UFP-Quality Assurance and Project Plan

Prepared for

Former GE Facility
Road #3, Kilometer 122.9
Patillas, Puerto Rico 00723
United States

Prepared By

MWH Americas, Inc.
35055 W. Twelve Mile Road, Suite 140
Farmington Hills, Michigan

Revision Number: 0
Revision Date: 05/21/2012

INTRODUCTION

This Quality Assurance and Project Plan (QAPP) has been prepared on behalf of GE Energy (GE) by MWH Americas, Inc. (MWH). The purpose of the QAPP is to support sampling activities at the former General Electric facility located in Patillas, Puerto Rico. Groundwater contains volatile organic compounds (VOCs) that originated from a French Sump that was removed in 1991.

This QAPP was prepared based on the Uniform Federal Policy (UFP) for QAPPs, Final Version 1, March 2005, as requested by the USEPA, for sampling in support of closure activities.

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QAPP Worksheets
UFP-QAPP for Former GE Facility
Patillas, Puerto Rico

QAPP Worksheet #1
(UFP-QAPP Section 2.1)
Title and Approval Page

Site Name/Project Name: Former GE Facility
Site Location: Road #3, Km 122.9, Patillas, Puerto Rico

Document Title: Worksheets for Former GE Facility, Patillas Puerto Rico

Lead Organization: General Electric

Preparer's Name and Organizational Affiliation: Brad Toth, MWH

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Preparation Date (Day/Month/Year): 04/06/2012

Investigative Organization's Project Manager/Date: Bradly R Toth 5/21/12
Signature

Printed Name/Organization: Bradly Toth, MWH

Investigative Organization's Project QA Officer/Date: 5/21/12
Signature

Printed Name/Organization: Joseph Rock, MWH

Lead Organization's Project Manager/Date: 5/21/12
Signature

Printed Name/Organization: Joel Robinson, GE Project Manager

Approval Signatures/Date: _____
Signature

Printed Name/Title: Jesse Avilés, USEPA Project Manager

Approval Authority: USEPA

Other Approval Signatures/Date: _____
Signature

Printed Name/Title:

QAPP Worksheet #2
(UFP-QAPP Section 2.2.4)
QAPP Identifying Information

This document has been prepared to support the following activities:

1. *Ongoing groundwater monitoring during the completion of the RCRA Facility Investigation (RFI) and the future Corrective Measures Study (CMS) process*;
2. *Potential future sampling activities associated with the implementation of corrective measures.*

Site Name/Project Name: Former GE Facility
Site Location: Road #3, Km 122.9
Patillas, Puerto Rico
Site Number/Code: NA
Operable Unit: NA
Contractor Name: MWH
Contractor Number: NA
Contract Title: NA
Work Assignment Number: TD-3

Title: Former GE Facility
Revision Number: 0

Revision Date: 11/21/2011
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1. Identify regulatory program: RCRA
2. Identify approval entity: USEPA Region 2
3. The QAPP is (select one): ☐Generic ☒Project Specific
4. List dates of scoping sessions that were held: None
5. List dates and titles of QAPP documents written for previous site work, if applicable:

   Title Approval Date

6. List organizational partners (stakeholders) and connection with lead organization:
   USEPA Region 2 is overseeing the closure of this site, which is being performed by GE. Because the site is located in Puerto Rico, the Puerto Rico Environmental Quality Board (EQB) provides technical input on the project.
7. List data users:
   USEPA, GE, EQB, MWH
8. If any required QAPP elements and required information are not applicable to the project, then circle the omitted QAPP elements and required information on the attached table. Provide an explanation for their exclusions below:

QAPP Worksheet #2
QAPP Identifying Information
(continued)

Required QAPP Element(s) and Corresponding QAPP Section(s)	Required Information	Crosswalk to Related Documents
Project Management and Objectives		
2.1 Title and Approval Page	- Title and Approval Page	Worksheet #1
2.2 Document Format and Table of Contents 2.2.1 Document Control Format 2.2.2 Document Control Numbering System 2.2.3 Table of Contents 2.2.4 QAPP Identifying Information	- Table of Contents - QAPP Identifying Information	Worksheet #2
2.3 Distribution List and Project Personnel Sign-Off Sheet 2.3.1 Distribution List 2.3.2 Project Personnel Sign-Off Sheet	- Distribution List - Project Personnel Sign-Off Sheet	Worksheet #3 Worksheet #4
2.4 Project Organization 2.4.1 Project Organizational Chart 2.4.2 Communication Pathways 2.4.3 Personnel Responsibilities and Qualifications 2.4.4 Special Training Requirements and Certification	- Project Organizational Chart - Communication Pathways - Personnel Responsibilities and Qualifications Table - Special Personnel Training Requirements Table	Worksheet #5 Worksheet #6 Worksheet #7 NA – No specialized training required
2.5 Project Planning/Problem Definition 2.5.1 Project Planning (Scoping) 2.5.2 Problem Definition, Site History, and Background	- Project Planning Session Documentation (including Data Needs tables) - Project Scoping Session Participants Sheet - Problem Definition, Site History, and Background - Site Maps (historical and present)	Worksheet #9 Worksheet #10
2.6 Project Quality Objectives and Measurement Performance Criteria 2.6.1 Development of Project Quality Objectives Using the Systematic Planning Process 2.6.2 Measurement Performance Criteria	- Site-Specific PQOs - Measurement Performance Criteria Table	Worksheet #11 Worksheet #12

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Required QAPP Element(s) and Corresponding QAPP Section(s)	Required Information	Crosswalk to Related Documents
2.7 Secondary Data Evaluation	- Sources of Secondary Data and Information - Secondary Data Criteria and Limitations Table	Worksheet #13
2.8 Project Overview and Schedule 2.8.1 Project Overview 2.8.2 Project Schedule	- Summary of Project Tasks - Reference Limits and Evaluation Table - Project Schedule/Timeline Table	Worksheet #14 Worksheet #15 Worksheet #16
Measurement/Data Acquisition		
3.1 Sampling Tasks 3.1.1 Sampling Process Design and Rationale 3.1.2 Sampling Procedures and Requirements 3.1.2.1 Sampling Collection Procedures 3.1.2.2 Sample Containers, Volume, and Preservation 3.1.2.3 Equipment/Sample Containers Cleaning and Decontamination Procedures 3.1.2.3 Field Equipment Calibration, Maintenance, Testing, and Inspection Procedures 3.1.2.4 Supply Inspection and Acceptance Procedures 3.1.2.6 Field Documentation Procedures	- Sampling Design and Rationale - Sample Location Map - Sampling Locations and Methods/SOP Requirements Table - Analytical Methods/SOP Requirements Table - Field Quality Control Sample Summary Table - Sampling SOPs - Project Sampling SOP References Table - Field Equipment Calibration, Maintenance, Testing, and Inspection Table	Worksheet #18 GWTP design drawings P&ID-1 through P&ID-15 Worksheet #19 Worksheet #20 Attachment B, Field Sampling SOPs Worksheet #21 Worksheet #22
3.2 Analytical Tasks 3.2.1 Analytical SOPs 3.2.2 Analytical Instrument Calibration Procedures 3.2.3 Analytical Instrument and Equipment Maintenance, Testing, and Inspection Procedures 3.2.4 Analytical Supply Inspection and Acceptance Procedures	- Analytical SOPs - Analytical SOP References Table - Analytical Instrument Calibration Table - Analytical Instrument and Equipment Maintenance, Testing, and Inspection Table	Attachment A, Laboratory SOPs

QAPP Worksheet #2
QAPP Identifying Information
(continued)

Required QAPP Element(s) and Corresponding QAPP Section(s)	Required Information	Crosswalk to Required Documents
3.3 Sample Collection Documentation, Handling, Tracking, and Custody Procedures 3.3.1 Sample Collection Documentation 3.3.2 Sample Handling and Tracking System 3.3.3 Sample Custody	- Sample Collection Documentation Handling, Tracking, and Custody SOPs - Sample Container Identification - Sample Handling Flow Diagram - Example Chain-of-Custody Form and Seal	Worksheet # 26 and #27
3.4 Quality Control Samples 3.4.1 Sampling Quality Control Samples 3.4.2 Analytical Quality Control Samples	- QC Samples Table - Screening/Confirmatory Analysis Decision Tree	Worksheet # 28 and Attachment C
3.5 Data Management Tasks 3.5.1 Project Documentation and Records 3.5.2 Data Package Deliverables 3.5.3 Data Reporting Formats 3.5.4 Data Handling and Management 3.5.5 Data Tracking and Control	- Project Documents and Records Table - Analytical Services Table - Data Management SOPs	Worksheet # 29 Worksheet # 30
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4.1 Assessments and Response Actions 4.1.1 Planned Assessments 4.1.2 Assessment Findings and Corrective Action Responses	- Assessments and Response Actions - Planned Project Assessments Table - Audit Checklists - Assessment Findings and Corrective Action Responses Table	Worksheet # 31 Worksheet # 32
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QAPP Worksheet #2
QAPP Identifying Information
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Required QAPP Element(s) and Corresponding QAPP Section(s)	Required Information	Crosswalk to Related Documents
Data Review		
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5.2 Data Review Steps 5.2.1 Step I: Verification 5.2.2 Step II: Validation 5.2.2.1 Step IIa Validation Activities 5.2.2.2 Step IIb Validation Activities 5.2.3 Step III: Usability Assessment 5.2.3.1 Data Limitations and Actions from Usability Assessment 5.2.3.2 Activities	- Verification (Step I) Process Table - Validation (Steps IIa and IIb) Process Table - Validation (Steps IIa and IIb) Summary Table - Usability Assessment	Worksheet # 34 Worksheet # 35 Worksheet # 36 Worksheet # 37
5.3 Streamlining Data Review 5.3.1 Data Review Steps To Be Streamlined 5.3.2 Criteria for Streamlining Data Review 5.3.3 Amounts and Types of Data Appropriate for Streamlining		

QAPP Worksheet #3

(UFP-QAPP Manual Section 2.3.1)

List those entities to whom copies of the approved QAPP, subsequent QAPP revisions, addenda, and amendments will be sent.

☐ Worksheet Not Applicable (State Reason)

Distribution List

QAPP Recipients	Title	Organization	Telephone Number	Fax Number	E-mail Address	Document Control Number
Mr. Jesse Avilés	USEPA Project Manager	Caribbean Environmental Protection Division United States Environmental Protection Agency	787-977-5882		Aviles.jesse@epa.gov	
Josephine Acevedo Esquilin	EQB Project Manager	Puerto Rico Environmental Quality Board	787-767-8181	787-767-8118	josephineacevedo@jca.gobierno.pr	
Joel Robinson	EHS Project Manager	GE Energy	412-319-7000		Joel.robinson@ge.com	
Bradly Toth	MWH Project Manager	MWH Americas, Inc.	248-522-8333	248-522-8344	Bradly.r.toth@us.mwhglobal.com	
Joseph Rock	MWH Quality Assurance Officer	MWH Americas, Inc.	503-220-5412		Joseph.m.rock@us.mwhglobal.com	

QAPP Worksheet #4

(UFP-QAPP Manual Section 2.3.2)

Have copies of this form signed by key project personnel from each organization to indicate that they have read the applicable sections of the QAPP and will perform the tasks as described. Ask each organization to forward signed sheets to the central project file.

Project Personnel Sign-Off Sheet

Organization: USEPA Region 2

Project Personnel	Title	Telephone Number	Signature	Date QAPP Read
Mr. Jesse Avilés	USEPA Project Manager	787-977-5882		

Organization: General Electric

Project Personnel	Title	Telephone Number	Signature	Date QAPP Read
Joel Robinson	EHS Project Manager	412-319-7000		

QAPP Worksheet #4
Project Personnel Sign-Off Sheet
(Continued)

Organization: MWH Americas, Inc.

