National Aeronautics and Space Administration

George C. Marshall Space Flight Center
Marshall Space Flight Center, AL 35812

February 12, 2025

TO: Ms Courtney Allen, PCB Coordinator
U.S. Environmental Protection Agency, Region 6
1445 Ross Avenue, Suite 1200
Mail Code: 6MM-RP
Dallas, TX 75202-2733

Mr. Estuardo Silva, Administrator
Louisiana Department of Environmental Quality
Remediation Division
600 North 5th Street
Baton Rouge, Louisiana 70802

FROM: Andrew Watson
National Aeronautics and Space Administration
Marshall Space Flight Center
Environmental Engineering & Occupational Health Office
Mail Code AS10
Huntsville, AL 35812

SUBJECT: AOIs 1/2/3 Cap Removal and Excavation/ Backfill Workplan
NASA Michoud Assembly Facility
Agency Interest Number 9145
Federal Facility Designation No. LA4800014587
13800 Old Gentilly Road
New Orleans, Orleans Parish, LA

Ms. Allen,

The National Aeronautics and Space Administration (NASA) presents this Areas-of-Interest (AOIs) 1, 2, and 3 Excavation and Backfill Work Plan. The plan includes the planning-level details for the excavation, disposal, and restoration of these AOIs. The purpose of this work plan is to establish a documented EPA & LDEQ approved remedial path forward for these sites at Michoud Assembly Facility (MAF).

Please direct any questions to the undersigned at the address listed above; by email at andrew.l.watson@nasa.gov; or by phone at 256-527-9967.

Andrew Watson Digitally signed by Andrew Watson
Date: 2025.02.12 09:06:25 -06'00'

Andrew Watson
MAF Remedial Project Manager

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Area of Investigation 1, 2, and 3
Excavation and Backfill Work Plan

Final Revision 3

February 2025

Prepared for

National Aeronautics and Space Administration
Michoud Assembly Facility

13800 Old Gentilly Road
New Orleans (Orleans Parish), Louisiana
LDEQ AI# 9145

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Professional Certification

I certify that the geologic work produced in this report was prepared by me or under my direct supervision and has been performed in accordance with accepted standards and practices. This certification is not a guaranty or warranty, either expressed or implied.

Scott Engel, PG

02/07/2025
Date

Louisiana License Number: 611

Expiration date: March 10, 2025

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Acronyms and Abbreviations

Acronym	Definition
AOI	area of investigation
AOIC	area of investigation concentration
bgs	below ground surface
BMP	best management practice
BTEX	benzene, toluene, ethylbenzene, total xylenes
CFR	*Code of Federal Regulations*
COC	constituent of concern
EPA	U.S. Environmental Protection Agency
GIS	geographic information system
GPS	global positioning system
HASP	health and safety plan
HAZWOPER	Hazardous Waste Operations and Emergency Response
I-	Interstate
ID	identification number
LDEQ	Louisiana Department of Environmental Quality
LRS	Limiting RECAP Standard
MAF or Site	Michoud Assembly Facility
mg/kg	milligram(s) per kilogram
MO	management option
MSFC	Marshall Space Flight Center
NASA	National Aeronautics and Space Administration
NFA	No Further Action
NOPSi	New Orleans Public Service Inc.

Acronym	Definition
ORO	oil range organics
OSHA	Occupational Safety and Health Administration
PCB	polychlorinated biphenyl
PDF	portable document format
PLS	professional land surveyor
PPM	part(s) per million
QA	quality assurance
QC	quality control
RCRA	Resource Conservation and Recovery Act
RECAP	Risk Evaluation/Corrective Action Program
RGO	remedial goal objective
SAP	sampling and analysis plan
$Soil_i$	soil standard for industrial land use
$Soil_{SSGW}$	soil standard for protection of groundwater
$Soil_{ni}$	soil standard for nonindustrial land use
SVOC	semivolatile organic compound
TCLP	toxicity characteristics leaching procedure
TPH	total petroleum hydrocarbons
TSCA	Toxic Substance Control Act
UCL	upper confidence limit
VOC	volatile organic compound
WP	Work Plan

1. Introduction

The U.S. National Aeronautics and Space Administration (NASA) owns and operates the Michoud Assembly Facility (MAF or Site), located in New Orleans, Louisiana as a component installation of the NASA George C. Marshall Space Flight Center (MSFC) based in Huntsville, Alabama. A series of environmental investigations between 1998 and 2022 characterized and identified soil impacted by polychlorinated biphenyls (PCBs) at 16 areas of investigation (AOIs) along Saturn Boulevard on the MAF property, each varying in size and degree of impact. The three AOIs with the highest concentrations of PCBs were in proximity to each other and combined into AOI 1, 2, and 3 to be managed under the U.S. Environmental Protection Agency (EPA) Toxic Substance Control Act (TSCA) standards. The direct contact exposure risk was managed by a limited excavation and engineered cap that was approved by EPA and implemented in 2021 to 2022. However, NASA has an agency-wide objective to eliminate long-term environmental liabilities and land use restrictions; therefore, NASA has elected to conduct additional remediation and evaluation of AOI 1, 2, and 3 to remove the completed engineered cap and remediate the residual impacts to achieve unrestricted closure based on nonindustrial Louisiana Risk Evaluation/ Corrective Action Program (RECAP) standards (LDEQ 2003). This document presents the Work Plan for the remediation of PCB impacts in AOI 1, 2, and 3 at MAF.

1.1 Objective

The objective of this Work Plan is to achieve a No Further Action (NFA) under RECAP for nonindustrial land use at AOI 1, 2, and 3. This will be done by remediating the historical PCB concentrations in soil by excavation and offsite disposal to achieve an AOI concentration (AOIC) below Louisiana Department of Environmental Quality (LDEQ) RECAP Management Option 1 (MO-1) soil standard for nonindustrial land use ($Soil_{ni}$) of 0.21 milligram(s) per kilogram (mg/kg) for soils 0 to 15 feet below ground surface (bgs), and below the standard for protection of groundwater ($Soil_{SSGW}$) of 19 mg/kg for soil greater than 15 feet bgs. At a minimum, this will be achieved by the removal of soil with impacts above the RECAP MO-1 soil standard for industrial use ($Soil_i$) of 0.90 mg/kg and the $Soil_{SSGW}$. Once completed, the residual soils will be evaluated to determine that the subsequent 95% upper confidence limit (UCL) AOIC meets the $Soil_{ni}$ or if additional remediation will be needed.

1.2 Scope of Work

This Work Plan outlines the planned excavation and backfill of AOI 1, 2, and 3 at the MAF through the following steps:

1. Create a waste profile for the AOI for disposal.
2. Resample and verify subsurface soil (>15 feet bgs) locations with historical PCB concentrations above 19 mg/kg.
3. Confirm sampling of backfill material.
4. Remove engineered cap and associated infrastructure.
5. Excavate soil to target depth and extent.
6. Confirmation sampling of the excavation floor and sidewalls.
7. Survey excavation extents.
8. Backfill and compact excavations.

9. Plug and abandon associated groundwater monitoring well network.
10. Prepare final report for NFA determination.

1.3 Project Organization

NASA's MSFC Environmental Engineering and Occupational Health Office manages this project with support from MAF Operations Office. The Remediation Program Manager from MSFC is Mr. Andrew Watson. The MAF representatives for this project are Mr. Eric Stack and Mr. Keith Savoy. The LDEQ administrator for this project is Mr. Estuardo Silva of the Remediation Services Division.

2. Environmental Setting and AOI 1, 2, and 3 History

2.1 Site Location and Use

The current MAF is located on approximately 835 acres of land in east New Orleans, Louisiana, in Orleans Parish along a natural levee that is cut by Bayou Sauvage. A Site vicinity map is provided as Figure 2-1. A Site map showing the location of AOI 1, 2, and 3 is presented on Figure 2-2. A topographic map of the Site and surrounding area is included as Figure 2-3. The MAF facility has been used for various industrial manufacturing purposes since the early 1940s and was acquired by NASA in the 1960s for design and assembly of large space vehicles. Currently, MAF's primary operation is the manufacture and assembly of the Space Launch System (core stage) and the large structures and composites for the Orion crew exploration vehicle.

2.2 Adjacent Land Use

The facility is located adjacent to the Gulf Intracoastal Waterway and land use around the MAF is predominantly heavy industrial.

Commercial establishments are located along both sides of Chef Menteur Highway (US Highway 90). The area south of US Highway 90 consists of undeveloped land and transportation facilities. A New Orleans Public Service Inc. (NOPSi) gas and oil-fired electrical power plant and municipal training facilities are located between MAF and Interstate (I-)510, which connect the Michoud area with Interstate I-10 to the north. The municipal training facilities include a fire training academy, which is located immediately southwest of the MAF.

2.3 Regional Geology and Site Geology

The Site is underlain by thick unconsolidated sediments of the St. Bernard Delta, deposited by the tributary channels of the Mississippi River. The upper 1,200 feet of the sedimentary column consists of anisotropic, essentially horizontal layers of interbedded clays, silty clays, silty sands, and sand. The shallow subsurface geology (approximately 0 to 45 feet bgs) is characterized by surficial silty sands and fill from 0 to 4 feet bgs; a clay layer interbedded with silt, sand, and peat lenses from 4 to 16 feet bgs; and a silty clay layer grading to a more permeable silt-sand unit between 16 and 45 feet bgs.

2.4 Site Hydrogeology

The Surficial Aquifer and the majority of surface water at the MAF, with the exception of minor perimeter stormwater, flows from the Site via overland flow or subsurface drains into the Borrow Canal, followed by pumping from the canal (as necessary) into the adjacent Michoud Canal. Because the Site has a low elevation and no significant topographic relief, drainage under existing gradients is quite poor. The potentiometric surface is approximately 2 to 5 feet bgs. This artificially low potentiometric surface is maintained by onsite pumping systems. The stormwater drainage systems are located approximately 6 to 8 feet bgs and the elevation of water inside the stormwater drainage system is a few feet lower than the potentiometric surface. Some sections of the stormwater drainage system appear to be surrounded by backfill materials (sand or gravel), based on observations made during the installation of the recovery wells in AOC B. This higher permeability backfill material might allow groundwater to flow preferentially through these zones.

2.4.1 Surficial Aquifer

From the surface to a depth of up to 8 feet bgs, a heterogeneous gray or brown silty clay to fine sand with some shell fragments has been used for fill and surface leveling during construction at MAF. The lower portion of this fill is saturated, and the water table is artificially maintained at 3 to 4 feet bgs to provide sediment stability for structural integrity of the buildings. Below the surface fill, a highly plastic, dark gray, moist to wet, soft to very soft clay with dark brown peat, cypress roots, wood, and some zones of silty sand. This stratigraphic unit extends to a depth up to about 20 feet bgs. The reported hydraulic conductivities are low and meet the definition of a Class 3 nondrinking groundwater zone because of the amount of clay and peat. The groundwater in this surface fill and the underlying clay and peat has been grouped together and called the Surficial Aquifer.

2.4.2 Shallow Aquifer

Below the Surficial Aquifer is the Shallow Aquifer. The Site's LDEQ Hazardous Waste Operating Permit deems the Shallow Aquifer as the compliance aquifer for the facility and is a Class 3 nondrinking groundwater zone. The Shallow Aquifer is made up of gray silty to medium-grained sand with interbedded clay layers extending from a depth of about 16 to 45 feet bgs. The Shallow Aquifer is semiconfined on MAF property and is hydrologically connected with the adjacent Intracoastal Waterway that bounds MAF on the south and east sides.

2.5 Underground Utilities at AOI 1, 2, and 3

Saturn AOI 1, 2, and 3 is located on the south side of Saturn Boulevard, approximately 450 feet northeast of the intersection of Saturn Boulevard and Venus Drive. It lies among a multitude of active, subsurface utility lines running northeast-southwest along Saturn Boulevard and extending from the south side of Saturn AOI 1, 2, and 3 toward building 420 to the south. Utilities within the limits of the engineered cap were relocated as part of the cap construction.

2.6 Regulatory History of Saturn Boulevard

PCB-impacted soil and groundwater around Saturn Boulevard was initially discovered in May 1998 while excavating soil for repairs to the firewater system. Five soil samples and one water sample were collected in May 1998 and analyzed for metals, volatile organic compounds (VOCs), semivolatile organic compounds (SVOCs), and pesticides for waste characterization for offsite disposal. Only PCB Aroclor-1260 was detected in the samples. A grab sample of the water that had seeped into the soil excavation was analyzed for total petroleum hydrocarbons (TPH) - oil range organics, VOCs, SVOCs, PCBs, and pesticides. Only PCBs (Aroclor-1260) and endrin were detected in the excavation water sample. The results identifying PCBs (Aroclor-1260) impacts were reported to LDEQ on May 21, 1998.

Since that initial discovery, several environmental investigations have been performed along Saturn Boulevard, resulting in 16 AOIs for PCBs identified along Saturn Boulevard (Figure 2-2). LDEQ deferred the PCB contamination to (EPA) Region VI in September 2008 because the PCB concentrations in soil exceeded 25 parts per million (ppm) and is regulated under TSCA. The source of the PCB contamination was never determined.

2.7 History of AOI 1, 2, and 3

To date, more than 4,000 soil samples were collected in AOI Saturn 1, 2, and 3, with total PCB concentrations ranging from <0.1 mg/kg (below detection levels) to 9,380 mg/kg. Between 2017 and 2019, NASA completed a hydrogeology evaluation and a TSCA Risk-Based Clean-up Application for submittal to EPA (NASA 2019). Before approving the TSCA-Risk-Based Clean Up Application, EPA requested additional study, which included the following:

- PCB congeners analysis of samples collected from seven monitoring wells in the vicinity of Saturn AOIs 01, 02, and 03 (Saturn-1, 2, and 3) and two outfalls.
- Sampling and calculation for PCB retardation in soils.

In *Saturn Boulevard AOI Saturn 1, 2, and 3 Using TSCA Risk-Based Clean-up Application Part 1* (NASA 2019), an ecological and human health risk assessment established a site-specific remedial goal objective (RGO) for PCBs of 24.1 mg/kg. This RGO was calculated to be protective of human health and the environment. The risk assessment defined an area of approximately 0.5 acre in AOI Saturn 1, 2, and 3, with PCB concentrations exceeding the established RGO. EPA agreed that a constructed cap was a suitable remedy for PCB contaminated soils at Saturn-1, 2, and 3 based on the results of these studies. EPA Region 6 provided approval in a letter dated, June 10, 2020 (EPA 2020). The engineered cap design was submitted to Anupa Ahuja of EPA Region 6 in March of 2021 for review (NASA 2021b). Final approval was received on March 11, 2021 (Anupa, pers. comm. 2021).

The engineered cap covers approximately 0.65 acre (161 feet by 175 feet) south of Saturn Boulevard. A clay fill soil type was brought in and spread and compacted to a depth of 14 inches. The 14-inch layer of fill was mixed with cement during the soil cement operation and compacted to a density of 95% compaction and allowed to settle/cure for 14 days. Following that, a combination of geosynthetic layer and the geonet was placed on the soil cement. Next, a layer of 6 inches of aggregate base stone was placed with 5 inches of modified binder asphaltic concrete and a final layer of 2 inches surface asphaltic concrete. Once the cap was constructed, a fence was built to enclose the entire area of the cap with a gate that leads out to Saturn Boulevard. Finally, solar lights were installed for security measures. The project was considered substantially complete on October 22, 2021; the asphalt pavement was complete and the construction completion report was submitted in June 2022 (KSWA 2022).

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3. Site Risk and Exposure Assessment

3.1 AOI Risk and Exposure

The Site ranking for the Saturn AOIs is Group IV with a low likelihood of threat to human health or the environment. There is no current release or demonstrable long-term threat of release via soil runoff or groundwater discharge of constituents of concern (COCs) from the Saturn AOIs to a surface water body, based on the low water solubility of PCBs and affinity to adhere to soil particles rather than to leach into groundwater. Saturn AOI 1, 2, and 3 is located approximately 0.36 mile west of Michoud Canal and approximately 0.58 mile north of the Gulf Intracoastal Waterway. A topographic map of the Site and surrounding area is shown on Figure 2-3. Based on the current industrial use of the MAF facility, recreational species, commercial species, threatened or endangered species and/or their habitats are not currently being exposed nor are they expected to be exposed to PCBs present at AOI-1, 2, and 3. No obvious impacts to ecological receptors or their habitats are present and none are expected in the future. The only foreseeable future receptors are industrial workers and construction contractors working directly in AOI-1, 2, and 3.

3.2 Exposure Media

An exposure medium is any environmental medium that might serve as a source of exposure for human or ecological receptors to one or more COCs through current and/or future exposure pathways. The current exposure media in AOI-1, 2, and 3 includes surface soil, subsurface soil, and potential Surficial Aquifer groundwater.

3.3 Exposure Points

Exposure points are locations where current or future potential receptors might contact impacted media. The only foreseeable future receptors are industrial workers and construction contractors who potentially come into contact with surface or subsurface soils during ground-disturbing activities. No other exposure points within AOI-1, 2, and 3 were identified during previous site investigations. There is no demonstrable long-term threat of release via soil runoff or groundwater discharge of COCs from AOI-1, 2, and 3 because of the low water solubility of PCBs and the affinity of PCBs to adhere to soil particles rather than leach into groundwater, and the surrounding monitoring well network has not detected PCBs in groundwater. Recreational, commercial, threatened, or endangered species and/or their habitats are not currently nor exposed or expected to be exposed to COCs. There are no obvious impacts to ecological receptors or their habitats and none are expected in the future. The Site is currently controlled with an operations and maintenance plan outlined in *Operations and Maintenance Plan of Remedial Cap and Monitoring Well Sampling and Analysis Plan AOI Saturn 1, 2, and 3* (NASA 2021a).

3.4 Sitewide Conveyance Notification

On November 16, 2009, NASA filed a Conveyance Notification for Michoud Assembly Facility with the Conveyance Office of the Civil District Court at the Orleans Parish Courthouse (NASA 2009). The MAF Conveyance Notification and Land Use Master Plan state that this government-owned property is only intended for industrial purposes. The only foreseeable future receptors identified are industrial workers and construction contractors working directly in AOI 1, 2, and 3.

3.5 Groundwater Classification

Groundwater within the Surficial and Shallow Aquifers are classified as GW-3A.

4. Remedial Action Plan

4.1 Selected Remedies

NASA has chosen excavation, offsite disposal, and backfill as the remedial strategy for AOI 1, 2, and 3.

4.2 Regulatory Requirements and Remedial Goals

General remedial goals for this Remedial Action Plan include the following:

- Protect human health and environment to extent practicable.
- Limit exposure to potential receptors, and continue with current land and groundwater use restrictions on the Site.

To fulfill NASA's goal of removing the need for future liability, land use restrictions, and conveyance notifications, a Limiting RECAP Standard (LRS) for PCBs was deemed appropriate for the remediation of the AOIs based on the LDEQ RECAP Table 2 MO-1 Standards or the RECAP screening standards (LDEQ 2003). The soil left in place and the backfill material to be used are to contain PCB concentrations less than the LRS presented on Exhibit 4-1. NASA will excavate the soil sample locations with historical concentrations above the industrial LRS. Following excavation, the collected confirmation samples and residual historical soil samples will be evaluated using the 95% UCL to document that the AOIC is below the soil standard for nonindustrial land use ($Soil_{ni}$), eliminating the need for any further action, land use restrictions, or conveyance notifications.

Exhibit 4-1. PCBs Limiting RECAP Standards

Media	LRS
Surface soil (0 to 15 feet bgs)	$Soil_{ni}$ – 0.21 mg/kg
Surface soil (0 to 15 feet bgs)	$Soil_{i}$ = 0.90 mg/kg
Subsurface soil (>15 feet bgs)	$Soil_{SSGW}$ = 19 mg/kg

4.3 Disposal Requirements

The soils and any potential groundwater and sediment will be disposed of at the River Birch Landfill in Avondale, Louisiana. NASA will discuss potential COCs with River Birch Landfill. Any potential groundwater and related sediment generated during excavation activities will be sampled for COCs and submitted to an accredited analytical laboratory for analysis to generate a disposal profile.

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5. Excavation and Backfill

5.1 Soil Profiling for Disposal

The soil excavated from AOI 1, 2, and 3 is intended to be disposed at River Birch Landfill located at 2000 S Kenner Avenue, Avondale, Louisiana 70094. The landfill requires the following analytical information to profile the soil for proper disposal:

- Total PCB concentration
- Toxic characteristic leaching procedure (TCLP) for VOCs
- TCLP for SVOCs
- TCLP for Resource Conservation and Recovery Act (RCRA) metals

NASA will provide the landfill with PCB concentration data from the previous delineation events. Representative samples will be collected from AOI 1, 2, and 3 for the remaining constituents using the following general procedures:

- Use direct-push drilling technology (for example, Geoprobe) to collect samples from evenly distributed locations throughout AOI 1, 2, and 3. One sample will be collected per approximately 500 square feet of surface area in the AOI from 0 to 22 feet bgs.
- Samples will be delivered to the analytical laboratory for analysis of TCLP VOCs, TCLP SVOCs, and TCLP RCRA metals.

Each boring location will be recorded via handheld global positioning system (GPS) by the field staff. Analytical results will be provided to the landfill for waste disposal profile development and approval.

5.2 Subsurface Soil Confirmation Sampling

During the historical investigations, a limited number of subsurface soil samples collected from depths greater than 15 feet bgs had reported concentrations above the $Soil_{SSGW}$. Before initiating excavation activities, soil borings will be advances at the locations with historical exceedances and resampled to determine the current concentrations to determine if excavation deeper than 15 feet bgs is needed to meet the $Soil_{SSGW}$.

5.3 Excavation

5.3.1 AOI 1, 2, and 3

Upon arrival at AOI 1, 2, and 3, a professional land surveyor (PLS) will mark out excavation extents. Additionally, a professional utility locator will use ground-penetrating radar to clear the subsurface of utilities and other obstructions before excavation.

Any excavation areas where the extent of the former runway beneath Saturn Boulevard is encountered shall have the corresponding sidewall stabilized with sheet piles to preserve the structural integrity of the former runway. Specifications for the sheet pile wall shall be made by a licensed professional engineer. The excavation perimeter will be sloped to a 1.5 to 1 ratio to minimize the risk of a cave-in within the excavation.

AOI 1, 2, and 3 are to have the top 5 feet of soil excavated using methods appropriate for working in proximity to buried utilities, such as hydro excavation or hand excavation. Following the removal of the top 5 feet of soil, work can proceed using heavy equipment to remove the remaining soil to the target depth and extents. The target depths and extents are illustrated on Figure 5-1 and Figure 5-2. An estimated 10,244 cubic yards of soil is anticipated to be removed from AOI 1, 2, and 3. Any potential groundwater encountered will be pumped into tanks to continue excavation activities and profiled for disposal.

5.4 Soil Management During Excavation

5.4.1 Stockpiling

Excavated contaminated soil from AOI 1, 2, and 3 that cannot be immediately transported offsite and excavated "clean" soil from adjacent to AOI 1, 2, and 3 can be temporarily stockpiled onsite in an area approved by NASA. Any soil excavated for excavation stabilization purposes outside of the AOI 1, 2, and 3 boundaries will be stockpiled separately from the contaminated soils within the AOIs.

Stockpiles will be kept in a neat and well-drained condition on even ground, given due consideration to drainage at all times. The ground surface at stockpile locations will be cleared before placing sheeting down.

Soil that is placed in temporary stockpiles will be maintained at all times. All stockpiled soil must be placed on impermeable plastic sheeting (minimum 6-mil thick) with a berm around the entire perimeter of the stockpile. The plastic sheeting and berm will prevent the runoff of soil and potential contaminants to surrounding areas. The berm can be constructed with hay bales, dimensional lumber, or other equivalent methods. The bottom plastic sheeting should be lapped over the berm materials, and the soil stockpile should be covered with plastic sheeting to prevent erosion or leaching of contaminants to underlying soil and prevent exposure to precipitation and wind. Plastic sheeting that covers soil stockpile will be secured using sandbags or equivalent weighted material. Silt fencing should be placed around the stockpile area to prevent sediment migration. Daily end of day inspections will be performed to observe and document that the soil stockpile is secured, protected from inclement weather, and that adjacent stormwater catch basins are adequately protected in the unlikely event that a release from the soil stockpile occurs.

At the conclusion of this project, after the stockpiled soil has been returned to the excavation pit for re-use or disposed elsewhere, the area will be restored to a prestockpile condition. Residual plastic or debris will not be left at the project site following stockpile removal.

5.5 Water Management and Disposal

The depth to groundwater in the work zone is typically between 1 and 3 feet bgs. As such, excavation dewatering might be required to facilitate construction. If groundwater from either the Surficial Aquifer or Shallow Aquifer is encountered during excavation/construction or if stormwater accumulates in the excavation, water collection and disposal will be carefully managed by the excavation/construction contractor.

The excavation/construction contractor's work plan shall include estimates of expected dewatering quantities. The excavation/construction contractor shall provide or subcontract vacuum truck services with adequate volume to handle fluids generated during the dewatering process. Groundwater encountered during the excavation and other water evacuated from the excavation shall be containerized and

transported to the MAF waste storage area, or appropriate offsite disposal facility, which is a RCRA facility storage area that complies with section *40 Code of Federal Regulations* (CFR) 262 to 265. The waste will either be treated or disposed according to the guidelines outlined in section 40 CFR Section 262.15-17, 264, and 265.

At the conclusion of the project, any vessel used to store evacuated water shall be cleaned and sediment removed. Wash water shall be containerized and disposed of in the same manner as the evacuated water. Accumulated sediment shall be placed in the stockpiled soil area, where it can be combined and sampled for disposal at an appropriate disposal facility. A Sampling and Analysis Plan (SAP) is provided as Appendix A.

5.6 Soil Disposal

All excavated material will be loaded onto dump trucks and transported offsite to the River Birch landfill in Avondale, Louisiana. Disposal manifests will be completed by NASA Contractor S3 on behalf of the Owner (NASA).

5.7 Requirements for Offsite (Backfill) Soils

NASA will collect a soil sample from each borrow pit and analyze offsite soils brought in for use as backfill for total PCBs, TPH, VOCs, SVOCs, and RCRA metals). Analytical testing will be completed from a sample of backfill material from the borrow site, with at least one test from each borrow site. The resulting data will be compared against applicable non-industrial RECAP standards. Material will not be brought onsite until tests indicate the material does not exceed the standards and have been approved by NASA. A SAP is provided as Appendix A.

5.8 Confirmation Sampling in Excavation Pit

Sampling will be performed by trained environmental personnel. Once the excavations have reached the defined horizontal and vertical limits of the AOIs, confirmation sampling will be conducted before backfilling to document that the residual soils do not exceed the RECAP MO-1 $Soil_i$ of 0.9 mg/kg and the AOIC is below the $Soil_{ni}$ of 0.21 mg/kg for surface soils and $Soil_{SSGW}$ of 19 mg/kg for subsurface soils.

Soil samples will be collected from each of the four sides of the excavation and from the bottom of the excavation. Each soil sample will be collected from the approximate center of the excavation wall or every 20 linear feet of sidewall, if the wall is greater than 40 feet in length. Soil samples will be collected from the bottom of the excavation at a rate of one sample approximately every 500 square feet of excavation bottom.

Collection of soil samples will be accomplished with hand tools from soil retrieval from the excavation pit with an excavator. Decontaminated hand tools will be used to remove the surface layer of soil, and a soil sample will be retrieved with a decontaminated stainless-steel scoop or disposable gloves. Chrome-plated tools will not be used.

Soil samples will be collected using the procedure outlined below. New, disposable nitrile gloves will be worn during sample collection and changed between samples as follows:

- Remove the top layer of soil to the desired sampling depth using a decontaminated hand tool.
- Transfer the soil sample to a labeled, laboratory-prepared sample jar using a decontaminated stainless-steel or plastic laboratory spoon. Follow proper labeling procedures. Fill the jar(s) completely to minimize headspace.
- Quickly and adequately seal the sample container. Clean the jar rim(s) before tightening the lids.
- Immediately upon completion of sample collection, samples will be labeled and placed on ice in coolers and kept at proper temperature (0 to 6 degrees Celsius). The samples will remain under proper chain of custody until relinquished to laboratory control.
- Use a field notebook to record a description of the soil that was sampled, the location of the soil sample, the sample identification number (ID), and the date and time of the soil sample collection. Record the sample on the soil sampling field forms and chain of custody. The excavation soil confirmation sample ID will include a prefix identifying the individual AOI and the side of the excavation (north, south, east, west, or bottom). For example, the west side confirmation soil sample collected would be identified as "AOI-123_Excavation_West_YYYYMMDD."
- Decontaminate the equipment between collection of soil samples. Decontamination will include the following steps:
  - Rinse with tap water and scrub with brush until free of large particles.
  - Wash with phosphate-free detergent solution.
  - Rinse with tap water.
  - Rinse with distilled water.

All confirmation soil samples will be submitted to an analytical laboratory for analysis of total PCBs.

A SAP is provided as Appendix A.

5.9 Backfill Requirements

The excavations at AOI 1, 2, and 3 will be backfilled using fill material with high clay content. The backfill material will be placed in approximately 12-inch compacted lifts. The excavation contractor will be responsible for the exact compaction methodology. The excavation will be filled until it matches the surrounding grade. Once the excavation is brought back to original grade and contoured to match the surrounding soils, the excavation subcontractor will hydroseed the disturbed area in its entirety. All backfill material will be sampled and analyzed before use for total PCBs and confirmed to be below the RECAP MO-1 $Soil_{ni}$ of 0.21 mg/kg.

5.10 Laboratory Analysis

The confirmation soil samples will be analyzed via EPA Method 8082A for Total PCBs. Sample preservation, handling, and analysis will meet the requirements of Hazardous Waste Test Methods/ SW-846, latest revision, and appropriate EPA and LDEQ guidance and will meet the requirements of RCRA, and RECAP. The samples will be analyzed by a Louisiana-certified laboratory.

Analytical results will be reported by the laboratory as definitive data to meet the data quality objectives for quantitative risk assessment and are considered acceptable for use in RECAP.

5.11 Quality Assurance/Quality Control

Sampling and analysis will be conducted in accordance with standard USEPA SW-846 methods with appropriate quality assurance (QA)/quality control (QC) samples, including field duplicates, matrix spikes, matrix spike duplicates, trip blanks, field blanks, and internal lab reference standards, as outlined in LRS. A site-specific Quality Assurance Project Plan is provided as Appendix B. The QA/QC documentation will include the following:

- Sample documentation
- Records of field equipment calibration
- Determination and documentation of laboratory detection limits
- Analyte identification and quantification
- QC blanks (trip, field, equipment)
- Matrix spike recoveries
- Performance evaluation samples
- Analytical error determination
- Total measurement error determination

The QA/QC samples will be handled and managed in the same manner as the other samples relative to sample collection and chain-of-custody procedures. The following outlines the QA/QC set to be used for the AOI 1, 2, and 3 excavations:

- One duplicate sample will be collected for every 20 confirmation samples. Duplicate samples are blind samples that are treated the same as the field samples and are subjected to the same analyses by the same laboratory as the field samples.
- One matrix spike/matrix spike duplicate sample of soil will be collected for every 20 field samples.
- One trip blank, provided by the analyzing laboratory, will accompany any samples being analyzed for VOCs during shipment to the laboratory.

As a part of the analytical results reporting package, the analytical laboratory will provide a narrative of any issues that would indicate if the data are not usable. That narrative includes problems with laboratory blanks and surrogate samples. In addition, the laboratory complies with the QA requirements sections found in the various analytical methods that were used for the project. NASA will evaluate (using RECAP Form 3) and conduct independent (third party) validation of the laboratory results to determine that precision, accuracy, and completeness of objectives were met.

