OBG
Part of Ramboll

Michael Baker
INTERNATIONAL

OBG|Baker Environmental Solutions Joint Venture

SITE INVESTIGATION WORK PLAN

ERIE COKE SITE

ERIE COUNTY, PENNSYLVANIA

PADEP Contract No.: SAP4000023226
General Environmental Technical Assistance Contract
Work Requisition No.: GTAC7-6-181

Prepared for:

pennsylvania
DEPARTMENT OF ENVIRONMENTAL PROTECTION

Commonwealth of Pennsylvania
Department of Environmental Protection

Submitted by:
OBG | Baker Environmental Solutions Joint Venture
Moon Township, Pennsylvania

July 2022

FINAL

SITE INVESTIGATION
WORK PLAN

ERIE COKE SITE

ERIE COUNTY, PENNSYLVANIA

PADEP Contract No.: SAP4000023226
Work Requisition No.: GTAC7-6-181

Submitted to:

Commonwealth of Pennsylvania
Department of Environmental Protection
Northwest Regional Office
Environmental Cleanup Program
Hazardous Sites Cleanup Section
230 Chestnut Street
Meadville, PA 16335

Submitted by:

OBG | Baker Environmental Solutions Joint Venture
Airside Business Park
100 Airside Drive
Coraopolis, Pennsylvania 15108

July 2022

Prepared By:

Christopher H. Kupfer, P.G.

Project Manager

OBG | Baker Environmental
Solutions Joint Venture

Approved By:

Scott K. Moffett, P.G., PMP
Program Manager

OBG | Baker Environmental
Solutions Joint Venture

NOTICE

The information in this document has been funded by the Pennsylvania Department of Environmental Protection (PADEP) under Contract No. SAP4000023226 to OBG | Baker Environmental Solutions Joint Venture (OBG | Baker). This document has been formally released by OBG | Baker to the PADEP.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

LIST OF ATTACHMENTS

1.0 INTRODUCTION

This Work Plan has been prepared by OBG | Baker Federal Solutions Joint Venture (OBG | Baker) for the Pennsylvania Department of Environmental Protection (PADEP or Department) as authorized under their General Technical Assistance Contract (GTAC), Contract Number 4000023226, Work Requisition Number 7-6-181. The Work Plan presents the strategy and technical approach, as well as schedule, for conducting a Site Investigation at the Erie Coke Site (site) located in Erie, Pennsylvania. The Work Plan was prepared based on information obtained during review of historical files, site scoping meeting and subsequent site walk in March 2022, a site reconnaissance in April 2022, and discussions/correspondences with Department personnel throughout the Work Plan development. The associated Field Sampling and Analysis Plan (FSAP) and Quality Assurance Project Plan (QAPP) are included in Attachment A. Project personnel are required to review the information presented in this Work Plan/FSAP/QAPP, as well as the site-specific Health and Safety Plan (HASP), prior to conducting the site investigation.

2.0 BACKGROUND

The following sections present pertinent background information related to the site location and physical setting, historical operations, and project objectives.

2.1 Site Location and Physical Setting

The Erie Coke Site is located at 925 East Bay Drive in the City of Erie, Erie County, Pennsylvania at 42° 08’ 40.6602” N latitude and -80° 04’ 3.5976” W longitude on the USGS Erie North Quadrangle map (Figure 1). Erie Coke Corporation (Erie Coke) owns several parcels of land totaling approximately 183 acres. The site is bordered to the north by Lake Erie and Lampe Marina, to the east by East Avenue Boat Ramp (East Ave. Boat Launch), to the south by a residential area and the Barber National Institute, and to the west by the City of Erie wastewater treatment plant and downtown Erie (Figure 2).

The site is located within a state designated Environmental Justice Area. The site is sparsely vegetated and not in use. The site is generally flat, except for steep banks along the site’s extreme northern and southern borders. The northern bank separates the site from Lake Erie and the southern bank separates the site from East Bay Drive. Access to the site for vehicles is restricted at the East Avenue gate entrance. However, other site controls, such as fencing, are not adequate to restrict trespassers from accessing the site.

General land uses proximate to the site include commercial, industrial, and residential areas. The population within a three-mile radius relies exclusively on a public water supply operated by Erie Water Works.

2.2 Site Operational History

To aid in understanding and locations of historical site features, Figure 3 presents a historical operations aerial map and Figure 4 presents an unscaled historical site layout.

An industrial manufacturing facility has operated at the site since approximately 1833. Beginning in 1833, the Jarvis Company, and later, the Perry Iron Company operated a blast furnace on site. In 1925, Pickand, Mather & Co. began operating 37 coke ovens on site. In 1942, Interlake Iron Company (a.k.a., Perry Furnace Company), began operating an additional 35 coke ovens, known as “B-Battery”. In 1952, 23 new coke ovens, known as “A Battery,” replaced the original 37 ovens that were installed in 1925. In 1967, steel production and coke production at the site stopped until Interlake Iron Company restarted the coke ovens under an agreement with Koppers Company, Inc. in 1970. In 1974, Koppers Company, Inc. began leasing and operating the coke ovens and Koppers Company, Inc. subsequently bought the property in 1980. Koppers Company, Inc. operated the coke ovens until it sold the property to Erie Coke Corporation in 1987. In 1987, Erie Coke Corporation acquired the property and began operating the facility, which contained 58 coke ovens, a coke oven battery under firing system, two boilers, a byproduct tar recovery system, associated railroad lines, and a wastewater treatment system. In 2018, Erie Coke Corporation sold the railroad lines that run through the site to Robindale Energy & Associated Companies.

The facility has a long history of violations of Pennsylvania environmental laws, including the Air Pollution Control Act, the Solid Waste Management Act, and the Clean Streams Law, as well as federal environmental laws and regulations. These violations resulted in numerous Department legal actions against Erie Coke Corporation including, Notices of Violations, Administrative Orders, Civil Assessment of Civil Penalties, Consent Decrees, and an Air Quality Title V permit denial.

In August 2018, approximately 600 gallons of wastewater from a finishing tank at the facility's wastewater treatment plant was released onto the ground on site. In March 2019, a large Aboveground Storage Tank (AST) at the facility wastewater treatment plant failed causing a large volume of wastewater to be released onto the ground. The wastewater released into the environment contained, among other hazardous substances, benzene, naphthalene, ammonia, and cyanide.

In July 2019, the Department conducted a limited sampling event by collecting soil, surface water, and groundwater samples for analysis from the site. The surface soil samples were comprised primarily of coke material and little actual soil because most of the site is covered with coal/coke/breeze material. One surface soil sample exhibited concentrations of benzo(a)pyrene exceeding Land Recycling and Remediation Standards Act, 35 P.S. § 6026.101-6026.909 ("Act 2"), Statewide Human Health Standard (SHS) Direct Contact Medium-Specific Concentrations (MSCs) for Non-Residential Soils. Two surface water samples were collected from standing stormwater on site and were compared to Title 25, Chapter 93 Water Quality Standards. Various constituents exceeded Surface Water Quality Human Health Criteria. Groundwater samples exhibited concentrations of lead, benzo(b)fluoranthene, and chrysene that exceeded Non-Residential, Non-Use Aquifer MSCs.

In December 2019, Erie Coke Corporation announced the immediate and permanent closure of the facility. Upon notice of the shutdown, the Department sought a court order to secure a $1 million account previously established by Erie Coke Corporation for environmental improvements as required by an Environmental Hearing Board Order. The court order required the money to be applied to the safe shutdown of the facility. The Department directed Erie Coke to address all regulatory issues associated with closure, including removal of all waste and wastewaters from the site. However, the $1 million only covered disposal of a portion of the wastewaters on site. The shutdown of the coke ovens and byproducts recovery plant was completed in December 2019.

In May 2020, the Department requested the U.S. Environmental Protection Agency (USEPA) to conduct a Removal Site Evaluation and determine if the site meets the threshold criteria for an USEPA Removal Action. During the Removal Site Evaluation in July 2020, USEPA documented tanks, totes, drums, and piping that, according to available labels and a materials list provided by the facility, contain hazardous substances, pollutants, and contaminants, including Site specific K-listed hazardous wastes, Polychlorinated Biphenyls (PCBs), mercury, sulfuric acid, solvents, corrosive liquids such as "weak ammonia liquor" and asbestos. In September 2020, USEPA signed an Action Memorandum to request and document approval of a Time-Critical Removal Action and funding for the site. In September 2020, USEPA began the removal action to mitigate threats posed to the public health and welfare due to the threatened release of hazardous substances from the site.

Currently, USEPA has demolished most of the buildings (few that remain consist primarily of only the outer brick structure), removed and disposed of waste, recycled appropriate scrap materials, and is actively mitigating risks associated with remaining tanks, containers and piping posing the greatest threat to public health, welfare, and the environment. Because the on-going USEPA removal actions do not include an investigation or management of contaminated soil, groundwater, surface water, or sediment, the Department has tasked OBG | Baker with the investigation.

2.3 Project Objectives

The objectives of work to be performed under this contractual assignment are to assess the level and extent of hazardous substances, pollutants, and/or contaminants at the site. Site Investigation activities will include sampling of surface and subsurface soils, groundwater, surface water, sediment, and unknown material deposits. This will also include sampling of identified outfalls, seeps and sediment along the Lake Erie shoreline to identify if contaminants have migrated off site.

Specific Areas of Concern (AOCs) that were identified by the Department during the site kickoff and during the subsequent site reconnaissance will be a biased focus of the soil and groundwater aspects of the investigation. In the larger site areas where AOCs have not been identified, a strategic sampling grid will be used to attain the project objective of sufficiently investigating all areas of the site.

The primary goal of this Site Investigation is to collect data necessary to support the evaluation/assessment of the former industrial site. Specifically, the objectives are as follows:

- Determine if hazardous substances, pollutants, or contaminants have been released into the environment on the Erie Coke property through surface and subsurface soil sampling, groundwater grab sampling, and subsequent installation/sampling of monitoring wells.

- Characterize likely discharge points of potential groundwater contamination through sampling of seeps and sediment along the Lake Erie shoreline.

- Characterize surface soils through grid sampling and biased sampling toward significant depression areas.

- Characterize subsurface soils through test boring advancement (rotasonic technology) and collection of soil samples for analysis at strategic and biased depths across the site (both identified AOCs and within the grids of the unidentified AOCs).

- Locate, map, and characterize the condition/integrity and potential contaminant impact to the subsurface from breaches in the two National Pollutant Discharge Elimination System (NPDES) outfalls (#001 and #002) and associated lines.

3.0 SCOPE OF WORK

To accomplish the project objectives and facilitate project planning and management, this project will be performed in accordance with the following tasks:

- Task 1000 – Project Management
- Task 1050 – Mobilization/Demobilization
- Task 2000 – Data Evaluation
- Task 2070 – Report Preparation
- Task 2071 – Letter Report Preparation
- Task 2200 – Project Meetings
- Task 3000 – Utility Clearance/Site Survey
- Task 3010 – Sample Collection
- Task 3013 – Stream/Sediment Sampling
- Task 3020 – Laboratory Analyses
- Task 3030 – Monitoring Well Installation
- Task 3040 – Geophysical Investigation (*NPDES Outfall Investigation)*
- Task 3060 – Groundwater Monitoring
- Task 3080 – Investigation Derived Waste (IDW) Management
- Task 4100 – Site Preparation

A detailed scope for each proposed task is provided in the following sections. It should be noted that the tasks in the ensuing sections of this Work Plan are presented in numeric order and not necessarily in the order that they will take place during the lifecycle of the project.

Field activities will be performed in accordance with this Work Plan and associated FSAP/QAPP (Attachment A) as well as the site-specific HASP. The FSAP has been prepared to provide guidance for the field activities by describing detailed sampling and data collection methods. Table 1 present a summary of the proposed sampling and analytical program for all matrices. The proposed sample locations are shown on Figures 5-1 through 5-3.

3.1 Task 1000 – Project Management

OBG | Baker's Project Manager, Mr. Christopher Kupfer, P.G., will be responsible for managing the overall efforts associated with this site. Mr. Kupfer will be responsible for management of the ongoing work as well as aid in development of this Work Plan and associated documents in conjunction with the Department project team.

Once this Work Plan is authorized, project management will include the following activities:

- Internal communication and coordination with project staff

- Control budget and schedule and track progress of work tasks
- Personnel scheduling/planning for assignments
- Monthly progress report preparation
- Communications and coordination with the Department

In addition, this task includes program management efforts by OBG | Baker's GTAC Program Manager, Mr. Scott Moffett, P.G., PMP. Under this task, Mr. Moffett will provide program support including reviewing activities and resolution of issues, as necessary, to be consistent with the GTAC expectations/requirements. For cost estimating purposes, this task is assumed to start from the notice to proceed through completion of the assignment.

3.2 Task 1050 – Mobilization/Demobilization

This task includes pre-field preparation/coordination activities as well as mobilization and demobilization of OBG | Baker personnel and equipment to the site. In addition, this task includes daily vehicle charges associated with the site investigation.

Prior to mobilization, a project orientation meeting with OBG | Baker personnel will be held to review the site history and layout, project objectives, information needs, field procedures, and health and safety issues presented in the site-specific HASP.

3.3 Task 2000 – Data Evaluation

This task involves data management activities and evaluation of the data collected during the Site Investigation, as follows:

- Communications and coordination of data with the Department Regional Project Officer
- Database preparation and population using the laboratory-prepared Electronic Data Deliverables (EDDs)
- Data and Quality Assurance/Quality Control (QA/QC) evaluation
- Tabulation of field and analytical data
- Comparison of soil and groundwater analytical results to appropriate Residential and Non-Residential Medium Specific Concentrations (MSCs) set forth in Act 2.
- Comparison of surface water analytical results to PADEP Water Quality Criteria (WQC). USEPA screening values and referenced literature values will be used for those constituents that do not have established PADEP WQCs.
- Comparison of sediment samples to Biological Technical Assistance Group (BTAG) criteria. Pennsylvania soil MSCs will be used for comparison when a BTAG number for a constituent found in sediment does not exist.

It should be noted that some of the above activities will be completed twice, once for the Data Summary Report, and again for the full Site Investigation Report. The contents of each report are presented in the appropriate sections below.

3.4 Task 2070 – Report Preparation

This task is intended to cover work efforts related to preparation of the Site Investigation Report once the data have been evaluated from both groundwater sampling events. In general, the report will include, but not be limited to, the following:

- Executive summary
- Summary of site description, history, and previous investigations
- Summary of the field sampling activities
- Presentation of sample location maps, groundwater contour maps, contaminant distribution maps (if applicable/valuable), and analytical data
- Discussion of the laboratory analytical results
- Conclusions and recommendations

Figures and tables will be prepared and included in the report to aid in presentation and comprehension of the investigation results. A photographic log will also be developed conveying the various operational wastes (e.g., coke, breeze, ash, etc.) and soils encountered on site.

All draft and final documents will be submitted electronically (PDF) to the Department. In addition, one hard copy of the Draft and two hard copies of the Final Site Investigation Report will be provided to the Department Regional Project Officer.

3.5 Task 2071 – Letter Report Preparation

Two separate letter reports will be developed within this scope of work. The initial letter report (Data Summary Report No. 1) will provide a summary of the analytical results from the soil and groundwater grab samples and a presentation of the proposed final number, locations, and depths of the groundwater monitoring wells. As this is strictly a data summary report, the report will be limited to a presentation of the laboratory analytical results of all sampled media compared to the appropriate criteria and applicable support documents.

For the purpose of this report, laboratory analytical results will be reduced and presented in a tabular format highlighting applicable criteria exceedances (i.e., 'hits' tables). This will allow for a more purposeful and succinct meeting of the analytical results between the Department and OBG | Baker. As its purpose, there will be no detailed descriptions of field activities/methodologies, interpretation of the data, conclusions, or recommendations provided in this report as these will be provided later in the full Site Investigation Report. Supporting documents will include scaled site figures in the letter report depicting the locations of all sample locations across the site including test boring and monitoring well locations.

At the request of the Department, a second letter report also will be developed (Data Summary Report No. 2). This Data Summary Report will be developed after completing the first of two rounds of groundwater sampling at the site from the newly-installed monitoring wells. As this also is strictly a data summary report, it will be similar to the initial letter report in that there will be little description of the investigation field activities.

All draft and final documents will be submitted electronically (PDF) to the Department. In addition, one hard copy of the Final Data Summary Reports will be provided to the Department Regional Project Officer.

3.6 Task 2200 – Project Meetings

For the scope of work included herein, three remote project meetings are anticipated. The first project meeting will include a discussion of the findings from the NPDES outfall mapping and video inspection report from the subcontractor. The focus of the meeting will be to come to an agreement on what steps should be taken for sufficient characterization of the soil and groundwater in the vicinity of the lines with respect to historical breaches forming potential AOCs along the lines. This meeting is anticipated to take place near the end of the field activities.

The second proposed project meeting will be to discuss the findings from Data Summary Report #1. The focus of the meeting will be to come to an agreement on the final number and locations of the proposed groundwater monitoring well locations.

The third proposed project meeting will take place between the Department and OBG | Baker to discuss the findings summarized in the Data Summary Report No. 2 letter.

3.7 Task 3000 – Utility Clearance/Site Survey

Because of the nature of the scope of work, the utility clearance and site survey activities have been segregated into four distinct activities.

3.7.1 Utility Clearance

Although unlikely, utility companies (e.g., pipeline, gas, electric, water, sewer, and telephone) suspected of having underground lines on site or in the immediate vicinity of the site will be contacted by OBG | Baker prior to the start of the intrusive field activities through the Pennsylvania One Call System. It is believed that no on-site meetings with the utility companies are warranted to achieve the necessary clearance. It is likely that the utility companies will not mark underground lines on most of the site being it is private property. Because it is believed that there are no active underground utilities on site that will hinder the site investigation activities, a geophysical survey is not believed to be warranted for additional clearances.

3.7.2 Aerial Image Survey

It should be noted that the aerial drone survey was previously funded under a preliminary scope of work. However, the data deliverables generated from the drone survey will be used in the development of finalized version of this Draft Work Plan and all other ensuing project reporting documents. Therefore, this task has been included in the Work Plan discussion.

At the request of the Department, an aerial drone flyover of the entire site was completed before completion of all site investigation activities. The aerial drone digital photographs will be used by the Department for presentational documents and the digitized base map developed will be used for all project related documents moving forward.

The survey was completed May 12th and 13th, 2022, with a DJI Matrice 300 RTK drone using the Zenmuse P1 sensor. The Zenmuse P1 sensor is used for projects where high-precision mapping activities are needed. The Matrice 300 had approximately a 35-minute flight time, and the associated kit had four sets of batteries to allow all day operation.

The scope of work included initially checking airspace classifications for the area and determine if there are restrictions or additional tasks required by the U.S. Federal Aviation Administration (FAA). The airspace above the site was within the proper airspace class to fly the drone.

After equipment preparation and loading, the drone pilot mobilized to the site to complete the aerial image collection. After meeting with site personnel, the drone pilot installed a ground control layout and complete safety planning. All field activities were supported with an on-site surveyor. Currently, the drone survey and photoimaging data are in post-field processing and will be available for all ensuing project deliverables.

3.7.3 Boundary Survey

At the request of the Department, a boundary survey will be completed at the site. Initially, the survey will include an office exercise pulling the deeds to the various parcels of the site in review and coordination of the on-site activities. OBG | Baker will prepare deed composites of the record information obtained for the subject and adjoining properties, performing research for record information of real property deeds, plats, and roadways, obtained from the Erie County Recorder of Deeds.

OBG | Baker will utilize this information to perform a field-run boundary survey of the subject parcel. The boundary survey will include the physical locations of the existing property corner and right of way monumentation on the subject and adjoining properties. The property evidence will be evaluated in the office and final boundaries of the subject properties will be determined under the direct supervision of a licensed Pennsylvania Professional Land Surveyor in compliance with Manual of Practice for Pennsylvania Land Surveyors as adopted July 10, 1998. Any missing corners will be monumented with 3/4-inch rebar, 30-inches long with identifiable cap or an equivalent durable marker which will be stated on the final drawing. In addition, line staking will be done at intervisible locations setting the same ¾ inch rebar. It should be noted that the boundary survey does include submerged lands.

For the on-site work, carsonite markers and wooden stakes at property corners marked 'Boundary' will be installed at the appropriate locations. Iron pins also will be installed at each line stake point. The surveying activities will be completed to an accuracy of 0.1 feet by a Pennsylvania-licensed surveyor. A new boundary drawing (PDF and AutoCAD versions) will be provided to the Department but will not include legal descriptions.

3.7.4 Monitoring Well Survey

For purposes of this Work Plan, an estimate of 12 groundwater monitoring wells will be installed during this initial phase of the investigation. From that, each of the 12 wells will need to be surveyed for accurate placement on a scaled site map and for groundwater flow mapping.

The monitoring well survey activities under this task will include locating the horizontal position and establishing elevations of the newly-installed monitoring wells. The horizontal data will be to the nearest 0.1-foot and referenced to the Pennsylvania State Plane Coordinate System, North American Datum (NAD) 1983. The vertical data will be to the nearest 0.01-foot and referenced to the North American Vertical Datum (NAVD) 1988. These surveying activities also will be conducted under the direction of a professional land surveyor licensed to practice surveying in the Commonwealth of Pennsylvania.

3.8 Task 3010 – Sample Collection

As previously discussed, the site history has documented releases from tanks and other operational issues throughout the site's history causing environmental concerns across the various AOCs. A site reconnaissance was completed in April 2022 to further identify AOCs and proposed sampling locations. This task includes all soil sampling activities (regardless of collection method) and groundwater grab sampling activities. For consistency, delineation, and overall site characterization, OBG | Baker and the Department agreed that all coke, fill, soil, sediment, and groundwater grab samples presented below will be analyzed for VOCs, SVOCs, metals (including mercury), and PCBs by a subcontracted laboratory. In addition, pesticide analysis will be performed on 25% of the non-aqueous samples to assess for its presence across the site. Dioxin analysis will also be performed on 10% of the non-aqueous samples collected within the footprint of the former coke plant areas. Both dioxin and pesticides will be analyzed for all groundwater grab samples and the first found of groundwater sampling of the monitoring wells. General chemistry will also be analyzed for all aqueous samples.

3.8.1 Soil Sampling Activities

Surface and subsurface soil samples (including coke and potentially other fill material) will be collected from the site to determine if hazardous substances, pollutants, or contaminants have been released into the environment. The proposed sample locations are shown on Figures 5-1 through 5-3 and the sampling and analytical program is summarized on Table 1. A general overview of the soil sampling is provided below. Specific sampling and field screening procedures are detailed in the FSAP (Attachment A). As shown on the figures, proposed soil borings (and soil samples) have been placed in locations that will aid in the identification of contaminant impact at each AOC. Some sample locations have been skewed to areas of obvious or suspected contamination for better characterization. All borings will be advance to native material, if present.

For investigation of areas that are not related to a specific AOC, one test boring will be advanced in loosely gridded areas shown on Figures 5-1 through 5-3 (actual grids not shown to mitigate figure clutter). Within each grid area, the test boring location may be moved to an area of a potentially higher environmental concern (e.g., stained area, stressed vegetation, etc.) for a better understanding of site conditions.

Although a large portion of the site is covered in coke and/or fill material, the collection of a majority of the surface soil samples will still be attempted to be collected with hand tools or hand auger/shovel. If collection appears to difficult, the surface soil samples will be collected from the retrieved soil cores of a drilling rig utilizing rotasonic technology. The rotasonic drilling method will be used for the subsurface soil sampling and includes a combination of rotary power, hydraulic pull down pressure, and mechanically generated oscillations to advance a dual line of drill pipe.