Project Personnel	Title	Telephone Number	Signature	Date QAPP Read
Bradly R Toth	MWH Project Manager	248-522-8333		
Kimberly Kesler-Arnold	MWH Principal Hydrogeologist	248-522-8333		
Brigid Zvirbulis	MWH Project Chemist	248-522-8333		
Joseph Rock	MWH Quality Assurance Officer	503-220-5412		

Organization: PPA

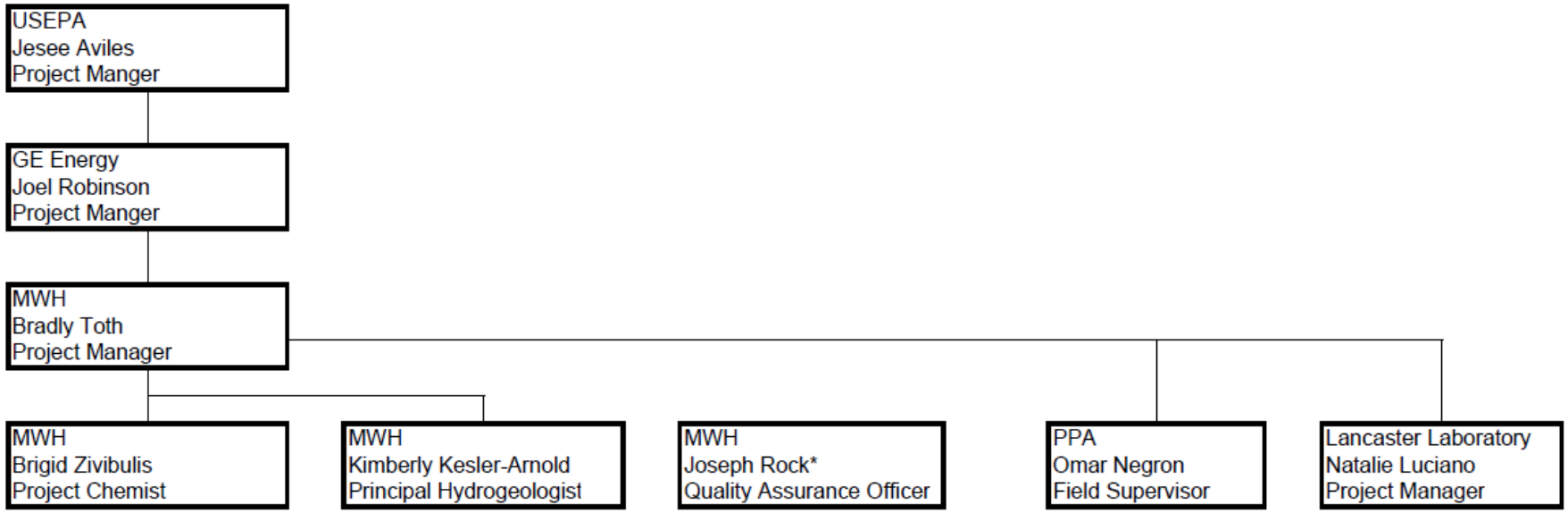
Project Personnel	Title	Telephone Number	Signature	Date QAPP Read
Omar Negron	GES Project Manager and Field Supervisor	939-579-1010		

Organization: Lancaster Laboratories

Project Personnel	Title	Telephone Number	Signature	Date QAPP Read
Natalie Luciano	Lancaster Project Manager	717-656-2300		

QAPP Worksheet #5

(UFP-QAPP Manual Section 2.4.1)



* The MWH QAO is independent from any office obtaining or using environmental data during this project.

QAPP Worksheet #6

(UFP-QAPP Manual Section 2.4.2)

Describe the communication pathways and modes of communication that will be used during the project, after the QAPP has been approved. Describe the procedures for soliciting and/or obtaining approval between project personnel, between different contractors, and between samplers and laboratory staff. Describe the procedure that will be followed when any project activity originally documented in an approved QAPP requires real-time modifications to achieve project goals or a QAPP amendment is required. Describe the procedures for stopping work and identify who is responsible.

☐ Worksheet Not Applicable (State Reason)

Communication Pathways

Communication Drivers	Responsible Entity	Name	Phone Number	Procedure (Timing, Pathways, etc.)
Point of Contact with USEPA and EQB	GE EHS Project Manager	Joel Robinson	412-319-7000	Communications requiring notification to USEPA or EQB will be submitted to Joel Robinson. Mr. Robinson will directly contact USEPA and EQB.
Manage all Project Phases	GE EHS Project Manager	Joel Robinson	412-319-7000	All project related communications are immediately directed to the GE EHS Project Manager who will forward communications to the USEPA. The GE EHS Project Manager maintains stop work authority.
Daily Field Reports	Field Supervisor	Omar Negron	939-579-1010	Field concerns and communications are directed to the MWH Project Manager. The MWH Project Manager forwards the communications as needed to the GE EHS Project Manager.
QAPP Changes in the Field	Field Supervisor	Omar Negron	939-579-1010	Quality changes and communications with regards to the QAPP will be directed to the MWH Project Manager. The MWH Project Manager will forward the communications to the MWH Project Chemist for consultation.

Communication Pathways

Communication Drivers	Responsible Entity	Name	Phone Number	Procedure (Timing, Pathways, etc.)
QAPP Amendments	MWH Project Chemist	Brigid Zvirbulis	248-522-8304	Project Chemist will amend the QAPP and submit to the GE EHS and then USEPA for approval before the changes are implemented.
Laboratory Data Quality Issues	Laboratory Project Manager	Natalie Luciano	717-656-2300	All QA/QC issues with project field samples will be reported by the Laboratory QA Manager to MWH Project Chemist. MWH Project Chemist will communicate to the MWH Project Manager and GE EHS Project Manager.
Field Corrective Actions	MWH Project Manager Field Supervisor	Bradly Toth Omar Negron	248-522-8310	The need for corrective action for field issues will be determined by the MWH Project Manager in consultation with the Field Supervisor, and GE EHS Project Manager.
Release of Analytical Data	MWH Project Chemist	Brigid Zvirbulis	248-522-8304	No analytical data can be released until validation is completed and the MWH Project Chemist has approved the release with review and approval from GE EHS Project Manager.
Project Quality	Quality Assurance Officer	Joseph Rock	503-220-5412	The Quality Assurance Officer will be responsible for identifying and resolving quality issues for the duration of the project. The QAO will coordinate with the proper Project Manager to resolve quality issues.

QAPP Worksheet #7

(UFP-QAPP Manual Section 2.4.3)

Identify project personnel associated with each organization, contractor, and subcontractor participating in responsible roles. Include data users, decision-makers, project managers, QA officers, project contacts for organizations involved in the project, project health and safety officers, geotechnical engineers and hydrogeologists, field operation personnel, analytical services, and data reviewers. Identify project team members with an asterisk (*). Attach resume to this worksheet or note the location of the resumes.

☐ Worksheet Not Applicable (State Reason)

Personnel Responsibilities and Qualification Table

Name	Title	Organizational Affiliation	Responsibilities	Education and Experience Qualifications
Bradly Toth	Project Manager	MWH	Oversees project activities	B.A., Chemistry; M.S.E., Environmental Engineering, 13 years of experience
Kimberly Kesler-Arnold	Principal Hydrogeologist	MWH	Senior-level review of deliverables and quality control.	B.S., Geology; M.S., Engineering Geology; 31 years of experience; CPG
Dan McNeely	Health and Safety Officer	MWH	Oversees health and safety for field activities	B.S., Geography; 6 years experience; ACM inspector; DOT Haz Mat training; OSHA Construction Safety & Health
Brigid Zvirbulis	Project Chemist	MWH	Analytical chemistry oversight	B.S., Chemistry, and B.S., Chemical Engineering; 18 years of experience
Joseph Rock	Quality Assurance Officer	MWH	Identify and resolve quality issues for the duration of the project.	B.S., Environmental Science; 12 years of experience
Omar Negron	Field Supervisor	GES	Direct and perform sampling activities	B.S., Geology; 19 years of experience; PG

QAPP Worksheet #8

(UFP-QAPP Manual Section 2.4.4)

Provide the following information for those projects requiring personnel with specialized training. Attach training records and/or certificates to the QAPP or note their location

☑ Worksheet Not Applicable (State Reason) No specialized training is required.

Special Personnel Training Requirements Table

Project Function	Specialized Training – Title or Description of Course	Training Provider	Training Date	Personnel/Groups Receiving Training	Personnel Titles/ Organizational Affiliation	Location of Training Records/Certificates

QAPP Worksheet #9

(UFP-QAPP Manual Section 2.5.1)

Since 2007, GE project managers and representatives have been coordinating with Jesse Aviles (USEPA) during each phase of the project to ensure that appropriate steps are taken to achieve closure. Planning sessions have included conference calls, emails, and formal letters. The following items have been discussed during these planning sessions: offsite property access; groundwater monitoring frequency; groundwater modeling; completion of Environmental Indicators and delineation of offsite groundwater; completion of RFI Report; and closure of loading dock vault.

The project path forward was set forth during a conference call on June 28, 2007, between GE (Michael Goldstein) and USEPA (Jesse Aviles). During this planning session, GE agreed to complete the Governmental Performance Results Act (GRPA) Environmental Indicator (Ell CA-750 "Migration of Contaminated Groundwater Under Control" for the facility. However, it was recognized that to complete this El, information on down gradient groundwater quality would be required. To provide information on down gradient groundwater quality, GE had been attempting to obtain access to adjacent properties (to install monitoring wells) for several months without success. Therefore, (as agreed by GE and USEPA) in lieu of continuing to try to obtain access to off-site properties to install additional monitoring wells, GE completed a constituent fate and transport model to predict the characteristics of down gradient, offsite groundwater. The results were provided to USEPA.

Additional groundwater sampling was requested by USEPA in 2009. The proposed sampling is outlined in GE's letter to USEPA dated May 13, 2009.

Complete this worksheet for each project scoping session held. Identify project team members who are responsible for planning the project.

Project Scoping Session Participants Sheet

Project Name: **Projected Date(s) of Sampling:** **Project Manager:**	**Site Name:** **Site Location:**
Date of Session: **Scoping Session Purpose:**	

Name	Title	Affiliation	Phone #	E-mail Address	Project Role

Comments/Decisions:

Action Items:

Consensus Decisions:

QAPP Worksheet #10

(UFP-QAPP Manual Section 2.5.2)

Clearly define the problem and the environmental questions that should be answered for the current investigation and develop the project decision "If…, then…" statements in the QAPP, linking data results with possible actions. The prompts below are meant to help the project team define the problem. They are not comprehensive.

Problem Definition

The problem to be addressed by the project: Historical operations associated with a French Sump have resulted in the presence of VOCs in groundwater beneath the Site and down-gradient of the Site.

The environmental questions being asked:

Do the concentration of VOCs in groundwater or soil present unacceptable risks to human health and the environment?
Has the extent of VOCs in groundwater and soil been defined?
Is active remediation of the groundwater or soil necessary to protect human health and the environment?

Observations from any site reconnaissance reports:

The Site is located on the southeastern coast of Puerto Rico at Road #3, Km 122.9, Patillas, Puerto Rico. The Site location is shown on Figure 1. The Site covers approximately 7.8 acres. From November 1974 to March 1987, GE (operating as Caribe General Electric Products) manufactured and assembled electro-mechanical products. A French Sump was constructed at the facility in 1977 and was used for waste disposal until 1980. The location of the sump is shown on Figure 2. The Site was idle from 1987 to 1993, when no manufacturing operations were conducted. Since 1993, GE has used the facility for warehousing and assembly operations under the current name of GE Puerto Rico Investment, Inc.

In October 1990, soils in and adjacent to the former French Sump were excavated, stabilized, and shipped to a Resource Conservation and Recovery Act (RCRA)-approved landfill. The U.S. EPA accepted the closure of the sump as complete in March 1991. The impacted groundwater that is the subject of this investigation is associated with the former French Sump and extends south-southwest from the facility to the flood plain of the Rio Grande de Patillas.

Investigation of the groundwater impacts in the area of the French Sump began in 1989 as part of a RCRA Facility Investigation (RFI). Eleven onsite monitoring wells were installed adjacent to and downgradient of the former French Sump (see Figure 2). Five monitoring wells were also installed offsite to assess groundwater quality. Of the total 16 wells, one onsite well (P-4A) was abandoned; one offsite well (P-12) cannot be located and was presumably destroyed; and four offsite wells (P-13S, P-13D, P-14S, and P-14D) have had their access permission rescinded by the property owner.

The RFI Report (SEC, 1991) was submitted to the U.S. EPA in 1991. Quarterly groundwater sampling was conducted from 1991 through 1999. Volatile organic compounds (VOCs), namely 1,1,1-trichloroethane (1,1,1-TCA) and 1,1-dichloroethene (1,1-DCE), were identified in the RFI Report as the constituents of concern (COCs) in groundwater within the alluvial/colluvial aquifer beneath the Site. The extent of 1,1,1-TCA does not extend offsite. However, the extent of 1,1-DCE impacted groundwater extends offsite to the south-southwest, which is generally consistent with the direction of apparent groundwater flow.

Problem Definition

In 2003, GE installed six additional monitoring wells offsite to determine the extent of the 1,1-DCE in groundwater. The results of this investigation were provided to U.S. EPA in a Supplemental RFI Report (EarthTech, 2005). U.S. EPA's response to this Supplemental RFI Report stated that the information was not sufficient to determine the extent of impacted groundwater, and therefore the CA-750 determination could not be completed. At the time of the Supplemental RFI, the farthest downgradient wells (P-13S/D and P-14S/D) had not been sampled for nine years, and access to these wells had been rescinded. From 1991 through 1996, these wells were sampled eight times and VOCs were not detected.

In 2006, GE installed an additional monitoring well cluster (P-20S and P-20D) to further delineate the extent of 1,1-DCE in groundwater. Analytical results from the shallow well (P-20S) did not show the presence of 1,1-DCE. However, groundwater samples from the deeper well (P-20D) indicated 1,1-DCE downgradient and offsite at a concentration of 37 to 44 micrograms per liter (µg/l), which is greater than its Maximum Contaminant Level (MCL) of 7 µg/l.

Based on these results, the U.S. EPA requested that GE pursue access to additional downgradient properties to install monitoring wells to further define the extent of the 1,1-DCE in groundwater. GE intended to install these additional wells downgradient of P-20S/D and upgradient of P-13S/D and P-14S/S. Although numerous attempts were made by GE, access was not granted to the properties, and the wells could not be installed. As a result, GE and U.S. EPA agreed that the project should move forward to estimate the extent of 1,1-DCE in groundwater without the use of these wells.

