	0.37 J	41 J	34 J	0.034 U	8900 J	12000 J	9200 J	10000 J	11000 J	60000 J
Total pentachlorodibenzo-p-dioxin (PeCDD)	pg/g	2.3 J	1.6 J	3.3 J	2.8 J	1.2 J	210 J	340 J	200 J	330 J	290 J	320 J
Total tetrachlorodibenzofuran (TCDF)	pg/g	580 J	8.2 J	1100 J	840 J	0.92 J	130000 J	220000 J	140000 J	240000 J	210000 J	240000 J
Total tetrachlorodibenzo-p-dioxin (TCDD)	pg/g	120 J	2.9 J	210 J	170 J	1.4 J	25000 J	41000 J	21000 J	38000 J	33000 J	34000 J
TEQ												
Total WHO Dioxin TEQ(Human/Mammal)(ND=0)	pg/g	140 J	2.6 J	260 J	200 J	0.37 J	32000 J	52000 J	28000 J	50000 J	45000 J	50000 J
Total WHO Dioxin TEQ(Human/Mammal)(ND=0.5)	pg/g	140 J	2.7 J	260 J	200 J	0.42 J	32000 J	52000 J	28000 J	50000 J	45000 J	50000 J

Notes:
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- J- - Estimated concentration, result may be biased low
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- TEQ - Toxicity Equivalent Quotient
- ft bgs - Feet below ground surface
- pg/g - picogram per grams

Table 2-4

Supplemental Design Investigation Analytical Results - Northern Impoundment
Final 100% Remedial Design - Northern Impoundment
San Jacinto River Waste Pits Site
Harris County, Texas

Sample Location: Sample Identification: Sample Date: Sample Depth: Parameters	Units	SJSB079 11215702-072521-SS-SJSB079(10-12) 07/25/2021 (10-12) ft bgs	SJSB079 11215702-072521-SS-SJSB079(12-14) 07/25/2021 (12-14) ft bgs	SJSB079 11215702-072521-SS-SJSB079(14-16) 07/25/2021 (14-16) ft bgs	SJSB079 11215702-072521-SS-SJSB079(16-18) 07/25/2021 (16-18) ft bgs	SJSB080 11215702-072221-SS-SJSB080(0-2) 07/22/2021 (0-2) ft bgs	SJSB080 11215702-072221-SS-SJSB080(2-4) 07/22/2021 (2-4) ft bgs	SJSB080 11215702-072221-SS-SJSB080(4-6) 07/22/2021 (4-6) ft bgs	SJSB080 11215702-072221-SS-SJSB080(6-8) 07/22/2021 (6-8) ft bgs	SJSB080 11215702-072221-SS-SJSB080(8-10) 07/22/2021 (8-10) ft bgs	SJSB080 11215702-072221-SS-SJSB080(10-12) 07/22/2021 (10-12) ft bgs	SJSB080 11215702-072221-SS-SJSB080(12-14) 07/22/2021 (12-14) ft bgs
Dioxins/Furans												
1,2,3,4,6,7,8,9-Octachlorodibenzofuran (OCDF)	pg/g	4.5 J	0.10 U	0.88 J	0.15 U	370	370	220	68	25	0.37 U	0.32 U
1,2,3,4,6,7,8,9-Octachlorodibenzo-p-dioxin (OCDD)	pg/g	100	100	460	240	7000 J	3900	3100	1500	750	57	58
1,2,3,4,6,7,8-Heptachlorodibenzofuran (HpCDF)	pg/g	6.9	0.24 J	0.68 J	0.068 U	990	710	660	150	57	0.58 U	0.16 U
1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin (HpCDD)	pg/g	5.2 J	4.1 J	21	14	530	280	210	120	57	1.9 J	2.9 J
1,2,3,4,7,8,9-Heptachlorodibenzofuran (HpCDF)	pg/g	2.3 J	0.11 J	0.35 J	0.060 U	300	210	170	50	16	0.13 U	0.061 U
1,2,3,4,7,8-Hexachlorodibenzofuran (HxCDF)	pg/g	23	1.4 J	2.0 J	0.049 U	3100	2100	1700	610	160	1.5 J	0.23 U
1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin (HxCDD)	pg/g	0.070 U	0.11 U	0.19 U	0.18 U	3.0 J	2.0 J	1.3 J	0.79 J	0.49 U	0.20 U	0.17 U
1,2,3,6,7,8-Hexachlorodibenzofuran (HxCDF)	pg/g	6.8	0.36 J	0.65 J	0.045 U	840	590	460	150	44	0.42 J	0.092 U
1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin (HxCDD)	pg/g	0.075 U	0.12 U	0.23 U	0.21 U	14	8.0 J	5.7 J	3.3 J	1.4 J	0.070 U	0.073 U
1,2,3,7,8,9-Hexachlorodibenzofuran (HxCDF)	pg/g	0.61 U	0.038 U	0.11 U	0.042 U	45	32	21	10	2.4 J	0.11 U	0.028 U
1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin (HxCDD)	pg/g	0.067 U	0.11 U	1.4 J	0.18 U	6.3 J	4.3 J	3.3 J	0.24 U	0.81 J	0.062 U	0.22 U
1,2,3,7,8-Pentachlorodibenzofuran (PeCDF)	pg/g	14	1.8 J	1.7 J	0.16 U	1900	1300	810	360	110	0.98 J	0.13 J
1,2,3,7,8-Pentachlorodibenzo-p-dioxin (PeCDD)	pg/g	1.4 J	0.11 U	0.16 U	0.37 U	140	94	58	23	9.0	0.055 U	0.055 U
2,3,4,6,7,8-Hexachlorodibenzofuran (HxCDF)	pg/g	0.58 J	0.042 U	0.10 U	0.044 U	92	66	38	19	4.7 J	0.038 U	0.027 U
2,3,4,7,8-Pentachlorodibenzofuran (PeCDF)	pg/g	8.1	0.70 J	1.1 J	0.16 U	1000	690	420	180	59	0.46 J	0.042 U
2,3,7,8-Tetrachlorodibenzofuran (TCDF)	pg/g	380	6.4	30	1.1 J	47000 J	28000 J	19000 J	7500 J	3300 J	26	2.7
2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	pg/g	140	1.9	12	0.14 U	17000 J	11000 J	6900 J	2300 J	1100 J	9.0	1.1 J
Total heptachlorodibenzofuran (HpCDF)	pg/g	12 J	0.35 J	1.0 J	0.27 U	1500 J	1100 J	930 J	240 J	90 J	0.89 J	0.16 J
Total heptachlorodibenzo-p-dioxin (HpCDD)	pg/g	13 J	19 J	80 J	54 J	1000 J	540 J	420 J	230 J	140 J	8.9 J	11 J
Total hexachlorodibenzofuran (HxCDF)	pg/g	35 J	1.7 J	2.6 J	0.19 U	4600 J	3200 J	2500 J	900 J	240 J	2.2 J	0.32 J
Total hexachlorodibenzo-p-dioxin (HxCDD)	pg/g	3.6 J	12 J	27 J	15 J	99 J	58 J	44 J	25 J	19 J	6.0 J	5.8 J
Total pentachlorodibenzofuran (PeCDF)	pg/g	33 J	3.8 J	2.8 J	0.56 U	4500 J	3000 J	1900 J	830 J	260 J	2.2 J	0.13 J
Total pentachlorodibenzo-p-dioxin (PeCDD)	pg/g	1.8 J	0.11 U	3.5 U	2.4 U	170 J	110 J	67 J	27 J	12 J	1.6 J	1.3 J
Total tetrachlorodibenzofuran (TCDF)	pg/g	730 J	9.7 J	53 J	1.1 J	71000 J	51000 J	33000 J	13000 J	6200 J	48 J	4.5 J
Total tetrachlorodibenzo-p-dioxin (TCDD)	pg/g	150 J	4.5 J	12 J	1.0 U	19000 J	12000 J	7600 J	2500 J	1300 J	14 J	2.2 J
TEQ												
Total WHO Dioxin TEQ(Human/Mammal)(ND=0)	pg/g	190 J	3.1 J	16 J	0.32 J	23000 J	14000 J	9200 J	3200 J	1500 J	12 J	1.4 J
Total WHO Dioxin TEQ(Human/Mammal)(ND=0.5)	pg/g	190 J	3.1 J	16 J	0.64 J	23000 J	14000 J	9200 J	3200 J	1500 J	12 J	1.5 J

Notes:
- U - Not detected at the associated reporting limit
- J - Estimated concentration
- UJ - Not detected; associated reporting limit is estimated
- J- - Estimated concentration, result may be biased low
- J+ - Estimated concentration, result may be biased high
- TEQ - Toxicity Equivalent Quotient
- ft bgs - Feet below ground surface
- pg/g - picogram per grams

Table 2-4

Supplemental Design Investigation Analytical Results - Northern Impoundment
Final 100% Remedial Design - Northern Impoundment
San Jacinto River Waste Pits Site
Harris County, Texas

Sample Location: Sample Identification: Sample Date: Sample Depth: Parameters	Units	SJSB080 11215702-072221-SS-SJSB080(14-16) 07/22/2021 (14-16) ft bgs	SJSB080 11215702-072221-SS-SJSB080(16-18) 07/22/2021 (16-18) ft bgs	SJSB080 11215702-072221-DUP-4 07/22/2021 (16-18) ft bgs Field Duplicate	SJSB081 11215702-080521-BN-SJSB081(0-2) 08/05/2021 (0-2) ft bgs	SJSB081 11215702-080521-BN-SJSB081(2-4) 08/05/2021 (2-4) ft bgs	SJSB081 11215702-080521-BN-SJSB081(4-6) 08/05/2021 (4-6) ft bgs	SJSB081 11215702-080521-BN-SJSB081(6-8) 08/05/2021 (6-8) ft bgs	SJSB081 11215702-080521-BN-DUP-13 08/05/2021 (6-8) ft bgs Field Duplicate	SJSB081 11215702-080521-BN-SJSB081(8-10) 08/05/2021 (8-10) ft bgs	SJSB081 11215702-080521-BN-SJSB081 (8-10)-R 08/05/2021 (8-10) ft bgs Lab Duplicate	SJSB081 11215702-080521-BN-SJSB081(10-12) 08/05/2021 (10-12) ft bgs
Dioxins/Furans												
1,2,3,4,6,7,8,9-Octachlorodibenzofuran (OCDF)	pg/g	0.32 U	0.89 U	0.32 U	110 J	730 J+	460	0.85 U	0.72 U	510	320	3.4 J
1,2,3,4,6,7,8,9-Octachlorodibenzo-p-dioxin (OCDD)	pg/g	120	72	72	2700	2500	2600	340	320	2400	2300	240
1,2,3,4,6,7,8-Heptachlorodibenzofuran (HpCDF)	pg/g	0.13 U	0.55 U	0.18 U	66 J	1600	830	0.35 J	0.30 U	1000 J	560 J	7.4
1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin (HpCDD)	pg/g	6.4	3.5 J	3.5 J	110	230	180	15	14	130	110	12
1,2,3,4,7,8,9-Heptachlorodibenzofuran (HpCDF)	pg/g	0.055 U	0.22 J	0.051 U	19 J	530 J+	310	0.10 U	0.063 U	400 J	230 J	2.8 J
1,2,3,4,7,8-Hexachlorodibenzofuran (HxCDF)	pg/g	0.096 U	1.3 J	0.35 J	220	4700	3100 J	0.60 J	0.29 J	3500 J	1900 J	41 J
1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin (HxCDD)	pg/g	0.12 U	0.28 U	0.22 U	0.99 U	4.9 J	1.8 U	0.38 J	0.33 U	1.2 U	3.9 U	0.27 J
1,2,3,6,7,8-Hexachlorodibenzofuran (HxCDF)	pg/g	0.035 U	0.42 J	0.10 U	67 J	1500	850	0.20 J	0.086 J	920 J	400 J	10
1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin (HxCDD)	pg/g	0.12 U	0.18 J	0.077 U	1.1 U	14 J	13 J	0.46 J	0.41 U	1.3 U	5.6 J	0.54 J
1,2,3,7,8,9-Hexachlorodibenzofuran (HxCDF)	pg/g	0.11 U	0.31 U	0.023 U	1.4 U	84 J	42	0.16 J	0.11 U	56 J	27 J	0.87 J
1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin (HxCDD)	pg/g	0.46 J	0.27 U	0.27 U	0.97 U	7.1 J	9.3 J	0.86 J	0.80 U	4.5 J	4.8 U	1.1 J
1,2,3,7,8-Pentachlorodibenzofuran (PeCDF)	pg/g	0.038 U	1.1 J	0.27 J	180	4200	2200	0.52 J	0.27 J	2300 J	800 J	38 J
1,2,3,7,8-Pentachlorodibenzo-p-dioxin (PeCDD)	pg/g	0.073 U	0.20 J	0.055 U	14 J	290	260	0.12 U	0.085 U	110	54 J	1.5 J
2,3,4,6,7,8-Hexachlorodibenzofuran (HxCDF)	pg/g	0.028 U	0.059 J	0.022 U	8.1 J	180 J	94	0.089 J	0.040 U	96 J	45 J	1.2 J
2,3,4,7,8-Pentachlorodibenzofuran (PeCDF)	pg/g	0.038 U	0.66 J	0.10 J	110	2200	1400	0.28 J	0.056 U	1000 J	450 J	14
2,3,7,8-Tetrachlorodibenzofuran (TCDF)	pg/g	1.1 U	27 J	6.3 J	5600	93000 J	92000 J	8.0	3.2	45000 J	23000 J	530 J
2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	pg/g	0.34 U	9.1 J	2.1 J	1700	36000 J	37000 J	3.8	1.4	13000 J	7700 J	210
Total heptachlorodibenzofuran (HpCDF)	pg/g	0.095 J	1.0 J	0.29 J	110 J	2500 J	1300 J	0.35 J	0.73 J	1700 J	930 J	12 J
Total heptachlorodibenzo-p-dioxin (HpCDD)	pg/g	24 J	12 J	13 J	360 J	470 J	380 J	52 J	58 J	310 J	290 J	48 J
Total hexachlorodibenzofuran (HxCDF)	pg/g	0.17 J	2.3 J	0.45 J	350 J	7400 J	4700 J	1.1 J	0.45 J	5200 J	2600 J	61 J
Total hexachlorodibenzo-p-dioxin (HxCDD)	pg/g	8.7 J	3.6 J	4.5 J	59 J	99 J	79 J	14 J	16 J	57 J	63 J	16 J
Total pentachlorodibenzofuran (PeCDF)	pg/g	0.038 U	2.4 J	0.49 J	430 J	10000 J	5700 J	0.88 J	0.33 J	5100 J	2000 J	72 J
Total pentachlorodibenzo-p-dioxin (PeCDD)	pg/g	2.1 J	0.81 J	0.93 J	14 J	290 J	260 J	0.68 J	2.7 J	110 J	64 J	1.5 J
Total tetrachlorodibenzofuran (TCDF)	pg/g	1.9 J	50 J	11 J	12000 J	170000 J	150000 J	13 J	5.4 J	70000 J	39000 J	1100 J
Total tetrachlorodibenzo-p-dioxin (TCDD)	pg/g	2.6 J	10 J	2.6 J	1900 J	40000 J	41000 J	3.8 J	3.5 J	14000 J	8400 J	230 J
TEQ												
Total WHO Dioxin TEQ(Human/Mammal)(ND=0)	pg/g	0.15 J	13 J	2.9 J	2300 J	47000 J	47000 J	5.2 J	2.0 J	19000 J	11000 J	280 J
Total WHO Dioxin TEQ(Human/Mammal)(ND=0.5)	pg/g	0.44 J	13 J	3.0 J	2300 J	47000 J	47000 J	5.3 J	2.1 J	19000 J	11000 J	280 J

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- UJ - Not detected; associated reporting limit is estimated
- J- - Estimated concentration, result may be biased low
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- TEQ - Toxicity Equivalent Quotient
- ft bgs - Feet below ground surface
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Table 2-4

Supplemental Design Investigation Analytical Results - Northern Impoundment
Final 100% Remedial Design - Northern Impoundment
San Jacinto River Waste Pits Site
Harris County, Texas

Sample Location: Sample Identification: Sample Date: Sample Depth: Parameters	Units	SJSB081 11215702-080521-BN-SJSB081 (10-12)-R 08/05/2021 (10-12) ft bgs Lab Duplicate	SJSB081 11215702-080521-BN-SJSB081(12-14) 08/05/2021 (12-14) ft bgs	SJSB081 11215702-080521-BN-SJSB081(14-16) 08/05/2021 (14-16) ft bgs	SJSB081 11215702-080521-BN-SJSB081(16-18) 08/05/2021 (16-18) ft bgs	SJSB082 11215702-080921-BN-SJSB082(0-2) 08/09/2021 (0-2) ft bgs	SJSB082 11215702-080921-BN-SJSB082(2-4) 08/09/2021 (2-4) ft bgs	SJSB082 11215702-080921-BN-SJSB082(4-6) 08/09/2021 (4-6) ft bgs	SJSB082 11215702-080921-BN-SJSB082(6-8) 08/09/2021 (6-8) ft bgs	SJSB082 11215702-080921-DUP-16 08/09/2021 (6-8) ft bgs Field Duplicate	SJSB082 11215702-080921-BN-SJSB082(8-10) 08/09/2021 (8-10) ft bgs	SJSB082 11215702-080921-BN-SJSB082 (8-10)-R 08/09/2021 (8-10) ft bgs Lab Duplicate
Dioxins/Furans												
1,2,3,4,6,7,8,9-Octachlorodibenzofuran (OCDF)	pg/g	2.3 U	0.45 U	0.52 U	0.45 U	220 J	8.3 J	17	0.30 U	0.29 U	3.8 J	2.2 U
1,2,3,4,6,7,8,9-Octachlorodibenzo-p-dioxin (OCDD)	pg/g	160	620	690	210	3100	230	350	300	210	940	630
1,2,3,4,6,7,8-Heptachlorodibenzofuran (HpCDF)	pg/g	4.4 J	0.20 U	0.30 U	0.18 U	300	19	43	0.33 U	0.28 U	2.8 J	0.93 U
1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin (HpCDD)	pg/g	8.2	31	35	11	160	7.0	15	16	8.6	30	25
1,2,3,4,7,8,9-Heptachlorodibenzofuran (HpCDF)	pg/g	1.9 U	0.062 U	0.068 U	0.071 U	84 J	7.9	16	0.15 U	0.15 U	0.86 U	0.36 U
1,2,3,4,7,8-Hexachlorodibenzofuran (HxCDF)	pg/g	18 J	0.25 J	0.16 J	0.12 J	960	69 J	170	0.70 J	0.58 J	8.5	2.9 J
1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin (HxCDD)	pg/g	0.35 U	0.64 U	0.61 U	0.29 U	3.0 U	0.33 U	0.44 U	0.40 U	0.33 U	0.48 U	0.50 U
1,2,3,6,7,8-Hexachlorodibenzofuran (HxCDF)	pg/g	4.2 J	0.17 J	0.10 J	0.052 U	260	17	43	0.24 J	0.20 J	2.3 J	0.67 J
1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin (HxCDD)	pg/g	0.36 J	0.82 J	0.71 J	0.26 U	7.1 J	0.40 J	0.74 J	0.43 J	0.27 J	0.76 J	0.64 J
1,2,3,7,8,9-Hexachlorodibenzofuran (HxCDF)	pg/g	0.41 U	0.20 U	0.18 U	0.11 U	15 J	1.4 J	3.0 J	0.15 U	0.083 U	0.25 U	0.14 U
1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin (HxCDD)	pg/g	0.76 U	2.7 J	3.1 J	1.1 J	5.0 U	0.50 U	0.60 U	0.87 J	0.50 U	1.7 J	1.5 J
1,2,3,7,8-Pentachlorodibenzofuran (PeCDF)	pg/g	12 J	0.22 J	0.068 U	0.17 J	1100	47	130	0.53 J	0.39 J	6.9	2.1 J
1,2,3,7,8-Pentachlorodibenzo-p-dioxin (PeCDD)	pg/g	1.0 J	0.31 J	0.15 U	0.096 U	93 J	3.1 J	9.3	0.22 J	0.15 J	0.95 J	0.37 J
2,3,4,6,7,8-Hexachlorodibenzofuran (HxCDF)	pg/g	0.57 J	0.052 U	0.040 U	0.036 U	34 J	2.0 J	4.8 J	0.096 J	0.077 J	0.31 J	0.10 U
2,3,4,7,8-Pentachlorodibenzofuran (PeCDF)	pg/g	7.0	0.068 U	0.069 U	0.052 U	1200	22	71	0.31 J	0.24 J	4.6 J	1.5 J
2,3,7,8-Tetrachlorodibenzofuran (TCDF)	pg/g	410	4.3	0.85 J	0.87 J	44000 J	1300 J	3900 J	14	9.7	320 J	110 J
2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	pg/g	150	1.1 J	0.47 J	0.39 J	10000	520 J	1500 J	5.5	3.9	84 J	29 J
Total heptachlorodibenzofuran (HpCDF)	pg/g	7.5 J	0.20 J	0.30 J	0.14 J	450 J	31 J	70 J	0.54 J	0.49 J	4.7 J	1.8 J
Total heptachlorodibenzo-p-dioxin (HpCDD)	pg/g	32 J	140 J	150 J	56 J	390 J	35 J	51 J	49 J	33 J	100 J	80 J
Total hexachlorodibenzofuran (HxCDF)	pg/g	26 J	0.61 J	0.44 J	0.20 J	1500 J	100 J	250 J	1.2 J	0.94 J	13 J	4.4 J
Total hexachlorodibenzo-p-dioxin (HxCDD)	pg/g	12 J	40 J	48 J	20 J	70 J	14 J	16 J	12 J	8.9 J	23 J	20 J
Total pentachlorodibenzofuran (PeCDF)	pg/g	29 J	0.22 J	0.069 U	0.17 J	3500 J	110 J	320 J	1.2 J	0.63 J	19 J	5.7 J
Total pentachlorodibenzo-p-dioxin (PeCDD)	pg/g	3.3 J	6.4 J	8.7 J	3.7 J	110 J	6.0 J	14 J	2.0 J	1.5 J	5.4 J	3.7 J
Total tetrachlorodibenzofuran (TCDF)	pg/g	740 J	4.6 J	1.8 J	1.6 J	90000 J	2600 J	8200 J	26 J	18 J	610 J	210 J
Total tetrachlorodibenzo-p-dioxin (TCDD)	pg/g	170 J	7.1 J	8.2 J	3.1 J	11000 J	570 J	1700 J	7.3 J	5.6 J	94 J	34 J
TEQ												
Total WHO Dioxin TEQ(Human/Mammal)(ND=0)	pg/g	200 J	2.7 J	1.5 J	0.78 J	15000 J	670 J	2000 J	7.7 J	5.4 J	120 J	42 J
Total WHO Dioxin TEQ(Human/Mammal)(ND=0.5)	pg/g	200 J	2.8 J	1.7 J	0.87 J	15000 J	670 J	2000 J	7.7 J	5.4 J	120 J	42 J

Notes:
- U - Not detected at the associated reporting limit
- J - Estimated concentration
- UJ - Not detected; associated reporting limit is estimated
- J- - Estimated concentration, result may be biased low
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- TEQ - Toxicity Equivalent Quotient
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Table 2-4

Supplemental Design Investigation Analytical Results - Northern Impoundment
Final 100% Remedial Design - Northern Impoundment
San Jacinto River Waste Pits Site
Harris County, Texas

Sample Location: / Sample Identification: / Sample Date: / Sample Depth:	Units	SJSB082 11215702-080921-BN-SJSB082(10-12) 08/09/2021 (10-12) ft bgs	SJSB082 11215702-080921-BN-SJSB082(12-14) 08/09/2021 (12-14) ft bgs	SJSB082 11215702-080921-BN-SJSB082(14-16) 08/09/2021 (14-16) ft bgs	SJSB082 11215702-080921-BN-SJSB082(16-18) 08/09/2021 (16-18) ft bgs	SJSB083 11215702-072221-BN-SJSB083(0-2) 07/22/2021 (0-2) ft bgs	SJSB083 11215702-072221-BN-SJSB083(2-4) 07/22/2021 (2-4) ft bgs	SJSB083 11215702-072221-BN-SJSB083(4-6) 07/22/2021 (4-6) ft bgs	SJSB083 11215702-072221-BN-SJSB083(6-8) 07/22/2021 (6-8) ft bgs	SJSB083 11215702-072221-BN-SJSB083(8-10) 07/22/2021 (8-10) ft bgs	SJSB083-Waste 11215702-072221-BN-SJSB083(8-10)-WC 07/22/21 (8-10) ft bgs	SJSB083 11215702-072221-BN-SJSB083(10-12) 07/22/2021 (10-12) ft bgs
Parameters												
Dioxins/Furans												
1,2,3,4,6,7,8,9-Octachlorodibenzofuran (OCDF)	pg/g	0.26 U	0.55 U	0.32 U	0.28 J	510	35	3.3 J	0.078 U	530	370	6.5 J
1,2,3,4,6,7,8,9-Octachlorodibenzo-p-dioxin (OCDD)	pg/g	980	600	1000	190	2400	1700	1700	1000	3800	4100	1600
1,2,3,4,6,7,8-Heptachlorodibenzofuran (HpCDF)	pg/g	0.22 U	0.43 U	0.28 U	0.27 J	750	69	0.44 J	0.23 J	450	140	12
1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin (HpCDD)	pg/g	36	23	42	6.8	160	71	77	51	160	180	62
1,2,3,4,7,8,9-Heptachlorodibenzofuran (HpCDF)	pg/g	0.033 U	0.058 U	0.15 U	0.16 J	250	23	0.051 U	0.059 U	160	46	5.2 J
1,2,3,4,7,8-Hexachlorodibenzofuran (HxCDF)	pg/g	0.30 J	0.24 U	0.29 U	0.40 J	2800	280	1.0 J	0.64 J	1700	500	44
1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin (HxCDD)	pg/g	0.53 U	0.49 U	0.69 U	0.29 J	3.2 J	0.31 U	0.93 J	0.78 J	0.70 U	2.1 J	0.89 J
1,2,3,6,7,8-Hexachlorodibenzofuran (HxCDF)	pg/g	0.13 J	0.047 U	0.12 J	0.13 J	760	75	0.36 J	0.041 U	410	140	12
1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin (HxCDD)	pg/g	0.74 J	0.57 J	0.87 J	0.20 J	11 J	0.39 U	1.9 J	1.4 J	8.0 J	7.2 J	1.1 J
1,2,3,7,8,9-Hexachlorodibenzofuran (HxCDF)	pg/g	0.086 U	0.092 U	0.12 U	0.073 J	49 J	5.0 J	0.024 U	0.038 U	28 J	9.8 J	0.29 U
1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin (HxCDD)	pg/g	2.0 J	1.7 J	2.2 J	0.67 J	5.5 J	3.2 J	4.3 J	3.2 J	5.7 J	8.8 J	3.2 J
1,2,3,7,8-Pentachlorodibenzofuran (PeCDF)	pg/g	0.23 J	0.051 U	0.20 J	0.12 J	2100	200	0.62 J	0.74 J	980	330	16
1,2,3,7,8-Pentachlorodibenzo-p-dioxin (PeCDD)	pg/g	0.25 J	0.21 J	0.30 J	0.054 U	210	12	0.15 U	0.15 U	91	31	1.2 J
2,3,4,6,7,8-Hexachlorodibenzofuran (HxCDF)	pg/g	0.033 J	0.032 U	0.061 J	0.018 U	87 J	9.0	0.024 U	0.042 U	44	16	0.30 U
2,3,4,7,8-Pentachlorodibenzofuran (PeCDF)	pg/g	0.15 J	0.053 U	0.16 J	0.034 U	1300	98	0.34 J	0.079 U	560	190	8.1
2,3,7,8-Tetrachlorodibenzofuran (TCDF)	pg/g	6.0	0.50 U	5.4	1.5	220000	4400	16	29	38000	11000	430
2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	pg/g	2.2	0.26 U	1.7 J	0.50 J	23000	1700	5.9	9.7	11000	3100	140
Total heptachlorodibenzofuran (HpCDF)	pg/g	0.18 J	0.43 J	0.50 J	0.49 J	1200 J	110 J	0.44 J	0.23 J	740 J	240 J	20 J
Total heptachlorodibenzo-p-dioxin (HpCDD)	pg/g	130 J	91 J	180 J	31 J	380 J	190 J	220 J	120 J	460 J	490 J	180 J
Total hexachlorodibenzofuran (HxCDF)	pg/g	0.55 J	0.33 J	0.65 J	0.60 J	4200 J	420 J	1.4 J	0.64 J	2400 J	740 J	59 J
Total hexachlorodibenzo-p-dioxin (HxCDD)	pg/g	28 J	24 J	50 J	12 J	72 J	28 J	67 J	37 J	71 J	92 J	42 J
Total pentachlorodibenzofuran (PeCDF)	pg/g	0.55 J	0.054 U	0.51 J	0.12 J	5200 J	460 J	0.96 J	0.74 J	2400 J	770 J	34 J
Total pentachlorodibenzo-p-dioxin (PeCDD)	pg/g	5.4 J	4.2 J	8.7 J	2.7 J	210 J	14 J	11 J	6.5 J	91 J	37 J	7.6 J
Total tetrachlorodibenzofuran (TCDF)	pg/g	12 J	0.87 J	10 J	2.7 J	160000 J	8200 J	29 J	57 J	67000 J	21000 J	820 J
Total tetrachlorodibenzo-p-dioxin (TCDD)	pg/g	6.1 J	2.8 J	7.4 J	2.5 J	25000 J	1800 J	7.8 J	9.7 J	12000 J	3400 J	160 J
TEQ												
Total WHO Dioxin TEQ(Human/Mammal)(ND=0)	pg/g	4.1 J	0.85 J	3.6 J	0.96 J	46000 J	2200 J	9.8 J	14 J	15000 J	4400 J	200 J
Total WHO Dioxin TEQ(Human/Mammal)(ND=0.5)	pg/g	4.1 J	1.1 J	3.7 J	0.99 J	46000 J	2200 J	9.8 J	14 J	15000 J	4400 J	200 J

Notes:
U - Not detected at the associated reporting limit
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UJ - Not detected; associated reporting limit is estimated
J- - Estimated concentration, result may be biased low
J+ - Estimated concentration, result may be biased high
TEQ - Toxicity Equivalent Quotient
ft bgs - Feet below ground surface
pg/g - picogram per grams

Table 2-4

Supplemental Design Investigation Analytical Results - Northern Impoundment
Final 100% Remedial Design - Northern Impoundment
San Jacinto River Waste Pits Site
Harris County, Texas

Sample Location: Sample Identification: Sample Date: Sample Depth: Parameters	Units	SJSB083-Waste 11215702-072221-BN-SJSB083(10-12)-WC 07/22/21 (10-12) ft bgs	SJSB083 11215702-072221-BN-SJSB083(12-14) 07/22/2021 (12-14) ft bgs	SJSB083 11215702-072221-BN-SJSB083(14-16) 07/22/2021 (14-16) ft bgs	SJSB083 11215702-072221-BN-SJSB083(16-18) 07/22/2021 (16-18) ft bgs	SJSB083 11215702-072221-BN-SJSB083(18-20) 07/22/2021 (18-20) ft bgs	SJSB084 11215702-072021-BN-SJSB084(0-2) 07/20/2021 (0-2) ft bgs	SJSB084 11215702-072021-BN-SJSB084(2-4) 07/20/2021 (2-4) ft bgs	SJSB084 11215702-072021-BN-SJSB084(4-6) 07/20/2021 (4-6) ft bgs	SJSB084 11215702-072021-BN-SJSB084(6-8) 07/20/2021 (6-8) ft bgs	SJSB084 11215702-072021-BN-SJSB084(8-10) 07/20/2021 (8-10) ft bgs	SJSB084 11215702-072021-BN-SJSB084(10-12) 07/20/2021 (10-12) ft bgs
Dioxins/Furans												
1,2,3,4,6,7,8,9-Octachlorodibenzofuran (OCDF)	pg/g	0.14 U	2.3 J	0.080 U	7.3 J	0.34 U	570	100	6.7 U	1.0 U	6.9 U	1.4 U
1,2,3,4,6,7,8,9-Octachlorodibenzo-p-dioxin (OCDD)	pg/g	1100	1300	980	360	19 J	7000	2500	2300	1600	1900	1400
1,2,3,4,6,7,8-Heptachlorodibenzofuran (HpCDF)	pg/g	1.6 J	1.6 J	0.40 J	0.30 J	0.29 U	320	65	1.2 J	0.45 J	0.27 J	0.23 J
1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin (HpCDD)	pg/g	39	51	40	19	1.1 U	270	77	84	63	71	52
1,2,3,4,7,8,9-Heptachlorodibenzofuran (HpCDF)	pg/g	0.68 J	0.32 J	0.049 U	0.036 U	0.11 U	110	19	0.46 J	0.076 U	0.080 U	0.062 U
1,2,3,4,7,8-Hexachlorodibenzofuran (HxCDF)	pg/g	5.5 J	3.1 J	0.88 J	0.029 U	0.75 J	1100	200	2.8 J	1.4 J	0.25 J	0.24 J
1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin (HxCDD)	pg/g	0.26 U	0.54 J	0.42 J	0.35 J	0.073 U	4.3 J	1.2 J	0.85 J	0.92 J	0.78 J	0.88 J
1,2,3,6,7,8-Hexachlorodibenzofuran (HxCDF)	pg/g	1.3 J	0.76 J	0.27 J	0.029 U	0.23 U	300	52	0.85 J	0.57 J	0.15 J	0.055 U
1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin (HxCDD)	pg/g	0.30 U	1.1 J	0.93 J	0.099 U	0.12 U	11	2.4 J	2.0 J	1.6 J	1.7 J	1.1 J
1,2,3,7,8,9-Hexachlorodibenzofuran (HxCDF)	pg/g	0.29 J	0.053 U	0.034 U	0.028 U	0.16 U	20	4.6 U	1.2 U	1.1 U	1.0 U	1.1 U
1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin (HxCDD)	pg/g	2.2 J	2.7 J	2.4 J	1.3 J	0.13 U	8.6 J	2.9 J	4.2 J	3.1 J	3.6 J	2.8 J
1,2,3,7,8-Pentachlorodibenzofuran (PeCDF)	pg/g	3.4 J	1.9 J	0.53 J	0.039 U	0.49 J	860	220	2.4 J	1.6 J	0.63 J	0.64 J
1,2,3,7,8-Pentachlorodibenzo-p-dioxin (PeCDD)	pg/g	0.58 J	0.14 U	0.16 U	0.11 U	0.14 U	82	21	0.52 J	0.14 U	0.34 J	0.40 J
2,3,4,6,7,8-Hexachlorodibenzofuran (HxCDF)	pg/g	0.079 U	0.053 U	0.034 U	0.028 U	0.082 U	35 J	6.7 J	0.092 J	0.098 J	0.049 U	0.042 U
2,3,4,7,8-Pentachlorodibenzofuran (PeCDF)	pg/g	2.0 J	0.97 J	0.37 J	0.043 U	0.38 J	530	200	1.6 J	0.89 J	0.21 J	0.21 J
2,3,7,8-Tetrachlorodibenzofuran (TCDF)	pg/g	95	50	16	1.2 J	12	18000	8100	120	52	8.4	18
2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	pg/g	34	17	6.0	0.11 U	3.3	9600	2300	29	15	2.8	4.0
Total heptachlorodibenzofuran (HpCDF)	pg/g	2.3 J	2.3 J	0.40 J	0.82 J	0.51 J	530 J	110 J	2.5 J	0.67 J	1.0 J	0.44 J
Total heptachlorodibenzo-p-dioxin (HpCDD)	pg/g	120 J	170 J	130 J	54 J	3.3 J	770 J	270 J	240 J	200 J	210 J	190 J
Total hexachlorodibenzofuran (HxCDF)	pg/g	7.1 J	3.8 J	1.1 J	0.029 U	1.4 J	1600 J	300 J	5.8 J	3.4 J	1.4 J	1.4 J
Total hexachlorodibenzo-p-dioxin (HxCDD)	pg/g	30 J	39 J	38 J	12 J	1.5 J	130 J	48 J	63 J	47 J	53 J	50 J
Total pentachlorodibenzofuran (PeCDF)	pg/g	6.6 J	2.9 J	0.90 J	0.043 U	1.4 J	2200 J	630 J	6.2 J	3.1 J	1.1 J	1.1 J
Total pentachlorodibenzo-p-dioxin (PeCDD)	pg/g	6.0 J	6.2 J	7.6 J	1.6 J	0.56 J	100 J	29 J	11 J	8.4 J	11 J	8.9 J
Total tetrachlorodibenzofuran (TCDF)	pg/g	180 J	99 J	31 J	1.3 J	24 J	62000 J	22000 J	230 J	100 J	17 J	33 J
Total tetrachlorodibenzo-p-dioxin (TCDD)	pg/g	38 J	17 J	8.5 J	0.32 U	3.8 J	11000 J	2600 J	38 J	22 J	9.0 J	10 J
TEQ												
Total WHO Dioxin TEQ(Human/Mammal)(ND=0)	pg/g	47 J	24 J	8.9 J	0.59 J	4.7 J	12000 J	3200 J	45 J	22 J	6.0 J	7.7 J
Total WHO Dioxin TEQ(Human/Mammal)(ND=0.5)	pg/g	47 J	24 J	9.0 J	0.72 J	4.8 J	12000 J	3200 J	45 J	23 J	6.1 J	7.8 J

Notes:
U - Not detected at the associated reporting limit
J - Estimated concentration
UJ - Not detected; associated reporting limit is estimated
J- - Estimated concentration, result may be biased low
J+ - Estimated concentration, result may be biased high
TEQ - Toxicity Equivalent Quotient
ft bgs - Feet below ground surface
pg/g - picogram per grams

Table 2-4

Supplemental Design Investigation Analytical Results - Northern Impoundment
Final 100% Remedial Design - Northern Impoundment
San Jacinto River Waste Pits Site
Harris County, Texas

Sample Location: Sample Identification: Sample Date: Sample Depth: Parameters	Units	SJSB084 11215702-072021-BN-SJSB084(12-14) 07/20/2021 (12-14) ft bgs	SJSB084 11215702-072021-BN-SJSB084(14-16) 07/20/2021 (14-16) ft bgs	SJSB084 11215702-072021-BN-SJSB084(16-18) 07/20/2021 (16-18) ft bgs	SJSB085 11215702-072321-BN-SJSB085(0-2) 07/23/2021 (0-2) ft bgs	SJSB085 11215702-072321-BN-SJSB085(2-4) 07/23/2021 (2-4) ft bgs	SJSB085 11215702-072321-BN-SJSB085(4-6) 07/23/2021 (4-6) ft bgs	SJSB085 11215702-072321-BN-SJSB085(6-8) 07/23/2021 (6-8) ft bgs	SJSB085 11215702-072321-BN-SJSB085 (6-8)-R 07/23/2021 (6-8) ft bgs Lab Duplicate	SJSB085 11215702-072321-BN-SJSB085(8-10) 07/23/2021 (8-10) ft bgs	SJSB085 11215702-072321-BN-SJSB085(10-12) 07/23/2021 (10-12) ft bgs	SJSB085 11215702-072321-BN-SJSB085(12-14) 07/23/2021 (12-14) ft bgs
Dioxins/Furans												
1,2,3,4,6,7,8,9-Octachlorodibenzofuran (OCDF)	pg/g	0.84 U	1.7 U	2.8 U	770	13 J	0.88 U	2.5 J	0.31 U	1.1 U	0.66 U	0.64 U
1,2,3,4,6,7,8,9-Octachlorodibenzo-p-dioxin (OCDD)	pg/g	1700	1300	1800	5300	1600	1000	2500 J	810 J	750	2100	1700
1,2,3,4,6,7,8-Heptachlorodibenzofuran (HpCDF)	pg/g	0.11 U	0.24 J	0.72 J	1200	16	0.64 U	1.3 J	0.49 U	1.0 J	0.24 U	0.20 U
1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin (HpCDD)	pg/g	62	56	72	300	59	34	72 J	30 J	24	82	73
1,2,3,4,7,8,9-Heptachlorodibenzofuran (HpCDF)	pg/g	0.12 U	0.087 U	0.10 U	380	5.4 J	0.20 U	0.40 U	0.065 U	0.26 U	0.048 U	0.10 U
1,2,3,4,7,8-Hexachlorodibenzofuran (HxCDF)	pg/g	0.40 J	0.19 J	0.44 J	3600	54	2.0 J	3.5 J	0.37 U	2.5 J	0.28 J	0.37 J
1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin (HxCDD)	pg/g	0.98 J	1.0 J	0.66 J	4.5 J	0.82 U	0.44 U	0.68 U	0.47 U	0.42 U	1.1 U	0.87 U
1,2,3,6,7,8-Hexachlorodibenzofuran (HxCDF)	pg/g	0.21 J	0.12 J	0.25 J	960	14	0.59 J	1.0 J	0.14 U	0.77 J	0.11 U	0.12 U
1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin (HxCDD)	pg/g	1.5 J	1.2 J	1.4 J	16	1.7 J	0.68 J	1.5 J	0.80 J	0.53 J	1.7 J	1.9 J
1,2,3,7,8,9-Hexachlorodibenzofuran (HxCDF)	pg/g	1.4 U	1.2 U	1.2 U	49	1.1 J	0.12 U	0.044 U	0.10 U	0.12 U	0.20 U	0.12 U
1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin (HxCDD)	pg/g	3.5 J	3.4 J	3.9 J	9.4 J	2.8 J	1.5 J	3.1 J	1.4 U	0.98 J	3.8 J	3.6 J
1,2,3,7,8-Pentachlorodibenzofuran (PeCDF)	pg/g	0.73 J	0.55 J	0.62 J	2400	45	1.5 J	2.5 J	0.35 J	1.7 J	0.17 J	0.30 J
1,2,3,7,8-Pentachlorodibenzo-p-dioxin (PeCDD)	pg/g	0.54 J	0.16 U	0.14 U	240	4.4 J	0.21 J	0.49 J	0.15 J	0.27 J	0.35 J	0.29 J
2,3,4,6,7,8-Hexachlorodibenzofuran (HxCDF)	pg/g	0.078 U	0.052 U	0.050 U	100	1.8 J	0.092 J	0.12 J	0.031 U	0.090 J	0.033 U	0.026 U
2,3,4,7,8-Pentachlorodibenzofuran (PeCDF)	pg/g	0.23 J	0.11 J	0.15 J	1600	26	0.97 J	1.6 J	0.24 J	0.95 J	0.083 J	0.14 J
2,3,7,8-Tetrachlorodibenzofuran (TCDF)	pg/g	8.1	4.7	3.9	98000 J	1700 J	65	97 J	17 J	55	3.4	12
2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	pg/g	2.8	1.5 J	1.4 J	31000 J	530	19	31 J	4.6 J	18	1.5 J	3.6
Total heptachlorodibenzofuran (HpCDF)	pg/g	0.12 U	0.52 J	1.1 J	1900 J	27 J	1.0 J	2.2 J	0.16 J	1.5 J	0.24 J	0.27 J
Total heptachlorodibenzo-p-dioxin (HpCDD)	pg/g	220 J	200 J	230 J	710 J	150 J	110 J	200 J	83 J	79 J	240 J	200 J
Total hexachlorodibenzofuran (HxCDF)	pg/g	2.0 J	1.7 J	1.9 J	5300 J	82 J	3.1 J	5.2 J	0.61 J	3.9 J	0.59 J	0.62 J
Total hexachlorodibenzo-p-dioxin (HxCDD)	pg/g	58 J	58 J	60 J	130 J	27 J	28 J	45 J	26 J	19 J	57 J	47 J
Total pentachlorodibenzofuran (PeCDF)	pg/g	1.2 J	0.79 J	1.1 J	6200 J	110 J	3.7 J	6.4 J	0.86 J	4.1 J	0.35 J	0.69 J
Total pentachlorodibenzo-p-dioxin (PeCDD)	pg/g	10 J	11 J	13 J	260 J	9.1 J	6.0 J	8.7 J	6.8 J	4.1 J	11 J	9.7 J
Total tetrachlorodibenzofuran (TCDF)	pg/g	16 J	9.8 J	7.9 J	170000 J	2900 J	120 J	180 J	29 J	100 J	5.4 J	21 J
Total tetrachlorodibenzo-p-dioxin (TCDD)	pg/g	12 J	12 J	11 J	34000 J	580 J	24 J	38 J	8.9 J	23 J	7.0 J	9.8 J
TEQ												
Total WHO Dioxin TEQ(Human/Mammal)(ND=0)	pg/g	6.0 J	3.6 J	3.8 J	42000 J	720 J	27 J	44 J	7.4 J	25 J	4.2 J	7.0 J
Total WHO Dioxin TEQ(Human/Mammal)(ND=0.5)	pg/g	6.1 J	3.7 J	3.9 J	42000 J	720 J	27 J	44 J	7.4 J	25 J	4.3 J	7.0 J

Notes:
- U - Not detected at the associated reporting limit
- J - Estimated concentration
- UJ - Not detected; associated reporting limit is estimated
- J- - Estimated concentration, result may be biased low
- J+ - Estimated concentration, result may be biased high
- TEQ - Toxicity Equivalent Quotient
- ft bgs - Feet below ground surface
- pg/g - picogram per grams

Table 2-4

Supplemental Design Investigation Analytical Results - Northern Impoundment
Final 100% Remedial Design - Northern Impoundment
San Jacinto River Waste Pits Site
Harris County, Texas

Sample Location: / Sample Identification: / Sample Date: / Sample Depth:	Units	SJSB085 11215702-072321-BN-SJSB085(14-16) 07/23/2021 (14-16) ft bgs	SJSB085 11215702-072321-BN-SJSB085(16-18) 07/23/2021 (16-18) ft bgs	SJSB086 11215702-080421-BN-SJSB086(0-2) 08/04/2021 (0-2) ft bgs	SJSB086 11215702-080421-BN-SJSB086(2-4) 08/04/2021 (2-4) ft bgs	SJSB086 11215702-080421-BN-SJSB086(4-6) 08/04/2021 (4-6) ft bgs	SJSB086 11215702-080421-BN-SJSB086(6-8) 08/04/2021 (6-8) ft bgs	SJSB086 11215702-080421-BN-DUP-12 08/04/2021 (6-8) ft bgs Field Duplicate	SJSB086 11215702-080421-BN-SJSB086(8-10) 08/04/2021 (8-10) ft bgs	SJSB086 11215702-080421-BN-SJSB086(10-12) 08/04/2021 (10-12) ft bgs	SJSB086 11215702-080421-BN-SJSB086(12-14) 08/04/2021 (12-14) ft bgs	SJSB086 11215702-080421-BN-SJSB086(14-16) 08/04/2021 (14-16) ft bgs
Parameters												
Dioxins/Furans												
1,2,3,4,6,7,8,9-Octachlorodibenzofuran (OCDF)	pg/g	1.8 U	0.52 U	0.45 U	1.9 U	0.48 U	0.45 U	0.45 U	0.45 U	0.45 U	0.45 U	0.45 U
1,2,3,4,6,7,8,9-Octachlorodibenzo-p-dioxin (OCDD)	pg/g	1600	1300	580	1300	700	880	490	1700	1400	760	1800
1,2,3,4,6,7,8-Heptachlorodibenzofuran (HpCDF)	pg/g	0.85 U	0.28 U	0.31 U	1.0 U	0.18 U	0.18 U	0.27 U	0.18 U	0.25 U	0.27 U	0.18 U
1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin (HpCDD)	pg/g	66	51	25	69	38	30	17	70	66	35	72
1,2,3,4,7,8,9-Heptachlorodibenzofuran (HpCDF)	pg/g	0.20 U	0.071 U	0.075 U	0.43 J	0.058 U	0.069 U	0.053 U	0.063 U	0.062 U	0.057 U	0.045 U
1,2,3,4,7,8-Hexachlorodibenzofuran (HxCDF)	pg/g	0.86 J	0.67 J	0.32 J	0.52 J	0.054 J	0.040 U	0.18 J	0.049 U	0.065 U	0.43 J	0.23 J
1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin (HxCDD)	pg/g	0.73 U	0.82 U	0.60 U	0.61 U	0.55 U	0.45 U	0.37 U	0.92 U	1.0 U	0.42 U	0.99 U
1,2,3,6,7,8-Hexachlorodibenzofuran (HxCDF)	pg/g	0.26 U	0.27 J	0.17 J	0.38 J	0.084 J	0.040 U	0.084 J	0.080 J	0.067 U	0.21 J	0.11 J
1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin (HxCDD)	pg/g	1.6 J	1.2 J	0.94 J	1.4 J	0.97 J	0.67 J	0.48 U	1.8 J	1.8 J	0.78 J	1.7 J
1,2,3,7,8,9-Hexachlorodibenzofuran (HxCDF)	pg/g	0.16 U	0.13 U	0.20 U	0.25 U	0.13 U	0.13 U	0.12 U	0.13 U	0.16 U	0.11 U	0.13 U
1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin (HxCDD)	pg/g	3.6 J	2.8 J	1.9 J	2.9 J	2.0 J	1.3 J	0.89 J	3.9 J	4.2 J	1.7 J	3.6 J
1,2,3,7,8-Pentachlorodibenzofuran (PeCDF)	pg/g	0.70 J	0.58 J	0.47 J	0.51 J	0.042 U	0.069 J	0.36 J	0.052 U	0.070 U	0.30 J	0.14 J
1,2,3,7,8-Pentachlorodibenzo-p-dioxin (PeCDD)	pg/g	0.37 J	0.39 J	0.27 J	0.27 J	0.19 J	0.17 J	0.14 J	0.14 U	0.32 J	0.21 J	0.32 J
2,3,4,6,7,8-Hexachlorodibenzofuran (HxCDF)	pg/g	0.10 J	0.048 U	0.089 U	0.10 U	0.069 U	0.069 U	0.069 U	0.035 U	0.076 U	0.045 U	0.031 U
2,3,4,7,8-Pentachlorodibenzofuran (PeCDF)	pg/g	0.33 J	0.31 J	0.21 J	0.18 J	0.042 U	0.051 U	0.11 J	0.050 U	0.072 U	0.18 J	0.053 U
2,3,7,8-Tetrachlorodibenzofuran (TCDF)	pg/g	21	16	11	0.89 J	0.35 U	0.40 U	1.0 J	0.30 U	0.23 U	6.5	1.7
2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	pg/g	6.3	5.2	2.7	0.24 J	0.13 J	0.21 J	0.29 J	0.24 J	0.25 J	1.4 J	0.54 J
Total heptachlorodibenzofuran (HpCDF)	pg/g	1.1 J	0.28 J	0.31 J	2.0 J	0.17 J	0.14 J	0.27 J	0.15 J	0.25 J	0.27 J	0.11 J
Total heptachlorodibenzo-p-dioxin (HpCDD)	pg/g	190 J	170 J	64 J	140 J	83 J	89 J	61 J	230 J	210 J	83 J	200 J
Total hexachlorodibenzofuran (HxCDF)	pg/g	1.4 J	1.1 J	0.78 J	1.5 J	0.32 J	0.19 J	0.45 J	0.26 J	0.23 J	0.72 J	0.48 J
Total hexachlorodibenzo-p-dioxin (HxCDD)	pg/g	46 J	43 J	17 J	24 J	17 J	18 J	14 J	54 J	58 J	17 J	48 J
Total pentachlorodibenzofuran (PeCDF)	pg/g	1.5 J	1.4 J	1.1 J	1.5 J	0.14 J	0.069 J	0.46 J	0.052 U	0.073 U	0.48 J	0.14 J
Total pentachlorodibenzo-p-dioxin (PeCDD)	pg/g	9.3 J	10 J	2.8 J	2.8 J	2.2 J	2.3 J	1.8 J	8.3 J	9.6 J	2.6 J	7.5 J
Total tetrachlorodibenzofuran (TCDF)	pg/g	38 J	29 J	19 J	3.1 J	1.0 J	0.88 J	1.6 J	1.0 J	0.73 J	13 J	3.8 J
Total tetrachlorodibenzo-p-dioxin (TCDD)	pg/g	13 J	12 J	6.1 J	3.5 J	2.4 J	2.3 J	2.3 J	6.7 J	7.9 J	3.5 J	7.4 J
TEQ												
Total WHO Dioxin TEQ(Human/Mammal)(ND=0)	pg/g	11 J	8.7 J	4.9 J	2.3 J	1.2 J	1.1 J	1.0 J	2.0 J	2.3 J	3.2 J	2.9 J
Total WHO Dioxin TEQ(Human/Mammal)(ND=0.5)	pg/g	11 J	7.6 J	5.0 J	2.3 J	1.3 J	1.2 J	1.1 J	2.2 J	2.3 J	3.2 J	2.9 J

Notes:
U - Not detected at the associated reporting limit
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San Jacinto River Waste Pits Site
Harris County, Texas

Sample Location: / Sample Identification: / Sample Date: / Sample Depth:	Units	SJSB086 11215702-080421-BN-SJSB086(16-18) 08/04/2021 (16-18) ft bgs	SJSB087 11215702-081021-BN-SJSB087(0-2) 08/10/2021 (0-2) ft bgs	SJSB087 11215702-081021-BN-SJSB087(2-4) 08/10/2021 (2-4) ft bgs	SJSB087 11215702-081021-BN-SJSB087(4-6) 08/10/2021 (4-6) ft bgs	SJSB087 11215702-081021-BN-SJSB087(6-8) 08/10/2021 (6-8) ft bgs	SJSB087 11215702-081021-BN-DUP-17 08/10/2021 (6-8) ft bgs Field Duplicate	SJSB087 11215702-081021-BN-SJSB087(8-10) 08/10/2021 (8-10) ft bgs	SJSB087 11215702-081021-BN-SJSB087(10-12) 08/10/2021 (10-12) ft bgs	SJSB087 11215702-081021-BN-SJSB087(12-14) 08/10/2021 (12-14) ft bgs	SJSB087 11215702-081021-BN-SJSB087 (12-14)-R 08/10/2021 (12-14) ft bgs Lab Duplicate	SJSB087 11215702-081021-BN-SJSB087(14-16) 08/10/2021 (14-16) ft bgs
Parameters												
Dioxins/Furans												
1,2,3,4,6,7,8,9-Octachlorodibenzofuran (OCDF)	pg/g	0.58 U	90	330	48	3.3 U	0.88 U	14	0.88 U	1.9 U	2.6 U	9.9 U
1,2,3,4,6,7,8,9-Octachlorodibenzo-p-dioxin (OCDD)	pg/g	1100	2000	4300	2600	830	520	990	1100	300	420	930
1,2,3,4,6,7,8-Heptachlorodibenzofuran (HpCDF)	pg/g	0.18 U	150	810	89	0.92 U	0.35 U	24	0.35 U	3.0 J	2.9 J	20 J
1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin (HpCDD)	pg/g	45	89	220	82	29	21	45	40	11	14	36
1,2,3,4,7,8,9-Heptachlorodibenzofuran (HpCDF)	pg/g	0.042 U	54	270 J+	30	0.30 U	0.036 U	8.2	0.061 U	0.98 U	0.94 U	9.2
1,2,3,4,7,8-Hexachlorodibenzofuran (HxCDF)	pg/g	0.064 J	1100	2800	370	0.98 J	0.17 J	66	0.30 J	9.5	8.4	74 J
1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin (HxCDD)	pg/g	0.83 U	1.2 U	2.3 U	1.0 U	0.49 U	0.42 U	0.63 U	0.60 U	0.31 U	0.28 U	0.59 U
1,2,3,6,7,8-Hexachlorodibenzofuran (HxCDF)	pg/g	0.034 U	260	710	95	0.33 J	0.068 J	17	0.11 J	2.8 J	2.8 J	18 J
1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin (HxCDD)	pg/g	0.97 J	3.0 J	11 J	2.3 J	0.76 J	0.56 J	1.2 J	1.1 J	0.29 J	0.39 J	0.95 J
1,2,3,7,8,9-Hexachlorodibenzofuran (HxCDF)	pg/g	0.11 U	19	46 J	6.2 J	0.081 J	0.065 J	1.1 J	0.16 J	0.20 J	0.20 U	1.3 J
1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin (HxCDD)	pg/g	2.4 J	2.9 J	6.5 J	3.2 J	1.5 J	1.4 J	2.3 J	2.8 J	0.57 J	0.70 U	2.6 J
1,2,3,7,8-Pentachlorodibenzofuran (PeCDF)	pg/g	0.065 J	1200	1800	250	0.58 J	0.13 J	40	0.18 J	7.4	6.7	42 J
1,2,3,7,8-Pentachlorodibenzo-p-dioxin (PeCDD)	pg/g	0.23 J	23	130	11	0.086 U	0.13 J	3.1 J	0.15 U	0.64 J	0.64 J	3.1 J
2,3,4,6,7,8-Hexachlorodibenzofuran (HxCDF)	pg/g	0.025 U	37	71 J	12	0.046 U	0.024 U	1.8 J	0.045 U	0.39 U	0.39 J	1.9 J
2,3,4,7,8-Pentachlorodibenzofuran (PeCDF)	pg/g	0.045 U	440	930	100	0.35 J	0.030 U	20	0.084 U	4.3 J	3.8 J	21 J
2,3,7,8-Tetrachlorodibenzofuran (TCDF)	pg/g	0.17 U	12000 J	48000 J	4200 J	22 J	3.3 J	1200 J	5.0	280	270	1100 J
2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	pg/g	0.17 J	3100 J	19000 J	1800 J	6.8 J	1.3 J	430	1.7 J	80	75	440 J
Total heptachlorodibenzofuran (HpCDF)	pg/g	0.28 J	250 J	1300 J	140 J	1.5 J	0.12 J	37 J	0.14 J	4.7 J	4.8 J	35 J
Total heptachlorodibenzo-p-dioxin (HpCDD)	pg/g	160 J	250 J	490 J	210 J	88 J	74 J	130 J	150 J	33 J	45 J	150 J
Total hexachlorodibenzofuran (HxCDF)	pg/g	0.15 J	1600 J	4000 J	550 J	1.4 J	0.30 J	96 J	0.57 J	15 J	13 J	110 J
Total hexachlorodibenzo-p-dioxin (HxCDD)	pg/g	46 J	44 J	83 J	39 J	21 J	18 J	27 J	40 J	8.1 J	10 J	39 J
Total pentachlorodibenzofuran (PeCDF)	pg/g	0.065 J	2600 J	4100 J	530 J	1.7 J	0.22 J	90 J	0.18 J	17 J	16 J	96 J
Total pentachlorodibenzo-p-dioxin (PeCDD)	pg/g	8.1 J	31 J	140 J	18 J	3.8 J	3.7 J	7.7 J	4.3 J	1.7 J	2.5 J	9.2 J
Total tetrachlorodibenzofuran (TCDF)	pg/g	0.51 J	21000 J	91000 J	7900 J	35 J	6.5 J	2300 J	8.6 J	540 J	540 J	2100 J
Total tetrachlorodibenzo-p-dioxin (TCDD)	pg/g	6.9 J	3400 J	21000 J	1900 J	9.7 J	3.6 J	470 J	4.8 J	88 J	83 J	480 J
TEQ												
Total WHO Dioxin TEQ(Human/Mammal)(ND=0)	pg/g	1.5 J	4600 J	25000 J	2300 J	10 J	2.4 J	570 J	3.4 J	110 J	110 J	570 J
Total WHO Dioxin TEQ(Human/Mammal)(ND=0.5)	pg/g	1.6 J	4600 J	25000 J	2300 J	10 J	2.4 J	570 J	3.5 J	110 J	110 J	570 J

Notes:
- U - Not detected at the associated reporting limit
- J - Estimated concentration
- UJ - Not detected; associated reporting limit is estimated
- J- - Estimated concentration, result may be biased low
- J+ - Estimated concentration, result may be biased high
- TEQ - Toxicity Equivalent Quotient
- ft bgs - Feet below ground surface
- pg/g - picogram per grams

Table 2-4

Supplemental Design Investigation Analytical Results - Northern Impoundment
Final 100% Remedial Design - Northern Impoundment
San Jacinto River Waste Pits Site
Harris County, Texas

Sample Location: Sample Identification: Sample Date: Sample Depth: Parameters	Units	SJSB087 11215702-081021-BN-SJSB087 (14-16)-R 08/10/2021 (14-16) ft bgs Lab Duplicate	SJSB087 11215702-081021-BN-SJSB087(16-18) 08/10/2021 (16-18) ft bgs	SJSB088 11215702-080621-BN-SJSB088(0-2) 08/06/2021 (0-2) ft bgs	SJSB088 11215702-080621-BN-SJSB088(2-4) 08/06/2021 (2-4) ft bgs	SJSB088 11215702-080621-BN-SJSB088(4-6) 08/06/2021 (4-6) ft bgs	SJSB088 11215702-080621-BN-SJSB088(6-8) 08/06/2021 (6-8) ft bgs	SJSB088 11215702-080621-BN-SJSB088 (6-8)-R 08/06/2021 (6-8) ft bgs Lab Duplicate	SJSB088 11215702-080621-BN-DUP-14 08/06/2021 (6-8) ft bgs Field Duplicate	SJSB088 11215702-080621-BN-SJSB088(8-10) 08/06/2021 (8-10) ft bgs	SJSB088 11215702-080621-BN-SJSB088(10-12) 08/06/2021 (10-12) ft bgs	SJSB088 11215702-080621-BN-SJSB088(12-14) 08/06/2021 (12-14) ft bgs
Dioxins/Furans												
1,2,3,4,6,7,8,9-Octachlorodibenzofuran (OCDF)	pg/g	27	2.6 U	400	420	970	960	860	1200	1200	0.54 U	0.071 U
1,2,3,4,6,7,8,9-Octachlorodibenzo-p-dioxin (OCDD)	pg/g	1400	210	1600	1400 J-	3900	4600	5700	6000	6300	170	150
1,2,3,4,6,7,8-Heptachlorodibenzofuran (HpCDF)	pg/g	52 J	0.68 U	890	940	2100	2200	2000	2700	2400	0.33 J	0.051 U
1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin (HpCDD)	pg/g	52	10	120 J	120 J	300	340	370	420	420	9.5	7.0
1,2,3,4,7,8,9-Heptachlorodibenzofuran (HpCDF)	pg/g	18	0.26 U	310	300 J+	820	700	760	970	770	0.060 U	0.062 U
1,2,3,4,7,8-Hexachlorodibenzofuran (HxCDF)	pg/g	180 J	0.50 J	2900	2900	7700	7300	9400	9800	7700	0.75 J	0.047 U
1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin (HxCDD)	pg/g	0.86 U	0.35 U	5.5 J	1.6 U	7.0 J	2.9 U	9.2 U	5.5 J	5.4 J	0.11 U	0.34 J
1,2,3,6,7,8-Hexachlorodibenzofuran (HxCDF)	pg/g	49 J	0.24 U	770	800	2100	1900	2100	2500	2000	0.18 J	0.048 U
1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin (HxCDD)	pg/g	1.6 J	0.38 U	12 J	8.7 J	20 J	30 J	25 J	28 J	29 J	0.12 U	0.28 J
1,2,3,7,8,9-Hexachlorodibenzofuran (HxCDF)	pg/g	3.2 J	0.17 U	38 J	32 J	110 J	98 J	140	150 J	91 J	0.022 U	0.10 U
1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin (HxCDD)	pg/g	3.4 J	0.90 J	2.0 U	1.4 U	8.2 J	2.6 U	15 U	12 U	12 J	0.10 U	0.57 U
1,2,3,7,8-Pentachlorodibenzofuran (PeCDF)	pg/g	120 J	0.31 U	2100	2300	4900	4500	5800	7000	5200	0.45 J	0.071 U
1,2,3,7,8-Pentachlorodibenzo-p-dioxin (PeCDD)	pg/g	7.4 J	0.43 U	300	300 J+	330	320	380	290	300	0.13 U	0.093 U
2,3,4,6,7,8-Hexachlorodibenzofuran (HxCDF)	pg/g	5.6 J	0.17 U	81 J	95 J	210 J	210 J	220	290	200 J	0.023 U	0.034 U
2,3,4,7,8-Pentachlorodibenzofuran (PeCDF)	pg/g	54 J	0.32 U	1700	1800	2400	2300	2800	2900	2400	0.18 J	0.075 U
2,3,7,8-Tetrachlorodibenzofuran (TCDF)	pg/g	2600 J	5.8	130000 J	170000 J	130000 J	120000 J	130000 J	110000 J	130000 J	10	0.79 J
2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	pg/g	1200 J	1.8 J	25000 J	25000 J	35000 J	40000 J	55000 J	49000 J	36000 J	3.9	0.32 J
Total heptachlorodibenzofuran (HpCDF)	pg/g	83 J	0.56 J	1400 J	1400 J	3400 J	3400 J	3300 J	4400 J	3700 J	0.49 J	0.062 U
Total heptachlorodibenzo-p-dioxin (HpCDD)	pg/g	190 J	44 J	250 J	250 J	640 J	700 J	750 J	910 J	850 J	35 J	33 J
Total hexachlorodibenzofuran (HxCDF)	pg/g	260 J	0.50 J	4300 J	4300 J	11000 J	10000 J	13000 J	14000 J	11000 J	0.93 J	0.10 J
Total hexachlorodibenzo-p-dioxin (HxCDD)	pg/g	45 J	15 J	59 J	31 J	110 J	140 J	160 J	150 J	140 J	11 J	11 J
Total pentachlorodibenzofuran (PeCDF)	pg/g	260 J	0.35 U	6000 J	6400 J	92000 J	11000 J	14000 J	15000 J	12000 J	0.78 J	0.075 U
Total pentachlorodibenzo-p-dioxin (PeCDD)	pg/g	13 J	2.1 J	300 J	300 J	330 J	320 J	430 J	320 J	300 J	0.13 U	2.3 J
Total tetrachlorodibenzofuran (TCDF)	pg/g	5500 J	7.8 J	160000 J	200000 J	190000 J	180000 J	320000 J	200000 J	190000 J	17 J	1.2 J
Total tetrachlorodibenzo-p-dioxin (TCDD)	pg/g	1300 J	3.1 J	28000 J	27000 J	39000 J	45000 J	62000 J	53000 J	39000 J	3.9 J	2.0 J
TEQ												
Total WHO Dioxin TEQ(Human/Mammal)(ND=0)	pg/g	1500 J	2.7 J	39000 J	43000 J	50000 J	54000 J	71000 J	63000 J	51000 J	5.2 J	0.58 J
Total WHO Dioxin TEQ(Human/Mammal)(ND=0.5)	pg/g	1500 J	3.0 J	39000 J	43000 J	50000 J	54000 J	71000 J	63000 J	51000 J	5.3 J	0.68 J

Notes:
- U - Not detected at the associated reporting limit
- J - Estimated concentration
- UJ - Not detected; associated reporting limit is estimated
- J- - Estimated concentration, result may be biased low
- J+ - Estimated concentration, result may be biased high
- TEQ - Toxicity Equivalent Quotient
- ft bgs - Feet below ground surface
- pg/g - picogram per grams

Table 2-4

Supplemental Design Investigation Analytical Results - Northern Impoundment
Final 100% Remedial Design - Northern Impoundment
San Jacinto River Waste Pits Site
Harris County, Texas