Continuous four-inch diameter soil core samples will be collected for lithologic identification and field screening during boring advancement. As each boring is advanced, the inner casing will collect a continuous 4-inch nominal diameter soil core in 5- or 10-foot long increments. Once the soil core is extracted, it will be placed directly into a clear polyethylene liner using a vibration technique of the rotasonic rig. Housing the sample in a clear plastic liner will allow the OBG | Baker geologist to log the core and field screen the continuous soil sample while minimizing potential volatilization. Based on the anticipation of significant fill and non-cohesive soils, an outer 6-inch diameter casing will likely be needed to advance the borings deeper than ten feet to achieve the desired boring depths.

Field screening of surface (0 to 1-foot depth interval) and subsurface soil samples will consist of placing the tip of a PID through small slits cut in the polyethylene liner at approximately one-foot intervals to measure the total concentration of VOCs in parts per million (ppm). If the surface soil sample is collected by hand, a representative sample will be placed in a sealable bag with the PID inserted into the bag for screening. The PID responses will be recorded on the associated boring logs. At the request of the Department, a field radiation meter will also be used to field screen the retrieved soil samples. In addition to the PID and radiation meter results, other items that will be documented on the boring logs include geologic descriptions of the soil type, odor, discoloration, recovery amount, sample depth, moisture content, grain size, and any other features observed in the soil sample.

Based on the anticipated shallow depth of groundwater, depths of the soil borings are anticipated to be no more than 15 feet below ground surface (bgs). All borings will be terminated once groundwater is encountered, unless the boring is being advanced for the collection of a groundwater grab sample or later for monitoring well installation.

3.8.1.1 Soil Sample Selection Methodology

Retrieved soil cores will be field-screened and up to three soil samples described below will be collected from each rotasonic boring for laboratory analysis:

Identified Areas with Contaminant Impact:

- One surface sample from 0-1 foot bgs to represent the potential greatest exposure pathway of contaminants on site.
- One 'worst-case' soil sample based on PID readings and/or visual evidence of staining/odor.
- One soil sample collected at the soil/groundwater interface.

Areas with NO Obvious Contaminant Impact:

- One surface sample from 0-1 foot bgs to represent the potential greatest exposure pathway of contaminants on site.
- One soil sample from 4-5 feet bgs to document subsurface conditions and potentially delineate contaminant impact not obvious through screening (e.g., metals, pesticides).

As noted above, in lieu of any detected PID readings or visual evidence of staining/odor, borings will be terminated at five feet or when native material is encountered, whichever is deeper. In these areas, up to two soil samples will be collected for laboratory analysis and include a surface soil sample (or just below the fill/soil interface, if present) and a sample at the boring terminus (4-5 feet bgs). This sampling methodology should provide a sufficient vertical profile of potential contaminant impact.

3.8.1.2 Background and Operational Material Sampling

At the request of the Department, representative samples of the coke from across the site will be sampled for characterization purposes. Therefore, as part of the scope of work, three samples of coke material will be collected from various locations around the site for laboratory analysis. The findings will allow a better evaluation of site conditions at the time of development in the future.

In addition to the three samples of coke product collected for analysis, an additional three soil samples will be collected across the site at the coke/soil interface. The sample depth could be near surface or several feet below grade. The analyses of these three soil samples at the interface will allow a better assessment of potential leaching of contaminants from site operations into the subsurface soil horizon. These samples were also requested by the Department.

To provide an evaluation of background site conditions, a total of six background soil samples will also be collected from the site. Note that these samples are not intended to be true native background samples but rather 'Erie Coke background' as they are intended to evaluate soils not impacted from former historical site operations.

It is anticipated that these samples will be collected near the southern site boundary away from Lake Erie. To allow for representation of the entire site, three borings will be advanced in three separate topographically-upgradient, non-operational areas of the site. The three boring locations are not shown on site figures as their locations will be determined in the field based on investigation findings. At each boring location, soil sampling will follow the methodology above for non-impacted areas; one surface soil sample and one at-depth soil sample from 4-5 feet bgs will be collected for analysis.

Because of the shallow and variable depth to groundwater (anticipated to be between 8 and 15 feet bgs across the site) and unknown thickness of contaminant impact across the site, field decisions will be made on the number and depths of the soil samples (e.g., if contamination extends to near the water table, only one sample would be collected for vertical delineation purposes).

As summarized in the IDW Management section of this Work Plan, residual soil cuttings from the sonic drill rig not collected for laboratory analysis will be returned to its boring of origin unless waste material (e.g., liquid or semi-solid waste, oils, etc.) or notable contamination is present based on field screening and visual/olfactory observations. Surrounding site materials will be used to backfill any remaining void in the open borehole.

It should be noted that if it appears that the rotasonic drilling rig is incapable of collecting representative at-depth soil samples in a particular area, an excavator may be used to advance test pits/trenches to achieve the desired depth.

3.8.2 Groundwater Grab Sampling Activities

In addition to the collection of soil samples across the site, groundwater grab samples also will be collected from select boring locations. It is believed that collection of groundwater grab samples will enable a more thorough preliminary evaluation of groundwater conditions at the site before final placement of the proposed monitoring wells. All groundwater grab samples will be analyzed for VOCs, SVOCs, metals (including mercury), PCBs, pesticides, dioxin, and general chemistry by a subcontracted laboratory.

Because of the size of the site and numerous potential AOCs, several groundwater grab samples will be collected from across the site. If an AOC exhibits expansive contamination, additional groundwater grab samples may be collected from the area. In unidentified AOCs across the site (e.g., non-operational gridded areas throughout plant and wooded areas), groundwater grab samples will be collected in areas that may exhibit groundwater impact from other site operations and also in areas that will provide adequate spatial coverage for groundwater characterization across the site.

For purposes of this Work Plan and associated Cost Estimate, a total of 15 groundwater grab samples are initially proposed to be collected across the site. Nine of the proposed general groundwater grab sample locations are shown on Figures 5-1 and 5-2. However, to accomplish sufficient site coverage and also address contaminant impact not yet identified, an additional six groundwater grab samples have been included in the investigation. Based on real time findings, the locations of the additional six groundwater grab samples will be at the discretion of the field geologist. These locations will ultimately be surveyed for placement on a scaled site figure for the report.

It should be noted that the number of groundwater grab samples is based on a review of site history, site reconnaissance findings, and the methodologies above. The final number of groundwater grab samples may be higher or lower based on observed site conditions.

Because of the unknown production and definitive depths of the aquifer beneath the site, multiple collection options may be implemented. If boring advancement is not difficult and groundwater production is sufficient, groundwater grab samples may be collected using a discrete groundwater sampler advanced to the desired depth in an adjacent borehole.

If groundwater production is limited, a temporary 2-inch diameter Polyvinyl Chloride (PVC) well screen and riser may be lowered to the bottom of the borehole through the 6-inch casing. Other site work can be completed while allowing time for groundwater to flow into the screen/riser until sufficient volume is present to retrieve the groundwater grab sample using either a peristaltic pump with dedicated tubing or a disposable bailer.

3.8.3 Exploratory Borings

At the request of the Department, a total of five soil borings will be advanced across the site to determine the depth of the top of bedrock. Although continuous soil samples will be collected for geologic logging purposes, no soil or groundwater grab samples will be submitted for laboratory analysis. However, if liquid waste is encountered during advancement, an attempt will be made to sample the waste and discussions will be initiated with the Department on how to proceed with further sampling.

Because there may be a concern for allowing site contamination to migrate downward during the boring advancements, the five exploratory soil borings will be advanced in areas with little to no evidence of contaminant impact. Therefore, the five exploratory soil borings may be advanced near the completion of the intrusive field activities once a cursory evaluation of impacted and non-impacted areas have been identified. Furthermore, these five borings also will be spread across the site to provide a better understanding of the overburden depth across the site.

3.9 Task 3013 – Stream/Sediment Sampling

To evaluate if contaminant impact from the site is migrating through surface and near-surface channeling, surface water and sediment samples will be collected as part of the Site Investigation activities. This task is segregated into specific sampling activities summarized below. Specific sampling procedures are described in the FSAP (Attachment A).

Surface water samples will be collected using a peristaltic pump and/or dip sampling techniques. Sediment samples will be collected using disposable and/or decontaminated stainless steel hand tools. Both surface water and sediment samples will be analyzed for VOCs, SVOCs, metals (including mercury), general chemistry, pesticides, and PCBs. Field parameter measurements of the surface water samples will include pH, specific conductance, temperature, dissolved oxygen, and Oxidation/Reduction Potential (ORP). These will be recorded in the field notebook for future reporting.

3.9.1 Lake Erie Shoreline Investigation Activities

One of the objectives of the Department was a complete evaluation of the Lake Erie shoreline within the bounds of the Erie Coke property. To accomplish this evaluation, OBG | Baker personnel performed a site reconnaissance on April 14, and 15, 2022. The site reconnaissance included the traversing of more than 2,000 feet of shoreline that abuts the site. The focus is primarily between Lampe Marina and the East Avenue boat launch, including the depositional area on the west side of the East Avenue boat launch (off property). As the shoreline was traversed, a handheld Global Position System (GPS) unit was used to geolocate identified areas of interest for future sampling. No seeps were identified along the shoreline during the April 2022 site reconnaissance, but other sampling areas were identified. These locations are shown on

Figures 5-1 and 5-2.

In addition to the surface water, sediment, and materials sampling, sediment samples also will be collected at approximate 250-foot intervals along the length of the shoreline to provide spatial coverage for sufficient characterization. Based on this set interval, a total eight sediment samples will be collected along the shoreline during the investigation activities.

3.9.2 Depression Areas Investigation

Although the site is relatively flat, there are large depression areas across the site that may be collection points of potential contamination from the years of operational history. Therefore, surface water and sediment/soil samples will be collected from each of these areas. It is anticipated that one surface water sample from each area will suffice for characterization. Because these are low-lying potential collection points of deeper contaminant impact, a shallow boring will be advanced in each depression area instead of only collection of a surface soil sample. One rotasonic soil core run will be advanced to a depth of five feet bgs in the designated areas. The samples will be collected and field screened following the same methodologies presented above for soil sampling and are summarized on Table 1. Additional samples may be collected for analysis if obvious contaminant impact is present. For estimation purposes, a total of three depression areas are included in this scope of work.

3.10 Task 3020 – Laboratory Analysis

This task will involve the following:

- Communications and coordination with the laboratory
- Sample tracking and management
- Laboratory analyses

At the direction of the Department all laboratory analytical services will be provided by a subcontracted laboratory. OBG | Baker will communicate directly with the laboratory to coordinate bottle/sample handling requirements, analyses, and analytical reporting.

Sample tracking and management will involve coordinating with the laboratory and tracking the samples from the time of collection through receipt of results. OBG | Baker will assign a single contact person to coordinate daily sample shipments to the laboratory and track sample data to ensure the samples have been received and processed by the laboratory. The laboratory management activities will include the following:

- Coordinating sample requirements and bottleware
- Accepting bottle delivery

- Sample bottle sorting and labeling
- Sample delivery/shipment to the laboratory
- Tracking sample delivery and receipt of the data
- Monitoring incoming data for completeness

The laboratory will be required to provide services as outlined in this Work Plan and associated QAPP (Attachment A). The services to be provided include the following:

- Analyze samples in accordance with th
- e methods and quantities provided in Table 1.
- Provide EDDs in an Excel spreadsheet format.

It should be noted that the number of samples described in Table 1 is based on the anticipated minimum number of samples to be collected and will likely expand as contamination is encountered during the sampling and screening activities. The laboratory will be made aware of this and will be requested to provide an additional 20% of bottleware to allow for scope or work expansion. Requests for Quote also will be based on the 20% expansion of the scope.

3.11 Task 3030 – Monitoring Well Installation

For purposes of this Work Plan and associated Cost Estimate, a total of 12 groundwater monitoring wells are proposed for this initial phase of the investigation. Because the well locations will be based on the findings from the soil and groundwater grab sample analytical results, the locations of the wells have yet to be determined. From that, proposed placement locations on Work Plan figures herein would prove counterproductive in cluttering applicable figures.

It is anticipated that the specific number and locations will be discussed, and agreed upon, with the Department based on the results of the groundwater grab and soil samples presented in a letter report. A general overview of the well installation is provided below. Specific well installation methods are detailed in the FSAP (Attachment A).

The well borings (anticipated to be 15 to 25 feet deep) will be drilled using rotasonic drilling methods, which use a combination of rotary power, hydraulic pull down pressure, and mechanically generated oscillations to advance a dual line of drill pipe. The inner drill pipe (4-inch nominal diameter) contains a core bit and represents the core barrel sampler, while the outer pipe (6-inch nominal diameter) is used to prevent collapse of the borehole and in construction of wells. Rotasonic methods are ideally suited for monitoring well installations because the methods minimize generation of waste, reduce difficulties with heaving sands, and provide for more controlled well installations and reduced development time due to the ability to vibrate the outer casing in or out of the borehole.

As was earlier described for the soil sampling drilling, continuous soil core samples will be collected for lithologic identification during well boring advancement. As directed by OBG | Baker's on-site geologist, the wells will be constructed using 2-inch inside diameter (ID), Schedule 40, PVC well casing and screen materials. Well screens (0.010-inch slot) will be up to 10 feet in length based on encountered geologic conditions. The wells will be installed at the bottom of the borehole.

Development of digitized versions of all soil boring logs, groundwater grab sample boring logs, and the monitoring well installation construction diagrams are also included under this task.

3.11.1 Monitoring Well Development

Monitoring well development activities will be performed no sooner than 48 hours after completing the installation of the 12 groundwater monitoring wells. Before development, groundwater level and total well depth measurements will be collected to calculate the volume of groundwater present within the well casing and determine the appropriate volume to be evacuated for development. Furthermore, any potable water that was needed during construction to suppress heaving sands (if present) will also be incorporated into the well development volume warranting removal.

Wells will be developed by bailing, surging, or pumping to remove fine sediments and residual drill cuttings from the well casing and the borehole annulus. The method of development will be based on the hydrogeologic conditions encountered and construction specifications (groundwater depth, total well depth, production/recharge rate, etc.). However, it is anticipated that most of the monitoring wells will be developed using a dedicated, disposable polyethylene bailer and retrieval line or a disposable Whale pump (or similar).

During development, the bailer will also be used to agitate (i.e., stir up) the water within the well to remove suspended solids. Assuming sufficient groundwater production, development will continue until the development water is clear or five well volumes have been removed, whichever is achieved first (not including potable water possibly introduced during well construction).

Water generated from the well development activities will be containerized accordingly. The management of IDW is discussed further in Section 3.14 (Task 3080 - IDW Management) of this Work Plan.

3.12 Task 3040 – Geophysical Investigation (*NPDES Outfall Investigation*)

This investigation is being completed under Task 3040 (Geophysical Investigation) to keep it separate from the other investigative activities and is the nearest applicable task name. From the on-site kickoff and associated meeting, the Department expanded the initial scope of work to include an investigation of the two NPDES outfall piping runs (#001 and #002) traversing the site (some outfall features shown on Figure 5-1). During the on-site kickoff, it was evident that the condition and competency of both piping runs were not ideal. Because breaches in the lines over years of operation would likely be considered an AOC, the Department requested that an investigation into both runs be completed. The investigation has been segregated into two tasks; sampling at the outfalls themselves, and the outfall mapping with subsequent soil and groundwater grab sampling at identified breaches in the lines.

3.12.1 Outfall Sampling

After Outfall #001 has been cleaned out using an excavator during the site preparation activities, one surface water and sediment sample will be collected directly beneath the outfall. In addition, one other sediment sample will be collected along the cleared outfall drainage channel between the outfall and the Lake Erie shoreline. Grab samples along the cleared drainage will be field screened and evaluated for contaminant impact (staining, odor, etc.). The sediment sample that appears most impacted will be submitted for analysis of VOCs, SVOCs, metals (including mercury), PCBs, and pesticides by a subcontracted laboratory. Surface water samples will include the sediment analytical suite with the addition of general chemistry.

Because Outfall #002 discharges adjacent to the Lake Erie shoreline, only one surface water and sediment sample will be collected. The sediment sample will be collected directly below the outfall discharge piping.

If no water is flowing from the outfalls at the time of the sampling, the outfalls will be revisited later during the field activities after a recent rain event to collect the aqueous sample.

3.12.2 Outfall Mapping with Strategic Sampling

It was agreed between the Department and OBG | Baker that it would be best to delay the start of this part of the investigation until near the end of the other intrusive activities. Having Real-time investigation findings and heavy equipment on site (e.g., excavator and skid steer) will aid in this part of the ensuing outfall investigation.

The initial step in the investigation process will be to subcontract a firm capable of mapping the two outfall runs and complete a video inspection. An attempt to clear applicable pathways/entrance points will be completed during the site preparation activities (Section 3.15 - Task 4100). After an on-site, pre-bid meeting, the subcontractor will complete the video inspection and mapping of the two outfall piping runs. The video inspection and mapping report from the subcontractor will be presented to the Department and a subsequent meeting will take place between the Department and OBG | Baker to discuss the findings. A copy of this report will also be included as an attachment in the Site Investigation Report. For cost estimating purposes, it is assumed that clean out of any accumulated sediment within the piping runs will not be required.

For any section along both outfall lines where it appears there has been a notable breach in the line, soil sampling activities will take place following the same screening and sampling methodologies described above in Section 3.8.1. For estimation purposes, a total of six borings (three from each outfall piping run) will be advanced to investigate potential impact to subsurface soils from breaches in the lines. Soil sampling and screening for potential laboratory analysis will begin below the bottom of the outfall piping. Only one soil sample will be collected from each boring unless notable contamination is present. If so, screening and sampling will follow the soil sampling activities presented previously in this Work Plan. For estimation purposes, a total of two groundwater grab samples have been included in the associated Cost Estimate to investigate potential impact to the shallow aquifer (one from each run).

As noted in Section 3.8.1 (Soil Sampling Activities), at-depth soil sampling activities may be completed by excavation with a backhoe if the rotasonic drill rig cannot reach the desired location or depth along the outfall lines.

3.13 Task 3060 – Groundwater Monitoring

At the direction of the Department, two groundwater sampling events are included in this scope of work. Based on the findings from these two events presented in the Site Investigation Report, additional groundwater sampling events may be added out of scope.

For purposes of this Work Plan and associated Cost Estimate, a total of 12 shallow (15-25 feet deep) groundwater monitoring wells will be installed and sampled as part of the investigation activities.

3.13.1 Groundwater Sampling Event No. 1

After completing the well development activities, the 12 monitoring wells (locations currently unknown) will be allowed to rest a minimum of 48-hours (ideally one week) to allow the wells to stabilize prior to sampling (generally accepted practice).

A complete round of groundwater level and total depth measurements from the wells will be collected and recorded in the field notebook prior to initiating the purging and sampling activities. The monitoring wells will be purged prior to sampling to collect a representative groundwater sample from the aquifer.

The wells will be sampled using low flow purging/sampling methods to minimize sampling-induced turbidity problems and provide samples more representative of ambient groundwater quality. If groundwater production is not sufficient, the purging and sampling activities will be completed with dedicated, disposable polyethylene bailers. Specific sampling procedures are detailed in the FSAP (Attachment A).

The groundwater samples from the initial sampling event will be analyzed for VOCs, SVOCs, metals (total and dissolved, including mercury), general chemistry, pesticides, and PCBs. After collection of the samples for laboratory analysis, field parameter samples will be collected and measured for pH, specific conductance, temperature, dissolved oxygen, ORP, and turbidity. The field parameters will be recorded in the field notebook.

3.13.2 Groundwater Sampling Event No. 2

At the direction of the Department, two groundwater sampling events have been included in this scope of work. The second groundwater sampling event will take place no sooner than three months after completion of the initial groundwater sampling event. The timeframe between the two events is to assess if there are potential seasonal variations in hydrology and geochemistry at the site.

A virtual meeting will take place between the Department and OBG | Baker after completion of the initial groundwater sampling event and evaluation of the data. The purpose of this meeting will be to discuss any potential changes to the second groundwater sampling event. As an example that was discussed during the site kickoff, if it appears that pesticides have no notable detections during the initial groundwater sampling event, their analysis may be eliminated from the second round of groundwater sampling.

3.14 Task 3080 – IDW Management

Wastes will be generated from performance of the site investigation field activities identified herein. Because of the large size of the site, all laydown areas and decontamination areas will be on site.

Liquid IDW generated during the field activities will be temporarily stored in a portable liquids storage tank (a.k.a., ‘frac’ tank). It is estimated that a 4,000-gallon frac tank will be used to temporarily house the IDW liquids until disposal. It is anticipated that at the conclusion of the well installation and initial groundwater sampling activities, the frac tank will be removed from the site by the IDW subcontractor and its contents properly disposed at a Department-approved disposal facility. For the subsequent second groundwater sampling event, waste volume will be substantially reduced. With this reduced volume, drums will be used instead of a frac tank to temporarily store the IDW liquids.

As agreed upon by the Department, most rotasonic drill rig soil cuttings generated from the investigation field activities will be returned to their boring of origin after logging, field screening, and sample collection. Any remaining borehole void will be backfilled with surrounding material. The exception would be if a notable amount of contaminant impact is observed in the retrieved soil core. If encountered, the contaminated soil will be drummed, labeled, and characterized for later off-site disposal.

Soil cuttings generated from the monitoring well installation activities cannot be returned to the borehole to allow installation of the well materials. Therefore, soil cuttings from well installation activities that do not appear to be notably contaminated (e.g., no elevated PID readings) will be spread on the ground surface near the boring of origin.

Decontamination solids (collected on the decontamination pad) generated from the test boring and well installation equipment will be placed in properly labeled, steel, 55-gallon drums by the drilling subcontractor for later characterization and disposal.

Decontamination fluids (collected on the decontamination pad) generated from the test boring and well installation activities will be placed in the frac tank by the drilling subcontractor for later characterization and disposal.

Solid wastes not anticipated to be a threat to the environment (e.g., trash bags, rope, paper towels, bailers, liners, etc.) will be disposed as municipal trash in an on-site rolloff box provided by the IDW subcontractor.

In addition to the use of a frac tank and rolloff box from the IDW subcontractor, a conex box also will be provided by the IDW subcontractor for the temporary storage of equipment, coolers, bottleware, and supplies during the investigation. It should be noted that both the conex box and the frac tank will be locked at all times.

In addition to the staging of the conex box and frac tank in a centralized staging area, a temporary decontamination pad will be constructed by the drilling subcontractor to collect liquids and solids accumulated from the decontamination of test boring and well installation drilling equipment. To eliminate the need for excessive transportation of accumulated wastes, the decontamination pad will be constructed adjacent to the conex box and frac tank. The decontamination pad will be dismantled by the drilling subcontractor at the completion of the drilling and well installation activities.

The characterization and disposal of IDW will be conducted following completion of the initial groundwater sampling event. It is anticipated that the proposed 4,000-gallon frac tank will be of sufficient size to house the IDW liquids generated from the investigation activities. With respect to waste characterization, one representative non-aqueous (e.g., soil) and aqueous (e.g., groundwater/wastewater) sample will be collected from the IDW drums and frac tank, respectively, and will be analyzed for waste characterization parameters.

As noted on Table 1, other waste profile analyses will be required in addition to the VOC, SVOC, and metals analyses. Although the waste profile analytical suite will be dependent upon the IDW subcontractor, it is anticipated that the aqueous profile sample likely will be analyzed for Target

Compound List (TCL) VOCs, TCL SVOCs, pH, flashpoint, reactive cyanide, reactive sulfide, and Resource Conservation and Recovery Act (RCRA) Metals. The non-aqueous waste profile sample will also be analyzed for Toxicity Characteristic Leaching Procedure (TCLP) SVOCs, TCLP VOCs, and TCLP metals.

Once received, the analytical results of the samples will be emailed to the IDW subcontractor to initiate the removal and proper disposal of the accumulated wastes. The IDW results and recommendations for an appropriate disposal facility will be provided to the Department for approval. A preliminary cost for disposal has been included for estimation purposes. It is assumed that the IDW will be nonhazardous.

