Groundwater Monitoring Report for the Unexploded Ordnance Open Burn / Open Detonate Facility
Marpi, Saipan, CNMI

Prepared For:

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May 1, 2018

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Approved by DEQ/BECQ Manager	Derek Chambers	Date
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TABLE OF CONTENTS

TABLES

FIGURES

APPENDICES

ACRONYMS

ºC	degree Celsius
ºF	degree Fahrenheit
µg/L	micrograms per Liter
APEC	Allied Pacific Environmental Consulting
BECQ	Bureau of Environmental and Coastal Quality
CFR	Code of Federal Regulation
CNMI	Commonwealth of the Northern Mariana Islands
COPCs	chemicals of potential concern
DEQ	Department of Environmental Quality
DFES	Department of Fire and Emergency Services
DPS	Department of Public Safety
DQO	data quality objectives
ESLs	Environmental Screening Levels
HPDE	high density polyethylene
IDW	investigation-derived waste
MPLA	Mariana Public Lands Authority
mg/L	milligram per Liter
msl	mean sea level
mS/cm	milliSiemen per centimeter
mV	millivolt
NTU	Neptholometric units
OB/OD	Open Burn/Open Detonation
ORP	oxidation-reduction potential
PCBs	Polychlorinated Biphenyls
PPE	personal protective equipment
PPT	parts per thousand
QA	quality assurance
QC	quality control
RAP	Regional Analytical Program
RCRA	Resource Conservation and Recovery Act
SAP	sampling and analysis plan
SOP	standard operating procedure
SVOCs	semi-volatile organic compounds

TKN	Total Kjeldahl Nitrogen
TPH	total petroleum hydrocarbons
U.S. EPA	United States Environmental Protection Agency
USGS	United States Geological Survey
USPHS	United States Public Health Services
UXO	unexploded ordnance
VOCs	volatile organic compounds

1.0 INTRODUCTION

The Commonwealth of the Northern Mariana Islands (CNMI) Department of Environmental Quality (DEQ) tasked Allied Pacific Environmental Consulting (APEC) to collect groundwater samples satisfy the requirements for the 2008 Remedial Action Plan (RAP) for the Unexploded Ordnance Open Burn/Open Detonate (OB/OD) Facility located in Marpi, Saipan. The OB/OD Facility is located on a limestone plateau on the northeast side of the island of Saipan (Figure 1). The 2008 RAP is equivalent to a Resource Conservation and Recovery Act (RCRA) permit to operate a hazardous remediation waste storage and treatment facility. In general, groundwater sampling was conducted in accordance with the Sampling and Analysis Plan (SAP) prepared for this project. The SAP is included in Appendix A.

Specific tasks documented in the SAP and include:

- Annual groundwater sampling of monitoring wells installed at the OB/OD facility.

1.1 PROJECT ORGANIZATION

Principal Data Users – Data generated during the implementation of this SAP will be used by the CNMI Burea of Environmental and Coastal Quality (BECQ) to make decisions regarding ongoing monitoring at the perimeter of the property, and continued use of the site for detonation of unexploded ordnance. The primary contact for CNMI BECQ/DEQ is Mr. Ray Masga, Director. Captain (CAPT) Derek Chambers, US Public Health Services (USPHS) is managing the contract for this sampling project.

1.2 PROJECT OBJECTIVES

The project objectives are to obtain groundwater samples from four monitoring wells located around the open burn pit and compare the results to the initial groundwater results collected at the site. In addition, groundwater results were compared to the Tropical Pacific Edition, Environmental Screening Levels (ESLs) (Hawaii Dept. of Health, 2016) to determine if detected parameters present a risk to human health and the environment.

Unexploded ordnance (UXO) deposited on the island of Saipan during World War II is present on the island. UXO has been encountered during clearing land for commercial and residential development that is ongoing on Saipan. When the UXO is cleared, it is stored at the Marpi OB/OD facility until a maximum explosive weight is achieved, then detonated using plastic explosives. Detonation occurs in an open burn/open detonation pit (UXO Pit), to eliminate the potential explosive hazard. The purpose of the OB/OD facility is to render unserviceable ordnance and other pyrotechnic devices harmless by either suppression of detonation or open burning. In May 2007, four groundwater monitoring wells (UXO-1, UXO-2, UXO-3, and UXO-4) were installed around the site perimeter (Figure 1) and groundwater samples were collected.

Initial sampling data results indicated evidence of multiple constituents in groundwater, and established an environmental baseline for groundwater conditions. In order to continue use of the OB/OD facility, it is necessary to continue monitoring the underlying groundwater conditions, and to determine whether offsite migration of contamination is occurring.

2.0 BACKGROUND

The following sections document the history of the site and describe the site setting.

2.1 SITE LOCATION AND DESCRIPTION

The CNMI consists of a chain of 14 islands in the North Pacific Ocean. Saipan, the major inhabited island, is approximately 15º North latitude and 145º East longitude. The island is approximately 15 miles long and 5 miles wide at the widest point (48 square miles) (CNMI DEQ, 1995).

The geographic coordinates of the site are approximately 15 degrees, 16 minutes, 9.5 seconds North latitude; 145 degrees, 49 minutes, 19.24 seconds West longitude. The OB/OD facility does not have a physical address, but is located near the northern end of the island. The site is located at elevations ranging from 50 to 60 meters above mean sea level (msl), and is situated approximately one-half mile from the Pacific Ocean (Figure 1). The site is comprised of a 5,000-square-foot area surrounding an existing UXO storage cave and an OB/OD Pit. The site is undeveloped land, with the exception of the UXO storage cave and the OB/OD pit. Surrounding land use is undeveloped land, with the exception of the Marpi Landfill, located approximately 800 feet from the OB/OD pit location. There are no potable water wells located within a half mile radius of the site. The site is currently managed the CNMI Department of Fire and Emergency Services (DFES). T*he Marianas Public Lands Authority (MPLA) parcel number for the site is 051-A-02.*

2.2 OPERATIONAL HISTORY

The site currently serves as a UXO storage area and an OB/OD unit for the disposal of UXO discovered on the island. The area has been used for these operations for several years, although the exact number of years has not been confirmed. DFES in conjunction with the United States Navy Explosives Ordnance Disposal Detachment currently conducts OB/OD operations at the site. Prior to this use, the site had not been used since the formation of the CNMI in 1976. Prior to the formation of the CNMI, the site was vacant land, and was possibly used for military purposes by Japan and the United States during and after World War II. An old, narrow-gauge railroad is also present on the site or near the site boundary, suggesting potential Japanese military use.

2.3 PREVIOUS INVESTIGATIONS AND REGULATORY INVOLVEMENT

2.3.1 Previous Investigations

In April and May 2007, U.S. Environmental Protection Agency (U.S. EPA) performed the field activities as described in the January 2007 *Sampling and Analysis Plan, Targeted Brownfields Assessment* (UXO SAP). Field activities included: clearing the proposed work areas of UXO, installation of a perimeter fence on the site access road, installation of four groundwater monitoring wells, and sampling and analysis of groundwater from monitoring wells. Groundwater samples were analyzed for common chemicals found in military munitions. laboratory analysis for groundwater included total petroleum hydrocarbon (TPH) compounds, explosives and energetics, semi-volatile organic compounds (SVOCs), volatile organic compounds (VOCs), metals, inorganic compounds, polychlorinated biphenyls (PCBs), ammonia, total kjeldahl nitrogen (TKN), nitrogen as nitrate and nitrites, perchlorates, phosphorous, white phosphorous, and pesticides. Results of previous groundwater sampling results are included in the Summary Table (Appendix B).

2.3.2 Regulatory Involvement

UXO storage and disposal have been occurring at the site under the authority of a RAP issued the EPA in accordance with RCRA regulations, Title 40 Code of Federal Regulations (CFR) parts 270.79 through 270.230. This RAP is equivalent to a RCRA permit issued pursuant to Title 40 CFR parts 270.1 through 270.51 (Permit).

This RAP was issued to the CNMI Department of Public Safety (DPS or the Permittee) to operate a hazardous remediation waste storage and treatment facility at Marpi Point, Saipan.

2.4 PHYSICAL SETTING

The following paragraphs related to the physical setting of the site are summarized from United States Geological Survey (USGS) information and other supporting documentation.

2.4.1 Physiographic Conditions

The terrain in the area appears to be generally flat, with slight sloping to the northeast. The site elevation is approximately 50 to 60 meters above mean sea level (msl), based on the USGS 7.5-minute topographic map, Saipan quadrangle, dated 1983.

The climate in Saipan is characterized by temperatures ranging from 78 to 85 degrees Fahrenheit (ºF), relatively high humidity, and an average rainfall of 83.1 inches per year. Most of the rainfall occurs during the period from July through October, while the typical dry season occurs between January and April (CNMI DEQ, 1995).

2.4.2 Geologic Conditions

Saipan is characterized by limestone and calcareous sediments that cover approximately 90 percent of the island. Volcanic rock makes up the remaining 10 percent of the island's surface area, but exists beneath all the limestone formations at the island's core (CNMI DEQ, 1995).

The Mariana Islands are located west of the Mariana Trench, the subduction zone for the westward-moving Pacific Plate. As a result of their position with respect to regional plate tectonics, the Mariana Islands formed as part of a classic island arc chain. Uplifting forces related to the plate subduction result in the development of a chain of volcanoes. Due to the warm tropical waters, coral reefs develop along the shores of the volcanoes. Periodic changes in sea level and two separate periods of volcanic activity resulted in exposed limestone reef formations, while new reefs grew on the volcanic substrate brought closer to the surface of the water. The succession of raised reefs can be seen in the form of terraces that characterize Saipan (CNMI DEQ, 1995).

Upon conclusion of the initial active volcanic period, the first major limestone formation grew over Saipan. This formation is known as Takpochau Limestone, and it covers much of the interior of the island today. The major limestone formation that was formed after the second period of volcanic activity is referred to as the Mariana Limestone (CNMI DEQ, 1995).

Geologic logs from monitoring wells installed at the site documented shallow subsurface material as silty to sandy clay ranging in depth from 6 inches to 10 feet below ground surface, dependant on the location. Shallow material was underlain by limestone. Limestone on this part of the island is primarily composed of early Pleistocene-age Mariana Limestone, which is mainly light-colored, coarsely porous, finely to coarsely fragmental limestone that contains abundant coral (USGS, 2003).

2.4.3 Groundwater Conditions

Previous investigation conducted at the site indicates that groundwater beneath the site is tidally influenced. U.S. EPA also observed a significant change in groundwater depths in well UXO-1, where depths rose approximately 1 foot over a 5-hour period when consecutive readings were collected. This change in groundwater is consistent with the diurnal tidal conditions that exist throughout the Mariana Islands. Tidal conditions affect groundwater flow beneath the site. As water elevation changes over the course of the day, groundwater flows away and back towards the site creating a back and forth groundwater flow. Based on United States Geological Survey water resources report for Saipan (Carruth, 2003), the overall direction of groundwater flow beneath the site is toward the northeast. Groundwater beneath the site occurs in a limestone aquifer and fresh to brackish groundwater is situated above seawater (basal groundwater).

2.5 ENVIRONMENTAL CONCEPTUAL SITE MODEL

There are no residences within a half mile radius of the OB/OD facility and there are no potable water supply wells within a half mile radius of the site (Figure 1). The Marpi Municipal Solid Waste Landfill is located approximately 1,400 feet east of the site. There are no residents within a half mile radius of the site. Property adjacent and in the vicinity of the site is vacant, undeveloped forest. The site is used to detonate and destroy UXO encountered throughout the island of Saipan. The facility is occupied on a part time basis by DFES personnel. The property has a fence and gate restricting access to the public.

Groundwater beneath the site occurs within a limestone water bearing unit. Limestone aquifers are highly permeable and are susceptible to contaminant migration to groundwater. According to the CNMI Groundwater Management Zone map, groundwater beneath the site and surrounding area is classified as Class III (Horsley Witten Group, 2006). Class III groundwater is defined as non-potable water with chloride concentrations greater than 500 parts per million. There are no residents or potable water supply wells within a half mile radius of the site. Site personnel and occasional users/trespassers are the human receptors of concern at the site.

Groundwater eventually discharges to the ocean along the shoreline. Groundwater with potential contaminants may reach the northeast shoreline and discharge into the ocean. Recreational users and aquatic organism habitat are the receptors of concern downgradiient direction of the site.

The potential exists, however, that future development in the area could potentially use groundwater as a drinking water source. Additionally, there are several agricultural homesteads located east to southeast of the site that could potentially use groundwater for livestock drinking water.

3.0 PROJECT DATA QUALITY OBJECTIVES

Data quality objectives (DQOs) are quantitative and qualitative criteria that establish the level of uncertainty associated with a set of data.

Based on the use of the property as an OB/OD facility, the potential exists that a release of hazardous waste or hazardous constituents to groundwater from the residual contamination could occur. Previous detonations, conducted under the emergency RCRA permits issued by the U.S. EPA, have potentially impacted groundwater, and ongoing monitoring at the site will be required for future permitting. There is a need to protect the groundwater and coastal resources of Saipan and ensure that groundwater contamination is not occurring as a result of OB/OD operations.

Groundwater samples will be collected from monitoring wells at four locations along the cross- to down gradient perimeter of the site (Figure 1). Monitoring wells UXO-1 through UXO-3 are located on an existing coral road on the northeastern perimeter of the site. Relative to the direction of groundwater flow these wells are considered more or less down gradient of the UXO burn pit. The fourth monitoring well (UXO-4) is located northwest of the OB/OD burn pit and is considered a cross gradient well relative to the direction of groundwater flow. The well locations are positioned to assess if site operations impact groundwater migrating off the site.

Groundwater assessment from monitoring wells at the site and at perimeter of the property down gradient of the open burn pit will determine if UXO disposal activities at the facility impact groundwater and potentially affect human and ecological receptors at the site and down gradient of the site. Groundwater samples from the four groundwater monitoring wells at the site perimeter were collected and analyzed for the following chemicals of potential concern (COPCs):

- Explosive and energetic compounds
- Metals
- Nitrate-nitrite
- Ammonia
- Phosphate
- Kjeldahl nitrogen
- Perchlorates
- Nitro-Cellulose
- White phosphorus

Analytical data generated were compared to the baseline concentrations from the 2007 results to determine if the presence of COPCs is increasing with ongoing OB/OD facility activities. In addition, the groundwater results were compared to the ESLs.

3.2 DATA REVIEW AND VALIDATION

A Tier II evaluation report of the project’s analytical data was prepared by Enthalpy Analytical. The Tier II report includes Quality Assurance/Quality Control (QA/QC) assessment for the laboratory data. The analytical results were evaluated to identify any problems, determine the accuracy, precision and usability of the data.

The following criteria will be evaluated during a Tier II evaluation:

- Data package completeness
- Laboratory QA/QC summaries
- Holding times
- Blank contamination
- Matrix-related recoveries
- Field duplicates

Upon completion of evaluation, the data was classified within the report as one of the following:

- Acceptable for use without qualifications
- Acceptable for use with qualifications
- Unacceptable for use.

The data with qualifications were attached to the report. The analytical data evaluation Tier II review report compared data to specific project quality objectives, which include target analytes, sensitivity, analytical accuracy, analytical and sampling precision, and analytical completeness.

4.0 LABORATORY ANALYSES

Enthalpy Analytical Laboratory located in Berkeley, California performed groundwater analysis for groundwater and quality control samples. Collected water samples were analyzed for parameters specified in RFP17BECQ-192 proposal from BECQ. Groundwater samples were analyzed for the following:

- Explosive and Energetic Compounds by U.S. EPA Method 8330
- Metals by U.S. EPA Method 200.7 and 245.1
- Nitrate-Nitrite by U.S. EPA Method SM 4500-N_{org}
- Ammonia by U.S. EPA Method SM 4500-NH_3
- Phosphate by U.S. EPA Method 365.4 (Phosphorous)
- TKN by U.S. EPA Method 351.1
- Perchlorates by U.S. EPA Method 314.0
- Nitroaromatics and Nitroamines by U.S. EPA Method 353.2
- White Phosphorus by U.S. EPA Method 7580.

Sample containers, preservatives, and holding times are summarized in Table 4-1.

TABLE 4-1. Analytical Methods, Containers, Preservatives & Holding Times

Analytical Parameters	Methods	Container Size	Preservative	Holding Time
Explosives	EPA 8330	1 L amber glass	Ice	7 days
Metals/Mercury	EPA 200.7	500 mL HDPE plastic	Nitric acid	6 months
Nitrate-Nitrite	EPA 245.1	500 mL HDPE plastic	Nitric acid	28 days
Nitroaromatics/Nitroamines	EPA 300.0	500 mL HDPE plastic	Ice	48 hours
Ammonia	EPA 353.2	250 mL HDPE plastic	Ice	48 hours
Phosphorous	SM 4500-	100 mL HDPE	Ice	28 days

	NH3	plastic		
TKN	SM 4500-Norg	1 L HDPE plastic	Sulfuric acid	24 hours
Perchlorate	EPA 314.0	250 mL HDPE plastic	Ice	28 days
White Phosphorous	EPA 7580	1 L HDPE	Ice	5 days

Note: HDPE = high density polyethylene

To provide quality control for the analytical program, the following measures were used:

- Additional sample volume was collected and used for matrix spike/matrix spike duplicate analysis for at least one groundwater sample per analytical method.
- One laboratory blind duplicate was collected from groundwater monitoring well UXO-2.
- An equipment blank for non-dedicated equipment was collected after cleaning the sampling equipment after groundwater samples were collected from monitoring well UXO-1.

5.0 FIELD METHODS AND PROCEDURES

The following sections describe in detail the groundwater sample collection methods. Specific analysis requests for the groundwater samples are given in the sections of the SAP (Appendix A).

The groundwater monitoring wells were inspected to determine the condition of the wells. The monitoring wells were locked and the locks were cut-off because the keys to the locks were not found. The locks were rusted and not in good working order. New locks were placed on the wells and the keys were given to BECQ. Photos of the well condition can be found in the photo log (Appendix C).

Initially, depth to water and bottom of well depths were recorded for all wells. Groundwater samples were collected employing low-flow sampling methodology. Groundwater samples were to be collected using low flow sampling techniques in accordance with the SAP. However site conditions did not allow for the use of the bladder pump brought to the site. Depth to water beneath the site was near the maximum depth for pumping groundwater under ideal conditions and water conditions (high turbidity, suspended silt and sand in groundwater) were not ideal for use of the pump. In accordance with the standard operating procedure (SOP) for groundwater sampling teflon bailers were used to collect groundwater samples from the wells. The SOP for groundwater sampling is provided in Appendix A of the SAP (Appendix A).

5.1 GROUNDWATER SAMPLING

A Solonist water level meter was used to measure depth to water within each monitoring well. Three volumes of groundwater were purged from each monitoring well prior to collecting groundwater samples. Three volumes of water were removed from each well to ensure that stagnant water within the well was removed and that representative sample of groundwater from the underlying aquifer was obtained. Volume of water was calculated by measuring the depth to water, depth to the bottom of the well and the well radius. Purged water was poured into a 5-gallon plastic bucket to ensure the volume of water removed from each well. Field measurement for groundwater parameters pH, temperature, oxidation reduction potential (ORP), conductivity, turbidity, dissolved oxygen and salinity were recorded before and after purging for each well. All groundwater sampling equipment was placed on visqueen/plastic sheet laid out on the ground near the monitoring well that was sampled. All field notes were recorded in a field book or on sampling forms dedicated for the project.

A Horiba water quality meter was used to record field-measured groundwater parameters. After three well casing of water was removed the groundwater samples were placed in laboratory provided sample bottles using the Teflon bailer. Sample time, date, well identification number, site name, and the name of the samplers were placed on the bottle labels and recorded in a field book. The filled sample bottles were placed in coolers filled with ice to keep the samples cool.

5.2 DECONTAMINATION PROCEDURES

All non-dedicated equipment that came into contact with potentially contaminated groundwater was cleaned in accordance with the SOP included in the SAP. Equipment was cleaned adjacent to the visqueen/plastic sheeting placed on the ground next to each well sampled. The cleaned equipment was stored on the plastic sheeting. All equipment that came into contact with groundwater was cleaned with soap and water, rinsed with de-ionized water, rinsed with isopropyl alcohol, and triple rinsed again with de-ionized water.

5.3 INVESTIGATION DERIVED WASTE

Investigation Derived Waste (IDW) was generated while collecting groundwater samples at the site. IDW included the following:

- Used personal protective equipment (PPE)
- Disposable sampling equipment
- Cleaning fluids
- Monitoring well purge water.

Used PPE and disposable equipment was double-bagged and placed in a municipal refuse dumpster. These wastes are not considered hazardous and were disposed in a trash receptacle (dumpster) and eventually sent to the Marpi municipal solid waste landfill. Cleaning fluids included water, de-ionized water, non-phosphate detergent and isopropyl alcohol. These fluids were contained in spray bottles. The volume and concentration of the cleaning fluids were sufficiently low to allow disposal to the unpaved area at the site. Approximately two to three gallons of purge water was generated from each monitoring well. In accordance with the request for proposal RFP17BECQ-192 scope of work, purge water was not expected to contain any significant levels of contamination, and was disposed of onto an unpaved area of the site.

5.4 LABEL NOMENCLATURE

A unique, identifiable name was assigned to each monitoring well location. Wells will be identified with the prefix UXO, followed by the monitoring well number (i.e., UXO-1). The following groundwater samples were identified by the monitoring well location where the samples were collected:

- OBODUXO1; Monitoring well UXO-1
- OBODUXO2; Monitoring well UXO-2
- OBODUXO03; Monitoring well UXO-3

- OBODUXO04; Monitoring well UXO-4

Duplicates and blank samples were assigned fictitious names. The blind duplicate sample collected from monitoring well UXO-2 was identified as OBODUXO29. An equipment blank collected after cleaning equipment used to collect a groundwater sample from UXO-1 was designated as OBODUXO1B. A matrix spike/matrix spike duplicate sample was collected from monitoring well UXO-3 was designated as OBODUXO3MSMSD.

5.5 CHAIN OF CUSTODY DOCUMENTATION

All sample shipments for analyses were accompanied with a completed chain-of-custody document. The chain-of-custody document identified the contents of each shipment, and maintained the custodial integrity of the samples. Generally, a sample is considered to be in someone's custody if it is either in someone's physical possession, in someone's view, locked up, or kept in a secured area that is restricted to authorized personnel. The Chain of custody was signed in the "relinquished by" box. The date, time, and air bill number were noted on the chain of custody and a copy of the chain of custody was sent by email to the laboratory project manager.

5.6 SAMPLE PACKAGING AND SHIPPING

All sample containers were placed in 50-quart coolers consisting of hard plastic. The packaging procedures for concentration samples were as follows:

1. Samples were placed in coolers filled with plastic bottles containing frozen water.
2. The bottom of the cooler was lined with bubble wrap to prevent breakage during shipment.
3. Labels were attached to the water samples and covered with clear tape.
4. All glass sample containers were enclosed in bubble wrap to prevent breakage.
5. Remaining space in cooler with ice and sample bottles were filled with packing material to prevent breakage and the chain of custody was enclosed in a ziplock plastic bag affixed to the underside of the cooler lid.
6. Each cooler was secured with packing tape, and custody seals were affixed to two sides of the cooler lid.

5.7 QUALITY CONTROL

This section discusses the quality control samples collected to support the DQO and SAP.

Field contamination was assessed through the collection of different types of blanks. An equipment field blank was collected and analyzed for the same parameters as the groundwater samples collected at the site.

5.7.1 Equipment Blanks

Equipment blank OBODUXO1B was collected to evaluate field sampling and decontamination procedures by pouring de-ionized water (for inorganics) over the decontaminated sampling equipment and collecting the poured water in sample collection bottles. The equipment blank collected was analyzed for all COPCs.

5.7.2 Field Duplicate

Assessment of sample variability is accomplished through the collection and analysis of a field duplicate sample. One duplicate groundwater sample designated as OBODUXO29 was collected at the site. The blind duplicate sample was collected from monitoring well UXO-2.

5.7.3 Laboratory Quality Control (QC) Samples

A water sample collected from UXO-3 was collected for use as the laboratory QC samples for matrix spike and matrix spike duplicate analysis. The water sample was designated as OBODUXO03MSMSD. The laboratory was alerted as to which sample is to be used for QC analysis by a notation on the sample container label and the chain-of-custody record.

5.8 FIELD VARIANCES

Because conditions in the field may vary, it may become necessary to implement minor modifications to sampling as presented in this plan. When appropriate, the CNMI DEQ/BECQ will be notified and a verbal approval will be obtained before implementing the changes. Modifications to the approved plan will be documented in the sampling project report.

6.0 RESULTS

Groundwater samples and quality control samples were collected from groundwater monitoring wells UXO-1, UXO-2, UXO-3 and UXO-4 on February 22 and February 23, 2018. The results of the groundwater monitoring event are presented in the following sections.

6.1 FIELD MEASUREMENTS

Depth to water was measured in each groundwater monitoring well. In addition field measurements for the groundwater parameters; temperature, pH, dissolved oxygen, conductivity, ORP, turbidity and salinity were also recorded for groundwater samples collected from each well. Field measurement data collected with a field water quality meter are not quantitative results. The results are qualitative results intended for screening level purpose. The data is used to identify significant differences or outliers from typical groundwater characteristics. Outlier data may indicate changes to groundwater geochemistry. Results of field measurement are presented in Table 6-1.

TABLE 6-1. Field Measurements for Groundwater at the OB/OD Facility, Saipan, CNMI

PARAMETER	WELL UXO-1	WELL UXO-2	WELL UXO-2	WELL UXO-4
Depth to Water (feet)	189.36	183.54	186.82	191.00
Bottom of Well (feet)	201.53	196.52	202.00	202.42
pH	7.26	8.00	6.15	5.93
Temperature (ºC)	27.69	27.58	27.37	27.50
Conductivity (mS/cm)	5.88	10.4	5.71	9.99
ORP (mV)	284	151	67	139
DO (mg/L)	6.73	4.51	3.87	6.79
Turbidity (NTU)	>1000	832	>1000	567
Salinity (ppt)	1.3	5.8	3.0	0.1

Notes:
ºC = degree Celsius
mS/cm = milli Siemen per centimeter
mV = milli Volt
mg/L = milligram per Liter
NTU = neptholometric unit
ppt = parts per thousand

pH concentrations for groundwater samples collected from the four monitoring wells vary from 5.93 to 8.00. The pH concentrations fall within the range for groundwater 6 to 8 pH units.

Temperature of groundwater ranged between 27.3 to 27.7 ºC. Groundwater temperature is slightly cooler than ambient air temperature. In general, groundwater temperature throughout the Marianas is approximately equivalent to ambient air temperature.

Conductivity varied from 5.71 mS/cm to 10.40 mS/cm. Conductivity concentrations in groundwater samples from UXO-1 and UXO-3 were lower than the conductivity recorded in groundwater samples collected from UXO-2 and UXO-4.

Dissolved oxygen in groundwater samples ranged from 3.87 to 6.79 mg/L. Oxygen concentration in groundwater in limestone aquifers typically are highly oxygenated (6 to 8 mg/L). Dissolved oxygen concentrations in the groundwater samples are slightly lower than typically groundwater in limestone aquifers.

Turbidity ranged from 567 NTUs to greater than 1000 NTUs for the groundwater samples collected from the monitoring wells. Turbidity is a measured of the amount of suspended solid particles (clay, silt and sand) within groundwater. Physical observation of groundwater during purging and sampling supported the turbidity readings. Groundwater was turbidity was high. The color of groundwater samples ranged from grey to brown. Groundwater samples contained silt and sand particles. It is evident that the wells contain sediment (clay, silt and sand at the bottom of each well.

Salinity is a measure of chloride levels in groundwater. Salinity concentrations for the groundwater samples ranged from 0.1 part per thousand (ppt) to 5.8 ppt. Salinity values greater than 1 ppt are considered brackish water. Concentrations around 13 ppt are considered sea water. Groundwater sample from UXO-4 located closer to the interior of the island is fresh water. The perimeter wells indicate that the groundwater is brackish, which is consistent with the CNMI Groundwater Management Zone classification of the groundwater within the area as Class III water.

6.2 QUALITY CONTROL RESULTS

In addition, to the groundwater samples an equipment blank and blind duplicate sample were collected. The equipment blank and blind duplicate samples were analyzed for the same parameters as the groundwater samples. The equipment blank was collected after cleaning non-dedicated sampling equipment after sampling groundwater monitoring well UXO-1. No analytes were reported above the laboratory detection limits for the equipment blank samples.

A blind duplicate sample designated as OBODUXO29 was collected from groundwater monitoring well UXO-2. The percent difference between the blind sample OBODUXO29 (UXO29) and the sample OBODOUXO02 (UXO02) was within acceptable range for all analytes except chromium. The result for the sample UXO02 was reported as not detected at or above the reporting limit (>5.0 microgram per liter (µg/L)) for chromium and the result for UXO29 was reported at 16 µg/L. Reported results for chromium were considered not precise and should be considered estimated values. “J” data qualifier was added to the reported chromium results.

Analytic results for the parameters nitrate-nitrite, phosphate and white phosphorous in Table 6-2 were given an “H” data qualifier flag. The “H” flag meant that the sample analysis exceeded the holding time for analysis. Holding times for these parameters were 48 hours, 24 hours and 5 days respectively. Holding times were exceeded as a result of shipping samples off island for analysis. The “H” flag indicates that the analytical results reported are estimated values. The data is considered useable. As a result of the laboratory QC results, the laboratory reported high responses for cobalt and zinc results for the equipment blank (OBODUXO01B) analysis. The reported results for cobalt and zinc were not detected at or above the reporting limit. The cobalt and zinc results were given a “b” data qualifier. The QC sample result for nitrogen nitrates in the matrix spike/matrix spike duplicate sample reported high recovery rates data results for nitrogen nitrite and nitrate were given a “b” data qualifier. The “b” data qualifier indicates that the data is useable but reported results are an estimate. The analysis for the qualifier flags were reported for the analytical results. All of the data was considered useable.

6.3 GROUNDWATER ANALYTICAL RESULTS

Groundwater samples collected on February 22 and 23, 2018 were analyzed for the following parameters:

- Explosive and energetic compounds
- Metals
- Nitrate-nitrite
- Ammonia
- Phosphate
- Kjeldahl nitrogen
- Perchlorates
- Nitro-Cellulose
- White phosphorus

Results for groundwater samples are presented in summarized in Table 6-2 and the laboratory report is included in Appendix D.

No explosives and energetic compounds, white phosphorous or perchlorate were detected in the groundwater samples at or above the reporting limits.

Phosphorous was detected in groundwater samples collected from all four monitoring wells at concentrations ranging from 0.043 mg/L to 0.33 mg/L.

Ammonia was detected in groundwater samples collected from monitoring wells UXO-1 and UXO-3 at 0.26 mg/L and 0.13 mg/L respectively.

Nitrogen as nitrite and nitrate were detected in groundwater samples collected from all 4 monitoring wells at concentrations ranging from 4.4 mg/L to 17.2 mg/L.

Total Kjeldahl Nitrogen was detected in groundwater samples collected from monitoring wells UXO-1, UXO-2, and UXO-3. Concentrations ranged from 1.1 mg/L to 2.0 mg/L.

Metals were detected in groundwater samples collected from all four monitoring wells. The following metals were reported at or above reporting limits:

- Arsenic
- Barium
- Chromium
- Cobalt
- Copper
- Nickel
- Silver
- Vanadium
- Zinc

Arsenic was detected in groundwater samples collected from monitoring wells UXO-1, UXO-3 and UXO-4 at concentrations ranging from 18 µg/L to 49 µg/L.

Barium was detected in groundwater samples collected from all four monitoring wells at concentrations ranging from 9.4 µg/L to 49 µg/L.

Chromium was detected in groundwater samples collected from all four monitoring wells at estimated concentrations ranging from 16 µg/L to 38 µg/L.

Cobalt was detected in groundwater samples collected from monitoring wells UXO-1, UXO-3 and UXO-4 at concentrations ranging from 7.4 µg/L to 15 µg/L.

Copper was detected in groundwater samples collected from all four monitoring wells at concentrations ranging from 11 µg/L to 50 µg/L.

Nickel was detected in groundwater samples collected from all four monitoring wells at concentrations ranging from 6.3 µg/L to 52 µg/L.

Silver was detected in groundwater samples from all four monitoring wells at concentrations ranging from 9.5 µg/L to 42 µg/L.

Vanadium was detected in groundwater samples from all four monitoring wells at concentrations ranging from 30 µg/L to 80 µg/L.

Zinc was detected in groundwater samples from all four monitoring wells at concentrations ranging from 84 µg/L to 220 µg/L.

In general, the greatest concentrations of detected analytes for all sample parameters were found in the groundwater sample collected from monitoring well UXO-1.

Results for groundwater sampling collected in February 2018 were compared to the results of groundwater samples analyzed in 2007. A summary table for all groundwater samples collected at the OB/OD facility is included in Appendix B. The parameters for inorganics, ammonia, nitrogen as nitrite – nitrate, perchlorate, phosphorous, white phosphorous, TKN, and explosives were compared to the 2007 results.

The 2007 groundwater monitoring event did not detect perchlorate, and white phosphorous. Phosphorous, metals, ammonia, nitrogen as nitrite and nitrate, TKN and explosives were detected. The explosive analytes 1,3,5-Trinitrobenzene, 3-nitrobenzene, and RDX were reported as detected below reporting limits but above the method detection limits. The reported results were estimated values for the 2007 event. The metals detected during the 2007 groundwater monitoring event included arsenic, barium, chromium, cobalt, copper, nickel and zinc.

No explosives, white phosphorous, perchlorates were detected in groundwater samples collected and analyzed during the February 2018 sample event. The February 2018 results for ammonia, TKN, and phosphorous are similar to 200t sample event. The results for nitrogen as nitrite and nitrogen as nitrates were reported as detected in all four wells similar to the 2007 sample event. The concentrations of nitrogen for the 2018 event are higher than the 2007 event. However, the laboratory QC report indicated that the nitrogen recovery rates were biased high and the reported results are an estimate. The nitrogen results are within an order of magnitude as the 2007 results and likely there is no significant change in nitrogen concentrations at the site.

Total metals results were higher than previous groundwater sample results. The results were suspected as biased high due to the turbidity of the groundwater samples collected. Total metal analysis includes the groundwater and suspended solid within the groundwater samples. Total metals analysis is a common procedure, but for monitoring wells with greater sediment load (turbidity) results can be biased. APEC contacted Ethalpy Analytical to re-analyze the metal parameter as dissolved metals by filtering the groundwater samples through a 0.35 micron filter to remove silt and clay size suspended particles within the samples. Results of dissolved metals analysis were less than the total metals samples collected in February 2018 and comparable to the 2007 groundwater sample results. Dissolved metals detected in the groundwater samples were:

- Barium
- Vanadium
- Zinc

Barium was detected in samples collected from all four monitoring wells at concentrations ranging from 15 µg/L to 96 µg/L.

Vanadium was detected in groundwater samples collected from monitoring wells UXO-1, UXO-2 and UXO-3 at concentrations ranging from 6.1 µg/L to 8 µg/L.

Zinc was detected in groundwater samples collected from monitoring well UXO-3 at concentration of 28 µg/L.

None of the dissolved metal results exceeded the ESLs. Results of the total metals and dissolved metals are included in the summary table (Appendix B).

Typical metals associated with UXO are arsenic, copper, lead, mercury and zinc (U.S. EPA, 2012).

7.0 CONCLUSION

No explosives and energetic compounds, white phosphorous or perchlorate were detected in the groundwater samples at or above the reporting limits. Groundwater results collected in February 2018 are comparable to the 2007 sampling event. Groundwater results do not indicate contaminants from UXO disposal activities. Total metals were detected in groundwater samples collected from the site. The total metals analysis was believed to be biased high due to the turbidity (suspended solids) within groundwater samples. Detected results for dissolved metals detected barium, vanadium, and zinc in groundwater samples collected at the site. The metals were not detected at concentrations that exceeded the ESLs.

Groundwater samples were collected at the site on February 22 and 23, 2018. Groundwater samples were analyzed for parameters associated with UXO disposal operations that occur at the site periodically. Sample parameters include inorganics (metals and mercury), ammonia, nitrogen as nitrite, nitrogen as nitrate, TKN, phosphorous, perchlorate, explosives, and white phosphorous.

Depth to groundwater beneath the site ranged from 183 to 191 below ground surface. Field measurement for groundwater characteristic indicated that the water in three of the four wells is brackish. Groundwater beneath the site occurs within a limestone water bearing unit. Limestone aquifers are highly permeable and are susceptible to contaminant migration to groundwater. According to the CNMI Groundwater Management Zone map, groundwater beneath the site and surrounding area is classified as Class III (Horsley Witten Group, 2006). Class III groundwater is defined as non-potable water with chloride concentrations greater than 500 parts per million. There are no residents or potable water supply wells within a half mile radius of the site. Site personnel and occasional users/trespassers are the human receptors of concern at the site.

Groundwater eventually discharges to the ocean along the shoreline. Groundwater with potential contaminants may reach the northeast shoreline and discharge into the ocean. Recreational users and aquatic organism habitat are the receptors of concern down gradient direction of the site.

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FIGURES

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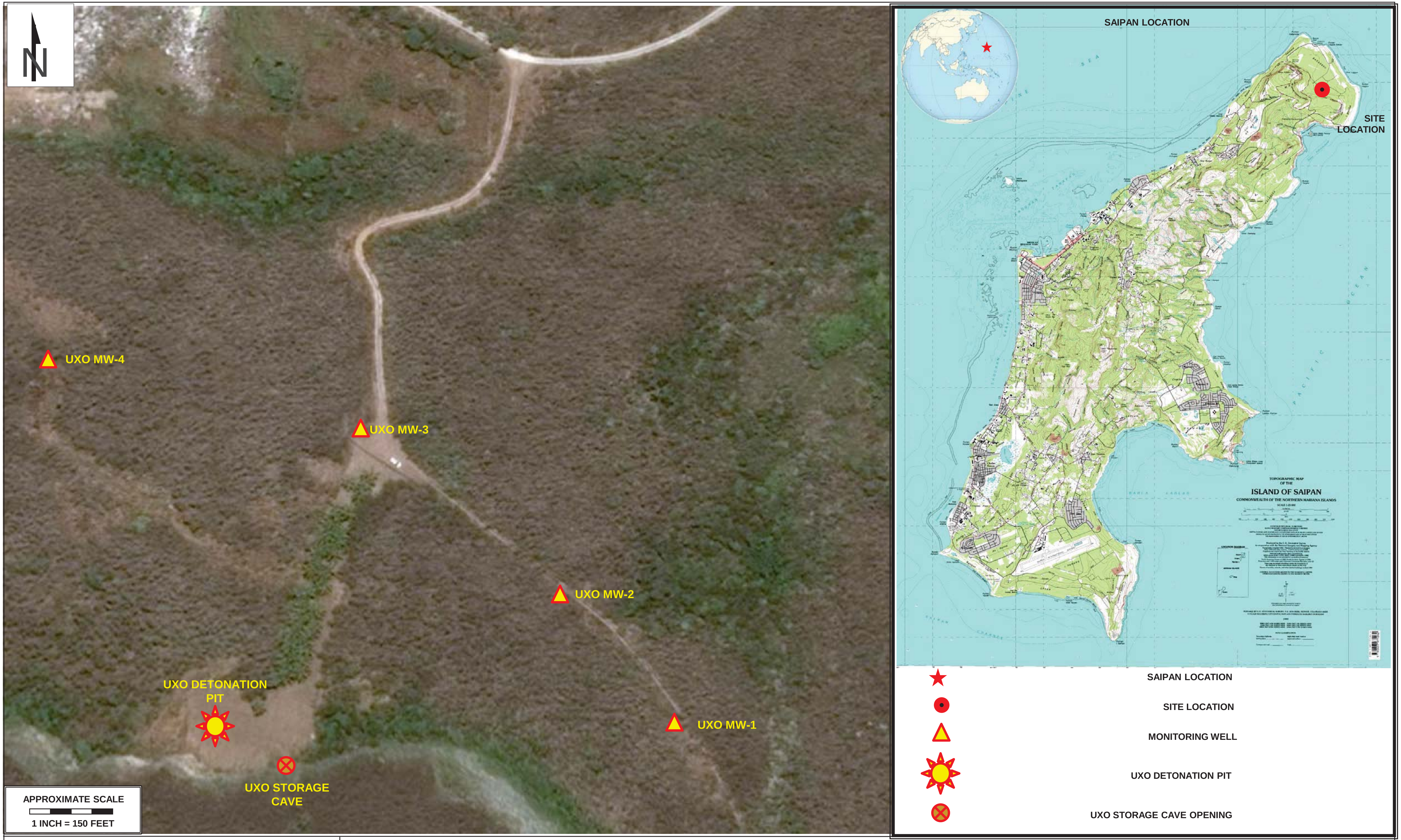

apec
allied pacific environmental consulting

TITLE: SITE LOCATION MAP AND SAMPLE LOCATION MAP.

PROJECT: UNEXPLODED ORDNANCE OPEN BURN/OPEN DETONATE FACILITY MARPI, SAIPAN, CNMI.

FIGURE: 1

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Appendix A

Sampling and Analysis Plan

Final Sampling and Analysis Plan
Annual Groundwater Monitoring
Unexploded Ordnance Open Burn / Open Detonate Facility
Marpi, Saipan, CNMI

Prepared For:

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January 16, 2018

Final Sampling and Analysis Plan
Annual Groundwater Monitoring
Unexploded Ordnance Open Burn / Open Detonate Facility
Marpi, Saipan, CNMI

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January 16, 2017

Approved by DEQ/BECQ Director	Ray Masga	Date
Approved by DEQ/BECQ Manager	Derek Chambers	Date
Approved by APEC Project Manager	Brian Thomas	Date

TABLE OF CONTENTS

TABLES

FIGURES

APPENDICES

ACRONYMS

µg/L	Micrograms per liter
APEC	Allied Pacific Environmental Consulting
BECQ	Bureau of Environmental and Coastal Quality
CFR	Code of Federal Regulation
CNMI	Commonwealth of the Northern Mariana Islands
COPCs	chemicals of potential concern
DEQ	Department of Environmental Quality
DPS	Department of Public Safety
DQI	data quality indicator
DQO	data quality objectives
ERS	Emergency Response Section
ERT	Environmental Response Team
FSP	Field Sampling Plan
GC	Gas Chromatograph
GPS	Global Positioning System
IDW	investigation-derived waste
MPLA	Mariana Public Lands Authority
msl	mean sea level
OB/OD	open burn/open detonate
OERR	Office of Emergency and Remedial Response
PM	Project Manager
PPE	personal protective equipment
PQL	practical quantitation limit
PVC	Polyvinyl chloride
QA	quality assurance
QAPP	Quality Assurance Project Plan
QC	quality control
RAP	Regional Analytical Program
RCRA	Resource Conservation and Recovery Act
RL	Reporting Limit
RPD	Relative Percent Difference
SAP	sampling and analysis plan
SVOCs	semi-volatile organic compounds

TPH	total petroleum hydrocarbons
U.S. EPA	United States Environmental Protection Agency
USGS	United States Geological Survey
USPHS	United States Public Health Services
UXO	unexploded ordnance
VOA	Volatile organic analysis
VOCs	volatile organic compounds

1.0 INTRODUCTION

The Commonwealth of the Northern Mariana Islands (CMNI) Department of Environmental Quality (DEQ) tasked Allied Pacific Environmental Consulting (APEC) to prepare this Sampling and Analysis Plan (SAP) as for groundwater monitoring to satisfy the requirements for the 2008 Remedial Action Plan (RAP) for the Unexploded Ordnance Open Burn/Open Detonate (OB/OD) Facility located in Marpi, Saipan. The 2008 RAP is equivalent to a Resource Conservation and Recovery Act (RCRA) permit to operate a hazardous remediation waste storage and treatment facility. A SAP combines the basic elements of a Quality Assurance Project Plan (QAPP) and a Field Sampling Plan (FSP). This SAP has been prepared for use by the Commonwealth of the Northern Mariana Islands (CNMI) Department of Environmental Quality (DEQ), who will also be referred to as the DEQ for the purposes of this SAP.