Sample Location: Sample Identification: Sample Date: Sample Depth: Parameters	Units	SJSB088 11215702-080621-BN-SJSB088(14-16) 08/06/2021 (14-16) ft bgs	SJSB088 11215702-080621-BN-SJSB088(16-18) 08/06/2021 (16-18) ft bgs	SJSB088 11215702-080621-BN-SJSB088 (16-18)-R 08/06/2021 (16-18) ft bgs Lab Duplicate	SJSB088 11215702-080621-BN-SJSB088(18-20) 08/06/2021 (18-20) ft bgs	SJSB088 11215702-080621-BN-SJSB088(20-22) 08/06/2021 (20-22) ft bgs	SJSB088 11215702-080621-BN-SJSB088(22-24) 08/06/2021 (22-24) ft bgs	SJSB089 11215702-080721-BN-SJSB089(0-2) 08/07/2021 (0-2) ft bgs	SJSB089 11215702-080721-BN-SJSB089(2-4) 08/07/2021 (2-4) ft bgs	SJSB089 11215702-080721-BN-SJSB089(4-6) 08/07/2021 (4-6) ft bgs	SJSB089 11215702-080721-BN-SJSB089(6-8) 08/07/2021 (6-8) ft bgs	SJSB089 11215702-080721-BN-DUP-19 08/07/2021 (6-8) ft bgs Field Duplicate
Dioxins/Furans												
1,2,3,4,6,7,8,9-Octachlorodibenzofuran (OCDF)	pg/g	0.39 U	9.2 U	20	0.40 U	0.17 U	0.20 U	28	1.3 U	0.39 U	0.39 U	0.39 U
1,2,3,4,6,7,8,9-Octachlorodibenzo-p-dioxin (OCDD)	pg/g	390	150 J	280 J	220	290	210	1900	480	910	1100	1600 J
1,2,3,4,6,7,8-Heptachlorodibenzofuran (HpCDF)	pg/g	0.13 U	17 J	57	0.26 U	0.26 U	0.21 U	41	2.1 J	0.35 U	0.16 U	0.14 U
1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin (HpCDD)	pg/g	20	8.4 J	16	11	16	11	55	17	41	48	72
1,2,3,4,7,8,9-Heptachlorodibenzofuran (HpCDF)	pg/g	0.061 U	6.6 J	23	0.14 U	0.077 U	0.0030 U	13	0.74 J	0.16 J	0.072 U	0.081 U
1,2,3,4,7,8-Hexachlorodibenzofuran (HxCDF)	pg/g	0.14 U	64 J	260 J	0.64 J	0.28 J	0.23 U	100	7.6	0.99 J	0.087 U	0.18 U
1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin (HxCDD)	pg/g	0.36 J	0.43 U	0.39 U	0.040 U	0.70 J	0.34 J	0.85 J	0.43 J	0.58 J	0.74 J	0.84 J
1,2,3,6,7,8-Hexachlorodibenzofuran (HxCDF)	pg/g	0.049 U	16 J	54	0.18 U	0.0075 U	0.21 U	27	2.0 J	0.28 J	0.11 J	0.11 J
1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin (HxCDD)	pg/g	0.44 J	0.44 U	0.79 J	0.38 J	0.66 J	0.035 U	1.5 J	0.52 J	0.85 J	1.4 J	1.8 J
1,2,3,7,8,9-Hexachlorodibenzofuran (HxCDF)	pg/g	0.094 U	1.5 U	3.2 J	0.14 U	0.14 U	0.0030 U	1.8 J	0.17 U	0.11 U	0.18 U	0.11 U
1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin (HxCDD)	pg/g	2.1 J	0.40 U	0.82 U	0.042 U	0.84 J	0.52 J	2.3 J	1.1 J	2.4 J	3.0 J	3.7 J
1,2,3,7,8-Pentachlorodibenzofuran (PeCDF)	pg/g	0.054 U	40 J	130 J	0.90 J	0.28 U	0.32 U	62	4.3 J	0.96 J	0.063 U	0.072 U
1,2,3,7,8-Pentachlorodibenzo-p-dioxin (PeCDD)	pg/g	0.098 U	2.9 J	7.8	0.14 J	0.11 J	0.33 J	4.6 J	0.45 J	0.23 J	0.36 J	0.31 J
2,3,4,6,7,8-Hexachlorodibenzofuran (HxCDF)	pg/g	0.035 U	1.8 J	5.3 J	0.083 U	0.086 U	0.0025 U	3.0 J	0.22 U	0.064 U	0.037 U	0.042 U
2,3,4,7,8-Pentachlorodibenzofuran (PeCDF)	pg/g	0.056 U	19 J	75	0.66 J	0.22 U	0.25 U	32	2.0 J	0.64 J	0.065 U	0.075 U
2,3,7,8-Tetrachlorodibenzofuran (TCDF)	pg/g	1.2 J	930 J	3600 J	2.6	3.5	0.77 J	1600 J	110	37	1.0 J	2.4
2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	pg/g	0.51 J	410 J	1400 J	1.6	1.2 J	0.36 J	630 J	39	13	0.71 J	1.1 J
Total heptachlorodibenzofuran (HpCDF)	pg/g	0.11 J	28 J	95 J	0.55 J	0.42 J	0.32 J	63 J	3.4 J	0.66 J	0.16 J	0.14 J
Total heptachlorodibenzo-p-dioxin (HpCDD)	pg/g	96 J	29 J	47 J	49 J	81 J	54 J	170 J	68 J	120 J	150 J	220 J
Total hexachlorodibenzofuran (HxCDF)	pg/g	0.24 J	90 J	360 J	1.2 J	0.65 J	0.60 J	160 J	11 J	1.6 J	0.38 J	0.41 J
Total hexachlorodibenzo-p-dioxin (HxCDD)	pg/g	35 J	9.5 J	13 J	20 J	30 J	19 J	37 J	21 J	33 J	39 J	47 J
Total pentachlorodibenzofuran (PeCDF)	pg/g	0.060 U	94 J	320 J	2.6 J	0.79 J	0.66 J	160 J	9.8 J	2.3 J	0.066 U	0.079 U
Total pentachlorodibenzo-p-dioxin (PeCDD)	pg/g	6.4 J	3.8 J	9.5 J	2.8 J	8.7 J	6.3 J	10 J	5.0 J	7.4 J	8.1 J	7.4 J
Total tetrachlorodibenzofuran (TCDF)	pg/g	2.1 J	2000 J	6700 J	13 J	7.9 J	1.4 J	3600 J	210 J	70 J	2.2 J	4.2 J
Total tetrachlorodibenzo-p-dioxin (TCDD)	pg/g	4.8 J	440 J	1600 J	3.1 J	4.4 J	5.2 J	690 J	45 J	18 J	5.0 J	5.4 J
TEQ												
Total WHO Dioxin TEQ(Human/Mammal)(ND=0)	pg/g	1.2 J	520 J	1800 J	2.5 J	2.2 J	1.0 J	820 J	53 J	18 J	2.5 J	3.5 J
Total WHO Dioxin TEQ(Human/Mammal)(ND=0.5)	pg/g	1.3 J	520 J	1800 J	2.5 J	2.2 J	1.1 J	820 J	53 J	18 J	2.5 J	3.5 J

Notes:
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Table 2-4

Supplemental Design Investigation Analytical Results - Northern Impoundment
Final 100% Remedial Design - Northern Impoundment
San Jacinto River Waste Pits Site
Harris County, Texas

Sample Location: Sample Identification: Sample Date: Sample Depth: Parameters	Units	SJSB089 11215702-080721-BN-DUP-19-R 08/07/2021 (6-8) ft bgs Lab Duplicate	SJSB089 11215702-080721-BN-SJSB089(8-10) 08/07/2021 (8-10) ft bgs	SJSB089 11215702-080721-BN-SJSB089 (8-10)-R 08/07/2021 (8-10) ft bgs Lab Duplicate	SJSB089 11215702-080721-BN-SJSB089(10-12) 08/07/2021 (10-12) ft bgs	SJSB089 11215702-080721-BN-SJSB089 (10-12)-R 08/07/2021 (10-12) ft bgs Lab Duplicate	SJSB089 11215702-080721-BN-SJSB089(12-14) 08/07/2021 (12-14) ft bgs	SJSB089 11215702-080721-BN-SJSB089(14-16) 08/07/2021 (14-16) ft bgs	SJSB089 11215702-080721-BN-SJSB089(16-18) 08/07/2021 (16-18) ft bgs	SJSB090 11215702-080221-BN-SJSB090(0-2) 08/02/2021 (0-2) ft bgs	SJSB090 11215702-080221-BN-SJSB090(2-4) 08/02/2021 (2-4) ft bgs	SJSB090 11215702-080221-BN-SJSB090(4-6) 08/02/2021 (4-6) ft bgs
Dioxins/Furans												
1,2,3,4,6,7,8,9-Octachlorodibenzofuran (OCDF)	pg/g	0.38 U	0.92 U	0.92 U	1.2 U	0.45 U	0.067 U	0.11 U	0.39 U	820	170 J-	11 J
1,2,3,4,6,7,8,9-Octachlorodibenzo-p-dioxin (OCDD)	pg/g	940 J	770	740	390 J	210 J	66	940	25	5100	1600	850
1,2,3,4,6,7,8-Heptachlorodibenzofuran (HpCDF)	pg/g	0.49 U	1.6 J	1.4 U	1.9 J	0.56 U	0.13 U	0.069 U	0.041 U	2000	390 J-	20
1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin (HpCDD)	pg/g	48	27	32	14	8.1	2.5 J	40	0.94 U	360	83	54
1,2,3,4,7,8,9-Heptachlorodibenzofuran (HpCDF)	pg/g	0.36 U	0.51 J	0.54 U	0.64 J	0.36 U	0.056 U	0.085 U	0.053 U	650	130 J-	7.4
1,2,3,4,7,8-Hexachlorodibenzofuran (HxCDF)	pg/g	0.20 U	5.5 J	5.3 J	5.1 J	2.0 J	0.25 U	0.066 U	0.056 U	6800	1000	73
1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin (HxCDD)	pg/g	0.93 U	0.38 J	0.45 U	0.26 J	0.28 U	0.24 J	0.61 J	0.24 J	4.8 J	0.84 J	0.68 J
1,2,3,6,7,8-Hexachlorodibenzofuran (HxCDF)	pg/g	0.13 U	1.5 J	1.2 J	1.4 J	0.48 J	0.050 J	0.065 U	0.054 U	1800	240 J-	18
1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin (HxCDD)	pg/g	1.6 J	0.65 J	0.89 J	0.35 J	0.24 U	0.098 J	1.2 J	0.060 U	25	4.0 J	1.5 J
1,2,3,7,8,9-Hexachlorodibenzofuran (HxCDF)	pg/g	0.16 U	0.17 U	0.16 U	0.14 U	0.11 U	0.032 U	0.13 U	0.039 U	110 J	9.6	1.4 J
1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin (HxCDD)	pg/g	3.4 J	1.5 J	1.8 J	0.81 J	0.53 U	0.21 U	4.4 J	0.12 U	9.5 J	2.4 J	2.6 J
1,2,3,7,8-Pentachlorodibenzofuran (PeCDF)	pg/g	0.14 J	4.9 J	3.0 J	2.6 J	1.2 J	0.15 J	0.076 U	0.055 U	5000	410 J-	57
1,2,3,7,8-Pentachlorodibenzo-p-dioxin (PeCDD)	pg/g	0.35 J	0.34 J	0.44 J	0.34 J	0.20 J	0.069 U	0.29 J	0.075 U	320	35	5.3 J
2,3,4,6,7,8-Hexachlorodibenzofuran (HxCDF)	pg/g	0.060 U	0.22 U	0.18 U	0.14 U	0.11 U	0.033 U	0.048 U	0.040 U	200	18	2.1 J
2,3,4,7,8-Pentachlorodibenzofuran (PeCDF)	pg/g	0.090 J	2.1 J	1.7 J	1.3 J	0.68 J	0.050 U	0.079 U	0.057 U	2600	230 J-	34
2,3,7,8-Tetrachlorodibenzofuran (TCDF)	pg/g	2.7	100	84	70 J	38 J	3.7	1.1 J	0.60 J	110000 J	12000 J	2000 J
2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	pg/g	1.0 J	39	32	25 J	14 J	1.5	0.60 J	0.24 J	49000 J	5100 J	700 J
Total heptachlorodibenzofuran (HpCDF)	pg/g	0.30 J	2.6 J	2.4 J	3.1 J	0.98 J	0.13 J	0.085 U	0.053 U	3100 J	610 J	36 J
Total heptachlorodibenzo-p-dioxin (HpCDD)	pg/g	150 J	90 J	98 J	49 J	28 J	8.9 J	160 J	3.0 J	740 J	190 J	120 J
Total hexachlorodibenzofuran (HxCDF)	pg/g	0.55 J	8.3 J	7.6 J	7.6 J	3.0 J	0.30 J	0.13 J	0.056 U	9800 J	1400 J	100 J
Total hexachlorodibenzo-p-dioxin (HxCDD)	pg/g	43 J	21 J	27 J	13 J	7.5 J	3.1 J	47 J	1.5 J	180 J	40 J	26 J
Total pentachlorodibenzofuran (PeCDF)	pg/g	0.23 J	11 J	7.2 J	5.9 J	2.8 J	0.15 J	0.090 U	0.060 U	12000 J	1000 J	140 J
Total pentachlorodibenzo-p-dioxin (PeCDD)	pg/g	7.7 J	4.1 J	4.6 J	1.9 J	1.2 J	0.64 J	9.1 J	0.25 U	330 J	39 J	8.5 J
Total tetrachlorodibenzofuran (TCDF)	pg/g	4.7 J	200 J	160 J	140 J	64 J	7.2 J	2.0 J	0.89 J	220000 J	25000 J	3600 J
Total tetrachlorodibenzo-p-dioxin (TCDD)	pg/g	5.3 J	45 J	37 J	29 J	15 J	2.1 J	7.4 J	0.60 J	56000 J	5800 J	780 J
TEQ												
Total WHO Dioxin TEQ(Human/Mammal)(ND=0)	pg/g	3.1 J	52 J	43 J	34 J	19 J	1.0 J	2.3 J	0.33 J	62000 J	6600 J	930 J
Total WHO Dioxin TEQ(Human/Mammal)(ND=0.5)	pg/g	3.1 J	52 J	43 J	34 J	19 J	2.0 J	2.3 J	0.40 J	62000 J	6600 J	930 J

Notes:
- U - Not detected at the associated reporting limit
- J - Estimated concentration
- UJ - Not detected; associated reporting limit is estimated
- J- - Estimated concentration, result may be biased low
- J+ - Estimated concentration, result may be biased high
- TEQ - Toxicity Equivalent Quotient
- ft bgs - Feet below ground surface
- pg/g - picogram per grams

Table 2-4

Supplemental Design Investigation Analytical Results - Northern Impoundment
Final 100% Remedial Design - Northern Impoundment
San Jacinto River Waste Pits Site
Harris County, Texas

Sample Location: / Sample Identification: / Sample Date: / Sample Depth:	Units	SJSB090 11215702-080221-BN-SJSB090(6-8) 08/02/2021 (6-8) ft bgs	SJSB090 11215702-080221-BN-DUP-11 08/02/2021 (6-8) ft bgs Field Duplicate	SJSB090 11215702-080221-BN-SJSB090(8-10) 08/02/2021 (8-10) ft bgs	SJSB090 11215702-080221-BN-SJSB090 (8-10)-R 08/02/2021 (8-10) ft bgs Lab Duplicate	SJSB090 11215702-080221-BN-SJSB090(10-12) 08/02/2021 (10-12) ft bgs	SJSB090 11215702-080221-BN-SJSB090(12-14) 08/02/2021 (12-14) ft bgs	SJSB090 11215702-080221-BN-SJSB090(14-16) 08/02/2021 (14-16) ft bgs	SJSB090 11215702-080221-BN-SJSB090(16-18) 08/02/2021 (16-18) ft bgs	SJSB091 11215702-080321-BN-SJSB091(0-2) 08/03/2021 (0-2) ft bgs	SJSB091 11215702-080321-BN-SJSB091(2-4) 08/03/2021 (2-4) ft bgs	SJSB091 11215702-080321-BN-SJSB091(4-6) 08/03/2021 (4-6) ft bgs
Parameters												
Dioxins/Furans												
1,2,3,4,6,7,8,9-Octachlorodibenzofuran (OCDF)	pg/g	0.67 U	0.67 U	3.3 U	5.0 J	0.67 U	1.8 U	0.67 U	0.88 U	3.3 U	0.67 U	0.67 U
1,2,3,4,6,7,8,9-Octachlorodibenzo-p-dioxin (OCDD)	pg/g	250	280	630	490	1400	890	780	780	4400	770	340
1,2,3,4,6,7,8-Heptachlorodibenzofuran (HpCDF)	pg/g	0.22 U	0.057 U	7.8	12	0.23 J	1.9 J	0.45 J	0.12 U	0.50 J	0.21 J	0.21 J
1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin (HpCDD)	pg/g	11	12	28	28	59	36	31	31	130	32	10
1,2,3,4,7,8,9-Heptachlorodibenzofuran (HpCDF)	pg/g	0.25 U	0.062 U	2.8 J	4.2 J	0.049 U	0.83 J	0.050 U	0.14 U	0.14 U	0.045 U	0.044 U
1,2,3,4,7,8-Hexachlorodibenzofuran (HxCDF)	pg/g	0.88 J	0.25 J	31	48	0.54 J	4.8 J	0.61 J	0.13 U	1.1 J	0.51 J	0.35 J
1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin (HxCDD)	pg/g	0.55 J	0.33 J	0.49 J	0.40 U	0.76 J	0.55 J	0.57 J	0.84 J	1.5 J	0.58 J	0.33 J
1,2,3,6,7,8-Hexachlorodibenzofuran (HxCDF)	pg/g	0.21 U	0.11 J	8.2	13	0.14 J	1.1 J	0.19 J	0.14 U	0.39 J	0.19 J	0.12 J
1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin (HxCDD)	pg/g	0.39 J	0.44 J	0.75 J	0.68 J	1.3 J	0.81 J	0.72 J	0.89 J	3.0 J	0.91 J	0.28 J
1,2,3,7,8,9-Hexachlorodibenzofuran (HxCDF)	pg/g	0.14 U	0.11 J	0.66 J	0.89 J	0.14 J	0.17 J	0.10 J	0.10 J	0.19 J	0.080 J	0.080 J
1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin (HxCDD)	pg/g	0.27 U	0.75 J	1.5 J	1.3 J	3.2 J	1.8 J	1.8 J	2.8 J	5.6 J	2.1 J	0.57 J
1,2,3,7,8-Pentachlorodibenzofuran (PeCDF)	pg/g	0.71 J	0.19 J	29	42	0.51 J	0.86 J	0.28 J	0.17 U	1.1 J	0.56 J	0.31 J
1,2,3,7,8-Pentachlorodibenzo-p-dioxin (PeCDD)	pg/g	0.38 U	0.089 U	1.7 J	2.8 J	0.31 J	0.22 J	0.075 U	0.23 U	0.26 U	0.31 J	0.11 J
2,3,4,6,7,8-Hexachlorodibenzofuran (HxCDF)	pg/g	0.15 U	0.048 U	1.0 J	1.5 J	0.033 U	0.092 J	0.027 U	0.096 U	0.076 U	0.040 J	0.065 J
2,3,4,7,8-Pentachlorodibenzofuran (PeCDF)	pg/g	0.27 U	0.16 J	15	21	0.19 J	0.39 J	0.18 J	0.17 U	0.50 J	0.23 J	0.23 J
2,3,7,8-Tetrachlorodibenzofuran (TCDF)	pg/g	12	4.9	620 J	1200 J	7.5	16	7.4	2.9	31	11	14
2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	pg/g	4.5	1.9	190 J	420 J	2.5	5.5	2.3	0.87 J	8.6	4.2	3.2
Total heptachlorodibenzofuran (HpCDF)	pg/g	0.25 U	0.062 U	13 J	20 J	0.23 J	3.3 J	0.45 J	0.14 U	0.50 J	0.21 J	0.21 J
Total heptachlorodibenzo-p-dioxin (HpCDD)	pg/g	36 J	47 J	73 J	71 J	190 J	110 J	120 J	120 J	300 J	83 J	38 J
Total hexachlorodibenzofuran (HxCDF)	pg/g	0.88 J	0.47 J	45 J	72 J	0.83 J	6.5 J	0.90 J	0.11 U	1.7 J	0.82 J	0.62 J
Total hexachlorodibenzo-p-dioxin (HxCDD)	pg/g	7.1 J	13 J	16 J	16 J	48 J	26 J	28 J	35 J	51 J	21 J	11 J
Total pentachlorodibenzofuran (PeCDF)	pg/g	0.71 J	0.35 J	70 J	99 J	0.92 J	2.0 J	0.79 J	0.19 U	2.8 J	2.1 J	0.75 J
Total pentachlorodibenzo-p-dioxin (PeCDD)	pg/g	0.38 U	1.3 J	3.7 J	4.7 J	7.3 J	4.1 J	3.0 J	4.3 J	5.0 J	4.5 J	1.9 J
Total tetrachlorodibenzofuran (TCDF)	pg/g	23 J	8.0 J	1100 J	2500 J	14 J	29 J	14 J	4.2 J	58 J	25 J	32 J
Total tetrachlorodibenzo-p-dioxin (TCDD)	pg/g	4.5 J	2.8 J	210 J	470 J	8.6 J	8.9 J	5.5 J	4.5 J	12 J	9.5 J	5.4 J
TEQ												
Total WHO Dioxin TEQ(Human/Mammal)(ND=0)	pg/g	6.1 J	2.9 J	260 J	560 J	5.3 J	9.1 J	4.1 J	2.2 J	16 J	6.7 J	5.2 J
Total WHO Dioxin TEQ(Human/Mammal)(ND=0.5)	pg/g	6.4 J	2.9 J	260 J	560 J	5.3 J	9.1 J	4.1 J	2.3 J	16 J	6.7 J	5.2 J

Notes:
U - Not detected at the associated reporting limit
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UJ - Not detected; associated reporting limit is estimated
J- - Estimated concentration, result may be biased low
J+ - Estimated concentration, result may be biased high
TEQ - Toxicity Equivalent Quotient
ft bgs - Feet below ground surface
pg/g - picogram per grams

Table 2-4

Supplemental Design Investigation Analytical Results - Northern Impoundment
Final 100% Remedial Design - Northern Impoundment
San Jacinto River Waste Pits Site
Harris County, Texas

Sample Location: Sample Identification: Sample Date: Sample Depth: Parameters	Units	SJSB091 11215702-080321-BN-SJSB091(6-8) 08/03/2021 (6-8) ft bgs	SJSB091 11215702-080321-BN-DUP-18 08/03/2021 (6-8) ft bgs Field Duplicate	SJSB091 11215702-080321-BN-SJSB091(8-10) 08/03/2021 (8-10) ft bgs	SJSB091 11215702-080321-BN-SJSB091(10-12) 08/03/2021 (10-12) ft bgs	SJSB091 11215702-080321-BN-SJSB091(12-14) 08/03/2021 (12-14) ft bgs	SJSB091 11215702-080321-BN-SJSB091(14-16) 08/03/2021 (14-16) ft bgs	SJSB091 11215702-080321-BN-SJSB091(16-18) 08/03/2021 (16-18) ft bgs	SJSB092 11215702-072521-BN-SJSB092(0-2) 07/25/2021 (0-2) ft bgs	SJSB092 11215702-072521-BN-SJSB092(2-4) 07/25/2021 (2-4) ft bgs	SJSB092 11215702-072521-BN-SJSB092(4-6) 07/25/2021 (4-6) ft bgs	SJSB092 11215702-072521-BN-SJSB092(6-8) 07/25/2021 (6-8) ft bgs
Dioxins/Furans												
1,2,3,4,6,7,8,9-Octachlorodibenzofuran (OCDF)	pg/g	0.67 U	0.67 U	0.67 U	0.67 U	0.67 U	0.67 U	0.67 U	450	250	1.6 U	0.075 U
1,2,3,4,6,7,8,9-Octachlorodibenzo-p-dioxin (OCDD)	pg/g	930	1700	1400	1500	1100	1200	1900	1800	1200	640	1100
1,2,3,4,6,7,8-Heptachlorodibenzofuran (HpCDF)	pg/g	0.057 U	0.12 J	0.038 U	0.20 J	0.049 U	0.063 J	0.042 U	910	540	1.9 J	0.050 U
1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin (HpCDD)	pg/g	39	63	55	62	47	59	82	110	72 J	28	43
1,2,3,4,7,8,9-Heptachlorodibenzofuran (HpCDF)	pg/g	0.065 U	0.062 U	0.043 U	0.068 U	0.055 U	0.046 U	0.046 U	330	170	1.0 J	0.048 U
1,2,3,4,7,8-Hexachlorodibenzofuran (HxCDF)	pg/g	0.096 J	0.15 J	0.076 J	0.071 U	0.048 U	0.048 U	0.040 U	3300	1800	11	0.036 U
1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin (HxCDD)	pg/g	0.66 J	0.77 J	0.71 J	1.0 J	0.75 J	0.81 J	0.84 J	1.9 U	1.1 U	0.15 U	0.31 U
1,2,3,6,7,8-Hexachlorodibenzofuran (HxCDF)	pg/g	0.068 J	0.047 U	0.033 U	0.071 U	0.050 U	0.049 U	0.039 U	880	500	2.8 J	0.039 U
1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin (HxCDD)	pg/g	1.1 J	1.4 J	1.3 J	1.7 J	1.3 J	1.5 J	2.2 J	9.4 J	7.0 J	0.16 U	0.35 U
1,2,3,7,8,9-Hexachlorodibenzofuran (HxCDF)	pg/g	0.15 J	0.20 J	0.14 J	0.14 J	0.086 J	0.087 J	0.14 J	46 J	28 J	0.11 U	0.037 U
1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin (HxCDD)	pg/g	2.7 J	3.3 J	3.1 J	2.4 J	2.6 J	3.2 J	4.5 J	6.3 U	1.1 U	0.14 U	0.30 U
1,2,3,7,8-Pentachlorodibenzofuran (PeCDF)	pg/g	0.11 J	0.16 J	0.099 J	0.058 U	0.057 U	0.051 U	0.048 U	2200	1400 J	9.9	0.058 U
1,2,3,7,8-Pentachlorodibenzo-p-dioxin (PeCDD)	pg/g	0.29 J	0.30 J	0.082 U	0.27 J	0.30 J	0.12 U	0.12 U	290	200	0.19 U	0.17 U
2,3,4,6,7,8-Hexachlorodibenzofuran (HxCDF)	pg/g	0.043 J	0.035 U	0.023 U	0.054 U	0.036 U	0.037 U	0.030 U	82 J	57 J	0.12 U	0.036 U
2,3,4,7,8-Pentachlorodibenzofuran (PeCDF)	pg/g	0.057 U	0.059 U	0.048 J	0.062 U	0.057 U	0.054 U	0.049 U	1500	1100	6.6 J	0.066 U
2,3,7,8-Tetrachlorodibenzofuran (TCDF)	pg/g	3.1	1.3 U	1.4 U	0.91 U	1.3 U	0.93 U	0.51 U	210000	110000	340	7.4
2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	pg/g	0.72 J	0.56 J	0.50 J	0.51 J	0.74 J	0.53 J	0.39 J	21000 J	16000 J	93	3.1
Total heptachlorodibenzofuran (HpCDF)	pg/g	0.065 U	0.27 J	0.043 U	0.20 J	0.055 U	0.063 J	0.046 U	1500 J	820 J	3.6 J	0.083 U
Total heptachlorodibenzo-p-dioxin (HpCDD)	pg/g	130 J	210 J	190 J	190 J	130 J	150 J	210 J	260 J	170 J	94 J	160 J
Total hexachlorodibenzofuran (HxCDF)	pg/g	0.35 J	0.34 J	0.24 J	0.14 J	0.086 J	0.087 J	0.14 J	4800 J	2700 J	14 J	0.077 U
Total hexachlorodibenzo-p-dioxin (HxCDD)	pg/g	40 J	54 J	51 J	50 J	36 J	45 J	58 J	37 J	35 J	24 J	38 J
Total pentachlorodibenzofuran (PeCDF)	pg/g	0.11 J	0.16 J	0.15 J	0.089 J	0.080 J	0.063 J	0.049 U	5700 J	3800 J	24 J	0.066 U
Total pentachlorodibenzo-p-dioxin (PeCDD)	pg/g	7.3 J	10 J	8.5 J	9.5 J	9.2 J	11 J	13 J	290 J	200 J	1.9 U	2.9 U
Total tetrachlorodibenzofuran (TCDF)	pg/g	4.3 J	2.5 J	2.6 J	1.6 J	2.9 J	1.9 J	1.3 J	160000 J	130000 J	670 J	13 J
Total tetrachlorodibenzo-p-dioxin (TCDD)	pg/g	6.4 J	7.4 J	6.2 J	9.0 J	7.3 J	8.6 J	9.2 J	23000 J	17000 J	93 J	3.1 J
TEQ												
Total WHO Dioxin TEQ(Human/Mammal)(ND=0)	pg/g	2.5 J	2.6 J	2.0 J	2.4 J	2.3 J	2.0 J	2.6 J	43000 J	28000 J	130 J	4.6
Total WHO Dioxin TEQ(Human/Mammal)(ND=0.5)	pg/g	2.5 J	2.7 J	2.1 J	2.4 J	2.4 J	2.2 J	2.7 J	43000 J	28000 J	130 J	4.8

Notes:
- U - Not detected at the associated reporting limit
- J - Estimated concentration
- UJ - Not detected; associated reporting limit is estimated
- J- - Estimated concentration, result may be biased low
- J+ - Estimated concentration, result may be biased high
- TEQ - Toxicity Equivalent Quotient
- ft bgs - Feet below ground surface
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Final 100% Remedial Design - Northern Impoundment
San Jacinto River Waste Pits Site
Harris County, Texas

Sample Location: Sample Identification: Sample Date: Sample Depth:	Units	SJSB092 11215702-072521-BN-SJSB092(8-10) 07/25/2021 (8-10) ft bgs	SJSB092 11215702-072521-BN-SJSB092(10-12) 07/25/2021 (10-12) ft bgs	SJSB092 11215702-072521-BN-SJSB092(12-14) 07/25/2021 (12-14) ft bgs	SJSB092 11215702-072521-BN-SJSB092(14-16) 07/25/2021 (14-16) ft bgs	SJSB092 11215702-072521-BN-SJSB092(16-18) 07/25/2021 (16-18) ft bgs	SJSB093 11215702-082421-BN-SJSB093(0-2) 08/24/2021 (0-2) ft bgs	SJSB093 11215702-082421-BN-SJSB093(2-4) 08/24/2021 (2-4) ft bgs	SJSB093 11215702-082421-BN-SJSB093(4-6) 08/24/2021 (4-6) ft bgs	SJSB093 11215702-082421-BN-SJSB093(6-8) 08/24/2021 (6-8) ft bgs	SJSB093 11215702-082421-BN-SJSB093(8-10) 08/24/2021 (8-10) ft bgs	SJSB093 11215702-082421-BN-SJSB093(10-12) 08/24/2021 (10-12) ft bgs
Parameters												
Dioxins/Furans												
1,2,3,4,6,7,8,9-Octachlorodibenzofuran (OCDF)	pg/g	4.9 J	0.11 U	110	0.55 U	0.067 U	650 J	580 J	7.9 U	0.051 U	30 J	9.2 J
1,2,3,4,6,7,8,9-Octachlorodibenzo-p-dioxin (OCDD)	pg/g	870	1100	1300	340	450	920 J	680 J	460	420	810	480
1,2,3,4,6,7,8-Heptachlorodibenzofuran (HpCDF)	pg/g	0.66 U	0.87 U	200	0.40 U	0.44 U	1500	1200	16 J	0.62 U	63 J	19 J
1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin (HpCDD)	pg/g	46	52	55	12	20	110 J	99 J	22 J	22 J	51 J	31 J
1,2,3,4,7,8,9-Heptachlorodibenzofuran (HpCDF)	pg/g	0.66 J	0.046 U	69	0.20 U	0.047 U	520 J	350 J	5.7 J	0.36 U	22 J	8.7 J
1,2,3,4,7,8-Hexachlorodibenzofuran (HxCDF)	pg/g	1.4 J	2.0 J	660	0.78 J	0.66 J	3900	3000	53 J	0.53 U	180	86
1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin (HxCDD)	pg/g	0.20 U	0.16 U	0.86 U	0.35 U	0.33 U	1.2 U	0.29 U	2.1 U	0.22 U	0.056 U	1.3 U
1,2,3,6,7,8-Hexachlorodibenzofuran (HxCDF)	pg/g	0.47 J	0.51 J	180	0.29 J	0.029 U	1000	760	13 J	0.040 U	46 J	22 J
1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin (HxCDD)	pg/g	0.23 U	0.17 U	0.98 U	0.32 J	0.61 J	33 J	10 J	0.098 U	0.22 U	2.2 J	2.4 U
1,2,3,7,8,9-Hexachlorodibenzofuran (HxCDF)	pg/g	0.053 U	0.38 U	11 J	0.18 U	0.41 U	5.7 U	2.4 U	4.6 U	0.75 U	0.20 U	0.23 U
1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin (HxCDD)	pg/g	2.7 J	2.6 J	0.85 U	0.77 J	1.6 J	13 J	11 J	2.5 J	0.22 U	2.1 J	2.3 U
1,2,3,7,8-Pentachlorodibenzofuran (PeCDF)	pg/g	1.9 J	1.4 J	550	0.54 J	0.063 U	2900	2500	43 J	0.084 U	140	91
1,2,3,7,8-Pentachlorodibenzo-p-dioxin (PeCDD)	pg/g	0.20 U	0.22 U	82	0.24 J	0.11 U	390 J	430 J	6.0 J	0.19 U	20 J	13 J
2,3,4,6,7,8-Hexachlorodibenzofuran (HxCDF)	pg/g	0.055 U	0.084 U	22 J	0.12 J	0.028 U	190 J	160 J	4.0 U	0.035 U	8.0 J	5.6 J
2,3,4,7,8-Pentachlorodibenzofuran (PeCDF)	pg/g	0.92 J	0.97 J	420	0.42 J	0.065 U	2900	2400	40 J	0.30 U	120	82
2,3,7,8-Tetrachlorodibenzofuran (TCDF)	pg/g	70	71	33000	27	20	120000 J	110000 J	1600	0.11 U	5000	4200
2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	pg/g	18	17 J	6800 J	7.2	4.5	27000	29000	450	0.17 U	1300	1000
Total heptachlorodibenzofuran (HpCDF)	pg/g	1.3 J	0.87 J	310 J	0.68 J	0.44 J	2300 J	1700 J	25 J	0.97 J	98 J	33 J
Total heptachlorodibenzo-p-dioxin (HpCDD)	pg/g	150 J	150 J	150 J	38 J	64 J	240 J	180 J	67 J	87 J	140 J	91 J
Total hexachlorodibenzofuran (HxCDF)	pg/g	1.9 J	2.9 J	990 J	1.4 J	1.1 J	5600 J	4300 J	81 J	1.5 J	260 J	130 J
Total hexachlorodibenzo-p-dioxin (HxCDD)	pg/g	42 J	39 J	26 J	8.6 J	16 J	120 J	86 J	19 J	31 J	36 J	38 J
Total pentachlorodibenzofuran (PeCDF)	pg/g	3.6 J	2.4 J	1500 J	1.3 J	0.24 U	8600 J	7300 J	120 J	0.84 J	400 J	270 J
Total pentachlorodibenzo-p-dioxin (PeCDD)	pg/g	4.1 U	3.3 U	82 J	1.3 J	1.7 U	620 J	490 J	9.0 J	5.1 J	36 J	33 J
Total tetrachlorodibenzofuran (TCDF)	pg/g	130 J	150 J	50000 J	47 J	33 J	260000 J	240000 J	3700 J	1.7 J	11000 J	9500 J
Total tetrachlorodibenzo-p-dioxin (TCDD)	pg/g	18 J	17 J	7400 J	8.3 J	4.5 J	30000 J	31000 J	500 J	1.3 J	1400 J	1100 J
TEQ												
Total WHO Dioxin TEQ(Human/Mammal)(ND=0)	pg/g	27 J	26 J	10000 J	11 J	7.1 J	41000 J	42000 J	640 J	0.35 J	1900 J	1500 J
Total WHO Dioxin TEQ(Human/Mammal)(ND=0.5)	pg/g	27 J	26 J	10000 J	11 J	7.2 J	41000 J	42000 J	640 J	0.68 J	1900 J	1500 J

Notes:
- U - Not detected at the associated reporting limit
- J - Estimated concentration
- UJ - Not detected; associated reporting limit is estimated
- J- - Estimated concentration, result may be biased low
- J+ - Estimated concentration, result may be biased high
- TEQ - Toxicity Equivalent Quotient
- ft bgs - Feet below ground surface
- pg/g - picogram per grams

Table 2-4

Supplemental Design Investigation Analytical Results - Northern Impoundment
Final 100% Remedial Design - Northern Impoundment
San Jacinto River Waste Pits Site
Harris County, Texas

Sample Location: Sample Identification: Sample Date: Sample Depth: Parameters	Units	SJSB093 11215702-082421-BN-SJSB093(12-14) 08/24/2021 (12-14) ft bgs	SJSB093 11215702-082421-BN-SJSB093(14-16) 08/24/2021 (14-16) ft bgs	SJSB093 11215702-082421-BN-SJSB093(16-18) 08/24/2021 (16-18) ft bgs	SJSB094 11215702-072621-BN-SJSB094(0-2) 07/26/2021 (0-2) ft bgs	SJSB094 11215702-072621-BN-SJSB094(2-4) 07/26/2021 (2-4) ft bgs	SJSB094 11215702-072621-BN-SJSB094(4-6) 07/26/2021 (4-6) ft bgs	SJSB094 11215702-072621-BN-SJSB094(6-8) 07/26/2021 (6-8) ft bgs	SJSB094 11215702-072621-BN-SJSB094 (6-8)-R 07/26/2021 (6-8) ft bgs Lab Duplicate	SJSB094 11215702-072621-BN-DUP-8 07/26/2021 (6-8) ft bgs Field Duplicate	SJSB094 11215702-072621-BN-DUP-8-R 07/26/2021 (6-8) ft bgs Lab Duplicate	SJSB094 11215702-072621-BN-SJSB094(8-10) 07/26/2021 (8-10) ft bgs
Dioxins/Furans												
1,2,3,4,6,7,8,9-Octachlorodibenzofuran (OCDF)	pg/g	4.7 U	1.1 U	1.2 U	460 J	530	570	180 J	130	12 J	9.5 J	56 J
1,2,3,4,6,7,8,9-Octachlorodibenzo-p-dioxin (OCDD)	pg/g	340	170	220	720 J	750	1700	680 J	1200 J	1200	1100	620
1,2,3,4,6,7,8-Heptachlorodibenzofuran (HpCDF)	pg/g	7.7 J	0.72 U	0.60 U	1100	1100	1300	290 J	300	19 J	21	110
1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin (HpCDD)	pg/g	19 J	12 J	13 J	68 J	70 J	140	42 J	61	48	42	32 J
1,2,3,4,7,8,9-Heptachlorodibenzofuran (HpCDF)	pg/g	3.9 U	0.48 U	0.41 U	280	360	360	110	100	5.9 J	5.9 J	39
1,2,3,4,7,8-Hexachlorodibenzofuran (HxCDF)	pg/g	35 J	1.2 U	0.81 U	3200	3600	4400	1300 J	1100	62 J	61	430
1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin (HxCDD)	pg/g	1.1 U	1.2 U	0.70 U	3.6 J	0.97 U	1.5 UJ	1.2 U	3.5 U	1.0 J	0.65 U	0.45 U
1,2,3,6,7,8-Hexachlorodibenzofuran (HxCDF)	pg/g	8.8 J	0.50 U	0.78 U	740	960	1100	330 J	230	16 J	16	130
1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin (HxCDD)	pg/g	0.69 U	1.4 U	1.0 U	7.0 J	0.93 U	9.1 J	1.2 U	3.9 J	1.2 J	1.1 J	0.52 U
1,2,3,7,8,9-Hexachlorodibenzofuran (HxCDF)	pg/g	1.2 U	0.55 U	0.87 U	42 J	57 J	45 J	16 J	16 J	0.99 J	1.1 J	5.5 J
1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin (HxCDD)	pg/g	1.2 U	1.6 U	1.5 U	5.6 J	0.88 U	7.0 J	1.1 U	4.1 U	2.7 J	2.5 J	0.45 U
1,2,3,7,8-Pentachlorodibenzofuran (PeCDF)	pg/g	30 J	1.5 U	1.4 U	2200	2700	2900	920 J	740	51 J	50	320
1,2,3,7,8-Pentachlorodibenzo-p-dioxin (PeCDD)	pg/g	4.4 U	2.8 U	0.96 U	290	370	340	100 J	110	7.1	6.3 J	41
2,3,4,6,7,8-Hexachlorodibenzofuran (HxCDF)	pg/g	2.2 U	0.49 U	0.61 U	100	130	140	32 J	27 J	2.6 J	1.9 J	13 J
2,3,4,7,8-Pentachlorodibenzofuran (PeCDF)	pg/g	26 J	1.4 U	0.079 U	1600	2000	2000	700 J	700	47 J	36	240
2,3,7,8-Tetrachlorodibenzofuran (TCDF)	pg/g	1100	45	10 J	110000 J	140000 J	130000 J	47000 J	45000 J	2300 J	2400 J	16000 J
2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	pg/g	300	10 J	2.4 J	24000 J	23000 J	26000 J	10000 J	12000 J	570 J	720 J	3700 J
Total heptachlorodibenzofuran (HpCDF)	pg/g	14 J	1.4 J	1.2 J	1500 J	1700 J	1900 J	480 J	470 J	30 J	31 J	180 J
Total heptachlorodibenzo-p-dioxin (HpCDD)	pg/g	77 J	47 J	58 J	130 J	140 J	320 J	89 J	150 J	160 J	140 J	87 J
Total hexachlorodibenzofuran (HxCDF)	pg/g	52 J	2.7 J	3.1 J	4600 J	5400 J	6500 J	1900 J	1500 J	92 J	91 J	650 J
Total hexachlorodibenzo-p-dioxin (HxCDD)	pg/g	36 J	27 J	28 J	48 J	17 J	37 J	9.9 J	43 J	42 J	37 J	16 J
Total pentachlorodibenzofuran (PeCDF)	pg/g	83 J	4.5 J	1.4 J	6200 J	7500 J	7800 J	2600 J	2300 J	150 J	140 J	860 J
Total pentachlorodibenzo-p-dioxin (PeCDD)	pg/g	15 J	13 J	10 J	290 J	370 J	340 J	100 J	120 J	12 J	12 J	41 J
Total tetrachlorodibenzofuran (TCDF)	pg/g	2300 J	120 J	18 J	210000 J	210000 J	220000 J	87000 J	80000 J	4400 J	5000 J	26000 J
Total tetrachlorodibenzo-p-dioxin (TCDD)	pg/g	340 J	16 J	7.8 J	26000 J	26000 J	28000 J	11000 J	14000 J	620 J	790 J	4100 J
TEQ												
Total WHO Dioxin TEQ(Human/Mammal)(ND=0)	pg/g	420 J	15 J	3.6 J	36000 J	39000 J	41000 J	15000 J	17000 J	830 J	990 J	5500 J
Total WHO Dioxin TEQ(Human/Mammal)(ND=0.5)	pg/g	430 J	17 J	4.4 J	36000 J	39000 J	41000 J	15000 J	17000 J	830 J	990 J	5500 J

Notes:
U - Not detected at the associated reporting limit
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J- - Estimated concentration, result may be biased low
J+ - Estimated concentration, result may be biased high
TEQ - Toxicity Equivalent Quotient
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pg/g - picogram per grams

Table 2-4

Supplemental Design Investigation Analytical Results - Northern Impoundment
Final 100% Remedial Design - Northern Impoundment
San Jacinto River Waste Pits Site
Harris County, Texas

Sample Location: Sample Identification: Sample Date: Sample Depth: Parameters	Units	SJSB094 11215702-072621-BN-SJSB094(10-12) 07/26/2021 (10-12) ft bgs	SJSB094 11215702-072621-BN-SJSB094(12-14) 07/26/2021 (12-14) ft bgs	SJSB094 11215702-072621-BN-SJSB094(14-16) 07/26/2021 (14-16) ft bgs	SJSB094 11215702-072621-BN-SJSB094(16-18) 07/26/2021 (16-18) ft bgs	SJSB095 11215702-072821-BN-SJSB095(0-2) 07/28/2021 (0-2) ft bgs	SJSB095 11215702-072821-BN-SJSB095(2-4) 07/28/2021 (2-4) ft bgs	SJSB095 11215702-072821-BN-SJSB095(4-6) 07/28/2021 (4-6) ft bgs	SJSB095 11215702-072821-BN-SJSB095(6-8) 07/28/2021 (6-8) ft bgs	SJSB095 11215702-072821-BN-DUP-10 07/28/2021 (6-8) ft bgs Field Duplicate	SJSB095 11215702-072821-BN-SJSB095(8-10) 07/28/2021 (8-10) ft bgs	SJSB095 11215702-072821-BN-SJSB095 (8-10)-R 07/28/2021 (8-10) ft bgs Lab Duplicate
Dioxins/Furans												
1,2,3,4,6,7,8,9-Octachlorodibenzofuran (OCDF)	pg/g	0.17 U	0.15 U	0.11 U	0.11 U	340 J	18 J	0.17 U	0.12 U	0.61 J	25	13
1,2,3,4,6,7,8,9-Octachlorodibenzo-p-dioxin (OCDD)	pg/g	840	1400	1300	45	1400	1700	240	190	240	1300 J	550 J
1,2,3,4,6,7,8-Heptachlorodibenzofuran (HpCDF)	pg/g	1.1 U	0.086 U	0.079 U	0.33 U	790	4.4 J	0.26 U	0.060 U	0.34 U	33	24
1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin (HpCDD)	pg/g	36	65	60	2.6 J	88 J	60	12	10 J	11	38 J	18 J
1,2,3,4,7,8,9-Heptachlorodibenzofuran (HpCDF)	pg/g	0.091 U	0.080 U	0.077 U	0.058 U	250	2.0 J	0.068 U	0.057 U	0.054 U	10	6.5
1,2,3,4,7,8-Hexachlorodibenzofuran (HxCDF)	pg/g	2.7 J	0.047 U	0.046 U	0.029 U	2800	7.0	0.045 U	0.029 U	1.2 J	100	62
1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin (HxCDD)	pg/g	0.27 U	0.37 U	0.91 J	0.097 U	1.2 U	0.33 U	0.13 U	0.080 U	0.14 U	0.71 J	0.36 U
1,2,3,6,7,8-Hexachlorodibenzofuran (HxCDF)	pg/g	0.62 J	0.047 U	0.045 U	0.030 U	740	1.6 J	0.044 U	0.027 U	0.42 J	28	17
1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin (HxCDD)	pg/g	0.31 U	0.41 U	1.6 J	0.11 U	1.3 U	0.40 U	0.15 U	0.091 U	0.15 U	1.3 J	0.63 J
1,2,3,7,8,9-Hexachlorodibenzofuran (HxCDF)	pg/g	0.12 U	0.047 U	0.046 U	0.029 U	40 J	0.36 U	0.045 U	0.026 U	0.040 U	1.3 J	0.98 J
1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin (HxCDD)	pg/g	2.4 J	4.8 J	4.4 J	0.096 U	4.8 J	0.33 U	0.74 J	0.50 J	1.0 J	1.7 J	0.99 J
1,2,3,7,8-Pentachlorodibenzofuran (PeCDF)	pg/g	1.7 J	0.066 U	0.063 U	0.047 U	2100	0.54 U	0.078 U	0.044 U	0.55 J	74	50
1,2,3,7,8-Pentachlorodibenzo-p-dioxin (PeCDD)	pg/g	0.32 U	0.24 U	0.23 U	0.11 U	290	0.50 U	0.17 U	0.099 U	0.13 U	9.3	6.3
2,3,4,6,7,8-Hexachlorodibenzofuran (HxCDF)	pg/g	0.11 U	0.048 U	0.046 U	0.028 U	88 J	0.36 U	0.041 U	0.027 U	0.038 U	3.6 J	1.9 J
2,3,4,7,8-Pentachlorodibenzofuran (PeCDF)	pg/g	1.3 J	0.068 U	0.069 U	0.047 U	1700	0.57 U	0.085 U	0.051 U	0.48 J	55	37
2,3,7,8-Tetrachlorodibenzofuran (TCDF)	pg/g	83	4.3 U	2.4 U	6.4 U	110000 J	140	11 U	5.5 UJ	27 J	3500 J	2400 J
2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	pg/g	22	0.13 U	1.3 J	1.4 J	23000 J	42	0.16 U	1.7 J	6.3 J	810 J	710 J
Total heptachlorodibenzofuran (HpCDF)	pg/g	1.1 J	0.086 U	0.23 U	0.33 J	1200 J	8.3 J	0.26 J	0.060 U	0.34 J	50 J	35 J
Total heptachlorodibenzo-p-dioxin (HpCDD)	pg/g	130 J	190 J	190 J	8.1 J	200 J	150 J	45 J	38 J	44 J	100 J	58 J
Total hexachlorodibenzofuran (HxCDF)	pg/g	3.3 J	0.074 U	0.11 U	0.036 U	4100 J	8.6 J	0.078 U	0.036 U	1.6 J	160 J	92 J
Total hexachlorodibenzo-p-dioxin (HxCDD)	pg/g	32 J	52 J	50 J	2.0 J	32 J	18 J	9.1 J	8.9 J	11 J	20 J	14 J
Total pentachlorodibenzofuran (PeCDF)	pg/g	4.0 J	0.068 U	0.069 U	0.14 U	6200 J	2.6 J	0.27 U	0.094 U	1.0 J	190 J	130 J
Total pentachlorodibenzo-p-dioxin (PeCDD)	pg/g	5.2 J	8.8 J	8.4 J	0.26 U	290 J	1.3 U	1.2 U	0.48 U	0.90 J	10 J	7.9 J
Total tetrachlorodibenzofuran (TCDF)	pg/g	160 J	8.1 J	3.0 J	9.8 J	200000 J	240 J	19 J	8.9 J	49 J	6400 J	4900 J
Total tetrachlorodibenzo-p-dioxin (TCDD)	pg/g	22 J	1.1 J	4.1 J	1.4 J	25000 J	42 J	0.45 U	1.7 J	6.3 J	880 J	780 J
TEQ												
Total WHO Dioxin TEQ(Human/Mammal)(ND=0)	pg/g	32 J	1.6 J	3.0 J	1.4 J	35000 J	58 J	0.27 J	1.9 J	9.6 J	1200 J	980 J
Total WHO Dioxin TEQ(Human/Mammal)(ND=0.5)	pg/g	32 J	2.0 J	3.2 J	1.9 J	35000 J	59 J	1.0 J	2.3 J	9.7 J	1200 J	980 J

Notes:
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Table 2-4

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Final 100% Remedial Design - Northern Impoundment
San Jacinto River Waste Pits Site
Harris County, Texas

Sample Location: Sample Identification: Sample Date: Sample Depth: Parameters	Units	SJSB095 11215702-072821-BN-SJSB095(10-12) 07/28/2021 (10-12) ft bgs	SJSB095 11215702-072821-BN-SJSB095 (10-12)-R 07/28/2021 (10-12) ft bgs Lab Duplicate	SJSB095 11215702-072821-BN-SJSB095(12-14) 07/28/2021 (12-14) ft bgs	SJSB095 11215702-072821-BN-SJSB095(14-16) 07/28/2021 (14-16) ft bgs	SJSB095 11215702-072821-BN-SJSB095 (14-16)-R 07/28/2021 (14-16) ft bgs Lab Duplicate	SJSB095 11215702-072821-BN-SJSB095(16-18) 07/28/2021 (16-18) ft bgs	SJSB096 11215702-072721-BN-SJSB096(0-2) 07/27/2021 (0-2) ft bgs	SJSB096 11215702-072721-BN-SJSB096(2-4) 07/27/2021 (2-4) ft bgs	SJSB096 11215702-072721-BN-SJSB096(4-6) 07/27/2021 (4-6) ft bgs	SJSB096 11215702-072721-BN-SJSB096(6-8) 07/27/2021 (6-8) ft bgs	SJSB096 11215702-072721-BN-DUP-9 07/27/2021 (6-8) ft bgs Field Duplicate
Dioxins/Furans												
1,2,3,4,6,7,8,9-Octachlorodibenzofuran (OCDF)	pg/g	0.10 U	0.92 U	0.12 U	0.70 J	1.1 U	0.12 U	700	290	3.8 J	0.51 J	0.13 U
1,2,3,4,6,7,8,9-Octachlorodibenzo-p-dioxin (OCDD)	pg/g	200 J	500 J	130	170 J	400 J	260	1100	610	950	980	820
1,2,3,4,6,7,8-Heptachlorodibenzofuran (HpCDF)	pg/g	0.62 U	0.52 U	0.29 U	0.66 U	1.6 U	0.28 U	1500	650	7.6	0.18 J	0.071 U
1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin (HpCDD)	pg/g	11	19	6.5	7.7	17	15	130	43 J	36	39	34
1,2,3,4,7,8,9-Heptachlorodibenzofuran (HpCDF)	pg/g	0.35 J	0.26 U	0.043 U	0.28 J	0.51 U	0.061 U	450	200	2.6 J	0.041 U	0.072 U
1,2,3,4,7,8-Hexachlorodibenzofuran (HxCDF)	pg/g	3.8 J	0.69 J	0.032 U	2.1 J	4.0 J	0.019 U	4400	2000	25	0.74 J	0.29 J
1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin (HxCDD)	pg/g	0.097 U	0.34 U	0.057 U	0.33 J	0.39 U	0.28 U	5.9 J	2.1 J	0.26 U	0.59 J	0.23 U
1,2,3,6,7,8-Hexachlorodibenzofuran (HxCDF)	pg/g	0.91 J	0.30 J	0.032 U	0.64 J	1.3 J	0.018 U	1200	500	6.4 J	0.25 J	0.033 U
1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin (HxCDD)	pg/g	0.11 U	0.53 J	0.060 U	0.20 J	0.38 J	0.29 U	13	4.0 J	0.27 U	0.81 J	0.82 J
1,2,3,7,8,9-Hexachlorodibenzofuran (HxCDF)	pg/g	0.17 J	0.15 U	0.030 U	0.17 J	0.15 U	0.018 U	89	23 J	0.26 U	0.12 J	0.034 U
1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin (HxCDD)	pg/g	1.1 J	1.5 J	0.054 U	0.78 J	1.4 J	0.26 U	10	2.6 J	2.1 J	2.9 J	0.23 U
1,2,3,7,8-Pentachlorodibenzofuran (PeCDF)	pg/g	2.9 J	0.58 J	0.071 U	2.7 J	3.2 J	0.052 U	3500	1300	18	0.86 J	0.042 U
1,2,3,7,8-Pentachlorodibenzo-p-dioxin (PeCDD)	pg/g	0.14 U	0.22 J	0.10 U	0.43 J	0.47 J	0.15 U	550	130	2.6 J	0.29 J	0.15 U
2,3,4,6,7,8-Hexachlorodibenzofuran (HxCDF)	pg/g	0.14 J	0.089 J	0.029 U	0.13 J	0.16 J	0.017 U	150	47 J	0.73 J	0.043 J	0.032 U
2,3,4,7,8-Pentachlorodibenzofuran (PeCDF)	pg/g	2.1 J	0.41 J	0.078 U	2.7 J	2.2 J	0.056 U	3200	930	13	0.35 J	0.041 U
2,3,7,8-Tetrachlorodibenzofuran (TCDF)	pg/g	150 J	27 J	17	170	150	3.6 U	250000 J	61000 J	910 J	8.8	8.6
2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	pg/g	40 J	7.0 J	4.1	35	38	0.13 U	60000 J	15000 J	210	2.4	2.5
Total heptachlorodibenzofuran (HpCDF)	pg/g	1.1 J	0.82 J	0.29 J	1.1 J	2.5 J	0.28 J	2200 J	980 J	12 J	0.18 J	0.072 U
Total heptachlorodibenzo-p-dioxin (HpCDD)	pg/g	44 J	78 J	25 J	32 J	72 J	66 J	230 J	88 J	120 J	150 J	130 J
Total hexachlorodibenzofuran (HxCDF)	pg/g	5.0 J	1.2 J	0.075 U	3.3 J	5.6 J	0.052 U	6200 J	2900 J	32 J	1.3 J	0.29 J
Total hexachlorodibenzo-p-dioxin (HxCDD)	pg/g	13 J	18 J	6.2 J	9.3 J	18 J	17 J	99 J	27 J	25 J	38 J	30 J
Total pentachlorodibenzofuran (PeCDF)	pg/g	7.0 J	1.2 J	0.078 U	7.6 J	8.3 J	0.056 U	9300 J	3400 J	48 J	1.9 J	0.057 U
Total pentachlorodibenzo-p-dioxin (PeCDD)	pg/g	0.42 U	2.9 J	0.69 U	1.5 J	3.6 J	5.9 J	590 J	150 J	5.7 J	5.9 J	5.0 J
Total tetrachlorodibenzofuran (TCDF)	pg/g	300 J	48 J	25 J	300 J	280 J	6.1 J	390000 J	110000 J	1500 J	15 J	14 J
Total tetrachlorodibenzo-p-dioxin (TCDD)	pg/g	40 J	9.3 J	4.1 J	40 J	43 J	1.2 J	70000 J	16000 J	230 J	7.9 J	4.1 J
TEQ												
Total WHO Dioxin TEQ(Human/Mammal)(ND=0)	pg/g	57 J	11 J	5.9	54 J	55 J	0.23	87000 J	22000 J	310 J	4.9 J	4.1 J
Total WHO Dioxin TEQ(Human/Mammal)(ND=0.5)	pg/g	57 J	11 J	6.0	54 J	55 J	0.60	87000 J	22000 J	310 J	4.9 J	4.2 J

Notes:
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- UJ - Not detected; associated reporting limit is estimated
- J- - Estimated concentration, result may be biased low
- J+ - Estimated concentration, result may be biased high
- TEQ - Toxicity Equivalent Quotient
- ft bgs - Feet below ground surface
- pg/g - picogram per grams

Table 2-4

Supplemental Design Investigation Analytical Results - Northern Impoundment
Final 100% Remedial Design - Northern Impoundment
San Jacinto River Waste Pits Site
Harris County, Texas

Sample Location: Sample Identification: Sample Date: Sample Depth: Parameters	Units	SJSB096 11215702-072721-BN-SJSB096(8-10) 07/27/2021 (8-10) ft bgs	SJSB096 11215702-072721-BN-SJSB096 (8-10)-R 07/27/2021 (8-10) ft bgs Lab Duplicate	SJSB096 11215702-072721-BN-SJSB096(10-12) 07/27/2021 (10-12) ft bgs	SJSB096 11215702-072721-BN-SJSB096 (10-12)-R 07/27/2021 (10-12) ft bgs Lab Duplicate	SJSB096 11215702-072721-BN-SJSB096(12-14) 07/27/2021 (12-14) ft bgs	SJSB096 11215702-072721-BN-SJSB096(14-16) 07/27/2021 (14-16) ft bgs	SJSB096 11215702-072721-BN-SJSB096(16-18) 07/27/2021 (16-18) ft bgs	SJSB097 11215702-082221-BN-SJSB097(0-2) 08/22/2021 (0-2) ft bgs	SJSB097 11215702-082221-BN-SJSB097(2-4) 08/22/2021 (2-4) ft bgs	SJSB097 11215702-082221-BN-SJSB097(4-6) 08/22/2021 (4-6) ft bgs	SJSB097 11215702-082221-BN-SJSB097(6-8) 08/22/2021 (6-8) ft bgs
Dioxins/Furans												
1,2,3,4,6,7,8,9-Octachlorodibenzofuran (OCDF)	pg/g	37	63	0.74 J	0.66 U	0.095 U	0.74 J	0.60 J	58 J	0.71 U	0.76 U	0.98 U
1,2,3,4,6,7,8,9-Octachlorodibenzo-p-dioxin (OCDD)	pg/g	1000	610	1200	940	460	360	600	2500	350	430	320
1,2,3,4,6,7,8-Heptachlorodibenzofuran (HpCDF)	pg/g	68 J	160 J	1.4 J	1.2 U	0.050 U	0.039 U	0.40 J	9.0 J	0.021 U	0.57 U	0.31 U
1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin (HpCDD)	pg/g	41	31	51	40	24	18	27	73 J	23 J	25 J	17 J
1,2,3,4,7,8,9-Heptachlorodibenzofuran (HpCDF)	pg/g	22 J	60 J	0.39 J	0.45 U	0.048 U	0.036 U	0.059 U	0.84 U	0.025 U	0.039 U	0.27 U
1,2,3,4,7,8-Hexachlorodibenzofuran (HxCDF)	pg/g	200 J	630 J	4.9 J	3.7 J	0.038 U	0.024 U	0.91 J	2.3 U	0.024 U	0.42 U	0.31 U
1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin (HxCDD)	pg/g	0.79 J	1.1 U	0.49 J	0.68 U	0.19 U	0.29 J	0.29 U	1.7 U	0.52 U	0.59 U	0.48 U
1,2,3,6,7,8-Hexachlorodibenzofuran (HxCDF)	pg/g	51 J	140 J	1.2 J	1.1 J	0.038 U	0.025 U	0.036 U	1.0 U	0.24 U	0.44 U	0.23 U
1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin (HxCDD)	pg/g	1.3 J	1.8 J	1.3 J	1.1 J	0.21 U	0.54 J	0.33 U	2.0 J	0.048 U	0.093 U	1.0 J
1,2,3,7,8,9-Hexachlorodibenzofuran (HxCDF)	pg/g	3.3 J	8.5	0.25 J	0.17 U	0.037 U	0.024 U	0.036 U	0.79 U	0.21 U	0.53 U	0.69 U
1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin (HxCDD)	pg/g	2.7 J	1.3 U	3.3 J	2.9 J	2.3 J	1.6 J	2.5 J	2.7 U	1.2 U	1.6 J	1.6 J
1,2,3,7,8-Pentachlorodibenzofuran (PeCDF)	pg/g	150 J	410 J	3.6 J	3.7 J	0.26 J	0.037 U	0.53 J	1.5 J	0.51 J	0.17 U	0.65 J
1,2,3,7,8-Pentachlorodibenzo-p-dioxin (PeCDD)	pg/g	24 J	62 J	0.16 U	0.73 J	0.10 U	0.11 U	0.15 U	0.095 U	0.15 U	0.12 U	0.10 U
2,3,4,6,7,8-Hexachlorodibenzofuran (HxCDF)	pg/g	6.5 J	15	0.066 U	0.14 J	0.038 U	0.024 U	0.034 U	0.86 U	0.20 U	0.57 U	0.32 U
2,3,4,7,8-Pentachlorodibenzofuran (PeCDF)	pg/g	120 J	380 J	2.6 J	2.7 J	0.16 J	0.040 U	0.12 U	1.6 U	0.52 U	0.58 U	0.038 U
2,3,7,8-Tetrachlorodibenzofuran (TCDF)	pg/g	8000 J	25000 J	190	230	11	3.9	32	26	0.067 U	3.8 J	2.3 J
2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	pg/g	1900 J	5700 J	45	58	3.3	0.95 J	8.7	0.062 U	0.54 J	1.1 U	0.95 U
Total heptachlorodibenzofuran (HpCDF)	pg/g	100 J	260 J	1.8 J	2.0 J	0.050 U	0.039 U	0.40 J	20 J	0.42 J	1.3 J	0.71 J
Total heptachlorodibenzo-p-dioxin (HpCDD)	pg/g	140 J	95 J	160 J	140 J	100 J	71 J	130 J	230 J	94 J	110 J	66 J
Total hexachlorodibenzofuran (HxCDF)	pg/g	290 J	880 J	6.4 J	6.0 J	0.038 U	0.027 U	0.91 J	9.7 J	0.65 J	2.2 J	1.6 J
Total hexachlorodibenzo-p-dioxin (HxCDD)	pg/g	36 J	32 J	41 J	42 J	28 J	24 J	42 J	47 J	28 J	31 J	22 J
Total pentachlorodibenzofuran (PeCDF)	pg/g	400 J	1200 J	8.5 J	9.8 J	0.43 J	0.040 U	0.53 J	9.1 J	1.5 J	1.1 J	1.3 J
Total pentachlorodibenzo-p-dioxin (PeCDD)	pg/g	24 J	75 J	7.7 J	8.4 J	3.9 J	4.8 J	9.2 J	7.4 J	6.1 J	11 J	4.0 J
Total tetrachlorodibenzofuran (TCDF)	pg/g	14000 J	44000 J	360 J	440 J	17 J	5.6 J	60 J	52 J	0.94 J	4.3 J	2.9 J
Total tetrachlorodibenzo-p-dioxin (TCDD)	pg/g	2100 J	6300 J	45 J	68 J	3.3 J	2.2 J	8.7 J	3.5 J	3.5 J	1.1 J	2.3 J
TEQ												
Total WHO Dioxin TEQ(Human/Mammal)(ND=0)	pg/g	2800 J	8500 J	67 J	84 J	5.1 J	1.9 J	13 J	4.4 J	0.89 J	0.92 J	0.78 J
Total WHO Dioxin TEQ(Human/Mammal)(ND=0.5)	pg/g	2800 J	8500 J	67 J	84 J	5.2 J	1.9 J	13 J	5.2 J	1.2 J	1.8 J	1.4 J

Notes:
U - Not detected at the associated reporting limit
J - Estimated concentration
UJ - Not detected; associated reporting limit is estimated
J- - Estimated concentration, result may be biased low
J+ - Estimated concentration, result may be biased high
TEQ - Toxicity Equivalent Quotient
ft bgs - Feet below ground surface
pg/g - picogram per grams

Table 2-4

Supplemental Design Investigation Analytical Results - Northern Impoundment
Final 100% Remedial Design - Northern Impoundment
San Jacinto River Waste Pits Site
Harris County, Texas