In June 2009, GE performed a groundwater monitoring event, and in July 2009, GE performed fate and transport modeling to estimate the extent of 1,1-DCE in groundwater. The output of the model, which contained the necessary information to make the CA-750 determination, was provided to U.S. EPA in September 2009. The model estimated that 1,1-DCE may have reached the Rio Grande de Patillas at a concentration of 23 µg/L. This concentration is less than 10 times the MCL for 1,1-DCE (7 µg/L) and is considered an insignificant discharge to a surface water by U.S. EPA (Documentation of Environmental Indicator Determination, RCRA Corrective Action, Environmental Indicator (EI) RCRIS code (CA750), Migration of Contaminated Groundwater Under Control, Interim Final 2/5/99).

Subsequent to the fate and transport modeling and at the request of the U.S. EPA, GE performed additional groundwater monitoring events (September 2009, December 2009, and March 2010). The results of these monitoring events were previously submitted to U.S. EPA.

In September 2010, GE performed a Phase II ESA and industrial building cleaning at the facility following cessation of operations. The Phase II ESA sample results did no not reveal environmental impacts not already discovered during the course of previous RFI activities. Cleaning activities revealed the existence of a previously unknown and currently unused concrete sump. The bottom of the former concrete sump was covered with sediment, which was removed and disposed of offsite. Waste characterization sample results indicated that Volatile Organic Compounds (VOCs) (namely 1,1,1-trichloroethane, 1,1-dichloroethane, methylene chloride, trichloroethene, and vinyl chloride) were present in the sediment water at concentrations greater than 1 milligram per liter. The presence of the sump was not known at the time that the Phase II was conducted.

In September 2011, GE voluntarily collected soil and groundwater samples from the loading dock area to evaluate whether the presence of VOCs in sediment found in the concrete vault had resulted in environmental impacts. Seven soil borings were installed in the vicinity of the loading dock to evaluate soil conditions. VOCs similar to those observed in the vault sediment were only detected in one sample, SB-27 (4.5'), which was collected immediately adjacent to the vault. The detected VOCs were 1,1-dichloroethane (11 micrograms per kilogram, µg/kg), trans-1,2-dichloroethene (2 µg/kg), and vinyl chloride (10 µg/kg), and the detected concentrations were below USEPA Risk-Based Screening Levels for residential and industrial soil. VOCs similar to those observed

Problem Definition

in the vault sediment were not detected above respective laboratory detection limits in any of the other soils samples collected as part of this sampling effort. In addition temporary groundwater monitoring wells were installed at four locations. VOCs similar to those observed in the vault sediment were only detected in two of the groundwater samples. The samples with similar VOCs were collected from TW-SB-26 (located 20 feet down gradient of the vault) and TW-SB-27 (located immediately adjacent to the vault). The compounds detected included chloroethane, 1,1-dichloroethane, 1,1-dichloroethene, cis-1,2-dichloroethene, trans-1,2-dichloroethene, trichloroethene, and vinyl chloride. Of these compounds, the concentrations of 1,2-dichloroethene, trichloroethene, and vinyl chloride exceeded maximum contaminant levels (MCLs) for drinking water. The concentrations of these VOCs were higher in the sample collected immediately adjacent to the vault (TW-SB-27), and were significantly less in the sample collected down gradient (TW-SB-26). For example, the vinyl chloride concentration in the groundwater immediately adjacent to the vault was 120 µg/L and the vinyl chloride concentration in the groundwater 20 feet down gradient was 3 µg/L. The data obtained as part of this assessment provide adequate delineation of the observed compounds and indicate that they are limited in extent.

Because the results of the investigation indicate that the vault operations have not significantly impacted soil and groundwater, GE has decided to permanently close the vault in place. One additional groundwater monitoring well will be installed and the monitoring well will be incorporated into future groundwater monitoring programs.

A synopsis of secondary data or information from site report:
None

The possible classes of contaminants and the affected matrices: Project sample matrices, sample areas, sample types, and analytical groups, are listed in Worksheet 14.

The rationale for inclusion of chemical and nonchemical analyses: Groundwater data have been collected and evaluated from the site and surrounding monitoring wells. Evaluation of the data has identified VOCs, namely 1,1,1-TCA and 1,1-DCE, as the compounds of concern that will be included for chemical and nonchemical analyses.

Information concerning various environmental indicators:
Groundwater elevations will be measured to evaluate the horizontal and vertical groundwater flow directions that may affect VOC migration. Groundwater elevations will be measured during each groundwater monitoring event.

Project decision conditions ("If..., then..." statements): Actions to be taken for action level exceedences will vary according to sample type and sampling event. During routine sampling events, if action level exceedences for groundwater occur at monitoring wells, then groundwater monitoring will be continued until Cleanup Goals have been achieved through natural attenuation processes or the implementation of institutional controls or corrective actions. Corrective action may include active remediation (if appropriate).

QAPP Worksheet #11
(UFP-QAPP Manual Section 2.6.1)
Use this worksheet to develop project quality objectives (PQOs) in terms of type, quantity, and quality of data determined using a systematic planning process. Provide a detailed discussion of PQOs in the QAPP. List PQOs in the form of qualitative and quantitative statements. These statements should answer questions such as those listed below. These questions are examples only, however; they are neither inclusive nor appropriate for all projects.

Project Quality Objectives /Systematic Planning Process Statements

Who will use the data? USEPA, EQB, GE, and MWH will use the data to evaluate groundwater quality.
What will the data be used for? The data will be used to evaluate whether VOCs in groundwater present an unacceptable risk to human health and the environment.
What types of data are needed? Groundwater will be collected from monitoring wells for analysis of: • Volatile organic compounds (VOCs) will be analyzed by SW846 Method 8260B Surface water will be collected from nearby rivers for analysis of : • VOCs will be analyzed by SW846 Method 8260B Soil will be collected from onsite for analysis of: • VOCs will be analyzed by SW846 Method 8260B, methanol field preservation Water quality parameters may be recorded with a water quality meter at the time of groundwater aqueous sample collection and include: pH, temperature, specific conductivity, dissolved oxygen, turbidity, and oxidation/reduction potential (ORP)

How "good" does the data need to be in order to support the environmental decision? The data will be definitive data analyzed in accordance with the laboratory's standard operating procedures (SOPs) provided in this QAPP and QC limits stipulated in this QAPP. 100% of the definitive data will undergo data validation and certification.

Where, when, and how should the data be collected/generated?

Groundwater

Groundwater sampling will be performed for two consecutive quarters and then semi-annually during the completion of the Remedial Investigation. Groundwater samples will be collected using the procedures outlined in the attached SOP for Groundwater Sampling with Passive Diffusion Bag Samplers. Sampling locations are also presented in this SOP.

Surface Water (Rio Grande de Patillas)

Surface water samples will be collected from four locations: one upstream sample (near PR-3) and three down-gradient samples. Surface water samples will be collected prior to disturbing the stream sediment. Samples will be collected directly from the river at mid-depth. Pore-water beneath and adjacent to the river from three locations southwest of the Site. These locations are co-located with three of the surface water sampling locations and will be biased towards the eastern bank of the river. These samples will be collected using a stainless-steel PushPoint sampler from approximately 3 to 4 feet below the river bed. Following sample collection, an attempt will be made to measure the difference between the groundwater piezometric surface and the river water surface.

Soil

Soil samples will be collected from six locations in the loading dock area. These locations have been selected to provide coverage near the concrete sump and the associated piping.

Who will collect and generate the data? PPA, on behalf of MWH, will collect groundwater, surface water and soil samples and record field parameters (groundwater only). Lancaster Laboratory (Lancaster) will analyze the samples according to SOPs provided in this QAPP.

How will the data be reported? Lancaster will supply electronically an analytical data package (comprehensive Level 4 equivalent) and an electronic data deliverable (EDD) in a simple excel format established by MWH. A Level 4 data package includes all components necessary for the complete reconstruction of the analysis. These include but are not limited to all raw data for initial and continuing calibration, reconstructed ion chromatograms, sample preparation data, copies of pages from analysis notebooks, instrument run logs, case narratives, and quality control summaries and supporting raw data. All electronic data submitted by the laboratory is required to be error free and in complete agreement with the hard-copy data reports (provided in .pdf electronic format). The disk must be submitted with a transmittal letter from the laboratory that certifies the file is in agreement with the hard-copy data reports and has been found to be free of errors. Minimum reporting requirements shall be as defined in the U.S. EPA Contract Laboratory Program National Functional Guidelines for Organic Data Review EPA-540/R-08-01, June 2008. The final .pdf reports must contain full calibrations.

How will the data be archived? EDD disks will be maintained in MWH's file system. The final repository for all project analytical and field data will be GE.

QAPP Worksheet #12

(UFP-QAPP Manual Section 2.6.2)

Complete this worksheet for each matrix, analytical group, and concentration level. Identify the data quality indicators (DQIs), measurement performance criteria (MPC), and QC sample and/or activity used to assess the measurement performance for both the sampling and analytical measurement systems. Use additional worksheets if necessary. If MPC for a specific DQI vary within an analytical parameter, i.e., MPC are analyte-specific, then provide analyte-specific MPC on an additional worksheet.

Worksheet #12
Measurement Performance Criteria Table

Matrix	Soil
Analytical Group	VOCs
Concentration Level	Low

Sampling Procedure/SOP	Analytical Method/SOP	Data Quality Indicators (DQIs)	Measurement Performance Criteria	QC Sample and/or Activity Used to Assess Measurement Performance	QC Sample Assesses Error for Sampling (S), Analytical (A) or Both (S&A)
Soil Sampling (MWH SOP-07)	SW-846 8260B	Precision	RPD ≤ 30 When detects for both primary and duplicate samples ≥ QL.	Field Duplicates	S & A
		Accuracy and Precision	Laboratory specified recovery limits and RPD < 30%	Matrix Spike/Matrix Spike Duplicate	A
		Accuracy/Lab Contamination	No detections exceeding the RL	Method Blank	A
		Accuracy/Field Contamination	No detected target compounds	Field Blank	S & A
		Accuracy/Transport Contamination	No detected target compounds	Trip Blank	A
		Accuracy/Bias	Percent (%) recovery as follows: DBFM – 71-114% 1,2-DCA-d4 – 70-109% Toluene-d8 70-123% 4-BFB 70-111%	Surrogates Spike	A
		Accuracy	Laboratory specified recovery limits and RPD<30	Laboratory Control Sample	A
		Sensitivity	Detection limits≤ PALs	Detection Limits	S

Worksheet #12
Measurement Performance Criteria Table

Matrix	Soil
Analytical Group	VOCs
Concentration Level	Low

Sampling Procedure/SOP	Analytical Method/SOP	Data Quality Indicators (DQIs)	Measurement Performance Criteria	QC Sample and/or Activity Used to Assess Measurement Performance	QC Sample Assesses Error for Sampling (S), Analytical (A) or Both (S&A)
		Calibration Accuracy	r^2 >0.990 and RSD <15% %D <20	Initial Calibration Continuing Calibration	A A
		Field Completeness	90%	Data Completeness Check	S
		Analytical Completeness	%Collected >90 %Valid >90	Data Completeness Check	S & A

DL – Detection Limit
%D – Percent Difference
RSD – relative standard deviation
r^2 – correlation coefficient
RL – Reporting Limit
RPD – Relative Percent Difference

Worksheet #12
Measurement Performance Criteria Table

Matrix	Groundwater and Surface water
Analytical Group	VOCs
Concentration Level	Low

Sampling Procedure/SOP	Analytical Method/SOP	Data Quality Indicators (DQIs)	Measurement Performance Criteria	QC Sample and/or Activity Used to Assess Measurement Performance	QC Sample Assesses Error for Sampling (S), Analytical (A) or Both (S&A)
Groundwater/Surface water Sampling (MWH SOP-05 and SOP-09)	SW-846 8260B	Precision	RPD ≤ 20 When detects for both primary and duplicate samples ≥ QL.	Field Duplicates	S & A
		Accuracy and Precision	Laboratory specified recovery limits and RPD <25%	Matrix Spike/Matrix Spike Duplicate	A
		Accuracy/Lab Contamination	No detections exceeding the RL	Method Blank	A
		Accuracy/Field Contamination	No detected target compounds	Field Blank	S & A
		Accuracy/Transport Contamination	No detected target compounds	Trip Blank	A
		Accuracy/Bias	Percent (%) recovery as follows: DBFM – 80-116% 1,2-DCA-d4 – 77-113% Toluene-d8 80-113% 4-BFB 78-113%	Surrogates Spike	A
		Accuracy	Laboratory specified recovery limits and RPD<30	Laboratory Control Sample	A
		Sensitivity	Detection limits≤ PALs	Detection Limits	S
		Calibration Accuracy	r^2 >0.990 and RSD <15% %D <20	Initial Calibration Continuing Calibration	A A
		Field Completeness	90%	Data Completeness Check	S
		Analytical Completeness	%Collected >90 %Valid >90	Data Completeness Check	S & A

DL – Detection Limit
%D – Percent Difference
RL – Reporting Limit
RPD – Relative Percent Difference
r^2 – correlation coefficient
RSD – relative standard deviation

QAPP Worksheet #13

(UFP-QAPP Manual Section 2.7)

Identify all secondary data and information that will be used for the project and their originating sources. Specify how the secondary data will be used and the limitations on their use.

