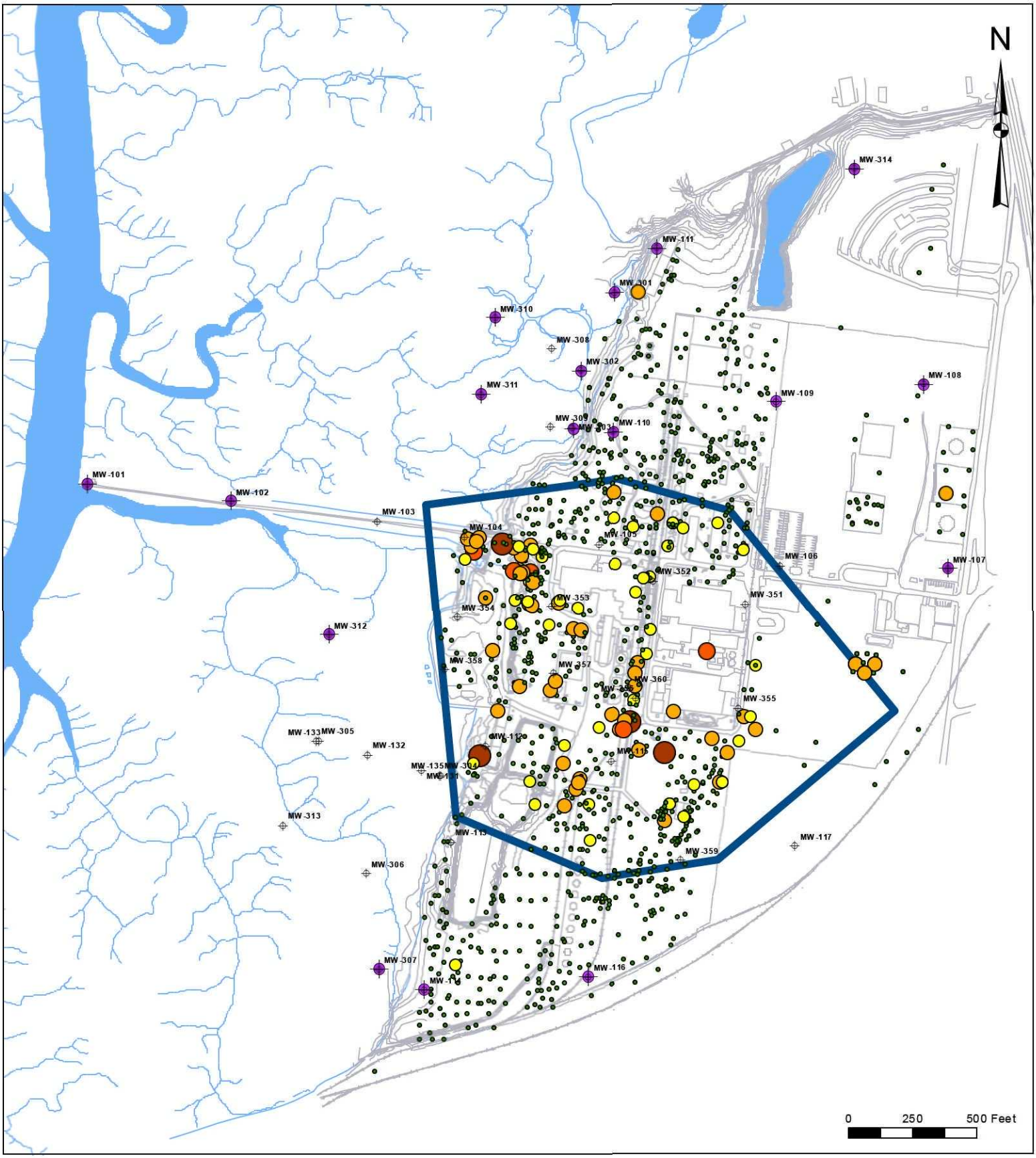

Figure 4
Aroclor 1268 Distribution in Soil

Prepared for:

LCP SITE STEERING COMMITTEE

WORK PLAN FOR COMPREHENSIVE GROUNDWATER SAMPLING - 2012 (OPERABLE UNIT 2)

LCP CHEMICALS SITE BRUNSWICK, GEORGIA

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April 2012
Revised May 8, 2012

WORKPLAN FOR COMPREHENSIVE SITE-WIDE GROUNDWATER SAMPLING – 2012 (OPERABLE UNIT 2)

LCP CHEMICALS SITE OPERABLE UNIT TWO
BRUNSWICK, GEORGIA

Prepared for:
LCP SITE STEERING COMMITTEE

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April 2012 (revised May 8, 20120)

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WORKPLAN FOR COMPREHENSIVE SITE-WIDE GROUNDWATER SAMPLING – 2012 (OPERABLE UNIT 2) LCP CHEMICALS SITE BRUNSWICK, GEORGIA

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EPS

1 INTRODUCTION

1.1 Overview

Honeywell International (formerly AlliedSignal, Inc.), the Atlantic Richfield Company (ARCO), and the Georgia Power Company are Responsible Parties (RPs) under an Administrative Order on Consent (AOC), to conduct Remedial Investigation and Feasibility Studies (RI/FS) for the LCP Chemicals Site (LCP Site) in Brunswick, Georgia. The LCP Site is being managed as three Operable Units (OUs). OU2 addresses groundwater beneath the LCP Site.