5.12 Physical Security

Because MAF is an industrial manufacturing facility for NASA, it is highly secure from any public or unauthorized access. The Site is completely fenced, guarded, and is surrounded on the south and east sides by a large canal and the Intracoastal Waterway. Site access is only granted through secured gates via proper clearance and credentials.

5.13 Best Management Practices

MAF uses effective institutional controls, including physical security measures, as a conveyance notification. Along with these controls, any construction or excavation should be conducted with best management practices (BMPs) and minimize exposure to and migration of potential subsurface contamination in the work area.

5.13.1 Antitracking Measures

Construction contractors and any subcontractors will employ antitracking measures to prevent the spread of potentially contaminated material. Antitracking measures may include, but are not limited to, the following:

- Antitracking mats for entry and exit of work zone
- Stone tracking pads
- Wheel wash stations and associated containment structures
- Mechanical or vacuum-assisted street sweepers

Antitracking measures shall be placed at construction entrances, exits, staging, transfer, and/or temporary storage areas, as appropriate. Because of the potential for COC contamination, the contractors and subcontractors shall assume that any vehicle or equipment used in the "work zone" has been in contact with contaminated soil and cleaned accordingly before leaving the work zone to cross MAF property and/or exit MAF. The contractor shall make efforts to minimize the amount of vehicle and equipment traffic in and out of the work zone.

5.13.2 Construction and Transport Vehicle Management

Contractors will be present during excavation/construction to ensure that vehicles and equipment not directly engaged in excavation are parked in designated zones outside of known contaminated areas. Equipment or soil transport vehicles shall be parked in such a way that does not interfere with Site traffic or operation. MAF personnel will designate parking areas for all project vehicles.

5.13.3 Dust Control Practices

Given the relative shallowness of the groundwater table and the generally saturated conditions of the work area, dust generation is not expected to be an issue. Should conditions become favorable for fugitive dust during excavation activities, preventive measures will be taken to control excessive dust generation. Contractors shall minimize wind erosion and dust transport from stockpiles. Contractors shall also ensure that necessary dust controls (for example, tarps and routine street sweeping) are implemented and maintained during periods of operation. Water shall only be used as a last resort to prevent the creation of contaminated runoff. Absorbent socks will be placed to prevent excess water runoff.

5.13.4 Erosion Control Practices

Erosion prevention and sediment control measures shall be implemented by the contractors to prevent the migration of potentially contaminated soil and runoff from the worksite and stockpile areas. Erosion control measures shall be installed around the perimeter of the work area and inspected by the contractor on a regular basis. The contractor shall take all necessary precautions to prevent any excavation runoff from entering the onsite sewer system. Soil stockpiles shall be constructed in a way to prevent contact with rain or surface water. After the completion of the project, the contractor will restore all disturbed areas to their previous conditions. This includes patching paving, rough grading, and applying straw and seed of appropriate mixtures of grass to match existing vegetation.

5.14 Surveying

Following the completion of excavation, the GPS coordinates of the extent of the AOI excavation and elevation data of the excavation surface will be collected by a PLS with current Louisiana registration. The

geospatial data (northing/easting and latitude/longitude) will be provided via Excel spreadsheet to NASA geographic information system (GIS) personnel for integration into the NASA GIS database. Using these data, NASA will create figures depicting the spatial extent of each AOI excavation and the locations of samples collected.

5.15 Monitoring Well Abandonment

Once soil standards have been met and there are no residual soils above the $Soil_{SSGW}$, monitoring wells associated with AOI 1, 2, and 3 will be abandoned by a Louisiana-licensed driller in accordance with Louisiana Department of Natural Resources regulations.

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6. Health and Safety

A project-specific Health and Safety Plan (HASP) is presented in Appendix C. The HASP will be maintained onsite during the entire project. During field activities, field personnel will adhere to the HASP to ensure that sample collection and decontamination is completed in a safe manner. The purpose of this HASP is to assign responsibilities, establish personnel protection standards, specify safe operating procedures, and address contingencies that may arise while conduction screening and sampling at the Site. During sampling activities, a daily safety "tailgate" meeting will be conducted before work each day to advise personnel of ongoing and new health and safety concerns.

During this meeting, field personnel will be informed of the possible chemical and physical hazards. Involved personnel will be required to read and sign the HASP; it will always be accessible in the field. Depending on project role, personnel are required to have up-to-date certifications in either 24-hour or 40-hour Occupational Safety and Health Administration (OSHA) hazardous waste operations and emergency response (HAZWOPER) standard (29 CFR 1910.120) training before fieldwork.

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7. Contingency Plan

7.1 Contingency for Change in Site Use

The Sitewide Conveyance Notification filed by NASA with the Conveyance Office of the Civil District Court at the Orleans Parish Courthouse in 2009 (NASA 2009) states that "…If land use changes from industrial/commercial to nonindustrial at any area(s) within the described property boundaries, the responsible party shall notify the LDEQ within 30 days and the area(s) shall be reevaluated to determine of conditions are appropriate for the proposed land use."

Because each of the AOIs will be remediated to below the RECAP MO-1 $Soil_{ni}$ for surface soils and $Soil_{SSGW}$ subsurface soils, additional land use restriction or conveyance notifications because of these AOIs will not be necessary.

7.2 Contingency for Surface Contamination Migration

It is unlikely that surface contamination migration will occur because of the BMPs, including antitracking measures, erosion prevention and sediment control, dust control, and vehicle management, that are planned. If PCB contamination at the surface occurs due to excavation activities, excavation and removal of the impacted material will be conducted. To ensure the complete removal of impacted material, confirmation sampling will be conducted in a similar manner to that of the source AOI.

7.3 Contingency for Initial Confirmation Samples Exceeding RECAP MO-1 $Soil_i$

If results from any of the initial confirmation samples indicate an exceedance of the RECAP MO-1 $Soil_i$, or result in an AOIC greater than the $Soil_{ni}$, then over-excavation and re-sampling will be conducted. If over-excavation is required, then the sidewall will be excavated approximately 5 feet laterally. Any vertical over-excavation will take place in approximate 3-foot intervals until over-excavation soil confirmation samples indicate the in situ soils are in compliance with the target LRS. Over-excavation extents may be adjusted based on field observations or if laboratory analytical results indicate close proximity to the applicable regulatory limits or the 95% UCL calculated value is over the $Soil_{ni}$. Over-excavation and re-sampling will continue until confirmation samples on each side and bottom of the excavation, along with incorporation of the historical in situ data from the residual soils, indicate the residual in situ soil AOIC is below the $Soil_{ni}$ of 0.21 mg/kg, making the AOI eligible for an nonindustrial NFA determination.

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8. Reporting

Results of the remediation activities, sampling, and analysis will be compiled into a final report and submitted to NASA and LDEQ after the remediation of AOI 1, 2, and 3. The report will include tabulated data results, figure of the excavated AOI and sampled locations, laboratory analytical reports, disposal and backfill documentation, daily field summary reports, and a discussion of findings, and conclusions. The report will make a determination as to achievement of the remediation goal for each AOI.

Data reporting packages will be prepared by the analytical laboratory in portable document format (PDF), with all pages numbered sequentially. The PDF files will be read-only, such that data items cannot be edited. Electronic copies will be provided on the analytical laboratory's website. A separate electronic data deliverable file will be produced by the analyzing laboratory and sent directly to NASA's GIS and Database Manager to be merged into the MAF GIS database. All records of the sampling and analysis events and associated groundwater surface elevations and analytical data will be maintained in electronic format at the NASA Remediation Project Manager's office at MSFC in accordance with Section VII.A.9 of the NASA RCRA permit number LA4800014587-OP-RN-1.

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9. References

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Figures

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Figure 2-1
Vicinity Map
Michoud Assembly Facility

Map Document: O:\NASA\Michoud\maps\SaturnBlvd\AOI_123_PCB_2302\MAF_Vicinity0911.mxd

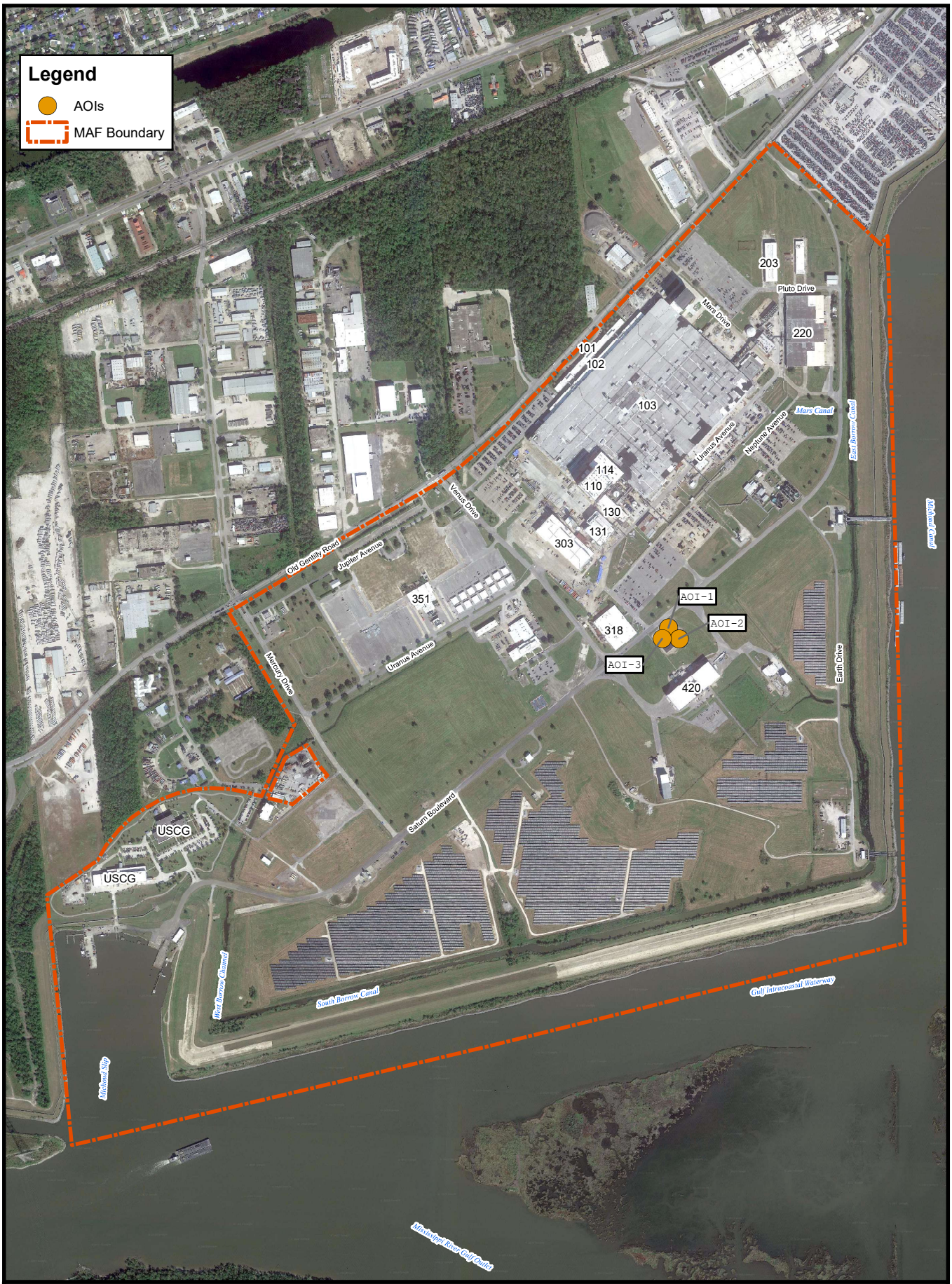

Figure 2-2
AOI Site Map
Excavation and Backfill Work Plan
Areas of Investigation 1, 2 and 3
Michoud Assembly Facility

Map Document: O:\NASA\Michoud\maps\SaturnBlvd\AOI_123_PCB_2302\AOI_123_Overview.mxd

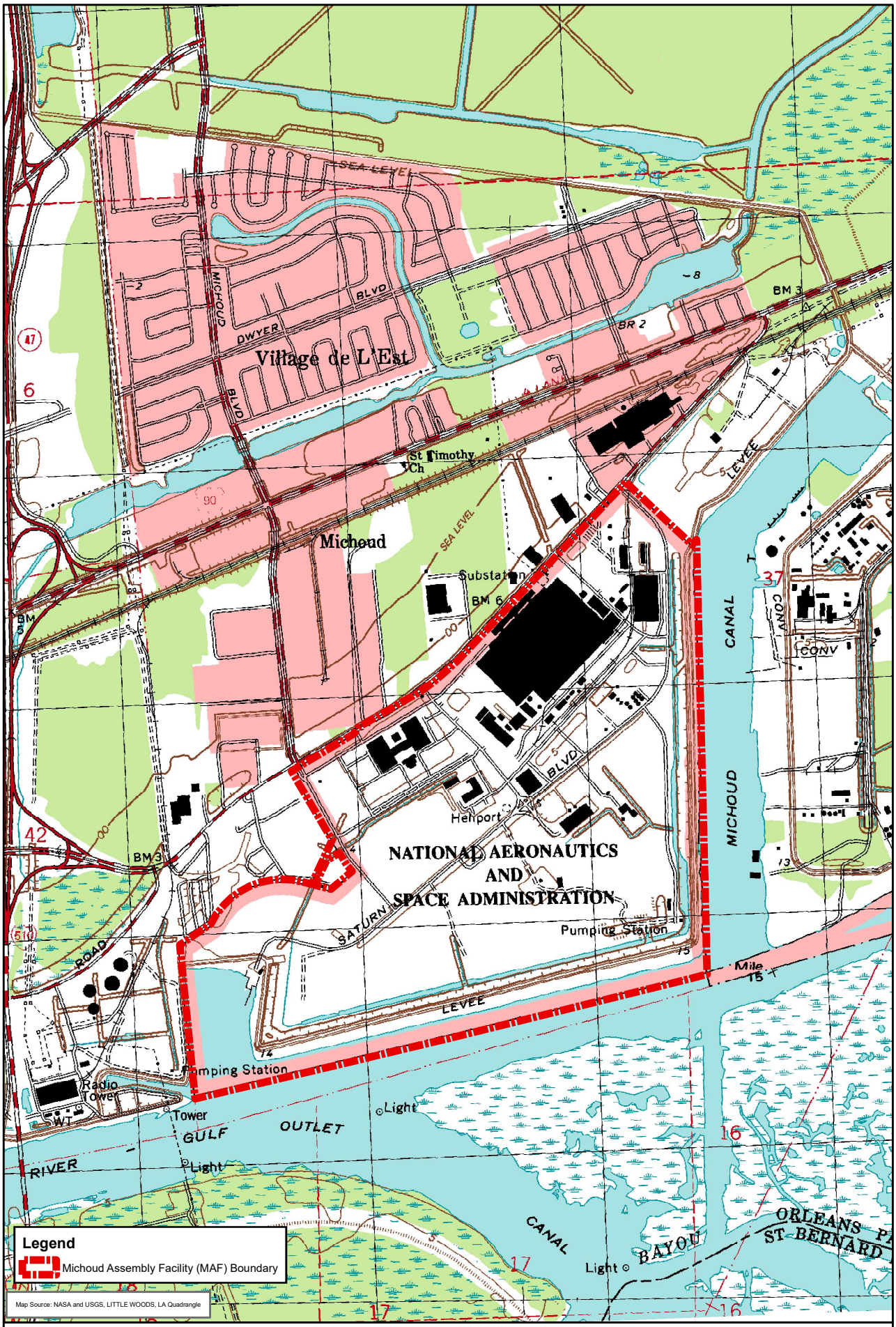

Figure 2-3
Topographic Map
Excavation and Backfill Work Plan
Areas of Investigation 1, 2 and 3
Michoud Assembly Facility

Map Document: (O:\NASA\Michoud\maps\SaturnBlvd\AOI_123_PCB_2302\MAF_Quad.mxd)

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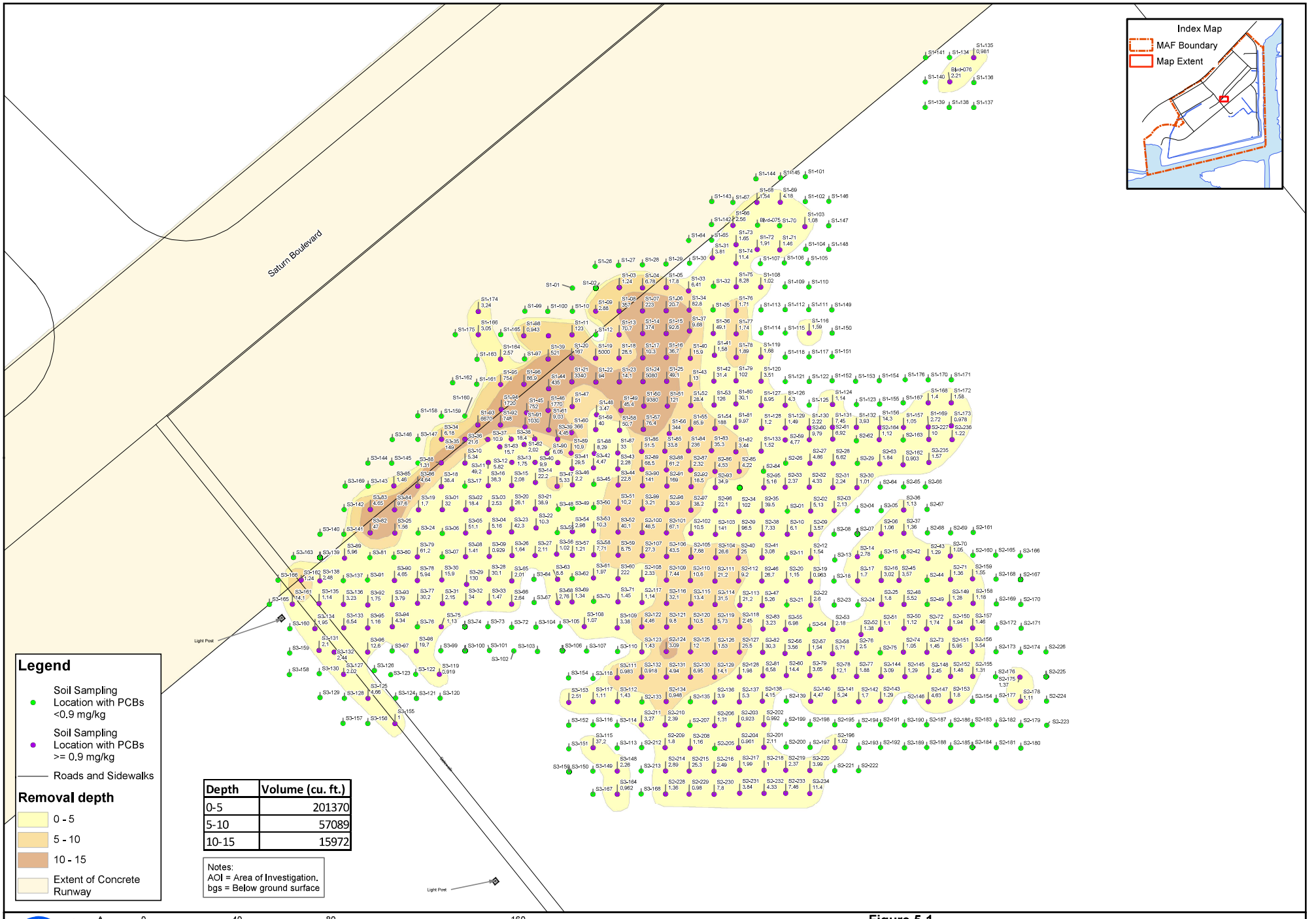

Figure 5-1
AOI 1, 2, and 3 Proposed Shallow Excavation Extent
Excavation and Backfill Work Plan Areas of Investigation 1, 2 and 3
Michoud Assembly Facility

Map Document: O:\NASA\Michoud\maps\SaturnBlvd\AOI_123_PCB_2302\AOI_123_PCB_Shallow.mxd

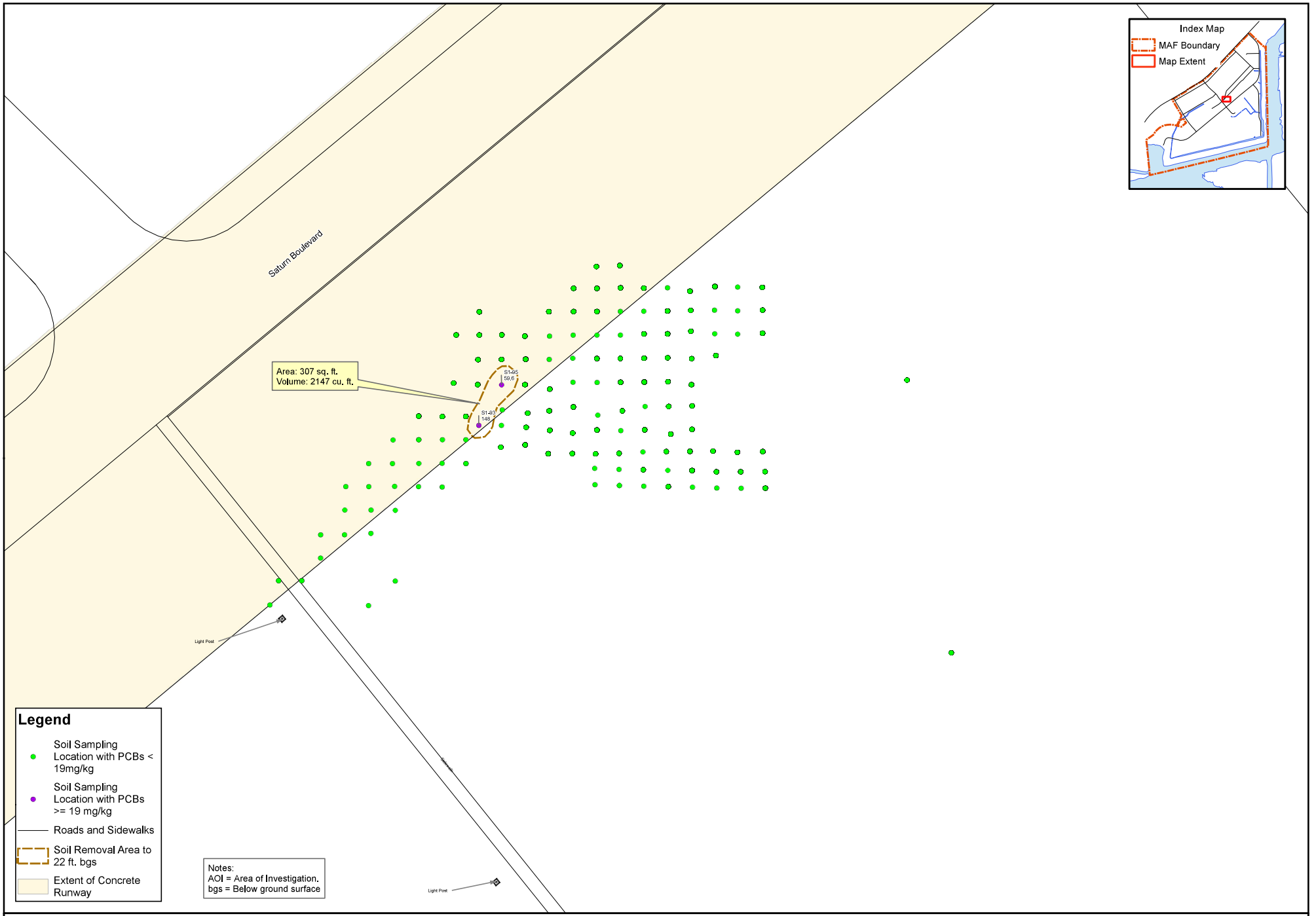

Figure 5-2
AOI 1, 2, and 3 Proposed Deep Excavation Extent
Excavation and Backfill Work Plan Areas of Investigation 1, 2 and 3
Michoud Assembly Facility

Map Document: O:\NASA\Michoud\maps\SaturnBlvd\AOI_123_PCB_2302\AOI_123_PCB_gt15.mxd

Appendix A
Sampling and Analysis Plan

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Sampling and Analysis Plan for Area of Investigation 1, 2, and 3 Excavation and Backfill Work Plan

Final Revision 2

February 2025

Prepared for

National Aeronautics and Space Administration
Michoud Assembly Facility

13800 Old Gentilly Road
New Orleans (Orleans Parish), Louisiana
LDEQ AI# 9145

Contents

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Acronyms and Abbreviations

Acronym	Definition
°C	degree(s) Celsius
AOI	area of investigation
bgs	below ground surface
BTEX	benzene, toluene, ethylbenzene, and total xylenes
CFR	*Code of Federal Regulations*
DPT	direct-push technology
EDD	electronic data deliverable
EPA	U.S. Environmental Protection Agency
GIS	geographic information system
HASP	health and safety plan
HAZWOPER	hazardous waste operations and emergency response
ID	identification number
LDEQ	Louisiana Department of Environmental Quality
LRS	Limiting RECAP Standard
MAF	Michoud Assembly Facility
mg/kg	milligram(s) per kilogram
mL	milliliter(s)
MO	management option
MSFC	Marshall Space Flight Center
NASA	National Aeronautics and Space Administration
OSHA	Occupational Safety and Health Administration
oz.	ounce
PCB	polychlorinated biphenyl

PDF	portable document format
QA	quality assurance
QAPP	quality assurance project plan
QC	quality control
RCRA	Resource Conservation and Recovery Act
RECAP	Risk Evaluation/Corrective Action Plan
SAP	sampling and analysis plan
$Soil_i$	soil standard for industrial land use
$Soil_{ssgw}$	soil standard for protection of groundwater
SVOC	semivolatile organic compound
TCLP	toxicity characteristic leaching procedure
TPH	total petroleum hydrocarbons
VOC	volatile organic compound

1. Introduction

The Michoud Assembly Facility (MAF) is in New Orleans, Louisiana, and is a component installation facility for the National Aeronautics and Space Administration (NASA) Marshall Space Flight Center (MSFC) in Huntsville, Alabama. A series of environmental investigations beginning in the 1990s and continuing to the present have characterized soil and groundwater contaminated with polychlorinated biphenyls (PCBs) in Areas of Investigation (AOIs) 1, 2, and 3. Because AOIs 1, 2, and 3 are in proximity to each other, they have been combined into a single site (AOI 1, 2, and 3) to be managed under the U.S. Environmental Protection Agency (EPA) Toxic Substances Control Act standards.

1.1 Objective

The purpose of this Sampling and Analysis Plan (SAP) is to outline the sampling and analysis activities that will be completed during remediation of AOI 1, 2, and 3, as outlined in the *Area of Investigation 1, 2, and 3 Excavation and Backfill Work Plan* (Work Plan; NASA 2024).

1.2 Site Background

The 832-acre MAF is approximately 16 miles east of the New Orleans business district within the New Orleans East section of metropolitan New Orleans. Land use adjacent to MAF is predominantly heavy industry and the nearest residential land use is approximately 1 mile to the north.

1.3 Objectives of Planned Field Activities

The overall objective of the activities outlined in this SAP is to provide the methodology for managing excavated soil, backfill soil, soil profiling for disposal, and excavation confirmation sampling for the AOI 1, 2, and 3 remediation project.

NASA plans to excavate AOI 1, 2, and 3 to the Louisiana Department of Environmental Quality (LDEQ) Risk Evaluation/Corrective Action Plan (RECAP) (LDEQ 2023) Management Option 1 (MO-1) soil standard for industrial land use ($Soil_i$) for PCBs of 0.9 milligram per kilogram (mg/kg) for surface soil (less than 15 feet below ground surface [bgs]) and soil protection of groundwater standard ($Soil_{ssgw}$)of 19 mg/kg for subsurface soil (deeper than 15 feet bgs). These excavations require sampling to confirm the remediation of PCB contaminants to the target Limiting RECAP Standards (LRSs). The backfill material will be sampled to confirm the fill is free of contamination prior to arrival onsite. The soil in the AOI will be characterized for disposal purposes. Any groundwater or sediment generated during excavation activities will be sampled to generate a waste profile for disposal purposes. Sampling will be completed in accordance with the Quality Assurance Project Plan (QAPP) found in Appendix B of the Work Plan (NASA 2024).

1.4 Soil Management During Excavation

Upon completion of the soil profiling and approval by the landfill, excavation of the AOI will be completed to a maximum depth of 22 feet bgs.

Contaminated soil excavated from the AOI that cannot be immediately transported offsite and “clean” soil excavated from areas adjacent to the AOI can be temporarily stockpiled onsite in designated areas

approved by NASA. Any soil outside the AOI boundaries that is designated for excavation stabilization purposes will be stockpiled separately from the contaminated soil within the AOI boundaries.

NASA will place and grade stockpiles of excavated materials as specified. Each stockpile will be kept in a neat, well-drained condition on even ground, giving due consideration to drainage at all times. The ground surface at stockpile locations will be cleared before placing down impermeable plastic sheeting.

Soil that is placed in temporary stockpiles must be well-maintained at all times. Stockpiled soil must be placed on impermeable plastic sheeting (minimum 6-mil thick) with a berm around the entire perimeter of the stockpile. The plastic sheeting and berm will prevent the runoff of soil and potential contaminants to surrounding areas. The berm can be constructed with hay bales, dimensional lumber, or other equivalent methods. The bottom plastic sheeting should be lapped over the berm materials, and the soil stockpile should be covered with plastic sheeting to prevent erosion or leaching of contaminants to underlying soil and exposure to precipitation and wind. Plastic sheeting that covers the soil stockpile will be secured using sandbags or equivalent weighted material. Silt fencing should be placed around the stockpile area to prevent soil or sediment runoff. Daily end-of-day inspections will be performed to observe and document that the soil stockpile is secured and protected from inclement weather and that adjacent stormwater catch basins are adequately protected in the unlikely event that a release from the soil stockpile occurs.

At the conclusion of the project and after the stockpiled soil has been returned to the excavation pit for reuse or disposed of elsewhere, the area will be restored to its pre-stockpile condition. Residual plastic or debris should not be left unattended at the project site following stockpile removal.

2. Soil Sampling and Analysis

This section of the SAP discusses soil sampling and analysis activities for the AOI 1, 2, and 3 remediation project.

2.1 Sampling Frequency

As stated in the Work Plan (NASA 2024), excavation and backfill activities will proceed in two phases: (1) soil disposal profiling and (2) excavation confirmation, stockpile, and backfill. The exact timing and frequency of each phase will be dictated by the schedule of the work being conducted in AOI 1, 2, and 3. Additional samples may be collected at some future date based on the sampling and analysis results.

2.2 Soil Disposal Profiling

To conduct a thorough excavation of AOI 1, 2, and 3, soil profiles will be compiled through sampling. Soil profiling helps identify proper disposal procedures and confirms or adjusts the extent of previous delineations and excavations. Soil profile sampling will be completed before any excavation occurs.

A qualified professional utility locator will mark each sampling location with flagging or stakes to confirm each planned location is clear of subsurface utilities. If asphalt or concrete is at the surface, the surface cover will be removed to expose the natural soil surface.

Direct-push technology (DPT) will be used to collect samples in an evenly distributed manner within the AOI. One sample will be collected for every approximately 500 square feet of surface area within the AOI to a target depth of 22 feet bgs. Samples will be delivered to the analytical laboratory for analysis using toxicity characteristic leaching procedure (TCLP) for volatile organic compounds, TCLP for semivolatile organic compounds, and TCLP for Resource Conservation and Recovery Act (RCRA) metals. Final boring locations will be documented via handheld GPS devices used by field staff. Analytical results will be provided to River Birch Landfill in Avondale, Louisiana, for waste profile development and approval.