☐ Worksheet Not Applicable (State Reason)

Secondary Data Criteria and Limitations Table

Secondary Data	Data Source (Originating Organization, Report Title, and Date)	Data Generator(s) (Originating Org., Data Types, Data Generation/Collection Dates)	How Data Will Be Used	Limitations on Data Use
Groundwater Data	SEC: RFI Report, 1991	SEC: VOC groundwater data	Used in support of future groundwater sampling activities.	For sampling plan purposes only.
Groundwater Data	EarthTech: Supplemental RFI Report, 2005	EarthTech: VOC groundwater data	Used in support of future groundwater sampling activities	For sampling plan purposes only.
Groundwater Data	GE: 2006, June 2009, July 2009, September 2009, December 2009 and march 2010	GE: VOC groundwater data	Used in support of future groundwater sampling activities	For sampling plan purposes only.

QAPP Worksheet #14

(UFP-QAPP Manual Section 2.8.1)

Provide a brief overview of the listed project activities.

☐ Worksheet Not Applicable (State Reason)

Please note that all the analysis tasks are listed below; however, each sampling scenario will consist of sampling tasks as follows:

Groundwater samples: analyze for VOCs

Surface Water (Rio Grande de Patillas) samples; analyze for VOCs

Summary of Project Tasks

Sampling Tasks: Collect and analyze groundwater samples from onsite monitoring wells (17 wells); collect and analyze surface water samples from the Rio Grande de Patillas (4 locations); collect and analyze pore water samples from the Rio Grande de Patillas (3 locations). The total number of samples to be collected (not including quality control samples) is 17 groundwater samples, 4 surface water samples, and 3 pore water samples.
Analysis Tasks: VOCs in Water/Soil – SW846 Method 8260B
Quality Control Tasks: The following QC samples will be collected: Field Duplicates: Collected at a frequency of 1 per 10 samples of a given matrix. Field Blanks - A field blank, consisting of equipment rinsate, will be collected at a frequency of 1 per sampling event. Laboratory Control Sample (LCS) - The laboratory will analyze one LCS sample for each sample delivery group (SDG) for each analyte/matrix. Surrogate Spikes - The laboratory will spike each sample analyzed for VOCs with surrogate compounds. Method Blanks - The laboratory will analyze a method blank for each SDG for each analytical group. Initial calibration verification (ICV) samples will be analyzed after the standard curve is analyzed. Continuing calibration verification (CCV) samples will be analyzed after each set of 10 samples. Trip Blanks – A trip blank will be analyzed at the frequency of one per cooler containing VOC samples. MS/MSDs – An MS/MSD pair will be collected and analyzed for every 20 or fewer investigative samples of a given matrix.
Secondary Data: Utilize data identified in Worksheet #13.
Data Management Tasks: Validate data and add qualifiers to the EDD, utilize EDD to create tables from the database.
Documentation and Records: Field data will be maintained in a bound field notebook and kept on file by MWH.
Assessment/Audit Tasks: The laboratory QAO will perform an internal audit at a minimum annually.
Data Review Tasks: The laboratory will review all data prior to issuing the analytical report to verify report completeness. MWH will review field data for completeness and will assess the usability of the data as part of the project final report.

QAPP_Worksheet_#15

(UFP-QAPP Manual Section 2.8.1)

Complete this worksheet for each matrix, analytical group, and concentration level. Identify the target analytes/contaminants of concern and project-required action limits. Next, determine the quantitation limits (QLs) that must be met to achieve the project quality objectives. Finally, list the published and achievable detection and quantitation limits for each analyte.

Reference Limits and Evaluation Table

Matrix: Soil

Analytical Group: VOC (Method 8260B)

Concentration Level: Low

Analyte	CAS Number	Project Action Limit[1] (µg/kg)	Project Quantitation Limit (µg/kg)	Analytical_Method		Achievable_Laboratory_Limits [2]	
				MDLs (µg/kg)	Method QLs (µg/kg)	MDLs (µg/kg)	QLs (µg/kg)
1,1,1,2-Tetrachloroethane	630-20-6	9,300	10	1	5	1	5
1,1,1-Trichloroethane	***71-55-6***	***38,000,000***	***10***	***1***	***5***	***1***	***5***
1,1,2,2-Tetrachloroethane	79-34-5	2,800	10	1	5	1	5
1,1,2-Trichloroethane	79-00-5	5,300	10	1	5	1	5
1,1-Dichloroethane	75-34-3	17,000	10	1	5	1	5
1,1-Dichloroethene	***75-35-4***	***1,100,000***	***10***	***1***	***5***	***1***	***5***
1,1-Dichloropropene	563-58-6		10	1	5	1	5
1,2,3-Trichlorobenzene	87-61-6	490,000	50	1	5	1	5
1,2,3-Trichloropropane	96-18-4	3,300	10	1	5	1	5
1,2,4-Trichlorobenzene	120-82-1	99,000	10	1	5	1	5

Reference Limits and Evaluation Table

Matrix: Soil

Analytical Group: VOC (Method 8260B)

Concentration Level: Low

Analyte	CAS Number	Project Action Limit[1] (µg/kg)	Project Quantitation Limit (µg/kg)	Analytical_Method		Achievable_Laboratory_Limits [2]	
				MDLs (µg/kg)	Method QLs (µg/kg)	MDLs (µg/kg)	QLs (µg/kg)
1,2,4-Trimethylbenzene	95-63-6	260,000	10	1	5	1	5
1,2-Dibromo-3-chloropropane	96-12-8	69	10	2	5	2	5
1,2-Dibromoethane	106-93-4	170	10	1	5	1	5
1,2-Dichlorobenzene	95-50-1	9,800,000	10	1	5	1	5
1,2-Dichloroethane	107-06-2	2,200	10	1	5	1	5
1,2-Dichloropropane	78-87-5	4,700	10	1	5	1	5
1,3,5-Trimethylbenzene	108-67-8		10	1	5	1	5
1,3-Dichlorobenzene	541-73-1		10	1	5	1	5
1,3-Dichloropropane	142-28-9	20,000,000	10	1	5	1	5
1,4-Dichlorobenzene	106-46-7	12,000	10	1	5	1	5
2,2-Dichloropropane	594-20-7		10	1	5	1	5
2-Butanone	78-93-3	200,000,000	100	4	10	4	10
2-Chlorotoluene	95-49-8	20,000,000	10	1	5	1	5

Reference Limits and Evaluation Table

Matrix: Soil

Analytical Group: VOC (Method 8260B)

Concentration Level: Low

Analyte	CAS Number	Project Action Limit[1] (µg/kg)	Project Quantitation Limit (µg/kg)	Analytical_Method		Achievable_Laboratory_Limits [2]	
				MDLs (µg/kg)	Method QLs (µg/kg)	MDLs (µg/kg)	QLs (µg/kg)
4-Chlorotoluene	106-43-4	20,000,000	10	1	5	1	5
4-Methyl-2-pentanone	108-10-1	53,000,000	100	3	10	3	10
Acetone	67-64-1	630,000,000	100	7	20	7	20
Benzene	71-43-2	5,400	10	0.5	5	0.5	5
Bromobenzene	108-86-1	1,800,000	10	1	5	1	5
Bromochloromethane	74-97-5	680,000	10	1	5	1	5
Bromodichloromethane	75-27-4	1,400	10	1	5	1	5
Bromoform	75-25-2	220,000	10	1	5	1	5
Bromomethane	74-83-9	32,000	10	2	5	2	5
Carbon Tetrachloride	56-23-5	3,000	10	1	5	1	5
Chlorobenzene	108-90-7	1,400,000	10	1	5	1	5
Chloroethane	75-00-3	61,000,000	10	2	5	2	5
Chloroform	67-66-3	1,500	10	1	5	1	5
Chloromethane	74-87-3	500,000	10	2	5	2	5
Dibromochloromethane	124-48-1	3,300	10	1	5	1	5
Dibromomethane	74-95-3	110,000	10	1	5	1	5

Reference Limits and Evaluation Table

Matrix: Soil

Analytical Group: VOC (Method 8260B)

Concentration Level: Low

Analyte	CAS Number	Project Action Limit[1] (µg/kg)	Project Quantitation Limit (µg/kg)	Analytical_Method		Achievable_Laboratory_Limits [2]	
				MDLs (µg/kg)	Method QLs (µg/kg)	MDLs (µg/kg)	QLs (µg/kg)
Dichlorodifluoromethane	75-71-8	780,000	10	2	5	2	5
Ethylbenzene	100-41-4	27,000	5	1	5	1	5
Hexachlorobutadiene	87-68-3	22,000	3	2	5	2	5
Isopropylbenzene	98-82-8	11,000,000	10	1	5	1	5
Methyl Tertiary Butyl Ether	1634-04-4	220,000	100	0.5	5	0.5	5
Methylene Chloride	75-09-2	53,000	10	2	5	2	5
Naphthalene	91-20-3		25	1	5	1	5
Styrene	100-42-5	36,000,000	10	1	5	1	5
Tetrachloroethene	127-18-4	2,600	10	1	5	1	5
Toluene	108-88-3	45,000,000	10	1	5	1	5
Trichloroethene	79-01-6	14,000	10	1	5	1	5
Trichlorofluoromethane	75-69-4	3,400,000	10	2	5	2	5
Vinyl Chloride	75-01-4	1,700	10	1	5	1	5
cis-1,2-Dichloroethene	156-59-2	2,000,000	10	1	5	1	5
cis-1,3-Dichloropropene	10061-01-5		10	1	5	1	5
m+p+o-Xylene	XYLENES1314	53,000,000	20	1	5	1	5
n-Butylbenzene	104-51-8	51,000,000	10	1	5	1	5
n-Propylbenzene	103-65-1		10	1	5	1	5
p-Isopropyltoluene	99-87-6	21,000,000	6	1	5	1	5

Reference Limits and Evaluation Table

Matrix: Soil

Analytical Group: VOC (Method 8260B)

Concentration Level: Low

Analyte	CAS Number	Project Action Limit[1] (µg/kg)	Project Quantitation Limit (µg/kg)	Analytical_Method		Achievable_Laboratory_Limits [2]	
				MDLs (µg/kg)	Method QLs (µg/kg)	MDLs (µg/kg)	QLs (µg/kg)
sec-Butylbenzene	135-98-8		10	1	5	1	5
tert-Butylbenzene	98-06-6		10	1	5	1	5
trans-1,2-Dichloroethene	156-60-5	690,000	10	1	5	1	5
trans-1,3-Dichloropropene	10061-02-6		10	1	5	1	5

[1] Project Action Limits are United States Environmental Protection Agency Region Screening Levels for Industrial Soil – May 2010.
[2] Laboratory SOPs are provided in Appendix C.
Constituents of Concern are indicated in bold and italic text.
µg/kg– micrograms per kilogram, MDLs – Method Detection Limits, QLs – Quantitation Limits

Reference Limits and Evaluation Table

Matrix: Groundwater/Surface water

Analytical Group: VOC (Method 8260B)

Concentration Level: Low

Analyte	CAS Number	Project Action Limit[1] (µg/L)	Project Quantitation Limit (µg/L)	Analytical_Method		Achievable_Laboratory_Limits [2]	
				MDLs (µg/L)	Method QLs (µg/L)	MDLs (µg/L)	QLs (µg/L)
1,1,1,2-Tetrachloroethane	630-20-6		1	1	5	1	5
1,1,1-Trichloroethane	***71-55-6***	***200***	***1***	***0.8***	***5***	***0.8***	***5***
1,1,2,2-Tetrachloroethane	79-34-5		1	1	5	1	5
1,1,2-Trichloroethane	79-00-5	5.0	1	0.8	5	0.8	5
1,1-Dichloroethane	75-34-3		1	1	5	1	5
1,1-Dichloroethene	***75-35-4***	***7.0***	***1***	***0.8***	***5***	***0.8***	***5***
1,1-Dichloropropene	563-58-6		1	1	5	1	5
1,2,3-Trichlorobenzene	87-61-6		5	1	5	1	5
1,2,3-Trichloropropane	96-18-4		1	1	5	1	5
1,2,4-Trichlorobenzene	120-82-1		5	1	5	1	5
1,2,4-Trimethylbenzene	95-63-6		1	1	5	1	5
1,2-Dibromo-3-chloropropane	96-12-8		2	2	5	2	5
1,2-Dibromoethane	106-93-4	0.22	1	0.22	1	0.22	1
1,2-Dichlorobenzene	95-50-1		1	1	5	1	5
1,2-Dichloroethane	107-06-2	5.0	1	1	5	1	5

Reference Limits and Evaluation Table

Matrix: Groundwater/Surface water

Analytical Group: VOC (Method 8260B)

Concentration Level: Low

Analyte	CAS Number	Project Action Limit[1] (µg/L)	Project Quantitation Limit (µg/L)	Analytical_Method		Achievable_Laboratory_Limits [2]	
				MDLs (µg/L)	Method QLs (µg/L)	MDLs (µg/L)	QLs (µg/L)
1,2-Dichloropropane	78-87-5	5.0	1	1	5	1	5
1,3,5-Trimethylbenzene	108-67-8		1	1	5	1	5
1,3-Dichlorobenzene	541-73-1		1	1	5	1	5
1,3-Dichloropropane	142-28-9		1	1	5	1	5
1,4-Dichlorobenzene	106-46-7		1	1	5	1	5
2,2-Dichloropropane	594-20-7		1	1	5	1	5
2-Butanone	78-93-3		25	3	10	3	10
2-Chlorotoluene	95-49-8		1	1	5	1	5
4-Chlorotoluene	106-43-4		1	1	5	1	5
4-Methyl-2-pentanone	108-10-1		50	3	10	3	10
Acetone	67-64-1		25	6	20	6	20
Benzene	71-43-2	5.0	1	0.5	5	0.5	5
Bromobenzene	108-86-1		1	1	5	1	5
Bromochloromethane	74-97-5		1	1	5	1	5
Bromodichloromethane	75-27-4	80	1	1	5	1	5