This document presents a plan to conduct a comprehensive sampling of groundwater from all wells in the site-wide monitoring well network. Furthermore there will be additional site assessment using direct-push (DP) methods. DP assessment is proposed along an upland marsh transect in support of both flux modeling and as an element of a petroleum hydrocarbon non-aqueous phase liquid (LNAPL) assessment. These activities are being performed at the request of the U.S. Environmental Protection Agency (EPA) and the Georgia Environmental Protection Division (EPD) of the Department of Natural Resources.

1.2 Background

The first groundwater sampling activity under the Superfund site characterization process occurred in 1994, involving DP sampling by EPA. Monitoring wells were installed and sampled as part of the Remedial Investigation (RI) over the period of 1995-1997 in accordance with methods and analytical testing programs approved by the EPA and EPD. An additional site characterization study involving installation of additional monitoring wells (including the "horizontal" monitoring wells) was performed in 2000. Selective monitoring was initiated by the RPs in 2001 and subsequent events have occurred in 2003, 2004, 2005, 2006, 2007, 2009, 2010 and 2011.

1.3 Study Objectives

One of the objectives of the proposed 2012 monitoring event is to obtain a comprehensive and synoptic measurement of groundwater quality and hydraulic head information from the entire network of on-site monitoring wells. This information will be used to inform decisions around each of the OUs.

A second objective is to provide information for evaluating the contaminant flux ~~in~~ from groundwater ~~as it flows across the uplands-marsh boundary~~into the marsh.

A third objective is to assess for the presence of LNAPL along the marsh-upland border.

1.4 Document Organization

The remainder of this document is organized as described below:

- Section 2 presents an evaluation of past groundwater sampling data in support of the proposed scope for the comprehensive groundwater sampling;
- Section 3 describes the field methods;
- Section 4 describes laboratory tests and methods;
- Section 5 describes the decontamination procedures;
- Sections 6 and 7 address quality control and documentation protocols, respectively; and
- Section 8 provides a list of references.

2 SAMPLING SCOPE

2.1 Review of Previous Sampling Events to Determine Parameters List for 2012 Event

2.1.1 Approach and Summary of Evaluation

The early RI groundwater sampling events on the site tested for a broad suite of chemical constituents. These past sampling events have been evaluated to identify specific chemical groups that can be eliminated from the 2012 sampling event. There are 138 monitoring wells and 12 horizontal wells on the site (Figure 1). Eliminating unnecessary analytical groups from the program is consistent with EPA guidance.

All of the major analytical groups are represented in the database generated from the past groundwater sampling events. These analytical groups include Target Analyte List (TAL) metals and Target Compound List (TCL) organics – TCL organics include volatile organic compounds (VOCs), semi-volatile organic compounds (SVOCs) including polycyclic aromatic hydrocarbons (PAHs), pesticides, and polychlorinated biphenyls (PCBs).

The analytical group scoping process involved comparing all of the groundwater data records from monitoring wells sampled from 1995 to present, taking maximum detections of each analyte and comparing that value to EPA's Regional Screening Level (RSL) value for groundwater (MCL where available, otherwise tap water). The results of this evaluation can be summarized as follows:

- A number of different metals exceed the RSL and therefore the full list of TAL metals is retained for the 2012 sampling program;
- A number of different VOCs exceed the RSL and therefore the VOC chemical group is retained for the 2012 sampling program;
- Only two of the non-PAH SVOC constituents exceed the RSL: 2,4,6-trichlorophenol and bis(2-ethylhexyl)phthalate. Detections are infrequent and slight in concentration and therefore non-PAH SVOCs are not a parameter group of interest (further details of this evaluation follow below). PAHs are retained as an analytical group for the 2012 sampling program.
- Three pesticides are detected above the RSL (aldrin, alpha-BHC, and dieldrin) but these detections are infrequent and slight in concentration and therefore this is not a parameter group of interest (further details of this evaluation follow below).
- PCB detections did occur in some of the early sampling events (1995, 1996) where on-site laboratories (TEG and later QAL) were being utilized. Detections were infrequent and generally qualified later with a non-detect result. It is proposed to conduct testing for PCBs for wells located within the footprint where soil conditions exceed the extraction-based soil screening level (ESSL) derived from the 2009 batch leaching study. More information on the PCB detections in groundwater and the ESSL comparison follows below.