2.3 Subsurface Soil Characterization

To confirm current concentrations in subsurface soil and the need to excavate beyond 15 feet bgs, samples will be collected from the historical locations with reported concentrations above the $Soil_{ssgw}$ of 19 mg/kg at depths greater than 15 feet bgs. These samples will be collected by dual-tube DPT methods to isolate the upper 15 feet of soil to minimize the potential for cross contamination. Samples will be submitted to the laboratory for PCB analysis.

2.4 Sampling of Planned Offsite Backfill Soil

NASA will collect a soil sample from each borrow pit and analyze offsite soils brought in for use as backfill for total PCBs, TPH, volatile organic compounds (VOCs), semivolatile organic compounds (SVOCs), and RCRA metals. Analytical testing will be completed from a sample of backfill material from the borrow site, with at least one test from each borrow site. The resulting data will be compared against applicable non-industrial RECAP standards. Material will not be brought onsite until tests indicate the material does not exceed the standards and have been approved by NASA.

2.5 Confirmation Sampling in Excavation

Once the excavation has reached the defined horizontal and vertical limits of each AOI and prior to backfilling, confirmation sampling will be conducted to document that the extent of contamination exceeding the RECAP MO-1 $Soil_i$ for surface soil (less than 15 feet bgs) and $Soil_{ssgw}$ for subsurface soil (deeper than 15 feet bgs) has been removed. If the results from any of the initial confirmation samples indicate an exceedance of the LRSs, over-excavation and resampling will be conducted.

If over-excavation is required, the sidewall will be excavated approximately 5 feet laterally. Any vertical over-excavation will take place in approximate 3-foot intervals until over-excavation soil confirmation samples indicate that the in situ soil is in compliance with the LRSs. Over-excavation extents may be adjusted based on field observations or if laboratory analytical results indicate close proximity to the applicable regulatory limits. Over-excavation and resampling will continue until confirmation samples on each side and bottom of the excavation indicate that the in situ soil is below the LRSs.

During excavation activities, groundwater present at the site will be pumped into one or more tanks. This groundwater will be sampled for PCBs to create a profile for proper disposal. Any sediments contained within the tank after pumping will be sampled for total TCLP and total PCBs to create a profile for proper disposal.

To conduct confirmation sampling, soil samples will be collected from each of the four sides of the excavation and from the bottom of the excavation. Each soil sample will be collected from the approximate center of the excavation wall or every 20 linear feet of sidewall if the wall is greater than 40 feet in length. Soil samples will be collected from the bottom of the excavation at a rate of 1 sample for approximately every 500 square feet of excavation bottom.

The sampling team will use hand tools to collect samples. Chrome-plated tools will not be used. New, disposable nitrile gloves will be worn during sample collection and changed between samples.

Soil samples will be collected using the following procedure:

- Remove the top layer of soil to the desired sampling depth using a decontaminated hand tool.
- Transfer the soil sample to a labeled, laboratory-prepared sample jar using a decontaminated stainless-steel or plastic laboratory spoon. Fill the jar(s) completely to minimize headspace.
- Quickly and adequately seal the sample container. Clean the jar rim(s) before tightening the lids.
- Immediately upon completion of sample collection, label the samples following proper labeling procedures and place on ice in coolers kept at the proper temperature (0 to 6 degrees Celsius [°C]). The samples will remain under proper chain of custody until relinquished to laboratory control.
- Use a field notebook to record a description of the soil that was sampled, the location of the soil sample, the sample identification number (ID), and the date and time of the soil sample collection. Record the sample on the soil sampling field forms and chain of custody. The excavation soil confirmation sample ID will include a prefix identifying the individual AOI, the side of the excavation (north, south, east, west, or bottom). For example, the west side confirmation soil sample collected would be identified as "AOI-123_Excavation_West_YYYYMMDD."
- Decontaminate the equipment between collection of soil samples.

The decontamination of sampling equipment between samples will include the following steps:

1. Rinse with tap water and scrub with brush until free of large particles.
2. Wash with phosphate-free detergent solution.
3. Rinse with tap water.
4. Rinse with distilled water.

All confirmation soil samples will be submitted to an analytical laboratory for analysis of total PCBs.

2.6 Sample Analysis

Table A-1 provides the volume, container type, preservation, and holding time specifications for each sample type and analytical method. The sample volume, container, and preservation requirements will be in accordance with requirements for the selected analytical methods and the laboratory's requirements for those methods. Sample containers will be pre-cleaned and pre-preserved containers supplied by the laboratory.

Table A-1. Containers, Preservation, and Holding Times

Sample Type	Analyte Method	Medium	Containers	Sample Volume	Preservation	Maximum Holding Time
Soil Disposal Characterization	Full TCLP - Methods 6010, 8260, 8270, 8151, and 8082	Soil	Glass	One 1-liter clear jar	4°C	14 days to analysis
Soil Disposal Characterization	PCBs Method 8082A	Soil	Glass	One 4-oz. clear jar	4°C	14 days to analysis
Excavation Confirmation	PCBs Method 8082A	Soil	Glass	One 4-oz. clear jar	4°C	365 days to analysis
Backfill	Soil TPH Method 8015B	Soil	Glass	One 4-oz. clear jar	4°C	14 days to analysis
Backfill	Soil TPH Method 8015B	Soil	Glass	One 2-oz. clear jar	4°C	14 days to analysis
Backfill	Soil VOCs Method 8260B	Soil	Glass	Two 14-mL amber vials	Methanol 4°C	14 days to analysis
Backfill	Soil SVOCs	Soil	Glass	One 4-oz. clear jar	4°C	14 days to analysis
Backfill	Soil RCRA Metals Method 6010	Soil	Glass	One 4-oz. clear jar	4°C	180 days to analysis

Sample Type	Analyte Method	Medium	Containers	Sample Volume	Preservation	Maximum Holding Time
Purged Groundwater and Sediment	Full TCLP Methods 6010, 8260, 8270, 8151, and 8082	Sediment	Glass	One 1-liter clear jar	4°C	14 days to analysis
Purged Groundwater and Sediment	Total PCBs Method 8082	Sediment	Glass	One 4-oz. clear jar	4°C	365 days to analysis
Purged Groundwater and Sediment	Total PCBs Method 8082	Water	Glass	Two 100-mL clear jars	4°C	365 days to analysis

mL = milliliter(s)
oz. = ounce

Sample preservation, handling, and analysis will meet the requirements of Hazardous Waste Test Methods SW-846, latest revision; appropriate EPA and LDEQ guidance; and RCRA and RECAP requirements. The samples will be analyzed by a laboratory certified by the State of Louisiana.

2.7 Monitoring Well Abandonment

Once soil standards have been met, a driller licensed by the State of Louisiana will plug and abandon all monitoring wells associated with AOI 1, 2, and 3 in accordance with the Louisiana Department of Natural Resources (LDNR) and the LDEQ's Guidance Manual for Environmental Boreholes and Monitoring Systems. Monitoring wells will be abandoned by removing the protective surface completion and then attempting to pull the monitoring well casing from the borehole. Once the well materials have been removed from the borehole, the borehole shall be grouted in place with a cement-bentonite slurry from the bottom of the boring to the ground surface. If the well materials cannot be pulled from the borehole, the well may be grouted in place with a cement-bentonite slurry via tremie from the bottom to the top. The licensed driller will submit the well abandonment forms to LDNR (copies will also be sent to the LDEQ and EPA for their records).

3. Equipment Decontamination

Decontamination will be performed on all non-dedicated sampling equipment and any other item that will, or may have, come in contact with site soil and groundwater. Decontamination will be performed before drilling, installation, and sampling and between drilling and sampling locations. The following decontamination procedure will be followed for sampling equipment:

1. Wash water-level meter and non-disposable sampling equipment with a brush and phosphate-free detergent solution (Alconox, Liquinox, or similar laboratory detergent and potable water).
2. Rinse equipment thoroughly with potable water and then double rinse with distilled water. Allow to air dry and then wrap with aluminum foil until transported to next sampling location.
3. Rinse water quality field parameter sensors and flow-through cell with distilled water between sampling locations. After completion of the sampling event, follow manufacturer's recommendations for cleaning and maintenance of flow-through cell and sensors.

For excavation equipment, decontamination will be completed between each excavation location. The following decontamination procedure will be followed for excavation and drill rig tooling:

1. Set up a decontamination pad, consisting of a designated flat area with an impermeable liner, to capture the water and detergents used in the decontamination process.
2. Place the excavation equipment on or above the cleaning pad. The equipment should be elevated far enough above the pad to prevent contaminated water from splashing back on it.
3. Use a high-pressure washer to remove soil and debris from the equipment.
4. Use Alconox, Liquinox, or another phosphate-free detergent in conjunction with potable water to fully decontaminate tooling.
5. Conduct a final rinse of tooling with potable water.
6. Pump all cleaning/rinse water out of the decontamination pad and place in containers for proper storage and disposal.

Water and solids generated through equipment decontamination will be containerized and transported to the MAF waste storage area or appropriate offsite disposal facility, which is a RCRA-permitted facility storage area that complies with *Code of Federal Regulations* (CFR) Title 40, Section 761.65(b)(2). The waste will be disposed of using the guidelines outlined in 40 CFR Section 761.62.

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4. Sampling and Handling Documentation

Additional sampling and handling documentation guidance is detailed in the QAPP found in Appendix B of the Work Plan (NASA 2024). The following is a subset of this documentation pertaining specifically to field sampling.

4.1 Quality Assurance and Quality Control

Sampling and analysis will be conducted in accordance with standard EPA SW-846 methods with appropriate quality assurance (QA)/quality control (QC) samples, including field duplicates, matrix spikes, matrix spike duplicates, trip blanks, field blanks, and internal lab reference standards as outlined in LDEQ RECAP standards. A site-specific QAPP is provided as Appendix B to the Work Plan (NASA 2024). The QA/QC documentation will include the following:

- Sample documentation
- Records of field equipment calibration
- Determination and documentation of laboratory detection limits
- Analyte identification and quantification
- QC blanks (trip, field, equipment)
- Matrix spike recoveries
- Performance evaluation samples
- Analytical error determination
- Total measurement error determination

The QA/QC samples will be handled and managed in the same manner as the other samples relative to sample collection and chain-of-custody procedures. The following outlines the QA/QC set to be used for the AOI 1, 2, and 3 excavations:

- One duplicate sample collected every 20 confirmation samples. Duplicate samples are "blind samples" that are treated the same as the field samples and are subjected to the same analyses by the same laboratory as the field samples.
- One matrix spike/matrix spike duplicate sample of soil collected every 20 field samples.
- One trip blank, provided by the analytical laboratory, to accompany any samples being analyzed for volatile organic compounds during shipment to the laboratory.

As a part of the analytical results reporting package, the analytical laboratory will provide a narrative of any issues that would indicate if the data were not usable. That narrative includes problems with laboratory blanks and surrogate samples. In addition, the laboratory complies with the QA requirements sections found in the various analytical methods that are used for the project. NASA will evaluate (using RECAP Form 3) and conduct independent (third-party) validation of the laboratory results to determine that precision, accuracy, and completeness of objectives were met.

4.2 Sampling Container Labeling

Sample labels are completed with an indelible, waterproof ink. Label information includes the unique sample ID, date and time of sampling, sample type (i.e., surface water, soils, sediment, and groundwater), and the preservative added, if applicable. The sample numbering and nomenclature system for each activity are identified in each AOI-specific work plan and will be based on NASA geographic information system (GIS) nomenclature requirements.

4.3 Chain of Custody

Proper sample handling and custody procedures ensure the custody and integrity of samples beginning at the time of collection in the field and continuing through transport, sample receipt, preparation, and analysis. A sample is in custody if it is in actual physical possession or in a secured area restricted for access only to authorized personnel. The chain-of-custody form and custody seals are used to document sample handling during transfer from the field to the laboratory and among contractors. The following list of items should be included on the chain-of-custody form and information identified on sample containers should match the chain-of-custody form.

- Date and time of collection
- Site identification
- Sample matrix
- Container type
- Number of containers
- Preservative used (if any)
- Notation if the sample was filtered
- Analyses required
- Name of collector
- Custody transfer signatures and dates and time of transfer
- Name of laboratory admitting the samples
- Bill of lading (if applicable)
- Special instructions for the laboratory (free product noted, deliverable requirements, etc.)

4.4 Sample Collection Log Sheets

Sample collection log sheets (Attachment A-1) will be maintained for all samples and will be submitted to the NASA Remediation Project Manager along with original chain-of-custody forms.

4.5 Sample Shipment or Delivery

Sample handling and custody requirements are intended to maintain control over, and document possession of, environmental samples following collection in the field through shipment to the analytical laboratory. Samples will be placed in shipping coolers containing double-bagged, cubed ice immediately following collection. The samples will be grouped in the shipping cooler by the order in which the samples are collected. The samples will be held until a time pre-arranged with the laboratory and the laboratory-supplied courier can pick up the samples. If a courier is not available, the samples will be shipped by domestic package service (i.e., FedEx or UPS). Overnight shipping will be used as the default option, with expedited or “First” overnight being used at the discretion of the technical advisor. Sample coolers will be sealed tightly with packing tape and affixed with a laboratory-provided seal to prevent tampering during transit.

5. Health and Safety

A project-specific health and safety plan (HASP) must be developed for the sampling of site soil. This HASP will be maintained onsite during the entire project. During field activities, field personnel will adhere to the HASP to ensure that sample collection and decontamination is completed in a safe manner. The purpose of this HASP is to assign responsibilities, establish personnel protection standards, specify safe operating procedures, and address contingencies that may arise while conducting screening and sampling at the site. During sampling activities, a daily safety "tailgate" meeting will be conducted prior to work each day to advise personnel of ongoing and new health and safety concerns.

During this daily tailgate meeting, field personnel will be informed of the possible chemical and physical hazards. All involved personnel will be required to read and sign the HASP. The HASP will be accessible in the field. Depending on project role, all personnel are required to have up-to-date certifications in either 24-hour or 40-hour Occupational Safety and Health Administration (OSHA) hazardous waste operations and emergency response (HAZWOPER) standard training (29 CFR Section 1910.120) before fieldwork.

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6. Reporting Requirements

The sampling and analysis results will be compiled and submitted to NASA and LDEQ at the end of the excavation as a part of the AOI 1, 2, and 3 Remediation Report. The draft report will be submitted within 60 days of the end of the excavation events, and a final report will be submitted within 90 days of the end of the excavation event. The report will include tabulated data results, delineation of excavation, figures of sampled locations, and a conclusion from the remedial action.

The analytical laboratory project manager will prepare data reporting packages in electronic form and send them to the technical advisor. The electronic copy will be in portable document format (PDF) with all pages numbered sequentially. The PDF files will be read-only so that data items cannot be edited. Electronic copies will be provided on the analytical laboratory's website.

For data validation purposes, the analytical laboratory will produce an EQuIS 3 electronic data deliverable (EDD) file and send it to the technical advisor. The analytical laboratory will produce a separate EDD file and send it directly to the GIS and database manager to merge into the NASA GIS database. All records of the sampling and analysis events and associated groundwater surface elevations and analytical data will be maintained in electronic format in the Document Catalogue and at the NASA Remediation Project Manager's office at MSFC in accordance with Section VII.A.9 of the NASA RCRA permit number LA4800014587-OP-RN-1.

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7. References

Louisiana Department of Environmental Quality (LDEQ). 2023. *Risk Evaluation/Corrective Action Program (RECAP).* October.

National Aeronautics and Space Administration (NASA). 2024. *Area of Investigation 1, 2, and 3 Excavation and Backfill Work Plan.* Draft. February.

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Attachment A-1
Soil Sampling Logs

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SOIL SAMPLING LOG

LOG OF SAMPLE: _____

Sheet 1 of 1

Project Name				**AOI No.**	
Project No.		Date		**QA/QC Sample**	
Sample Name				**Geologist/ Samplers**	
Surface Elevation					
Sample *Depth*		*Elev.*		**Weather** **High Temperature: __°F Precip:____** **Low Temperature: __°F**	
Sample Collection Method **( ) Excavator ( ) Geoprobe (DPT) ( ) Auger**				**Water Level** **First Encountered:_____** **On Completion:____24 hr _**	

PID Reading (ppm)	Depth (ft bgs)		GPS Coordinates	Descriptions and Remarks
	From	To		

Notes:
bgs – below ground surface dk -- dark
lt – light
w/ – with
Med -- medium
v. -- very rk – rock
frag -- fragments

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Appendix B
Quality Assurance Project Plan

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Quality Assurance Project Plan for Area of Investigation 1, 2, and 3 Excavation and Backfill Work Plan

Revised Final

April 2024

Prepared for

National Aeronautics and Space Administration
Michoud Assembly Facility

13800 Old Gentilly Road
New Orleans (Orleans Parish), Louisiana
LDEQ AI# 9145

Contents

Attachments

Tables

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Acronyms and Abbreviations

°C	degree(s) Celsius
AA	atomic adsorption
AOI	area of investigation
CLP	Contract Laboratory Program
CoC	chain of custody
DQO	data quality objective
EDD	electronic data deliverable
GC	gas chromatography
GIS	geographic information system
HASP	health and safety plan
HAZWOPER	Hazardous Waste Operations and Emergency Response
LCS	laboratory control sample
LDEQ	Louisiana Department of Environmental Quality
MAF	Michoud Assembly Facility
MDL	method detection limit
mg/kg	milligram(s) per kilogram
mL	milliliter(s)
MS	matrix spike
MSD	matrix spike duplicate
NASA	National Aeronautics and Space Administration
ND	nondetect
OSHA	Occupational Safety and Health Administration
oz.	ounce
PBMS	performance-based measurement system

PCB	polychlorinated biphenyl
PDF	portable document format
PM	project manager
QA	quality assurance
QC	quality control
QAPP	quality assurance project plan
RCRA	Resource Conservation and Recovery Act
RECAP	Risk Evaluation/Corrective Action Program
RPD	relative percent difference
SAP	sampling and analysis plan
SOP	standard operating procedure
SQL	sample quantitation limit
SW	solid waste
TCLP	toxicity characteristic leaching procedure
VOC	volatile organic compound

1. Project Overview

This Quality Assurance Project Plan (QAPP) has been developed for the *Area of Investigation 1, 2, and 3 Excavation and Backfill Work Plan* (Work Plan; Jacobs 2024). This Work Plan outlines the approach and methods to remediate the soil in Area of Investigation (AOI) 1, 2, and 3 at Michoud Assembly Facility (MAF) in New Orleans, Louisiana. AOIs 1, 2, and 3 were in proximity to each other and, therefore, were combined into a single site (AOI 1, 2, and 3) to be managed under the U.S. Environmental Protection Agency (EPA) Toxic Substances Control Act standards.

To complete the remediation objective, excavated soil, sediment, and groundwater (if encountered) will be characterized for landfill disposal, and the intended backfill material will be sampled to determine its suitability for use. This process will help confirm that AOI 1, 2, and 3 has been remediated (that is, excavated) to the Risk Evaluation/Corrective Action Program (RECAP) (LDEQ 2023) Management Option 1 (MO-1) industrial soil standard of 0.9 milligram per kilogram for surface soil (< 15 feet below ground surface [bgs]) or the soil protection of groundwater standard of 19 mg/kg for subsurface soil (≥ 15 feet bgs).

1.1 Project Organization

The following sections discuss the lines of authority and project management organization specific to quality assurance (QA) in this investigation. Because there are several groups working together to form the project team, effective and clear communication between all parties is a necessity.

1.1.1 LDEQ Team Member

The Louisiana Department of Environmental Quality (LDEQ) team member will provide final approval of work plans and reports submitted to LDEQ by NASA. NASA reserves the right to initiate work under work plans submitted to LDEQ before receipt of written approval from LDEQ.

1.1.2 NASA Remediation Program Manager

NASA's Remediation Program Manager will direct all work at the site, will conduct communications between NASA and LDEQ, will be a liaison between NASA management and the project team, and will provide direction and responsibility for all documents, including work plans, reports, and project correspondence.

1.1.3 NASA Project Manager

The NASA Project Manager (NASA PM) will be the alternate point of contact for the project for NASA management and LDEQ. The NASA PM will assist with the overall environmental investigation and remediation program at Michoud Assembly Facility (MAF).

1.1.4 Project Manager

The PM will report directly to the NASA Remediation Program Manager and will provide the principal point of contact and control for matters concerning the project and field investigation implementation. The PM will be responsible for the following tasks:

- Take on full subcontractor management authority.

- Perform QA and quality control (QC) audits on various phases on the project's operations, if necessary.
- Review and approve this QAPP and other QA plans and procedures.
- Oversee project-specific issues relating to contracts, technical specifications, QA, and health and safety.
- Establish project policies and procedures to meet the specific objectives of the project.
- Offer direction and review of data validation activities.
- Coordinate status meetings.
- Assess the overall project for compliance with federal, state, and local regulations and laws.

1.1.5 Technical Advisor

The technical advisor will report directly to the PM and will provide coordination for matters concerning the project and field investigation implementation. The technical advisor will be responsible for the following tasks:

- Coordinate field investigations activities and develop a detailed schedule.
- Orient all field staff concerning the project.
- Develop and meet ongoing project staffing requirement, including a mechanism to review and evaluate each work product.
- Review the work performed on each project to help ensure its quality, responsiveness, and timeliness.
- Represent the project team at all meetings, if necessary.
- Assess final usability of data per results of field and data validation processes.
- Work with the analytical laboratory PM to resolve laboratory technical problems pertaining to project samples, including selection of proper methodology to mitigate matrix interferences.

1.1.6 Field Team Leader

The field team leader will be responsible for all aspects of fieldwork performed as part of a specific AOI. The primary duty of the field team leader is to confirm that field sampling is performed in accordance with the project sampling and analysis plan (SAP), this QAPP, the project health and safety plan (HASP), and LDEQ's RECAP. The field team leader will be responsible for the following project tasks:

- Maintaining field records
- Ensuring that field personnel are properly trained, equipped, and familiar with the HASP
- Overseeing sample collection, handling, and shipping
- Ensuring the proper functioning of field equipment
- Informing the laboratory when samples are shipped to the lab
- Informing the laboratory of sample characteristics, which might impact analysis, such as known contamination, odor, and visible staining

1.1.7 Analytical Laboratory Project Manager

The analytical laboratory PM will work directly with the field team leader and will have the following duties:

- Making sure all necessary laboratory resources are available to meet project schedules
- Shipping sample containers and preservatives to the field team leader
- Overseeing production and final review of analytical reports
- Coordinating laboratory analyses
- Supervising in-house chain-of-custody (CoC) procedures and documentation
- Providing sample acknowledgement forms within 24 hours of sample receipt
- Scheduling sample analyses
- Overseeing laboratory data review
- Approving final analytical reports before submission
- Overseeing laboratory QA
- Overseeing QA/QC documentation
- Defining appropriate laboratory QA procedures
- Determining whether to implement laboratory corrective actions, if required
- Contacting the Technical Advisor to obtain approval for sample disposal (only laboratories accredited by LDEQ will be used to analyze samples)

1.1.8 Geographic Information System and Database Manager

The geographic information system (GIS) and database manager will directly with the field team leader and Technical Advisors and will have the following duties:

- Be responsible for all analytical and geographical information generated to be incorporated into NASA's database and GIS.
- Prepare project-related figures (for example, potentiometric and sampling results).

1.2 Project Description

This QAPP has been developed to address the QA issues pertaining to data collected by the environmental investigations at NASA's MAF in New Orleans, Louisiana, specifically AOI 1, 2, and 3. This QAPP describes specific protocols that will be followed for sample handling and storage, CoC, laboratory analyses, reporting, data validation, and corrective actions.

The goal of the QAPP is to assure that the data collected meet the data quality objectives (DQOs) established in Section 1.3. All QA/QC procedures will be in accordance with applicable professional standards, government regulations and guidelines, and specific project goals and requirements.

1.3 Data Quality Objectives and Criteria

Data will be collected to investigate AOI 1, 2, and 3 and quantify potential risks. Additionally, data could be used to guide remedial actions at the site, confirm remedial effectiveness at reducing the mass, toxicity, mobility, volume, or concentration of contaminants, and to gauge the effectiveness of interim measures designed to alleviate immediate or short-term threats to human health, safety, or sensitive environmental receptors, should any be necessary. To support these DQOs, sensitive environmental action criteria are extremely low. Table 4-1 in the Work Plan presents each analyte that will be measured in each sample, methodology, estimated laboratory reporting limits, and performance measures and criteria.

1.4 Performance Criteria

Performance criteria to meet the DQOs of each project are discussed specifically in Sections 1.4, 2.6, and 3. Definitions for data accuracy, precision, completeness, representativeness, and comparability are provided, as are the project's data usability criteria and guidelines.

1.4.1 Precision

Precision is a measure of the degree to which two or more measurements agree. Determining the agreement among replicate measurement of the sample assesses the precision of the analytical method. Precision of sampling and analysis techniques are assessed through the evaluation of agreement between analytical measurements of duplicate samples.

Precision of sampling and analysis methods will be assessed through the collection of field duplicate samples at a minimum rate of one field duplicate per 20 investigative samples collected. The relative percent difference (RPD) in the results for each analyte will be computed for each field duplicate pair using the equation provided in Section 2.6. The goal for precision of field duplicate results is +/- 35% RPD for soil and sediment samples and +/-25% RPD for groundwater samples. However, if one or both samples in a field duplicate pair have a concentration less than 10 times the method detection limit (MDL), the field precision goal will be +/- 5 times the MDL.

Natural variation in soil and sediment will affect how closely these goals are met. If variation is high, then these goals are unrealistic. Consequently, RPD results from field duplicates of soil and sediment samples will not be used as the sole basis of invalidating any analytical data.

Precision of the analytical method will be assessed through duplicate analyses of laboratory QC and field samples. Data for duplicate analysis will be evaluated only if both of the samples in the duplicate pair have a concentration greater than the sample quantitation limit (SQL). Only Louisiana-accredited laboratories will perform the analytical services.

1.4.2 Accuracy

Accuracy is the degree of agreement between an observed value and an accepted reference or true value. The equations used to assess accuracy are included in Section 2.6. Both field and laboratory blank samples will be analyzed to quantify potential sample contamination as a measure of data accuracy. The accuracy objective for blank analysis results is a concentration less than the MDL.

Accuracy in the field will be assessed through the collection of field blanks and adherence to all sample handling, preservation, and holding time requirements. The accuracy objective for field blanks will be nondetect (ND) results (< MDL) for all analytical parameters of interest.

Laboratory accuracy could be evaluated by the analysis of laboratory control samples (LCSs) and matrix spike (MS) and matrix spike duplicate (MSD) samples, with results expressed as a percentage recovery measured relative to the true (known) concentration. The accuracy objectives and equations for LCS and MS/MSD recoveries for each analyte are discussed in Section 2.6. Moreover, laboratory preparation blank results could be used to measure any contamination introduced during the analytical process. The accuracy objective for laboratory preparation blanks will be nondetected results (< MDL).

1.4.3 Completeness

Completeness is the percentage of valid measurements or data points obtained as a proportion of the number of measurements or data points planned for the project. Percentage completeness is calculated by the number of valid measurements and data points obtained divided by the number of measurement and data points planned.

Field completeness will be affected by factors such as sampling efforts being carried out according to work plan instructions and sample collection techniques, while laboratory completeness will be affected by factors such as sample bottle breakage and acceptance or rejection of the analytical results during the data validation process. The field and laboratory completeness goals are 95%.

1.4.4 Representativeness

Representativeness is a qualitative objective that is defined as the degree to which data accurately and precisely represents the characteristic of a population, the parameter variations at a sampling point, the process condition, or an environmental condition within a defined spatial and temporal boundary.

Field representativeness is achieved by collecting a sufficient number of unbiased (representative) samples and implementing a QC program for sample collection and handling before analyses. The sampling approaches developed for this project will provide samples that are representative of site conditions.

Representativeness in the laboratory is guaranteed via the proper analytical procedures, appropriate sample handling and preparation methods, meeting sample-holding times, and analyzing and assessing duplicate samples. In addition to this QAPP, the laboratory's QAPPs discuss procedures to make sure that analysis results are representative of actual conditions for the samples submitted.

1.4.5 Comparability

Comparability is the confidence with which one data set can be compared to another. Comparability is dependent upon the proper design of the sampling program and will be satisfied by ensuring that the standard field protocols are consistently followed and that the sampling techniques specified in the work plans are consistently used.

Analytical data will be comparable when the sampling and analytical methods described in this QAPP are used for sample collection and laboratory analysis. This goal is achieved through the consistent use of standard techniques to collect and analyze representative samples. Results of sample analyses will be consistently reported in appropriate units. Comparability is also dependent upon the laboratory obtaining

the QA objectives for accuracy and precision. All data that meet the QA objectives described in this document, and are considered usable, will be considered comparable data.

1.4.6 Special Training and Certification

All personnel working on the MAF site will have received the 40-hour Occupational Safety and Health Administration (OSHA) Hazardous Waste Operations and Emergency Response (HAZWOPER) training with annual 8-hour refreshers and annual medical monitoring. All contractors must also provide notification before arrival to the site and photo identification to the MAF security office for badge clearance.

1.5 Documents and Records

1.5.1 Field Operation Records

Field operation records include sample collection records, CoCs, custody seals, QC sample records, field procedures, and corrective action reports. Field sampling activities are documented on field data sheets as contained in project sampling plans. At each site, station identifications, location, sampling time, date, and sample collector's name and signature are recorded. If a field or lab QA/QC sample is to be collected at a specific sample or if a split sample is to be collected, this information will be documented on the field data sheets. Values for all measured field parameters will be recorded. Observational data will be recorded including water appearance, weather, biological activity, unusual odors, and other sample-specific information. CoCs will be filled out for all samples collected and include the information documented in Section 2.3.

Any problems or comments related to a specific sample will also be documented on the field data sheet. Such information would include details around moving a base station or circumstances at a site that prevented a sample from being collected.

Any corrective actions necessary to ensure that sample integrity is maintained will be documented. If field standard operating procedures (SOPs) are violated or deviations are made, a corrective action report will be completed to document what occurred, to correct the failure, and to relay the effect of the action on the sample in question.

1.5.2 Laboratory Records

Laboratory records will include all of the data in the data-reporting package (Section 1.5.4) as well as any laboratory records generated for the project samples. In addition to the items in the data-reporting package, at a minimum, the following records will be maintained by the laboratory:

- Sample preparation log books
- Standard solutions preparation log books
- Temperature records for storage units (for example, standards and samples)
- Equipment calibration and maintenance records
- Certification records for standards

1.5.3 Data Handling Records

Data generated as part of this project will be handled according to the data management steps outlined in Section 2.10, as well as the verification and validation procedures identified in Section 3.

1.5.4 Data Package Format and Documentation Control

The analytical laboratory will prepare data packages consistent with the data level identified in Section 3. The data package will include the following reportable data:

- Sample identifications (with both field and laboratory identifications)
- Analytes, concentrations, and units
- Analysis date
- Analysis time
- Analysis method
- Laboratory qualifiers and definitions
- Percent moisture and results reported on a dry weight basis (soil and sediment)

Additionally, the data packages QC summary will include the following information:

- MDL and SQL determinations
- Test reports for samples with SQL and MDL
- Surrogate recovery data (as applicable to each analyte)
- Test reports or summary forms for laboratory blank samples
- Test reports or summary forms for LCSs
- Test reports or summary forms for MS/MSD
- Test reports for laboratory duplicates
- Instrument run logs, extraction logs and digestion logs
- Initial calibration data with summary report
- Initial calibration verification with summary report
- Continuing calibration verification with summary report
- Initial calibration blank with summary report
- Continuing calibration blank with summary report
- Sample check in forms
- Contaminant of concern documentation
- Raw data
- Case narrative
- Performance evaluation samples
- Quarterly detectability samples

The analytical laboratory PM will prepare data-reporting packages in electronic form and submit them to the technical advisor. The electronic copy will be in portable document format (PDF) with all pages numbered sequentially. The PDF files will be read-only so that data items cannot be edited. Electronic copies will be provided on the analytical laboratory's website. For data validation purposes, the analytical laboratory will produce an EQuIS 3 electronic data deliverable (EDD) file and send it to the technical advisor. The analytical laboratory will produce a separate EDD file and send it directly to the GIS and database manager to merge into the MAF GIS database.