Sample Location: / Sample Identification: / Sample Date: / Sample Depth: / Parameters	Units	SJSB097 11215702-082221-BN-DUP-20 08/22/2021 (6-8) ft bgs Field Duplicate	SJSB097 11215702-082221-BN-SJSB097(8-10) 08/22/2021 (8-10) ft bgs	SJSB097 11215702-082221-BN-SJSB097(10-12) 08/22/2021 (10-12) ft bgs	SJSB097 11215702-082221-BN-SJSB097(12-14) 08/22/2021 (12-14) ft bgs	SJSB097 11215702-082221-BN-SJSB097(14-16) 08/22/2021 (14-16) ft bgs	SJSB098 11215702-082021-BN-SJSB098(0-2) 08/20/2021 (0-2) ft bgs	SJSB098 11215702-082021-BN-SJSB098(2-4) 08/20/2021 (2-4) ft bgs	SJSB098 11215702-082021-BN-SJSB098(4-6) 08/20/2021 (4-6) ft bgs	SJSB098 11215702-082021-BN-SJSB098(6-8) 08/20/2021 (6-8) ft bgs	SJSB098 11215702-082021-BN-SJSB098(8-10) 08/20/2021 (8-10) ft bgs	SJSB098 11215702-082021-BN-SJSB098(10-12) 08/20/2021 (10-12) ft bgs
Dioxins/Furans												
1,2,3,4,6,7,8,9-Octachlorodibenzofuran (OCDF)	pg/g	1.3 J	1.0 U	0.089 U	0.089 U	0.089 U	39 J	73 J	120 J	57 J	130 J	82
1,2,3,4,6,7,8,9-Octachlorodibenzo-p-dioxin (OCDD)	pg/g	420	66 J	22	26	26	1800	1800	3000	1900	1700	1600
1,2,3,4,6,7,8-Heptachlorodibenzofuran (HpCDF)	pg/g	1.5 J	0.62 U	0.082 U	0.064 U	0.064 U	8.3 J	31 J	38 J	13 J	250	150
1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin (HpCDD)	pg/g	24 J	3.6 U	1.1 J	1.6 J	1.7 J	58 J	71 J	120	77	95	71
1,2,3,4,7,8,9-Heptachlorodibenzofuran (HpCDF)	pg/g	0.082 U	0.29 U	0.079 U	0.047 U	0.0030 U	1.3 U	9.9 J	12 J	3.0 J	80	48
1,2,3,4,7,8-Hexachlorodibenzofuran (HxCDF)	pg/g	0.86 U	0.69 U	0.064 U	0.067 U	0.063 U	8.5 J	120	130	24 J	790	450
1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin (HxCDD)	pg/g	0.17 U	0.76 U	0.055 J	0.10 J	0.069 J	0.76 U	1.6 J	0.18 U	2.2 U	2.0 U	0.94 J
1,2,3,6,7,8-Hexachlorodibenzofuran (HxCDF)	pg/g	0.84 U	0.92 U	0.056 U	0.050 U	0.047 U	2.3 J	29 J	31 J	6.5 J	200	110
1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin (HxCDD)	pg/g	0.18 U	0.74 J	0.098 U	0.16 J	0.12 U	2.5 J	6.3 J	3.7 J	2.7 J	7.8 J	4.0 J
1,2,3,7,8,9-Hexachlorodibenzofuran (HxCDF)	pg/g	0.52 J	0.94 U	0.016 U	0.083 U	0.083 U	1.5 U	15 J	13 J	0.10 U	0.62 U	39
1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin (HxCDD)	pg/g	0.52 U	0.96 J	0.21 U	0.25 U	0.17 U	2.7 U	3.8 J	5.0 J	1.6 J	3.7 J	1.7 J
1,2,3,7,8-Pentachlorodibenzofuran (PeCDF)	pg/g	1.2 J	1.2 J	0.10 U	0.14 U	0.074 U	4.7 J	120	130	16 J	620	340
1,2,3,7,8-Pentachlorodibenzo-p-dioxin (PeCDD)	pg/g	0.14 U	0.15 U	0.15 J	0.16 J	0.16 J	2.1 J	14 J	16 J	2.8 J	76	48
2,3,4,6,7,8-Hexachlorodibenzofuran (HxCDF)	pg/g	0.63 U	0.44 U	0.014 U	0.085 U	0.085 U	1.1 U	9.2 J	8.6 U	1.5 U	40 J	23
2,3,4,7,8-Pentachlorodibenzofuran (PeCDF)	pg/g	1.2 J	0.68 U	0.096 U	0.096 U	0.096 U	4.5 J	100	110	12 J	530	280
2,3,7,8-Tetrachlorodibenzofuran (TCDF)	pg/g	1.4 J	9.3 J	1.2 J	1.1	0.11 U	180	5500	4500	360	21000	10000
2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	pg/g	0.095 U	2.1 U	0.44 J	1.0 J	0.050 J	47	1300	1300	110	7100 J	2700 J
Total heptachlorodibenzofuran (HpCDF)	pg/g	3.0 J	1.1 J	0.22 J	0.086 J	0.12 J	18 J	59 J	72 J	28 J	430 J	260 J
Total heptachlorodibenzo-p-dioxin (HpCDD)	pg/g	93 J	11 J	3.9 J	6.5 J	5.4 J	190 J	240 J	370 J	77 J	230 J	190 J
Total hexachlorodibenzofuran (HxCDF)	pg/g	3.3 J	3.2 J	0.12 J	0.20 J	0.23 J	20 J	200 J	210 J	42 J	1100 J	690 J
Total hexachlorodibenzo-p-dioxin (HxCDD)	pg/g	25 J	7.3 J	1.9 J	2.0 J	2.1 J	34 J	81 J	93 J	50 J	50 J	38 J
Total pentachlorodibenzofuran (PeCDF)	pg/g	2.8 J	3.0 J	0.24 J	0.23 J	0.36 J	19 J	350 J	370 J	50 J	1800 J	1200 J
Total pentachlorodibenzo-p-dioxin (PeCDD)	pg/g	3.0 J	2.4 J	0.41 J	0.34 J	0.86 J	9.7 J	21 J	46 J	13 J	96 J	56 J
Total tetrachlorodibenzofuran (TCDF)	pg/g	2.4 J	14 J	1.8 J	8.0 J	0.11 J	360 J	10000 J	10000 J	480 J	46000 J	34000 J
Total tetrachlorodibenzo-p-dioxin (TCDD)	pg/g	1.4 J	3.7 J	0.81 J	1.1 J	0.32 J	51 J	1400 J	1500 J	130 J	7900 J	7300 J
TEQ												
Total WHO Dioxin TEQ(Human/Mammal)(ND=0)	pg/g	0.97 J	1.2 J	0.73 J	1.3 J	0.24 J	71 J	1900 J	1800 J	160 J	9600 J	3900 J
Total WHO Dioxin TEQ(Human/Mammal)(ND=0.5)	pg/g	1.3 J	2.6 J	0.77 J	1.4 J	0.29 J	71 J	1900 J	1800 J	160 J	9600 J	3900 J

Notes:
U - Not detected at the associated reporting limit
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Final 100% Remedial Design - Northern Impoundment
San Jacinto River Waste Pits Site
Harris County, Texas

Sample Location: / Sample Identification: / Sample Date: / Sample Depth: / Parameters	Units	SJSB098 11215702-082021-BN-SJSB098(12-14) 08/20/2021 (12-14) ft bgs	SJSB098 11215702-082021-BN-SJSB098(14-16) 08/20/2021 (14-16) ft bgs	SJSB098 11215702-082021-BN-SJSB098(16-18) 08/20/2021 (16-18) ft bgs	SJSB099 11215702-072421-SS-SJSB099(0-2) 07/24/2021 (0-2) ft bgs	SJSB099 11215702-072421-SS-SJSB099(2-4) 07/24/2021 (2-4) ft bgs	SJSB099 11215702-072421-SS-SJSB099(4-6) 07/24/2021 (4-6) ft bgs	SJSB099 11215702-072421-SS-SJSB099(6-8) 07/24/2021 (6-8) ft bgs	SJSB099 11215702-072421-SS-SJSB099(8-10) 07/24/2021 (8-10) ft bgs	SJSB099 11215702-072421-SS-SJSB099(10-12) 07/24/2021 (10-12) ft bgs	SJSB099 11215702-072421-SS-SJSB099 (10-12)-R 07/25/2021 (10-12) ft bgs Lab Duplicate	SJSB099 11215702-072421-SS-SJSB099(12-14) 07/24/2021 (12-14) ft bgs
Dioxins/Furans												
1,2,3,4,6,7,8,9-Octachlorodibenzofuran (OCDF)	pg/g	9.8 J	0.39 U	0.22 U	1700	1300 J+	2.9 J	0.53 J	0.063 U	5.4 J	4.3 U	0.094 U
1,2,3,4,6,7,8,9-Octachlorodibenzo-p-dioxin (OCDD)	pg/g	610	610	19	11000	11000	160	110	120	440	360	220
1,2,3,4,6,7,8-Heptachlorodibenzofuran (HpCDF)	pg/g	19	0.38 U	0.14 U	2800	2100	3.1 J	0.45 J	0.61 J	6.5 J	6.1 J	0.057 U
1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin (HpCDD)	pg/g	36	37	1.2 J	670	640	6.3	3.4 J	4.8 J	28	22	12
1,2,3,4,7,8,9-Heptachlorodibenzofuran (HpCDF)	pg/g	6.5 J	0.20 U	0.057 U	790	620	1.0 J	0.055 U	0.20 J	2.5 J	2.5 J	0.055 U
1,2,3,4,7,8-Hexachlorodibenzofuran (HxCDF)	pg/g	61	1.3 J	0.051 U	6600	6000	11	1.2 J	1.6 J	21	22	0.021 U
1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin (HxCDD)	pg/g	0.83 J	0.60 J	0.044 U	6.3 J	8.2 J	0.30 J	0.32 J	0.058 U	0.52 J	0.73 U	0.31 J
1,2,3,6,7,8-Hexachlorodibenzofuran (HxCDF)	pg/g	15	0.43 J	0.064 U	1500	1700	2.9 J	0.31 J	0.43 J	5.8 J	4.9 J	0.022 U
1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin (HxCDD)	pg/g	1.3 J	1.1 J	0.088 U	49 J	41 J	0.41 J	0.069 U	0.068 U	1.1 J	0.91 J	0.51 J
1,2,3,7,8,9-Hexachlorodibenzofuran (HxCDF)	pg/g	0.051 U	0.15 U	0.082 U	84 J	100 J	0.071 U	0.028 U	0.049 U	0.52 J	0.51 J	0.30 J
1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin (HxCDD)	pg/g	2.3 J	2.2 J	0.099 U	12 J	8.3 J	0.067 U	0.23 J	0.058 U	1.8 J	1.7 U	0.82 J
1,2,3,7,8-Pentachlorodibenzofuran (PeCDF)	pg/g	48	0.93 J	0.11 U	4000	4300	9.4	1.0 J	1.2 J	13	12	0.26 J
1,2,3,7,8-Pentachlorodibenzo-p-dioxin (PeCDD)	pg/g	6.4 J	0.47 J	0.015 U	390	430	1.0 J	0.068 U	0.064 U	0.16 U	1.4 J	0.092 U
2,3,4,6,7,8-Hexachlorodibenzofuran (HxCDF)	pg/g	3.1 J	0.16 U	0.064 U	170	220	0.27 J	0.028 U	0.046 U	0.81 J	0.63 J	0.021 U
2,3,4,7,8-Pentachlorodibenzofuran (PeCDF)	pg/g	40	0.53 U	0.073 U	2500	2700	5.5 J	0.51 J	0.71 J	8.0	8.9	0.037 U
2,3,7,8-Tetrachlorodibenzofuran (TCDF)	pg/g	1600	20	0.44 J	160000 J	120000 J	290	27	34	390	480	2.8 U
2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	pg/g	490	6.8	0.10 U	35000 J	40000 J	94	10	11	130	150	1.3 J
Total heptachlorodibenzofuran (HpCDF)	pg/g	31 J	0.93 J	0.29 J	4500 J	3600 J	5.4 J	0.74 J	1.0 J	11 J	11 J	0.057 U
Total heptachlorodibenzo-p-dioxin (HpCDD)	pg/g	150 J	160 J	4.0 J	1500 J	1400 J	22 J	13 J	19 J	94 J	74 J	41 J
Total hexachlorodibenzofuran (HxCDF)	pg/g	87 J	2.2 J	0.31 J	9400 J	9100 J	16 J	1.5 J	2.0 J	32 J	31 J	0.30 J
Total hexachlorodibenzo-p-dioxin (HxCDD)	pg/g	54 J	48 J	1.6 J	190 J	180 J	4.5 J	2.9 J	3.9 J	28 J	21 J	13 J
Total pentachlorodibenzofuran (PeCDF)	pg/g	130 J	2.5 J	0.40 J	10000 J	11000 J	23 J	2.0 J	2.3 J	34 J	34 J	0.26 J
Total pentachlorodibenzo-p-dioxin (PeCDD)	pg/g	19 J	7.0 J	0.86 J	390 J	430 J	1.0 J	0.068 U	0.064 U	0.16 U	4.8 J	0.86 J
Total tetrachlorodibenzofuran (TCDF)	pg/g	3300 J	52 J	0.99 J	250000 J	280000 J	590 J	59 J	70 J	830 J	870 J	4.8 J
Total tetrachlorodibenzo-p-dioxin (TCDD)	pg/g	540 J	14 J	0.20 J	38000 J	43000 J	100 J	10 J	11 J	140 J	170 J	1.3 J
TEQ												
Total WHO Dioxin TEQ(Human/Mammal)(ND=0)	pg/g	680 J	10 J	0.062 J	53000 J	54000 J	130 J	13 J	15 J	180 J	210 J	1.7 J
Total WHO Dioxin TEQ(Human/Mammal)(ND=0.5)	pg/g	680 J	11 J	0.16 J	53000 J	54000 J	130 J	13 J	15 J	180 J	210 J	1.9 J

Notes:
- U - Not detected at the associated reporting limit
- J - Estimated concentration
- UJ - Not detected; associated reporting limit is estimated
- J- - Estimated concentration, result may be biased low
- J+ - Estimated concentration, result may be biased high
- TEQ - Toxicity Equivalent Quotient
- ft bgs - Feet below ground surface
- pg/g - picogram per grams

Table 2-4

Supplemental Design Investigation Analytical Results - Northern Impoundment
Final 100% Remedial Design - Northern Impoundment
San Jacinto River Waste Pits Site
Harris County, Texas

Sample Location: Sample Identification: Sample Date: Sample Depth: Parameters	Units	SJSB099 11215702-072421-SS-SJSB099(14-16) 07/24/2021 (14-16) ft bgs	SJSB099 11215702-072421-SS-SJSB099(16-18) 07/24/2021 (16-18) ft bgs	SJSB099 11215702-072421-DUP-6 07/24/2021 (16-18) ft bgs Field Duplicate	SJSB100 11215702-082321-BN-SJSB100(0-2) 08/23/2021 (0-2) ft bgs	SJSB100 11215702-082321-BN-SJSB100(2-4) 08/23/2021 (2-4) ft bgs	SJSB100 11215702-082321-BN-SJSB100(4-6) 08/23/2021 (4-6) ft bgs	SJSB100 11215702-082321-BN-SJSB100(6-8) 08/23/2021 (6-8) ft bgs	SJSB100 11215702-082321-BN-SJSB100(8-10) 08/23/2021 (8-10) ft bgs	SJSB100 11215702-082321-BN-SJSB100(10-12) 08/23/2021 (10-12) ft bgs	SJSB100 11215702-082321-BN-SJSB100(12-14) 08/23/2021 (12-14) ft bgs	SJSB100 11215702-082321-BN-SJSB100(14-16) 08/23/2021 (14-16) ft bgs
Dioxins/Furans												
1,2,3,4,6,7,8,9-Octachlorodibenzofuran (OCDF)	pg/g	1.0 J	0.59 J	1.1 J	170 J	2.9 J	4.2 U	0.82 U	2.2 U	0.16 U	0.092 U	0.16 U
1,2,3,4,6,7,8,9-Octachlorodibenzo-p-dioxin (OCDD)	pg/g	350	280	360	4600	380	220	340	200	52	15	49
1,2,3,4,6,7,8-Heptachlorodibenzofuran (HpCDF)	pg/g	0.90 J	0.50 J	0.90 J	23 J	0.83 J	1.3 U	1.6 U	0.61 U	0.22 U	0.14 U	0.24 U
1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin (HpCDD)	pg/g	17	13	17	170	18 J	15 J	25 J	8.8 J	2.8 J	1.1 J	2.9 J
1,2,3,4,7,8,9-Heptachlorodibenzofuran (HpCDF)	pg/g	0.24 J	0.15 J	0.058 U	5.1 J	0.50 J	0.63 U	0.036 U	0.61 U	0.12 U	0.052 U	0.073 U
1,2,3,4,7,8-Hexachlorodibenzofuran (HxCDF)	pg/g	2.5 J	0.76 J	1.4 J	15 J	0.82 J	1.7 U	1.7 U	1.4 U	0.26 U	0.14 U	0.29 U
1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin (HxCDD)	pg/g	0.11 U	0.14 U	0.48 J	5.0 J	0.67 J	0.84 U	0.051 U	0.48 U	0.28 J	0.18 J	0.14 J
1,2,3,6,7,8-Hexachlorodibenzofuran (HxCDF)	pg/g	0.55 J	0.30 J	0.54 J	7.9 J	0.63 J	0.41 U	1.3 U	0.48 U	0.28 J	0.22 U	0.17 U
1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin (HxCDD)	pg/g	0.12 U	0.15 U	0.50 J	6.3 J	0.69 J	1.2 J	1.3 J	0.76 J	0.23 J	0.17 J	0.18 J
1,2,3,7,8,9-Hexachlorodibenzofuran (HxCDF)	pg/g	0.050 U	0.032 U	0.045 U	5.0 J	0.44 J	1.2 U	0.055 U	0.43 U	0.13 U	0.11 U	0.098 U
1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin (HxCDD)	pg/g	1.3 J	0.72 J	1.3 J	8.6 J	1.3 J	2.2 J	0.052 U	1.3 J	0.43 J	0.21 U	0.21 U
1,2,3,7,8-Pentachlorodibenzofuran (PeCDF)	pg/g	1.8 J	0.47 J	1.1 J	12 J	1.2 J	1.5 J	0.082 U	0.15 U	0.31 U	0.22 U	0.28 U
1,2,3,7,8-Pentachlorodibenzo-p-dioxin (PeCDD)	pg/g	0.11 U	0.089 U	0.11 U	5.7 J	0.64 J	1.3 J	0.13 U	1.2 J	0.32 J	0.29 J	0.23 J
2,3,4,6,7,8-Hexachlorodibenzofuran (HxCDF)	pg/g	0.050 U	0.035 U	0.044 U	4.4 J	0.13 J	0.45 U	0.65 U	0.64 U	0.14 U	0.18 U	0.085 U
2,3,4,7,8-Pentachlorodibenzofuran (PeCDF)	pg/g	1.2 J	0.36 J	0.67 J	10 J	1.1 J	1.2 U	0.066 U	0.90 U	0.26 U	0.25 U	0.012 U
2,3,7,8-Tetrachlorodibenzofuran (TCDF)	pg/g	55	14	27	230	7.3 J	15	0.076 U	3.4 J	0.33 U	0.28 U	0.54 U
2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	pg/g	19	5.0	10	66	1.2 J	5.4 J	0.10 U	0.14 U	0.0048 U	0.13 J	0.13 J
Total heptachlorodibenzofuran (HpCDF)	pg/g	1.1 J	0.65 J	1.3 J	52 J	2.1 J	3.1 J	1.6 J	1.6 J	0.46 J	0.23 J	0.48 J
Total heptachlorodibenzo-p-dioxin (HpCDD)	pg/g	64 J	55 J	66 J	530 J	63 J	54 J	95 J	32 J	8.0 J	3.3 J	9.3 J
Total hexachlorodibenzofuran (HxCDF)	pg/g	3.1 J	1.1 J	1.9 J	50 J	2.3 J	5.1 J	4.3 J	3.1 J	0.80 J	0.70 J	0.91 J
Total hexachlorodibenzo-p-dioxin (HxCDD)	pg/g	18 J	16 J	21 J	120 J	18 J	22 J	28 J	11 J	3.3 J	1.7 J	2.1 J
Total pentachlorodibenzofuran (PeCDF)	pg/g	4.1 J	0.84 J	1.7 J	38 J	4.2 J	5.2 J	2.9 J	4.9 J	0.58 J	0.55 J	0.73 J
Total pentachlorodibenzo-p-dioxin (PeCDD)	pg/g	1.4 J	1.5 J	1.5 J	15 J	2.7 J	3.3 J	6.2 J	1.2 J	1.1 J	0.68 J	0.36 J
Total tetrachlorodibenzofuran (TCDF)	pg/g	100 J	23 J	48 J	420 J	9.6 J	24 J	2.8 J	6.2 J	0.33 J	0.28 J	1.8 J
Total tetrachlorodibenzo-p-dioxin (TCDD)	pg/g	19 J	5.0 J	10 J	78 J	3.7 J	9.5 J	1.5 J	0.85 J	0.66 J	0.30 J	0.36 J
TEQ												
Total WHO Dioxin TEQ(Human/Mammal)(ND=0)	pg/g	26 J	6.9 J	14 J	110 J	3.7 J	8.8 J	0.48 J	1.9 J	0.49 J	0.47 J	0.44 J
Total WHO Dioxin TEQ(Human/Mammal)(ND=0.5)	pg/g	26 J	7.0 J	14 J	110 J	3.7 J	9.2 J	0.81 J	2.3 J	0.58 J	0.57 J	0.51 J

Notes:
- U - Not detected at the associated reporting limit
- J - Estimated concentration
- UJ - Not detected; associated reporting limit is estimated
- J- - Estimated concentration, result may be biased low
- J+ - Estimated concentration, result may be biased high
- TEQ - Toxicity Equivalent Quotient
- ft bgs - Feet below ground surface
- pg/g - picogram per grams

Table 2-4

Supplemental Design Investigation Analytical Results - Northern Impoundment
Final 100% Remedial Design - Northern Impoundment
San Jacinto River Waste Pits Site
Harris County, Texas

Sample Location: Sample Identification: Sample Date: Sample Depth: Parameters	Units	SJSB101 11215702-072521-SS-SJSB101(0-2) 07/25/2021 (0-2) ft bgs	SJSB101-Waste 11215702-072521-SS-SJSB101(0-2)-WC 07/25/21 (0-2) ft bgs	SJSB101 11215702-072521-SS-SJSB101(2-4) 07/25/2021 (2-4) ft bgs	SJSB101-Waste 11215702-072521-SS-SJSB101(2-4)-WC 07/25/21 (2-4) ft bgs	SJSB101 11215702-072521-SS-SJSB101(4-6) 07/25/2021 (4-6) ft bgs	SJSB101 11215702-072521-SS-SJSB101(6-8) 07/25/2021 (6-8) ft bgs	SJSB101 11215702-072521-SS-SJSB101(8-10) 07/25/2021 (8-10) ft bgs	SJSB101 11215702-072521-SS-SJSB101(10-12) 07/25/2021 (10-12) ft bgs	SJSB101 11215702-072521-SS-SJSB101 (10-12)-R 07/25/2021 (10-12) ft bgs Lab Duplicate	SJSB101 11215702-072521-SS-SJSB101(12-14) 07/25/2021 (12-14) ft bgs	SJSB101 11215702-072521-SS-SJSB101(14-16) 07/25/2021 (14-16) ft bgs
Dioxins/Furans												
1,2,3,4,6,7,8,9-Octachlorodibenzofuran (OCDF)	pg/g	1700	1400	1400	1200	640	0.61 J	0.095 U	5.0 J	3.5 U	1.7 J	0.66 J
1,2,3,4,6,7,8,9-Octachlorodibenzo-p-dioxin (OCDD)	pg/g	10000	10000	9700	5800	4500	110	88	170	150	180	95
1,2,3,4,6,7,8-Heptachlorodibenzofuran (HpCDF)	pg/g	3100	2500	2300	2800	1100	0.72 J	0.20 J	7.5	6.6	0.94 J	0.24 J
1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin (HpCDD)	pg/g	540	670	610	470	280	3.9 J	3.2 J	7.0	7.1	11	5.1 J
1,2,3,4,7,8,9-Heptachlorodibenzofuran (HpCDF)	pg/g	1000	890	700	860	370	0.26 J	0.034 U	2.5 J	4.2 J	0.060 U	0.044 U
1,2,3,4,7,8-Hexachlorodibenzofuran (HxCDF)	pg/g	10000	8500	7300	10000	3400	2.3 J	0.56 J	26	36	0.72 J	0.029 U
1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin (HxCDD)	pg/g	6.1 J	4.5 J	7.5 J	7.1 J	2.4 J	0.24 J	0.20 J	0.073 U	0.33 U	0.13 U	0.085 U
1,2,3,6,7,8-Hexachlorodibenzofuran (HxCDF)	pg/g	2800	2200	1800	2600	1000	0.57 J	0.14 J	6.7	7.6	0.038 U	0.030 U
1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin (HxCDD)	pg/g	36 J	40 J	44 J	30 J	18 J	0.19 J	0.23 J	0.076 U	0.23 J	0.14 U	0.095 U
1,2,3,7,8,9-Hexachlorodibenzofuran (HxCDF)	pg/g	180	120	110 J	140 J	65 J	0.36 U	0.025 U	0.74 U	0.69 J	0.28 U	0.25 U
1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin (HxCDD)	pg/g	18 J	16 J	11 J	15 J	6.9 J	0.26 J	0.059 U	0.37 J	0.45 U	1.1 J	0.083 U
1,2,3,7,8-Pentachlorodibenzofuran (PeCDF)	pg/g	7000	5500	4700	5500	2200	1.7 J	0.31 J	18	11	0.045 U	0.035 U
1,2,3,7,8-Pentachlorodibenzo-p-dioxin (PeCDD)	pg/g	400 J	370	380	280	160	0.079 U	0.080 U	1.6 J	0.77 J	0.11 U	0.083 U
2,3,4,6,7,8-Hexachlorodibenzofuran (HxCDF)	pg/g	340	250	220	260	120	0.046 U	0.028 U	0.52 J	0.76 J	0.035 U	0.029 U
2,3,4,7,8-Pentachlorodibenzofuran (PeCDF)	pg/g	3400	2900	2700	2400	1300	0.83 J	0.051 U	11	6.0	0.045 U	0.038 U
2,3,7,8-Tetrachlorodibenzofuran (TCDF)	pg/g	160000 J	140000 J	150000 J	100000 J	62000 J	42	6.9	540 J	290 J	1.1 J	0.71 J
2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	pg/g	44000 J	35000 J	42000 J	34000 J	18000 J	13	1.8	170 J	92 J	0.11 U	0.077 U
Total heptachlorodibenzofuran (HpCDF)	pg/g	4900 J	4300 J	3800 J	4300 J	1900 J	1.3 J	0.20 J	13 J	14 J	0.94 J	0.24 J
Total heptachlorodibenzo-p-dioxin (HpCDD)	pg/g	1100 J	1400 J	1300 J	970 J	590 J	12 J	13 J	20 J	19 J	35 J	18 J
Total hexachlorodibenzofuran (HxCDF)	pg/g	15000 J	13000 J	11000 J	15000 J	5200 J	3.2 J	0.70 J	39 J	51 J	1.0 J	0.25 J
Total hexachlorodibenzo-p-dioxin (HxCDD)	pg/g	190 J	190 J	190 J	150 J	82 J	3.2 J	3.1 J	5.5 J	7.2 J	12 J	5.5 J
Total pentachlorodibenzofuran (PeCDF)	pg/g	16000 J	14000 J	12000 J	12000 J	5300 J	3.7 J	0.31 J	40 J	27 J	0.17 U	0.038 U
Total pentachlorodibenzo-p-dioxin (PeCDD)	pg/g	400 J	370 J	380 J	280 J	160 J	0.079 U	0.080 U	1.6 J	2.4 J	1.2 J	0.083 U
Total tetrachlorodibenzofuran (TCDF)	pg/g	260000 J	230000 J	250000 J	170000 J	100000 J	72 J	9.6 J	1100 J	530 J	1.6 J	0.71 J
Total tetrachlorodibenzo-p-dioxin (TCDD)	pg/g	48000 J	38000 J	46000 J	37000 J	19000 J	13 J	1.8 J	190 J	100 J	1.0 J	0.15 U
TEQ												
Total WHO Dioxin TEQ(Human/Mammal)(ND=0)	pg/g	63000 J	52000 J	59000 J	47000 J	25000 J	18 J	2.7 J	230 J	130 J	0.47 J	0.15 J
Total WHO Dioxin TEQ(Human/Mammal)(ND=0.5)	pg/g	63000 J	52000 J	59000 J	47000 J	25000 J	18 J	2.7 J	230 J	130 J	0.62 J	0.27 J

Notes:
U - Not detected at the associated reporting limit
J - Estimated concentration
UJ - Not detected; associated reporting limit is estimated
J- - Estimated concentration, result may be biased low
J+ - Estimated concentration, result may be biased high
TEQ - Toxicity Equivalent Quotient
ft bgs - Feet below ground surface
pg/g - picogram per grams

Table 2-4

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Final 100% Remedial Design - Northern Impoundment
San Jacinto River Waste Pits Site
Harris County, Texas

Sample Location: / Sample Identification: / Sample Date: / Sample Depth: / Parameters	Units	SJSB101 11215702-072521-SS-SJSB101(16-18) 07/25/2021 (16-18) ft bgs	SJSB101 11215702-072521-SS-SJSB101(18-20) 07/25/2021 (18-20) ft bgs	SJSB102 11215702-081921-BN-SJSB102(0-2) 08/19/2021 (0-2) ft bgs	SJSB102 11215702-081921-BN-SJSB102(2-4) 08/19/2021 (2-4) ft bgs	SJSB102 11215702-081921-BN-SJSB102(4-6) 08/19/2021 (4-6) ft bgs	SJSB102 11215702-081921-BN-SJSB102(6-8) 08/19/2021 (6-8) ft bgs	SJSB102 11215702-081921-BN-SJSB102(8-10) 08/19/2021 (8-10) ft bgs	SJSB102 11215702-081921-BN-SJSB102(10-12) 08/19/2021 (10-12) ft bgs	SJSB102 11215702-081921-BN-SJSB102(12-14) 08/19/2021 (12-14) ft bgs	SJSB102 11215702-081921-BN-SJSB102 (12-14)-R 08/19/2021 (12-14) ft bgs Lab Duplicate	SJSB102 11215702-081921-BN-SJSB102(14-16) 08/19/2021 (14-16) ft bgs
Dioxins/Furans												
1,2,3,4,6,7,8,9-Octachlorodibenzofuran (OCDF)	pg/g	19	0.38 U	150 J	12 U	13 J	1.4 U	1.1 U	0.26 U	1.9 J	2.7 J	0.0043 U
1,2,3,4,6,7,8,9-Octachlorodibenzo-p-dioxin (OCDD)	pg/g	180	150	2900	160	710	580	590	890	590	620	800
1,2,3,4,6,7,8-Heptachlorodibenzofuran (HpCDF)	pg/g	1.2 J	0.15 U	120 J	3.0 U	12 J	0.63 U	0.34 U	0.13 U	1.0 J	5.9 J	0.11 U
1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin (HpCDD)	pg/g	9.3	7.3	180 J	14 J	34 J	49 J	27 J	39	25	28	35
1,2,3,4,7,8,9-Heptachlorodibenzofuran (HpCDF)	pg/g	0.088 U	0.074 U	15 J	1.1 U	3.9 J	0.044 U	0.22 U	0.0079 U	0.34 J	2.9 J	0.0058 U
1,2,3,4,7,8-Hexachlorodibenzofuran (HxCDF)	pg/g	1.3 J	0.38 J	120 J	1.1 U	28 J	3.1 U	2.0 U	0.24 U	3.3 J	45 J	0.093 U
1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin (HxCDD)	pg/g	0.097 U	0.26 J	7.0 J	0.099 U	1.4 U	0.90 U	0.091 U	0.58 J	0.43 J	0.37 U	0.44 J
1,2,3,6,7,8-Hexachlorodibenzofuran (HxCDF)	pg/g	0.052 U	0.18 U	37 J	0.23 U	8.1 J	0.87 U	0.041 U	0.21 U	0.88 J	10	0.0039 U
1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin (HxCDD)	pg/g	0.11 U	0.21 U	13 J	1.3 U	2.8 J	0.14 U	0.63 J	1.2 J	0.63 J	0.65 J	0.94 J
1,2,3,7,8,9-Hexachlorodibenzofuran (HxCDF)	pg/g	0.29 U	0.092 U	1.0 U	1.2 U	0.13 U	0.31 U	0.35 U	0.0084 U	0.0093 U	5.6 J	0.15 U
1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin (HxCDD)	pg/g	0.096 U	0.34 J	11 J	1.1 U	1.4 J	3.7 J	1.9 J	1.2 J	1.1 J	1.5 J	1.4 J
1,2,3,7,8-Pentachlorodibenzofuran (PeCDF)	pg/g	1.0 J	0.33 J	98 J	1.6 U	23 J	1.5 J	3.4 J	0.35 U	2.9 J	28 J	0.20 U
1,2,3,7,8-Pentachlorodibenzo-p-dioxin (PeCDD)	pg/g	0.16 U	0.19 U	20 J	1.0 U	3.8 J	1.4 J	0.31 U	0.50 J	0.43 J	0.39 J	0.15 J
2,3,4,6,7,8-Hexachlorodibenzofuran (HxCDF)	pg/g	0.049 U	0.074 U	13 J	0.80 U	2.2 U	0.038 U	0.037 U	0.22 U	0.24 U	2.5 J	0.0037 U
2,3,4,7,8-Pentachlorodibenzofuran (PeCDF)	pg/g	0.077 U	0.25 U	95 J	1.2 U	23 J	1.8 U	1.9 U	0.0070 U	2.3 J	9.5	0.096 U
2,3,7,8-Tetrachlorodibenzofuran (TCDF)	pg/g	24	6.6	3900	17	960	54	41	3.1	87	55	3.5
2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	pg/g	8.5	2.1	960	3.0 J	230	16	0.16 U	0.71 J	23	14	0.014 U
Total heptachlorodibenzofuran (HpCDF)	pg/g	3.0 J	0.38 J	220 J	10 J	20 J	0.63 J	0.56 J	0.20 J	1.9 J	11 J	0.18 J
Total heptachlorodibenzo-p-dioxin (HpCDD)	pg/g	34 J	29 J	450 J	25 J	91 J	100 J	82 J	120 J	84 J	86 J	110 J
Total hexachlorodibenzofuran (HxCDF)	pg/g	1.6 J	0.74 J	250 J	5.0 J	41 J	4.6 J	2.4 J	0.67 J	5.0 J	68 J	0.25 J
Total hexachlorodibenzo-p-dioxin (HxCDD)	pg/g	9.6 J	13 J	120 J	7.6 J	33 J	22 J	31 J	43 J	26 J	23 J	33 J
Total pentachlorodibenzofuran (PeCDF)	pg/g	1.0 J	19 J	380 J	4.5 J	66 J	3.9 J	5.8 J	0.72 J	7.8 J	53 J	0.47 J
Total pentachlorodibenzo-p-dioxin (PeCDD)	pg/g	0.16 U	4.2 J	30 J	2.1 J	11 J	4.7 J	4.0 J	8.3 J	5.1 J	3.7 J	6.9 J
Total tetrachlorodibenzofuran (TCDF)	pg/g	42 J	13 J	8900 J	20 J	2400 J	110 J	57 J	4.6 J	190 J	120 J	9.8 J
Total tetrachlorodibenzo-p-dioxin (TCDD)	pg/g	8.5 J	4.9 J	1100 J	3.8 J	270 J	17 J	0.16 U	6.9 J	27 J	18 J	4.1 J
TEQ												
Total WHO Dioxin TEQ(Human/Mammal)(ND=0)	pg/g	11 J	3.0 J	1400 J	4.9 J	340 J	24 J	4.9 J	2.5 J	34 J	31 J	1.4 J
Total WHO Dioxin TEQ(Human/Mammal)(ND=0.5)	pg/g	11 J	3.2 J	1400 J	5.9 J	340 J	24 J	5.6 J	2.5 J	34 J	31 J	1.4 J

Notes:
- U - Not detected at the associated reporting limit
- J - Estimated concentration
- UJ - Not detected; associated reporting limit is estimated
- J- - Estimated concentration, result may be biased low
- J+ - Estimated concentration, result may be biased high
- TEQ - Toxicity Equivalent Quotient
- ft bgs - Feet below ground surface
- pg/g - picogram per grams

Table 2-4

Supplemental Design Investigation Analytical Results - Northern Impoundment
Final 100% Remedial Design - Northern Impoundment
San Jacinto River Waste Pits Site
Harris County, Texas

Sample Location: Sample Identification: Sample Date: Sample Depth: Parameters	Units	SJSB102 11215702-081921-BN-SJSB102(16-18) 08/19/2021 (16-18) ft bgs	SJSB102 11215702-081921-BN-SJSB102 (16-18)-R 08/19/2021 (16-18) ft bgs Lab Duplicate	SJSB102 11215702-081921-BN-SJSB102(18-20) 08/19/2021 (18-20) ft bgs	SJSB102 11215702-081921-BN-SJSB102(20-22) 08/19/2021 (20-22) ft bgs	SJSB102 11215702-081921-BN-SJSB102(22-24) 08/19/2021 (22-24) ft bgs	SJSB103 11215702-082121-BN-SJSB103(0-2) 08/21/2021 (0-2) ft bgs	SJSB103 11215702-082121-BN-SJSB103(2-4) 08/21/2021 (2-4) ft bgs	SJSB103 11215702-082121-BN-SJSB103(4-6) 08/21/2021 (4-6) ft bgs	SJSB103 11215702-082121-BN-SJSB103(6-8) 08/21/2021 (6-8) ft bgs	SJSB103 11215702-082121-BN-SJSB103(8-10) 08/21/2021 (8-10) ft bgs	SJSB103 11215702-082121-BN-SJSB103(10-12) 08/21/2021 (10-12) ft bgs
Dioxins/Furans												
1,2,3,4,6,7,8,9-Octachlorodibenzofuran (OCDF)	pg/g	7.6 U	8.5 J	2.0 U	1.4 U	0.69 U	1.6 U	0.10 U	2.5 U	1.4 U	0.76 U	0.089 U
1,2,3,4,6,7,8,9-Octachlorodibenzo-p-dioxin (OCDD)	pg/g	900	760	810	790	730	35 U	35 U	220	14 J	8.4 U	28
1,2,3,4,6,7,8-Heptachlorodibenzofuran (HpCDF)	pg/g	3.5 U	3.7 J	1.4 U	0.51 U	0.93 U	0.67 U	1.3 U	1.1 U	0.88 U	0.55 U	0.064 U
1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin (HpCDD)	pg/g	40 J	38 J	52 J	40 J	40 J	2.6 U	0.14 U	11 J	2.1 U	1.9 U	1.0 J
1,2,3,4,7,8,9-Heptachlorodibenzofuran (HpCDF)	pg/g	1.7 U	0.70 U	1.3 U	0.57 U	0.69 U	0.057 U	0.39 U	0.60 U	0.62 U	0.53 U	0.047 U
1,2,3,4,7,8-Hexachlorodibenzofuran (HxCDF)	pg/g	10 J	5.6 J	2.9 U	1.2 U	0.87 U	0.29 U	0.81 U	1.7 U	1.3 U	1.3 U	0.063 U
1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin (HxCDD)	pg/g	1.1 U	0.64 U	2.6 U	3.3 U	1.5 U	0.062 U	0.46 U	0.40 U	0.82 U	1.0 U	0.043 J
1,2,3,6,7,8-Hexachlorodibenzofuran (HxCDF)	pg/g	3.0 U	2.4 J	1.4 U	0.68 U	0.48 U	0.38 U	0.83 U	0.91 U	1.5 U	1.2 U	0.051 U
1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin (HxCDD)	pg/g	1.7 U	0.76 U	4.1 U	3.9 U	2.7 U	0.27 U	0.14 U	1.0 J	0.62 J	1.4 J	0.055 U
1,2,3,7,8,9-Hexachlorodibenzofuran (HxCDF)	pg/g	1.6 U	0.22 U	2.6 U	1.2 U	0.57 U	0.47 U	0.13 U	0.62 U	0.72 U	1.3 U	0.083 U
1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin (HxCDD)	pg/g	2.6 J	1.2 J	5.1 U	2.7 U	3.2 U	0.55 U	0.14 U	1.0 J	0.86 J	1.7 J	0.12 U
1,2,3,7,8-Pentachlorodibenzofuran (PeCDF)	pg/g	7.9 J	4.5 J	1.6 U	1.9 U	1.4 U	0.36 J	0.18 U	1.2 J	2.8 J	2.6 J	0.074 U
1,2,3,7,8-Pentachlorodibenzo-p-dioxin (PeCDD)	pg/g	2.3 U	0.15 U	4.1 U	3.6 U	3.9 U	1.4 J	1.0 U	0.46 J	2.0 J	1.8 J	0.043 J
2,3,4,6,7,8-Hexachlorodibenzofuran (HxCDF)	pg/g	0.91 U	0.13 U	1.5 U	0.64 U	0.59 U	0.48 U	0.41 U	0.39 U	0.88 U	0.85 U	0.085 U
2,3,4,7,8-Pentachlorodibenzofuran (PeCDF)	pg/g	7.7 J	3.4 J	3.2 U	1.3 U	0.48 U	0.11 U	0.53 U	1.3 U	2.1 U	1.6 U	0.096 U
2,3,7,8-Tetrachlorodibenzofuran (TCDF)	pg/g	290 J	140 J	16	1.4 U	0.50 U	5.6 J	2.1 J	13	7.4 J	5.2 J	0.96 J
2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	pg/g	72 J	38 J	6.0 U	0.98 U	1.7 U	0.12 U	0.34 U	11	2.4 U	1.2 U	0.29 J
Total heptachlorodibenzofuran (HpCDF)	pg/g	7.7 J	5.6 J	2.6 J	1.1 J	1.6 J	1.6 J	2.7 J	2.3 J	2.1 J	1.4 J	0.12 J
Total heptachlorodibenzo-p-dioxin (HpCDD)	pg/g	120 J	120 J	130 J	95 J	100 J	5.5 J	4.3 J	42 J	4.3 J	4.0 J	4.0 J
Total hexachlorodibenzofuran (HxCDF)	pg/g	19 J	10 J	8.8 J	4.0 J	2.8 J	3.7 J	2.7 J	4.1 J	4.6 J	4.8 J	0.21 J
Total hexachlorodibenzo-p-dioxin (HxCDD)	pg/g	33 J	27 J	55 J	40 J	40 J	1.9 J	1.3 J	12 J	3.4 J	5.8 J	1.7 J
Total pentachlorodibenzofuran (PeCDF)	pg/g	26 J	13 J	6.5 J	7.8 J	4.5 J	4.0 J	6.0 J	2.8 J	5.5 J	5.0 J	0.26 J
Total pentachlorodibenzo-p-dioxin (PeCDD)	pg/g	9.6 J	4.1 J	15 J	10 J	15 J	1.4 J	4.1 J	5.5 J	3.4 J	3.9 J	0.61 J
Total tetrachlorodibenzofuran (TCDF)	pg/g	600 J	270 J	28 J	2.6 J	1.7 J	11 J	5.3 J	64 J	8.7 J	6.8 J	2.7 J
Total tetrachlorodibenzo-p-dioxin (TCDD)	pg/g	84 J	48 J	7.6 J	6.2 J	4.1 J	0.12 U	0.34 U	11 J	2.4 J	1.2 J	0.56 J
TEQ												
Total WHO Dioxin TEQ(Human/Mammal)(ND=0)	pg/g	110 J	55 J	2.4 J	0.64 J	0.62 J	1.0 J	0.21 J	13 J	3.0 J	2.7 J	0.45 J
Total WHO Dioxin TEQ(Human/Mammal)(ND=0.5)	pg/g	110 J	55 J	8.9 J	3.9 J	4.0 J	2.2 J	1.1 J	14 J	4.8 J	3.9 J	0.49 J

Notes:
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- TEQ - Toxicity Equivalent Quotient
- ft bgs - Feet below ground surface
- pg/g - picogram per grams

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Supplemental Design Investigation Analytical Results - Northern Impoundment
Final 100% Remedial Design - Northern Impoundment
San Jacinto River Waste Pits Site
Harris County, Texas

Sample Location: Sample Identification: Sample Date: Sample Depth: Parameters	Units	SJSB103 11215702-082121-BN-SJSB103(12-14) 08/21/2021 (12-14) ft bgs	SJSB104 11215702-072421-BN-SJSB104(0-2) 07/24/2021 (0-2) ft bgs	SJSB104 11215702-072421-BN-SJSB104(2-4) 07/24/2021 (2-4) ft bgs	SJSB104 11215702-072421-BN-SJSB104(4-6) 07/24/2021 (4-6) ft bgs	SJSB104 11215702-072421-BN-SJSB104(6-8) 07/24/2021 (6-8) ft bgs	SJSB104 11215702-072421-BN-SJSB104(8-10) 07/24/2021 (8-10) ft bgs	SJSB104 11215702-072421-BN-SJSB104(10-12) 07/24/2021 (10-12) ft bgs	SJSB104 11215702-072421-BN-SJSB104(12-14) 07/24/2021 (12-14) ft bgs	SJSB104 11215702-072421-BN-SJSB104(14-16) 07/24/2021 (14-16) ft bgs	SJSB104 11215702-072421-BN-SJSB104(16-18) 07/24/2021 (16-18) ft bgs	SJSB105 11215702-072321-BN-SJSB105(0-2) 07/23/2021 (0-2) ft bgs
Dioxins/Furans												
1,2,3,4,6,7,8,9-Octachlorodibenzofuran (OCDF)	pg/g	0.099 U	1.5 U	0.25 U	0.54 U	0.86 U	1.7 U	0.075 U	1.7 U	0.042 U	0.092 U	470
1,2,3,4,6,7,8,9-Octachlorodibenzo-p-dioxin (OCDD)	pg/g	49	1300	1100	710	1300	770	1400	430	80	130	3200
1,2,3,4,6,7,8-Heptachlorodibenzofuran (HpCDF)	pg/g	0.064 U	0.48 U	0.14 U	0.33 U	0.14 U	0.59 U	0.043 U	0.021 U	0.030 U	0.038 U	800
1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin (HpCDD)	pg/g	3.0 J	41	46	29	48	32	56	17	2.4 J	3.6 J	180
1,2,3,4,7,8,9-Heptachlorodibenzofuran (HpCDF)	pg/g	0.047 U	0.10 J	0.028 U	0.089 J	0.040 U	0.068 J	0.041 U	0.021 U	0.029 U	0.036 U	240
1,2,3,4,7,8-Hexachlorodibenzofuran (HxCDF)	pg/g	0.063 U	0.90 J	0.12 J	0.76 J	0.10 J	0.33 J	0.049 U	0.024 U	0.019 U	0.042 U	2500
1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin (HxCDD)	pg/g	0.13 J	0.56 U	0.66 U	0.45 U	0.58 U	0.59 U	0.33 U	0.11 U	0.060 U	0.058 U	3.0 J
1,2,3,6,7,8-Hexachlorodibenzofuran (HxCDF)	pg/g	0.041 U	0.30 J	0.080 J	0.25 J	0.049 J	0.087 J	0.051 U	0.026 U	0.021 U	0.046 U	710
1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin (HxCDD)	pg/g	0.21 J	0.84 J	0.87 J	0.66 J	0.81 J	0.73 J	0.37 U	0.12 U	0.076 U	0.065 U	11
1,2,3,7,8,9-Hexachlorodibenzofuran (HxCDF)	pg/g	0.083 U	0.22 U	0.35 U	0.27 U	0.29 U	0.28 U	0.36 U	0.026 U	0.27 U	0.35 U	40
1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin (HxCDD)	pg/g	0.24 U	1.7 J	2.4 J	1.4 J	2.2 J	2.1 J	3.6 J	0.11 U	0.062 U	0.056 U	6.7 J
1,2,3,7,8-Pentachlorodibenzofuran (PeCDF)	pg/g	0.088 U	0.91 J	0.30 J	0.75 J	0.26 J	0.24 J	0.074 U	0.046 U	0.046 U	0.056 U	2000
1,2,3,7,8-Pentachlorodibenzo-p-dioxin (PeCDD)	pg/g	0.25 J	0.31 J	0.23 J	0.22 J	0.20 J	0.21 J	0.21 U	0.082 U	0.068 U	0.083 U	240
2,3,4,6,7,8-Hexachlorodibenzofuran (HxCDF)	pg/g	0.085 U	0.047 J	0.032 J	0.055 J	0.017 U	0.019 U	0.049 U	0.025 U	0.020 U	0.045 U	80
2,3,4,7,8-Pentachlorodibenzofuran (PeCDF)	pg/g	0.096 U	0.54 J	0.12 J	0.43 J	0.095 J	0.034 U	0.074 U	0.049 U	0.046 U	0.055 U	1400
2,3,7,8-Tetrachlorodibenzofuran (TCDF)	pg/g	0.28 U	38	3.2	24	2.6	1.2 J	2.2	1.3	0.91 J	0.063 U	83000 J
2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	pg/g	0.075 J	9.9	1.0 J	7.0	0.91 J	0.38 J	0.11 U	0.051 U	0.081 U	0.071 U	27000 J
Total heptachlorodibenzofuran (HpCDF)	pg/g	0.11 J	0.78 J	0.11 J	0.57 J	0.12 J	0.77 J	0.13 U	0.20 U	0.030 U	0.038 U	1200 J
Total heptachlorodibenzo-p-dioxin (HpCDD)	pg/g	8.5 J	140 J	160 J	110 J	160 J	100 J	160 J	46 J	8.5 J	12 J	420 J
Total hexachlorodibenzofuran (HxCDF)	pg/g	0.28 J	1.5 J	0.59 J	1.3 J	0.44 J	0.78 J	0.36 J	0.051 U	0.27 J	0.35 J	3700 J
Total hexachlorodibenzo-p-dioxin (HxCDD)	pg/g	2.7 J	28 J	43 J	26 J	40 J	30 J	47 J	8.7 J	3.2 J	1.1 J	110 J
Total pentachlorodibenzofuran (PeCDF)	pg/g	0.36 J	2.1 J	0.54 J	1.7 J	0.47 J	0.36 J	0.11 U	0.13 U	0.083 U	0.056 U	5400 J
Total pentachlorodibenzo-p-dioxin (PeCDD)	pg/g	0.39 J	5.2 J	9.8 J	5.4 J	8.0 J	6.9 J	4.5 U	1.1 U	0.92 U	0.35 U	260 J
Total tetrachlorodibenzofuran (TCDF)	pg/g	0.43 J	68 J	5.9 J	43 J	5.1 J	2.6 J	2.4 J	1.7 J	0.91 J	0.18 U	160000 J
Total tetrachlorodibenzo-p-dioxin (TCDD)	pg/g	0.39 J	14 J	7.2 J	10 J	5.5 J	5.1 J	1.3 U	0.60 U	2.1 J	0.22 U	30000 J
TEQ												
Total WHO Dioxin TEQ(Human/Mammal)(ND=0)	pg/g	0.40 J	15 J	2.7 J	11 J	2.6 J	1.6 J	1.7 J	0.43	0.14 J	0.075 J	36000 J
Total WHO Dioxin TEQ(Human/Mammal)(ND=0.5)	pg/g	0.46 J	15 J	2.8 J	11 J	2.6 J	1.7 J	1.8 J	0.53	0.25 J	0.20 J	36000 J

Notes:
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San Jacinto River Waste Pits Site
Harris County, Texas

Sample Location: Sample Identification: Sample Date: Sample Depth: Parameters	Units	SJSB105 11215702-072321-BN-SJSB105(2-4) 07/23/2021 (2-4) ft bgs	SJSB105 11215702-072321-BN-SJSB105(4-6) 07/23/2021 (4-6) ft bgs	SJSB105 11215702-072321-BN-SJSB105(6-8) 07/23/2021 (6-8) ft bgs	SJSB105 11215702-072321-BN-SJSB105(8-10) 07/23/2021 (8-10) ft bgs	SJSB105 11215702-072321-BN-SJSB105(10-12) 07/23/2021 (10-12) ft bgs	SJSB105 11215702-072321-BN-SJSB105(12-14) 07/23/2021 (12-14) ft bgs	SJSB105 11215702-072321-BN-SJSB105 (12-14)-R 07/23/2021 (12-14) ft bgs Lab Duplicate	SJSB105 11215702-072321-BN-SJSB105(14-16) 07/23/2021 (14-16) ft bgs	SJSB105 11215702-072321-BN-SJSB105 (14-16)-R 07/23/2021 (14-16) ft bgs Lab Duplicate	SJSB105 11215702-072321-BN-SJSB105(16-18) 07/23/2021 (16-18) ft bgs	SJSB106 11215702-080821-BN-SJSB106(0-2) 08/08/2021 (0-2) ft bgs
Dioxins/Furans												
1,2,3,4,6,7,8,9-Octachlorodibenzofuran (OCDF)	pg/g	480	3.9 J	0.47 U	0.49 U	0.39 U	4.3 J	13 J	2.9 J	0.87 U	0.32 U	31
1,2,3,4,6,7,8,9-Octachlorodibenzo-p-dioxin (OCDD)	pg/g	1600	1500	1800	1600	1100	1600	1300	1400	1600	1400	4400
1,2,3,4,6,7,8-Heptachlorodibenzofuran (HpCDF)	pg/g	1200	5.0 J	0.52 U	0.15 U	0.32 U	7.0 J	25 J	1.3 J	1.1 U	0.20 U	4.7 U
1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin (HpCDD)	pg/g	110	49	68	64	37	64	49	57	70	57	130
1,2,3,4,7,8,9-Heptachlorodibenzofuran (HpCDF)	pg/g	440	1.6 J	0.18 U	0.080 U	0.062 U	2.1 J	9.0	0.68 U	0.41 U	0.049 U	0.78 J
1,2,3,4,7,8-Hexachlorodibenzofuran (HxCDF)	pg/g	4200	17	1.8 J	0.55 J	1.0 J	24 J	98 J	3.3 J	3.6 J	0.38 J	2.2 J
1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin (HxCDD)	pg/g	3.4 J	0.54 U	0.50 U	0.92 U	0.63 U	0.58 U	0.77 U	0.62 U	1.1 U	0.76 U	2.5 J
1,2,3,6,7,8-Hexachlorodibenzofuran (HxCDF)	pg/g	1100	5.2 J	0.53 J	0.22 U	0.29 J	6.8 J	22	1.0 J	0.96 J	0.14 U	1.1 J
1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin (HxCDD)	pg/g	8.4 J	0.90 J	1.9 J	1.4 J	0.89 J	1.2 J	1.4 J	1.2 J	1.8 J	1.3 J	3.0 J
1,2,3,7,8,9-Hexachlorodibenzofuran (HxCDF)	pg/g	54 J	0.38 U	0.053 U	0.046 U	0.040 U	0.41 U	1.4 J	0.21 U	0.22 U	0.11 U	0.18 U
1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin (HxCDD)	pg/g	5.1 J	2.1 J	3.2 J	3.1 J	1.8 J	2.8 J	2.0 J	2.6 J	3.1 J	3.6 J	6.4 J
1,2,3,7,8-Pentachlorodibenzofuran (PeCDF)	pg/g	2600	12	1.2 J	0.44 J	0.86 J	18 J	68 J	2.9 J	2.6 J	0.39 J	2.0 J
1,2,3,7,8-Pentachlorodibenzo-p-dioxin (PeCDD)	pg/g	300	1.9 J	0.15 U	0.16 U	0.27 J	2.6 J	7.9	0.59 J	0.71 J	0.32 J	0.58 U
2,3,4,6,7,8-Hexachlorodibenzofuran (HxCDF)	pg/g	110	0.53 J	0.051 U	0.044 U	0.039 U	0.79 J	2.8 J	0.12 J	0.16 U	0.029 U	0.18 U
2,3,4,7,8-Pentachlorodibenzofuran (PeCDF)	pg/g	1900	9.2	1.0 J	0.39 J	0.54 J	13 J	58 J	2.1 J	2.3 J	0.18 J	1.1 J
2,3,7,8-Tetrachlorodibenzofuran (TCDF)	pg/g	130000 J	610 J	71	33	39	900 J	3700 J	160	150	14	71 J
2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	pg/g	33000 J	170	20	8.1	11	250 J	970 J	41	41	4.3	27 J
Total heptachlorodibenzofuran (HpCDF)	pg/g	1900 J	8.0 J	0.70 J	0.15 J	0.32 J	11 J	42 J	2.2 J	1.9 J	0.20 J	8.9 J
Total heptachlorodibenzo-p-dioxin (HpCDD)	pg/g	230 J	170 J	190 J	200 J	110 J	200 J	150 J	180 J	210 J	200 J	310 J
Total hexachlorodibenzofuran (HxCDF)	pg/g	6000 J	24 J	2.3 J	0.78 J	1.3 J	36 J	140 J	5.3 J	5.6 J	0.62 J	6.6 J
Total hexachlorodibenzo-p-dioxin (HxCDD)	pg/g	59 J	33 J	40 J	51 J	26 J	45 J	39 J	42 J	54 J	51 J	65 J
Total pentachlorodibenzofuran (PeCDF)	pg/g	6800 J	34 J	3.4 J	0.83 J	1.7 J	48 J	200 J	7.9 J	8.0 J	0.72 J	6.1 J
Total pentachlorodibenzo-p-dioxin (PeCDD)	pg/g	320 J	7.7 J	8.3 J	13 J	6.0 J	12 J	14 J	8.6 J	11 J	11 J	0.58 U
Total tetrachlorodibenzofuran (TCDF)	pg/g	210000 J	1100 J	120 J	57 J	70 J	1600 J	6300 J	290 J	280 J	27 J	110 J
Total tetrachlorodibenzo-p-dioxin (TCDD)	pg/g	37000 J	190 J	26 J	16 J	18 J	270 J	1100 J	50 J	51 J	11 J	27 J
TEQ												
Total WHO Dioxin TEQ(Human/Mammal)(ND=0)	pg/g	48000 J	240 J	29 J	13 J	17 J	350 J	1400 J	60 J	60 J	7.6 J	39 J
Total WHO Dioxin TEQ(Human/Mammal)(ND=0.5)	pg/g	48000 J	240 J	29 J	13 J	17 J	350 J	1400 J	60 J	60 J	7.7 J	39 J

Notes:
- U - Not detected at the associated reporting limit
- J - Estimated concentration
- UJ - Not detected; associated reporting limit is estimated
- J- - Estimated concentration, result may be biased low
- J+ - Estimated concentration, result may be biased high
- TEQ - Toxicity Equivalent Quotient
- ft bgs - Feet below ground surface
- pg/g - picogram per grams

Table 2-4

Supplemental Design Investigation Analytical Results - Northern Impoundment
Final 100% Remedial Design - Northern Impoundment
San Jacinto River Waste Pits Site
Harris County, Texas

Sample Location: Sample Identification: Sample Date: Sample Depth: Parameters	Units	SJSB106 11215702-080821-BN-SJSB106 (0-2)-R 08/08/2021 (0-2) ft bgs Lab Duplicate	SJSB106 11215702-080821-BN-SJSB106(2-4) 08/08/2021 (2-4) ft bgs	SJSB106 11215702-080821-BN-SJSB106(4-6) 08/08/2021 (4-6) ft bgs	SJSB106 11215702-080821-BN-SJSB106(6-8) 08/08/2021 (6-8) ft bgs	SJSB106 11215702-080821-BN-DUP-15 08/08/2021 (6-8) ft bgs Field Duplicate	SJSB106 11215702-080821-BN-SJSB106(8-10) 08/08/2021 (8-10) ft bgs	SJSB106 11215702-080821-BN-SJSB106(10-12) 08/08/2021 (10-12) ft bgs	SJSB106 11215702-080821-BN-SJSB106(12-14) 08/08/2021 (12-14) ft bgs	SJSB106 11215702-080821-BN-SJSB106(14-16) 08/08/2021 (14-16) ft bgs	SJSB106 11215702-080821-BN-SJSB106(16-18) 08/08/2021 (16-18) ft bgs
Dioxins/Furans											
1,2,3,4,6,7,8,9-Octachlorodibenzofuran (OCDF)	pg/g	5.6 U	0.69 J	3.1 J	0.65 J	0.078 U	0.65 J	0.77 J	0.61 J	0.80 J	0.80 J
1,2,3,4,6,7,8,9-Octachlorodibenzo-p-dioxin (OCDD)	pg/g	3600	950 J	2700	1400	810	1000	1900	1300	990	1100
1,2,3,4,6,7,8-Heptachlorodibenzofuran (HpCDF)	pg/g	1.2 U	0.39 U	1.0 U	0.37 U	0.084 U	0.47 U	0.45 U	0.37 U	0.51 U	0.37 U
1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin (HpCDD)	pg/g	100	36	73	58	35	47	85	61	46	53
1,2,3,4,7,8,9-Heptachlorodibenzofuran (HpCDF)	pg/g	0.093 U	0.12 U	0.26 J	0.076 U	0.076 U	0.092 U	0.13 U	0.097 U	0.11 U	0.095 U
1,2,3,4,7,8-Hexachlorodibenzofuran (HxCDF)	pg/g	0.67 U	0.42 J	0.92 J	0.037 U	0.030 U	0.065 U	0.046 U	0.058 U	0.078 U	0.057 U
1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin (HxCDD)	pg/g	1.5 U	0.79 J	0.77 J	0.94 J	0.25 U	0.68 J	0.75 J	1.0 J	0.38 U	0.87 J
1,2,3,6,7,8-Hexachlorodibenzofuran (HxCDF)	pg/g	0.27 U	0.069 U	0.46 J	0.037 U	0.029 U	0.063 U	0.047 U	0.054 U	0.078 U	0.057 U
1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin (HxCDD)	pg/g	1.8 J	1.0 J	1.5 J	1.3 J	0.27 U	1.4 J	2.1 J	1.9 J	0.44 U	1.4 J
1,2,3,7,8,9-Hexachlorodibenzofuran (HxCDF)	pg/g	0.12 U	0.27 J	0.21 J	0.036 U	0.024 U	0.056 U	0.044 U	0.055 U	0.071 U	0.15 J
1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin (HxCDD)	pg/g	3.6 J	2.7 J	3.1 J	3.3 J	2.8 J	3.3 J	5.2 J	3.8 J	3.9 J	3.8 J
1,2,3,7,8-Pentachlorodibenzofuran (PeCDF)	pg/g	0.50 J	0.69 J	0.13 U	0.072 U	0.053 U	0.37 J	0.076 U	0.076 U	0.10 U	0.093 U
1,2,3,7,8-Pentachlorodibenzo-p-dioxin (PeCDD)	pg/g	0.39 J	0.29 U	0.32 U	0.25 U	0.23 U	0.38 U	0.35 U	0.30 U	0.24 U	0.28 U
2,3,4,6,7,8-Hexachlorodibenzofuran (HxCDF)	pg/g	0.15 U	0.18 J	0.073 U	0.037 U	0.026 U	0.058 U	0.045 U	0.054 U	0.076 U	0.053 U
2,3,4,7,8-Pentachlorodibenzofuran (PeCDF)	pg/g	0.41 J	0.17 U	0.13 U	0.075 U	0.062 U	0.080 U	0.076 U	0.078 U	0.11 U	0.11 U
2,3,7,8-Tetrachlorodibenzofuran (TCDF)	pg/g	22 J	4.5	17	2.7	0.79 U	3.5	0.77 U	0.99 U	2.3 U	3.2
2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	pg/g	6.6 J	1.8	5.3	0.90 J	0.098 U	1.5 J	0.19 U	0.69 J	0.18 U	1.4 J
Total heptachlorodibenzofuran (HpCDF)	pg/g	2.0 J	0.39 J	1.3 J	0.57 J	0.084 U	0.47 J	0.45 J	0.27 J	0.51 J	0.28 J
Total heptachlorodibenzo-p-dioxin (HpCDD)	pg/g	240 J	100 J	190 J	190 J	110 J	130 J	240 J	180 J	140 J	160 J
Total hexachlorodibenzofuran (HxCDF)	pg/g	2.0 J	0.87 J	1.6 J	0.037 U	0.030 U	0.065 U	0.047 U	0.058 U	0.14 U	0.15 J
Total hexachlorodibenzo-p-dioxin (HxCDD)	pg/g	42 J	24 J	35 J	55 J	38 J	38 J	64 J	54 J	43 J	48 J
Total pentachlorodibenzofuran (PeCDF)	pg/g	2.7 J	3.8 J	0.51 U	0.075 U	0.062 U	0.75 J	0.076 U	0.078 U	0.11 U	0.14 U
Total pentachlorodibenzo-p-dioxin (PeCDD)	pg/g	8.0 J	0.29 U	0.32 U	0.25 U	0.23 U	0.38 U	0.35 U	0.30 U	0.24 U	0.28 U
Total tetrachlorodibenzofuran (TCDF)	pg/g	39 J	6.4 J	27 J	2.4 J	0.79 J	5.7 J	0.77 J	0.99 J	1.6 J	2.8 J
Total tetrachlorodibenzo-p-dioxin (TCDD)	pg/g	12 J	4.6 J	5.3 J	5.6 J	2.4 J	4.4 J	1.8 J	4.9 J	2.3 J	1.4 J
TEQ											
Total WHO Dioxin TEQ(Human/Mammal)(ND=0)	pg/g	12 J	3.4 J	9.2 J	2.7 J	0.87 J	3.2 J	2.2 J	2.4 J	1.2 J	3.2 J
Total WHO Dioxin TEQ(Human/Mammal)(ND=0.5)	pg/g	12 J	3.6 J	9.4 J	2.9 J	1.1 J	3.4 J	2.6 J	2.6 J	1.6 J	3.4 J

Notes:
- U - Not detected at the associated reporting limit
- J - Estimated concentration
- UJ - Not detected; associated reporting limit is estimated
- J- - Estimated concentration, result may be biased low
- J+ - Estimated concentration, result may be biased high
- TEQ - Toxicity Equivalent Quotient
- ft bgs - Feet below ground surface
- pg/g - picogram per grams

Table 2-5

Supplemental Design Investigation Waste Characterization Results
Final 100% Remedial Design - Northern Impoundment
San Jacinto River Waste Pits Site
Harris County, Texas