2.1.2 Evaluation of SVOCs

Table 1 is a listing of non-PAH detections in groundwater with comparison to MCLs (or Tap Water RSLs where no MCL exists). The table highlights each instance where the groundwater criteria is exceeded – gray highlight is used to indicate that the parameter is also reported as part of the standard VOC analysis, and yellow highlight is used for parameters that are only reported under the standard SVOC analysis. VOCs are proposed for the 2012 program and thus the gray highlight cases will be part of the sampling event. That leaves only two SVOCs that exceed criteria: 2,4,6-trichlorophenol and bis(2-ethylhexyl)phthalate.

2,4,6-trichlorophenol

Three detections of 2,4,6-trichlorophenol occurred in past sampling events. All of these detections were above the RSL (detects range from 8 to 26 parts per billion (ppb) compared to the RSL of 6.1 ppb). Figure 2a shows the location and magnitude of the detections.

bis(2-ethylhexyl)phthalate

Nine detections of bis(2-ethylhexyl)phthalate occurred in past sampling events. Only one of these detections was above the RSL (detect of 7 ppb compared to the RSL of 6.1 ppb). Figure 2b shows the location and magnitude of the detections.

2.1.3 Evaluation of Pesticides

Table 2 is a listing of pesticide detections in groundwater with comparison to MCLs (or Tap Water RSLs where no MCL exists). The table highlights each instance where the groundwater criteria are exceeded. Three pesticides exceed criteria: aldrin, alpha-BHC, and dieldrin.

Aldrin

Two detections of aldrin occurred in past sampling events. One of these detections was above the RSL (0.071 ppb compared to the RSL of 0.004 ppb). Figure 3a shows the location and magnitude of the detections.

alpha-BHC

Five detections of alpha-BHC occurred in past sampling events. Two of these detections were above the RSL (detects of 0.088 and 0.027 ppb compared to the RSL of 0.011 ppb). Figure 3b shows the location and magnitude of the detections.

Dieldrin

Two detections of dieldrin occurred in past sampling events. Both of these detections were above the RSL (detects of 0.077 and 0.018 ppb compared to the RSL of 0.004 ppb). Figure 3c shows the location and magnitude of the detections.

2.1.4 Evaluation of PCBs

Table 3 is a listing of PCB detections in groundwater with comparison to Tap Water RSLs. Three different PCB Aroclors have been detected (all are above criteria): Aroclor 1016, Aroclor 1260, and Aroclor 1268.

Aroclor 1016

One detection of Aroclor 1016 occurred in past sampling events. This detection was above the RSL (40 ppb compared to the RSL of 0.96 ppb). Three other sampling events all showed non-detect result for Aroclor 1016 at this well location (MW-302).

Aroclor 1260

One detection of Aroclor 1260 occurred in past sampling events. This detection was above the RSL (detect of 0.52 ppb compared to the RSL of 0.034 ppb). Two other sampling events showed non-detect result for Aroclor 1260 at this well location (MW-359B).

Aroclor 1268

Eight detections (seven well locations) of Aroclor 1268 occurred in past sampling events. All of these detections were from on-site laboratory testing (either TEG or QAL). Six of the wells showed non-detect in a subsequent sampling event. One of the wells with Aroclor 1268 showed a detection in both the initial sampling and a subsequent sampling at well MW-356A (sampled on 04/22/96 analyzed by TEG (4.7 ppb) and sampled later on 06/26/96 analyzed by QAL (1.6 ppb)); this well has not been subsequently tested for Aroclor 1268.

Figure 4 shows the locations were PCBs have been detected in any of the past sampling events, along with soils data mapped in comparison to the soils ESSL criteria (5 ppb Aroclor 1268). Given the fact that nearly all of the past PCB detections were subsequently nullified by subsequent testing, it is proposed to apply the >ESSL footprint as the basis for selecting wells that will be tested for PCBs in the 2012 event. All wells shown within the "PCB ESSL Exceedence" polygon displayed on Figure 4 are proposed for PCB analysis.

2.2 Proposed Scope for the 2012 Sampling Event

2.2.1 Shoreline Transect for Flux Modeling

The table below indicates the proposed sampling locations for this program.

Monitoring Wells (south to north along transect)	Direct Push Points	DP Sampling Interval
MW-114A, B, C		
	DP-1	A – span water table B – 30 ft bgs
MW-113A, B, C		
	DP-2	A – span water table B – 30 ft bgs
MW-112A, B, C		
	DP-3	A – span water table B – 30 ft bgs
MW-358A, B		

MW-354 A, B		
MW-104 B, C (A well destroyed during past removal action)	DP-4	A – span water table
	DP-5	A – span water table B – 30 ft bgs
MW-110A, B, C		
	DP-6	A – span water table B – 30 ft bgs
MW-111 A, B, C		

Figure 5 shows the sampling transect that intersects the existing monitoring wells shown in the table above and also shows the proposed locations of the DP investigation along the transect; the DP locations span the distance between monitoring wells at critical locations along the transect (DP-4 will provide the equivalent of an "A" well at the MW-104 cluster location).