Specific tasks are documented in the SAP and include:

- Annual sampling of monitoring wells installed at the OB/OD facility.

1.1 PROJECT ORGANIZATION

Principal Data Users – Data generated during the implementation of this SAP will be used by the CNMI BECQ/DEQ to make decisions regarding ongoing monitoring at the perimeter of the property, and continued use of the site for detonation of unexploded ordnance. The primary contact for CNMI BECQ/DEQ is Mr. Ray Masga, Director. CAPT Derek Chambers, US Public Health Services (USPHS) is managing the contract for this sampling project.

1.2 DISTRIBUTION LIST

Three paper copies and a digital copy of the final SAP will be distributed to CAPT Chambers.

1.3 STATEMENT OF THE SPECIFIC PROBLEM

The environmental concerns and conditions that will be addressed by this SAP are based on available information.

Unexploded ordnance (UXO) deposited on the island of Saipan during World War II is present on the island. UXO has been encountered during clearing land for commercial and residential development that is ongoing on Saipan. When the UXO is cleared, it is stored at the Marpi OB/OD facility until a maximum explosive weight is achieved, then detonated using plastic explosives. Detonation occurs in an open burn/open detonation pit (UXO Pit), to eliminate the potential explosive hazard. The purpose of the OB/OD facility is to render unserviceable ordnance and other pyrotechnic devices harmless by either suppression of detonation or open burning. In May 2007, four groundwater monitoring wells were installed around the site perimeter and groundwater samples were collected. Initial sampling data results indicated evidence of multiple constituents in groundwater, and established an environmental baseline for groundwater conditions. In order to continue use of the OB/OD facility, it is necessary to continue monitoring the underlying groundwater conditions, and to determine whether offsite migration of contamination is occurring.

2.0 BACKGROUND

The following sections document the history of the site and describe the site setting.

2.1 SITE LOCATION AND DESCRIPTION

The CNMI consists of a chain of 14 islands in the North Pacific Ocean. Saipan, the major inhabited island, is approximately 15º North latitude and 145º East longitude. The island is approximately 15 miles long and 5 miles wide at the widest point (48 square miles) (CNMI DEQ, 1995).

The geographic coordinates of the site are approximately 15 degrees, 16 minutes, 9.5 seconds North latitude; 145 degrees, 49 minutes, 19.24 seconds West longitude. The OB/OD facility does not have a physical address, but is located near the northern end of the island. The site is located at elevations ranging from 50 to 60 meters above mean sea level (msl), and is situated approximately one-half mile from the Pacific Ocean (Figure 1). The site is comprised of a 5,000-square-foot area surrounding an existing UXO storage cave and an OB/OD Pit. The site is undeveloped land, with the exception of the UXO storage cave and the OB/OD pit. Surrounding land use is undeveloped land, with the exception of the Marpi Landfill, located approximately 800 feet from the OB/OD pit location. The site is currently owned by the CNMI Department of Public Safety, Fire Division. T*he Marianas Public Lands Authority (MPLA) parcel number for the site is 051-A-02.*

2.2 OPERATIONAL HISTORY

The site currently serves as a UXO storage area and an OB/OD unit for the disposal of UXO discovered on the island. The area has been used for these operations for several years, although the exact number of years has not been confirmed. The CNMI Department of Public Safety (DPS), in conjunction with the United States Navy Explosives Ordnance Disposal Detachment, currently conducts OB/OD operations at the site. Prior to this use, the site had not been used since the formation of the CNMI in 1976. Prior to the formation of the CNMI, the site was vacant land, and was possibly used for military purposes by Japan and the United States during and after World War II. An old, narrow-gauge railroad is also present on the site or near the site boundary, suggesting potential Japanese military use.

2.3 PREVIOUS INVESTIGATIONS AND REGULATORY INVOLVEMENT

2.3.1 Previous Investigations

Targeted Brownfields Assessment, OB/OD facility, Saipan, CNMI, November 2007

In April and May of 2007, U.S. Environmental Protection Agency (EPA) performed the field activities as described in the January 2007 *Sampling and Analysis Plan, Targeted Brownfields Assessment* (UXO SAP). Field activities included: clearing the proposed work areas of UXO, installation of a perimeter fence on the site access road, installation of four groundwater monitoring wells, and sampling and analysis of groundwater from monitoring wells. Groundwater samples were analyzed for common chemicals found in military munitions. Analytical results showed detections of total petroleum hydrocarbon (TPH) compounds, explosives and energetics, semi-volatile organic compounds (SVOCs), metals, inorganic compounds, and pesticides.

2.3.2 Regulatory Involvement

UXO storage and disposal have been occurring at the site under the authority of a RAP issued the EPA in accordance with RCRA and its implementing regulations, Title 40 Code of Federal Regulations (CFR) parts 270.79 through 270.230. This RAP is equivalent to a RCRA permit issued pursuant to Title 40 CFR parts 270.1 through 270.51 (Permit).

This RAP is issued to the CNMI Department of Public Safety (DPS or the Permittee) to operate a hazardous remediation waste storage and treatment facility at Marpi Point, Saipan.

2.4 PHYSICAL SETTING

The following paragraphs related to the physical setting of the site are summarized from United States Geological Survey (USGS) information and other supporting documentation.

2.4.1 Physiographic Conditions

The terrain in the area appears to be generally flat, with slight sloping to the northeast. The site elevation is approximately 50 to 60 meters above mean sea level (msl), based on the USGS 7.5-minute topographic map, Saipan quadrangle, dated 1983.

The climate in Saipan is characterized by temperatures ranging from 78 to 85 degrees Fahrenheit (°F), relatively high humidity, and an average rainfall of 83.1 inches per year. Most of the rainfall occurs during the period from July through October, while the typical dry season occurs between January and April (CNMI DEQ, 1995).

2.4.2 Geologic Conditions

Saipan is characterized by limestone and calcareous sediments that cover approximately 90 percent of the island. Volcanic rock makes up the remaining 10 percent of the island's surface area, but exists beneath all the limestone formations at the island's core (CNMI DEQ, 1995).

The Mariana Islands are located to the west of the Mariana Trench, the subduction zone for the westward-moving Pacific Plate. As a result of their position with respect to regional plate tectonics, the Mariana Islands formed as part of a classic island arc chain. Uplifting forces related to the plate subduction result in the development of a chain of volcanoes. Due to the warm tropical waters, coral reefs develop along the shores of the volcanoes. Periodic changes in sea level and two separate periods of volcanic activity resulted in exposed limestone reef formations, while new reefs grew on the volcanic substrate brought closer to the surface of the water. The succession of raised reefs can be seen in the form of terraces that characterize Saipan (CNMI DEQ, 1995).

Upon conclusion of the initial active volcanic period, the first major limestone formation grew over Saipan. This formation is known as Takpochau Limestone, and it covers much of the interior of the island today. The major limestone formation that was formed after the second period of volcanic activity is referred to as the Mariana Limestone (CNMI DEQ, 1995).

Geologic logs from monitoring wells installed at the site documented shallow subsurface material as silty to sandy clay ranging in depth from 6 inches to 10 feet below ground surface (bgs), dependant on the location. Shallow material was underlain by limestone. Limestone on this part of the island is primarily composed of early Pleistocene-age Mariana Limestone, which is mainly light-colored, coarsely porous, finely to coarsely fragmental limestone that contains abundant coral (USGS, 2003).

2.4.3 Groundwater Conditions

Depth to groundwater measured in all wells in May 2007 ranged from 1.65 to 2.42 feet above msl. U.S. EPA also observed a significant change in groundwater depths in well UXO-1, where depths rose approximately 1 foot over a 5-hour period when consecutive readings were collected. This change in groundwater elevation suggests that there is likely tidal influence to the onsite monitoring wells. Based on the water level readings in May 2007, the approximate groundwater flow direction was estimated to be west-northwest; however, based on the topography of the site and available groundwater data for this area of the island, groundwater flow direction is unknown. Further groundwater elevation readings need to be collected at the site to accurately characterize groundwater flow directions.

Prior to conducting groundwater sampling, depth to groundwater measurements should be collected at all site monitoring wells to accurately determine groundwater flow.

2.5 ENVIRONMENTAL AND/OR HUMAN IMPACT

There are no residences in the vicinity of the OB/OD facility and groundwater in the vicinity of the site is not currently used as a drinking water source. The potential exists, however, that future development in the area could potentially use groundwater as a drinking water source. Additionally, there are several agricultural homesteads located east to southeast of the site that could potentially use groundwater for livestock drinking water.

The potential exists for environmental impact because the vicinity of the OB/OD facility may be habitat for the federally endangered Nightingale Reed-Warbler.

3.0 PROJECT DATA QUALITY OBJECTIVES

Data quality objectives (DQOs) are quantitative and qualitative criteria that establish the level of uncertainty associated with a set of data.

3.1 PROJECT TASK AND PROBLEM DEFINITION

Based on the use of the property as an OB/OD facility, the potential exists that a release of hazardous waste or hazardous constituents to groundwater from the residual contamination could occur. Previous detonations, conducted under the emergency RCRA permits issued by the U.S. EPA, have potentially impacted groundwater, and ongoing monitoring at the site will be required for future permitting. There is a need to protect the groundwater and coastal resources of Saipan and ensure that groundwater contamination is not occurring as a result of OB/OD operations.

Prior to sampling activities, depth to groundwater measurements will be recorded to more accurately determine groundwater flow direction. Previous data do not support a definitive flow direction.

Groundwater samples from the four groundwater monitoring wells at the site perimeter will be collected and analyzed for the following chemicals of potential concern (COPCs):

- Explosive and energetic compounds
- Metals
- Nitrate-nitrite
- Ammonia
- Phosphate
- Kjeldahl nitrogen
- Perchlorates
- Nitro-Cellulose
- White phosphorus

Analytical data generated will be compared to the baseline concentrations from the 2007 results to determine if the presence of COPCs is increasing with ongoing OB/OD facility activities.

3.2 DATA QUALITY OBJECTIVES

The following sections outline the 7-Step DQO process completed in accordance with *Guidance on Systematic Planning Using the Data Quality Objectives Process, U.S. EPA QA/G-4* (U.S. EPA, 2006).

3.2.1 Step 1: State the Problem

Conceptual Site Model

- The media of concern is groundwater.
- The principal COPCs are explosive and energetic compounds, nitro-cellulose, nitrate-nitrite, ammonia, Kjeldahl nitrogen, perchlorates, phosphate, white phosphorus, and metals.
- The groundwater medium was potentially contaminated with COPCs due to OB/OD operations at the site, and potentially could be contaminated by future operations.
- Groundwater flow direction is unknown.

Exposure Scenarios

Given the current conditions, exposure potential at the site is minimal, because groundwater resources are not currently used in the area. The exposure scenario is based on the future use of the groundwater resource below the site.

Other Considerations and Constraints

The area surrounding the OB/OD facility is covered in dense foliage that makes access to some locations difficult. Additionally, some of this vegetation provides habitat for federally endangered species. Therefore, all efforts to minimize impacts to potential habitat for federally listed endangered species must be made during sampling activities.

3.2.2 Step 2 – Identify the Decision

This section describes the decision that new data are needed to address the contamination problem. The principal study question and alternative action are outlined below.

Principal Study Question: Is groundwater at the perimeter of the OB/OD facility above baseline concentrations for the COPCs?

Alternative Action 1: If yes, engineering controls for the OB/OD facility will need to be created and implemented, or the UXO disposal activities halted.

Alternative Action 2: If no, continue to monitor groundwater with no change to OB/OD facility activities.

Decision Statement

Determine if UXO disposal activities are affecting groundwater and if COPCs are migrating off site.

3.2.3 Step 3 – Inputs to the Decision

Information Currently Available

- Previous depth to water measurement from the four monitoring wells indicated that groundwater beneath the site is tidally influenced. Direction of groundwater flow based on these measurements was inconclusive. The USGS Groundwater Resources Investigation Report (Caruth, 2003) indicates that the regional direction of groundwater flow is towards the northeast. Further relative groundwater elevation data at the site need to be collected.
- Baseline analytical data for COPCs in groundwater at the perimeter of the site.
- Information on COPCs from similar remedial and treatment activities of World War II UXO at the Andersen Air Force Base OB/OD facility in Yigo, Guam.

New Data Required

The following data are required to resolve the decision statement.

- Ongoing groundwater monitoring data at the site perimeter for COPCs.
- Ongoing collection of groundwater elevation data for all monitoring wells at site perimeter to determine accurate groundwater flow direction.

Basis for Determining the Action Levels

Baseline concentrations collected during the 2007 groundwater monitoring event at the facility will be used as the site actions levels to determine if concentrations of COPCs have increased in groundwater beneath the site.

Data Collection Methods

Planned groundwater collection techniques are described in Sections 6.2 of this SAP. The following information is provided to assist in documenting that the DQO process has been completed. Groundwater samples will be collected from monitoring wells installed along the perimeter of the property.

Data Measurement Methods

The site-specific measurement methods are described in Section 5 of this document. The information regarding measurement methods is provided below to assist in documenting that the DQO process has been completed.

3.2.4 Step 4 – Define the Boundaries of the Study

The specific characteristics that define the population being studied are the COPC concentrations in groundwater within the specified spatial and temporal boundaries.

Spatial Boundaries

Additional data will be generated from samples collected from the monitoring wells at the site perimeter. All monitoring wells were installed on cleared land adjacent to either existing or newly installed access roads. Some of the vegetation cleared consisted of tangan tangan, a primary habitat for the endangered Reed Warbler. If re-growth has occurred, impacts to the tangan tangan must be minimized.

Temporal Boundaries

Because only a single groundwater sample will be collected at each location, analytical data will represent only the concentrations of COPCs at a certain point in time. Groundwater data can be influenced by the season, past rainfall, tidal influence, and sampling date.

Project timing and scheduling will take into account the following:

- Schedule of staff.
- Schedule of sample shipping due to all samples requiring off-island laboratory analysis, and lengthy shipping times.

Based on the above considerations, sampling should commence with enough time to ship samples off-island the following day. Due to lengthy shipping times, sample coolers will be packed full with ice around the samples to ensure that the samples will arrive at the laboratory with the sample temperatures at 4 degrees Celsius ± 2 degrees. The laboratory selected for analyzing the groundwater samples should be located on the west coast to reduce the number of transit flights and length of time for analysis.

Scale of Decision Making

The scale of decision-making concerning groundwater will cover the general area where the groundwater was sampled, and will be compared to its position relative to determined or inferred groundwater gradient. Contaminant concentrations in downgradient wells are likely to be indicative of contaminants from site operations. Contaminant concentrations in up- to cross-gradient wells are likely to be indicative of an offsite source.

Prior to groundwater monitoring well installation, a groundwater flow direction was estimated to be east-northeast. During the May 2007 depth to groundwater measurements, an approximate flow direction was determined to be west-northwest. However, tidal and other influences were noted indicating the need for additional data to determine true groundwater flow direction.

Ongoing depth to groundwater measurements need to be collected to accurately determine groundwater flow direction. If groundwater flow direction is in fact determined to be west-northwest, then UXO-4 will serve as the downgradient well, and should indicate if any contamination is leaving the site in groundwater flowing west-northwest. One of the ongoing goals for the project will be to determine which direction groundwater flows at the site.

Practical Constraints on Data Collection

- Groundwater parameters defined in Section 6.2 should stabilize prior to sample collection to ensure a representative sample.

Other Constraints on Data Collection

- Turnaround times on analytical data are always estimated and cannot be assured. Sample and system problems may indiscriminately increase data turnaround times.
- Definitive data should undergo a U.S. EPA Tier 1A validation prior to final reporting.
- No site access issues are expected.

3.2.5 Step 5 – Develop Decision Rules

Site Action Level

The baseline concentrations collected during the 2007 sampling event will be the site action levels for the COPCs. Where COPCs were not detected, the laboratory practical quantitation limits (PQLs) or reporting limits (RLs) from the 2007 sampling results are used.

Project Decision Rules:

- If COPCs concentrations are above baseline concentrations, then data will be used for decisions regarding any additional environment investigation/remediation that may be required.

- If COPCs concentrations are not detected above baseline conditions in any of the samples collected then data will document no COPCs have migrated offsite via groundwater.

3.2.6 Step 6 – Specify Tolerable Limits on Decision Errors

Range of the Parameter(s) of Interest

For all investigation areas and parameters, the range of interest for COPCs is from the method detection limit (MDL) to anything above the action levels or RLs. Quantitatively precise and accurate determinations of contaminant concentrations that are significantly above (i.e., >100 times) the action levels are not necessary.

Baseline Condition (The Null Hypothesis)

COPCs are not present in perimeter groundwater above site action levels.

Alternative Condition (The Alternative Hypothesis)

COPCs are present in perimeter groundwater above site action levels.

3.2.7 Step 7 – Optimize the Design for Obtaining Data

The sampling design was based on estimated groundwater flow direction and accessibility of sample locations. Monitoring well locations were selected to maximize the potential to detect COPCs migrating offsite through groundwater. Because only one sampling event was completed at the study area, there is no information on sampling data variability for the study area. Without these variability data, it is not possible to statistically calculate the appropriate number of samples needed to satisfy the decision error objective prior to sampling. However, once ongoing monitoring samples have been collected and analyzed, it will be possible to calculate whether the decision error objectives have been achieved.

3.2.8 Action Level Selection

Groundwater Action Levels

Groundwater action levels are based on the results of the initial 2007 groundwater sampling event.

3.3 DATA QUALITY INDICATORS (DQIs)

The DQIs for this project were developed following the guidelines in *U.S. EPA Guidance for Quality Assurance Project Plans, EPA QA/G-5 Final* (U.S. EPA 240/B-01/003, 2002). All sampling procedures are documented in Section 6.2, and standard operating procedures detailed in Appendix A. These steps will be followed to ensure representativeness of sample results by obtaining characteristic samples. Approved U.S. EPA methods and standard reporting limits will be used. All data not rejected will be considered complete.

3.4 DATA REVIEW AND VALIDATION

Tier 1A/1B review involves evaluation of quality control data for the project for 100 percent of the data generated.

If, during or after the review of the Tier 1A or 1B evaluation report of the project's analytical data, it is found that the data contain excess Quality Assurance/Quality Control (QA/QC) problems or if the data do not meet the DQI goals, then the Project Manager may determine that additional data evaluation is necessary. Additional evaluation may include the *U.S. EPA Region IX Superfund Data Evaluation/ Validation Guidance R9QA/006.1* Tier 2 or 3 evaluation.

The following criteria will be evaluated during a Tier 1A evaluation:

- Data package completeness

- Laboratory QA/QC summaries
- Holding times
- Blank contamination
- Matrix-related recoveries
- Field duplicates
- Random data checks.

Upon completion of evaluation, an analytical data evaluation Tier 1A review report will be delivered to the project manager, and the data will be classified within the report as one of the following:

- Acceptable for use without qualifications
- Acceptable for use with qualifications
- Unacceptable for use.

The data with qualifications will be attached to the report. The analytical data evaluation Tier 1A review report will compare data to specific project quality objectives, which include target analytes, sensitivity, analytical accuracy, analytical and sampling precision, and analytical completeness.

Unacceptable data may be more thoroughly examined to determine whether corrective action could mitigate data usability.

3.5 DATA MANAGEMENT

Samples will be collected and logged on chain-of-custody forms as discussed in Section 9.3. Sampling information will also be recorded on sampling forms, as discussed in Section 9.1. Samples will be kept secure in the custody of the sampler at all times, which will assure that all preservation parameters are being followed. All samples will be transferred to the analytical laboratories via a certified carrier in a property custody-sealed container with chain-of-custody documentation, as discussed in Section 9.3. The laboratories will note any evidence of tampering upon receipt.

4.0 SAMPLING RATIONALE

Sampling rationale for the collection of groundwater samples is outlined below. Additional information is provided in Section 3.2.5, Develop Decision Rules; and Section 3.2.7, Optimize the Design. Sample locations are shown on Figure 2.

Groundwater samples will be collected from monitoring wells at four locations along the cross- to downgradient perimeter of the site (Figure 2). The monitoring well network will identify any COPCs migrating offsite through groundwater. Wells UXO-1 through UXO-3 are located on an existing coral road on the northeastern perimeter of the site. The fourth monitoring well is located to the northwest of the OB/OD pit in an area primarily covered with elephant grass. These locations minimize impacts to potential habitat for federally endangered species during sampling activities.

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5.0 REQUEST FOR ANALYSES

Groundwater samples will be analyzed for the following:

- Explosive and Energetic Compounds by U.S. EPA Method 8330
- Metals by U.S. EPA Method 200.7 and 245.1
- Nitrate-Nitrite by U.S. EPA Method 353.2
- Ammonia by U.S. EPA Method 350.1
- Phosphate by U.S. EPA Method 365.4
- Kjeldahl Nitrogen by U.S. EPA Method 351.1
- Perchlorates by U.S. EPA Method 314.0
- Nitro-Cellulose by U.S. EPA Method 353.2
- White Phosphorus by U.S. EPA Method 7580.

Sample containers, preservatives, and holding times are summarized in Table 5-1. To provide quality control for the analytical program, the following measures will be used:

- All groundwater analyses will be conducted by Enthalpy Analytical Laboratory in Orange, California.
- Additional sample volume will be collected and used for matrix spike/matrix spike duplicate analysis for at least one groundwater sample per analytical method.
- One laboratory blind duplicate will be collected for every ten samples of groundwater.
- An equipment blank for non-dedicated equipment will be collected for each day of sampling when non-dedicated sampling equipment is used.

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6.0 FIELD METHODS AND PROCEDURES

The following sections describe in detail the groundwater sample collection methods. Specific analysis requests for the groundwater samples are given in the sections of the SAP preceding this section. Section 7 of this SAP describes sample packaging. Section 9 of this SAP describes sample tracking and shipping, and requirements for field notes.

Groundwater samples will be collected employing low-flow sampling methodology. Detailed groundwater sampling procedures are provided below in Section 6.2 and the detailed standard operating procedures in Appendix A.

6.1 FIELD EQUIPMENT

The following sections provide information regarding the field equipment, sampling supplies, and consumables that will be used to collect the groundwater samples outlined in this SAP.

6.1.1 List of Equipment Needed

The equipment listed in Table 6-1 will be used to obtain environmental samples from the respective media in accordance with the following sampling standard operating procedures (SOPs):

- SOP - 04 *Monitoring Well Sampling*
- ERT *Superfund Program Representative Sampling Guidance Volume 5: Water and Sediment, Part II Groundwater*
- U.S. EPA Ground Water Issue: *Low-Flow (Minimal Drawdown) Groundwater Sampling Procedures*
- ASTM Standard Practice for *Low-Flow Purging and Sampling for Wells and Devices Used for Ground-Water Quality Investigations.*

Copies of these SOPs are included in Appendix A.

6.1.2 Equipment Maintenance

Field instrumentation for groundwater samples will be operated, calibrated, and maintained in accordance with the manufacturer’s instructions, and in the manner indicated in the SOPs listed in Section 6.1.1 above.

6.2 GROUNDWATER SAMPLING

A low-flow sampling procedure will be used to collect all groundwater samples to ensure the sampling of undisturbed formation water and the accurate measurement of field parameters. This procedure is detailed in a U.S. EPA guidance document included as Appendix A. The procedure involves the withdrawal of groundwater from the middle portion of the well screen at low flows until field-measured parameters (pH, conductivity, turbidity, temperature, redox potential (ORP), and dissolved oxygen) stabilize. After parameter stabilization, the groundwater sample is collected. If the low-flow technique is unsuccessful at any well according to the criteria stated in the guidance, three well volumes will be purged from the well, and grab samples will be collected directly from the monitoring wells using a polyethylene bailer.

The list below summarizes the procedures to be followed for low-flow sampling:

- An adequately sized visqueen/plastic sheet will be laid out on the ground near the sampling well for placing the sampling equipment.
- A 1.5-inch bladder pump will be placed in the well in the middle of the screen interval, and purging will proceed according to the U.S. EPA low-flow guidance (0.1 to 0.5 liter per minute).
- Field parameters and purge rates will be logged and recorded in the site log book.
- Sampling will occur according to the U.S. EPA Guidance after field parameters have stabilized according to the U.S. EPA Guidance criteria.
- If the low-flow technique is unsuccessful per U.S. EPA Guidance criteria, three well water volumes will be evacuated from the well, and sampling will occur after field parameters have stabilized.
- Groundwater samples will be transferred directly into the containers from the bladder pump tubing while minimizing turbulence and bubbles. Samples for metals analysis will be field filtered with a 0.45-micron filter.

6.3 DECONTAMINATION PROCEDURES

All non-dedicated equipment that comes into contact with potentially contaminated soil or groundwater will be decontaminated in accordance with SOP - 01, and the procedures outlined below. The SOPs are provided in Appendix A. Equipment will be decontaminated in a pre-designated area on pallets, racks, or plastic sheeting and clean equipment will be stored in an uncontaminated area. Disposable equipment intended for one-time use will not be decontaminated, but will be packaged for appropriate disposal. Decontamination will occur after each use of a piece of equipment. The non-dedicated equipment that will require decontamination is itemized in Table 6-1.

7.0 SAMPLE CONTAINERS, PRESERVATION AND STORAGE

All sample containers will be delivered to the field team in a pre-cleaned and pre-preserved condition from the container supplier. Container, preservation, and holding time requirements are summarized in Table 5-1.

7.1 WATER SAMPLES

Water samples will be placed in a cooler with ice in a secure location onsite pending shipment to the analytical laboratory. Sample coolers will be retained in the custody of field personnel at all times, or secured so as to deny access to anyone else. The procedures for shipping samples are as follows:

- Ice in bags or frozen plastic water bottles.
- The drain plug of the cooler, if any, will be taped shut to prevent leakage.
- The bottom of the cooler will be lined with bubble wrap to prevent breakage during shipment.
- Screw caps will be checked for tightness.
- All glass sample containers will be wrapped in bubble wrap.

Samples will be placed in coolers with the appropriate chain-of-custody documentation. All forms will be enclosed in plastic bags and affixed to the underside of the cooler lid. Ice will be placed on top of and around samples. Empty space in the cooler will be filled with bubble wrap or packing material to prevent movement and breakage during shipment. Each cooler will be securely taped shut with strapping tape, and custody seals will be affixed to the front and back of each cooler.

8.0 DISPOSAL OF INVESTIGATION-DERIVED WASTE

In the process of collecting environmental samples at this site during sampling will generate different types of potentially contaminated investigation derived waste (IDW) that include the following:

- Used personal protective equipment (PPE)
- Disposable sampling equipment
- Decontamination fluids
- Monitoring well purge water.

Used PPE and disposable equipment will be double-bagged and placed in a municipal refuse dumpster. These wastes are not considered hazardous and can be sent to a municipal landfill. Any PPE and disposable equipment that is to be disposed of but could still be reused will be rendered inoperable before disposal in the refuse dumpster.

Decontamination fluids that will be generated in the sampling event will consist of residual contaminants, and water with non-phosphate detergent. The volume and concentration of the decontamination fluid will be sufficiently low to allow disposal to the unpaved area at the site.

Monitoring well purge water is not expected to contain any significant levels of contamination, and therefore will be disposed of onto an unpaved area of the site.

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9.0 SAMPLE DOCUMENTATION AND SHIPMENT

The following sections discuss field notations and shipping procedures.

9.1 FIELD NOTES

Field notes will document where, when, how, and from whom any vital project information was obtained. Field notes will be complete and accurate enough to permit reconstruction of field activities. A separate logbook will be maintained for each project. Logbooks are bound, with consecutively numbered pages. Each page will be dated and the time of entry noted based on a 24-hour clock. All entries will be legible, written in ink, and signed by the individual making the entries. Language will be factual, objective, and free of personal opinions. The following information will be recorded, if applicable, during the collection of each sample:

- Sample location and description
- Site or sampling area sketch showing sample location and measured distances
- Sampler's name(s)
- Date and time of sample collection
- Designation of sample as composite or grab
- Type of sample (matrix)
- Type of sampling equipment used
- Field instrument readings and calibration (e.g., VOC air monitoring data)
- Field observations and details related to analysis or integrity of samples (e.g., weather conditions, noticeable odors, colors, etc.)
- Preliminary sample descriptions (e.g., for soils: clay loam, very wet; for water: clear water with strong ammonia-like odor)
- Sample preservation
- Sample identification numbers and any explanatory codes
- Shipping arrangements (overnight air bill number)
- Name(s) of recipient laboratory(ies).

In addition to the sampling information, the following specific information will also be recorded for each day of sampling:

- Team members and their responsibilities

- Time of arrival/entry on site and time of site departure
- Other personnel on site
- Summary of any meetings or discussions with tribal, contractor, or federal agency personnel
- Deviations from sampling plans, site safety plans, and SAP procedures
- Changes in personnel and responsibilities, with reasons for the changes
- Levels of safety protection
- Calibration readings for any equipment used, and equipment model and serial number
- Record of photographs

9.1.1 Photographs

Photographs will be taken at the sampling locations and at other areas of interest on site. They will serve to verify information entered in the field logbook. For each photograph taken, the following information will be included in the field notes or recorded in a separate field photography log:

- Time, date, location, and weather conditions
- Description of the subject photographed
- Name of person taking the photograph.

9.2 SAMPLE NOMENCLATURE

A unique, identifiable name will be assigned to each monitoring well location. Wells will be identified with the prefix UXO, followed by the monitoring well number (i.e., UXO-1). Groundwater samples will be identified by the monitoring well location where they were collected.

Duplicates and blank samples will be assigned fictitious names. For duplicates, the sample will be identified by placing a 9 behind the sample name of the associated field samples. For example, the duplicate sample of UXO-1 will be UXO-19. Equipment blanks will be identified with the prefix “B” followed by the well number in the order collected (i.e., UXO-2B, will be the equipment blank collected from UXO-2, etc.). Matrix Spike/Matrix Spike Duplicate Sample will be indentified with the prefix “MS/MSD” i.e UXO-MS/MSD.

9.3 SAMPLE CHAIN-OF-CUSTODY FORMS AND CUSTODY SEALS

All sample shipments for analyses will be accompanied by a chain-of-custody document. Chain-of-custody document will be completed and sent with the samples in each cooler.

The chain-of-custody document will identify the contents of each shipment, and maintain the custodial integrity of the samples. Generally, a sample is considered to be in someone's custody if it is either in someone's physical possession, in someone's view, locked up, or kept in a secured area that is restricted to authorized personnel. Until the samples are shipped, the custody of the samples will be the responsibility of the field staff. The sampling team leader or designee will sign the chain-of-custody form in the "relinquished by" box and note date, time, and air bill number.

The shipping containers in which samples are stored (usually a sturdy picnic cooler or ice chest) will be sealed with self-adhesive custody seals any time they are not in someone's possession or view before shipping. All custody seals will be signed and dated.

9.4 PACKAGING AND SHIPMENT

All sample containers will be placed in a sturdy shipping container (such as a hard plastic cooler). The packaging procedures for concentration samples are as follows:

1. Ice will be either packed in re-sealable double plastic bags or frozen in plastic bottles. Seal the drain plug of the cooler with fiberglass or duct tape to prevent melting ice from leaking out of the cooler.
2. The bottom of the cooler should be lined with bubble wrap to prevent breakage during shipment.
3. Check screw caps for tightness, and if not full, mark the sample volume level of liquid samples on the outside of the sample bottles with indelible ink.
4. Affix sample labels onto the containers with clear tape.
5. Wrap all glass sample containers in bubble wrap to prevent breakage.
6. Place samples in a sturdy cooler(s) and pack the cooler with as much ice as possible. Enclose the appropriate chain-of-custody in a ziplock plastic bag affixed to the underside of the cooler lid.
7. Fill any empty space in the cooler with packing material to prevent movement and breakage during shipment.
8. Each cooler will be securely taped shut with packing tape, and custody seals will be affixed to two sides of the cooler lid.

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10.0 QUALITY CONTROL

This section discusses the quality control samples that are planned to support the sampling activities, including field and laboratory QC samples and confirmation samples.

10.1 FIELD QUALITY CONTROL SAMPLES

Field contamination is usually assessed through the collection of different types of blanks. An equipment field blank is planned for this investigation, and a description of the planned blank is provided in the paragraphs below.

10.1.1 Equipment Blanks

An equipment blanks will be collected to evaluate field sampling and decontamination procedures by pouring deionized water (for inorganics) over the decontaminated sampling equipment and collecting the poured water in sample collection bottles. The equipment blank collected will be analyzed for all COPCs.

The equipment rinsate blanks will be preserved, packaged, and sealed in the manner described for the environmental samples. The equipment blank will be assigned a well number followed by the letter “B” (i.e. UXO-2B). The equipment blank will be collected from the bladder pump used to sample the monitoring well associated with the well that was sampled prior to cleaning the pump. For example after cleaning UXO-2, an equipment blank will be collected from the pump and labeled “UXO-2B.”

10.1.2 Field Duplicate

Assessment of sample variability is accomplished through the collection and analysis of a field duplicate sample. One duplicate groundwater sample will be collected at the site. Due to the lack of information on the site, this location will be assigned arbitrarily and may be changed in the field based on observations indicating locations where detectable levels of COPCs are expected to be present. Duplicate samples are assigned at a rate of one for every ten field samples.

The field duplicate samples will be preserved, packaged, and sealed in the same manner as other samples of the same matrix. A separate sample number and station number will be assigned to the blind duplicate, and will be submitted to the laboratory.

10.2 LABORATORY QUALITY CONTROL (QC) SAMPLES

Samples from selected groundwater locations will be identified for use as laboratory QC samples for matrix spike and matrix spike duplicate analysis in Table 5-1. Additional volume will be supplied when required, and the laboratory will be alerted as to which sample is to be used for QC analysis by a notation on the sample container label and the chain-of-custody record or packing list.

At a minimum, one laboratory QC sample per 20 samples is required (including blanks and duplicates). For this sampling event, samples collected at the locations determined in the field will be designated on the chain-of-custody document as laboratory QC samples. Due to the lack of information on the site, these locations have been assigned arbitrarily and may be changed in the field based on field observations indicating locations where detectable levels of COPCs are expected to be present.

11.0 FIELD VARIANCES

Because conditions in the field may vary, it may become necessary to implement minor modifications to sampling as presented in this plan. When appropriate, the CNMI DEQ/BECQ will be notified and a verbal approval will be obtained before implementing the changes. Modifications to the approved plan will be documented in the sampling project report.

12.0 REFERENCES

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TABLES

Table 5-1 Analytical Methods, Containers,Holding Times Preservatives

Analytical Parameters	Analyical Method	Container (Sixe/Volume)	Preservation Requirement	Maximum Holding Time
Explosives	EPA 8330	1 L Glass	none	7 days
Metals	EPA 200.7	500 ml poly	Nitric acid	6 months
Mercury	EPA 245.1	500 ml poly	Nitric acid	28 days
Nitrate-Nitrite	EPA 300	500 ml poly	none	48 hrs
Nitro-Cellulose	EPA 353.2	500 ml poly	none	48 hrs
Ammonia	SM 4500-NH3	250 ml poly	Sulfuric acid	28 days
Phosphate	SM 4500-P-B-E	100 ml poly	none	24 hours
Total Kjeldahl Nitrogen	SM 4500-Norg	1 L poly	Sulfuric acid	28 days
Perchlorate	EPA 314.0	250 ml poly	none	28 days
White Phosphorus	EPA 7580	1 L poly	none	5 days

Table 6-1 Groundwater Monitoring Sampling Equipment, OB/OD Facility, Saipan CNMI

Equipment	Use
Horiba U-52	Water quality meter (DO, ORP, pH, Temp.,turbidity, conductivity and salinity)
Solonist Water Level Meter	Measure depth to water in monitoring wells
1.5-inch Dia bladder pump	QED Low-flow pump to purge monitoring wells
1/4-inch diam PE tubing	polyethylene tubing for purging and sampling groundwater monnitoring wells
Pump Controler	Low flow pump control to control pump rate
Compressed Air Cylinder	Air to punp bladder pump to purge groundwater
Camera	Document well and site conditions
Spray Bottles	Decontaminaitoin equipment for pump and water indicator
Plastic 10-gallon tubs	Decontaminaitoin equipment for pump and water indicator
Brushes	Decontaminaitoin equipment for pump and water indicator
Plastic sheetinig	Decontaminaitoin equipment for pump and water indicator
Paper towels	Decontaminaitoin equipment for pump and water indicator
Alconox	Decontaminaitoin equipment for pump and water indicator
Isopropyl alcohol	Decontaminaitoin equipment for pump and water indicator
Nitrile gloves	Personnel Protective Equipment and QA sample control
48 quart hard plastic coolers	Sample container
Log Book	Document field activities
ink pen, sharpie	Document field activities

Notes:
DO - dissolved oxygen
ORP - oxidation reduction potential
Temp. - temperature

FIGURES

Appendix A

Standard Operating Procedures

apec STANDARD OPERATING PROCEDURES:
SOP 01 - EQUIPMENT DECONTAMINATION

1.0 PURPOSE

The standard operating procedure (SOP) describes methods of equipment decontamination for use during site activities at project sites.

1.2 SCOPE

These procedures shall be followed during decontamination of field equipment used to sample environmental media.

This procedure shall serve as management-approved professional guidance for APEC personnel. It is not intended to obviate the need for professional judgment that may arise in unforeseen circumstances. The project manager must approve deviations from this procedure in the planning or execution of activities.

1.3 DEFINITIONS

None.

1.4 RESPONSIBILITIES

The Project Manager is responsible for identifying instances of non-compliance with this procedure and ensuring that decontamination activities are in compliance with this procedure.

The Project Manager is responsible for ensuring that decontamination activities conducted during all projects are in compliance with this procedure.

The Field Team is responsible for ensuring that all field equipment is decontaminated according to this procedure.

1.5 PROCEDURES

Decontamination of equipment used in soil/sediment sampling, groundwater monitoring, well drilling and well development, as well as equipment used to sample ground water, surface water, sediment, waste, wipe, asbestos, and unsaturated zone is necessary to prevent cross-contamination and to maintain the highest integrity possible in collected samples. Planning a decontamination program requires consideration of the following factors:

- The location where the decontamination procedures will be conducted
- The types of equipment requiring decontamination
- The frequency of equipment decontamination
- The cleaning technique and types of cleaning solutions appropriate to the contaminants of concern
- The method for containing the residual contaminants and wash water from the decontamination process

- The use of a quality control measure to determine the effectiveness of the decontamination procedure

This subsection describes standards for decontamination, including the techniques to be used, frequency of decontamination, cleaning solutions, and effectiveness.

1.6 DECONTAMINATION AREA

An appropriate location for the decontamination area at a site shall be selected on the basis of the ability to control access to the area, the ability to control residual material removed from equipment, the need to store clean equipment, and the ability to restrict access to the area being investigated. The decontamination area shall be located an adequate distance away and upwind from potential contaminant sources to avoid contamination of clean equipment.

1.7 TYPES OF EQUIPMENT

Drilling equipment that must be decontaminated includes drill bits, auger sections, drill- string tools, drill rods, split barrel samplers, tremie pipes, clamps, hand tools, and steel cable. Decontamination of monitoring well development and groundwater sampling equipment includes submersible pumps, bailers, interface probes, water level meters, bladder pumps, air lift pumps, peristaltic pumps, and lysimeters. Other sampling equipment that requires decontamination includes, but is not limited to, hand trowels, hand augers, slide hammer samplers, shovels, stainless steel spoons and bowls, soil sample liners and caps, wipe sampling templates, COLIWASA samplers, and dippers. Equipment with a porous surface, such as rope, cloth hoses, and wooden blocks, cannot be thoroughly decontaminated and shall be properly disposed of after one use.

1.8 FREQUENCY OF EQUIPMENT DECONTAMINATION

Down-hole drilling equipment and equipment used in monitoring well development and purging shall be decontaminated prior to initial use and between each borehole or well. However, down-hole drilling equipment may require more frequent cleaning to prevent cross-contamination between vertical zones within a single borehole. Groundwater sampling shall be initiated by sampling groundwater from the monitoring well where the least contamination is suspected. All groundwater, surface water, and soil sampling devices shall be decontaminated prior to initial use and between collection of each sample to prevent the possible introduction of contaminants into successive samples.

1.9 CLEANING SOLUTIONS AND TECHNIQUES

A rinse decontamination procedure is acceptable for equipment such as bailers, water level meters, new and re-used soil sample liners, and hand tools. The decontamination procedure shall consist of the following: (1) wash with a non-phosphate detergent (Alconox, Liquinox, or other suitable detergent) and potable water solution, (2) rinse in a bath with potable water, (3) spray with isopropyl alcohol, (4) rinse in a bath with deionized or distilled water, and (5) spray with deionized or distilled water. If possible, equipment shall be disassembled prior to cleaning. A second wash should be added at the beginning of the process if equipment is very soiled.

Decontaminating submersible pumps requires additional effort because internal surfaces become contaminated during usage. These pumps shall be decontaminated by washing and rinsing the outside surfaces using the procedure described for small equipment or by steam cleaning. Internal surfaces shall be decontaminated by recirculating fluids through the pump while it is operating. This recirculation can be done using a relatively long (typically 4 feet) large diameter pipe (4-inch or greater) equipped with a bottom cap. The pipe shall be filled with the decontamination fluids, the pump placed within the closed pipes, and the pump operated while recirculating the fluids back into the pipe. The decontamination sequence shall include (1) detergent and potable water, (2) potable water rinse, (3) isopropyl spray into the pump, (4) potable water rinse, and (5) deionized water rinse. The decontamination fluids shall be changed after each decontamination cycle.