All samples collected during this investigation will be named according to NASA's reporting format. The analytical results from the certified laboratory, boring information, and lithological information will be delivered to NASA following the data transfer protocol for the MAF Resource Conservation and Recovery Act (RCRA) electronic database.

1.5.5 Data Archiving and Retrieval

All field-collected data will be maintained in its original format by the contractor. Laboratory data, this QAPP, work plans, SAPs, HASPs, and NASA-LDEQ correspondence will be archived electronically and in paper form at NASA's Marshall Space Flight Center Environmental Engineering and Occupational Health Office in Huntsville, Alabama. Laboratory data packages, this QAPP, Work Plan, SAP, HASP, and NASA-LDEQ correspondence will be maintained in electronic form in a document catalogue.

2. Data Generation and Acquisition Elements

2.1 Sampling Process Design

Each work plan will document sampling design, field sampling methods, equipment used and decontamination procedures, cross-contamination prevention and reduction measures, and sampling handling and custody procedures. The sampling procedures provided in these documents are designed to produce the type and quality of data consistent with objectives of this project and follow LDEQ's RECAP requirements.

2.2 Sampling Methods

2.2.1 Sample Volume, Containers, and Preservation

The sample volume, container, and preservation requirements will be in accordance with requirements for the selected analytical methods and the laboratory's requirements for those methods. All sample containers will be precleaned and prepreserved containers supplied by the laboratory. Table 2-1 provides volume, container type, preservation, and holding time specifications for each sample type and analytical method.

Table 2-1. Containers, Preservation, and Holding Times

Sample Type	Analyte Method	Medium	Containers	Sample Volume	Preservation	Maximum Holding Time
Soil Disposal Characterization	Full TCLP Method 6010, 8260, 8270, 8151, 8082	Soil	Glass	1-liter clear jar	4°C	14 days to analysis
	PCBs Method 8082A	Soil	Glass	one 4-oz. clear jar	4°C	14 days to analysis
Excavation Confirmation	PCBs Method 8082A	Soil	Glass	one 4-oz. clear jar	4°C	365 days to analysis
Backfill	Soil TPH Method 8015B	Soil	Glass	one 4-oz. clear jar	4°C	14 days to analysis
		Soil	Glass	one 2-oz. clear jar	4°C	14 days to analysis
	Soil BTEX Method 8260B	Soil	Glass	two 14-mL amber vial	4°C	14 days to analysis
	Full TCLP Method 6010, 8260, 8270, 8151, 8082	Soil	Glass	1-liter clear jar	4°C	14 days to analysis

Sample Type	Analyte Method	Medium	Containers	Sample Volume	Preservation	Maximum Holding Time
Backfill	Corrosivity Ignitability Reactivity Method 9045D, D93/1010A, 9034-9030B, 9012B	Soil	Glass	one 4-oz. clear jar	4°C	7 days to analysis
Purged Groundwater and Sediment	Full TCLP Method 6010, 8260, 8270, 8151, 8082	Sediment	Glass	1-liter clear jar	4°C	14 days to analysis
	Total PCBs Method 8082	Sediment	Glass	one 4-oz. clear jar	4°C	365 days to analysis
	Total PCBs Method 8082	Water	Glass	two 100-mL clear jar	4°C	365 days to analysis

°C = degree(s) Celsius
BTEX = benzene, toluene, ethylbenzene, xylenes
mL = milliliter(s)
oz. = ounce
PCB = polychlorinated biphenyl
TCLP = toxicity characteristic leaching procedure
TPH = total petroleum hydrocarbons

2.2.2 Sampling and Measurement System Failure Response and Corrective Action Process

Failure of a sampling or measurement system will be reported to the PM and Technical Advisor. The Technical Advisor is responsible for corrective actions, as described in Section 3. For the purpose of this section and subsequent sections, all field and laboratory personnel will adhere to the following basic rules for recording information:

- Legible writing in indelible, waterproof ink with no obliterations or mark covers.
- Correction of errors with a single line followed by an initials and date.
- Closeouts on incomplete pages with an initialed and dated mark through.

2.3 Field Sample Handling and Custody

2.3.1 Chain of Custody

Proper sample handling and custody procedures ensure the custody and integrity of samples beginning at the time of collection in the field and continuing through transport, sample receipt, preparation, and analysis. A sample is in custody if it is in actual physical possession or in a secured area restricted for access only to authorized personnel. The CoC form and custody seals are used to document sample handling during transfer from the field to the laboratory and among contractors. The following list of

items should be included on the CoC form and information identified on sample containers should match CoC forms (custody forms and custody seals from the analytical laboratory will be included in the SAP):

- Date and time of collection
- Site identification
- Sample matrix
- Container type
- Number of containers
- Preservative used (if any)
- Notation if the sample was filtered
- Analyses required
- Name of collector
- Custody transfer signatures and dates and time of transfer
- Name of laboratory admitting the samples
- Bill of lading (if applicable)
- Special instructions for the laboratory (for example, free product noted or deliverable requirements)

2.3.2 Sampling Labeling

Sample labels are completed with an indelible, waterproof ink. Label information includes the unique sample identification number, date and time of sampling, sample type (that is, soil, sediment, and groundwater), and the preservative added, if applicable. The sample numbering and nomenclature system for each activity are identified in each specific work plan and will be based NASA GIS nomenclature requirements (Attachment 1).

2.3.3 Sample Handling

The required sample volumes, container types, and preservation requirements for standard analytical methods proposed for the project are listed in Table 2-1. Sample handling and custody requirements are intended to maintain control over and document possession of environmental samples following collection in the field through shipment to the analytical laboratory. Immediately following collection, samples will be placed in shipping coolers containing double-bagged, cubed ice. The samples will be grouped in the shipping cooler by the order in which the samples are collected. The samples will be held until a prearranged time with the laboratory and the laboratory-supplied courier can pick up the samples. If a courier is not available, the sample will be shipped by domestic package service (that is, FedEx or UPS). Overnight shipping will be used as the default option, with expedited or "first" overnight being used at the discretion of the Technical Advisor. Sample coolers will be sealed tightly with packing tape and affixed with a laboratory provided seal to prevent tampering during transit.

2.3.4 Failures in Chain of Custody and Corrective Action

All failures associated with CoC procedures will be immediately reported to the person who signed the CoC; typically, this will be the field team leader or the technical advisor. These failures include the following items:

- Delays in transfer resulting in holding time violations
- Violations of sample preservation requirements
- Incomplete documentation, including signatures
- Possible tampering of samples
- Broken or spilled samples

The technical advisor will determine if the procedural violation might have compromised the validity of the resulting data. Any failures that have reasonable potential to compromise data validity should result in the sampling event being repeated. The resolution of the situation will be reported to the NASA Remediation Program Manager. Corrective action reports will be maintained by the PM or technical advisor.

2.4 Laboratory Sample Handling and Custody

2.4.1 Sample Receipt

Upon receipt by the laboratory, the sample container custody seal should be broken, initialed, dated, and affixed to paper to be included with the final report. Sample containers and analytical samples will be inspected for integrity and the results of the inspection documented on the CoC or associated document (that is, a sample receipt report or equivalent). The following information should be noted on the CoC:

- Name of person inspecting the cooler
- Integrity of custody seals
- Sample cooler temperature
- Evidence of preservation
- Physical condition of sample container

A sample receipt checklist will be generated that will ask for details of the sample receipt, such as temperature of the cooler. Acceptable cooler temperature is 4°C +/- 2°C. The sample requirements apply to sample storage units at the laboratory and for laboratory standards. The field team leader and the technical advisor will be notified if the cooler temperature is out of compliance. If a temperature deviation is discovered, the samples will be immediately chilled to be within the required temperature range. The technical advisor will evaluate the length of time that the samples were outside of the desired temperature range, along with the actual temperature when discovered, to determine if the samples are suitable for analysis or should be discarded. Sample cooler temperature requirements only apply to soil and groundwater samples, not air or soil gas.

After sample analysis, the unused portion of the sample and sample extracts and digestates together with all identifying labels will be stored in accordance with the laboratory sample storage procedures. In the event the technical advisor identifies samples that should be kept longer, the technical advisor will notify the analytical laboratory manager and request that the specific samples be maintained until released in writing by the technical advisor. The laboratory will notify the field team leader before disposal of any project samples.

2.4.2 Sample Labeling

The field sample number will be recorded on the sample inventory, the CoC, and on the sample label. All samples will be assigned discrete sample identification numbers (sample control numbers) upon receipt by the laboratory. The laboratory sample control number will remain the same throughout the analysis and data entry procedures. Final results will be reported with both the field sample identification number and the laboratory sample control number.

2.4.3 Sample Custody

The laboratory will be responsible for maintaining an accurate custody record for each sample in its possession. Records will be maintained to document the date and time the sample is checked out of

sample storage for analysis and the date and time at which the sample is returned. The analytical laboratory PM will be responsible for supplying the field team leader with a sample acknowledgement form within 24 hours of sample receipt. This form will provide sample receipt information, sample log-in information, and the laboratory project number for the samples. A complete, signed CoC will be sent by the laboratory to the technical advisor with the final data report.

2.5 Analytical Methods

EPA solid waste (SW-846) methods of analysis will be used for all samples collected, as listed in Table 4-1 of the Work Plan. Procedures for laboratory analysis, with any modifications, are further documented in the laboratory SOPs. Additionally, performance-based measurement system (PBMS) methods could also be used as specified in Section 2.5.1. The SW-846 methods contain inherent flexibility as described in Section 2.1 of Chapter 2 of SW-846. If this type of flexibility is employed during this project, documentation will be provided as described in Section 2.5.2.

2.5.1 Performance-based Measurement System Methods

PBMS methods are sample preparation and analytical methods that differ in some part of the procedures from the methods that are specified for this project. A PBMS is "a set of processes wherein the data quality needs, mandates or limitations of a program or project are specified and serve as criteria for selecting appropriate methods to meet those needs in a cost-effective manner" (62 *Federal Register* 52098). Examples of where PBMS methods might be used in this project are in overcoming matrix interference problems, lowering detection limits, and otherwise improving data quality to meet project DQOs.

If a laboratory uses PBMS methods, it should meet the QA/QC criteria recommended in the SW-846 manual. At a minimum, method performance should be supported by the QC components in Chapter 1 (Quality Control) of SW-846, including the QC information that should be documented. Specifically, Section 4.3.4 (Test Methods) of Chapter 1 describes the minimum written documentation requirements for laboratory procedures. Section 4.4 (Laboratory QA and QC Procedures) of Chapter 1 describes the minimum QA/QC requirements for analytical procedures including proficiency (precision, bias, and MDL), control procedures and control limits (LCS, method blank, and MSs), corrective action, and data handling.

Where PBMS methods are used in this project, documentation will be provided as described in Section 2.5.2.

2.5.2 Documentation for Alternative Analytical Procedures

Where alternative analytical procedures are used in this project, information will be required to demonstrate performance, which is equivalent to the methods listed for this project. Alternative analytical procedures include those involving the inherent flexibility as allowed in SW-846 methods in Section 2.1 of Chapter 2 of SW-846, as well as those based on PBMS. Documentation of this demonstration must be in writing and include the performance data and the detailed description of the procedures that would appear in a SOP.

2.5.3 Standards Traceability

All standards used in the laboratory are traceable to certified reference materials. Standards preparation will be fully documented and maintained in a standards logbook. Each documentation includes information concerning the standard identification, starting material, including concentration, amount

used and lot number, date prepared, expiration date, and preparer's initials and signature. The reagent bottle is labeled in a way that traces the reagent back to the preparation.

2.5.4 Failures in Measurement Systems and Corrective Actions

Failures in measurement systems occur and in many cases the field technician or lab analyst will be able to correct the problem. If resolved by the field technician or lab analyst, then they will document the problem on the field data sheet or laboratory record and complete the analysis. If the problem is not resolvable, then it is conveyed to the technical advisor or analytical laboratory PM, who will make the determination. If it is concluded that the analytical system failures might compromise the sample results, the resulting data will not be reported. The nature and disposition of the problem is reported on the data report, which is sent to the technical advisor.

2.6 Quality Control

General QC requirements acceptability criteria are outlined in this section. These requirements are for all media.

2.6.1 Field Blank

Field blanks will be collected at a frequency of one per day of sampling, as necessary. Sampling events requiring the collection of field blanks are limited to where groundwater or surface water is a media in which CoC are measured. Field blanks consist of analyte-free distilled water (provided by the laboratory) taken to the field and transferred to the appropriate container in precisely the same manner as a sample during the course of a sampling event. These blanks are used to assess the potential contamination from field sources such as sample handling procedures, equipment, airborne materials, and transport. The analysis of field blanks should yield values less than the MDL. When target parameter concentrations are high, blank values should be less than 5% of the lowest value of the batch.

2.6.2 Field Duplicates

Typically, field duplicates will be collected at a frequency of one per 20 field samples (at a rate of 5%). A field duplicate is defined as a second sample (or measurement) from the same location, collected in immediate succession, using identical techniques. The duplicate sample will be collected from the same material as the sample it is duplicating. Duplicate samples are sealed, handled, stored, shipped, and analyzed in the same manner as the primary sample. Precision of duplicate results is calculated by the RPD as defined by 100 times the difference (range) of each duplicate set, divided by the average value (mean) of the set.

2.6.3 Trip Blanks

Prepared trip blanks will be provided in sample containers from the analytical laboratories, when samples are intended to be analyzed for volatile organic compounds (VOCs). Trip blanks will be treated in the same manner with respect to handling and custody procedures as primary samples and one will be included in each cooler containing field samples requiring VOC analysis. Trip blanks must be marked for analysis on the CoC.

2.6.4 Laboratory Measurement Quality Control Requirements and Acceptability Criteria

Detailed laboratory QC requirements are contained within each individual method and laboratory QA manuals. The minimum requirements for the QC samples are outlined in the following text. These requirements are for all media. Laboratory QC sample results are reported with the data report.

2.6.5 Laboratory Duplicates, Matrix Spikes, and Matrix Spike Duplicates

Duplicate analysis is performed as a measurement of precision of the analytical process. Laboratory duplicates are independently repeated measurements of the same sample, which is performed by the same analyst and under the same conditions. The procedure involves the analysis of two sample aliquots (or splits) carried through all stages of preparation and analysis. The calculation for RPD is performed from the two sample results. The duplicate procedure is performed at least once per 20 samples (5%).

MS samples are prepared by adding a known amount of an analyte to a known amount of sample. MS is added at the beginning of the laboratory's sample preparation procedures and is carried through the entire measurement process. A portion of the sample alone (without a) is also carried through the analytical process.

To produce reliable recovery results, the spike level must be similar to the sample concentration. Because MS samples are prepared and analyzed at the same time as the sample, only a reasonable estimate of an appropriate spiking level can be made. When samples are collected in field areas and expected to have high concentrations, they will be identified for the laboratory so that corresponding spike levels can be better determined. The amount of the spike should be at a level less than or equal to the midpoint of the calibration curve for each analyte. Spike levels are only considered appropriate for assessing accuracy if they are greater than 20% and less than four times the native sample concentration. A spike recovery measures the effects of interferences caused by the sample matrix in the analytical process.

MS procedures are performed once per batch of 20 samples. MS is performed twice and the second spike is called MSD. This procedure evaluates the precision associated with the procedure and the analyst performing the procedure and is calculated as an RPD, as described in the following text.

Control limit criteria for MS/MSDs will be the laboratory's established control limits, which will be submitted to LDEQ upon selection for a particular project. It is critical to use project-specific samples for the MS/MSD analysis. Therefore, the sample(s) to be used for the MS/MSD will be documented in the CoC.

2.6.6 Laboratory Control Standard and Laboratory Control Standard Duplicates

The LCS is an aliquot of solid certified reference material containing the analyte being measured. The LCS is treated like a field sample from the beginning of the procedure and is carried through the entire measurement process. The LCS is performed once per batch of 20 analytical samples.

The percent recovery of the target analytes in the LCS assists in determining whether the procedure is in control. It is further used to evaluate the accuracy and bias of all or a portion of the measurement process. If the recovery of routine analytes in the LCS is lower than control limits, the laboratory will reextract and reanalyze for the analyte in all samples associated with the LCS. If the recovery of the routine analytes in the LCS is higher than control limits and the samples are ND for the analytes the data could be accepted. If

the recovery of the routine analytes in the LCS is higher than control limits and the routine analyte is present in the samples, then the samples with the analyte present must be reextracted and reanalyzed. If insufficient quantity of sample is provided to perform a MS/MSD, a LCS duplicate is prepared and analyzed.

2.6.7 Detectability Check Sample

The laboratory should routinely check the instrument MDL to verify the laboratory's ability to reliably detect the parameter at the MDL used for reporting detected results and calculation of ND results. The detectability check standard will be evaluated and reported on a quarterly basis; the results will be maintained on file with the MDL data.

2.6.8 Method Blank

The method blank is analyte-free water that is processed simultaneously with and under the same conditions as the samples. The method blank is analyzed to demonstrate that the analytical system itself is not contaminated with the analyte(s) being measured. The method blank results should be below the SQL or corrective action must be taken. No corrective action is warranted if there is no detection in a sample from the same sample group as the blank. If the method blank analysis indicates any of the following, corrective action must be taken (or noted in the laboratory report):

- If a target is found in a blank above the SQL.
- If the sample concentration is less than the SQL, report the result with a "U."
- If the sample concentration is greater than the SQL but less than the blank result, report the result at the same amount as the blank (with a "U") or qualify the result as unusable.
- If the sample concentration is greater than the SQL and greater than the blank amount, professional judgment should be used to qualify the data.

Common laboratory contaminants can be assessed at 5 or 10 times the SQL, depending on which compound is identified in the method blank.

2.6.9 Additional Method-specific QC Requirements

Additional QC samples could be run (that is, continuing calibration samples and interference check samples) as specified in the method SOPs. The requirement for these samples, their acceptance criteria, and corrective actions are method specific.

2.6.10 Failures in Quality Control and Corrective Action

The technical advisor evaluates all qualified data. As differences in field duplicate sample results are used to assess the entire sampling process, including environmental variability, the arbitrary rejection of results based on predetermined limits is impractical. Therefore, the technical advisor's professional judgment will be relied on when evaluating results. Rejecting sample results based on wide variability is a possibility. Field blank values exceeding the acceptability criteria might automatically invalidate associated field samples if the levels exceed action levels or laboratory standards. In such cases, field duplicate exceedances and laboratory blank contamination will also be noted. Equipment blanks for metals analysis will be examined very closely. Corrective actions will involve procedures to identify the cause of failure and possible resampling or reanalysis. Failures of a laboratory's QC for measurement will be evaluated by the analytical laboratory PM and the finding reported to the technical advisor.

2.7 Instrument and Equipment Testing, Inspection, and Maintenance

All sampling equipment testing and maintenance requirements are detailed in the manufacturer's specifications for a particular piece of equipment. Sampling equipment is inspected and tested on receipt before each use and is assured appropriate for use. Field instruments and equipment will be maintained in accordance with the manufacturer's instructions, and all maintenance and calibration records will be documented in each instrument's dedicated logbook. Field instruments that fail two consecutive calibration requirements will be tagged as "nonfunctional" and returned to the manufacturer for repair or replacement. Acceptable criteria are detailed in the manufacturer's documentation for each instrument.

The laboratory's QAP contains all equipment testing and maintenance procedures for laboratory tools, gauges, and instruments, as well as equipment testing and maintenance requirements. Testing and maintenance records are maintained and are available for inspection. Instruments requiring daily or in-use testing could include, but are not limited to, water baths, ovens, autoclaves, incubators, refrigerators, and laboratory pure water. Critical spare parts for essential equipment are maintained or are available through a preferred vendor to prevent downtime. Maintenance records are available for inspection at the laboratory.

2.8 Instrument and Equipment Calibration and Frequency

2.8.1 Field Equipment Calibration

Field equipment calibration requirements are contained in the manufacturer's documentation. All field equipment requiring calibration will be conducted according to the manufacturer's specifications, including tolerance limits and frequencies. Calibration will be conducted daily before use. Precalibration and postcalibration logs will be kept to confirm that equipment has maintained calibration during its use.

2.8.2 Laboratory Equipment Calibration

Detailed laboratory calibrations are contained within the laboratory's SOPs. The Analytical Laboratory Manager identifies all tools, gauges, instruments, and other sampling, measuring, and testing equipment used for data collection activities affecting quality that must be controlled and, at specified periods, calibrated to maintain bias within specified limits. Calibration records are maintained and are available for inspection. Equipment requiring periodic calibrations includes, but is not limited to, thermometers, pH meters, balances, incubators, turbidity meters, and analytical instruments.

2.9 Inspection and Acceptance of Supplies and Consumables

All new batches of field and laboratory supplies are inspected before use to ensure that they are adequate and not contaminated. Acceptance criteria are detailed in the manufacturer's documentation for the product. The Analytical Laboratory Manager provides additional details on acceptance requirements for laboratory supplies and consumables. The procurement of purchased items and services that directly affect the quality of the project activities will be planned and controlled to confirm that the quality of the items and services are known, documented, and meet the QAPP requirements and acceptance criteria.

2.10 Data Management

Data management provides a process for tracing the path of the data from its generation in the field or laboratory to its final use or storage. The following elements are included in this process: recording, validation, transformation, transmittal, reduction, analysis, tracking, and storage and retrieval.

2.10.1 Data Recording

Sample collection will be documented and tracked using field log forms, field logbook entries, and CoC records. Field personnel will complete these forms, which then will be reviewed for correctness and completeness by the field team leader. Copies of these forms will be maintained in the project files.

2.10.2 Data Validation

Data validation is addressed in Section 3.

2.10.3 Data Transmittal

The field team leader will be responsible for assuring that field data are entered onto appropriate field data forms and will report any problems to the technical advisor. The field team leader will submit the complete field data forms to the technical advisor for review and error checking and will ensure that all samples collected in the field are submitted to the appropriate laboratory according to the methods outlined in this QAPP.

Analytical results will be received by the technical advisor or field team leader from each laboratory in their standard electronic format that will allow for easy integration into a digital database. Once reviewed by the technical advisor or field team leader, the data will be included in the database. When data are appended to the database, a report of the data will be generated and compared to the reports. Corrective actions as needed will be employed when discrepancies are found. All field data forms and lab data will be stored and organized by AOI. Data can be transferred electronically either on thumb drive, file share, or as an email attachment.

2.10.4 Data Analysis

Data analysis will be conducted to evaluate if the performance objectives for each AOI are being met. To this end, applications including Microsoft Excel, Microsoft Access, Environmental Systems Research Institute ArcMap, or equivalents might be used to analyze data.

2.10.5 Data Storage and Retrieval

Data will ultimately be stored in NASA's GIS database. Before entry into the database, data will be stored by the laboratories on internal network systems. Each is required to back up their network systems on a regularly scheduled and frequent basis. Data will also be stored as a digital copy. Analytical laboratories will also retain electronic copies of all data generated by their laboratory.

Only final versions of electronic data will be entered into the database. All electronic data will be verified before and after integration with the database against the hard-copy reports that accompany the data.

2.11 Reports to Management

2.11.1 Laboratory Data Report

Laboratory data reports contain the results of all specified QC measures in Section 2.6, which include, but are not limited to, filter and reagent blanks, field blanks, laboratory duplicates, laboratory control standards, calibration, and MS. This information is reviewed by the technical advisor and compared to the prespecified acceptance criteria to determine acceptability of the database.

Data are conventionally placed into one of five different levels depending on the intended use of the data. These five levels, the applicable data uses, and examples of the type of data are shown in Table 2-2.

Table 2-2. Data Analytical Levels

Analytical Level	Data Uses	Examples
Level 1	▪ Site characterization ▪ Monitoring during implementation	▪ Portable instruments ▪ Field test kits
Level 2	▪ Site characterization ▪ Evaluation of alternatives ▪ Engineering designs ▪ Monitoring during implementation	▪ Organics by GC ▪ Inorganics by AA ▪ Inorganics by X-ray diffraction
Level 3	▪ Risk assessment ▪ Site characterization ▪ Evaluation of alternatives ▪ Engineering designs ▪ Monitoring during implementation	▪ Analysis using analyte-specific U.S. Environmental Protection Agency procedures other than Contract Laboratory Program (CLP)
Level 4	▪ Risk assessment ▪ Site characterization ▪ Evaluation of alternatives ▪ Engineering designs	▪ Organic and inorganic analysis by GC–mass spectrometry, AA, ICP, and CLP analysis
Level 5	▪ Risk assessment	▪ Non-conventional parameters ▪ Modified methods ▪ Appendix 8 parameters

AA = atomic adsorption
CLP = Contract Laboratory Program
GC = gas chromatography
ICP = sample spike standard

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3. Data Validation and Usability

3.1 Introduction

All previously collected data and data collected through planned activities will be usable for risk assessment purposes.

3.1.1 Reports to Management

The field team leader will report to the technical advisor daily following each field event. This report will include any problems, delays, or corrective actions that could be required or that might affect the subsequent sampling efforts. The report will also include a brief synopsis of the work conducted during the field-monitoring event.

3.2 Data Review, Verification, and Validation Procedures

For the purposes of this QAPP, verification means the processes taken to determine compliance of data with project requirements, including documentation and technical criteria. Validation means those processes taken independently of the data-generation processes to determine the usability of data for its intended uses. Integrity means the processes taken to assure that no inaccurate or falsified data will be reported.

All data obtained from field and laboratory measurements will be reviewed and verified for conformance to project requirements and then validated against the scope of this QAPP and the DQOs developed for each SAP. Only data that meets appropriate QC measures and DQOs will be considered acceptable.

The procedures for verification and validation of data are described in Section 3.3. The field team leader is responsible for ensuring that field data are properly reviewed and verified for integrity. The analytical laboratory PM is responsible for ensuring that laboratory data are scientifically valid, defensible, of acceptable precision and accuracy, and reviewed for integrity. The PM or technical advisor will be responsible for ensuring that all data are properly reviewed and verified, submitted in the required format to the project database, and for either validating the data or approving the validation report. Finally, the technical advisor is responsible for validating that all data to be reported meet the objectives of the project.

3.3 Verification and Validation Methods

All data will be verified to ensure the data are representative of the samples analyzed and locations where measurements were made and that the data and associated QC data conform to project specifications. All staff and management of the respective field, laboratory, and data management groups responsible for the integrity, validation, and verification of whatever data each task generates or evaluates throughout the process. The field team leader and analytical laboratory pm ensure the verification of field information, raw data, electronically generated data, information on CoC forms, and hard-copy output from instruments.

Verification, validation, and a review of data integrity will be performed under the direction of the PM using self-assessments and peer review as appropriate. Data validation will consist of a review of 100% of the data package using the Data Evaluation Checklist in Attachment 2, the RECAP Form 2, “Analytical Data

Summary," in Attachment 3 and the RECAP Form 3, "Analytical Data Evaluation," in Attachment 4. These forms will be reviewed by the technical advisor. The Data Evaluation Checklist in Attachment 2 could be updated to reflect a more stringent data review and validation program. The data to be verified are evaluated against project specifications and are checked for errors, especially errors in transcription, calculations, and data input.

The technical advisor identifies potential outliers by examining results for unreasonable data. These outliers are also identified using computer-based statistical software. If a question arises or an error or potential outlier is identified, the field team leader or the analytical laboratory PM responsible for generating the data will be contacted to resolve the issue. Issues that can be resolved are corrected and documented electronically or by initialing and dating the associated paperwork. If an issue cannot be correct, the technical advisor will determine the appropriate course of action or the data associated with the issue will be rejected.

The technical advisors are each responsible for ensuring that verified data are scientifically valid, defensible, of known precision, accuracy, and integrity, meet the DQOs of the project, and are reportable. A final element of the validation process involves reevaluating the data for anomalies. The PM may designate experts familiar with the project to perform this evaluation. Any suspected errors or anomalous data must be addressed by the manager of the task associated with the data before data validation can be completed.

3.4 Reconciliation and User Requirements

The project data will be subject to a usability review. This review is intended to assess the usability of the field and laboratory data and to document that all project decisions are supported by data of appropriate quality. The data usability review may result in the qualification of some data with respect to the intended use. The technical advisor will assess whether or not the validated data may be used to support project decisions and will describe potential consequences of using qualified data in the project decision-making process.

4. References

Jacobs. 2024. *Area of Investigation 1, 2, and 3 Excavation and Backfill Work Plan.*

Louisiana Department of Environmental Quality (LDEQ). 2003. *2003 Risk Evaluation/Corrective Action Program (RECAP)*. October.

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Attachment 1
NASA GIS Dictionaries

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MSFC ERMA Domains

This section provides definitions of each of the values in the database domain sets (valid values) defined for NASA's MSFC ERMA project database.

Contents: **Page**

Domain Lists *(ordered by Domain No.)*

Domain # or ldomain	domainname *(domain_catalog.domainname)*	Reference Table *(attribute_catalog. tablename)*	Reference Column *(attribute_catalog. columnname)*
10001	Method of entry	many tables	method_of_entry
10002	Data Status	many tables	data_status_code
10107	Depth reference level	sample_location	ref_elev_descrp
10107	Depth reference level	well	depth_ref_level
10245	Fluid contact type	fluid	fc_type
10245	Fluid contact type	fluid_pen	fc_type
10246	Fluid contact status	fluid_pen	fc_status
10250	Main lithology	lithology	lith_type
10250	Main lithology	strat_unit	main_litho_type
13201	Collection Method	sample_data	collection_meth
13201	Collection Method	well_sample_data	collection_meth
13202	Sampling Equipment	sample_data	sampling_equip
13202	Sampling Equipment	well_sample_data	sampling_equip
13203	Sampling Location Type	sample_location	location_type
13204	Sampling Type	sample_data	sample_type
13204	Sampling Type	well_sample_data	sample_type
13205	Sample Matrix	sample_data	sample_matrix
13205	Sample Matrix	well_sample_data	sample_matrix
13208 **	Analysis Method **	analytic_methods	analysis_method
13208 **	Analysis Method **	analytic_results	analysis_method
13208 **	Analysis Method **	value_name_class	analysis_method
13209	Analysis Basis	analytic_methods	analysis_basis
13212 ***	Value Name ***	analytic_results	value_name
13212 ***	Value Name ***	value_name_class	value_name
13213 ****	CAS Number ****	analytic_results	cas_number

list_domain.ldomain (table.column)

Domain # or ldomain	domainname *(domain_catalog.domainname)*	Reference Table *(attribute_catalog. tablename)*	Reference Column *(attribute_catalog. columnname)*
13214	Value Qualifier	analytic_results	value_qualifier
13214	Value Qualifier	down_hole_test	value_qualifier
13215	QA Qualifier	analytic_results	qa_qualifier
13216	Sampling Location Status	sample_location	location_status
13401	Well Status	well	well_status
13402	Well Type	well	well_type
13403	Completion Method	well_completion	completion_mthd
13404	Drilling Method	well_completion	drilling_method
13405	Casing Status	well_completion	casing_status
13406	Casing or Screen Material	well_completion	casing_type
13406	Casing or Screen Material	well_completion	screen_material
13407	Fill or Seal Type	well_completion	fill_type
13407	Fill or Seal Type	well_completion	seal_type
13408	Screen Type	well_completion	screen_type
13409	Pump Type	well_completion	pump_type
13410	Leach Method	analytic_methods	leach_method
13410	Leach Method	analytic_results	leach_method
13410	Leach Method	value_name_class	leach_method
13411	Preparation Method	analytic_methods	prep_method
13412	Validated Status	analytic_results	validated_status
13413	Laboratory Concentration Qualifier	analytic_results	lab_conc_qual
13414	Laboratory Qualifier	analytic_results	lab_qualifier
100005	survey_type	sample_location	survey_method
100005	survey_type	sample_location	ref_elev_method
100005	survey_type	well	survey_method
100005	survey_type	well	ref_elev_method
100005	survey_type	well	gnd_elev _method
100006	aquifer_names	well_completion	Aquifer
100007	dhtest_method	down_hole_test	test_method
100008	value_units	analytic_results	value_units
100008	value_units	down_hole_test	value_units
100008	value_units	analytic_screen_bg	bk^^_units
100008	value_units	analytic_screen_bg	^^^_units
100009	dht_value_name	down_hole_test	value_name

** list_an_mthd table
**** list_cas_num table
*** list_val_name table
# list_domain.ldomain & mslink.domain_catalog & attribute_catalog.columndomain (joins columns)

^^ - Background Values

Code - Sample matrix description - Sample_matrix

BK-SB Sub-surface Soil Background Criteria - SB
BK-SD Sediment Background Criteria – SE, SX
BK-SS Surface Soil Background Criteria – SS

BK-WG	Groundwater Background Criteria – WG
BK-WS	Surface Water Background Criteria - WS
	^^^ - Screening Values
ECOSD	Sediment Ecological Criteria – SE, SX
ECOSS	Surface Soil Ecological Criteria – SS
ECOWS	Surface Water Ecological Criteria - WS
GWPSO	Groundwater Protection Criteria for Soil (SSL) – SO
RBCSO	Risk Based Criteria for Soil (PRG) – SO
RBCWA	Risk Based Criteria for Water (PRG) – WG

Domain Definitions (ordered by Domain No.)