The DP program will involve two offset borings. The shallow DP boring (A) will involve collection of a soil core from the ground surface to approximately 5 ft below the water table, in order to allow visual observation of the soil across the zone of water table fluctuation for the presence of petroleum hydrocarbon LNAPL (i.e., the "smear zone"). After the core is extracted, a temporary well with a pre-packed well screen will be placed in the borehole to facilitate collection of a groundwater sample and to check for the presence of dissolved LNAPL. A ten-foot length screen interval is proposed for the shallow installation to ensure spanning of the water table while also ensuring adequate depth to obtain a representative groundwater sample. The offset DP boring (B) will be advanced using the same DP and temporary well installations methods to a depth consistent with the "B" well of the nearby monitoring wells along the transect, strictly for the collection of a groundwater sample. A 5-foot screen interval will be used for the deeper DP boring in order to be more consistent with existing monitoring well installations. Turbidity will be monitored during purging of the DP locations. If turbidity exceeds 10 NTUs, a standard metals container will be filled (pre-preserved with acid) along with a second metals container (without acid) to allow for both an unfiltered and filtered metals analysis.

The groundwater samples will be analyzed for the following constituents of interest:

- TAL Metals
- Mercury
- Volatile Organic Compounds
- Polynuclear Aromatic Hydrocarbons
- Polychlorinated Biphenyls
- pH – laboratory
- Total Dissolved Solids (TDS) – for use in equivalent fresh-water head adjustment

The DP temporary well points will also be sampled for geochemical parameters including:

- Silica
- Sulfate/Sulfide
- Chloride
- Total Organic Carbon

2.2.2 Site-wide Comprehensive Sampling

All of the monitoring wells present on the site (including the 12 horizontal wells) will be sampled for the 2012 event. Water levels and field parameters (pH, ORP, DO, temperature, turbidity) will be measured in all site wells in addition to the laboratory testing. Laboratory testing will be conducted as follows:

- TAL metals — All wells
- Mercury — All wells
- Hexavalent Chromium — 5 - 10% of wells with past total chromium detects
- VOCs — All wells
- PAHs — All wells
- PCBs — MW-104, -105, -106; MW-112, -113; MW-351 to -359; MW-501 to MW-519
- pH – laboratory — All wells
- TDS — All wells

~~Note that all wells within the "proximate" grouping of the caustic brine pool program~~The following wells will be analyzed for geochemical parameters in addition to the analytes listed above~~:~~:

- MW-500 series wells
- MW-352, MW-353, MW-356, MW-357, MW-105, MW-115, MW-360
- Horizontal wells HW_East 2-5 and HW_West 2-5

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The selection of wells for chromium speciation analysis is based on the historical detection of dissolved chromium (total) in groundwater. All of the past results for total chromium were extracted from the database and the results were mapped in GIS to examine the concentration distribution. A total of 12 wells (8% of the total number of monitoring wells on the site) have been selected, on the basis of spanning the range of total chromium detections and also to provide spatial distribution across the monitoring well network (Figure 6). Wells selected for hexavalent chromium include:

- Upland wells north of B Street: MW-108A, MW-110A, and MW-111A
- Upland wells south of B Street: MW-112C, MW-115C, MW-353B, MW-358B, HWwest3
- CBP area wells: MW-508B, MW-509B, MW-504B, MW-505B, MW-505A, MW-510B
- Marsh wells: MW-101D, MW-307B, MW-312B, MW-313B

3 FIELD METHODS

3.1 Sequence of Field Activities

Field activities will occur in the following order:

1. Installation of DP temporary well points
2. Site wide groundwater level measurements
3. Groundwater sampling.

Installation of the DP well points will be completed as the first step of this work plan to support the characterization of the LCP Site potentiometric surface during the site wide groundwater level measurement task. Inclusion of the DP well points will increase the number of available water level measurement points along the marsh-upland border. Site wide groundwater level measurements will be completed with several teams to complete the task in the shortest period as feasible to minimize tidal or temporal influences on the dataset. Electronic water-level probes will first be checked for kinks or stretch by initially laying the probe on the ground surface alongside a standard tape measure. The depth to groundwater is quite shallow at this site and therefore the probe is not susceptible to vertical stretch during the water level measurement.

Groundwater sampling will first be complete along the marsh transect (DP well points and monitoring wells) following by all other site monitoring wells. Groundwater samples from the marsh transect will be analyzed on an expedited schedule to allow for potential follow-up work during the current field mobilization. All other samples will be analyzed with a standard turnaround time.