Solvents other than isopropyl alcohol may be used, depending upon the contaminants involved. For example, if polychlorinated biphenyls (PCBs) or chlorinated pesticides are contaminants of concern, hexane may be used as the decontamination solvent. However, if samples are also to be analyzed for volatile organics, hexane shall not be used. In addition, some decontamination solvents have health effects that must be considered. Decontamination water shall consist of distilled or deionized water. Steam-distilled water 'shall not be used in the decontamination process as this type of water usually contains elevated concentrations of metals.

Equipment used for measuring field parameters such as pH, temperature, specific conductivity, and turbidity shall be rinsed with deionized or distilled water after each measurement. New, unused soil sample liners and caps will also be washed with a fresh detergent solution and rinsed with potable water followed by distilled or deionized water to remove any dirt or cutting oils that may be on them prior to use.

1.10 RECORDS

The decontamination process shall be described in the field logbook.

1.11 HEALTH AND SAFETY

It is the responsibility of the Site Health and Safety Officer (SHSO) to set up the site zones (i.e., exclusion, transition, and clean) and decontamination areas. Generally the decon area is located within the transition zone, upwind of intrusive activities, and serves as the area where both personnel and equipment are washed to minimize the spread of contamination into the clean zone. For equipment, a series of buckets are set up on a visqueen-lined bermed area. Separate spray bottles containing isopropyl alcohol (or alternative cleaning solvent as described in the APEC Work Plan or Field Sampling Plan) and distilled water are used for final rinsing of equipment. Depending on the nature of the hazards and the site location, decontamination of heavy equipment such as augers, pump drop pipe, and vehicles may be accomplished using a variety of techniques.

Personnel responsible for equipment decon must wear the PPE specified in the site- specific Health and Safety Plan (HSP). Generally this includes at a minimum Tyvek® coveralls, steel-toed boots with boot covers or steel-toed rubber boots, safety glasses, ANSI-Standard hard hats, and hearing protection (if heavy equipment is in operation). It should be noted that air monitoring by the SHSO may result in an upgrade to the use of half-face respirators and cartridges in the decon area; therefore, this equipment must be available onsite. If safe alternatives are not achievable, site activities will be discontinued immediately.

In addition to the aforementioned precautions, the following safe work practices will be employed:

<u>Chemical Hazards Associated With Equipment Decontamination</u>

1. Avoid skin contact with and/or incidental ingestion of decon solutions and water.

2. Utilize PPE as specified in the site-specific HSP to maximize splash protection.

3. Refer to safety data sheets (SDSs), safety personnel, and/or consult sampling personnel regarding appropriate safety measures (i.e., handling, PPE - skin, respiratory, etc.).

4. Take necessary precautions when handling detergents and reagents.

Physical Hazards Associated With Equipment Decontamination

1. To avoid possible back strain, it is recommended that the decon area be raised 1 to 2 feet above ground level.

2. To avoid heat stress, over exertion, and exhaustion, it is a recommended that equipment decon be rotated among all site personnel.

3. Take necessary precautions when handling field sampling equipment.

1.12 REFERENCES

None.

apec STANDARD OPERATING PROCEDURES:
SOP - 2, RECORD KEEPING, SAMPLE LABELING, AND CHAIN-OF-CUSTODY PROCEDURES

1.0 PURPOSE

The purpose of this standard operating procedure (SOP) is to establish standard protocols for all APEC field personnel for use in maintaining field and sampling activity records, writing sample logs, labeling samples, ensuring that proper sample custody procedures are utilized, and completing chain-of-custody/analytical request forms.

1.1 SCOPE

This procedure shall apply to all sample collection conducted during APEC activities. This procedure shall serve as management-approved professional guidance for the APEC personnel. It is not intended to obviate the need for professional judgment that may arise in unforeseen circumstances. Deviations from this procedure in the planning or the execution of activities must be approved by the project manager.

1.2 DEFINITIONS

1.2.1 Logbook

A bound field notebook with consecutively numbered, water-repellent pages that is clearly identified with the name of the affected activity, the person assigned responsibility for maintenance of the logbook, and the beginning and ending dates of the entries.

1.2.2 Chain of Custody (COC)

Documentation of the process of custody control. Custody control includes possession of a sample changes hands from the time of its collection in the field to its receipt by the analytical laboratory, and through analysis and storage prior to disposal.

1.2.3 Project Laboratory Coordinator

The person for each project who is the main point of contact with the laboratory project manager. This may or may not be the project manager.

1.3 RESPONSIBILITIES

APEC field personnel are responsible for following these procedures during conduct of sampling activities. APEC field personnel are responsible for recording pertinent data into the logbook to satisfy project requirements and for attesting to the accuracy of the entries by dated signature.

The Project Manager is responsible for ensuring that all field personnel follow these procedures. The contracted laboratory coordinator is responsible for verifying that the COC/Analytical Request Forms have been completed properly and match the sampling and analytical plan. The Project Manager is responsible for notifying the laboratory, data managers, and data validators in writing if analytical request changes are required as a corrective action. These small changes are different from change orders, which involve changes to the scope of the subcontract with the laboratory and must be made in accordance with a respective contract.

The Project Manager is responsible for determining which team members shall record information in the field logbook and for checking sample logbooks and chain-of-custody forms to ensure compliance with these procedures. The contracted Laboratory Project Manager or sample control department manager is responsible for reporting any sample documentation or chain-of-custody problems to the Project Manager within 24 hours of sample receipt.

The Project Manager is responsible for evaluating project compliance with these procedures. The Project Manager, or designee, is responsible for reviewing logbook entries, sample labeling, and chain-of- custody records to ensure that all are adequate to meet project requirements.

1.4 PROCEDURES

Standards for documenting field activities, labeling the samples, documenting sample custody, and completing chain-of-custody/analytical request forms are provided in this procedure. The standards presented in this section shall be followed to ensure that samples collected are maintained for their intended purpose and that the conditions encountered during field activities are documented.

1.4.1 Record Keeping

The field logbook or field forms serves as the primary record of field activities. Entries shall be made chronologically and in sufficient detail to allow the writer or a knowledgeable reviewer to reconstruct each day's events.

1.4.2 Sample Labeling

A sample label with adhesive backing shall be affixed to each individual sample container. Clear tape shall be placed over each label (preferably prior to sampling) to prevent the labels from tearing off, falling off, being smeared, and to prevent loss of information on the label. The following information shall be recorded with a waterproof marker on each label:

- Project name or number (optional)
- Unique ID sample number
- Date and time of collection
- Sampler's initials
- Matrix (optional)
- Sample preservatives (if applicable)
- Analysis to be performed on sample (typically for water samples only) This shall be identified by the method number or name identified in the subcontract with the laboratory

These labels may be obtained from the analytical laboratory or printed from a computer file onto adhesive labels.

1.4.3 Custody Procedures

For samples intended for chemical analysis, sample custody procedures shall be followed through collection, transfer, analysis, and disposal to ensure that the integrity of the samples is maintained. Custody of samples shall be maintained in accordance with EPA chain-of-custody guidelines as prescribed in EPA *NEIC Policies and Procedures,* National Enforcement Investigations Center, Denver, Colorado, revised May 1986; EPA *RCRA Ground Water Monitoring Technical Enforcement Guidance Document (TEGD), Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLI* (EPA OSWER Directive 9355 3-01), Appendix 2 of the *Technical Guidance Manual for Solid Waste Water Quality Assessment Test (SWAT) Proposals and Reports,* and *Test Methods for Evaluating Solid Waste* (EPA SW-846). A description of sample custody procedures is provided below.

1.4.3.1 Sample Collection Custody Procedures

According to EPA *NEIC Policies and Procedures,* a sample is considered to be in custody if:

- It is in one's actual physical possession or view
- It is in one's physical possession and has not been tampered with (i.e., it is under lock or official seal)
- It is retained in a secured area with restricted access
- It is placed in a container and secured with an official seal such that the sample cannot be reached without breaking the seal

Custody seals shall be placed on sample containers immediately after sample collection and on shipping coolers if the cooler is to be removed from the sampler's custody. Custody seals will be placed in such a manner that they must be broken to open the containers or coolers. The custody seals shall be labeled with the following information:

- Sampler's name or initials
- Date and time that the sample/cooler was sealed.

These seals are designed to enable detection of sample tampering.

Field personnel shall also log individual samples onto chain-of-custody forms when a sample is collected. These forms may also serve as the request for analyses. Procedures for completing these forms are include completing unique ID sample number, matrix, date and time of collection, number of containers, analytical methods to be performed on the sample, and preservatives added (if any). The COC will include the FedEx Waybill shipping number so that the coolers can be tracked during shipment.

The samplers will sign the COC form signifying that they were in possession of the samples up to the time of shipping the samples to the laboratory. The person delivering the samples for transport will sign and indicate the date and time on the accompanying COC form. A copy of the COC form shall be along with any other documents required for shipping such as the Commercial Invoice Form and TSCA Certification Form) placed inside a self-sealing bag and taped to the inside of the cooler. Each cooler must be associated with a unique COC form. Whenever a transfer of custody takes place, both parties shall sign and date the accompanying carbon copy COC forms, and the individual relinquishing the samples shall retain a copy of each form. One exception is when the samples are shipped; the delivery service personnel will not sign or receive a copy because they do not open the coolers. The laboratory shall attach copies of the completed COC forms to the reports containing the results of the analytical tests. An email will be sent to the laboratory Project Manager informing them the number of coolers sent, Waybill number and a copy of the COC.

1.4.3.2 Laboratory Custody Procedures

The following are custody procedures to be followed by an independent laboratory receiving samples for chemical analysis; the procedures in their laboratory Quality Assurance Plan must follow these same procedures. A designated sample custodian shall take custody of all samples upon their arrival at the analytical laboratory. The custodian shall inspect all sample labels and COC forms to ensure that the information is consistent, and that each is properly completed. The custodian will also measure the temperature of the samples in the coolers upon arrival and note the condition of the samples including:

- if the samples show signs of damage or tampering
- if the containers are broken or leaking
- if headspace is present in sample vials
- proper preservation of samples (made by pH measurement)
- if any sample holding times have been exceeded

All of the above information should be documented on a sample receipt by the custodian. Any discrepancy or improper preservation shall be noted by the laboratory and shall be documented with corrective action taken.

The custodian shall then assign a unique laboratory number to each sample and distribute the samples to secured storage areas maintained at 4ºC. The unique laboratory number for each sample, the unique ID sample number, the client name, date and time received, analysis due date, and storage shall also be manually logged onto a sample receipt record and later entered into the laboratory's computerized data management system. The custodian shall also sign the shipping bill and maintain a copy.

Laboratory personnel shall be responsible for the care and custody of samples from the time of their receipt at the laboratory through their exhaustion or disposal. Samples should be logged in and out on internal laboratory COC forms each time they are removed from storage for extraction or analysis.

1.5 COMPLETING CHAIN-OF-CUSTODY/ANALYTICAL REQUEST FORMS

COC form/analytical request completion procedures are crucial in properly transferring the custody and responsibility of samples from field personnel to the laboratory. This form also is important for accurately and concisely requesting analyses for each sample; it is essentially a release order from the analysis subcontract.

The COC form at a minimum will include the following items that must be completed by the field team:

- The name of the APEC Project Manager shall be the name that will appear on the COC document. Do not write the name of the Project Coordinator or Point of Contact for the project.

- The project name; write it as it is to appear on the Sampling and Analysis Plan (SAP).

- The Laboratory Project Manager’s name and laboratory address.

- Shipment Method**:** State the method of shipment, e.g., hand carry; air courier via FED EX, UPS or DHL. If shipping by air courier include the shipment tracking number on the COC form.

- The comment section area shall be used by the field team to communicate observations, potential hazards, or limitations that may have occurred in the field or additional information regarding analysis. For example: a specific metals list, explanation of Mod 8015, Mod 8015 + Kerosene, samples expected to contain high analyte concentrations.

- Turn around time (TAT): TAT for contract work will be included on the COC form as determined in the contract between APEC and the laboratory responsible for analysis.

- The type of container used and number of bottles shipped for each sample location (e.g., I liter glass amber, for a given parameter in that column).

- Field personnel must indicate on the COC the correct preservative used for the analysis requested.

- Unique sample identification; this ID number/name for each sample location will be included on the COC. The sample location description will be included on field notes and the unique sample identification number/name will be referenced to the sample location.

- Sampler's will be identified on the COC form.

- Relinquished By: This space shall contain the signature of the person who turned over the custody of the samples to a second party (other than an express mail carrier such as FEDEX, DHL or UPS.

- Received By: Typically, this is signed by a representative of the receiving laboratory. Alternately, this signature could be from a field crew member who delivered the samples in person from the field to the laboratory. A courier such as Federal Express or DHL does not sign this because they do not open the coolers. It must also be used by the prime contracting laboratory when samples are to be sent to a subcontractor.

- Relinquished By: In the case of subcontracting, the primary laboratory will sign the “Relinquished By” space and fill out an additional COC to accompany the samples being subcontracted.

- Received By (Laboratory): This space is for the final destination, e.g., at a subcontracted laboratory.

1.6 RECORDS

The COC/analytical request form shall be faxed approximately daily to the Project Laboratory Coordinator for verification of accuracy. Following the completion of sampling activities, the sample logbook and COC forms will be transmitted to the Project Manager for storage in project files. The Project Manager shall review COC forms on a monthly basis at a minimum. The data-validators shall receive a copy also. The original COC/analytical request form shall be submitted by the laboratory along with the data delivered. Any changes to the analytical requests that are required shall be made in writing to the laboratory. A copy of this written change shall be sent to the data-validators and placed in the project files. The reason for the change shall be included in the project files so that recurring problems may be easily identified.

1.7 HEALTH AND SAFETY

Not applicable.

1.8 REFERENCES

State of California Water Resources Control Board. 1988. Technical Guidance Manual for Solid Waste Water Quality Assessment Test (SWAT) Proposals and Reports.

USEPA. 1986. EPA NEIC Policies and Procedures, National Enforcement Investigations Center, Denver, Colorado.

USEPA. 1988. Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA (EPA USWER Directive 9355 3-01).

USEPA. 1992. RCRA Ground Water Monitoring Technical Enforcement Guidance Document (TEGD).

USEPA. 1995 and as updated. Test Methods for Evaluating Solid Waste (SW-846), Third edition.

1.9 ATTACHMENTS

None

apec STANDARD OPERATING PROCEDURES:
SOP - 03, SAMPLE HANDLING, STORAGE, AND SHIPPING

1.0 SAMPLE HANDLING, STORAGE, AND SHIPPING

1.1 Purpose

This standard operating procedure (SOP) sets forth the methods for use by APEC field personnel engaged in handling, storing, and transporting samples.

1.2 Scope

This procedure applies to all samples, and sample containers handled, stored, shipped, or otherwise transported during APEC Activities.

This procedure shall serve as management-approved professional guidance for APEC personnel. It is not intended to obviate the need for professional judgment that may arise in unforeseen circumstances. Deviations from this procedure in planning or in the execution of planned activities must be approved by the project manager.

1.3 Definitions

None.

1.4 Responsibilities

The Field Manager is responsible for ensuring that all samples are shipped according to this procedure.

The Project Manager and the Laboratory Project Manager are responsible for identifying instances of noncompliance with this procedure and ensuring that future sample transport activities are in compliance with this procedure.

The Project Manager is responsible for ensuring that sample handling, storage, and transport activities conducted during all projects are in compliance with this procedure.

1.5 Procedure

1.5.1 Handling and Storage

Immediately following collection, all samples will be labeled. The lids of the containers shall not be sealed with packing tape, but may be covered with custody seals or placed directly into self-sealing bags. The sample containers shall be placed in an insulated cooler with frozen water bottles or ice in double, sealed self- sealing bags. Samples should occupy the lower portion of the cooler, while the ice should occupy the upper portion. Packing material shall be placed on the bottom and top (and optionally on the sides) of the inside of the cooler. An absorbent material (e.g., proper absorbent cloth material) shall be placed on the bottom of the cooler to contain liquids in case of spillage. All empty space between sample containers shall be filled with either packing material or ice bottles. Prior to shipping, glass sample containers should be wrapped on the sides, tops, and bottoms with bubble wrap or other appropriate padding and/or surrounded by Styrofoam to prevent breakage during transport. All glass containers for water samples must be packed in an upright position, never stacked or on their sides. Prior to shipment, the ice or frozen water bottles in the coolers shall be replaced so that samples will be maintained as close to 4 degrees Celsius (ºC) as possible from the time of collection through transport of the samples to the analytical laboratory. Samples shall be shipped within 24 hours to allow the laboratory to meet holding times for analyses. The procedures for maintaining sample temperatures at 4ºC ± 2ºC, pertains to all field samples.

1.5.2 Shipping

All appropriate U.S. Department of Transportation (DOT) regulations (e.g., 49 Code of Federal Regulations (CFR), Parts 171-179) shall be followed in shipment of air, soil, water, and other samples. Elements of these procedures are summarized below.

Soil sample shipments are typically brought to the courier at the airport where a United States Department of Agriculture (USDA) representative is contacted by the courier to make an inspection. Alternatively, shipments can be delivered directly to the courier at the airport. USDA inspection occurs outside of Guam.

1.5.2.1 Hazardous Materials Shipment

Field personnel must state whether any sample is suspected to be a hazardous material. A sample should be assigned to be hazardous unless enough evidence exists to indicate it is non-hazardous. If hazardous, the procedures summarized below must be followed.

Any substance or material that is capable of posing an unreasonable risk to life, health, or property when transported is classified as hazardous. Hazardous materials identification should be performed by checking the list of dangerous goods for that particular mode of transportation. If not on that list, materials can be classified by checking the Hazardous Materials Table (49 CFR 172.102 including Appendix A) or by determining if the material meets the definition of any hazard class or division (49 CFR Part 173).

All persons offering for shipment any hazardous material must be properly trained in the appropriate regulations, as required by HM-126F, Training for Safe Transportation of Hazardous Materials. The training covers loading, unloading, handling, storing, and transporting of hazardous materials, as well as emergency preparedness in the case of accidents. Carriers such as commercial couriers must also be trained. Modes of shipment include air, highway, rail, and water.

When shipping hazardous materials, including bulk chemicals or samples suspected of being hazardous, the proper shipping papers (49 CFR 172 Subpart C), package marking (49 CFR 172 Subpart D), labeling (49 CFR 172 Subpart E), placarding (49 CFR 172 Subpart F, generally for carriers), and packaging must be used. A copy of 49 CFR should be referred to each time hazardous material/potentially hazardous samples are shipped.

According to Section 2.7 of the International Air Transport Association (IATA) Dangerous Goods Regulations publication, very small quantities of certain dangerous goods may be transported without certain marking and documentation requirements as described in 49 CFR Part 172. However, other labeling and packing requirements must still be followed. A "Dangerous Goods in Excepted Quantities" label must be completed and attached to the associated shipping cooler. Certain dangerous goods are not allowed on certain airlines in any quantity.

The Hazardous Materials Regulations do not apply to hydrochloric acid (HCI), nitric acid (HN03)1 sulfuric acid (HSO4), and sodium hydroxide

(NAOH) added to water samples if their pH or percentage by weight criteria are met. These samples may be shipped as non-hazardous materials as discussed below.

1.5.2.2 Non-hazardous Materials Shipment

If the samples are suspected to be non-hazardous, based on previous site sample results, field screening results, or visual observations, if applicable, then samples may be shipped as non-hazardous.

When a cooler is ready for shipment to the laboratory, two copies of the chain-of-custody form shall be placed inside a self-sealing bag and taped to the inside of an insulated cooler. The coolers will then be sealed with waterproof tape and labeled "Fragile," "This-End-Up" (or directional arrows pointing up), or other appropriate notices. Chain-of-custody seals will be placed on the coolers.

1.5.2.3 Shipments from Outside the Continental United States

Shipment of sample coolers to the U.S. from locations outside the continental U.S. is controlled by the USDA and is subject to their inspection and regulation. Documentation is required to prove that the receiving analytical laboratory is certified by the USDA to receive and properly dispose of soil; this is called a "USDA Soil Import Permit." In addition, all sample coolers must be inspected by a USDA representative, affixed with a label indicating that the coolers contain environmental samples, and shipping forms stamped by the USDA inspector prior to shipment. In addition, samples shipped from U.S. territorial possessions or foreign countries must be cleared by the U.S. Customs Service upon entry into the United States. As long as the commercial invoice is properly completed (see below), shipments typically pass through U.S. Customs without the need to open coolers for inspection.

Completion and use of proper paperwork will, in most cases, naive or eliminate the need of the USDA and U.S. Customs to inspect the contents. Paperwork may be placed on the outside of coolers for non-hazardous materials.

In summary, the paperwork listed below should be taped to the outside of the coolers to assist sample shipments. If a shipment is made up of multiple pieces (e.g., more than one cooler), the paperwork need be attached only to one cooler, provided that the courier agrees. AU other coolers in the shipment need only be taped and have address and chain- of-custody seats affixed.

Courier Shipping Form & Commercial Invoice - Both forms should be placed inside a clear plastic adhesive-backed pouch which adheres to the package (typically supplied by the courier) and placed on the cooler lid.

Soil Import Permit and USDA Letter (soil only) - The laboratory shall supply these documents prior to mobilization. The USDA in Hawaii often <u>does</u> stop shipments of soil without these documents. The 2" x 2" USDA label (described below), the USDA letter, and soil impact permit should be stapled together and placed inside a clear plastic pouch. Clear plastic adhesive-backed pouches which adhere to the package are typically supplied by the courier.

The Soil Import Permit label should be supplied by the laboratory. Original labels are preferred, but copies of this label which are cut out to the 2" x 2" dimensions are acceptable. Placing one label and one stapled to the actual permit is suggested.

Water samples are not controlled by the USDA, so the requirements for soil listed above do not apply.

Chain-of-Custody Seals. Seals should be supplied by the laboratory. Project personnel must sign and date these; at least two seals should be placed in such a manner that they stick to both the cooler lid and body. Placing the seals over the tape, then covering it with clear packing tape, is suggested. This prevents the seal front coming loose and enables detection of tampering.

Address Label. A label stating the destination (laboratory address) should be affixed to each cooler.

Upon receipt of sample coolers at the laboratory, the sample custodian shall inspect the sample containers. The samples shall then be immediately extracted and/or analyzed, or stored in a refrigerated storage area until they are removed for extraction and/or analysis. Whenever the samples are not being extracted or analyzed, they shall be returned to refrigerated storage.

1.6 RECORDS

Records shall be maintained as required by implementing these procedures.

1.7 HEALTH AND SAFETY

1. Avoid lifting heavy coolers with back muscles; instead, use leg muscles or dollies.

2. Wear proper gloves, as defined in the project Health and Safety Plan, when handling sample containers to avoid contacting any materials that may have spilled out of the sample containers.

1.8 REFERENCES

None

1.9 ATTACHMENTS

None.

apec STANDARD OPERATING PROCEDURES:
SOP - 04, GROUNDWATER/MONITORING WELL SAMPLING

1.1 PURPOSE

This standard operating procedure (SOP) describes the monitoring well sampling procedures to be used by APEC personnel.

1.2 SCOPE

This document applies to all APEC personnel involved in ground-water and sampling activities.

This procedure shall serve as management-approved professional guidance for the APEC personnel. It is not intended to obviate the need for professional judgment that may arise in unforeseen circumstances. Deviations from this procedure in planning or in the execution of planned activities must be approved by the project manager.

1.3 DEFINITIONS

None.

1.4 RESPONSIBILITIES

The Project Manager is responsible for ensuring that these standard groundwater sampling activities are followed during projects conducted by APEC. The Project Manager is responsible for conducting evaluations to ensure that these procedures are being followed throughout the project.

The Field Manager is responsible for ensuring that the project field staff implement the SOP.

Minimum qualifications for sampling personnel are that one individual in the field team shall have a minimum of 6 months of experience with sampling monitoring wells.

It is the responsibility of the field sampler and/or task manager to directly supervise the groundwater sampling procedures and ensure that the SOP is implemented in accordance with the described procedure, and to record all pertinent data collected during sampling. If deviations from the procedure are required because of anomalous field conditions, the deviation must first be approved by the Project Manager and then documented in the field logbook and associated report or equivalent document.

1.5 PROCEDURES

1.5.1 Purpose

This procedure establishes the method for sampling groundwater monitoring wells for contaminants and general groundwater chemistry.

1.5.2 Preparation

1.5.2.1 Site Background Information

A thorough understanding of the purposes of the sampling event shall be established prior to commencing field activities. A review of all available data obtained from the site and pertinent to the water sampling shall also be conducted. Available well history data to be reviewed shall include, but not be limited to, well locations, sampling history, purging rates, turbidity problems, previously used purging methods, well installation methods, well completion records, well development methods, previous analytical results, presence of an immiscible phase, historical water levels, and general hydrogeologic conditions.

Previous groundwater development and sampling field notes provide a good indication of well purging rates and the types of problems that may be encountered during sampling, such as excessive turbidity and low well yield. The data may also indicate where dedicated pumps are placed in the water column. To help minimize the potential for cross-contamination, well purging and sampling, and water level measurement collection shall proceed from the least contaminated to the most contaminated as indicated in previous analytical results. This order may be changed in the field if conditions warrant, particularly if dedicated sampling equipment is used. A review of prior sampling procedures and results may also identify which purging and sampling techniques are appropriate for the parameters to be tested under a given set of field conditions.

1.5.2.2 Groundwater Analysis Selection

The requisite field and laboratory analyses shall be established prior to performing water sampling. The types and numbers of quality assurance/quality control (QA/QC) samples to be collected shall be decided, as shall the type and volume of sample preservatives, the number of sample containers (e.g., coolers), and the quantity of ice or other chilling materials. The sampling personnel shall ensure that the appropriate number of property sized sample containers are brought to the site, including extras in case of breakage or unexpected field conditions. Sample bottle type, analytical parameters, analytical method, preservatives and holding times are presented in the project specific Sampling and Analysis Plan (SAP).

1.5.3 Groundwater Sampling Procedures

Groundwater sampling procedures at a site shall include: (1) measurement of well depth to ground water, (2) assessment of the presence or absence of an immiscible phase, (3) calculation of the purge volume, (4) purging of static water within the well and well bore, (5) measurement of depth to bottom of the well, and (6) obtaining a groundwater sample. Each step is discussed in sequence below. Depending upon specific field conditions, additional steps may be necessary. As a rule, at least 24 hours should separate well development and well sampling events.

1.5.3.1 Measurement of Static Water Level Elevation

The depth to standing water and the total depth of the well shall be measured to the nearest 0.01 foot to provide baseline hydrologic data, to calculate the volume of water in the well, and to provide information on the integrity of the well (e.g., identification of siltation problems). Each well shall be marked with a permanent, easily identified reference point for water level measurements whose location and elevation have been surveyed.

Before purging well, water levels should be measured in all of the wells within the zone of influence of the well being purged. Water levels should be measured twice in quick succession and each measurement recorded. This will provide a water level database that describes water levels across the site at one time (a synoptic sampling). The water level in each well shall also be measured immediately prior to well purging. Depth to water measurements should be compared to historical water level measurements for the well, if there are previous records.

The device used to measure the water level surface and depth of the well shall be sufficiently sensitive and accurate so that a measurement to the nearest 0.01 foot can be obtained reliably. An electronic water level meter will usually be appropriate for this measurement; however, when the groundwater within a particular well is highly contaminated, an inexpensive weighted tape measure or steel tape with water paste indicator can be used to determine well depth to prevent adsorption of contaminants onto the meter tape. The presence of light, non- aqueous phase liquids (LNAPLS) and/or dense, non-aqueous phase liquids (DNAPLS) in a well requires measurement of the elevation of the top and the bottom of the product, generally using an interface probe. Water levels in such wells must then be corrected for density effects to accurately determine the elevation of the water table.

1.5.3.2 Decontamination of Equipment

A decontamination station shall be established before beginning sampling. The station shall consist of an area of at least 4 feet by 2 feet covered with plastic sheeting and be located upwind of the well being sampled. The station shall be large enough to fit the appropriate number of wash and rinse buckets, and have sufficient room to place equipment after decontamination. One central cleaning area may be used throughout the entire sampling event. The area around the well being sampled shall also be covered with plastic sheeting to prevent spillage.

Each piece of equipment shall be cleaned prior to entering the well. Decontamination shall also be conducted prior to the start of sampling at a site, even if the equipment is known to have been cleaned subsequent to its last usage. This precaution is taken to minimize the potential for cross-contamination. Additionally, each piece of equipment used at the site shall be cleaned prior to leaving the site. Dedicated sampling equipment need only be decontaminated prior to installation within the well. Clean sampling equipment shall not be placed directly on the ground or other contaminated surfaces prior to insertion into the well. Dedicated sampling equipment that has been certified by the manufacturer as being decontaminated can be placed in the well without onsite decontamination.

1.5.3.3 Detection of Immiscible Phase Layers

The following steps for detecting the presence of LNAPL and DNAPL shall be completed before the well is evacuated for conventional sampling:

1. Sample the headspace in the well head immediately after the well is opened for organic vapors using either a photo ionization detector (PID) or an organic vapor analyzer (OVA), and record measurements.

2. Lower an interface probe into the well to determine the existence of any immiscible layer(s), LNAPL and/or DNAPL, and record measurements.

3. Confirm the presence or absence of an immiscible phase by slowly lowering a bailer to the appropriate depth, then visually observing the results after sample recovery.

4. In some cases, it may be necessary to utilize hydrocarbon- and water- sensitive paste for measurement of LNAPL thickness. This is accomplished by smearing adjacent, thin layers of both hydrocarbon- and water-sensitive pastes along a steel measuring tape and inserting the tape into the well. An engineering tape showing tenths and hundredths of feet is required. Record depth to water, as shown by the mark on the water-sensitive paste, and depth to product, as shown by the mark on product-sensitive paste. In wells where the approximate depth to water and product thickness are not known, it is best to apply both pastes to the tape over a fairly long interval (5 feet or more). Under these conditions, measurements are obtained by trial and error, and may require several insertions and retrievals of the tape before product and water are encountered by the paste covered interval of the tape. In wells where approximate depths of air-product and product-water interfaces are known, pastes may be applied over shorter intervals. Water depth measurements should not be used in preparation of water-table contour maps until they are corrected for depression by the product.

If the well contains an immiscible phase, it may be desirable to sample this phase separately. It may also not be meaningful to conduct water sample analysis of water obtained from a well containing LNAPLs or DNAPLs. The project manager shall be consulted if this situation is encountered.

1.5.3.4 Purging Equipment and Use

The water present in a well prior to sampling may not be representative of *in situ* ground-water quality and shall be removed prior to sampling. The evacuation procedure shall ensure that all stagnant water is replaced by fresh formation water upon completion of purging. All groundwater removed from potentially contaminated wells shall be allowed to be discharged to non-paved ground surface at the site. Groundwater is not anticipated to be contaminated. If gross contamination is evident, the project manager will be notified and purge water will be contained prior to collecting a groundwater sample.

Purging shall be accomplished by removing groundwater from the well at low flow rates using a pump. According to the USEPA (1992), the rate at which groundwater is removed from the well during purging ideally should be less than 0.2 to 0.5 Liter per minute (L/min). The USEPA further states that wells should be purged at rates below those used to develop the well to prevent further development of the well, to prevent damage to the well, and to avoid disturbing accumulated corrosion or reaction products in the well. The USEPA also indicates that wells should be purged at or below their recovery rate so that migration of water in the formation above the well screen does not occur.

Realistically, the purge rate should be low enough that substantial drawdown in the well does not occur during purging. A low purge rate also will reduce the possibility of stripping volatile organic compounds (VOCs) from groundwater, and will reduce the likelihood of mobilizing colloids in the subsurface that are immobile under natural flow conditions.

The sampler shall ensure that purging does not cause formation water to cascade down the sides of the well screen. Wells shall not be purged to dryness if recharge causes the formation water to cascade down the sides of the screen, as this will cause an accelerated loss of volatiles. This problem should be anticipated; water shall be purged from the well at a rate that does not cause recharge water to be excessively agitated unless an extremely slow recharging well is encountered where complete evacuation is unavoidable.

In high yield wells (wells that exhibit 80% recovery in less than 2 hours), purging shall be conducted at relatively low flow rates and shall remove water from the entire screened interval of the well to ensure that fresh water from the formation is present throughout the entire saturated interval. In general, the intake of the purge pump shall be set in the middle of the screened section to allow purging and at the same time minimize disturbance/overdevelopment of the screened interval in the well. During the well purging procedure, water level and/or product level measurements shall be collected to assess the hydraulic effects of purging. The well can then be sampled when it recovers sufficiently to provide enough water for the analytical parameters specified.

For low yield wells (those that exhibit less than 80% recovery in less than 2 hours), one borehole volume of water shall be removed. The well then shall be allowed to recover sufficiently to provide enough water for the specified analytical parameters, and sampled.

Water samples shall be collected on a regular basis during well evacuation and analyzed in the field preferably using in-line devices for temperature, pH, specific conductivity, dissolved oxygen, salinity, Redox potential (ORP), and turbidity. At least four to six readings shall be taken during the purging process. These parameters are measured to demonstrate that the natural character of the formation waters has stabilized. Purging shall be considered complete when three consecutive field parameter measurements stabilize within approximately 10%. This criterion may not be applicable to temperature if a submersible pump is used during purging due to the heating of the water by the pump motor. All information obtained during the purging and sampling process shall be entered into a groundwater sampling forms or a logbook. All blanks on this field log shall be completed during field sampling.

The following paragraphs list available purging equipment and methods for their use.

1.3.4.1 Bailers and Pumps

Submersible Pump: A stainless steel submersible pump may be utilized for the purging of both shallow and deep wells prior to sampling the ground water for volatile, semivolatile, and non-volatile constituents. For wells over 200 feet deep, the submersible pump is one of the few technologies available to feasibly accomplish purging under any yield conditions. For shallow wells with low yields, submersible pumps are generally inappropriate due to overpumpage of the wells (<1 gallon per minute), which causes increased aeration of the water within the well.

Prior to the placement of the pump in the well, the pump and drop pipe shall be steam cleaned or otherwise decontaminated. The submersible pump shall be equipped with an anti-backflow check valve to limit the amount of water that will flow back down the drop pipe into the well. The pump intake shall be placed approximately 2 to 3 feet below the air-water interface within the well and maintained in that position during purging. Additionally, when the pump is being pulled out of the well subsequent to purging, care shall be taken to avoid dumping water within the drop pipe and pump stages back into the well.

Bladder Pump: A stainless steel and/or Teflon®) bladder pump can be utilized- for purging and sampling wells up to 200 feet in depth for volatile, semivolatile, and non-volatile constituents. Additionally, the bladder pump can be utilized for purging and obtaining groundwater samples overlain by a LNAPL layer as long as care is taken not to draw the product layer into the bladder pump. Use of the bladder pump is most effective in low to moderate yield wells where the pump can cause depression of the water table and allow significant inflow of fresh formation water.

The bladder pump can be operated by either compressed dry nitrogen or compressed dry air depending upon availability. Note that the driving gas utilized must be dry to avoid damage to the bladder pump control box. Decontamination of the bladder pump must be accomplished prior to use. Once purging is complete, the samples can be collected directly from the bladder pump.

Centrifugal or Diaphragm Pump: A centrifugal or diaphragm pump may be utilized to purge a well if the water level is within 20 feet of ground surface. A new or properly decontaminated hose is lowered into the well and water withdrawn at a rate that does not cause excessive well drawdown. The hose bottom shall be placed approximately 2 to 3 feet below the air-water interface and maintained in that position during purging.

Air Lift Pump: Air lift pumps are not appropriate for purging or sampling.

Bailer: Using a bailer to purge a well should be avoided because it can result in overdevelopment of the well and create excessive purge rates. If a bailer must be used, the bailer, bailer wire, and reel must be decontaminated as described in Section 5.3.2 prior to its use. Teflon® -coated cable mounted on a reel is recommended for lowering the bailer in and out of the well.

The bailer shall be lowered below the water level of the well with as little disturbance of the water as possible to minimize aeration of the water in the well. One way to gauge the depth of water on the reel is to mark the depth to water on the bailer wire with a stainless steel clip. In this manner, less time is spent trying to identify the water level in the well. If low flow parameters do not stabilize during purging or if the monitoring well goes dry during purging, then a bailer may be appropriate for collecting groundwater samples. Use of bailers for purging monitoring wells shall be approved in advance by the Project Manager.

1.5.3.5 Monitor Well Sampling Methodologies

1.5.3.5.1 Sampling Light, Non-Aqueous Phase Liquids (LNAPL)

LNAPL, if present, must be collected prior to any purging activities. The sampling device shall generally consist of a dedicated or disposable bailer equipped with a bottom- discharging device. The bailer shall be lowered slowly until contact is made with the surface of the LNAPL, and lowered to a depth less than that of the immiscible fluid/water interface depth as determined by measurement with the interface probe. The bailer shall then be allowed to fill with the LNAPL and retrieved.

When sampling LNAPLS, bailers should never be dropped into a well and should be removed from the well in a manner that causes as little agitation of the sample as possible. For example, the bailer should not be removed in a jerky fashion or be allowed to continually bang against the well casing as it is raised. When using bailers to collect LNAPL samples for inorganic analyses, the bailer shall be composed of fluorocarbon resin. -Bailers used to collect LNAPL samples for organic analyses shall be constructed of stainless steel. The cable used to raise and lower the bailer shall be composed of an inert material (e.g., stainless steel) or coated with an inert material (e.g., PTFE).

1.5.3.5.2 Sampling Dense, Non-Aqueous Phase Liquids (DNAPL)

DNAPL shall be collected prior to any purging activities. The best method for collecting DNAPL is to use a double check valve, stainless steel bailer, or a Kemmerer (discrete interval) sampler. The sample shall be collected by slow, controlled lowering of the bailer to the bottom of the well, activation of the closing device, and retrieval.

1.5.3.5.3 Groundwater Sampling Methodology

The well shall be sampled after it has recovered sufficiently to provide enough volume for the groundwater sampling parameters. A period of no more than 2 hours shall elapse between purging and sampling to prevent groundwater interaction with the casing and atmosphere. This may not be possible with a slowly recharging well. Water level shall be measured and recorded prior to sampling to demonstrate the degree of recovery of the well. Sampling equipment (e.g., especially bailers) shall never be dropped into the well, because this could cause aeration of the water upon impact. Additionally, the sampling methodology utilized shall allow for the collection of a groundwater sample in as undisturbed a condition as possible, minimizing the potential for volatilization or aeration. This includes minimizing agitation and aeration during transfer to sample containers.

Sampling equipment shall be constructed of inert material. Equipment with neoprene fittings, PVC boilers, tygon tubing, silicon rubber bladders, neoprene impellers, polyethylene, and viton is not acceptable. If bailers are used, an inert cable/chain (e.g., fluorocarbon resin-coated wire or single strand stainless steel wire) shall be used to raise and lower the bailer. Generally, bladder and submersible pumps are acceptable sampling devices for all analytical parameters. Dedicated equipment is highly recommended for all sampling programs. The following text describes sampling methods utilizing submersible pumps, bladder pumps and bailers.

1. Submersible Pumps: When operated under low-flow rate conditions (100 to 300 ml/minute or less) submersible pumps are as effective as bladder pumps in acquiring samples for volatile organic analysis as well as other analytes. The submersible pump must be specifically designed for groundwater sampling (i.e., pump composed of stainless steel and PTFE sample discharge lines composed of PTFE) and must have a controller mechanism allowing flow of the required low flow rate. The pump rate must be adjusted so that flow is continuous and does not pulsate to avoid aeration and agitation within the sample discharge lines. The pump shall be run for several minutes at the low flow rate used for sampling to ensure that the ground water in the lines was obtained at the low flow rate. Higher pumping rates than 100 to 300 ml/minute may be used when collecting samples to be analyzed for non-volatile constituents.

2. Bladder Pumps: A gas-operated Teflon® or stainless steel bladder pump with adjustable flow control and equipped with Teflon®-lined tubing can be effectively utilized to collect a groundwater sample and is considered to be the best overall device for sampling inorganic and organic constituents. Positive gas displacement bladder pumps shall be operated in a continuous manner so that they minimize discharge pulsation that can aerate samples in the return tube or upon discharge. If a bladder pump is utilized for the well purging process, the same bladder pump can also be utilized for sample collection after purging is complete.

Before the compressor is started, several precautions must be taken. First, position the gas operated compressor downwind of the well cap. Second, ground the engine block. This can be done by connecting a wire (with clips on either end) to the engine and to a stake that has been hammered into the ground. Third, make sure the purge water exiting the well is collected into a drum or bucket. Finally, connect the red compression hose from the well cap to the control box. Do not connect the compression hose from the compressor to the control box until after the engine has been started.

When all precautions are completed and the engine has been started, connect the block compression hose to the control box. Slowly adjust the control knobs so as to discharge water in the shortest amount of time but maintaining a near constant flow. This does not mean that the compressor must be set so as to discharge the water as hard as possible. The optimal setting is one that produces the largest volume of purge water per minute (not per purge cycle) while maintaining a near constant flow rate.

Prior to sampling, the flow rate (purge rate) must be adjusted to yield 100 to 300 milliliter (ml) per minute. Avoid settings that produce pulsating streams of water instead of a steady stream. The pump shall be operated at this low flow rate for several minutes to ensure that the groundwater being sampled is being withdrawn at the low extraction rate. The flow rate of 100 ml/minute must be obtained so as not to cause fluctuation in pH, pH-sensitive analytes, and the loss of volatile constituents. Higher flow rates can be used once the samples for the analysis of volatile components have been collected. At no time shall the sample flow rate exceed the flow rate used while purging.

For those samples requiring filtration, it is recommended that an in-line high capacity filter be used after all nonfiltered samples have been collected.

3. **Bailers:** A single- or double-check valve Teflon® or stainless steel bailer equipped with a bottom discharging device can be utilized to collect ground- water samples. Bailers have a number of disadvantages, however, including a tendency to alter the chemistry of groundwater samples due to degassing, volatilization, and aeration; the possibility of creating high ground-water entrance velocities; differences in operator techniques resulting in variable samples; and difficulty in determining where in the water column the sample was collected. Bailers therefore shall be used for groundwater sampling only when other types of sampling devices cannot be utilized for technical or logistical reasons. The use of bailers for ground-water sampling shall be approved in advance by the Project Manager.

The bailer shall be thoroughly decontaminated before being lowered into the well if they are not disposable bailers sealed in plastic. Two to three rinse samples shall be collected and discharged prior to acquisition of the actual sample. Each time the bailer is lowered to the water table, it shall be lowered in such a way as to minimize disturbance and aeration of the water column within the well.

The preferred alternative when using bailers for sampling is to use disposable Teflon® bailers equipped with bottom-discharging devices. Use of disposable bailers reduces decontamination time and limits the potential for cross- contamination.