OBG | Baker will coordinate the waste removal date with the Department to have the manifests signed prior to the wastes being removed from the site. OBG | Baker personnel will be on site to oversee the loading and removal of the IDW.

Although it cannot be confirmed, it is anticipated that once the waste stream has been characterized, no further characterization sampling will be necessary prior to further waste removal activities (e.g., aqueous wastes from second round of groundwater sampling).

3.15 Task 4100 – Site Preparation

To complete the site investigation in an efficient and timely manner, numerous site preparation activities will be completed on site at the project onset. However, before mobilization, this task also includes the review of all investigation-related documents and an internal meeting to discuss the investigation methodology.

As part of the initial mobilization activities, an excavator and skid steer will be brought on site to complete some of the site preparation activities. A frac tank, rolloff box, conex box, and drums also will be mobilized during the site preparation activities. A summary of these activities is provided below.

- Procurement of field equipment and supplies; coordination with subcontractors and vendors.

- Delivery, placement, and staging of subcontractor and vendor equipment including equipment calibrations, heavy equipment off loading/staging/fueling, etc.

- Site walk with field personnel to review notable findings and features from the April 2022 site reconnaissance. Access pathways to the various sampling locations will also be discussed.

- Demarcating (stakes, paint, flagging, etc.) boring and sample locations based on the site walk above. If new locations are identified, they will be surveyed with the handheld GPS unit and noted in the field notebook.

- Develop an access pathway and cleanout of Outfall #001 and drainage pathway to Lake Erie shoreline with an excavator. Most of the outfall piping discharge is plugged with sediment and debris. Sampling will be completed here later as described in Section 3.12.

- Cleanout and remove debris from around the various outfall appurtenances (e.g., access pits) with excavator, skid steer, and/or by hand for later mapping access.

- Remove part of fencing and develop pathway with the excavator and skid steer for proposed boring locations in the asbestos brick landfill area.

- Develop pathways to, and clearing around, each of the proposed test boring locations that are inaccessible. This would include the wooded areas surrounding the partial perimeter of the site and in areas where debris may hinder access with the drill rig. A handheld GPS unit will be used to guide personnel to the desired boring locations.

4.0 PROJECT MANAGEMENT AND PROJECT SCHEDULE

This section provides an overview of the project management and staff and proposed work schedule.

4.1 Personnel

The primary participants for this project and their responsibilities are shown below. It should be noted that availability of specific field personnel is dependent on timing of the actual field work and may be subject to change.

- Mr. Scott Moffett, P.G., PMP – GTAC Program Manager
- Mr. Christopher Kupfer, P.G. – Project Manager
- Mr. Joseph Burawa, P.G. – Project QC Officer
- Environmental Specialist/Site Supervisor – To Be Determined
- Ms. Shannon Horn – Data Management Specialist

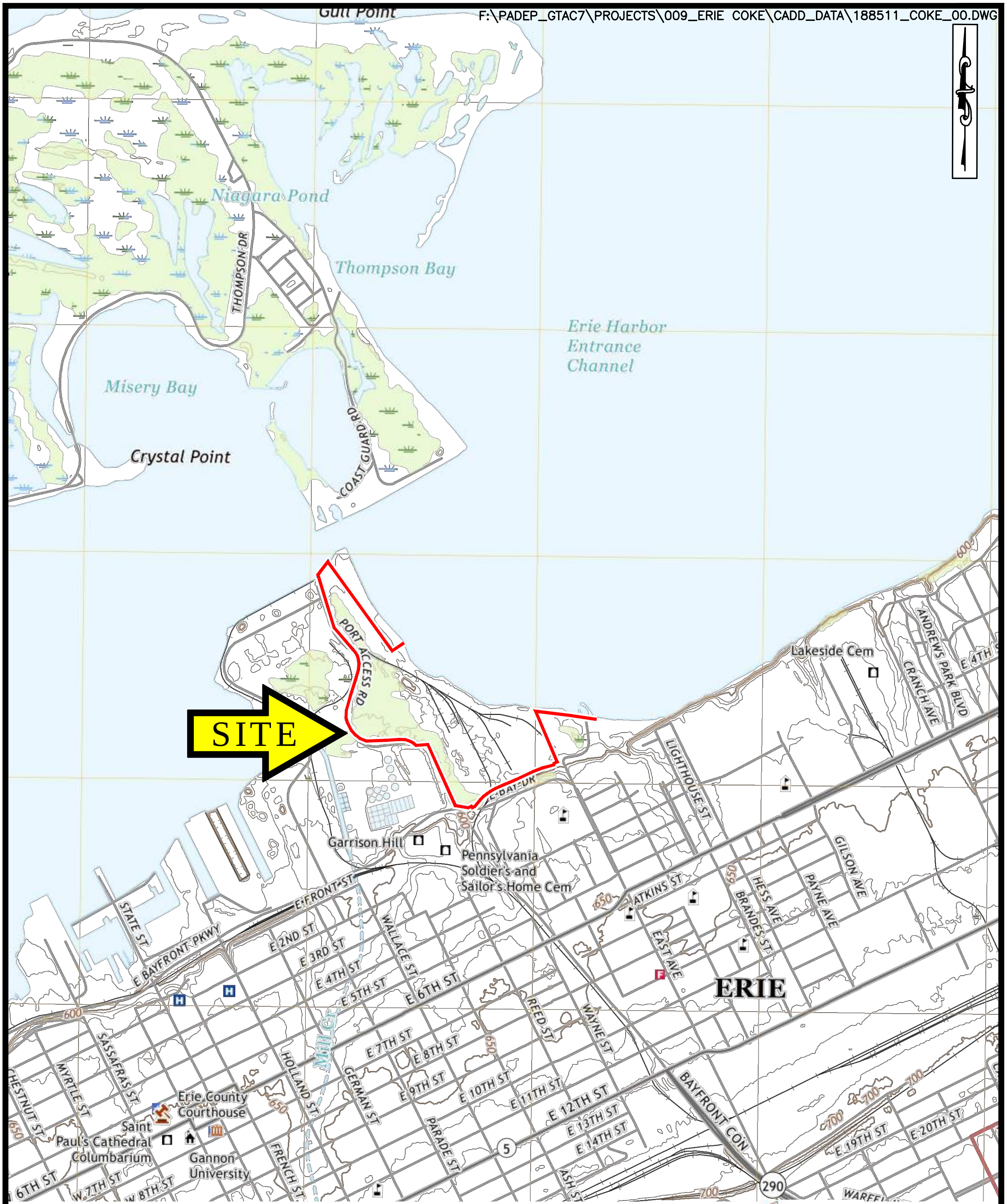
OBG | Baker's Project Manager, Mr. Christopher Kupfer, will be responsible for managing the overall technical and administrative efforts associated with this project, including interface and final negotiations with the Department. Field activities will be managed and coordinated by Mr. Kupfer. Mr. Kupfer also will be responsible for managing OBG | Baker support personnel and ensuring that the field tasks and QA/QC procedures are implemented according to the Work Plan, FSAP, QAPP, and HASP. The lead environmental specialist and site supervisor will be responsible for overall implementation of the field program (as well as oversee site Health and Safety). Mr. Burawa will provide senior review and technical guidance. Resources required to support this investigation will be obtained through Mr. Moffett.

4.2 Project Schedule

Th project is estimated to be completed in 44 weeks (10 months) from the notice to proceed as depicted on Figure 6.

FIGURES

F:\PADEP_GTAC7\PROJECTS\009_ERIE COKE\CADD_DATA\188511_COKE_00.DWG



NOTE:
WATER LOTS NOT SHOWN

SOURCE:
USGS: ERIE NORTH, PA, 2019

FIGURE 1
SITE LOCATION MAP
ERIE COKE SITE
CITY OF ERIE, ERIE COUNTY, PENNSYLVANIA

QUADRANGLE LOCATION

SCALE:	0 — 2000	**DATE:**	JUNE 2022
S.O. NO.:	188511	**FILE:**	188511_COKE_00
DSN/DWN:	DMG/RRR	**CHK:**	CHK

OBG Part of Ramboll
Michael Baker INTERNATIONAL
OBG|Baker Environmental Solutions Joint Venture

SCALE: 0 500

S.O. NO.: 188511

DSN/DWN: CHK/RRR

DATE: JUNE 2022

FILE: 188511_COKE_01

CHK: CHK

OBG Part of Ramboll

Michael Baker INTERNATIONAL

OBG|Baker Environmental Solutions Joint Venture

FIGURE 2
SITE FEATURES
ERIE COKE PLANT
ERIE COUNTY, PENNSYLVANIA

F:\PADEP_GTAC7\PROJECTS\009_ERIE_COKE\CADD_DATA\188511_COKE_01.DWG

NOTE:
DATE OF PHOTOGRAPH UNKNOWN

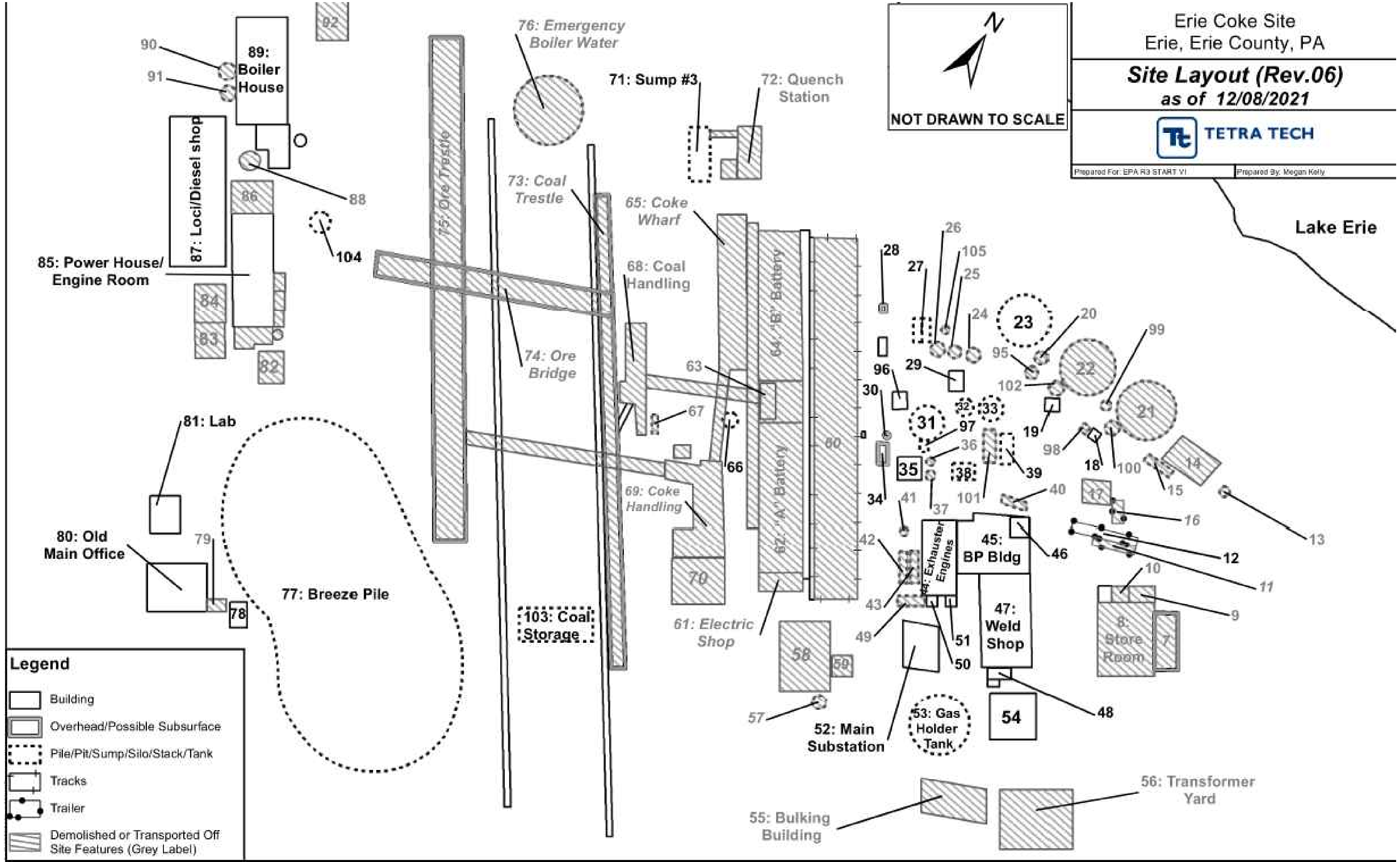
IMAGE SOURCE: ERIE COKE

SCALE: NOT TO SCALE
S.O. NO.: 188511
DSN/DWN: CHK/RRR

DATE: MAY 2022
FILE: 188511_COKE_01
CHK: CHK

OBG Part of Ramboll
Michael Baker INTERNATIONAL
OBG|Baker Environmental Solutions Joint Venture

FIGURE 3
HISTORICAL OPERATIONS AERIAL MAP
ERIE COKE PLANT
ERIE COUNTY, PENNSYLVANIA



1 Electric Shop
2 Safety/ Personnel Building
3 Nurse
4 Guard House
5 Truck Scale
6 Office
7 Dock
8 Store Room
9 Purchase Office
10 Electric Office
11 Trailer #4
12 Trailer #3
13 Soda Silo
14 Waste Water Office
15 Caustic Tank
16 Women's Trailer
17 Forman's Office
18 Meter/Acid Building
19 Chemical Feed Building
20 Wash Tank
21 SBR2
22 SBR1
23 T-101
24 Liquor Settling 3
25 Liquor Settling 2
26 Liquor Settling 1
27 Sump/Covered Pit
28 Sump #1
29 Phenol Pump House
30 City Water Plant
31 Tar Storage Tank
32 Waste Water Tank
33 Liquor Storage
34 Natural Gas
35 Pump House
36 Absorber
37 Thionizer
38 BP Pit/Sump #2
39 T-33
40 T-3
41 Hot Drain Tank
42 West Decantor
43 East Decantor
44 Exhauster Engines
45 By-Products Building
46 Sulfur Pit
47 Weld Shop & Maintenance Office
48 Fire Pump
49 Flushing Liquor Tank
50 Storage
51 Hourly Lunch Room
52 Main Substation
53 Gas Holder
54 Main Shower Building/Lockers
55 Bulking Building
56 Transformer Yard
57 Stack #1
58 Bag House
59 Control Room
60 Pusher Tracks
61 Electric Shop
62 "A" Battery
63 Coal Bins
64 "B" Battery
65 Coke Wharf
66 Stack #2
67 Bulk Density Oil
68 Coal Handling
69 Coke Handling
70 Conveyor Belts
71 Sump #3
72 Quench Station
73 Coal Trestle
74 Ore Bridge
75 Ore Trestle
76 Emergency Boiler Water for Coal Field Sprays
77 Breeze Pile
78 Western Storage Building #3
79 City Water Lines
80 Old Main Office
81 Lab
82 Western Storage Building #1
83 Western Shower House
84 Western Storage Building #2
85 Power House/Engine Room
86 Lake Water Pump
87 Loci/Diesel Shop
88 Deaerator
89 Boiler House
90 Coal Silo #1
91 Coal Silo #2
92 Thaw Shed
93 R.R. Scale House
94 H2O Storage House
95 Clarifier Tank
96 Fire Supply House
97 Battery Pit
98 AB-W-02
99 Sulfur Sludge Tank
100 Lake Water Tank
101 Rain Water Tank
102 Tank 103
103 Coal Storage
104 Containment Ring
105 Flare

IMAGE SOURCE

SCALE: NOT TO SCALE
S.O. NO.: 188511
DSN/DWN: CHK/RRR

DATE: MAY 2022
FILE: 188511_COKE_01
CHK: CHK

OBG
Part of Ramboll
Michael Baker
INTERNATIONAL
OBG|Baker Environmental Solutions Joint Venture

FIGURE 4
HISTORICAL SITE LAYOUT
ERIE COKE PLANT
ERIE COUNTY, PENNSYLVANIA

LEGEND

- ● –SOIL BORING SAMPLE
- ● –SURFACE SOIL SAMPLE
- 🟩 –SURFACE WATER / SEDIMENT SAMPLE
- ⊞ –SEDIMENT SAMPLE
- △ –GROUNDWATER GRAB SAMPLE
- ○ –MATERIAL SAMPLE
- ⊗ –OUTFALL
- — –PROPERTY BOUNDARY (APPROX.)

SOURCE:
IMAGE: DRONE FLOWN JUNE 2022
BUILDING INFO TETRA TECH; 12/08/2021

F:\PADEP_GTAC7\PROJECTS\009_Erie Coke\CADD_Data\188511_COKE_07.dwg 6/29/2022 7:55 AM

REVISIONS

DRAWN	CHK/RRR
REVIEWED	CHK
S.O.#	188511
CADD#	188511_COKE_07

NORTH

OBG Part of Ramboll
Michael Baker INTERNATIONAL
OBG|Baker Environmental Solutions Joint Venture

SAMPLE LOCATION MAP
INDUSTRIAL AREA SOUTH
ERIE COKE SITE
ERIE COUNTY, PENNSYLVANIA

SCALE 80 0 40 80
1 inch = 80 ft.

DATE JULY 2022

SHEET NO.
5-1
OF

LEGEND

- ◉ –SOIL BORING SAMPLE
- ● –SURFACE SOIL SAMPLE
- ▣ –SURFACE WATER / SEDIMENT SAMPLE
- ⊞ –SEDIMENT SAMPLE
- △ –GROUNDWATER GRAB SAMPLE
- ○ –MATERIAL SAMPLE
- ⊗ –OUTFALL
- –––– –PROPERTY BOUNDARY (APPROX.)

SOURCE:
IMAGE: DRONE FLOWN JUNE 2022
BUILDING INFO TETRA TECH; 12/08/2021

REVISIONS

DRAWN	CHK/RRR
REVIEWED	CHK
S.O.#	188511
CADD#	188511_COKE_07

NORTH

OBG
Part of Ramboll

Michael Baker
INTERNATIONAL

OBG|Baker Environmental Solutions Joint Venture

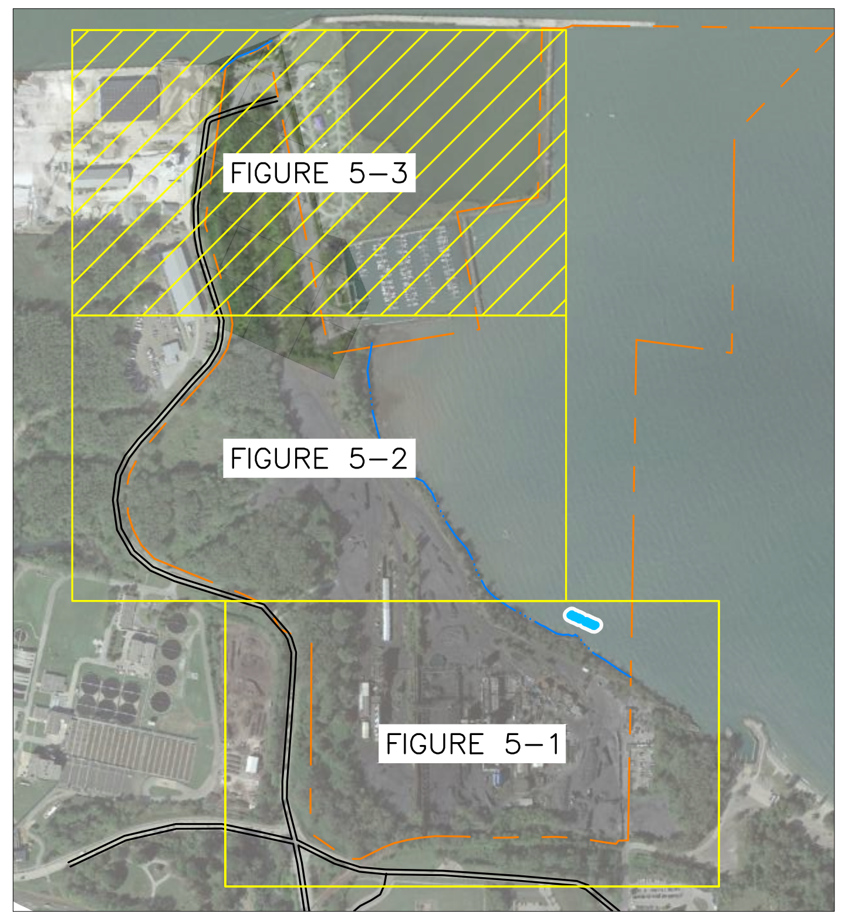
SAMPLE LOCATION MAP
INDUSTRIAL AREA NORTH
ERIE COKE SITE
ERIE COUNTY, PENNSYLVANIA

SCALE 80 0 40 80
1 inch = 80 ft.

DATE JULY 2022

SHEET NO.
5-2
OF

KEY MAP



LEGEND

- ◉ –SOIL BORING SAMPLE
- ● –SURFACE SOIL SAMPLE
- ⊞ –SURFACE WATER / SEDIMENT SAMPLE
- ⊞ –SEDIMENT SAMPLE
- △ –GROUNDWATER GRAB SAMPLE
- ○ –MATERIAL SAMPLE
- ---- –PROPERTY BOUNDARY (APPROX.)

SOURCE:
IMAGE: DRONE FLOWN JUNE 2022
BUILDING INFO TETRA TECH; 12/08/2021

F:\PADEP_GTAC7\PROJECTS\009_Erie Coke\CADD_Data\188511_COKE_07.dwg 7/27/2022 3:56 PM

REVISIONS

DRAWN	CHK/RRR
REVIEWED	CHK
S.O.#	188511
CADD#	188511_COKE_07

NORTH

OBG Part of Ramboll
Michael Baker INTERNATIONAL
OBG|Baker Environmental Solutions Joint Venture

SAMPLE LOCATION MAP
MARINA
ERIE COKE SITE
ERIE COUNTY, PENNSYLVANIA

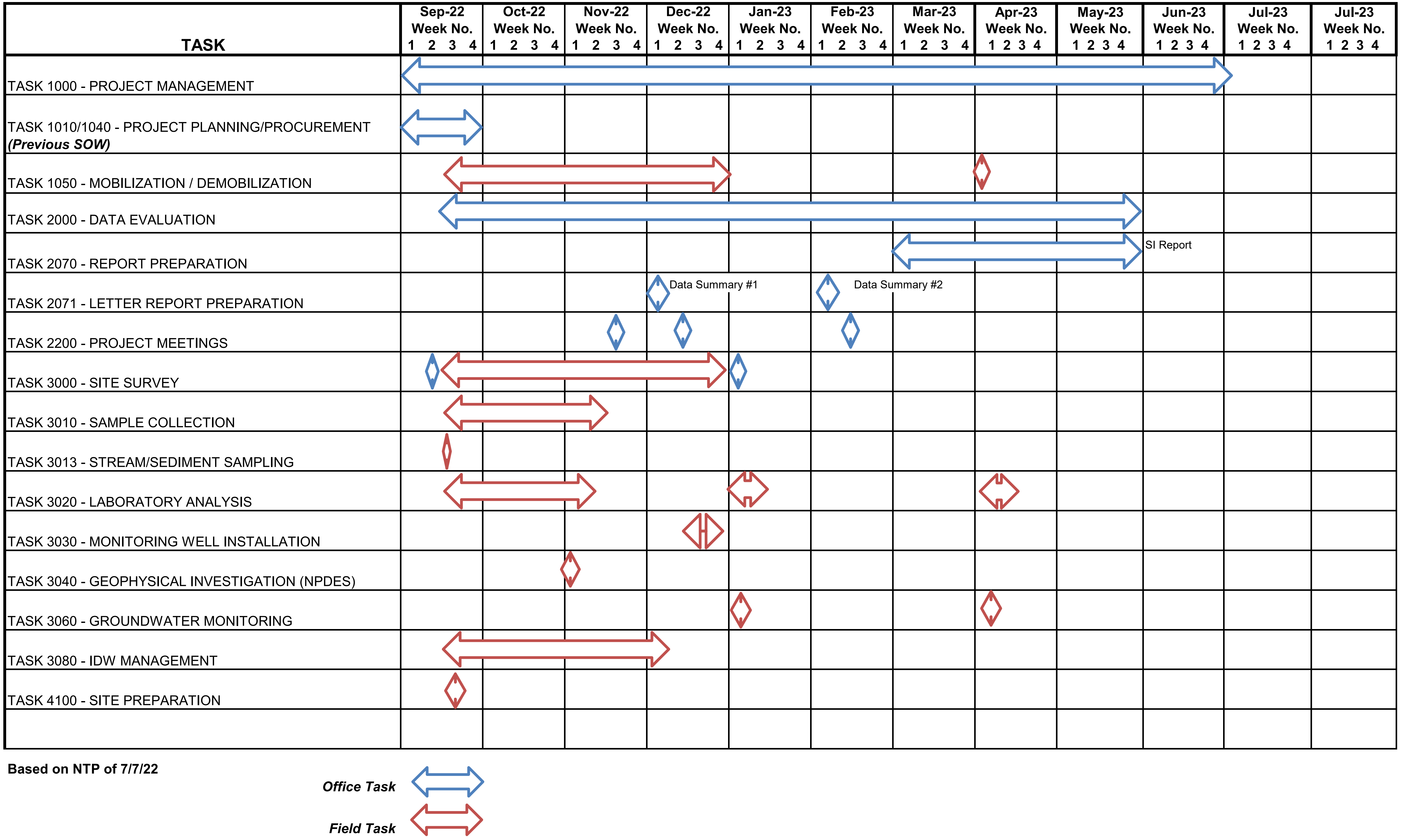
SCALE 80 0 40 80
1 inch = 80 ft.