3.2 Direct Push Procedure

DP technology will be used to install temporary monitoring wells in general accordance with the procedures outlined in the USEPA Region IV Science and Ecosystem Support Division standard operating procedure for Design and Installation of Monitoring Wells (SESDGUID-101-R0 dated February 2008). ~~The DP procedure will utilize dual-tube (DT) technology to set temporary well points at depths listed in Section 2.2.1. DT technology uses both an outer and inner rod. The outer rod is equipped with a cutting shoe that cuts a soil core which is collected inside of the outer casing sliding into the acetate liner held in place by the inside rod string. When at depth, the inside rod string and the soils retained in the acetate liner is removed from inside of the outer rods. The outer rods remain in the ground thereby providing a cased hole. A clean liner is then attached to the inner rods, sent back down within the outer rods and another outer rod is added to the drill string.~~Standard DP procedures will be used in the deep boring ("B") to obtain a continuous soil core, in order to establish the local lithology and to field screen for LNAPL potential. The hole will then be reamed with a larger diameter (3 ½ inch) rod and a 2-inch ID pre-packed well screen with 2-inch ID PVC riser casing will be inserted inside the rod, then the rod extracted leaving the well in place. The shallow DP well point ("A") will be offset from the

deep installation, and this does not require the soil core step (with exception of location DP-4 where only a shallow DP boring will be made).

Each DP well will be surveyed for top of casing elevation and geographic position to the nearest 1/100th of a foot.

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~~After reaching a desired depth the inner rod string (and soil core for "A" DP locations) will be withdrawn and a temporary well casing will be inserted inside the outer rod without collapse of the borehole. A 0.75" ID pre-pack screen will be placed at both "A" (spanning water table) and "B" (approximately 30' below ground surface) DP locations.~~

3.3 Site Wide Water Level Measurement Procedure

Water level measurements will be conducted in every monitoring well on site after the DP temporary wells have been set. Sampling teams will make every attempt possible to obtain the water level measurement at slack low tide – wells within and bordering the marsh exhibit tidal fluctuation. Water level measurements will be made as follows:

- decontaminate water level meter probe that is graduated to 0.01 feet (for more details on decontamination procedures, see Section 5);
- lower tip of the probe into well until it touches the water surface (beeping sound begins);
- raise and lower tip and adjust length of cable to placement on the top of the casing (notched or otherwise marked reference point); water levels will be measured from the same point each time on the top of the casing;
- mark depth on cable with thumb nail and hold;
- read and record the water level measurement in increments to the nearest 0.01 foot in the logbook and/or on the water level form; and
- decontaminate prior to measuring next location.

3.4 Groundwater Sampling Procedure

Field sampling procedures are designed to ensure the collection of data that are representative of site conditions. Sampling will be conducted in general accordance with the procedures outlined in the USEPA Region IV Science and Ecosystem Support Division standard operating procedure for Groundwater Sampling (SESDPROC-301-R2 dated October 2011). General water quality parameters will be measured in purged groundwater using a flow-through cell monitor (e.g., Horiba U-22 or equivalent).

3.4.1 Purging and Sampling Procedure

3.4.1.1 Tubing–in-Screen-Interval Method

The "Tubing-in-Screen-Interval" (TSI) method will be applied to vertical monitoring wells consistent with past groundwater sampling events and work plans. TSI methodology is used primarily when calculated purge volumes for the traditional purging method are ~~excessive~~

extreme and present issues related to timely completion of the project and/or management of investigation derived waste.

3.4.1.2 Purge and Sample Collection Criteria

Purging of the monitoring well will be completed by first setting the peristaltic pump tubing or intake point of the submersible pump at the approximate mid-portion of the screened interval of the well. The well screen interval is available from well construction diagrams.

The following steps will be taken during well purging and sampling:

- Water Level Measurements: Static water levels will be measured before any fluids are withdrawn and before any equipment enters the well prior to purging. Water level measurements will be conducted immediately prior to well purging with a "clean" electronic sounder. If the casing cap is air-tight, time will be allowed prior to measurement for the equilibration of pressures after the cap is removed.
- Purging Requirements: TSI purge methods using peristaltic pumps will be used. Purge water is passed into a flow-through cell. The purge water samples shall be measured for pH, Eh, DO, temperature, conductivity, and turbidity every 10 minutes for a minimum of 30 minutes of purging. There is no pre-established purge volume goal for this site, rather the purging is deemed complete after a minimum of 30 minutes of purge time and also must meet the stabilization criteria (see below). At that time measurements will be taken on a 5-minute cycle until parameters stabilize indicating the well is sufficiently purged.
- Measurements: The temperature, pH, Eh, DO, conductivity, and turbidity will be measured and recorded during purging. The sample may be collected when pH and conductivity have stabilized and turbidity is below 10 NTU. Stabilization is defined as follows: pH ± 0.1 units and conductivity ± 5% for three consecutive measurements. If these parameters do not stabilize, the sample will be taken after five well volumes have been removed. The total number of well volumes removed will be recorded in the field forms.
- Collection Period: Groundwater samples will be collected immediately after the completion of purging. Sample containers appropriate for the analyte group are provided by the laboratory.