Sample Location: Sample Identification: Sample Date: Sample Depth: Sample Type:	Units	SJSB101-Waste 11215702-072521-SS-SJSB101(0-2)-WC 07/25/21 (0-2) ft bgs	SJSB101-Waste 11215702-072521-SS-SJSB101(2-4)-WC 07/25/21 (2-4) ft bgs	SJSB102-Waste 11215702-081921-BN-SJSB102(8-10)-WC 08/19/21 (8-10) ft bgs	SJSB102-Waste 11215702-081921-BN-SJSB102(10-12)-WC 08/19/21 (10-12) ft bgs	SJSB083-Waste 11215702-072221-BN-SJSB083(8-10)-WC 07/22/21 (8-10) ft bgs	SJSB083-Waste 11215702-072221-BN-SJSB083(10-12)-WC 07/22/21 (10-12) ft bgs
TCLP Herbicides							
2,4,5-TP (Silvex)	mg/L	0.0064 U	0.0064 U	0.0064 U	0.0064 U	0.0064 U	0.0064 U
2,4-Dichlorophenoxyacetic acid (2,4-D)	mg/L	0.020 U	0.020 U	0.020 U	0.020 U	0.020 U	0.020 U
TCLP Metals							
Arsenic	mg/L	0.041 U	0.041 U	0.041 U	0.041 U	0.041 U	0.041 U
Barium	mg/L	1.4 J	0.98 J	0.22 J	0.28 J	0.86 J	0.39 J
Cadmium	mg/L	0.0028 U	0.0028 U	0.0028 U	0.0028 U	0.0028 U	0.0028 U
Chromium	mg/L	0.019 U	0.019 U	0.019 U	0.019 U	0.019 U	0.019 U
Lead	mg/L	0.033 J	0.029 U	0.029 U	0.029 U	0.029 U	0.029 U
Mercury	mg/L	0.00013 U	0.00016 J	0.00013 U	0.00013 U	0.00013 U	0.00013 U
Selenium	mg/L	0.036 U	0.036 U	0.036 U	0.036 U	0.50 U	0.036 U
Silver	mg/L	0.0085 U	0.0085 U	0.0085 U	0.0085 U	0.0085 U	0.0085 U
Polychlorinated Biphenyls							
Aroclor-1016 (PCB-1016)	ug/kg	13 U	10 U	7.2 U	8.5 U	11 U	8.0 U
Aroclor-1221 (PCB-1221)	ug/kg	14 U	11 U	7.9 U	9.2 U	12 U	8.7 U
Aroclor-1232 (PCB-1232)	ug/kg	9.5 U	7.7 U	5.4 U	6.4 U	8.2 U	6.0 U
Aroclor-1242 (PCB-1242)	ug/kg	5.7 U	4.6 U	3.3 U	3.8 U	4.9 U	3.6 U
Aroclor-1248 (PCB-1248)	ug/kg	9.3 U	7.6 U	5.3 U	6.3 U	8.1 U	5.9 U
Aroclor-1254 (PCB-1254)	ug/kg	12 U	9.5 U	6.7 U	7.8 U	10 U	7.4 U
Aroclor-1260 (PCB-1260)	ug/kg	1500	1900	6.3 U	7.4 U	670	7.0 U
TCLP Pesticides							
Chlordane, technical	mg/L	0.0029 U	0.0029 U	0.0029 U	0.0029 U	0.0029 U	0.0029 U
Endrin	mg/L	0.000091 U	0.000091 U	0.000091 U	0.000091 U	0.000091 U	0.000091 U
gamma-BHC (lindane)	mg/L	0.00012 U	0.00012 U	0.00012 U	0.00012 U	0.00012 U	0.00012 U
Heptachlor	mg/L	0.00018 U	0.00018 U	0.00018 U	0.00018 U	0.00018 U	0.00018 U
Heptachlor epoxide	mg/L	0.00014 U	0.00014 U	0.00014 U	0.00014 U	0.00014 U	0.00014 U
Methoxychlor	mg/L	0.00031 U	0.00031 U	0.00031 U	0.00031 U	0.00031 U	0.00031 U
Toxaphene	mg/L	0.020 U	0.020 U	0.020 U	0.020 U	0.020 U	0.020 U
TCLP Semi-Volatile Organic Compounds (SVOCs)							
1,4-Dichlorobenzene	mg/L	0.0045 U	0.0045 U	0.0045 U	0.0045 U	0.0045 U	0.0045 U
2,4,5-Trichlorophenol	mg/L	0.0079 U	0.0079 U	0.0079 U	0.0079 U	0.0079 U	0.0079 U
2,4,6-Trichlorophenol	mg/L	0.0095 U	0.0095 U	0.0095 U	0.0095 U	0.0095 U	0.0095 U
2,4-Dinitrotoluene	mg/L	0.0079 U	0.0079 U	0.0079 U	0.0079 U	0.0079 U	0.0079 U
2-Methylphenol	mg/L	0.0040 U	0.0040 U	0.0040 U	0.0040 U	0.0040 U	0.0040 U
3&4-Methylphenol	mg/L	0.0079 U	0.0079 U	0.0079 U	0.0079 U	0.0079 U	0.0079 U
Hexachlorobenzene	mg/L	0.0055 U	0.0055 U	0.0055 U	0.0055 U	0.0055 U	0.0055 U
Hexachlorobutadiene	mg/L	0.0084 U	0.0084 U	0.0084 U	0.0084 U	0.0084 U	0.0084 U
Hexachloroethane	mg/L	0.0040 U	0.0040 U	0.0040 U	0.0040 U	0.0040 U	0.0040 U
Methylphenol (cresol)	mg/L	0.012 U	0.012 U	0.012 U	0.012 U	0.012 U	0.012 U
Nitrobenzene	mg/L	0.012 U	0.012 U	0.012 U	0.012 U	0.012 U	0.012 U
Pentachlorophenol	mg/L	0.0075 U	0.0075 U	0.0075 U	0.0075 U	0.0075 U	0.0075 U
Pyridine	mg/L	0.0082 U	0.0082 U	0.0082 U	0.0082 U	0.0082 U	0.0082 U
TCLP Volatile Organic Compounds (VOCs)							
1,1-Dichloroethene	mg/L	0.057 U	0.057 U	0.11 U	0.11 U	0.057 U	0.057 U
1,2-Dichloroethane	mg/L	0.029 U	0.029 U	0.058 U	0.058 U	0.029 U	0.029 U
1,4-Dichlorobenzene	mg/L	0.020 U	0.020 U	0.041 U	0.041 U	0.020 U	0.020 U
2-Butanone (Methyl ethyl ketone) (MEK)	mg/L	0.058 U	0.058 U	0.12 U	0.12 U	0.058 U	0.058 U
Benzene	mg/L	0.039 U	0.039 U	0.079 U	0.079 U	0.039 U	0.039 U
Carbon tetrachloride	mg/L	0.066 U	0.066 U	0.13 U	0.13 U	0.066 U	0.066 U
Chlorobenzene	mg/L	0.032 U	0.032 U	0.063 U	0.063 U	0.032 U	0.032 U
Chloroform (Trichloromethane)	mg/L	0.042 U	0.042 U	0.085 U	0.085 U	0.042 U	0.042 U
Tetrachloroethene	mg/L	0.040 U	0.040 U	0.080 U	0.080 U	0.040 U	0.040 U
Trichloroethene	mg/L	0.030 U	0.030 U	0.060 U	0.060 U	0.030 U	0.030 U
Vinyl chloride	mg/L	0.073 U	0.073 U	0.15 U	0.15 U	0.073 U	0.073 U
General Chemistry							
Cyanide (total)	mg/kg	0.51 U	0.50 U	0.29 U	0.36 U	0.48 U	0.37 U
Free liquid	none	0.10 CNF	0.10 CNF	0.10 CNF	0.10 CNF	0.10 CNF	0.10 CFL
Ignitability	Deg F	140	140	140	140	140	140
pH, lab	s.u.	9.5 J-	8.0 J-	8.8 J-	8.4 J-	8.6 J-	8.9 J-
Reactive cyanide	mg/kg	0.011 U	0.011 U	0.012 U	0.011 U	0.011 U	0.012 U
Reactive sulfide	mg/kg	1.2 U	1.2 U	1.3 U	1.2 U	1.2 U	25
Sulfide	mg/kg	15 U	17 U	8.2 U	9.1 U	13 U	11 U

Notes:
U - Not detected at the associated reporting limit
J - Estimated concentration
J- - Estimated concentration, result may be biased low
CNL - Contains Free Liquid
CNF - Contains No Free Liquid
TCLP - Toxicity Characteristic Leaching Procedure
mg/L - milligrams per liter
ug/kg - micrograms per kilogram
ft bgs - feet below ground surface
mg/kg - micrograms per kilogram
s.u. - standard units

Table 2-6

RI, PDI-1, PDI-2, and SDI Dioxins and Furans Results Summary - Northern Impoundment
Final 100% Remedial Design - Northern Impoundment
San Jacinto River Waste Pits Site
Harris County, Texas

ELEVATION	SJGB010	SJGB011	SJGB012	SJGB013	SJGB014	SJGB015	SJGB016	SJGB017	SJSB028	DUP (28 8-10)	SJSB029	SJSB030	SJSB031	DUP (31 0-2)	SJSB032	DUP (32 4-6)	SJSB033	SJSB034	SJSB035	DUP (35 12-14)	SJSB036	SJSB037	SJSB038
																		5.12 J	1.32 J				
													2.46 J	1.72 J									
									59.2 J			5.54 J						1.17 J	0.585 J				
+5													0.77 J				95.6 J						
+4									2.4 J		14.9 J	1.9 J						3.04 J	0.995				
+3													0.666 J		3,410 J		1,050						
+2	4,720 J	12,700 J	4,050 J						35.9 J		2.95 J	0.735 J						0.988 J	0.896 J				
+1													0.719 J		7,660 J		7,120 J				50,500 J		
0	26,900 J	22,200 J	25,100 J		31,600 J			1.95 J	12.3 J		2.12 J	2.81 J						0.98 J	0.64 J				
-1							3,520 J						0.726 J		3,170 J	1,740 J	5,740 J					40,400	
-2	6,350 J	9,430 J	24,400 J		210 J			1.46 J	7.13 J	21.2 J	1.48 J	0.44 J						0.812 J	0.801 J		276 J		
-3							75.3 J						0.97 J		6.19 J		1,700					0.873 J	
-4	194 J	14,800 J	17,700 J		531 J	1.22 J		0.909 J	3.35 J		1.35 J	0.82 J						0.592 J	1.26 J	0.471 J			
-5							0.464 J						0.333 J		85.8 J		157 J						
-6		8,710 J			213 J	0.640 J		0.853 J	2.59 J		2.45 J	0.453 J						1.5 J	0.962 J		519 J		
-7				5,100 J			2.33 J						0.653 J		26.5 J		24 J				19 J	618 J	
-8		3.37 J			18.6 J	1.48 J		0.177 J	2.39 J		1.36 J	0.592						0.897 J	0.516 J		189 J	2.59 J	96,700
-9				1,740 J			6.15 J						0.362 J		15.9 J		17.6 J					11.5 J	364 J
-10					1.29 J	1.51 J			1.19 J		0.769 J	0.982 J											152 J
-11				338 J											2.13 J		12.5 J						4.71 J
-12						0.850 J					9.13 J												
-13				104 J											12.7 J								
-14																							
-15				25.2 J																			
-16																							
-17																							
-18																							
-19																							
-20																							
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-33																							
-34																							
-35																							

Note:
J - Estimated concentration

Table 2-6

RI, PDI-1, PDI-2, and SDI Dioxins and Furans Results Summary - Northern Impoundment
Final 100% Remedial Design - Northern Impoundment
San Jacinto River Waste Pits Site
Harris County, Texas

ELEVATION	SJSB045	DUP (45 2-4)	DUP (45 6-8)	SJSB045-C1	SJSB046	DUP (46 12-14)	SJSB046-C1	DUP (46-C1 16-18)	SJSB047	SJSB047-C1	SJSB048	SJSB048-C1	SJSB049	SJSB050	DUP (50 2-4)	SJSB050-C1	DUP (50-C1 16-18)	SJSB051	DUP (51 16-18)	SJSB052	DUP (52 16-18)	SJSB052-C1	SJSB053
+5																							
+4																							
+3																							
+2																							
+1																							
0																							
-1				286 J																			
-2	10.3 J				636 J		1,550 J		1.19 J		1.7 J							3.02 J				9.22 J	
-3				190 J										7.41 J									
-4	3.42 J	5.26 J			2,660 J		3,350 J		1.35 J	7,470 J	1.02 J	623 J						4.98 J				1.2 J	
-5				286 J									23,600 J	3.05 J	3.13 J					2.07 J			
-6	5.58 J				8,610 J		2,820 J		1.53 J	6,310 J	1.72 J	55.1 J				2.27 J		2.48 J				0.493 J	
-7				46.8 J									6,640 J	1.33 J						1.94 J			
-8	2.16 J		4.88 J		28,500 J		11,700 J		2.73 J	139 J	2.46 J	592 J				1.97 J		2.64 J				1.47 J	
-9				54.6 J									2,350 J	1.48 J						1.99 J			1.79 J
-10	3.25 J				6,930 J		14,900 J		2.03 J	29.4 J	2.52 J	4.95 J				2.22 J		3.03 J				2.32 J	
-11				50.4 J									110 J	3.38 J						1.99 J			0.917 J
-12	0.717 J				111 J		55.1 J		1.41 J	769 J	1.77 J	323 J				3.1 J		1.71 J				1.39 J	
-13				3.79 J									251 J	2.71 J						2.01 J			1.44 J
-14	1.52 J				3,420 J	3,370 J	2,230 J		1.69 J	685 J	2.03 J	6.35 J				1.31 J		2.91 J				1.71 J	
-15				22.4 J									112 J	1.81 J						2.8 J			1.44 J
-16	2.36 J				1,710 J		205 J		1.98 J	821 J	1.66 J	147 J				1.54 J		2.35 J				1.79 J	
-17				5.81 J									117 J	1.77 J						2.24 J			1.28 J
-18	4.96 J				3,400 J		5,690 J	3,980 J	1.67 J	327 J	2.56 J	143 J				3.38 J		2.48 J	1.7 J			2.08 J	
-19													28.1 J	0.351 J						0.694 J			1.79 J
-20					4.82 J					7.35 J		219 J				2.88 J							
-21													5.87 J							12.1 J	10.1 J		0.22 J
-22												11.8 J				1.33 J	0.473 J						
-23																							3.33 J
-24												1.07 J											
-25																							0.35 J
-26																							
-27																							
-28																							
-29																							
-30																							
-31																							
-32																							
-33																							
-34																							
-35																							

Note:
J - Estimated concentration

Table 2-6

RI, PDI-1, PDI-2, and SDI Dioxins and Furans Results Summary - Northern Impoundment
Final 100% Remedial Design - Northern Impoundment
San Jacinto River Waste Pits Site
Harris County, Texas

ELEVATION	SJSB053-C1	SJSB054	SJSB055	SJSB055-C1	SJSB056	SJSB056-C1	DUP (56-C1 14-16)	SJSB057	SJSB058	SJSB070	SJSB071	SJSB072	SJSB072-R	SJSB073	SJSB074	DUP-5 (74 2-4)	SJSB075	SJSB076	SJSB076-R	SJSB077	DUP-3 (77 6-8)	SJSB077-R
+5																						
+4															7,800 J							
+3																	NA	3,000 J				
+2												NA		9.6 J	70,000 J	59,000 J				NA		
+1									12 J								NA	49,000 J				
0											34,700 J	NA		31,000 J	30,000 J					NA		
-1									36,100 J	43,900 J							55,000 J	63,000 J				
-2											45,900 J	NA		26,000 J	87 J					NA		
-3									48,400 J	68,600 J							NA	210 J				
-4			1.36 J			0.792 J					26.8 J	NA		68,000 J	5.1 J					63,000 J	61,000 J	
-5									324 J	45,600 J							NA	11 J				
-6			1.07 J			1.14 J					2.24 J	12 J		83,000 J	3.1 J					77,000 J		
-7	0.806 J	16,600 J							1,160 J	24,300 J							270 J	150 J	110 J			
-8			0.814 J			0.26 J					1.03 J	340 J		41 J	0.37 J					50 J		150 J
-9	0.855 J	1,550 J		34.3 J					376 J	16,700 J							0.88 J	21 J				
-10			1.28 J			0.597 J					1.48 J	1.3 J		5.2 J	2.6 J					24 J		23 J
-11	1.34 J	6.43 J		31.1 J					9,890 J	1,000 J							1.8 J	5.2 J				
-12			2.53 J		3.35 J	1.4 J					0.523 J	1.7 J		15 J	0.84 J					350 J		330 J
-13	1.4 J	5.94 J		1.34 J					136 J	609 J							6.7 J	3.7 J				
-14			0.89 J		1.65 J	1.33 J					44.6 J	34 J		5.6 J						0.21 J		
-15	0.936 J	17.6 J		0.697 J					788 J	6.9 J												
-16			1.09 J		0.803 J	0.596 J					45.4 J	0.52 J										
-17	1.76 J	5.28 J		1.07 J					0.524 J	4.69 J												
-18			1.42 J		0.782 J	0.593 J	0.624 J	24,200 J				74 J	120 J									
-19	1.15 J	369 J		1.16 J																		
-20			0.92 J		3.76 J	0.962 J		37,600 J				0.81 J										
-21	2.2 J	32.7 J		0.671 J																		
-22					0.928 J			3,540 J														
-23		6.52 J		1.12 J																		
-24					2.91 J			372 J														
-25				5.49 J																		
-26					4.44 J			7.6 J														
-27																						
-28					0.457 J			2.93 J														
-29																						
-30								15.9 J														
-31																						
-32								1.59 J														
-33																						
-34								1.5 J														
-35																						

Note:
J - Estimated concentration

Table 2-6

RI, PDI-1, PDI-2, and SDI Dioxins and Furans Results Summary - Northern Impoundment
Final 100% Remedial Design - Northern Impoundment
San Jacinto River Waste Pits Site
Harris County, Texas

ELEVATION	SJSB078	DUP-2 (78 14-16)	SJSB078-R	SJSB079	DUP-7 (79 8-10)	SJSB080	DUP-4 (80 16-18)	SJSB081	DUP-13 (81 6-8)	SJSB081-R	SJSB082	DUP-16 (82 6-8)	SJSB082-R	SJSB083	SJSB083 WC	SJSB084	SJSB085	SJSB085-R	SJSB086	DUP-12 (86 6-8)	SJSB087	DUP-17 (87 6-8)	SJSB087-R
+5																							
+4																							
+3																							
+2	33,000 J			32,000 J		23,000 J																	
+1																							
0	47,000 J			52,000 J		14,000 J																	
-1											15,000 J												
-2	86,000 J			28,000 J		9,200 J		2,300 J						46,000 J					5.0 J				
-3											670 J					12,000 J					4,600 J		
-4	32 J		140 J	50,000 J		3,200 J		47,000 J						2,200 J					2.3 J				
-5											2,000 J					3,200 J	42,000 J				25,000 J		
-6	64 J		100 J	45,000 J	50,000 J	1,500 J		47,000 J						9.8 J					1.3 J				
-7											7.7 J	5.4 J				45 J	720 J				2,300 J		
-8	91 J		110 J	190 J		12 J		5.3 J	2.1 J					14 J					1.2 J	1.1 J			
-9											120 J		42 J			23 J	27 J				10 J	2.4 J	
-10	16 J			3.1 J		1.5 J		19,000 J		11,000 J				15,000 J	4,400 J				2.2 J				
-11											4.1 J					6.1 J	44 J	7.4 J			570 J		
-12	7.3 J	12 J		16 J		0.44 J		280 J		200 J				200 J	47 J				2.3 J				
-13											1.1 J					7.8 J	25 J				3.5 J		
-14	120 J		140 J	0.64 J		13 J	3.0 J	2.8 J						24 J					3.2 J				
-15											3.7 J					6.1 J	4.3 J				110 J		110 J
-16	2.7 J							1.7 J						9.0 J					2.9 J				
-17											0.99 J					3.7 J	7.0 J				570 J		1,500 J
-18	260 J		200 J					0.87 J						0.72 J					1.6 J				
-19																3.9 J	11 J				3.0 J		
-20	0.42 J													4.8 J									
-21																	7.8 J						
-22																							
-23																							
-24																							
-25																							
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-32																							
-33																							
-34																							
-35																							

Note:
J - Estimated concentration

Table 2-6

RI, PDI-1, PDI-2, and SDI Dioxins and Furans Results Summary - Northern Impoundment
Final 100% Remedial Design - Northern Impoundment
San Jacinto River Waste Pits Site
Harris County, Texas

ELEVATION	SJSB088	DUP-14 (88 6-8)	SJSB088-R	SJSB089	SJSB089-R	DUP-19 (89 6-8)	SJSB089 (DUP-19)-R	SJSB090	DUP-11 (90 6-8)	SJSB090-R	SJSB091	DUP-18 (91 6-8)	SJSB092	SJSB093	SJSB094	SJSB094-R	DUP-8 (94 6-8)	SJSB094 (DUP-8)-R	SJSB095	DUP-10 (95 6-8)	SJSB095-R	SJSB096	DUP-9 (96 6-8)	SJSB096-R
+5																								
+4																								
+3																								
+2																								
+1																								
0																								
-1								62,000 J						41,000 J										
-2	39,000 J			820 J															35,000 J					
-3								6,600 J			16 J			42,000 J										
-4	43,000 J			53 J									43,000 J		36,000 J				59 J					
-5								930 J			6.7 J			640 J										
-6	50,000 J			18 J									28,000 J		39,000 J				1.0 J			87,000 J		
-7								6.4 J	2.9 J		5.2 J			0.68 J										
-8	54,000 J	63,000 J	71,000 J	2.5 J		3.5 J	3.1 J						130 J		41,000 J				2.3 J	9.7 J		22,000 J		
-9								260 J		560 J	2.5 J	2.7 J		1,900 J										
-10	51,000 J			52 J	43 J								4.8		15,000 J	17,000 J	830 J	990 J	1,200 J		980 J	310 J		
-11								5.3 J			2.1 J			1,500 J										
-12	5.3 J			34 J	19 J								27 J		5,500 J				57 J		11 J	4.9 J	4.2 J	
-13								9.1 J			2.4 J			430 J										
-14	0.68 J			2.0 J									26 J		32 J				6.0			2,800 J		8,500 J
-15								4.1 J			2.4 J			17 J										
-16	1.3 J			2.3 J									10,000 J		2.0 J				54 J		55 J	67 J		84 J
-17								2.3 J			2.2 J			4.4 J										
-18	520 J		1,800 J	0.40 J									11 J		3.2 J				0.60			5.2 J		
-19											2.7 J													
-20	2.5 J												7.2 J		1.9 J							1.9 J		
-21																								
-22	2.2 J																					13 J		
-23																								
-24	1.1 J																							
-25																								
-26																								
-27																								
-28																								
-29																								
-30																								
-31																								
-32																								
-33																								
-34																								
-35																								

Note:
J - Estimated concentration

Table 2-6

RI, PDI-1, PDI-2, and SDI Dioxins and Furans Results Summary - Northern Impoundment
Final 100% Remedial Design - Northern Impoundment
San Jacinto River Waste Pits Site
Harris County, Texas

ELEVATION	SJSB097	DUP-20 (97 6-8)	SJSB098	SJSB099	DUP-6 (99 16-18)	SJSB099-R	SJSB100	SJSB101	SJSB101 WC	SJSB101-R	SJSB102	SJSB102-R	SJSB103	SJSB104	SJSB105	SJSB105-R	SJSB0106	DUP-15 (106 6-8)	SJSB106-R
+5																			
+4																			
+3																			
+2																			
+1																			
0				53,000 J				63,000 J	52,000 J										
-1																			
-2				54,000 J				59,000 J	47,000 J		1,400 J								
-3																	39 J		12 J
-4				130 J				25,000 J			5.9 J				36,000 J				
-5														15 J			3.6 J		
-6				13 J				18 J			340 J				48,000 J				
-7														2.8 J			9.4 J		
-8				15 J				2.7 J			24 J				240 J				
-9														11 J			2.9 J	1.1 J	
-10				180 J		210 J		230 J		130 J	5.6 J				29 J				
-11														2.6 J			3.4 J		
-12				1.9 J				0.62 J			2.5 J				13 J				
-13							110 J							1.7 J			2.6 J		
-14			71 J	26 J				0.27 J			34 J	31 J			17 J				
-15	5.2 J						3.7 J						2.2 J	1.8 J			2.6 J		
-16			1,900 J	7.0 J	14 J			11 J			1.4 J				350 J	1,400 J			
-17	1.2 J						9.2 J						1.1 J	0.53			1.6 J		
-18			1,800 J					3.2 J			110 J	55 J			60 J	60 J			
-19	1.8 J						0.81 J						14 J	0.25 J			3.4 J		
-20			160 J								8.9 J				7.7 J				
-21	1.4 J	1.3 J					2.3 J						4.8 J	0.20 J					
-22			9,600 J								3.9 J								
-23	2.6 J						0.58 J						3.9 J						
-24			3,900 J								4.0 J								
-25	0.77 J						0.57 J						0.49 J						
-26			680 J																
-27	1.4 J						0.51 J						0.46 J						
-28			11 J																
-29	0.29 J																		
-30			0.16 J																
-31																			
-32																			
-33																			
-34																			
-35																			

Note:
J - Estimated concentration

Table 3-1

2019 Treatability Waste Material Characterization Results - Northern Impoundment
Final 100% Remedial Design - Northern Impoundment
San Jacinto River Waste Pits Site
Harris County, Texas

Area: Sample Location: Sample Identification: Sample Date: Report Sample Delivery Group (SDG):	Units	Initial Sample - Southwest Initial 11187072-NORTH-IMPCT-INITIALS 10/15/2019 180-97287-1, 180-97287-2	Composite Sample 2 - Northwest Area 2 11187072-N.TREATMENT AREA #2 12/18/2019 180-100205-1	Composite Sample 3 - Northeast Area 3 11187072-N.TREATMENT AREA #3 12/18/2019 180-100205-1	Composite Sample 4 - Southeast Area 4 11187072-N.TREATMENT AREA #4 12/18/2019 180-100205-1
General Chemistry					
Cyanide (total)	mg/kg	0.43 U	0.37 U	0.40 U	0.40 U
Free liquid	none	U	U	U	U
Ignitability	Deg F	> 140	> 140	> 140	> 140
Percent solids	%	--	71.4	67.4	66.7
pH, lab	s.u.	7.9 J	8.5 J	8.7 J	7.9 J
Sulfide	mg/kg	76 J	72	59	24 J
TCLP-Dioxins/Furans					
1,2,3,4,6,7,8,9-Octachlorodibenzofuran (OCDF)	pg/L	7.6 U	95 J	19 U	16 U
1,2,3,4,6,7,8,9-Octachlorodibenzo-p-dioxin (OCDD)	pg/L	34 U	77 J	11 U	9.9 U
1,2,3,4,6,7,8-Heptachlorodibenzofuran (HpCDF)	pg/L	5.3 U	9.0 U	8.5 U	8.3 U
1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin (HpCDD)	pg/L	3.4 U	23 J	7.5 U	5.9 U
1,2,3,4,7,8,9-Heptachlorodibenzofuran (HpCDF)	pg/L	6.2 U	31 J	12 U	11 U
1,2,3,4,7,8-Hexachlorodibenzofuran (HxCDF)	pg/L	2.9 U	15 U	12 U	10 U
1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin (HxCDD)	pg/L	4.5 U	20 J	8.7 U	6.9 U
1,2,3,6,7,8-Hexachlorodibenzofuran (HxCDF)	pg/L	3.1 U	13 U	11 U	11 U
1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin (HxCDD)	pg/L	4.7 U	7.9 U	9.2 U	7.5 U
1,2,3,7,8,9-Hexachlorodibenzofuran (HxCDF)	pg/L	2.2 U	15 J	7.3 U	7.1 U
1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin (HxCDD)	pg/L	4.3 U	6.7 U	7.9 U	6.3 U
1,2,3,7,8-Pentachlorodibenzofuran (PeCDF)	pg/L	4.6 U	10 U	8.4 U	8.3 U
1,2,3,7,8-Pentachlorodibenzo-p-dioxin (PeCDD)	pg/L	8.4 U	19 U	20 U	16 U
2,3,4,6,7,8-Hexachlorodibenzofuran (HxCDF)	pg/L	2.5 U	9.2 U	7.5 U	6.8 U
2,3,4,7,8-Pentachlorodibenzofuran (PeCDF)	pg/L	4.6 U	11 U	9.2 U	9.4 U
2,3,7,8-Tetrachlorodibenzofuran (TCDF)	pg/L	2.8 U	11 J	6.5 U	6.6 U
2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	pg/L	3.4 U	12 U	12 U	12 U
Total heptachlorodibenzofuran (HpCDF)	pg/L	6.2 U	31 J	12 U	11 U
Total heptachlorodibenzo-p-dioxin (HpCDD)	pg/L	10 U	23 J	7.5 U	5.9 U
Total hexachlorodibenzofuran (HxCDF)	pg/L	3.1 U	15 J	12 U	11 U
Total hexachlorodibenzo-p-dioxin (HxCDD)	pg/L	4.7 U	20 J	9.2 U	7.5 U
Total pentachlorodibenzofuran (PeCDF)	pg/L	4.6 U	11 U	9.2 U	9.4 U
Total pentachlorodibenzo-p-dioxin (PeCDD)	pg/L	8.4 U	19 U	20 U	16 U
Total tetrachlorodibenzofuran (TCDF)	pg/L	2.8 U	11 J	6.5 U	6.6 U
Total tetrachlorodibenzo-p-dioxin (TCDD)	pg/L	4.4 J	12 U	12 U	12 U
TCLP-Glycol					
2-Ethoxyethanol	mg/L	2.5 U	2.5 U	2.5 U	2.5 U
Ethylene glycol	mg/L	1.9 U	1.9 U	1.9 U	1.9 U
Ethylene glycol monomethyl ether (2-methyoxyethanol)	mg/L	2.4 U	2.4 U	2.4 U	2.4 U
TCLP-Herbicides					
2,4,5-TP (Silvex)	mg/L	0.0030 U	0.0030 U	0.0030 U	0.0030 U
2,4-Dichlorophenoxyacetic acid (2,4-D)	mg/L	0.020 U	0.020 U	0.020 U	0.020 U
Dinoseb	mg/L	0.038 U	0.038 U	0.038 U	0.038 U
TCLP-Metals					
Arsenic	mg/L	0.041 U	0.041 U	0.041 U	0.041 U
Barium	mg/L	1.1 J	0.53 J	0.44 J	0.48 J
Cadmium	mg/L	0.0028 U	0.0028 U	0.0028 U	0.0028 U
Chromium	mg/L	0.0078 U	0.0078 U	0.011 J	0.0078 U
Lead	mg/L	0.029 U	0.029 U	0.029 U	0.029 U
Mercury	mg/L	0.00010 U	0.00010 U	0.00010 U	0.00010 U
Selenium	mg/L	0.036 U	0.036 U	0.036 U	0.036 U
Silver	mg/L	0.0085 U	0.0085 U	0.0085 U	0.0085 U

Table 3-1

2019 Treatability Waste Material Characterization Results - Northern Impoundment
Final 100% Remedial Design - Northern Impoundment
San Jacinto River Waste Pits Site
Harris County, Texas

Area: Sample Location: Sample Identification: Sample Date: Report Sample Delivery Group (SDG):	Units	Initial Sample - Southwest Initial 11187072-NORTH-IMPCT-INITIALS 10/15/2019 180-97287-1, 180-97287-2	Composite Sample 2 - Northwest Area 2 11187072-N.TREATMENT AREA #2 12/18/2019 180-100205-1	Composite Sample 3 - Northeast Area 3 11187072-N.TREATMENT AREA #3 12/18/2019 180-100205-1	Composite Sample 4 - Southeast Area 4 11187072-N.TREATMENT AREA #4 12/18/2019 180-100205-1
Misc					
Methomyl	ug/L	0.12 U	0.13 U	0.12 U	0.13 U
TCLP-PCBs					
Aroclor-1016 (PCB-1016)	mg/L	0.00018 U	0.00019 U	0.00019 U	0.00019 U
Aroclor-1221 (PCB-1221)	mg/L	0.00022 U	0.00022 U	0.00023 U	0.00023 U
Aroclor-1232 (PCB-1232)	mg/L	0.00020 U	0.00020 U	0.00021 U	0.00021 U
Aroclor-1242 (PCB-1242)	mg/L	0.00035 U	0.00036 U	0.00036 U	0.00036 U
Aroclor-1248 (PCB-1248)	mg/L	0.00012 U	0.00012 U	0.00012 U	0.00012 U
Aroclor-1254 (PCB-1254)	mg/L	0.00037 U	0.00037 U	0.00038 U	0.00038 U
Aroclor-1260 (PCB-1260)	mg/L	0.00015 U	0.00015 U	0.00016 U	0.00016 U
TCLP-Pesticides					
4,4'-DDD	mg/L	0.00021 U	0.00021 U	0.00021 U	0.00021 U
4,4'-DDE	mg/L	0.00012 U	0.00012 U	0.00012 U	0.00012 U
4,4'-DDT	mg/L	0.00012 U	0.00012 U	0.00012 U	0.00012 U
alpha-Chlordane	mg/L	--	0.00015 U	0.00015 U	0.00015 U
Chlordane	mg/L	0.0029 U	0.0029 U	0.0029 U	0.0029 U
Dieldrin	mg/L	0.00011 U	0.00011 U	0.00011 U	0.00011 U
Endosulfan I	mg/L	0.00027 U	0.00027 U	0.00027 U	0.00027 U
Endosulfan II	mg/L	0.00013 U	0.00013 U	0.00013 U	0.00013 U
Endosulfan sulfate	mg/L	0.00026 U	0.00026 U	0.00026 U	0.00026 U
Endrin	mg/L	0.000091 U	0.000091 U	0.000091 U	0.000091 U
gamma-BHC (lindane)	mg/L	0.00012 U	0.00012 U	0.00012 U	0.00012 U
gamma-Chlordane	mg/L	--	0.00016 U	0.00016 U	0.00016 U
Heptachlor	mg/L	0.00018 U	0.00018 U	0.00018 U	0.00018 U
Heptachlor epoxide	mg/L	0.00014 U	0.00014 U	0.00014 U	0.00014 U
Methoxychlor	mg/L	0.00031 U	0.00031 U	0.00031 U	0.00031 U
Mirex	mg/L	0.000084 U	0.000084 U	0.000084 U	0.000084 U
Toxaphene	mg/L	0.020 U	0.020 U	0.020 U	0.020 U
TCLP-Semi-Volatile Organic Compounds (SVOCs)					
1,4-Dichlorobenzene	mg/L	0.0045 U	0.0045 U	0.0045 U	0.0045 U
2,4,5-Trichlorophenol	mg/L	0.0079 U	0.0079 U	0.0079 U	0.0079 U
2,4,6-Trichlorophenol	mg/L	0.0095 U	0.0095 U	0.0095 U	0.0095 U
2,4-Dinitrotoluene	mg/L	0.0079 U	0.0079 U	0.0079 U	0.0079 U
2-Methylphenol	mg/L	0.0040 U	0.0040 U	0.0040 U	0.0040 U
3&4-Methylphenol	mg/L	0.0079 U	0.0079 U	0.0079 U	0.0079 U
Hexachlorobenzene	mg/L	0.0055 U	0.0055 U	0.0055 U	0.0055 U
Hexachlorobutadiene	mg/L	0.0084 U	0.0084 U	0.0084 U	0.0084 U
Hexachloroethane	mg/L	0.0040 U	0.0040 U	0.0040 U	0.0040 U
Nitrobenzene	mg/L	0.012 U	0.012 U	0.012 U	0.012 U
Pentachlorophenol	mg/L	0.0075 U	0.0075 U	0.0075 U	0.0075 U
Pyridine	mg/L	0.0082 U	0.0082 U	0.0082 U	0.0082 U

Table 3-1

2019 Treatability Waste Material Characterization Results - Northern Impoundment
Final 100% Remedial Design - Northern Impoundment
San Jacinto River Waste Pits Site
Harris County, Texas

Area: Sample Location: Sample Identification: Sample Date: Report Sample Delivery Group (SDG):	Units	Initial Sample - Southwest Initial 11187072-NORTH-IMPCT-INITIALS 10/15/2019 180-97287-1, 180-97287-2	Composite Sample 2 - Northwest Area 2 11187072-N.TREATMENT AREA #2 12/18/2019 180-100205-1	Composite Sample 3 - Northeast Area 3 11187072-N.TREATMENT AREA #3 12/18/2019 180-100205-1	Composite Sample 4 - Southeast Area 4 11187072-N.TREATMENT AREA #4 12/18/2019 180-100205-1
TCLP-Volatile Organic Compounds (VOCs)					
1,1,1,2-Tetrachloroethane	mg/L	0.16 U	0.16 U	0.16 U	0.16 U
1,1,1-Trichloroethane	mg/L	0.10 U	0.10 U	0.10 U	0.10 U
1,1,2,2-Tetrachloroethane	mg/L	0.12 U	0.12 U	0.12 U	0.12 U
1,1,2-Trichloroethane	mg/L	0.096 U	0.096 U	0.096 U	0.096 U
1,1-Dichloroethene	mg/L	0.11 U	0.11 U	0.11 U	0.11 U
1,2,3-Trichloropropane	mg/L	0.11 U	0.11 U	0.11 U	0.11 U
1,2-Dibromoethane (Ethylene dibromide)	mg/L	0.11 U	0.11 U	0.11 U	0.11 U
1,2-Dichloroethane	mg/L	0.058 U	0.058 U	0.058 U	0.058 U
1,3-Dichloropropene	mg/L	0.13 U	0.13 U	0.13 U	0.13 U
1,4-Dichlorobenzene	mg/L	0.041 U	0.041 U	0.041 U	0.041 U
2-Butanone (Methyl ethyl ketone) (MEK)	mg/L	0.12 U	0.12 U	0.12 U	0.12 U
4-Methyl-2-pentanone (Methyl isobutyl ketone) (MIBK)	mg/L	0.074 U	0.074 U	0.074 U	0.074 U
Acetone	mg/L	0.13 U	0.13 U	0.13 U	0.13 U
Acetonitrile	mg/L	2.0 U	2.0 U	2.0 U	2.0 U
Acrylonitrile	mg/L	1.3 U	1.3 U	1.3 U	1.3 U
Benzene	mg/L	0.079 U	0.079 U	0.079 U	0.079 U
Bromodichloromethane	mg/L	0.094 U	0.094 U	0.094 U	0.094 U
Bromoform	mg/L	0.10 U	0.10 U	0.10 U	0.10 U
Bromomethane (Methyl bromide)	mg/L	0.18 U	0.18 U	0.18 U	0.18 U
Carbon disulfide	mg/L	0.12 U	0.12 U	0.12 U	0.12 U
Carbon tetrachloride	mg/L	0.13 U	0.13 U	0.13 U	0.13 U
Chlorobenzene	mg/L	0.063 U	0.063 U	0.063 U	0.063 U
Chloroform (Trichloromethane)	mg/L	0.085 U	0.085 U	0.085 U	0.085 U
Dichlorodifluoromethane (CFC-12)	mg/L	0.12 U	0.12 U	0.12 U	0.12 U
Ethylbenzene	mg/L	0.086 U	0.086 U	0.086 U	0.086 U
Hexachlorobutadiene	mg/L	0.073 U	0.073 U	0.073 U	0.073 U
Isobutanol (isobutyl alcohol)	mg/L	3.6 U	3.6 U	3.6 U	3.6 U
Methyl acrylonitrile	mg/L	1.6 U	1.6 U	1.6 U	1.6 U
Methylene chloride	mg/L	0.15 U	0.15 U	0.15 U	0.15 U
Styrene	mg/L	0.053 U	0.053 U	0.053 U	0.053 U
Tetrachloroethene	mg/L	0.080 U	0.080 U	0.080 U	0.080 U
Toluene	mg/L	0.067 U	0.067 U	0.067 U	0.067 U
trans-1,3-Dichloropropene	mg/L	0.069 U	0.069 U	0.069 U	0.069 U
Trichloroethene	mg/L	0.060 U	0.060 U	0.060 U	0.060 U
Trichlorofluoromethane (CFC-11)	mg/L	0.058 U	0.058 U	0.058 U	0.058 U
Vinyl chloride	mg/L	0.15 U	0.15 U	0.15 U	0.15 U
Xylenes (total)	mg/L	0.17 U	0.17 U	0.17 U	0.17 U

Notes:
TCLP - Toxicity Characteristic Leaching Procedure
mg/L - milligrams per Liter
ug/L - microgram per Liter
mg/kg - milligram per kilogram
Deg F - Degrees in Fahrenheit
s.u. - standard unit
U - Not detected at the associated reporting limit.
J - Estimated concentration.

-- Data not available

Table 3-2

2019 Pilot Test Effluent Characterization Results - Northern Impoundment
Final 100% Remedial Design - Northern Impoundment
San Jacinto River Waste Pits Site
Harris County, Texas

Area:	Units	Estimated Discharge Criteria [1,2]	Non-homogenized Contact Water	Excavation Seepage Water	Homogenized Contact Water - from tank feeding clarifier	Homogenized Contact Water - from tank feeding clarifier/filter	Equalized Contact Water - from tank feeding clarifier/filter	Clarified Effluent - from mix tank	Filter Effluent - from mix tank	Clarifier Underflow - composite	Settled Sludge - from bottom of cone bottom tank
Sample Location:			Contact-Initial	EXC-1	INF3	INF4	INF4	CEFF	FEFF	CUI	SS
Sample Identification:			11187072-CONTACT-INITIAL	11187072-091319-LL-EXC-1	INF 3	INF 4	DUP	1. CEFF, CEFF-Filtered	FEFF 1, FEFF-Filtered	CUI	SS
Sample Date:			9/24/2019	9/13/2019	10/25/2019	10/25/2019	10/25/2019	10/25/2019 , 11/5/2019	10/26/2019, 11/5/2019	10/26/2019	10/26/2019
Sample Type:							Duplicate				
Report Sample Delivery Group (SDG):			180-96144-1	600-191956-1, 600-191956-2	600-194690-1	600-194690-1	600-194690-1	600-194690-1, 320-56102-1	600-194690-1, 320-56102-1	600-194690-1	600-194690-1
Dioxins/Furans											
1,2,3,4,6,7,8,9-Octachlorodibenzofuran (OCDF)	pg/L	100	130	5.8 U	590	370 J-	--	6.4 U	5.5 U	--	--
1,2,3,4,6,7,8,9-Octachlorodibenzo-p-dioxin (OCDD)	pg/L	100	3300	90 J	15000 J+	8800 J	--	44 U	44 U	--	--
1,2,3,4,6,7,8-Heptachlorodibenzofuran (HpCDF)	pg/L	50	160	6.9 U	880 J-	600 J-	--	2.9 U	1.9 U	--	--
1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin (HpCDD)	pg/L	50	150	4.1 U	840	540 J-	--	4.9 J	6.7 J	--	--
1,2,3,4,7,8,9-Heptachlorodibenzofuran (HpCDF)	pg/L	50	58	1.8 U	320	240 J-	--	1.4 U	1.3 U	--	--
1,2,3,4,7,8-Hexachlorodibenzofuran (HxCDF)	pg/L	50	410	19 J	3100	2500 J-	--	3.9 J	1.6 J	--	--
1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin (HxCDD)	pg/L	50	2.8 U	0.82 U	11 U	4.9 U	--	2.6 U	0.83 U	--	--
1,2,3,6,7,8-Hexachlorodibenzofuran (HxCDF)	pg/L	50	110	5.6 J	790	650 J-	--	1.7 J	0.77 U	--	--
1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin (HxCDD)	pg/L	50	4.1 U	0.83 U	30 J	20 J-	--	1.6 J	0.79 U	--	--
1,2,3,7,8,9-Hexachlorodibenzofuran (HxCDF)	pg/L	50	4.2 U	0.68 U	53	40 J-	--	2.0 U	0.52 U	--	--
1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin (HxCDD)	pg/L	50	1.8 U	0.74 U	18 J-	8.5 J-	--	1.4 U	0.73 U	--	--
1,2,3,7,8-Pentachlorodibenzofuran (PeCDF)	pg/L	50	200	11 J	2100	1900	--	2.5 J	1.5 J	--	--
1,2,3,7,8-Pentachlorodibenzo-p-dioxin (PeCDD)	pg/L	50	18 U	1.1 U	160	130	--	0.94 U	0.99 U	--	--
2,3,4,6,7,8-Hexachlorodibenzofuran (HxCDF)	pg/L	50	12 U	0.73 U	93	73 J-	--	1.2 U	0.52 U	--	--
2,3,4,7,8-Pentachlorodibenzofuran (PeCDF)	pg/L	50	110	6.2 J	1200	1100	--	0.65 U	0.63 U	--	--
2,3,7,8-Tetrachlorodibenzofuran (TCDF)	pg/L	10	3900	220	50000	46000	--	37	7.1 J	--	--
2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	pg/L	10	1500	61	18000	15000	--	13	3.2 J	--	--
Total heptachlorodibenzofuran (HpCDF)	pg/L	NL	280 J	11 J	1600 J	1100 J	--	4.3 J	1.9 J	--	--
Total heptachlorodibenzo-p-dioxin (HpCDD)	pg/L	NL	370 J	10 J	2000 J	1300 J	--	8.2 J	13 J	--	--
Total hexachlorodibenzofuran (HxCDF)	pg/L	NL	620 J	25 J	4600 J	3800 J	--	8.8 J	1.6 J	--	--
Total hexachlorodibenzo-p-dioxin (HxCDD)	pg/L	NL	35 J	0.83 U	260 J	180 J	--	5.6 J	0.83 U	--	--
Total pentachlorodibenzofuran (PeCDF)	pg/L	NL	490 J	26 J	5000 J	4600 J	--	2.5 J	1.5 J	--	--
Total pentachlorodibenzo-p-dioxin (PeCDD)	pg/L	NL	20 J	1.1 U	190 J	160 J	--	0.94 U	0.99 U	--	--
Total tetrachlorodibenzofuran (TCDF)	pg/L	NL	8100 J	390 J	100000 J	100000 J	--	68 J	11 J	--	--
Total tetrachlorodibenzo-p-dioxin (TCDD)	pg/L	NL	1600 J	66 J	20000 J	16000 J	--	13 J	3.2 J	--	--
Dioxins/Furans (dissolved)											
1,2,3,4,6,7,8,9-Octachlorodibenzofuran (OCDF) (dissolved)	pg/L	100	--	2.1 U	170	11 U	--	13 J	22 J	--	--
1,2,3,4,6,7,8,9-Octachlorodibenzo-p-dioxin (OCDD) (dissolved)	pg/L	100	--	17 UJ	5400 J+	280 J+	--	21 U	29 U	--	--
1,2,3,4,6,7,8-Heptachlorodibenzofuran (HpCDF) (dissolved)	pg/L	50	--	3.6 J	240	12 J	--	2.5 J	6.0 J	--	--
1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin (HpCDD) (dissolved)	pg/L	50	--	1.1 U	250	27 J	--	2.4 J	6.4 J	--	--
1,2,3,4,7,8,9-Heptachlorodibenzofuran (HpCDF) (dissolved)	pg/L	50	--	2.8 J	88	4.9 U	--	1.1 U	4.9 J	--	--
1,2,3,4,7,8-Hexachlorodibenzofuran (HxCDF) (dissolved)	pg/L	50	--	7.6 J	750	31 J	--	0.91 U	3.1 J	--	--
1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin (HxCDD) (dissolved)	pg/L	50	--	1.2 U	4.6 U	3.1 U	--	2.9 J	4.9 J	--	--
1,2,3,6,7,8-Hexachlorodibenzofuran (HxCDF) (dissolved)	pg/L	50	--	2.7 J	190	9.8 J	--	0.89 U	3.5 J	--	--
1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin (HxCDD) (dissolved)	pg/L	50	--	1.2 U	6.7 J	2.1 J	--	1.1 U	4.4 J	--	--
1,2,3,7,8,9-Hexachlorodibenzofuran (HxCDF) (dissolved)	pg/L	50	--	2.0 U	14 J	4.8 U	--	1.9 J	3.8 J	--	--
1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin (HxCDD) (dissolved)	pg/L	50	--	1.1 U	5.7 J	1.7 U	--	0.97 U	4.8 J	--	--
1,2,3,7,8-Pentachlorodibenzofuran (PeCDF) (dissolved)	pg/L	50	--	3.4 U	450	20 J	--	1.2 U	3.2 J	--	--
1,2,3,7,8-Pentachlorodibenzo-p-dioxin (PeCDD) (dissolved)	pg/L	50	--	1.6 U	40 J	3.0 J	--	3.1 J	4.6 J	--	--
2,3,4,6,7,8-Hexachlorodibenzofuran (HxCDF) (dissolved)	pg/L	50	--	0.71 U	23 J	2.8 U	--	1.5 J	3.0 J	--	--
2,3,4,7,8-Pentachlorodibenzofuran (PeCDF) (dissolved)	pg/L	50	--	1.7 U	250	11 J	--	1.2 U	1.3 U	--	--
2,3,7,8-Tetrachlorodibenzofuran (TCDF) (dissolved)	pg/L	10	--	21	11000	540 J	--	2.7 J	1.1 U	--	--
2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD) (dissolved)	pg/L	10	--	7.1 J	3800	150 J	--	1.1 U	1.6 U	--	--
Total heptachlorodibenzofuran (HpCDF) (dissolved)	pg/L	NL	--	6.4 J	430 J	20 J	--	2.5 J	11 J	--	--
Total heptachlorodibenzo-p-dioxin (HpCDD) (dissolved)	pg/L	NL	--	1.1 U	630 J	51 J	--	2.4 J	6.4 J	--	--
Total hexachlorodibenzofuran (HxCDF) (dissolved)	pg/L	NL	--	12 J	1100 J	48 J	--	3.4 J	13 J	--	--
Total hexachlorodibenzo-p-dioxin (HxCDD) (dissolved)	pg/L	NL	--	1.2 U	74 J	6.9 J	--	2.9 J	14 J	--	--
Total pentachlorodibenzofuran (PeCDF) (dissolved)	pg/L	NL	--	3.4 J	1100 J	44 J	--	1.3 U	3.2 J	--	--
Total pentachlorodibenzo-p-dioxin (PeCDD) (dissolved)	pg/L	NL	--	1.6 U	51 J	3.0 J	--	4.4 J	4.6 J	--	--
Total tetrachlorodibenzofuran (TCDF) (dissolved)	pg/L	NL	--	39 J	21000 J	920 J	--	2.7 J	1.1 U	--	--
Total tetrachlorodibenzo-p-dioxin (TCDD) (dissolved)	pg/L	NL	--	7.1 J	4000 J	170 J	--	1.1 U	1.6 U	--	--
Herbicides											
2,4,5-TP (Silvex)	ug/L	NL	0.29 U	0.020 U	--	--	--	--	--	--	--
2,4-Dichlorophenoxyacetic acid (2,4-D)	ug/L	NL	1.9 U	0.040 U	--	--	--	--	--	--	--
Metals											
Aluminum	mg/L	NL	0.048 U	--	--	--	--	--	--	--	--
Antimony	mg/L	25.623	0.0098 U	0.0039 U	0.0039 U	0.0039 U	--	0.0039 U	0.0039 U	--	--
Arsenic	mg/L	0.164	0.012 U	0.089	0.026	0.023	--	0.0029 U	0.0029 U	--	--
Barium	mg/L	N/A	0.17	2.1	1.1	0.96	--	0.29	0.28	--	--
Beryllium	mg/L	NL	0.00037 J	0.00042 U	0.0074	0.0062	--	0.00042 U	0.00042 U	--	--
Boron	mg/L	NL	--	1.1	0.26	0.25	--	0.21	0.20	--	--
Cadmium	mg/L	0.0439	0.00050 U	0.00080 J	0.0028 J	0.0025 J	--	0.00040 J	0.00028 U	--	--
Calcium	mg/L	NL	35	250	130	120	--	55	53	--	--
Chromium	mg/L	0.389	0.0012 U	0.0017 J	0.12	0.11	--	0.0016 U	0.0016 U	--	--
Cobalt	mg/L	NL	0.0030 U	0.0066 J	0.051	0.043	--	0.00040 J	0.00031 U	--	--
Copper	mg/L	0.0167	0.011 U	0.0081 U	0.11	0.093	--	0.0081 U	0.0081 U	--	--
Iron	mg/L	NL	0.022 J	13	110	88	--	0.29 J	0.13 J	--	--
Lead	mg/L	0.107	0.0025 U	0.0022 U	0.12	0.098	--	0.0022 U	0.0022 U	--	--
Magnesium	mg/L	NL	22	250	58	54	--	33	31	--	--
Manganese	mg/L	NL	0.14	2.7	1.1	1.0	--	0.088	0.029	--	--
Mercury	mg/L	0.000598	0.00010 U	--	--	--	--	--	--	--	--
Mercury	ng/L	598	--	--	28 J	--	6.3 J	18 J	2.5 J	--	--
Mercury	ug/L	0.598	--	0.10 U	--	--	--	--	--	--	--
Molybdenum	mg/L	NL	0.0079 J	0.0068 J	0.0084 J	0.0090 J	--	0.010	0.010	--	--
Nickel	mg/L	0.103	0.0024 U	0.0036 J	0.095	0.081	--	0.0021 J	0.0020 J	--	--
Phosphorus	mg/L	NL	0.050 U	--	--	--	--	--	--	--	--
Potassium	mg/L	NL	12	27	25	23	--	12	12	--	--
Selenium	mg/L	0.619	0.013 U	0.0029 U	0.0029 U	0.0029 U	--	0.0029 U	0.0029 U	--	--
Silver	mg/L	0.00493	0.00084 U	0.0013 U	0.0013 U	0.0013 U	--	0.0013 U	0.0013 U	--	--
Sodium	mg/L	NL	250	2400	340	350	--	350	360	--	--
Strontium	mg/L	NL	0.31	2.5	0.84	0.79	--	0.48	0.46	--	--
Thallium	mg/L	0.5	0.0090 U	--	0.0042 U	0.0042 U	--	0.0042 U	0.026 U	--	--
Thallium	ug/L	500	--	0.14 U	--	--	--	--	--	--	--
Tin	mg/L	NL	--	0.00059 U	0.0048 J	0.0057 J	--	0.00059 U	0.00059 U	--	--
Titanium	mg/L	NL	--	0.0077 J	0.23	0.22	--	0.0011 J	0.00070 J	--	--
Vanadium	mg/L	NL	0.0019 U	0.00047 U	0.20	0.17	--	0.0036 J	0.0028 J	--	--
Zinc	mg/L	0.165	0.011 U	0.031	0.40	0.36	--	0.045	0.036	--	--

Table 3-2

2019 Pilot Test Effluent Characterization Results - Northern Impoundment
Final 100% Remedial Design - Northern Impoundment
San Jacinto River Waste Pits Site
Harris County, Texas

Area:	Units	Estimated Discharge Criteria [1,2]	Non-homogenized Contact Water	Excavation Seepage Water	Homogenized Contact Water - from tank feeding clarifier	Homogenized Contact Water - from tank feeding clarifier/filter	Equalized Contact Water - from tank feeding clarifier/filter	Clarified Effluent - from mix tank	Filter Effluent - from mix tank	Clarifier Underflow - composite	Settled Sludge - from bottom of cone bottom tank
Sample Location:			Contact-Initial	EXC-1	INF3	INF4	INF4	CEFF	FEFF	CUI	SS
Sample Identification:			11187072-CONTACT-INITIAL	11187072-091319-LL-EXC-1	INF 3	INF 4	DUP	1. CEFF, CEFF-Filtered	FEFF 1, FEFF-Filtered	CUI	SS
Sample Date:			9/24/2019	9/13/2019	10/25/2019	10/25/2019	10/25/2019	10/25/2019 , 11/5/2019	10/26/2019, 11/5/2019	10/26/2019	10/26/2019
Sample Type:							Duplicate				
Report Sample Delivery Group (SDG):			180-96144-1	600-191956-1, 600-191956-2	600-194690-1	600-194690-1	600-194690-1	600-194690-1, 320-56102-1	600-194690-1, 320-56102-1	600-194690-1	600-194690-1
Metals (dissolved)											
Aluminum (dissolved)	mg/L	NL	0.048 U	--	--	--	--	0.048 U	0.048 U	--	--
Antimony (dissolved)	mg/L	25.623	0.0098 U	0.0039 U	0.0039 U	0.0039 U	--	0.0098 U	0.0098 U	--	--
Arsenic (dissolved)	mg/L	0.164	0.012 U	0.037	0.014	0.0041 J	--	0.012 U	0.012 U	--	--
Barium (dissolved)	mg/L	N/A	0.18	1.9	0.55	0.30	--	0.30	0.32	--	--
Beryllium (dissolved)	mg/L	NL	0.00030 U	0.00042 U	0.0026 J	0.00042 U	--	0.00030 U	0.00030 U	--	--
Boron (dissolved)	mg/L	NL	--	1.1	0.22	0.20	--	--	--	--	--
Cadmium (dissolved)	mg/L	0.0439	0.00050 U	0.00080 J	0.0013 J	0.00040 J	--	0.00050 U	0.00050 U	--	--
Calcium (dissolved)	mg/L	NL	37	240	67	55	--	59	57	--	--
Chromium (dissolved)	mg/L	0.389	0.0012 U	0.0016 U	0.048	0.0039 J	--	0.0012 U	0.0012 U	--	--
Cobalt (dissolved)	mg/L	NL	0.0030 U	0.0064 J	0.017	0.0012 J	--	0.0030 U	0.0030 U	--	--
Copper (dissolved)	mg/L	0.0167	0.014	0.0081 U	0.036	0.0081 U	--	0.0072 J	0.0053 J	--	--
Iron (dissolved)	mg/L	NL	0.020 U	0.12 J	40	2.9	--	0.056 J	0.020 U	--	--
Lead (dissolved)	mg/L	0.107	0.0025 U	0.0022 U	0.037	0.0022 U	--	0.0025 U	0.0025 U	--	--
Magnesium (dissolved)	mg/L	NL	22	250	42	32	--	32	31	--	--
Manganese (dissolved)	mg/L	NL	0.15	2.6	0.34	0.035	--	0.064	0.028	--	--
Mercury (dissolved)	mg/L	0.000598	0.00037	--	--	--	--	--	--	--	--
Mercury (dissolved)	ng/L	598	--	--	--	22 J	--	1.7	1.7	--	--
Mercury (dissolved)	ug/L	0.598	--	0.10 U	--	--	--	--	--	--	--
Molybdenum (dissolved)	mg/L	NL	0.0076 J	0.011	0.0084 J	0.010	--	0.010 J	0.0096 J	--	--
Nickel (dissolved)	mg/L	0.103	0.0024 U	0.0050 J	0.033	0.0030 J	--	0.0024 U	0.0024 U	--	--
Phosphorus (dissolved)	mg/L	NL	0.066 J	--	--	--	--	0.050 U	0.050 U	--	--
Potassium (dissolved)	mg/L	NL	11	27	17	13	--	14	13	--	--
Selenium (dissolved)	mg/L	0.619	0.013 U	0.0029 U	0.0029 U	0.0029 U	--	0.013 U	0.013 U	--	--
Silver (dissolved)	mg/L	0.00493	0.00084 U	0.0013 U	0.0013 U	0.0013 U	--	0.00084 U	0.00084 U	--	--
Sodium (dissolved)	mg/L	NL	260	2400	340	350	--	330	330	--	--
Strontium (dissolved)	mg/L	NL	0.32	2.4	0.57	0.47	--	0.51	0.49	--	--
Thallium (dissolved)	mg/L	0.5	0.0090 U	--	0.0042 U	0.0042 U	--	0.0090 U	0.0090 U	--	--
Thallium (dissolved)	ug/L	500	--	0.14 J	--	--	--	--	--	--	--
Tin (dissolved)	mg/L	NL	--	0.0014 J	0.0012 J	0.00059 U	--	--	--	--	--
Titanium (dissolved)	mg/L	NL	--	0.0022 J	0.17	0.025	--	--	--	--	--
Vanadium (dissolved)	mg/L	NL	0.0019 U	0.00047 U	0.086	0.012	--	0.0038 J	0.0035 J	--	--
Zinc (dissolved)	mg/L	0.165	0.013 U	0.015 U	0.15	0.026 J	--	0.012	0.014	--	--
General Chemistry											
Alkalinity (as CaCO3 pH=4.5)	mg/L	NL	210	--	--	--	--	--	--	--	--
Alkalinity, bicarbonate	mg/L	NL	210	1000	190 J	170 J	--	160 J	140	--	--
Alkalinity, carbonate	mg/L	NL	5.0 U	20 U	20 UJ	20 UJ	--	20 UJ	20 U	--	--
Alkalinity, total (as CaCO3)	mg/L	NL	--	1000	190 J	170 J	--	160 J	140	--	--
Ammonia-N	mg/L	NL	2.7	7.1	0.073 J	0.23	--	0.067 U	0.067 U	--	--
Biochemical oxygen demand (BOD)	mg/L	NL	6.0 U	10 U	--	--	--	--	--	--	--
Bromide	mg/L	NL	1.5	9.9	0.12 J	0.15 J	--	0.20 J	0.30 J	--	--
Chemical oxygen demand (COD)	mg/L	NL	92	82	170	310	--	27	16	--	--
Chloride	mg/L	NL	400	4200	540	500	--	480	820	--	--
Cyanide (total)	mg/kg	NL	--	--	--	--	--	--	--	--	--
Cyanide (total)	ug/L	NL	--	3.1 U	--	--	--	--	--	--	--
Ferrous iron	mg/L	NL	--	0.016 UJ	--	--	--	--	--	--	--
Fluoride	mg/L	NL	--	--	1.2 U	0.26 J	--	0.34	0.060 UJ	--	--
Free liquid	none	NL	--	--	--	--	--	--	--	--	--
Hydrogen sulfide	mg/L	NL	--	0.048 U	--	--	--	--	--	--	--
Ignitability	Deg F	NL	--	--	--	--	--	--	--	--	--
Nitrate (as N)	mg/L	NL	--	0.025 U	R	R	--	R	R	--	--
Nitrite (as N)	mg/L	NL	--	0.030 U	R	R	--	R	R	--	--
Oil and grease (n-Hexane Extractable Material [HEM]), total	mg/L	NL	--	--	2.0 J	2.1 J	1.8 J	--	--	--	--
Oil and grease (Silica Gel Treated n-Hexane Extractable Material [SGT HEM]), non-polar material	mg/L	NL	--	--	1.0 U	1.0 U	1.0 U	--	--	--	--
Percent solids	%	NL	--	--	--	--	--	--	--	--	--
pH, lab	s.u.	NL	7.8 J	6.9 J	8.2 J	7.9 J	8.9 J	7.7 J	7.8 J	--	--
Phosphorus	mg/L	NL	--	0.031 J	1.1	0.25	--	0.066	0.095	--	--
Phosphorus, total (as PO4)	mg/L	NL	--	0.095 J	3.3	0.77	--	0.20	0.29	--	--
Sulfate	mg/L	NL	8.7	6.5	37	36	--	1.9 U	62	--	--
Sulfide	mg/kg	NL	--	--	--	--	--	--	--	--	--
Sulfide	mg/L	NL	--	0.045 U	0.57	0.061	0.19	0.0090 U	0.0090 U	--	--
TOC average duplicates	mg/L	NL	4.5	--	--	--	--	--	--	--	--
Total dissolved solids (TDS)	mg/L	NL	910	8800	980	1100	--	1300	1300	--	--
Total organic carbon (TOC)	mg/L	NL	--	24	17 J	9.2 J	--	5.0 J	4.3 J	--	--
Total suspended solids (TSS)	mg/L	NL	3400	240	3500	4600	--	11	2.2	16000	110000
PCBs											
Aroclor-1016 (PCB-1016)	ug/L	NL	0.18 U	0.56 U	--	--	--	--	--	--	--
Aroclor-1221 (PCB-1221)	ug/L	NL	0.22 U	0.46 U	--	--	--	--	--	--	--
Aroclor-1232 (PCB-1232)	ug/L	NL	0.20 U	0.13 U	--	--	--	--	--	--	--
Aroclor-1242 (PCB-1242)	ug/L	NL	0.34 U	0.17 U	--	--	--	--	--	--	--
Aroclor-1248 (PCB-1248)	ug/L	NL	0.11 U	0.21 U	--	--	--	--	--	--	--
Aroclor-1254 (PCB-1254)	ug/L	NL	0.36 U	0.15 U	--	--	--	--	--	--	--
Aroclor-1260 (PCB-1260)	ug/L	NL	0.15 U	0.35 U	--	--	--	--	--	--	--
PCBs (dissolved)											
Aroclor-1016 (PCB-1016) (dissolved)	ug/L	NL	--	0.64 U	--	--	--	--	--	--	--
Aroclor-1221 (PCB-1221) (dissolved)	ug/L	NL	--	0.52 U	--	--	--	--	--	--	--
Aroclor-1232 (PCB-1232) (dissolved)	ug/L	NL	--	0.14 U	--	--	--	--	--	--	--
Aroclor-1242 (PCB-1242) (dissolved)	ug/L	NL	--	0.19 U	--	--	--	--	--	--	--
Aroclor-1248 (PCB-1248) (dissolved)	ug/L	NL	--	0.24 U	--	--	--	--	--	--	--
Aroclor-1254 (PCB-1254) (dissolved)	ug/L	NL	--	0.17 U	--	--	--	--	--	--	--
Aroclor-1260 (PCB-1260) (dissolved)	ug/L	NL	--	0.40 U	--	--	--	--	--	--	--

Table 3-2

2019 Pilot Test Effluent Characterization Results - Northern Impoundment
Final 100% Remedial Design - Northern Impoundment
San Jacinto River Waste Pits Site
Harris County, Texas