Reference Limits and Evaluation Table

Matrix: Groundwater/Surface water

Analytical Group: VOC (Method 8260B)

Concentration Level: Low

Analyte	CAS Number	Project Action Limit[1] (µg/L)	Project Quantitation Limit (µg/L)	Analytical_Method		Achievable_Laboratory_Limits [2]	
				MDLs (µg/L)	Method QLs (µg/L)	MDLs (µg/L)	QLs (µg/L)
Bromoform	75-25-2	80	1	1	5	1	5
Bromomethane	74-83-9		1	1	5	1	5
Carbon Tetrachloride	56-23-5	5.0	1	1	5	1	5
Chlorobenzene	108-90-7	100	1	0.8	5	0.8	5
Chloroethane	75-00-3		1	1	5	1	5
Chloroform	67-66-3	80	1	0.8	5	0.8	5
Chloromethane	74-87-3		1	1	5	1	5
Dibromochloromethane	124-48-1	80	1	1	5	1	5
Dibromomethane	74-95-3		5	1	5	1	5
Dichlorodifluoromethane	75-71-8		1	2	5	2	5
Ethylbenzene	100-41-4	700	1	0.8	5	0.8	5
Hexachlorobutadiene	87-68-3		5	2	5	2	5
Isopropylbenzene	98-82-8		5	1	5	1	5
Methyl Tertiary Butyl Ether	1634-04-4		5	0.5	5	0.5	5
Methylene Chloride	75-09-2	5.0	5	2	5	2	5
Naphthalene	91-20-3		5	1	5	1	5
Styrene	100-42-5	100	1	1	5	1	5

Reference Limits and Evaluation Table

Matrix: Groundwater/Surface water

Analytical Group: VOC (Method 8260B)

Concentration Level: Low

Analyte	CAS Number	Project Action Limit[1] (µg/L)	Project Quantitation Limit (µg/L)	Analytical_Method		Achievable_Laboratory_Limits [2]	
				MDLs (µg/L)	Method QLs (µg/L)	MDLs (µg/L)	QLs (µg/L)
Tetrachloroethene	127-18-4	5.0	1	0.8	5	0.8	5
Toluene	108-88-3	1,000	1	0.7	5	0.7	5
Trichloroethene	79-01-6	5.0	1	1	5	1	5
Trichlorofluoromethane	75-69-4		1	2	5	2	5
Vinyl Chloride	75-01-4	2.0	1	1	5	1	5
cis-1,2-Dichloroethene	156-59-2	70	1	0.8	5	0.8	5
cis-1,3-Dichloropropene	10061-01-5		1	1	5	1	5
m+p+o-Xylene	XYLENES1314	10,000	2	0.8	5	0.8	5
n-Butylbenzene	104-51-8		1	1	5	1	5
n-Propylbenzene	103-65-1		1	1	5	1	5
p-Isopropyltoluene	99-87-6		1	1	5	1	5
sec-Butylbenzene	135-98-8		1	1	5	1	5
tert-Butylbenzene	98-06-6		1	1	5	1	5
trans-1,2-Dichloroethene	156-60-5	100	1	0.8	5	0.8	5
trans-1,3-Dichloropropene	10061-02-6		1	1	5	1	5

[1] Project Action Limits are United States Environmental Protection Agency Maximum Contaminant Levels – June 2011. 1,2-Dibromoethane is not a constituent of concern and therefore the Project Action Limit has been set to the MDL.
[2] Laboratory SOPs are provided in Appendix C.
Constituents of Concern are indicated in bold and italic text.
µg/kg– micrograms per kilogram, MDLs – Method Detection Limits, QLs – Quantitation Limits

QAPP Worksheet #16

(UFP-QAPP Manual Section 2.8.2)

List all project activities as well as the QA assessments that will be performed during the course of the project. Include the anticipated start and completion dates.

☐ Worksheet Not Applicable (State Reason)

Project Schedule Timeline Table

Activities	Organization	Dates (MM/DD/YY)		Deliverable	Anticipated Deliverable Due Date
		Anticipated Date(s) of Initiation	Anticipated Date of Completion		
QAPP Approval	MWH/USEPA	December 22, 2011	April 31, 2012	Final QAPP	April 16, 2012
Quarterly Sampling Round 1 (monitoring wells and surface water sampling)	MWH	May 28, 2012	June 1, 2012	Groundwater Monitoring Report	July 1, 2012
Mobilization - Quarterly Sampling Round 2 (monitoring wells)	MWH	November 5, 2012	Novmeber 9, 2012	Groundwater Monitoring Report	December 20, 2012

QAPP Worksheet #17

(UFP-QAPP Section 3.1.1)

Describe the project sampling approach. Provide the rationale for selecting sample locations and matrices for each analytical group and concentration level.

☐ Worksheet Not Applicable (State Reason)

Sampling Design and Rationale

Describe and provide a rationale for choosing the sampling approach (e.g., grid system, biased statistical approach):

The sampling program is designed to monitor for changes to the current conditions of groundwater associated with the former French Sump until the final CMS is approved. The specific objectives of this program are as follows:

- Collect groundwater elevation data to confirm that groundwater flow regimes are consistent with historical flow patterns.
- Collect and analyze groundwater samples from monitoring wells to further verify that impacted groundwater has remained within the horizontal and vertical extent of the existing area of impacted groundwater. The monitoring well network was selected based on historical sample results, the scope of work described in the *Groundwater Modeling Work Plan* (MWH, 2007), and the results presented in the *Groundwater Modeling Report* (MWH, 2009).
- Collect and analyze surface water and pore water samples from the Rio Grande de Patillas to provide data on changes in surface water quality. This sampling is being performed to evaluate whether VOC-impacted groundwater may be venting to the Rio Grande de Patillas. Sample locations were selected based on professional judgment to get adequate coverage upstream and downstream of the projected plume area.

Describe the sampling design and rationale in terms of what matrices will be sampled, what analytical groups will be analyzed and at what concentration levels, the sampling locations (including QC, critical, and background samples), the number of samples to be taken, and the sampling frequency (including seasonal consideration): Refer to Worksheet #18 for the sampling design. Refer to Worksheet #20 for associated QC samples. Refer to Appendix A for sampling SOPs.

QAPP_Worksheet_#18

(UFP-QAPP Manual Section 3.1.1)

List all site locations that will be sampled and include sample/ID number, if available. (Provide a range of sampling locations or ID numbers if a site has a large number.) Specify matrix and, if applicable, depth at which samples will be taken. Only a short reference for the sampling location rationale is necessary for the table. The text of the QAPP should clearly identify the detailed rationale associated with each reference. Complete all required information, using additional worksheets if necessary.

Sampling Locations and Methods/SOP Requirements Table

Sampling Location/ID Number	Matrix	Depth (feet)	Analytical Group	Concentration Level	Number of Samples (identify field duplicates)	Sampling SOP Reference[1]	Rationale for Sampling Location
Monitoring wells (P-4, P-7, P-7A, P-8, P-9, P-10A, P-11, P-15DD, P-16S, P-17D, P-18S, P-18D, P-19S, P-19D, P-20S, P-20D)	Groundwater	9.7 – 54.5 feet bgs	VOCs	Low	17 samples, one field duplicate, one de-ionized water blank, one matrix spike/matrix spike duplicate, and one trip blank per monitoring event.	SOP 101	The monitoring well network was selected based on historical sample results, the scope of work described in the Groundwater Modeling Work Plan (MWH, 2007), and the results presented in the Groundwater Modeling Report (MWH, 2009).
Surface water samples (SW-BG, SW-01, SW-02, and SW-03)	Surface Water	Mid-river	VOCs	Low	4 samples, one field duplicate, one matrix spike/matrix spike duplicate, and one trip blank	SOP 09	Sample locations were selected based on professional judgment to get adequate coverage upstream and downstream of the projected plume area.
Pore-water samples (PW-01, PW-02, PW-03)	Groundwater	0-4 feet below the river bed	VOCs	Low	3 samples	SOP-102	Sample locations were selected based on professional judgment to get adequate coverage upstream and downstream of the projected plume area.

Note that sampling locations will also be sample designations for primary samples. Sample designation for QC samples will be TB (trip blank) and EQB (equipment rinsate blank), plus sample date, e.g.TBmmddyy, Samples for matrix spikes and duplicates (MS/MSD) will be identified on the chain of custody and extra sample volume noted. Field duplicates will be identified by adding a 4-digit suffix to the sampling location, e.g. DUP-9999.

[1] Provided in Appendix A.

NA - Not Applicable

VOCs – Volatile Organic Compounds

QAPP Worksheet #19

(UFP-QAPP Manual Section 3.1.1)

For each matrix, analytical group and concentration level, list the analytical and preparation method/SOP and associated sample volume, container specifications, preservation requirements, and maximum holding time.

☐ Worksheet Not Applicable (State Reason)

Analytical SOP Requirements Table

Matrix	Analytical Group	Concentration Level	Analytical and Preparation Method/SOP Reference[1]	Sample Volume	Containers (number, size, and type)	Preservation Requirements (chemical, temperature, light protected)	Maximum Holding Time (preparation/ analysis)
Soil	VOC	Low	SW-846 8260B	5 g	3x Field preserved vials	2xNaHSO4 and 1x MEOH, 2 Ice to 4+/-2 deg. C	14 days
Water	VOCs	Low	SW-846 8260B	5 ml	3 X 40 mL glass vials w/PTFE septa cap	Ice to 4+/-2 deg. C, HCl to pH < 2	14 days

C - Celsius
HCl – Hydrochloric Acid
mL – milliliter
PTFE - Polytetrafluoroethylene
VOC - Volatile Organic Compound
[1] Lab SOPs are included in Appendix C.

QAPP Worksheet #20

(UFP-QAPP Manual Section 3.1.1)

Summarize by matrix, analytical group, and concentration level the number of field QC samples that will be collected and sent to the laboratory.

☐ Worksheet Not Applicable (State Reason)

Field Quality Control Sample Summary Table

Matrix	Analytical Group	Concentration Level	Analytical and Preparation SOP Reference[1]	No. of Sampling Locations	No. of Field Duplicate Pairs	No. of MS/MSD	No. of Trip Blanks	No. of Equip. Blanks	No. of PT Samples	Total No. of Samples to Lab
Water	VOCs	Low	SW-846 8260B	27	5	3	4	2	0	57
Soil	VOCs	Low	SW-846 8260B	9	1	0	0	0	0	10

VOC - Volatile Organic Compound

QAPP Worksheet #21

(UFP-QAPP Manual Section 3.1.2)

List all SOPs associated with project sampling including, but not limited to, sample collection, sample preservation, equipment cleaning and decontamination, equipment testing, inspection and maintenance, supply inspection and acceptance, and sample handling and custody. Include copies of the SOPs as attachments or reference all in the QAPP. Sequentially number sampling SOP references in the Reference Number column. The reference number can be used throughout the QAPP to refer to a specific SOP.

☐ Worksheet Not Applicable (State Reason)

Project Sampling SOP References Table

Reference Number	Title, Revision Date and/or Number	Originating Organization	Equipment Type	Modified for Project Work? (Check if yes)	Comments
SOP 01	Drilling Methods	MWH	Mechanical drilling equipment	☐	
SOP 02	Groundwater Monitoring Well Design and Installation	MWH	Pumps, water level indicator, water quality meter	☐	
SOP 05	Water Sampling and Field Measurement	MWH	Water quality measurement equipment	☐	
SOP 06	Sample Management and Shipping	MWH	NA	☐	
SOP 07	Soil Sampling	MWH	NA	☒	Added Appendix A for VOC Sample Collection with Terra Core sampler.
SOP 09	Surface Water and Sediment Sampling	MWH	NA	☐	
SOP 10	Surveying	MWH	NA	☐	
SOP 13	Operating and Calibration Procedures for field Equipment	MWH	Field sampling equipment	☐	
SOP 14	Field Documentation	MWH	NA	☐	
SOP 15	Field Logbook	MWH	NA	☐	
SOP 17	Logging	MWH	NA	☐	

Project Sampling SOP References Table

Reference Number	Title, Revision Date and/or Number	Originating Organization	Equipment Type	Modified for Project Work? (Check if yes)	Comments
SOP 19	Borehole Abandonment	MWH	NA	☐	
SOP 21	Monitoring Well Destruction	MWH	NA	☐	
SOP 22	Installation of Temporary Monitoring Wells	MWH	Pumps, water level indicator, water quality meter	☐	
SOP 25	Shallow Hand Auger Sampling	MWH	Hand auger	☐	
SOP 29	Drum Sampling	MWH	NA	☐	
SOP 31	Drilling Equipment Decontamination	MWH	NA	☐	
SOP 101	Passive Diffusion Bag Sampling	MWH	Passive Diffusion Bags	☒	
SOP 102	Porewater Sampling	MWH	Push-point sampler	☒	

NA - Not Applicable
SOPs are included as Appendix A.