1.5.3.6 Sample Handling and Preservation

Many of the chemical constituents and physiochemical parameters to be measured or evaluated during groundwater monitoring programs are chemically unstable, therefore samples must be preserved. The U.S. Environmental Protection Agency document entitled *Test Methods for Evaluating Solid Waste - Physical Chemical Method (SW-846),* includes a discussion of appropriate sample preservation procedures. In addition, SW-846 specifies the sample containers that shall be used for each constituent or common set of parameters. In general, check with specific laboratory requirements prior to obtaining field samples. In many cases, the laboratory will supply the necessary sample bottles and required preservatives.

Improper sample handling may alter the analytical results of the sample. Therefore, samples shall be transferred in the field from the sampling equipment directly into the container that has been prepared specifically for that analysis or set of compatible parameters as described in the project specific SAP. It is not an acceptable practice for samples to be composited in a common container in the field and then split in the laboratory, or poured first into a wide mouth container and then transferred into smaller containers.

Groundwater samples shall be collected and placed in their proper containers in the order of decreasing volatility and increasing stability. A preferred collection order for some common ground-water parameters is:

- Volatile organic constituents (VOCs) and total organic halogens (TOX)
- Dissolved gases, total organic carbon (TOC), total fuel hydrocarbons
- Semivolatile organics, pesticides
- Total metals, general minerals (unfiltered)
- Dissolved metals, general minerals (filtered)
- Phenols
- Cyanide
- Sulfate and chloride
- Turbidity
- Nitrate and ammonia
- Radionuclides

When sampling for VOCs, water samples shall be collected in vials or containers specifically designed to prevent loss of VOCs from the sample. These vials shall be provided by an analytical laboratory, preferably by the laboratory that will perform the analysis. Groundwater from the sampling device shall be collected in vials by allowing the groundwater to slowly flow along the sides of the vial. Sampling equipment shall not touch the interior of the vial. The vial shall be filled above the top of the vial to form a positive meniscus with no overflow. No headspace shall be present in the sample container once the container has been capped. This can be checked by inverting the bottle once the sample is collected and tapping the side of the vial to dislodge air bubbles. Sometimes it is not possible to collect a sample without air bubbles, particularly water that is aerated. In these cases, the investigator shall note the problem to account for possible error. Cooling samples may also produce headspace, but this will typically disappear once the sample is warmed prior to analysis. In addition, if the samples are shipped by air, air bubbles form most of the time. Field logs and laboratory analysis reports shall note any headspace in the sample container(s) at the time of receipt by the laboratory, as well as at the time the sample was first transferred to the sample container at the wellhead.

1.5.3.6.1 Special Handling Considerations

Samples requiring analysis for organics shall not be filtered. Samples shall not be transferred from one container to another because this could cause aeration or a loss of organic material onto the walls of the container. Total organic halogens (TOX) and total organic carbon (TOC) samples shall be handled and analyzed in the same manner as VOC samples.

Groundwater samples to be analyzed for metals shall be spent into two portions. One portion shall be filtered through a 0.45-micron membrane filter, transferred to a container, preserved with nitric acid to a pH less than 2, and analyzed for dissolved metals.

Remember to include a filter blank for each lot of filters used and always record the lot number of the filters. In addition, allow at least 500 ml of effluent to flow through the filter prior to sampling. The remaining portion shall be transferred to a container, preserved with nitric acid, and analyzed for total metals. Any difference in concentration between the total and dissolved fractions may be attributed to the original metallic ion content of the particles and adsorption of ions onto the particles.

1.5.3.6.2 Field Sampling Preservation

Samples should be preserved immediately upon collection. Ideally, sample jars contain preservatives of known concentration and volume during the initial filling of the jar to a predetermined final sample volume. For example, metals require storage in aqueous media at pH of 2 or less. Typically, 0.5 ml of 1:1 nitric acid added to 500 n-d of ground water will produce a pH less than 2.0. Certain matrices that have alkaline pH (greater than 7) may require more preservative than is typically required. An early assessment of preservation techniques, such as the use of pH strips after initial preservation, may therefore be appropriate. It should be noted that introduction of preservatives will dilute samples, and may require normalization of results. Guidance for the preservation of environmental samples can be found in the EPA "Handbook for Sampling and Sample Preservation of Water and Wastewater:" (EPA 1982). Additional guidance can be found in other EPA documents (EPA 1992, EPA 1995.)

1.5.3.6.3 Field Sampling Log

A groundwater sampling log shall document the following:

- Identification of well
- Well depth
- Static water level depth and measurement technique
- Presence of immiscible layers and detection method
- Well yield
- Purge volume and pumping rate
- Time that the well was purged
- Collection method for immiscible layers
- Sample identification numbers
- Well evacuation procedure/equipment
- Sample withdrawal procedure/equipment
- Date and time of collection
- Well sampling sequence
- Types of sample containers used and sample identification numbers
- Preservative(s) used
- Parameters requested for analysis
- Field analysis data
- Sample distribution and transporter
- Field observations on sampling event
- Name of collector

- Climatic conditions including air temperature

1.6 RECORDS

Information collected during groundwater sampling should be documented on the groundwater sampling log form in indelible ink. Copies of this information shall be sent to the Project Manager and to the project files. The Project Manager or designee shall review all groundwater sampling forms on a minimum monthly basis.

1.7 HEALTH AND SAFETY

Depending upon the site-specific contaminants, various protective programs must be implemented prior to sampling the first well. The site-specific Health and Safety Plan (HSP) should be reviewed paying particular attention to the control measures planned for the well sampling tasks. Preliminary area monitoring of sampling wells should be conducted to determine the potential hazard to sampling personnel. If significant contamination is observed, contact with potential contaminants in both vapor phase and liquid matrix shall be minimized through the use of respirators and disposable clothing. Depending upon the type of contaminant expected or determined in previous sampling efforts, the following safe work practices shall be employed:

<u>Particulate or Metal Compounds</u>

1. Avoid skin contact with and/or incidental ingestion of purge water.
2. Wear long-sleeved protective gloves and splash protection (i.e., Saranex or splash suits and face shields) as warranted.

<u>Volatile Organic Compounds</u>

1. Avoid breathing constituents venting from the well by approaching upwind, and/or by use of respiratory protection.
2. Pre survey the well head-space with a flame ionization detector/photo ionization detector (FID/PID) prior to sampling.
3. If monitoring results indicate organic vapors that exceed action levels as specified in the HSP, sampling activities may need to be conducted in Level C protection. At a minimum, skin protection will be required by use of Tyvek® or other media that is protective against the media being encountered.

<u>Physical Hazards Associated With Well Sampling:</u>

1. To avoid lifting injuries associated with pump and bailers retrieval, use large muscles of the legs, not the back.
2. Stay clear of all moving equipment and avoid wearing loose fitting clothing.
3. When using pocket knives for cutting purposes, cut away from self
4. To avoid slip/trip/fall (wet) conditions as a result of pump discharge, use textured boots/boot cover bottoms.
5. To avoid heat/cold stress as a result of exposure to extreme temperatures and PPE, drink electrolyte replacement fluids (1-2 cups/hour is recommended) and, in cases of extreme cold, wear fitted insulating clothing.
6. Be aware of restricted mobility due to the wearing of PPE.

In addition, standard health and safety practices should be observed according to the site- specific HSP. Suggested minimum protection during well sampling activities shall include inner disposable vinyl gloves, outer chemical-protective nitrile gloves, rubberized steel- toed boots, and an ANSI-Standard hard hat.

Half-face respirators and cartridges and Tyvek® suits may be necessary depending on the contaminant concentrations, and shall always be available onsite.

1.8 REFERENCES

EPA. 1982. Handbook for Sampling and Sample Preservation of Water and Wastewater. EPA-600/4-82-029. September 1982.

NJDEP. 1986. Field Sampling Procedures Manual. New Jersey Department of Environmental Protection.

SOP 2, *IDW Management*

SOP 1, *Equipment Decontamination*

SOP 8, *Field QC Samples(Water and Soil)*

USEPA. 1986. RCRA Ground-Water Monitoring Technical Enforcement Guidance Document.

USEPA. 1992. RCRA Ground-Water Monitoring: Draft Technical Enforcement Guidance Document.

USEPA. 1995 and as revised. Test Methods for Evaluating Solid Waste- Physical/Chemical Methods (SW-846). January 1995.

USEPA. 1994a and as revised. Contract Laboratory Program (CLP) Statement of Work (SOW) for Organic Analysis.

USEPA. 1994b and as revised. Contract Laboratory Program (CLP) Statement of Work (SOW) for Inorganics Analysis.

U.S. EPA Environmental Response Team. 1988. Response Engineering and Analytical Contract Standard Operating Procedures. U.S. EPA, Research Triangle Park, NC.

1.9 ATTACHMENTS

None.

apec STANDARD OPERATING PROCEDURES:
SOP - 05, FIELD QC SAMPLES (WATER, SOIL)

1.0 PURPOSE

This standard operating procedure (SOP) describes the number and types of field Quality Control (QC) samples that will be collected during APEC site field work.

1.1 SCOPE

This procedure applies to all site sample collection activities conducted during the APEC field work. This procedure shall serve as management-approved professional guidance for APEC personnel. It is not intended to obviate the need for professional judgment that may arise in unforeseen circumstances. Deviations from this procedure in the planning or execution of activities must be approved by the project manager.

1.2 DEFINITIONS

Trip Blanks - Trip blanks are samples that originate from ASTM Type 11 analyte-free water taken from the laboratory to the sampling site and returned to the laboratory with samples to be analyzed for volatile organic compounds.

Equipment Rinsate Samples - An equipment rinsate (i.e., "decontamination rinsate," or "equipment blank") sample consists of analyte-free water which has been poured over or though the sample collection equipment after its final decontamination rinse. Analytical results of equipment rinsate samples are used to access equipment cleanliness and the effectiveness of the decontamination process.

Field Blanks - Field blanks are samples of the source water used as the field decontamination rinse water of sampling equipment, and should be from the same source water as used to generate the equipment rinsate sample.

Field Duplicate - A field duplicate is a second sample taken from the same source at the same time and analyzed under identical conditions to assist in evaluating sample variance. There are two types of field duplicates: replicates and collocates. Replicates are identical samples that have typically been homogenized, while collocates are samples collected next to each other (e.g., laterally or vertically, in separate containers, and not homogenized).

Reference Samples - Reference samples are samples taken from media similar to site media, but that are collected outside the zone of contamination, usually offsite.

1.3 RESPONSIBILITIES

The Project Manager is responsible for ensuring that field QC samples are collected and analyzed according to this procedure. The Laboratory Project Manager is responsible for ensuring that field QC samples are analyzed according to the specifications of the project Statement of Work and the analytical methods.

1.4 PROCEDURES

Field QC checks may include submission of trip blank, equipment rinsate, field blank, duplicate, and reference samples to the laboratory. Suggested frequency and types of QC check samples are discussed in the following guidance documents: *RCRA Technical Enforcement Guidance Document,* Section 4.6.1 (EPA

1986); the use and frequency of these field QC samples should be incorporated as appropriate. Types of field QC samples are discussed in general below.

1.4.1 Trip Blanks

Trip blanks are prepared by the laboratory using organic-free water. They are sent by the laboratory, to the field. Trip blanks shall be placed in sample coolers by the laboratory prior to transport to the site so that they accompany the samples throughout the sample collection/handling/transport process. Once prepared, trip blanks should not be opened until they reach the laboratory. One set of two 40 milliliter vials will form a trip blank and will accompany each cooler containing samples to be analyzed for volatile organics compounds (VOCS) by methods such as 8010/601, 8020/602, 8240/624, and modified 8015 (only if purge and trap analysis is performed, e.g., for gasoline, not for extraction and analysis for diesel fuel). Trip blanks will be analyzed for VOCs only (EPA 1987). Results of trip blank analyses are used to assess whether samples have been contaminated by VOCs during sample handling and transport to the laboratory. Because trip banks are typically not analyzed for in tissue samples, they are not required for tissue sampling programs.

1.4.2 Equipment Rinsate Samples

Equipment rinsate samples are collected by pumping the source water over and/or through the decontaminated sampling equipment. This runoff water is collected into the sample containers directly, or with the use of a funnel if necessary. The source water may be poured by use of an electric or hand submersible pump by tipping the jug of water upside down, or by use of a stopcock and gravity.

One equipment rinsate sample shall be collected per day per sampling technique utilized that day (NEESA 1988 and EPA 1986). Initially, rinsate samples from every other day will be analyzed (NEESA 1988). The samples will be analyzed for the same parameters for which samples collected utilizing a particular sampling method were analyzed. If analytes pertinent to the project are found in the rinsates, the remaining rinsate samples will be analyzed unless holding times have been exceeded. If no analytes are found in any rinsate samples, the frequency of analysis may be decreased from every other day to weekly. Results of rinsate samples are used to determine whether equipment decontamination was effective.

When disposable or dedicated sampling equipment is utilized, only one equipment rinsate sample will be collected per equipment lot or project phase. Disposable and/or dedicated sampling equipment may include stainless steel bowls or trowels that will be used for collection of only one soil sample, disposable bailers for groundwater sampling, dedicated submersible pumps for groundwater sampling, or other such equipment. These disposable and/or dedicated sampling equipment are typically pre-cleaned and individually wrapped by the manufacturer prior to delivery to the site. In this case, the equipment rinsate sample is used to provide verification that contaminants are not being introduced to the samples via sampling equipment

Sampling devices (e.g., gloved hands, dip nets, or traps) for collection of tissue samples are generally non-intrusive into the organisms collected, so equipment rinsate samples will not be collected as long as the devices have been properly cleaned following SOP - 1.0, *Equipment Decontamination,* and the devices appear clean.

1.4.3 Field Blanks

Field blanks are collected simply by pouring the source water into sample containers. Field blanks, consisting of samples of the source water used as the final decontamination rinse water, will be analyzed to assess whether the wash or rinse water contained contaminants that may have been carried over into the site samples.

The final decontamination rinse water source, the field blank source water, and equipment rinsate source water should all be from the same purified water source. Tap water used for steam cleaning augers or used in the initial decontamination buckets need not be collected and analyzed as a field blank, because augers typically do not touch the actual samples and because the final decontamination rinse water should be from a purified source.

Field blanks are collected at a frequency of one per sampling event per each source of water for all levels of QC. A sampling event is considered to be from the time sampling personnel arrive at a site until they leave for more than a week. Field blanks win be analyzed for the same analyses as the samples collected during the period that the water sources are being used for decontamination. If the same lot of the water source is used, a field blank needs to be collected only once per lot.

1.4.4 Field Duplicates

Field duplicates consist of either collocated or replicate samples. Collocated samples will be collected from adjacent locations or liners or water samples collected from the same well at the same time; these provide information on the entire sample measurement system, including sampling, analysis, and non-homogeneities of the media sampled. Alternatively, replicates may be collected. Replicates are collected at the same time (e.g., homogenized or split samples), and provide information for various points in the analytical process. Sampling error can be approximated by the inclusion of collocated and replicated versions of the same sample.

Field duplicates for ground water and surface water samples will generally consist of replicates. Field duplicates for soil samples will consist primarily of collocates. Soil field duplicates that are to be analyzed for volatile constituents will consist only of collocates; no soil samples that are to be analyzed for volatiles will be replicated (i.e., homogenized or otherwise processed or split) in the field. A separate sample will be collected to provide duplicates for non-volatile analyses. The sample may be homogenized and split in the field to form an original and duplicate (replicate) sample, or an additional volume into a separate sample container may be collected to form a duplicate (collocate) sample. Alternatively, replicates may be formed by homogenization in the laboratory. Duplicates will be analyzed for the same analytical parameters as their associated original sample.

Field duplicates for biological tissue samples will consist of splits of the original sample. Twice the required volume of organisms for one sample will be collected and placed into one food grade self-sealing bag. The sample will later be homogenized in the laboratory and split, producing an original and a replicate sample. Replicates will be analyzed for the same analytical parameters as their associated original samples.

1.4.5 Reference Samples

Reference sampling is conducted to distinguish site-related contamination from naturally occurring or other non-site related levels of chemicals, i.e., to assess background levels. There are two types of background levels of chemicals:

- Naturally occurring levels, which are concentrations of chemicals present in the environment that have not been influenced by humans (e.g., iron, aluminum)

- Anthropogenic levels, which are concentrations of chemicals that are present in the environment due to human-made, non-site sources (e.g., industry, automobiles)

Reference samples will be collected for each medium sampled at a site. Site-specific conditions will dictate the number of reference samples necessary to characterize background concentrations of contaminants of concern. However, at least one reference sample from each medium will be collected during each sampling event at a site. The samples will be analyzed for all the analytes for which site samples of that medium are analyzed for. Background analysis, especially for metals, should be performed to assess the typical naturally occurring levels.

At least one reference sample will be collected for each biological species collected at a site. It may be difficult to find a nearby offsite location similar enough to the project site that has the same biological species available for offsite reference sample collection. Therefore, reference sample locations may need to be more distant from the site than for soil or water offsite reference samples. Collection methods will be identical for site and reference samples.

1.5 RECORDS

Records of the collection of field QC samples should be kept in the sample logbook by the methods discussed in SOP - 2.0 *Record Keeping, Sample Labeling, and Chain-of-Custody.*

1.6 HEALTH AND SAFETY

The project specific Health and Safety Plan shall be followed when collecting or working with potentially hazardous environmental samples.

1.7 REFERENCES

EPA. 1987. Data Quality Objectives for Remedial Response Activities: Development Process

NEESA. 1988. Sampling and Chemical Analysis Quality Assurance Requirements for the Navy Installation Restoration Program, NEESA 20.2-047B, June.

EPA. 1992. RCRA Technical Enforcement Guidance Document.

SOP - 1.0, *Equipment Decontamination*

apec STANDARD OPERATING PROCEDURES:
SOP – 06, LOGBOOKS

1.0 PURPOSE

This standard operating procedure (SOP) describes the activities and responsibilities of APEC personnel pertaining to the identification, use, and control of logbooks and associated field data records.

1.1 SCOPE

This document applies to all APEC personnel involved with the use and control of logbooks and associated records pertaining to quality-related activities. This procedure shall serve as management-approved professional guidance for APEC personnel. It is not intended to obviate the need for professional judgment that may arise in unforeseen circumstances. Deviations from this procedure in the planning or execution of activities must be approved by the project manager.

1.2 DEFINITIONS

1.2.1 Logbook

A bound field notebook with consecutively numbered, water-repellent pages that is clearly identified with the name of the affected activity, the person assigned responsibility for maintenance of the logbook, and the beginning and ending dates of the entries.

1.2.2 Data Form

A predetermined format utilized for recording field data that may become, by reference, a part of the logbook. For example: soil boring logs, trenching logs, surface soil sampling logs, groundwater sample logs, and well construction logs are data forms.

1.3 RESPONSIBILITIES

The Project Manager is responsible for determining which team members shall record information in field logbooks and for obtaining and maintaining control of the required logbooks. The Field Manager is responsible for ensuring that the logbook is completed properly and daily. The Field Manager is also responsible for submitting copies to the project manager, who is responsible for filing it and submitting a copy to the client (if required by the Statement of Work).

The Project Manager or designee is responsible for reviewing logbook entries to determine compliance with this procedure and to ensure that the entries are adequate to meet the project requirements.

The logbook user is responsible for recording pertinent data into the logbook to satisfy project requirements and for attesting to the accuracy of the entries by dated signature. The logbook user is also responsible for safeguard of the logbook while having custody of it.

1.4 PROCEDURE

The field logbook serves as the primary record of field activities. Entries shall be made chronologically and in sufficient detail to allow the writer or a knowledgeable reviewer to reconstruct the applicable events. The logbook shall be stored in a clean location and used only when outer gloves used for personal protective equipment have been removed.

Individual data forms may be generated to provide systematic data collection documentation. Entries on these forms shall meet the same requirements as entries in the logbook and shall be referenced in the applicable logbook entry. Individual data forms shall reference the applicable logbook and page number. At a minimum, names of all samples collected shall be included in the logbook even if recorded elsewhere.

All field descriptions and observations are entered into the logbook using indelible black ink.

Typical information to be entered includes, but is not limited to, the following:

- Date and time of all onsite activities
- Site location and description
- Weather conditions
- Field work documentation
- Descriptions of and rationale for approved deviations from the Work Plan or Field Sampling Plan
- Field instrumentation readings
- Personnel present
- Photograph references
- Sample locations
- Sample identification, as described in SOP – 2.0, *Sample Naming*
- Sample naming
- Field QC sample information
- Field descriptions, equipment used, and field activities accomplished to reconstruct field operations
- Meeting information
- Important times and dates of telephone conversations, correspondence, or deliverables
- Field calculations
- PPE level
- Calibration records
- Subcontractors present
- Equipment decontamination procedures and effectiveness

Description of Logbook Entries

Logbook entries shall contain the following information, as applicable, for each activity recorded. Some of these details may be entered on data forms as described previously.

Name of Activity For example, Asbestos Bulk Sampling, Charcoal Canister Sampling, Aquifer Testing.

Task Team Members and Equipment Name all members on the field team involved in the specified activity. List equipment used by serial number or other unique identification, including calibration information.

Activity Location Indicate location of sampling area as indicated in the Field Sampling Plan.

Weather Indicate general weather and precipitation conditions.

Level of Personal Protective Equipment The level of personal protective equipment (PPE), e.g., Level D, should be recorded.

Methods Indicate method or procedure number employed for the activity.

Sample Numbers Indicate the unique numbers associated with the physical samples. Identify QC samples.

Sample Type and Volume Indicate the medium, container type, preservative, and the volume for each sample.

Time and Date Record the time and date when the activity was performed (e.g., 0830/08/OC'T/89). Use the 24-hour clock for recording the time and two digits for recording the day of the month and the year.

Analyses Indicate the appropriate code for analyses to be performed on each sample, as specified in the Field Sampling Plan.

Field Measurements Indicate measurements and field instrument readings taken during the activity.

Chain of Custody and Distribution Indicate chain-of-custody for each sample collected and indicate to whom samples are transferred and the destination.

The logbook shall reference data maintained in other logs, forms, etc. Entry errors shall be corrected by drawing a single line through the incorrect entry, then initialing and dating this change. An explanation for the correction should be entered if the correction is for more than just a mistake.

Each entry or group of entries shall be signed or initialed by the person making the entry at least at the end of each day.

Logbook page numbers shall be entered on each page to facilitate identification of photocopies.

If a person's initials are used for identification, or if uncommon acronyms are used, these should be identified on a page at the beginning of the logbook.

At least weekly and preferably daily, the preparer shall photocopy and retain the pages completed during that session for backup. This will prevent loss of a large amount of information if the logbook is lost.

A technical review of each logbook shall be performed by a knowledgeable individual such as the Field Manager, Project Manager, or QC Supervisor, at a frequency .commensurate with the level of activity (weekly is suggested, or at a minimum monthly. These reviews shall be documented by the dated signature of the reviewer on the last page or page immediately following the material reviewed.

1.5 RECORDS

The field logbook shall be retained as a permanent project record. If a particular project requires submittal of photocopies of logbooks, this shall be performed as required. The field logbook shall be reviewed by the Project Manager on at least a monthly basis.

1.6 HEALTH AND SAFETY

In order to keep the logbook clean, it should be stored in a clean location and used only when outer gloves used for personal protective equipment have been removed.

1.7 REFERENCES

SOP 11.0, *Sample Naming*

1.8 ATTACHMENTS

None.

Appendix B

Groundwater Summary Table

Table 3. Round 2 of the Baseline Monitoring Program, Groundwater Monitoring Results – June 2010.

	Sample Location		UXO1						UXO2						UXO3						UXO4					
	Sample Identifier		UXO1				Dissolved Metals		UXO2				Dissolved Metals		UXO3				Dissolved Metals		UXO4				Dissolved Metals	
	Sampling Date		11-May-2007		22-Feb-2018		22-Feb-2018		11-May-2007		22-Feb-2018		22-Feb-2018		26-Apr-2007		22-Feb-2018				26-Apr-2007		23-Feb-2018		23-Feb-2018	
Analytical Method	Analyte	Unit	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q
Volatile Organic Compounds																										
SW8620	Acetone	µg/L	630		NS		NS		390		NS		NS		750		NS		NS		NA	U	NS		NS	
SW8620	Benzene	µg/L	0.5	U	NS		NS		0.5	U	NS		NS		0.5	U	NS		NS		0.5	U	NS		NS	
SW8620	Bromochloromethane	µg/L	0.5	U	NS		NS		0.5	U	NS		NS		0.5	U	NS		NS		0.5	U	NS		NS	
SW8620	Bromodichloromethane	µg/L	0.5	U	NS		NS		0.5	U	NS		NS		0.5	U	NS		NS		0.5	U	NS		NS	
SW8620	Bromoform	µg/L	0.5	U	NS		NS		0.5	U	NS		NS		0.5	U	NS		NS		0.5	U	NS		NS	
SW8620	Bromobenzene	µg/L	0.5	U	NS		NS		0.5	U	NS		NS		0.5	U	NS		NS		0.5	U	NS		NS	
SW8620	Butylbenzene	µg/L	0.5	U	NS		NS		0.5	U	NS		NS		0.5	U	NS		NS		0.5	U	NS		NS	
SW8620	sec-Butylbenzene	µg/L	0.5	U	NS		NS		0.5	U	NS		NS		0.5	U	NS		NS		0.5	U	NS		NS	
SW8620	tert-Butylbenzene	µg/L	0.5	U	NS		NS		0.5	U	NS		NS		0.5	U	NS		NS		0.5	U	NS		NS	
SW8620	tert-Butyl methyl ether (MTBE)	µg/L	2.0	U	NS		NS		2.0	U	NS		NS		2.0	U	NS		NS		NA		NS		NS	
SW8620	Carbon tetrachloride	µg/L	0.5	U	NS		NS		0.5	U	NS		NS		0.5	U	NS		NS		0.5	U	NS		NS	
SW8620	Chlorobenzene	µg/L	0.5	U	NS		NS		0.5	U	NS		NS		0.5	U	NS		NS		0.5	U	NS		NS	
SW8620	Chloroethane	µg/L	0.5	U	NS		NS		0.5	U	NS		NS		0.5	U	NS		NS		NA		NS		NS	
SW8620	Chloroform	µg/L	0.5	U	NS		NS		0.5	U	NS		NS		0.5	U	NS		NS		0.5	U	NS		NS	
SW8620	2-Chlorotoluene	µg/L	0.5	U	NS		NS		0.5	U	NS		NS		0.5	U	NS		NS		0.5	U	NS		NS	
SW8620	4-Chlorotoluene	µg/L	0.5	U	NS		NS		0.5	U	NS		NS		0.5	U	NS		NS		0.5	U	NS		NS	
SW8620	1,2-Dibromo-3-chloropropane	µg/L	2.0	U	NS		NS		2.0	U	NS		NS		2.0	U	NS		NS		2.0	U	NS		NS	
SW8620	1,2-Dibromoethane (Ethylene dibromide)	µg/L	0.5	U	NS		NS		0.5	U	NS		NS		0.5	U	NS		NS		0.5	U	NS		NS	
SW8620	o-Dichlorobenzene (1,2-Dichlorobenzene)	µg/L	0.5	U	NS		NS		0.5	U	NS		NS		0.5	U	NS		NS		0.5	U	NS		NS	
SW8620	m-Dichlorobenzene (1,3-Dichlorobenzene)	µg/L	0.5	U	NS		NS		0.5	U	NS		NS		0.5	U	NS		NS		0.5	U	NS		NS	
SW8620	p-Dichlorobenzene (1,4-Dichlorobenzene)	µg/L	0.5	U	NS		NS		0.5	U	NS		NS		0.5	U	NS		NS		0.5	U	NS		NS	
SW8620	1,1-Dichloroethane	µg/L	0.5	U	NS		NS		0.5	U	NS		NS		0.5	U	NS		NS		NA		NS		NS	
SW8620	1,2-Dichloroethane	µg/L	0.5	U	NS		NS		0.5	U	NS		NS		0.5	U	NS		NS		0.5	U	NS		NS	
SW8620	1,1-Dichloroethene	µg/L	0.5	U	NS		NS		0.5	U	NS		NS		0.5	U	NS		NS		NA		NS		NS	
SW8620	cis-1,2-Dichloroethene	µg/L	0.5	U	NS		NS		0.5	U	NS		NS		0.5	U	NS		NS		0.5	U	NS		NS	
SW8620	trans-1,2-Dichloroethene	µg/L	0.5	U	NS		NS		0.5	U	NS		NS		0.5	U	NS		NS		NA		NS		NS	
SW8620	1,2-Dichloropropane	µg/L	0.5	U	NS		NS		0.5	U	NS		NS		0.5	U	NS		NS		0.5	U	NS		NS	
SW8620	1,3-Dichloropropane	µg/L	0.5	U	NS		NS		0.5	U	NS		NS		0.5	U	NS		NS		0.5	U	NS		NS	
SW8620	2,2-Dichloropropane	µg/L	0.5	U	NS		NS		0.5	U	NS		NS		0.5	U	NS		NS		NA		NS		NS	
SW8620	1,1-Dichloropropene	µg/L	0.5	U	NS		NS		0.5	U	NS		NS		0.5	U	NS		NS		0.5	U	NS		NS	
SW8620	cis-1,3-Dichloropropene	µg/L	0.5	U	NS		NS		0.5	U	NS		NS		0.5	U	NS		NS		0.5	U	NS		NS	
SW8620	trans-1,3-Dichloropropene	µg/L	0.5	U	NS		NS		0.5	U	NS		NS		0.5	U	NS		NS		0.5	U	NS		NS	
SW8620	Dibromochloromethane	µg/L	0.5	U	NS		NS		0.5	U	NS		NS		0.5	U	NS		NS		0.5	U	NS		NS	
SW8620	Dichlorodifluoromethane	µg/L	0.5	U	NS		NS		0.5	U	NS		NS		0.5	U	NS		NS		NA		NS		NS	
SW8620	Ethylbenzene	µg/L	0.5	U	NS		NS		0.5	U	NS		NS		0.5	U	NS		NS		0.5	U	NS		NS	
SW8620	Hexachlorobutadiene	µg/L	0.5	U	NS		NS		0.5	U	NS		NS		0.5	U	NS		NS		0.5	U	NS		NS	
SW8620	Isopropylbenzene	µg/L	0.5	U	NS		NS		0.5	U	NS		NS		0.5	U	NS		NS		0.5	U	NS		NS	
SW8620	p-Isopropyltoluene	µg/L	0.5	U	NS		NS		0.5	U	NS		NS		0.5	U	NS		NS		0.5	U	NS		NS	
SW8620	Methyl bromide (Bromomethane)	µg/L	0.5	U	NS		NS		0.5	U	NS		NS		0.5	U	NS		NS		NA		NS		NS	
SW8620	Methyl chloride (Chloromethane)	µg/L	0.5	U	NS		NS		0.5	U	NS		NS		0.5	U	NS		NS		NA		NS		NS	
SW8620	Methyl ethyl ketone (2-Butanone)	µg/L	4.0	U	NS		NS		4.0	U	NS		NS		4.0	U	NS		NS		4.0	U	NS		NS	
SW8620	Methylene bromide (Dibromomethane)	µg/L	0.5	U	NS		NS		0.5	U	NS		NS		0.5	U	NS		NS		0.5	U	NS		NS	
SW8620	Methylene chloride (Dichloromenthane)	µg/L	0.5	U	NS		NS		0.5	U	NS		NS		0.5	U	NS		NS		NA		NS		NS	
SW8620	Naphthalene	µg/L	0.5	U	NS		NS		0.5	U	NS		NS		0.5	U	NS		NS		0.5	U	NS		NS	
SW8620	Propylbenzene	µg/L	0.5	U	NS		NS		0.5	U	NS		NS		0.5	U	NS		NS		0.5	U	NS		NS	
SW8620	Styrene	µg/L	0.5	U	NS		NS		0.5	U	NS		NS		0.5	U	NS		NS		0.5	U	NS		NS	
SW8620	1,1,1,2-Tetrachloroethane	µg/L	0.5	U	NS		NS		0.5	U	NS		NS		0.5	U	NS		NS		0.5	U	NS		NS	
SW8620	1,1,2,2-Tetrachloroethane	µg/L	0.5	U	NS		NS		0.5	U	NS		NS		0.5	U	NS		NS		0.5	U	NS		NS	
SW8620	Tetrachloroethene	µg/L	0.5	U	NS		NS		0.5	U	NS		NS		0.5	U	NS		NS		0.5	U	NS		NS	
SW8620	Toluene	µg/L	0.5	U	NS		NS		0.5	U	NS		NS		0.3	J	NS		NS		0.4	J	NS		NS	
SW8620	1,2,3-Trichlorobenzene	µg/L	0.5	U	NS		NS		0.5	U	NS		NS		0.5	U	NS		NS		0.5	U	NS		NS	
SW8620	1,2,4-Trichlorobenzene	µg/L	0.5	U	NS		NS		0.5	U	NS		NS		0.5	U	NS		NS		0.5	U	NS		NS	
SW8620	1,1,1-Trichloroethane	µg/L	0.5	U	NS		NS		0.5	U	NS		NS		0.5	U	NS		NS		0.5	U	NS		NS	
SW8620	1,1,2-Trichloroethane	µg/L	0.5	U	NS		NS		0.5	U	NS		NS		0.5	U	NS		NS		0.5	U	NS		NS	
SW8620	Trichloroethene	µg/L	0.5	U	NS		NS		0.5	U	NS		NS		0.5	U	NS		NS		0.5	U	NS		NS	
SW8620	Trichlorofluoromethane	µg/L	0.5	U	NS		NS		0.5	U	NS		NS		0.5	U	NS		NS		NA		NS		NS	
SW8620	1,1,2-Trichloro-1,2,3-trifluoroethane	µg/L	0.5	U	NS		NS		0.5	U	NS		NS		0.5	U	NS		NS		NA		NS		NS	
SW8620	1,2,3-Trichloropropane	µg/L	0.5	U	NS		NS		0.5	U	NS		NS		0.5	U	NS		NS		0.5	U	NS		NS	
SW8620	1,2,4-Trimethylbenzene	µg/L	0.5	U	NS		NS		0.5	U	NS		NS		0.5	U	NS		NS		0.5	U	NS		NS	
SW8620	1,3,5-Trimethylbenzene	µg/L	0.5	U	NS		NS		0.5	U	NS		NS		0.5	U	NS		NS		0.5	U	NS		NS	
SW8620	Vinyl chloride	µg/L	0.5	U	NS		NS		0.5	U	NS		NS		0.5	U	NS		NS		NA	U	NS		NS	
SW8620	Xylenes (total)	µg/L	1.0	U	NS		NS		1.0	U	NS		NS		1.0	U	NS		NS		1.0	U	NS		NS	

Table 3. Round 2 of the Baseline Monitoring Program, Groundwater Monitoring Results – June 2010.

	Sample Location		UXO1						UXO2						UXO3						UXO4					
	Sample Identifier		UXO1				Dissolved Metals		UXO2				Dissolved Metals		UXO3				Dissolved Metals		UXO4				Dissolved Metals	
	Sampling Date		11-May-2007		22-Feb-2018		22-Feb-2018		11-May-2007		22-Feb-2018		22-Feb-2018		26-Apr-2007		22-Feb-2018				26-Apr-2007		23-Feb-2018		23-Feb-2018	
Analytical Method	**Analyte**	**Unit**	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q
SVOCs																										
SW8270C	Acenaphthene	µg/L	1.0	U	NS		NS		1.0	U	NS		NS		0.9	U	NS		NS		1.0	U	NS		NS	
SW8270C	Acenaphthylene	µg/L	1.0	U	NS		NS		1.0	U	NS		NS		0.9	U	NS		NS		1.0	U	NS		NS	
SW8270C	Anthracene	µg/L	1.0	U	NS		NS		1.0	U	NS		NS		0.9	U	NS		NS		1.0	U	NS		NS	
SW8270C	Benzo(a)anthracene	µg/L	1.0	U	NS		NS		1.0	U	NS		NS		0.9	U	NS		NS		1.0	U	NS		NS	
SW8270C	Benzo(b)fluoranthene	µg/L	1.0	U	NS		NS		1.0	U	NS		NS		0.9	U	NS		NS		1.0	U	NS		NS	
SW8270C	Benzo(k)fluoranthene	µg/L	1.0	U	NS		NS		1.0	U	NS		NS		0.9	U	NS		NS		1.0	U	NS		NS	
SW8270C	Benzo(g,h,i)perylene	µg/L	1.0	U	NS		NS		1.0	U	NS		NS		0.9	U	NS		NS		1.0	U	NS		NS	
SW8270C	Benzo(a)pyrene	µg/L	1.0	U	NS		NS		1.0	U	NS		NS		0.9	U	NS		NS		1.0	U	NS		NS	
SW8270C	Benzyl alcohol	µg/L	5.0	U	NS		NS		5.0	U	NS		NS		4.7	U	NS		NS		5.0	U	NS		NS	
SW8270C	bis(2-Chloroethoxy)methane	µg/L	1.0	U	NS		NS		1.0	U	NS		NS		0.9	U	NS		NS		1.0	U	NS		NS	
SW8270C	bis(2-Chloroethyl)ether	µg/L	1.0	U	NS		NS		1.0	U	NS		NS		0.9	U	NS		NS		1.0	U	NS		NS	
SW8270C	bis(2-Ethylhexyl)phthalate	µg/L	1.0	U	NS		NS		0.9	J	NS		NS		0.9	J	NS		NS		1.0	U	NS		NS	
SW8270C	4-Bromophenyl phenyl ether	µg/L	1.0	U	NS		NS		1.0	U	NS		NS		0.9	U	NS		NS		1.0	U	NS		NS	
SW8270C	Butyl benzyl phthalate	µg/L	1.0	U	NS		NS		1.0	U	NS		NS		0.9	U	NS		NS		1.0	U	NS		NS	
	Carbazole	µg/L	1.0	U	NS		NS		1.0	U	NS		NS				NS		NS				NS		NS	
SW8270C	4-Chloro-3-methyl phenol	µg/L	5.0	U	NS		NS		5.0	U	NS		NS		4.7	U	NS		NS		5.0	U	NS		NS	
SW8270C	4-Chloroaniline	µg/L	5.0	U	NS		NS		5.0	U	NS		NS		4.7	U	NS		NS		5.0	U	NS		NS	
SW8270C	2-Chloronaphthalene	µg/L	1.0	U	NS		NS		1.0	U	NS		NS		0.9	U	NS		NS		1.0	U	NS		NS	
SW8270C	2-Chlorophenol	µg/L	1.0	U	NS		NS		5.0	U	NS		NS		4.7	U	NS		NS		5.0	U	NS		NS	
SW8270C	4-Chlorophenyl phenyl ether	µg/L	1.0	U	NS		NS		1.0	U	NS		NS		0.9	U	NS		NS		1.0	U	NS		NS	
SW8270C	2,2'-oxybis(1-Chloropropane)	µg/L	1.0	U	NS		NS		1.0	U	NS		NS		0.9	U	NS		NS				NS		NS	
SW8270C	Chrysene	µg/L	1.0	U	NS		NS		1.0	U	NS		NS		0.9	U	NS		NS		1.0	U	NS		NS	
SW8270C	Dibenz(a,h)anthracene	µg/L	1.0	U	NS		NS		1.0	U	NS		NS		0.9	U	NS		NS		1.0	U	NS		NS	
SW8270C	Dibenzofuran	µg/L	1.0	U	NS		NS		1.0	U	NS		NS		0.9	U	NS		NS		1.0	U	NS		NS	
SW8270C	1,2-Dichlorobenzene	µg/L	1.0	U	NS		NS		1.0	U	NS		NS		0.9	U	NS		NS		1.0	U	NS		NS	
SW8270C	1,3-Dichlorobenzene	µg/L	1.0	U	NS		NS			U	NS		NS		0.9	U	NS		NS		1.0	U	NS		NS	
SW8270C	1,4-Dichlorobenzene	µg/L	1.0	U	NS		NS			U	NS		NS		0.9	U	NS		NS		1.0	U	NS		NS	
SW8270C	3,3'-Dichlorobenzidine	µg/L	5.0	U	NS		NS		5.0	U	NS		NS		4.7	U	NS		NS		5.0	U	NS		NS	
SW8270C	2,4-Dichlorophenol	µg/L	5.0	U	NS		NS		5.0	U	NS		NS		4.7	U	NS		NS		5.0	U	NS		NS	
SW8270C	2,6-Dichlorophenol	µg/L	2.0	U	NS		NS		2.0	U	NS		NS		NS		NS		NS		NS		NS		NS	
SW8270C	Diethyl phthalate	µg/L	1.0	U	NS		NS		1.0	U	NS		NS		0.9	U	NS		NS		1.0	U	NS		NS	
SW8270C	Dimethyl phthalate	µg/L	1.0	U	NS		NS		1.0	UJ	NS		NS		0.9	U	NS		NS		1.0	U	NS		NS	
SW8270C	2,4-Dimethylphenol	µg/L	5.0	U	NS		NS		5.0	U	NS		NS		4.7	U	NS		NS		5.0	U	NS		NS	
SW8270C	Di-n-butyl phthalate	µg/L	1.0	U	NS		NS		14.0		NS		NS		0.9	U	NS		NS		0.5	J	NS		NS	
SW8270C	1,3-Dinitrobenzene	µg/L	5.0	U	NS		NS		5.0	U	NS		NS		NS	U	NS		NS		NS		NS		NS	
SW8270C	4,6-Dinitro-2-methylphenol	µg/L	5.0	U	NS		NS		5.0	U	NS		NS		4.7	U	NS		NS		5.0	U	NS		NS	
SW8270C	2,4-Dinitrophenol	µg/L	5.0	U	NS		NS		5.0	U	NS		NS		4.7	U	NS		NS		5.0	U	NS		NS	
SW8270C	2,4-Dinitrotoluene	µg/L	1.0	U	NS		NS		1.0	U	NS		NS		0.9	U	NS		NS		1.0	U	NS		NS	
SW8270C	2,6-Dinitrotoluene	µg/L	1.0	U	NS		NS		1.0	U	NS		NS		0.9	U	NS		NS		1.0	U	NS		NS	
SW8270C	Di-n-octyl phthalate	µg/L	1.0	U	NS		NS		1.0	U	NS		NS		0.9	U	NS		NS		1.0	U	NS		NS	
SW8270C	Diphenylamine	µg/L	1.0	U	NS		NS		1.0	U	NS		NS		0.9	U	NS		NS		1.0	U	NS		NS	
SW8270C	1,4-Dioxane	µg/L	44.0		NS		NS		9.2		NS		NS		33	J	NS		NS		4.0		NS		NS	
SW8270C	Fluoranthene	µg/L	1.0	U	NS		NS		1.0	U	NS		NS		0.9	U	NS		NS		1.0	U	NS		NS	
SW8270C	Fluorene	µg/L	1.0	U	NS		NS		1.0	U	NS		NS		0.9	U	NS		NS		1.0	U	NS		NS	
SW8270C	Hexachlorobenzene	µg/L	1.0	U	NS		NS		1.0	U	NS		NS		0.9	U	NS		NS		1.0	U	NS		NS	
SW8270C	Hexachlorobutadiene	µg/L	1.0	U	NS		NS		1.0	U	NS		NS		0.9	U	NS		NS		1.0	U	NS		NS	
SW8270C	Hexachlorocyclopentadiene	µg/L	1.0	U	NS		NS		1.0	U	NS		NS		0.9	U	NS		NS		1.0	U	NS		NS	

Table 3. Round 2 of the Baseline Monitoring Program, Groundwater Monitoring Results – June 2010.