Area:	Units	Estimated Discharge Criteria [1,2]	Non-homogenized Contact Water	Excavation Seepage Water	Homogenized Contact Water - from tank feeding clarifier	Homogenized Contact Water - from tank feeding clarifier/filter	Equalized Contact Water - from tank feeding clarifier/filter	Clarified Effluent - from mix tank	Filter Effluent - from mix tank	Clarifier Underflow - composite	Settled Sludge - from bottom of cone bottom tank
Sample Location:			Contact-Initial	EXC-1	INF3	INF4	INF4	CEFF	FEFF	CUI	SS
Sample Identification:			11187072-CONTACT-INITIAL	11187072-091319-LL-EXC-1	INF 3	INF 4	DUP	1. CEFF, CEFF-Filtered	FEFF 1, FEFF-Filtered	CUI	SS
Sample Date:			9/24/2019	9/13/2019	10/25/2019	10/25/2019	10/25/2019	10/25/2019 , 11/5/2019	10/26/2019, 11/5/2019	10/26/2019	10/26/2019
Sample Type:							Duplicate				
Report Sample Delivery Group (SDG):			180-96144-1	600-191956-1, 600-191956-2	600-194690-1	600-194690-1	600-194690-1	600-194690-1, 320-56102-1	600-194690-1, 320-56102-1	600-194690-1	600-194690-1
Pesticides											
alpha-Chlordane	ug/L	NL	--	0.10 U	--	--	--	--	--	--	--
Chlordane	ug/L	NL	0.27 U	0.13 U	--	--	--	--	--	--	--
Endrin	ug/L	NL	0.0086 U	0.015 U	--	--	--	--	--	--	--
gamma-BHC (lindane)	ug/L	NL	0.011 U	0.013 U	--	--	--	--	--	--	--
gamma-Chlordane	ug/L	NL	--	0.015 U	--	--	--	--	--	--	--
Heptachlor	ug/L	NL	0.017 U	0.013 U	--	--	--	--	--	--	--
Heptachlor epoxide	ug/L	NL	0.013 U	0.015 U	--	--	--	--	--	--	--
Hexachlorobenzene	ug/L	NL	0.016 U	--	--	--	--	--	--	--	--
Methoxychlor	ug/L	NL	0.029 U	0.019 U	--	--	--	--	--	--	--
Toxaphene	ug/L	NL	1.9 U	5.1 U	--	--	--	--	--	--	--
Semi-Volatile Organic Compounds (SVOCs)											
2,2'-Oxybis(1-chloropropane) (bis(2-Chloroisopropyl) ether)	ug/L	NL	0.56 U	--	--	--	--	--	--	--	--
2,4,5-Trichlorophenol	ug/L	NL	0.59 U	4.4 U	--	--	--	--	--	--	--
2,4,6-Trichlorophenol	ug/L	NL	0.65 UJ	3.5 U	--	--	--	--	--	--	--
2,4-Dichlorophenol	ug/L	NL	0.49 UJ	--	--	--	--	--	--	--	--
2,4-Dimethylphenol	ug/L	NL	0.39 UJ	--	--	--	--	--	--	--	--
2,4-Dinitrophenol	ug/L	NL	15 U	--	--	--	--	--	--	--	--
2,4-Dinitrotoluene	ug/L	NL	0.49 U	2.2 U	--	--	--	--	--	--	--
2,6-Dinitrotoluene	ug/L	NL	0.58 U	2.9 U	--	--	--	--	--	--	--
2-Chloronaphthalene	ug/L	NL	0.57 UJ	--	--	--	--	--	--	--	--
2-Chlorophenol	ug/L	NL	0.62 UJ	--	--	--	--	--	--	--	--
2-Methylnaphthalene	ug/L	NL	0.60 UJ	--	--	--	--	--	--	--	--
2-Methylphenol	ug/L	NL	2.9 UJ	1.5 U	--	--	--	--	--	--	--
2-Nitroaniline	ug/L	NL	5.3 U	--	--	--	--	--	--	--	--
2-Nitrophenol	ug/L	NL	0.59 U	--	--	--	--	--	--	--	--
3&4-Methylphenol	ug/L	NL	3.6 UJ	1.4 U	--	--	--	--	--	--	--
3,3'-Dichlorobenzidine	ug/L	NL	5.6 U	--	--	--	--	--	--	--	--
3-Nitroaniline	ug/L	NL	0.64 U	--	--	--	--	--	--	--	--
4,6-Dinitro-2-methylphenol	ug/L	NL	14 U	--	--	--	--	--	--	--	--
4-Bromophenyl phenyl ether	ug/L	NL	0.61 U	--	--	--	--	--	--	--	--
4-Chloro-3-methylphenol	ug/L	NL	0.59 U	--	--	--	--	--	--	--	--
4-Chloroaniline	ug/L	NL	0.42 UJ	--	--	--	--	--	--	--	--
4-Chlorophenyl phenyl ether	ug/L	NL	0.59 UJ	--	--	--	--	--	--	--	--
4-Nitroaniline	ug/L	NL	0.56 U	--	--	--	--	--	--	--	--
4-Nitrophenol	ug/L	NL	1.4 U	--	--	--	--	--	--	--	--
Acenaphthene	ug/L	NL	0.63 UJ	--	--	--	--	--	--	--	--
Acenaphthylene	ug/L	NL	0.63 UJ	--	--	--	--	--	--	--	--
Acetophenone	ug/L	NL	0.60 U	--	--	--	--	--	--	--	--
Anthracene	ug/L	NL	0.47 U	--	--	--	--	--	--	--	--
Atrazine	ug/L	NL	6.1 U	--	--	--	--	--	--	--	--
Benzaldehyde	ug/L	NL	1.1 U	--	--	--	--	--	--	--	--
Benzo(a)anthracene	ug/L	NL	0.72 U	--	--	--	--	--	--	--	--
Benzo(a)pyrene	ug/L	NL	0.51 U	--	--	--	--	--	--	--	--
Benzo(b)fluoranthene	ug/L	NL	0.93 U	--	--	--	--	--	--	--	--
Benzo(g,h,i)perylene	ug/L	NL	0.66 UJ	--	--	--	--	--	--	--	--
Benzo(k)fluoranthene	ug/L	NL	0.85 U	--	--	--	--	--	--	--	--
Biphenyl (1,1-Biphenyl)	ug/L	NL	0.57 UJ	--	--	--	--	--	--	--	--
bis(2-Chloroethoxy)methane	ug/L	NL	0.64 UJ	--	--	--	--	--	--	--	--
bis(2-Chloroethyl)ether	ug/L	NL	0.38 UJ	--	--	--	--	--	--	--	--
bis(2-Ethylhexyl)phthalate (DEHP)	ug/L	NL	60 U	--	--	--	--	--	--	--	--
Butyl benzylphthalate (BBP)	ug/L	NL	4.4 U	--	--	--	--	--	--	--	--
Caprolactam	ug/L	NL	4.5 U	--	--	--	--	--	--	--	--
Carbazole	ug/L	NL	0.49 U	--	--	--	--	--	--	--	--
Chrysene	ug/L	NL	0.78 U	--	--	--	--	--	--	--	--
Dibenz(a,h)anthracene	ug/L	NL	0.69 U	--	--	--	--	--	--	--	--
Dibenzofuran	ug/L	NL	0.70 UJ	--	--	--	--	--	--	--	--
Diethyl phthalate	ug/L	NL	5.5 U	--	--	--	--	--	--	--	--
Dimethyl phthalate	ug/L	NL	0.54 U	--	--	--	--	--	--	--	--
Di-n-butylphthalate (DBP)	ug/L	NL	7.1 U	--	--	--	--	--	--	--	--
Di-n-octyl phthalate (DnOP)	ug/L	NL	6.6 U	--	--	--	--	--	--	--	--
Fluoranthene	ug/L	NL	0.58 U	--	--	--	--	--	--	--	--
Fluorene	ug/L	NL	0.66 UJ	--	--	--	--	--	--	--	--
Hexachlorobenzene	ug/L	NL	0.54 U	3.4 U	--	--	--	--	--	--	--
Hexachlorobutadiene	ug/L	NL	0.66 UJ	2.7 U	--	--	--	--	--	--	--
Hexachlorocyclopentadiene	ug/L	NL	R	--	--	--	--	--	--	--	--
Hexachloroethane	ug/L	NL	0.60 UJ	3.4 U	--	--	--	--	--	--	--
Indeno(1,2,3-cd)pyrene	ug/L	NL	0.82 U	--	--	--	--	--	--	--	--
Isophorone	ug/L	NL	0.52 U	--	--	--	--	--	--	--	--
Naphthalene	ug/L	NL	0.57 UJ	--	--	--	--	--	--	--	--
Nitrobenzene	ug/L	NL	4.8 U	2.7 U	--	--	--	--	--	--	--
N-Nitrosodi-n-propylamine	ug/L	NL	0.68 U	--	--	--	--	--	--	--	--
N-Nitrosodiphenylamine	ug/L	NL	1.1 U	--	--	--	--	--	--	--	--
Pentachlorophenol	ug/L	NL	8.1 U	3.3 U	--	--	--	--	--	--	--
Phenanthrene	ug/L	NL	0.53 U	--	--	--	--	--	--	--	--
Phenol	ug/L	NL	4.7 UJ	--	--	--	--	--	--	--	--
Pyrene	ug/L	NL	0.52 U	--	--	--	--	--	--	--	--
Pyridine	ug/L	NL	5.2 UJ	2.3 U	--	--	--	--	--	--	--

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Area:	Units	Estimated Discharge Criteria [1,2]	Non-homogenized Contact Water	Excavation Seepage Water	Homogenized Contact Water - from tank feeding clarifier	Homogenized Contact Water - from tank feeding clarifier/filter	Equalized Contact Water - from tank feeding clarifier/filter	Clarified Effluent - from mix tank	Filter Effluent - from mix tank	Clarifier Underflow - composite	Settled Sludge - from bottom of cone bottom tank
Sample Location:			Contact-Initial	EXC-1	INF3	INF4	INF4	CEFF	FEFF	CUI	SS
Sample Identification:			11187072-CONTACT-INITIAL	11187072-091319-LL-EXC-1	INF 3	INF 4	DUP	1. CEFF, CEFF-Filtered	FEFF 1, FEFF-Filtered	CUI	SS
Sample Date:			9/24/2019	9/13/2019	10/25/2019	10/25/2019	10/25/2019	10/25/2019 , 11/5/2019	10/26/2019, 11/5/2019	10/26/2019	10/26/2019
Sample Type:							Duplicate				
Report Sample Delivery Group (SDG):			180-96144-1	600-191956-1, 600-191956-2	600-194690-1	600-194690-1	600-194690-1	600-194690-1, 320-56102-1	600-194690-1, 320-56102-1	600-194690-1	600-194690-1
Volatile Organic Compounds (VOCs)											
1,1,1-Trichloroethane	ug/L	NL	2.5 U	--	--	--	--	--	--	--	--
1,1,2-Trichloroethane	ug/L	NL	2.4 U	--	--	--	--	--	--	--	--
1,1-Dichloroethane	ug/L	NL	1.8 U	--	--	--	--	--	--	--	--
1,1-Dichloroethene	ug/L	NL	2.9 U	0.76 U	--	--	--	--	--	--	--
1,2,4-Trichlorobenzene	ug/L	NL	3.7 U	--	--	--	--	--	--	--	--
1,2-Dichlorobenzene	ug/L	NL	2.0 U	--	--	--	--	--	--	--	--
1,2-Dichloroethane	ug/L	NL	1.5 U	1.0 U	--	--	--	--	--	--	--
1,2-Dichloropropane	ug/L	NL	2.5 U	--	--	--	--	--	--	--	--
1,3-Dichlorobenzene	ug/L	NL	1.6 U	--	--	--	--	--	--	--	--
1,4-Dichlorobenzene	ug/L	NL	1.0 U	0.91 U	--	--	--	--	--	--	--
2-Butanone (Methyl ethyl ketone) (MEK)	ug/L	NL	2.9 U	1.6 U	--	--	--	--	--	--	--
Benzene	ug/L	NL	2.0 U	0.56 U	--	--	--	--	--	--	--
Bromodichloromethane	ug/L	NL	2.4 U	--	--	--	--	--	--	--	--
Bromoform	ug/L	NL	2.6 U	--	--	--	--	--	--	--	--
Carbon disulfide	ug/L	NL	--	1.7 U	--	--	--	--	--	--	--
Carbon tetrachloride	ug/L	NL	3.3 U	0.92 U	--	--	--	--	--	--	--
Chlorobenzene	ug/L	NL	1.6 U	0.82 U	--	--	--	--	--	--	--
Chloroethane	ug/L	NL	2.6 U	--	--	--	--	--	--	--	--
Chloroform (Trichloromethane)	ug/L	NL	2.1 U	0.82 U	--	--	--	--	--	--	--
cis-1,2-Dichloroethene	ug/L	NL	1.6 U	--	--	--	--	--	--	--	--
cis-1,3-Dichloropropene	ug/L	NL	1.6 U	--	--	--	--	--	--	--	--
Ethylbenzene	ug/L	NL	2.2 U	--	--	--	--	--	--	--	--
Hexachlorobutadiene	ug/L	NL	--	1.2 U	--	--	--	--	--	--	--
m&p-Xylenes	ug/L	NL	1.9 U	1.3 U	--	--	--	--	--	--	--
o-Xylene	ug/L	NL	2.4 U	0.93 U	--	--	--	--	--	--	--
Tetrachloroethene	ug/L	NL	2.0 U	1.2 U	--	--	--	--	--	--	--
Toluene	ug/L	NL	1.7 U	--	--	--	--	--	--	--	--
trans-1,2-Dichloroethene	ug/L	NL	2.5 U	--	--	--	--	--	--	--	--
trans-1,3-Dichloropropene	ug/L	NL	1.7 U	--	--	--	--	--	--	--	--
Trichloroethene	ug/L	NL	1.5 U	1.6 U	--	--	--	--	--	--	--
Vinyl chloride	ug/L	NL	3.7 U	0.85 U	--	--	--	--	--	--	--
Xylenes (total)	ug/L	NL	4.3 U	2.0 U	--	--	--	--	--	--	--

Notes:
[1] Per an EPA email dated February 18, 2020, compliance with the Texas Surface Water Quality Standards will be determined using the minimum level from the EPA approved method (1613B), cited in 40 CFR Part 136, in sampling of dioxin concentrations for surface water discharges during the site remedial action.
[2] Estimated discharge criteria were calculated for all parameters except dioxins and furans utilizing the TCEQ model, TEXTOX MENU # 5 for bays or wide tidal rivers.

TCLP - Toxicity Characteristic Leaching Procedure
EPA - US Environmental Protection Agency
CFR - Code of Federal Regulations
TCEQ - Texas Commission on Environmental Quality
BHC - benzene hexachloride
PCB - polychlorinated biphenyl
mg/L - milligrams per Liter
ug/L - microgram per Liter
mg/kg - milligram per kilogram
pg/L - picograms per Liter

Deg F - Degrees in Fahrenheit
s.u. - standard unit
J - Estimated concentration.
J- - Estimated concentration, result may be biased high.
U - Not detected at the associated reporting limit.
Dup - indicates the result from a duplicate sample
UJ - Not detected; associated reporting limit is estimated.
NL - No limit
-- Data not available

Table 3-3

2019 Bench-Scale Contact Water Filtration Results - Northern Impoundment
Final 100% Remedial Design - Northern Impoundment
San Jacinto River Waste Pits Site
Harris County, Texas

Area:	Units	Non-homogenized contact water - effluent from 100 µm filter	Non-homogenized contact water - effluent from 10 µm filter	Non-homogenized contact water - effluent from 1 µm filter	Non-homogenized contact water - effluent from 0.45 µm filter	Non-homogenized contact water - effluent from 0.1 µm filter
Sample Location:		Filter Test	Filter Test	Filter Test	Filter Test	Filter Test
Sample Identification:		11187072-Filter Test-1	11187072-Filter Test-3	11187072-Filter Test-4	11187072-Filter Test-5	11187072-Filter Test-6
Sample Date:		9/30/2019	9/30/2019	9/30/2019	9/30/2019	9/30/2019
Report Sample Delivery Group (SDG):		320-54852-1	320-54852-1	320-54852-1	320-54852-1	320-54852-1
Filter Size:		100 µm	10 µm	1 µm	0.45 µm	0.1 µm
Solids Collected on Filter						
	mg/L	9.53	4099	342	3.27	0.05
Dioxins/Furans						
1,2,3,4,6,7,8,9-Octachlorodibenzofuran (OCDF)	pg/L	61 J	24 U	0.90 U	1.9 U	1.8 U
1,2,3,4,6,7,8,9-Octachlorodibenzo-p-dioxin (OCDD)	pg/L	1900	850	12 U	4.0 U	4.6 U
1,2,3,4,6,7,8-Heptachlorodibenzofuran (HpCDF)	pg/L	84	30 J	0.75 U	1.1 U	1.2 U
1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin (HpCDD)	pg/L	75	30 J	1.7 U	0.53 U	1.4 U
1,2,3,4,7,8,9-Heptachlorodibenzofuran (HpCDF)	pg/L	28 J	11 J	0.87 U	0.47 U	0.47 U
1,2,3,4,7,8-Hexachlorodibenzofuran (HxCDF)	pg/L	210	74	1.1 U	0.60 U	1.2 U
1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin (HxCDD)	pg/L	2.7 U	1.7 U	2.0 U	1.9 U	1.9 U
1,2,3,6,7,8-Hexachlorodibenzofuran (HxCDF)	pg/L	53	20 J	0.44 U	1.2 U	0.86 U
1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin (HxCDD)	pg/L	2.7 U	0.84 U	0.45 U	0.62 U	1.3 U
1,2,3,7,8,9-Hexachlorodibenzofuran (HxCDF)	pg/L	4.5 U	2.1 U	0.67 U	0.75 U	1.1 U
1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin (HxCDD)	pg/L	2.3 U	0.60 U	0.71 U	0.57 U	1.5 U
1,2,3,7,8-Pentachlorodibenzofuran (PeCDF)	pg/L	100	39 J	0.53 U	0.60 U	0.64 U
1,2,3,7,8-Pentachlorodibenzo-p-dioxin (PeCDD)	pg/L	9.4 J	4.2 J	0.92 U	1.0 U	1.2 U
2,3,4,6,7,8-Hexachlorodibenzofuran (HxCDF)	pg/L	7.0 J	2.8 U	0.36 U	0.94 U	0.47 U
2,3,4,7,8-Pentachlorodibenzofuran (PeCDF)	pg/L	59	22 J	0.56 U	0.57 U	0.66 U
2,3,7,8-Tetrachlorodibenzofuran (TCDF)	pg/L	2500	820	8.7 J	1.6 J	0.93 J
2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	pg/L	800	270	3.6 J	0.76 U	0.65 U
Total heptachlorodibenzofuran (HpCDF)	pg/L	140 J	52 J	1.6 J	1.1 J	1.2 J
Total heptachlorodibenzo-p-dioxin (HpCDD)	pg/L	190 J	78 J	3.9 J	0.53 U	2.3 J
Total hexachlorodibenzofuran (HxCDF)	pg/L	310 J	110 J	1.8 J	2.9 J	3.2 J
Total hexachlorodibenzo-p-dioxin (HxCDD)	pg/L	27 J	7.5 J	2.7 J	2.5 J	4.6 J
Total pentachlorodibenzofuran (PeCDF)	pg/L	250 J	91 J	0.56 U	0.69 U	0.66 U
Total pentachlorodibenzo-p-dioxin (PeCDD)	pg/L	9.4 J	4.2 J	0.92 U	1.0 U	1.2 U
Total tetrachlorodibenzofuran (TCDF)	pg/L	4200 J	1400 J	13 J	1.6 J	0.93 J
Total tetrachlorodibenzo-p-dioxin (TCDD)	pg/L	860 J	290 J	5.0 J	0.76 U	0.65 U

Notes:
- mg/L - milligrams per Liter
- pg/L - picograms per Liter
- µm - micron
- U - Not detected at the associated reporting limit.
- J - Estimated concentration.

Table 3-4

2019 Focused Filtration Testing Results - Northern Impoundment
Final 100% Remedial Design - Northern Impoundment
San Jacinto River Waste Pits Site
Harris County, Texas

Area: Sample Location: Sample Identification: Sample Date: Report Sample Delivery Group (SDG): Filter Size:	Units	Pilot Test Filter Effluent - effluent from 1 um filter FEFF 11187072-FEFF-1um 1/9/2020 320-57624-1 1 um	Pilot Test Filter Effluent - effluent from 0.45 um filter FEFF 11187072-FEFF-0.45um 1/9/2020 320-57624-1 0.45 um	Pilot Test Filter Effluent - effluent from 0.1 um filter FEFF 11187072-FEFF-0.1um 1/9/2020 320-57624-1 0.1um	Pilot Test Filter Effluent - effluent from 0.050 um filter FEFF 11187072-FEFF-0.050um 1/13/2020 320-57717-1 0.05 um	Pilot Test Filter Effluent - effluent from 0.025 um filter FEFF 11187072-FEFF-0.025um 1/13/2020 320-57717-1 0.025 um
Dioxins/Furans						
1,2,3,4,6,7,8,9-Octachlorodibenzofuran (OCDF)	pg/L	1.5 J	1.0 J	2.1 J	1.3 J	0.93 U
1,2,3,4,6,7,8,9-Octachlorodibenzo-p-dioxin (OCDD)	pg/L	9.3 U	3.6 U	14 U	3.7 U	14 U
1,2,3,4,6,7,8-Heptachlorodibenzofuran (HpCDF)	pg/L	0.51 U	0.52 U	0.95 U	0.67 U	0.84 U
1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin (HpCDD)	pg/L	1.1 U	0.722 U	1.7 U	0.73 J	1.3 J
1,2,3,4,7,8,9-Heptachlorodibenzofuran (HpCDF)	pg/L	0.29 U	0.20 U	0.27 U	0.80 U	0.96 U
1,2,3,4,7,8-Hexachlorodibenzofuran (HxCDF)	pg/L	0.40 U	0.41 U	0.50 U	0.65 U	0.72 U
1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin (HxCDD)	pg/L	1.8 U	1.6 U	1.8 U	1.6 J	1.8 J
1,2,3,6,7,8-Hexachlorodibenzofuran (HxCDF)	pg/L	0.41 U	0.42 U	0.50 U	0.63 U	0.71 U
1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin (HxCDD)	pg/L	0.30 U	0.30 U	0.33 U	0.66 J	0.85 J
1,2,3,7,8,9-Hexachlorodibenzofuran (HxCDF)	pg/L	0.29 U	0.30 U	0.50 J	0.96 U	0.68 U
1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin (HxCDD)	pg/L	0.26 U	0.50 J	0.29 U	0.44 U	0.52 U
1,2,3,7,8-Pentachlorodibenzofuran (PeCDF)	pg/L	0.25 U	0.33 U	0.32 U	0.59 U	0.78 U
1,2,3,7,8-Pentachlorodibenzo-p-dioxin (PeCDD)	pg/L	0.40 U	0.40 U	0.35 U	1.1 U	1.2 U
2,3,4,6,7,8-Hexachlorodibenzofuran (HxCDF)	pg/L	0.30 U	0.31 U	0.34 U	0.41 U	0.48 U
2,3,4,7,8-Pentachlorodibenzofuran (PeCDF)	pg/L	0.26 U	0.33 U	0.35 U	0.62 U	0.80 U
2,3,7,8-Tetrachlorodibenzofuran (TCDF)	pg/L	0.22 U	0.21 U	0.24 U	0.34 U	0.41 U
2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	pg/L	0.40 U	0.41 U	0.48 U	0.62 U	0.70 U
Total heptachlorodibenzofuran (HpCDF)	pg/L	0.51 J	0.52 J	0.95 J	0.80 U	0.96 U
Total heptachlorodibenzo-p-dioxin (HpCDD)	pg/L	2.5 J	0.72 J	3.2 J	1.8 J	2.9 J
Total hexachlorodibenzofuran (HxCDF)	pg/L	0.41 U	0.42 U	0.50 J	0.96 J	0.68 J
Total hexachlorodibenzo-p-dioxin (HxCDD)	pg/L	1.8 J	2.1 J	1.8 J	5.6 J	2.6 J
Total pentachlorodibenzofuran (PeCDF)	pg/L	0.30 U	0.33 U	0.43 U	0.62 U	0.80 U
Total pentachlorodibenzo-p-dioxin (PeCDD)	pg/L	0.40 U	0.40 U	0.35 U	1.1 U	1.2 U
Total tetrachlorodibenzofuran (TCDF)	pg/L	0.22 U	0.21 U	0.24 U	0.34 U	0.41 U
Total tetrachlorodibenzo-p-dioxin (TCDD)	pg/L	0.40 U	0.41 U	0.48 U	1.0 J	0.90 J

Notes:
- pg/L - picograms per Liter
- µm - micron
- U - Not detected at the associated reporting limit.
- J - Estimated concentration.

Table 3-5

2019 Armored Cap Test Results - Northern Impoundment
Final 100% Remedial Design - Northern Impoundment
San Jacinto River Waste Pits Site
Harris County, Texas

Area:		Elutriate From Armored Cap Material	Elutriate From Armored Cap Material	Elutriate From Armored Cap Material
Sample Location:	Units	Berm	Eastern	Western
Sample Identification:		11187072-Berm-GW	11187072-Eastern-GW	11187072-Western-GW
Sample Date:		1/29/2020	1/29/2020	1/29/2020
Report Sample Delivery Group (SDG):		320-58170-1	320-58170-1	320-58170-1
Dioxins/Furans				
1,2,3,4,6,7,8,9-Octachlorodibenzofuran (OCDF)	pg/L	21 U	14 U	13.8 U
1,2,3,4,6,7,8,9-Octachlorodibenzo-p-dioxin (OCDD)	pg/L	83 U	94 U	51 U
1,2,3,4,6,7,8-Heptachlorodibenzofuran (HpCDF)	pg/L	7.54 U	7.54 U	7.54 U
1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin (HpCDD)	pg/L	9.52 U	9.52 U	9.52 U
1,2,3,4,7,8,9-Heptachlorodibenzofuran (HpCDF)	pg/L	5.85 U	5.85 U	0.71 U
1,2,3,4,7,8-Hexachlorodibenzofuran (HxCDF)	pg/L	5.92 U	5.92 U	0.79 U
1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin (HxCDD)	pg/L	7.72 U	7.72 U	7.72 U
1,2,3,6,7,8-Hexachlorodibenzofuran (HxCDF)	pg/L	6.14 U	0.81 U	0.70 U
1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin (HxCDD)	pg/L	0.48 U	0.52 U	0.48 U
1,2,3,7,8,9-Hexachlorodibenzofuran (HxCDF)	pg/L	6.25 U	6.25 U	0.53 U
1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin (HxCDD)	pg/L	6.10 U	6.10 U	6.10 U
1,2,3,7,8-Pentachlorodibenzofuran (PeCDF)	pg/L	0.46 U	0.48 U	0.42 U
1,2,3,7,8-Pentachlorodibenzo-p-dioxin (PeCDD)	pg/L	6.12 U	6.12 U	0.47 U
2,3,4,6,7,8-Hexachlorodibenzofuran (HxCDF)	pg/L	5.39 U	0.55 U	0.49 U
2,3,4,7,8-Pentachlorodibenzofuran (PeCDF)	pg/L	0.51 U	0.55 U	0.46 U
2,3,7,8-Tetrachlorodibenzofuran (TCDF)	pg/L	0.28 U	0.36 U	0.35 U
2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	pg/L	0.60 U	0.44 U	3.4 J
Total heptachlorodibenzofuran (HpCDF)	pg/L	13 J	8.9 J	3.2 J
Total heptachlorodibenzo-p-dioxin (HpCDD)	pg/L	15 J	16 J	8.3 J
Total hexachlorodibenzofuran (HxCDF)	pg/L	6.8 J	3.9 J	0.79 U
Total hexachlorodibenzo-p-dioxin (HxCDD)	pg/L	5.0 J	3.4 J	4.1 J
Total pentachlorodibenzofuran (PeCDF)	pg/L	0.51 U	0.55 U	0.46 U
Total pentachlorodibenzo-p-dioxin (PeCDD)	pg/L	1.1 J	0.62 J	0.47 U
Total tetrachlorodibenzofuran (TCDF)	pg/L	0.28 U	0.36 U	0.35 U
Total tetrachlorodibenzo-p-dioxin (TCDD)	pg/L	0.60 U	0.44 U	3.4 J

Table 3-5

2019 Armored Cap Test Results - Northern Impoundment
Final 100% Remedial Design - Northern Impoundment
San Jacinto River Waste Pits Site
Harris County, Texas

Area:		Solids Washed From Armored Cap Material	Solids Washed From Armored Cap Material	Solids Washed From Armored Cap Material
Sample Location:	Units	Berm	Eastern	Western
Sample Identification:		11187072-Berm-Solids	11187072-Eastern-Solids	11187072-Western-Solids
Sample Date:		1/29/2020	1/29/2020	1/29/2020
Report Sample Delivery Group (SDG):		320-58170-1	320-58170-1	320-58170-1
Dioxins/Furans				
1,2,3,4,6,7,8,9-Octachlorodibenzofuran (OCDF)	pg/g	5.0 J	4.0 J	12 J
1,2,3,4,6,7,8,9-Octachlorodibenzo-p-dioxin (OCDD)	pg/g	320	280	540
1,2,3,4,6,7,8-Heptachlorodibenzofuran (HpCDF)	pg/g	1.9 J	0.75 U	3.2 J
1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin (HpCDD)	pg/g	0.61 U	12	26
1,2,3,4,7,8,9-Heptachlorodibenzofuran (HpCDF)	pg/g	0.30 U	0.24 U	0.29 U
1,2,3,4,7,8-Hexachlorodibenzofuran (HxCDF)	pg/g	0.27 U	0.18 J	0.21 U
1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin (HxCDD)	pg/g	0.48 U	0.46 U	0.69 U
1,2,3,6,7,8-Hexachlorodibenzofuran (HxCDF)	pg/g	0.23 U	0.14 U	0.17 U
1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin (HxCDD)	pg/g	0.86 J	0.38 J	0.67 J
1,2,3,7,8,9-Hexachlorodibenzofuran (HxCDF)	pg/g	0.18 U	0.24 J	0.11 U
1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin (HxCDD)	pg/g	0.62 J	0.48 J	0.68 J
1,2,3,7,8-Pentachlorodibenzofuran (PeCDF)	pg/g	0.12 U	0.12 J	0.13 U
1,2,3,7,8-Pentachlorodibenzo-p-dioxin (PeCDD)	pg/g	0.15 U	0.18 U	0.17 U
2,3,4,6,7,8-Hexachlorodibenzofuran (HxCDF)	pg/g	0.16 U	0.095 U	0.12 U
2,3,4,7,8-Pentachlorodibenzofuran (PeCDF)	pg/g	0.13 U	0.12 U	0.17 U
2,3,7,8-Tetrachlorodibenzofuran (TCDF)	pg/g	0.73 J	2.2	2.5
2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	pg/g	0.56 J	0.98 J	1.0 J
Total heptachlorodibenzofuran (HpCDF)	pg/g	3.8 J	2.0 J	9.6 J
Total heptachlorodibenzo-p-dioxin (HpCDD)	pg/g	20 J	33 J	62 J
Total hexachlorodibenzofuran (HxCDF)	pg/g	0.69 J	1.2 J	1.9 J
Total hexachlorodibenzo-p-dioxin (HxCDD)	pg/g	5.0 J	4.9 J	7.9 J
Total pentachlorodibenzofuran (PeCDF)	pg/g	0.69 J	0.12 J	1.4 J
Total pentachlorodibenzo-p-dioxin (PeCDD)	pg/g	0.15 U	0.18 U	0.20 J
Total tetrachlorodibenzofuran (TCDF)	pg/g	0.73 J	3.6 J	5.0 J
Total tetrachlorodibenzo-p-dioxin (TCDD)	pg/g	0.56 J	0.98 J	1.0 J
Total WHO Dioxin TEQ(Human/Mammal)(ND=0)	pg/g	0.898	1.54	1.84
Total WHO Dioxin TEQ(Human/Mammal)(ND=0.5)	pg/g	1.06	1.68	2.02
Percent solids	%	99.6	99.6	99.7

Table 3-5

2019 Armored Cap Test Results - Northern Impoundment
Final 100% Remedial Design - Northern Impoundment
San Jacinto River Waste Pits Site
Harris County, Texas

Area:		Crushed Rock Armored Cap Material	Crushed Rock Armored Cap Material	Crushed Rock Armored Cap Material
Sample Location:	Units	Berm	Eastern	Western
Sample Identification:		11187072-Berm-Rock	11187072-Eastern Rock	11187072-Western-Rock
Sample Date:		2/11/2020	2/11/2020	2/11/2020
Report Sample Delivery Group (SDG):		320-58545-1	320-58545-1	320-58545-1
Dioxins/Furans				
1,2,3,4,6,7,8,9-Octachlorodibenzofuran (OCDF)	pg/g	0.57 U	0.58 U	3.4 U
1,2,3,4,6,7,8,9-Octachlorodibenzo-p-dioxin (OCDD)	pg/g	9.6 J	61	160
1,2,3,4,6,7,8-Heptachlorodibenzofuran (HpCDF)	pg/g	0.229 U	0.27 U	1.2 J
1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin (HpCDD)	pg/g	0.59 J	4.4 J	12
1,2,3,4,7,8,9-Heptachlorodibenzofuran (HpCDF)	pg/g	0.18 J	0.027 U	0.14 J
1,2,3,4,7,8-Hexachlorodibenzofuran (HxCDF)	pg/g	0.085 U	0.098 U	0.13 U
1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin (HxCDD)	pg/g	0.24 U	0.27 U	0.30 U
1,2,3,6,7,8-Hexachlorodibenzofuran (HxCDF)	pg/g	0.076 U	0.090 U	0.11 U
1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin (HxCDD)	pg/g	0.046 U	0.26 U	0.33 U
1,2,3,7,8,9-Hexachlorodibenzofuran (HxCDF)	pg/g	0.27 U	0.18 U	0.20 U
1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin (HxCDD)	pg/g	0.042 U	0.13 J	0.26 J
1,2,3,7,8-Pentachlorodibenzofuran (PeCDF)	pg/g	0.17 J	0.16 J	0.13 J
1,2,3,7,8-Pentachlorodibenzo-p-dioxin (PeCDD)	pg/g	0.093 J	0.11 J	0.058 U
2,3,4,6,7,8-Hexachlorodibenzofuran (HxCDF)	pg/g	0.084 J	0.059 U	0.068 U
2,3,4,7,8-Pentachlorodibenzofuran (PeCDF)	pg/g	0.050 U	0.060 U	0.057 U
2,3,7,8-Tetrachlorodibenzofuran (TCDF)	pg/g	0.11 J	0.15 J	0.18 J
2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	pg/g	0.059 U	0.14 J	0.15 J
Total heptachlorodibenzofuran (HpCDF)	pg/g	0.46 J	0.38 J	3.7 J
Total heptachlorodibenzo-p-dioxin (HpCDD)	pg/g	1.3 J	12 J	26 J
Total hexachlorodibenzofuran (HxCDF)	pg/g	0.35 J	0.18 J	0.98 J
Total hexachlorodibenzo-p-dioxin (HxCDD)	pg/g	0.24 J	1.1 J	2.1 J
Total pentachlorodibenzofuran (PeCDF)	pg/g	0.17 J	0.16 J	0.13 J
Total pentachlorodibenzo-p-dioxin (PeCDD)	pg/g	0.093 J	0.11 J	0.24 J
Total tetrachlorodibenzofuran (TCDF)	pg/g	0.23 J	0.15 J	0.18 J
Total tetrachlorodibenzo-p-dioxin (TCDD)	pg/g	0.059 U	0.14 J	0.15 J
Total WHO Dioxin TEQ(Human/Mammal)(ND=0)	pg/g	0.128	0.345	0.379
Total WHO Dioxin TEQ(Human/Mammal)(ND=0.5)	pg/g	0.204	0.404	0.474
Percent solids	%	99.7	94.4	94.2

Notes:
pg/L - picograms per Liter
U - Not detected at the associated reporting limit.
J - Estimated concentration.
TEQ - toxic equivalency
WHO - World Health Organization

Table 3-6

Analytical Results from 2020 Field Filtration Testing
Final 100% Remedial Design - Northern Impoundment
San Jacinto River Waste Pits Site
Harris County, Texas

Parameter	Units	Influent - Sand-Filtered and Clarified Contact Water	1 µm Filtrate	0.5 µm Filtrate
TSS	mg/L	11	3.8	2.0 U
Total TCDD	pg/L	6.5 J	3.6 J	3.8 J
Total TCDF	pg/L	20 J	5.6 J	0.96 J
2,3,7,8-TCDD	pg/L	1.9 J	0.72 U	0.56 U
2,3,7,8-TCDF	pg/L	12	3.4 J	0.96 J

Notes:
mg/L - milligram per liter
pg/L - picogram per liter
µm - micrometer
TSS = total suspended solids
Total TCDD = Total tetrachlorinated dibenzo-p-dioxin
Total TCDF = Total tetrachlorodibenzofuran
2,3,7,8-TCDD = 2,3,7,8 tetrachlorinated dibenzo-p-dioxin
2,3,7,8-TCDF = 2,3,7,8 tetrachlorodibenzofuran
J - Estimated concentration
U - Not detected at the associated reporting limit

Table 3-7

Results from Filtrate Generated from Particle Size Analysis - Approach B Filtration Testing
Final 100% Remedial Design - Northern Impoundment
San Jacinto River Waste Pits Site
Harris County, Texas

Filter Size (µm)	With Chemical Addition						Without Chemical Addition					
	Solids on Filter (mg/L)	Solids Retained (%)	Total TCDD (pg/L)	Total TCDF (pg/L)	2,3,7,8-TCDD (pg/L)	2,3,7,8-TCDF (pg/L)	Solids on Filter (mg/L)	Solids Retained (%)	Total TCDD (pg/L)	Total TCDF (pg/L)	2,3,7,8-TCDD (pg/L)	2,3,7,8-TCDF (pg/L)
100	29.2	0.26	13,000 J	68,000 J	12,000	35,000	18	0.45	3,000 J	16,000 J	2,700	9,500
41	2,226	19.54	8,600 J	41,000 J	8,000	23,000	136.6	3.42	28,000 J	13,000 J	26,000	80,000
10	8,756	76.86	42 J	160 J	37	97	3,577	89.49	59 J	260 J	52	140
1	325.6	2.86	17 J	59 J	12	34	228.5	5.72	120 J	600 J	110	350
0.45	33.2	0.29	11 J	29 J	6.1 J	19	22.6	0.57	4.5 J	21 J	4.5 J	11
0.1	22.4	0.20	13 J	49 J	11	31	14.4	0.36	15 J	81 J	15	48

Notes:
mg/L - milligram per liter
pg/L - picogram per liter
µm - micrometer
Total TCDD = Total tetrachlorinated dibenzo-p-dioxin
Total TCDF = Total tetrachlorodibenzofuran
2,3,7,8-TCDD = 2,3,7,8 tetrachlorinated dibenzo-p-dioxin
2,3,7,8-TCDF = 2,3,7,8 tetrachlorodibenzofuran
J - Estimated concentration

Table 3-8

Constituent Concentrations throughout Treatment Process - Additional WTS Treatability Testing
Final 100% Remedial Design - Northern Impoundment
San Jacinto River Waste Pits Site
Harris County, Texas

Parameter	Units	Supernatant after Initial Setting	Supernatant after Chemical Addition and Settling	Chemical Addition Supernatant - 5-µm Filtrate	Chemical Addition Supernatant - 1-µm Filtrate
Total TCDD	pg/L	650 J	19 J	1.1 U	0.96 U
Total TCDF	pg/L	2,900 J	99 J	2.5 J	2.4 J
2,3,7,8-TCDD	pg/L	600	19	1.1 U	0.96 U
2,3,7,8-TCDF	pg/L	1,600	56	2.5 U	2.4 J
TSS	mg/L	1,050	5	2	2

Notes:
mg/L - milligram per liter
pg/L - picogram per liter
µm - micrometer
WTS - Water Treatment System
Total TCDD = Total tetrachlorinated dibenzo-p-dioxin
Total TCDF = Total tetrachlorodibenzofuran
2,3,7,8-TCDD = 2,3,7,8 tetrachlorinated dibenzo-p-dioxin
2,3,7,8-TCDF = 2,3,7,8 tetrachlorodibenzofuran
J - Estimated concentration
U - Not detected at the associated reporting limit

Table 4-1

Applicable or Relevant and Appropriate Requirements (ARAR)
Final 100% Remedial Design - Northern Impoundment
San Jacinto River Waste Pits Site
Harris County, Texas

Item No.	Media/Topic	Status, Regulations, Standards, or Requirements	Citations or References	Description	Comment
1.	Surface Water	Clean Water Act (CWA): Sections 303 and 304: Federal Water Quality Criteria.	33 U.S.C. §§1313 and 1314 (304(a))	Under §303 (33 U.S.C. §1313), individual states have established water quality standards to protect existing and attainable uses. CWA §301(b)(1)(C) requires that pollutants contained in direct discharges be controlled beyond BCT/BAT equivalents. Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) §121(d)(2)(B)(i) establishes conditions under which water quality criteria, which were developed by USEPA as guidance for states to establish location-specific water quality standards, are to be considered relevant and appropriate. Two kinds of water quality criteria have been developed under CWA §304 (33 U.S.C. §1314): one for protection of human health, and another for protection of aquatic life. These requirements include establishment of total maximum daily loads (TMDL).	A TMDL for dissolved nickel in the Houston Ship Channel System has been adopted and an implementation plan approved. Discharge criteria for the Northern Impoundment, including nickel, was determined by establishing Water Quality-Based Effluent Limitations (WQBELs) using TexTox Menus model provided by TCEQ; therefore, the use of the same model used to develop the TMDL ensures that the cumulative effects will not cause an exceedance of the water quality criteria for nickel. Per the 2020 Texas Integrated Report – Texas 303(d) list, San Jacinto River Segment 1005 is classified as impaired body of water for dioxin and polychlorinated biphenyls (PCBs) in edible tissues as category 5; therefore, it is suitable for development of a TMDL. A TMDL for dioxin and PCBs in edible tissues Segment 1005 has not been developed yet. The Texas Surface Water Quality Standard (TSWQS) for dioxins is applicable for surface water discharge from the Northern Impoundment, in accordance with the EPA's February 18, 2020, e-mail (included in Appendix D of this Northern Impoundment 90% RD Package), which stated: *EPA has determined that compliance with the TSWQS ARAR will be attained as follows:* *- The state surface water quality standard for Dioxins/Furans is 7.97 x 10-8 µg/L [0.0797 pg/L] (as TCDD equivalents);* *- Compliance with the TSWQS will be determined by using minimum level of the EPA approved method (1613B), cited in 40 CFR Part 136 (GUIDELINES ESTABLISHING TEST PROCEDURES FOR THE ANALYSIS OF POLLUTANTS), in sampling of surface water discharges during the Site remedial action.* *- If an effluent sample analyzed for dioxin is below the minimum level using the EPA approved method, the sample result would be identified as non-detect and the discharge would be determined to be in compliance with the ARAR.* *This approach is consistent with the state's guidance and other permits issued by TCEQ. EPA's determination is contingent on the water treatment facility using a 1 micron final filtration step in the water treatment process.*
2.	Surface Water	Clean Water Act (CWA): Criteria and standards for imposing technology -based treatment requirements under §402.	33 U.S.C. §1342; 40 CFR Part 125 Subpart A	Both on-site and off-site discharges from CERCLA Sites to surface waters are required to meet the substantive CWA (National Pollutant Discharge Elimination System) NPDES requirements.	On-site discharges to surface water must comply with the substantive technical requirements of the CWA but do not require a permit. Off-site discharges to a Publicly Owned Treatment Work (POTW) would be regulated under the conditions of a NPDES permit for the POTW. Water that is generated during removal activities in the Northern Impoundment will be treated and discharged to the San Jacinto River (Segment 1005). The discharge location(s) have yet to be determined but will be in close proximity to the Northern Impoundment, so only the substantive requirements of an NPDES permit, but not an NPDES permit, will be required. Water quality-based effluent limitations using TexTox menu # 5 for bay or wide tidal river were calculated and considered for the water treatment design. Development of the treatment system discharge limits are discussed further below.

Table 4-1

Applicable or Relevant and Appropriate Requirements (ARAR)
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Item No.	Media/Topic	Status, Regulations, Standards, or Requirements	Citations or References	Description	Comment
3.	Surface Water	Clean Water Act (CWA): Section 307(b): Pretreatment standards.	33 U.S.C. §1317(b)	CERCLA §121(e) states that no Federal, state, or local permit for direct discharges is required for the portion of any removal or remedial action conducted entirely on-site (the aerial extent of contamination and all suitable areas in close proximity to the contamination necessary for implementation of the response action) (USEPA, 1988).	If off-site discharges from a CERCLA response activity were to enter receiving waters directly or indirectly, through treatment at a POTW, the POTW must comply with applicable Federal, State, and Local substantive requirements and formal administrative permitting requirements. Per the RD as described in this Northern Impoundment 90% RD Package, contact water generated during excavation activities will not be discharged to a POTW; therefore this regulation does not apply.
4.	Surface Water	Clean Water Act (CWA).	Section 401: Water Quality Certification 33 U.S.C. §1341 30 TAC Chapter 279	Requires activities that involve a discharge into navigable waters of the U.S. to obtain certification from state or regional regulatory agencies that the proposed discharge will comply with CWA Sections 301, 302, 303, 306, and 307.	Water Quality Certification is a requirement of projects that involve discharge of dredge/fill or would impact waters of the U.S. or wetland. The cofferdam barrier wall to be installed at the Northern Impoundment is considered "fill material"; therefore, Section 401 would apply to the project. The project will comply with substantive requirements of Section 401.
5.	Surface Water	Clean Water Act (CWA).	CWA Section 404 and 404(b)(1): Dredge and Fill 33 U.S.C. §1344 (b)(1); 33 CFR 320 and 330; 40 CFR 230	Discharges of dredged and fill material into waters of the U.S. must comply with the CWA §404 (33 U.S.C. 1344) guidelines and demonstrate the public interest is served.	The San Jacinto River is a water of the U.S. These requirements are applicable to dredging, in-water disposal, capping, construction of berms or levees, stream channelization, excavation and/or dewatering within the river. Therefore, they would apply to the work in the Northern Impoundment. Under the 404(b)(1) guidelines, efforts should be made to avoid, minimize, and mitigate adverse effects on the waters of the U.S. and, where possible, select a practicable (engineering feasible) alternative with the least adverse effects. A permit for the on-site work will not be required; however, the substantive technical requirements of Section 404 will apply in the development, evaluation, and implementation of the remedial action to minimize adverse impacts to waters of the U.S. AA “Waters and Wetlands Delineation Report” will be included in a submittal to the USACE following submittal of the Northern Impoundment 90% RD.
6.	Surface Water	Storm Water Discharge from Construction Activities.	40 CFR 450 30 TAC Chapter 205	Requires new construction project that will disturb 5 or more acres to request coverage under a Texas Commission on Environmental Quality (TCEQ) construction general permit (TX15000) and develop a storm water pollution prevention plan (SWPPP) to control discharges of storm water associated with construction activities in accordance with the NPDES program.	A permit is not required, however, the work must comply with the substantive technical requirements of these regulations. A SWPPP will be developed and implemented using best management practices to minimize erosion and entrainment of sediments in stormwater runoff.
7.	Surface Water	Texas Surface Water Quality Standards.	30 TAC §307.4-7, 10	These state regulations provide general narrative criteria, anti-degradation policy, numerical criteria for pollutants, numerical and narrative criteria for water-quality related uses (e.g., human use), and site-specific criteria for San Jacinto River basin.	The TSWQS for dioxins is applicable for surface water discharge from the Northern Impoundment, in accordance with EPA's February 18, 2020, e-mail quoted in Item No. 1, and included in Appendix D of this Northern Impoundment 90% RD Package.
8.	Surface Water	Texas Water Quality: Pollutant Discharge Elimination System (TPDES).	30 TAC §279.10	These state regulations require storm water discharge permits for either industrial discharge or construction-related discharge. The State of Texas was authorized by USEPA to administer the NPDES program in Texas on September 14, 1998.	No permit is required for on-site activities. A SWPPP will be developed and implemented using best management practices to minimize soil erosion and entrainment of sediments in stormwater runoff.

Table 4-1

Applicable or Relevant and Appropriate Requirements (ARAR)
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Item No.	Media/Topic	Status, Regulations, Standards, or Requirements	Citations or References	Description	Comment
9.	Surface Water	Texas Water Quality: Water Quality Certification.	30 TAC §279.10	These state regulations establish procedures and criteria for applying for, processing, and reviewing state certifications under CWA, §401. It is the purpose of this chapter, consistent with the Texas Water Code and the federal CWA, to maintain the chemical, physical, and biological integrity of the state's waters.	Water Quality Certification is a requirement for projects that involve discharge of dredge fill or would impact waters of the U.S. or wetlands. The cofferdam barrier wall that will be installed at the Northern Impoundment, as described in this 90% Northern Impoundment RD Package, is considered "fill material"; therefore, Section 401 would apply to the project. The BMP installation and removal activities will comply with substantive requirements of Section 401.
10.	Surface Water	Water Use.	TWC Sections 11.121 and 11.138; 30 TAC §297.11	Impoundment, diversion and storage, taking or use of state water with certain exemptions as provided in state law require obtaining a water rights permit. These exemptions are not applicable to the Northern Impoundment. These state regulations establish procedures for applying for, and obtaining the temporary diversion of surplus state water under a temporary water rights permit.	A temporary use permit is a requirement for projects that involve the use of state water and/or divert water for up to three years. Projects that would use more than 10 acre-feet of water and/or exceed one year term are subject to public notice and hearing. Hydrodynamic modeling was performed at the request of the Harris County Flood Control District (HCFCD) to evaluate the effect the cofferdam barrier wall planned for the Northern Impoundment may have on the water levels of the surrounding floodplain. Results of the evaluation suggest that the effect of the structure on the floodplain would be negligible under 2-year, 10-year, and 100-year flood event scenarios. This evaluation was summarized in a letter submitted to the HCFCD on March 30, 2022. A revised version of the letter was submitted on May 6, 2022, which addressed comments from the HCFCD that were received on April 8, 2022. The revised letter is included in Appendix D of this Northern Impoundment 90% RD package. At the request of the Texas Department of Transportation (TxDOT) the Respondents also evaluated the potential effect the cofferdam barrier would have on the river velocity and shear stress. The results of this evaluation were submitted to TxDOT on April 11, 2022. This submittal is also included in Appendix D.
11.	Waste	Resource Conservation And Recovery Act (RCRA): Hazardous Waste Management.	42 U.S.C. §§6921 et seq.; 40 CFR Parts 260 - 268	RCRA Subtitle C and its implementing regulations contain the federal requirements for the management of hazardous wastes.	This requirement would apply to certain activities if the waste materials or affected soils contain RCRA listed hazardous waste or exhibit a hazardous waste characteristic. Waste management in the Northern Impoundment would be required to comply with these regulations. Based on the results of the pre-design investigations (PDI-1, PDI-2) and supplemental design investigation (SDI), the Northern Impoundment waste materials sampled to date are not listed hazardous waste, do not contain listed hazardous waste above RCRA-thresholds, and are not classified as characteristic hazardous waste. The evaluation and designation of the material as non-hazardous was summarized in a letter to the EPA dated October 20, 2020. The EPA provided a response letter dated November 19, 2020, supporting the waste classification. These letters are included in Appendix D of this Northern Impoundment 90% RD Package. The results of the SDI confirmed the waste classification, as described in Section 3.3 of the main text of the Northern Impoundment 90% RD Package.
12.	Waste	Toxic Substances Control Act (TSCA).	15 USC §2601, et. seq.; 40 CFR 761.61 (c)	40 CFR 761.61 provides TSCA clean-up and disposal options for PCB remediation waste, which includes PCB-contaminated soil, sediment, sewage or industrial sludge, and building material. 761.61(c) is the risk-based option for PCB remediation waste.	Total PCB concentrations in the Northern Impoundment are below the regulatory threshold of 50 mg/kg, calculated as specified in 40 CFR 761 that could require management of any waste materials as a TSCA waste.
13.	Waste	RCRA: General Requirements for Solid Waste Management.	42 U.S.C. §§6941, et seq.; 40 CFR 258)	Requirements for construction for municipal solid waste landfills that receive RCRA Subtitle D wastes, including industrial solid waste. Requirements for run-on/run-off control systems, groundwater monitoring systems, surface water requirements, etc.	The Northern Impoundment remedial activities will not involve the construction of a municipal landfill; therefore, this regulation does not apply.

Table 4-1

Applicable or Relevant and Appropriate Requirements (ARAR)
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Item No.	Media/Topic	Status, Regulations, Standards, or Requirements	Citations or References	Description	Comment
14.	Waste	30 Texas Administrative Code (TAC) Part 1: Industrial Solid Waste and Municipal Hazardous Waste General Terms	30 TAC §§335.1 - 335.15	Substantive requirements for the transportation of industrial solid and hazardous wastes; requirements for the location, design, construction, operation, and closure of solid waste management facilities.	This regulation contains guidelines to promote the proper collection, handling, storage, processing, and disposal of industrial solid waste or municipal hazardous waste in a manner consistent with the purposes of Texas Health and Safety Code, Chapter 361. These regulations also define the classification of the Industrial Solid Waste from the Northern Impoundment. They are applicable and will be followed for waste materials from the Northern Impoundment that are transported to off-site landfills.
15.	Waste	30 TAC Part 1: Industrial Solid Waste and Municipal Hazardous Waste: Notification.	30 TAC Chapter 335 Subchapter P	Requires placement of warning signs in contaminated and hazardous areas if a determination is made by the executive director of the Texas Water Commission a potential hazard to public health and safety exists which will be eliminated or reduced by placing a warning sign on the contaminated property.	It is not expected that warning signs will be necessary based on this regulation. The Northern Impoundment will be protected with appropriate signage and other site controls as defined in the Health and Safety Plan. Any issues with respect to maintenance of current signage required pursuant to the Operations and Maintenance (O&M) Plan for the Time Critical Removal Action (TCRA) are expected to be addressed through modifications to the O&M Plan.
16.	Waste	30 TAC Part 1: Industrial Solid Waste and Municipal Hazardous Waste: Generators.	30 TAC Chapter 335, Subchapter C	Standards for hazardous waste generators either disposing of waste on-site or shipping off-site with the exception of conditionally exempt small quantity generators. The definition of hazardous involves state and federal standards.	Waste management with respect to RA activities associated with the Northern Impoundment would be required to comply with these regulations. Based on the results of the PDIs and SDI for the RD, the Northern Impoundment waste materials sampled to date are not listed hazardous waste, do not contain listed hazardous waste above RCRA -thresholds, and are not classified as characteristic hazardous waste. The evaluation and designation of the material as non-hazardous was summarized in a letter to the EPA dated October 20, 2020. The EPA provided a response letter dated November 19, 2020, supporting the waste classification. These letters are included in Appendix D of the Northern Impoundment 90% RD Package. The results of the SDI confirmed the waste classification, as described in Section 3.3 of the main text of the Northern Impoundment 90% RD Package.
17.	Waste	Hazardous Materials Transportation Act	49 U.S.C. §§1801, et seq.; 49 CFR Subchapter C	Establishes standards for packaging, documenting, and transporting hazardous materials.	These requirements would apply to all hazardous material transported to and from work sites for the Northern Impoundment RA. Based on the results of the PDIs and the SDI, it is not expected that the waste materials excavated from beneath the Northern Impoundment and transported off-site will be classified as hazardous material so these requirements would not apply.
18.	Air	Clean Air Act (CAA).	42 U.S.C. §§7401, et seq.	Authorization of potential emissions of dust, volatile organic compounds (VOCs), and/or hazardous air pollutants (HAP) resulting from the excavation, solidification and stabilization of the soil in the Northern Impoundment.	Any air discharges are required to be in compliance with the substantive technical requirements of the CAA and the work will be required to comply with any applicable TCEQ requirements regarding such emissions.
19.	Air	Texas Air Quality Rules.	30 TAC Chapter 116	Authorization of potential emissions of dust, VOCs, and/or HAP resulting from the excavation, solidification and stabilization of the soil in the Northern Impoundment.	TCEQ is the designated authority to issue air permits in Texas, so discharges must comply with the substantive technical requirements of this regulation. Emissions generated from equipment used to extract, handle, process, condition, reclaim or destroy contaminants for the purpose of remediation are covered by a TCEQ's permit by rule (PBR) as long as emissions are limited to 5 ton per year or 1 pound per hour for the site activities (30 TAC 106.533). Prior to commencing construction, emission calculations would be performed with respect to compliance with the PBR.
20.	Dredging/Floodplain	Rivers And Harbors Act of 1899: Obstruction of navigable waters (generally wharves, piers, etc.); excavation and fill.	33 U.S.C. §401	Controls the alteration of navigable waters (i.e., waters subject to ebb and flow of the tide shoreward to the mean high water mark). Activities controlled include construction of structures such as piers, berms, and installation of pilings as well as excavation and fill. Section 10 may be applicable for any action that may obstruct or alter a navigable waterway. No permit is required for on-site activities. However, substantive requirements might limit in-water construction activities.	The cofferdam barrier wall to be installed at the Northern Impoundment is considered "fill material"; therefore, Section 10 of the Rivers and Harbors Act of 1899 would apply to the BMP installation and removal activities and the work will be performed in a manner that complies with substantive requirements of Section 10.

Table 4-1

Applicable or Relevant and Appropriate Requirements (ARAR)
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Item No.	Media/Topic	Status, Regulations, Standards, or Requirements	Citations or References	Description	Comment
21.	Dredging/Floodplain	Coastal Zone Management Act.	16 USC §§1451, et seq.; 15 CFR 930	Federal activities must be consistent with, to the maximum extent practicable, state coastal zone management programs. Federal agencies must supply the state with a consistency determination.	The San Jacinto River lies within the Coastal Zone Boundary (GLO TCMP). During the Remedial Investigation/Feasibility Study (RI/FS), an evaluation was made as to whether remedial alternatives may affect (adversely or not) the coastal zone and provides a technical basis for the lead agency (EPA) to determine whether the activity will be consistent with the state's TCMP. These requirements have been incorporated into the design as applicable.
22.	Dredging/Floodplain	FEMA (Federal Emergency Management Agency), Department of Homeland Security (Operating Regulations).	42 U.S.C. 4001, et seq.; 44 CFR Chapter 1	Prohibits alterations to river or floodplains that may increase potential for flooding.	The FEMA flood insurance rate map ID 48201C074M, effective on 1/6/2017, indicates that the Northern Impoundment is located within a designated coastal zone (Zone VE), which is within the Riverine Floodway. As stated in Item No. 10 above, hydrodynamic modeling was conducted as part of the RD to determine if the cofferdam structure, as described in the Northern Impoundment 90% RD Package, would have any adverse effect on the floodplain. The results of that evaluation suggest that the impacts would be negligible.
23.	Dredging/Floodplain	National Flood Insurance Program (NFIP) Regulations.	42 U.S.C. Subchapter III, §§4101, et seq.	Provides federal flood insurance to local authorities and requires that the local authorities not allow fill in the river that would cause an increase in water levels associated with floods.	As stated in Item No. 10 above, hydrodynamic modeling was conducted to determine if the cofferdam structure would have any adverse effect on the floodplain. The results of that evaluation suggest that the impacts would be negligible.
24.	Dredging/Floodplain	Floodplain Management and Wetlands Protection.	Executive Orders (EO) 11988 and 11990	Requires federal agencies to conduct their activities to avoid, if possible, adverse impacts associated with the destruction or modification of wetlands and occupation or modification of floodplains. Executive Orders 11988 and 11990 require federal projects to avoid adverse effects and minimize potential harm to wetlands and within flood plains. The EO 11990 requires federal agencies to avoid to the extent possible the long and short-term adverse impacts associated with the destruction or modification of wetlands and to avoid direct or indirect support of new construction in wetlands wherever there is a practicable alternative.	The Northern Impoundment is within a floodplain and the temporary structure (cofferdam barrier wall) will be constructed in the river. As stated in Item No. 10 above, hydrodynamic modeling was conducted to determine if the cofferdam structure would have any adverse effect on the floodplain. The results of that evaluation suggest that the impacts would be negligible. The Respondents will be preparing and submitting to the USACE a “Waters and Wetlands Delineation Report” to address requirements under EO 11990.
25.	Dredging/Floodplain	Texas Coastal Coordination Council Policies for Development in Critical Areas.	31 TAC §501.23	Dredging in critical areas is prohibited if activities have adverse effects or degradation on shellfish and/or jeopardize the continued existence of endangered species or results in an adverse effect on a coastal natural resource area (CNRA) 5; prohibits the location of facilities in coastal natural resource areas unless adverse effects are prevented and/or no practicable alternative. Specifies compensatory mitigation.	Any removal (excavation) activities will occur within the cofferdam wall and footprint of the Northern Impoundment and do not currently involve dredging, and therefore will not impact critical areas. An updated Threatened and Endangered (T&E) Species Habitat Suitability Evaluation will be included in a submittal to the USACE following submittal of the Northern Impoundment 90% RD.
26.	Dredging/Floodplain	Texas Coastal Management Plan (TCMP) Consistency.	31 TAC, §506.12	Specifies federal actions within the TCMP boundary that may adversely affect CNRAs, specifically, selection of remedial actions.	The San Jacinto River lies within the Coastal Zone Boundary (GLO TCMP). During the RI/FS, an evaluation was made as to whether remedial alternatives may affect (adversely or not) the coastal zone and provides a technical basis for the lead agency (EPA) to determine whether the activity will be consistent with the state's TCMP. These requirements will be incorporated into the design as applicable.
27.	Dredging/Floodplain	Texas State Code - obstructions to navigation.	Natural Resources Code §51.302 Prohibition and Penalty	Prohibits construction or maintenance of any structure or facility on land owned by the state without an easement, lease, permit, or other instrument from the state.	Because this is a CERCLA action, a formal instrument should not be required; however, the work will be coordinated with the State.

Table 4-1

Applicable or Relevant and Appropriate Requirements (ARAR)
Final 100% Remedial Design - Northern Impoundment
San Jacinto River Waste Pits Site
Harris County, Texas

Item No.	Media/Topic	Status, Regulations, Standards, or Requirements	Citations or References	Description	Comment
28.	Dredging/Floodplain	Floodplain Management of Harris County, Texas.	Texas Code Section 240.901 and TTC Sections 251.001-251.059 and Sections 254.001-254.019	Establishes construction requirements along the segment of the San Jacinto River at or near the Northern Impoundment.	The FEMA flood insurance rate map ID 48201C074M, effective on January 6, 2017, indicates that the Northern Impoundment is located within a designated coastal zone (Zone VE), which is within the Riverine Floodway. Much of the surrounding property that may be used for offices, laydown and staging areas are above an elevation with a 1 percent annual exceedance probability (AEP) for flooding Zone AE. Design of any temporary structure, including gas or liquid storage tanks, will comply with Harris County Texas floodplain management requirements. Additionally, at the request of HCFCD, as stated in Item No. 10 above, hydrodynamic modeling was conducted as part of the RD to determine if the cofferdam structure would have any adverse effect on the floodplain. The results of that evaluation suggest that the impacts would be negligible.
29.	Wildlife Protection	Endangered Species Act.	16 U.S.C. §§ 1531, et seq.	Federal agencies must ensure that actions they authorize, fund, or carry out are not likely to adversely modify or destroy critical habitat of endangered or threatened species. Actions authorized, funded, or carried out by federal agencies may not jeopardize the continued existence of endangered or threatened species as well as adversely modify or destroy their critical habitats.	During the RI/FS in 2010, a desktop review of photographs and U.S. Fish and Wildlife Service (USFWS) and National Marine Fisheries Service (NMFS) species and habitat maps was performed. Another evaluation was performed in 2021. Both evaluations concluded that there are no federally listed T&E or critical habitats present on the Northern Impoundment or in areas in the vicinity of the Northern Impoundment. An updated evaluation will be included in a submittal to the USACE following submittal of the Northern Impoundment 90% RD.
30.	Wildlife Protection	Fish and Wildlife Coordination Act.	16 U.S.C. §§661, et seq., 16 U.S.C. §742a, 16 U.S.C. § 2901	Requires adequate provision for protection of fish and wildlife resources. This title has been expanded to include requests for consultation with USFWS for water resources development projects (Mueller, 1980). Any modifications to rivers and channels require consultation with the USFWS, Department of Interior, and state wildlife resources agency. Project-related losses (including discharge of pollutants to water bodies) may require mitigation or compensation.	Depending on the site conditions after final restoration of the Northern Impoundment after remedial activities are completed, consultation with the USFWS, Department of Interior, and state wildlife resources agency may be required to address adequate protection of fish and wildlife resources.
31.	Wildlife Protection	Bald and Golden Eagle Protection Act.	16 U.S.C. §668a-d	Makes it unlawful to take, import, export, possess, buy, sell, purchase, or barter any bald or golden eagle, nest, or egg. “Take” is defined as pursuing, hunting, shooting, poisoning, wounding, killing, capturing, trapping and collecting, molesting, or disturbing.	No readily available information suggests bald or golden eagles frequent the Northern Impoundment; however, if bald or golden eagles are identified prior to or during construction, activities will be designed to conserve the species and their habitat.
32.	Wildlife Protection	Migratory Bird Treaty Act.	16 U.S.C. §§703-712; 50 CFR §10.12	Makes it unlawful to take, import, export, possess, buy, sell, purchase, or barter any migratory bird. “Take” is defined as pursuing, hunting, shooting, poisoning, wounding, killing, capturing, and trapping and collecting.	The Northern Impoundment remedy will be carried out in a manner to avoid adversely affecting migratory bird species, including individual birds or their nests.

Table 4-1

Applicable or Relevant and Appropriate Requirements (ARAR)
Final 100% Remedial Design - Northern Impoundment
San Jacinto River Waste Pits Site
Harris County, Texas

Item No.	Media/Topic	Status, Regulations, Standards, or Requirements	Citations or References	Description	Comment
33.	Wildlife Protection	State of Texas Threatened and Endangered (T&E) Species Regulations.	31 TAC 65.171 - 65.176	No person may take, possess, propagate, transport, export, sell or offer for sale, or ship any species of fish or wildlife listed as threatened or endangered.	During the RI/FS in 2010, a desktop review of photographs and USFWS and NMFS species and habitat maps was performed. Another evaluation was performed in 2021. Both evaluations concluded that there are no federally listed T&E or critical habitats present on the Northern Impoundment or in areas in the vicinity of the Northern Impoundment. An updated T&E Habitat Suitability Evaluation will be included in a submittal to the USACE following submittal of the Northern Impoundment 90% RD.
34.	Historic Preservation	National Historic Preservation Act.	16 U.S.C. §§ 470, et seq.; 36 CFR 800	Section 106 of this statute requires federal agencies to consider effects of their undertakings on historic properties. Historic properties may include any district, Site, building, structure, or object included in or eligible for the National Register of Historic Places (NRHP), including artifacts, records, and material remains related to such a property.	According to the San Jacinto River Waste Pits RI/FS cultural resources assessment, no NRHP-eligible properties are documented in the area of concern. This was further confirmed by a cultural resources assessment completed in December 2021. This assessment will be included in a submittal to the USACE following submittal of the 90% RD. This requirement is therefore not applicable.
35.	Historic Preservation	Natural Resources Code, Antiquities Code of Texas.	Texas Parks and Wildlife Commission Regulations 191.092-171	Requires that the Texas Historical Commission staff review any action that has the potential to disturb historic and archeological Sites on public land. Actions that need review include any construction program that takes place on land owned or controlled by a state agency or a state political subdivision, such as a city or a county. Without local control, this requirement does not apply.	According to the San Jacinto River Waste Pits RI/FS cultural resources assessment, no NRHP-eligible properties are documented in the area of concern. This was further confirmed by a cultural resources assessment completed in December 2021. This assessment will be included in a submittal to the USACE following submittal of the Northern Impoundment 90% RD. This requirement is therefore not applicable.
36.	Historic Preservation	Practice and Procedure, Administrative Code of Texas.	13 TAC Part 2, Chapter 26	Regulations implementing the Antiquities Code of Texas. Describes criteria for evaluating archaeological Sites and permit requirements for archaeological excavation.	This requirement is only applicable if an archaeological site is found; based on evaluations during the RI/FS, it is unlikely that archaeological resources would be found on the Northern Impoundment. This was further confirmed by a cultural resources assessment completed in December 2021. This requirement is therefore not expected to be applicable.
37.	Noise	Noise Control Act.	42 U.S.C. §§4901, et seq.; 40 CFR Subchapter G §201, et seq.	Noise Control Act remains in effect but unfunded.	Noise is regulated at the state level.
38.	Noise	Noise Regulations.	Texas Penal Code Chapter 42, Section 42.01	The Texas Penal Code regulates any noise that exceeds 85 decibels after the noise is identified as a public nuisance.	A noise is presumed to be unreasonable if the noise exceeds a decibel level of 85 at the point of potential human exposure after the person making the noise receives notice from a magistrate or peace officer that the noise is a public nuisance. Activities associated with the Northern Impoundment RA, as described in the Northern Impoundment 90% RD Package, are not likely to exceed the 85-decibel level beyond the immediate work area. The activities are not anticipated to constitute a public nuisance due to the isolation of the work, its location adjacent to a freeway with high volumes of traffic during normal working hours, and the industrial nature of activities on the Northern Impoundment. As indicated in the Site-Wide Monitoring Plan (Appendix J), noise impacts from pile driving will be assessed and monitored by the remedial contractor at the start of work.