If the purge water exceeds a pH of 9.0 standard units, the site protocol requires the water to be containerized as an investigative-derived waste (otherwise, the site protocol allows for the purge water to be directed away from the active work area and discharged to the ground surface to allow it to seep through the permeable sands).

3.4.2 Sampling Sequence

The preferred order of sample collection according to the major analytical groups is:

1. Target Analyte List (TAL) metals;
2. Inorganics/geochemical indicator parameters;
3. PAHs;
4. PCBs;
5. pH for lab analysis; ~~and~~and
6. VOCs.

3.4.3 Sampling of Horizontal Wells

3.4.3.1 Purging Procedure

Horizontal wells contain a large volume of standing water within the casing owing to their ~~excessive~~ length (approximately 2200 ft), thus requiring a unique purging and sampling approach. The south side of each duct will be connected to a diaphragm pump, or a dedicated submersible centrifugal pump capable of pumping in the 1-3 gpm range will be used in each well duct. The entire volume of stored water in the well duct will be evacuated and the purge water will be monitored for pH, conductivity and temperature. A pH criterion has been established that will trigger more frequent monitoring if the pH exceeds 8.0. If the purge water exceeds a pH of 9.0 standard units, the site protocol requires the water to be containerized as an investigative-derived waste (otherwise, the site protocol allows for the purge water to be directed away from the active work area and discharged to the ground surface to allow it to seep through the permeable sands). Purge volumes will be recorded on field forms. After this primary purge is complete, the ½-inch sampling tubes on the north side of each well duct will be connected to a peristaltic pump and one volume of the stagnant water in the tubes will be evacuated. After this purging, a water quality meter (e.g., Horiba U-22 or equivalent) connected to a flow-through cell will be used to monitor the stability of field parameters (i.e., temperature, pH, Eh, conductivity, DO, and turbidity). A pH meter will be used to record the pH readings. Stabilization is defined as follows: pH ± 0.1 standard units and conductivity ± 5%. After these parameters have stabilized, the groundwater will be sampled for chemical analyses as outlined in Section 3.4.2.

3.5 Equipment Calibration

Calibration of field instruments will be performed each day prior to sampling and at the intervals specified by the manufacturer or more frequently as conditions dictate. In the event that an internally calibrated field instrument fails to meet calibration/checkout procedures, it will be returned to the manufacturer for service.

3.6 Sample Documentation

3.6.1 Overview

Documents for recording sampling events will include a daily field activity log, field measurement logs, and photographs as appropriate. Sample information to be included on sample labels, custody seals, and chain-of-custody forms is described below.

3.6.2 Sample Identification and Documentation

After sample collection, all sample containers will be labeled with an identification number that uniquely identifies the sample. The samples will be identified with a unique alpha-numeric identification that follows the format "YYDDD-Z" where:

- YY is the year the sample was taken;
- DDD is the Julian date of sample collection;
- ~~X is the Decision Unit designation; and~~

- ~~Z-~~MW-# is the ~~Sampling Unit~~monitoring well designation (or other appropriate designation such as "HW" for horizontal wells).

Each sample container will have a sample label. The sample identification number will be logged in the field notes sheet, along with the following information about the sampling event:

- Sampling personnel;
- Date and time of collection;
- Observations on ambient conditions;
- ~~Decision Unit / Sampling Unit~~Well designation~~s~~;
- Method of sampling; and
- Intended sample processing methods and analyses.

3.6.3 Sample Labels

Each sample container will be labeled with the following information: unique sample number, date, time, project name and/or number, sampler's initials, and requested analytical parameters/methods. Indelible ink will be used to record information on the sample label.

3.6.4 Custody Seals

Custody seals will be used when a sample shipment is picked up by the laboratory or sent to the laboratory by overnight courier. Signed and dated custody seals will be attached to the top of the shipping container in such a way that it is necessary to break the seal to open the container. Custody seals ensure that any tampering during transportation will be detected by the receiving laboratory.

3.6.5 Chain-of-Custody Forms

Chain-of-custody forms provide the documentation to trace sample possession from the time of sample collection until receipt by the laboratory. One chain-of-custody form will be filled out for each cooler or shipping container and will list all the samples contained in the cooler or container. One copy of the completed form will be placed in a plastic bag and taped to the inside lid of the shipping container and one copy will be kept with the project files.

3.7 Field Activity Logs

3.7.1 Introduction

A field logbook will be maintained to record the details of field investigation activities and field data. This logbook will be bound and will have sequentially numbered pages. Entries will be written in indelible ink and will be initialed and dated by the field personnel recording the information. Several types of field activity logs will be maintained, including site health and safety logs, equipment calibration logs, and field sampling logs.