	Sample Location		UXO1						UXO2						UXO3						UXO4					
	Sample Identifier		UXO1				Dissolved Metals		UXO2				Dissolved Metals		UXO3				Dissolved Metals		UXO4				Dissolved Metals	
	Sampling Date		11-May-2007		22-Feb-2018		22-Feb-2018		11-May-2007		22-Feb-2018		22-Feb-2018		26-Apr-2007		22-Feb-2018				26-Apr-2007		23-Feb-2018		23-Feb-2018	
Analytical Method	**Analyte**	**Unit**	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q
SW8270C	Hexachloroethane	µg/L	1.0	U	NS		NS		1.0	U	NS		NS		0.9	U	NS		NS		1.0	U	NS		NS	
SW8270C	Indeno(1,2,3-cd)pyrene	µg/L	1.0	U	NS		NS		1.0	U	NS		NS		0.9	U	NS		NS		1.0	U	NS		NS	
SW8270C	Isophorone	µg/L	1.0	U	NS		NS		1.0	U	NS		NS		0.9	U	NS		NS		1.0	U	NS		NS	
SW8270C	2-Methylnaphthalene	µg/L	1.0	U	NS		NS		1.0	U	NS		NS		0.9	U	NS		NS		1.0	U	NS		NS	
SW8270C	2-Methylphenol (o-Cresol)	µg/L	5.0	U	NS		NS		5.0	U	NS		NS		4..7	U	NS		NS		5.0	U	NS		NS	
SW8270C	3- and 4-Methylphenols (m- and p-Cresols)	µg/L	5.0	U	NS		NS		5.0	U	NS		NS		4..7	U	NS		NS		5.0	U	NS		NS	
SW8270C	Naphthalene	µg/L	1.0	U	NS		NS		1.0	U	NS		NS		0.9	U	NS		NS		1.0	U	NS		NS	
SW8270C	1-Naphthylamine	µg/L	2.0	U	NS		NS		2.0	U	NS		NS		NS		NS		NS		NS		NS		NS	
SW8270C	2-Naphthylamine	µg/L	2.0	U	NS		NS		2.0	U	NS		NS		NS		NS		NS		NS		NS		NS	
SW8270C	2-Nitroaniline	µg/L	5.0	U	NS		NS		5.0	U	NS		NS		4.7	U	NS		NS		5.0	U	NS		NS	
SW8270C	3-Nitroaniline	µg/L	5.0	U	NS		NS		5.0	U	NS		NS		4.7	U	NS		NS		5.0	U	NS		NS	
SW8270C	4-Nitroaniline	µg/L	5.0	U	NS		NS		5.0	U	NS		NS		4.7	U	NS		NS		5.0	U	NS		NS	
SW8270C	Nitrobenzene	µg/L	1.0	U	NS		NS		1.0	U	NS		NS		0.9	U	NS		NS		1.0	U	NS		NS	
SW8270C	2-Nitrophenol	µg/L	5.0	U	NS		NS		5.0	U	NS		NS		4.7	U	NS		NS		5.0	U	NS		NS	
SW8270C	4-Nitrophenol	µg/L	5.0	U	NS		NS		5.0	U	NS		NS		4.7	U	NS		NS		5	U	NS		NS	
SW8270C	N-Nitroso-di-n-propylamine	µg/L	1.0	U	NS		NS		1.0	U	NS		NS		0.9	U	NS		NS		5.0	U	NS		NS	
SW8270C	Pentachlorophenol	µg/L	5.0	U	NS		NS		5.0	UJ	NS		NS		4.7	U	NS		NS		3.0	UJ	NS		NS	
SW8270C	Phenanthrene	µg/L	1.0	U	NS		NS		1.0	U	NS		NS		0.9	U	NS		NS		5.0	U	NS		NS	
SW8270C	Phenol	µg/L	5.0	U	NS		NS		5.0	U	NS		NS		4.7	U	NS		NS		3.0	U	NS		NS	
SW8270C	Pyrene	µg/L	1.0	U	NS		NS		1.0	U	NS		NS		0.9	U	NS		NS		3.0	U	NS		NS	
SW8270C	1,2,4_Trichlorobenzene	µg/L	1.0	U	NS		NS		1.0	U	NS		NS		0.9	U	NS		NS				NS		NS	
SW8270C	2,4,5-Trichlorophenol	µg/L	1.0	U	NS		NS		5.0	U	NS		NS		4.7	U	NS		NS		5.9	U	NS		NS	
SW8270C	2,4,6-Trichlorophenol	µg/L	5.0	U	NS		NS		5.0	U	NS		NS		4.7	U	NS		NS		5.9	U	NS		NS	
Pesticides																										
SW8081A	Aldrin	µg/L	0.050	U	NS		NS		0.0500	U	NS		NS		0.099	UJ	NS		NS		0.050	UJ	NS		NS	
SW8081A	alpha-BHC	µg/L	0.050	U	NS		NS		0.0500	U	NS		NS		0.099	UJ	NS		NS		0.050	UJ	NS		NS	
SW8081A	beta-BHC	µg/L	0.050	U	NS		NS		0.0500	U	NS		NS		0.099	UJ	NS		NS		0.050	UJ	NS		NS	
SW8081A	delta-BHC	µg/L	0.050	U	NS		NS		0.0500	U	NS		NS		0.099	UJ	NS		NS		0.050	UJ	NS		NS	
SW8081A	gamma-BHC (Lindane)	µg/L	0.050	U	NS		NS		0.0500	U	NS		NS		0.099	UJ	NS		NS		0.050	UJ	NS		NS	
SW8081A	alpha-chlordane	µg/L	0.050	U	NS		NS		0.0500	U	NS		NS		0.099	UJ	NS		NS		0.050	UJ	NS		NS	
SW8081A	gamma-chlordane	µg/L	0.050	U	NS		NS		0.0500	U	NS		NS		0.099	UJ	NS		NS		0.050	UJ	NS		NS	
SW8081A	Chlordane (technical)	µg/L	5.000	U	NS		NS		5.00	U	NS		NS		9.94	UJ	NS		NS		5.00	UJ	NS		NS	
SW8081A	Dieldrin	µg/L	0.100	U	NS		NS		0.1000	U	NS		NS		0.199	UJ	NS		NS		0.100	UJ	NS		NS	
SW8081A	4,4'-DDD	µg/L	0.100	U	NS		NS		0.1000	U	NS		NS		0.199	UJ	NS		NS		0.100	UJ	NS		NS	
SW8081A	4,4'-DDE	µg/L	0.100	U	NS		NS		0.1000	U	NS		NS		0.199	UJ	NS		NS		0.100	UJ	NS		NS	
SW8081A	4,4'-DDT	µg/L	0.100	U	NS		NS		0.1000	U	NS		NS		0.199	UJ	NS		NS		0.100	UJ	NS		NS	
SW8081A	Endrin	µg/L	0.100	U	NS		NS		0.1000	U	NS		NS		0.199	UJ	NS		NS		0.100	UJ	NS		NS	
SW8081A	Endrin aldehyde	µg/L	0.100	U	NS		NS		0.1000	U	NS		NS		0.199	UJ	NS		NS		0.100	UJ	NS		NS	
SW8081A	Endrin ketone	µg/L	0.100	U	NS		NS		0.1000	U	NS		NS		0.199	UJ	NS		NS		0.100	UJ	NS		NS	
SW8081A	Endosulfan-I	µg/L	0.050	U	NS		NS		0.0500	U	NS		NS		0.099	UJ	NS		NS		0.050	UJ	NS		NS	
SW8081A	Endosulfan-II	µg/L	0.100	U	NS		NS		0.1000	U	NS		NS		0.199	UJ	NS		NS		0.100	UJ	NS		NS	
SW8081A	Endosulfan sulfate	µg/L	0.100	U	NS		NS		0.1000	U	NS		NS		0.199	UJ	NS		NS		0.100	UJ	NS		NS	
SW8081A	Heptachlor	µg/L	0.050	U	NS		NS		0.0500	U	NS		NS		0.099	UJ	NS		NS		0.050	UJ	NS		NS	
SW8081A	Heptachlor epoxide	µg/L	0.050	U	NS		NS		0.0500	U	NS		NS		0.099	UJ	NS		NS		0.050	UJ	NS		NS	
SW8081A	Methoxychlor	µg/L	0.500	U	NS		NS		0.5000	U	NS		NS		0.994	UJ	NS		NS		0.050	UJ	NS		NS	
SW8081A	Toxaphene	µg/L	5.000	U	NS		NS		5.00	U	NS		NS		9.94	UJ	NS		NS		5.00	UJ	NS		NS	

Table 3. Round 2 of the Baseline Monitoring Program, Groundwater Monitoring Results – June 2010.

	Sample Location		UXO1						UXO2						UXO3						UXO4					
	Sample Identifier		UXO1				Dissolved Metals		UXO2				Dissolved Metals		UXO3				Dissolved Metals		UXO4				Dissolved Metals	
	Sampling Date		11-May-2007		22-Feb-2018		22-Feb-2018		11-May-2007		22-Feb-2018		22-Feb-2018		26-Apr-2007		22-Feb-2018				26-Apr-2007		23-Feb-2018		23-Feb-2018	
Analytical Method	**Analyte**	**Unit**	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q
TPH																										
8015B	TPH as Gasoline	µg/L	85		NS		NS		54		NS		NS		120		NS		NS		26		NS		NS	
8015B	TPH as Diesel	µg/L	1200		NS		NS		3000		NS		NS		860		NS		NS		180		NS		NS	
8015B	TPH as Motor Oil	µg/L	1000		NS		NS		790		NS		NS		750		NS		NS		660		NS		NS	
PCBs																										
SW8081A	Aroclor 1016	µg/L	1.00	U	NS		NS		1.00	U	NS		NS		1.99	UJ	NS		NS		1.00	UJ	NS		NS	
SW8081A	Aroclor 1221	µg/L	2.00	U	NS		NS		2.00	U	NS		NS		3.98	UJ	NS		NS		2.00	UJ	NS		NS	
SW8081A	Aroclor 1232	µg/L	1.00	U	NS		NS		1.00	U	NS		NS		1.99	UJ	NS		NS		1.00	UJ	NS		NS	
SW8081A	Aroclor 1242	µg/L	1.00	U	NS		NS		1.00	U	NS		NS		1.99	UJ	NS		NS		1.00	UJ	NS		NS	
SW8081A	Aroclor 1248	µg/L	1.00	U	NS		NS		1.00	U	NS		NS		1.99	UJ	NS		NS		1.00	UJ	NS		NS	
SW8081A	Aroclor 1254	µg/L	1.00	U	NS		NS		1.00	U	NS		NS		1.99	UJ	NS		NS		1.00	UJ	NS		NS	
SW8081A	Aroclor 1260	µg/L	1.00	U	NS		NS		1.00	U	NS		NS		1.99	UJ	NS		NS		1.00	UJ	NS		NS	
SW8081A	Aroclor 1262	µg/L	1.00	U	NS		NS		1.00	U	NS		NS		1.99	UJ	NS		NS		1.00	UJ	NS		NS	
SW8081A	Aroclor 1268	µg/L	1.00	U	NS		NS		1.00	U	NS		NS		1.99	UJ	NS		NS		1.00	UJ	NS		NS	
Metals																										
200.7	Aluminum	µg/L	25	J	NA		NA		33	J	NA		NA		20	U	NA		NA		20	U	NA		NA	
200.7	Antimony	µg/L	2.0	U	10	U	1.0	U	2.0	U	10	U	10	U	1.0	U	10	U	10	U	1.0	U	10	U	10	U
200.7	Arsenic	µg/L	1.9	J	49		10	U	1.2	J	10	U	10	U	3.5		27		10	U	0.63	J	20		10	U
200.7	Barium	µg/L	30		51		27		53		9.4		15		26.0		140		43		26		190		96	
200.7	Beryllium	µg/L	1.0	U	2.0	U	2.0	U	1.0	U	2.0	U	2.0	U	0.50	U	2.0	U	2.0	U	0.50	U	2.0	U	2.0	U
200.7	Boron	µg/L	230		NA	NA	NA		500		NA		NA		220		NA		NA		110		NA		NA	
200.7	Cadmiun	µg/L	2.0	U	5.0	U	5.0	U	2.0	U	5.0	U	5.0		1.0	U	5.0	U	5.0		1.0	U	5.0	U	5	U
200.7	Calcium	µg/L	150000		NA		NA		120000		NA		NA		120000		NA		NA		120000		NA		NA	
200.7	Chromiun	µg/L	2.0	U	38		5.0	U	2.0	U	5.0	U	5.0		1.0	U	29		5.0		1.6		18		5	U
200.7	Cobalt	µg/L	1.5		15		5.0	U	4.1		5.0	U	5.0		4.3		14		5.0		0.67		7.4		5	U
200.7	Copper	µg/L	5.1		50		5.0	U	9.3		11		5.0		1.0	J	37		5.0		2.0	U	20		5	U
200.7	Iron	µg/L	100	U	NA		NA		100	U	NA		NA		960		NA		NA		100	U	NA		NA	
200.7	Lead	µg/L	4.0	U	5.0	U	5.0	U	4.0	U	5.0	U	5.0		2.0	U	2.0	U	5.0		2.0	U	5.0	U	5	U
200.7	Magnesium	µg/L	57000		NA		NA		120000		NA		NA		55000		NA		NA		28000		NA		NA	
200.7	Mercury	µg/L	0.030	U	0.20	U	0.20	U	0.030	U	0.20	U	0.20		0.030	U	0.20	U	0.20		0.030	U	0.31		0.20	U
200.7	Manganese	µg/L	120		NA		NA		500		NA		NA		600		NA		NA		42		NA		NA	
200.7	Molybdenum	µg/L	5.0		5.0	U	5.0	U	6.5		5.0	U	5.0		17		5.0	U	5.0		2.4		5.0	U	5	U
200.7	Nickel	µg/L	10		52		5.0	U	12		6.3		5.0		11		28		5.0		6.9		21		5	U
200.7	Potassium	µg/L	16000		NA		NA		43000		NA		NA		17000		NA		NA		6900		NA		NA	
200.7	Selenium	µg/L	2.0	U	10	U	10	U	2.4		10	U	10	U	2.0	U	10	U	10		2.0	U	10	U	10	U
200.7	Silver	µg/L	1.0	U	42	U	5.0	U	1.0	U	9.5		5.0	U	0.50	U	13		5.0		0.50	U	18		5	U
200.7	Sodium	µg/L	560000		NA		NA		120000		NA		NA		520000		NA		NA		270000		NA		NA	
200.7	Thallium	µg/L	4.0	U	10	U	12		4.0	U	10	U	12	U	2.0	U	10	U	12	U	2.0	U	10	U	10	U
200.7	Vanadium	µg/L	8.0	U	80		7		8.0	U	30		8.0		4.0	U	77		6.1		4.0	U	41		5	U
200.7	Zinc	µg/L	7.4	J	190		20	U	15		140		28		5.0	U	220		20	U	2.8	J	84		20	U
General Chemistry																										
	Cyanide	µg/L	10	U			NS		10	U			NS		10	U	NS		NS		10	U	NS		NS	
	Ammonia as N	mg/L	0.6		0.26		NS		0.17	J	0.10	U	NS		0.87	J	0.13		NS		0.30	U	0.10	U	NS	
	Nitrogen, Nitrate+Nitrite	mg/L	2.1	J	9.3		NS		0.30		17.2		NS		0.22	J	6.1		NS		0.40	J	4.4		NS	
	Total Kjeldahl Nitrogen	mg/L	0.97		2.0		NS		0.60		1.7		NS		0.97	J	1.1		NS		0.40	J	1.0	U	NS	
	Perchlorate	µg/L	4.0	U	4.0	U	NS		10	U	4.0	U	NS		4.0	U	4.0	U	NS		2.0	U	4.0	U	NS	
	Phosphorous	mg/L	2.0	J	0.087		NS		1.2		0.2		NS		0.30	U	0.24		NS		0.30	U	0.043		NS	
Nitro-Cellulose																										
SW8330	1,3,5-Trinitrobenzene	µg/L	0.085	J	1	U	NS		0.069	J	1	U	NS		0.11	U	1	U	NS		0.035	J	1	U	NS	
SW8330	1,3-Dinitrobenzene	µg/L	0.10	U	1	U	NS		0.099	U	1	U	NS		0.11	U	1	U	NS		0.11	U	1	U	NS	
SW8330	2,4,6-Trinitrotoluene	µg/L	0.10	U	1	U	NS		0.099	U	1	U	NS		0.11	U	1	U	NS		0.11	U	1	U	NS	
SW8330	2,4-Dinitrotoluene	µg/L	0.10	U	1	U	NS		0.099	U	1	U	NS		0.11	U	1	U	NS		0.11	U	1	U	NS	
SW8330	2,6-Dinitrotoluene	µg/L	0.10	U	1	U	NS		0.087	J	1	U	NS		0.11	U	1	U	NS		0.11	U	1	U	NS	
SW8330	2-Amino-4,6-dinitrotoluene	µg/L	0.20	U	1	U	NS		0.20	U	1	U	NS		0.22	U	1	U	NS		0.22	U	1	U	NS	
SW8330	2-Nitrotoluene	µg/L	0.50	U	1	U	NS		0.50	U	1	U	NS		0.55	U	1	U	NS		0.56	U	1	U	NS	
SW8330	3-Nitrotoluene	µg/L	0.50	U	1	U	NS		0.50	U	1	U	NS		0.55	U	1	U	NS		0.15	J	1	U	NS	
SW8330	4-Amino-2,6-dinitrotoluene	µg/L	0.10	U	1	U	NS		0.099	U	1	U	NS		0.11	U	1	U	NS		0.11	U	1	U	NS	
SW8330	4-Nitrotoluene	µg/L	0.50	U	1	U	NS		0.50	U	1	U	NS		0.55	U	1	U	NS		0.56	U	1	U	NS	
SW8330	HMX	µg/L	0.10	U	1	U	NS		0.033	J	1	U	NS		0.11	U	1	U	NS		0.11	U	1	U	NS	
SW8330	Nitrobenzene	µg/L	0.10	U	1	U	NS		0.099	U	1	U	NS		0.11	U	1	U	NS		0.11	U	1	U	NS	
SW8330	Nitroglycerin	µg/L	0.65	U	NA		NS		0.64	U	NA		NS		0.72	U	NA		NS		0.72	U	NA		NS	
SW8330	RDX	µg/L	0.10	U	1	U	NS		0.110	PG	1	U	NS		0.11	U	1	U	NS		0.11	U	1	U	NS	
SW8330	Tetryl	µg/L	0.10	U	1	U	NS		0.099	U	1	U	NS		0.11	U	1	U	NS		0.11	U	1	U	NS	

Table 3. Round 2 of the Baseline Monitoring Program, Groundwater Monitoring Results – June 2010.

	Sample Location		UXO1						UXO2						UXO3						UXO4					
	Sample Identifier		UXO1				Dissolved Metals		UXO2				Dissolved Metals		UXO3				Dissolved Metals		UXO4				Dissolved Metals	
	Sampling Date		11-May-2007		22-Feb-2018		22-Feb-2018		11-May-2007		22-Feb-2018		22-Feb-2018		26-Apr-2007		22-Feb-2018				26-Apr-2007		23-Feb-2018		23-Feb-2018	
Analytical Method	**Analyte**	**Unit**	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q
White Phosporus																										
	White Phosphorus	µg/L	0.0131	U	0.43	U	NS		0.0131	U	0.43	U	NS		0.0131	U	0.43	U	NS		0.0131	U	0.43	U	NS	

CASRN = Chemical Abstracts Service Registry Number
NA = Not analyzed
NS = not specified
µg/L = micrograms per liter
mg/L = milligrams per liter

Data Qualifiers:
J = The analyte was positively identified; the quantitation is estimated.
U = The analyte was analyzed for, but not detected. The associated numerical value is at or below the method detection limit.

UJ = The analyte was not detected; however, the quantitation limit is estimated due to discrepancies in the associated quality control criteria.

PG = The percent difference between the original and confirmation analyses is greater than 40%

Appendix C

Photograph Log

Photo 1 OB/OD Site Monitoring Well UXO-1

Photo 2 OB/OD Site Monitoring Well UXO-2

Photo 3 OB/OD Site Monitoring Well UXO-3

Photo 4. OB/OD Site Monitoring Well UXO-4.

Appendix D

Laboratory Analytical Report

CHAIN OF CUSTODY

ENTHALPY
ANALYTICAL
Formerly Curtis & Tompkins Labs

2323 Fifth Street
Berkeley, CA 94710

Phone (510) 486-0900
Fax (510) 486-0532

Page 1 of 1
Chain of Custody #

C&T LOGIN # 297491

Project No: (
Project Name: (
Project P. O. No:
EDD Format: Report Level ☐ II ☐ III ☐ IV
Turnaround Time: ☐ RUSH ☐ Standard

Sampler: Thomas Rabauliman
Report To: Brian Thomas
Company: APEC
Telephone: 671 688 5009
Email: apecguam@guam.net

Lab No.	Sample ID.	SAMPLING Date Collected	SAMPLING Time Collected	MATRIX Water	MATRIX Solid	# of Containers	HCl	H2SO4	HNO3	NaOH	None	Explosive EPA 8330	Metals EPA 200.7	Mercury EPA 245.1	Nitrate-Nitrite EPA 300	Nitro-Cellulose EPA 353.2	Ammonia SM 4500-NH3	Phosphate SM 4500-P BE	TKN SM 4500-N org	Perchlorate EPA 314.0	White Phosphorus EPA 7580
	OBODUX01	2/22/18	1305	X								X	X	X	X	X	X	X	X	X	X
	OBODUX01B	2/22/18	1332	X								X	X	X	X	X	X	X	X	X	X
	OBODUX02	2/22/18	1516	X								X	X	X	X	X	X	X	X	X	X
	OBODUX029	2/22/18	1500	X								X	X	X	X	X	X	X	X	X	X
	OBODUX03	2/22/18	1636	X								X	X	X	X	X	X	X	X	X	X
	OBODUX0MS/MSD	2/22/18	1651	X								X	X	X	X	X	X	X	X	X	X
	OBODUX04	2/23/18	1010	X								X	X	X	X	X	X	X	X	X	X

Notes:
OBODUX02 Collected
2/22/18 @ 1416

SAMPLE RECEIPT
☐ Intact
☐ Cold
☐ On Ice
☐ Ambient

RELINQUISHED BY:
Brian DATE: 2/23/18 TIME: 1318
DATE: TIME:
DATE: TIME:

RECEIVED BY:
kp DATE: 2-27-18 TIME: 1140
DATE: TIME:
DATE: TIME:

SAMPLE RECEIPT CHECKLIST

ENTHALPY

Section 1: Login # 297491 Client: APEC
Date Received: 2-27-18 Project:

Section 2: Samples received in a cooler? ☑ Yes, how many? 7 ☐ No (**skip Section 3 below**)
8093 1190 6648
If no cooler Sample Temp (°C): using IR Gun # ☐ A, or ☐ B
8093 1190 6637
☐ Samples received on ice directly from the field. Cooling process had begun
8093 1190 6582
If in cooler: Date Opened 2-27-18 By (print) kp (sign) kp
Shipping info (if applicable) FedEx 8093 1190 6556, 8093 1190 6615, 8116 0853 0702
Are custody seals present? ☐ No, or ☑ Yes. If yes, where? ☑ on cooler, ☐ on samples, ☐ on package
☐ Date: 2-23-17 How many 14 ☑ Signature, ☐ Initials, ☐ None
8093 1190 6626
Were custody seals intact upon arrival? ☑ Yes ☐ No ☐ N/A

Section 3: ***Important*** **: Notify PM if temperature exceeds 6°C or arrive frozen.**
Packing in cooler: (if other, describe) newspaper
☑ Bubble Wrap, ☐ Foam blocks, ☑ Bags, ☐ None, ☐ Cloth material, ☐ Cardboard, ☐ Styrofoam, ☐ Paper towels
☐ Samples received on ice directly from the field. Cooling process had begun
Type of ice used : ☑ Wet, ☑ Blue/Gel, ☐ None Temperature blank(s) included? ☐ Yes, ☐ No
Temperature measured using ☐ Thermometer ID: , or IR Gun # ☑ A ☐ B
Cooler Temp (°C): #1: 4.9, #2: 5.2, #3: 4.3, #4: 4.0, #5: 2.2, #6: 3.8, #7: 3.7

Section 4:	YES	NO	N/A
Were custody papers dry, filled out properly, and the project identifiable	X		
Were Method 5035 sampling containers present?		X	
If YES, what time were they transferred to freezer?			
Did all bottles arrive unbroken/unopened?	X		
Are there any missing / extra samples?		X	
Are samples in the appropriate containers for indicated tests?	X		
Are sample labels present, in good condition and complete?	X		
Does the container count match the COC?			X
Do the sample labels agree with custody papers?	X		
X Was sufficient amount of sample sent for tests requested?		X	
Did you change the hold time in LIMS for unpreserved VOAs?			X
Did you change the hold time in LIMS for preserved terracores?			X
Are bubbles > 6mm absent in VOA samples?			X
Was the client contacted concerning this sample delivery?		X	
If YES, who was called? By Date:			

Section 5:	YES	NO	N/A
Are the samples appropriately preserved? (if N/A, skip the rest of section 5)		X	
Did you check preservatives for all bottles for each sample?	X		
Did you document your preservative check?	X		

pH strip lot# 803DH1971, pH strip lot# , pH strip lot#

Preservative added:
☐ H2SO4 lot# 0000136036 added to samples 1,5 on/at 13:40 2/27/18
☐ HCL lot# added to samples on/at
☐ HNO3 lot# 2017013053 added to samples 1,5,7 6 on/at 13:28 2/27/18
☐ NaOH lot# added to samples kp on/at

Section 6:
Explanations/Comments:
Sample 6 did not have enough for MS/MSD analysis. ~~for some~~ kp

Date Logged in 2-27-18 **By (print)** kp **(sign)** kp
Date Labeled 2-27-18 **By (print)** kp Tky **(sign)** kp Tky

Enthalpy Sample Preservation for 297491

Sample	pH: <2	>9	>12	Other
-001a	[X]	[ ]	[ ]	
b	[X]	[ ]	[ ]	
c	[X]	[ ]	[ ]	
d	[X]	[ ]	[ ]	
e	[X]	[ ]	[ ]	
f	[X]	[ ]	[ ]	
g	[X]	[ ]	[ ]	
h	[X]	[ ]	[ ]	
i	[X]	[ ]	[ ]	
j	[ ]	[ ]	[ ]	
k	[ ]	[ ]	[ ]	
l	[ ]	[ ]	[ ]	
m	[ ]	[ ]	[ ]	
n	[ ]	[ ]	[ ]	
o	[ ]	[ ]	[ ]	
-002a	[X]	[ ]	[ ]	
b	[X]	[ ]	[ ]	
c	[X]	[ ]	[ ]	
d	[X]	[ ]	[ ]	
e	[X]	[ ]	[ ]	
f	[X]	[ ]	[ ]	
g	[X]	[ ]	[ ]	
h	[ ]	[ ]	[ ]	
i	[ ]	[ ]	[ ]	
j	[ ]	[ ]	[ ]	
k	[ ]	[ ]	[ ]	
l	[ ]	[ ]	[ ]	
m	[ ]	[ ]	[ ]	
-003a	[X]	[ ]	[ ]	
b	[X]	[ ]	[ ]	
c	[X]	[ ]	[ ]	
d	[X]	[ ]	[ ]	
e	[X]	[ ]	[ ]	
f	[X]	[ ]	[ ]	
g	[X]	[ ]	[ ]	
h	[X]	[ ]	[ ]	
i	[X]	[ ]	[ ]	
j	[ ]	[ ]	[ ]	
k	[ ]	[ ]	[ ]	
l	[ ]	[ ]	[ ]	
m	[ ]	[ ]	[ ]	
n	[ ]	[ ]	[ ]	
o	[ ]	[ ]	[ ]	
-004a	[X]	[ ]	[ ]	
b	[X]	[ ]	[ ]	
c	[X]	[ ]	[ ]	
d	[X]	[ ]	[ ]	
e	[X]	[ ]	[ ]	
f	[X]	[ ]	[ ]	
g	[X]	[ ]	[ ]	
h	[X]	[ ]	[ ]	
i	[X]	[ ]	[ ]	
j	[ ]	[ ]	[ ]	
k	[ ]	[ ]	[ ]	
l	[ ]	[ ]	[ ]	
m	[ ]	[ ]	[ ]	
n	[ ]	[ ]	[ ]	
o	[ ]	[ ]	[ ]	
p	[ ]	[ ]	[ ]	
-005a	[X]	[ ]	[ ]	
b	[X]	[ ]	[ ]	
c	[X]	[ ]	[ ]	
d	[X]	[ ]	[ ]	
e	[X]	[ ]	[ ]	
f	[X]	[ ]	[ ]	
g	[X]	[ ]	[ ]	
h	[X]	[ ]	[ ]	
i	[X]	[ ]	[ ]	
j	[X]	[ ]	[ ]	
k	[X]	[ ]	[ ]	
l	[X]	[ ]	[ ]	
m	[X]	[ ]	[ ]	
n	[X]	[ ]	[ ]	
o	[X]	[ ]	[ ]	
p	[X]	[ ]	[ ]	
q	ψ ~~[X]~~	[ ]	[ ]	
r	[ ]	[ ]	[ ]	
s	[ ]	[ ]	[ ]	
t	[ ]	[ ]	[ ]	
u	[ ]	[ ]	[ ]	
v	[ ]	[ ]	[ ]	
w	[ ]	[ ]	[ ]	
x	[ ]	[ ]	[ ]	
y	[ ]	[ ]	[ ]	
z	[ ]	[ ]	[ ]	
aa	[ ]	[ ]	[ ]	
-006a	[X]	[ ]	[ ]	
b	[X]	[ ]	[ ]	
c	[X]	[ ]	[ ]	
d	[X]	[ ]	[ ]	
e	[X]	[ ]	[ ]	
f	[X]	[ ]	[ ]	
g	[X]	[ ]	[ ]	
h	[X]	[ ]	[ ]	
i	[X]	[ ]	[ ]	
j	[ ]	[ ]	[ ]	
k	[ ]	[ ]	[ ]	
l	[ ]	[ ]	[ ]	
m	[ ]	[ ]	[ ]	
n	[ ]	[ ]	[ ]	
o	[ ]	[ ]	[ ]	

Analyst: TKY

Date: 2/27/18

ENTHALPY

ANALYTICAL

Enthalpy Analytical

2323 Fifth Street, Berkeley, CA 94710, Phone (510) 486-0900

Laboratory Job Number 297491
ANALYTICAL REPORT

APEC

Project : STANDARD

Level : II

Sample ID	Lab ID
OBO DUXO 1	297491-001
OBO DUXO 1B	297491-002
OBO DUXO 2	297491-003
OBO DUXO 29	297491-004
OBO DUXO 3	297491-005
OBO DUXO 04	297491-006

This data package has been reviewed for technical correctness and completeness. Release of this data has been authorized by the Laboratory Manager or the Manager's designee, as verified by the following signature which applies to this PDF file as well as any associated electronic data deliverable files. The results contained in this report meet all requirements of NELAP and pertain only to those samples which were submitted for analysis. This report may be reproduced only in its entirety.

Signature: Will Rice

Date: 03/26/2018

Will Rice
Project Manager
will.rice@enthalpy.com
(510) 204-2221 Ext 13102

CA ELAP# 2896, NELAP# 4044-001

CASE NARRATIVE

Laboratory number:	**297491**
Client:	**APEC**
Request Date:	**02/27/18**
Samples Received:	**02/27/18**

This data package contains sample and QC results for six water samples, requested for the above referenced project on 02/27/18. The samples were received cold and intact.

Nitroaromatics and Nitroamines by HPLC (EPA 8330):
No analytical problems were encountered.

Metals (EPA 200.7 and EPA 245.1):
High responses were observed for cobalt and zinc in the ICV analyzed 03/02/18 15:55; these analytes were not detected at or above the RL in the associated sample, and affected data was qualified with "b". No other analytical problems were encountered.

Ion Chromatography (EPA 300.0):
High recoveries were observed for nitrogen, nitrate in the MS/MSD of OBO DUXO 3 (lab # 297491-005); the LCS was within limits, and the associated RPD was within limits. Many samples were analyzed outside of hold time; affected data was qualified with "b". No other analytical problems were encountered.

Perchlorate by Ion Chromatography (EPA 314.0):
No analytical problems were encountered.

Ammonia Nitrogen (SM4500NH3-D):
No analytical problems were encountered.

Total Kjeldahl Nitrogen (SM4500NH3-C):
No analytical problems were encountered.

Orthophosphate Phosphorous (SM4500P-E):
No analytical problems were encountered.

CHAIN OF CUSTODY

ENTHALPY
ANALYTICAL
Formerly Curtis & Tompkins Labs
2323 Fifth Street
Berkeley, CA 94710

Phone (510) 486-0900
Fax (510) 486-0532

C&T LOGIN # 297491

Page 1 of 1
Chain of Custody # ______

Project No: (
Project Name: (
Project P. O. No:
EDD Format:
Report Level ☐ II ☐ III ☐ IV
Turnaround Time: ☐ RUSH ______ ☐ Standard

Sampler: Thomas Rabauliman
Report To: Brian Thomas
Company: APEC
Telephone: 671 688 5009
Email: apecguam@guam.net

Lab No.	Sample ID.	SAMPLING Date Collected	SAMPLING Time Collected	MATRIX Water	MATRIX Solid	# of Containers	CHEMICAL PRESERVATIVE HCl	H2SO4	HNO3	NaOH	None	Explosive EPA 8330	Metals EPA 200.7	Mercury EPA 245.1	Nitrate-Nitrite EPA 300	Nitro-Cellulose EPA 353.2	Ammonia SM 4500-NH3	Phosphate SM 4500-PBE	TKN SM 4500-N org	Perchlorate EPA 314.0	White Phosphorus EPA 7580
	OBODUX01	2/22/18	1305	X								X	X	X	X	X	X	X	X	X	X
	OBODUX01B	2/22/18	1332	X								X	X	X	X	X	X	X	X	X	X
	OBODUX02	2/22/18	1416	X								X	X	X	X	X	X	X	X	X	X
	OBODUX029	2/22/18	1500	X								X	X	X	X	X	X	X	X	X	X
	OBODUX03	2/22/18	1636	X								X	X	X	X	X	X	X	X	X	X
	OBODUX0MS/MSD	2/22/18	1651	X								X	X	X	X	X	X	X	X	X	X
	OBODUX04	2/23/18	1010	X								X	X	X	X	X	X	X	X	X	X

Notes:
OBODUX02 Collected
2/22/18 @ 1416

SAMPLE RECEIPT
☐ Intact
☐ Cold
☐ On Ice
☐ Ambient

RELINQUISHED BY:	DATE:	TIME:	RECEIVED BY:	DATE:	TIME:
Brian	2/23/18	1318	KP	2-27-18	1140

SAMPLE RECEIPT CHECKLIST

ENTHALPY

Section 1: Login # 297491 Client: APEC
Date Received: 2-27-18 Project:

Section 2: Samples received in a cooler? ☑ Yes, how many? 7 ☐ No **(skip Section 3 below)**
If no cooler Sample Temp (°C): ______ using IR Gun # ☐ A, or ☐ B
☐ Samples received on ice directly from the field. Cooling process had begun
If in cooler: Date Opened 2-27-18 By (print) kp (sign) kp
Shipping info (if applicable) FedEx 8093 1190 6556, 8093 1190 6615, 8116 0853 0702
8093 1190 6648
8093 1190 6637
8093 1190 6562
8093 1190 6626
Are custody seals present? ☐ No, or ☑ Yes. If yes, where? ☑ on cooler, ☐ on samples, ☐ on package
☐ Date: 2-23-17 How many 14 ☑ Signature, ☐ Initials, ☐ None
Were custody seals intact upon arrival? ☑ Yes ☐ No ☐ N/A

Section 3: ***Important*** **: Notify PM if temperature exceeds 6°C or arrive frozen.**
Packing in cooler: (if other, describe) newspaper
☑ Bubble Wrap, ☐ Foam blocks, ☑ Bags, ☐ None, ☐ Cloth material, ☐ Cardboard, ☐ Styrofoam, ☐ Paper towels
☐ Samples received on ice directly from the field. Cooling process had begun
Type of ice used : ☑ Wet, ☑ Blue/Gel, ☐ None Temperature blank(s) included? ☐ Yes, ☐ No
Temperature measured using ☐ Thermometer ID: ______, or IR Gun # ☑ A ☐ B
Cooler Temp (°C): #1: 4.9, #2: 5.2, #3: 4.3, #4: 4.0, #5: 2.2, #6: 3.8, #7: 3.7

Section 4:	YES	NO	N/A
Were custody papers dry, filled out properly, and the project identifiable	X		
Were Method 5035 sampling containers present?		X	
If YES, what time were they transferred to freezer?			
Did all bottles arrive unbroken/unopened?	X		
Are there any missing / extra samples?		X	
Are samples in the appropriate containers for indicated tests?	X		
Are sample labels present, in good condition and complete?	X		
Does the container count match the COC?			X
Do the sample labels agree with custody papers?	X		
X Was sufficient amount of sample sent for tests requested?		X	
Did you change the hold time in LIMS for unpreserved VOAs?			X
Did you change the hold time in LIMS for preserved terracores?			X
Are bubbles > 6mm absent in VOA samples?			X
Was the client contacted concerning this sample delivery?		X	
If YES, who was called? ______ By ______ Date: ______			

Section 5:	YES	NO	N/A
Are the samples appropriately preserved? (if N/A, skip the rest of section 5)		X	
Did you check preservatives for all bottles for each sample?	X		
Did you document your preservative check?	X		

pH strip lot# 8013DH1971, pH strip lot# ______, pH strip lot# ______
Preservative added:
☐ H2SO4 lot# 0000136036 added to samples 1,5 on/at 13:40 2/27/18
☐ HCL lot# ______ added to samples ______ on/at ______
☐ HNO3 lot# 2017013053 added to samples 1,5,7 6 on/at 13:28 2/27/18
☐ NaOH lot# ______ added to samples kp on/at ______

Section 6:
Explanations/Comments:
Sample 6 did not have enough for MS/MSD analysis. ~~for some~~ kp

Date Logged in 2-27-18 **By (print)** kp **(sign)** kp
Date Labeled 2-27-18 **By (print)** kp Tky **(sign)** kp Tky

Enthalpy Sample Preservation for 297491

Sample	pH: <2	>9	>12	Other
-001a	☒	☐	☐	
b	☒	☐	☐	
c	☒	☐	☐	
d	☒	☐	☐	
e	☒	☐	☐	
f	☒	☐	☐	
g	☒	☐	☐	
h	☒	☐	☐	
i	☒	☐	☐	
j	☐	☐	☐	
k	☐	☐	☐	
l	☐	☐	☐	
m	☐	☐	☐	
n	☐	☐	☐	
o	☐	☐	☐	
-002a	☒	☐	☐	
b	☒	☐	☐	
c	☒	☐	☐	
d	☒	☐	☐	
e	☒	☐	☐	
f	☒	☐	☐	
g	☒	☐	☐	
h	☐	☐	☐	
i	☐	☐	☐	
j	☐	☐	☐	
k	☐	☐	☐	
l	☐	☐	☐	
m	☐	☐	☐	
-003a	☒	☐	☐	
b	☒	☐	☐	
c	☒	☐	☐	
d	☒	☐	☐	
e	☒	☐	☐	
f	☒	☐	☐	
g	☒	☐	☐	
h	☒	☐	☐	
i	☒	☐	☐	
j	☐	☐	☐	
k	☐	☐	☐	
l	☐	☐	☐	
m	☐	☐	☐	
n	☐	☐	☐	
o	☐	☐	☐	
-004a	☒	☐	☐	
b	☒	☐	☐	
c	☒	☐	☐	
d	☒	☐	☐	
e	☒	☐	☐	
f	☒	☐	☐	
g	☒	☐	☐	
h	☒	☐	☐	
i	☒	☐	☐	
j	☐	☐	☐	
k	☐	☐	☐	
l	☐	☐	☐	
m	☐	☐	☐	
n	☐	☐	☐	
o	☐	☐	☐	
p	☐	☐	☐	
-005a	☒	☐	☐	
b	☒	☐	☐	
c	☒	☐	☐	
d	☒	☐	☐	
e	☒	☐	☐	
f	☒	☐	☐	
g	☒	☐	☐	
h	☒	☐	☐	
i	☒	☐	☐	
j	☒	☐	☐	
k	☒	☐	☐	
l	☒	☐	☐	
m	☒	☐	☐	
n	☒	☐	☐	
o	☒	☐	☐	
p	☒	☐	☐	
q	~~☒~~	☐	☐	
r	☐	☐	☐	
s	☐	☐	☐	
t	☐	☐	☐	
u	☐	☐	☐	
v	☐	☐	☐	
w	☐	☐	☐	
x	☐	☐	☐	
y	☐	☐	☐	
z	☐	☐	☐	
aa	☐	☐	☐	
-006a	☒	☐	☐	
b	☒	☐	☐	
c	☒	☐	☐	
d	☒	☐	☐	
e	☒	☐	☐	
f	☒	☐	☐	
g	☒	☐	☐	
h	☒	☐	☐	
i	☒	☐	☐	
j	☐	☐	☐	
k	☐	☐	☐	
l	☐	☐	☐	
m	☐	☐	☐	
n	☐	☐	☐	
o	☐	☐	☐	

Analyst: TKY

Date: 2/27/18

Detections Summary for 297491

Results for any subcontracted analyses are not included in this summary.