Table 5-1

Excavation Removal Elevations
Final 100% Remedial Design – Northern Impoundment
San Jacinto River Waste Pits Site
Harris County, Texas

	SJSB073	SJSB058	SJSB101[1]	SJSB071[1]	SJSB037	SJSB070	SJSB099	SJGB013	SJSB100	SJSB098[1]	SJSB057[1]	SJSB103	SJSB097	SJSB056	SJSB056-C1	SJSB095	SJSB055-C1	SJSB055	SJSB096	SJGB014
Starting Elevation (Mud-line)	**1.29**	**0.62**	**-0.15**	**-0.80**	**1.43**	**-1.17**	**-0.61**	**-8.04**	**-13.36**	**-14.36**	**-18.39**	**-15.36**	**-15.64**	**-12.40**	**-4.29**	**-2.07**	**-9.54**	**-4.90**	**-6.55**	**-1.22**
ELEVATION (feet NAVD88)																				
+7																				
+6																				
+5																				
+4																				
+3																				
+2																				
+1	9.6	12			NA															
0	9.6	12	**63000**		NA															
-1	**31000**	**36100**	**63000**	**34700**	NA	**43900**	**53000**													**31625**
-2	**31000**	**36100**	**59000**	**34700**	NA	**43900**	**53000**									**35000**				**31625**
-3	**26000**	**48400**	**59000**	**45900**	**40400**	**68600**	**54000**									**35000**				**210.4**
-4	**26000**	**48400**	**25000**	**45900**	**40400**	**68600**	**54000**								0.79	**59**				**210.4**
-5	**68000**	**324**	**25000**	26.8	0.87	**45600**	**130**								0.79	**59**		1.36		**531.3**
-6	**68000**	**324**	18	26.8	0.87	**45600**	**130**								1.14	1.0		1.36		**531.3**
-7	**83000**	**1160**	18	2.24		**24300**	13								1.14	1.0		1.07	**87000**	**213.3**
-8	**83000**	**1160**	2.7	2.24		**24300**	13	**5100**							0.26	9.7		1.07	**87000**	**213.3**
-9	**41.0**	**376**	2.7	1.03	**618**	**16700**	15	**5100**							0.26	9.7		0.81	**22000**	18.6
-10	**41.0**	**376**	**230**	1.03	2.59	**16700**	15	**1740**							0.60	**1200**	**34.3**	0.81	**22000**	18.6
-11	5.2	**9890**	**230**	1.48	11.5	**1000**	**210**	**1740**							0.60	**1200**	**34.3**	1.28	**310**	1.29
-12	5.2	**9890**	0.62	1.48		**1000**	**210**	**338**						3.35	1.4	**57**	**31.1**	1.28	**310**	1.29
-13	15	**136**	0.62	0.52		**609**	1.9	**338**	**110**					3.35	1.4	**57**	**31.1**	2.53	4.9	
-14	15	**136**	0.27	0.52		**609**	1.9	**104**	**110**	**71**				1.65	1.33	6.0	1.34	2.53	4.9	
-15	5.6	**788**	0.27	**44.6**		6.9	26	**104**	3.7	**71**		2.2		1.65	1.33	6.0	1.34	0.89	**8500**	
-16	5.6	**788**	11	**44.6**		6.9	26	25.2	3.7	**1900**		2.2	5.2	0.80	0.60	**55**	0.70	0.89	**8500**	
-17		0.52	11	**45.4**		4.69	14	25.2	9.2	**1900**		1.1	5.2	0.80	0.60	**55**	0.70	1.09	**84.0**	
-18		0.52	3.2	**45.4**		4.69	14		9.2	**1800**	**24200**	1.1	1.2	0.78	0.62	0.60	1.07	1.09	**84.0**	
-19			3.2						0.81	**1800**	**24200**	14	1.2	0.78	0.62	0.60	1.07	1.42	5.2	
-20									0.81	**160**	**37600**	14	1.8	3.76	0.96		1.16	1.42	5.2	
-21									2.3	**160**	**37600**	4.8	1.8	3.76	0.96		1.16	0.92	1.9	
-22									2.3	**9600**	**3540**	4.8	1.4	0.93			0.67	0.92	1.9	
-23									0.58	**9600**	**3540**	3.9	1.4	0.93			0.67		13	
-24									0.58	**3900**	**372**	3.9	2.6	2.91			1.12		13	
-25									0.57	**3900**	**372**	0.49	2.6	2.91			1.12			
-26									0.57	**680**	7.6	0.49	0.77	4.44			5.49			
-27									0.51	**680**	7.6	0.46	0.77	4.44			5.49			
-28									0.51	11	2.93	0.46	1.4	0.46						
-29										11	2.93		1.4	0.46						
-30										0.16	15.9		0.29							
-31										0.16	15.9		0.29							
-32											1.59									
-33											1.59									
-34											1.5									
-35											1.5									
Calculated Exc. Elev.	**-10.71**	**-17.38**	**-17.65**	**-18.80**	**-9.57**	**-15.17**	**-12.61**	**-16.04**	**-15.36**	**-28.36**	**-26.39**	**-16.99**	**-15.64**	**-12.40**	**-21.92**	**-18.07**	**-13.54**	**-4.90**	**-18.55**	**-9.22**
Calculated Exc. Depth	**12**	**18**	**17.50**	**18**	**11**	**14**	**12**	**8**	**2**	**14**	**8**	**1.63**	**0**	**0**	**17.63**	**16**	**4**	**0**	**12**	**8**
Hydraulic Heave Elevation	**-20.00**	**-19.02**	**-18.38**	**-18.48**	**-20.02**	**-20.07**	**-22.27**	**-21.70**	**-20.41**	**-24.53**	**-15.65**	**-23.14**	**-26.20**	**-27.27**	**-28.24**	**-29.19**	**-31.84**	**-23.28**	**-28.55**	**-26.44**
Hydraulic Heave Depth	**21.29**	**19.64**	**18.23**	**17.68**	**21.45**	**18.90**	**21.66**	**13.66**	**7.05**	**10.17**	**-2.74**	**7.78**	**10.56**	**14.87**	**23.95**	**27.12**	**22.30**	**18.38**	**22.00**	**25.22**

Notes:

- Bold font indicates dioxins results >30 ng/kg TEQ.
- Yellow shading indicates material >30 ng/kg TEQ being removed.
- Green shading indicates material <30 ng/kg TEQ being removed.
- Red line indicates the elevation in each boring at which there is risk of hydraulic heave (Factor of Safety <1.25).
- Green line indicates the target removal elevation for each boring.
- Black line indicates the target removal and hydraulic heave elevations are essentially identical.
- Dark grey shading indicates soil borings in the northwest corner.

[1] Excavation to the deepest elevation of dioxins concentrations >30 ng/kg TEQ would be at risk of hydraulic heave.

Notes:

Table 5-1

Excavation Removal Elevations
Final 100% Remedial Design – Northern Impoundment
San Jacinto River Waste Pits Site
Harris County, Texas

	SJSB053-C1	SJSB053	SJSB054	SJSB094	SJSB052-C1	SJSB052	SJSB051	SJSB092	SJSB093	SJSB038	SJGB016	SJSB104	SJSB088	SJSB090	SJGB015	SJSB050-C1	SJSB033	SJGB012[1]	SJSB072[1]	SJSB074
Starting Elevation (Mud-line)	-7.40	-9.70	-7.40	-4.22	-2.20	-5.70	-2.70	-4.93	-1.53	-1.98	-2.07	-5.49	-2.12	-1.50	-5.94	-6.30	3.12	0.43	1.42	3.34
ELEVATION (feet NAVD88)																				
+7																				
+6																				
+5																				
+4																				
+3																	**95.6**			**7800**
+2																	**95.6**			**7800**
+1																	**1050**		NA	**70000**
0																	**1050**	**4050.5**	NA	**70000**
-1																	**7120**	**4050.5**	NA	**30000**
-2					9.22				**41000**	NA	**3517.8**		**39000**	**62000**			**7120**	**25065.3**	NA	**30000**
-3					9.22		3.02		**41000**	NA	**3517.8**		**39000**	**62000**			**5740**	**25065.3**	NA	**87**
-4				**36000**	1.2		3.02		**42000**	NA	**75.3**		**43000**	**6600**			**5740**	**24424.6**	NA	**87**
-5				**36000**	1.2		4.98	**43000**	**42000**	NA	**75.3**	15	**43000**	**6600**			**1700**	**24424.6**	NA	5.1
-6				**39000**	0.49	2.07	4.98	**43000**	**640**	NA	0.46	15	**50000**	**930**	1.22	2.27	**1700**	**17740**	NA	5.1
-7	0.806		**16600**	**39000**	0.49	2.07	2.48	**28000**	**640**	NA	0.46	2.8	**50000**	**930**	1.22	2.27	**157**	**17740**	12	3.1
-8	0.806		**16600**	**41000**	1.47	1.94	2.48	**28000**	0.68	NA	2.33	2.8	**71000**	6.4	0.64	1.97	**157**		12	3.1
-9	0.855		**1550**	**41000**	1.47	1.94	2.64	**130**	0.68	NA	2.33	11	**71000**	6.4	0.64	1.97	24		**340**	0.37
-10	0.855	1.79	**1550**	**17000**	2.32	1.99	2.64	**130**	**1900**	**96700**	6.15	11	**51000**	**260**	1.48	2.22	24		**340**	0.37
-11	1.34	1.79	6.43	**17000**	2.32	1.99	3.03	4.8	**1900**	**364**	6.15	2.6	**51000**	**260**	1.48	2.22	17.6		1.3	2.6
-12	1.34	0.92	6.43	**5500**	1.39	1.99	3.03	4.8	**1500**	**152**		2.6	5.3	5.3	1.51	3.1	17.6		1.3	2.6
-13	1.4	0.92	5.94	**5500**	1.39	1.99	1.71	27	**1500**	4.71		1.7	5.3	5.3	1.51	3.1	12.5		1.7	0.84
-14	1.4	1.44	5.94	**32**	1.71	2.01	1.71	27	**430**			1.7	0.68	9.1	0.85	1.31	12.5		1.7	0.84
-15	0.94	1.44	17.6	**32**	1.71	2.01	2.91	26	**430**			1.8	0.68	9.1	0.85	1.31			**34**	
-16	0.94	1.44	17.6	2.0	1.79	2.8	2.91	26	17			1.8	1.3	4.1		1.54			**34**	
-17	1.76	1.44	5.28	2.0	1.79	2.8	2.35	**10000**	17			0.53	1.3	4.1		1.54			0.52	
-18	1.76	1.28	5.28	3.2	2.08	2.24	2.35	**10000**	4.4			0.53	**1800**	2.3		3.38			0.52	
-19	1.15	1.28	**369**	3.2	2.08	2.24	2.48	11	4.4			0.25	**1800**	2.3		3.38			**120**	
-20	1.15	1.79	**369**	1.9		0.69	2.48	11				0.25	2.5			2.88			**120**	
-21	2.2	1.79	**32.7**	1.9		0.69		7.2				0.20	2.5			2.88			0.81	
-22	2.2	0.22	**32.7**			12.1		7.2				0.20	2.2			1.33			0.81	
-23		0.22	6.52			12.1							2.2			1.33				
-24		0.34	6.52										1.1							
-25		0.34											1.1							
-26		0.35																		
-27		0.35																		
-28																				
-29																				
-30																				
-31																				
-32																				
-33																				
-34																				
-35																				
Calculated Exc. Elev.	-11.93	-9.70	-23.40	-16.22	-16.91	-5.70	-2.70	-18.93	-15.53	-15.60	-14.16	-5.49	-20.12	-11.50	-9.57	-6.30	-8.88	-17.62	-20.58	-4.66
Calculated Exc. Depth	4.53	0	16	12	14.71	0	0	14	14	13.62	12.09	0	18	10	4	0	12	18.05	22	8
Hydraulic Heave Elevation	-24.37	-22.35	-23.73	-24.63	-24.11	-23.20	-22.01	-23.40	-22.91	-22.70	-22.84	-22.70	-21.98	-23.05	-22.82	-22.79	-18.68	-18.31	-18.35	-18.97
Hydraulic Heave Depth	16.97	12.65	16.33	20.41	21.91	17.50	19.31	18.47	21.38	20.72	20.77	17.21	19.86	21.55	16.88	16.49	21.80	18.74	19.77	22.31

Notes:
- Bold font indicates dioxins results >30 ng/kg TEQ.
- Yellow shading indicates material >30 ng/kg TEQ being removed.
- Green shading indicates material <30 ng/kg TEQ being removed.
- Red line indicates the elevation in each boring at which there is risk of hydraulic heave (Factor of Safety <1.25).
- Green line indicates the target removal elevation for each boring.
- Black line indicates the target removal and hydraulic heave elevations are essentially identical.
- Dark grey shading indicates soil borings in the northwest corner.

[1] Excavation to the deepest elevation of dioxins concentrations >30 ng/kg TEQ would be at risk of hydraulic heave.

Table 5-1

Excavation Removal Elevations
Final 100% Remedial Design – Northern Impoundment
San Jacinto River Waste Pits Site
Harris County, Texas

	SJSB076	SJSB075	SJSB036	SJGB011	SJSB032	SJSB077	SJGB010	SJSB078[1]	SJSB080	SJSB079	SJSB081	SJSB082	SJSB046-C1	SJSB083	SJSB102	SJSB028	SJSB045	SJSB045-C1	SJSB046	SJSB084
Starting Elevation (Mud-line)	**2.26**	**2.28**	**2.25**	**0.41**	**1.71**	**1.42**	**0.88**	**1.82**	**1.77**	**1.05**	**-2.26**	**-1.75**	**-2.39**	**-2.93**	**-2.05**	**4.48**	**-2.10**	**-1.30**	**-2.00**	**-3.86**
ELEVATION (feet NAVD88)																				
+7																				
+6																				
+5																				
+4																59.2				
+3																59.2				
+2	**3000**	NA	NA		**3410**			**33000**	**23000**							2.4				
+1	**3000**	NA	NA		**3410**	NA	**4723.8**	**33000**	**23000**	**32000**						2.4				
0	**49000**	NA	NA	**12724.8**	**7660**	NA	**4723.8**	**47000**	**14000**	**32000**						35.9				
-1	**49000**	NA	**50500**	**12724.8**	**7660**	NA	**30873.4**	**47000**	**14000**	**52000**						35.9		**286**		
-2	**63000**	**55000**	NA	**22222.8**	**3170**	NA	**30873.4**	**86000**	**9200**	**52000**	**2300**	**15000**	**1550**		**1400**	12.3	10.3	**286**	**636**	
-3	**63000**	**55000**	NA	**22222.8**	**3170**	NA	**6354**	**86000**	**9200**	**28000**	**2300**	**15000**	**1550**	**46000**	**1400**	12.3	10.3	**190**	**636**	
-4	**210**	NA	**276**	**9427.6**	6.19	NA	**6354**	**140**	**3200**	**28000**	**47000**	**670**	**3350**	**46000**	5.9	21.2	5.26	**190**	**2660**	**12000**
-5	**210**	NA	**276**	**9427.6**	6.19	**63000**	**194**	**140**	**3200**	**50000**	**47000**	**670**	**3350**	**2200**	5.9	21.2	5.26	**286**	**2660**	**12000**
-6	11	NA	NA	**14768.5**	**85.8**	**63000**	**194**	**100**	**1500**	**50000**	**47000**	**2000**	**2820**	**2200**	**340**	3.35	5.58	**286**	**8610**	**3200**
-7	11	NA	NA	**14768.5**	**85.8**	**77000**		**100**	**1500**	**50000**	**47000**	**2000**	**2820**	9.8	**340**	3.35	5.58	**46.8**	**8610**	**3200**
-8	**150**	**270**	**519**	**8707.4**	26.5	**77000**		**110**	12	**50000**	5.3	7.7	**11700**	9.8	24	2.59	4.88	**46.8**	**28500**	**45**
-9	**150**	**270**	19	**8707.4**	26.5	**150**		**110**	12	**190**	5.3	7.7	**11700**	14	24	2.59	4.88	**54.6**	**28500**	**45**
-10	21	0.88	**189**	3.37	15.9	**150**		16	1.5	**190**	**19000**	**120**	**14900**	14	5.6	2.39	3.25	**54.6**	**6930**	23
-11	21	0.88		3.37	15.9	24		16	1.5	3.1	**19000**	**120**	**14900**	**15000**	5.6	2.39	3.25	**50.4**	**6930**	23
-12	5.2	1.8			2.13	24		12	0.44	3.1	**280**	4.1	**55.1**	**15000**	2.5	1.19	0.72	**50.4**	**111**	6.1
-13	5.2	1.8			2.13	**350**		12	0.44	16	**280**	4.1	**55.1**	**200**	2.5	1.19	0.72	3.79	**111**	6.1
-14	3.7	6.7			12.7	**350**		**140**	13	16	2.8	1.1	**2230**	**200**	**34**		1.52	3.79	**3420**	7.8
-15	3.7	6.7			12.7	0.21		**140**	13	0.64	2.8	1.1	**2230**	24	**34**		1.52	22.4	**3420**	7.8
-16						0.21		2.7		0.64	1.7	3.7	**205**	24	1.4		2.36	22.4	**1710**	6.1
-17								2.7			1.7	3.7	**205**	9.0	1.4		2.36	5.81	**1710**	6.1
-18								**260**			0.87	0.99	**5690**	9.0	**110**		4.96	5.81	**3400**	3.7
-19								**260**			0.87	0.99	**5690**	0.72	**110**		4.96		**3400**	3.7
-20								0.42						0.72	8.9				4.82	3.9
-21								0.42						4.8	8.9				4.82	3.9
-22														4.8	3.9					
-23															3.9					
-24															4.0					
-25															4.0					
-26																				
-27																				
-28																				
-29																				
-30																				
-31																				
-32																				
-33																				
-34																				
-35																				
Calculated Exc. Elev.	**-9.74**	**-9.82**	**-10.75**	**-9.59**	**-8.29**	**-14.58**	**-15.21**	**-20.18**	**-8.23**	**-10.95**	**-14.26**	**-11.75**	**-20.39**	**-19.07**	**-20.05**	**-1.52**	**-2.10**	**-13.30**	**-20.00**	**-9.86**
Calculated Exc. Depth	**12**	**12.10**	**13**	**10**	**10**	**16**	**16**	**22**	**10**	**12**	**12**	**10**	**18**	**16.14**	**18**	**6**	**0**	**12**	**18**	**6**
Hydraulic Heave Elevation	**-18.86**	**-18.52**	**-18.64**	**-19.19**	**-19.02**	**-18.76**	**-18.73**	**-18.72**	**-19.00**	**-19.16**	**-20.47**	**-20.49**	**-21.13**	**-21.25**	**-20.91**	**-19.48**	**-19.65**	**-20.37**	**-20.90**	**-21.10**
Hydraulic Heave Depth	**21.12**	**20.80**	**20.89**	**19.60**	**20.73**	**20.18**	**19.61**	**20.54**	**20.77**	**20.21**	**18.21**	**18.74**	**18.74**	**18.32**	**18.86**	**23.96**	**17.55**	**19.07**	**18.90**	**17.24**

Notes:
- Bold font indicates dioxins results >30 ng/kg TEQ.
- Yellow shading indicates material >30 ng/kg TEQ being removed.
- Green shading indicates material <30 ng/kg TEQ being removed.
- Red line indicates the elevation in each boring at which there is risk of hydraulic heave (Factor of Safety <1.25).
- Green line indicates the target removal elevation for each boring.
- Black line indicates the target removal and hydraulic heave elevations are essentially identical.
- Dark grey shading indicates soil borings in the northwest corner.

[1] Excavation to the deepest elevation of dioxins concentrations >30 ng/kg TEQ would be at risk of hydraulic heave.

Table 5-1

Excavation Removal Elevations
Final 100% Remedial Design – Northern Impoundment
San Jacinto River Waste Pits Site
Harris County, Texas

	SJSB087	SJGB017	SJSB086	SJSB047-C1	SJSB047	SJSB085	SJSB048	SJSB048-C1[1]	SJSB049	SJSB089	SJSB050	SJSB105	SJSB106	SJSB091	SJSB029	SJSB030	SJSB031	SJSB034	SJSB035
Starting Elevation (Mud-line)	**-3.01**	**-1.85**	**-2.72**	**-4.00**	**-2.10**	**-5.67**	**-2.40**	**-4.00**	**-5.10**	**-2.88**	**-3.40**	**-4.36**	**-3.10**	**-3.58**	**2.68**	**4.33**	**5.12**	**6.99**	**6.64**
ELEVATION (feet NAVD88)																			
+7																		5.12	1.32
+6																		5.12	1.32
+5																	2.46	1.17	0.59
+4																5.54	2.46	1.17	0.59
+3															14.90	5.54	0.77	3.04	1.00
+2															14.9	1.9	0.77	3.04	1.00
+1															2.95	1.9	0.67	0.99	0.90
0															2.95	0.74	0.67	0.99	0.90
-1															2.12	0.74	0.72	0.98	0.64
-2		1.95			1.19		1.7								2.12	2.81	0.72	0.98	0.64
-3	**4600**	1.95	5.0		1.19		1.7			**820**	7.41		**39**		1.48	2.81	0.73	0.81	0.80
-4	**4600**	1.46	5.0	**7470**	1.35		1.02	**623**		**820**	7.41	**36000**	**39**	16	1.48	0.44	0.73	0.81	0.80
-5	**25000**	1.46	2.3	**7470**	1.35		1.02	**623**	**23600**	**53**	3.13	**36000**	3.6	16	1.35	0.44	0.97	0.59	1.26
-6	**25000**	0.91	2.3	**6310**	1.53	**42000**	1.72	**55.1**	**23600**	**53**	3.13	**48000**	3.6	6.7	1.35	0.82	0.97	0.59	1.26
-7	**2300**	0.91	1.3	**6310**	1.53	**42000**	1.72	**55.1**	**6640**	18	1.33	**48000**	9.4	6.7	2.45	0.82	0.33	1.5	0.96
-8	**2300**	0.85	1.3	**139**	2.73	**720**	2.46	**592**	**6640**	18	1.33	**240**	9.4	5.2	2.45	0.45	0.33	1.5	0.96
-9	10	0.85	1.2	**139**	2.73	**720**	2.46	**592**	**2350**	3.5	1.48	**240**	2.9	5.2	1.36	0.45	0.65	0.897	0.52
-10	10	0.18	1.2	29.4	2.03	27	2.52	4.95	**2350**	3.5	1.48	29	2.9	2.7	1.36	0.59	0.65	0.897	0.52
-11	**570**	0.18	2.2	29.4	2.03	27	2.52	4.95	**110**	**52**	3.38	29	3.4	2.7	0.77	0.59	0.36		
-12	**570**		2.2	**769**	1.41	**44**	1.77	**323**	**110**	**52**	3.38	13	3.4	2.1	0.77	0.98	0.36		
-13	3.5		2.3	**769**	1.41	**44**	1.77	**323**	**251**	**34**	2.71	13	2.6	2.1	9.13	0.98			
-14	3.5		2.3	**685**	1.69	25	2.03	6.35	**251**	**34**	2.71	17	2.6	2.4	9.13				
-15	**110**		3.2	**685**	1.69	25	2.03	6.35	**112**	2.00	1.81	17	2.6	2.4					
-16	**110**		3.2	**821**	1.98	4.3	1.66	**147**	**112**	2.00	1.81	**1400**	2.6	2.4					
-17	**1500**		2.9	**821**	1.98	4.3	1.66	**147**	**117**	2.30	1.77	**1400**	1.6	2.4					
-18	**1500**		2.9	**327**	1.67	7.0	2.56	**143**	**117**	2.30	1.77	**60**	1.6	2.2					
-19	3.0		1.6	**327**	1.67	7.0	2.56	**143**	28.1	0.40	0.351	**60**	3.4	2.2					
-20	3.0		1.6	7.35		11		**219**	28.1	0.40	0.351	7.7	3.4	2.7					
-21				7.35		11		**219**	5.87			7.7		2.7					
-22						7.8		11.8	5.87										
-23						7.8		11.8											
-24								1.07											
-25								1.07											
-26																			
-27																			
-28																			
-29																			
-30																			
-31																			
-32																			
-33																			
-34																			
-35																			
Calculated Exc. Elev.	**-19.01**	**-17.04**	**-13.09**	**-20.00**	**-4.28**	**-13.67**	**-3.20**	**-22.00**	**-19.10**	**-14.88**	**-3.40**	**-20.36**	**-15.38**	**-18.10**	**2.68**	**4.33**	**5.12**	**-9.55**	**-14.71**
Calculated Exc. Depth	**16**	**15.19**	**10.37**	**16**	**2.18**	**8**	**1**	**18**	**14**	**12**	**0**	**16**	**12.28**	**14.52**	**0**	**0**	**0**	**16.54**	**21.35**
Hydraulic Heave Elevation	**-21.16**	**-22.02**	**-21.65**	**-21.35**	**-16.76**	**-22.55**	**-19.70**	**-21.87**	**-22.86**	**-22.73**	**-20.58**	**-21.95**	**-23.14**	**-22.79**	**-19.95**	**-19.64**	**-18.90**	**-23.99**	**-20.54**
Hydraulic Heave Depth	**18.15**	**20.17**	**18.93**	**17.35**	**14.66**	**16.88**	**17.30**	**17.87**	**17.76**	**19.85**	**17.18**	**17.59**	**20.04**	**19.21**	**22.63**	**23.97**	**24.02**	**30.98**	**27.18**

Notes:
- Bold font indicates dioxins results >30 ng/kg TEQ.
- Yellow shading indicates material >30 ng/kg TEQ being removed.
- Green shading indicates material <30 ng/kg TEQ being removed.
- Red line indicates the elevation in each boring at which there is risk of hydraulic heave (Factor of Safety <1.25).
- Green line indicates the target removal elevation for each boring.
- Black line indicates the target removal and hydraulic heave elevations are essentially identical.
- Dark grey shading indicates soil borings in the northwest corner.

[1] Excavation to the deepest elevation of dioxins concentrations >30 ng/kg TEQ would be at risk of hydraulic heave.

Table 5-2

Water Treatment Basis of Sizing
Final 100% Remedial Design - Northern Impoundment
San Jacinto River Waste Pits Site
Harris County, Texas

Equipment/Process Description	Sizing/Selection Criteria	Bulk Water Design Value	Contact Water Design Value	Notes & Design Assumptions
Dewatering Pump(s)	Between the dewatering pump(s), influent tank(s), and effluent storage tanks, dewater the entire excavation (BMP) area from a 24-hour 9.3-inch (99.9th percentile during the anticipated construction season) rainfall event in under 5 days	4,000 gpm	2,000 gpm	- Pump(s) will shutdown on high level in influent tank(s) - See pump schedule for preliminary discharge head
Influent Tanks	See dewatering pump(s) criteria	~1 million gallons (working volume)	~2 million gallons (working volume)	- Rain for Rent LakeTank B-32 storage tank (~1.3 million-gallons) - 80% working volume per tank (~1 million gallons) - Minimum 12-inch freeboard - Minimum 24-inch water level to keep bottom liner in place
Effluent Storage Tanks	See dewatering pump(s) criteria	N/A	~4.8 million gallons (working volume)	- Rain for Rent LakeTank B-36 storage tank (~1.5 million-gallons) - 80% working volume per tank (~1.2 million gallons) - Minimum 12-inch freeboard - Minimum 24-inch water level to keep bottom liner in place
Containment Area Sump Pumps	Dewater the containment areas to allow work to resume as reasonably practicable	N/A	TBD by Contractor	- Contractor will select pump(s) to dewater the containment areas - Pumps will shutdown on low level in containment area sump(s) - Pumps will shutdown on high level in receiving tanks - See pump schedule for preliminary discharge head and flowrate
Frac Tanks	Provide flow equalization	N/A	18,000 gal (working volume)	
Transfer Pump (Effluent Storage Area Frac Tank)	Transfer containment water from the effluent storage area to the influent tanks	N/A	600 gpm	- Pump will shutdown on low level in effluent storage area frac tank - Pump will shutdown on high level in influent tanks - See Pump schedule for preliminary discharge head
Transfer Pump (Treatment Sytem (WTS) Area Frac Tank)	Transfer treated effluent from the WTS to the effluent storage tanks	N/A	1,000 gpm	- Pump will shutdown on low level in treatment system (WTS) area frac tank - Pump will shutdown on high level in effluent storage tanks (as relevant) - See pump schedule for preliminary discharge head
Transfer Pump (Effluent Storage)	Transfer water stored in the effluent storage tanks to the treatment system (WTS) area for retreatment or discharge to river	N/A	1,000 gpm	- Pump will shutdown on low level in effluent storage tanks (as relevant) - Pump will shutdown on high level in influent tanks (as relevant) - See pump schedule for preliminary discharge head
Treatment Feed Pump(s)	Base 300 gpm treatment rate with option to double to 600 gpm	N/A	300 gpm (base) 600 gpm (optional)	- Pump(s) will operate on VFD to adjust treatment rate, as required - Pump(s) will shutdown on low level in influent tanks - Pump(s) will shutdown on high level in rapid mix tank(s)
Rapid Mix Tank(s)	Minimum 7 minute retention time	N/A	Min. 2,100 gal (working volume)	- Mixer(s) will operate at high enough velocity to fully mix chemicals
Flocculation/Clarifier Feed Pump(s)	Base 300 gpm treatment rate with option to double to 600 gpm	N/A	300 gpm (base) 600 gpm (optional)	- Pump(s) will operate on VFD to adjust treatment rate, as required - Pump(s) will shutdown on low level in rapid mix tank(s) - Pump(s) will shutdown on high level in flocculation/clarifier tank(s)
Flocculation/Clarifier Tank(s) (Flocculation Section)	Minimum 7 minute retention time	N/A	Min. 2,100 gal (working volume)	- Tank(s) will include separate flocculation and inclined plate clarifier sections - Flocculation and clarification sections will flow by gravity - Flocculation section will include baffles to prevent vortexing - Flocculation section will be mixed by top entry variable speed mixer(s) - Mixer(s) will have paddle-type blades to prevent shearing solids

Table 5-2

Water Treatment Basis of Sizing
Final 100% Remedial Design - Northern Impoundment
San Jacinto River Waste Pits Site
Harris County, Texas

Equipment/Process Description	Sizing/Selection Criteria	Bulk Water Design Value	Contact Water Design Value	Notes & Design Assumptions
Flocculation/Clarifier Tank(s) (Clarification Section)	Maximum 0.25 gpm/ft^2 hydraulic loading rate	N/A	Min. 1,200 ft^2	- Tank(s) will include separate flocculation and inclined plate clarifier sections - Flocculation and clarification sections will flow by gravity - Clarification section will include sludge hopper to allow for sludge withdrawal
Filter Feed Pump(s)	Base 300 gpm treatment rate with option to double to 600 gpm	4,000 gpm	300 gpm (base) 600 gpm (optional)	- Pump(s) will operate on VFD to adjust treatment rate, as required - Pump(s) will shutdown on low level in flocculation/clarifier tank(s) - Pump(s) will shutdown on high level in treatment system (WTS) area frac tank
Sand Filters	5-15 gpm/ft2 hydraulic loading rate	Min. 800 ft^2 (active filter area)	Min. 60 ft^2 (active filter area)	- Minimum of three vessels with forward-feed automated backwash
Bag or Cartridge Filtration System(s) (10 um)	300 gpm 10 micron filtration capacity with minimum 95% removal efficiency	Min. 4,000 gpm	Min. 300 gpm	- Rain for Rent BF2000 10-um Bag Filtration Units (2,000 gpm) (bulk water) - Rosedale Filter Cartridge Model PL-POMF-R1-10-P2
Bag or Cartridge Filtration System (1 um)	300 gpm 1 micron filtration capacity with minimum 95% removal efficiency	Min. 4,000 gpm	Min. 300 gpm	- Rain for Rent BF2000 1-um Bag Filtration Units (2,000 gpm) (bulk water) - Rosedale Filter Cartridge Model PL-POMF-R1-1-P2
Granular Activated Carbon (GAC) Adsorbers (Lead/Lag)	Two stage 20 minute total empty bed contact time with maximum 2-5 gpm/ft2 hydraulic loading rate	N/A	Min. 60 ft^2 (active bed area) Min. 800 ft^3 (bed volume)	- GAC vessels will be lead-lag with 10 minute contact time each
Flocculation/Clarifier Tank Sludge Pump(s)	At a rate sufficient to remove generated solids	N/A	TBD by Contractor	- Pump(s) will be positive displacement pump(s) (e.g., air diaphragm) - Flowrate will depend on solids accumulation rate - Flowrate will be adjusted during start-up and operations
Dewatering Boxes	Allow for dewatering of sludge from inclined plate clarifier in flocculatio/clarifier tank to 6-8 percent solids	N/A	25 cy Each	- Filter fabric over a false bottom box to trap solids and allow water to drain
Polymer Feed Pump(s)	Flow paced based upon treatment rate	TBD by Contractor	TBD by Contractor	- Use of chemical metering pumps (e.g., diaphragm, peristaltic) - Flowrate (dosing rate) will be adjusted during start-up and operations
Coagulant Feed Pump(s)	Flow paced based upon treatment rate	TBD by Contractor	TBD by Contractor	- Use of chemical metering pumps (e.g., diaphragm, peristaltic) - Flowrate (dosing rate) will be adjusted during start-up and operations
Caustic Feed Pump(s) (as needed)	Flow paced based upon measured pH of contact water leading to rapid mix tank	N/A	TBD by Contractor	- Use of chemical metering pumps (e.g., diaphragm, peristaltic) - Flowrate (dosing rate) will be adjusted during start-up and operations
Acid Feed Pump(s) (as needed)	Flow paced based upon measured pH of contact water leading to rapid mix tank	N/A	TBD by Contractor	- Use of chemical metering pumps (e.g., diaphragm, peristaltic) - Flowrate (dosing rate) will be adjusted during start-up and operations
Organosulfide Feed Pump(s) (as needed)	Flow paced based upon treatment rate	N/A	TBD by Contractor	- Use of chemical metering pumps (e.g., diaphragm, peristaltic) - Flowrate (dosing rate) will be adjusted during start-up and operations
Discharge Diffuser	Adequately diffuse discharge flows into the river to mitigate potential erosion and scouring issues	Min. 4,000 gpm	Min. 1,000 gpm	- Refer to civil details

Notes:
- The 100% process flow diagram (drawing P-001 & P-002) and piping and instrumentation diagrams (drawings P-003 through P-009) illustrate the major water treatment system equipment and components.
- The 100% pump schedule (drawing P-017) illustrate the pump criteria and preliminary selections
- The 100% civil details (drawing C-27) illustrate the design of the discharge diffuser

Abbreviations:
gpm - Gallons per Minute
VFD - Variable Frequency Drive
ft^2 - Square Feet
ft^3 - Cubic Feet
ppm - Parts per Million
gph - Gallons per Hour
cy - Cubic Yard

Table 6-1

Sand Separation Area Analytical Results - Northern Impoundment
Final 100% Remedial Design - Northern Impoundment
San Jacinto River Waste Pits Site
Harris County, Texas

Area Sample Location: Sample Identification: Sample Date: Sample Depth:	Units	Sand Separation Area SJSSA01 11187072-120719-SS-SJSSA01 (0-1) 12/7/2019 (0-1) ft bgs	Sand Separation Area SJSSA01 11187072-120719-SS-SJSSA01 (0-2.5 CM) 12/7/2019 (0-2.5) cm	Sand Separation Area SJSSA01 11187072-120719-SS-SJSSA01 (1-2) 12/7/2019 (1-2) ft bgs	Sand Separation Area SJSSA01 11187072-120719-SS-SJSSA01 (2-4) 12/7/2019 (2-4) ft bgs	Sand Separation Area SJSSA01 11187072-120719-SS-SJSSA01 (4-6) 12/7/2019 (4-6) ft bgs	Sand Separation Area SJSSA01 11187072-120719-SS-SJSSA01 (7.5-10 CM) 12/7/2019 (7.5-10) cm	Sand Separation Area SJSSA01 11187072-120719-SS-SJSSA01 (15-17.5 CM) 12/7/2019 (15-17.5) cm
Dioxins/Furans								
1,2,3,4,6,7,8,9-Octachlorodibenzofuran (OCDF)	pg/g	48	--	23	4.5 U	35	--	--
1,2,3,4,6,7,8,9-Octachlorodibenzo-p-dioxin (OCDD)	pg/g	2400	--	1100	330	1100	--	--
1,2,3,4,6,7,8-Heptachlorodibenzofuran (HpCDF)	pg/g	6.6 J	--	2.5 J	0.86 J	3.9 J	--	--
1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin (HpCDD)	pg/g	62	--	41	16	45	--	--
1,2,3,4,7,8,9-Heptachlorodibenzofuran (HpCDF)	pg/g	1.0 J	--	0.19 U	0.14 U	0.65 J	--	--
1,2,3,4,7,8-Hexachlorodibenzofuran (HxCDF)	pg/g	1.8 J	--	0.79 J	0.25 J	1.7 J	--	--
1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin (HxCDD)	pg/g	1.0 J	--	0.65 J	0.54 J	0.81 J	--	--
1,2,3,6,7,8-Hexachlorodibenzofuran (HxCDF)	pg/g	0.91 J	--	0.39 J	0.096 U	0.74 J	--	--
1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin (HxCDD)	pg/g	1.5 J	--	0.96 U	0.62 U	1.3 J	--	--
1,2,3,7,8,9-Hexachlorodibenzofuran (HxCDF)	pg/g	0.15 U	--	0.41 J	0.20 J	0.12 U	--	--
1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin (HxCDD)	pg/g	3.2 J	--	2.4 J	1.5 J	2.5 J	--	--
1,2,3,7,8-Pentachlorodibenzofuran (PeCDF)	pg/g	1.1 J	--	0.74 J	0.44 J	1.2 J	--	--
1,2,3,7,8-Pentachlorodibenzo-p-dioxin (PeCDD)	pg/g	0.48 J	--	0.32 U	0.29 U	0.29 U	--	--
2,3,4,6,7,8-Hexachlorodibenzofuran (HxCDF)	pg/g	0.55 J	--	0.20 J	0.095 U	0.14 U	--	--
2,3,4,7,8-Pentachlorodibenzofuran (PeCDF)	pg/g	0.75 J	--	0.14 U	0.12 U	0.17 U	--	--
2,3,7,8-Tetrachlorodibenzofuran (TCDF)	pg/g	27	--	21	15	38	--	--
2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	pg/g	8.6	--	7.0	3.4	12	--	--
Total heptachlorodibenzofuran (HpCDF)	pg/g	17 J	--	7.4 J	2.7 J	11 J	--	--
Total heptachlorodibenzo-p-dioxin (HpCDD)	pg/g	210 J	--	170 J	63 J	160 J	--	--
Total hexachlorodibenzofuran (HxCDF)	pg/g	7.4 J	--	3.5 J	0.45 J	5.5 J	--	--
Total hexachlorodibenzo-p-dioxin (HxCDD)	pg/g	49 J	--	41 J	27 J	46 J	--	--
Total pentachlorodibenzofuran (PeCDF)	pg/g	4.0 J	--	1.5 J	0.44 J	3.3 J	--	--
Total pentachlorodibenzo-p-dioxin (PeCDD)	pg/g	9.6 J	--	5.3 J	6.6 J	10 J	--	--
Total tetrachlorodibenzofuran (TCDF)	pg/g	38 J	--	31 J	15 J	53 J	--	--
Total tetrachlorodibenzo-p-dioxin (TCDD)	pg/g	14 J	--	11 J	11 J	17 J	--	--
Total WHO Dioxin TEQ(Human/Mammal)(ND=0)	pg/g	14.4	--	10.4	5.43	17.4	--	--
Total WHO Dioxin TEQ(Human/Mammal)(ND=0.5)	pg/g	14.4	--	10.6	5.63	17.6	--	--
Radiochemistry								
Cesium-137	pCi/g	--	0.1323 U+/-0.08434	--	--	--	0.1896 U+/-0.1132	0.1845 U+/-0.09896
Lead-210	pCi/g	--	0.713 +/-0.0564	--	--	--	0.694 +/-0.0588	0.5 +/-0.0513
General Chemistry								
Percent solids	%	45.2	--	57.4	53.6	57.2	--	--

Notes:
pg/g - picogram per gram
pCi/g - picocuries per gram
DUP - indicates the result from a duplicate sample
U - Not detected at the associated reporting limit.
J - Estimated concentration.
-- - Not analyzed

Table 6-1

Sand Separation Area Analytical Results - Northern Impoundment
Final 100% Remedial Design - Northern Impoundment
San Jacinto River Waste Pits Site
Harris County, Texas

Area Sample Location: Sample Identification: Sample Date: Sample Depth:	Units	Sand Separation Area SJSSA01 11187072-120719-SS-SJSSA01 (22.5-25 CM) 12/7/2019 (22.5-25) cm	Sand Separation Area SJSSA01 11187072-120719-SS-SJSSA01 (30-32.5 CM) 12/7/2019 (30-32.5) cm	Sand Separation Area SJSSA01 11187072-120719-SS-SJSSA01 (37.5-40 CM) 12/7/2019 (37.5-40) cm	Sand Separation Area SJSSA01 11187072-120719-SS-SJSSA01 (45-47.5 CM) 12/7/2019 (45-47.5) cm	Sand Separation Area SJSSA01 11187072-120719-SS-SJSSA01 (52.5-55 CM) 12/7/2019 (52.5-55) cm	Sand Separation Area SJSSA01 11187072-120719-SS-SJSSA01 (60-62.5 CM) 12/7/2019 (60-62.5) cm	Sand Separation Area SJSSA01 11187072-120719-SS-SJSSA01 (70-72.5 CM) 12/7/2019 (70-72.5) cm
Dioxins/Furans								
1,2,3,4,6,7,8,9-Octachlorodibenzofuran (OCDF)	pg/g	--	--	--	--	--	--	--
1,2,3,4,6,7,8,9-Octachlorodibenzo-p-dioxin (OCDD)	pg/g	--	--	--	--	--	--	--
1,2,3,4,6,7,8-Heptachlorodibenzofuran (HpCDF)	pg/g	--	--	--	--	--	--	--
1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin (HpCDD)	pg/g	--	--	--	--	--	--	--
1,2,3,4,7,8,9-Heptachlorodibenzofuran (HpCDF)	pg/g	--	--	--	--	--	--	--
1,2,3,4,7,8-Hexachlorodibenzofuran (HxCDF)	pg/g	--	--	--	--	--	--	--
1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin (HxCDD)	pg/g	--	--	--	--	--	--	--
1,2,3,6,7,8-Hexachlorodibenzofuran (HxCDF)	pg/g	--	--	--	--	--	--	--
1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin (HxCDD)	pg/g	--	--	--	--	--	--	--
1,2,3,7,8,9-Hexachlorodibenzofuran (HxCDF)	pg/g	--	--	--	--	--	--	--
1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin (HxCDD)	pg/g	--	--	--	--	--	--	--
1,2,3,7,8-Pentachlorodibenzofuran (PeCDF)	pg/g	--	--	--	--	--	--	--
1,2,3,7,8-Pentachlorodibenzo-p-dioxin (PeCDD)	pg/g	--	--	--	--	--	--	--
2,3,4,6,7,8-Hexachlorodibenzofuran (HxCDF)	pg/g	--	--	--	--	--	--	--
2,3,4,7,8-Pentachlorodibenzofuran (PeCDF)	pg/g	--	--	--	--	--	--	--
2,3,7,8-Tetrachlorodibenzofuran (TCDF)	pg/g	--	--	--	--	--	--	--
2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	pg/g	--	--	--	--	--	--	--
Total heptachlorodibenzofuran (HpCDF)	pg/g	--	--	--	--	--	--	--
Total heptachlorodibenzo-p-dioxin (HpCDD)	pg/g	--	--	--	--	--	--	--
Total hexachlorodibenzofuran (HxCDF)	pg/g	--	--	--	--	--	--	--
Total hexachlorodibenzo-p-dioxin (HxCDD)	pg/g	--	--	--	--	--	--	--
Total pentachlorodibenzofuran (PeCDF)	pg/g	--	--	--	--	--	--	--
Total pentachlorodibenzo-p-dioxin (PeCDD)	pg/g	--	--	--	--	--	--	--
Total tetrachlorodibenzofuran (TCDF)	pg/g	--	--	--	--	--	--	--
Total tetrachlorodibenzo-p-dioxin (TCDD)	pg/g	--	--	--	--	--	--	--
Total WHO Dioxin TEQ(Human/Mammal)(ND=0)	pg/g	--	--	--	--	--	--	--
Total WHO Dioxin TEQ(Human/Mammal)(ND=0.5)	pg/g	--	--	--	--	--	--	--
Radiochemistry								
Cesium-137	pCi/g	0.1497 U+/-0.08256	0.1376 U+/-0.08681	0.1214 U+/-0.07948	0.09617 U+/-0.07003	0.09826 U+/-0.06292	0.1139 U+/-0.07255	0.1443 U+/-0.07964
Lead-210	pCi/g	0.635 +/-0.0545	0.682 +/-0.0577	0.513 +/-0.059	0.538 +/-0.0583	0.599 +/-0.0532	0.465 +/-0.0503	0.456 +/-0.0478
General Chemistry								
Percent solids	%	--	--	--	--	--	--	--

Notes:
pg/g - picogram per gram
pCi/g - picocuries per gram
DUP - indicates the result from a duplicate sample
U - Not detected at the associated reporting limit.
J - Estimated concentration.
-- - Not analyzed

Table 6-1

Sand Separation Area Analytical Results - Northern Impoundment
Final 100% Remedial Design - Northern Impoundment
San Jacinto River Waste Pits Site
Harris County, Texas

Area:		Sand Separation Area	Sand Separation Area	Sand Separation Area	Sand Separation Area	Sand Separation Area	Sand Separation Area	Sand Separation Area	Sand Separation Area
Sample Location:		SJSSA01	SJSSA02	SJSSA02	SJSSA02	SJSSA02	SJSSA02	SJSSA02	SJSSA02
Sample Identification:	Units	11187072-120719-SS-SJSSA01 (80-82.5 CM)	11187072-120719-SS-SJSSA02 (0-2.5 CM)	11187072-120719-SS-SJSSA02(0-1)	11187072-120719-SS-SJSSA02(1-2)	11187072-120719-SS-SJSSA02(2-4)	11187072-120719-SS-SJSSA02(4-6)	11187072-120719-SS-SJSSA02 (7.5-10 CM)	11187072-120719-SS-SJSSA02 (15-17.5 CM)
Sample Date:		12/7/2019	12/7/2019	12/7/2019	12/7/2019	12/7/2019	12/7/2019	12/7/2019	12/7/2019
Sample Depth:		(80-82.5) cm	(0-2.5) cm	(0-1) ft bgs	(1-2) ft bgs	(2-4) ft bgs	(4-6) ft bgs	(7.5-10) cm	(15-17.5) cm
Dioxins/Furans									
1,2,3,4,6,7,8,9-Octachlorodibenzofuran (OCDF)	pg/g	--	--	3.8 U	4.3 U	25	5.3 U	--	--
1,2,3,4,6,7,8,9-Octachlorodibenzo-p-dioxin (OCDD)	pg/g	--	--	400	510	1000	450	--	--
1,2,3,4,6,7,8-Heptachlorodibenzofuran (HpCDF)	pg/g	--	--	0.67 U	2.6 J	4.2 J	0.90 U	--	--
1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin (HpCDD)	pg/g	--	--	14 J	21	44	22	--	--
1,2,3,4,7,8,9-Heptachlorodibenzofuran (HpCDF)	pg/g	--	--	0.083 U	0.52 U	0.77 U	0.062 U	--	--
1,2,3,4,7,8-Hexachlorodibenzofuran (HxCDF)	pg/g	--	--	0.094 U	1.1 J	2.3 J	0.42 J	--	--
1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin (HxCDD)	pg/g	--	--	0.14 U	0.33 J	0.39 J	0.39 J	--	--
1,2,3,6,7,8-Hexachlorodibenzofuran (HxCDF)	pg/g	--	--	0.092 U	0.35 J	0.73 J	0.23 J	--	--
1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin (HxCDD)	pg/g	--	--	0.32 J	0.42 J	1.1 J	0.54 J	--	--
1,2,3,7,8,9-Hexachlorodibenzofuran (HxCDF)	pg/g	--	--	0.13 U	0.12 U	0.20 U	0.11 U	--	--
1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin (HxCDD)	pg/g	--	--	0.80 J	1.4 J	2.3 J	1.0 J	--	--
1,2,3,7,8-Pentachlorodibenzofuran (PeCDF)	pg/g	--	--	0.095 U	0.063 U	1.3 J	0.10 U	--	--
1,2,3,7,8-Pentachlorodibenzo-p-dioxin (PeCDD)	pg/g	--	--	0.062 U	0.17 J	0.42 J	0.080 U	--	--
2,3,4,6,7,8-Hexachlorodibenzofuran (HxCDF)	pg/g	--	--	0.097 U	0.084 U	0.25 J	0.081 U	--	--
2,3,4,7,8-Pentachlorodibenzofuran (PeCDF)	pg/g	--	--	0.092 U	0.061 U	1.2 J	0.26 J	--	--
2,3,7,8-Tetrachlorodibenzofuran (TCDF)	pg/g	--	--	3.6 J	3.2	18	2.0	--	--
2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	pg/g	--	--	1.1 J	1.1 J	6.8	0.62 J	--	--
Total heptachlorodibenzofuran (HpCDF)	pg/g	--	--	1.5 J	4.8 J	11 J	2.3 J	--	--
Total heptachlorodibenzo-p-dioxin (HpCDD)	pg/g	--	--	48 J	77 J	150 J	70 J	--	--
Total hexachlorodibenzofuran (HxCDF)	pg/g	--	--	0.85 J	3.1 J	8.7 J	2.2 J	--	--
Total hexachlorodibenzo-p-dioxin (HxCDD)	pg/g	--	--	18 J	34 J	51 J	26 J	--	--
Total pentachlorodibenzofuran (PeCDF)	pg/g	--	--	0.095 U	1.1 J	6.1 J	0.88 J	--	--
Total pentachlorodibenzo-p-dioxin (PeCDD)	pg/g	--	--	4.3 J	8.8 J	11 J	4.6 J	--	--
Total tetrachlorodibenzofuran (TCDF)	pg/g	--	--	7.7 J	6.8 J	49 J	5.0 J	--	--
Total tetrachlorodibenzo-p-dioxin (TCDD)	pg/g	--	--	7.0 J	11 J	20 J	5.2 J	--	--
Total WHO Dioxin TEQ(Human/Mammal)(ND=0)	pg/g	--	--	1.83	2.34	10.9	1.51	--	--
Total WHO Dioxin TEQ(Human/Mammal)(ND=0.5)	pg/g	--	--	1.91	2.36	10.9	1.57	--	--
Radiochemistry									
Cesium-137	pCi/g	0.1333 U+/-0.08375	0.1145 U+/-0.07314	--	--	--	--	0.114 U+/-0.06986	0.08665 U+/-0.05227
Lead-210	pCi/g	0.399 U+/-0.0504	0.657 +/-0.0547	--	--	--	--	0.552 +/-0.0573	0.346 +/-0.0448
General Chemistry									
Percent solids	%	--	--	71.2	75.2	76.0	79.7	--	--

Notes:
pg/g - picogram per gram
pCi/g - picocuries per gram
DUP - indicates the result from a duplicate sample
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J - Estimated concentration.
-- - Not analyzed

Table 6-1

Sand Separation Area Analytical Results - Northern Impoundment
Final 100% Remedial Design - Northern Impoundment
San Jacinto River Waste Pits Site
Harris County, Texas

Area Sample Location: Sample Identification: Sample Date: Sample Depth:	Units	Sand Separation Area SJSSA02 11187072-120719-SS-SJSSA02 (22.5-25 CM) 12/7/2019 (22.5-25) cm	Sand Separation Area SJSSA02 11187072-120719-SS-SJSSA02 (30-32.5 CM) 12/7/2019 (30-32.5) cm	Sand Separation Area SJSSA02 11187072-120719-SS-SJSSA02 (37.5-40 CM) 12/7/2019 (37.5-40) cm	Sand Separation Area SJSSA02 11187072-120719-SS-SJSSA02 (45-47.5 CM) 12/7/2019 (45-47.5) cm	Sand Separation Area SJSSA02 11187072-120719-SS-SJSSA02 (52.5-55 CM) 12/7/2019 (52.5-55) cm	Sand Separation Area SJSSA02 11187072-120719-SS-SJSSA02 (60-62.5 CM) 12/7/2019 (60-62.5) cm	Sand Separation Area SJSSA02 11187072-120719-SS-SJSSA02 (70-72.5 CM) 12/7/2019 (70-72.5) cm
Dioxins/Furans								
1,2,3,4,6,7,8,9-Octachlorodibenzofuran (OCDF)	pg/g	--	--	--	--	--	--	--
1,2,3,4,6,7,8,9-Octachlorodibenzo-p-dioxin (OCDD)	pg/g	--	--	--	--	--	--	--
1,2,3,4,6,7,8-Heptachlorodibenzofuran (HpCDF)	pg/g	--	--	--	--	--	--	--
1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin (HpCDD)	pg/g	--	--	--	--	--	--	--
1,2,3,4,7,8,9-Heptachlorodibenzofuran (HpCDF)	pg/g	--	--	--	--	--	--	--
1,2,3,4,7,8-Hexachlorodibenzofuran (HxCDF)	pg/g	--	--	--	--	--	--	--
1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin (HxCDD)	pg/g	--	--	--	--	--	--	--
1,2,3,6,7,8-Hexachlorodibenzofuran (HxCDF)	pg/g	--	--	--	--	--	--	--
1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin (HxCDD)	pg/g	--	--	--	--	--	--	--
1,2,3,7,8,9-Hexachlorodibenzofuran (HxCDF)	pg/g	--	--	--	--	--	--	--
1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin (HxCDD)	pg/g	--	--	--	--	--	--	--
1,2,3,7,8-Pentachlorodibenzofuran (PeCDF)	pg/g	--	--	--	--	--	--	--
1,2,3,7,8-Pentachlorodibenzo-p-dioxin (PeCDD)	pg/g	--	--	--	--	--	--	--
2,3,4,6,7,8-Hexachlorodibenzofuran (HxCDF)	pg/g	--	--	--	--	--	--	--
2,3,4,7,8-Pentachlorodibenzofuran (PeCDF)	pg/g	--	--	--	--	--	--	--
2,3,7,8-Tetrachlorodibenzofuran (TCDF)	pg/g	--	--	--	--	--	--	--
2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	pg/g	--	--	--	--	--	--	--
Total heptachlorodibenzofuran (HpCDF)	pg/g	--	--	--	--	--	--	--
Total heptachlorodibenzo-p-dioxin (HpCDD)	pg/g	--	--	--	--	--	--	--
Total hexachlorodibenzofuran (HxCDF)	pg/g	--	--	--	--	--	--	--
Total hexachlorodibenzo-p-dioxin (HxCDD)	pg/g	--	--	--	--	--	--	--
Total pentachlorodibenzofuran (PeCDF)	pg/g	--	--	--	--	--	--	--
Total pentachlorodibenzo-p-dioxin (PeCDD)	pg/g	--	--	--	--	--	--	--
Total tetrachlorodibenzofuran (TCDF)	pg/g	--	--	--	--	--	--	--
Total tetrachlorodibenzo-p-dioxin (TCDD)	pg/g	--	--	--	--	--	--	--
Total WHO Dioxin TEQ(Human/Mammal)(ND=0)	pg/g	--	--	--	--	--	--	--
Total WHO Dioxin TEQ(Human/Mammal)(ND=0.5)	pg/g	--	--	--	--	--	--	--
Radiochemistry								
Cesium-137	pCi/g	0.04357 U+/-0.02621	0.03245 U+/-0.02093	0.08767 U+/-0.0544	0.06205 U+/-0.04939	0.07463 U+/-0.046	0.0845 U+/-0.0547	0.06443 U+/-0.03829
Lead-210	pCi/g	0.28 +/-0.0495	0.226 +/-0.0474	0.245 +/-0.0566	0.342 +/-0.0461	0.326 +/-0.0472	0.331 +/-0.0483	0.38 +/-0.0497
General Chemistry								
Percent solids	%	--	--	--	--	--	--	--

Notes:
pg/g - picogram per gram
pCi/g - picocuries per gram
DUP - indicates the result from a duplicate sample
U - Not detected at the associated reporting limit.
J - Estimated concentration.
-- - Not analyzed

Table 6-1

Sand Separation Area Analytical Results - Northern Impoundment
Final 100% Remedial Design - Northern Impoundment
San Jacinto River Waste Pits Site
Harris County, Texas

Area: Sample Location: Sample Identification: Sample Date: Sample Depth:	Units	Sand Separation Area SJSSA02 11187072-120719-SS-SJSSA02 (80-82.5 CM) 12/7/2019 (80-82.5) cm	Sand Separation Area SJSSA03 11187072-120619-SS-SJSSA03 (0-2.5 CM) 12/6/2019 (0-2.5) cm	Sand Separation Area SJSSA03 11187072-120619-SS-SJSSA03(0-1) 12/6/2019 (0-1) ft bgs	Sand Separation Area SJSSA03 11187072-120619-SS-SJSSA03(1-2) 12/6/2019 (1-2) ft bgs	Sand Separation Area SJSSA03 11187072-120619-SS-SJSSA03(2-4) 12/6/2019 (2-4) ft bgs	Sand Separation Area SJSSA03 11187072-120619-SS-SJSSA03(4-6) 12/6/2019 (4-6) ft bgs	Sand Separation Area SJSSA03 11187072-120619-SS-SJSSA03 (7.5-10 CM) 12/6/2019 (7.5-10) cm	Sand Separation Area SJSSA03 11187072-120619-SS-SJSSA03 (15-17.5 CM) 12/6/2019 (15-17.5) cm
Dioxins/Furans									
1,2,3,4,6,7,8,9-Octachlorodibenzofuran (OCDF)	pg/g	--	--	10 U	5.5 U	1.6 U	120	--	--
1,2,3,4,6,7,8,9-Octachlorodibenzo-p-dioxin (OCDD)	pg/g	--	--	980	810	700	2300	--	--
1,2,3,4,6,7,8-Heptachlorodibenzofuran (HpCDF)	pg/g	--	--	2.2 J	1.1 U	0.42 U	11	--	--
1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin (HpCDD)	pg/g	--	--	41	34	30	90	--	--
1,2,3,4,7,8,9-Heptachlorodibenzofuran (HpCDF)	pg/g	--	--	0.35 U	0.23 U	0.082 U	1.5 J	--	--
1,2,3,4,7,8-Hexachlorodibenzofuran (HxCDF)	pg/g	--	--	4.1 J	0.66 J	0.084 U	2.6 J	--	--
1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin (HxCDD)	pg/g	--	--	0.56 J	0.48 J	0.40 J	0.95 J	--	--
1,2,3,6,7,8-Hexachlorodibenzofuran (HxCDF)	pg/g	--	--	1.2 J	0.095 U	0.081 U	1.5 J	--	--
1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin (HxCDD)	pg/g	--	--	0.79 J	0.87 J	0.56 J	2.7 J	--	--
1,2,3,7,8,9-Hexachlorodibenzofuran (HxCDF)	pg/g	--	--	0.096 U	0.14 U	0.11 U	0.21 U	--	--
1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin (HxCDD)	pg/g	--	--	2.7 J	2.3 J	2.2 J	3.9 J	--	--
1,2,3,7,8-Pentachlorodibenzofuran (PeCDF)	pg/g	--	--	4.6 J	0.32 J	0.091 U	1.1 J	--	--
1,2,3,7,8-Pentachlorodibenzo-p-dioxin (PeCDD)	pg/g	--	--	0.40 J	0.32 J	0.20 J	0.62 J	--	--
2,3,4,6,7,8-Hexachlorodibenzofuran (HxCDF)	pg/g	--	--	0.37 J	0.10 U	0.090 U	0.34 J	--	--
2,3,4,7,8-Pentachlorodibenzofuran (PeCDF)	pg/g	--	--	4.9 J	0.26 J	0.083 U	0.89 J	--	--
2,3,7,8-Tetrachlorodibenzofuran (TCDF)	pg/g	--	--	34	12	0.92 J	24	--	--
2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	pg/g	--	--	8.4	3.8	0.20 J	8.5	--	--
Total heptachlorodibenzofuran (HpCDF)	pg/g	--	--	5.0 J	2.8 J	0.98 J	27 J	--	--
Total heptachlorodibenzo-p-dioxin (HpCDD)	pg/g	--	--	160 J	130 J	110 J	270 J	--	--
Total hexachlorodibenzofuran (HxCDF)	pg/g	--	--	8.8 J	2.3 J	0.52 J	24 J	--	--
Total hexachlorodibenzo-p-dioxin (HxCDD)	pg/g	--	--	53 J	53 J	32 J	61 J	--	--
Total pentachlorodibenzofuran (PeCDF)	pg/g	--	--	19 J	2.1 J	0.78 J	16 J	--	--
Total pentachlorodibenzo-p-dioxin (PeCDD)	pg/g	--	--	12 J	11 J	6.1 J	9.3 J	--	--
Total tetrachlorodibenzofuran (TCDF)	pg/g	--	--	82 J	28 J	2.8 J	58 J	--	--
Total tetrachlorodibenzo-p-dioxin (TCDD)	pg/g	--	--	20 J	17 J	4.9 J	15 J	--	--
Total WHO Dioxin TEQ(Human/Mammal)(ND=0)	pg/g	--	--	15.5	6.42	1.32	14.8	--	--
Total WHO Dioxin TEQ(Human/Mammal)(ND=0.5)	pg/g	--	--	15.5	6.45	1.35	14.8	--	--
Radiochemistry									
Cesium-137	pCi/g	0.03835 U+/-0.02381	0.09548 U+/-0.05456	--	--	--	--	0.1187 U+/-0.07539	0.09875 U+/-0.06434
Lead-210	pCi/g	0.266 +/-0.0437	0.487 +/-0.0502	--	--	--	--	0.516 +/-0.0512	0.278 +/-0.0511
General Chemistry									
Percent solids	%	--	--	62.3	71.8	76.6	67.8	--	--

Notes:
pg/g - picogram per gram
pCi/g - picocuries per gram
DUP - indicates the result from a duplicate sample
U - Not detected at the associated reporting limit.
J - Estimated concentration.
-- - Not analyzed

Table 6-1

Sand Separation Area Analytical Results - Northern Impoundment
Final 100% Remedial Design - Northern Impoundment
San Jacinto River Waste Pits Site
Harris County, Texas

Area Sample Location: Sample Identification: Sample Date: Sample Depth:	Units	Sand Separation Area SJSSA03 11187072-120619-SS-SJSSA03 (22.5-25 CM) 12/6/2019 (22.5-25) cm	Sand Separation Area SJSSA03 11187072-120619-SS-SJSSA03 (30-32.5 CM) 12/6/2019 (30-32.5) cm	Sand Separation Area SJSSA03 11187072-120619-SS-SJSSA03 (37.5-40 CM) 12/6/2019 (37.5-40) cm	Sand Separation Area SJSSA03 11187072-120619-SS-SJSSA03 (45-47.5 CM) 12/6/2019 (45-47.5) cm	Sand Separation Area SJSSA03 11187072-120619-SS-SJSSA03 (52.5-55 CM) 12/6/2019 (52.5-55) cm	Sand Separation Area SJSSA03 11187072-120619-SS-SJSSA03 (60-62.5 CM) 12/6/2019 (60-62.5) cm	Sand Separation Area SJSSA03 11187072-120619-SS-SJSSA03 (70-72.5 CM) 12/6/2019 (70-72.5) cm
Dioxins/Furans								
1,2,3,4,6,7,8,9-Octachlorodibenzofuran (OCDF)	pg/g	--	--	--	--	--	--	--
1,2,3,4,6,7,8,9-Octachlorodibenzo-p-dioxin (OCDD)	pg/g	--	--	--	--	--	--	--
1,2,3,4,6,7,8-Heptachlorodibenzofuran (HpCDF)	pg/g	--	--	--	--	--	--	--
1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin (HpCDD)	pg/g	--	--	--	--	--	--	--
1,2,3,4,7,8,9-Heptachlorodibenzofuran (HpCDF)	pg/g	--	--	--	--	--	--	--
1,2,3,4,7,8-Hexachlorodibenzofuran (HxCDF)	pg/g	--	--	--	--	--	--	--
1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin (HxCDD)	pg/g	--	--	--	--	--	--	--
1,2,3,6,7,8-Hexachlorodibenzofuran (HxCDF)	pg/g	--	--	--	--	--	--	--
1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin (HxCDD)	pg/g	--	--	--	--	--	--	--
1,2,3,7,8,9-Hexachlorodibenzofuran (HxCDF)	pg/g	--	--	--	--	--	--	--
1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin (HxCDD)	pg/g	--	--	--	--	--	--	--
1,2,3,7,8-Pentachlorodibenzofuran (PeCDF)	pg/g	--	--	--	--	--	--	--
1,2,3,7,8-Pentachlorodibenzo-p-dioxin (PeCDD)	pg/g	--	--	--	--	--	--	--
2,3,4,6,7,8-Hexachlorodibenzofuran (HxCDF)	pg/g	--	--	--	--	--	--	--
2,3,4,7,8-Pentachlorodibenzofuran (PeCDF)	pg/g	--	--	--	--	--	--	--
2,3,7,8-Tetrachlorodibenzofuran (TCDF)	pg/g	--	--	--	--	--	--	--
2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	pg/g	--	--	--	--	--	--	--
Total heptachlorodibenzofuran (HpCDF)	pg/g	--	--	--	--	--	--	--
Total heptachlorodibenzo-p-dioxin (HpCDD)	pg/g	--	--	--	--	--	--	--
Total hexachlorodibenzofuran (HxCDF)	pg/g	--	--	--	--	--	--	--
Total hexachlorodibenzo-p-dioxin (HxCDD)	pg/g	--	--	--	--	--	--	--
Total pentachlorodibenzofuran (PeCDF)	pg/g	--	--	--	--	--	--	--
Total pentachlorodibenzo-p-dioxin (PeCDD)	pg/g	--	--	--	--	--	--	--
Total tetrachlorodibenzofuran (TCDF)	pg/g	--	--	--	--	--	--	--
Total tetrachlorodibenzo-p-dioxin (TCDD)	pg/g	--	--	--	--	--	--	--
Total WHO Dioxin TEQ(Human/Mammal)(ND=0)	pg/g	--	--	--	--	--	--	--
Total WHO Dioxin TEQ(Human/Mammal)(ND=0.5)	pg/g	--	--	--	--	--	--	--
Radiochemistry								
Cesium-137	pCi/g	0.07308 U+/-0.04441	0.06646 U+/-0.043	0.08151 U+/-0.04759	0.0821 U+/-0.05179	0.094 U+/-0.05404	0.06385 U+/-0.0392	0.05209 U+/-0.0324
Lead-210	pCi/g	0.302 +/-0.0498	0.447 +/-0.0471	0.261 +/-0.0447	0.452 +/-0.0469	0.286 +/-0.0498	0.0695 U+/-0.0435	0.402 +/-0.0489
General Chemistry								
Percent solids	%	--	--	--	--	--	--	--

Notes:
pg/g - picogram per gram
pCi/g - picocuries per gram
DUP - indicates the result from a duplicate sample
U - Not detected at the associated reporting limit.
J - Estimated concentration.
-- - Not analyzed

Table 6-1

Sand Separation Area Analytical Results - Northern Impoundment
Final 100% Remedial Design - Northern Impoundment
San Jacinto River Waste Pits Site
Harris County, Texas