Table	Column	Domain #	Value	Definition
Many tables * *method_of_entry*	*method_of_entry*	10001	C	Computed
			D	Digitized
			K	Keyed in
			T	Translated
Many tables * *data_status*	*data_status_code*	10002	IM	Interpreted, modified official
			IN	Interpreted, new
			IO	Interpreted, official
			M	Measured
			P	Process
well & sample_location	*depth_ref_level*	10107	DF	Derrick floor
	ref_elev_descrp		GL	Ground level or sea floor
			KB	Kelly bushing
			TC	Top of Casing
fluid_pen * *fluid_contact_type*	*fc_type*	10245	FLP	Floating Product
			OTH	Other
			WAT	Water
fluid_pen * *fluid contact status*	*fc_status*	10246	ORIG	Original
			PROD	Produced
lithology, strat_unit * *main_ lithology*	*lith_type, main_litho_type*	10250	AH	Anhydrite
			AK	Arkose
			AL	Argillaceous limestone
			BR	Breccia
			CG	Conglomerate
			CH	Inorganic clays of high plasticity, fat clays
			CK	Chalk
			CL	Inorganic clays of low to medium plasticity
			CO	General coal (carbonaceous)
			CY	Clay
			DL	Dolomitic limestone
			DM	Dolomite
			DY	Dykes
			EX	Extrusive (volcanic) rocks
			GC	Clayey gravels, poorly graded gravel-sand-clay mixtures
			GK	Greywacke
			GM	Silty gravels, poorly graded gravel-sand-silt mixtures

Table	Column	Domain #	Value	Definition
uscs & usgs soil & rock classification systems			GP	Poorly graded gravels, gravel-sand mixtures; little or no fines
			GV	Gravel
			GW	Well-graded gravels, gravel-sand mixtures; little or no fines
			IG	Igneous rocks in general
			IN	General intrusives (plutonics)
			KM	Potassium and magnesium salts
			LC	Limestone (calcareous)
			LG	Lignite (brown coal)
			LS	Sandy limestone
			MH	Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, elastic silts
			ML	Inorganic silts and very fine sands, rock flour, silty or clayey fine sands with slight plasticity
			MM	Metamorphics in general
			MR	Marl
			MS	Mudstone
			NA	Halite
			NP	No ASTM classification, problems in sampling
			NU	No ASTM classification, reasons unknown
			OH	Organic clays of medium to high plasticity
			OL	Organic silts and organic silt-clays of low plasticity
			PT	Peat and other highly organic soils
			QT	Quartzite
			SA	Sand
			SC	Clayey sands, poorly graded sand-clay mixtures
			SH	Shale
			SJ	Silt
			SL	General salt (saliferous)
			SM	Silty sands, poorly graded sand-silt mixtures
			SP	Poorly graded sands, gravely sands; little or no fines
			SS	Sandstone
			ST	Siltstone
			SW	Well-graded sands, gravely sands; little or no fines
			TF	Tuff
			TI	Tillite diamictite
			VA	Volcanic agglomerate/breccia
			Z	Other

Table	Column	Domain #	Value	Definition
sample_data, well_sample_data * *collection_method*	*collection_meth*	13201	BL	Undisturbed bulk sample
			CF	Flow-weighted composite
			CS	Composite sample
			CT	Time-weighted composite
			DB	Disturbed bulk sample
			GR	Grab
			NA	Not applicable
			OT	Other
			QC	Quality-control samples
			UN	Unknown
sample_data, well_sample_data * *sampling equipment*	*sampling_equip*	13202	AC	Air canister
			AL	Air lift sampler
			AP	Air lift pump
			AS	Ashing
			BA	Bailer
			BP	Gas-operated bladder pump
			BR	Brass (California) ring
			CF	Continuous-flight auger
			CH	Charcoal sampling tube
			CL	Clover-leaf dredge sampler
			CP	Centrifugal pump
			CR	Cutting returns
			DS	Drive sample (2-inch/ASTM-D1586)
			E1	Electrical submersible pump (pre-1982)
			E2	Electrical submersible pump (1982+)
			EK	Eckman dredge sampler
			FP	Fishing Pole (biotic sample)
			GB	Glass bottle or jar
			GD	Electrical submersible pump (gear-driven)
			GP	Gas-operated, double-acting piston pump
			HA	Hand auger
			HB	Hand-bucket auger
			HP	Hydro-Punch
			HR	Electrical submersible pump (helical rotor)
			HS	Hollow-stem auger
			HV	High-volume air sample
			KS	Kemmerer sampler
			LY	Lysimeter
			NA	Not applicable
			NQ	NQ wireline rock coring (ASTM-D2113)
			NX	NX rock coring (ASTM-D2113)
			PI	Piston pump
			PP	Peristaltic pump

Table	Column	Domain #	Value	Definition
			S3	Stainless steel spoon & bowl
			SC	Scraped from exposed surface
			SH	Shelby tube (ASTM-D1587)
			SL	Suction-lift pump
			SP	Submersible pump
			SS	Split spoon
			ST	Submersible turbine pump
			SW	Swab or wipe
			SY	Syringe
			TM	Metal trowel or shovel
			TS	Thief sample and/or thief type sampler
			TU	Tube sampler (3"/ASTM-D3550)
			UN	Unknown
			VD	VanDorn sampler
			WF	Wellhead faucet (grab sample from)
sample_location ** sampling location type*	*location_type*	13203	AA	Ambient air
			BR	Nonfixed location receptacle, including barrels and containers
			CH	Channel/ditch
			CP	Cone penetrometer/hydropunch
			CV	Cave, underground
			FW	Faucet/tap
			GP	Geo-probe
			GPY	Geophysics
			LK	Lake/pond
			MG	Methane gas
			MHI	Manhole Industrial
			OC	Outcrop
			PR	Soil gas probe
			QC	Field QC sample
			RV	River/stream
			SA	Screened water
			SB	Soil boring
			SD	Sediment
			SE	Seep
			SP	Spring
			SS	Surface survey
			SW	Surface water
			SX	SS or SD
			TK	Fixed-location receptacle, including tanks, containers, vats
			TP	Test pit
			TR	Trenching
			UN	Unknown
sample_data, well_sample_data	*sample_type*	13204	AB	Ambient conditions blank
			AV	Average of QA duplicates

Table	Column	Domain #	Value	Definition
			BD	Blank-spike duplicate
			BS	Blank spike
			D	Inorganic duplicate QC sample
			DL	Dilution normal environmental sample
			EB	Equipment blank
			FD	Field duplicate
			FR	Field replicate/duplicate
* *sampling_type*			FS	Field spike
			KD	Known (external reference material) duplicate
			LB	Lab blank
			LR	Lab replicate
			MB	Material blank
			MS	Lab-matrix spike
			N	Normal environmental sample
			RB	Material rinse blank
			RD	Regulatory duplicate
			RE	Reanalysis normal environmental sample
			RM	Known (external reference material)
			SD	Lab-matrix spike duplicate
			TB	Trip blank
sample_data, well_sample_data	*sample_matrix*	13205	AA	Ambient air
			AQ	Air quality-control matrix
			DC	Drill cuttings
			DW	Development water
			LD	Drilling fluid
			LF	Floating/free product on groundwater table
			LO	Oil, all types
* *sapmle_matrix*			PW	Purge water
			SE	Sediment (assoc. w/surface H_20)
			SG	Soil gas
			SL	Sludge
			SO	Soil
			SQ	Soil quality-control matrix
			SS	Scrapings
			SW	Swab or wipe
			SX	Sediment (dry)
			TA	Animal tissue
			TP	Plant tissue
			TQ	Tissue quality-control matrix
			UN	Unknown
			WD	Well development water
			WE	Estuary

Table	Column	Domain #	Value	Definition
			WF	Filtered water
			WG	Ground water
			WH	Equipment wash water (for QC)
			WL	Leachate
			WM	Special water-quality-control matrix
			WO	Ocean water
			WP	Drinking water
			WQ	Water quality control matrix (QC)
			WR	Filtered residue water
			WS	Surface water
			WU	Unfiltered water
			WW	Waste water
analytic_methods **analytic_results** **value_name_class** **test_method*	*analysis_method*	13208		For domain values and definitions, see *an_mthd.txt*
analytic_methods * *analysis_basis*	*analysis_basis*	13209	D W X U	Dry Wet Not Applicable Unknown
analytic_results **value_name_class**	*value_name*	13212		For domain values and definitions, see *val_name.txt*
analytic_results	*cas_number*	13213		For domain values and definitions, see *cas_num.txt*
analytic_results **down_hole_test** * *value_qualifier*	*value_qualifier*	13214	< = > # I J L ND R TR	Reported data is less than the contractual detection limit Equal to Reported data is greater than the contractual detection limit but not quantifiable above some upper limit (Exceeded calibration E) Reported data is less than the contractual detection limit but still quantifiable Interference of co-elution Value is an estimated quantity Radiological data results are less than or equal to the counting error Not Detected (also U) Rejected value, do not use Trace; between the contract detection recorded limit (CDRL) and the instrument detection limit (IDL)

Table	Column	Domain #	Value	Definition
analytic_results	*qa_qualifier*	13215	BI	For inorganic samples, the reported value is less than the instrument detection limit
			BJ	The reported value is less than the instrument standardization but is greater than the instrument detection limit
* *qa_qualifier*			BO	For organic samples, the analyte is found in the associated blank as well as in the sample. This indicates possible contamination of the blank.
			D	Analysis was performed at a secondary dilution factor
			E	Identifies compounds that occur in concentrations that exceed the calibration range of the GC/MS for that specific analysis
			JI	For inorganics, the analyte was tested for and detected. The associated numerical value is an estimated quantity usable for decision making.
			JO	For organics, the result is an estimated quantity. The mass-spectral data indicate the presence of a compound that meets the identification criteria, but the result is less than the contract-required quantitation limit and greater than zero.
			N	Spike sample recovery is outside control limits. Presumptive evidence of the presence of the analyte.
			NJ	Presumptive evidence of the presence of the material at an estimated quantity
			R	The data are unusable
			UI	For inorganics, the analyte is below the detection limits of the methods and instruments used. The associated numerical value is the calculated contract-required quantitation limit based on wet weight of the soil sample. The contract-required quantitation limit based on dry weight is higher.

Table	Column	Domain #	Value	Definition
			UJ	The material was analyzed for but was not detected. The contract-required quantitation limit is estimated.
			UO	For organics, the analysis did not detect the material. The associated numerical value is the contract-required quantitation limit corrected for dilution and percent moisture.
sample_location	*location_status*	13216	A	Station has been inspected in last 5 years and meets study objectives
* *sample_location status*			B	Station was constructed in accordance with regulating agency guidelines
			C	Station is inadequate in some manner
			D	Dry (not sampled)
			E	Failed UXO clearance
well	*well_status*	13401	CLO	Closed
			COL	Collapsed
			DAM	Damaged
* *well_status*			DRY	Dry Hole
			LOS	Lost Drilling Fluid
			NAW	Not a well
			NOR	Normal
			NUS	Not usable
			OBS	Obstructed
			OTH	Other
			PLG	Plugged
			SCH	Scheduled
			UNK	Unknown
			USE	In use
			UXO	Failed UXO Clearance
well	*well_type*	13402	ABN	Abandoned well
			BCK	Background well
			CP	Cone penetrometer/hydropunch
			CW	Cluster Well
			EB	Engineering boring
			EXW	Extraction well
			IJW	Injection well
			IRR	Irrigation well
			LEA	Leachate well
			MNW	Monitoring well
* *well_ type*			MW	Monitoring well
			MWI	Inactive monitoring well
			OBS	Observation well

Table	Column	Domain #	Value	Definition
			OFF	Off-site well
			PRG	Purge well
			PRW	Production well (public water supply)
			PVT	Private water-supply well
			PZ	Piezometer
			QC	Quality control
			SB	Soil/Geologic boring
			SS	Soil-sample location
			SSH	Seismic shot hole
			TST	Test well
			VAP	Vapor well
			VW	Vadose well
well_completion	*completion_mthd*	13403	C	Concrete, porous
			GP	Gravel pack with perforations
			GS	Gravel pack with screen
			H	Horizontal gallery/collector
			NC	Not Completed
			NP	Natural fiber pack
* *completion method*			OE	Open-end
			OP	Open
			OTH	Other
			P	Perforated or slotted
			S	Screen
			SP	Sand point
			UNK	Unknown
			W	Walled or shored
well_completion	*drilling_method*	13404	AH	Air hammer
			AP	Air percussion
			AR	Air rotary
			CO	Coring
			CT	Cable tool
			HA	Hollow-stem auger
			JT	Jetting
* *drilling method*			MR	Mud rotary
			OTH	Other
			RR	Reverse rotary
			SA	Solid-stem auger
			UNK	Unknown
			WC	Wireline coring
			WR	Water rotary
well_completion	*casing_status*	13405	O	Other
			P	Permanent
			R	Removed
* *casing_status*			S	Surface
			T	Temporary
			U	Unknown

Table	Column	Domain #	Value	Definition
well_completion * *casing type or screen material*	*casing_type* *screen_material*	13406	ABS	Acrylonitrile butadiene styrene
			BRK	Brick
			CBS	Carbon steel
			CNC	Concrete
			COP	Copper
			COS	Coated steel
			FBG	Fiberglass
			GLS	Galvanized steel
			LCS	Low carbon steel
			MET	Other metal
			OTH	Other
			P40	PVC schedule 40
			P80	PVC schedule 80
			PLA	Other plastics
			PLY	Polypropylene
			PVC	Polyvinyl chloride (PVC)
			RST	Rock or stone
			S30	Stainless steel 304
			S31	Stainless steel 3161
			SLS	Stainless steel
			STL	Steel
			TFL	Teflon
			TIL	Tile
			UNK	Unknown
			WD	Wood
			WRI	Wrought iron
well_completion * *fill or seal type*	*seal_type* *fill_type*	13407	BF	Backfill
			BP	Bentonite pellets
			BS	Bentonite slurry
			CG	Cement grout
			CH	Chemical grout
			CO	Concrete
			GB	Granular bentonite
			GP	Gravel pack
			OT	Other
			SP	Sand pack
			UN	Unknown
			VG	Volclay grout
well_completion * *screen type*	*screen_type*	13408	BS	Bridge slot
			CS	Continuous-slot wire-wound
			MS	Machine slotted casing
			NS	No screen
			OT	Other
			PP	Perforated pipe
			PB	Pipe base
			S2	Slotted PVC
			ST	Shutter type

Table	Column	Domain #	Value	Definition
			UN	Unknown
well_completion * *pump_type*	*pump_type*	13409	B C H O S U	Bailer Combination Hydrostar Organic/bladder Submersible Unknown
analytic_methods **analytic_results** **value_name_class**	*leach_method*	13410	AXAF	Acid extraction of air filters, southwest laboratory of oklahoma, inc.
			DISWAT	Leaching of analyte from soil samples using distilled water
			FLDFLT	Field filtering for dissolved metals
			NONE	None
			SW1310	Extraction procedure (ep) toxicity test method and structural integrity
			SW1310A	Extraction procedure (ep) toxicity test method and structural integrity test
			SW1311	Toxicity characteristic leaching procedure
			SW1312	Synthetic precipitation leaching procedure
			WET	California waste extraction test (wet)
			WOS	Water extraction of soils for the determination of anions and cations
analytic_methods see list_domain.txt for all values and definitions	*prep_method*	13411	A412	Cyanide
			A412B	Total Cyanide after Distillation
			A417A	Nitrogen (Ammonia) Preliminary Distillation
			A503D	Sludge Samples (Soil, Sediment, Sludge)
				…
analytic_results	*validated_status*	13412	1 2 3 4	Unvalidated/Screening data Review of surrogate and associated blank information Validation using summary forms Validation using raw data and summary forms

Table	Column	Domain #	Value	Definition
analytic_results	*lab_conc_qual*	13413	U	Non-detect (<)
			J	Estimated (TR)
			=	Detected
			E	Exceeded calibration (>)
analytic_results	*lab_qualifier*	13414	U	Non-detect (<)
			J	Estimated (TR)
			=	Detected
			E	Exceeded calibration (>)
well,	*survey_method*	100005	C	Calculated from map
sample_location	*gnd_elev _method*		D	Digitized from map
	ref_elev_method		G	Global Positioning System
			GM	GPS & Manual (tape/compass)
* *survey_type*			O	Other
			ST	Stadia
			TR	Transit
			U	Unknown
well_completion	*aquifer*	100006	331TCMB	Tuscumbia Aquifer
* *aquifer_names*			337FRPN	Fort Payne Aquifer
			PERCHED	Perched Aquifer in Regolith
			REGOLITH	Regolith Aquifer
			TUSFP	Tuscombia/Ft. Payne Aquifer
down_hole_test	*test_method*	100007	CPT	Cone Penetrometer Test
			GE40	GW velocity & direction meas.
* *dhtest_method*			SPT	Standard Penetration Test
			VST	Vein Shear Test
			YSIP	YSI Probe
down_hole_test	*value_units*	100008	DEGREE	Azimuth in degrees
analytic_results	*bk^^_units*		FLOW_AZ	Flow azimuth
analytic_screen_bg	*^^^_units*		G/CM3	grams per cubic centimeter
			M/DAY	meters per day
* *value_units*			MEQ/100G	
			MG/KG	milligrams per kilogram
			MG/L	milligrams per liter
			NTU	N turbidity units
			PERCENT	percent
			PH UNITS	pH
			UG/KG	micrograms per kilogram
			UG/L	micrograms per liter
			UNITS	Huh? units
down_hole_test	*value_name*	100009	COND	Conductivity
* *dht_value_name*			DO	Dissolved Oxygen
			FLOWD	Flow Direction
			FLOWV	Flow Velocity
			ORP	Oxidation-Reduction Potential
			SALINITY	Salinity
			TEMP	Temperature

Other Domain Sets

In addition to the default domain set, there are three large domain specific lists. The existing schema includes the **analytic_methods** and **analytic_results** tables, which use these domain lists to supplement the columns in these tables as follows:

- *an_mthd.txt* --- Contains values for the *analysis_method* column in the **analytic_methods, analytic_results, and value_name_class** tables; domain number 13208.

- *cas_num.txt* --- Contains values for the *cas_number* column in the **analytic_results** table; domain number 13213.

- *val_name.txt* --- Contains values for the *value_name* column in the **analytic_results,** and **value_name_class** tables; domain number 13212.

Data files and documentation are found in %ACTIVEPROJECT %\data\dictionary\…

Domain Tables

The data definitions in each of these tables are as follows:

List Analytic Methods Table Data Dictionary
(ERMA Database Table Name: **list_an_mthd**)

Column	Required	Type (Size)	Definition
ldomain	yes	integer	13208 - List domain number.
domainvalue	yes	character (15)	The optional domain values (delivered in the *an_mthd.txt* file) for analytic methods.
domaindesc	yes	character (64)	The descriptions of each domain value.
erma_used		character(1)	Y (yes) if value is used in MSFC list.

List Domain Table Data Dictionary
(ERMA Database Table Name: **list_domain**)

Column	Required	Type (Size)	Definition
ldomain	yes	integer	List domain number.
domainvalue	yes	character (15)	The domain value.
erma_used		character(1)	Y (yes) if value is used in MSFC list.
domaindesc	yes	char (240)	The definition of each domain value.

List Value Name Table Data Dictionary
(ERMA Database Table Name: **list_val_name**)

Column	Required	Type (Size)	Definition
ldomain	yes	integer	13212 - List domain number.
domainvalue	yes	character (12)	The optional domain values (delivered in the *val_name.txt* file) for value names.
erma_used		character(1)	Y (yes) if value is used in MSFC list.
domaindesc	yes	character (64)	The descriptions of each domain value.

List CAS Number Table Data Dictionary
(ERMA Database Table Name: **list_cas_num**)

Column	Required	Type (Size)	Definition
ldomain	yes	integer	13213 - List domain number.
domainvalue	yes	character (15)	The optional domain values (delivered in the *cas_num.txt* file) for CAS numbers.
erma_used		character(1)	Y (yes) if value is used in MSFC list.
domaindesc	yes	character (64)	The descriptions of each domain value.

Edit Notes:
11-Sep-96 - Added FP - Fishing Pole domain #13202
12-Sep-96 - Added CHMM01 - Fish Tissue Pesticide Ex. CH2M (domain #13210)
20-Sep-96 - Added and edited domain lists 29-Jul-97 - Minor edits
07-Aug-98 - Modified order of Domain Definitions (by domain #) and updated several lists.
Feb-05 - Removed unnecessary lists and added 13410 through 13414
Feb-05 - Added ema_used in list domains to indicate value is used.

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Introducing the MSFC ERMA Data Dictionary

This document contains detailed information about the project schema, domains, and features defined for NASA's MSFC ERMA project database. This document is for both MSFC and Michoud (MAF) analytic data management (just called MSFC except where noted). The project schema is defined in this section. The domain values are listed and defined in "MSFC ERMA Domains." All of this information is useful for understanding the schema structures, project planning, reporting, and creating joins and views.

NOTE: This is an evolving document, please contact the MSFC ERMA Database Administrator for the current version.

Schema Definitions

The MSFC ERMA project schema consists of database tables, columns, and domains that are applicable to environmental/geology data studies. The MSFC (ERMA) project schema is divided into logical schema components. They are Sample Location, and Well (Boring) components.

Each schema component definition includes a table/join-column diagram, descriptions of the database tables in that schema, and definitions of the data types/values that can be stored in each column. Required columns, key columns, index columns, and the columns for values are also noted.

Note: You can, supply null values for many columns, except where indicated by "no" in the "Nulls" column for each table in this document.

Key columns are one or more columns that contain data that uniquely identifies each record in a given table. Key columns prevent the creation of duplicate records in the project database. Unique Key columns require a unique value, no duplicate values, in that table's column.

Sample Location Component

The sample location component tables (**sample_data**, **sample_location**, **sample_fld_data, analytic_methods**, and **analytic_results**) for storing point sample information and analytical results, and three tables (**list_an_mthd**, **list_val_name**, and **list_cas_num)** that store domain (valid list) values. (For information on the domains, see "MSFC ERMA Domains.")

The sample location component is designed to store and manage environmental (point) sample data, regardless of where and how the samples are obtained. Therefore, data stored in these tables can be used to study air, soil, surface water, shallow ground, or ambient environments.

The data model in Figure 1 shows the table relationships in the sample location component. A record in the **sample_location** table may be associated with several records in the **sample_data** table. For example, if you have a monitoring station set up at a specific location, you will obtain numerous samples over time, all having the same location. Each record in the **sample_location** table must be uniquely identified by the name in the *location_name* column, which links the **sample_location** table to the **sample_data** table. And each record in the **sample_data** table must be uniquely identified by the identification in the *sample_id* column in that table. These linkages are called *joins* (join columns).

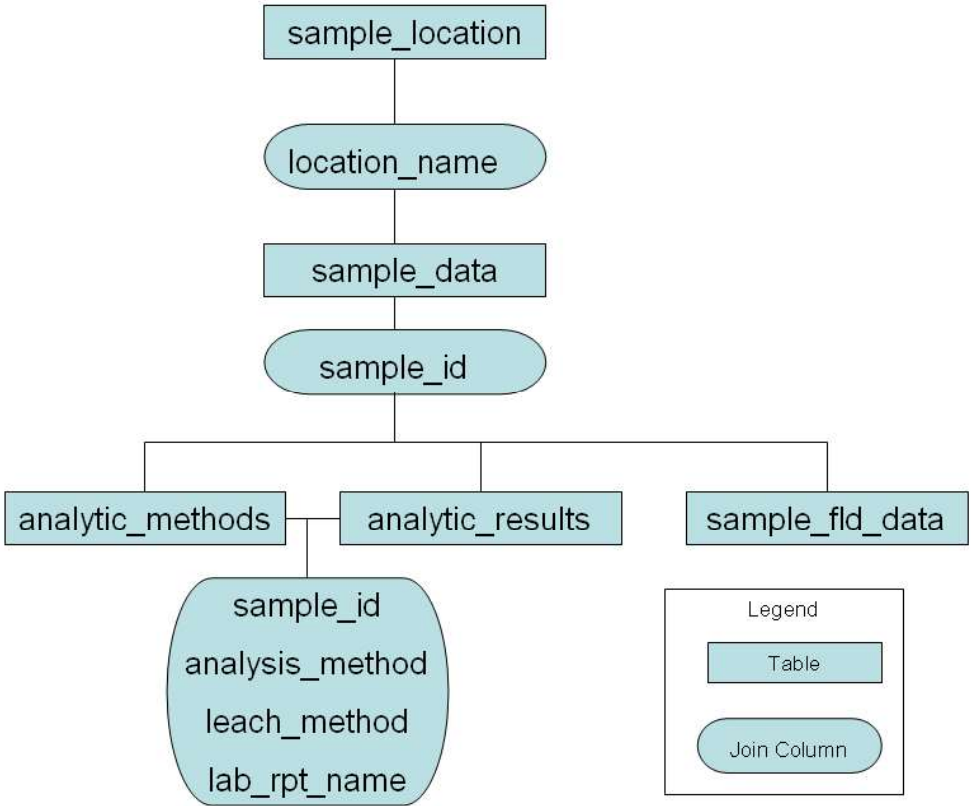

Figure 1 - Data Model for the Sample Location Component

As shown in the data model, the **sample_data** table may be associated with several records in the **analytic_methods** table (MSFC only) and/or in the **analytic_results** table. The **analytic_methods** table stores information about the process by which the samples were analyzed in the laboratory. As a result, you can have multiple records for each of the sample partitions, such as volatile organics, inorganics, and filtered metals, that were subjected to different preparation or analytical procedures per *sample_id*. The **analytic_methods** table and the **sample_data** table share the *sample_id* column (and thus are joined by this column) that lets you determine all the analytic tests to which a specific sample was subjected.

The **analytic_results** table stores each analytical result generated by the specified testing procedure. There will be a unique record for each *sample_id, analysis_method, leach_method, lab_rpt_name* and component that was analyzed for. The **analytic_results** table also has the *sample_id* column that joins the results to the **sample_data** table. The *value_name* describes the chemical component that was analyzed. The **analytic_methods** table is joined to the **analytic_results** table through the *sample_id, analysis_method, leach_method, and lab_rpt_name* columns.

The sample field data (**sample_fld_data** table) is used to store common measurements taken in the field. Common measurements include pH, Eh, etc.

Well (Boring) Component

The data model in Figure 2 shows the table relationships for the **well, well_sample_data**, and **well_completion**. The data model in Figure 3 shows the table relationships for the well (boring) geologic component. The **well** table can also be used to store information on soil and/or rock borings. A record in the **well** table may have several records in each of the **strat_pen**, **fluid_pen**, and **lithology** tables. The **strat_unit** table manages the geologic column for the site by letting you define the stratigraphic formations, members, beds, and so forth, in the site. When a stratigraphic unit is encountered in a well, the elevation is stored in the **strat_pen** table, which is joined to a record in the **well** table (by the *strat_pen.well_name* column to the *well.official_name* column) and to a record in the **strat_unit** table (by the *strat_pen.strat_unit_name* column to the *strat_unit.strat_name* column).

The **fluid** table is used to store information about different types of fluids (water or other fluid levels) that may be encountered in the subsurface. When a fluid is encountered in a well, the fluid level is stored in the **fluid_pen** table, which is joined to a record in the **well** table (by the *fluid_pen.well_name* column to the *well.official_name* column) and to a record in the **fluid** table (by the *fluid_pen.fc_name* column to the *fluid.fc_name* column).

The **lithology** table is used to store any changes in lithology that occur in the well (boring). This table can also be used to store soil horizons. The lithology table is joined to the **well** table by the *lithology.well_name* column to the *well.official_name* column.

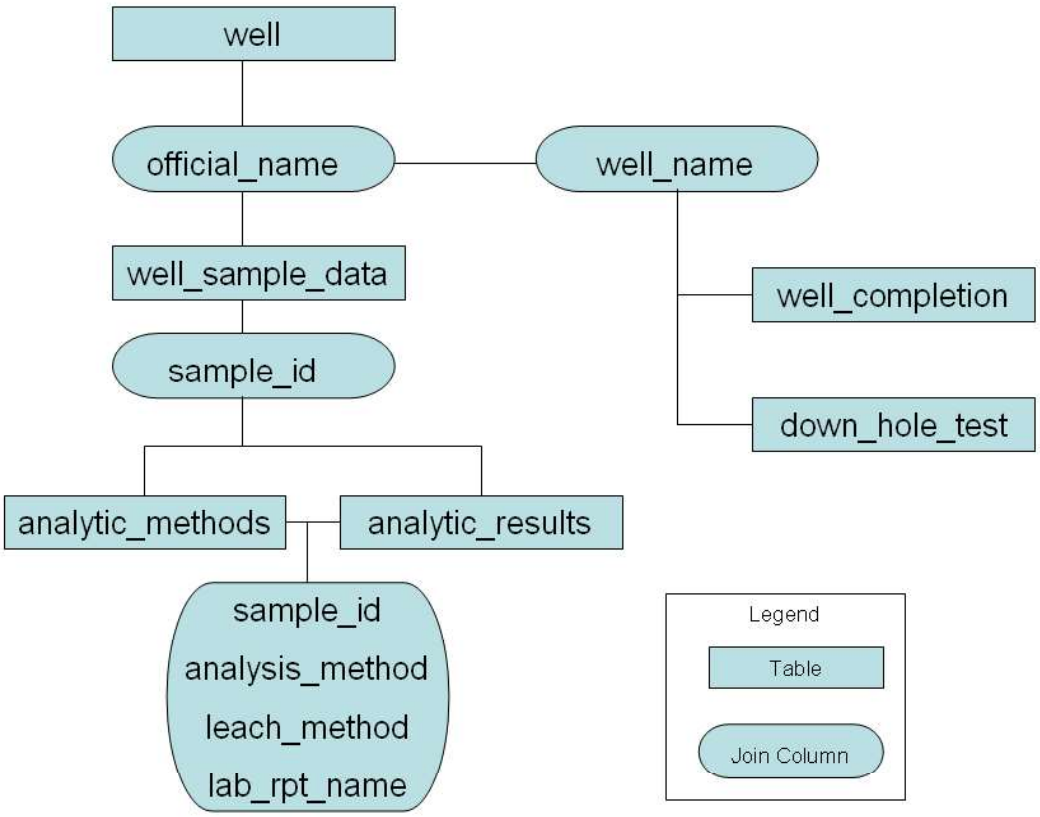

Figure 2 - Data Model for the Well (Borings) Geologic Component

The **well_sample_data** table contains similar information as the **sample_data**. The **well_sample_data** is joined to the **analytic_methods** (MSFC only) and **analytic_results** tables. The **well_sample_data** table also contains columns for the well name and the depths at which the samples were taken. The **well_completion** table, and additional columns in the **well** table, provide a structure for storing information about the screening and back-filling methods used in well completion at various depths. The **down_hole_test** table provides a structure for storing information about down-hole tests, such as pressure tests.