QAPP Worksheet #22

(UFP-QAPP Manual Section 3.1.2.4)

Identify all field equipment and instruments (other than analytical instrumentation) that require calibration, maintenance, testing, or inspection and provide the SOP reference number for each type of equipment. In addition, document the frequency of activity, acceptance criteria, and corrective action requirements on the worksheet.

☐ Worksheet Not Applicable (State Reason)

Field Equipment Calibration, Maintenance, Testing, and Inspection Table

Field Equipment	Calibration Activity	Maintenance Activity	Testing Activity	Inspection Activity	Frequency	Acceptance Criteria	Corrective Action	Responsible Person	SOP Reference[1]
Water Quality Meter	1. Calibrate pH meter with pH 4 and 7 solutions. 2. Check calibration of conductivity meter with 1 solution. 3. Check calibration of redox meter with 1 solution. 4. Check calibration of DO meter – 100% saturation.	1. Check that battery of unit is fully charged prior to use. 2. Clean probe prior to use. 3. Check that the pH, specific conductivity redox, and turbidity solutions are within acceptable dates of use and replace as necessary.	1. Check calibrations for pH, specific conductivity, redox, and DO.		Prior to use and end of day.	1. pH - ± 0.1 standard unit of standards. 2. Specific conductivity ± 10% of standard solution. 3. Redox ±10% of standard solution. 4. DO ± 0.2 mg/L.	If any of the meters fail, replace and retest with new standard solutions. If calibration continues to fail, replace the meter.	Field sampler	SOP 03
Turbidity Meter	Calibrate turbidity meter with zero and 1 other solution	Check that the turbidity solutions are within acceptable dates of use and replace as necessary.	Check calibration for turbidity.		Daily before start of work.	Turbidity < 5 NTUs for zero solution, ± 10% of standard solution.		Field sampler	SOP 03
Water level Indicator	None	Clean with Alconox and rinse with distilled water	Place probe in water and listen for tone.	Ensure water level indicator is clean	Prior to use and between each well	Water level indicator is clean and works	Replace batteries or replace water level indicator	Field sampler	SOP 03

Field Equipment Calibration, Maintenance, Testing, and Inspection Table

Field Equipment	Calibration Activity	Maintenance Activity	Testing Activity	Inspection Activity	Frequency	Acceptance Criteria	Corrective Action	Responsible Person	SOP Reference[1]
PID/FID meter	Check calibration against 100% Isobutylene (PID) and 100% CH_4 (FID)	Avoid humid conditions. Turn hydrogen supply on for FID and off after use.	Insert probe into Tedlar bag containing either Isobutylene or methane (CH_4)		Prior to use and end of day.	Within limits stated on the calibration cylinder	Replace batteries or replace unit. Replace hydrogen tank if empty (for FID).	Field sampler	SOP 07

[1]Specify the appropriate reference letter or number from the Project Sampling SOP References table (Worksheet #21).
DO - Dissolved Oxygen
mg/L - Milligrams per liter
NTUs - Nephelometric Turbidity Units
PID - Photoionization Detector
FID - Flame Ionization Detector

QAPP Worksheet #23

(UFP-QAPP Manual Section 3.2.1)

List all SOPs that will be used to perform onsite or offsite analysis. Indicate whether the procedure produces screening or definitive data. Sequentially number analytical SOP reference in the Reference Number column. Include copies of the SOPs as attachments or reference in the QAPP. The reference number can be used throughout the QAPP to refer to a specific SOP.

☐ Worksheet Not Applicable (State Reason)

Analytical SOP References Table

Lab SOP Number	Title, Revision Date, and/or Number	Definitive or Screening Data	Analytical Group	Instrument	Organization Performing Analysis	Modified for Project Work? (Y/N)
VOCs 8260B Aqueous	2898…Determination of Volatile Target Compounds and Gasoline Range Organics (GRO) by Capillary Column Gas Chromatography/Mass Spectrometry (GC/MS) in Waters and Wastewaters by Method 8260B, Revision16, 08/04/11	Definitive	VOCs	GC/MS	LANCASTER	N
VOCs 8260B Solid	10237… Determination of Volatile Target Compounds and Gasoline Range Organics (GRO) by Capillary Column Gas Chromatography/Mass Spectrometry (GC/MS) in Soils and Solids by Method 8260B, Revision 2, 07/12/11	Definitive	VOCs	GC/MS	LANCASTER	N
VOC Preparation Solid	0388… Preparation of Vials for Field Preservation of Soils for Volatile Analysis, Revision 12, 08/29/11	N/A	Organic Preparation	N/A	LANCASTER	N
Percent Moisture SM20 2540G Solid	0111 Moisture (Gravimetric), Rev 11, 5/10/11	Definitive	Wet Chemistry	Gravimetric analysis	LANCASTER	N

QAPP Worksheet #24

(UFP-QAPP Manual Section 3.2.2)

Identify all analytical instrumentation that requires calibration and provide the SOP reference number for each. In addition, document the frequency, acceptance criteria, and corrective action requirements on the worksheet.

Analytical Instrument Calibration Table

Instrument	Calibration Procedure	Frequency of Calibration	Acceptance Criteria	Corrective Action (CA)	Person Responsible for CA	SOP Reference[1]
GC/MS (VOC)	BFB Tuning	Prior to initial calibration and calibration verification (every 12 hours)	Refer to criteria listed in the method	Retune instrument and verify	Lab analyst	VOCs 8260B Aqueous; VOCs 8260BSolid; and VOC Preparation Solid
	Multipoint initial calibration (minimum five points)	Prior to sample analysis, or when calibration verification fails	All analytes $\leq$15% RSD or correlation coefficient $\geq$ 0.990	Correct the problem and repeat the initial calibration	Lab analyst	
	Second-source calibration verification	Once for each multipoint initial calibration	All analytes within $\pm$30% of expected value	Correct the problem and repeat initial calibration	Lab analyst	
	Continuing calibration verification	At start of each analytical sequence and every 12 hours thereafter	All analytes within $\pm$20% of expected value	Correct problem, then recalibrate and reanalyze all samples since the last acceptable continuing calibration verification	Lab analyst	

BFB – Bromofluorobenzene
GC/MS – Gas Chromatography/ Mass Spectrometry
ICAL – Initial Calibration
ICV – Initial Calibration Verification
NA - Not Applicable
RRF - Relative Response Factor
RSD - Relative Standard Deviation

QAPP Worksheet #25

(UFP-QAPP Manual Section 3.2.3)

Identify all analytical instruments that require maintenance, testing, or inspection and provide the SOP reference number for each. In addition, document the frequency, acceptance criteria, and corrective action requirements on the worksheet.

Analytical Instrument and Equipment Maintenance, Testing, and Inspection Table

Instrument/ Equipment	Maintenance Activity	Testing Activity	Inspection Activity	Frequency	Acceptance Criteria	Corrective Action	Responsible Person	SOP Reference
VOA's, Agilent 6890 GC/5973 MS	As needed, replacement of components	Continuing calibration verification (CCV) per 12 hour tune period	Visual inspection of components	As needed	Initial calibration or continuing calibration verification passes method criteria	Perform additional maintenance prior to instrument calibration or CCV.	Analysts or group leaders	SOP-MS-004
Analytical Balance	Annual Calibration/Verification	Daily Check with Class 1 weights	Visual inspection	Annual Calib/Daily Check	See SOP	See SOP	Outside vendor for calibration/Analyst for daily checks	LOM-SOP-LAB-208

CCV - Continuing Calibration Verification
SOP - Standard Operating Procedure

QAPP Worksheet #26

(UFP-QAPP Manual Appendix A)

Use this worksheet to identify components of the project-specific sample handling system. Record personnel, and their organizational affiliations, who are primarily responsible for ensuring proper handling, custody, and storage of field samples from the time of collection, to laboratory delivery, to final sample disposal. Indicate the number of days field samples and their extracts/digestates will be archived prior to disposal.

☐ Worksheet Not Applicable (State Reason)

Sample Handling System

SAMPLE COLLECTION, PACKAGING, AND SHIPMENT
Sample Collection (Personnel/Organization): Sampling personnel from PPA
Sample Packaging (Personnel/Organization): Sampling personnel from PPA
Coordination of Shipment (Personnel/Organization): Sampling personnel from MWH and PPA
Type of Shipment/Carrier: FedEx
SAMPLE RECEIPT AND ANALYSIS
Sample Receipt (Personnel/Organization): Sample log-in and management personnel from the laboratory
Sample Custody and Storage (Personnel/Organization): Sample log-in and management personnel from the laboratory
Sample Preparation (Personnel/Organization): Sample analyst from the laboratory
Sample Determinative Analysis (Personnel/Organization): Sample analyst from the laboratory
SAMPLE ARCHIVING
Field Sample Storage (No. of days from sample collection): Samples will be shipped via FedEx the same day or next day as sampled.
Sample Extract/Digestate Storage (No. of days from extraction/digestion): See Worksheet#19
Biological Sample Storage (No. of days from sample collection): Not applicable
SAMPLE DISPOSAL
Personnel/Organization: Sample analyst from the laboratory
Number of Days from Analysis: A minimum of 30 days after reporting is complete

QAPP Worksheet #27

(UFP-QAPP Manual Section 3.3.3)

Describe the procedures that will be used to maintain sample custody and integrity. Include examples of chain-of-custody forms, traffic reports, sample identification, custody seals, laboratory sample receipt forms, and laboratory sample transfer forms. Attach or reference applicable SOPs.

☐ Worksheet Not Applicable (State Reason)

Sample Custody Requirements

Sample Handling and Custody Requirements

Custody is one of several factors, which are necessary for the admissibility of environmental data as evidence in a court of law. Custody procedures help to satisfy the two major requirements for admissibility: relevance and authenticity. Sample custody is addressed in three parts: field sample collection, laboratory analysis, and final evidence files. Final evidence files, including all originals of laboratory reports and purge files, are maintained under document control in a secure area.

A sample or evidence file is under your custody if:

- The item is in actual possession of a person; or
- The item is in the view of the person after being in actual possession of the person; or
- The item was in actual physical possession but is locked up to prevent tampering; or
- The item is in a designated and identified secure area.

Field Custody Procedures

Field logbooks will provide the means of recording data collecting activities performed. As such, entries will be described in as much detail as possible so that persons going to the facility could reconstruct a particular situation without reliance on memory.

Field logbooks will be bound, field survey books or notebooks. Logbooks will be assigned to field personnel, but will be stored in the document control center when not in use. Each logbook will be identified by the project-specific document number.

The title page of each logbook will contain the following:

- Person to whom the logbook is assigned.
- Logbook number.
- Project name.

- Project start date, and
- End date.

Entries into the logbook will contain a variety of information. At the beginning of each entry, the date, start time, weather, names of all sampling team members present, level of personal protection being used, and the signature of the person making the entry will be entered. The names of visitors to the site, field sampling or investigation team personnel and the purpose of their visit will also be recorded in the field logbook.

Measurements made and samples collected will be recorded. All entries will be made in ink, signed, and dated and no erasures will be made. If an incorrect entry is made, the information will be crossed out with a single strike mark which is signed and dated by the sampler. Whenever a sample is collected, or a measurement is made, a detailed description of the location of the station, which includes compass and distance measurements, shall be recorded. The number of the photographs taken of the station, if any, will also be noted. All equipment used to make measurements will be identified, along with the date of calibration.

Samples will be collected following the sampling procedures documented in this QAPP. The equipment used to collect samples will be noted, along with the time of sampling, sample description, depth at which the sample was collected, volume and number of containers. Sample site-specific identification numbers will be assigned prior to sample collection. The site-specific sample number should be consistent with those described in Worksheet 18 of this QAPP.

The sample packaging and shipment procedures summarized below will ensure that the samples will arrive at the laboratory with the CoC intact.

(a) The field sampler is personally responsible for the care and custody of the samples until they are transferred or properly dispatched. As few people as possible should handle the samples.

(b) All sample containers will be provided by the analytical laboratory. Sample containers will be prepared according to procedures specified in USEPA's "Specifications and Guidance for Obtaining Contaminant-free Sample Containers", 1992. Sample containers will be I-Chem Superfund Analyzed™ (or equivalent) pre-cleaned glass (formerly 300 series) with Teflon lined caps or septa. The lead field person will note (in a bound notebook) the materials received, condition, date of receipt, and whether or not the materials are acceptable.

All bottles will be labeled. Sample numbers, sampling locations, date/time of collection, and type of analysis, will be included on the label and in the field notebook.

(c) The Chain of Custody (CoC) is to be completed for each sample using waterproof ink, unless prohibited by weather conditions.

(d) Samples are accompanied by a properly completed CoC form. The sample identification and locations will be listed on the CoC form. When transferring the possession of samples, the individuals relinquishing and receiving will sign, date, and note the time on the record. This record documents transfer of custody of samples from the sampler to another person, to the laboratory, or to/from a secure storage area.