Area Sample Location: Sample Identification: Sample Date: Sample Depth:	Units	Sand Separation Area SJSSA03 11187072-120619-SS-SJSSA03 (80-82.5 CM) 12/6/2019 (80-82.5) cm	Sand Separation Area SJSSA04 11187072-120919-BN-SJSSA04 (0-2.5 CM) 12/9/2019 (0-2.5) cm	Sand Separation Area SJSSA04 11187072-120919-BN-SJSSA04(0-1) 12/9/2019 (0-1) ft bgs	Sand Separation Area SJSSA04 11187072-120919-BN-SJSSA04(1-2) 12/9/2019 (1-2) ft bgs	Sand Separation Area SJSSA04 11187072-120919-BN-SJSSA04(2-4) 12/9/2019 (2-4) ft bgs	Sand Separation Area SJSSA04 11187072-120919-BN-SJSSA04(4-6) 12/9/2019 (4-6) ft bgs	Sand Separation Area SJSSA04 11187072-120919-BN-SJSSA04 (7.5-10 CM) 12/9/2019 (7.5-10) cm	Sand Separation Area SJSSA04 11187072-120919-BN-SJSSA04 (15-17.5 CM) 12/9/2019 (15-17.5) cm
Dioxins/Furans									
1,2,3,4,6,7,8,9-Octachlorodibenzofuran (OCDF)	pg/g	--	--	12 U	35 U	9.2 U	190	--	--
1,2,3,4,6,7,8,9-Octachlorodibenzo-p-dioxin (OCDD)	pg/g	--	--	720	2100	750	4700	--	--
1,2,3,4,6,7,8-Heptachlorodibenzofuran (HpCDF)	pg/g	--	--	1.7 U	4.2 J	1.0 U	20	--	--
1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin (HpCDD)	pg/g	--	--	31	57	31	180	--	--
1,2,3,4,7,8,9-Heptachlorodibenzofuran (HpCDF)	pg/g	--	--	0.32 U	0.56 U	0.36 U	2.2 U	--	--
1,2,3,4,7,8-Hexachlorodibenzofuran (HxCDF)	pg/g	--	--	1.2 J	1.8 J	0.78 J	5.6 J	--	--
1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin (HxCDD)	pg/g	--	--	0.63 J	0.98 J	0.63 J	1.9 J	--	--
1,2,3,6,7,8-Hexachlorodibenzofuran (HxCDF)	pg/g	--	--	0.41 J	1.2 J	0.33 J	2.6 J	--	--
1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin (HxCDD)	pg/g	--	--	0.88 J	1.5 J	0.99 J	4.4 J	--	--
1,2,3,7,8,9-Hexachlorodibenzofuran (HxCDF)	pg/g	--	--	0.61 J	0.31 U	0.16 U	0.39 J	--	--
1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin (HxCDD)	pg/g	--	--	2.4 J	2.3 J	2.5 J	5.7 J	--	--
1,2,3,7,8-Pentachlorodibenzofuran (PeCDF)	pg/g	--	--	1.1 J	1.6 J	0.70 J	3.9 J	--	--
1,2,3,7,8-Pentachlorodibenzo-p-dioxin (PeCDD)	pg/g	--	--	0.40 U	0.71 U	0.40 U	0.88 J	--	--
2,3,4,6,7,8-Hexachlorodibenzofuran (HxCDF)	pg/g	--	--	0.16 U	0.31 U	0.16 U	0.92 J	--	--
2,3,4,7,8-Pentachlorodibenzofuran (PeCDF)	pg/g	--	--	0.77 J	1.0 J	0.60 J	2.1 J	--	--
2,3,7,8-Tetrachlorodibenzofuran (TCDF)	pg/g	--	--	43	50	29	110	--	--
2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	pg/g	--	--	11	13	7.7	31	--	--
Total heptachlorodibenzofuran (HpCDF)	pg/g	--	--	4.9 J	12 J	2.5 J	65 J	--	--
Total heptachlorodibenzo-p-dioxin (HpCDD)	pg/g	--	--	130 J	220 J	120 J	610 J	--	--
Total hexachlorodibenzofuran (HxCDF)	pg/g	--	--	4.1 J	6.4 J	1.1 J	29 J	--	--
Total hexachlorodibenzo-p-dioxin (HxCDD)	pg/g	--	--	41 J	40 J	39 J	96 J	--	--
Total pentachlorodibenzofuran (PeCDF)	pg/g	--	--	2.7 J	5.4 J	2.1 J	16 J	--	--
Total pentachlorodibenzo-p-dioxin (PeCDD)	pg/g	--	--	8.9 J	5.3 J	7.7 J	13 J	--	--
Total tetrachlorodibenzofuran (TCDF)	pg/g	--	--	72 J	89 J	52 J	180 J	--	--
Total tetrachlorodibenzo-p-dioxin (TCDD)	pg/g	--	--	21 J	19 J	16 J	39 J	--	--
Total WHO Dioxin TEQ(Human/Mammal)(ND=0)	pg/g	--	--	16.7	20.4	11.9	49.2	--	--
Total WHO Dioxin TEQ(Human/Mammal)(ND=0.5)	pg/g	--	--	16.9	20.8	12.1	49.3	--	--
Radiochemistry									
Cesium-137	pCi/g	0.06432 U+/-0.04086	0.1421 U+/-0.08159	--	--	--	--	0.0665 U+/-0.03796	0.04764 U+/-0.02799
Lead-210	pCi/g	0.476 +/-0.055	1.11 +/-0.0613	--	--	--	--	1 +/-0.0639	0.93 +/-0.0592
General Chemistry									
Percent solids	%	--	--	41.6	50.8	46.1	42.6	--	--

Notes:
pg/g - picogram per gram
pCi/g - picocuries per gram
DUP - indicates the result from a duplicate sample
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J - Estimated concentration.
-- - Not analyzed

Table 6-1

Sand Separation Area Analytical Results - Northern Impoundment
Final 100% Remedial Design - Northern Impoundment
San Jacinto River Waste Pits Site
Harris County, Texas

Area Sample Location: Sample Identification: Sample Date: Sample Depth:	Units	Sand Separation Area SJSSA04 11187072-120919-BN-SJSSA04 (22.5-25 CM) 12/9/2019 (22.5-25) cm	Sand Separation Area SJSSA04 11187072-120919-BN-SJSSA04 (30-32.5 CM) 12/9/2019 (30-32.5) cm	Sand Separation Area SJSSA04 11187072-120919-BN-SJSSA04 (37.5-40 CM) 12/9/2019 (37.5-40) cm	Sand Separation Area SJSSA04 11187072-120919-BN-SJSSA04 (45-47.5 CM) 12/9/2019 (45-47.5) cm	Sand Separation Area SJSSA04 11187072-120919-BN-SJSSA04 (52.5-55 CM) 12/9/2019 (52.5-55) cm	Sand Separation Area SJSSA04 11187072-120919-BN-SJSSA04 (60-62.5 CM) 12/9/2019 (60-62.5) cm	Sand Separation Area SJSSA04 11187072-120919-BN-SJSSA04 (70-72.5 CM) 12/9/2019 (70-72.5) cm
Dioxins/Furans								
1,2,3,4,6,7,8,9-Octachlorodibenzofuran (OCDF)	pg/g	--	--	--	--	--	--	--
1,2,3,4,6,7,8,9-Octachlorodibenzo-p-dioxin (OCDD)	pg/g	--	--	--	--	--	--	--
1,2,3,4,6,7,8-Heptachlorodibenzofuran (HpCDF)	pg/g	--	--	--	--	--	--	--
1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin (HpCDD)	pg/g	--	--	--	--	--	--	--
1,2,3,4,7,8,9-Heptachlorodibenzofuran (HpCDF)	pg/g	--	--	--	--	--	--	--
1,2,3,4,7,8-Hexachlorodibenzofuran (HxCDF)	pg/g	--	--	--	--	--	--	--
1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin (HxCDD)	pg/g	--	--	--	--	--	--	--
1,2,3,6,7,8-Hexachlorodibenzofuran (HxCDF)	pg/g	--	--	--	--	--	--	--
1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin (HxCDD)	pg/g	--	--	--	--	--	--	--
1,2,3,7,8,9-Hexachlorodibenzofuran (HxCDF)	pg/g	--	--	--	--	--	--	--
1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin (HxCDD)	pg/g	--	--	--	--	--	--	--
1,2,3,7,8-Pentachlorodibenzofuran (PeCDF)	pg/g	--	--	--	--	--	--	--
1,2,3,7,8-Pentachlorodibenzo-p-dioxin (PeCDD)	pg/g	--	--	--	--	--	--	--
2,3,4,6,7,8-Hexachlorodibenzofuran (HxCDF)	pg/g	--	--	--	--	--	--	--
2,3,4,7,8-Pentachlorodibenzofuran (PeCDF)	pg/g	--	--	--	--	--	--	--
2,3,7,8-Tetrachlorodibenzofuran (TCDF)	pg/g	--	--	--	--	--	--	--
2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	pg/g	--	--	--	--	--	--	--
Total heptachlorodibenzofuran (HpCDF)	pg/g	--	--	--	--	--	--	--
Total heptachlorodibenzo-p-dioxin (HpCDD)	pg/g	--	--	--	--	--	--	--
Total hexachlorodibenzofuran (HxCDF)	pg/g	--	--	--	--	--	--	--
Total hexachlorodibenzo-p-dioxin (HxCDD)	pg/g	--	--	--	--	--	--	--
Total pentachlorodibenzofuran (PeCDF)	pg/g	--	--	--	--	--	--	--
Total pentachlorodibenzo-p-dioxin (PeCDD)	pg/g	--	--	--	--	--	--	--
Total tetrachlorodibenzofuran (TCDF)	pg/g	--	--	--	--	--	--	--
Total tetrachlorodibenzo-p-dioxin (TCDD)	pg/g	--	--	--	--	--	--	--
Total WHO Dioxin TEQ(Human/Mammal)(ND=0)	pg/g	--	--	--	--	--	--	--
Total WHO Dioxin TEQ(Human/Mammal)(ND=0.5)	pg/g	--	--	--	--	--	--	--
Radiochemistry								
Cesium-137	pCi/g	0.1216 U+/-0.0706	0.1144 U+/-0.0658	0.09033 U+/-0.06255	0.128 U+/-0.07696	0.1268 U+/-0.07849	0.1293 U+/-0.07496	0.1496 U+/-0.08865
Lead-210	pCi/g	0.889 +/-0.0681	1.05 +/-0.0586	0.638 +/-0.0505	0.607 +/-0.0531	0.832 +/-0.0595	0.881 +/-0.0591	0.84 +/-0.052
General Chemistry								
Percent solids	%	--	--	--	--	--	--	--

Notes:
pg/g - picogram per gram
pCi/g - picocuries per gram
DUP - indicates the result from a duplicate sample
U - Not detected at the associated reporting limit.
J - Estimated concentration.
-- - Not analyzed

Table 6-1

Sand Separation Area Analytical Results - Northern Impoundment
Final 100% Remedial Design - Northern Impoundment
San Jacinto River Waste Pits Site
Harris County, Texas

Area Sample Location: Sample Identification: Sample Date: Sample Depth:	Units	Sand Separation Area SJSSA04 11187072-120919-BN-SJSSA04 (80-82.5 CM) 12/9/2019 (80-82.5) cm	Sand Separation Area SJSSA05 11187072-120819-BN-SJSSA05 (0-1) 12/8/2019 (0-1) ft bgs	Sand Separation Area SJSSA05 11187072-120819-BN-SJSSA05 (0-2.5 CM) 12/8/2019 (0-2.5) cm	Sand Separation Area SJSSA05 11187072-120819-BN-SJSSA05 (1-2) 12/8/2019 (1-2) ft bgs	Sand Separation Area SJSSA05 11187072-120819-BN-SJSSA05 (2-4) 12/8/2019 (2-4) ft bgs	Sand Separation Area SJSSA05 11187072-120819-BN-DUP2 12/8/2019 (4-6) ft bgs	Sand Separation Area SJSSA05 11187072-120819-BN-SJSSA05 (4-6) 12/8/2019 (4-6) ft bgs	Sand Separation Area SJSSA05 11187072-120819-BN-SJSSA05 (7.5-10 CM) 12/8/2019 (7.5-10) cm
Dioxins/Furans									
1,2,3,4,6,7,8,9-Octachlorodibenzofuran (OCDF)	pg/g	--	10 J	--	3.4 U	4.3 U	4.4 U	2.4 U	--
1,2,3,4,6,7,8,9-Octachlorodibenzo-p-dioxin (OCDD)	pg/g	--	550	--	190	140	380	160	--
1,2,3,4,6,7,8-Heptachlorodibenzofuran (HpCDF)	pg/g	--	1.5 J	--	0.49 J	0.63 J	0.77 J	0.43 J	--
1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin (HpCDD)	pg/g	--	18	--	8.0	7.2	15	6.6 J	--
1,2,3,4,7,8,9-Heptachlorodibenzofuran (HpCDF)	pg/g	--	0.27 J	--	0.23 J	0.39 J	0.066 U	0.071 U	--
1,2,3,4,7,8-Hexachlorodibenzofuran (HxCDF)	pg/g	--	2.1 J	--	0.26 J	0.21 J	0.28 J	0.13 U	--
1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin (HxCDD)	pg/g	--	0.37 J	--	0.36 J	0.31 J	0.45 J	0.29 J	--
1,2,3,6,7,8-Hexachlorodibenzofuran (HxCDF)	pg/g	--	0.49 J	--	0.090 U	0.12 U	0.12 U	0.14 U	--
1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin (HxCDD)	pg/g	--	0.56 U	--	0.29 U	0.41 U	0.38 U	0.31 U	--
1,2,3,7,8,9-Hexachlorodibenzofuran (HxCDF)	pg/g	--	0.10 U	--	0.31 J	0.20 J	0.17 J	0.18 J	--
1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin (HxCDD)	pg/g	--	1.4 J	--	0.71 J	0.76 J	1.1 J	0.54 J	--
1,2,3,7,8-Pentachlorodibenzofuran (PeCDF)	pg/g	--	1.8 J	--	0.33 J	0.24 J	0.38 J	0.27 J	--
1,2,3,7,8-Pentachlorodibenzo-p-dioxin (PeCDD)	pg/g	--	0.18 U	--	0.15 U	0.13 U	0.16 U	0.20 U	--
2,3,4,6,7,8-Hexachlorodibenzofuran (HxCDF)	pg/g	--	0.11 U	--	0.071 U	0.094 U	0.088 U	0.11 U	--
2,3,4,7,8-Pentachlorodibenzofuran (PeCDF)	pg/g	--	1.0 J	--	0.094 U	0.10 U	0.086 U	0.13 U	--
2,3,7,8-Tetrachlorodibenzofuran (TCDF)	pg/g	--	78	--	6.0	2.9 J	9.9 J	4.5	--
2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	pg/g	--	18	--	1.5	0.76 J	2.7	1.3 J	--
Total heptachlorodibenzofuran (HpCDF)	pg/g	--	3.7 J	--	1.4 J	1.9 J	1.8 J	1.0 J	--
Total heptachlorodibenzo-p-dioxin (HpCDD)	pg/g	--	70 J	--	29 J	25 J	65 J	24 J	--
Total hexachlorodibenzofuran (HxCDF)	pg/g	--	3.5 J	--	0.57 J	0.41 J	0.45 J	0.18 J	--
Total hexachlorodibenzo-p-dioxin (HxCDD)	pg/g	--	20 J	--	11 J	12 J	28 J	10 J	--
Total pentachlorodibenzofuran (PeCDF)	pg/g	--	4.5 J	--	0.33 J	0.24 J	0.85 J	0.27 J	--
Total pentachlorodibenzo-p-dioxin (PeCDD)	pg/g	--	3.3 J	--	2.4 J	3.3 J	7.6 J	3.0 J	--
Total tetrachlorodibenzofuran (TCDF)	pg/g	--	130 J	--	9.1 J	4.1 J	16 J	6.4 J	--
Total tetrachlorodibenzo-p-dioxin (TCDD)	pg/g	--	22 J	--	4.0 J	4.1 J	14 J	4.5 J	--
Total WHO Dioxin TEQ(Human/Mammal)(ND=0)	pg/g	--	27.0	--	2.42	1.33	4.17	1.98	--
Total WHO Dioxin TEQ(Human/Mammal)(ND=0.5)	pg/g	--	27.1	--	2.53	1.44	4.30	2.13	--
Radiochemistry									
Cesium-137	pCi/g	0.1537 U+/-0.08935	--	0.1064 U+/-0.06604	--	--	--	--	0.1099 U+/-0.06103
Lead-210	pCi/g	0.749 +/-0.055	--	0.212 +/-0.052	--	--	--	--	0.259 +/-0.0486
General Chemistry									
Percent solids	%	--	64.1	--	71.3	75.8	76.5	68.5	--

Notes:
pg/g - picogram per gram
pCi/g - picocuries per gram
DUP - indicates the result from a duplicate sample
U - Not detected at the associated reporting limit.
J - Estimated concentration.
-- - Not analyzed

Table 6-1

Sand Separation Area Analytical Results - Northern Impoundment
Final 100% Remedial Design - Northern Impoundment
San Jacinto River Waste Pits Site
Harris County, Texas

Area Sample Location: Sample Identification: Sample Date: Sample Depth:	Units	Sand Separation Area SJSSA05 11187072-120819-BN-SJSSA05 (15-17.5 CM) 12/8/2019 (15-17.5) cm	Sand Separation Area SJSSA05 11187072-120819-BN-SJSSA05 (22.5-25 CM) 12/8/2019 (22.5-25) cm	Sand Separation Area SJSSA05 11187072-120819-BN-SJSSA05 (30-32.5 CM) 12/8/2019 (30-32.5) cm	Sand Separation Area SJSSA05 11187072-120819-BN-SJSSA05 (37.5-40 CM) 12/8/2019 (37.5-40) cm	Sand Separation Area SJSSA05 11187072-120819-BN-SJSSA05 (45-47.5 CM) 12/8/2019 (45-47.5) cm	Sand Separation Area SJSSA05 11187072-120819-BN-SJSSA05 (52.5-55 CM) 12/8/2019 (52.5-55) cm	Sand Separation Area SJSSA05 11187072-120819-BN-SJSSA05 (60-62.5 CM) 12/8/2019 (60-62.5) cm
Dioxins/Furans								
1,2,3,4,6,7,8,9-Octachlorodibenzofuran (OCDF)	pg/g	--	--	--	--	--	--	--
1,2,3,4,6,7,8,9-Octachlorodibenzo-p-dioxin (OCDD)	pg/g	--	--	--	--	--	--	--
1,2,3,4,6,7,8-Heptachlorodibenzofuran (HpCDF)	pg/g	--	--	--	--	--	--	--
1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin (HpCDD)	pg/g	--	--	--	--	--	--	--
1,2,3,4,7,8,9-Heptachlorodibenzofuran (HpCDF)	pg/g	--	--	--	--	--	--	--
1,2,3,4,7,8-Hexachlorodibenzofuran (HxCDF)	pg/g	--	--	--	--	--	--	--
1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin (HxCDD)	pg/g	--	--	--	--	--	--	--
1,2,3,6,7,8-Hexachlorodibenzofuran (HxCDF)	pg/g	--	--	--	--	--	--	--
1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin (HxCDD)	pg/g	--	--	--	--	--	--	--
1,2,3,7,8,9-Hexachlorodibenzofuran (HxCDF)	pg/g	--	--	--	--	--	--	--
1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin (HxCDD)	pg/g	--	--	--	--	--	--	--
1,2,3,7,8-Pentachlorodibenzofuran (PeCDF)	pg/g	--	--	--	--	--	--	--
1,2,3,7,8-Pentachlorodibenzo-p-dioxin (PeCDD)	pg/g	--	--	--	--	--	--	--
2,3,4,6,7,8-Hexachlorodibenzofuran (HxCDF)	pg/g	--	--	--	--	--	--	--
2,3,4,7,8-Pentachlorodibenzofuran (PeCDF)	pg/g	--	--	--	--	--	--	--
2,3,7,8-Tetrachlorodibenzofuran (TCDF)	pg/g	--	--	--	--	--	--	--
2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	pg/g	--	--	--	--	--	--	--
Total heptachlorodibenzofuran (HpCDF)	pg/g	--	--	--	--	--	--	--
Total heptachlorodibenzo-p-dioxin (HpCDD)	pg/g	--	--	--	--	--	--	--
Total hexachlorodibenzofuran (HxCDF)	pg/g	--	--	--	--	--	--	--
Total hexachlorodibenzo-p-dioxin (HxCDD)	pg/g	--	--	--	--	--	--	--
Total pentachlorodibenzofuran (PeCDF)	pg/g	--	--	--	--	--	--	--
Total pentachlorodibenzo-p-dioxin (PeCDD)	pg/g	--	--	--	--	--	--	--
Total tetrachlorodibenzofuran (TCDF)	pg/g	--	--	--	--	--	--	--
Total tetrachlorodibenzo-p-dioxin (TCDD)	pg/g	--	--	--	--	--	--	--
Total WHO Dioxin TEQ(Human/Mammal)(ND=0)	pg/g	--	--	--	--	--	--	--
Total WHO Dioxin TEQ(Human/Mammal)(ND=0.5)	pg/g	--	--	--	--	--	--	--
Radiochemistry								
Cesium-137	pCi/g	0.1084 U+/-0.06582	0.07979 U+/-0.04556	0.09782 U+/-0.05617	0.07139 U+/-0.05011	0.06645 U+/-0.04037	0.09536 U+/-0.05946	0.08828 U+/-0.04935
Lead-210	pCi/g	0.35 +/-0.0423	0.119 +/-0.0422	0.181 +/-0.079	0.073 +/-0.0455	0.0704 U+/-0.0418	0.317 +/-0.0542	0.352 +/-0.0526
General Chemistry								
Percent solids	%	--	--	--	--	--	--	--

Notes:
pg/g - picogram per gram
pCi/g - picocuries per gram
DUP - indicates the result from a duplicate sample
U - Not detected at the associated reporting limit.
J - Estimated concentration.
-- - Not analyzed

Table 6-1

Sand Separation Area Analytical Results - Northern Impoundment
Final 100% Remedial Design - Northern Impoundment
San Jacinto River Waste Pits Site
Harris County, Texas

Area		Sand Separation Area	Sand Separation Area	Sand Separation Area	Sand Separation Area	Sand Separation Area	Sand Separation Area	Sand Separation Area	Sand Separation Area	Sand Separation Area
Sample Location:		SJSSA05	SJSSA05	SJSSA05	SJSSA06	SJSSA06	SJSSA06	SJSSA06	SJSSA06	SJSSA06
Sample Identification:	Units	11187072-120819-BN-DUP1	11187072-120819-BN-SJSSA05 (70-72.5 CM)	11187072-120819-BN-SJSSA05 (80-82.5 CM)	11187072-120619-SS-SJSSA06 (0-2.5 CM)	11187072-120619-SS-SJSSA06(0-1)	11187072-120619-SS-SJSSA06(1-2)	11187072-120619-SS-DUP1	11187072-120619-SS-SJSSA06(2-4)	11187072-120619-SS-SJSSA06(4-6)
Sample Date:		12/8/2019	12/8/2019	12/8/2019	12/6/2019	12/6/2019	12/6/2019	12/6/2019	12/6/2019	12/6/2019
Sample Depth:		(60-62.5) cm	(70-72.5) cm	(80-82.5) cm	(0-2.5) cm	(0-1) ft bgs	(1-2) ft bgs	(1-2) ft bgs	(2-4) ft bgs	(4-6) ft bgs
Dioxins/Furans										
1,2,3,4,6,7,8,9-Octachlorodibenzofuran (OCDF)	pg/g	--	--	--	--	10 J	4.8 U	9.0 U	3.4 U	46 U
1,2,3,4,6,7,8,9-Octachlorodibenzo-p-dioxin (OCDD)	pg/g	--	--	--	--	380	210	230	200	1300 J
1,2,3,4,6,7,8-Heptachlorodibenzofuran (HpCDF)	pg/g	--	--	--	--	3.1 J	2.7 J	19 J	2.8 J	100 J
1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin (HpCDD)	pg/g	--	--	--	--	16	9.9	12	9.3	75 J
1,2,3,4,7,8,9-Heptachlorodibenzofuran (HpCDF)	pg/g	--	--	--	--	0.79 U	1.0 U	9.3	0.93 U	41 J
1,2,3,4,7,8-Hexachlorodibenzofuran (HxCDF)	pg/g	--	--	--	--	9.6	9.2 J	120 J	9.7	420 J
1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin (HxCDD)	pg/g	--	--	--	--	0.20 J	0.20 J	0.71 J	0.16 J	0.65 U
1,2,3,6,7,8-Hexachlorodibenzofuran (HxCDF)	pg/g	--	--	--	--	2.3 J	2.4 J	31 J	2.3 J	110 J
1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin (HxCDD)	pg/g	--	--	--	--	0.45 J	0.24 J	0.91 J	0.42 J	0.64 U
1,2,3,7,8,9-Hexachlorodibenzofuran (HxCDF)	pg/g	--	--	--	--	0.24 J	0.17 J	2.8 J	0.15 J	7.3 J
1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin (HxCDD)	pg/g	--	--	--	--	0.87 J	0.72 J	1.2 J	0.58 J	4.0 J
1,2,3,7,8-Pentachlorodibenzofuran (PeCDF)	pg/g	--	--	--	--	6.6	6.2 J	160 J	6.2	250 J
1,2,3,7,8-Pentachlorodibenzo-p-dioxin (PeCDD)	pg/g	--	--	--	--	0.69 J	0.70 J	7.7 J	0.68 J	25 J
2,3,4,6,7,8-Hexachlorodibenzofuran (HxCDF)	pg/g	--	--	--	--	0.35 J	0.32 J	9.5	0.37 J	11 J
2,3,4,7,8-Pentachlorodibenzofuran (PeCDF)	pg/g	--	--	--	--	4.7 J	5.1 J	190 J	5.4 J	170 J
2,3,7,8-Tetrachlorodibenzofuran (TCDF)	pg/g	--	--	--	--	270	300 J	1900 J	290	3900
2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	pg/g	--	--	--	--	74	83 J	360 J	82	2800
Total heptachlorodibenzofuran (HpCDF)	pg/g	--	--	--	--	6.1 J	5.3 J	34 J	4.3 J	180 J
Total heptachlorodibenzo-p-dioxin (HpCDD)	pg/g	--	--	--	--	55 J	38 J	42 J	35 J	250 J
Total hexachlorodibenzofuran (HxCDF)	pg/g	--	--	--	--	16 J	15 J	190 J	15 J	630 J
Total hexachlorodibenzo-p-dioxin (HxCDD)	pg/g	--	--	--	--	14 J	11 J	18 J	11 J	62 J
Total pentachlorodibenzofuran (PeCDF)	pg/g	--	--	--	--	19 J	20 J	530 J	20 J	700 J
Total pentachlorodibenzo-p-dioxin (PeCDD)	pg/g	--	--	--	--	2.7 J	2.2 J	11 J	2.2 J	28 J
Total tetrachlorodibenzofuran (TCDF)	pg/g	--	--	--	--	600 J	650 J	4500 J	640 J	17000 J
Total tetrachlorodibenzo-p-dioxin (TCDD)	pg/g	--	--	--	--	84 J	94 J	420 J	94 J	3100 J
Total WHO Dioxin TEQ(Human/Mammal)(ND=0)	pg/g	--	--	--	--	105	117	637	115	3330
Total WHO Dioxin TEQ(Human/Mammal)(ND=0.5)	pg/g	--	--	--	--	105	117	637	115	3330
Radiochemistry										
Cesium-137	pCi/g	0.1223 U+/-0.06922	0.1146 U+/-0.06916	0.06587 U+/-0.04211	0.06482 U+/-0.03688	--	--	--	--	--
Lead-210	pCi/g	0.333 +/-0.0544	0.442 +/-0.0572	0.365 +/-0.0568	0.221 +/-0.057	--	--	--	--	--
General Chemistry										
Percent solids	%	--	--	--	--	83.6	89.6	55.0	82.5	60.9

Notes:
pg/g - picogram per gram
pCi/g - picocuries per gram
DUP - indicates the result from a duplicate sample
U - Not detected at the associated reporting limit.
J - Estimated concentration.
-- - Not analyzed

Table 6-1

Sand Separation Area Analytical Results - Northern Impoundment
Final 100% Remedial Design - Northern Impoundment
San Jacinto River Waste Pits Site
Harris County, Texas

Area Sample Location: Sample Identification: Sample Date: Sample Depth:	Units	Sand Separation Area SJSSA06 11187072-120619-SS-SJSSA06 (7.5-10 CM) 12/6/2019 (7.5-10) cm	Sand Separation Area SJSSA06 11187072-120619-SS-SJSSA06 (15-17.5 CM) 12/6/2019 (15-17.5) cm	Sand Separation Area SJSSA06 11187072-120619-SS-SJSSA06 (22.5-25 CM) 12/6/2019 (22.5-25) cm	Sand Separation Area SJSSA06 11187072-120619-SS-SJSSA06 (30-32.5 CM) 12/6/2019 (30-32.5) cm	Sand Separation Area SJSSA06 11187072-120619-SS-SJSSA06 (37.5-40 CM) 12/6/2019 (37.5-40) cm	Sand Separation Area SJSSA06 11187072-120619-SS-SJSSA06 (45-47.5 CM) 12/6/2019 (45-47.5) cm	Sand Separation Area SJSSA06 11187072-120619-SS-SJSSA06 (52.5-55 CM) 12/6/2019 (52.5-55) cm
Dioxins/Furans								
1,2,3,4,6,7,8,9-Octachlorodibenzofuran (OCDF)	pg/g	--	--	--	--	--	--	--
1,2,3,4,6,7,8,9-Octachlorodibenzo-p-dioxin (OCDD)	pg/g	--	--	--	--	--	--	--
1,2,3,4,6,7,8-Heptachlorodibenzofuran (HpCDF)	pg/g	--	--	--	--	--	--	--
1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin (HpCDD)	pg/g	--	--	--	--	--	--	--
1,2,3,4,7,8,9-Heptachlorodibenzofuran (HpCDF)	pg/g	--	--	--	--	--	--	--
1,2,3,4,7,8-Hexachlorodibenzofuran (HxCDF)	pg/g	--	--	--	--	--	--	--
1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin (HxCDD)	pg/g	--	--	--	--	--	--	--
1,2,3,6,7,8-Hexachlorodibenzofuran (HxCDF)	pg/g	--	--	--	--	--	--	--
1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin (HxCDD)	pg/g	--	--	--	--	--	--	--
1,2,3,7,8,9-Hexachlorodibenzofuran (HxCDF)	pg/g	--	--	--	--	--	--	--
1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin (HxCDD)	pg/g	--	--	--	--	--	--	--
1,2,3,7,8-Pentachlorodibenzofuran (PeCDF)	pg/g	--	--	--	--	--	--	--
1,2,3,7,8-Pentachlorodibenzo-p-dioxin (PeCDD)	pg/g	--	--	--	--	--	--	--
2,3,4,6,7,8-Hexachlorodibenzofuran (HxCDF)	pg/g	--	--	--	--	--	--	--
2,3,4,7,8-Pentachlorodibenzofuran (PeCDF)	pg/g	--	--	--	--	--	--	--
2,3,7,8-Tetrachlorodibenzofuran (TCDF)	pg/g	--	--	--	--	--	--	--
2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	pg/g	--	--	--	--	--	--	--
Total heptachlorodibenzofuran (HpCDF)	pg/g	--	--	--	--	--	--	--
Total heptachlorodibenzo-p-dioxin (HpCDD)	pg/g	--	--	--	--	--	--	--
Total hexachlorodibenzofuran (HxCDF)	pg/g	--	--	--	--	--	--	--
Total hexachlorodibenzo-p-dioxin (HxCDD)	pg/g	--	--	--	--	--	--	--
Total pentachlorodibenzofuran (PeCDF)	pg/g	--	--	--	--	--	--	--
Total pentachlorodibenzo-p-dioxin (PeCDD)	pg/g	--	--	--	--	--	--	--
Total tetrachlorodibenzofuran (TCDF)	pg/g	--	--	--	--	--	--	--
Total tetrachlorodibenzo-p-dioxin (TCDD)	pg/g	--	--	--	--	--	--	--
Total WHO Dioxin TEQ(Human/Mammal)(ND=0)	pg/g	--	--	--	--	--	--	--
Total WHO Dioxin TEQ(Human/Mammal)(ND=0.5)	pg/g	--	--	--	--	--	--	--
Radiochemistry								
Cesium-137	pCi/g	0.05367 U+/-0.03063	0.03911 U+/-0.02794	0.06255 U+/-0.03486	0.1076 U+/-0.06432	0.0544 U+/-0.0336	0.07865 U+/-0.04602	0.0497 U+/-0.03368
Lead-210	pCi/g	0.161 +/-0.0493	0.0939 +/-0.0491	0.215 +/-0.0476	0.113 +/-0.0522	0.0852 +/-0.0513	0.166 +/-0.0478	0.0697 U+/-0.0434
General Chemistry								
Percent solids	%	--	--	--	--	--	--	--

Notes:
pg/g - picogram per gram
pCi/g - picocuries per gram
DUP - indicates the result from a duplicate sample
U - Not detected at the associated reporting limit.
J - Estimated concentration.
-- - Not analyzed

Table 6-1

Sand Separation Area Analytical Results - Northern Impoundment
Final 100% Remedial Design - Northern Impoundment
San Jacinto River Waste Pits Site
Harris County, Texas

Area Sample Location: Sample Identification: Sample Date: Sample Depth:	Units	Sand Separation Area SJSSA06 11187072-120619-SS-SJSSA06 (60-62.5 CM) 12/6/2019 (60-62.5) cm	Sand Separation Area SJSSA06 11187072-120619-SS-SJSSA06 (70-72.5 CM) 12/6/2019 (70-72.5) cm	Sand Separation Area SJSSA06 11187072-120619-SS-SJSSA06 (80-82.5 CM) 12/6/2019 (80-82.5) cm	Sand Separation Area SJSSA07 11187072-120919-BN-SJSSA07 (0-2.5 CM) 12/9/2019 (0-2.5) cm	Sand Separation Area SJSSA07 11187072-120919-BN-SJSSA07(0-1) 12/9/2019 (0-1) ft bgs	Sand Separation Area SJSSA07 11187072-120919-BN-SJSSA07(1-2) 12/9/2019 (1-2) ft bgs	Sand Separation Area SJSSA07 11187072-120919-BN-SJSSA07(2-4) 12/9/2019 (2-4) ft bgs	Sand Separation Area SJSSA07 11187072-120919-BN-SJSSA07(4-6) 12/9/2019 (4-6) ft bgs
Dioxins/Furans									
1,2,3,4,6,7,8,9-Octachlorodibenzofuran (OCDF)	pg/g	--	--	--	--	44	5.4 U	0.17 U	27 U
1,2,3,4,6,7,8,9-Octachlorodibenzo-p-dioxin (OCDD)	pg/g	--	--	--	--	2400	430	36	890
1,2,3,4,6,7,8-Heptachlorodibenzofuran (HpCDF)	pg/g	--	--	--	--	4.8 J	0.64 U	0.15 U	0.52 U
1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin (HpCDD)	pg/g	--	--	--	--	61	16	1.4 U	39
1,2,3,4,7,8,9-Heptachlorodibenzofuran (HpCDF)	pg/g	--	--	--	--	1.3 U	0.21 U	0.17 U	0.70 U
1,2,3,4,7,8-Hexachlorodibenzofuran (HxCDF)	pg/g	--	--	--	--	1.3 J	0.12 U	0.092 U	0.33 U
1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin (HxCDD)	pg/g	--	--	--	--	1.1 J	0.40 J	0.19 J	0.51 U
1,2,3,6,7,8-Hexachlorodibenzofuran (HxCDF)	pg/g	--	--	--	--	1.1 J	0.15 J	0.088 U	0.31 U
1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin (HxCDD)	pg/g	--	--	--	--	1.9 J	0.59 J	0.11 U	0.54 U
1,2,3,7,8,9-Hexachlorodibenzofuran (HxCDF)	pg/g	--	--	--	--	0.78 J	0.097 U	0.071 U	0.26 U
1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin (HxCDD)	pg/g	--	--	--	--	2.7 J	1.3 J	0.096 U	2.6 J
1,2,3,7,8-Pentachlorodibenzofuran (PeCDF)	pg/g	--	--	--	--	1.1 J	0.16 U	0.11 U	0.39 U
1,2,3,7,8-Pentachlorodibenzo-p-dioxin (PeCDD)	pg/g	--	--	--	--	0.51 U	0.28 U	0.15 U	0.66 U
2,3,4,6,7,8-Hexachlorodibenzofuran (HxCDF)	pg/g	--	--	--	--	0.60 J	0.093 U	0.070 U	0.24 U
2,3,4,7,8-Pentachlorodibenzofuran (PeCDF)	pg/g	--	--	--	--	0.74 J	0.16 U	0.12 U	0.41 U
2,3,7,8-Tetrachlorodibenzofuran (TCDF)	pg/g	--	--	--	--	28	2.7	0.073 U	0.25 U
2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	pg/g	--	--	--	--	8.6	1.1 J	0.10 U	0.34 U
Total heptachlorodibenzofuran (HpCDF)	pg/g	--	--	--	--	15 J	1.5 J	0.17 U	5.6 J
Total heptachlorodibenzo-p-dioxin (HpCDD)	pg/g	--	--	--	--	220 J	75 J	5.7 J	130 J
Total hexachlorodibenzofuran (HxCDF)	pg/g	--	--	--	--	8.8 J	0.15 J	0.092 U	0.33 U
Total hexachlorodibenzo-p-dioxin (HxCDD)	pg/g	--	--	--	--	38 J	20 J	1.9 J	28 J
Total pentachlorodibenzofuran (PeCDF)	pg/g	--	--	--	--	4.8 J	0.17 U	0.12 U	0.43 U
Total pentachlorodibenzo-p-dioxin (PeCDD)	pg/g	--	--	--	--	3.7 J	4.2 J	0.28 J	5.4 J
Total tetrachlorodibenzofuran (TCDF)	pg/g	--	--	--	--	47 J	3.1 J	0.073 U	0.25 U
Total tetrachlorodibenzo-p-dioxin (TCDD)	pg/g	--	--	--	--	11 J	3.8 J	0.40 J	0.57 J
Total WHO Dioxin TEQ(Human/Mammal)(ND=0)	pg/g	--	--	--	--	14.0	1.90	0.030	0.917
Total WHO Dioxin TEQ(Human/Mammal)(ND=0.5)	pg/g	--	--	--	--	14.3	2.09	0.213	1.62
Radiochemistry									
Cesium-137	pCi/g	0.03504 U+/-0.02395	0.05251 U+/-0.03429	0.04477 U+/-0.02713	0.112 U+/-0.06301	--	--	--	--
Lead-210	pCi/g	0.113 +/-0.0485	0.188 +/-0.054	0.0941 +/-0.0531	0.905 +/-0.062	--	--	--	--
General Chemistry									
Percent solids	%	--	--	--	--	43.4	64.4	81.7	56.0

Notes:
pg/g - picogram per gram
pCi/g - picocuries per gram
DUP - indicates the result from a duplicate sample
U - Not detected at the associated reporting limit.
J - Estimated concentration.
-- - Not analyzed

Table 6-1

Sand Separation Area Analytical Results - Northern Impoundment
Final 100% Remedial Design - Northern Impoundment
San Jacinto River Waste Pits Site
Harris County, Texas

Area Sample Location: Sample Identification: Sample Date: Sample Depth:	Units	Sand Separation Area SJSSA07 11187072-120919-BN-SJSSA07 (7.5-10 CM) 12/9/2019 (7.5-10) cm	Sand Separation Area SJSSA07 11187072-120919-BN-SJSSA07 (15-17.5 CM) 12/9/2019 (15-17.5) cm	Sand Separation Area SJSSA07 11187072-120919-BN-SJSSA07 (22.5-25 CM) 12/9/2019 (22.5-25) cm	Sand Separation Area SJSSA07 11187072-120919-BN-SJSSA07 (30-32.5 CM) 12/9/2019 (30-32.5) cm	Sand Separation Area SJSSA07 11187072-120919-BN-SJSSA07 (37.5-40 CM) 12/9/2019 (37.5-40) cm	Sand Separation Area SJSSA07 11187072-120919-BN-SJSSA07 (45-47.5 CM) 12/9/2019 (45-47.5) cm	Sand Separation Area SJSSA07 11187072-120919-BN-SJSSA07 (52.5-55 CM) 12/9/2019 (52.5-55) cm
Dioxins/Furans								
1,2,3,4,6,7,8,9-Octachlorodibenzofuran (OCDF)	pg/g	--	--	--	--	--	--	--
1,2,3,4,6,7,8,9-Octachlorodibenzo-p-dioxin (OCDD)	pg/g	--	--	--	--	--	--	--
1,2,3,4,6,7,8-Heptachlorodibenzofuran (HpCDF)	pg/g	--	--	--	--	--	--	--
1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin (HpCDD)	pg/g	--	--	--	--	--	--	--
1,2,3,4,7,8,9-Heptachlorodibenzofuran (HpCDF)	pg/g	--	--	--	--	--	--	--
1,2,3,4,7,8-Hexachlorodibenzofuran (HxCDF)	pg/g	--	--	--	--	--	--	--
1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin (HxCDD)	pg/g	--	--	--	--	--	--	--
1,2,3,6,7,8-Hexachlorodibenzofuran (HxCDF)	pg/g	--	--	--	--	--	--	--
1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin (HxCDD)	pg/g	--	--	--	--	--	--	--
1,2,3,7,8,9-Hexachlorodibenzofuran (HxCDF)	pg/g	--	--	--	--	--	--	--
1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin (HxCDD)	pg/g	--	--	--	--	--	--	--
1,2,3,7,8-Pentachlorodibenzofuran (PeCDF)	pg/g	--	--	--	--	--	--	--
1,2,3,7,8-Pentachlorodibenzo-p-dioxin (PeCDD)	pg/g	--	--	--	--	--	--	--
2,3,4,6,7,8-Hexachlorodibenzofuran (HxCDF)	pg/g	--	--	--	--	--	--	--
2,3,4,7,8-Pentachlorodibenzofuran (PeCDF)	pg/g	--	--	--	--	--	--	--
2,3,7,8-Tetrachlorodibenzofuran (TCDF)	pg/g	--	--	--	--	--	--	--
2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	pg/g	--	--	--	--	--	--	--
Total heptachlorodibenzofuran (HpCDF)	pg/g	--	--	--	--	--	--	--
Total heptachlorodibenzo-p-dioxin (HpCDD)	pg/g	--	--	--	--	--	--	--
Total hexachlorodibenzofuran (HxCDF)	pg/g	--	--	--	--	--	--	--
Total hexachlorodibenzo-p-dioxin (HxCDD)	pg/g	--	--	--	--	--	--	--
Total pentachlorodibenzofuran (PeCDF)	pg/g	--	--	--	--	--	--	--
Total pentachlorodibenzo-p-dioxin (PeCDD)	pg/g	--	--	--	--	--	--	--
Total tetrachlorodibenzofuran (TCDF)	pg/g	--	--	--	--	--	--	--
Total tetrachlorodibenzo-p-dioxin (TCDD)	pg/g	--	--	--	--	--	--	--
Total WHO Dioxin TEQ(Human/Mammal)(ND=0)	pg/g	--	--	--	--	--	--	--
Total WHO Dioxin TEQ(Human/Mammal)(ND=0.5)	pg/g	--	--	--	--	--	--	--
Radiochemistry								
Cesium-137	pCi/g	0.05777 U+/-0.03325	0.1033 U+/-0.0658	0.0679 U+/-0.03908	0.1 U+/-0.05852	0.06529 U+/-0.04338	0.0502 U+/-0.03476	0.07514 U+/-0.04497
Lead-210	pCi/g	0.853 +/-0.0707	0.912 +/-0.0704	1.05 +/-0.0803	0.655 +/-0.0602	0.156 +/-0.0533	0.0682 U+/-0.0423	0.0808 U+/-0.0502
General Chemistry								
Percent solids	%	--	--	--	--	--	--	--

Notes:
pg/g - picogram per gram
pCi/g - picocuries per gram
DUP - indicates the result from a duplicate sample
U - Not detected at the associated reporting limit.
J - Estimated concentration.
-- - Not analyzed

Table 6-1

Sand Separation Area Analytical Results - Northern Impoundment
Final 100% Remedial Design - Northern Impoundment
San Jacinto River Waste Pits Site
Harris County, Texas

Area		Sand Separation Area	Sand Separation Area	Sand Separation Area	Sand Separation Area	Sand Separation Area	Sand Separation Area	Sand Separation Area	Sand Separation Area
Sample Location:		SJSSA07	SJSSA07	SJSSA07	SJSSA08	SJSSA08	SJSSA08	SJSSA08	SJSSA08
Sample Identification:	Units	11187072-120919-BN-SJSSA07 (60-62.5 CM)	11187072-120919-BN-SJSSA07 (70-72.5 CM)	11187072-120919-BN-SJSSA07 (80-82.5 CM)	11187072-120419-SS-SJSSA08 (0-2.5 CM)	11187072-120419-SS-SJSSA08(0-1)	11187072-120419-SS-SJSSA08(1-2)	11187072-120419-SS-SJSSA08(2-4)	11187072-120419-SS-SJSSA08(4-6)
Sample Date:		12/9/2019	12/9/2019	12/9/2019	12/4/2019	12/4/2019	12/4/2019	12/4/2019	12/4/2019
Sample Depth:		(60-62.5) cm	(70-72.5) cm	(80-82.5) cm	(0-2.5) cm	(0-1) ft bgs	(1-2) ft bgs	(2-4) ft bgs	(4-6) ft bgs
Dioxins/Furans									
1,2,3,4,6,7,8,9-Octachlorodibenzofuran (OCDF)	pg/g	--	--	--	--	20	53	93	8.6 U
1,2,3,4,6,7,8,9-Octachlorodibenzo-p-dioxin (OCDD)	pg/g	--	--	--	--	930	2600	3600	830
1,2,3,4,6,7,8-Heptachlorodibenzofuran (HpCDF)	pg/g	--	--	--	--	3.1 J	6.6 J	13	2.3 J
1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin (HpCDD)	pg/g	--	--	--	--	28	73	110	35
1,2,3,4,7,8,9-Heptachlorodibenzofuran (HpCDF)	pg/g	--	--	--	--	0.53 U	1.0 U	2.2 J	0.41 U
1,2,3,4,7,8-Hexachlorodibenzofuran (HxCDF)	pg/g	--	--	--	--	0.84 J	2.5 J	10	4.0 J
1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin (HxCDD)	pg/g	--	--	--	--	0.31 J	0.98 J	1.4 J	0.35 J
1,2,3,6,7,8-Hexachlorodibenzofuran (HxCDF)	pg/g	--	--	--	--	0.37 J	1.1 J	3.2 J	0.99 J
1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin (HxCDD)	pg/g	--	--	--	--	0.57 J	1.7 J	2.6 J	0.90 J
1,2,3,7,8,9-Hexachlorodibenzofuran (HxCDF)	pg/g	--	--	--	--	0.16 U	0.16 U	0.34 J	0.21 U
1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin (HxCDD)	pg/g	--	--	--	--	1.3 J	3.0 J	4.8 J	2.3 J
1,2,3,7,8-Pentachlorodibenzofuran (PeCDF)	pg/g	--	--	--	--	0.49 J	1.2 J	6.9 J	2.7 J
1,2,3,7,8-Pentachlorodibenzo-p-dioxin (PeCDD)	pg/g	--	--	--	--	0.20 J	0.49 J	1.5 J	0.52 J
2,3,4,6,7,8-Hexachlorodibenzofuran (HxCDF)	pg/g	--	--	--	--	0.12 U	0.25 J	0.59 J	0.16 U
2,3,4,7,8-Pentachlorodibenzofuran (PeCDF)	pg/g	--	--	--	--	0.29 J	0.86 J	5.2 J	2.6 J
2,3,7,8-Tetrachlorodibenzofuran (TCDF)	pg/g	--	--	--	--	11	32	260	120
2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	pg/g	--	--	--	--	4.1	10	75	35
Total heptachlorodibenzofuran (HpCDF)	pg/g	--	--	--	--	7.1 J	16 J	29 J	4.6 J
Total heptachlorodibenzo-p-dioxin (HpCDD)	pg/g	--	--	--	--	89 J	240 J	370 J	130 J
Total hexachlorodibenzofuran (HxCDF)	pg/g	--	--	--	--	4.4 J	12 J	29 J	6.5 J
Total hexachlorodibenzo-p-dioxin (HxCDD)	pg/g	--	--	--	--	18 J	50 J	80 J	40 J
Total pentachlorodibenzofuran (PeCDF)	pg/g	--	--	--	--	3.6 J	7.3 J	27 J	8.7 J
Total pentachlorodibenzo-p-dioxin (PeCDD)	pg/g	--	--	--	--	2.4 J	6.4 J	11 J	8.2 J
Total tetrachlorodibenzofuran (TCDF)	pg/g	--	--	--	--	26 J	68 J	540 J	260 J
Total tetrachlorodibenzo-p-dioxin (TCDD)	pg/g	--	--	--	--	6.4 J	17 J	92 J	47 J
Total WHO Dioxin TEQ(Human/Mammal)(ND=0)	pg/g	--	--	--	--	6.44	16.5	109	49.9
Total WHO Dioxin TEQ(Human/Mammal)(ND=0.5)	pg/g	--	--	--	--	6.45	16.5	109	49.9
Radiochemistry									
Cesium-137	pCi/g	0.09191 U+/-0.05208	0.08917 U+/-0.05545	0.08095 U+/-0.04787	0.07898 U+/-0.0474	--	--	--	--
Lead-210	pCi/g	0.0815 +/-0.0467	0.0969 U+/-0.0587	0.198 +/-0.0468	0.076 U+/-0.0475	--	--	--	--
General Chemistry									
Percent solids	%	--	--	--	--	76.3	67.5	57.7	70.1

Notes:
pg/g - picogram per gram
pCi/g - picocuries per gram
DUP - indicates the result from a duplicate sample
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J - Estimated concentration.
-- - Not analyzed

Table 6-1

Sand Separation Area Analytical Results - Northern Impoundment
Final 100% Remedial Design - Northern Impoundment
San Jacinto River Waste Pits Site
Harris County, Texas

Area Sample Location: Sample Identification: Sample Date: Sample Depth:	Units	Sand Separation Area SJSSA08 11187072-120419-SS-SJSSA08 (7.5-10 CM) 12/4/2019 (7.5-10) cm	Sand Separation Area SJSSA08 11187072-120419-SS-SJSSA08 (15-17.5 CM) 12/4/2019 (15-17.5) cm	Sand Separation Area SJSSA08 11187072-120419-SS-SJSSA08 (22.5-25 CM) 12/4/2019 (22.5-25) cm	Sand Separation Area SJSSA08 11187072-120419-SS-SJSSA08 (30-32.5 CM) 12/4/2019 (30-32.5) cm	Sand Separation Area SJSSA08 11187072-120419-SS-SJSSA08 (37.5-40 CM) 12/4/2019 (37.5-40) cm	Sand Separation Area SJSSA08 11187072-120419-SS-SJSSA08 (45-47.5 CM) 12/4/2019 (45-47.5) cm	Sand Separation Area SJSSA08 11187072-120419-SS-SJSSA08 (52.5-55 CM) 12/4/2019 (52.5-55) cm
Dioxins/Furans								
1,2,3,4,6,7,8,9-Octachlorodibenzofuran (OCDF)	pg/g	--	--	--	--	--	--	--
1,2,3,4,6,7,8,9-Octachlorodibenzo-p-dioxin (OCDD)	pg/g	--	--	--	--	--	--	--
1,2,3,4,6,7,8-Heptachlorodibenzofuran (HpCDF)	pg/g	--	--	--	--	--	--	--
1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin (HpCDD)	pg/g	--	--	--	--	--	--	--
1,2,3,4,7,8,9-Heptachlorodibenzofuran (HpCDF)	pg/g	--	--	--	--	--	--	--
1,2,3,4,7,8-Hexachlorodibenzofuran (HxCDF)	pg/g	--	--	--	--	--	--	--
1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin (HxCDD)	pg/g	--	--	--	--	--	--	--
1,2,3,6,7,8-Hexachlorodibenzofuran (HxCDF)	pg/g	--	--	--	--	--	--	--
1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin (HxCDD)	pg/g	--	--	--	--	--	--	--
1,2,3,7,8,9-Hexachlorodibenzofuran (HxCDF)	pg/g	--	--	--	--	--	--	--
1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin (HxCDD)	pg/g	--	--	--	--	--	--	--
1,2,3,7,8-Pentachlorodibenzofuran (PeCDF)	pg/g	--	--	--	--	--	--	--
1,2,3,7,8-Pentachlorodibenzo-p-dioxin (PeCDD)	pg/g	--	--	--	--	--	--	--
2,3,4,6,7,8-Hexachlorodibenzofuran (HxCDF)	pg/g	--	--	--	--	--	--	--
2,3,4,7,8-Pentachlorodibenzofuran (PeCDF)	pg/g	--	--	--	--	--	--	--
2,3,7,8-Tetrachlorodibenzofuran (TCDF)	pg/g	--	--	--	--	--	--	--
2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	pg/g	--	--	--	--	--	--	--
Total heptachlorodibenzofuran (HpCDF)	pg/g	--	--	--	--	--	--	--
Total heptachlorodibenzo-p-dioxin (HpCDD)	pg/g	--	--	--	--	--	--	--
Total hexachlorodibenzofuran (HxCDF)	pg/g	--	--	--	--	--	--	--
Total hexachlorodibenzo-p-dioxin (HxCDD)	pg/g	--	--	--	--	--	--	--
Total pentachlorodibenzofuran (PeCDF)	pg/g	--	--	--	--	--	--	--
Total pentachlorodibenzo-p-dioxin (PeCDD)	pg/g	--	--	--	--	--	--	--
Total tetrachlorodibenzofuran (TCDF)	pg/g	--	--	--	--	--	--	--
Total tetrachlorodibenzo-p-dioxin (TCDD)	pg/g	--	--	--	--	--	--	--
Total WHO Dioxin TEQ(Human/Mammal)(ND=0)	pg/g	--	--	--	--	--	--	--
Total WHO Dioxin TEQ(Human/Mammal)(ND=0.5)	pg/g	--	--	--	--	--	--	--
Radiochemistry								
Cesium-137	pCi/g	0.0429 U+/-0.02742	0.06693 U+/-0.04252	0.09049 U+/-0.04816	0.04994 U+/-0.02875	0.1452 U+/-0.07804	0.1771 U+/-0.1092	0.1565 U+/-0.08324
Lead-210	pCi/g	0.0758 U+/-0.045	0.0683 U+/-0.0422	0.083 U+/-0.0493	0.0681 U+/-0.0405	0.611 +/-0.0567	0.833 +/-0.0641	0.54 +/-0.0671
General Chemistry								
Percent solids	%	--	--	--	--	--	--	--

Notes:
- pg/g - picogram per gram
- pCi/g - picocuries per gram
- DUP - indicates the result from a duplicate sample
- U - Not detected at the associated reporting limit.
- J - Estimated concentration.
- -- - Not analyzed

Table 6-1

Sand Separation Area Analytical Results - Northern Impoundment
Final 100% Remedial Design - Northern Impoundment
San Jacinto River Waste Pits Site
Harris County, Texas

Area Sample Location: Sample Identification: Sample Date: Sample Depth:	Units	Sand Separation Area SJSSA08 11187072-120419-SS-SJSSA08 (60-62.5 CM) 12/4/2019 (60-62.5) cm	Sand Separation Area SJSSA08 11187072-120419-SS-SJSSA08 (70-72.5 CM) 12/4/2019 (70-72.5) cm	Sand Separation Area SJSSA08 11187072-120419-SS-SJSSA08 (80-82.5 CM) 12/4/2019 (80-82.5) cm	Sand Separation Area SJSSA09 11187072-120819-BN-SJSSA09 (0-1) 12/8/2019 (0-1) ft bgs	Sand Separation Area SJSSA09 11187072-120819-BN-SJSSA09 (0-2.5 CM) 12/8/2019 (0-2.5) cm	Sand Separation Area SJSSA09 11187072-120819-BN-SJSSA09 (1-2) 12/8/2019 (1-2) ft bgs	Sand Separation Area SJSSA09 11187072-120819-BN-SJSSA09 (2-4) 12/8/2019 (2-4) ft bgs	Sand Separation Area SJSSA09 11187072-120819-BN-SJSSA09 (4-6) 12/8/2019 (4-6) ft bgs
Dioxins/Furans									
1,2,3,4,6,7,8,9-Octachlorodibenzofuran (OCDF)	pg/g	--	--	--	4.4 U	--	3.6 U	4.1 U	7.3 U
1,2,3,4,6,7,8,9-Octachlorodibenzo-p-dioxin (OCDD)	pg/g	--	--	--	300	--	180	180	130
1,2,3,4,6,7,8-Heptachlorodibenzofuran (HpCDF)	pg/g	--	--	--	0.83 J	--	1.2 J	1.1 J	1.1 J
1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin (HpCDD)	pg/g	--	--	--	7.4	--	6.2 J	6.1 J	5.5 J
1,2,3,4,7,8,9-Heptachlorodibenzofuran (HpCDF)	pg/g	--	--	--	0.087 U	--	0.35 J	0.56 J	0.32 J
1,2,3,4,7,8-Hexachlorodibenzofuran (HxCDF)	pg/g	--	--	--	0.33 J	--	0.78 J	3.3 J	0.64 J
1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin (HxCDD)	pg/g	--	--	--	0.087 U	--	0.096 U	0.24 J	0.27 J
1,2,3,6,7,8-Hexachlorodibenzofuran (HxCDF)	pg/g	--	--	--	0.073 U	--	0.32 J	0.82 J	0.28 J
1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin (HxCDD)	pg/g	--	--	--	0.31 U	--	0.50 U	0.21 U	0.19 U
1,2,3,7,8,9-Hexachlorodibenzofuran (HxCDF)	pg/g	--	--	--	0.13 J	--	0.28 J	0.46 J	0.23 J
1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin (HxCDD)	pg/g	--	--	--	0.34 J	--	0.58 J	0.44 J	0.36 J
1,2,3,7,8-Pentachlorodibenzofuran (PeCDF)	pg/g	--	--	--	0.35 J	--	0.64 J	1.2 J	0.40 J
1,2,3,7,8-Pentachlorodibenzo-p-dioxin (PeCDD)	pg/g	--	--	--	0.14 U	--	0.15 U	0.18 U	0.12 U
2,3,4,6,7,8-Hexachlorodibenzofuran (HxCDF)	pg/g	--	--	--	0.070 U	--	0.073 U	0.10 U	0.094 U
2,3,4,7,8-Pentachlorodibenzofuran (PeCDF)	pg/g	--	--	--	0.092 U	--	0.079 U	0.61 J	0.092 U
2,3,7,8-Tetrachlorodibenzofuran (TCDF)	pg/g	--	--	--	13	--	20	44	14
2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	pg/g	--	--	--	3.0	--	4.4	9.7	3.0
Total heptachlorodibenzofuran (HpCDF)	pg/g	--	--	--	2.3 J	--	4.0 J	2.5 J	3.0 J
Total heptachlorodibenzo-p-dioxin (HpCDD)	pg/g	--	--	--	27 J	--	18 J	22 J	16 J
Total hexachlorodibenzofuran (HxCDF)	pg/g	--	--	--	0.83 J	--	3.3 J	4.6 J	1.2 J
Total hexachlorodibenzo-p-dioxin (HxCDD)	pg/g	--	--	--	3.3 J	--	4.3 J	5.0 J	3.3 J
Total pentachlorodibenzofuran (PeCDF)	pg/g	--	--	--	0.76 J	--	0.74 J	2.7 J	0.40 J
Total pentachlorodibenzo-p-dioxin (PeCDD)	pg/g	--	--	--	0.14 U	--	0.15 U	0.18 U	0.14 J
Total tetrachlorodibenzofuran (TCDF)	pg/g	--	--	--	19 J	--	29 J	68 J	20 J
Total tetrachlorodibenzo-p-dioxin (TCDD)	pg/g	--	--	--	3.0 J	--	4.4 J	11 J	3.3 J
Total WHO Dioxin TEQ(Human/Mammal)(ND=0)	pg/g	--	--	--	4.56	--	6.75	15.0	4.70
Total WHO Dioxin TEQ(Human/Mammal)(ND=0.5)	pg/g	--	--	--	4.67	--	6.87	15.1	4.79
Radiochemistry									
Cesium-137	pCi/g	0.1584 U+/-0.0959	0.1831 U+/-0.09753	0.183 U+/-0.1084	--	0.08415 U+/-0.05819	--	--	--
Lead-210	pCi/g	0.294 U+/-0.0491	0.596 +/-0.0531	0.524 +/-0.0536	--	0.095 +/-0.0428	--	--	--
General Chemistry									
Percent solids	%	--	--	--	71.0	--	75.2	78.4	75.4

Notes:
pg/g - picogram per gram
pCi/g - picocuries per gram
DUP - indicates the result from a duplicate sample
U - Not detected at the associated reporting limit.
J - Estimated concentration.
-- - Not analyzed

Table 6-1

Sand Separation Area Analytical Results - Northern Impoundment
Final 100% Remedial Design - Northern Impoundment
San Jacinto River Waste Pits Site
Harris County, Texas

Area Sample Location: Sample Identification: Sample Date: Sample Depth:	Units	Sand Separation Area SJSSA09 11187072-120819-BN-SJSSA09 (7.5-10 CM) 12/8/2019 (7.5-10) cm	Sand Separation Area SJSSA09 11187072-120819-BN-SJSSA09 (15-17.5 CM) 12/8/2019 (15-17.5) cm	Sand Separation Area SJSSA09 11187072-120819-BN-SJSSA09 (22.5-25 CM) 12/8/2019 (22.5-25) cm	Sand Separation Area SJSSA09 11187072-120819-BN-SJSSA09 (30-32.5 CM) 12/8/2019 (30-32.5) cm	Sand Separation Area SJSSA09 11187072-120819-BN-SJSSA09 (37.5-40 CM) 12/8/2019 (37.5-40) cm	Sand Separation Area SJSSA09 11187072-120819-BN-SJSSA09 (45-47.5 CM) 12/8/2019 (45-47.5) cm	Sand Separation Area SJSSA09 11187072-120819-BN-SJSSA09 (52.5-55 CM) 12/8/2019 (52.5-55) cm
Dioxins/Furans								
1,2,3,4,6,7,8,9-Octachlorodibenzofuran (OCDF)	pg/g	--	--	--	--	--	--	--
1,2,3,4,6,7,8,9-Octachlorodibenzo-p-dioxin (OCDD)	pg/g	--	--	--	--	--	--	--
1,2,3,4,6,7,8-Heptachlorodibenzofuran (HpCDF)	pg/g	--	--	--	--	--	--	--
1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin (HpCDD)	pg/g	--	--	--	--	--	--	--
1,2,3,4,7,8,9-Heptachlorodibenzofuran (HpCDF)	pg/g	--	--	--	--	--	--	--
1,2,3,4,7,8-Hexachlorodibenzofuran (HxCDF)	pg/g	--	--	--	--	--	--	--
1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin (HxCDD)	pg/g	--	--	--	--	--	--	--
1,2,3,6,7,8-Hexachlorodibenzofuran (HxCDF)	pg/g	--	--	--	--	--	--	--
1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin (HxCDD)	pg/g	--	--	--	--	--	--	--
1,2,3,7,8,9-Hexachlorodibenzofuran (HxCDF)	pg/g	--	--	--	--	--	--	--
1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin (HxCDD)	pg/g	--	--	--	--	--	--	--
1,2,3,7,8-Pentachlorodibenzofuran (PeCDF)	pg/g	--	--	--	--	--	--	--
1,2,3,7,8-Pentachlorodibenzo-p-dioxin (PeCDD)	pg/g	--	--	--	--	--	--	--
2,3,4,6,7,8-Hexachlorodibenzofuran (HxCDF)	pg/g	--	--	--	--	--	--	--
2,3,4,7,8-Pentachlorodibenzofuran (PeCDF)	pg/g	--	--	--	--	--	--	--
2,3,7,8-Tetrachlorodibenzofuran (TCDF)	pg/g	--	--	--	--	--	--	--
2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	pg/g	--	--	--	--	--	--	--
Total heptachlorodibenzofuran (HpCDF)	pg/g	--	--	--	--	--	--	--
Total heptachlorodibenzo-p-dioxin (HpCDD)	pg/g	--	--	--	--	--	--	--
Total hexachlorodibenzofuran (HxCDF)	pg/g	--	--	--	--	--	--	--
Total hexachlorodibenzo-p-dioxin (HxCDD)	pg/g	--	--	--	--	--	--	--
Total pentachlorodibenzofuran (PeCDF)	pg/g	--	--	--	--	--	--	--
Total pentachlorodibenzo-p-dioxin (PeCDD)	pg/g	--	--	--	--	--	--	--
Total tetrachlorodibenzofuran (TCDF)	pg/g	--	--	--	--	--	--	--
Total tetrachlorodibenzo-p-dioxin (TCDD)	pg/g	--	--	--	--	--	--	--
Total WHO Dioxin TEQ(Human/Mammal)(ND=0)	pg/g	--	--	--	--	--	--	--
Total WHO Dioxin TEQ(Human/Mammal)(ND=0.5)	pg/g	--	--	--	--	--	--	--
Radiochemistry								
Cesium-137	pCi/g	0.09609 U+/-0.05366	0.08249 U+/-0.05073	0.1153 U+/-0.06196	0.09361 U+/-0.0574	0.0758 U+/-0.04698	0.06056 U+/-0.03959	0.08343 U+/-0.05239
Lead-210	pCi/g	0.0718 U+/-0.0451	0.0967 +/-0.0467	0.0732 U+/-0.0459	0.0755 +/-0.0432	0.0714 U+/-0.0446	0.12 +/-0.0473	0.08 U+/-0.0481
General Chemistry								
Percent solids	%	--	--	--	--	--	--	--

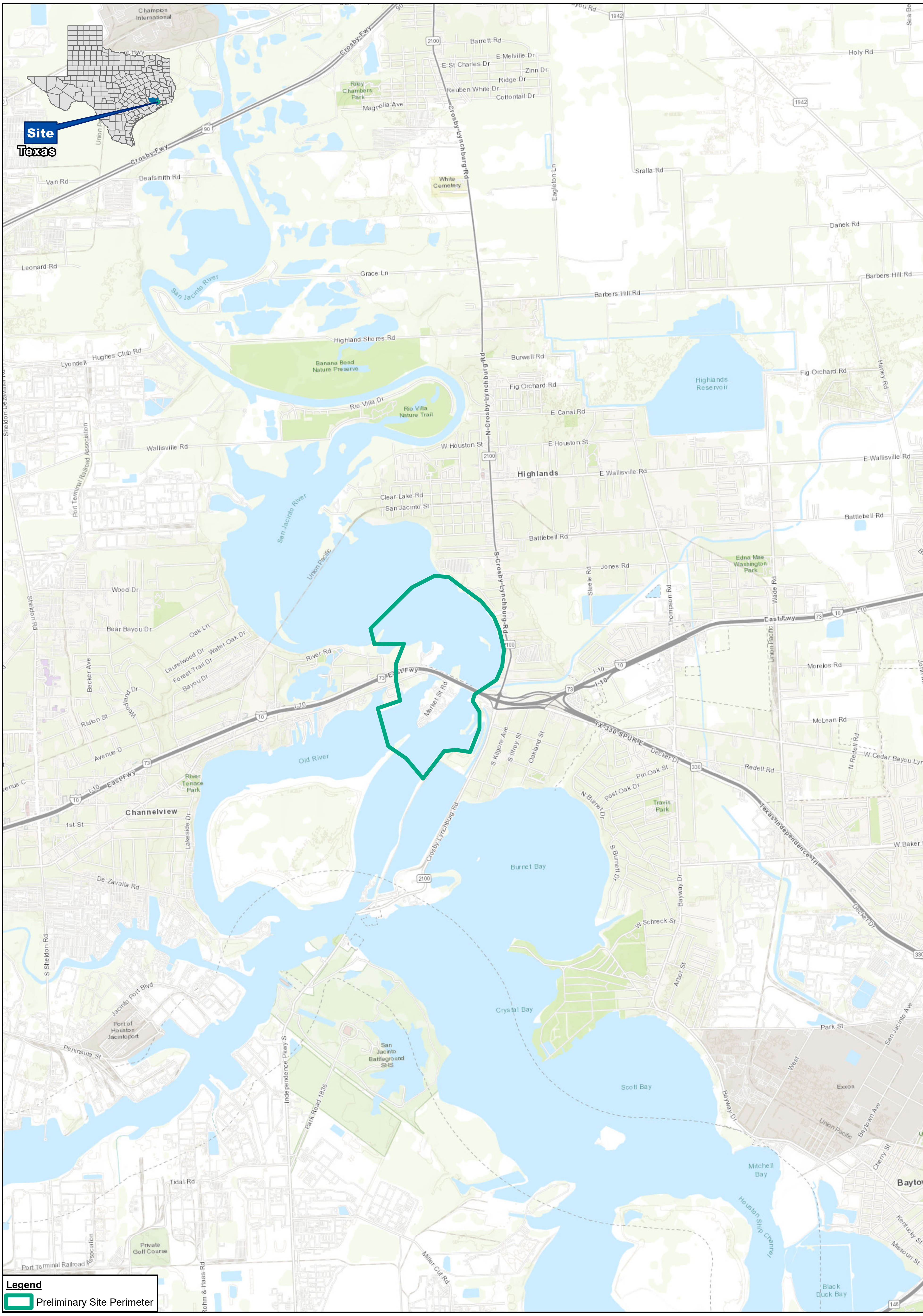
Notes:
- pg/g - picogram per gram
- pCi/g - picocuries per gram
- DUP - indicates the result from a duplicate sample
- U - Not detected at the associated reporting limit.
- J - Estimated concentration.
- -- - Not analyzed

Table 6-1

Sand Separation Area Analytical Results - Northern Impoundment
Final 100% Remedial Design - Northern Impoundment
San Jacinto River Waste Pits Site
Harris County, Texas

Area Sample Location: Sample Identification: Sample Date: Sample Depth:	Units	Sand Separation Area SJSSA09 11187072-120819-BN-SJSSA09 (60-62.5 CM) 12/8/2019 (60-62.5) cm	Sand Separation Area SJSSA09 11187072-120819-BN-SJSSA09 (70-72.5 CM) 12/8/2019 (70-72.5) cm	Sand Separation Area SJSSA09 11187072-120819-BN-SJSSA09 (80-82.5 CM) 12/8/2019 (80-82.5) cm
Dioxins/Furans				
1,2,3,4,6,7,8,9-Octachlorodibenzofuran (OCDF)	pg/g	--	--	--
1,2,3,4,6,7,8,9-Octachlorodibenzo-p-dioxin (OCDD)	pg/g	--	--	--
1,2,3,4,6,7,8-Heptachlorodibenzofuran (HpCDF)	pg/g	--	--	--
1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin (HpCDD)	pg/g	--	--	--
1,2,3,4,7,8,9-Heptachlorodibenzofuran (HpCDF)	pg/g	--	--	--
1,2,3,4,7,8-Hexachlorodibenzofuran (HxCDF)	pg/g	--	--	--
1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin (HxCDD)	pg/g	--	--	--
1,2,3,6,7,8-Hexachlorodibenzofuran (HxCDF)	pg/g	--	--	--
1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin (HxCDD)	pg/g	--	--	--
1,2,3,7,8,9-Hexachlorodibenzofuran (HxCDF)	pg/g	--	--	--
1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin (HxCDD)	pg/g	--	--	--
1,2,3,7,8-Pentachlorodibenzofuran (PeCDF)	pg/g	--	--	--
1,2,3,7,8-Pentachlorodibenzo-p-dioxin (PeCDD)	pg/g	--	--	--
2,3,4,6,7,8-Hexachlorodibenzofuran (HxCDF)	pg/g	--	--	--
2,3,4,7,8-Pentachlorodibenzofuran (PeCDF)	pg/g	--	--	--
2,3,7,8-Tetrachlorodibenzofuran (TCDF)	pg/g	--	--	--
2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	pg/g	--	--	--
Total heptachlorodibenzofuran (HpCDF)	pg/g	--	--	--
Total heptachlorodibenzo-p-dioxin (HpCDD)	pg/g	--	--	--
Total hexachlorodibenzofuran (HxCDF)	pg/g	--	--	--
Total hexachlorodibenzo-p-dioxin (HxCDD)	pg/g	--	--	--
Total pentachlorodibenzofuran (PeCDF)	pg/g	--	--	--
Total pentachlorodibenzo-p-dioxin (PeCDD)	pg/g	--	--	--
Total tetrachlorodibenzofuran (TCDF)	pg/g	--	--	--
Total tetrachlorodibenzo-p-dioxin (TCDD)	pg/g	--	--	--
Total WHO Dioxin TEQ(Human/Mammal)(ND=0)	pg/g	--	--	--
Total WHO Dioxin TEQ(Human/Mammal)(ND=0.5)	pg/g	--	--	--
Radiochemistry				
Cesium-137	pCi/g	0.09455 U+/-0.06032	0.1217 U+/-0.06699	0.05701 U+/-0.03507
Lead-210	pCi/g	0.0744 U+/-0.0461	0.0816 +/-0.0451	0.105 +/-0.0417
General Chemistry				
Percent solids	%	--	--	--

Notes:
pg/g - picogram per gram
pCi/g - picocuries per gram
DUP - indicates the result from a duplicate sample
U - Not detected at the associated reporting limit.
J - Estimated concentration.
-- - Not analyzed



Paper Size ANSI B

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Miles

Map Projection: Lambert Conformal Conic
Horizontal Datum: North American 1983
Grid: NAD 1983 StatePlane Texas South Central FIPS 4204 Feet

GHD

SAN JACINTO RIVER WASTE PITS SITE
HARRIS COUNTY, TEXAS

Project No. 11215702
Revision No. -
Date May 11, 2022

VICINITY MAP

FIGURE 1-1

Q:\GIS\PROJECTS\11215000s\11215702\RPT006\11215702_202205_RPT006_GIS001-1.mxd

Data source: Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), (c) OpenStreetMap contributors, and the GIS User Community.