DATE JULY 2022

SHEET NO.
5-3
OF

Figure 6

Proposed Project Schedule
Site Investigation
Erie Coke Site



Based on NTP of 7/7/22

TABLES

Table 1
Proposed Sampling Activities
Site Investigation
Erie Coke Site

Site Feature	Sampling Media	Number of Borings	Number of Samples	Anticipated Boring Depth (Feet)	Anticipated Sample Depth Intervals for Lab Analysis (Feet)	Comments	Rationale
Caustic Tank	Soil	1	3	5	**No Contam:** 0-1', 4-5' **Contam:** 0-1', Highest PID, Surface Water (S/W) interface.	For Boring: 3 samples collected if contamination observed; 2 samples if no contamination observed. 2 surface soil samples also not from boring	1 of the 2 surface soil sample locations will be advanced to 5 ft for vertical profiling. Borings will be advanced deeper if evidence of notable impact in soil samples.
	Groundwater Grab	1	1	15	10 - 15'	Groundwater grab sample collected at first encountered water in native material. Total and dissolved metal analyses.	Boring advanced to water table (WT) should be from boring that exhibits most notable contaminant impact.
SBR2 Tank	Soil	1	3	5	**No Contam:** 0-1', 4-5' **Contam:** 0-1', Highest PID, S/W interface.	2 surface soil samples around tank footprint with 1 being a boring advanced in area of potential impact for deeper 4-5' sample	1 of the 2 surface soil sample locations will be advanced to 5 ft for vertical profiling. Borings will be advanced deeper if evidence of notable impact in soil samples.
SBR1 Tank	Soil	1	3	5	**No Contam:** 0-1', 4-5' **Contam:** 0-1', Highest PID, S/W interface.	2 surface soil samples around tank footprint with 1 boring advanced in area of potential impact for deeper 4-5' sample	1 of the 2 surface soil sample locations will be advanced to 5 ft for vertical profiling. Borings will be advanced deeper if evidence of notable impact in soil samples.
T-101 Tank	Soil	1	3	5	**No Contam:** 0-1', 4-5' **Contam:** 0-1', Highest PID, S/W interface.	3 surface soil samples around tank footprint with 1 boring advanced in area of potential impact for deeper 4-5' sample	1 of the 2 surface soil sample locations will be advanced to 5 ft for vertical profiling. Borings will be advanced deeper if evidence of notable impact in soil samples.
Phenol Pump House	Surface Water	N/A	1	N/A	N/A	Samples to be collected directly below pipe near Lake Erie shoreline	Likely collection point for effluent from pump house on the above embankment
	Sediment	N/A	1	N/A	N/A		
Tar Storage Tank	Soil	1	4	5	**No Contam:** 0-1', 4-5' **Contam:** 0-1', Highest PID, S/W interface.	3 surface soil samples around tank footprint with 1 boring advanced in area of potential impact for deeper 4-5' sample	1 of the 3 surface soil sample locations will be advanced to 5 ft for vertical profiling. Borings will be advanced deeper if evidence of notable impact in soil samples.
Liquor Storage	Soil	1	4	5	**No Contam:** 0-1', 4-5' **Contam:** 0-1', Highest PID, S/W interface.	1 surface soil sample outside of containment and 2 inside containment. 1 boring advanced in area of potential impact for deeper 4-5' sample	1 of the 3 surface soil sample locations will be advanced to 5 ft for vertical profiling. Borings will be advanced deeper if evidence of notable impact in soil samples.
BP Pit/Sump #2	Soil	1	2	5	**No Contam:** 0-1', 4-5' **Contam:** 0-1', Highest PID, S/W interface.	1 soil boring adjacent to sump/pit advanced to 5 ft. minimum. At-depth soil samples collected below base of sump/pit from most impacted depth interval.	Borings will be advanced deeper than bottom of sump/pit for adequate characterization.
T-33	Soil	1	3	5	**No Contam:** 0-1', 4-5' **Contam:** 0-1', Highest PID, S/W interface.	2 surface soil samples around tank footprint with 1 boring advanced in area of potential impact for deeper 4-5' sample	1 of the 2 surface soil sample locations will be advanced to 5 ft for vertical profiling. Borings will be advanced deeper if evidence of notable impact in soil samples.
Exhauster Engines	Soil	N/A	1	N/A	0-1	Surface soil sample beneath exhausts collected from stained/low lying area	Surface soil sample for characterization of soil impact for operational exhaust
By-Product Building	Soil	1	2	5	**No Contam:** 0-1', 4-5' **Contam:** 0-1', Highest PID, S/W interface.	1 soil boring advanced to 5 ft. adjacent to bldg.	Boring will provide adequate characterization of the building area.
Sulfur Pit	Soil	1	2	5	**No Contam:** 0-1', 4-5' **Contam:** 0-1', Highest PID, S/W interface.	1 soil boring advanced to 5 ft. minimally adjacent to pit. At-depth sample collected below base of pit from most impacted depth interval	Boring will provide adequate characterization of the soils adjacent to and beneath the pit.

Table 1
Proposed Sampling Activities
Site Investigation
Erie Coke Site

Site Feature	Sampling Media	Number of Borings	Number of Samples	Anticipated Boring Depth (Feet)	Anticipated Sample Depth Intervals for Lab Analysis (Feet)	Comments	Rationale
Weld Shop & Maintenance Office	Soil	1	2	5	**No Contam:** 0-1', 4-5' **Contam:** 0-1', Highest PID, S/W interface.	1 soil boring advanced to 5 ft. adjacent to shop	Boring will provide adequate characterization of the shop area.
Gas Holder	Soil	1	3	5	**No Contam:** 0-1', 4-5' **Contam:** 0-1', Highest PID, S/W interface.	1 soil boring advanced to 5 ft. adjacent to gas holder tank	Surface soil and boring spaced on opposite sides of tank will provide adequate characterization of the tank area.
Bulking Building	Soil	2	4	5	**No Contam:** 0-1', 4-5' **Contam:** 0-1', Highest PID, S/W interface.	2 soil borings advanced to 5 ft. adjacent to building	Borings will provide adequate characterization of the building area.
Transformer Yard	Soil	3	6	5	**No Contam:** 0-1', 4-5' **Contam:** 0-1', Highest PID, S/W interface.	Collect samples toward low-lying or stained areas spread out across transformer storage area	Area excluded from larger grid sampling system to allow for adequate coverage.
	Surface Water	N/A	1	N/A	N/A	1 SW and 1 sediment sample collected from the collection vaults located near the center of the transformer yard.	Subsurface structures are likely collection point for surface and near surface impact.
	Sediment	N/A	1	N/A	N/A		
Bag House	Soil	2	4	5	**No Contam:** 0-1', 4-5' **Contam:** 0-1', Highest PID, S/W interface.	2 soil borings advanced to 5 ft. near building	Borings will provide adequate characterization of the building area.
Coke Wharf	Soil	1	2	5	**No Contam:** 0-1', 4-5' **Contam:** 0-1', Highest PID, S/W interface.	1 soil boring advanced to 5 ft. adjacent to wharf area	Boring will provide adequate characterization of the shop area.
Coal Handling	Soil	2	4	5	**No Contam:** 0-1', 4-5' **Contam:** 0-1', Highest PID, S/W interface.	Advance 1 boring near both ends of area. Large areas of standing water are present need worked around. Excavator may be needed for rig if hand augers can't collect samples	PADEP requested borings advanced in this area as this may be a low-lying collection point.
Sump #3	Surface Water	N/A	1	N/A	N/A	Collect one SW/Sediment sample from within the sump	Low-lying area may be an AOC as it could be a collection point for contamination.
	Sediment	N/A	1	N/A	N/A		
Lab Building Area	Soil	N/A	1	N/A	0-1	Surface soil sample of low-lying, stained depression area near Lab bldg.	Potential collection point for surface contamination
	Soil	4	9	5	0-1, 4-5, 14-15	4 borings advanced around perimeter of bldg. skewed toward vaults, UST, and low-lying, stained areas. Excavator will be needed to access all sides of bldg.	1 boring on each side of bldg. skewed toward potential conduits should provide adequate characterization.
	Groundwater Grab	1	1	15	15	1 boring advanced to WT for collection of groundwater grab sample.	Boring advanced to WT should be from boring that exhibits most notable contaminant impact.
	Surface Water	N/A	2	N/A	N/A	1 aqueous sample from each of the two vaults adjacent to lab bldg.	Vaults can be a conduit for contamiant impact to subsurface.
	Sediment	N/A	2	N/A	N/A	1 sediment sample from each of the two vaults adjacent to lab bldg.	

Table 1
Proposed Sampling Activities
Site Investigation
Erie Coke Site

Site Feature	Sampling Media	Number of Borings	Number of Samples	Anticipated Boring Depth (Feet)	Anticipated Sample Depth Intervals for Lab Analysis (Feet)	Comments	Rationale
Power House/Engine Room	Soil	N/A	1	N/A	0-1	Collect surface soil sample beneath tipped end of staged fiberglass AST	1 surface soil sample should suffice for characterization as most of tank is in the air (pitched upward along woodline).
	Soil	1	5	5	**No Contam:** 0-1', 4-5' **Contam:** 0-1', Highest PID, S/W interface.	4 surface soil samples around bldg. with 1 boring advanced in area of potential impact	1 of the 4 surface soil sample locations will be advanced to 5 ft for vertical profiling. Borings will be advanced deeper if evidence of notable impact in soil samples.
	Soil	5	10	5	**No Contam:** 0-1', 4-5' **Contam:** 0-1', Highest PID, S/W interface.	3 discharge areas identified; 5 soil borings total. Longer Discharge Areas #1 and #2 have boring at beginning and end of discharge area. Discharge Area #3 is shorter with 1 boring at end.	3 discharge areas into the woodline from Engine Room Bldg. is a likely place for impact.
	Groundwater Grab	1	1	15	15	Groundwater grab sample collected from boring that exhibits the most impact	Groundwater grab sample can be from area around bldg, or from any of the discharge areas
Loci/Diesel Shop	Soil	3	6	5	**No Contam:** 0-1', 4-5' **Contam:** 0-1', Highest PID, S/W interface.	3 borings advanced around perimeter of bldg. skewed toward stained/low-lying areas.	1 boring on most sides of bldg. should provide adequate characterization.
	Groundwater Grab	1	1	15	15	1 boring advanced to WT for collection of groundwater grab sample. Boring advanced to WT should be from boring that exhibits notable contaminant impact.	Boring advanced to WT should be from boring that exhibits most notable contaminant impact.
	Surface Water	N/A	1	N/A	N/A	1 aqueous sample from pit inside bldg.	Concrete pit in center of bldg. can be a conduit for contaminant impact
	Sediment	N/A	1	N/A	N/A	1 sediment sample from pit inside bldg.	
Boiler House	Soil	3	6	5	**No Contam:** 0-1', 4-5' **Contam:** 0-1', Highest PID, S/W interface.	3 borings advanced around perimeter of bldg. skewed toward stained/low-lying areas. 1 boring adjacent to pit.	1 boring on sides of bldg. should provide adequate characterization.
	Groundwater Grab	1	1	15	15	1 boring advanced to WT for collection of groundwater grab sample.	Boring advanced to WT should be from boring adjacent to pit, unless other borings exhibit notable contaminant impact.
	Surface Water	N/A	1	N/A	N/A	1 aqueous sample from pit adjacent to bldg.	Concrete pit adjacent to outside bldg. wall is likely a conduit for contaminant impact, if present
	Sediment	N/A	1	N/A	N/A	1 sediment sample from pit adjacent to bldg.	
Battery Pit	Soil	1	2	10	Below pit (5 ft?), 10'	1 soil boring adjacent to pit advanced to 5 ft. minimum. At-depth soil samples collected below base of pit from most impacted depth interval.	Boring will be advanced deeper than bottom of pit for adequate characterization.
Coal Storage (North / South Coal Yards)	Soil	2	4	5	**No Contam:** 0-1', 4-5' **Contam:** 0-1', Highest PID, S/W interface.	1 boring in South Coal Yard and 1 boring in North Coal yard. Borings spread out for coverage but not in areas under standing water (area varies weekly from precip.). Access to yards may need to be constructed with excavator.	Low-lying area may be an AOC. Borings advanced to 5 ft initially, further if obvious contamination in the borings.
	Groundwater Grab	2	2	15	15	1 boring advanced to WT for collection of groundwater grab sample from each yard.	Aid in evaluating groundwater impact from years of coal storage in the two yards. Use 2 most impacted (PID, staining, odor) soil borings for collection of the groundwater grab samples.
Containment Ring	Soil	1	2	5	**No Contam:** 0-1', 4-5' **Contam:** 0-1', Highest PID, S/W interface.	1 soil boring advanced to 5 ft. adjacent to ring slab	Boring will provide adequate characterization of the ring area.
Depression Areas Investigation	Surface Water	3	3	5	N/A	Collect using hand-dip method from standing water	Some proposed areas identified during site reconnaissance. Others may be found during field activities.
	Soil/Sediment		6		**No Contam:** 0-1', 4-5' **Contam:** 0-1', Highest PID, S/W interface.	Initial sample collected below fill (coke)/soil interface, if notable thickness present.	

Table 1
Proposed Sampling Activities
Site Investigation
Erie Coke Site

Site Feature	Sampling Media	Number of Borings	Number of Samples	Anticipated Boring Depth (Feet)	Anticipated Sample Depth Intervals for Lab Analysis (Feet)	Comments	Rationale
NPDES Outfall Piping Runs #001/#002	Soil	6	6	6	5-6	Borings/soil samples collected at 3 locations along each outfall line. 1 groundwater grab sample per outfall line. Boring/sample number may change based on outfall investigation findings.	Samples to be collected in areas where breaches in the outfalls may have impacted the media below. Samples to be collected directly beneath base of piping.
	Groundwater Grabs		2	15	15		
	Surface Water	N/A	3	N/A	N/A	Collect at discharge points of Outfall Runs #001 and #002. Also SW/Sed sample where Run #001 meets the Lake Erie shoreline or most impacted area from exploratory shallow trench from outfall toward the shoreline w excavator. Outfall #001 is actually located off property to the east.	Discharge points likely to exhibit contaminant impact if present. Outfall #001 is overgrown (outfall buried) and area will need exavated prior to sampling.
	Sediment		3				
West Truck Station	Surface Water	N/A	1	N/A	N/A	One SW sample from the drainage channel	Standing water/sediment sampled as area may be collection point for contamination on site.
	Sediment	N/A	1	N/A	N/A	One sediment sample the drainage channel	
Rescreen Station #2	Soil	1	3	15	0-1, 4-5, 14-15	1 boring advanced adjacent to pit advanced to WT.	1 boring advanced below depth of pit should provide adequate characterization.
	Groundwater Grab	1	1	15	15	1 boring advanced to WT for collection of groundwater grab sample.	Low-lying collection points across the site are strategic for groundwater grab sample locations.
	Surface Water	N/A	1	N/A	N/A	1 aqueous sample from pit	Concrete pit can be a conduit for contaminant impact
	Sediment	N/A	1	N/A	N/A	1 sediment sample from pit.	
Asbestos Brick Landfill	Soil	3	6	5	**No Contam:** 0-1', 4-5' **Contam:** 0-1', Highest PID, S/W interface.	Excavator needed to remove fencing and debris to acess boring locations. Borings advanced along low-lying, down gradient perimeter of area.	Allow a better assessment of potential leaching of contaminants from items stockpiled in the landfill. Characterization of fill contents (asbestos brick, etc.) not included in this phase of work.
Non-AOC Areas Within Plant Footprint	Soil	22	40	5	**No Contam:** 0-1', 4-5' **Contam:** 0-1', Highest PID, S/W interface.	Borings strategically located in areas to provide adequate coverage. Sampling grid used, but sampling to be biased toward potential environmental concerns (staining, etc.)	Coverage of borings across the should provide adequate characterization. Use of biased grid sampling should provide adequate characterization.
Groundwater Monitoring Wells	Groundwater	12	12	20	N/A	Analyses also include total and dissolved metals for both events	Groundwater Sampling Event No. 1
			12			Pesticides and other analyses may be eliminated from second sampling event if no notable detections from first event.	Groundwater Sampling Event No. 2
Coke Samples	Coke/Soil	3	6	0 - <5	0-1, - <5'	Collected at 3 separate locations across the site for coverage. 1 sample of coke and 1 sample of soil at coke/soil interface at each location	Requested by Department; Characterization of coke material needed for future site development

Table 1
Proposed Sampling Activities
Site Investigation
Erie Coke Site

Site Feature	Sampling Media	Number of Borings	Number of Samples	Anticipated Boring Depth (Feet)	Anticipated Sample Depth Intervals for Lab Analysis (Feet)	Comments	Rationale
Background Soil	Soil	3	6	5	0-1, 4-5	Two soil samples from each of the three borings. Borings not shown on site figures and will be determined in field based on site observations.	To provide documentation of ambient background conditions at the site.
Coke/Soil Interface	Soil	N/A	6	0	1-2	Collected at six separate locations across the site for coverage. Sample could be near surface to several feet deep.	Requested by Department; Allow a better assessment of potential leaching of contaminants from site operations into the subsurface soil horizon.
Lake Erie Shoreline	Sediment	N/A	8	N/A	N/A	Collect using dedicated sampling spoons. Sampling in each section should be biased to potential contamination. These samples do not include sampling at erosion area EA-1 and below Pump House. One random sediment sample will also be analyzed for Total Organic Carbon for potential criteria development.	Number of samples based on 1 sample/250 ft (approx.) of shoreline along the site.
Seeps	Surface Water	N/A	2	N/A	N/A	Collect using hand-dip method	None identified during site reconnaissance but 2 of each included if any are found during the field activities.
	Sediment		2			Collect using dedicated stainless steel sampling spoons	
Material Sample MS-1	Process Material	N/A	1	N/A	N/A	At PADEP request, sample white substance 0-3 ft deep along Lake Erie embankment walls. Sample ID: "MS-1" for 'Material Sample-1'.	Provide characterization of unknown material located along embankment of Lake Erie.
Material Sample MS-2	Process Material	N/A	1	N/A	N/A	At PADEP request, area west of channel where many large round metallic vat/tank bottoms have been dumped along the edge of Lake Erie. Collect sample along waterline beneath the vats.	Provide characterization of large volume of unknown material dumped/located along embankment of Lake Erie.
Material Sample MS-3	Process Material	N/A	1	N/A	N/A	At PADEP request, material will be sampled that was dumped along the edge of Lake Erie near Outfall #001. Collect sample near waterline and beneath the unknown material.	Provide characterization of large volume of unknown material dumped/located along embankment of Lake Erie near Outfall #001.
Erosion Area EA-1	Soil	N/A	1	N/A	N/A	At PADEP request, 1 soil sample from erosion area.	Erosion area may be a collection point for migration of contamination off site into Lake Erie.
Descretionary Groundwater Grab Samples	Groundwater Grabs	6	6	15	15	6 additional groundwater grabs in previously-unidentified contaminated areas and/or to provide adequate site coverage of groundwater quality.	Locations and final number at descretion of geologist. Collect in areas where no other groundwater grabs are already proposed.
Exploratory Borings	Soil	5	0	<50	None	At PADEP request, 5 borings will be advanced to bedrock. Borings will not be a contuation of an existing impacted boring to mitigate potential downward contaminant migration. No samples will be submitted for analysis unless contamination encountered.	Boring will be spread across the site to provide adequate coverage and interpretation of bedrock depth. 2 borings near upgradient wooded area, 2 near center of plant, 1 boring near Lake Erie coastline.
Investigation Derived Waste (IDW) Profile	Aqueous	N/A	1	N/A	N/A	1 grab sample from frac tank	Extensive list of analyses provided in Work Plan may be modified based on disposal requirements of IDW subcontractor
	Non-Aqueous	N/A	1	N/A	N/A	1 composite sample from all accumulated soilds drums	

Table 1
Proposed Sampling Activities
Site Investigation
Erie Coke Site

Site Feature	Sampling Media	Number of Borings	Number of Samples	Anticipated Boring Depth (Feet)	Anticipated Sample Depth Intervals for Lab Analysis (Feet)	Comments	Rationale
	Quality Assurance / Quality Control (QA/QC) Samples						
QA/QC Duplicate Samples	Groundwater Grab		2			15 groundwater grab samples proposed above	Duplicates collected 10% rate of each sampling media
	Groundwater (Well)		4			12 groundwater well samples x 2 sampling events	
	Surface Water		3			22 total surface water samples proposed above	
	Sediment		3+shoreline			22 sediment samples proposed above+shoreline	
	Soil		15+grid			141 soil samples proposed above +grid samples	
Matrix Spike/Matrix Spike Duplicate (MS/MSD) Samples	Groundwater Grab		1			Based on same sample number as above for the duplicate samples	MS/MSD samples based on approximate 5% rate per matrix.
	Groundwater (Well)		1				
	Surface Water		1				
	Sediment		1				
	Soil		7				
QA/QC Field Blanks	Potable Water		3			1 of potable decon water by driller and 1 of decon water for each of the 2 groundwater sampling events	Document the quality of the water used for the decontamination process
QA/QC Equipment Rinsate Blanks	Laboratory-Grade Water		6			4 rinsates of drilling equipment (80+ borings) and 1 rinsate of pump for each of the 2 groundwater sampling events. SW/Sed collected w disposable equipment - no rinsate.	Completed on all non-disposable sampling equipment at a rate of 5% of each piece of equipment.
QA/QC Trip Blanks	Laboratory-Grade Water		24			A majority of the intrusive field activities should be completed within 4 weeks. An additional 4 trip blanks for the 2 groundwater sampling events.	Based on samples being submitted for analysis 5 days/week thru completion of intrusive activities

OBG|Baker Environmental Solutions Joint Venture

FIELD SAMPLING AND ANALYSIS PLAN AND QUALITY ASSURANCE PROJECT PLAN

ERIE COKE SITE

ERIE COUNTY, PENNSYLVANIA

PADEP Contract No.: SAP4000023226
General Environmental Technical Assistance Contract
Work Requisition No.: GTAC7-6-181

Prepared for:

Commonwealth of Pennsylvania
Department of Environmental Protection

Submitted by:
OBG | Baker Environmental Solutions Joint Venture
Moon Township, Pennsylvania

June 2022

TABLE OF CONTENTS

TABLE OF CONTENTS (Continued)

LIST OF TABLES

LIST OF ATTACHMENTS

1.0 INTRODUCTION

This Field Sampling and Analysis Plan (FSAP) and Quality Assurance Project Plan (QAPP) has been prepared by OBG | Baker Federal Solutions Joint Venture (OBG | Baker) for the Pennsylvania Department of Environmental Protection (PADEP) as authorized under their General Technical Assistance Contract (GTAC), Contract Number 4000023226, Work Requisition Number 7-6-181. This FSAP and QAPP are associated with the investigation activities proposed to be conducted at the Erie Coke Site (site) located in Erie, Pennsylvania.