The three additional tables (**well_completion**, **down_hole_test**, and **well_sample_data**) are joined to the **well** table by joins from the *well_completion .well_name* column, or the *down_hole_test .well_name* column or the *well_sample_data .well_name* column to the *well.official_name* column. There may be multiple records in the **down_hole_test** and **well_sample_data** tables for one well record. Figure 3 shows the table relationships for the well and well related sample data.

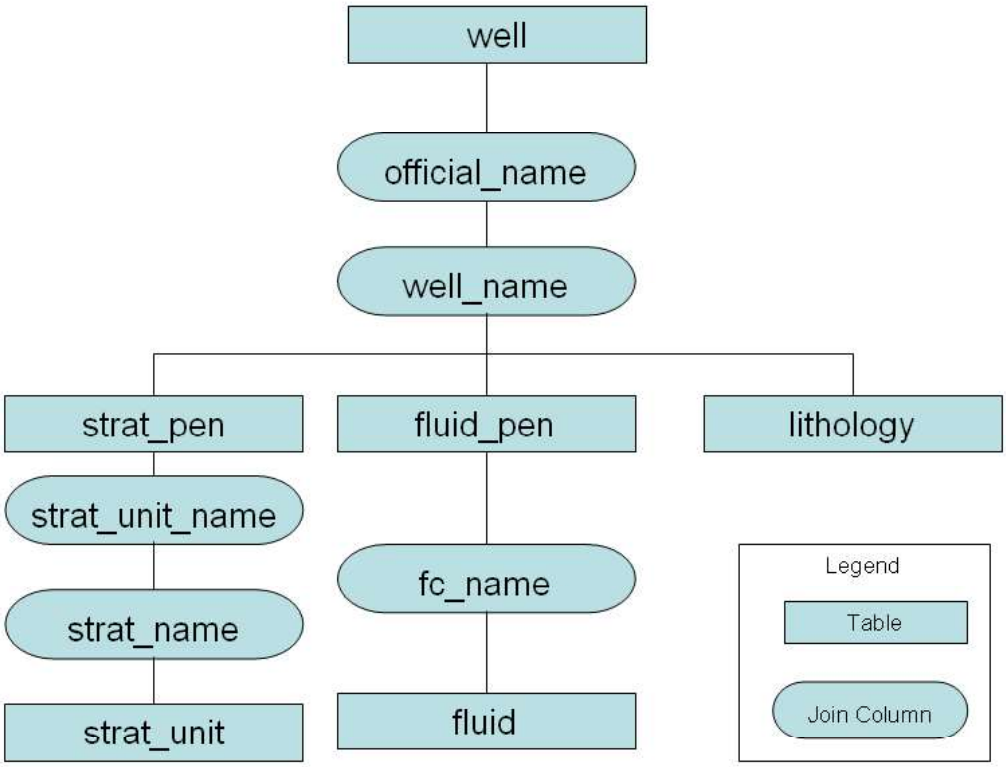

Figure 3 - Data Model for the Well (Borings) Sample Data Component

Data Restrictions:

Single quote (‘), semicolon (;), pound (#) and pipe (|) characters are not allowed in any data (column) field or any remarks. These are reserved characters that will cause data reporting, or loading errors.

Table 1 - Analytical Methods Table Data Dictionary (MSFC only)

(ERMA Database Table Name: **analytic_methods**)

Description: This table is used to store information that describes the laboratory where the samples were analyzed, when the samples were analyzed, and how they were analyzed. Each record must contain a unique sample identification, analysis method, leach method and lab report name.

Column	Nulls	Type (Size)	Definition
sample_id (key column, index column)	no	character (20)	A unique character string that identifies a specific sample specimen. (This column joins this table to both the **sample_data.sample_id** and **analytic_results.sample_id** table.column.)
analysis_method (key column) list_domain 13208 (list_an_method table)	no	character (15)	A value that represents a standard method of analysis associated with a specific parameter or analyte. Examples are A403 (alkalinity) and CLP390 (Contractor Lab Program).[2] (This column joins this table to the **analytic_results.analysis_method** table.column.)
leach_method (key column) list_domain 13410	no	character(15)	Leach method followed by the lab. (This column joins the **analytic_results.leach_method** table.column.)
lab_rpt_name (key column)	no	character (20)	A laboratory report name that corresponds to the analytical methods and/or results. (This column joins this table to the **analytic_results.lab_rpt_name** table.column.)
analysis_basis list_domain 13209		character (1)	A value that represents the basis under which the laboratory's results are reported. Examples are W (wet) and D (dry).[2]
analysis_date		integer	The date (in the format YYYYMMDD) that the sample was analyzed by the laboratory.
analysis_time		integer	Time the (in the format HHMM) analysis was performed.
dilution_factor		double	Sample dilution factor
lab_name		character (20)	The analytical laboratory that performed the analysis of a sample.
lab_recd_date		integer	The date (in the format YYYYMMDD) that the sample was received by the laboratory.
lab_sample_id		character (15)	A unique identifier assigned to the sample by the laboratory and included in the reporting of the results.
percent_solid		double	Percent solids
qc_batch		character (20)	Quality control batch
remarks		character (40)	Miscellaneous remarks
leach_date		integer	Date the (in the format YYYYMMDD) analytical sample was leached
leach_time		integer	Time the (in the format HHMM) analytical sample was leached.
prep_method list_domain 13411		character(15)	Preparation method followed by lab
prep_date		integer	Date the (in the format YYYYMMDD) sample was prepared for analysis.
prep_time		integer	Time the (in the format HHMM) sample was prepared for analysis.

[2] For default domain values, see "Domain Definitions" in this document. You can supplement default values with your own values.

creation_date[1]	no	integer	The date (in the format YYYYMMDD) that the record is initially entered into the database. This row occurs in most tables. It is documented only here.
revision_date[1]	no	integer	The last date (in the format YYYYMMDD) that the record was modified. This row occurs in most tables. It is documented only here.

Table 2 - Analytical Results Table Data Dictionary (MSFC only)

(ERMA Database Table Name: **analytic_results**)

Description: This table is used to store information that identifies the samples that were analyzed and describes the results of the analyses. Each record must contain a unique sample identification, analysis method, leach method, lab report name and the name of the chemical or analyte evaluated in the sample.

Column	Nulls	Type (Size)	Definition
sample_id *(key column, index column)*	no	character (20)	A unique character string that identifies a specific sample specimen. (This is a join column to both the **sample_data.sample_id** and **analytic_methods.sample_id** table.column.)
analysis_method *(key column)* *list_domain 13208*	no	character (15)	Analytical Method. (This column joins this table to the **analytic_methods.analysis_method** table.column.)
value_name *(key column, index column)* *list_domain 13212*	no	character (15)	A value that represents an abbreviated commonly used name of a constituent or analyte. Examples are PCE and TCE .[2]
leach_method *(key column)* *list_domain 13410*	no	character(15)	Leach method followed by the lab. (This column joins the analytic_methods.leach_method table.column.)
lab_rpt_name *(key column)*	no	character (20)	A laboratory report name that corresponds to the analytical methods and/or results. (This column joins this table to the **analytic_methods.lab_rpt_name** table.column.)
cas_number *list_domain 13213*		character (15)	A value that contains a Chemical Abstract Services (CAS) number for a constituent or analyte.
detection_limit		double	The laboratory-supplied minimum detectable quantity of a parameter based on laboratory conditions, analytical method, or field conditions.
measured_value	no	double	The reported result associated with the analysis for this constituent.
qa_qualifier *list_domain 13215*		character (2)	A qualifier that applies when the quality of the result is suspect. An example is BO (organic samples, the analyte is found in the associated blank as well as in the sample indicating possible contamination of the blank).[2]
value_qualifier *list_domain 13214*		character (5)	A qualifier that applies to the analytical result (measured_value). (EPA or CLP flags can be entered.) Examples are U (less than), E (greater than) , J (the value is an estimated quantity), and R (rejected).[2]
value_units *list_domain 100008*		character (8)	The reported units of measure associated with the analysis result in the *measured_value* column. Examples are: mg/L, ug/L, mg/kg, ug/kg, ppm, ppb, etc.
lab_qualifier *list_domain 13414*		character (6)	Lab reported qa_qualifier (Prior to validation or data usability review)
validated_status *list_domain 13412*		character (2)	Laboratory data was validated.

[2] For default domain values, see "Domain Definitions" in this document

Column	Nulls	Type (Size)	Definition
lab_conc_qual list_domain 13413		character (2)	Lab reported value_qualifier (Prior to validation or data usability review)

Table 3 - Analytical Results Table Data Dictionary (MAF only)

(ERMA Database Table Name: **analytic_results**)

Description: This table is used to store information that identifies the samples that were analyzed, it describes the analytic method and results. Each record must contain a unique sample identification, analysis method, and the name of the chemical or analyte (value_name) evaluated in the sample.

Column	Nulls	Type (Size)	Definition
sample_id *(key column, index column)*	no	character (20)	A unique character string that identifies a specific sample specimen. (This is a join column to both the **sample_data.sample_id** and **analytic_methods.sample_id** table.column.)
analysis_method *(key column)* *list_an_mthd 13208*	no	character (15)	Analytical Method. (This column joins this table to the **analytic_methods.analysis_method** table.column.)
value_name *(key column, index column)* *list_domain 13212*	no	character (15)	A value that represents an abbreviated commonly used name of a constituent or analyte. Examples are PCE and TCE .[2]
leach_method *(key column)* *list_domain 13410*		character(15)	Leach method followed by the lab. (This column joins the analytic_methods.leach_method table.column.)
lab_rpt_name *(key column)*		character (20)	A laboratory report name that corresponds to the analytical methods and/or results. (This column joins this table to the **analytic_methods.lab_rpt_name** table.column.)
cas_number *list_domain 13213*		character (15)	A value that contains a Chemical Abstract Services (CAS) number for a constituent or analyte.
detection_limit		double	The laboratory-supplied minimum detectable quantity of a parameter based on laboratory conditions, analytical method, or field conditions.
measured_value	no	double	The reported result associated with the analysis for this constituent.
qa_qualifier *list_domain 13215*		character (2)	A qualifier that applies when the quality of the result is suspect. An example is BO (organic samples, the analyte is found in the associated blank as well as in the sample indicating possible contamination of the blank).[2]
value_qualifier *list_domain 13214*		character (5)	A qualifier that applies to the analytical result (measured_value). (EPA or CLP flags can be entered.) Examples are U (less than), E (greater than) , J (the value is an estimated quantity), and R (rejected).[2]
value_units *list_domain 100008*		character (8)	The reported units of measure associated with the analysis result in the *measured_value* column. Examples are: mg/L, ug/L, mg/kg, ug/kg, ppm, ppb, etc.
lab_qualifier *list_domain 13414*		character (6)	Lab reported qa_qualifier (Prior to validation or data usability review)
validated_status *list_domain 13412*		character (2)	Laboratory data was validated.

[2] For default domain values, see "Domain Definitions" in this document.

Column	Nulls	Type (Size)	Definition
lab_conc_qual *list_domain 13413*		character (2)	Lab reported value_qualifier (Prior to validation or data usability review)
analysis_basis *list_domain 13209*		character (1)	A value that represents the basis under which the laboratory's results are reported. Examples are W (wet) and D (dry).[2]
analysis_date		datetime	The date (datetime format) that the sample was analyzed by the laboratory.
dilution_factor		double	Sample dilution factor
lab_name		character (20)	The analytical laboratory that performed the analysis of a sample.
lab_recd_date		datetime	The date (datetime format) that the sample was received by the laboratory.
lab_sample_id		character (15)	A unique identifier assigned to the sample by the laboratory and included in the reporting of the results.
percent_solid		double	Percent solids
qc_batch		character (20)	Quality control batch
remarks		character (64)	Miscellaneous remarks
leach_date		datetime	Date (datetime format) analytical sample was leached
prep_method *list_domain 13411*		character(15)	Preparation method followed by lab
prep_date		datetime	Date (datetime format) sample was prepared for analysis.

Table 4 - Analytical Screening and BG Table Data Dictionary

(ERMA Database Table Name: **analytic_screen_bg**)

Description: This table is used to store the Screening and BG (background) information for each analyte.

Column	Nulls	Type (Size)	Definition
value_name_class	no	character (20)	This is the value name classification group, that groups constituent or analytes.
value_name *(key column)* *list_domain 13212*	no	character (15)	A value that represents an abbreviated commonly used name of a constituent or analyte. Examples are PCE and TCE. This column joins this table to **analytic_results.value_name.**
value_name_desc	no	character (100)	Full Value name description
*bk**_criteria*	no	double	The reported background result associated with the analysis for this constituent.
*bk**_units* *list_domain 100008*		character (8)	The reported units of measure associated with the analysis result in the *BK**_value* column. You can define a domain set for this column. mg/L, ug/L, mg/kg, ug/kg, ppm, ppb, etc.
****_criteria*	no	double	The reported screening (PRG) result associated with the analysis for this constituent.
****_units* *list_domain 100008*		character (8)	The reported units of measure associated with the analysis result in the ****_value* column. You can define a domain set for this column. mg/L, ug/L, mg/kg, ug/kg, ppm, ppb, etc.

** - Background Values

Code - Sample matrix description - Sample_matrix

BK-SB	Sub-surface Soil Background Criteria - SO
BK-SD	Sediment Background Criteria – SE
BK-SS	Surface Soil Background Criteria – SO
BK-WG	Groundwater Background Criteria – WG
BK-WS	Surface Water Background Criteria - WS

*** - Screening Values

ECOSD	Sediment Ecological Criteria – SE
ECOSS	Surface Soil Ecological Criteria – SO
ECOWS	Surface Water Ecological Criteria - WS
GWPSO	Groundwater Protection Criteria for Soil (SSL) – SO
RBCSO	Risk Based Criteria for Soil (PRG) – SO
RBCWA	Risk Based Criteria for Water (PRG) – WG

Table 5 - Down-Hole Well Test Table Data Dictionary

(ERMA Database Table Name: **down_hole_test**)

Description: This table stores down hole test data that were conducted in the wells, or borings. Each record must contain a unique well name, a unique date, a unique time, a unique value_name, and a unique test method for each record.

Column	Nulls	Type (Size)	Definition
well_name (key column)	no	character (20)	A unique name that identifies the well. (This column joins this table to the **well.official_name** table.column, and tells the software the e/n coordinates related to this subsurface data.)
top_depth		double	The top along-hole depth (AHD) of the section of the well that is being tested. (Top depth is relative to the *ref_elevation* column value stored in the corresponding **well** table.)[3]
bottom_depth		double	The bottom AHD of the test section. (Bottom depth is relative to the *ref_elevation* column value stored in the corresponding **well** table.)[3]
top_depth_ft		double	The top along-hole depth in feet (AHD) of the section of the well that is being tested.
bottom_depth_ft		double	The bottom AHD in feet of the test section.
contractor		character (20)	The company that contracted the test.
descript		character (80)	A description related to this down-hole test. This text can be posted to boring logs, cross sections, maps, and reports.
measured_value	no	double	The result associated with the test.
test_date (key column)	no	integer	The date (in the format YYYYMMDD) that the well was tested.
test_time (key column)	no	integer	The time (in the format HHMMSS) that the well was tested
test_duration		integer	The elapsed time (in the format HHMMSS) for the test results reported in the *measured_value* column.
test_method (key column) *list_domain 100007*	no	character (4)	The type of test conducted in the well. Examples are SPT (Standard Penetration Test), CPT (Cone Penetrometer Test), and VST (Vein Shear Test).
value_name (key column) *list_domain 100009*	no	character (12)	A value resulting from a test (either water or soil) conducted in the well. Examples are water: velocity, and direction; soil: permeability, core length, and natural gamma. (Note: this value_name is specific to this table, not to be confused with other table's value_name.)
value_qualifier *list_domain 13214*		character (2)	A qualifier that applies to the analytical result. (EPA or CLP flags can be entered.) Examples are < (less than), > (greater than), J (the value is an estimated quantity), ND (not detected) and R (rejected).[2]

[3] The units must be consistent with the units specified during project creation.

[2] For default domain values, see "Domain Definitions" in this document. You can supplement default values with your own values.

Column	Nulls	Type (Size)	Definition
value_units *list_domain 100008*		character (8)	The reported units of measure associated with the analysis result in the *measured_value* column. You can define a domain set for this column. mg/L, ug/L, mg/kg, ug/kg, ppm, ppb, etc.
remarks		character (240)	Miscellaneous remarks.

Table 6 - Field/Sample Event Dictionary

(ERMA Database Table Name: **field_event)**

Description: This table is used to uniquely describe field or sample events.

Column	Nulls	Type (Size)	Definition
field_event_grp (key column)	no	character (20)	A unique name that indicates the field or sampling event grouping for which samples, borings, or other data was collected or established. This column is a foreign key to the **well**, & **sample_location** (tables) **field_event_grp** (columns); and **sample_data,** & **well_sample_data** (tables) **sampl_event_grp** (columns).
alt_sample_group (key column, MSFC only)	no	character (50)	A unique alternate or contractor developed sample group code. Usually found as the prefix to the sample_id.
descript	no	Varchar (MAX)	Brief description of the field or sampling event including date.

Table 7 - Fluid Table Data Dictionary

(ERMA Database Table Name: **fluid**)

Description: This table is used to store information about fluids present in the project area. Each record must contain a unique fluid name and a unique fluid type.

Column	Nulls	Type (Size)	Definition
fc_name (key column, index column)	no, unique	character (8)	A unique abbreviated name for a fluid encountered in the project area. (This name is required for storing an associated depth value.) Examples are SW (static water) and FP (free product). (This column joins this table to the **fluid_pen.fc_name** table.colmun.)
full_name		character (30)	A more lengthy description of a fluid in the project area. For example, you might have specific names for water levels corresponding to each aquifer in the project.
fc_type (key column) *list_domain 10245*	no	character (4)	A value that classifies the fluid type. Examples are WAT (water) and FLP (floating product).
descript		character (40)	An optional description related to this fluid.

Table 8 - Fluid Penetrations Data Dictionary

(ERMA Database Table Name: **fluid_pen**)

Description: This table is used to store information that describes the penetrations of fluids by wells (fluid contacts). This includes the potentiometric surfaces of aquifers, immiscible fluids, or combinations of both. A fluid contact is a surface (in a reservoir) that separates two regions characterized by predominant differences in fluid saturations. Each record must contain a unique well name, a unique fluid name, fc_date, and the along-hole depth (AHD) of the fluid penetrated by the well.

Column	Nulls	Type (Size)	Definition
well_name (key column)	no	character (20)	A unique name that identifies the well. (This column joins this table to the **well.official_name** table.column.)
fc_name (key column, index column)	no	character (8)	A unique abbreviated name for the fluid that was penetrated by the well. This is a join column to the **fluid.fc_name** table.column.
depth (key column)	no	double	A value that represents the AHD of the fluid. This value is used in posting fluid contacts on boring logs, cross sections, and horizon maps.[3]
depth_ft		double	A value that represents the AHD in feet of the fluid.
fc_date (key column)	no	integer	The date (in the format YYYYMMDD) that the fluid was measured. This value can be used to generate hydrographs.
fc_status list_domain 10246		character (4)	fluid status
fc_type list_domain 10245		character (4)	fluid type (WAT - water)
field_event_grp		character (20)	An optional description that identifies the sampling event date or grouping for which this sample was collected. This is a foreign join column to the **field_event** table **field_event_grp** *column.*

[3] The units must be consistent with the units specified during project creation.

Table 9 - Lithology Data Dictionary
(ERMA Database Table Name: **lithology**)

Description: This table is used to store lithological descriptions and qualifiers related to a well as determined from log analyses, core samples, and other means. Each record must contain a unique well name and the top along-hole depth (AHD) of the stratigraphic unit that contains this lithology.

Column	Nulls	Type (Size)	Definition
well_name (key column, index column)	no	character (20)	A unique name that identifies the well. (This column joins this table to the **well** table **official_name** column.)
top_depth (key column)	no	double	The top AHD of the lithologic unit specified. This value is used to post stratigraphic penetrations on boring logs, cross sections, and horizon maps.[3]
bottom_depth		double	The bottom AHD of the lithologic unit. This value can be used to generate thickness maps for a specified lithologic unit.[3]
top_depth_ft (key column)		double	The top AHD in feet of the lithologic unit specified.
bottom_depth_ft		double	The bottom AHD in feet of the lithologic unit.
lith_type (key column) *list_domain 10250*	no	character (2)	A value that represents a dominant specific lithologic type. The default values include both the USCS (Unified Soil Classification System) and the USGS rock unit classes. Examples are CL (clay), GW (well-graded gravels) and SS (sandstone).[2] For each default value, a lithologic pattern feature and a pattern cell for each geologic feature is available in patterning.
percentage		integer	percent of the lith_type
strat_unit_name		character (8)	An optional specification of the stratigraphic unit that contains this lithologic unit.
descript		char (240)	A description related to this lithologic unit. This text can be posted to boring logs, cross sections, maps, and reports.

[2] For default domain values, see "Domain Definitions" in this document. You can supplement default values with your own values.
[3] The depth units (feet) must be consistent with the units specified during project creation.

Table 10 - Operable Units Table Data Dictionary
(ERMA Database Table Name: **operable_unit**)

Description: This table is used to store Operable Unit information and data. Each record must contain a unique operable unit name identification.

Column	Nulls	Type (Size)	Definition
name	no	char (60)	Operable unit name identification.
ou_id *(key column)*	no, unique	char (10)	Operable unit identification. This column joins to **swmu_loc** table **ou_id** column, optional link to the **well** table **ou_id** column and **sample_data** table **ou_id** column.

Table 11 - Quality Control Table Data Dictionary
(ERMA Database Table Name: **qc_***)

Description: These tables are used to store Quality Control information and data. Each QC table listed is identical to existing (parallel) ERMA database tables.

QC table	Table abbreviation	ERMA database table
qc_sd	qsd	sample_data
qc_am	qam	analytic_methods
qc_ar	qar	analytic_results

Sample_equip, site_id, and ou_id columns do not apply in QC samples

Table 12 - Sample Data Table Data Dictionary
(ERMA Database Table Name: **sample_data**)

Description: This table is used to store information that identifies and describes the samples collected at particular sample locations. Each record must contain unique sample identification.

Column	Nulls	Type (Size)	Definition
sample_id (key column, index column)	no, unique	character (20)	A unique character string that identifies a specific sample specimen. (This column joins this table to the **analytic_methods.sample_id** and **analytic_results.sample_id** table.colunm.)
location_name *foreign key to sample_location table*	no	character (20)	A unique name for the physical location where a sample was collected.. Each sample collection point must have a unique name within the project database. (This column joins this table to the **sample_location.location_name** table.column.)
collection_date	no	Integer (MSFC) Datetime (MAF)	The date (in the format YYYYMMDD) that the sample was collected. In datetime format for MAF
collection_time		integer	The time (based on the 24-hour clock in the format HHMM) that the sample was taken (MSFC only)
collection_meth *list_domain 13201*		character (2)	A value that represents a sample collection method. Examples are undisturbed bulk sample, time-weighted composite, and grab samples.[2]
top_depth		double	The top AHD of the sample. (Top depth is relative to *reference_elev* column in the **sample_location** table .)
bottom_depth		double	The bottom AHD of the sample. (Bottom_depth is relative to *reference_elev* column in the **sample_location** table.)
contractor		character (20)	Contractor, group, or office responsible for the field sample collection.
site_id		character (10)	MSFC site sampled ie. IWTF, building number, or drillers mud pit (DMP). (This is a join to **swmu_loc** table and **site_id** column.)
ou_id		character (10)	Operable unit identification for sample in conjunction to operable unit delineation. This column is a join to the **operable_unit** table and **ou_id** column.
samp_event_grp		character (20)	An optional description that identifies the sampling event which this sample was collected. This is a foreign join column to the **field_event** table **field_event_grp** *column.*
sample_matrix *list_domain 13205*		character (2)	A value that represents a medium for sample specimens. Examples are soil gas, purge water (PW), ground water (GW), surface water (WS), and soil (SO).[2]
sample_type *list_domain 13204*		character (2)	A value that represents (from a QA perspective) a type of collected sample. Examples are equipment blank, column duplicate, and normal environmental sample.[2]
sampling_equip *list_domain 13202*		character (2)	The sampling equipment type. Examples are air canister, hand auger (HA), split spoon (SS).[2]
remarks		character (240)	Descriptive comments related to this sample record.

[2] For default values, see the appropriate domain set in this document. You can supplement default domains with your own values.

Table 13 - Sample Field Data Table Data Dictionary

(ERMA Database Table Name: **sample_fld_data**)

Description: This table is used to store information that describes sample field data during the sample collection. Each record must contain a unique sample identification. This table is joined to the **sample_data** and **well_sample_data** tables by the *sample_id column*. Water level depth is stored in the fluid_pen table.

Column	Nulls	Type (Size)	Definition
sample_id (key column, index column)	no, unique	character (20)	A unique character string that identifies a specific sample specimen. (This column joins this table to the **sample_data.sample_id** and **well_sample_data.sample_id** table.column.)
conductivity		double	Conductivity measurement (µMHOS/cm)
ph		double	pH field test
tds		double	Total Dissolved Solid field test (mg/l)
temperature		double	Temperature of sample. (C Centigrade)
turbidity		double	Water turbidity (NTU)
salinity		double	
dox		double	Dissolved Oxygen
eh		double	Eh – field measurement

Table 14 - Sample Location Table Data Dictionary

(ERMA Database Table Name: **sample_location**)

Description: This table is used to store information about the locations from which samples were taken at the project site. Each record must contain a unique location name.

The sample location name (location_name), naming convention (AAxx-NNN) follow:
Prefixes (AA) CV cave, FT fish tissue, GP geoprobe, SB soil boring, SD sediment, SS surface soil, SW surface water, SX surface soil (coincide with well), SP spring, TP tissue plant, and TA tissue animal.
Prefixes (xx) xx = OU (Operable Unit number), BK = Background, or 00 = several OUs (For MAF xx = AOC [area of concern ID])
Increment (NNN) is the incremental sample number

Column	Nulls	Type (Size)	Definition
creation_date[1]	no	integer	The date (in the format YYYYMMDD) that the record is entered into the database.
revision_date[1]	no	integer	The last date (in the format YYYYMMDD) that the record was modified.
location_name (key column, index column)	no, unique	character (20)	A unique name for the physical location where a sample is collected. Examples are an NPDES discharge point and a meteorological tower. Each sample collection point must have a unique name in the database. (This column joins this table to the **sample_data.location_name** table.column.)
reporting_name		character (20)	An alternate reporting name.
location_status *list_domain 13216*		character (3)	A value that represents the operational status and relative quality of the sampling location. The default domain set was derived from the EPA's GRITS (Groundwater Information Tracking System) schema that relates to QA of the sampling station.[2] (B, normal; D, dry)
location_type *list_domain 13203*		character (3)	A value that represents the type of sampling location. Examples are ambient air, cone penetrometer, sediment (SD), and surface water (SW).[2]
reference_elev		double	The reference elevation of the sample location. (This value is required if you want the data to appear in its proper location in a 3-D graphics file.)[3] This value is usually ground surface elevation.
reference_elev_ft		double	The reference elevation in feet of the sample location.
ref_elev_descrp *list_domain 10107*		character (3)	A brief narrative description of the *reference_elev* column value. Examples are top of casing (TC) and ground surface (GL).

[2] For default values, see the appropriate domain set in this document. You can supplement default domains with your own values.
[3] The units must be consistent with the units specified during project creation.

Column	Nulls	Type (Size)	Definition
longitude		double	An optional numerical value that represents the sample location's longitude coordinate. (This value can be calculated by the system from the easting value.)
latitude		double	An optional numerical value that represents the sample location's latitude coordinate. (This value can be calculated by the system from the northing value.)
easting	no	double	A numerical value that represents the sample location's easting coordinate. The current coordinate system is based upon the local projection see Map Projections
northing	no	double	A numerical value that represents the sample location's northing coordinate. The current coordinate system is based upon the local projection see Map Projections
survey_accuracy		double	Estimated accuracy for the easting, & northing coordinate in feet.
survey_method list_domain 100005		character (2)	The method used to determine the easting & northing coordinate. Examples are GPS (G) , Digitized (D), or Other (O).
field_event_grp		character (20)	The field event grouping for which samples, borings, or other data was collected or established. This column is a foreign key to the **field_event** (table) **field_event_grp** (column).
ref_elev_accuracy		double	Estimated accuracy for the reference elevation in feet.
ref_elev_method list_domain 100005		character (2)	The method used to determine the reference elevation. Examples are C calculated, and G for GPS.

Table 15 - Solid Waste Management Unit Table Data Dictionary

(ERMA Database Table Name: **swmu_loc**)

Description: This table is used to store Solid Waste Management Unit (SWMU) site, information, location and data. The site_id is unique, it is the join column to the sample_location, sample_data, well, and well_sample_data tables.

Table no longer used 2008 it is now in GIS

Column	Nulls	Type (Size)	Definition
ou_id	no	char (10)	Operable unit identification. This column joins to **operable_unit** table **ou_id** column
site_id (key column)	no, unique	char (10)	Short SWMU site identification
site_name		char (60)	Description of SWMU site
site_number		char (20)	Longer SWMU site identification
easting		real	easting
northing		real	northing
longitude		double	A numerical value that represents the swmu longitude coordinate.
latitude		double	A numerical value that represents the swmu latitude coordinate.
hea_site_id		char (20)	
site_descript		char (240)	Site description
site_descript2		char (240)	Site description continued

Table 16 - Stratigraphic Penetrations Data Dictionary

(ERMA Database Table Name: **strat_pen**)

Description: This table is used to store information that describes the penetrations of stratigraphic units (rock and soil units) by wells. Each record must contain a unique well name, a unique stratigraphic unit name, and the top along-hole depth (AHD) of the stratigraphic unit penetrated by the well.

Column	Nulls	Type (Size)	Definition
well_name (key column, index column)	no	character (20)	A unique name that identifies the well. (This column joins this table to the **well.official_name** table.column.)
strat_unit_name (key column, index column)	no	character (8)	A unique abbreviated name for the stratigraphic unit that was penetrated by the well. This value is not valid unless the same name has been entered in the **strat_unit.** ***strat_name*** table.column.
top_depth *(key column)*	no	double	The top AHD of the stratigraphic unit. This value is used to post stratigraphic penetrations on boring logs, cross sections, and horizon maps.[3]
bottom_depth		double	The bottom AHD of the stratigraphic unit. This value can be used to generate thickness maps for a specified stratigraphic unit.[3]
descript		character (80)	A description related to this stratigraphic penetration. This text can be posted to boring logs, cross sections, maps, and reports.

[3] The units must be consistent with the units specified during project creation.

Table 17 - Stratigraphic Units Table Data Dictionary

(ERMA Database Table Name: **strat_unit**)

Description: This table is used to store information about stratigraphic units (rock and soil) of significance to the characterization of the project site. Each record must contain a unique stratigraphic name (strat_name).