Client : APEC
Project : STANDARD
Location :

Client Sample ID : OBO DUXO 1 Laboratory Sample ID : 297491-001

Analyte	Result	Flags	RL	Units	Basis	IDF	Method	Prep Method
Arsenic	49		10	ug/L	TOTAL	1.000	EPA 200.7	EPA 200.7
Barium	51		5.0	ug/L	TOTAL	1.000	EPA 200.7	EPA 200.7
Chromium	38		5.0	ug/L	TOTAL	1.000	EPA 200.7	EPA 200.7
Cobalt	15		5.0	ug/L	TOTAL	1.000	EPA 200.7	EPA 200.7
Copper	50		5.0	ug/L	TOTAL	1.000	EPA 200.7	EPA 200.7
Nickel	52		5.0	ug/L	TOTAL	1.000	EPA 200.7	EPA 200.7
Silver	42		5.0	ug/L	TOTAL	1.000	EPA 200.7	EPA 200.7
Vanadium	80		5.0	ug/L	TOTAL	1.000	EPA 200.7	EPA 200.7
Zinc	190		20	ug/L	TOTAL	1.000	EPA 200.7	EPA 200.7
Nitrogen, Nitrite	4.7	b	0.25	mg/L	TOTAL	5.000	EPA 300.0	METHOD
Nitrogen, Nitrate	4.6	b	0.25	mg/L	TOTAL	5.000	EPA 300.0	METHOD
Ammonia-N	0.26		0.10	mg/L	TOTAL	1.000	SM4500NH3-D	SM4500NH3-B
Orthophosphate (as P)	0.087	b	0.030	mg/L	TOTAL	1.000	SM4500P-E	METHOD
Nitrogen, Total Kjeldahl	2.0		1.0	mg/L	TOTAL	1.000	SM4500NH3-C	SMWW20:4500-NORG

Client Sample ID : OBO DUXO 1B Laboratory Sample ID : 297491-002

Analyte	Result	Flags	RL	Units	Basis	IDF	Method	Prep Method
Nitrogen, Total Kjeldahl	1.4		1.0	mg/L	TOTAL	1.000	SM4500NH3-C	SMWW20:4500-NORG

Client Sample ID : OBO DUXO 2 Laboratory Sample ID : 297491-003

Analyte	Result	Flags	RL	Units	Basis	IDF	Method	Prep Method
Barium	9.4		5.0	ug/L	TOTAL	1.000	EPA 200.7	EPA 200.7
Copper	11		5.0	ug/L	TOTAL	1.000	EPA 200.7	EPA 200.7
Nickel	6.3		5.0	ug/L	TOTAL	1.000	EPA 200.7	EPA 200.7
Silver	9.5		5.0	ug/L	TOTAL	1.000	EPA 200.7	EPA 200.7
Vanadium	30		5.0	ug/L	TOTAL	1.000	EPA 200.7	EPA 200.7
Zinc	140		20	ug/L	TOTAL	1.000	EPA 200.7	EPA 200.7
Nitrogen, Nitrite	15	b	0.50	mg/L	TOTAL	10.00	EPA 300.0	METHOD
Nitrogen, Nitrate	2.2	b	0.50	mg/L	TOTAL	10.00	EPA 300.0	METHOD
Orthophosphate (as P)	0.20	b	0.030	mg/L	TOTAL	1.000	SM4500P-E	METHOD
Nitrogen, Total Kjeldahl	1.7		1.0	mg/L	TOTAL	1.000	SM4500NH3-C	SMWW20:4500-NORG

Client Sample ID : OBO DUXO 29 Laboratory Sample ID : 297491-004

Analyte	Result	Flags	RL	Units	Basis	IDF	Method	Prep Method
Arsenic	18		10	ug/L	TOTAL	1.000	EPA 200.7	EPA 200.7
Barium	19		5.0	ug/L	TOTAL	1.000	EPA 200.7	EPA 200.7
Chromium	16		5.0	ug/L	TOTAL	1.000	EPA 200.7	EPA 200.7
Copper	21		5.0	ug/L	TOTAL	1.000	EPA 200.7	EPA 200.7
Nickel	11		5.0	ug/L	TOTAL	1.000	EPA 200.7	EPA 200.7
Silver	12		5.0	ug/L	TOTAL	1.000	EPA 200.7	EPA 200.7
Vanadium	43		5.0	ug/L	TOTAL	1.000	EPA 200.7	EPA 200.7
Zinc	100		20	ug/L	TOTAL	1.000	EPA 200.7	EPA 200.7
Nitrogen, Nitrite	15	b	0.50	mg/L	TOTAL	10.00	EPA 300.0	METHOD
Nitrogen, Nitrate	2.2	b	0.50	mg/L	TOTAL	10.00	EPA 300.0	METHOD
Orthophosphate (as P)	0.33	b	0.030	mg/L	TOTAL	1.000	SM4500P-E	METHOD

Client Sample ID : OBO DUXO 3 Laboratory Sample ID : 297491-005

Analyte	Result	Flags	RL	Units	Basis	IDF	Method	Prep Method
Arsenic	27		10	ug/L	TOTAL	1.000	EPA 200.7	EPA 200.7
Barium	140		5.0	ug/L	TOTAL	1.000	EPA 200.7	EPA 200.7
Chromium	29		5.0	ug/L	TOTAL	1.000	EPA 200.7	EPA 200.7
Cobalt	14		5.0	ug/L	TOTAL	1.000	EPA 200.7	EPA 200.7
Copper	37		5.0	ug/L	TOTAL	1.000	EPA 200.7	EPA 200.7
Nickel	28		5.0	ug/L	TOTAL	1.000	EPA 200.7	EPA 200.7
Silver	13		5.0	ug/L	TOTAL	1.000	EPA 200.7	EPA 200.7
Vanadium	77		5.0	ug/L	TOTAL	1.000	EPA 200.7	EPA 200.7
Zinc	220		20	ug/L	TOTAL	1.000	EPA 200.7	EPA 200.7
Nitrogen, Nitrite	4.3	b	0.25	mg/L	TOTAL	5.000	EPA 300.0	METHOD
Nitrogen, Nitrate	1.8	b	0.25	mg/L	TOTAL	5.000	EPA 300.0	METHOD
Ammonia-N	0.13		0.10	mg/L	TOTAL	1.000	SM4500NH3-D	SM4500NH3-B
Orthophosphate (as P)	0.24	b	0.030	mg/L	TOTAL	1.000	SM4500P-E	METHOD
Nitrogen, Total Kjeldahl	1.1		1.0	mg/L	TOTAL	1.000	SM4500NH3-C	SMWW20:4500-NORG

Client Sample ID : OBO DUXO 04 Laboratory Sample ID : 297491-006

Analyte	Result	Flags	RL	Units	Basis	IDF	Method	Prep Method
Arsenic	20		10	ug/L	TOTAL	1.000	EPA 200.7	EPA 200.7
Barium	190		5.0	ug/L	TOTAL	1.000	EPA 200.7	EPA 200.7
Chromium	18		5.0	ug/L	TOTAL	1.000	EPA 200.7	EPA 200.7
Cobalt	7.4		5.0	ug/L	TOTAL	1.000	EPA 200.7	EPA 200.7
Copper	20		5.0	ug/L	TOTAL	1.000	EPA 200.7	EPA 200.7
Mercury	0.31		0.20	ug/L	TOTAL	1.000	EPA 245.1	METHOD
Nickel	21		5.0	ug/L	TOTAL	1.000	EPA 200.7	EPA 200.7
Silver	18		5.0	ug/L	TOTAL	1.000	EPA 200.7	EPA 200.7
Vanadium	41		5.0	ug/L	TOTAL	1.000	EPA 200.7	EPA 200.7
Zinc	84		20	ug/L	TOTAL	1.000	EPA 200.7	EPA 200.7
Nitrogen, Nitrite	1.8	b	0.05	mg/L	TOTAL	1.000	EPA 300.0	METHOD
Nitrogen, Nitrate	2.6	b	0.25	mg/L	TOTAL	5.000	EPA 300.0	METHOD
Orthophosphate (as P)	0.043	b	0.030	mg/L	TOTAL	1.000	SM4500P-E	METHOD

b = See narrative

Nitroaromatics and Nitroamines by HPLC

Lab #:	297491	Prep:	EPA 3535
Client:	APEC	Analysis:	EPA 8330
Project#:	STANDARD		
Field ID:	OBO DUXO 1	Batch#:	256844
Lab ID:	297491-001	Sampled:	02/22/18
Matrix:	Water	Received:	02/27/18
Units:	ug/L	Prepared:	02/28/18
Diln Fac:	1.000	Analyzed:	02/28/18

Analyte	Result	RL
HMX	ND	1.0
RDX	ND	1.0
1,3,5-Trinitrobenzene	ND	1.0
1,3-Dinitrobenzene	ND	1.0
Nitrobenzene	ND	1.0
Tetryl	ND	1.0
2,4,6-Trinitrotoluene	ND	1.0
2-Amino-4,6-dinitrotoluene	ND	1.0
4-Amino-2,6-dinitrotoluene	ND	1.0
2,4-Dinitrotoluene	ND	1.0
2,6-Dinitrotoluene	ND	1.0
2-Nitrotoluene	ND	1.0
4-Nitrotoluene	ND	1.0
3-Nitrotoluene	ND	1.0

Surrogate	%REC	Limits
1,2-Dinitrobenzene	92	46-127

ND= Not Detected
RL= Reporting Limit

Nitroaromatics and Nitroamines by HPLC

Lab #:	297491	Prep:	EPA 3535
Client:	APEC	Analysis:	EPA 8330
Project#:	STANDARD		
Field ID:	OBO DUXO 1B	Batch#:	256844
Lab ID:	297491-002	Sampled:	02/22/18
Matrix:	Water	Received:	02/27/18
Units:	ug/L	Prepared:	02/28/18
Diln Fac:	1.000	Analyzed:	02/28/18

Analyte	Result	RL
HMX	ND	1.0
RDX	ND	1.0
1,3,5-Trinitrobenzene	ND	1.0
1,3-Dinitrobenzene	ND	1.0
Nitrobenzene	ND	1.0
Tetryl	ND	1.0
2,4,6-Trinitrotoluene	ND	1.0
2-Amino-4,6-dinitrotoluene	ND	1.0
4-Amino-2,6-dinitrotoluene	ND	1.0
2,4-Dinitrotoluene	ND	1.0
2,6-Dinitrotoluene	ND	1.0
2-Nitrotoluene	ND	1.0
4-Nitrotoluene	ND	1.0
3-Nitrotoluene	ND	1.0

Surrogate	%REC	Limits
1,2-Dinitrobenzene	89	46-127

ND= Not Detected
RL= Reporting Limit

Nitroaromatics and Nitroamines by HPLC

Lab #:	297491	Prep:	EPA 3535
Client:	APEC	Analysis:	EPA 8330
Project#:	STANDARD		
Field ID:	OBO DUXO 2	Batch#:	256844
Lab ID:	297491-003	Sampled:	02/22/18
Matrix:	Water	Received:	02/27/18
Units:	ug/L	Prepared:	02/28/18
Diln Fac:	1.000	Analyzed:	02/28/18

Analyte	Result	RL
HMX	ND	1.0
RDX	ND	1.0
1,3,5-Trinitrobenzene	ND	1.0
1,3-Dinitrobenzene	ND	1.0
Nitrobenzene	ND	1.0
Tetryl	ND	1.0
2,4,6-Trinitrotoluene	ND	1.0
2-Amino-4,6-dinitrotoluene	ND	1.0
4-Amino-2,6-dinitrotoluene	ND	1.0
2,4-Dinitrotoluene	ND	1.0
2,6-Dinitrotoluene	ND	1.0
2-Nitrotoluene	ND	1.0
4-Nitrotoluene	ND	1.0
3-Nitrotoluene	ND	1.0

Surrogate	%REC	Limits
1,2-Dinitrobenzene	94	46-127

ND= Not Detected
RL= Reporting Limit

Nitroaromatics and Nitroamines by HPLC

Lab #:	297491	Prep:	EPA 3535
Client:	APEC	Analysis:	EPA 8330
Project#:	STANDARD		
Field ID:	OBO DUXO 29	Batch#:	256844
Lab ID:	297491-004	Sampled:	02/22/18
Matrix:	Water	Received:	02/27/18
Units:	ug/L	Prepared:	02/28/18
Diln Fac:	1.000	Analyzed:	02/28/18

Analyte	Result	RL
HMX	ND	1.1
RDX	ND	1.1
1,3,5-Trinitrobenzene	ND	1.1
1,3-Dinitrobenzene	ND	1.1
Nitrobenzene	ND	1.1
Tetryl	ND	1.1
2,4,6-Trinitrotoluene	ND	1.1
2-Amino-4,6-dinitrotoluene	ND	1.1
4-Amino-2,6-dinitrotoluene	ND	1.1
2,4-Dinitrotoluene	ND	1.1
2,6-Dinitrotoluene	ND	1.1
2-Nitrotoluene	ND	1.1
4-Nitrotoluene	ND	1.1
3-Nitrotoluene	ND	1.1

Surrogate	%REC	Limits
1,2-Dinitrobenzene	92	46-127

ND= Not Detected

RL= Reporting Limit

Nitroaromatics and Nitroamines by HPLC

Lab #:	297491	Prep:	EPA 3535
Client:	APEC	Analysis:	EPA 8330
Project#:	STANDARD		
Field ID:	OBO DUXO 3	Batch#:	256844
Lab ID:	297491-005	Sampled:	02/22/18
Matrix:	Water	Received:	02/27/18
Units:	ug/L	Prepared:	02/28/18
Diln Fac:	1.000	Analyzed:	02/28/18

Analyte	Result	RL
HMX	ND	1.0
RDX	ND	1.0
1,3,5-Trinitrobenzene	ND	1.0
1,3-Dinitrobenzene	ND	1.0
Nitrobenzene	ND	1.0
Tetryl	ND	1.0
2,4,6-Trinitrotoluene	ND	1.0
2-Amino-4,6-dinitrotoluene	ND	1.0
4-Amino-2,6-dinitrotoluene	ND	1.0
2,4-Dinitrotoluene	ND	1.0
2,6-Dinitrotoluene	ND	1.0
2-Nitrotoluene	ND	1.0
4-Nitrotoluene	ND	1.0
3-Nitrotoluene	ND	1.0

Surrogate	%REC	Limits
1,2-Dinitrobenzene	98	46-127

ND= Not Detected
RL= Reporting Limit

Nitroaromatics and Nitroamines by HPLC

Lab #:	297491	Prep:	EPA 3535
Client:	APEC	Analysis:	EPA 8330
Project#:	STANDARD		
Field ID:	OBO DUXO 04	Batch#:	256844
Lab ID:	297491-006	Sampled:	02/22/18
Matrix:	Water	Received:	02/27/18
Units:	ug/L	Prepared:	02/28/18
Diln Fac:	1.000	Analyzed:	02/28/18

Analyte	Result	RL
HMX	ND	1.0
RDX	ND	1.0
1,3,5-Trinitrobenzene	ND	1.0
1,3-Dinitrobenzene	ND	1.0
Nitrobenzene	ND	1.0
Tetryl	ND	1.0
2,4,6-Trinitrotoluene	ND	1.0
2-Amino-4,6-dinitrotoluene	ND	1.0
4-Amino-2,6-dinitrotoluene	ND	1.0
2,4-Dinitrotoluene	ND	1.0
2,6-Dinitrotoluene	ND	1.0
2-Nitrotoluene	ND	1.0
4-Nitrotoluene	ND	1.0
3-Nitrotoluene	ND	1.0

Surrogate	%REC	Limits
1,2-Dinitrobenzene	104	46-127

ND= Not Detected

RL= Reporting Limit

Batch QC Report

Nitroaromatics and Nitroamines by HPLC

Lab #:	297491	Prep:	EPA 3535
Client:	APEC	Analysis:	EPA 8330
Project#:	STANDARD		
Type:	BLANK	Diln Fac:	1.000
Lab ID:	QC921455	Batch#:	256844
Matrix:	Water	Prepared:	02/27/18
Units:	ug/L	Analyzed:	02/27/18

Analyte	Result	RL
HMX	ND	1.0
RDX	ND	1.0
1,3,5-Trinitrobenzene	ND	1.0
1,3-Dinitrobenzene	ND	1.0
Nitrobenzene	ND	1.0
Tetryl	ND	1.0
2,4,6-Trinitrotoluene	ND	1.0
2-Amino-4,6-dinitrotoluene	ND	1.0
4-Amino-2,6-dinitrotoluene	ND	1.0
2,4-Dinitrotoluene	ND	1.0
2,6-Dinitrotoluene	ND	1.0
2-Nitrotoluene	ND	1.0
4-Nitrotoluene	ND	1.0
3-Nitrotoluene	ND	1.0

Surrogate	%REC	Limits
1,2-Dinitrobenzene	88	46-127

ND= Not Detected
RL= Reporting Limit

Batch QC Report

Nitroaromatics and Nitroamines by HPLC

Lab #:	297491	Prep:	EPA 3535
Client:	APEC	Analysis:	EPA 8330
Project#:	STANDARD		
Matrix:	Water	Batch#:	256844
Units:	ug/L	Prepared:	02/27/18
Diln Fac:	1.000	Analyzed:	02/27/18

Type: BS   Lab ID: QC921456

Analyte	Spiked	Result	%REC	Limits
HMX	10.00	7.600	76	46-139
RDX	10.00	8.254	83	63-121
1,3,5-Trinitrobenzene	10.00	8.927	89	64-120
1,3-Dinitrobenzene	10.00	9.090	91	70-120
Nitrobenzene	10.00	9.283	93	70-120
Tetryl	10.00	9.971	100	66-139
2,4,6-Trinitrotoluene	10.00	9.386	94	78-120
2-Amino-4,6-dinitrotoluene	10.00	9.968	100	45-145
4-Amino-2,6-dinitrotoluene	10.00	9.341	93	49-130
2,4-Dinitrotoluene	10.00	10.02	100	73-120
2,6-Dinitrotoluene	10.00	8.128	81	65-120
2-Nitrotoluene	10.00	8.284	83	57-120
4-Nitrotoluene	10.00	9.655	97	65-120
3-Nitrotoluene	10.00	8.798	88	63-120

Surrogate	%REC	Limits
1,2-Dinitrobenzene	98	46-127

Type: BSD   Lab ID: QC921457

Analyte	Spiked	Result	%REC	Limits	RPD	Lim
HMX	10.00	8.557	86	46-139	12	53
RDX	10.00	9.256	93	63-121	11	20
1,3,5-Trinitrobenzene	10.00	9.476	95	64-120	6	20
1,3-Dinitrobenzene	10.00	9.625	96	70-120	6	20
Nitrobenzene	10.00	9.670	97	70-120	4	20
Tetryl	10.00	10.56	106	66-139	6	20
2,4,6-Trinitrotoluene	10.00	10.21	102	78-120	8	20
2-Amino-4,6-dinitrotoluene	10.00	10.50	105	45-145	5	20
4-Amino-2,6-dinitrotoluene	10.00	9.898	99	49-130	6	20
2,4-Dinitrotoluene	10.00	10.52	105	73-120	5	20
2,6-Dinitrotoluene	10.00	8.312	83	65-120	2	20
2-Nitrotoluene	10.00	8.475	85	57-120	2	20
4-Nitrotoluene	10.00	10.06	101	65-120	4	20
3-Nitrotoluene	10.00	9.945	99	63-120	12	20

Surrogate	%REC	Limits
1,2-Dinitrobenzene	100	46-127

RPD= Relative Percent Difference

Metals Analytical Report

Lab #:	297491	Project#:	STANDARD
Client:	APEC		
Field ID:	OBO DUXO 1	Diln Fac:	1.000
Lab ID:	297491-001	Sampled:	02/22/18
Matrix:	Water	Received:	02/27/18
Units:	ug/L		

Analyte	Result	RL	Batch#	Prepared	Analyzed	Prep	Analysis
Antimony	ND	10	256900	02/28/18	03/02/18	EPA 200.7	EPA 200.7
Arsenic	49	10	256900	02/28/18	03/02/18	EPA 200.7	EPA 200.7
Barium	51	5.0	256900	02/28/18	03/02/18	EPA 200.7	EPA 200.7
Beryllium	ND	2.0	256900	02/28/18	03/02/18	EPA 200.7	EPA 200.7
Cadmium	ND	5.0	256900	02/28/18	03/02/18	EPA 200.7	EPA 200.7
Chromium	38	5.0	256900	02/28/18	03/02/18	EPA 200.7	EPA 200.7
Cobalt	15	5.0	256900	02/28/18	03/08/18	EPA 200.7	EPA 200.7
Copper	50	5.0	256900	02/28/18	03/02/18	EPA 200.7	EPA 200.7
Lead	ND	5.0	256900	02/28/18	03/02/18	EPA 200.7	EPA 200.7
Mercury	ND	0.20	257056	03/05/18	03/06/18	METHOD	EPA 245.1
Molybdenum	ND	5.0	256900	02/28/18	03/02/18	EPA 200.7	EPA 200.7
Nickel	52	5.0	256900	02/28/18	03/02/18	EPA 200.7	EPA 200.7
Selenium	ND	10	256900	02/28/18	03/02/18	EPA 200.7	EPA 200.7
Silver	42	5.0	256900	02/28/18	03/02/18	EPA 200.7	EPA 200.7
Thallium	ND	10	256900	02/28/18	03/02/18	EPA 200.7	EPA 200.7
Vanadium	80	5.0	256900	02/28/18	03/02/18	EPA 200.7	EPA 200.7
Zinc	190	20	256900	02/28/18	03/08/18	EPA 200.7	EPA 200.7

ND= Not Detected
RL= Reporting Limit

Metals Analytical Report

Lab #:	297491	Project#:	STANDARD
Client:	APEC		
Field ID:	OBO DUXO 1B	Diln Fac:	1.000
Lab ID:	297491-002	Sampled:	02/22/18
Matrix:	Water	Received:	02/27/18
Units:	ug/L		

Analyte	Result	RL	Batch#	Prepared	Analyzed	Prep	Analysis
Antimony	ND	10	256900	02/28/18	03/02/18	EPA 200.7	EPA 200.7
Arsenic	ND	10	256900	02/28/18	03/02/18	EPA 200.7	EPA 200.7
Barium	ND	5.0	256900	02/28/18	03/02/18	EPA 200.7	EPA 200.7
Beryllium	ND	2.0	256900	02/28/18	03/02/18	EPA 200.7	EPA 200.7
Cadmium	ND	5.0	256900	02/28/18	03/02/18	EPA 200.7	EPA 200.7
Chromium	ND	5.0	256900	02/28/18	03/02/18	EPA 200.7	EPA 200.7
Cobalt	ND b	5.0	256900	02/28/18	03/02/18	EPA 200.7	EPA 200.7
Copper	ND	5.0	256900	02/28/18	03/02/18	EPA 200.7	EPA 200.7
Lead	ND	5.0	256900	02/28/18	03/02/18	EPA 200.7	EPA 200.7
Mercury	ND	0.20	257056	03/05/18	03/06/18	METHOD	EPA 245.1
Molybdenum	ND	5.0	256900	02/28/18	03/02/18	EPA 200.7	EPA 200.7
Nickel	ND	5.0	256900	02/28/18	03/02/18	EPA 200.7	EPA 200.7
Selenium	ND	10	256900	02/28/18	03/02/18	EPA 200.7	EPA 200.7
Silver	ND	5.0	256900	02/28/18	03/02/18	EPA 200.7	EPA 200.7
Thallium	ND	10	256900	02/28/18	03/02/18	EPA 200.7	EPA 200.7
Vanadium	ND	5.0	256900	02/28/18	03/02/18	EPA 200.7	EPA 200.7
Zinc	ND b	20	256900	02/28/18	03/02/18	EPA 200.7	EPA 200.7

b= See narrative
ND= Not Detected
RL= Reporting Limit

Metals Analytical Report

Lab #:	297491	Project#:	STANDARD
Client:	APEC		
Field ID:	OBO DUXO 2	Diln Fac:	1.000
Lab ID:	297491-003	Sampled:	02/22/18
Matrix:	Water	Received:	02/27/18
Units:	ug/L		

Analyte	Result	RL	Batch#	Prepared	Analyzed	Prep	Analysis
Antimony	ND	10	256900	02/28/18	03/02/18	EPA 200.7	EPA 200.7
Arsenic	ND	10	256900	02/28/18	03/02/18	EPA 200.7	EPA 200.7
Barium	9.4	5.0	256900	02/28/18	03/02/18	EPA 200.7	EPA 200.7
Beryllium	ND	2.0	256900	02/28/18	03/02/18	EPA 200.7	EPA 200.7
Cadmium	ND	5.0	256900	02/28/18	03/02/18	EPA 200.7	EPA 200.7
Chromium	ND	5.0	256900	02/28/18	03/02/18	EPA 200.7	EPA 200.7
Cobalt	ND	5.0	256900	02/28/18	03/08/18	EPA 200.7	EPA 200.7
Copper	11	5.0	256900	02/28/18	03/02/18	EPA 200.7	EPA 200.7
Lead	ND	5.0	256900	02/28/18	03/02/18	EPA 200.7	EPA 200.7
Mercury	ND	0.20	257056	03/05/18	03/06/18	METHOD	EPA 245.1
Molybdenum	ND	5.0	256900	02/28/18	03/02/18	EPA 200.7	EPA 200.7
Nickel	6.3	5.0	256900	02/28/18	03/02/18	EPA 200.7	EPA 200.7
Selenium	ND	10	256900	02/28/18	03/02/18	EPA 200.7	EPA 200.7
Silver	9.5	5.0	256900	02/28/18	03/02/18	EPA 200.7	EPA 200.7
Thallium	ND	10	256900	02/28/18	03/02/18	EPA 200.7	EPA 200.7
Vanadium	30	5.0	256900	02/28/18	03/02/18	EPA 200.7	EPA 200.7
Zinc	140	20	256900	02/28/18	03/08/18	EPA 200.7	EPA 200.7

ND= Not Detected
RL= Reporting Limit

Metals Analytical Report

Lab #:	297491	Project#:	STANDARD
Client:	APEC		
Field ID:	OBO DUXO 29	Diln Fac:	1.000
Lab ID:	297491-004	Sampled:	02/22/18
Matrix:	Water	Received:	02/27/18
Units:	ug/L		

Analyte	Result	RL	Batch#	Prepared	Analyzed	Prep	Analysis
Antimony	ND	10	256900	02/28/18	03/02/18	EPA 200.7	EPA 200.7
Arsenic	18	10	256900	02/28/18	03/02/18	EPA 200.7	EPA 200.7
Barium	19	5.0	256900	02/28/18	03/02/18	EPA 200.7	EPA 200.7
Beryllium	ND	2.0	256900	02/28/18	03/02/18	EPA 200.7	EPA 200.7
Cadmium	ND	5.0	256900	02/28/18	03/02/18	EPA 200.7	EPA 200.7
Chromium	16	5.0	256900	02/28/18	03/02/18	EPA 200.7	EPA 200.7
Cobalt	ND	5.0	256900	02/28/18	03/08/18	EPA 200.7	EPA 200.7
Copper	21	5.0	256900	02/28/18	03/02/18	EPA 200.7	EPA 200.7
Lead	ND	5.0	256900	02/28/18	03/02/18	EPA 200.7	EPA 200.7
Mercury	ND	0.20	257056	03/05/18	03/06/18	METHOD	EPA 245.1
Molybdenum	ND	5.0	256900	02/28/18	03/02/18	EPA 200.7	EPA 200.7
Nickel	11	5.0	256900	02/28/18	03/02/18	EPA 200.7	EPA 200.7
Selenium	ND	10	256900	02/28/18	03/02/18	EPA 200.7	EPA 200.7
Silver	12	5.0	256900	02/28/18	03/02/18	EPA 200.7	EPA 200.7
Thallium	ND	10	256900	02/28/18	03/02/18	EPA 200.7	EPA 200.7
Vanadium	43	5.0	256900	02/28/18	03/02/18	EPA 200.7	EPA 200.7
Zinc	100	20	256900	02/28/18	03/08/18	EPA 200.7	EPA 200.7

ND= Not Detected
RL= Reporting Limit

Metals Analytical Report

Lab #:	297491	Project#:	STANDARD
Client:	APEC		
Field ID:	OBO DUXO 3	Diln Fac:	1.000
Lab ID:	297491-005	Sampled:	02/22/18
Matrix:	Water	Received:	02/27/18
Units:	ug/L		

Analyte	Result	RL	Batch#	Prepared	Analyzed	Prep	Analysis
Antimony	ND	10	256900	02/28/18	03/02/18	EPA 200.7	EPA 200.7
Arsenic	27	10	256900	02/28/18	03/02/18	EPA 200.7	EPA 200.7
Barium	140	5.0	256900	02/28/18	03/02/18	EPA 200.7	EPA 200.7
Beryllium	ND	2.0	256900	02/28/18	03/02/18	EPA 200.7	EPA 200.7
Cadmium	ND	5.0	256900	02/28/18	03/02/18	EPA 200.7	EPA 200.7
Chromium	29	5.0	256900	02/28/18	03/02/18	EPA 200.7	EPA 200.7
Cobalt	14	5.0	256900	02/28/18	03/08/18	EPA 200.7	EPA 200.7
Copper	37	5.0	256900	02/28/18	03/02/18	EPA 200.7	EPA 200.7
Lead	ND	5.0	256900	02/28/18	03/02/18	EPA 200.7	EPA 200.7
Mercury	ND	0.20	257112	03/06/18	03/07/18	METHOD	EPA 245.1
Molybdenum	ND	5.0	256900	02/28/18	03/02/18	EPA 200.7	EPA 200.7
Nickel	28	5.0	256900	02/28/18	03/02/18	EPA 200.7	EPA 200.7
Selenium	ND	10	256900	02/28/18	03/02/18	EPA 200.7	EPA 200.7
Silver	13	5.0	256900	02/28/18	03/02/18	EPA 200.7	EPA 200.7
Thallium	ND	10	256900	02/28/18	03/02/18	EPA 200.7	EPA 200.7
Vanadium	77	5.0	256900	02/28/18	03/02/18	EPA 200.7	EPA 200.7
Zinc	220	20	256900	02/28/18	03/08/18	EPA 200.7	EPA 200.7

ND= Not Detected
RL= Reporting Limit

Metals Analytical Report

Lab #:	297491	Project#:	STANDARD
Client:	APEC		
Field ID:	OBO DUXO 04	Diln Fac:	1.000
Lab ID:	297491-006	Sampled:	02/22/18
Matrix:	Water	Received:	02/27/18
Units:	ug/L		

Analyte	Result	RL	Batch#	Prepared	Analyzed	Prep	Analysis
Antimony	ND	10	256900	02/28/18	03/02/18	EPA 200.7	EPA 200.7
Arsenic	20	10	256900	02/28/18	03/02/18	EPA 200.7	EPA 200.7
Barium	190	5.0	256900	02/28/18	03/02/18	EPA 200.7	EPA 200.7
Beryllium	ND	2.0	256900	02/28/18	03/02/18	EPA 200.7	EPA 200.7
Cadmium	ND	5.0	256900	02/28/18	03/02/18	EPA 200.7	EPA 200.7
Chromium	18	5.0	256900	02/28/18	03/02/18	EPA 200.7	EPA 200.7
Cobalt	7.4	5.0	256900	02/28/18	03/08/18	EPA 200.7	EPA 200.7
Copper	20	5.0	256900	02/28/18	03/02/18	EPA 200.7	EPA 200.7
Lead	ND	5.0	256900	02/28/18	03/02/18	EPA 200.7	EPA 200.7
Mercury	0.31	0.20	257056	03/05/18	03/06/18	METHOD	EPA 245.1
Molybdenum	ND	5.0	256900	02/28/18	03/02/18	EPA 200.7	EPA 200.7
Nickel	21	5.0	256900	02/28/18	03/02/18	EPA 200.7	EPA 200.7
Selenium	ND	10	256900	02/28/18	03/02/18	EPA 200.7	EPA 200.7
Silver	18	5.0	256900	02/28/18	03/02/18	EPA 200.7	EPA 200.7
Thallium	ND	10	256900	02/28/18	03/02/18	EPA 200.7	EPA 200.7
Vanadium	41	5.0	256900	02/28/18	03/02/18	EPA 200.7	EPA 200.7
Zinc	84	20	256900	02/28/18	03/08/18	EPA 200.7	EPA 200.7

ND= Not Detected
RL= Reporting Limit

Batch QC Report

Metals Analytical Report

Lab #:	297491	Prep:	EPA 200.7
Client:	APEC	Analysis:	EPA 200.7
Project#:	STANDARD		
Type:	BLANK	Diln Fac:	1.000
Lab ID:	QC921667	Batch#:	256900
Matrix:	Water	Prepared:	02/28/18
Units:	ug/L		

Analyte	Result	RL	Analyzed
Antimony	ND	10	03/02/18
Arsenic	ND	10	03/02/18
Barium	ND	5.0	03/02/18
Beryllium	ND	2.0	03/02/18
Cadmium	ND	5.0	03/02/18
Chromium	ND	5.0	03/02/18
Cobalt	ND	5.0	03/08/18
Copper	ND	5.0	03/02/18
Lead	ND	5.0	03/02/18
Molybdenum	ND	5.0	03/02/18
Nickel	ND	5.0	03/02/18
Selenium	ND	10	03/02/18
Silver	ND	5.0	03/02/18
Thallium	ND	10	03/02/18
Vanadium	ND	5.0	03/02/18
Zinc	ND	20	03/08/18

ND= Not Detected
RL= Reporting Limit

Batch QC Report

Metals Analytical Report

Lab #:	297491	Prep:	EPA 200.7
Client:	APEC	Analysis:	EPA 200.7
Project#:	STANDARD		
Matrix:	Water	Batch#:	256900
Units:	ug/L	Prepared:	02/28/18
Diln Fac:	1.000		

Type: BS Lab ID: QC921668

Analyte	Spiked	Result	%REC	Limits	Analyzed
Antimony	100.0	108.0	108	68-120	03/02/18
Arsenic	100.0	107.2	107	76-120	03/02/18
Barium	100.0	101.6	102	80-120	03/02/18
Beryllium	100.0	100.7	101	80-120	03/02/18
Cadmium	100.0	103.7	104	80-120	03/02/18
Chromium	100.0	102.2	102	80-120	03/02/18
Cobalt	100.0	104.1	104	80-120	03/08/18
Copper	100.0	100.6	101	80-120	03/02/18
Lead	100.0	109.9	110	80-120	03/02/18
Molybdenum	100.0	94.43	94	80-120	03/02/18
Nickel	100.0	101.9	102	80-120	03/02/18
Selenium	100.0	108.4	108	76-120	03/02/18
Silver	100.0	105.5	105	80-120	03/02/18
Thallium	50.00	53.44	107	80-127	03/02/18
Vanadium	100.0	110.8	111	80-120	03/02/18
Zinc	100.0	106.3	106	77-120	03/08/18

Type: BSD Lab ID: QC921669

Analyte	Spiked	Result	%REC	Limits	RPD	Lim	Analyzed
Antimony	100.0	102.5	103	68-120	5	20	03/02/18
Arsenic	100.0	101.5	101	76-120	5	20	03/02/18
Barium	100.0	100.3	100	80-120	1	20	03/02/18
Beryllium	100.0	99.08	99	80-120	2	20	03/02/18
Cadmium	100.0	101.2	101	80-120	2	20	03/02/18
Chromium	100.0	99.06	99	80-120	3	20	03/02/18
Cobalt	100.0	102.3	102	80-120	2	20	03/08/18
Copper	100.0	97.63	98	80-120	3	20	03/02/18
Lead	100.0	105.6	106	80-120	4	20	03/02/18
Molybdenum	100.0	97.13	97	80-120	3	20	03/02/18
Nickel	100.0	109.3	109	80-120	7	20	03/02/18
Selenium	100.0	104.8	105	76-120	3	20	03/02/18
Silver	100.0	102.3	102	80-120	3	21	03/02/18
Thallium	50.00	51.44	103	80-127	4	20	03/02/18
Vanadium	100.0	106.8	107	80-120	4	20	03/02/18
Zinc	100.0	103.3	103	77-120	3	23	03/08/18

RPD= Relative Percent Difference

Batch QC Report

Metals Analytical Report

Lab #:	297491	Prep:	EPA 200.7
Client:	APEC	Analysis:	EPA 200.7
Project#:	STANDARD		
Field ID:	OBO DUXO 3	Batch#:	256900
MSS Lab ID:	297491-005	Sampled:	02/22/18
Matrix:	Water	Received:	02/27/18
Units:	ug/L	Prepared:	02/28/18
Diln Fac:	1.000		

Type: MS   Lab ID: QC921838

Analyte	MSS Result	Spiked	Result	%REC	Limits	Analyzed
Antimony	<2.832	100.0	48.42	48	42-130	03/06/18
Arsenic	26.53	100.0	135.2	109	53-139	03/06/18
Barium	144.4	100.0	243.6	99	71-123	03/06/18
Beryllium	1.259	100.0	102.3	101	80-120	03/06/18
Cadmium	2.361	100.0	117.5	115	80-124	03/06/18
Chromium	29.17	100.0	126.8	98	76-124	03/06/18
Cobalt	13.77	100.0	112.5	99	75-122	03/08/18
Copper	37.16	100.0	138.0	101	69-125	03/06/18
Lead	<1.185	100.0	97.56	98	59-127	03/06/18
Molybdenum	<1.190	100.0	88.81	89	78-122	03/06/18
Nickel	28.44	100.0	130.1	102	70-123	03/06/18
Selenium	<2.791	100.0	89.07	89	50-144	03/06/18
Silver	13.11	100.0	112.8	100	66-125	03/06/18
Thallium	<1.934	50.00	44.95	90	65-130	03/06/18
Vanadium	77.41	100.0	179.3	102	77-124	03/06/18
Zinc	221.3	100.0	319.9	99	66-130	03/08/18

Type: MSD   Lab ID: QC921839

Analyte	Spiked	Result	%REC	Limits	RPD	Lim	Analyzed
Antimony	100.0	46.67	47	42-130	4	58	03/06/18
Arsenic	100.0	137.5	111	53-139	2	48	03/06/18
Barium	100.0	240.0	96	71-123	1	28	03/06/18
Beryllium	100.0	101.0	100	80-120	1	20	03/06/18
Cadmium	100.0	116.0	114	80-124	1	20	03/06/18
Chromium	100.0	124.2	95	76-124	2	25	03/06/18
Cobalt	100.0	111.7	98	75-122	1	20	03/08/18
Copper	100.0	137.2	100	69-125	1	27	03/06/18
Lead	100.0	97.49	97	59-127	0	32	03/06/18
Molybdenum	100.0	90.35	90	78-122	2	24	03/06/18
Nickel	100.0	128.5	100	70-123	1	26	03/06/18
Selenium	100.0	89.66	90	50-144	1	52	03/06/18
Silver	100.0	111.2	98	66-125	1	29	03/06/18
Thallium	50.00	44.19	88	65-130	2	30	03/06/18
Vanadium	100.0	178.2	101	77-124	1	23	03/06/18
Zinc	100.0	315.3	94	66-130	1	22	03/08/18

RPD= Relative Percent Difference

Batch QC Report

Metals Analytical Report

Lab #:	297491	Prep:	METHOD
Client:	APEC	Analysis:	EPA 245.1
Project#:	STANDARD		
Analyte:	Mercury	Diln Fac:	1.000
Type:	BLANK	Batch#:	257056
Lab ID:	QC922285	Prepared:	03/05/18
Matrix:	Water	Analyzed:	03/06/18
Units:	ug/L		

Result	RL
ND	0.20

ND= Not Detected
RL= Reporting Limit

Batch QC Report

Metals Analytical Report

Lab #:	297491	Prep:	METHOD
Client:	APEC	Analysis:	EPA 245.1
Project#:	STANDARD		
Analyte:	Mercury	Batch#:	257056
Matrix:	Water	Prepared:	03/05/18
Units:	ug/L	Analyzed:	03/06/18
Diln Fac:	1.000		

Type	Lab ID	Spiked	Result	%REC	Limits	RPD	Lim
BS	QC922286	2.000	1.829	91	80-120		
BSD	QC922287	2.000	1.795	90	80-120	2	20

RPD= Relative Percent Difference

Batch QC Report

Metals Analytical Report

Lab #:	297491	Prep:	METHOD
Client:	APEC	Analysis:	EPA 245.1
Project#:	STANDARD		
Analyte:	Mercury	Batch#:	257056
Field ID:	ZZZZZZZZZZ	Sampled:	02/28/18
MSS Lab ID:	297552-005	Received:	02/28/18
Matrix:	Water	Prepared:	03/05/18
Units:	ug/L	Analyzed:	03/06/18
Diln Fac:	1.000		

Type	Lab ID	MSS Result	Spiked	Result	%REC	Limits	RPD	Lim
MS	QC922288	<0.04000	2.000	1.818	91	63-120		
MSD	QC922289		2.000	1.813	91	63-120	0	36

RPD= Relative Percent Difference

Batch QC Report

Metals Analytical Report

Lab #:	297491	Prep:	METHOD
Client:	APEC	Analysis:	EPA 245.1
Project#:	STANDARD		
Analyte:	Mercury	Diln Fac:	1.000
Type:	BLANK	Batch#:	257112
Lab ID:	QC922512	Prepared:	03/06/18
Matrix:	Water	Analyzed:	03/07/18
Units:	ug/L		

Result	RL
ND	0.20

ND= Not Detected
RL= Reporting Limit

Batch QC Report

Metals Analytical Report

Lab #:	297491	Prep:	METHOD
Client:	APEC	Analysis:	EPA 245.1
Project#:	STANDARD		
Analyte:	Mercury	Batch#:	257112
Matrix:	Water	Prepared:	03/06/18
Units:	ug/L	Analyzed:	03/07/18
Diln Fac:	1.000		

Type	Lab ID	Spiked	Result	%REC	Limits	RPD	Lim
BS	QC922513	2.000	2.067	103	80-120		
BSD	QC922514	2.000	2.036	102	80-120	2	20

RPD= Relative Percent Difference

Batch QC Report

Metals Analytical Report

Lab #:	297491	Prep:	METHOD
Client:	APEC	Analysis:	EPA 245.1
Project#:	STANDARD		
Analyte:	Mercury	Batch#:	257112
Field ID:	ZZZZZZZZZZ	Sampled:	02/23/18
MSS Lab ID:	297541-002	Received:	02/28/18
Matrix:	Water	Prepared:	03/06/18
Units:	ug/L	Analyzed:	03/07/18
Diln Fac:	1.000		

Type	Lab ID	MSS Result	Spiked	Result	%REC	Limits	RPD	Lim
MS	QC922515	0.05153	2.000	2.143	105	63-120		
MSD	QC922516		2.000	2.100	102	63-120	2	36

RPD= Relative Percent Difference

Batch QC Report

Metals Analytical Report

Lab #:	297491	Prep:	METHOD
Client:	APEC	Analysis:	EPA 245.1
Project#:	STANDARD		
Analyte:	Mercury	Batch#:	257112
Field ID:	OBO DUXO 3	Sampled:	02/22/18
MSS Lab ID:	297491-005	Received:	02/27/18
Matrix:	Water	Prepared:	03/06/18
Units:	ug/L	Analyzed:	03/07/18
Diln Fac:	1.000		

Type	Lab ID	MSS Result	Spiked	Result	%REC	Limits	RPD	Lim
MS	QC922633	<0.04000	2.000	2.005	100	63-120		
MSD	QC922634		2.000	1.962	98	63-120	2	36

RPD= Relative Percent Difference

Enthalpy Analytical - Berkeley Analytical Report

Lab #:	297491	Prep:	METHOD
Client:	APEC	Analysis:	EPA 300.0
Project#:	STANDARD		
Matrix:	Water	Batch#:	256873
Units:	mg/L	Received:	02/27/18