The primary purpose of the FSAP and QAPP is to provide guidance for the field activities by describing the detailed sampling and data collection methods to be used.

2.0 FIELD SAMPLING AND ANALYSIS PLAN

2.1 Site Background

Pertinent background information related to the site location and physical setting, historical operations and investigation history is presented in the Work Plan.

2.2 Project Objectives

The project objectives are summarized in the Work Plan.

2.3 Investigation Procedures

The following sections present the investigation procedures that will be used during the field activities. Supplemental information regarding the sampling and field procedures can be found in the OBG | Baker Standard Operating Procedures (SOPs) referenced herein. Support activities, sampling locations, sample matrices, and analytical parameters are discussed in the Work Plan.

2.3.1 Soil Sampling

Surface and subsurface soil samples will be collected from the site. The following sections describe the sample collection and field screening methods to be used as well as the criteria for selecting samples for chemical analyses.

2.3.1.1 Surface Soil Sampling

If possible, surface soil samples (0 to 1-foot depth interval) will be collected using hand augers. Samples may also be collected with the drilling rig based on site conditions. Hand auger methodology is summarized below:

1. Advance the hand auger to the desired depth.

2. Bring the sampler to the surface, remove the soil, and place into an aluminum pan.

3. If applicable, collect samples for volatile organics analysis using a TerraCore® sampling device or similar. Preserve the sample by placing 5 grams of the sample in the vial containing methanol (supplied with the TerraCore® sampling kit).

4. After collecting the sample for volatile organics analysis, place a portion of the sample interval into a disposal zip-lock style bag and set aside, out of direct sunlight, for field screening using the Photoionization Detector (PID).

5. If homogeneity of the sample is in question, thoroughly homogenize the remaining portion of the sample interval for non-volatile constituents in a disposable aluminum pan to ensure that the sample is as representative as possible of the sample interval.

6. Transfer the proper sample volume into appropriate, laboratory-supplied containers and place the sample in a cooler with ice.

7. Record all pertinent sampling information such as soil description, sample depth, sample number, sample location, analysis/preservation, and time of sample collection in the field logbook.

After sampling, the boreholes will be backfilled with excess soil cuttings unless evidence of notable contamination is present, in which case the cuttings will be drummed accordingly.

Each surface sample will be field-screened for total volatile organic vapors using the PID. The field screening will be conducted by placing a portion of the sample into a disposal zip-lock style bag as described above (if not collected with drilling rig – see below). Shortly after collection, the bag will be pierced with the tip of the PID wand, and the highest reading recorded in the field logbook. In the event that field work is conducted under conditions (winter, rain) adverse to PID screening, the sample will be placed within a heated (if necessary) vehicle prior to screening.

In addition, the sample also will be field screened with a radiation meter. This screening has been requested by the Department. Since there is no lag time necessary between sample collection and screening, the radiation screening can be performed, and the response recorded, as soon as the sample is retrieved.

2.3.1.2 Subsurface Soil Sampling

Subsurface soil samples will be collected using rotasonic drilling methods, which include a combination of rotary power, hydraulic pull down pressure, and mechanically generated oscillations to advance a dual line of drill pipe. The inner drill pipe (typically 4-inch nominal diameter) contains a core bit and represents the core barrel sampler, while the outer pipe (typically 6-inch nominal diameter) is used to prevent collapse of the borehole. The samples will be collected continuously in minimum 5-foot increments from the ground surface to the desired depth. The Work Plan details the depth to which each boring will be advanced. The sampling will be conducted as summarized below:

1. Push/vibrate the sampling device to the desired depth.

2. Bring the sampler to the surface and extract the soil core while placing it directly into a clear polyethylene liner using the vibration technique of the rotasonic rig. Cut small slits in the polyethylene liner at approximate one-foot intervals for field screening for total

volatile organic vapors using the PID.

3. The field screening will be conducted by inserting the tip of the PID wand into the holes. The highest reading for each interval will be recorded in the field logbook. In addition, field screen the sample with a radiation meter. The sampler will ensure the liner is not shielding the soil sample from the radiation meter during screening.

4. Upon completion of the field screening, slice the liner with a cutting tool to expose the sample core.

5. If applicable, collect the sample for volatile organics analysis using a TerraCore® sampling device (or equivalent). Preserve the sample by placing 5 grams of the sample in the vial containing methanol (supplied with the TerraCore® sampling kit).

6. After collecting the sample for volatile organics analysis, thoroughly homogenize the remaining portion of the sample interval for non-volatile constituents in an aluminum pan to ensure that the sample is as representative as possible of the sample interval. This step may be eliminated if the sample appears to already be homogenized.

7. Transfer the proper sample volume into appropriate, laboratory-supplied containers and place the sample in a cooler with ice.

8. Record all pertinent sampling information such as soil description, sample depth, sample number, sample location, analysis/preservation, and time of sample collection in the field logbook.

2.3.1.3 Soil Sample Selection Methodology

Retrieved soil cores will be field-screened and up to three soil samples as described below will be collected from each sonic boring for laboratory analysis.

<u>Identified Areas with Contaminant Impact:</u>

- One surface sample from 0-1 foot bgs to represent the potential greatest exposure pathway of contaminants on site.

- One 'worst-case' soil sample based on PID readings and/or visual evidence of staining/odor.

- One soil sample collected at the soil/groundwater interface.

Areas with NO Obvious Contaminant Impact:

- One surface sample from 0-1 foot bgs to represent the potential greatest exposure pathway of contaminants on site.

- One soil sample from 4-5 feet bgs to document subsurface conditions and potentially delineate contaminant impact not obvious through screening (e.g., metals, pesticides).

As noted above, in lieu of any detected PID readings or visual evidence of staining/odor, borings will be terminated at five feet or when native material is encountered, whichever is deeper. In these areas, up to two soil samples will be collected for laboratory analysis and include a surface soil sample (or just below the fill/soil interface, if present) and a sample at the boring terminus (4-5 feet bgs). This sampling methodology should provide a sufficient vertical profile of potential contaminant impact.

After sampling, the boreholes will be backfilled with retrieved soil cuttings unless evidence of notable contamination is present, in which case the cuttings will be drummed accordingly. Any minimal (< 3 feet) remaining void will be filled with surrounding, nearby site material. If greater, the borehole will be backfilled with bentonite to grade.

2.3.1.4 Background and Operational Material Sampling

At the request of the Department, representative samples of the coke that is spread out across the site will be sampled for characterization purposes. Therefore, as part of the scope of work, three samples of coke material will be collected from various locations around the site for laboratory analysis. The findings will allow a better evaluation of site conditions at the time of development in the future.

In addition to the three samples of coke product collected for analysis, an additional three soil samples will be collected deeper at those locations at the coke/soil interface. The sample depth could be near surface or several feet below grade. The analyses of these three soil samples at the interface will allow a better assessment of potential leaching of contaminants from site operations into the subsurface soil horizon. These samples were also requested by the Department.

To provide an evaluation of native site conditions, a total of six background soil samples will also be collected from the site. It is anticipated that these samples will be collected near the southern site boundary away from Lake Erie. To allow for representation of the entire site, three borings will be advanced in three separate topographically-upgradient, non-operational areas of the site. At each boring location, soil sampling will follow the methodology above for non-impacted areas; one surface soil sample and one at-depth soil sample from 4-5 feet bgs will be collected for analysis.

Because of the shallow and variable depth to groundwater (anticipated to be between 8 and 15 feet bgs across the site) and unknown thickness of contaminant impact across the site, field decisions will be made on the number and depths of the soil samples (e.g., if contamination extends to near the water table, only one sample would be collected for vertical delineation purposes).

It should be noted that if it appears that the rotasonic drilling rig is incapable of collecting representative at-depth soil samples in a particular area, an excavator may be used to advance test pits/trenches to achieve the desired depth.

2.3.2 Monitoring Well Installation

For purposes of the Work Plan, an estimate of 12 shallow, overburden monitoring wells will be installed at the site. Specific well installation procedures are described below.

The monitoring well borings will be drilled using rotasonic drilling methods, which use a combination of rotary power, hydraulic pull down pressure, and mechanically generated oscillations to advance a dual line of drill pipe. The inner drill pipe (4-inch nominal diameter) contains a core bit and represents the core barrel sampler, while the outer pipe (6-inch nominal diameter) is used to prevent collapse of the borehole and in construction of wells. During drilling, continuous soil core samples will be collected for lithologic identification by advancing the inner core barrel in front of the outer drill pipe. The inner core barrel will then be mechanically lifted to the surface for sample recovery. The soil core will be vibrated out of the core barrel into a polyethylene liner. This process will be repeated until the desired depth is achieved.

2.3.3 Groundwater Sampling

Groundwater samples will be collected from several borings and monitoring wells at the site. Specific sampling procedures are described below.

Groundwater Grab Samples

Dependent upon the location, geology, hydrogeology, and difficulty of drilling, the collection of groundwater grab samples may be collected using multiple methods. If boring advancement to the desired depth is not difficult and groundwater production appears sufficient, the groundwater grab samples may be collected by advancing a second borehole adjacent to the initial boring. The samples may be collected using a 5-foot long, stainless steel, discrete sampler that is advanced to the desired depth. The cover of the sampler will then be retracted, thus allowing groundwater to flow into the device for sampling. The samples will be retrieved using a peristaltic pump and new, disposable, polyethylene tubing for each sample. Prior to sample collection, a minimum of three well volumes of groundwater will be purged from the borehole to reduce the turbidity to the extent practical. The samples will be placed into appropriate, laboratory-supplied containers with the appropriate preservatives. Samples for dissolved metals will be filtered in the field using 0.45-

micron disposable filters. After sampling, the boreholes will be backfilled with native material.

If groundwater production is limited or other conditions deter the methodology above, a temporary 2-inch diameter PVC well screen and riser will be lowered to the bottom of the borehole through the 6-inch casing. Other site work can be completed while allowing time for groundwater to flow into the screen/riser until sufficient volume is present to retrieve the groundwater grab sample (using peristaltic pump or disposable bailer). After collection of the sample, the temporary PVC well screen and riser will be removed from the borehole. The PVC materials will be inspected afterwards to determine if they are suitable for cleaning and reuse.

Monitoring Wells

Prior to sampling, a complete round of groundwater level measurements will be collected from the wells. The wells will be sampled using low flow purging/sampling methods as follows:

- At each well, the submersible pump (e.g., bladder pump) will be lowered to the approximate mid-point of the well's screened interval. The pumping rate will be set to create a low sustainable flow. A water level meter will be used concurrently to monitor the water level within the well casing. Ideally, the water level should remain in 'steady state' during low-flow pumping and not be drawn down. If drawdown in the well occurs, the pump flow rate will be reduced until the water level in the well casing stabilizes. Typically, flow rates of less than one liter per minute are used initially. However, the flow is dependent upon the hydrogeologic characteristics of the well sampled.

- Water Quality Parameters (WQPs) including pH, Oxidation/Reduction Potential (ORP), specific conductance, dissolved oxygen, temperature, and turbidity will be measured at approximate five minute intervals during purging and recorded in the field logbook. The field testing will be conducted within a flow-through cell that limits exposure of the groundwater to the atmosphere while the field measurements are recorded.

- In general, purging will be complete when three successive WQP readings have stabilized within 0.1 Standard Units for pH, 10 millivolts for ORP, 3% for specific conductance, and 10% for dissolved oxygen and turbidity is less than 10 Nephelometric Turbidity Units (NTUs). Temperature readings will be recorded, but not used for stabilization evaluation. Temperatures measured at the surface are affected to some extent by the difference between ambient air and groundwater temperatures and thus can vary over short periods. If after two hours (or three well volumes, whichever is sooner) of purging, WQPs have not reached a stable plateau, purging may be discontinued, and the sample collected. A full explanation of attempts to achieve stabilization will be recorded in the field logbook.

- Upon WQP stabilization, the groundwater samples will be collected from the end of the tubing and placed into appropriate, laboratory-supplied containers with the appropriate preservatives. Samples for dissolved metals will be filtered in the field using dedicated 0.45-micron disposable filters.

2.3.4 Surface Water/Seep Sampling

To evaluate if contaminant impact from the site is migrating through surface and near-surface channeling, surface water and sediment samples will be collected as part of the Site Investigation activities. This task is segregated into specific sampling activities summarized below.

Surface water samples will be collected using a peristaltic pump and/or dip sampling techniques. Sediment samples will be collected using disposable and/or decontaminated stainless steel hand tools. Both surface water and sediment samples will be analyzed for VOCs, SVOCs, metals (including mercury), general chemistry, pesticides, and PCBs. One Total Organic Carbon (TOC) sample will also be collected if the data is needed to formulate regulatory comparison criteria. Field parameters measurements of the surface water samples will include pH, specific conductance, temperature, dissolved oxygen, and ORP. These will be recorded in the field notebook for future reporting.

Lake Erie Shoreline Investigation Activities

In addition to the surface water, sediment, and materials sampling, sediment samples also will be collected at approximate 250-foot intervals along the length of the shoreline to provide spatial coverage for sufficient characterization. Based on this set interval, a total of eight sediment samples will be collected along the shoreline during the investigation activities.

On-Site Investigation Activities

Although the site is relatively flat, there are large depression areas across the site that may be collection points of potential contamination from the years of operational history. Therefore, surface water and sediment/soil samples will be collected from each of these areas. It is anticipated that one surface water sample from each area will suffice for characterization. If attainable, a hand auger will be used for the sediment/soil sample from each depression area. If refusal is encountered or the sample is too difficult to collect, the rotasonic drilling rig will be used to aid in sample collection. One soil core will be advanced to a depth of five feet bgs in the designated area. The sample will be collected and field screened following the same methodologies presented above for soil sampling. Additional samples may be collected for analysis if obvious contaminant impact is present.

After Outfall #001 has been cleaned out by an excavator during the site preparation activities, one surface water and sediment sample will be collected directly beneath the outfall. In addition, one other sediment sample will be collected along the cleared outfall drainage channel between the outfall and the Lake Erie shoreline. Grab samples along the cleared trench will be field screened and evaluated for contaminant impact (staining, odor, etc.). The sediment sample that appears most impacted will be submitted for laboratory analysis.

Because Outfall #002 discharges adjacent to the Lake Erie shoreline, only one surface water and sediment sample will be collected. The sediment sample will be collected directly below the outfall discharge piping.

If no water is flowing from the outfalls at the time of the sampling, the outfalls will be revisited later during the field activities after a recent rain event to collect the aqueous sample.

2.3.5 Investigation Derived Waste Management

The characterization and disposal of IDW will be conducted following completion of the initial groundwater sampling event. It is anticipated that the proposed 4,000-gallon frac tank will be of sufficient size to house the IDW liquids generated from the investigation activities. With respect to waste characterization, one representative non-aqueous (e.g., soil) and aqueous (e.g., groundwater / wastewater) sample will be collected from the IDW drums and frac tank, respectively, and will be analyzed for waste characterization.

Other waste profile analyses will be required in addition to the VOC, SVOC, and metals. Although the waste profile analytical suite will be dependent upon the IDW subcontractor, it is anticipated that the aqueous profile sample likely will be analyzed for Target Compound List (TCL) VOCs, TCL SVOCs, pH, flashpoint, reactive cyanide, reactive sulfide, and specific gravity. The solids waste profile sample will have a similar analytical suite without the applicable aqueous-based analyses and also include Toxicity Characteristic Leaching Procedure (TCLP) 11 Resource Conservation and Recovery Act (RCRA) Metals, TCLP SVOCs, TCLP VOCs, total volatile solids, free liquids, corrosivity, and specific gravity.

Although it cannot be confirmed, it is anticipated that once the waste stream has been characterized, no further characterization sampling will be necessary prior to further waste removal activities (e.g., aqueous wastes from second round of groundwater sampling). Because of the anticipated significant reduction in aqueous waste for the second round of groundwater sampling, drums will be used to temporarily house the waste instead of a frac tank.

2.3.6 Quality Assurance / Quality Control Samples

Field Quality Assurance/Quality Control (QA/QC) samples will include trip blanks, equipment rinsate blanks, field blanks, and field duplicate samples, and Matrix Spike/Matrix Spike Duplicate (MS/MSD) samples:

Trip Blanks: Trip blanks are samples of analyte-free water prepared at the laboratory before commencement of the sampling event and shipped to the sampling team along with the unopened sample containers. The trip blanks will be randomly selected and included in each cooler containing samples for VOC analysis. The results will be used to verify that the sample containers and method of sample container handling used throughout the sampling program did not contribute to contamination of the samples. In addition, the results will be used to identify other potential sources of field or laboratory contamination.

Equipment Rinsate Blanks: Equipment rinsate blanks will be collected by running laboratory-grade, organic-free, deionized water over/through the sampling equipment and placing it into the appropriate sample containers for laboratory analyses. Equipment rinsate blanks will be collected at a frequency of approximately 5 percent for each type of reusable sampling equipment. The results will be used to verify that the sampling equipment did not contribute to contamination of the samples.

Field Blanks: To document both the quality of the potable water used for the decontamination activities and document background/ambient site conditions, three field blanks will be collected as part of the investigation activities. One potable water field blank will be collected for analysis during the groundwater investigation activities. The sample will be collected from the holding tank (or similar) used by the drilling subcontractor for decontamination of equipment. The analysis of this field blank will document the integrity/quality of the water used for the decontamination process.

The second and third field blanks will be collected during the two groundwater sampling events by pouring laboratory-grade, organic-free, deionized water (supplied by the subcontracted laboratory) into the appropriate sample containers for laboratory analyses. The analysis of these two field blanks will document the integrity/quality of the water supplied by the laboratory in case erroneous detections are observed from the laboratory analytical results of the equipment rinsate samples and also document ambient site conditions during sample collection.

Being that the use of potable water and/or laboratory-grade deionized water is not anticipated for surface water or sediment sampling, no field blanks will be collected in association with those samples.

Field Duplicate Samples: Field duplicate samples will consist of one unique sample, split into two aliquots, and analyzed independently for the same parameters as the corresponding original samples. Duplicate soil and sediment samples analyzed for parameters other than VOCs will be homogenized and split. Samples for VOC analysis will not be mixed but select segments of the soil will be collected. Duplicate water samples will be collected simultaneously. Duplicate samples will be collected at a frequency of approximately ten percent for each group of samples of a similar matrix. The results will be used to verify the reproducibility of the laboratory results and degree of variability of reported concentrations.

MS/MSD Samples: MS/MSD samples will be prepared in the field using the same procedures as duplicate samples and analyzed for the same parameters as the corresponding original samples. MS/MSD samples will be prepared at a frequency of approximately 5 percent for each group of samples of a similar matrix. The laboratory will use the samples for internal QA/QC. In addition, the results will be used to evaluate the matrix effect of the sample upon the analytical methodology.

2.3.7 Sample Preservation and Handling

Sample preservation and handling will be conducted in accordance with Baker SOP F301 (Sample Preservation and Handling). Samples collected for laboratory analyses will be placed into appropriate, laboratory-supplied containers with the appropriate preservatives, stored on ice in coolers at approximately four degrees Celsius, and delivered to the laboratory via Federal Express. Chain-of-Custody forms will be completed and enclosed in the shipping packages. In addition, Chain-of-Custody seals will be placed on each shipping package.

2.4 Sample Designation

The samples, including QA/QC samples, will be designated with a unique sequence number. The samples will also be designated with a unique number that will serve to identify the sample media or type, sampling location, depth, and QA/QC qualifiers. The sample designation format will be as follows:

Sample Media or Type/Location - Depth and/or QA/QC Qualifier

An explanation of each of these identifiers is provided below.

Sample Media or Type	SS = Surface Soil Sample SB = Soil Boring Sample GW = Groundwater Grab Sample MW = Groundwater Monitoring Well Sample SW = Surface Water/Seep sample SD = Sediment Sample TB = Trip Blank ER = Equipment Rinsate Blank FB = Field Blank MS = Material Sample (not soil or sediment)
Location	Each sample location will be identified with a unique identification number

Depth	Depth indicators will be used for soil samples. The number will reference the beginning depth interval of the sample. For example: Soil: 00 = Ground surface to 1 foot bgs 4 = 4 to 5 feet bgs 15 = 15 to 16 feet bgs Groundwater Grab Samples: GW = Groundwater Grab GW01, GW02, etc. = Groundwater Grab Sample #01, #02, etc. (numbering sequential and not AOC dependent)
QA/QC	D = Field Duplicate Sample

Using the applicable sample designation format, the at-depth (12-13 ft. bgs) quality control duplicate soil sample from SB01-12D refers to:

SB01-12D	Soil boring number 01
SB01-12D	Soil sample depth interval of 12-13 feet bgs
SB01-12D	Field duplicate (QA/QC) sample

This sample designation format will be followed throughout the field sampling activities as all soil samples are proposed to be collected in one-foot increments. Required deviations to this format in response to field conditions will be documented in the field logbook.

2.5 Decontamination

Reusable sampling equipment (e.g., stainless steel spoons, hand augers, etc.) that comes into direct contact with the sample will be decontaminated between samples as follows:

- Wash equipment thoroughly with laboratory detergent and potable water using a brush to remove any particulate matter or surface film
- Rinse equipment thoroughly with potable water
- Air dry equipment

Drilling equipment (e.g., sonic cutting head, drill rods) that comes into direct contact with the soil will be decontaminated between borings and wells at a centralized decontamination pad using a high-pressure, hot water wash (a.k.a., 'steam cleaning'). Because the use of acetate or polyethylene liners will be used during boring advancement/sample collection, only the drilling materials coming in direct contact with the soil will warrant steam cleaning (e.g., cutting head). However, if notable contamination is encountered during boring advancement, all downhole drilling materials will be steam cleaned between borings.

The decontamination pad will be capable of containing water and sediment. In addition, the pad will be equipped with a sump and sump pump suitable to pump the spent decontamination water into the frac tank.

2.6 Monitoring and Data Collection Equipment

Field instruments will be used for screening (e.g., PID, radiation meter) various media samples and measuring water levels/well depths and WQPs (e.g., pH, specific conductance, temperature, dissolved oxygen, turbidity, and ORP). The PID and radiation meter will be calibrated and operated in accordance the manufacturer's instructions. The procedures to be used for on-site water quality testing and water level/well depth measurements are provided in the attached OBG | Baker SOPs F201 and F202, respectively.

2.7 Survey

At the request of the Department, two separate survey activities are included in the scope of work: a boundary survey and the monitoring well survey.

2.7.1 Boundary Survey

For the on-site work, carsonite markers and wooden stakes at property corners marked 'Boundary' will be installed at the appropriate locations. Iron pins also will be installed at each line stake point. The surveying activities will be completed to an accuracy of 0.1 feet by a Pennsylvania-licensed surveyor. A new boundary drawing will be provided to the Department but will not include legal descriptions.

2.7.2 Monitoring Well Survey

For purposes of this plan, a total of 12 groundwater monitoring wells will be installed and surveyed for accurate placement on a scaled site map and for groundwater flow mapping.