Column	Nulls	Type (Size)	Definition
strat_name (key column, index column)	no, unique	character (8)	A unique abbreviated name for a stratigraphic unit that exists in a project area. This value is required to load ***strat_pen.strat_unit_name*** *(table.column)* entries for this geologic unit.
full_name		character (50)	A more lengthy description of the stratigraphic unit name. This value is optional.
main_litho_type *list_domain 10250*		character (2)	An optional value that represents the main lithologic type in this stratigraphic unit. The default values include both the USCS (Unified Soil Classification System) and the USGS rock unit classes. Examples are GW (well-graded gravel) and SS (sandstone).[2] For each default value, ERMADM delivers a lithologic pattern feature and a pattern cell for geologic feature patterning in Site Geologist.
descript		Char (240)	An optional description related to this stratigraphic unit.

[2] For default domain values, see "Domain Definitions" in this document. You can supplement default values with your own values.

Table 18 - Value Name Classification Table Data Dictionary

(ERMA Database Table Name: **value_name_class**)

Description: This table is used aid in querying analytic result groups. For example analytic result groups like metals, VOC, SVOC, PCB, etc. are classified together.

Column	Nulls	Type (Size)	Definition
analysis_method (key column, index column) list domain 13208 (list_an_method table)	no	character (15)	Analytical Method. For examples see analytic_methods.analysis_method (This column joins to the **analytic_results.analysis_method** table.)
value_name (key column, index column) list domain 13212	no	character (15)	A value that represents an abbreviated commonly used name of a constituent or analyte. Examples are PCE and TCE. (This column joins to the **analytic_results.value_name** table.)
leach_method (key column) list_domain 13410	no	character(15)	Leach method followed by the lab. (This column joins the **analytic_results.leach_method** table.column.)
value_name_class	no	character (20)	The is the value name classification group, that groups constituents or analytes. Common groups include VOC, SVOC, metals, PCB, etc.
descript		char (100)	The description of the value name class, or expanded class name.
value_name_type		character (5)	The "value_name_type" field allows for differentiating between reportable target analytes and compounds, and compounds that are part of a laboratories quality control program. The current codes being used are "TAR" for target compounds and analytes, and "SUR" for surrogate compounds that are spiked into the samples by the lab for quality control purposes. The "SUR" compounds should always be reported in units of "PERCENT" recovery. You can use this field to select those reportable compounds and analytes when you query the data, and filter out the compounds associated with the laboratory quality control program.
anaylte_name	No	Char (50)	Reporting name and lab reporting name descriptive with *leach_method*

Table Added July 3, 2003 DSS

Table 19 - Well Table Data Dictionary

(ERMA Database Table Name: **well**)

Description: This table is used to store location information for any type of data collection point having a range of depths associated with it, such as exploration well, monitoring well, soil boring, and so on. Each record must contain an official well name.

The official well name (official_name) naming convention (AAAxx-NNNs) follow:

Prefixes (AAA) MW = monitoring well, CP = cone penetrometer, CW = cluster well, EB = engineering boring, GP = GeoProbe, TW = test well, SB = soil boring, "M-" = soil Borings/Coring (1960's Corps of Engineers), PZ = Piezometer, PW = producing/public (water) well, or RSA = undifferentiated RSA wells

Prefixes (xx) xx = OU (Operable Unit number), BK = Background, DY = Dye injection, or 00 = several OUs (For MAF xx = AOC [area of concern ID])

Increment (NNN) is the incremental well number (zero padded on left) (i.e. 001, 002… 099)

Suffixes (s) D = deep (in bedrock), R = residuum, IG = in-gradient, CG = cross gradient, or P = Piezometer. - Optional

Column	Nulls	Type (Size)	Definition
official_name (key column, index column)	no, unique	character (20)	A unique well name. (This column joins this table to the **strat_pen**, **fluid_pen**, and **lithology** tables [***well_name*** columns].)
reporting_name		character (20)	The well name found in reports. This name is not unique.
alias_name		character(20)	The well alias name. The final name of the well. Geoprobes commonly are redrilled and become piezometers and piezometers become monitoring wells. When the official_name and the alias_name are the same this is the final well at this location.
LADOTD_name		Character (20)	The Louisiana Dept. of Transportation and Development (LA DOTD) well name (MAF only)
ref_elevation		double	The reference elevation of well. (This value is required as a reference datum for all subsurface measurements [along hole depth AHD] in this well.)
depth_ref_level *list_domain 10107*		character (2)	The reference elevation description. This describes the *ref_elevation* value. Examples are ground level (GL), and top of casing (TC).
gl_elevation		double	The ground level elevation
total_depth		double	The final along-hole depth (AHD) of the bottom of the well.[3]
longitude		double	A numerical value that represents the well's longitude coordinate in decimal degrees. (This value can be calculated by the system from the easting value if the projection system is known.)
latitude		double	The well's latitude coordinate in decimal degrees.

[3] The units must be consistent with the units specified during project creation.

Column	Nulls	Type (Size)	Definition
easting	no	double	The well location's easting coordinate. The current coordinate system is based upon the Alabama East State Plane NAD 1983 projection, survey feet units.
northing	no	double	The well location's northing coordinate.
survey_accuracy		double	Estimated accuracy for the easting, & northing coordinate in survey feet.
survey_method list_domain 100005		character (2)	The method used to determine the well location. Examples are D digitized, C calculated, and G for GPS.
angle		double	The angle of drill inclination (where 0 or Null represents vertical and 90 represents horizontal) of the drilled well or borehole. *Most, if not all, borings are vertical at MSFC.*
azimuth		double	The azimuth angle that the hole (of a non-vertical well) is drilled. That is, compass direction from the top of the well towards the bottom of the well.
site		character (20)	MSFC site in which the well was drilled ie. IWTF, building number, or drillers mud pit (DMP). (This is not the swmu_loc site_id.)
ou_id		character (10)	Operable unit identification for well drilled in conjunction to operable unit delineation. This column is a join to the **operable_unit** table and **ou_id** column.
operator		character (25)	Organization responsible for the well ie. MSFC or RSA.
well_status list_domain 13401		character (3)	A value that represents the status of the well. Examples are Dry, Plugged, and In Use.[2]
well_type *list_domain 13402*		character (3)	A value that represents the well type. Examples are Geologic/Engineering Boring (EB), Monitoring Well (MW), Inactive Monitoring Well (MWI), and Soil Sample Location.
method_of_entry domain_list 10001		character (1)	How the data was entered in the database. Examples K keyed in, C Computed, D Digitized, or T Translated
remarks		char (240)	General remarks or original published reference. **Single quote (‘), semicolon {;}, pound (#) and pipe (|) characters are not allowed in any remarks.**
field_event_grp		character (20)	The field event grouping for which samples, borings, or other data was collected or established. This column is a foreign key to the **field_event** (table) **field_event_grp** (columns).
ref_elev_accuracy		double	Estimated accuracy for the reference elevation in feet.
ref_elev_method list_domain 100005		character (2)	The method used to determine the reference elevation. Examples are C calculated, and G for GPS.
gnd_elev_accuracy		double	Estimated accuracy for the ground elevation in feet.
gnd_elev _method list_domain 100005		character (2)	The method used to determine the ground elevation. Examples are C calculated, and G for GPS.

[2] For default domain values, see “Domain Definitions” in this document.

Table 20 - Well Completion Table Data Dictionary

(ERMA Database Table Name: **well_completion**)

Description: This table is used to store information relating to the completion of wells when installation (and other purposes for which the well was drilled) is complete. This includes screening material, fill type, and pumping equipment that was used in the well. Each record must contain a unique well name.

Column	Nulls	Type (Size)	Definition
well_name (key column)	no, unique	character (20)	A unique name that identifies the well. (This column joins this table to the **well.official_name** table.column.)
aquifer *list_domain 100006*		character (8)	The USGS aquifer code for the aquifer from which samples are obtained. This is also a foreign key to the fc_name column in the fluid table.
completion_mthd *list_domain 13403*		character (3)	The well completion method used to complete the well instalization. Examples include gravel w/ screen GS, open-end OE, and perferated/slotted P.
casing_inner_dia		double	The inside diameter (in inches) of the well structure.
casing_outer_dia		double	The outer diameter (in inches) of the well casing.
casing_status *list_domain 13405*		character (1)	A value that represents the status of the well casing. Examples are permanent (P), and removed (R).[2]
casing_top_elev		double	The elevation of the top of the casing at well completion.[3]
casing_top_depth		double	The along-hole depth (AHD) to the top of the casing. (This value is a depth, not an elevation.) Most of the time the value will be negative for casing top above ground. [3]
casing_bot_depth		double	The along-hole depth (AHD) to the bottom of the casing. (This value is a depth, not an elevation.) Rather than measured, the AHD can be estimated by the amount of casing installed in the hole. [3]
casing_type *list_domain 13406*		character (3)	A brief description of the casing material. Examples are PVC Schedule 40 (P40), and steel (STL).[2]
contractor		character (20)	The company that contracted or performed the well drilling.
drill_compl_date		integer	The date (in the format YYYYMMDD) that well drilling is completed.
drill_start_date		integer	The date (in the format YYYYMMDD) that well drilling started
driller_name		character (20)	The *drilling contractor or compay* who supervised the well drilling.
drilling_method *list_domain 13404*		character (3)	A value that represents the method used to drill the well. Examples are air hammer, hollow stem auger, and wireline coring.[2]
fill_top_depth		double	The AHD of the top of the fill. (Depth is relative to the *ref_elevation* column in the **well** table.)[3]
fill_bot_depth		double	The AHD of the bottom of the fill.

[2] For default domain values, see "Domain Definitions" in this document.

[3] The units must be consistent with the units specified during project creation.

Column	Nulls	Type (Size)	Definition
fill_grain_size		integer	The minimum grain size of the fill material. NOTE: the larger number is the smaller grain size.
fill_type *list_domain 13407*		character (2)	A brief description of the fill material used in the well. Examples are sand pack (SP) and gravel pack (GP).[2]
hole_diameter		double	The diameter of the drilled hole in inches.
pump_depth		double	The AHD of the pump. (Depth is relative to the *ref_elevation* column in the **well** table.)[3]
pump_id		character (10)	An equipment tracking number that provides a unique identifier or inventory control number for the equipment in the well.
pump_instal_date		integer	The date (in the format YYYYMMDD) that the pump was installed in the well.
pump_type *list_domain 13409*		character (1)	A brief description of the pump installed in the well. Examples are organic/bladder and submersible.[2]
screen_top_depth		double	The along-hole depth (AHD) of the top of the screen. (Depth is relative to the *ref_elevation* column in the **well** table.)[3]
screen_bot_depth		double	The AHD of the bottom of the screen.
screen_diameter		double	The diameter (in inches) of the screen.
screen_length		double	The length of the interval that has been screened inside the well.
screen_material *list_domain 13406*		character (3)	A brief description of the screen material. Examples are carbon steel and PVC.[2]
screen_slot_size		double	The well-screen slot size in thousandths of an inch. An example is 10 (10/1000).
screen_type *list_domain 13408*		character (2)	A brief description of the type of screen used in the well. Examples are bridge slot and slotted PVC (S2).[2]
seal_top_depth		double	The AHD of the seal top. (Depth is relative to the *ref_elevation* column in the **well** table.)[3]
seal_bot_depth		double	The AHD of the seal bottom.
seal_type *list_domain 13407*		character (2)	A brief description of the type of seal used in the well. Examples are bentonite slurry and cement grout (CG).[2]
strat_comp_zone		character (8)	The stratigraphic unit in which the well is completed. This name should be the same as the name in the *strat_name* column in the **strat_unit** table.
remarks		char (240)	Descriptive comments related to this well-completion record.

[2] For default domain values, see "Domain Definitions" in this document.

[3] The units must be consistent with the units specified during project creation.

Table 21 - Well Sample Data Table Data Dictionary

(ERMA Database Table Name: **well_sample_data**)

Description: This table stores information that identifies the samples collected, the sampling methods, and the locations along the well path at which the samples were taken. Each record must contain a unique sample identification, a well name, and the top along-hole depth (AHD) at which the sample was taken relative to the elevation of the location at which the well was drilled.

Column	Nulls	Type (Size)	Definition
sample_id (key column, index column)	no, unique	character (20)	A unique character string that identifies a specific sample specimen.
well_name	no	character (20)	A unique name that identifies the well. (This column joins this table to the **well.official_name** table.column.)
top_depth	no	double	The top AHD of the sample. (Top depth is relative to the well.*ref_elevation* column value.) This value is used to post sample locations on boring logs, cross sections, and horizon maps.[3] Point samples will just have the top_depth entered.
bottom_depth		double	The bottom AHD of the sample. (Bottom depth is relative to the well.*ref_elevation* column value.) This value is optional.[3]
samp_event_grp		character (20)	An optional description that identifies the sampling event date or grouping for which this sample was collected. This is a foreign join column to the **field_event** table **field_event_grp** *column.*
collection_date		integer	The date (in the format YYYYMMDD) that the well sample was collected.
collection_time		integer	The time (based on the 24-hour clock in the format HHMM) that the sample was taken.
collection_meth *list_domain 13201*		character (2)	A value that represents the method used to collect the sample. Examples are undisturbed composite sample (CS) and bulk sample (BL).[2]
contractor		character (20)	The company that contracted or performed the sampling.
site_id		character (10)	SWMU identification for well sample in conjuction to SWMU delineation. This column is a join to the **swmu_loc** table and **site_id** column.

[2] For default domain values, see "Domain Definitions" in this document.

[3] The units must be consistent with the units specified during project creation.

Column	Nulls	Type (Size)	Definition
ou_id		character (10)	Operable unit identification for well sample in conjuction to operable unit delineation. This column is a join to the **operable_unit** table and **ou_id** column.
sampling_equip *list_domain 13202*		character (2)	A value that represents the type of equipment used to collect the sample specimen. Examples split spoon (SS), and bucket/container
sample_type *list_domain 13204*		character (2)	A value that represents the type of sample collected from a QA perspective. Examples are equipment blank, column duplicate, and normal environmental sample.
sample_matrix *list_domain 13205*		character (2)	A value that represents the medium for a sample specimen. Examples are ground water (WG), purge water (PW), and drill cuttings (DC).
remarks		char (240)	Descriptive comments related to this well sample record.

Map Projection, Elevation, and Depth Notes:

The map projection, elevation, and depth unit information follow:

Map Projection:

MSFC: Alabama State Plane east, NAD 1983, feet units
Michoud (MAF): Louisiana State Plane, south, NAD 1983, feet units
Tables: Well and sample_location
Columns: easting and northing

Elevation and Depth units:

Elevation and depth units are feet
Columns: top_depth, bottom_depth, depth, ref_elevation, gl_elevation
Tables: well, sample_location, well_sample_data, sample_data, strat_pen, fluid_pen, etc.
Reference: Depths are relative to the reference elevation. Elevations are relative to mean sea level.

Change Notes:

July 2003 – Added value_name_class table
Oct. 2004 – Added reporting_name to sample_location table
February 2005 – Added analytic_results.leach_method, analytic_methods leach_method, .value_name_class.leach_method, qc_am.leach_method, qc_ar.leach_method columns.
February 2005 – Added lab_qualifier, validated_status, and lab_conc_qual columns to the analytic_results qc_ar tables
February 2005 – Added leach_date, prep_method, prep_date, prep_time columns to the analytic_methods qc_am tables
February 2005 – Removed extraction_date column from analytic_methods table
February 2005 – Set prep_date = extraction_date
February 2005 – Removed wetlands table (now GIS feature)
February 2005 – Removed tmp* tables
February 2005 – Added lab_rpt_name to analytic_results table
Feb. 28, 2005 – Renamed column edms_sample_group to field_event.alt_sample_group
Mar. 2, 2005 – Renamed table analytic_prg_bg to analytic_screen_bg
July 5, 2005 – Modified analytic_results.value_qualifier (and qc_ar.*) to char 5.
Oct. 8, 2008 – Added Yellow highlight to Key columns DSS
Oct. 8, 2008 - analytic_results.value_name analytic_screen_bg.value_name; value_name_class.value_name increased to char(15)
Oct. 8, 2008 – Added column value_name_class.anaylte_name char (50) DSS
May 6, 2009 – Added Michoud (MAF) specific tables and fields, Removed *_ft columns, Added datetime for MAF dates and times fields (except creation_date and revision_date); Added MAF specific analytic_results table; added MAF projection information;
July 19, 2012 – Updated Sample_id field to Char (20)
Apr. 25, 2017 – Updates

This MSFC document **G:\documents\Database_dictionary\msfcdb1.doc** last edited at **4/25/2017.**

Attachment 2
Data Evaluation Checklist

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Number	Data Evaluation Question	Yes	No	N/A
1	Is a Work Plan, Sampling Analysis Plan (SAP), or Quality Assurance Project Plan (QAPP) available?			
2	Are the chains of custody (CoCs) present?			
	Are the CoCs complete and signed off?			
	Were the samples received at or below 4 +/- 2 degrees Celsius?			
	Were all samples on the CoC analyzed?			
	Were any problems noted?			
3	Was a project narrative available from the lab?			
	Were any problems noted?			
4	Was the preparation time reported?			
	Was time of analysis reported?			
	Were all holding times met?			
5	Was determination of sample quantitation limits (SQLs) included in the data package?			
	Are SQLs reported with the sample results?			
6	Were initial calibrations included in the data packages?			
	Did all initial calibrations meet laboratory control criteria?			
7	Were initial calibration verifications included in the data package?			
	Did all initial calibration verifications meet laboratory criteria?			
8	Were continuing calibrations included in the data package?			
	Did all continuing calibrations meet laboratory criteria?			
9	Were initial calibration and continuing calibration blanks included in the package?			
	Were all initial calibration and continuing calibration blanks nondetect?			
10	Are instrument run logs included in the data package?			
11	Are extraction logs included in the data package?			
12	Are digestion logs included in the package?			
13	Are performance evaluation sample results included in the data package?			
14	Were quarterly detectability check standard results included in the data package?			
15	Was the frequency stated in the Work Plan or SAP for field duplicates, equipment rinsate, and trip blanks met?			

Number	Data Evaluation Question	Yes	No	N/A
16	Were all equipment rinsate blank, trip blank, and method blank results nondetect?			
17	Were all matrices, units, and detection limits reported correctly?			
18	Were all surrogate recoveries within lab control limits?			
19	Were all laboratory control sample spike recoveries within lab control limits?			
20	Were all matrix spike recoveries and relative percent differences (RPDs) within lab control limits?			
21	Were analytical duplicate RPDs within lab control limits?			
22	Were all field duplicate RPDs within lab control limits?			
23	Was the project completeness goals met?			

Data Evaluation Question
Sample Collection, Transfer, and Handling:
Accuracy:
Precision:
Data Qualifications based on Data Evaluation:

Field Sample	Constituent	Result Qualification	Reason For Qualification

Attachment 3
RECAP Form 2 - Analytical Data Summary

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RECAP FORM 2
ANALYTICAL DATA SUMMARY
Definitions

COC/CAS: *The potential or actual constituent of concern analyzed, and its defining Chemical Abstract service number.* ***EXAMPLE: Butyl benzyl pthlate/ 85-68-7***

DATE: *Date of completion of this report (yy,mm,dd).* ***EXAMPLE: 970131***.

LOCATION & DEPTH: *The unique identification assigned by the site to the location where the sample was collected, and the approximate depth of collection in feet.* ***EXAMPLE: B-1 (12ft)***

LIMITING STANDARD: *The lowest RECAP Standard (RS) or Screening Standard (SS) of all standards applicable to the given COC or source medium.* ***All results are to be reported in Parts per Million (PPM) such as mg/kg or mg/L***.

LINE # :*Assigned per unit of reported information. Used to ease reference in finding information and identifying possible QA/QC Flags.*

MEDIA SAMPLED: *The environmental medium that was sampled.* ***EXAMPLE: SOIL, WATER, AIR***

METHOD*: The analytical method(s) used to prepare and quantify a COC.* ***EXAMPLE: SW-846-8260. Note: Any alternate method outside of EPA or published RECAP methods must be pre-approved by the Department.***

OPTION USED: *Management option used to determine the limiting standard.* ***EXAMPLE: SO, MO-1, MO-2, or MO-3.***

PAGE __ of __: *Page sequence of report*. ***EXAMPLE: PAGE 1 OF 2.***

PQL: *The practical Quantitation Limit used.* ***All results are to be reported in Parts per Million (PPM) such as mg/kg or mg/L***.

QA/QC Flag: *Any factor associated with the sample analysis that may cause results to be rejected unless properly explained.* ***See additional instruction section.***

SAMPLE DATE: *The date that the sample was collected (yy,mm,dd).* ***EXAMPLE: 970101.***

SAMPLE IDENTIFICATION NO.: *The unique identification number that was used to identify this sample at the time of collection.* ***EXAMPLE: 970101-A. NOTE: Analytical (Laboratory) Sample IDs and Collection IDs are to be IDENTICAL.***

SAMPLE QUANTITATION LIMIT: *The lowest level at which the constituent could accurately and reproducibly be quantitated during the analysis of this sample.* ***EXAMPLE: 0.005. All results are to be reported in Parts per Million (PPM) such as mg/kg or mg/L***.

SAMPLE RESULT: *The concentration of a constituent in the sample as determined by the laboratory.* ***If a constituent was not detected this value should be reported as less than the sample quantitation limit****. EXAMPLE: < .005****. All results are to be reported in Parts per Million (PPM) such as mg/kg or mg/L****.*

SITE NAME: *The name by which the site is referred to in correspondence to the LDEQ.* ***EXAMPLE: RBCA Corporation, Baton Rouge Terminal.***

SITE PHYSICAL ADDRESS: *The physical address of the site that has been sampled.* ***EXAMPLE: 7290 BLUEBONNET BLVD, BATON ROUGE LA 70809.***

ADDITIONAL INSTRUCTIONS:

1. The QA/QC Flag box should be marked (with an X or appropriate qualifier) ***only if there is a QA/QC Flag***. Each Flag should be listed by Line number with a brief explanation of the QA/QC discrepancy provided at the end of the form. **EXAMPLE:**

   Line # 5: The sample duplicate was out of range by 5 percent most likely due to error from dilution necessitated by the high presence of sought analyte in the samples.

   Line #6 and Line #8: While the field blank was found to exceed the limiting standard, both samples were found to be below the MO-1 standards, and all other field and instrument verification QA/QC passed.

2. It is not necessary to report information within a cell that would be a duplicate of facts given in a cell directly above. **EXAMPLE: If Line # 1, 2, 3, 4, and 5 were all associated with the same sample location and depth, it is only necessary to list the location and depth in the appropriately provided space in Line # 1.**

Attachment 4
RECAP Form 3 - Analytical Data Evaluation

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RECAP FORM 3
ANALYTICAL DATA EVALUATION

Date_____

Facility Name _____

Agency Interest (AI #) _____

Physical Site Location _____

Operation Address _____

Owner/Responsible Party Address_____

1. Data Generation

1.A All sample collection was done in accordance to applicable RECAP collection guidelines. [ ] Yes [ ] No

1.B All generated data was obtained using EPA Methodology, RECAP approved methodology (as found in text), or methodology pre-approved by the Department. Any modifications to methodology have been noted, explained and pre-approved by the Department. [ ] Yes [ ] No

1.C All Data are analyte-specific and the identity and concentration are confirmed. [ ] Yes [ ] No

1.D All data were generated by a LDEQ certified laboratory. [ ] Yes [ ] No

2. Data Evaluation and Usability

2.A Methods used are appropriate for analyzed constituents:

1. Analysis used is specific for COCs. [ ] Yes [ ] No

2. Results are produced with the most appropriate sensitive method. (e.g. not using portable field analytical instruments). [ ] Yes [ ] No

2.B Sample Quantitation Limits (SQL)

Note: The SQL is not synonymous with the IDL (instrument detection limit) or the MDL (minimum detection limit). The SQL is derived after considering the effects

of dilutions, loss of instrument sensitivity, matrix interferences, and other interferences effecting the lower-end accuracy of analysis, and therefore resulting in the elevation of the method detection limit. The SQL will be the only detection limit considered for comparison to limiting standards.

1. All SQLs are less than reference concentrations (RS or SS). [ ] Yes [ ] No (If yes, proceed to Section 2C, Qualifiers and Codes).

2. Samples with SQLs greater than the limiting standard are not being reported as non-detected. (If yes, proceed to Item # 3 of this section). [ ] Yes [ ] No

   If the SQL is higher than the limiting standard, and a non-detect is being reported, data may still be considered by the Department if all the below conditions are met:

   (a) The non-detect results make up less than 5-10 percent of a sample set for a considered individual COC.

   (b) The ND is not classified as being from a key sampling location (e.g. drinking water well).

   (c) Documentation provided by a LDEQ accredited laboratory (with supporting evidence) is included in the document demonstrating that a practical quantitation limit was not achievable due to site or sample-specific conditions.

   Have the above three conditions been met? [ ] Yes [ ] No

   Note: If one or more of the above conditions cannot be met, the total (100%) value of the PQL may be reported as a positive detected result.

   Will this option be used and annotated in the Report? [ ] Yes [ ] No

   Note: If all answers in this item are "no," analytical results will be rejected and re-sampling will be required.

3. Are sample results higher than both the PQL and the limiting standard? [ ] Yes [ ] No (If so, results may be used despite elevated PQL).

2.C Qualifiers and Codes

1. All qualifiers and codes for flagged data have been noted on form 3 and supporting documentation has been included in the laboratory information package. [ ] Yes [ ] No

2. All data with a qualifier of "R" (unusable data) do not come from critical sample points (if so, resample will be required). [ ] Yes [ ] No

3. All data with a qualifier of "J" (estimated concentrations) have been included as positive results. [ ] Yes [ ] No

2.D Blank Samples

1. Field and laboratory blanks showed no signs of contamination, and no constituents were detected in blanks. (If no constituents or contaminants were detected, proceed to 2E, Tentatively Identified Compounds). [ ] Yes [ ] No

2. Contaminants or constituents found in blanks can be considered common laboratory contaminants as defined by EPA (acetone, 2-butanone, methylene chloride, toluene, or phthalates); and the same contaminants found in site samples are present at quantities less than 10 times the levels found in blanks. (If no, constituents are to be reported as detected COCs). [ ] Yes [ ] No

3. Contaminants or constituents found in blanks are not considered common laboratory contaminants as defined by EPA; and the same contaminants found in site samples are present at quantities less than 5 times the levels found in blanks (If no, constituents are to be reported as detected COCs). [ ] Yes [ ] No

2.E Tentatively Identified Compounds (TIC)

All possible TIC have been identified, evaluation is supported with documentation in the text, and information conforms to the requirements as listed in Section 2.5 of the RECAP. [ ] Yes [ ] No

2.F Historical Data

1. All quantitative historical data has been reviewed by current QA/QC guidelines, and all applicable supporting information is justified and included in the report. [ ] Yes [ ] No

2. All qualitative historical data is verifiable, has not been used quantitatively, and has only been used in the development of a conceptual model. [ ] Yes [ ] No

3. Documentation

3.A Laboratory information package assembled as follows [ ] Yes [ ] No:

1. Sample documentation (chains of custody, preparation time, time of analysis).
2. Sample and analyte identification and quantification.
3. Determination and documentation of sample quantitation limits (SQLs).
4. Initial and continuing calibration.
5. Performance evaluation samples (external QA or laboratory control samples)
6. Matrix spike recoveries.
7. Analytical error determination (determined with replicate samples).
8. Total measurement error determination summary. (Evaluates overall precision of measurement system from sample acquisition through analysis. Determined with field duplicate and matrix spike with matrix spike duplicate).
9. Explanation and supporting documentation for flagged data.

3.B All methods used in all analysis have produced tangible raw data (e.g. chromatograms, spectra, digital values), and are available to the Department upon request.
[ ] Yes [ ] No

1. Representative data is included in documentation as examples of method procedures. [ ] Yes [ ] No

2. All flagged data is supported with complete associated tangible raw data. (e.g. depiction of matrix interferences, spiked recoveries reported outside of control limits, evidence for need for dilution etc.). [ ] Yes [ ] No

Note: Any "no" answer must be explained at the conclusion of this form. Items not applicable should be left unmarked.

4. Submitter Information

Date_____

Name of Person submitting this evaluation_____

Affiliation_____

Signature_____ Date_____

Additional Preparers_____

Appendix C
Health and Safety Plan

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Site-Specific Health and Safety Plan for Area of Investigation 1, 2, and 3 Excavation and Backfill Work Plan

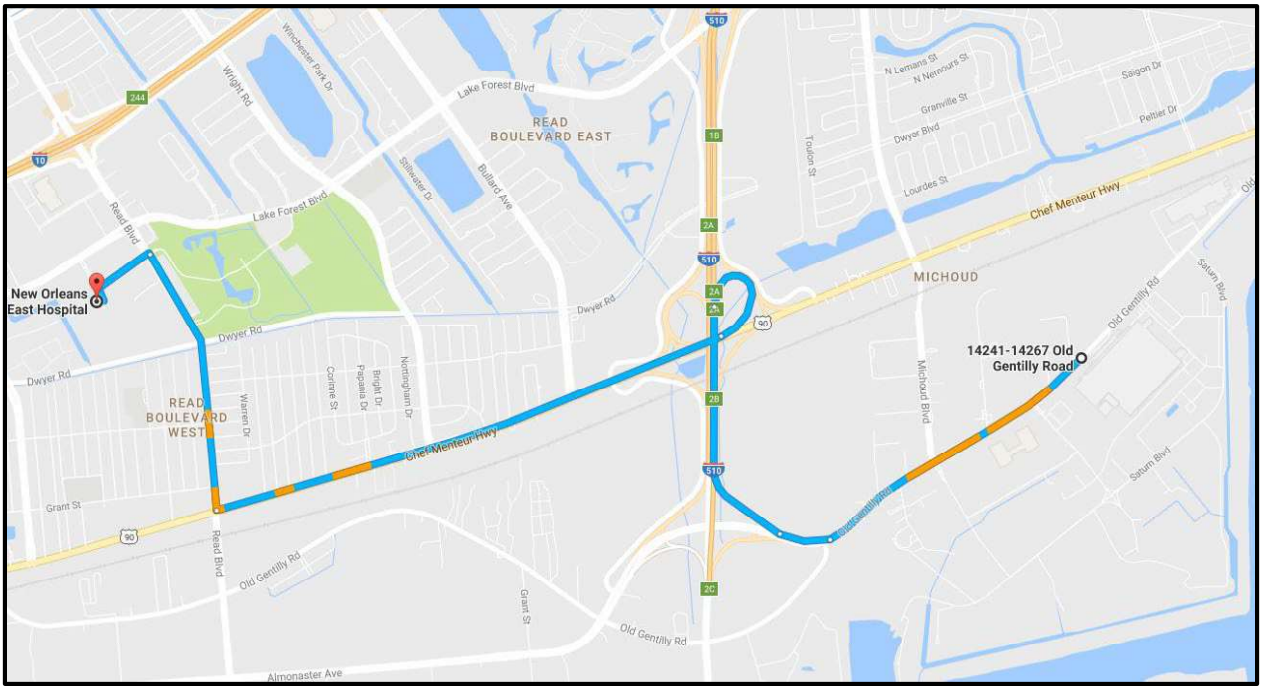
Revised Final

April 2024

Prepared for

National Aeronautics and Space Administration
Michoud Assembly Facility

13800 Old Gentilly Road
New Orleans (Orleans Parish), Louisiana
LDEQ AI# 9145



Directions to Hospital		Hospital Address
Head southwest on Old Gentilly Rd	13.8 mi	New Orleans East Hospital
Continue onto Almonaster Ave	0.1 mi	5620 Read Blvd
Merge onto I-510 N via ramp		New Orleans, LA 70127
Take exit 2A for US-90W	0.4 mi	(504) 592-6600
Continue on US-90W	1.8 mi	
Turn right onto Read Blvd	0.9 mi	
Turn left onto Methodist Hospital Street	0.2 mi	
Hospital will be on the left		

This facility is mappable by phone (goo.gl/xbpCRR).