3.7.2 Field Sampling Logs

In addition to the descriptions of field investigation activities and field data recorded in the field log book, details of sampling information may be provided on field sampling logs. Field sampling logs will generally include the following information:

- date and weather;
- personnel;
- time and description of investigative activities;
- sample medium and type;
- sample collection technique(s);
- sample containers, analyses, and preservatives;
- sample number, location, and depth;
- sampling times; and
- pertinent field observations.

3.7.3 Corrections to Documentation

All documents will be completed in permanent, waterproof ink. None of the field documents are to be destroyed or thrown away, even if they are damaged or contain inaccuracies that require a replacement document. Corrections will be made by crossing out mistakes with a single line and then dating and initialing the correction. The use of correction fluid is not permissible. The documents used during the field investigation will remain on-site in the field office during the field effort.

4 ANALYTICAL METHODS

Groundwater samples will be analyzed for VOCs, PAHs, PCBs, metals, and geochemical parameters using USEPA approved methods. Note that low-level methods will be employed for PAHs. Specific test methods are indicated below:

VOCs	8260C
PAHs	8270D
PCBs	8082A
Metals	6010C (for high concentration metals) or 200.8 (for low concentration metals)
Chromium	IC-ICP-MS
Mercury	7470A (or 1613E for low level methods where concentration is known to be low)
pH	SM 4500-H+B
TDS	SM 160.1

Geochemical parameters include the following:

Sulfide	SM 4500-S2-D
Chloride	SM 4500-Cl-C
Sulfate	300.0
Silica	SM 4500-SiO2
TOC	SM-4500
Bicarbonate	SM-2320B

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5 DECONTAMINATION AND WASTE HANDLING

5.1 Sample Equipment Decontamination

Field sampling equipment will be decontaminated on-site according to the procedures outlined in USEPA Region IV Science and Ecosystem Support Division standard operating procedure for Field Equipment Cleaning and Decontamination at the FEC(SESDPROC-206-R2). The general procedures for decontaminating the equipment are listed below.

- Wash equipment thoroughly with Liquinox® (or other phosphate-free detergent) and water using a brush or scrub pad to remove any particulate matter of surface film.
- Rinse equipment thoroughly with tap water.
- Rinse equipment thoroughly with deionized water and allow to air dry.
- Wrap equipment in one layer of aluminum foil.

Tap water from any municipal water treatment system or distilled/deionized water may be used for initial equipment rinses. The use of an untreated potable water supply is not an acceptable substitute for tap water.

5.2 Investigation-Derived Waste Management

Investigation-derived waste (IDW) that will be generated during the sampling event includes:

- personal protective equipment (PPE) and disposables (e.g., gloves);
- decontamination liquids; and
- purge water from monitoring wells.

PPE and other disposables will be discarded like regular waste. Decontamination liquids and solids will be containerized in plastic buckets and then consolidated in open-top drums. Purge water from monitoring wells will either be discharged to the ground surface or containerized and consolidated into onsite holding tanks for pH neutralization with the onsite treatment system (and discharged into the infiltration galleries). For vertical and horizontal wells, a pH criterion of <9.0 standard units has previously been established with the agency as a threshold for discharging purge water back onto the ground surface (this is done in the area of the cell building cap where the caustic brine pool underlies the area).

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6 QUALITY ASSURANCE/QUALITY CONTROL (QA/QC)

6.1 Field QC Samples

Two types of field QC samples will be collected, trip blank and field duplicate samples.

Trip Blank

A trip blank sample is designed to detect contamination of environmental samples during transport from the field to the laboratory. A trip blank (VOC sample bottle filled in the laboratory with analyte-free water) is transported to the site, handled like a sample, and returned to the laboratory for analysis. Trip blanks shall not be opened in the field. One trip blank shall accompany every cooler of water samples sent to the laboratory for the analysis of VOCs. This blank shall be analyzed for VOCs only.

Field Duplicate

A field duplicate is collected at the same sampling location in a manner similar to other environmental samples, so the laboratory cannot distinguish them. The field duplicate is designed to check variability arising from sampling activities or lack of sample homogeneity. The duplicate will be identified in a manner similar to other environmental samples so the laboratory cannot distinguish them. Five percent (i.e., 1 in 20) of all environmental water samples shall be field duplicates. Both duplicates (e.g., the sample and the duplicate) shall be analyzed for the same parameters in the laboratory.

6.2 Field Operations

Control of field operations and sampling methods will be established through by ensuring that each field team member is familiar with the provisions of the Workplan and Health & Safety Plan (HASP). Also, the EPS Project Manager will ensure that each field team member is familiar with the Workplan prior to implementation of field activities. The EPS Project Manager will also provide a QA review of field activities at the beginning of the sampling event to ensure that all procedures are followed and at least one additional time during the execution of this project for each sampling team through on-site monitoring of representative field activities. The Project Manager will regularly check field notebooks and forms.