The monitoring well survey activities under this task will include locating the horizontal position and establishing elevations of the newly-installed monitoring wells. The horizontal data will be to the nearest 0.1-foot and referenced to the Pennsylvania State Plane Coordinate System, North American Datum (NAD) 1983. The vertical data will be to the nearest 0.01-foot and referenced to the North American Vertical Datum (NAVD) 1988. These surveying activities also will be conducted under the direction of a professional land surveyor licensed to practice surveying in the Commonwealth of Pennsylvania.

The remaining sample locations will be surveyed by OBG | Baker for horizontal position within the Pennsylvania State Plane Coordinate System, NAD 1983 using mapping-grade GPS equipment. The horizontal accuracy will be within approximately two feet.

2.8 Site Management

The following sections outline the responsibilities and reporting requirements of on-site personnel.

2.8.1 Field Team Responsibilities

The field team will consist of a Field Team Leader and an Environmental Specialist. The Field Team Leader will coordinate the field activities and serve as the Site Health and Safety Officer. In addition, the Field Team Leader will ensure that all field activities are conducted in accordance with the Work Plan, FSAP, QAPP, and site-specific Health and Safety Plan. The Environmental Specialist will support the Field Team Leader during the sampling activities.

2.8.2 Reporting Requirements

The Field Team Leader will be responsible for tracking each day's field activities including, but not limited to, the following:

- Personnel on site
- Major activities of the day
- Subcontractor quantities (e.g., drilling footages)
- Samples collected and analyses requested
- Equipment on site
- Problems encountered
- Changes in scope of the investigation (discussed and agreed upon with the PADEP Regional Project Officer)
- Planned activities

In addition, the Field Team Leader will prepare Daily Activity Reports. These reports will be forwarded onto the Project Manager for review and discussion (if needed). The Project Manager will be responsible for submittal of the daily reports to the Department.

3.0 QUALITY ASSURANCE PROJECT PLAN

This QAPP presents the organization, objectives, functional activities, and specific QA/QC activities associated with the site investigation. It contains information concerning project objectives, sampling descriptions and rationale, and Data Quality Objectives (DQOs) as follows:

- Project Description
- Organization and Responsibility
- Data Quality Objectives
- Sampling Procedures
- Sample Custody Procedures and Frequency
- Analytical Procedures
- Data Reduction, Validation, and Reporting
- Preventive Action Procedures
- Corrective Action Procedures
- Quality Assurance Reports

3.1 Project Description

The project description and objectives are presented in the Work Plan.

3.2 Organization and Responsibility

The OBG | Baker project management organization is designed to provide a line of functional responsibility and authority supported by a management control structure and independent Quality Assurance (QA) review. This control structure provides for the following:

- Clearly identified lines of communication and coordination
- Project budget and schedule monitoring
- Key technical resources management
- Financial management and progress reports
- Quality Control (QC)

Key personnel for QA throughout the duration of this project are presented in the Work Plan.

3.3 Data Quality

3.3.1 Data Needs/Uses

The generation of data through the sampling and analyses efforts is intended to provide an assessment of current site conditions with respect to potential environmental impact from historical industrial operations conducted at the site. Table 1 of the Work Plan present a summary of the sampling and analytical program.

3.3.2 Data Quality Objectives

DQOs are qualitative or quantitative statements developed by the users to specify the quality of data needed from a particular data collection activity to support specific uses. DQOs consider analytical method precision, accuracy, representativeness, completeness, and comparability as discussed below.

Precision

Precision is a measure of the amount of variability and bias inherent in a data set. Furthermore, precision describes the reproducibility of measurements of the same parameter for samples collected under similar conditions.

Field duplicate precision monitors the consistency with which environmental samples were obtained and analyzed. In general, field duplicate results for solid matrix and aqueous matrix samples are precise if the Relative Percent Difference (RPD) is less than or equal to 35 percent and 20 percent, respectively. Field precision will be assessed through collection and measurement of field duplicate samples at a rate of 1 duplicate per 10 analytical samples per matrix.

Laboratory precision QC samples will be analyzed with a minimum frequency of 5 percent (i.e., 1 QC sample per 20 environmental samples per matrix). Laboratory precision will be measured via comparison of RPD values and precision control limits specified in the analytical method or by the laboratory’s QA/QC program. Laboratory limits at the time of analysis will be used to assess the data.

The RPD between the sample (or spike) and duplicate (or duplicate spike) will be calculated using the following formula:

$$\text{RPD} = \frac{\text{Amount in Sample 1} - \text{Amount in Sample 2}}{0.5(\text{Amount in Sample 1} + \text{Amount in Sample 2})} \quad \text{X} \;\; 100$$

Accuracy

Accuracy is the degree of agreement between an observed value and an accepted reference value. Accuracy in the field will be assessed using equipment rinsate, field, and trip blanks and will be ensured through adherence to all sample handling, preservation, and holding time requirements.

Accuracy in the laboratory will be measured through the comparison of a spiked sample result with a known or calculated value and is expressed as a percent recovery (%R). Percent recoveries will be derived from the analysis of known amounts of compounds spiked into deionized water (i.e., Laboratory Control Sample [LCS] analysis) or into actual samples (i.e., surrogate or internal MS analysis). LCS analysis, which may also be referred to as blank spike analysis, measures the accuracy of laboratory operations. Surrogate and MS analyses measure the accuracy of laboratory operations as affected by sample matrix. LCS and MS analyses will be performed at a frequency of 1 per 20 associated samples of similar matrix. Surrogate spike analysis is performed for all organic chromatographic analyses. Laboratory accuracy will be assessed via comparison of calculated %R values with accuracy control limits specified in the analytical method or by the laboratory's QA/QC program. Laboratory recovery limits at the time of analysis will be used to assess the data.

The %R for a spiked sample will be calculated by using the following formula:

$$\%R = \frac{\text{Amount in Spiked Sample - Amount in Sample}}{\text{Known Amount Added}} \text{ X } 100$$

The %R for LCS and surrogate compound results will be determined according to the following equation:

$$\%R = \frac{\text{Experimental Concentration}}{\text{Known Amount Added}} \text{ X } 100$$

Completeness

Completeness is a measure of the amount of usable, valid, analytical data obtained, compared with the amount expected to be obtained. Completeness is typically expressed as a percentage.

The ideal objective for completeness is 100 percent (i.e., every sample planned to be collected is collected; every sample submitted for analysis yields valid data). However, samples can be rendered unusable during shipping or preparation (e.g., bottles broken or extracts accidentally destroyed), errors can be introduced during analysis (e.g., loss of instrument sensitivity, introduction of ambient laboratory contamination), or strong matrix effects can become apparent (e.g., extremely low MS recovery). These instances result in data that do not meet QC criteria. Completeness will be calculated for each chemical category (e.g., VOCs, SVOCs, metals, etc.) per media. If critical data points are lost, re-sampling and/or re-analysis may be required. For this project, the completeness goal is 95 percent or greater.

Following completion of the analytical testing, the percent completeness will be calculated using the following equation:

$$\text{Completeness} = \frac{\text{(Number of Valid Measurements)}}{\text{(Number of Measurements Planned)}} \times 100$$

Representativeness

Representativeness is an expression of the degree to which the data accurately and precisely depict the actual characteristics of a population or environmental condition existing at an individual sampling point. Use of standardized sampling, handling, analytical, and reporting procedures ensures that the final data accurately represent actual site conditions.

Representativeness in this sampling and analysis program will be ensured by following the Work Plan, FSAP, and QAPP and using proper sampling techniques. From the analytical end, representativeness will be ensured by using the proper analytical procedures, meeting sample holding times, and analyzing and assessing field duplicate samples.

Comparability

Comparability is defined as the confidence with which one data set can be compared with another (e.g., between sampling points; between sampling events). Comparability will be achieved by using standardized sampling and analysis methods and data reporting formats (including use of consistent units of measure). In addition, consideration will be given to seasonal conditions and other environmental variations that could exist to influence analytical results.

3.4 Sampling Procedures

Field sample collection procedures are presented in the Work Plan and FSAP. Appropriate sample containers and preservatives will be obtained directly from the subcontracted analytical laboratory. The sample containers will be certified as clean by the laboratory. Tables 1 and 2 of this QAPP present a summary of sample containers, preservation, and holding times for the primary aqueous and solid samples.

3.5 Sample Custody Procedures

Each sample will be given a unique designation, which will be recorded in the field logbook, on the Chain-of-Custody record, and the label affixed to the sample container. The sample designation format is presented in the FSAP.

Sample labeling, custody seals, field tracking, field logbooks, and Chain-of-Custody procedures are described in Baker SOPs F302 (Chain-of-Custody) and F303 (Field Logbook). Samples for laboratory analyses will be stored on ice in coolers at approximately 4 degrees Celsius and submitted to a qualified, subcontracted laboratory. Chain-of-Custody forms will be completed and enclosed in the shipping packages. In addition, Chain-of-Custody seals will be placed on each shipping package.

3.6 Analytical Procedures

General procedures for field analyses and laboratory analyses provided below.

3.6.1 Field Analyses

Field instruments will be used for screening (e.g., PID, radiation meter) various media samples and measuring WQPs (e.g., pH, specific conductance, temperature, dissolved oxygen, turbidity, and ORP). The PID and radiation meter will be calibrated and operated in accordance the manufacturer's instructions. On-site water quality testing will be conducted in accordance with Baker SOP F201.

3.6.2 Laboratory Analyses

Table 1 of the Work Plan presents a summary of the proposed sampling and analytical program. The laboratory analyses will be conducted in accordance with standard U.S. Environmental Protection Agency (USEPA) methods and procedures used in the environmental industry.

3.7 Data Reduction and Reporting

Data reduction and reporting will ensure that all documents produced as part of the investigation can be accounted for upon project completion. Accountable documents include, but are not limited to, field logbooks, correspondence, Chain-of-Custody records, data packages, and photographs. The Project Manager will be responsible for maintaining a project file in which all accountable documents will be inventoried. The project records will be retained in accordance with OBG | Baker's and the Department's Document Retention Policy.

TABLE 1
SUMMARY OF CONTAINERS, ANALYSES, PRESERVATION, AND HOLDING TIMES FOR AQUEOUS SAMPLES

Parameter	Analytical Method	Container	Preservation	Holding Time
VOCs	Method 8260	Two40-ml glass vials with Teflon septum caps	Cool, 4°C HCl pH <2	14 days
SVOCs	Method 8270	Two 250-ml amber glass bottle with Teflon cap	Cool, 4°C	7 days to extraction; 40 days from extraction to analysis
Dioxins	Method 8290A	Two 1-L amber glass	Cool, 4°C	30 days to extraction
PCBs	Method 8082A	Two 250-liter amber glass bottle with Teflon cap	Cool, 4°C	7 days to extraction; 40 days from extraction to analysis
Total and Dissolved Metals (& Mercury)	Method 6010/7470A	500-ml polyethylene bottle - Each	HNO_3 pH<2	6 months; Mercury 28 days
Pesticides	Method 8081B	1-liter amber glass bottle with Teflon cap	Cool, 4°C	7 days to extraction; 40 days from extraction to analysis

TABLE 2

SUMMARY OF CONTAINERS, ANALYSES, PRESERVATION, AND HOLDING TIMES FOR NON-AQUEOUS SAMPLES

Parameter	Analytical Method	Container	Preservation	Holding Time
VOCs	Method 8260	TerraCore three – 40-ml glass VOA vials; one 2-ounce plastic	One vial with methanol; two vials with DI water; Cool, 4°C	14 days
SVOCs	Method 8270	One 8-ounce wide-mouth jar	Cool, 4°C	7 days to extraction; 40 days from extraction to analysis
Dioxins	Method 8290A	One 4-oz glass jar	Cool, 4°C	30 days to extraction
Pesticides / PCBs	Method 8081B	One 8-ounce wide-mouth jar	Cool, 4°C	7 days to extraction; 40 days from extraction to analysis
Metals (including mercury)	Method 6010/7470A	One 8-ounce wide-mouth jar	Cool, 4°C	6 months; Mercury 28 days

3.7.1 Field Data Procedures

Field sampling activities will be documented in field logbooks in which information pertinent to sample collection will be entered in indelible ink. The field logbooks will be completed and maintained as described in Baker SOP F303 (Field Logbook). Appropriate information will be entered daily including weather, names of field personnel and visitors on site, sample identification, brief descriptions of samples collected, date and time of collection, sampling methodology, sampling remarks and observations, field measurements, conditions and observations, description of activities, QA/QC samples collected, and list of photographs taken.

3.7.2 Laboratory Data Procedures

The following procedures summarize the practices that will be routinely used by laboratory staff for data reduction, validation, and reporting. Numerical analyses, including manual calculations, will be documented and subjected to QC review. Records of analyses must be legible and complete enough to permit reconstruction of the work by a qualified individual other than the originator.

Laboratory Data Validation

Laboratory data validation begins with the receipt of samples and the documentation of proper sample custody. It continues with raw data reduction to the reporting of data.

Data processing will be checked by an individual other than the analyst who performed the data processing. The checker will review the data for the following:

- Utilization of the proper equations
- Correctness of numerical input
- Correctness of computations
- Correct interpretation of raw data (e.g., chromatographs, strip charts, etc.)

All entries made in bench books, data sheets, computation sheets, etc., will be made in ink. No entry will be rendered illegible, and changes will be lined-through and initialed by the person making the correction.

Analytical Data Package Requirements

An Electronic Data Deliverable (EDD) in Microsoft Excel format of the analytical data will be submitted to OBG | Baker from the subcontracted laboratory. For each analytical method run, the laboratory will report all required analytes for each sample as a detected concentration or as not detected at the specific limits of quantitation. In addition, applicable method detection limits and instrument detection limits will be required for every analysis. The Department requested that all analytical methods are sufficient to attain levels below the appliable Residential and Non-Residential MSCs.

Each analytical method run will be clearly identified as belonging to a specific analytical batch. All samples must be reported with dates of collection, preparation, and analysis. The laboratory will also report dilution factors for each sample.

A complete set of QC results, including calibration data, will be reported for each analytical batch. All required method QC will be performed on project samples. The required QC samples and their frequency are identified in the FSAP. A standard turnaround time (for complete data packages) from sample receipt at the laboratory to data receipt will be requested for all samples. The laboratory will hold and make available all project raw data for a minimum period of seven years after the samples have been analyzed.

3.8 Preventive Action Procedures

3.8.1 Field Equipment

Specific preventive maintenance procedures recommended by the manufacturer will be followed for field equipment. Field instruments will be checked and calibrated by OBG | Baker daily before use. In addition, the calibration will be checked anytime there is a questionable response from the equipment. Calibration will be documented in the field logbooks.

3.8.2 Laboratory Instruments

A routine preventive maintenance program will be conducted by the laboratory to minimize the occurrence of instrument failure and other system malfunctions. Section supervisors and/or analysts (organic, inorganic) will perform routine scheduled maintenance, and coordinate with the vendor for the repair of all instruments. All laboratory instruments will be maintained in accordance with the manufacturer's specifications and the requirements of the specific method employed. This maintenance will be carried out on a regular, scheduled basis and documented in the laboratory instrument service logbook for each instrument. Emergency repair or scheduled manufacturers maintenance will be provided under a repair and maintenance contract with factory representatives.

3.9 Corrective Action Procedures

A corrective action protocol that is both technically effective and administratively compatible to ensure accurate and timely correction of non-conformance is imperative.

3.9.1 Field Procedures

The Field Team Leader will be responsible for all field activities. In this role, the Field Team Leader may be required to adjust the field program to accommodate site-specific needs. If it becomes necessary to modify the program, then the Field Team Leader will consult the Project Manager and PADEP Regional Project Officer regarding an appropriate corrective action. Agreed upon corrective actions for the program will be documented in the field logbook.

3.9.2 Laboratory Procedures

Nonconformance is any event, which is beyond the limits established for laboratory performance, such as data which fall outside accepted bounds for accuracy and precision due to improper equipment calibration/maintenance or improper data verification. Any activity in the laboratory which affects data quality can result in a nonconformance.

Nonconformance associated with the statistical analysis and review of data are straightforward to identify. The Laboratory QA Coordinator will be responsible for the assessment of QC sample information. The Project Manager and PADEP will be notified of any nonconformances.

Corrective actions will be designed to correct the associated problems and minimize the possibility of their recurrence. Examples of corrective actions are modifying nonconforming procedures; tagging, repairing, or replacing deficient equipment; training or replacing unqualified personnel; re-analyzing affected samples; marking rejected data, and reissuing affected reports.

3.10 Quality Assurance Reports

The Project Manager will be responsible for assessing the performance of measurement systems and data quality related to the field investigation. A written record will be maintained of the results of laboratory QC reports and other periodic assessments of measurement, data accuracy, precision, and completeness; performance and system audits; and any significant QC problems and recommended solutions. A QA/QC assessment will be performed any time a significant problem is identified.

The Project Manager will keep in contact with the PADEP Regional Project Officer through informal, verbal reports during the project as well as through monthly progress reports.

ATTACHMENT A

Standard Operating Procedures (SOPs)

TABLE OF CONTENTS

ON-SITE WATER QUALITY TESTING
(FIELD PARAMETERS)

1.0 PURPOSE

This SOP describes the procedures and equipment required to measure the following parameters of an aqueous sample in the field:

- pH
- Specific Conductance/Salinity
- Temperature
- Dissolved Oxygen Concentration (DO)
- Turbidity (Secchi Disc)
- Oxidation Reduction Potential (ORP)

The first three bullets above are typical field parameters. Dissolved oxygen, turbidity, and ORP may be used in particular applications according to project-specific requirements.

2.0 SCOPE

These procedures are applicable for use in an on-site water quality monitoring program to be conducted during Remedial Investigations or Site Investigations at hazardous or non-hazardous sites. The procedures and equipment described are applicable to nearly all aqueous samples, including, but not limited to, potable well water, monitoring well water, surface water, leachate and drummed water, etc.

This SOP provides generic information for measuring the parameters listed above with instruments and techniques in common use. Since instruments from different manufacturers may vary, review of the manufacturer's literature pertaining to the use of a specific instrument is required before use (preferably prior to mobilization to the field).

3.0 DEFINITIONS

Specific Conductance - A measurement of water’s capacity for conveying electrical current and is directly related to the concentrations of ionized substances in the water. The units of measurement for conductance (μmhos) are the inverse of μohms, the unit commonly used to express resistance. The terms conductivity and specific conductance are used synonymously.

Electrolytic Cell - An electrochemical cell in which electrical energy is supplied from an external source. This cell functions in much the same way as a galvanic cell, only in the opposite direction due to the external source of applied voltage.

Galvanic Cell - An electrochemical cell in which chemical energy is spontaneously converted to electrical energy. The electrical energy produced is supplied to an external circuit.

Oxidation - The process in which an atom or group of atoms loses electrons to achieve an increasing positive charge.

pH - The negative logarithm (base 10) of the hydrogen ion activity. The hydrogen ion activity is related to the hydrogen ion concentration, and, in a relatively weak solution, the two are nearly equal. Thus, for all practical purposes, pH is a measure of the hydrogen ion concentration. The range of pH is 0 to 14 standard units.

Resistance - A measure of the solution's ability to oppose the passage of electrical current. For metals and solutions, resistance is defined by Ohm's Law, $E = IR$, where E is the potential difference (in units of volts), I is the current (in units of Amperes), and R is the resistance (in units of ohms).

Turbidity - An optical property of water that causes light to be scattered or absorbed in the water, resulting in a decrease in water transparency. It is a function of at least three variables: 1) dissolved chemicals; such as tannins, acids, or salts; 2) suspended particles; such as silt, clay, and organic matter; and, 3) density of microbial and planktonic life.

Salinity - refers to the total amount of soluble salts in water, either naturally or added to the environment as pollutants.

ORP - Oxidation reduction occurs when electrons are transformed from one atom to another during a chemical reaction. The atom losing electrons is said to be "oxidized", while the atom gaining electrons is termed "reduced". ORP is typically measured using a platinum electrode, attached to a pH meter, which is set to read in ‘Millivolt’ mode.

4.0 RESPONSIBILITIES

Project Manager - The Project Manager is responsible for ensuring that project-specific plans are in accordance with these procedures, where applicable, or that other, approved procedures are developed. The Project Manager is responsible for determining which on-site water quality measurements shall be collected, the data quality objectives (DQOs) for these measurements, and for ensuring that these measurements are collected in accordance with project-specific plans.

Field Team Leader - The Field Team Leader is responsible for determining that these water quality measurement procedures are implemented in the field in accordance with this SOP, and/or in accordance with project-specific plans, and to ensure that personnel performing sampling activities have been briefed and trained to execute these procedures.

Sampling Personnel - It is the responsibility of the field sampling personnel to follow these procedures for collecting on-site water quality measurements including instrument calibration, quality control and recording of results, as well as care and maintenance of the instruments in the field. Furthermore, it is the sampling personnel’s responsibility to confirm that the meters are in good working order prior to mobilization to the field. In addition, extra batteries and meter probes also should be included in the field equipment list to minimize potential down time in the field.

5.0 PROCEDURES

The following sections provide general procedures for collecting pH, specific conductance/salinity, temperature, dissolved oxygen concentration, turbidity and ORP measurements.

Note: Though there are "multi-parameter" meters on the market today that can simultaneously measure the following parameters, only measurement with "parameter specific" meters will be discussed. If using a multi-parameter meter, all manufacturer's instructions for that specific model will be followed for calibration, maintenance, and care.

5.1 Measurement of pH

Measurement of pH is one of the most important and frequently used tests in water chemistry. Practically every phase of water supply and wastewater treatment, such as acid-base neutralization, water softening, and corrosion control, is pH dependent. Likewise, the pH of leachate can be correlated with other chemical analyses to determine the probable source of contamination. It is therefore important that reasonably accurate pH measurements be taken.

Measurements of pH also can be used to check the quality and corrosivity of soil and solid waste samples. However, these samples must be immersed in water prior to analysis; specific measurement techniques for solids are not described in this SOP.

5.1.1 Principles of Equipment Operation

Use of a pH meter relies on the same principle as other ion-specific electrodes. Measurement relies on the establishment of a potential difference across a glass or other type of membrane. The membrane is conductive to ionic species and, in combination with a standard or reference electrode, a potential difference proportional to hydrogen ion concentration can be generated and measured.

5.1.2 Equipment

The following equipment and reagents are needed for taking pH measurements:

- Laboratory-prepared buffer solutions for calibration of pH 4, 7 and 10, or other buffers which bracket the expected pH range.

5.1.3 Measurement Techniques for Field Determination of pH

A. pH Meter

Standardization, calibration, and operation and maintenance shall be performed according to the manufacturer's instructions for the "specific" model being used. The following general procedure is used for measuring pH with a pH meter:

1. The batteries shall be checked to make sure that they are fully charged and the instrument shall be calibrated prior to initiation of the field effort.

2. Immerse the tip of the electrodes in water overnight. If this is not possible due to field conditions, immerse the electrode tip in water for at least an hour before use. The electrode tip may be immersed in a rubber or plastic sack containing buffer solution for field transport or storage.

3. Turn meter on and allow it to stabilize for 3 to 5 minutes.

4. Make sure all electrolyte solutions within the electrode(s) are at their proper levels and that no air bubbles are present within the electrode(s). Shake electrode as if a mercury thermometer to move air bubbles from the tip to the top.

5. Calibration procedures should be performed:
    - Following significant ambient temperature changes
    - When meter reads erratically
    - At beginning and middle of each day of use

6. When the meter is moved to a new sampling location, a single-point check/calibration should be performed with pH 7 buffer.

7. Immerse the electrode(s) in the unknown solution, slowly stirring the probe until the pH stabilizes. Stabilization may take several seconds to minutes. If the pH continues to drift, the sample temperature may not be stable, a chemical reaction (e.g., degassing) may be taking place in the sample, or the meter or electrode may be malfunctioning. This must be clearly noted in the field logbook.