Site-Specific Health and Safety Plan for
Area of Investigation 1, 2, and 3
Excavation and Backfill Work Plan

Project Number:	D3795400
Name:	Area of Investigation 1, 2, and 3 Excavation and Backfill
Location:	13800 Old Gentilly Road, Orleans Parish, New Orleans, Louisiana
Client:	NASA/Marshall Space Flight Center
Client Contact:	Eric Stack
Phone No.:	(504) 257-0239 (Office) (504) 206-5547 (Mobile)

Section 5.1 provides additional site contacts/emergency numbers.

Jacobs Personnel Contact Information:

Title	**Name**	**Work**	**Mobile**
Field Safety Coordinator	TBD		
Project Manager	TBD		
Health and Safety QA	TBD		

Review and Approval:

Field Safety Coordinator _____ April 25, 2024
Date

Project Manager _____ April 25, 2024
Date

Health and Safety Officer _____ April 25, 2024
Date

Responsibilities for Field Safety Coordinator:

- Serves as the primary onsite contact for Jacobs health and safety procedures during field activities.
- Has the authority to stop Jacobs operations if conditions are judged to be hazardous to onsite personnel or the public.
- Performs discretionary audits to determine compliance of Safety, Health, and Environment Plan requirements.
- Provides access to the health and safety plan for all onsite employees.
- Instructs onsite personnel on the location of emergency communication equipment (that is, phones and radios as necessary).
- Has no responsibility for health and safety procedures of any contractor, subcontractor, client personnel or others on the site.

Date of Plan Preparation	Dates of Planned Field Activities
April 25, 2024	2024

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Contents

Acronyms and Abbreviations

AOI	area of investigation
bgs	below ground surface
CAS	Chemical Abstracts Service
CFR	*Code of Federal Regulations*
COC	contaminant of concern
DCE	dichloroethene
EPA	U.S. Environmental Protection Agency
HASP	health and safety plan
IDW	investigation-derived waste
LDEQ	Louisiana Department of Environmental Quality
MAF	Michoud Assembly Facility
NASA	National Aeronautics and Space Administration
NFA	No Further Action
OVC	organic vapor cartridge
PCB	polychlorinated biphenyl
PID	photoionization detector
PPE	personal protective equipment
ppm	part(s) per million
RECAP	Risk Evaluation/Corrective Action Program
SDS	Safety Data Sheet
SHE	Safety, Health, and Environmental
TCE	trichloroethene
VC	vinyl chloride

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1 Purpose

The purpose of this Health and Safety Plan (HASP) is to provide standards for worker safety and protection during environmental site excavation, sampling, and monitoring activities conducted in/around Areas of Investigation (AOIs) 1, 2, and 3 at the Michoud Assembly Facility (MAF) in New Orleans, Louisiana. This plan augments the National Aeronautics and Space Administration (NASA) Site Safety Plan approved by NASA on June 8, 2017, and the On-Site Safety, Health, and Environmental (SHE) Plan for MAF dated April 2018, revised April 2019. The task-specific plan, as required by the NASA Site Safety Plan, outlines standards and mandatory procedures relative to physical and chemical hazards encountered at sites, communication, training, worker health monitoring, decontamination procedures, and levels of personal protection. Any questions concerning this information should be directed to the Jacobs Project Manager, listed at the beginning of this HASP, at (334) 202-6053.

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2 Applicability

This plan is applicable to all personnel working at the previously referenced site, where mandatory worker health and safety training is required by state or federal agencies. It is intended for use at the previously referenced site where information regarding potential site hazards is available in the form of background research, personal communication with past or present property owners or workers, previous sampling results, etc.

A site-specific hazard evaluation is included in Section 4. Available information should be provided to site workers as outlined in Section 5.

Analysis of environmental media (i.e., soil) that may contain hazardous materials and other routine field activities are activities for which this plan is applicable. All activities will meet the requirements of Louisiana Department of Environmental Quality (LDEQ) Risk Evaluation/Corrective Action Program (RECAP), the U.S. Environmental Protection Agency's (EPA's) groundwater sampling guidelines presented in SESDPROC-301-R4, and the Marshall Space Flight Center's SHE Core Program Requirements and Quality Management System.

This plan does not cover procedures for entry into confined spaces. Project-specific attachments should be prepared and attached to this HASP if those activities are planned. Work of this nature shall be performed in accordance with *Code of Federal Regulations* (CFR) Title 29, Section 1926.250 subpart P "Excavation, Trenching and Shoring," 29 CFR 1910.146 "Permit Required Confined Space Entry," and the Jacobs "Employee Confined Space Entry Program."

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3 Site Description and History

The 832-acre MAF is located approximately 16 miles east of the New Orleans business district within the New Orleans East section of metropolitan New Orleans. Adjacent land use to MAF is predominantly heavy industry, and the nearest residential land use is approximately 1 mile to the north.

The project consists of the excavation of AOI 1, 2, and 3 to the Management Option-1 $Soil_i$ of 0.9 milligram per kilogram of polychlorinated biphenyls (PCBs). The main constituent of concern (COCs) for this site are Aroclor-1248 and Aroclor-1260. Relevant Safety Data Sheets (SDSs) are included as Attachment 1.

3.1 Activities Description

Jacobs will be onsite to oversee and perform the excavation and backfill activities at the Saturn AOIs at the MAF facility. The following is a list of equipment to be used during these field events:

- Excavator
- Trencher (for silt fence installation)
- Dump trucks
- Dozer (to install new clay material)
- Forklift (to unload/load sheet piles)
- Vibratory hammer (to install sheet piles)
- Sheepsfoot roller (to compact new clay backfill)
- Sheet pile material
- Other large construction equipment
- Peristaltic pump (with battery)
- Stainless steel or plastic trowel
- Photoionization detector (PID)
- 4-gas meter
- Distilled water, Alconox, bucket, and brush

3.2 Work Precautions

The following precautions must be taken during work:

- Do not eat, drink, use tobacco products, chew gum, or put hands in mouth while in the immediate work area.
- Wear gloves at applicable times while at the work site.
- Wear protective eyewear at applicable times while at the work site.
- Wash all exposed skin areas with soap and water before departing from the site.
- Remove and change any non-impervious clothing that becomes contaminated during site activities.
- Do not go anywhere on the site other than where directed by the Field Safety Coordinator.
- Wear disposable nitrile gloves while handling sampling equipment or samples.

3.3 Disposal Restrictions

Treat disposable items as ordinary refuse except when gross contamination is expected. In the event that refuse, including disposable personal protective equipment (PPE), is suspected of being grossly contaminated, the refuse will be collected and stored onsite for future disposal. Grossly contaminated investigation-derived waste (IDW) will be taken offsite and disposed of at the River Birch Landfill. Purged groundwater will be containerized onsite (in a frac tank) and will be transferred to the MAF hazardous waste yard, which is a Resource Conservation and Recovery Act (RCRA) facility storage area that complies with 40 CFR 264. The waste will be disposed using the guidelines outlined in 40 CFR 260-273.

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4 Hazard Evaluation

4.1 Physical Hazards

4.1.1 Operational Hazards

Before commencement of field activities, the Field Safety Coordinator will conduct a site reconnaissance to identify any visible or operational hazards.

Appropriate PPE will be worn at all times while work is being performed. This includes the use of disposable nitrile gloves when handling equipment and IDW.

AOI 1, 2, and 3 contains PCB-impacted groundwater and soil. Excavation activities include excavation of soils to 22 feet below ground surface (bgs) and soil sample collection using earth moving equipment and hand tools, which includes the following hazards: noise, contaminated soil and groundwater exposure, heavy equipment operations, bending, and lifting. Groundwater will be pumped from the excavation into a frac tank, which will minimize potential contact with impacted groundwater. The most likely scenario in which a hazard will impact field personnel is from operations related to the excavation. Personnel should wear their PPE, maintain contact with the operators, keep hands and loose clothing and hair away from equipment, avoid heavy lifting scenarios, and maintain an awareness of the excavation extents and should not enter the excavation. The excavator will be used for sample collection. The most likely scenario in which impacted groundwater would be a hazard to field personnel would be in transference of groundwater from the excavation into the frac tank. Personnel should allow equipment operators to transfer water and avoid areas where water can splash or generate vapors. The most likely scenario in which impacted soil would be a hazard to field personnel would be during soil sampling or transferring excavated soil into trucks or containment. Personnel should avoid heavy equipment and handle any soil with nitrile gloved hands and avoid ingesting or inhaling particulates.

4.1.2 Fall Hazards

Field activities can have the potential for fall hazards. Be aware of any uneven terrain, and clear paths of debris and materials that may be a hazard. While on the bridges, be aware of and avoid slick surfaces and space gaps while accessing the different components. If conditions are unsafe, seek an alternate route, or consult the Field Safety Coordinator.

4.1.3 Tools and Equipment

Tools and equipment used by Jacobs shall be inspected and maintained to be safe and adequate for their designated use. Housekeeping of the site shall be maintained to prevent trip hazards. Tools related to excavations and backfill will be operated by subcontractors, not by Jacobs.

Moving objects (including drums) over 50 pounds should not be attempted without the aid of other personnel and/or mechanical equipment. Lifting objects under 50 pounds should only be attempted using proper lifting technique, as follows:

1. Get as close to the object as possible.
2. Use a wide stance with one foot forward and to the side of the object for good balance.
3. Keep your back straight and use your legs and hips to lower yourself down to the object.
4. Slide the object as close to you as possible.
5. Put the hand (same side of your body as the forward foot) on the side of the object furthest from you.

6. Use this basic lifting technique for small objects when you can straddle the load and use a wide stance.
7. Put the other hand on the side of the object closest to you. Your hands should be on opposite corners.
8. Grasp the object firmly with both hands.
9. Prepare for the lift, tighten your core muscles, look forward and upward, and keep a straight and strong back.
10. Lift slowly and follow your head and shoulders. Hold the load close to your body. Lift by extending your legs with your back straight, and breathe out as you lift.

4.1.4 Traffic Hazard

Field activities could encounter Saturn Boulevard traffic on this project. Be aware of the surroundings and watch for traffic. If encroaching on a high-traffic area, orange cones or stations will be set out around the work area. Depending on traffic volume, the Field Safety Coordinator may recommend that a flag person may be necessary.

4.1.5 Noise Hazard

Operation of equipment may present a noise hazard to workers. Jacobs personnel will be provided with hearing protection to be used when noise levels are excessive.

4.1.6 Precautions

To reduce the health and safety risk to workers due to physical hazards at the project site, the following precautions will be observed:

1. American National Standards Institute (ANSI) Class II high-visibility clothing will be worn by personnel at all times on the project site.
2. Hard hats shall include high-visibility reflective tape.
3. Protective eyewear will be worn by personnel in the work area when appropriate.
4. Hearing protection will be worn by personnel as deemed necessary by the Field Safety Coordinator (or if there are noise levels greater than 85 decibels).
5. Leather or other substantial boots will be worn by personnel at all times on the project site.
6. Hand protection (leather gloves) will be worn by personnel when moving and/or lifting equipment as well as when using large hand tools (machetes, sledges, shovels, etc.). Nitrile (or equivalent) gloves will be worn by personnel when handling contaminated materials (e.g., soil, water, or equipment).
7. Before beginning each work shift, the area will be checked for site hazards, including overhead lines, underground lines, aboveground obstructions, tripping hazards, etc.

4.2 Chemical Hazards

The following subsections provide a summary of the anticipated primary COCs for activities in AOI 1, 2, and 3. Refer to attached SDS information (Attachment 1) for complete chemical hazard information.

4.2.1 Aroclor-1248

Aroclor-1248 (Chemical Abstracts Service [CAS] No. 12672-29-6) is hazardous in case of ingestion or inhalation. Aroclor-1248 has adverse effects and may cause damage to the liver and suspected to cause cancer through prolonged or repeated exposure. First aid measures include:

- Inhalation – Supply fresh air; consult doctor in case of complaints.
- Eye contact – Rinse eye open for several minutes under running water.
- Skin contact – Generally, the product does not irritate the skin.
- Ingestion – If symptoms persist, consult doctor.

In all cases of chemical contact, seek immediate medical attention. For additional information, refer to the SDS attached to this HASP (Attachment 1).

4.2.2 Aroclor-1260

Aroclor-1260 (CAS No. 11096-82-5) is hazardous in case of ingestion or inhalation. Aroclor-1260 may cause kidney damage through prolonged exposure. Additionally, Aroclor-1260 is highly flammable. First aid measures include the following:

- Eye contact – Immediately flush with plenty of water. After initial flushing, remove any contact lenses and continue flushing for at least 15 minutes. Assume adequate flushing by separating the eyelids with fingers.
- Skin contact – Wash thoroughly with soap and water. Get medical attention if irritation develops or persists.
- Inhalation – Remove to fresh air. If not breathing, give artificial respiration or give oxygen by trained personnel. Seek immediate medical attention.
- Ingestion – Do NOT induce vomiting. Call a physician or poison control center immediately. Never give anything by mouth to an unconscious person.

In all cases of chemical contact, seek immediate medical attention. For more information, refer to the SDS attached to the HASP (Attachment 1).

4.2.3 Vapor Hazards

Vapor produced by subsurface chemical contamination and organic decomposition sources have the potential to pose explosion and health hazards when vapors released to the atmosphere or accumulate within a structure/enclosed space or are trapped by a surficial impediment such as a structure foundation or pavement. Known potential vapor producing subsurface chemical contaminants at the site include Aroclor-1248 and Aroclor-1260.

Vapors are not visible and are often undetectable by smell or taste. Proper monitoring and ventilation of structures and/or workspace should always be implemented to prevent exposure and/or accumulation. Be aware of potential sources of heat or spark that could ignite flammable vapors. Appropriate monitoring shall be implemented as determined by the Field Safety Coordinator and in accordance with the SHE. Dizziness, headache, or drowsiness can be caused by exposure to vapors. If these occur, immediately leave the area, move to a well-ventilated area, and seek immediate medical attention. First aid measures include the following:

- Inhalation – Allow victim to rest in a well-ventilated area.

In all cases of contact, seek immediate medical attention. For additional information, refer to the SDS included as Attachment 1.

4.3 Biological Hazards

The following subsections outline biological hazards.

4.3.1 Stinging Insects

The most common stinging insects are bees, wasps, and ants. Few species of ants have medically important stings. While most bees possess a defensive sting and sting if grasped or crushed, only a few social species stings often enough or have sufficiently venomous stings to be of medical significance. These include the honeybees and the bumblebees. Respiratory dysfunction is the cause of most deaths, with the second most common cause being anaphylaxis; arteriosclerosis may be a compounding factor. If stung, seek medical attention immediately.

4.3.2 Alligators

While alligator bites are uncommon, alligators still pose a hazard as they can often be found near waterways and cannot always be detected. Being safe around these animals is straightforward. Keep your distance from, do not harass or corner, and never try to feed alligators.

4.3.3 Snakes

There are a variety of snakes native to Louisiana. Most of these snakes are harmless to humans. The seven species of venomous snakes in Louisiana fall into two categories: coral snakes and pit vipers (copperhead, cottonmouth, and rattlesnakes). It is often difficult to positively identify any snakes as venomous from a distance, and snakes should never be approached or disturbed.

4.3.4 Mosquitos and Other Biting Insects

Mosquitos are capable of transmitting a variety of diseases, such as the Dengue, Chikungunya, Zika, and West Nile viruses. People 65 years of age or older are at higher risk for complications from mosquito bites, but everyone is at risk. The best way to protect yourself is to use mosquito repellent containing DEET applied to exposed skin and clothing, wear long-sleeved shirts and pants, and avoid wearing perfumes or colognes when outdoors.

Ticks may also transmit disease to humans. When working in areas prone to insects, personnel should be inspected for ticks or signs of infected bites during breaks, wear long-sleeved shirts and pants, and use tick and bug repellent.

4.3.5 COVID-19

On August 16, 2022, NASA updated their COVID-19 protocol with the current Centers for Disease Control and Prevention recommendations effective August 11, 2022. NASA will no longer require COVID-19 Daily Checklists be filled out for employees and subcontractors prior to work each day.

4.4 Extreme Weather Hazards

The following subsections describe extreme weather hazards.

4.4.1 Heat Stress

Field activities in hot climates create a potential for heat stress. The warning symptoms of heat stress include fatigue, pale skin, dizziness, profuse sweating, loss of strength, headache, and reduced alertness and mental capacity. To prevent heat stress, personnel shall receive adequate water supplies and electrolyte replacement fluids and maintain scheduled work/rest periods.

If you, or anyone else, has symptoms of heat exhaustion, it is essential to immediately get out of the heat and rest, preferably in an air-conditioned room. If you cannot get inside, try to find the nearest cool and shady place.

Other recommended strategies include the following:

- Drink plenty of fluids, especially sports drinks to replace lost salt (avoid caffeine and alcohol).
- Remove any tight or unnecessary clothing.
- Take a cool shower, bath, or sponge bath.
- Apply other cooling measures, such as fans or ice towels.

If such measures fail to provide relief within 15 minutes, seek emergency medical help, because untreated heat exhaustion can progress to heat stroke.

4.4.2 Heat Stroke

Heat stroke results from prolonged exposure to high temperatures—usually in combination with dehydration—which leads to failure of the body's temperature control system. The medical definition of heat stroke is a core body temperature greater than 104 degrees Fahrenheit, with complications involving the central nervous system that occur after exposure to high temperatures. Heat stroke often occurs as a progression from milder heat-related illnesses such as heat cramps, heat syncope (fainting), and heat exhaustion. However, heat stroke can occur even if a person has no previous signs of heat injury.

Common symptoms include nausea, seizures, confusion, disorientation, and sometimes loss of consciousness or coma. Heat stroke is the most serious form of heat injury and is considered a medical emergency. If you suspect that someone has heat stroke, call emergency medical personnel and give first aid until paramedics arrive.

4.4.3 Cold Stress

Field activities in cold climates create a potential for cold stress (hypothermia). The warning symptoms of cold stress include fatigue, shivering, numbness, blue or pale skin, and reduced alertness and mental capacity. To prevent cold stress, personnel shall wear adequate clothing, and maintain scheduled work/rest periods.

If you, or anyone else, has symptoms of cold stress, it is essential to immediately get out of the cold and stay active.

Other recommended strategies include:

- Remove wet clothes and replace with dry clothes or blankets, cover the head.
- Drink warm (not hot) sugary drinks such as sports drinks. Avoid caffeinated beverages and alcohol.
- Cover all extremities completely.
- Place warm objects, such as hot packs or water bottles on the victim’s head, neck, chest, and groin.
- If moderate to severe hypothermia is suspected, call emergency medical personnel immediately.

4.4.4 Severe Weather

Field activities in this area may be interrupted by severe weather, including lightning and thunderstorms, high winds, and heavy rainfall. In the event of severe weather, all field activities should cease, and field personnel should seek shelter within a site building. In the case of lightning, work may not resume until 30 minutes after the last rumble of thunder, or as directed by MAF management.

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5 Communications and Training

Workers at state and federally listed or recognized sites must be provided with adequate information and training to recognize and evaluate potential hazards. Training shall comply with applicable regulations including 29 CFR 1910.1200 "Hazard Communication Standard."

5.1 Communication

The Field Safety Coordinator shall supply all onsite personnel with readily available access to this HASP. This plan shall cover, at a minimum, the following topics:

1. A brief description of the history of the location with regard to health and environmental hazards
2. A description of the activities to which the hazard evaluation summary is applicable
3. A description of any hazards which may be encountered, including:
   a. Physical Hazards - Terrain, traffic, equipment, severe weather (heat stress and cold stress), electrical hazards, and noise
   b. Chemical Hazards - Materials used and stored at the site and materials released at the site
   c. Biological Hazards - Insects, plants, animals, pathogens, and infectious materials
   d. Weather Hazards – Low/high temperatures, severe weather, and lightning
4. A description of the levels of protection selected for the operation
5. Equipment decontamination procedure if different from those specified herein
6. Summary of emergency contacts for use in the event of fire, explosion, medical emergency, or other emergency, including the location of the nearest telephone and an address and phone number to provide to emergency personnel

MAF Emergency Contact	**(504) 257-2333**
In the event of an emergency, call the MAF Emergency Number. Emergency First Responders dispatched by 911 Call Centers do not have gate access to the site and will not be able to reach you.	

New Orleans Emergency Medical Services	(504) 658-1557
New Orleans Fire Department Fire Station Engine 45	(504) 658-4700
New Orleans Police Department	(504) 658-6070
MAF Emergency	(504) 257-2333
Site Contact (Eric Stack; NASA)	(504) 206-5547
Program Manager (TBD; Jacobs)	(XXX) XXX-XXXX

7. A map showing the route to the nearest hospital is shown on the cover of this plan.

Prior to any employee or subcontractor beginning work on the site, the Field Safety Coordinator shall brief all Jacobs employees as well as subcontractors on the contents of this plan. Personnel will have the opportunity to review the plan and ask questions about the planned work or hazards. Also, the Field Safety Coordinator will complete a brief site reconnaissance to familiarize the personnel with site conditions, boundaries, and physical hazards.

By Jacobs voluntarily sharing this information with subcontractors and contractors, those firms are not relieved of the responsibility to provide their personnel with adequate and proper supervision, safety information, instruction, and equipment.

5.2 Health and Safety Training

All personnel will be provided with approved health and safety training as outlined in 29 CFR 1910.120(e). This training will include a briefing and review of this HASP and the MAF site health and safety training presentation provided by NASA. Also, before beginning field work, Jacobs personnel will be fit-tested for full-face respirators and maintain a full-face respirator and the appropriate organic vapor cartridges (OVCs). Documentation of this training will be maintained at a central location at the Jacobs office.

6 Personal Protection

PPE and safety requirements must be appropriate to protect against the known or worst potential hazards on the site. Protective equipment should be selected based on the concentrations and possible routes of exposure to known or potential worst-case substances. All Jacobs personnel engaged in work onsite will be participants in the Jacobs medical monitoring program described in Section 12 or a similar program.

Level D PPE is described in Section 8. Jacobs anticipates that Level D protection and basic site safety measures will be sufficient in normal circumstances at this project site. However, breathing zone conditions will be continuously monitored for the presence of volatile organic compounds using a handheld PID. If the PID indicates a sustained level of 1 part per million (ppm) or greater in the breathing zone, work will be stopped and the area evacuated (to at least 20 feet upwind). A sustained breathing zone reading is defined as a PID reading from 3 to 5 feet above ground surface sustained for at least 30 seconds.

6.1 Gloves and Clothing

Avoid skin contact with any of the COCs. PPE shall be used that inhibits or slows down permeation or degradation caused by the COCs. Consult with PPE manufacturer. Recommended materials for gloves include Viton, Viton/Butyl, Silver Shield/4H, and Barrier. Coveralls should be made from Tychem BR, CSM and TK, Trellchem HPS, and VPS (8-hour breakthrough).

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7 Levels of Protection

This plan is not intended for use when levels of protection above Level C are required. Levels D and C are described in the following subsections.

7.1 Level D

Level D is the basic work uniform for all site operations. Level D should be selected when performing environmental sampling involving dilute concentrations of contaminants on sites that have been characterized by previous analyses or research.

7.1.1 Criteria for Use of Level D

The following criteria indicate situations where Level D personal protection is adequate:

- No indication of airborne health hazards present
- No indication of gross contamination on the PID and/or organic vapor analyzer
- No handling of free product

7.1.2 Personal Protective Equipment

The following equipment is necessary for Level D personal protection:

- Standard work clothing
- Optional disposable chemical-resistant clothing appropriate for known or expected levels of contamination
- Steel-toe or protective-toe boots/shoes
- Safety glasses or safety goggles
- Hearing protection (ear plugs)
- Disposable latex or nitrile gloves
- Optional moisture-resistant outer gloves
- Hard hat

7.2 Level C

Level C protection should be selected when the type of airborne substance is known, concentration measured, criteria for using air-purifying respirators met (as described in Section 7.1), and skin and eye exposure is unlikely. Periodic monitoring of the air must be performed.

7.2.1 Criteria for Use of Level C

The following criteria indicate situations where Level C personal protection is necessary:

- PID indicates sustained breathing zone readings of 1.0 ppm or greater.
- During evaluation of air in breathing zone using a Draeger Pump and tubes.
- If threshold limit values for trichloroethene (TCE), dichloroethene (DCE), or vinyl chloride (VC) are met or exceeded in breathing zone, but the length of wear time should not exceed the intervals indicated in Section 7.

7.2.2 Personal Protective Equipment

The following equipment is necessary for Level C personal protection:

- Full-face mask, air-purifying respirator (National Institute for Occupational Safety & Health [NIOSH] approved), appropriate cartridge filters
- Chemical-resistant clothing
- Chemical-resistant gloves
- Steel- or protective-toe boots

8 Decontamination Procedures

The following subsections outline decontamination procedures.

8.1 Personnel Decontamination

If Level D protection is used, any disposable inner gloves or protective clothing should be sealed in a plastic bag and disposed of properly. Moisture-resistant outer gloves and outer boots should be scrubbed with a stiff brush, non-phosphate soap, and water, then rinsed to remove possible residual contamination. Disposable equipment should be used whenever possible.

If Level C protection is used, any chemical-resistant clothing in contact with contamination should be scrubbed with a stiff brush with non-phosphate soap and water, then rinsed to remove any residual contamination. OVCs should be replaced after every shift of use. OVCs can be used in situations with TCE concentrations up to 100 ppm for up to 8 hours, DCE concentrations up to 50 ppm for up to 8 hours, and VC concentrations over 1 ppm for up to 30 minutes.

8.2 Equipment Decontamination

Proper decontamination of all equipment is necessary to avoid transferring contaminants from the site, thereby increasing potential for exposure of onsite and offsite personnel. The measures described below should be followed before leaving all sites, as applicable to the equipment being used. Any variations from the procedures described in this section for reasons of worker health or safety must be described by the Project Manager in the site-specific hazard summary.

These measures are separate from, and may not be substituted for, other decontamination procedures associated with proper sampling protocol.

1. All non-disposable equipment must be thoroughly cleaned with an appropriate cleaning solution, rinsed with clean water, and wiped dry with paper towels between sampling events and before leaving the work site. Alternatively, the equipment may be wrapped in absorbent material and/or stored in plastic bags sealed to prevent contact with workers, vehicles, etc.

2. The rinse water from this operation will be collected and disposed of onsite as IDW.

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9 Emergency Procedures

The following subsections outline emergency procedures.

9.1 Inhalation

If warning signals such as dizziness, nausea, headache, shortness of breath, burning sensation in mouth, throat, or lung, or symptoms specific to hazard found at the site are apparent, the victim should leave the contaminated air space immediately. Have someone contact emergency services and obtain health and safety information about potential contaminants.

Do not attempt a rescue. Rescuers should make sure they are properly trained in first aid and rescue and that they are wearing proper respiratory and protective equipment before attempting the rescue. If someone falls unconscious, the victim should be pulled out of the contaminated area by qualified rescuers immediately if they do not have any injuries that would prohibit moving them (such as a spinal injury). The qualified rescuers should make sure that the area is safe to enter. If the area cannot be safely entered, the area should be ventilated.

If the victim is no longer breathing, mouth-to-mouth resuscitation or some other form of artificial respiration should be administered by a person who is properly trained and certified in a location away from the contaminated area.

Medical attention should be obtained as soon as possible.

9.2 Skin Exposure

The contaminated skin should be washed with copious amounts of soap and water. If clothing is contaminated, it should be removed immediately, and the skin washed thoroughly with running water. If a shower is available, it should be used immediately. Clothes should be removed while showering. This procedure may be lifesaving as certain highly toxic chemicals are rapidly absorbed through the skin.

All contaminated parts of the body, including the hair, should be thoroughly decontaminated. It may be necessary to wash repeatedly.

9.3 Ingestion

A poison control center or emergency service should be contacted immediately to determine an appropriate course of action. The SDS should also be consulted for COC-appropriate action. Vomiting should not be induced for any of the COCs onsite.

Medical attention should be obtained immediately.

9.4 Eyes

If a contaminant should get in the eyes, they should be washed with plenty of water. The eye itself should be held open, rotated, and flooded with water so that all surfaces are washed thoroughly. Washing should be continued for at least 15 minutes. The SDS should also be consulted for COC-appropriate action.

Medical attention should be obtained immediately.

9.5 Personal Injury

A first aid kit shall be readily available in case of an injury. Administer first aid and/or seek medical help, if necessary. Medical emergencies take precedence over decontamination procedures. A map showing the route to the nearest hospital is provided on the cover of this HASP. In the event that a phone is not readily

available onsite, it is the responsibility of the Field Safety Coordinator to identify the location of the nearest phone and provide this information to all onsite personnel.

9.6 Spill or Release of Hazardous Material

Clean up, isolate, or contain spills as appropriate. Contact emergency response personnel, Project Manager, and/or client company officials as appropriate.

9.7 Potential or Actual Fire/Explosion

If it is safe to do so, onsite personnel may use available firefighting equipment to control or extinguish the fire and remove or isolate materials that may contribute to the fire. Contact the fire department, Project Manager, and/or client company officials as appropriate.

9.8 Evacuation

In the event of an emergency that requires an evacuation of the site, verbal instructions will be given by the Field Safety Coordinator to evacuate the area. Personnel will immediately exit the site to the pre-designated upwind location. The Field Safety Coordinator will account for Jacobs personnel and will advise personnel of further instructions, if necessary. The Field Safety Coordinator will also advise responding offsite emergency personnel, if necessary. Personnel shall not re-enter the site until the emergency conditions have been corrected and the Field Safety Coordinator has authorized re-entry.

10 Medical Monitoring

All Jacobs personnel engaged in onsite activities shall be participants in a medical monitoring program similar to the following. As participants in this program, these individuals will have had recent physical examinations.

The following Jacobs personnel will be accessing the site during field activities, and the dates at which their medical monitoring program was last updated are included:

1. TBD Jacobs Date TBD
2. TBD Jacobs Date TBD

The primary goal of this medical monitoring program is to provide evaluation and ongoing surveillance of the health status of employees potentially exposed to toxic substances as a result of their work-related activities. An active health monitoring program for those employees potentially at risk is an important tool in evaluating the effects of chronic low-level exposures or acute exposures related to operations at hazardous waste sites. The effects of low-level exposures may not become apparent until years after the initial exposure.

This medical monitoring program includes laboratory testing, personnel medical history evaluation, physical examination, and other specific testing.

In addition to this annual re-examination, provisions are made for specific post-exposure examinations in the event of a suspected exposure during a particular field event.

The program shall meet or exceed the minimum requirements established in Occupational Safety and Health Administration (OSHA) standard 29 CFR 1910.120.

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11 Personnel Authorization

All personnel engaged in onsite activities must read this HASP. By signing and dating this form, the listed individual acknowledges that they have read, understand, and will comply with the requirements of this HASP.

Personnel Authorized to Enter Site

Name	Signature	Date

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12 Field Safety Coordinator's Summary

(To be completed by Field Safety Coordinator after completion of each phase of field work and returned to the Project Manager.)

Project Summary

Project Name:	
Project Number:	
Activities Completed:	
Date of Activities:	

During the execution of the activities covered by this HASP, there were:

1. No violations of the HASP provisions and no obvious contamination of Jacobs employees or subcontractors.
2. The following incidents, violations of the HASP provisions, or obvious contamination of Jacobs personnel or subcontractors. (Give details of who, when, type of contamination, circumstances, first aid or medical assistance administered in the space below.)

Signature_____ Date _____
Field Safety Coordinator

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Attachment 1
Safety Data Sheets

(will be provided before field work)

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