Paper Size ANSI B

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Feet

Map Projection: Lambert Conformal Conic
Horizontal Datum: North American 1983
Grid: NAD 1983 StatePlane Texas South Central FIPS 4204 Feet

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SAN JACINTO RIVER WASTE PITS SITE
HARRIS COUNTY, TEXAS

NORTHERN IMPOUNDMENT AND
SAND SEPARATION AREA

Project No. 11215702
Revision No. -
Date May 11, 2022

FIGURE 1-2

Q:\GIS\PROJECTS\11215000s\11215702\RPT006\11215702_202205_RPT006_GIS001-2.mxd

Data source: Google Earth Imagery

Paper Size ANSI B

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Feet

Map Projection: Lambert Conformal Conic
Horizontal Datum: North American 1983
Grid: NAD 1983 StatePlane Texas South Central FIPS 4204 Feet

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SAN JACINTO RIVER WASTE PITS SITE
HARRIS COUNTY, TEXAS

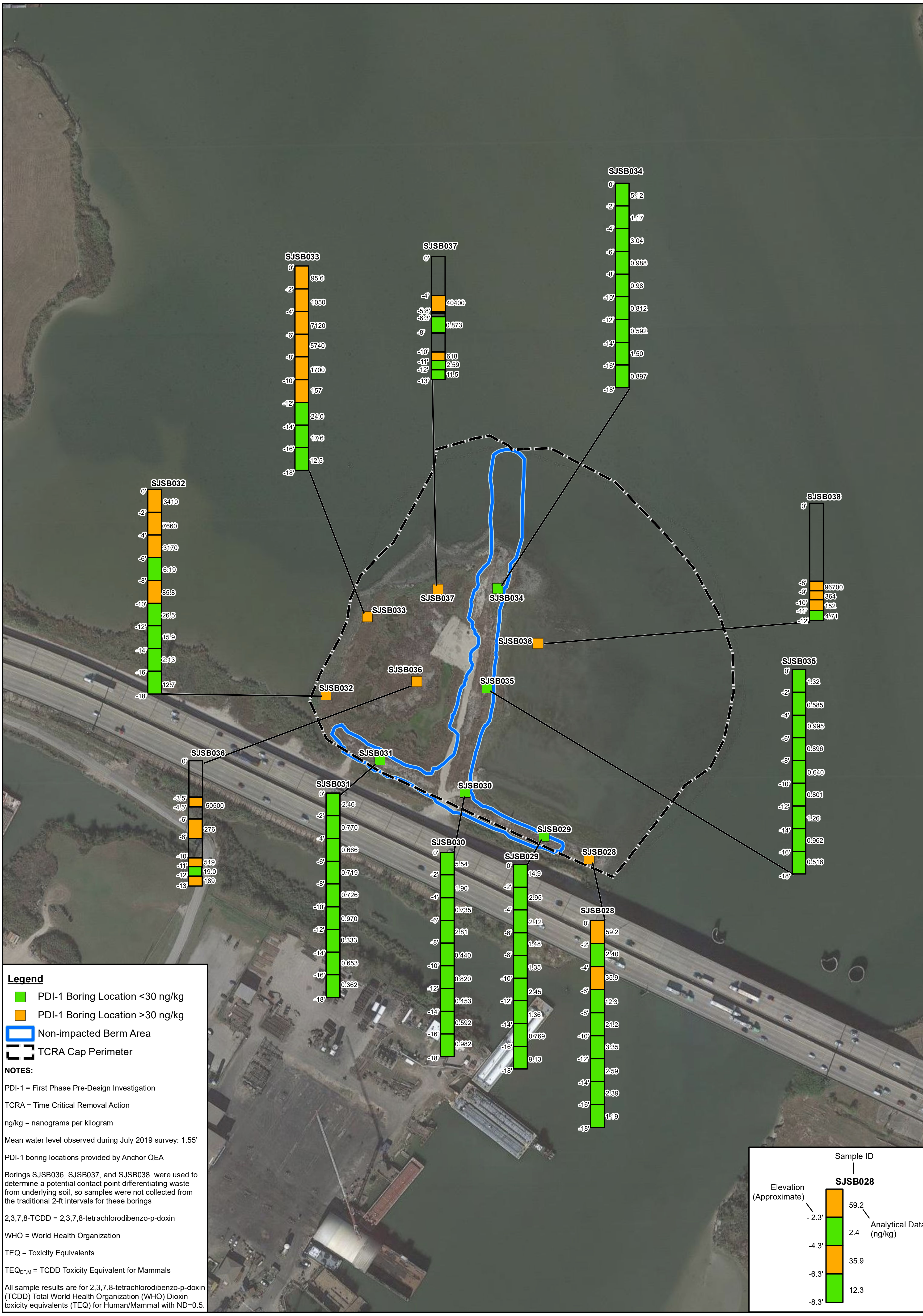
FIRST PHASE PRE-DESIGN
INVESTIGATION BORING LOCATIONS

Project No. 11215702
Revision No. -
Date May 11, 2022

FIGURE 2-1

Q:\GIS\PROJECTS\11215000s\11215702\RPT006\11215702_202205_RPT006_GIS002-1.mxd

Data source: Google Earth Imagery



NOTES:

PDI-1 = First Phase Pre-Design Investigation

TCRA = Time Critical Removal Action

ng/kg = nanograms per kilogram

Mean water level observed during July 2019 survey: 1.55'

PDI-1 boring locations provided by Anchor QEA

Borings SJSB036, SJSB037, and SJSB038 were used to determine a potential contact point differentiating waste from underlying soil, so samples were not collected from the traditional 2-ft intervals for these borings

2,3,7,8-TCDD = 2,3,7,8-tetrachlorodibenzo-p-doxin

WHO = World Health Organization

TEQ = Toxicity Equivalents

$TEQ_{DF,M}$ = TCDD Toxicity Equivalent for Mammals

All sample results are for 2,3,7,8-tetrachlorodibenzo-p-doxin (TCDD) Total World Health Organization (WHO) Dioxin toxicity equivalents (TEQ) for Human/Mammal with ND=0.5.

Paper Size ANSI B

0 60 120 180 240

Feet

N

Map Projection: Lambert Conformal Conic
Horizontal Datum: North American 1983
Grid: NAD 1983 StatePlane Texas South Central FIPS 4204 Feet

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SAN JACINTO RIVER WASTE PITS SITE
HARRIS COUNTY, TEXAS

FIRST PHASE PRE-DESIGN INVESTIGATION RESULTS

Project No. 11215702
Revision No. -
Date Jun 27, 2022

FIGURE 2-2

Q:\GIS\PROJECTS\11215000s\11215702\RPT006\11215702_202205_RPT006_GIS002-2.mxd

Data source: Google Earth Imagery

Paper Size ANSI B

0 40 80 120 160

Feet

N

Map Projection: Lambert Conformal Conic
Horizontal Datum: North American 1983
Grid: NAD 1983 StatePlane Texas South Central FIPS 4204 Feet

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SAN JACINTO RIVER WASTE PITS SITE
HARRIS COUNTY, TEXAS

SECOND PHASE PRE-DESIGN INVESTIGATION BORING LOCATIONS

Project No. 11215702
Revision No. -
Date Jun 10, 2022

FIGURE 2-3

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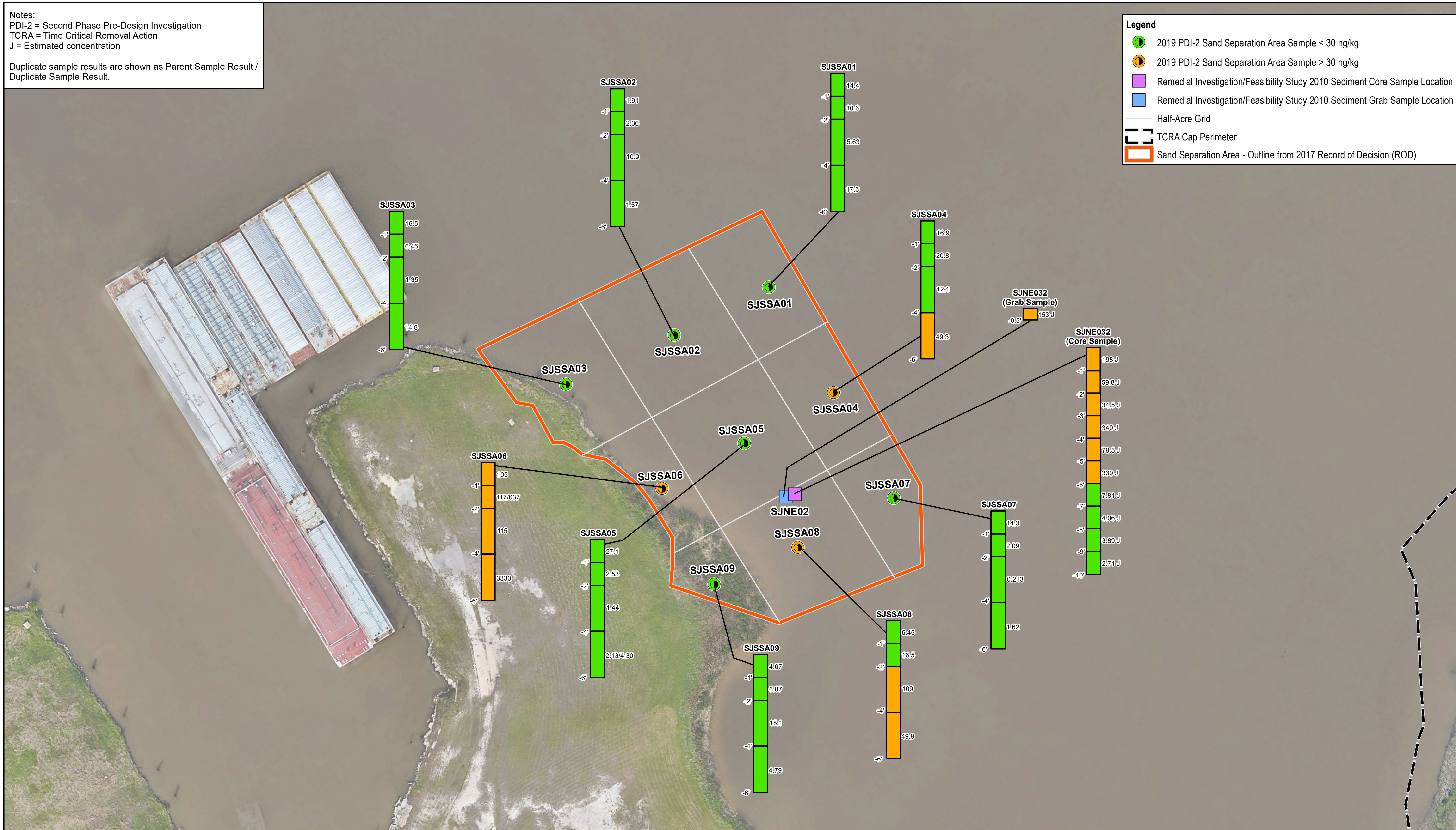

Map Projection: Lambert Conformal Conic
Horizontal Datum: North American 1983
Grid: NAD 1983 StatePlane Texas South Central FIPS 4204 Feet

GHD

SAN JACINTO RIVER WASTE PITS SITE
HARRIS COUNTY, TEXAS
NORTHERN IMPOUNDMENT

SAND SEPARATION AREA ANALYTICAL RESULTS

Project No. 11215702
Revision No. -
Date Jul 16, 2024

FIGURE 2-4

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Data source: ©2024 Google, Imagery Date 2/9/2023
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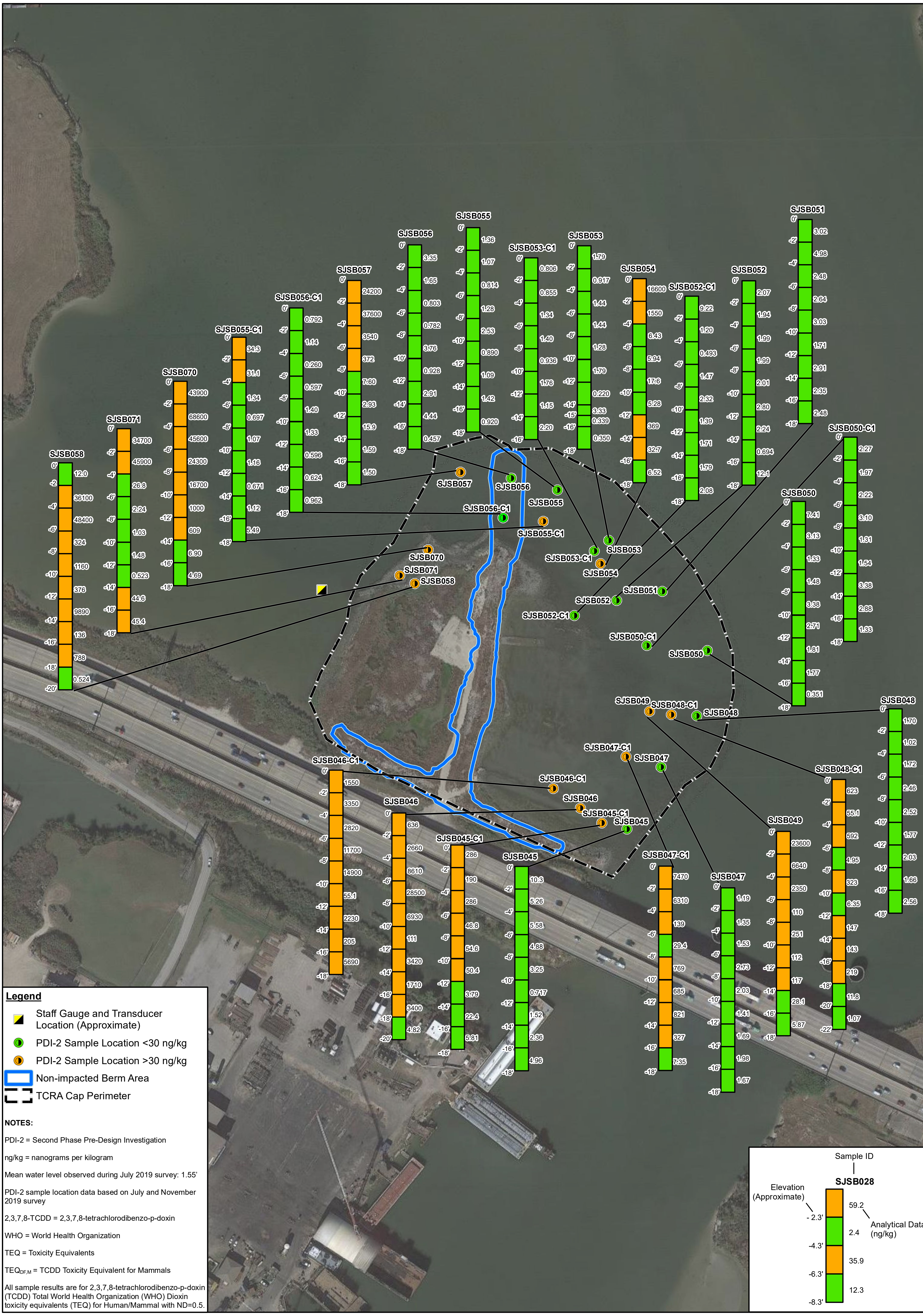

Paper Size ANSI B

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Feet

Map Projection: Lambert Conformal Conic
Horizontal Datum: North American 1983
Grid: NAD 1983 StatePlane Texas South Central FIPS 4204 Feet

N

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SAN JACINTO RIVER WASTE PITS SITE
HARRIS COUNTY, TEXAS

SECOND PHASE PRE-DESIGN INVESTIGATION RESULTS

Project No. **11215702**
Revision No. **-**
Date **Jun 27, 2022**

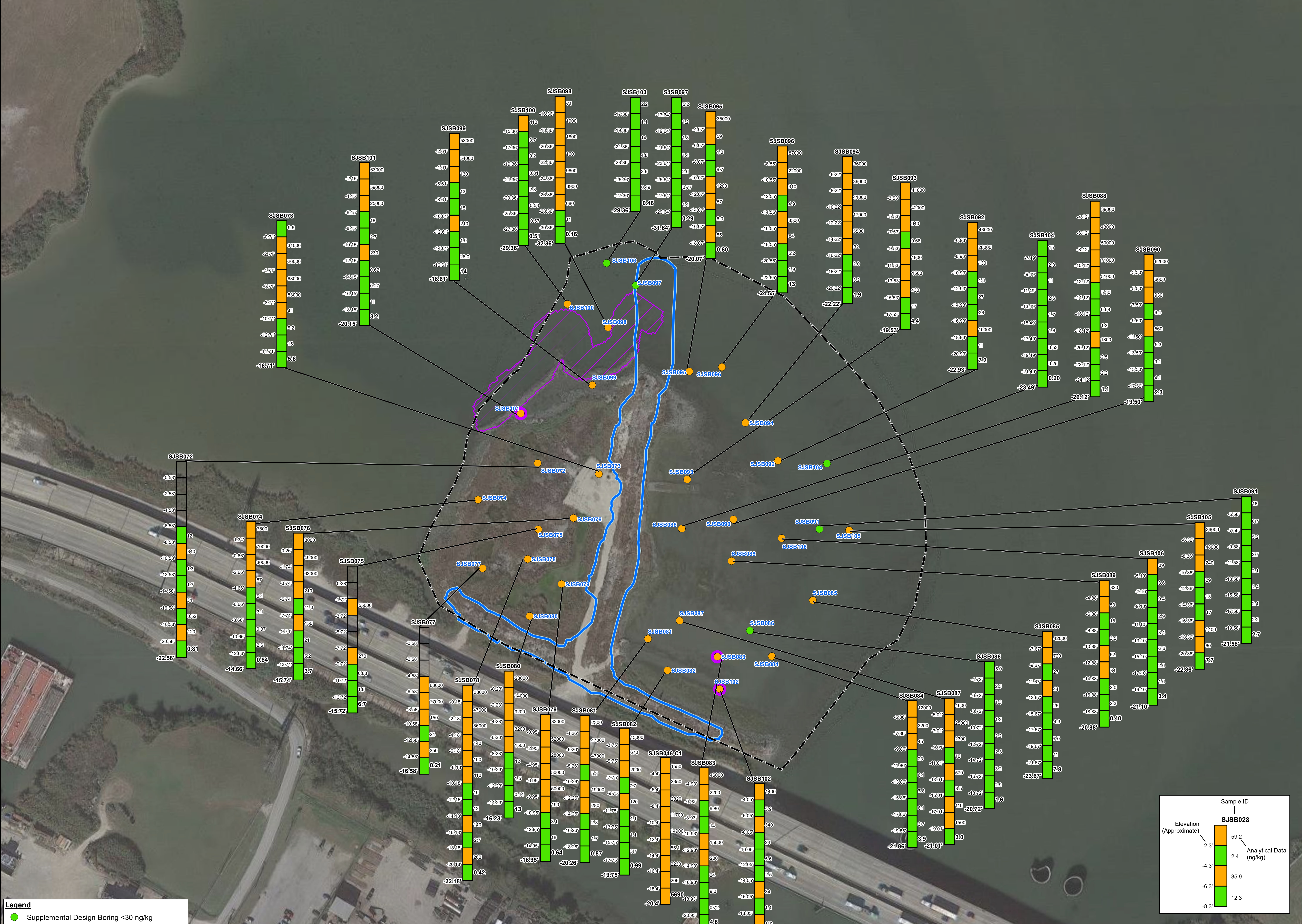
FIGURE 2-5

Q:\GIS\PROJECTS\11215000s\11215702\RPT006\11215702_202205_RPT006_GIS002-5.mxd

Data source: Google Earth Imagery

SUPPLEMENTAL DESIGN INVESTIGATION BORING LOCATIONS

FIGURE 2-6



Paper Size ANSI B

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Feet

Map Projection: Lambert Conformal Conic
Horizontal Datum: North American 1983
Grid: NAD 1983 StatePlane Texas South Central FIPS 4204 Feet

GHD

SAN JACINTO RIVER WASTE PITS SITE
HARRIS COUNTY, TEXAS

SUPPLEMENTAL DESIGN INVESTIGATION RESULTS

Project No. 11215702
Revision No. -
Date Jun 27, 2022

FIGURE 2-7

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Print date: 27 Jun 2022 - 13:34

Data source: Imagery - Google, 2019.

Map Projection: Lambert Conformal Conic
Horizontal Datum: North American 1983
Grid: NAD 1983 StatePlane Texas South Central FIPS 4204 Feet

GHD

SAN JACINTO RIVER WASTE PITS SITE
HARRIS COUNTY, TEXAS

VELOCITY MONITORS AND AMBIENT TURBIDITY MEASUREMENT LOCATIONS

Project No. 11215702
Revision No. -
Date May 11, 2022

FIGURE 2-8

Q:\GIS\PROJECTS\11215000s\11215702\RPT006\11215702_202205_RPT006_GIS002-8.mxd
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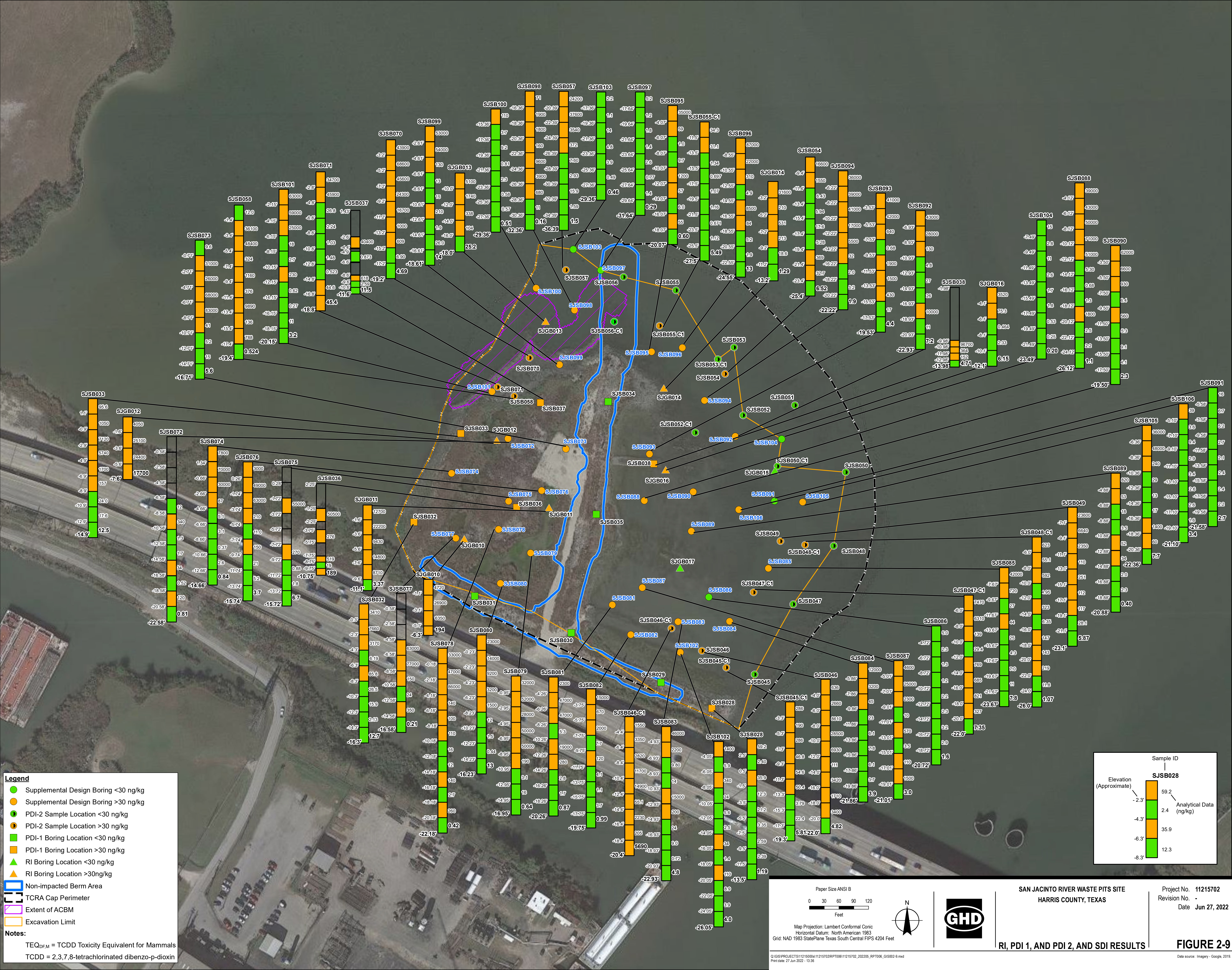
Data source: Imagery - Google, 2019.



Legend
Supplemental Design Boring <30 ng/kg
Supplemental Design Boring >30 ng/kg
PDI-2 Sample Location <30 ng/kg
PDI-2 Sample Location >30 ng/kg
PDI-1 Boring Location <30 ng/kg
PDI-1 Boring Location >30 ng/kg
RI Boring Location <30 ng/kg
RI Boring Location >30ng/kg
Non-impacted Berm Area
TCRA Cap Perimeter
Extent of ACBM
Excavation Limit
Notes:
$TEQ_{DF,M}$ = TCDD Toxicity Equivalent for Mammals
TCDD = 2,3,7,8-tetrachlorinated dibenzo-p-dioxin
Sample ID
SJSB028
Elevation (Approximate)
Analytical Data (ng/kg)
- 2.3'
59.2
2.4
-4.3'
35.9
-6.3'
12.3
-8.3'
Paper Size ANSI B
0 30 60 90 120
Feet
Map Projection: Lambert Conformal Conic
Horizontal Datum: North American 1983
Grid: NAD 1983 StatePlane Texas South Central FIPS 4204 Feet
N
GHD
SAN JACINTO RIVER WASTE PITS SITE
HARRIS COUNTY, TEXAS
Project No. 11215702
Revision No. -
Date Jun 27, 2022
RI, PDI 1, AND PDI 2, AND SDI RESULTS
FIGURE 2-9
Data source: Imagery - Google, 2019.

Paper Size ANSI B

0 40 80 120 160

Feet

Map Projection: Lambert Conformal Conic
Horizontal Datum: North American 1983
Grid: NAD 1983 StatePlane Texas South Central FIPS 4204 Feet

N

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SAN JACINTO RIVER WASTE PITS SITE
HARRIS COUNTY, TEXAS

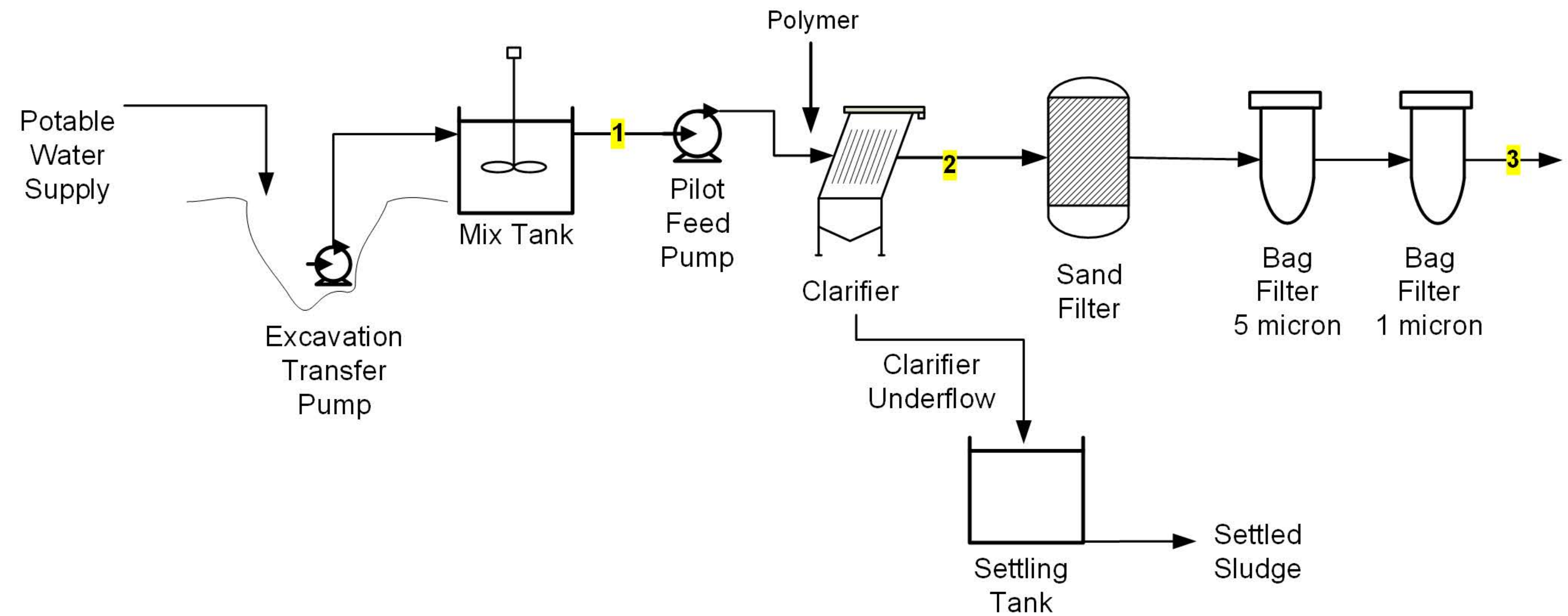
2019 TREATABILITY WASTE MATERIAL SAMPLE LOCATIONS

Project No. 11215702
Revision No. -
Date May 11, 2022

FIGURE 3-1

Q:\GIS\PROJECTS\11215000s\11215702\RPT006\11215702_202205_RPT006_GIS003-1.mxd

Data source: Google Earth Imagery



		Sample Point		
		1	2	3
Parameter		Contact Water (average)[2]	Clarifier Effluent[2]	Filter Effluent[2]
2,3,7,8 TCDD[1]	pg/L	16,500	13	<10
Copper	mg/L	0.10	0.0081 U	0.0081 U
Lead	mg/L	0.11	0.0022 U	0.0022 U
Zinc	mg/L	0.38	0.045	0.036
TSS	mg/L	4,050	11	2

Notes:
pg/L = picogram per liter
mg/L = milligram per liter
2,3,7,8 TCDD =Tetrachlorodibenzodioxin
TSS = total suspended solids
U = not detected at the associated reporting limit

1) The Minimum Level (ML) of EPA approved method 1613B is 10 pg/L.
2) Full analytical data set included in Table 3-2. Lab reports included in Appendix D.

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SAN JACINTO RIVER WASTE PITS SITE
HARRIS COUNTY, TEXAS

2019 PILOT TEST
PROCESS FLOW DIAGRAM

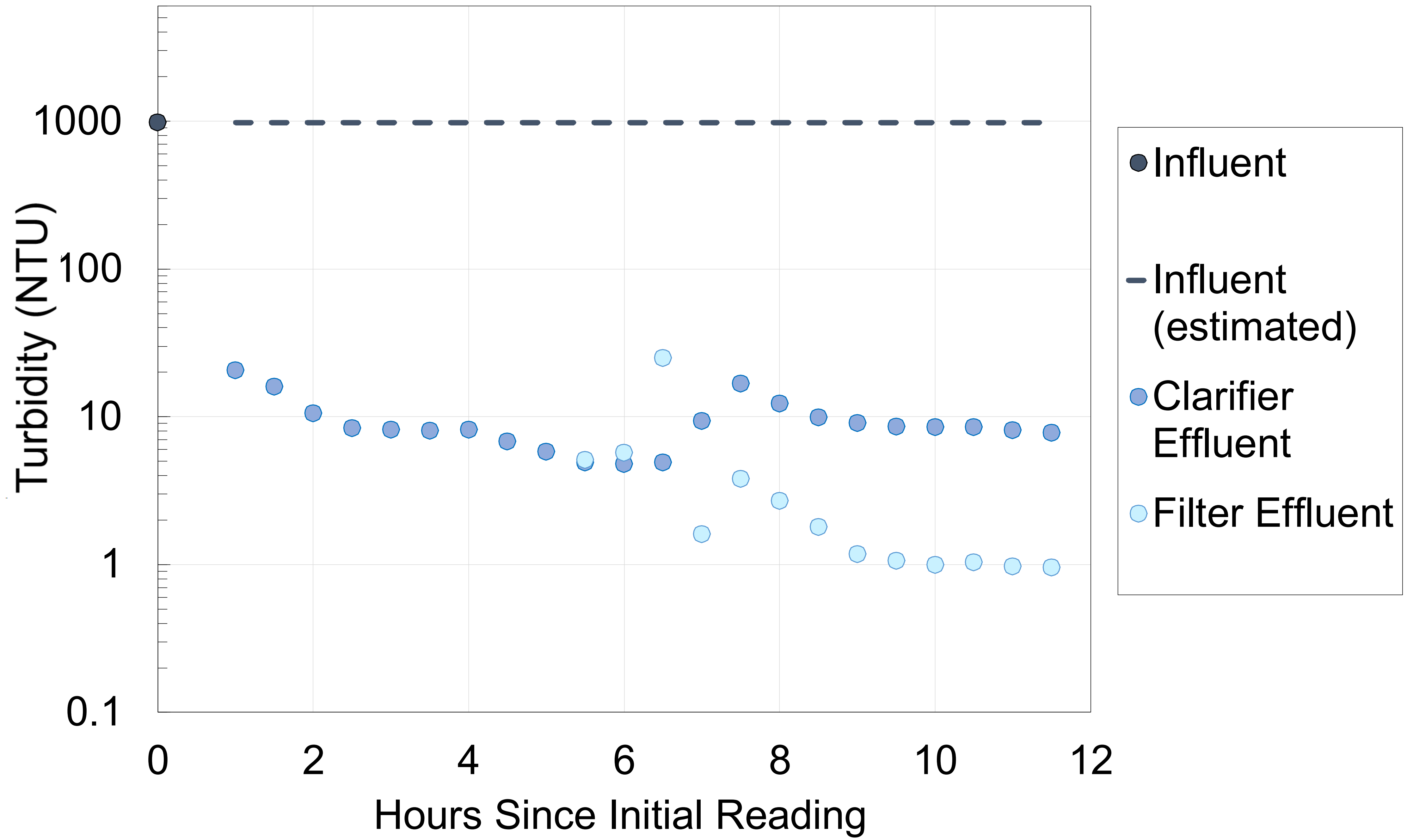
Project No. 11215702
Revision No. -
Date May 6, 2022

FIGURE 3-2

Q:\GIS\PROJECTS\11215000s\11215702\RPT006\11215702_202205_RPT006_GIS003-2.mxd

Notes:
NTU = Nephelometric Turbidity Unit

Turbidity was measured during the on-site water treatment pilot test. Real-time turbidity readings were taken for the influent, the post-clarification effluent, and the post-filtration effluent.



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SAN JACINTO RIVER WASTE PITS SITE
HARRIS COUNTY, TEXAS

2019 PILOT TEST
EFFLUENT TURBIDITY

Project No. 11215702
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Date May 6, 2022

FIGURE 3-3

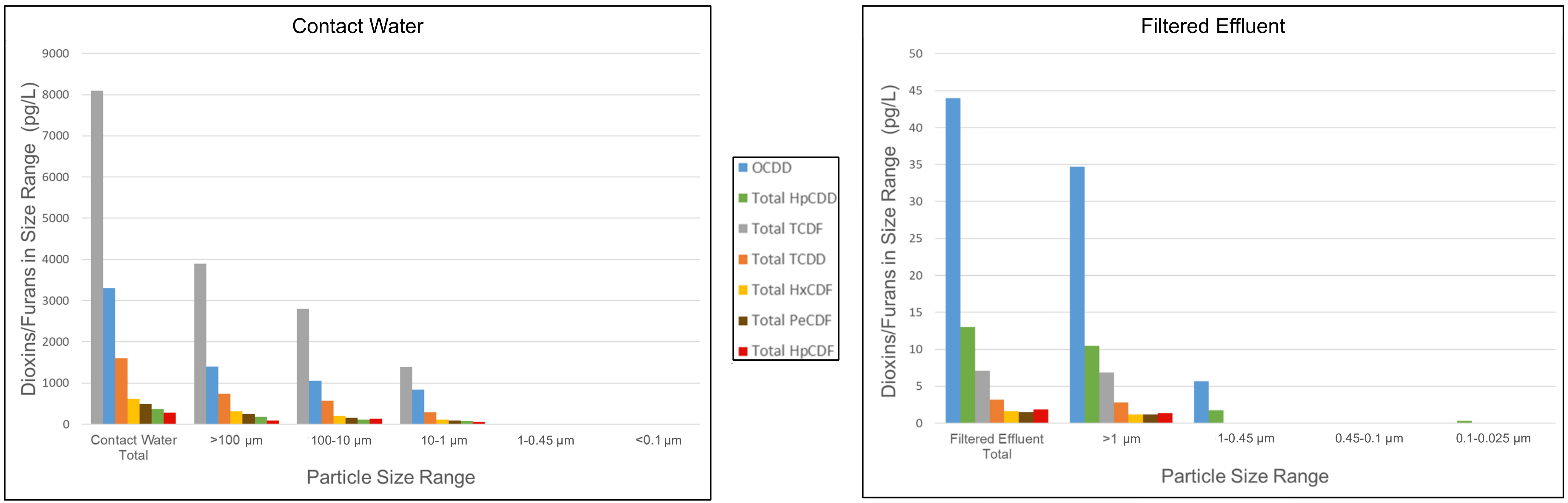
Q:\GIS\PROJECTS\11215000s\11215702\RPT006\11215702_202205_RPT006_GIS003-3.mxd

Notes:

pg/L = picogram per liter
µm = micron
TCDF =Tetrachlorodibenzofuran
OCDD = Octachlorodibenzodioxin
TCDD = Tetrachlorodibenzodioxin
HxCDF = Hexachlorodibenzofuran
PeCDF = Pentachlorodibenzofuran
HpCDD = Heptachlorodibenzodioxin
HpCDF = Heptachlorodibenzofuran

The graph on the left shows dioxin/furan results after the raw contact water was filtered through 100 µm, 10 µm, 1 µm, 0.45 µm, and 0.1 µm filters.

The graph on the right shows dioxin/furan results after the clarified and filtered effluent from the on-site pilot test was then filtered through 1 µm, 0.45 µm, 0.1 µm, 0.05 µm, and 0.025 µm filters.



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SAN JACINTO RIVER WASTE PITS SITE
HARRIS COUNTY, TEXAS

2019 FILTRATION TESTING RESULTS

Project No. 11215702
Revision No. -
Date May 6, 2022

FIGURE 3-4

Q:\GIS\PROJECTS\11215000s\11215702\RPT006\11215702_202205_RPT006_GIS003-4.mxd

Map Projection: Lambert Conformal Conic
Horizontal Datum: North American 1983
Grid: NAD 1983 StatePlane Texas South Central FIPS 4204 Feet

SAN JACINTO RIVER WASTE PITS SITE
HARRIS COUNTY, TEXAS

2019 ARMORED CAP MATERIAL SAMPLE LOCATIONS

Project No. 11215702
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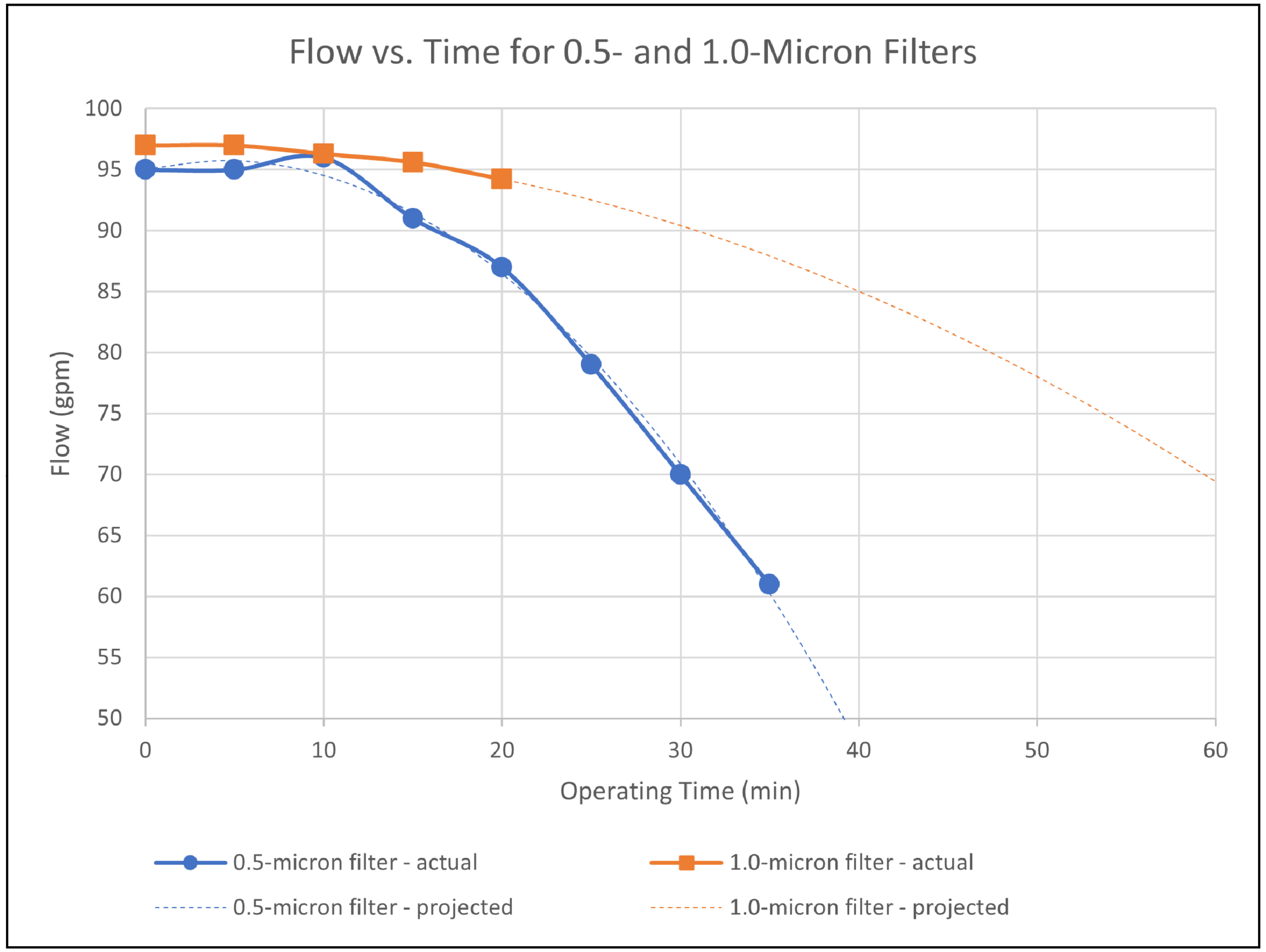
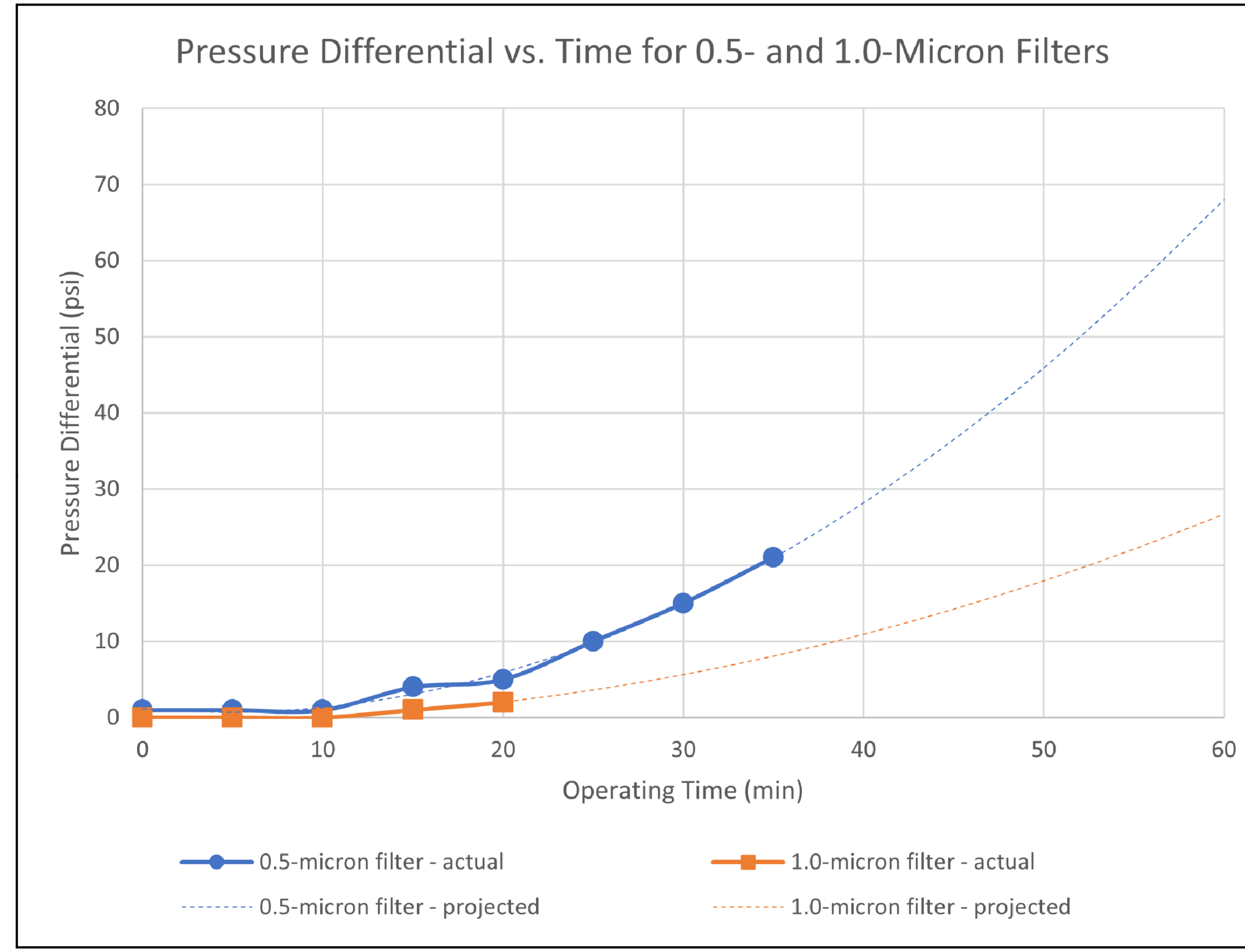
FIGURE 3-5

Q:\GIS\PROJECTS\11215000s\11215702\RPT006\11215702_202205_RPT006_GIS003-5.mxd

Data source: Google Earth Imagery





Notes:
- gpm = gallons per minute
- min = minutes
- psi = pounds per square inch

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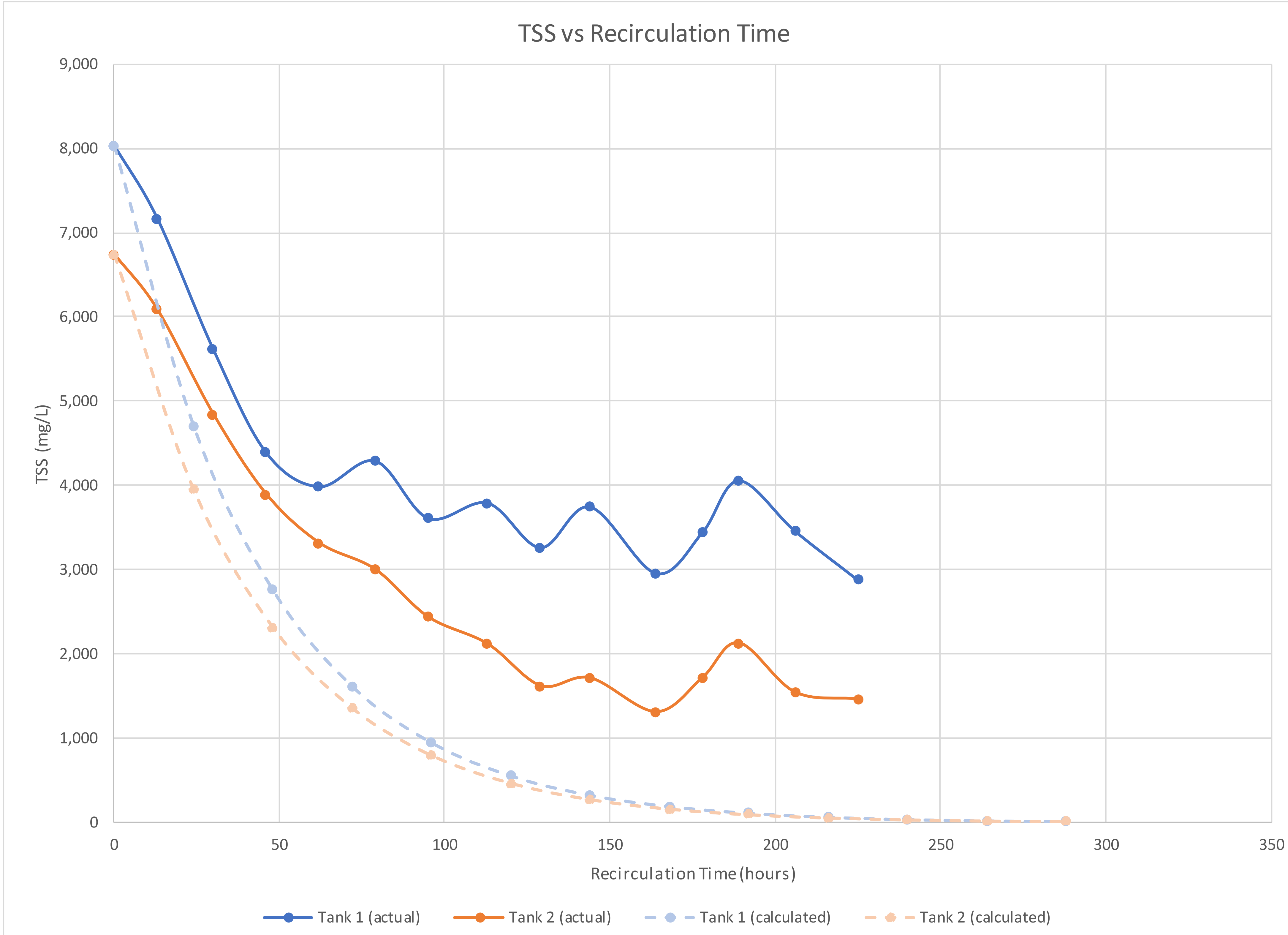
SAN JACINTO RIVER WASTE PITS SITE
HARRIS COUNTY, TEXAS

FLOW AND DIFFERENTIAL PRESSURE OVER TIME - FIELD FILTRATION TESTING

Project No. 11215702
Revision No. -
Date May 19, 2022

FIGURE 3-6

Q:\GIS\PROJECTS\11215000s\11215702\RPT006\11215702_202205_RPT006_GIS003-6.mxd



Notes:
- TSS = total suspended solids
- mg/L = milligrams per liter
- This graph shows the TSS values after recirculation. Expected TSS values for filtrate from Tank 1 and Tank 2 were calculated based on particle size distributions prior to recirculation versus filter pore sizes used during recirculation.

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SAN JACINTO RIVER WASTE PITS SITE
HARRIS COUNTY, TEXAS

ACTUAL VERSUS EXPECTED (CALCULATED) TSS VALUES - APPROACH B FILTRATION TESTING

Project No. 11215702
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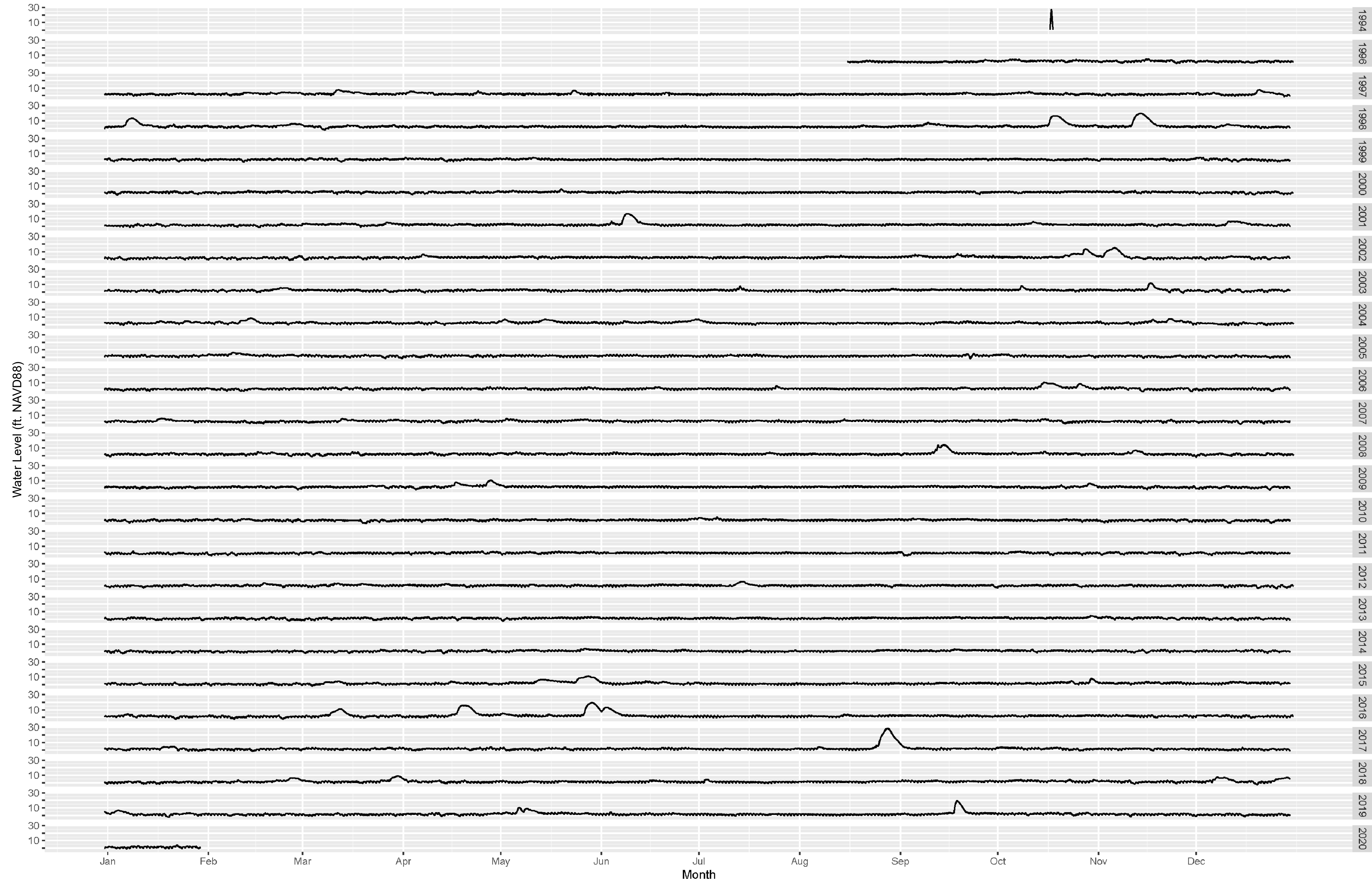
Date May 19, 2022

FIGURE 3-7

Q:\GIS\PROJECTS\11215000s\11215702\RPT006\11215702_202205_RPT006_GIS003-7.mxd



Legend

—— Water Surface Elevation (Feet NAVD88)

Notes:
San Jacinto River water surface elevations measured at the Sheldon Gage (USGS #08072050)

NAVD88 = North American Vertical Datum of 1988

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SAN JACINTO RIVER WASTE PITS SITE
HARRIS COUNTY, TEXAS

HISTORICAL RIVER ELEVATIONS - SHELDON GAGE

Project No. **11215702**
Revision No. **-**
Date **May 6, 2022**

FIGURE 5-1

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Legend

- Northern Impoundment Water Surface (Hindcasted)
- Sheldon Gage Water Surface (Measured)

Notes:
San Jacinto River water surface elevations measured at the Sheldon Gage (USGS #08072050)

NAVD88 = North American Vertical Datum of 1988

San Jacinto River water surface data at the Northern Impoundment based upon data obtained from a transducer installed in the river on the west side of the Northern Impoundment in July, 2019

BMP = Best Management Practice (ie: cofferdam or sheetpile wall)"

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SAN JACINTO RIVER WASTE PITS SITE
HARRIS COUNTY, TEXAS

UPDATED HINDCASTED WATER SURFACE ELEVATIONS - YEAR ROUND

Project No. 11215702
Revision No. -
Date Jul 8, 2024

FIGURE 5-2

Q:\GIS\PROJECTS\11215000s\11215702\RPT012\11215702_202405_RPT012_GIS007.mxd

Legend

Northern Impoundment Water Surface (Hindcasted)

Sheldon Gage Water Surface (Measured)

Notes:

San Jacinto River water surface elevations measured at the Sheldon Gage (USGS #08072050)

NAVD88 = North American Vertical Datum of 1988

San Jacinto River water surface data at the Northern Impoundment based upon data obtained from a transducer installed in the river on the west side of the Northern Impoundment in July, 2019

BMP = Best Management Practice (ie: cofferdam or sheetpile wall)"

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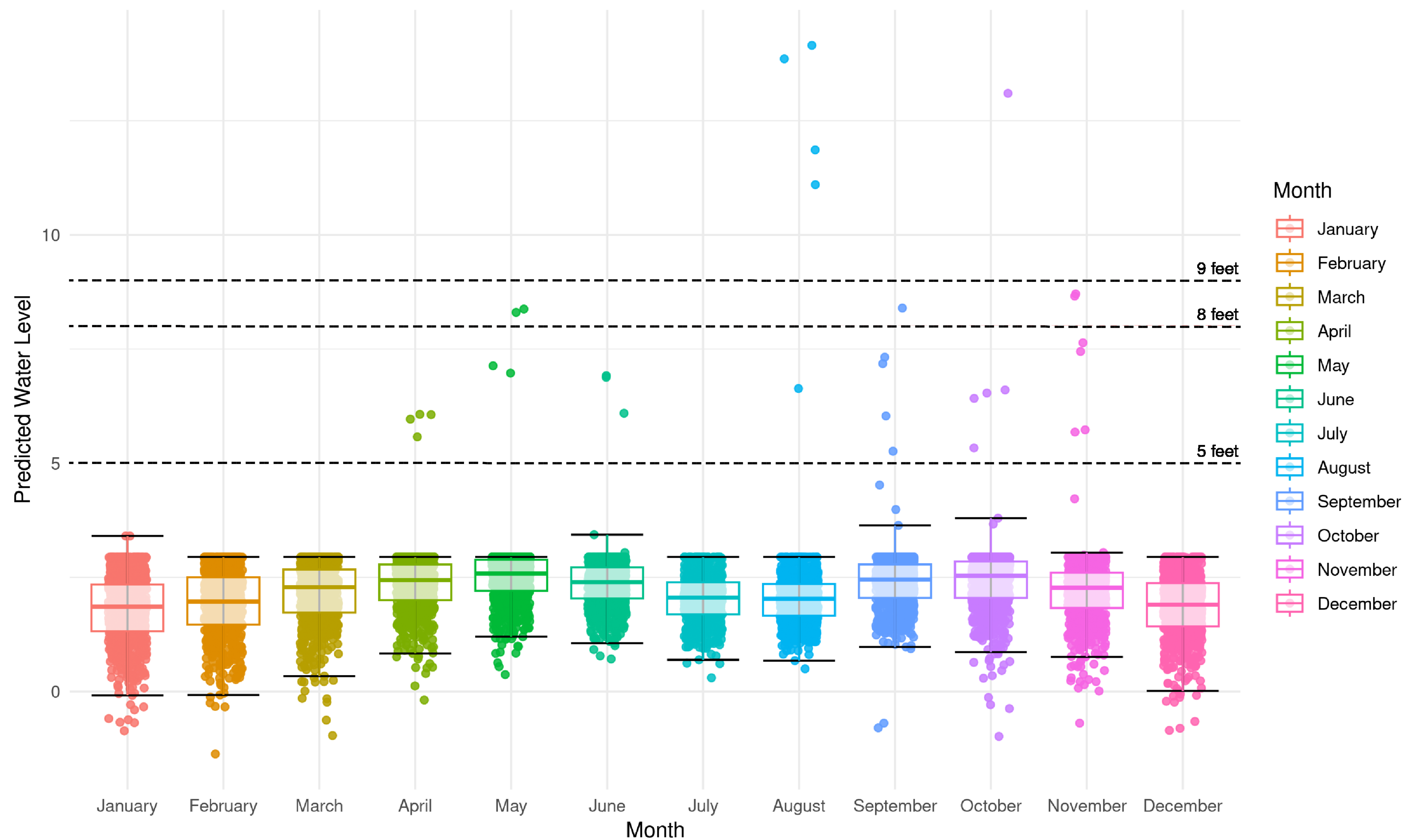
SAN JACINTO RIVER WASTE PITS SITE
HARRIS COUNTY, TEXAS

UPDATED HINDCASTED WATER SURFACE ELEVATIONS - NOVEMBER TO APRIL

Project No. 11215702
Revision No. -
Date Jul 8, 2024

FIGURE 5-3

Q:\GIS\PROJECTS\11215000s\11215702\RPT012\11215702_202405_RPT012_GIS008.mxd



Boxplot interpretation:
The bold horizontal line inside the box represents the median.
The height of the box is the interquartile range (IQR), showing the middle 50% of the data.
*The whiskers extend to 1.5 * IQR or the maximum/minimum values within this range (black lines).*
Points lying outside the whiskers are typically considered as outliers

Note:
Points shown are based on the highest 1-day value.

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SAN JACINTO RIVER WASTE PITS SITE
HARRIS COUNTY, TEXAS

Project No. 11215702
Revision No. -
Date Jul 8, 2024

MONTH-WISE BOXPLOTS
FOR DAILY MAXIMUM ELEVATIONS

FIGURE 5-4

Q:\GIS\PROJECTS\11215000s\11215702\RPT012\11215702_202405_RPT012_GIS009.mxd

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