(e) Samples will be properly packaged on ice at 4 degrees Centigrade (°C) for shipment and dispatched to the appropriate laboratory for analysis, with a separate signed custody record enclosed in the cooler. Each sample cooler will contain a temperature blank, which consists of a bottle of water. Shipping containers will be locked and secured with strapping tape and custody seals for shipment to the laboratory. If coolers are used for shipment the preferred procedure includes use of a custody seal attached to the front right and back left of the cooler. The custody seals are covered with clear plastic tape. The cooler is strapped shut with strapping tape in at least two locations.

(f) All shipments will be accompanied by the CoC record identifying the contents. The original record will accompany the shipment, and the duplicate copy will be retained by the sampler.

The following information is included on the CoC form:

- Laboratory
- Project ID
- Project number
- Samplers signature
- Location ID
- Sample ID
- Date collected
- Time collected
- Matrix
- Analyses required
- Method of sample shipment

(h) Samples will be shipped by FedEx the same day as collected. Commercial carriers are not required to sign off on the custody form as long as the custody forms are sealed inside the sample cooler and the custody seals remain intact.

Laboratory Receipt and Custody

Once samples are received at the laboratory, the field CoC record is completed and signed by the individual Laboratory Sample Custodian. The Laboratory Sample Custodian will check the sample bottle labels against the corresponding information listed on the field CoC records and note any discrepancies. Additionally, the laboratory sample receipt personnel will note any damaged or missing sample containers. The laboratory personnel will check chemical preservation for sample analyses that require addition of acid or base by recording the pH of each sample container during the sample login process. However, the pH of VOC sample vials will be checked after the sample is analyzed, so VOCs are not lost prior to analysis by opening the vial. This information will be recorded on the field CoC record and/or in a separate logbook. The temperature of the cooler temperature blank included in each cooler of samples will also be recorded at the time of sample receipt by the laboratory personnel. This temperature will also be recorded on the field CoC record, cooler receipt form, and/or in a separate logbook. Any discrepancies in sample identifications, sample analysis information, any indication that samples are missing upon receipt at the laboratory, or any indication that samples not received at the correct pH or temperature (4°± 2°C) will be communicated to the project chemist within 24 hours of sample receipt so that appropriate corrective action can be determined and implemented. Cooler receipt forms will be faxed to the project chemist or designee within 24 hours of sample receipt.

The following information is included on the laboratory cooler receipt form:

- Cooler temperature
- Condition of samples
- Preservation of samples
- Condition of custody seals

- Received by and relinquished by signatures
- Sample Identification

After the sample receipt information is checked and recorded, sample analysis information will be entered into the individual Laboratory Information Management System (LIMS) (or equivalent). Each sample will be provided a unique laboratory identification number and the analysis tests requested on the CoC records entered into the LIMS. After the required information has been entered into the LIMS, the Laboratory Sample Custodian will initiate an internal laboratory CoC. The internal CoC will document the transfer of samples from the storage location to the analyst for analysis and subsequently through final disposition at the laboratory. At a minimum, the internal CoC will include client identification, laboratory sample number, sample matrix, signatures for relinquishing and receiving samples or sample extracts or digestates, and reasons for the change in custody (procedure to be performed).

Samples will be stored in secure, limited access areas in an environment that maintains any required temperature preservation noted in Worksheet 19. Samples are required to be refrigerated at a temperature of 4° +/- 2°C. The temperature of the refrigerators or freezers used to store samples will be monitored by the project laboratories according to their internal standard operating procedures. Samples which do not require temperature preservation will be stored at room temperature. Disposal of unused raw sample volumes, sample extracts, and sample digestates will be in accordance with each laboratory's waste management procedures.

QAPP Worksheet #28

(UFP-QAPP Manual Section 3.4)

Complete a separate worksheet for each sampling technique, analytical method/SOP, matrix, analytical group, and concentration level. If method/SOP QC acceptance limits exceed the measurement performance criteria, the data obtained may be unusable for making project decisions.

Matrix	Soil
Analytical Group	VOA
Concentration Level	Low
Sampling SOP	SW846 8260B
Analytical Method/ SOP Reference	SW-846 8260B
Sampler's Name	MWH/GES personnel
Field Sampling Organization	GES
Analytical Organization	Lancaster Labs
No. of Sample Locations	See WS#20

QC Sample:	Frequency/Number	Method/SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)	Measurement Performance Criteria
Field Duplicate	1 per 10 samples	SW-846 8260B	evaluation in conjunction with parent sample results	Lancaster Laboratory Personnel	Accuracy	RPD<30
Surrogate Spike (organics)	per sample (including MS/MSD, LCS and blanks)	toluene-d8 70-123% 4-BFB 70-111% 12-DCA-d4 70-109% DBFM 71-114%	reanalyze if outside limits, if confirmed report	Lancaster Laboratory Personnel	Precision	% recovery within acceptance limits
Method Blanks	1 per 20 samples	Undetected with respect to reporting limit for each constituent	reanalyze to confirm detections	Lancaster Laboratory Personnel	Representativeness	Undetected results with respect to reporting limit
MS/MSD	1 per 20 samples	SW-846 8260B	evaluation in conjunction with LCS results	Lancaster Laboratory Personnel	Accuracy/Bias	RPD<30

QAPP Worksheet #28

(UFP-QAPP Manual Section 3.4)

Complete a separate worksheet for each sampling technique, analytical method/SOP, matrix, analytical group, and concentration level. If method/SOP QC acceptance limits exceed the measurement performance criteria, the data obtained may be unusable for making project decisions.

Matrix	Soil
Analytical Group	VOA
Concentration Level	Low
Sampling SOP	SW846 8260B
Analytical Method/ SOP Reference	SW-846 8260B
Sampler's Name	MWH/GES personnel
Field Sampling Organization	GES
Analytical Organization	Lancaster Labs
No. of Sample Locations	See WS#20

QC Sample:	Frequency/Number	Method/SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)	Measurement Performance Criteria
LCS	1 per 20 samples	All % recoveries must fall within statistically derived QC limits, which are reviewed and updated on a semi-annual basis	Reanalyze LCS and associated samples. Analytes in the LCS that fail high and are ND in the samples can be reported.	Lancaster Laboratory Personnel	Accuracy/Bias	RPD<30
Internal Standards	per sample (including MS/MSD, LCS and blanks	-50% to +100% of internal standard area of 12 hour STD. RT change ≤30 sec.	reanalyze, document if confirmed	Lancaster Laboratory Personnel	Precision	results within acceptance limits

QAPP Worksheet #28

(UFP-QAPP Manual Section 3.4)

Complete a separate worksheet for each sampling technique, analytical method/SOP, matrix, analytical group, and concentration level. If method/SOP QC acceptance limits exceed the measurement performance criteria, the data obtained may be unusable for making project decisions

Matrix	Water
Analytical Group	VOA
Concentration Level	Low
Sampling SOP	SW846 8260B
Analytical Method/ SOP Reference	SW-846 8260B
Sampler's Name	MWH/PPA personnel
Field Sampling Organization	MWH
Analytical Organization	Lancaster Labs
No. of Sample Locations	See WS#20

QC Sample:	Frequency/Number	Method/SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)	Measurement Performance Criteria
Field Duplicate	1 per 10 samples	SW-846 8260B	evaluation in conjunction with parent sample results	Lancaster Laboratory Personnel	Accuracy	RPD<30
Surrogate Spike (organics)	per sample (including MS/MSD, LCS and blanks	toluene-d8 70-123% 4-BFB 70-111% 12-DCA-d4 70-109% DBFM 71-114%	reanalyze if outside limits, if confirmed report	Lancaster Laboratory Personnel	Precision	% recovery within acceptance limits
method blanks	1 per 20 samples	undetected with respect to detection limit for each constituent	reanalyze to confirm detections	Lancaster Laboratory Personnel	Representativeness	undetected results with respect to detection limit
MS/MSD	1 per 20 samples	SW-846 8260B	evaluation in conjunction with LCS results	Lancaster Laboratory Personnel	Accuracy/Bias	RPD<20

QAPP Worksheet #28

(UFP-QAPP Manual Section 3.4)

Complete a separate worksheet for each sampling technique, analytical method/SOP, matrix, analytical group, and concentration level. If method/SOP QC acceptance limits exceed the measurement performance criteria, the data obtained may be unusable for making project decisions

Matrix	Water
Analytical Group	VOA
Concentration Level	Low
Sampling SOP	SW846 8260B
Analytical Method/ SOP Reference	SW-846 8260B
Sampler's Name	MWH/PPA personnel
Field Sampling Organization	MWH
Analytical Organization	Lancaster Labs
No. of Sample Locations	See WS#20

QC Sample:	Frequency/Number	Method/SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)	Measurement Performance Criteria
LCS	1 per 20 samples	All % recoveries must fall within statistically derived QC limits, which are reviewed and updated on a semi-annual basis	Reanalyze LCS and associated samples. Analytes in the LCS that fail high and are ND in the samples can be reported.	Lancaster Laboratory Personnel	Accuracy/Bias	results within acceptance limits
Internal Standards	per sample (including MS/MSD, LCS and blanks	-50% to +100% of internal standard area of 12 hour STD. RT change ≤30 sec.	reanalyze, document if confirmed	Lancaster Laboratory Personnel	Precision	results within acceptance limits

QAPP Worksheet #29

(UFP-QAPP Manual Section 3.5.1)

Identify the documents and records that will be generated for all aspects of the project including, but not limited to, sample collection and field measurement, onsite and offsite analysis, and data assessment.

Project Documents and Records Table

Sample Collection Documents and Records[1]	Onsite Analysis Documents and Records	Offsite Analysis Documents and Records	Data Assessment Documents and Records	Other
Field Notes (notebooks) Chain-of-Custody Records Custody Seals Daily Field Reports Corrective Action Forms Telephone Logs and E-Mails		Laboratory Sample Receipt, Custody, and Tracking Records Standard Traceability Logs Equipment Calibration Logs Sample Preparation Logs Sample Run Logs Equipment Maintenance, Testing, and Inspection Logs Corrective Action Forms Reported Field Sample Results Reported results for Standards, QC Checks, and QC Samples Instrument Printouts (raw data) for Field Samples, Standards, QC Checks, and QC Samples Sample Disposal Records Telephone Logs and E-Mails Extraction/Cleanup Records	Field Sampling Audit Checklists Fixed Laboratory Audit Checklists Data Validation Forms Corrective Action Forms Draft Groundwater Monitoring Report Final Groundwater Monitoring Report	Data Reporting: Procedures for completing the CoCs, sample bottle labels, and custody seal The laboratory data package will include at a minimum: Cover page; Case narrative; Sample receipt log; CoC; correction action form (including telephone logs and e-mail correspondence); Sample results; QC results (method blanks, LCS, ICV, CCV, serial dilution, MS/MSD, surrogates, ICS, matrix duplicate, field blanks, and field duplicates); Standard prep logs; Run logs; Instrument tuning, calibration, and internal standards; and Raw data Data Management: The laboratory will provide an analytical data package and an EDD

[1] Field forms are included in Appendix B.

QAPP Worksheet #30

(UFP-QAPP Manual Section 3.5.2.3)

Complete this worksheet for each matrix, analytical group, and concentration level. Identify all laboratories or organizations that will provide analytical services for the project, including onsite screening, onsite definitive, and offsite laboratory analytical work. If applicable, identify the subcontractor laboratories and backup laboratory or organization that will be used if the primary laboratory or organizations cannot be used.

☐ Worksheet Not Applicable (State Reason)

Analytical Services Table

Matrix	Analytical Group	Concentration Level	Sample Location/ID Numbers	Analytical SOP	Data Package Turnaround Time[1]	Laboratory/Organization (Name and Address, Contact Person and Telephone Number)	Backup Laboratory/Organization (Name and Address, Contact Person and Telephone Number
Water	Volatiles	Low	See Worksheet #18	VOCs 8260B Aqueous	Normal TAT – 15 business days	Lancaster Laboratories 2425 New Holland Pike Lancaster, PA 17601	NA
Soil	Volatiles	Low	See Worksheet #18	VOCs 8260B Solid	Normal TAT – 15 business days	Lancaster Laboratories 2425 New Holland Pike Lancaster, PA 17601	NA

1 – Turnaround time does not include validation by a Puerto Rico Certified Chemist. Validation and certification by a Puerto Rico Certified Chemist typically requires three additional weeks beyond the normal data package turnaround time.

QAPP Worksheet #31

(UFP-QAPP Manual Section 4.1.1)

Identify the type, frequency, and responsible parties of planned assessment activities that will be performed for the project.

☐ Worksheet Not Applicable (State Reason)

Planned Project Assessments Table

Assessment Type	Frequency	Internal or External	Organization Performing Assessment	Person(s) Responsible for Performing Assessment (Title and Organizational Affiliation)	Person(s) Responsible for Responding to Assessment Findings (Title and Organizational Affiliation)	Person(s) Responsible for Identifying and Implementing Corrective Actions (CA) (Title and Organizational Affiliation)	Person(s) Responsible for Monitoring Effectiveness of CA (Title and Organizational Affiliation)
Field Sampling Audit	TBD	Internal/External	GE/U.S.EPA and/or MWH	GE and/or U.S. EPA Quality Representative and MWH Quality Assurance (QA) Manager	MWH/PPA Field Sampling Personnel	MWH/PPA Field Sampling Personnel	GE and/or U.S. EPA Quality Representative and MWH Quality Assurance (QA) Manager
Laboratory Performance Audit	Annual	Internal	Laboratory (Lancaster)	Laboratory QA Officer (QAO)	Laboratory Director	Laboratory Director	Laboratory QAO

QAPP Worksheet #32

(UFP-QAPP Manual Section 4.1.2)

For each type of assessment describe procedures for handling QAPP and project deviations encountered during the planned project assessments.