7 DATA QUALITY EVALUATION AND REPORTING

7.1 Data Quality Evaluation

EPS will store the data in an MS Access normalized relational database. A database is defined as a large collection of data organized especially for rapid search and retrieval. Data are organized into standardized, structured tables that are specifically related to one another. MS Access is an industry-standard relational application for small to medium databases.

Before data is added to the database, it undergoes a validation process. In the case of hand written notes and hard copies, records are manually entered into an electronic spreadsheet, checked twice by two different people. Electronic records are then imported into a separate database (Build database) where several queries are used to perform additional data validation. In order to maintain internal consistency, each parameter is spell checked to ensure proper encoding, each Sample ID and date pair is evaluated to prevent duplicate entries, and all data are checked for proper units, methods, and matrix types.

The database is designed for use by two classes of users: the Database Manager (DM) and the End-User. A DM designs and maintains the structure of the database, appropriately prepares data for entry (outside of Access), correctly executes validation tests within Access during data entry, and informs end-users of any limitations to the dataset. An End-User queries data for day-to-day work (analysis, reports, thought experiments, etc.) and links data to outside applications (GIS, outside databases). There is one DM and any number of End-Users.

The database is not simply one database, but rather a collection of three separate databases: Build, Master, and Main. The Build database links directly to the Master database and is used exclusively by the DM to validate, format, and finally enter data into the Master database. The Master database stores all the data and is managed only by the DM. The Main database is an exact replicate of the Master database that is linked to by End-Users for day-to-day work. When changes are made to the Master database it is copied over to the Main database. This procedure, known as "compacting", ensures that the Main database always has the most up to date records, and that there is separation between the original records and those used on a daily basis.

The work necessary to validate raw data is performed in queries. A query in its basic form allows the user to select fields for a table or multiple tables. Queries can also perform statistical calculations, replace values, add and remove records, create and delete tables. Because of the heterogeneity of the raw data, DMs modify queries and update key fields in order to maintain proper encoding. The following is a step by step process used to “clean” raw data:

- Raw data are imported into a temporary table that has the same structure as the Master database’s Data table.
- Each set of raw data is assigned a batch number in order to track its addition.
- Raw data are checked for duplicate records. If duplicate records exist, they are assigned the proper Dup code. The database is designed to store all duplicate records that often are the result of multiple analysis methods and lab replicates. Original values are given a

Dup code of 0. Duplicate records are given values that are the sum their duplicate characteristics. Characteristic codes are listed below:

1 - Duplicate sample sent to the same lab (often with a different Sample ID)
2 - Split sample sent to different lab: generally with the same Sample ID
4 - A duplicate analysis by the same lab generally by another method
8 – A duplicate due to reporting both the diluted and undiluted result
16 – Miscellaneous

- The analyte names are checked for spelling to ensure proper encoding.
- Units and Methods are checked to ensure proper encoding.
- Missing values are checked in order to prevent errors of omission.
- Sample ID / Date pairs are checked.
- Sample IDs in the raw data are cross-checked with existing locations. New locations are added when necessary.
- All raw records are checked against the Master database's Data table to prevent duplicate entries.
- "Clean" data are added to the Master database.
- All temporary tables are deleted.

Note that all data are actually entered into the database. "Clean" data are to be used without qualification, whereas other data flagged during the data review process are to be used with appropriate professional judgment. Instead of being thrown out, all data is categorized to allow database End-Users flexibility in analyzing data: Records are given Dup codes, data quality flags, matrix codes, area designations, etc. Because the database is a living database, DMs often have to modify table structures and add keys to key tables to input new sources of data in order to categorize additional records. These modifications do not change existing records, but instead build upon them.

7.2 Data Reporting

Data deliverables from the analytical laboratory will consist of the following items:

- Case Narrative;
- Laboratory Final Reports;
- Surrogate Recovery Summary;
- Matrix Spike/Matrix Spike Duplicate Recovery Summary;
- Method Blank Summary;
- Laboratory Control Sample (LCS) Recovery Summary;
- Initial Calibration Summary Gas Chromatograph (GC) Method Printout;
- Continuing Calibration Summary;
- Analytical Sequence Printout;
- Chromatographs and Quantification Reports for all Samples, Standards, and QC Samples;
- Copies of Extraction Log Pages; and
- Copies of Chain-of-Custody Document.

For consistency and ease of review, the data deliverables will be organized in the same manner. The arrangement will be as follows:

- Sample Narrative;
- Final Reports;
- QC Summary Information;
- Analytical Sequence Printout(s);
- Sample Raw Data (arranged by sample number);
- Instrument Calibration Data (in chronological order);
- Raw QC Data;
- Blanks;
- LCS;
- Matrix Spike/ Matrix Spike Duplicate (MS/MSD);
- Extraction Logbook Pages; and
- Chain-of-Custody Documents.

8 REFERENCES

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Figures

EPS

Tables