8. After adjusting the temperature compensator to the sample temperature, read and record the pH of the solution. The pH value shall be recorded to the nearest 0.1 pH unit. Also record the sample temperature. All measurements shall be recorded in the Field Logbook.

9. Upon completion of measurement and removal of the electrode from the sample (or buffer), the electrode shall be thoroughly rinsed with deionized water and patted dry (never rub dry, due to potential interference by static electricity).

10. The electrode(s) shall remain immersed in storage solution provided, or pH buffer 4 water when not in use.

The sample used for pH measurement shall never be saved for subsequent conductivity or chemical analysis. All pH electrodes leak small quantities of electrolytes (e.g., sodium or potassium chloride) into the solution. Precipitation of saturated electrolyte solution within the electrode, especially at colder temperatures, or in cold water, may result in slow electrode response. Any visual observation of conditions which may interfere with pH measurement, such as oily materials, or turbidity, shall be noted in the Field Logbook.

5.2 Measurement of Specific Conductance/Salinity

Conductance provides a measure of dissolved ionic species in water and can be used to suggest the direction and extent of migration of contaminants in groundwater or surface water. Salinity refers to the total amount of soluble salts in water, either naturally or added to the environment as pollutants.

One basic measure of salinity is the ability of water to conduct electric current. Therefore, a measurement of specific conductance provides a measurement of salinity and the same instrument can be used. Salinity measurements also are important in ecological field investigations because flora and fauna can be limited in their distribution based on the salinity of the sampled waters.

Conductivity is a numerical expression of the ability of a water sample to carry an electric current. This value depends on the total concentration of the ionized substances dissolved in the water and the temperature at which the measurement is collected. The mobility of each of the various dissolved ions, their valences, and their actual and relative concentrations affect conductivity.

It is important to obtain a specific conductance and salinity measurement soon after taking the sample designated for laboratory analysis, since temperature changes, precipitation reactions, and absorption of carbon dioxide from the air affect the specific conductance.

5.2.1 Principles of Equipment Operation

An aqueous system containing ions will conduct an electric current. In a direct-current field, the positive ions (cations) migrate toward the negative electrode (cathode), while the negatively charged ions (anions) migrate toward the positive electrode (anode). Most inorganic acids, bases and salts (such as hydrochloric acid, sodium carbonate, or sodium chloride, respectively) are relatively good conductors. Conversely, organic compounds such as sucrose or benzene, which do not disassociate in aqueous solution, conduct a current very poorly, if at all.

A conductance cell and a Wheatstone Bridge (for the measurement of potential difference) may be used for measurement of electrical resistance. The ratio of current applied to voltage across the cell also may be used as a measure of conductance. The core element of the apparatus is the conductivity cell containing the solution of interest. Depending on ionic strength of the aqueous solution to be tested, a potential difference is developed across the cell which can be converted directly or indirectly (depending on instrument type) to a measurement of specific conductance.

5.2.2 Equipment

A portable conductivity meter, probe and thermometer are needed for taking specific conductance and salinity measurements. Typically, a variety of conductivity meters are available which also may be used to monitor salinity and temperatures. Probe types and cable lengths vary, so equipment may be obtained to meet the specific requirements of the sampling program.

5.2.3 Measurement Techniques for Specific Conductance/Salinity

Standardization, calibration, and operation and maintenance shall be performed according to manufacturers' instructions for the "specific" model being used. The general steps involved in taking specific conductance and salinity measurements are listed below.

1. Check batteries to make sure they are fully charged and calibrate instrument before going into the field.

2. Calibrate the instrument daily when used, at a minimum. Potassium chloride solutions with a specific conductance closest to the values expected in the field shall be used for the calibration process. Calibration information (time of calibration, solutions used, and meter output readings) shall be recorded in the field logbook.

3. Turn meter on and allow it to stabilize for 3 to 5 minutes.

4. Calibration procedures should be performed:
    - Following significant ambient temperature changes
    - When meter reads erratically
    - At beginning and middle of each day of use

5. Pour approximately 50 to 100 ml of sample into a rinsed plastic container. Immerse the electrode in the sample and measure the conductivity and salinity. If required by the meter being used, adjust the temperature setting to the sample temperature. Make sure that the electrode is fully immersed in the sample, but not touching the base of the container.

6. Read and record the results in the field logbook. For some antiquated meters also note the scale prior to recording the reading (i.e., 1x, 10x, 100x, etc.).

7. If the meter does not compensate for temperature variations, the corrections given in Attachment A shall be applied.

8. On some meters, specific conductance and salinity measurements may need to be reported with the associated temperature measurement. If the conductivity and salinity has been corrected, the measurements shall be reported as corrected to 25°C (Attachment A).

    a. Do not take readings if the sample temperature is less than 10° C, because the calibration curve no longer follows a straight line below this temperature. If necessary, heat the sample in your vehicle to at least 10° C.

    b. Measure the sample temperature to the nearest 0.1° C to comply with SW-846.

    c. Only report results to the nearest two significant digits for most circumstances because of the inherent inaccuracy in the test and conversion procedure(e.g., a calculated reading of 2353 umhos/cm @ 25° C should be reported as 2400 umhos/cm @ 25° C).

5.3 Measurement of Temperature

In combination with other parameters, temperature can be a useful indicator of the likelihood of biological action in a water sample. It can also be used to trace the flow direction of contaminated groundwater. Temperature measurements shall be taken in-situ, or as quickly as possible in the field after sample collection for laboratory analysis. Collected water samples may rapidly equilibrate with the temperature of their surroundings.

5.3.1 Equipment

Temperature measurements may be taken with Thermistor, alcohol-toluene, mercury or bimetal thermometers. In addition, most meters such as specific conductance or dissolved oxygen meters, which have temperature measurement capabilities, may also be used. Using such instrumentation along with suitable probes and cables, in-situ measurements of temperature can be performed.

5.3.2 Measurement Techniques for Water Temperature

If a thermometer is used on a collected water sample:

1. Visually inspect thermometer to ensure that there is not a break in the mercury column. If there is a break, the spare thermometer will be visually inspected. If both thermometers have a break in the mercury, neither will be used until the break is corrected. This will be done by cooling the bulb until the mercury is contained within the bulb.

2. Immerse the thermometer in the sample until temperature equilibrium is obtained (1-3 minutes). To avoid the possibility of contamination, the thermometer shall not be inserted into samples which will undergo subsequent chemical analysis.

3. Record values in a field logbook to the nearest 0.5 or 0.1EC, depending on the measurement device used.

If a temperature meter or probe is to be used, the instrument shall be calibrated according to the manufacturer's recommendations with an approved thermometer.

5.4 Measurement of Dissolved Oxygen Concentration

Dissolved oxygen (DO) levels in natural water and wastewater depend on the physical, chemical and biochemical activities in the water body. Conversely, the growth of many aquatic organisms, as well as the rate of corrosivity, is dependent on the dissolved oxygen concentration. Thus, analysis for dissolved oxygen is a key test in water pollution and waste treatment process control. If at all possible, DO measurements shall be taken in-situ, since concentration may show a large change in a short time, if the sample is not adequately preserved. Other means of sample preservation may involve directing the sample flow from the well directly into a flow cell, which limits sample/air contact.

The method discussed here is limited to the use of DO meters only. Chemical methods of analysis (e.g., Winkler methods) are available, but require more equipment and greater sample manipulation. Furthermore, DO meters, using a membrane electrode, are suitable for highly polluted waters, because the probe is completely submersible. DO meters also are free from interference caused by color, turbidity, colloidal material or suspended matter.

5.4.1 Principles of Equipment Operation

DO probes normally are electrochemical cells that have two solid metal electrodes of different potential immersed in an electrolyte. The electrolyte is retained by an oxygen-permeable membrane. The metal of higher nobility (the cathode) is positioned at the membrane. When a suitable potential exists between the two metals, reduction of oxygen to hydroxide ion (OH) occurs at the cathode surface. An electrical current is developed directly proportional to the rate of arrival of oxygen molecules at the cathode.

Since the current produced in the probe is directly proportional to the rate of arrival of oxygen at the cathode, it is important that a fresh supply of sample always be in contact with the membrane. Otherwise, the oxygen in the aqueous layer along the membrane is quickly depleted and false low readings are obtained. Therefore, it is necessary to stir the sample (or the probe) constantly to maintain fresh solution near the membrane interface. Stirring, however, shall not be so vigorous that additional oxygen is introduced through the air-water interface at the sample surface (frothing). To avoid this possibility, some probes are equipped with stirrers to agitate the solution near the probe, but to leave the surface of the solution undisturbed.

DO probes are relatively free of interferences. Interferences that can occur are reactions with oxidizing gases (such as chlorine) or with gases such as hydrogen sulfide which are not easily depolarized from the indicating electrode. If gaseous interference is suspected, it shall be noted in the Field Logbook and checked if possible. Temperature, pressure, and salinity variations also can cause interference. Automatic temperature compensation normally is provided by the manufacturer. Attachment B presents variations of DO in water as a fraction of temperature and pressure. Salinity should be compensated in accordance with the manufactures instructions.

5.4.2 Equipment

A portable conductivity meter, probe and thermometer (if not built into the conductivity meter) are needed for taking specific conductance and salinity measurements. A variety of conductivity meters are available which also may be used to monitor salinity and temperatures. Probe types and cable lengths vary, so equipment may be obtained to meet the specific requirements of the sampling program.

5.4.3 Measurement Techniques for Dissolved Oxygen Determination

Probes differ as to specifics of use. Follow the manufacturer's instructions for the specific model being used to obtain an accurate reading. The following general steps shall be used to measure the DO concentration.

1. Calibrate equipment and check batteries before going to the field.

2. The probe shall be conditioned in a water sample for as long as practical before use in the field. Long periods of dry storage followed by short periods of use in the field may result in inaccurate readings.

3. The instrument shall be calibrated in the field before each measurement or group of closely spaced measurements by placing the probe in a freshly air-saturated water sample of known temperature.

4. Immerse the probe in the sample. Be sure to provide for sufficient flow past the membrane, either by stirring the sample, or placing the probe in a flowing stream. Probes without stirrers which are placed in wells should be moved up and down.

5. Record the dissolved oxygen content and temperature of the sample in a field logbook.

6. Recalibrate the probe when the membrane is replaced, or following similar maintenance, or as needed. Follow the manufacturer's instructions.

Note that in-situ placement of the probe is preferable, since sample handling is not involved. This, however, may not always be practical. Be sure to record whether the liquid was analyzed in situ, or whether a sample was taken.

Special care shall be taken during sample collection to avoid turbulence which can lead to increased oxygen dissolution and positive test interferences.

5.5 <u>Measurement of Turbidity</u>

Turbidity is caused by fine particles suspended in the water which cause light to scatter, rather than traveling in a straight line. Clay, silt, plankton, and other microorganisms are all examples of particulates that cause turbidity.

Most portable field turbidity meters display results in Nephelometric Turbidity Units (NTU's). This process determines the turbidity level of measuring the amount of light scattered 90° by the suspended particles, by a light of known strength beamed through the solution.

5.5.1 Equipment

A portable turbidity meter, sample vials, standard solutions, and sample cap are typically needed.

5.5.2 Measurement Techniques for Turbidity Measurement

Follow the manufacturer’s instructions, for the specific model being used. The following general steps shall be used to measure turbidity.

1. Calibrate equipment and check batteries, or charge status.

2. Turn on meter and allow to stabilize.

3. Fill a sample vial completely with sample to be obtained, and place cap on vial.

4. Insert vial into light chamber. (Align vial into chamber the same way each time, by making use of tick marks on vial lid). Cover vial with cap.

5. Switch meter to appropriate range and read. Record results into field logbook.

6. Rinse vials with distilled water between each sample.

7. Calibration procedures should be performed:
    - Following significant ambient temperature changes
    - When meter reads erratically
    - At beginning and middle of each day of use.

5.6 Measurement of Oxidation Reduction Potential (ORP)

Oxidation reduction occurs when electrons are transformed from one atom to another during a chemical reaction. The atom losing electrons is said to be "oxidized", while the atom gaining electrons is termed "reduced". ORP is typically measured using a platinum electrode, attached to a pH meter, which is set to read in millivolt mode.

5.6.1 Equipment

Though there are ion specific meters for ORP on the market, their very small size and shape do not coincide well with typical multi-parameter set-ups in the field. Typically a pH meter, fitted with a special ORP electrode is used.

5.6.2 Measurement Techniques

At present, only a check solution is available on the market, which is used to verify the performance of the electrode. If the probe reads +/- a certain percentage of the solution’s stated value, then the electrode is assumed to be in proper working condition.

1. Check batteries and calibrate (check) meter/electrode before heading into the field.

2. Switch pH meter so that it's in the millivolt (mV) mode.

3. Place electrode in sample solution and read results in mV's. Record results in the field logbook.

4. Rinse electrode with distilled water.

6.0 QUALITY ASSURANCE RECORDS

Quality assurance records for on-site water quality management consist principally of observations and measurements recorded in the field logbook.

7.0 REFERENCES

American Public Health Association, 1980. Standard Methods for the Examination of Water and Wastewater, 15th Edition, APHA, Washington, D.C.

U.S. EPA, 1979. Methods for Chemical Analysis of Water and Wastes. EPA-600/4-79-020.

U.S. EPA, 1998. Test Methods for Evaluating Solid Wastes (SW-846) – Revision 5. http://www.epa.gov/epaoswer/hazwaste/test/main.htm#Table

U.S. Geological Survey, 1984. National Handbook of Recommended Methods for Water Data Acquisition, Chapter 5: Chemical and Physical Quality of Water and Sediment. U.S. Department of the Interior, Reston, Virginia.

ATTACHMENT A

SPECIFIC CONDUCTANCE CONVERSION TABLE

ATTACHMENT B

VARIATION OF DISSOLVED OXYGEN CONCENTRATION IN WATER AS A FUNCTION OF TEMPERATURE AND SALINITY

Temperature ºC	2.Dissolved Oxygen mg/l 2.1.Chloride Concentration in Water 2.1.1.0 2.1.2.5,000 2.1.3.10,000 2.1.4.15,000 2.1.5.20,000 2.2.Difference/ 100 mg chloride					
0	14.6	13.8	13.0	12.1	11.3	0.017
1	14.2	13.4	12.6	11.8	11.0	0.106
2	13.8	13.1	12.3	11.5	10.8	0.015
3	13.5	12.7	12.0	11.2	10.5	0.015
4	13.1	12.4	11.7	11.0	10.3	0.014
5	12.8	12.1	11.4	10.7	10.0	0.014
6	12.5	11.8	11.1	10.5	9.8	0.014
7	12.2	11.5	10.9	10.2	9.6	0.013
8	11.9	11.2	10.6	10.0	9.4	0.013
9	11.6	11.0	10.4	9.8	9.2	0.012
10	11.3	10.7	10.1	9.6	9.0	0.012
11	11.1	10.5	9.9	9.4	8.8	0.011
12	10.8	10.3	9.7	9.2	8.6	0.011
13	10.6	10.1	9.5	9.0	8.5	0.011
14	10.4	9.9	9.3	8.8	8.3	0.010
15	10.2	9.7	9.1	8.6	8.1	0.010

Temperature ºC	2.Dissolved Oxygen mg/l 2.1.Chloride Concentration in Water 2.1.1.0 2.1.2.5,000 2.1.3.10,000 2.1.4.15,000 2.1.5.20,000 2.2.Difference/ 100 mg chloride					
16	10.0	9.5	9.0	8.5	8.0	0.010
17	9.7	9.3	8.8	8.3	7.8	0.010
18	9.5	9.1	8.6	8.2	7.7	0.009
19	9.4	8.9	8.5	8.0	7.6	0.009
20	9.2	8.7	8.3	7.9	7.4	0.009
21	9.0	8.6	8.1	7.7	7.3	0.009
22	8.8	8.4	8.0	7.6	7.1	0.008
23	8.7	8.3	7.9	7.4	7.0	0.008
24	8.5	8.1	7.7	7.3	6.9	0.008
25	8.4	8.0	7.6	7.2	6.7	0.008
26	8.2	7.8	7.4	7.0	6.6	0.008
27	8.1	7.7	7.3	6.9	6.5	0.008
28	7.9	7.5	7.1	6.8	6.4	0.008
29	7.8	7.4	7.0	6.6	6.3	0.008
30	7.6	7.3	6.9	6.5	6.1	0.008

FIELD EQUIPMENT OPERATION AND MAINTENANCE PROCEDURES - WATER LEVEL, WATER-PRODUCT INTERFACE LEVEL,AND WELL DEPTH MEASUREMENTS

Page 1 of 4
SOP Number: F202
Effective Date: 10/06

TABLE OF CONTENTS

WATER LEVEL, WATER-PRODUCT INTERFACE LEVEL, AND WELL DEPTH MEASUREMENTS

1.0 PURPOSE

The purpose of this procedure is to describe the method of determining various down-hole measurements: groundwater levels and free product (a.k.a. non-aqueous phase liquid) levels, if present, and total depth of groundwater monitoring wells and piezometers.

2.0 SCOPE

The methods described in this SOP generally are applicable to the measurement of groundwater levels, NAPL levels, and total well depths in monitoring wells and piezometers.

3.0 DEFINITIONS

NAPL – Non-Aqueous Phase Liquids
LNAPL – Light Non-Aqueous Phase Liquids
DNAPL – Dense Non-Aqueous Phase Liquids
MSL – Mean Sea Level
IFP – Interface Probe

4.0 RESPONSIBILITIES

Project Manager - The Project Manager is responsible for ensuring that project-specific plans are in accordance with these procedures, where applicable, or that other approved procedures are developed.

Field Team Leader - The Field Team Leader is responsible for ensuring that these procedures are implemented in the field, and for ensuring that personnel performing these activities have been briefed and trained to execute these procedures.

Sampling Personnel - It is the responsibility of the sampling personnel to follow these procedures or to follow documented, project-specific procedures as directed by the Field Team Leader and/or the Project Manager. The sampling personnel are responsible for the proper acquisition of down-hole measurements.

5.0 PROCEDURES

Calculations of groundwater elevations and product or NAPL interface level measurements collected from a monitoring well give an indication of:

- The horizontal hydraulic gradient and the direction of groundwater flow.

- The vertical hydraulic gradient, if well nests are used (i.e., the direction of groundwater flow in the vertical plane).

- Floating or sinking free product thicknesses which are also known as Light Non-Aqueous Phase Liquids (LNAPLs) and Dense Non-Aqueous Phase Liquids (DNAPLs), respectively.

This information, when combined with other site specific information such as hydraulic conductivity or transmissivity, extent of contamination, and product density, may be used to estimate the rate of contaminant movement or source areas, etc.

Well depth is one of the factors used to determine the zone that a well monitors. Well depth also is used in the calculation of purge volumes as discussed in SOP F104, Groundwater Sample Acquisition.

The following sections briefly discuss the procedures for measuring groundwater levels, NAPL levels, and well depth. For all of the procedures discussed, it is assumed that the measurement will be taken from the top of the inner-most casing of the well or piezometer (though other measuring points can be used). The horizontal and vertical control is established for each well through a site survey, such that measurements may be converted to elevations above Mean Sea Level (MSL) or some other consistent datum (e.g., an on-site benchmark). A permanent notch or mark will be placed on the inner-most casing by Baker to facilitate consistent water level measurements over time.

The manufacturer's instructions for all equipment referenced herein should be read by the sampling personnel and accompany the equipment to the field.

5.1 Water Level Measurement

Water levels in groundwater monitoring wells or piezometers shall be measured from the permanent point indicated at the top of the inner-most casing (the surveyed elevation point), unless otherwise specified in the project plans, using an electronic water level measuring device (water level meter). The point of measurement will be documented in the field logbook if different from the top of the inner casing. The reason for deviating from the measurement point also should be noted.

Water levels are measured by lowering the probe into the well until the device indicates that water has been encountered, usually with either a constant buzz, or a light, or both. The water level is recorded to the nearest hundredth-of-a-foot (0.01 Feet) using the graduated markings on the water level indicator line. This measurement, when subtracted from the measuring point surveyed elevation, yields the groundwater elevation relative to either MSL or an on-site benchmark.

5.2 NAPL Level Measurements

The procedure for NAPL level measurement is nearly identical to that for groundwater elevation measurements. The only difference is the use of an interface probe (IFP) that can detect the level of both NAPL and water through varying indicator signals at the surface (IFP beeping and/or different color indicator light). Typically, encountering NAPLs in a monitoring well or piezometer is indicated by a constant sound. When water is encountered, the signal becomes an alternating on/off beeping sound. This allows for the measurement of both the top of the NAPL layer in a well and the water/NAPL interface. In addition, this same philosophy would be applicable to the water/DNAPL interface at the bottom of the well, if present.

The apparent water table elevation below the product level will be determined by subtracting the depth to water from the measuring point elevation. The corrected water table elevation will then be calculated using the following equation:

$$\mathrm{WTE}_c = \mathrm{WTE}_a + (\text{Free Product Thickness x } 0.80)$$

Where:

WTE_c = Corrected water table elevation
WTE_a = Apparent water table elevation
0.80 = Average value for the density of petroleum hydrocarbons. Site-specific data will be used where available.

However, the formula presented above should only be applied in the office during data evaluation for reporting purposes. For consistency, the actual measurements collected from the IFP in the field are what should be recorded in the site logbook.

5.3 Well Depth Measurements

Well depths typically are measured using a weighted measuring tape. A water level meter may also be used. The tape is lowered down the well until resistance is no longer felt, indicating that the weight has touched the bottom of the well. The weight should be moved in an up and down motion a few times so that obstructions, if present, may be bypassed. The slack in the tape then is collected until the tape is taut. The well depth measurement is read directly off of the measuring tape, at the top of the inner-most casing to the nearest 0.01-foot and recorded in the Field Logbook. It should be noted that on some weighted measuring tapes, the length shown on the measuring tape may not be truly representative of the entire well depth. This is because the weight at the end of the tape (below the 0.0 feet line) may extend below the base of the tape. Thus, the total well depth measured on the tape at the top of the casing may actually be greater. As a result, a measurement of the length from the tip of the weight to the end of the tape should be made prior to collecting well depth measurements. Furthermore, if a water level indicator is used, add the distance from the bottom of the probe to the point where water levels are measured (i.e., where the water level connects the circuit on the probe).

5.4 Decontamination of Measuring Devices

Water level indicators, IFPs, and weighted measuring tapes that come in contact with groundwater must be decontaminated using the following steps after use in each well:

- Rinse with potable water
- Rinse with deionized water
- Rinse with Methanol (if sampling for volatiles)
- Final Rinse with deionized water

Portions of the water level indicators or other similar equipment that do not come into contact with groundwater, but may encounter incidental contact during use, need only undergo potable water and deionized water rinses. In addition, if there is established documentation from a well indicating no historical evidence of contaminant impact, no decontamination is necessary other than providing a potable water rinse between wells. Furthermore, to mitigate the potential for cross contamination between wells, measurements should be collected from the least impacted to the most impacted wells on site, if possible.

6.0 QUALITY ASSURANCE RECORDS

The Field Logbook shall serve as the quality assurance record for water, product level, and/or well depth measurements. Both the time of day and the well order that the measurements were collected also should be documented in the field notebook.

FIELD EQUIPMENT OPERATION AND MAINTENANCE PROCEDURES - SAMPLE PRESERVATION AND HANDLING

Page 1 of 5
SOP Number: F301
Effective Date: 04/94

TABLE OF CONTENTS

SAMPLE PRESERVATION AND HANDLING

1.0 PURPOSE

This SOP describes the appropriate containers for samples of particular matrices, and the steps necessary to preserve those samples when shipped off site for chemical analysis. It also identifies the qualifications for individuals responsible for the transportation of hazardous materials and samples and the regulations set forth by the Department of Transportation regarding the same.