Field ID:	OBO DUXO 1	Diln Fac:	5.000
Type:	SAMPLE	Sampled:	02/22/18 13:05
Lab ID:	297491-001	Analyzed:	02/27/18 12:52

Analyte	Result	RL
Nitrogen, Nitrite	4.7 b	0.25
Nitrogen, Nitrate	4.6 b	0.25

Field ID:	OBO DUXO 1B	Diln Fac:	1.000
Type:	SAMPLE	Sampled:	02/22/18 13:32
Lab ID:	297491-002	Analyzed:	02/27/18 13:09

Analyte	Result	RL
Nitrogen, Nitrite	ND b	0.05
Nitrogen, Nitrate	ND b	0.05

Field ID:	OBO DUXO 2	Diln Fac:	10.00
Type:	SAMPLE	Sampled:	02/22/18 14:16
Lab ID:	297491-003	Analyzed:	02/27/18 13:27

Analyte	Result	RL
Nitrogen, Nitrite	15 b	0.50
Nitrogen, Nitrate	2.2 b	0.50

Field ID:	OBO DUXO 29	Diln Fac:	10.00
Type:	SAMPLE	Sampled:	02/22/18 15:00
Lab ID:	297491-004	Analyzed:	02/27/18 13:44

Analyte	Result	RL
Nitrogen, Nitrite	15 b	0.50
Nitrogen, Nitrate	2.2 b	0.50

b= See narrative
ND= Not Detected
RL= Reporting Limit

Enthalpy Analytical - Berkeley Analytical Report

Lab #:	297491	Prep:	METHOD
Client:	APEC	Analysis:	EPA 300.0
Project#:	STANDARD		
Matrix:	Water	Batch#:	256873
Units:	mg/L	Received:	02/27/18

Field ID:	OBO DUXO 3	Diln Fac:	5.000
Type:	SAMPLE	Sampled:	02/22/18 16:36
Lab ID:	297491-005	Analyzed:	02/27/18 14:02

Analyte	Result	RL
Nitrogen, Nitrite	4.3 b	0.25
Nitrogen, Nitrate	1.8 b	0.25

Field ID:	OBO DUXO 04	Lab ID:	297491-006
Type:	SAMPLE	Sampled:	02/22/18 10:10

Analyte	Result	RL	Diln Fac	Analyzed
Nitrogen, Nitrite	1.8 b	0.05	1.000	02/27/18 14:36
Nitrogen, Nitrate	2.6 b	0.25	5.000	02/27/18 16:29

Type:	BLANK	Diln Fac:	1.000
Lab ID:	QC921558	Analyzed:	02/27/18 10:47

Analyte	Result	RL
Nitrogen, Nitrite	ND	0.05
Nitrogen, Nitrate	ND	0.05

b= See narrative
ND= Not Detected
RL= Reporting Limit

Batch QC Report

Enthalpy Analytical - Berkeley Analytical Report

Lab #:	297491	Prep:	METHOD
Client:	APEC	Analysis:	EPA 300.0
Project#:	STANDARD		
Type:	LCS	Diln Fac:	1.000
Lab ID:	QC921559	Batch#:	256873
Matrix:	Water	Analyzed:	02/27/18 11:04
Units:	mg/L		

Analyte	Spiked	Result	%REC	Limits
Nitrogen, Nitrite	0.5000	0.4947	99	80-120
Nitrogen, Nitrate	0.5000	0.5110	102	80-120

Batch QC Report

Enthalpy Analytical - Berkeley Analytical Report

Lab #:	297491	Prep:	METHOD
Client:	APEC	Analysis:	EPA 300.0
Project#:	STANDARD		
Field ID:	OBO DUXO 3	Diln Fac:	25.00
MSS Lab ID:	297491-005	Batch#:	256873
Matrix:	Water	Sampled:	02/22/18 16:36
Units:	mg/L	Received:	02/27/18

Type:	MS	Analyzed:	02/28/18 10:48
Lab ID:	QC921560		

Analyte	MSS Result	Spiked	Result	%REC	Limits
Nitrogen, Nitrite	4.310	6.250	10.60	101	80-133
Nitrogen, Nitrate	1.762	6.250	9.882	130 *	80-120

Type:	MSD	Analyzed:	02/28/18 11:05
Lab ID:	QC921561		

Analyte	Spiked	Result	%REC	Limits	RPD	Lim
Nitrogen, Nitrite	6.250	10.60	101	80-133	0	20
Nitrogen, Nitrate	6.250	10.09	133 *	80-120	2	20

*= Value outside of QC limits; see narrative
RPD= Relative Percent Difference

Perchlorate

Lab #:	297491	Prep:	METHOD
Client:	APEC	Analysis:	EPA 314.0
Project#:	STANDARD		
Matrix:	Water	Sampled:	02/22/18
Units:	ug/L	Received:	02/27/18
Batch#:	257119	Analyzed:	03/06/18

Field ID: OBO DUXO 1 Lab ID: 297491-001
Type: SAMPLE Diln Fac: 1.000

Analyte	Result	RL
Perchlorate	ND	4.0

Field ID: OBO DUXO 1B Lab ID: 297491-002
Type: SAMPLE Diln Fac: 1.000

Analyte	Result	RL
Perchlorate	ND	4.0

Field ID: OBO DUXO 2 Lab ID: 297491-003
Type: SAMPLE Diln Fac: 10.00

Analyte	Result	RL
Perchlorate	ND	40

Field ID: OBO DUXO 29 Lab ID: 297491-004
Type: SAMPLE Diln Fac: 10.00

Analyte	Result	RL
Perchlorate	ND	40

Field ID: OBO DUXO 3 Lab ID: 297491-005
Type: SAMPLE Diln Fac: 1.000

Analyte	Result	RL
Perchlorate	ND	4.0

Field ID: OBO DUXO 04 Lab ID: 297491-006
Type: SAMPLE Diln Fac: 1.000

Analyte	Result	RL
Perchlorate	ND	4.0

Type: BLANK Diln Fac: 1.000
Lab ID: QC922544

Analyte	Result	RL
Perchlorate	ND	4.0

ND= Not Detected
RL= Reporting Limit

Batch QC Report

Perchlorate

Lab #:	297491	Prep:	METHOD
Client:	APEC	Analysis:	EPA 314.0
Project#:	STANDARD		
Field ID:	OBO DUXO 3	Batch#:	257119
MSS Lab ID:	297491-005	Sampled:	02/22/18
Matrix:	Water	Received:	02/27/18
Units:	ug/L	Analyzed:	03/06/18

Type:	LCS	Diln Fac:	1.000
Lab ID:	QC922545		

Analyte	Spiked	Result	%REC	Limits
Perchlorate	20.00	19.00	95	85-115

Type:	MS	Diln Fac:	10.00
Lab ID:	QC922546		

Analyte	MSS Result	Spiked	Result	%REC	Limits
Perchlorate	<0.5000	200.0	223.0	112	80-120

Type:	MSD	Diln Fac:	10.00
Lab ID:	QC922547		

Analyte	Spiked	Result	%REC	Limits	RPD	Lim
Perchlorate	200.0	217.0	109	80-120	3	15

RPD= Relative Percent Difference

Ammonia Nitrogen

Lab #:	297491	Prep:	SM4500NH3-B
Client:	APEC	Analysis:	SM4500NH3-D
Project#:	STANDARD		
Analyte:	Ammonia-N	Batch#:	257041
Matrix:	Water	Received:	02/27/18
Units:	mg/L	Prepared:	03/05/18 16:20
Diln Fac:	1.000	Analyzed:	03/05/18 18:34

Field ID	Type	Lab ID	Result	RL	Sampled
OBO DUXO 1	SAMPLE	297491-001	0.26	0.10	02/22/18 13:05
OBO DUXO 1B	SAMPLE	297491-002	ND	0.10	02/22/18 13:32
OBO DUXO 2	SAMPLE	297491-003	ND	0.10	02/22/18 14:16
OBO DUXO 29	SAMPLE	297491-004	ND	0.10	02/22/18 15:00
OBO DUXO 3	SAMPLE	297491-005	0.13	0.10	02/22/18 16:36
OBO DUXO 04	SAMPLE	297491-006	ND	0.10	02/22/18 10:10
	BLANK	QC922216	ND	0.10	

ND= Not Detected
RL= Reporting Limit

Batch QC Report

Ammonia Nitrogen

Lab #:	297491	Prep:	SM4500NH3-B
Client:	APEC	Analysis:	SM4500NH3-D
Project#:	STANDARD		
Analyte:	Ammonia-N	Batch#:	257041
Field ID:	OBO DUXO 3	Sampled:	02/22/18 16:36
MSS Lab ID:	297491-005	Received:	02/27/18
Matrix:	Water	Prepared:	03/05/18 16:20
Units:	mg/L	Analyzed:	03/05/18 18:34
Diln Fac:	1.000		

Type	Lab ID	MSS Result	Spiked	Result	%REC	Limits	RPD	Lim
LCS	QC922217		5.000	5.000	100	80-120		
MS	QC922218	0.1300	5.000	5.000	97	79-120		
MSD	QC922219		5.000	5.000	97	79-120	0	20

RPD= Relative Percent Difference

Orthophosphate Phosphorous

Lab #:	297491	Prep:	METHOD
Client:	APEC	Analysis:	SM4500P-E
Project#:	STANDARD		
Analyte:	Orthophosphate (as P)	Batch#:	256947
Matrix:	Water	Received:	02/27/18
Units:	mg/L	Prepared:	03/01/18 14:45
Diln Fac:	1.000	Analyzed:	03/01/18 15:00

Field ID	Type	Lab ID	Result	RL	Sampled
OBO DUXO 1	SAMPLE	297491-001	0.087 b	0.030	02/22/18 13:05
OBO DUXO 1B	SAMPLE	297491-002	ND b	0.030	02/22/18 13:32
OBO DUXO 2	SAMPLE	297491-003	0.20 b	0.030	02/22/18 14:16
OBO DUXO 29	SAMPLE	297491-004	0.33 b	0.030	02/22/18 15:00
OBO DUXO 3	SAMPLE	297491-005	0.24 b	0.030	02/22/18 16:36
OBO DUXO 04	SAMPLE	297491-006	0.043 b	0.030	02/22/18 10:10
	BLANK	QC921855	ND	0.030	

b= See narrative
ND= Not Detected
RL= Reporting Limit

Batch QC Report

Orthophosphate Phosphorous

Lab #:	297491	Prep:	METHOD
Client:	APEC	Analysis:	SM4500P-E
Project#:	STANDARD		
Analyte:	Orthophosphate (as P)	Batch#:	256947
Field ID:	OBO DUXO 1	Sampled:	02/22/18 13:05
MSS Lab ID:	297491-001	Received:	02/27/18
Matrix:	Water	Prepared:	03/01/18 14:45
Units:	mg/L	Analyzed:	03/01/18 15:00
Diln Fac:	1.000		

Type	Lab ID	MSS Result	Spiked	Result	%REC	Limits	RPD	Lim
MS	QC921856	0.08650	0.4000	0.5138 b	107	80-120		
MSD	QC921857		0.4000	0.5180 b	108	80-120	1	20
LCS	QC921858		0.4000	0.3919	98	90-110		

b= See narrative

RPD= Relative Percent Difference

Total Kjeldahl Nitrogen

Lab #:	297491	Prep:	SMWW20:4500-NORG
Client:	APEC	Analysis:	SM4500NH3-C
Project#:	STANDARD		
Analyte:	Nitrogen, Total Kjeldahl	Sampled:	02/22/18
Matrix:	Water	Received:	02/27/18
Units:	mg/L	Prepared:	03/02/18
Diln Fac:	1.000	Analyzed:	03/05/18
Batch#:	256997		

Field ID	Type	Lab ID	Result	RL
OBO DUXO 1	SAMPLE	297491-001	2.0	1.0
OBO DUXO 1B	SAMPLE	297491-002	1.4	1.0
OBO DUXO 2	SAMPLE	297491-003	1.7	1.0
OBO DUXO 29	SAMPLE	297491-004	ND	1.0
OBO DUXO 3	SAMPLE	297491-005	1.1	1.0
OBO DUXO 04	SAMPLE	297491-006	ND	1.0
	BLANK	QC922044	ND	1.0

ND= Not Detected
RL= Reporting Limit

Batch QC Report

Total Kjeldahl Nitrogen

Lab #:	297491	Prep:	SMWW20:4500-NORG
Client:	APEC	Analysis:	SM4500NH3-C
Project#:	STANDARD		
Analyte:	Nitrogen, Total Kjeldahl	Batch#:	256997
Field ID:	OBO DUXO 3	Sampled:	02/22/18
MSS Lab ID:	297491-005	Received:	02/27/18
Matrix:	Water	Prepared:	03/02/18
Units:	mg/L	Analyzed:	03/05/18
Diln Fac:	1.000		

Type	Lab ID	MSS Result	Spiked	Result	%REC	Limits	RPD	Lim
LCS	QC922045		20.00	18.70	94	78-120		
MS	QC922046	1.120	20.00	19.10	90	68-120		
MSD	QC922047		20.00	18.65	88	68-120	2	23

RPD= Relative Percent Difference

Nitroaromatics and Nitroamines by HPLC

Lab #:	297491	Prep:	EPA 3535
Client:	APEC	Analysis:	EPA 8330
Project#:	STANDARD		
Field ID:	OBO DUXO 1	Batch#:	256844
Lab ID:	297491-001	Sampled:	02/22/18
Matrix:	Water	Received:	02/27/18
Units:	ug/L	Prepared:	02/28/18
Diln Fac:	1.000	Analyzed:	02/28/18

Analyte	Result	RL
HMX	ND	1.0
RDX	ND	1.0
1,3,5-Trinitrobenzene	ND	1.0
1,3-Dinitrobenzene	ND	1.0
Nitrobenzene	ND	1.0
Tetryl	ND	1.0
2,4,6-Trinitrotoluene	ND	1.0
2-Amino-4,6-dinitrotoluene	ND	1.0
4-Amino-2,6-dinitrotoluene	ND	1.0
2,4-Dinitrotoluene	ND	1.0
2,6-Dinitrotoluene	ND	1.0
2-Nitrotoluene	ND	1.0
4-Nitrotoluene	ND	1.0
3-Nitrotoluene	ND	1.0

Surrogate	%REC	Limits
1,2-Dinitrobenzene	92	46-127

ND= Not Detected
RL= Reporting Limit

Nitroaromatics and Nitroamines by HPLC

Lab #:	297491	Prep:	EPA 3535
Client:	APEC	Analysis:	EPA 8330
Project#:	STANDARD		
Field ID:	OBO DUXO 1B	Batch#:	256844
Lab ID:	297491-002	Sampled:	02/22/18
Matrix:	Water	Received:	02/27/18
Units:	ug/L	Prepared:	02/28/18
Diln Fac:	1.000	Analyzed:	02/28/18

Analyte	Result	RL
HMX	ND	1.0
RDX	ND	1.0
1,3,5-Trinitrobenzene	ND	1.0
1,3-Dinitrobenzene	ND	1.0
Nitrobenzene	ND	1.0
Tetryl	ND	1.0
2,4,6-Trinitrotoluene	ND	1.0
2-Amino-4,6-dinitrotoluene	ND	1.0
4-Amino-2,6-dinitrotoluene	ND	1.0
2,4-Dinitrotoluene	ND	1.0
2,6-Dinitrotoluene	ND	1.0
2-Nitrotoluene	ND	1.0
4-Nitrotoluene	ND	1.0
3-Nitrotoluene	ND	1.0

Surrogate	%REC	Limits
1,2-Dinitrobenzene	89	46-127

ND= Not Detected
RL= Reporting Limit

Nitroaromatics and Nitroamines by HPLC

Lab #:	297491	Prep:	EPA 3535
Client:	APEC	Analysis:	EPA 8330
Project#:	STANDARD		
Field ID:	OBO DUXO 2	Batch#:	256844
Lab ID:	297491-003	Sampled:	02/22/18
Matrix:	Water	Received:	02/27/18
Units:	ug/L	Prepared:	02/28/18
Diln Fac:	1.000	Analyzed:	02/28/18

Analyte	Result	RL
HMX	ND	1.0
RDX	ND	1.0
1,3,5-Trinitrobenzene	ND	1.0
1,3-Dinitrobenzene	ND	1.0
Nitrobenzene	ND	1.0
Tetryl	ND	1.0
2,4,6-Trinitrotoluene	ND	1.0
2-Amino-4,6-dinitrotoluene	ND	1.0
4-Amino-2,6-dinitrotoluene	ND	1.0
2,4-Dinitrotoluene	ND	1.0
2,6-Dinitrotoluene	ND	1.0
2-Nitrotoluene	ND	1.0
4-Nitrotoluene	ND	1.0
3-Nitrotoluene	ND	1.0

Surrogate	%REC	Limits
1,2-Dinitrobenzene	94	46-127

ND= Not Detected
RL= Reporting Limit

Nitroaromatics and Nitroamines by HPLC

Lab #:	297491	Prep:	EPA 3535
Client:	APEC	Analysis:	EPA 8330
Project#:	STANDARD		
Field ID:	OBO DUXO 29	Batch#:	256844
Lab ID:	297491-004	Sampled:	02/22/18
Matrix:	Water	Received:	02/27/18
Units:	ug/L	Prepared:	02/28/18
Diln Fac:	1.000	Analyzed:	02/28/18

Analyte	Result	RL
HMX	ND	1.1
RDX	ND	1.1
1,3,5-Trinitrobenzene	ND	1.1
1,3-Dinitrobenzene	ND	1.1
Nitrobenzene	ND	1.1
Tetryl	ND	1.1
2,4,6-Trinitrotoluene	ND	1.1
2-Amino-4,6-dinitrotoluene	ND	1.1
4-Amino-2,6-dinitrotoluene	ND	1.1
2,4-Dinitrotoluene	ND	1.1
2,6-Dinitrotoluene	ND	1.1
2-Nitrotoluene	ND	1.1
4-Nitrotoluene	ND	1.1
3-Nitrotoluene	ND	1.1

Surrogate	%REC	Limits
1,2-Dinitrobenzene	92	46-127

ND= Not Detected
RL= Reporting Limit

Nitroaromatics and Nitroamines by HPLC

Lab #:	297491	Prep:	EPA 3535
Client:	APEC	Analysis:	EPA 8330
Project#:	STANDARD		
Field ID:	OBO DUXO 3	Batch#:	256844
Lab ID:	297491-005	Sampled:	02/22/18
Matrix:	Water	Received:	02/27/18
Units:	ug/L	Prepared:	02/28/18
Diln Fac:	1.000	Analyzed:	02/28/18

Analyte	Result	RL
HMX	ND	1.0
RDX	ND	1.0
1,3,5-Trinitrobenzene	ND	1.0
1,3-Dinitrobenzene	ND	1.0
Nitrobenzene	ND	1.0
Tetryl	ND	1.0
2,4,6-Trinitrotoluene	ND	1.0
2-Amino-4,6-dinitrotoluene	ND	1.0
4-Amino-2,6-dinitrotoluene	ND	1.0
2,4-Dinitrotoluene	ND	1.0
2,6-Dinitrotoluene	ND	1.0
2-Nitrotoluene	ND	1.0
4-Nitrotoluene	ND	1.0
3-Nitrotoluene	ND	1.0

Surrogate	%REC	Limits
1,2-Dinitrobenzene	98	46-127

ND= Not Detected
RL= Reporting Limit

Nitroaromatics and Nitroamines by HPLC

Lab #:	297491	Prep:	EPA 3535
Client:	APEC	Analysis:	EPA 8330
Project#:	STANDARD		
Field ID:	OBO DUXO 04	Batch#:	256844
Lab ID:	297491-006	Sampled:	02/22/18
Matrix:	Water	Received:	02/27/18
Units:	ug/L	Prepared:	02/28/18
Diln Fac:	1.000	Analyzed:	02/28/18

Analyte	Result	RL
HMX	ND	1.0
RDX	ND	1.0
1,3,5-Trinitrobenzene	ND	1.0
1,3-Dinitrobenzene	ND	1.0
Nitrobenzene	ND	1.0
Tetryl	ND	1.0
2,4,6-Trinitrotoluene	ND	1.0
2-Amino-4,6-dinitrotoluene	ND	1.0
4-Amino-2,6-dinitrotoluene	ND	1.0
2,4-Dinitrotoluene	ND	1.0
2,6-Dinitrotoluene	ND	1.0
2-Nitrotoluene	ND	1.0
4-Nitrotoluene	ND	1.0
3-Nitrotoluene	ND	1.0

Surrogate	%REC	Limits
1,2-Dinitrobenzene	104	46-127

ND= Not Detected
RL= Reporting Limit

Metals Analytical Report

Lab #:	297491	Project#:	STANDARD
Client:	APEC		
Field ID:	OBO DUXO 1	Diln Fac:	1.000
Lab ID:	297491-001	Sampled:	02/22/18
Matrix:	Water	Received:	02/27/18
Units:	ug/L		

Analyte	Result	RL	Batch#	Prepared	Analyzed	Prep	Analysis
Antimony	ND	10	256900	02/28/18	03/02/18	EPA 200.7	EPA 200.7
Arsenic	49	10	256900	02/28/18	03/02/18	EPA 200.7	EPA 200.7
Barium	51	5.0	256900	02/28/18	03/02/18	EPA 200.7	EPA 200.7
Beryllium	ND	2.0	256900	02/28/18	03/02/18	EPA 200.7	EPA 200.7
Cadmium	ND	5.0	256900	02/28/18	03/02/18	EPA 200.7	EPA 200.7
Chromium	38	5.0	256900	02/28/18	03/02/18	EPA 200.7	EPA 200.7
Cobalt	15	5.0	256900	02/28/18	03/08/18	EPA 200.7	EPA 200.7
Copper	50	5.0	256900	02/28/18	03/02/18	EPA 200.7	EPA 200.7
Lead	ND	5.0	256900	02/28/18	03/02/18	EPA 200.7	EPA 200.7
Mercury	ND	0.20	257056	03/05/18	03/06/18	METHOD	EPA 245.1
Molybdenum	ND	5.0	256900	02/28/18	03/02/18	EPA 200.7	EPA 200.7
Nickel	52	5.0	256900	02/28/18	03/02/18	EPA 200.7	EPA 200.7
Selenium	ND	10	256900	02/28/18	03/02/18	EPA 200.7	EPA 200.7
Silver	42	5.0	256900	02/28/18	03/02/18	EPA 200.7	EPA 200.7
Thallium	ND	10	256900	02/28/18	03/02/18	EPA 200.7	EPA 200.7
Vanadium	80	5.0	256900	02/28/18	03/02/18	EPA 200.7	EPA 200.7
Zinc	190	20	256900	02/28/18	03/08/18	EPA 200.7	EPA 200.7

ND= Not Detected
RL= Reporting Limit

Metals Analytical Report

Lab #:	297491	Project#:	STANDARD
Client:	APEC		
Field ID:	OBO DUXO 1B	Diln Fac:	1.000
Lab ID:	297491-002	Sampled:	02/22/18
Matrix:	Water	Received:	02/27/18
Units:	ug/L		

Analyte	Result	RL	Batch#	Prepared	Analyzed	Prep	Analysis
Antimony	ND	10	256900	02/28/18	03/02/18	EPA 200.7	EPA 200.7
Arsenic	ND	10	256900	02/28/18	03/02/18	EPA 200.7	EPA 200.7
Barium	ND	5.0	256900	02/28/18	03/02/18	EPA 200.7	EPA 200.7
Beryllium	ND	2.0	256900	02/28/18	03/02/18	EPA 200.7	EPA 200.7
Cadmium	ND	5.0	256900	02/28/18	03/02/18	EPA 200.7	EPA 200.7
Chromium	ND	5.0	256900	02/28/18	03/02/18	EPA 200.7	EPA 200.7
Cobalt	ND b	5.0	256900	02/28/18	03/02/18	EPA 200.7	EPA 200.7
Copper	ND	5.0	256900	02/28/18	03/02/18	EPA 200.7	EPA 200.7
Lead	ND	5.0	256900	02/28/18	03/02/18	EPA 200.7	EPA 200.7
Mercury	ND	0.20	257056	03/05/18	03/06/18	METHOD	EPA 245.1
Molybdenum	ND	5.0	256900	02/28/18	03/02/18	EPA 200.7	EPA 200.7
Nickel	ND	5.0	256900	02/28/18	03/02/18	EPA 200.7	EPA 200.7
Selenium	ND	10	256900	02/28/18	03/02/18	EPA 200.7	EPA 200.7
Silver	ND	5.0	256900	02/28/18	03/02/18	EPA 200.7	EPA 200.7
Thallium	ND	10	256900	02/28/18	03/02/18	EPA 200.7	EPA 200.7
Vanadium	ND	5.0	256900	02/28/18	03/02/18	EPA 200.7	EPA 200.7
Zinc	ND b	20	256900	02/28/18	03/02/18	EPA 200.7	EPA 200.7

b= See narrative
ND= Not Detected
RL= Reporting Limit

Metals Analytical Report

Lab #:	297491	Project#:	STANDARD
Client:	APEC		
Field ID:	OBO DUXO 2	Diln Fac:	1.000
Lab ID:	297491-003	Sampled:	02/22/18
Matrix:	Water	Received:	02/27/18
Units:	ug/L		

Analyte	Result	RL	Batch#	Prepared	Analyzed	Prep	Analysis
Antimony	ND	10	256900	02/28/18	03/02/18	EPA 200.7	EPA 200.7
Arsenic	ND	10	256900	02/28/18	03/02/18	EPA 200.7	EPA 200.7
Barium	9.4	5.0	256900	02/28/18	03/02/18	EPA 200.7	EPA 200.7
Beryllium	ND	2.0	256900	02/28/18	03/02/18	EPA 200.7	EPA 200.7
Cadmium	ND	5.0	256900	02/28/18	03/02/18	EPA 200.7	EPA 200.7
Chromium	ND	5.0	256900	02/28/18	03/02/18	EPA 200.7	EPA 200.7
Cobalt	ND	5.0	256900	02/28/18	03/08/18	EPA 200.7	EPA 200.7
Copper	11	5.0	256900	02/28/18	03/02/18	EPA 200.7	EPA 200.7
Lead	ND	5.0	256900	02/28/18	03/02/18	EPA 200.7	EPA 200.7
Mercury	ND	0.20	257056	03/05/18	03/06/18	METHOD	EPA 245.1
Molybdenum	ND	5.0	256900	02/28/18	03/02/18	EPA 200.7	EPA 200.7
Nickel	6.3	5.0	256900	02/28/18	03/02/18	EPA 200.7	EPA 200.7
Selenium	ND	10	256900	02/28/18	03/02/18	EPA 200.7	EPA 200.7
Silver	9.5	5.0	256900	02/28/18	03/02/18	EPA 200.7	EPA 200.7
Thallium	ND	10	256900	02/28/18	03/02/18	EPA 200.7	EPA 200.7
Vanadium	30	5.0	256900	02/28/18	03/02/18	EPA 200.7	EPA 200.7
Zinc	140	20	256900	02/28/18	03/08/18	EPA 200.7	EPA 200.7

ND= Not Detected

RL= Reporting Limit

Metals Analytical Report

Lab #:	297491	Project#:	STANDARD
Client:	APEC		
Field ID:	OBO DUXO 29	Diln Fac:	1.000
Lab ID:	297491-004	Sampled:	02/22/18
Matrix:	Water	Received:	02/27/18
Units:	ug/L		

Analyte	Result	RL	Batch#	Prepared	Analyzed	Prep	Analysis
Antimony	ND	10	256900	02/28/18	03/02/18	EPA 200.7	EPA 200.7
Arsenic	18	10	256900	02/28/18	03/02/18	EPA 200.7	EPA 200.7
Barium	19	5.0	256900	02/28/18	03/02/18	EPA 200.7	EPA 200.7
Beryllium	ND	2.0	256900	02/28/18	03/02/18	EPA 200.7	EPA 200.7
Cadmium	ND	5.0	256900	02/28/18	03/02/18	EPA 200.7	EPA 200.7
Chromium	16	5.0	256900	02/28/18	03/02/18	EPA 200.7	EPA 200.7
Cobalt	ND	5.0	256900	02/28/18	03/08/18	EPA 200.7	EPA 200.7
Copper	21	5.0	256900	02/28/18	03/02/18	EPA 200.7	EPA 200.7
Lead	ND	5.0	256900	02/28/18	03/02/18	EPA 200.7	EPA 200.7
Mercury	ND	0.20	257056	03/05/18	03/06/18	METHOD	EPA 245.1
Molybdenum	ND	5.0	256900	02/28/18	03/02/18	EPA 200.7	EPA 200.7
Nickel	11	5.0	256900	02/28/18	03/02/18	EPA 200.7	EPA 200.7
Selenium	ND	10	256900	02/28/18	03/02/18	EPA 200.7	EPA 200.7
Silver	12	5.0	256900	02/28/18	03/02/18	EPA 200.7	EPA 200.7
Thallium	ND	10	256900	02/28/18	03/02/18	EPA 200.7	EPA 200.7
Vanadium	43	5.0	256900	02/28/18	03/02/18	EPA 200.7	EPA 200.7
Zinc	100	20	256900	02/28/18	03/08/18	EPA 200.7	EPA 200.7

ND= Not Detected
RL= Reporting Limit

Metals Analytical Report

Lab #:	297491	Project#:	STANDARD
Client:	APEC		
Field ID:	OBO DUXO 3	Diln Fac:	1.000
Lab ID:	297491-005	Sampled:	02/22/18
Matrix:	Water	Received:	02/27/18
Units:	ug/L		

Analyte	Result	RL	Batch#	Prepared	Analyzed	Prep	Analysis
Antimony	ND	10	256900	02/28/18	03/02/18	EPA 200.7	EPA 200.7
Arsenic	27	10	256900	02/28/18	03/02/18	EPA 200.7	EPA 200.7
Barium	140	5.0	256900	02/28/18	03/02/18	EPA 200.7	EPA 200.7
Beryllium	ND	2.0	256900	02/28/18	03/02/18	EPA 200.7	EPA 200.7
Cadmium	ND	5.0	256900	02/28/18	03/02/18	EPA 200.7	EPA 200.7
Chromium	29	5.0	256900	02/28/18	03/02/18	EPA 200.7	EPA 200.7
Cobalt	14	5.0	256900	02/28/18	03/08/18	EPA 200.7	EPA 200.7
Copper	37	5.0	256900	02/28/18	03/02/18	EPA 200.7	EPA 200.7
Lead	ND	5.0	256900	02/28/18	03/02/18	EPA 200.7	EPA 200.7
Mercury	ND	0.20	257112	03/06/18	03/07/18	METHOD	EPA 245.1
Molybdenum	ND	5.0	256900	02/28/18	03/02/18	EPA 200.7	EPA 200.7
Nickel	28	5.0	256900	02/28/18	03/02/18	EPA 200.7	EPA 200.7
Selenium	ND	10	256900	02/28/18	03/02/18	EPA 200.7	EPA 200.7
Silver	13	5.0	256900	02/28/18	03/02/18	EPA 200.7	EPA 200.7
Thallium	ND	10	256900	02/28/18	03/02/18	EPA 200.7	EPA 200.7
Vanadium	77	5.0	256900	02/28/18	03/02/18	EPA 200.7	EPA 200.7
Zinc	220	20	256900	02/28/18	03/08/18	EPA 200.7	EPA 200.7

ND= Not Detected
RL= Reporting Limit

ENTHALPY
ANALYTICAL

Metals Analytical Report

Lab #:	297491	Project#:	STANDARD
Client:	APEC		
Field ID:	OBO DUXO 04	Diln Fac:	1.000
Lab ID:	297491-006	Sampled:	02/22/18
Matrix:	Water	Received:	02/27/18
Units:	ug/L		

Analyte	Result	RL	Batch#	Prepared	Analyzed	Prep	Analysis
Antimony	ND	10	256900	02/28/18	03/02/18	EPA 200.7	EPA 200.7
Arsenic	20	10	256900	02/28/18	03/02/18	EPA 200.7	EPA 200.7
Barium	190	5.0	256900	02/28/18	03/02/18	EPA 200.7	EPA 200.7
Beryllium	ND	2.0	256900	02/28/18	03/02/18	EPA 200.7	EPA 200.7
Cadmium	ND	5.0	256900	02/28/18	03/02/18	EPA 200.7	EPA 200.7
Chromium	18	5.0	256900	02/28/18	03/02/18	EPA 200.7	EPA 200.7
Cobalt	7.4	5.0	256900	02/28/18	03/08/18	EPA 200.7	EPA 200.7
Copper	20	5.0	256900	02/28/18	03/02/18	EPA 200.7	EPA 200.7
Lead	ND	5.0	256900	02/28/18	03/02/18	EPA 200.7	EPA 200.7
Mercury	0.31	0.20	257056	03/05/18	03/06/18	METHOD	EPA 245.1
Molybdenum	ND	5.0	256900	02/28/18	03/02/18	EPA 200.7	EPA 200.7
Nickel	21	5.0	256900	02/28/18	03/02/18	EPA 200.7	EPA 200.7
Selenium	ND	10	256900	02/28/18	03/02/18	EPA 200.7	EPA 200.7
Silver	18	5.0	256900	02/28/18	03/02/18	EPA 200.7	EPA 200.7
Thallium	ND	10	256900	02/28/18	03/02/18	EPA 200.7	EPA 200.7
Vanadium	41	5.0	256900	02/28/18	03/02/18	EPA 200.7	EPA 200.7
Zinc	84	20	256900	02/28/18	03/08/18	EPA 200.7	EPA 200.7

ND= Not Detected
RL= Reporting Limit

Enthalpy Analytical - Berkeley Analytical Report

Lab #:	297491	Prep:	METHOD
Client:	APEC	Analysis:	EPA 300.0
Project#:	STANDARD		
Matrix:	Water	Batch#:	256873
Units:	mg/L	Received:	02/27/18

Field ID:	OBO DUXO 1	Diln Fac:	5.000
Type:	SAMPLE	Sampled:	02/22/18 13:05
Lab ID:	297491-001	Analyzed:	02/27/18 12:52

Analyte	Result	RL
Nitrogen, Nitrite	4.7 b	0.25
Nitrogen, Nitrate	4.6 b	0.25

Field ID:	OBO DUXO 1B	Diln Fac:	1.000
Type:	SAMPLE	Sampled:	02/22/18 13:32
Lab ID:	297491-002	Analyzed:	02/27/18 13:09

Analyte	Result	RL
Nitrogen, Nitrite	ND b	0.05
Nitrogen, Nitrate	ND b	0.05

Field ID:	OBO DUXO 2	Diln Fac:	10.00
Type:	SAMPLE	Sampled:	02/22/18 14:16
Lab ID:	297491-003	Analyzed:	02/27/18 13:27

Analyte	Result	RL
Nitrogen, Nitrite	15 b	0.50
Nitrogen, Nitrate	2.2 b	0.50

Field ID:	OBO DUXO 29	Diln Fac:	10.00
Type:	SAMPLE	Sampled:	02/22/18 15:00
Lab ID:	297491-004	Analyzed:	02/27/18 13:44

Analyte	Result	RL
Nitrogen, Nitrite	15 b	0.50
Nitrogen, Nitrate	2.2 b	0.50

b= See narrative
ND= Not Detected
RL= Reporting Limit

Enthalpy Analytical - Berkeley Analytical Report

Lab #:	297491	Prep:	METHOD
Client:	APEC	Analysis:	EPA 300.0
Project#:	STANDARD		
Matrix:	Water	Batch#:	256873
Units:	mg/L	Received:	02/27/18

Field ID:	OBO DUXO 3	Diln Fac:	5.000
Type:	SAMPLE	Sampled:	02/22/18 16:36
Lab ID:	297491-005	Analyzed:	02/27/18 14:02

Analyte	Result	RL
Nitrogen, Nitrite	4.3 b	0.25
Nitrogen, Nitrate	1.8 b	0.25

Field ID:	OBO DUXO 04	Lab ID:	297491-006
Type:	SAMPLE	Sampled:	02/22/18 10:10

Analyte	Result	RL	Diln Fac	Analyzed
Nitrogen, Nitrite	1.8 b	0.05	1.000	02/27/18 14:36
Nitrogen, Nitrate	2.6 b	0.25	5.000	02/27/18 16:29

Type:	BLANK	Diln Fac:	1.000
Lab ID:	QC921558	Analyzed:	02/27/18 10:47

Analyte	Result	RL
Nitrogen, Nitrite	ND	0.05
Nitrogen, Nitrate	ND	0.05

b= See narrative
ND= Not Detected
RL= Reporting Limit

Perchlorate

Lab #:	297491	Prep:	METHOD
Client:	APEC	Analysis:	EPA 314.0
Project#:	STANDARD		
Matrix:	Water	Sampled:	02/22/18
Units:	ug/L	Received:	02/27/18
Batch#:	257119	Analyzed:	03/06/18

Field ID:	OBO DUXO 1	Lab ID:	297491-001
Type:	SAMPLE	Diln Fac:	1.000

Analyte	Result	RL
Perchlorate	ND	4.0

Field ID:	OBO DUXO 1B	Lab ID:	297491-002
Type:	SAMPLE	Diln Fac:	1.000

Analyte	Result	RL
Perchlorate	ND	4.0

Field ID:	OBO DUXO 2	Lab ID:	297491-003
Type:	SAMPLE	Diln Fac:	10.00

Analyte	Result	RL
Perchlorate	ND	40

Field ID:	OBO DUXO 29	Lab ID:	297491-004
Type:	SAMPLE	Diln Fac:	10.00

Analyte	Result	RL
Perchlorate	ND	40

Field ID:	OBO DUXO 3	Lab ID:	297491-005
Type:	SAMPLE	Diln Fac:	1.000

Analyte	Result	RL
Perchlorate	ND	4.0

Field ID:	OBO DUXO 04	Lab ID:	297491-006
Type:	SAMPLE	Diln Fac:	1.000

Analyte	Result	RL
Perchlorate	ND	4.0

Type:	BLANK	Diln Fac:	1.000
Lab ID:	QC922544		

Analyte	Result	RL
Perchlorate	ND	4.0

ND= Not Detected
RL= Reporting Limit

Ammonia Nitrogen

Lab #:	297491	Prep:	SM4500NH3-B
Client:	APEC	Analysis:	SM4500NH3-D
Project#:	STANDARD		
Analyte:	Ammonia-N	Batch#:	257041
Matrix:	Water	Received:	02/27/18
Units:	mg/L	Prepared:	03/05/18 16:20
Diln Fac:	1.000	Analyzed:	03/05/18 18:34

Field ID	Type	Lab ID	Result	RL	Sampled
OBO DUXO 1	SAMPLE	297491-001	0.26	0.10	02/22/18 13:05
OBO DUXO 1B	SAMPLE	297491-002	ND	0.10	02/22/18 13:32
OBO DUXO 2	SAMPLE	297491-003	ND	0.10	02/22/18 14:16
OBO DUXO 29	SAMPLE	297491-004	ND	0.10	02/22/18 15:00
OBO DUXO 3	SAMPLE	297491-005	0.13	0.10	02/22/18 16:36
OBO DUXO 04	SAMPLE	297491-006	ND	0.10	02/22/18 10:10
	BLANK	QC922216	ND	0.10	

ND= Not Detected
RL= Reporting Limit

Orthophosphate Phosphorous

Lab #:	297491	Prep:	METHOD
Client:	APEC	Analysis:	SM4500P-E
Project#:	STANDARD		
Analyte:	Orthophosphate (as P)	Batch#:	256947
Matrix:	Water	Received:	02/27/18
Units:	mg/L	Prepared:	03/01/18 14:45
Diln Fac:	1.000	Analyzed:	03/01/18 15:00

Field ID	Type	Lab ID	Result	RL	Sampled
OBO DUXO 1	SAMPLE	297491-001	0.087 b	0.030	02/22/18 13:05
OBO DUXO 1B	SAMPLE	297491-002	ND b	0.030	02/22/18 13:32
OBO DUXO 2	SAMPLE	297491-003	0.20 b	0.030	02/22/18 14:16
OBO DUXO 29	SAMPLE	297491-004	0.33 b	0.030	02/22/18 15:00
OBO DUXO 3	SAMPLE	297491-005	0.24 b	0.030	02/22/18 16:36
OBO DUXO 04	SAMPLE	297491-006	0.043 b	0.030	02/22/18 10:10
	BLANK	QC921855	ND	0.030	

b= See narrative
ND= Not Detected
RL= Reporting Limit

Total Kjeldahl Nitrogen

Lab #:	297491	Prep:	SMWW20:4500-NORG
Client:	APEC	Analysis:	SM4500NH3-C
Project#:	STANDARD		
Analyte:	Nitrogen, Total Kjeldahl	Sampled:	02/22/18
Matrix:	Water	Received:	02/27/18
Units:	mg/L	Prepared:	03/02/18
Diln Fac:	1.000	Analyzed:	03/05/18
Batch#:	256997		

Field ID	Type	Lab ID	Result	RL
OBO DUXO 1	SAMPLE	297491-001	2.0	1.0
OBO DUXO 1B	SAMPLE	297491-002	1.4	1.0
OBO DUXO 2	SAMPLE	297491-003	1.7	1.0
OBO DUXO 29	SAMPLE	297491-004	ND	1.0
OBO DUXO 3	SAMPLE	297491-005	1.1	1.0
OBO DUXO 04	SAMPLE	297491-006	ND	1.0
	BLANK	QC922044	ND	1.0

ND= Not Detected

RL= Reporting Limit

RTI LABORATORIES, INC.

RTI Laboratories
31628 Glendale St.
Livonia, MI 48150
TEL: (734) 422-8000
Website: www.rtilab.com

Wednesday, March 07, 2018

Will Rice
Enthalpy Analytical (Berkeley)
2323 Fifth Street
Berkeley, CA 94710
TEL: (510) 486-0900
FAX: (510) 486-0532

RE: 297491

Work Order #: 1803120

Dear Will Rice:

There were no problems with the analytical events associated with this report unless noted in the Case Narrative.

This report may only be reproduced in its entirety. Individual pages, reproduced without supporting documentation, do not contain related information and may be misinterpreted by other data reviewers.

Quality control data is within laboratory defined or method specified acceptance limits except if noted.

If you have any questions regarding these tests results, please feel free to call.