☐ Worksheet Not Applicable (State Reason)

Assessment Findings and Corrective Action Responses

Assessment Type	Nature of Deficiencies Documentation	Individual(s) Notified of Findings (Name, Title, Organization)	Timeframe of Notification	Nature of Corrective Action Response Documentation	Individual(s) Receiving Corrective Action Response (Name, Title, Org.)	Timeframe for Response
Field Sampling Audit	Written audit report	GE and/or U.S. EPA Quality Representative, MWH Project Manager (PM)	ASAP within 24hours	Email or letter	MWH/PPA field staff	24 hours
Laboratory Performance Audit	Written audit report	USACE QA Manager, MWH PM, Laboratory Director	ASAP within 48 hours	Corrective action form	Laboratory Director	48 hours

ASAP – As Soon As Possible.

QAPP Worksheet #33

(UFP-QAPP Manual Section 4.2)

Identify the frequency and type of planned QA Management Reports, the projected delivery date, the personnel responsible for report preparation, and the report recipients.

QA Management Reports Table

Type of Report	Frequency (daily, weekly monthly, quarterly, annually, etc.)	Projected Delivery Date(s)	Person(s) Responsible for Report Preparation (Title and Organizational Affiliation)	Report Recipient(s) (Title and Organizational Affiliation)
Groundwater Sampling	Quarterly, Semi-Annual	Three weeks after receipt of final, certified analytical data package.	MWH Project Manager	Joel Robinson, GE EHS Project Manager
Field Sampling – Surface water, pore-water, soil	One time event	Three weeks after receipt of final, certified analytical data package.	MWH Project Manager	Joel Robinson, GE EHS Project Manager

CQC – Contractor Quality Control
QA – Quality Assurance
TBD – To Be Determined

QAPP Worksheet #34

(UFP-QAPP Manual Section 5.2.1)

Describe the processes that will be followed to verify project data. Verification inputs include items such as those listed in Table 9 of the UFP-QAPP Manual (Section 5.1). Describe how each item will be verified, when the activity will occur, and what documentation is necessary, and identify the persons responsible. *Internal* or *external* is in relation to the data generator.

☐ Worksheet Not Applicable (State Reason)

Verification (Step I) Process Table

Verification Input	Description	Internal/ External	Responsible for Verification (Name, Organization)
Field data	Field notes will be reviewed to verify that required information was completed by the field sampler. The field sampler will provide the field notebook, CoCs, and any information regarding deviations from the Work Plan.	Internal	MWH Project Manager
Field Audit Forms and Corrective Action Documentation	Verify that the field audit forms and corrective action documentation (if any) are completed and properly filed.	Internal	MWH Project Manager
Laboratory Documentation	Verify that laboratory documentation (Worksheet #29) is filed according to the laboratory SOPs.	Internal	Lancaster Laboratory Project Manager
Analytical report	Verify that the analytical reports are completed and accurate prior to delivery to MWH.	Internal.	Lancaster Laboratory Project Manager
Laboratory Audit and Corrective Action Forms	Verify that the laboratory and corrective action forms are completed and filed.	Internal	Lancaster Laboratory Project Manager
Analytical report	The data validator will also verify the completeness of the analytical report as part of the data validation process.	Internal/External	MWH Project Chemist / Intergroup Consultants (Puerto Rican Certified Chemist)

QAPP Worksheet #35

(UFP-QAPP Manual Section 5.2.2)

Describe the processes that will be followed to validate project data. Validation inputs include items such as those listed in Table 9 of the UFP-QAPP Manual (Section 5.1). Describe how each item will be validated, when the activity will occur, and what documentation is necessary and identify the person responsible. Differentiate between steps IIa and IIb of validation.

☐ Worksheet Not Applicable (State Reason)

Validation (Steps IIa and IIb) Process Table

Step IIa/IIb	Validation Input	Description	Responsible for Validation (Name, Organization)
IIa	Field data	All field data will be reviewed against the QAPP requirements for completeness and accuracy.	MWH PM
IIa	SOPs	Ensure that all sampling and analytical SOPs were followed.	MWH PM
IIa	Method QC results	Verify that all required method QC were run and met the required limits.	MWH Project Chemist
IIb	QAPP QC results	Verify that all required QAPP QC were run and met the required limits.	MWH Project Chemist
IIb	Project quantitation limits	Verify that sample results met the project quantitation limits specified in this QAPP.	MWH Project Chemist
IIa	Raw data	Review raw data versus reported data for transcription errors.	MWH Project Chemist

PM - Project Manager
QC – Quality Control
QAPP - Quality Assurance Project Plan
SOP - Standard Operating Procedure

QAPP Worksheet #36

(UFP-QAPP Manual Section 5.2.2)

Identify the matrices, analytical groups, and concentration levels that each entity performing validation will be responsible for, as well as criteria that will be used to validate those data.

☐ Worksheet Not Applicable (State Reason)

Validation (Steps IIa and IIb) Summary Table

Step IIa/IIb	Matrix	Analytical Group	Concentration Level	Validation Criteria	Data Validator (title and organizational affiliation)
IIa	Water	VOCs	Low	USEPA NFGs for Organic data review, analytical SOP and QAPP Worksheets 12, 15, 24 and 28.	MWH Project Chemist
IIa	Soil	VOCs	Low	USEPA NFGs for Organic data review, analytical SOP and QAPP Worksheets 12, 15, 24 and 28.	MWH Project Chemist

Data validation actions will be based on U.S. EPA guidance documents (U.S. EPA Contract Laboratory Program National Functional Guidelines for Organic Data Review EPA-540/R-08-01, June 2008), the analytical method, and the professional judgment of the MWH Project Chemist. Data qualifiers will be applied to results that do not meet project goals and in accordance with this QAPP. The data validation checklists provided on the U.S. EPA Region II website will be used during data validation (http://www.epa.gov/region02/qa/documents.htm and attached).

MWH will perform Level III validation on 100% of the data. Level III validation includes (as applicable) but is not limited to:

- Review of sampling handling, CoC, sample preservation and cooler,
- Review of initial and continuing calibration verifications,
- Review of MS/MSD/MD results (and PDS results as appropriate),
- Review of LCS results,
- Review of low level calibration check
- Review of blank data (field, method, trip, continuing calibration etc)
- Review of ICS results
- Review of serial dilution
- Review of internal standards area counts and retention times
- Review of surrogate recoveries
- Review of mass spec tuning

QAPP Worksheet #37

(UFP-QAPP Manual Section 5.2.3)

Describe the procedures/methods/activities that will be used to determine whether data are of the right type, quality, and quantity to support environmental decision-making for the project. Describe how data quality issues will be addressed and how limitations of the use of the data will be handled.

☐ Worksheet Not Applicable (State Reason)

Usability Assessment

Summarize the usability assessment process and all procedures, including interim steps and any statistics, equations, and computer algorithms that will be used:

The data validator will perform Level III validation on 100% of the data for the samples in Worksheet #36. As discussed previously in Worksheet #36, Level III data review basically provides a review of QA/QC results without the recalculations.

Usability will be documented within a data validation summary report. The validation report will also contain a discussion on precision, accuracy, representativeness, comparability, and completeness, sensitivity, and reconciliation.

Measurement Performance Criteria

Measurement performance criteria describe how the Project Quality Objectives (PQOs) will be satisfied. The number of samples and analytical parameters are described in each of the previous PQO discussions. The analytical data generated during sampling activities will be evaluated based on QA/QC criteria as described in this QAPP. In addition, QA/QC evaluation criteria are included on Worksheets 12, 15, 24, and 28. Only data qualified as unusable (R) will be omitted from data analyses as these data are considered rejected and unusable due to QA/QC failure and/or gross holding time exceedances.

Data quality and quantity are measured by comparison of resulting data with established acceptable limits for precision, accuracy, representativeness, comparability, and completeness (PARCC), and sensitivity. Data outside PARCC/sensitivity QA objectives will be evaluated, according to Worksheet 28 (for each parameter) of this document and the criteria contained in the specified analytical methods, to determine what, if any, aspects of the data can be defensibly used to meet the project objectives.

Precision

Precision criteria for each analysis methods to be used for the sampling activities are summarized on Worksheet 28. Precision measures the reproducibility of data or measurements under specific conditions. Precision is a quantitative measure of the variability of a group of data compared to their average value. Precision is usually stated in terms of RPD or percent relative standard deviation (%RSD). Measurement of precision is dependent upon sampling technique and analytical method. Field duplicate and laboratory duplicate samples will be used to measure precision for project samples. Both sampling and analysis will be as consistent as possible. For a pair of measurements, RPD will be used in this project. For a series of measurements, %RSD will be used. The total precision of a series of measurements can be related by the additive nature of the variances. Equations for RPD and %RSD are presented below:

$$RPD = \frac{[D1 - D2]}{(D1 + D2)/2} \text{ x } 100\%$$

Where:

D1 and D2 = the two replicate values

$$\%RSD = S/x \text{ x } 100\%; \text{ and } S = \frac{\sqrt{\sum_{I=1}^{n} \frac{(x_i - x)^2}{n-1}}}{x}$$

Where:

S	=	standard deviation
x_1	=	each observed value
x	=	the arithmetic mean of all observed values
n	=	total number of values

Accuracy

Accuracy criteria for each analysis method to be used for the sampling activities are summarized on Worksheet 28. Accuracy measures the bias in a measurement system that may result from sampling or analytical error. Sources of error that may contribute to poor accuracy are:

- Laboratory error,
- Sampling inconsistency,
- Field and/or laboratory contamination,
- Handling,
- Matrix interference, and
- Preservation

Equipment blanks, as well as matrix spike QC samples, and LCSs, will be used to measure accuracy for project samples.

Accuracy is calculated using the percent recovery (%R) equation below:

$$\%R = \frac{SSR - SR}{SA} = 100$$

Where:

%R	=	% recovery
SSR	=	spike sample result
SR	=	sample result
SA	=	amount of spike added to sample

Representativeness

Representativeness criteria for each analysis method to be used for the sampling activities are summarized on Worksheet 28. Representativeness expresses the degree to which sample data represent the characteristics of the media or matrix from which they are collected. Samples that are considered representative are properly collected to accurately characterize the nature and extent of contamination at a general sample location. Representativeness will be measured by using standardized collection methods (e.g., sampling, handling, and preserving) and laboratory analytical methods. Only data qualified "R" as unusable will not be used.

Comparability

Comparability criteria for each analysis method to be used are summarized on Worksheet 28. Comparability expresses the confidence with which one data set can be compared with another data set from a different phase or from a different program. Comparability involves a composite of the above parameters as well as design factors such as sampling and analytical protocols. An acceptable level of comparability will be accomplished through the consistent use of accepted analytical and sampling methods.

Completeness/Usability

Completeness criteria for each analysis method to be used for the sampling are summarized on Worksheet 28. Completeness is defined as the percentage of data that is judged to be valid to achieve the objectives of the investigation compared to the total amount of data. Completeness is discussed on a per analyte basis. A sample will consist of several analytes and/or compounds and very rarely is an entire sample considered unusable. Discussing completeness on a per analyte basis allows for use of the majority of the data. Deficiencies in the data may be due to sampling techniques, poor accuracy, precision, or laboratory error. While the deficiencies may affect certain aspects of the data, usable data may still be extracted from applicable samples. An evaluation of completeness necessarily involves an evaluation of the impact of missing data on the ability of the project to achieve its goals. The goal for completeness/usability is 90%. The equation used for completeness is presented below:

$$C\ (\%) = \frac{D}{P \text{ x } n} \text{ x } 100$$

Where:

D = number of confident quantification's
P = number of analytical parameters per sample requested for analysis
n = number of samples requested for analysis

As indicated previously, assessment of completeness alone does not provide a comprehensive evaluation of data quality. Therefore, the percentage of usable and unusable data will also be calculated by the following equations:

% Usable Data = #Unqualified Positive + U + J+ UJ / Total Number of Results

% Unusable Data = R + UR/Total Number of Results

Separate % Completeness, % Usable Data, and % Unusable Data calculations will be performed for the project data.

Sensitivity

Sensitivity is defined as the ability to achieve the project-required method reporting limits as defined in Worksheet 15. Action limit goals for the samples are based on United States Environmental Protection Agency Maximum Contaminant Levels (published in June 2011). If the laboratory method reporting limits are greater than the action limits because they not technically achievable, the affected compounds will be reported to the method detection limit.

Reconciliation

The PQOs described in Worksheet 11 will be examined to determine if the objective was met. Each analysis will first be evaluated for data quality in terms of impacts from the data validation process. Based on the quality of the data, its usability will be determined. Note, only data qualified "R" as unusable will be excluded from use in the project. Based on the number of unusable analyses it will be determined if the PQOs were met. As part of the reconciliation of the objective, conclusions will be drawn and any limitations on the usability of any of the data will be described. Data will be reviewed and reported as having either positive or negative bias (as appropriate). Trends in data results will be discussed as appropriate and discussed with the laboratory, if necessary.