2.0 SCOPE

Some chemicals react with sample containers made of certain materials; for example, trace metals adsorb more strongly to glass than to plastic, while many organic chemicals may dissolve various types of plastic containers. It is therefore critical to select the correct container in order to maintain the integrity of the sample prior to analysis.

Many water and soil samples are unstable and may change in chemical character during shipment. Therefore, preservation of the sample may be necessary when the time interval between field collection and laboratory analysis is long enough to produce changes in either the concentration or the physical condition of the constituent(s). While complete and irreversible preservation of samples is not possible, preservation does retard the chemical and biological changes that may occur after the sample is collected.

Preservation techniques are usually limited to pH control, chemical addition(s), and refrigeration/freezing. Their purposes are to (1) retard biological activity, (2) retard hydrolysis of chemical compounds/complexes, (3) reduce constituent volatility, and (4) reduce adsorption effects.

Typical sample container and preservation requirements for this project are provided in Attachment A of this SOP. Note that sample container requirements (i.e., volumes) may vary by laboratory.

The Department of Transportation, Code of Federal Regulations (CFR) Title 49 establishes regulations for all materials offered for transportation. The transportation of environmental samples for analysis is regulated by Code of Federal Regulations Title 40 (Protection of the Environment), along with 49 CFR Part 172 Subpart H. The transportation of chemicals used as preservatives and samples identified as hazardous (as defined by 49 CFR Part 171.8) are regulated by 49 CFR Part 172.

3.0 DEFINITIONS

HCl - Hydrochloric Acid

H_2SO_4- Sulfuric Acid

HNO_3 - Nitric Acid

NaOH - Sodium Hydroxide

Normality (N) - Concentration of a solution expressed as equivalents per liter, where an equivalent is the amount of a substance containing one mole of replaceable hydrogen or its equivalent. Thus, a one molar solution of HCl, containing one mole of H, is “one-normal,” while a one molar solution of H_2SO_4 containing two moles of H, is “two-normal.”

4.0 RESPONSIBILITIES

Project Manager - The Project Manager is responsible for ensuring that project-specific plans are in accordance with these procedures, where applicable, or that other, approved procedures are developed. The Project Manager is responsible for development of documentation of procedures which deviate from those presented herein. The Project Manager is also responsible for proper certification of individuals responsible for transportation of samples of hazardous substances.

Field Team Leader - It is the responsibility of the Field Team Leader to ensure that these procedures are implemented in the field and to ensure that personnel performing sampling activities have been briefed and trained to execute these procedures. The Field Team Leader is responsible to ensure all samples and/or hazardous substances are properly identified, labeled, and packaged prior to transportation.

Sampling Personnel - It is the responsibility of the field sampling personnel to initiate sample preservation and handling. It is also the responsibility of the field sampling personnel to understand and adhere to the requirements for proper transportation of samples and/or hazardous substances.

5.0 PROCEDURES

The following procedures discuss sample containerization and preservation techniques that are to be followed when collecting environmental samples for laboratory analysis.

5.1 Sample Containers

For most samples and analytical parameters either glass or plastic containers are satisfactory. In general, if the analyte(s) to be measured is organic in nature, the container shall be made of glass. If the analyte(s) is inorganic, then glass or plastic containers may be used. Containers shall be kept out of direct sunlight (to minimize biological or photo-oxidation/photolysis of constituents) until they reach the analytical laboratory. The sample container shall have approximately five to ten percent air space (“ullage”) to allow for expansion/vaporization if the sample is heated during transport (one liter of water at 4EC expands by 15 milliliters if heated to 130EF/55EC); however, head space for volatile organic analyses shall be omitted.

Soil samples that will be tested for volatile organic compounds should generally be stored in EnCore™ samplers in accordance with SW-846 Method 5035.

The analytical laboratory shall provide sample containers that have been certified clean according to USEPA procedures. Shipping containers for samples, consisting of sturdy ice chests, are to be provided by the laboratory.

Once opened, the sample container must be used at once for storage of a particular sample. Unused, but opened, containers are to be considered contaminated and must be discarded. Because of the potential for introduction of contamination, they cannot be reclosed and saved for later use. Likewise, any unused containers which appear contaminated upon receipt, or which are found to have loose caps or missing liners (if required for the container) shall be discarded.

General sample container, preservative, and holding time requirements are listed in Attachment A.

5.2 Preservation Techniques

The preservation techniques to be used for various analytes are listed in Attachment A. Reagents required for sample preservation will either be added to the sample containers by the laboratory prior to their shipment to the field or added in the field using laboratory supplied preservatives. Some of the more commonly used sample preservation techniques include storage of sample at a temperature of 4EC, acidification of water samples, and storage of samples in dark (i.e. amber) containers to prevent the samples from being exposed to light.

Most samples (except metals) shall be stored at a temperature of 4EC. Additional preservation techniques shall be applied to water samples as follows:

- Water samples to be analyzed for volatile organics shall be acidified.
- Water samples to be analyzed for semivolatile organics shall be stored in dark containers.
- Water samples to be analyzed for pesticides/PCBs shall be stored in dark containers.
- Water samples to be analyzed for inorganic compounds shall be acidified.

These preservation techniques generally apply to samples of low-level contamination. The preservation techniques utilized for samples may vary. However, unless documented otherwise in the project plans, all samples shall be considered low concentration. All samples preserved with chemicals shall be clearly identified by indicating on the sample label that the sample is preserved.

5.3 Sample Holding Times

The elapsed time between sample collection and initiation of laboratory analyses is considered the holding time and must be within a prescribed time frame for each individual analysis to be performed. Sample holding times for routine sample collection are provided in Attachment A.

6.0 SAMPLE HANDLING AND TRANSPORTATION

After collection, the outside of all sample containers will be wiped clean with a damp paper towel; however sample handling should be minimized. Personnel should use extreme care to ensure that samples are not contaminated. If samples are placed in an ice chest, personnel should ensure that melted ice cannot cause sample containers to become submerged, as this may result in sample cross-contamination and loss of sample labels. To help prevent loss of labels, clear packing tape should be placed over the labels. Additionally, Sealable plastic bags, (zipper-type bags), should be used when glass sample containers are placed in ice chests to prevent cross-contamination, if breakage should occur.

Samples may be hand delivered to the laboratory or they may be shipped by common carrier. Relevant regulations for the storage and shipping of samples are contained in 40 CFR 261.4(d). Parallel state regulations may also be relevant. Shipment of dangerous goods by air cargo is also regulated by the United Nations/International Civil Aviation Organization (UN/ICAO). The Dangerous Goods Regulations promulgated by the International Air Transport Association (IATA) meet or exceed DOT and UN/ICAO requirements and should be used for shipment of dangerous goods via air cargo. Standard procedures for shipping environmental samples are given in Attachment B.

7.0 REFERENCES

American Public Health Association, 1981. Standard Methods for the Examination of Water and Wastewater. 15th Edition. APHA, Washington, D.C.

USEPA, 1984. "Guidelines Establishing Test Procedures for the Analysis of Pollutants under Clean Water Act." Federal Register, Volume 49 (209), October 26, 1984, p. 43234.

USEPA, 1979. Methods for Chemical Analysis of Water and Wastes. EPA-600/4-79-020. USEPA EMSL, Cincinnati, Ohio.

USEPA, Region IV, 1991. Environmental Compliance Branch Standard Operating Procedures and Quality Assurance Manual. Athens, Georgia.

USEPA, 1998. Test Methods for Evaluating Solid Wastes (SW-846) – Revision 5. http://www.epa.gov/epaoswer/hazwaste/test/main.htm#Table

Protection of the Environment, Code of Federal Regulation, Title 40, Parts 260 to 299.

Transportation, Code of Federal Regulation, Title 49, Parts 100 to 177.

ATTACHMENT A

REQUIRED CONTAINER, PRESERVATION TECHNIQUES AND HOLDING TIMES

ATTACHMENT B

SAMPLE SHIPPING PROCEDURES

ATTACHMENT B

SAMPLE SHIPPING PROCEDURES

Introduction

Samples collected during field investigations or in response to a hazardous materials incident must be classified by the project leader, prior to shipping by air, as either environmental or hazardous substances. The guidance for complying with U.S. DOT regulations in shipping environmental laboratory samples is given in the "National Guidance Package for Compliance with Department of Transportation Regulations in the Shipment of Environmental Laboratory Samples."

Pertinent regulations for the shipping of environmental samples are given in 40 CFR 261.4(d). Samples collected from process wastewater streams, drums, bulk storage tanks, soil, sediment, or water samples from areas suspected of being highly contaminated may require shipment as dangerous goods/hazardous substance. Regulations for packing, marking, labeling, and shipping of dangerous goods by air transport are promulgated by the United Nations International Civil Aviation Organization (UN/ICAO), which is equivalent to IATA.

Individuals responsible for transportation of environmental samples or dangerous goods/hazardous substances must be tested and certified by their employer. This is required by 49 CFR Part 172 Subpart H Docket HM-126 to assure the required qualifications for individuals offering materials for transportation.

Environmental samples shall be packed prior to shipment by commercial air carrier using the following procedures:

1. Select a sturdy cooler in good repair. Secure and tape the drain plug (inside and outside) with fiber or duct tape. Line the cooler with a large heavy duty plastic bag. This practice keeps the inside of the cooler clean and minimizes cleanup at the laboratory after samples are removed.

2. Allow sufficient headspace (ullage) in all bottles (except VOAs) to compensate for any pressure and temperature changes (approximately 10 percent of the volume of the container).

3. Be sure the lids on all bottles are tight (will not leak). In many regions custody seals are also applied to sample container lids. The reason for this practice is two-fold: to maintain integrity of samples and keep lid on the container should the lid loosen during shipment. Check with the appropriate regional procedures prior to field work. In many cases, the laboratory manager of the analytical lot to be used on a particular project can also provide this information.

4. It is good practice to wrap all glass containers in bubblewrap or other suitable packing material prior to placing in plastic bags.

5. Place all bottles in separate and appropriately sized polyethylene bags and seal the bags with tape (preferably plastic electrical tape, unless the bag is a zipper-type bag). Up to three VOA bottles, separately wrapped in bubblewrap, may be packed in one plastic bag.

6. Put ice that has been placed in properly sealed, double-bagged, heavy duty polyethylene bags on top of and between the samples. Fill all remaining space between the bottles with packing material. Fold and securely fasten the top of the large heavy duty plastic bag with tape (preferably electrical or duct).

7. Place the Chain-of-Custody Record and the Request for Analysis Form (if applicable) into a plastic bag, tape the bag to the inner side of the cooler lid, and then close the cooler and securely tape (preferably with fiber tape) the top of the cooler unit. Wrap the tape three to four times around each side of the cooler unit. Chain-of-custody seals (if required) should be affixed to the top and sides of the cooler within the securing tape so that the cooler cannot be opened without breaking the seal.

8. Label according to 40 CFR 261.4(d). The shipping containers should be marked “THIS END UP,” and arrow labels which indicate the proper upward position of the container should be affixed to the container. A label containing the name and address of the shipper and laboratory shall be placed on the outside of the container. It is good practice to secure this label with clear plastic tape to prevent removal during shipment by blurring of important information should the label become wet. The commercial carrier is not required to sign the COC record as long as the custody seals remain intact and the COC record stays in the cooler. The only other documentation required is the completed airbill, which is secured to the top of the shipping container. Please note several coolers/shipping containers may be shipped under one airbill. However, each cooler must be labeled as “Cooler 1 of 3, Cooler 2 of 3, etc.,” prior to shipping. Additionally it is good practice to label each COC form to correspond to each cooler (i.e., 1 of 3, 2 of 3, etc.).

FIELD EQUIPMENT OPERATION AND MAINTENANCE PROCEDURES - CHAIN-OF-CUSTODY

Page 1 of 6
SOP Number: F302
Effective Date: 04/94

TABLE OF CONTENTS

CHAIN-OF-CUSTODY

1.0 PURPOSE

The purpose of this SOP is to provide information on chain-of-custody procedures to be used to document sample handling.

2.0 SCOPE

This procedure describes the steps necessary for transferring samples through the use of Chain-of-Custody Records. A Chain-of-Custody Record is required, without exception, for the tracking and recording of samples collected for on-site or off-site analysis (chemical or geotechnical) during program activities (except wellhead samples taken for measurement of field parameters). Use of the Chain-of-Custody Record Form creates an accurate written record that can be used to trace the possession and handling of the sample from the moment of its collection through analysis. This procedure identifies the necessary custody records and describes their completion. This procedure does not take precedence over region-specific or site-specific requirements for chain-of-custody.

3.0 DEFINITIONS

Chain-of-Custody Record Form - A Chain-of-Custody Record Form is a printed two-part form that accompanies a sample or group of samples as custody of the sample(s) is transferred from one custodian to another custodian. One copy of the form must be retained in the project file. An example of a Chain-of-Custody Record Form is presented in Attachment B.

Custodian - The person responsible for the custody of samples at a particular time, until custody is transferred to another person (and so documented), who then becomes custodian. A sample is under one=s custody if:

! It is in one=s actual possession.
! It is in one=s view, after being in one=s physical possession.
! It was in one=s physical possession and then he/she locked it up to prevent tampering.
! It is in a designated and identified secure area.

Sample - A sample is physical evidence collected from a facility or the environment, which is representative of conditions at the point and time that it was collected.

4.0 RESPONSIBILITIES

Project Manager - The Project Manager is responsible for ensuring that project-specific plans are in accordance with these procedures, where applicable, or that other, approved procedures are developed. The Project Manager is responsible for development of documentation of procedures which deviate from those presented herein. The Project Manager is responsible for ensuring that chain-of-custody procedures are implemented. The Project Manager also is responsible for determining that custody procedures have been met by the analytical laboratory.

Field Team Leader - The Field Team Leader is responsible for determining that chain-of-custody procedures are implemented up to and including release to the shipper or laboratory. It is the responsibility of the Field

Team Leader to ensure that these procedures are implemented in the field and to ensure that personnel performing sampling activities have been briefed and trained to execute these procedures.

Sampling Personnel - It is the responsibility of the field sampling personnel to initiate chain-of-custody procedures, and maintain custody of samples until they are relinquished to another custodian, the sample shipper, or to a common carrier.

5.0 PROCEDURES

The term "chain-of-custody" refers to procedures which ensure that evidence presented in a court of law is valid. The chain-of-custody procedures track the evidence from the time and place it is first obtained to the courtroom, as well as providing security for the evidence as it is moved and/or passed from the custody of one individual to another.

Chain-of-custody procedures, record keeping, and documentation are an important part of the management control of samples. Regulatory agencies must be able to provide the chain-of-possession and custody of any samples that are offered for evidence, or that form the basis of analytical test results introduced as evidence. Written procedures must be available and followed whenever evidence samples are collected, transferred, stored, analyzed, or destroyed.

5.1 Sample Identification

The method of identification of a sample depends on the type of measurement or analysis performed. When in-situ measurements are made, the data are recorded directly in bound logbooks or other field data records with identifying information.

Information which shall be recorded in the field logbook (or other suitable form), when in-situ measurements or samples for laboratory analysis are collected, includes:

- Field Sampler(s)
- Project and Task Number
- Project Sample Number
- Sample location or sampling station number
- Date and time of sample collection and/or measurement
- Field observations
- Equipment used to collect samples and measurements
- Calibration data for equipment used

Measurements and observations should be recorded using waterproof ink.

5.1.1 Sample Label

Samples, other than in-situ measurements, are removed and transported from the sample location to a laboratory or other location for analysis. Before removal, however, a sample is often divided into portions, depending upon the analyses to be performed. Each portion is preserved in accordance with the Sampling and Analysis Plan. Each sample container is identified by a sample label (see Attachment A). Sample labels are provided, along with sample containers, by the analytical laboratory. The information recorded on the sample label includes (at a minimum):

- Project Name or Project Number.
- Station Location - The unique sample number identifying this sample.

Additional information on the sample label may also include:

- Date - A six-digit number indicating the day, month, and year of sample collection (e.g., 12/21/85).
- Time - A four-digit number indicating the 24-hour time of collection (for example: 0954 is 9:54 a.m., and 1629 is 4:29 p.m.).
- Medium - Water, soil, sediment, sludge, waste, etc.
- Sample Type - Grab or composite.
- Preservation - Type and quantity of preservation added.
- Analysis - VOA, BNAs, PCBs, pesticides, metals, cyanide, other.
- Sampled By - Printed name of the sampler.
- Remarks - Any pertinent additional information.

Using only the work assignment number of the sample label maintains the anonymity of sites. This may be necessary, even to the extent of preventing the laboratory performing the analysis from knowing the identity of the site (e.g., if the laboratory is part of an organization that has performed previous work on the site).

5.2 Chain-of-Custody Procedures

After collection, separation, identification, and preservation, the sample is maintained under chain-of-custody procedures until it is in the custody of the analytical laboratory and has been stored or disposed.

5.2.1 Field Custody Procedures

- Samples are collected as described in the site Sampling and Analysis Plan. Care must be taken to record precisely the sample location and to ensure that the sample number on the label matches the Chain-of-Custody Record exactly.
- The person undertaking the actual sampling in the field is responsible for the care and custody of the samples collected until they are properly transferred or dispatched.

- Sample labels shall be completed for each sample, using waterproof ink unless prohibited by weather conditions, e.g., a logbook notation would explain that a pencil was used to fill out the sample label if the pen would not function in freezing weather.

5.2.2 Transfer of Custody and Shipment

Samples are accompanied by a Chain-of-Custody Record Form. When transferring the possession of samples, the individual(s) relinquishing and receiving will sign, date, and note the time on the Record. This Record documents sample custody transfer from the sampler, often through another person, to the analyst in the laboratory. The Chain-of-Custody Record is filled out as given below.

- Enter header information (Project and Task number, samplers, and project name).
- Enter sample specific information (sample number, media, sample analysis required and analytical method, grab or composite, number and type of sample containers, and date/time sample was collected).
- Sign, date, and enter the time under "Relinquished by" entry.
- Have the person receiving the sample sign the "Received by" entry. If shipping samples by a common carrier, print the carrier to be used in this space (i.e., Federal Express).
- If a carrier is used, enter the airbill number under "Remarks," in the bottom right corner.
- Place the original (top, signed copy) of the Chain-of-Custody Record Form in a plastic zipper-type bag or other appropriate sample shipping package. Retain the copy with field records.
- Sign and date the custody seal, a 1- by 3-inch white paper label with black lettering and an adhesive backing. Attachment C is an example of a custody seal. The custody seal is part of the chain-of-custody process and is used to prevent tampering with samples after they have been collected in the field. Custody seals shall be provided by the analytical laboratory.
- Place the seal across the shipping container opening so that it would be broken if the container was to be opened.
- Complete other carrier-required shipping papers.

The custody record is completed using waterproof ink. Any corrections are made by drawing a line through and initialing and dating the change, then entering the correct information. Erasures are not permitted.

Common carriers will usually not accept responsibility for handling Chain-of-Custody Record Forms; this necessitates packing the record in the shipping container (enclosed with other documentation in a plastic zipper-type bag). As long as custody forms are sealed inside the shipping container and the custody seals are intact, commercial carriers are not required to sign the custody form.

The laboratory representative who accepts the incoming sample shipment signs and dates the Chain-of-Custody Record, completing the sample transfer process. It is then the laboratory's responsibility to maintain internal logbooks and custody records throughout sample preparation and analysis.

6.0 QUALITY ASSURANCE RECORDS

Once samples have been packaged and shipped, the COC copy and airbill receipt becomes part of the Quality Assurance Record.

7.0 REFERENCES

1. USEPA. User's Guide to the Contract Laboratory Program. Office of Emergency and Remedial Response, Washington, D.C. (EPA/540/P-91/002), January 1991.

ATTACHMENT A

EXAMPLE CLIENT (SAMPLE) LABEL

ATTACHMENT B

EXAMPLE CHAIN-OF-CUSTODY RECORD

ATTACHMENT C

EXAMPLE CUSTODY SEAL

FIELD EQUIPMENT OPERATION AND MAINTENANCE PROCEDURES - FIELD LOGBOOK

Page 1 of 4
SOP Number: F303
Effective Date: 03/05

TABLE OF CONTENTS

FIELD LOGBOOK FIELD LOGBOOK

1.0 PURPOSE

This SOP describes the process for maintaining a field logbook.

2.0 SCOPE

The field logbook is a document which records all major on-site activities conducted during a field investigation. At a minimum, the following activities/events shall be recorded in the field logbook by each member of the field crew.

- Arrival/departure of site workers and visitors
- Arrival/departure of equipment
- Sample pickup (sample numbers, carrier, time)
- Sampling activities
- Start and completion of boreholes, monitoring wells, or sampling activities
- Health and safety issues

Recording in the field logbook is initiated upon arrival at the site. Entries are made every day that on-site activities take place. At least one field logbook shall be maintained per site.

The field logbook becomes part of the permanent site file. Because information contained in the field logbook may be admitted as evidence in legal proceedings, it is critical that this document is properly maintained.

3.0 DEFINITIONS

Field logbook - The field logbook is a bound notebook with consecutively numbered pages. Upon entry of data, the logbook requires the signature of the responsible data/information recorder.

4.0 RESPONSIBILITIES

The Field Team Leader is responsible for maintaining a master field logbook for the duration of on-site activities. Each member of the sampling crew is responsible for maintaining a complete and accurate record of site activities for the duration of the crew members participation in the project.

5.0 PROCEDURES

The following sections present some of the information that must be recorded in the field logbook. In general, a record of all events and activities, as well as other potentially important information shall be recorded by each member of the field team.

5.1 Cover

The inside cover or title page of each field logbook shall contain the following information:

- Project and Task Number
- Project name and location
- Name of Field Team Leader
- Baker's address and telephone number (toll-free number preferably)
- Start date
- If several logbooks are required, a sequential field logbook number

It is good practice to list important phone numbers and points of contact here. This may include the telephone number of the hotel where the field crew is residing as well as applicable mobile phone number. The inclusion of this information may be invaluable if the field logbook is lost during field activities.

5.2 Daily Entries

Daily entries into the logbook may contain a variety of information. At the beginning of each day the following information should be recorded by each team member.

- Date
- Start time
- Weather
- All field personnel present (including subcontractors)
- All visitors present
- Other pertinent information (i.e., planned activities, schedule changes, expected visitors, and equipment changes)

During the day, an ongoing record of all pertinent site activities should be written in the logbook. The master logbook kept by the field team leader need not duplicate that recorded in other field logbooks, but should summarize the information in other books and, where appropriate, reference the page numbers of other logbooks where detailed information pertaining to a subject may be found.

Some specific information which should be recorded in the logbook includes the following:

- Equipment used, equipment numbers, calibration data, field servicing
- Field measurements
- Sample numbers, media, bottle size, preservatives, collection methods, and time
- Test boring and monitoring well construction information, including boring/well number and location
- Sketches for each sample location including appropriate measurements if required
- Photograph log
- Drum log
- Other pertinent information

All entries should be made in indelible ink; all pages numbered sequentially; and all pages must be signed or initialed and dated by the responsible field personnel completing the log. No erasures are permitted. If an incorrect entry is made, the entry shall be crossed out with a single line, initialed, and dated.

5.3 Photographs

If photographs are permitted at the site, the record shall be maintained in the field logbook. When movies, slides or photographs are taken of any site location, they are numbered or cross-referenced to correspond to logbook entries. The name of the photographer, date, time, site location, site description, direction of view and weather conditions are entered in the logbook as the photographs are taken. Special lenses, film, or other image-enhancement techniques also must be noted in the field logbook. Once processed, photographs shall be sequentially numbered and labeled corresponding to the field logbook entries.

6.0 QUALITY ASSURANCE RECORDS

Once on-site activities have been completed, the field logbook shall be considered a quality assurance record and stored in the project files at Baker's respective office.

7.0 REFERENCES

None.