Sincerely,

Jeannine Meyers

Jeannine Meyers

Project Manager

RTI Laboratories, Inc. - Workorder Sample Summary

WO#: 1803120

Date Reported: 3/7/2018
Original

Client: Enthalpy Analytical (Berkeley)

Project: 297491

Lab Sample ID	Client Sample ID	Tag No	Date Collected	Date Received	Matrix
1803120-001A	OBO DUXO 1		2/22/2018 1:05 PM	3/5/2018 4:14 PM	Water
1803120-002A	OBO DUXO 1B		2/22/2018 1:32 PM	3/5/2018 4:14 PM	Water
1803120-003A	OBO DUXO 2		2/22/2018 2:16 PM	3/5/2018 4:14 PM	Water
1803120-004A	OBO DUXO 29		2/22/2018 3:00 PM	3/5/2018 4:14 PM	Water
1803120-005A	OBO DUXO 3		2/22/2018 4:36 PM	3/5/2018 4:14 PM	Water
1803120-006A	OBO DUXO 04		2/22/2018 10:10 AM	3/5/2018 4:14 PM	Water

RTI Laboratories, Inc. - Case Narrative

WO#: 1803120

Date Reported: 3/7/2018
Original

Client:	Enthalpy Analytical (Berkeley)
Project:	297491

Concentrations reported with a J flag in the Qual field are values below the reporting limit (RL) but greater than the established method detection limit (MDL). There is greater uncertainty associated with these results and data should be considered as estimated. These analytes are not routinely reviewed nor narrated below as to their potential for being laboratory artifacts.

Concentrations reported with an E flag in the Qual field are values that exceed the upper quantification range. There is greater uncertainty associated with these results and data should be considered as estimated.

All sample analyses included a Method Blank, LCS/LCSD, MS/MSD, Duplicates, post digestion spikes, serial dilutions, and all method specified quality control, as applicable. All QC parameters were within established control limits except where noted on the QC report and/or below. Initial and continuing calibration results were within method specifications, except as noted below.

Pesticide and PCB analysis clarification:
Organochlorine Pesticides: Surrogates were not evaluated for CCV and CRQL samples for Chlordane and Toxaphene. Chlordane and Toxaphene are not present in the LCS, MS and MSD spiking solution.
Polychlorinated Biphenyls (PCB): The spiking solutions only contain the peaks for Aroclors 1016 and 1260.

Any comments or problems with the analytical events associated with this report are noted below.

Sample Receipt:
Receipt No. 1: Samples were received at the RTI Laboratories, Inc. via FedEx delivery on 3/5/2018. Total number of samples received are 6.

Sample Analysis:
Samples were analyzed at the RTI Laboratories, Inc. for:
White Phosphorus - Liquid - SW7580

Sample Analysis:
Samples were analyzed at the RTI Laboratories
White Phosphorus - Liquid - SW7580

Prep Batch (SW_7580APR) / 45944:
Sample 1803120-001A: Prep Method hold time was exceeded by 6.883 day(s)
Sample 1803120-002A: Prep Method hold time was exceeded by 6.865 day(s)
Sample 1803120-003A: Prep Method hold time was exceeded by 6.834 day(s)
Sample 1803120-004A: Prep Method hold time was exceeded by 6.804 day(s)
Sample 1803120-005A: Prep Method hold time was exceeded by 6.737 day(s)
Sample 1803120-006A: Prep Method hold time was exceeded by 7.005 day(s)

Prep Batch (SW_7580APR) / 45944:
Sample 1803120-005AMS: Prep Method hold time was exceeded by 6.737 day(s)
Sample 1803120-005AMSD: Prep Method hold time was exceeded by 6.737 day(s)

Analytical Comments for Test SW_7580A, Analytical RunNo 101095, Batch ID 45944:
Sample 1803120-001A: Recovery for surrogate Tripropyl phosphate exceeded control limits. Sample reanalyzed with similar results. Suspected matrix interference.
Sample 1803120-002A: Analytical Sequence's Prep Method hold time was exceeded by 6.865 day(s)
Sample 1803120-003A: Analytical Sequence's Prep Method hold time was exceeded by 6.834 day(s)
Sample 1803120-004A: Analytical Sequence's Prep Method hold time was exceeded by 6.804 day(s)
Sample 1803120-005A: Analytical Sequence's Prep Method hold time was exceeded by 6.737 day(s)
Sample 1803120-005AMS: Recovery for White Phosphorus exceeded control limits.
Sample 1803120-005AMSD: Recovery for White Phosphorus exceeded control limits.
Sample 1803120-006A: Analytical Sequence's Prep Method hold time was exceeded by 7.005 day(s)

Analytical Comments for Test SW_7580A, Analytical RunNo 101095, Batch ID 45944:
A-B Comments:
1803120-001A SW_7580A: Sample ID 1803120-001A: Recovery of surrogate exeeded limits.

RTI Laboratories, Inc. - Analytical Report

WO#: **1803120**

Date Reported: **3/7/2018**
Original

Client:	Enthalpy Analytical (Berkeley)	**Collection Date:**	2/22/2018 1:05:00 PM
Project:	297491		
Lab ID:	1803120-001	**Matrix:**	Water
Client Sample ID:	OBO DUXO 1		

Analysis	Result	RL	Qual	Units	DF	Date Analyzed
White Phosphorus - Liquid	**Method: SW7580**					**Analyst: DS**
White Phosphorus	ND	0.43		µg/L	1	3/6/2018 3:57 PM
Surr: Tripropylphosphate	21.3	27-112	S	%Rec	1	3/6/2018 3:57 PM

RTI Laboratories, Inc. - Analytical Report

WO#: **1803120**

Date Reported: **3/7/2018**
Original

Client:	Enthalpy Analytical (Berkeley)	**Collection Date:**	2/22/2018 1:32:00 PM
Project:	297491		
Lab ID:	1803120-002	**Matrix:**	Water
Client Sample ID:	OBO DUXO 1B		

Analysis	Result	RL	Qual	Units	DF	Date Analyzed
White Phosphorus - Liquid	**Method: SW7580**					**Analyst: DS**
White Phosphorus	ND	0.43	H	µg/L	1	3/6/2018 4:55 PM
Surr: Tripropylphosphate	30.6	27-112	mH	%Rec	1	3/6/2018 4:55 PM

RTI Laboratories, Inc. - Analytical Report

WO#: 1803120

Date Reported: 3/7/2018
Original

Client:	Enthalpy Analytical (Berkeley)	**Collection Date:**	2/22/2018 2:16:00 PM
Project:	297491		
Lab ID:	1803120-003	**Matrix:**	Water
Client Sample ID:	OBO DUXO 2		

Analysis	Result	RL	Qual	Units	DF	Date Analyzed
White Phosphorus - Liquid	**Method: SW7580**					**Analyst: DS**
White Phosphorus	ND	0.43	H	µg/L	1	3/6/2018 5:14 PM
Surr: Tripropylphosphate	31.0	27-112	mH	%Rec	1	3/6/2018 5:14 PM

RTI Laboratories, Inc. - Analytical Report

WO#: **1803120**

Date Reported: **3/7/2018**
Original

Client:	Enthalpy Analytical (Berkeley)	**Collection Date:**	2/22/2018 3:00:00 PM
Project:	297491		
Lab ID:	1803120-004	**Matrix:**	Water
Client Sample ID:	OBO DUXO 29		

Analysis	Result	RL	Qual	Units	DF	Date Analyzed
White Phosphorus - Liquid	**Method: SW7580**					**Analyst: DS**
White Phosphorus	ND	0.43	H	µg/L	1	3/6/2018 5:33 PM
Surr: Tripropylphosphate	27.4	27-112	mH	%Rec	1	3/6/2018 5:33 PM

RTI Laboratories, Inc. - Analytical Report

WO#: **1803120**

Date Reported: **3/7/2018**
Original

Client:	Enthalpy Analytical (Berkeley)	**Collection Date:**	2/22/2018 4:36:00 PM
Project:	297491		
Lab ID:	1803120-005	**Matrix:**	Water
Client Sample ID:	OBO DUXO 3		

Analysis	Result	RL	Qual	Units	DF	Date Analyzed
White Phosphorus - Liquid	**Method: SW7580**					**Analyst: DS**
White Phosphorus	ND	0.43	H	µg/L	1	3/6/2018 6:12 PM
Surr: Tripropylphosphate	34.5	27-112	mH	%Rec	1	3/6/2018 6:12 PM

RTI Laboratories, Inc. - Analytical Report

WO#: **1803120**

Date Reported: **3/7/2018**
Original

Client:	Enthalpy Analytical (Berkeley)	**Collection Date:**	2/22/2018 10:10:00 AM
Project:	297491		
Lab ID:	1803120-006	**Matrix:**	Water
Client Sample ID:	OBO DUXO 04		

Analysis	Result	RL	Qual	Units	DF	Date Analyzed
White Phosphorus - Liquid	**Method: SW7580**					**Analyst: DS**
White Phosphorus	ND	0.43	H	µg/L	1	3/6/2018 5:53 PM
Surr: Tripropylphosphate	27.6	27-112	mH	%Rec	1	3/6/2018 5:53 PM

RTI Laboratories, Inc. - DATES REPORT

WO#: **1803120**

Date Reported: **3/7/2018**
Original

Client: Enthalpy Analytical (Berkeley)

Project: 297491

Sample ID	Client Sample ID	Collection Date	Matrix	Test Name	Leachate Date	Prep Date	Analysis Date
1803120-001A	OBO DUXO 1	2/22/2018 1:05 PM	Water				
				SW_7580A-White Phosphorus - Liquid		3/6/2018 10:17 AM	3/6/2018 3:57 PM
1803120-002A	OBO DUXO 1B	2/22/2018 1:32 PM	Water				
				SW_7580A-White Phosphorus - Liquid		3/6/2018 10:17 AM	3/6/2018 4:55 PM
1803120-003A	OBO DUXO 2	2/22/2018 2:16 PM	Water				
				SW_7580A-White Phosphorus - Liquid		3/6/2018 10:17 AM	3/6/2018 5:14 PM
1803120-004A	OBO DUXO 29	2/22/2018 3:00 PM	Water				
				SW_7580A-White Phosphorus - Liquid		3/6/2018 10:17 AM	3/6/2018 5:33 PM
1803120-005A	OBO DUXO 3	2/22/2018 4:36 PM	Water				
				SW_7580A-White Phosphorus - Liquid		3/6/2018 10:17 AM	3/6/2018 6:12 PM
1803120-006A	OBO DUXO 04	2/22/2018 10:10 AM	Water				
				SW_7580A-White Phosphorus - Liquid		3/6/2018 10:17 AM	3/6/2018 5:53 PM

RTI Laboratories, Inc. - QC SUMMARY REPORT

WO#: 1803120

Date Reported: 3/7/2018

Original

Client: Enthalpy Analytical (Berkeley)

Project: 297491 **Batch ID:** 45944

Sample ID:	**MB-45944**	Samp Type:	**MBLK**	Test Code:	**SW_7580A**	Units:	**µg/L**	Prep Date:	**3/6/2018**	RunNo:	**101095**
Client ID:	**PBW**	Batch ID:	**45944**	TestNo:	**SW7580**			Analysis Date:	**3/6/2018**	SeqNo:	**1981173**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	Low Limit	High Limit	RPD Ref Value	%RPD	RPDLimit	Qual
White Phosphorus	ND	0.43									
Surr: Tripropylphosphate	350		1,000		34.8	27	112				m

Sample ID:	**LCS-45944**	Samp Type:	**LCS**	Test Code:	**SW_7580A**	Units:	**µg/L**	Prep Date:	**3/6/2018**	RunNo:	**101095**
Client ID:	**LCSW**	Batch ID:	**45944**	TestNo:	**SW7580**			Analysis Date:	**3/6/2018**	SeqNo:	**1981174**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	Low Limit	High Limit	RPD Ref Value	%RPD	RPDLimit	Qual
White Phosphorus	3.3	0.43	4.292	0	77.5	75	125				m
Surr: Tripropylphosphate	280		1,000		28.1	27	112				m

Sample ID:	**IDMP2-SS**	Samp Type:	**LCS**	Test Code:	**SW_7580A**	Units:	**µg/L**	Prep Date:	**3/6/2018**	RunNo:	**101095**
Client ID:	**LCSW**	Batch ID:	**45944**	TestNo:	**SW7580**			Analysis Date:	**3/6/2018**	SeqNo:	**1981175**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	Low Limit	High Limit	RPD Ref Value	%RPD	RPDLimit	Qual
White Phosphorus	2.5	0.43	4.292	0	58.5	75	125				S
Surr: Tripropylphosphate	210		1,000		20.5	27	112				S

Sample ID:	**IDMP3-SS**	Samp Type:	**LCS**	Test Code:	**SW_7580A**	Units:	**µg/L**	Prep Date:	**3/6/2018**	RunNo:	**101095**
Client ID:	**LCSW**	Batch ID:	**45944**	TestNo:	**SW7580**			Analysis Date:	**3/6/2018**	SeqNo:	**1981176**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	Low Limit	High Limit	RPD Ref Value	%RPD	RPDLimit	Qual
White Phosphorus	3.7	0.43	4.292	0	85.1	75	125				m
Surr: Tripropylphosphate	340		1,000		34.0	27	112				m

Sample ID:	**IDMP4-SS**	Samp Type:	**LCS**	Test Code:	**SW_7580A**	Units:	**µg/L**	Prep Date:	**3/6/2018**	RunNo:	**101095**
Client ID:	**LCSW**	Batch ID:	**45944**	TestNo:	**SW7580**			Analysis Date:	**3/6/2018**	SeqNo:	**1981177**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	Low Limit	High Limit	RPD Ref Value	%RPD	RPDLimit	Qual
White Phosphorus	3.7	0.43	4.292	0	85.8	75	125				m
Surr: Tripropylphosphate	320		1,000		32.1	27	112				m

RTI Laboratories, Inc. - QC SUMMARY REPORT

WO#: **1803120**

Date Reported: **3/7/2018**
Original

Client: Enthalpy Analytical (Berkeley)

Project: 297491 **Batch ID:** **45944**

Sample ID:	**1803120-005AMS**	Samp Type:	**MS**	Test Code:	**SW_7580A**	Units:	**µg/L**	Prep Date:	**3/6/2018** RunNo:	**101095**
Client ID:	**OBO DUXO 3MS1**	Batch ID:	**45944**	TestNo:	**SW7580**			Analysis Date:	**3/6/2018** SeqNo:	**1981180**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	Low Limit	High Limit	RPD Ref Value	%RPD	RPDLimit	Qual
White Phosphorus	2.8	0.43	4.292	0	64.6	75	125				SmH
Surr: Tripropylphosphate	280		1,000		28.5	27	112				H

Sample ID:	**1803120-005AMSD**	Samp Type:	**MSD**	Test Code:	**SW_7580A**	Units:	**µg/L**	Prep Date:	**3/6/2018** RunNo:	**101095**
Client ID:	**OBO DUXO 3SD1**	Batch ID:	**45944**	TestNo:	**SW7580**			Analysis Date:	**3/6/2018** SeqNo:	**1981182**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	Low Limit	High Limit	RPD Ref Value	%RPD	RPDLimit	Qual
White Phosphorus	2.9	0.43	4.292	0	67.1	75	125	2.773	3.77	25	Sm
Surr: Tripropylphosphate	300		1,000		29.5	27	112		0	25	

RTI Laboratories, Inc. - Definitions and Acronyms

WO#: 1803120

Date Reported: 3/7/2018
Original

DEFINITIONS:

DF: Dilution factor; the dilution factor applied to the prepared sample.

DUP: Duplicate; aliquots of a sample taken from the same container under laboratory conditions and processed and analyzed independently, used to calculate Precision (%RPD).

LCS: Laboratory Control Sample; prepared by adding a known amount of target analytes to a specified amount of clean matrix and prepared with the batch of samples, used to calculate Accuracy (%REC).

LCSD: A duplicate LCS sample, used to calculate both Accuracy (%REC) and Precision (%RPD)

MBLK: Method Blank; a sample of similar matrix that does not contain target analytes or interference that may impact the analytical results and is processed simultaneously with and under the same conditions as samples through all steps of the analytical procedure, used to assess and verify that the analytical process is free of contamination.

MDL: Method Detection Limit; The lowest concentration of analyte that can be detected by the method in the applicable matrix.

Mg/Kg or mg/L: Units of part per million (PPM) – milligram per Kilogram (W/W) or milligram per Liter (W/V).

MS: Matrix Spike; prepared by adding a known amount of target analytes to a specified amount of matrix sample for which an independent estimate of target analyte concentration is available, used to calculate Accuracy (%REC)

MSD: A duplicate MS sample, used to calculate both Accuracy (%REC) and Precision (%RPD)

% REC: Percent Recovery of a known spike (SPK); a measure of accuracy expressed as a percentage of a measured (recovered) concentration compared to the known concentration (SPK) added to the sample. This is compared to the Low Limit and High Limit.

% RPD: Relative Percent Difference; a measure of precision expressed as a percentage of the difference between two duplicates relative to the average concentration. This is compared to the RPD Limit.

PL: Permit limit:; Not included on all reports. Used primarily for wastewater discharge permits.

PQL: Practical Quantitation Limit; The lowest verified limit to which data is quantified without qualifications. Analyte concentrations below PQL are reported either as ND or as a number with a “J” qualifier.

Qual: Qualifier that applies to the analyte reported

RL: Reporting Limit: See PQL

SPK: Spike; used in the QC section for both SPK Value and SPK Ref Val

Ug/Kg or ug/L: Units of part per billion (PPB) – microgram per Kilogram (W/W) or microgram per Liter (W/V).

QUALIFIERS:

*/X: Reported value exceeds the maximum allowed concentration by regulation or permit

B: Analyte detected in the associated Method Blank at a concentration > RL.

E: Analyte concentration reported that exceeds the upper calibration standard. Greater uncertainty is associated with this result and data should be considered estimated.

H: Holding time for preparation or analysis has been exceeded

J: Analyte concentration is reported, and is less than the PQL and greater than or equal to the established MDL. Greater uncertainty is associated with this result and data reported is estimated. These analytes are not routinely reviewed nor narrated as to their potential for being laboratory artifacts.

M: Manual Integration used to determine area response

ND: Analyte concentration is less than the Reporting Limit.

P: Second column RPD exceeds 40%

R: % RPD exceeds control limits

S: % REC exceeds control limits

T: MBLK result is greater than 1/2 of the LOQ

U: The analyte concentration is less than the DL.

Enthalpy Berkeley

2323 Fifth Street
Berkeley, CA 94710
(510) 486-0900
(510) 486-0532

1803120

Project Number: 297491
Site:

Subcontract Laboratory:
RTI Laboratories
31628 Glendale Street
Livonia, MI 48150
(734) 292-2100
ATTN: Sample Receiving

Results due: Report Level: II

Please send report to: Will Rice (will.rice@enthalpy.com)
*** Please report using Sample ID rather than Enthalpy (Berkeley) Lab #.

Sample ID	Sampled	Matrix	Analysis	Lab #	Comments
OBO DUXO 1	02/22 13:05	Water	WHITE PHOSPHORUS	297491-001	
OBO DUXO 1B	02/22 13:32	Water	WHITE PHOSPHORUS	297491-002	
OBO DUXO 2	02/22 14:16	Water	WHITE PHOSPHORUS	297491-003	
OBO DUXO 29	02/22 15:00	Water	WHITE PHOSPHORUS	297491-004	
OBO DUXO 3	02/22 16:36	Water	WHITE PHOSPHORUS	297491-005	MS/MSD
OBO DUXO 04	02/22 10:10	Water	WHITE PHOSPHORUS	297491-006	

Notes:	Relinquished By:	Received By:
	Date/Time: 3/2/18 15:41	Date/Time: 3-5-18 14:35
	Date/Time:	Date/Time:

Signature on this form constitutes a firm Purchase Order for the services requested above.

ORIGIN ID:JEMA (510) 486-0900
SAMPLE CONTROL
ENTHALPY ANALYTICAL
2323 5TH STREET

BERKELEY, CA 94710
UNITED STATES US

SHIP DATE: 02MAR18
ACTWGT: 30.00 LB
CAD: 7603800/INET3980
DIMS: 36x18x18 IN

BILL SENDER

TO **SAMPLE RECEIVING**
RTI LABORATORY
31628 GLENDALE STREET

LIVONIA MI 48150
(734) 292-2100 REF:
INV:
PO: DEPT:

552J1/07F5/DCA5

FedEx Express

E

J181118012601uv

MON - 05 MAR 3:00P
STANDARD OVERNIGHT

TRK# 0201 **7717 0489 2157**

TT CFAA

48150
MI-US **DTW**

EMAX

Temp: 0.9-2.3°C
(corr.)

ENTHALPY

ANALYTICAL

Enthalpy Analytical
2323 Fifth Street, Berkeley, CA 94710, Phone (510) 486-0900

Laboratory Job Number 298959
ANALYTICAL REPORT

APEC
P.O. Box 5091
Agana, GU 96932

Project : STANDARD

Level : II

Sample ID	Lab ID
OBO DUXO 1	298959-001
OBO DUXO 1B	298959-002
OBO DUXO 2	298959-003
OBO DUXO 29	298959-004
OBO DUXO 3	298959-005
OBO DUXO 04	298959-006

This data package has been reviewed for technical correctness and completeness. Release of this data has been authorized by the Laboratory Manager or the Manager's designee, as verified by the following signature which applies to this PDF file as well as any associated electronic data deliverable files. The results contained in this report meet all requirements of NELAP and pertain only to those samples which were submitted for analysis. This report may be reproduced only in its entirety.

Signature: ______________________ Date: 04/24/2018

Tracy Babjar
Project Manager
tracy.babjar@enthalpy.com
(510) 204-2226 Ext 13107

CA ELAP# 2896, NELAP# 4044-001

CASE NARRATIVE

Laboratory number:	**298959**
Client:	**APEC**
Request Date:	**04/16/18**
Samples Received:	**02/27/18**

This data package contains sample and QC results for six water samples, requested for the above referenced project on 04/16/18. The samples were received cold and intact.

Metals (EPA 200.7 and EPA 245.1):

The samples were filtered outside the 40CFR136 recommended 15 minute holding time. Mercury was analyzed outside of hold time; affected data was qualified with "b". No other analytical problems were encountered.

Detections Summary for 298959

Results for any subcontracted analyses are not included in this summary.

Client : APEC
Project : STANDARD
Location :

Client Sample ID : OBO DUXO 1 Laboratory Sample ID : 298959-001

Analyte	Result	Flags	RL	Units	Basis	IDF	Method	Prep Method
Barium	27		5.0	ug/L	DISS.	1.000	EPA 200.7	METHOD
Vanadium	7.0		5.0	ug/L	DISS.	1.000	EPA 200.7	METHOD

Client Sample ID : OBO DUXO 1B Laboratory Sample ID : 298959-002

No Detections

Client Sample ID : OBO DUXO 2 Laboratory Sample ID : 298959-003

Analyte	Result	Flags	RL	Units	Basis	IDF	Method	Prep Method
Barium	15		5.0	ug/L	DISS.	1.000	EPA 200.7	METHOD
Copper	5.8		5.0	ug/L	DISS.	1.000	EPA 200.7	METHOD
Vanadium	8.0		5.0	ug/L	DISS.	1.000	EPA 200.7	METHOD
Zinc	28		20	ug/L	DISS.	1.000	EPA 200.7	METHOD

Client Sample ID : OBO DUXO 29 Laboratory Sample ID : 298959-004

Analyte	Result	Flags	RL	Units	Basis	IDF	Method	Prep Method
Barium	8.8		5.0	ug/L	DISS.	1.000	EPA 200.7	METHOD
Copper	5.6		5.0	ug/L	DISS.	1.000	EPA 200.7	METHOD
Vanadium	7.7		5.0	ug/L	DISS.	1.000	EPA 200.7	METHOD
Zinc	23		20	ug/L	DISS.	1.000	EPA 200.7	METHOD

Client Sample ID : OBO DUXO 3 Laboratory Sample ID : 298959-005

Analyte	Result	Flags	RL	Units	Basis	IDF	Method	Prep Method
Barium	43		5.0	ug/L	DISS.	1.000	EPA 200.7	METHOD
Vanadium	6.1		5.0	ug/L	DISS.	1.000	EPA 200.7	METHOD

Client Sample ID : OBO DUXO 04 Laboratory Sample ID : 298959-006

Analyte	Result	Flags	RL	Units	Basis	IDF	Method	Prep Method
Barium	96		5.0	ug/L	DISS.	1.000	EPA 200.7	METHOD

Dissolved Metals Analytical Report

Lab #:	298959	Project#:	STANDARD
Client:	APEC	Prep:	METHOD
Field ID:	OBO DUXO 1	Diln Fac:	1.000
Lab ID:	298959-001	Sampled:	02/22/18
Matrix:	Filtrate	Received:	02/27/18
Units:	ug/L		

Analyte	Result	RL	Batch#	Prepared	Analyzed	Analysis
Antimony	ND	10	258609	04/18/18	04/18/18	EPA 200.7
Arsenic	ND	10	258609	04/18/18	04/18/18	EPA 200.7
Barium	27	5.0	258609	04/18/18	04/18/18	EPA 200.7
Beryllium	ND	2.0	258609	04/18/18	04/18/18	EPA 200.7
Cadmium	ND	5.0	258609	04/18/18	04/18/18	EPA 200.7
Chromium	ND	5.0	258609	04/18/18	04/18/18	EPA 200.7
Cobalt	ND	5.0	258609	04/18/18	04/18/18	EPA 200.7
Copper	ND	5.0	258609	04/18/18	04/18/18	EPA 200.7
Lead	ND	5.0	258609	04/18/18	04/18/18	EPA 200.7
Mercury	ND b	0.20	258708	04/20/18	04/20/18	EPA 245.1
Molybdenum	ND	5.0	258609	04/18/18	04/18/18	EPA 200.7
Nickel	ND	5.0	258609	04/18/18	04/18/18	EPA 200.7
Selenium	ND	10	258609	04/18/18	04/18/18	EPA 200.7
Silver	ND	5.0	258609	04/18/18	04/18/18	EPA 200.7
Thallium	ND	12	258609	04/18/18	04/18/18	EPA 200.7
Vanadium	7.0	5.0	258609	04/18/18	04/18/18	EPA 200.7
Zinc	ND	20	258609	04/18/18	04/18/18	EPA 200.7

b= See narrative
ND= Not Detected
RL= Reporting Limit

Dissolved Metals Analytical Report

Lab #:	298959	Project#:	STANDARD
Client:	APEC	Prep:	METHOD
Field ID:	OBO DUXO 1B	Diln Fac:	1.000
Lab ID:	298959-002	Sampled:	02/22/18
Matrix:	Filtrate	Received:	02/27/18
Units:	ug/L		

Analyte	Result	RL	Batch#	Prepared	Analyzed	Analysis
Antimony	ND	10	258609	04/18/18	04/18/18	EPA 200.7
Arsenic	ND	10	258609	04/18/18	04/18/18	EPA 200.7
Barium	ND	5.0	258609	04/18/18	04/18/18	EPA 200.7
Beryllium	ND	2.0	258609	04/18/18	04/18/18	EPA 200.7
Cadmium	ND	5.0	258609	04/18/18	04/18/18	EPA 200.7
Chromium	ND	5.0	258609	04/18/18	04/18/18	EPA 200.7
Cobalt	ND	5.0	258609	04/18/18	04/18/18	EPA 200.7
Copper	ND	5.0	258609	04/18/18	04/18/18	EPA 200.7
Lead	ND	5.0	258609	04/18/18	04/18/18	EPA 200.7
Mercury	ND b	0.20	258708	04/20/18	04/20/18	EPA 245.1
Molybdenum	ND	5.0	258609	04/18/18	04/18/18	EPA 200.7
Nickel	ND	5.0	258609	04/18/18	04/18/18	EPA 200.7
Selenium	ND	10	258609	04/18/18	04/18/18	EPA 200.7
Silver	ND	5.0	258609	04/18/18	04/18/18	EPA 200.7
Thallium	ND	12	258609	04/18/18	04/18/18	EPA 200.7
Vanadium	ND	5.0	258609	04/18/18	04/18/18	EPA 200.7
Zinc	ND	20	258609	04/18/18	04/18/18	EPA 200.7

b= See narrative
ND= Not Detected
RL= Reporting Limit

Dissolved Metals Analytical Report

Lab #:	298959	Project#:	STANDARD
Client:	APEC	Prep:	METHOD
Field ID:	OBO DUXO 2	Diln Fac:	1.000
Lab ID:	298959-003	Sampled:	02/22/18
Matrix:	Filtrate	Received:	02/27/18
Units:	ug/L		

Analyte	Result	RL	Batch#	Prepared	Analyzed	Analysis
Antimony	ND	10	258609	04/18/18	04/18/18	EPA 200.7
Arsenic	ND	10	258609	04/18/18	04/18/18	EPA 200.7
Barium	15	5.0	258609	04/18/18	04/18/18	EPA 200.7
Beryllium	ND	2.0	258609	04/18/18	04/18/18	EPA 200.7
Cadmium	ND	5.0	258609	04/18/18	04/18/18	EPA 200.7
Chromium	ND	5.0	258609	04/18/18	04/18/18	EPA 200.7
Cobalt	ND	5.0	258609	04/18/18	04/18/18	EPA 200.7
Copper	5.8	5.0	258609	04/18/18	04/18/18	EPA 200.7
Lead	ND	5.0	258609	04/18/18	04/18/18	EPA 200.7
Mercury	ND b	0.20	258708	04/20/18	04/20/18	EPA 245.1
Molybdenum	ND	5.0	258609	04/18/18	04/18/18	EPA 200.7
Nickel	ND	5.0	258609	04/18/18	04/18/18	EPA 200.7
Selenium	ND	10	258609	04/18/18	04/18/18	EPA 200.7
Silver	ND	5.0	258609	04/18/18	04/18/18	EPA 200.7
Thallium	ND	12	258609	04/18/18	04/18/18	EPA 200.7
Vanadium	8.0	5.0	258609	04/18/18	04/18/18	EPA 200.7
Zinc	28	20	258609	04/18/18	04/18/18	EPA 200.7

b= See narrative
ND= Not Detected
RL= Reporting Limit

Dissolved Metals Analytical Report

Lab #:	298959	Project#:	STANDARD
Client:	APEC	Prep:	METHOD
Field ID:	OBO DUXO 29	Diln Fac:	1.000
Lab ID:	298959-004	Sampled:	02/22/18
Matrix:	Filtrate	Received:	02/27/18
Units:	ug/L		

Analyte	Result	RL	Batch#	Prepared	Analyzed	Analysis
Antimony	ND	10	258609	04/18/18	04/18/18	EPA 200.7
Arsenic	ND	10	258609	04/18/18	04/18/18	EPA 200.7
Barium	8.8	5.0	258609	04/18/18	04/18/18	EPA 200.7
Beryllium	ND	2.0	258609	04/18/18	04/18/18	EPA 200.7
Cadmium	ND	5.0	258609	04/18/18	04/18/18	EPA 200.7
Chromium	ND	5.0	258609	04/18/18	04/18/18	EPA 200.7
Cobalt	ND	5.0	258609	04/18/18	04/18/18	EPA 200.7
Copper	5.6	5.0	258609	04/18/18	04/18/18	EPA 200.7
Lead	ND	5.0	258609	04/18/18	04/18/18	EPA 200.7
Mercury	ND b	0.20	258708	04/20/18	04/20/18	EPA 245.1
Molybdenum	ND	5.0	258609	04/18/18	04/18/18	EPA 200.7
Nickel	ND	5.0	258609	04/18/18	04/18/18	EPA 200.7
Selenium	ND	10	258609	04/18/18	04/18/18	EPA 200.7
Silver	ND	5.0	258609	04/18/18	04/18/18	EPA 200.7
Thallium	ND	12	258609	04/18/18	04/18/18	EPA 200.7
Vanadium	7.7	5.0	258609	04/18/18	04/18/18	EPA 200.7
Zinc	23	20	258609	04/18/18	04/18/18	EPA 200.7

b= See narrative
ND= Not Detected
RL= Reporting Limit

Dissolved Metals Analytical Report

Lab #:	298959	Project#:	STANDARD
Client:	APEC	Prep:	METHOD
Field ID:	OBO DUXO 3	Diln Fac:	1.000
Lab ID:	298959-005	Sampled:	02/22/18
Matrix:	Filtrate	Received:	02/27/18
Units:	ug/L		

Analyte	Result	RL	Batch#	Prepared	Analyzed	Analysis
Antimony	ND	10	258609	04/18/18	04/18/18	EPA 200.7
Arsenic	ND	10	258609	04/18/18	04/18/18	EPA 200.7
Barium	43	5.0	258609	04/18/18	04/18/18	EPA 200.7
Beryllium	ND	2.0	258609	04/18/18	04/18/18	EPA 200.7
Cadmium	ND	5.0	258609	04/18/18	04/18/18	EPA 200.7
Chromium	ND	5.0	258609	04/18/18	04/18/18	EPA 200.7
Cobalt	ND	5.0	258609	04/18/18	04/18/18	EPA 200.7
Copper	ND	5.0	258609	04/18/18	04/18/18	EPA 200.7
Lead	ND	5.0	258609	04/18/18	04/18/18	EPA 200.7
Mercury	ND b	0.20	258708	04/20/18	04/20/18	EPA 245.1
Molybdenum	ND	5.0	258609	04/18/18	04/18/18	EPA 200.7
Nickel	ND	5.0	258609	04/18/18	04/18/18	EPA 200.7
Selenium	ND	10	258609	04/18/18	04/18/18	EPA 200.7
Silver	ND	5.0	258609	04/18/18	04/18/18	EPA 200.7
Thallium	ND	12	258609	04/18/18	04/18/18	EPA 200.7
Vanadium	6.1	5.0	258609	04/18/18	04/18/18	EPA 200.7
Zinc	ND	20	258609	04/18/18	04/18/18	EPA 200.7

b= See narrative
ND= Not Detected
RL= Reporting Limit

Dissolved Metals Analytical Report

Lab #:	298959	Project#:	STANDARD
Client:	APEC	Prep:	METHOD
Field ID:	OBO DUXO 04	Diln Fac:	1.000
Lab ID:	298959-006	Sampled:	02/22/18
Matrix:	Filtrate	Received:	02/27/18
Units:	ug/L		

Analyte	Result	RL	Batch#	Prepared	Analyzed	Analysis
Antimony	ND	10	258609	04/18/18	04/18/18	EPA 200.7
Arsenic	ND	10	258609	04/18/18	04/18/18	EPA 200.7
Barium	96	5.0	258609	04/18/18	04/18/18	EPA 200.7
Beryllium	ND	2.0	258609	04/18/18	04/18/18	EPA 200.7
Cadmium	ND	5.0	258609	04/18/18	04/18/18	EPA 200.7
Chromium	ND	5.0	258609	04/18/18	04/18/18	EPA 200.7
Cobalt	ND	5.0	258609	04/18/18	04/18/18	EPA 200.7
Copper	ND	5.0	258609	04/18/18	04/18/18	EPA 200.7
Lead	ND	5.0	258609	04/18/18	04/18/18	EPA 200.7
Mercury	ND b	0.20	258708	04/20/18	04/20/18	EPA 245.1
Molybdenum	ND	5.0	258609	04/18/18	04/18/18	EPA 200.7
Nickel	ND	5.0	258609	04/18/18	04/18/18	EPA 200.7
Selenium	ND	10	258609	04/18/18	04/18/18	EPA 200.7
Silver	ND	5.0	258609	04/18/18	04/18/18	EPA 200.7
Thallium	ND	10	258609	04/18/18	04/18/18	EPA 200.7
Vanadium	ND	5.0	258609	04/18/18	04/18/18	EPA 200.7
Zinc	ND	20	258609	04/18/18	04/18/18	EPA 200.7

b= See narrative
ND= Not Detected
RL= Reporting Limit

Batch QC Report

Dissolved Metals Analytical Report

Lab #:	298959	Prep:	METHOD
Client:	APEC	Analysis:	EPA 200.7
Project#:	STANDARD		
Type:	BLANK	Diln Fac:	1.000
Lab ID:	QC928522	Batch#:	258609
Matrix:	Filtrate	Prepared:	04/18/18
Units:	ug/L	Analyzed:	04/18/18

Analyte	Result	RL
Antimony	ND	10
Arsenic	ND	10
Barium	ND	5.0
Beryllium	ND	2.0
Cadmium	ND	5.0
Chromium	ND	5.0
Cobalt	ND	5.0
Copper	ND	5.0
Lead	ND	5.0
Molybdenum	ND	5.0
Nickel	ND	5.0
Selenium	ND	10
Silver	ND	5.0
Thallium	ND	12
Vanadium	ND	5.0
Zinc	ND	20

ND= Not Detected
RL= Reporting Limit

Batch QC Report

Dissolved Metals Analytical Report

Lab #:	298959	Prep:	METHOD
Client:	APEC	Analysis:	EPA 200.7
Project#:	STANDARD		
Matrix:	Filtrate	Batch#:	258609
Units:	ug/L	Prepared:	04/18/18
Diln Fac:	1.000	Analyzed:	04/18/18

Type: BS Lab ID: QC928523

Analyte	Spiked	Result	%REC	Limits
Antimony	100.0	111.8	112	68-120
Arsenic	100.0	113.5	114	76-120
Barium	100.0	96.65	97	80-120
Beryllium	100.0	102.2	102	80-120
Cadmium	100.0	102.6	103	80-120
Chromium	100.0	101.5	102	80-120
Cobalt	100.0	100.5	100	80-120
Copper	100.0	97.46	97	80-120
Lead	100.0	106.5	107	80-120
Molybdenum	100.0	106.4	106	80-120
Nickel	100.0	102.7	103	80-120
Selenium	100.0	102.1	102	76-120
Silver	100.0	108.2	108	80-120
Thallium	50.00	54.41	109	80-127
Vanadium	100.0	104.0	104	80-120
Zinc	100.0	115.7	116	77-120

Type: BSD Lab ID: QC928524

Analyte	Spiked	Result	%REC	Limits	RPD	Lim
Antimony	100.0	111.2	111	68-120	1	20
Arsenic	100.0	114.2	114	76-120	1	20
Barium	100.0	97.30	97	80-120	1	20
Beryllium	100.0	100.7	101	80-120	1	20
Cadmium	100.0	101.9	102	80-120	1	20
Chromium	100.0	101.0	101	80-120	0	20
Cobalt	100.0	101.1	101	80-120	1	20
Copper	100.0	98.49	98	80-120	1	20
Lead	100.0	106.5	107	80-120	0	20
Molybdenum	100.0	106.4	106	80-120	0	20
Nickel	100.0	102.3	102	80-120	0	20
Selenium	100.0	105.6	106	76-120	3	20
Silver	100.0	108.4	108	80-120	0	21
Thallium	50.00	52.92	106	80-127	3	20
Vanadium	100.0	103.5	103	80-120	0	20
Zinc	100.0	116.1	116	77-120	0	23

RPD= Relative Percent Difference

Batch QC Report

Dissolved Metals Analytical Report

Lab #:	298959	Prep:	METHOD
Client:	APEC	Analysis:	EPA 200.7
Project#:	STANDARD		
Field ID:	ZZZZZZZZZZ	Batch#:	258609
MSS Lab ID:	298971-001	Sampled:	04/16/18
Matrix:	Filtrate	Received:	04/16/18
Units:	ug/L	Prepared:	04/18/18
Diln Fac:	1.000	Analyzed:	04/18/18

Type: MS Lab ID: QC928525

Analyte	MSS Result	Spiked	Result	%REC	Limits
Antimony	<2.034	100.0	107.9	108	42-130
Arsenic	17.11	100.0	132.6	115	53-139
Barium	123.9	100.0	205.6	82	71-123
Beryllium	<0.1359	100.0	101.2	101	80-120
Cadmium	<0.5166	100.0	100.2	100	80-124
Chromium	<0.3271	100.0	99.64	100	76-124
Cobalt	<1.250	100.0	94.58	95	75-122
Copper	2.230	100.0	95.94	94	69-125
Lead	<1.293	100.0	94.93	95	59-127
Molybdenum	1.004	100.0	108.1	107	78-122
Nickel	4.566	100.0	100.7	96	70-123
Selenium	<2.368	100.0	115.9	116	50-144
Silver	<0.3994	100.0	86.62	87	66-125
Thallium	7.555	50.00	55.76	96	65-130
Vanadium	4.678	100.0	106.3	102	77-124
Zinc	7.176	100.0	117.2	110	66-130

Type: MSD Lab ID: QC928526

Analyte	Spiked	Result	%REC	Limits	RPD	Lim
Antimony	100.0	109.7	110	42-130	2	58
Arsenic	100.0	139.5	122	53-139	5	48
Barium	100.0	208.6	85	71-123	1	28
Beryllium	100.0	103.9	104	80-120	3	20
Cadmium	100.0	102.4	102	80-124	2	20
Chromium	100.0	100.5	101	76-124	1	25
Cobalt	100.0	96.90	97	75-122	2	20
Copper	100.0	98.08	96	69-125	2	27
Lead	100.0	98.10	98	59-127	3	32
Molybdenum	100.0	109.9	109	78-122	2	24
Nickel	100.0	103.9	99	70-123	3	26
Selenium	100.0	120.9	121	50-144	4	52
Silver	100.0	95.31	95	66-125	10	29
Thallium	50.00	57.28	99	65-130	3	30
Vanadium	100.0	108.4	104	77-124	2	23
Zinc	100.0	120.4	113	66-130	3	22

RPD= Relative Percent Difference

Batch QC Report

Dissolved Metals Analytical Report

Lab #:	298959	Prep:	METHOD
Client:	APEC	Analysis:	EPA 245.1
Project#:	STANDARD		
Analyte:	Mercury	Batch#:	258708
Matrix:	Water	Prepared:	04/20/18
Units:	ug/L	Analyzed:	04/20/18
Diln Fac:	1.000		

Type	Lab ID	Spiked	Result	%REC	Limits	RPD	Lim
BS	QC928934	2.000	1.979	99	80-120		
BSD	QC928935	2.000	1.946	97	80-120	2	20

RPD= Relative Percent Difference

Batch QC Report

Dissolved Metals Analytical Report

Lab #:	298959	Prep:	METHOD
Client:	APEC	Analysis:	EPA 245.1
Project#:	STANDARD		
Analyte:	Mercury	Batch#:	258708
Field ID:	ZZZZZZZZZZ	Sampled:	04/16/18
MSS Lab ID:	298971-001	Received:	04/16/18
Matrix:	Filtrate	Prepared:	04/20/18
Units:	ug/L	Analyzed:	04/20/18
Diln Fac:	1.000		

Type	Lab ID	MSS Result	Spiked	Result	%REC	Limits	RPD	Lim
MS	QC928936	<0.04000	2.000	1.841	92	63-120		
MSD	QC928937		2.000	1.864	93	63-120	1	36

RPD= Relative Percent Difference

Batch QC Report

Dissolved Metals Analytical Report

Lab #:	298959	Prep:	METHOD
Client:	APEC	Analysis:	EPA 245.1
Project#:	STANDARD		
Analyte:	Mercury	Diln Fac:	1.000
Type:	BLANK	Batch#:	258708
Lab ID:	QC928938	Prepared:	04/20/18
Matrix:	Filtrate	Analyzed:	04/20/18
Units:	ug/L		

Result	**RL**
ND	0.20

ND= Not Detected
RL= Reporting Limit