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Report

Closed-Loop Bioreactor Pilot Study Implementation Plan

Naval Weapons Industrial Reserve Plant
Plant 3, Area of Concern 22
Bethpage, New York

Prepared for:

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Plant 3, Area of Concern 22
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LIST OF ACRONYMS

µg/kg..........................microgram per kilogram
µg/L ....micrograms per liter
AOC ....Area of Concern
ARAR ....Applicable or Relevant and Appropriate Requirement
AS ....air sparging
bgs..............................below ground surface
BTEX.........................benzene, toluene, ethylbenzene and xylenes
CERCLA....................Comprehensive Environmental Response, Compensation, and Liability Act
cfm ....cubic feet per minute
CFR............................Code of Federal Regulations
CLB............................Closed-Loop Bioreactor
CLEAN ....Comprehensive Long-Term Environmental Action Navy
CMS ....Corrective Measures Study
COC ....contaminant of concern
CTO ....Contract Task Order
EFANE ....Engineering Field Activities Northeast
FFS.............................focused feasibility study
FS ....feasibility study
GAC ....granular-activated carbon
GRA ....general remedial action
HPC............................Heterotropic Plate Count
IAS ....Initial Assessment Study
IR ....Installation Restoration
ISTD ....in-situ thermal desorption
MCL...........................Maximum Contaminant Level
mg/kg ....milligram per kilogram
mg/L...........................milligrams per liter
MW............................megawatts
NAVFAC...................Naval Facilities Engineering Command
NCP............................National Contingency Plan
NFESC.......................Naval Facilities Engineering Service Center
NPW ....net present worth
NWIRP ....Naval Weapons Industrial Reserve Plant
NYCRR......................New York Codes, Rules and Regulations
NYSDEC ....New York State Department of Environmental Conservation
O&M..........................operation and maintenance
OSHA ....Occupational Safety and Health Administration
OVA...........................organic vapor analyzer
PA ....preliminary assessment
PAH ....polycyclic aromatic hydrocarbon

PHD ....Petroleum Hydrocarbon Degraders
PPE ....personal protective equipment
PRG............................preliminary remediation goal
RAB ....Restoration Advisory Board
RCRA ....Resource Conservation and Recovery Act
RFA............................RCRA Facility Assessment
RFI ....RCRA Facilities Investigation
RI ....remedial investigation
SI................................site investigation
STARS.......................Spill Technology and Remediation Series
SVE............................soil vapor extraction
SVOCs ....semivolatile organic compounds
SW-846......................Test Methods for Evaluating Solid Waste
SWMU.......................Solid Waste Management Unit
TAGM........................Technical and Administrative Guidance Memorandum
TBC............................to be considered
TCE............................trichloroethene
TCL............................Target Compound List
TESVE.......................thermally-enhanced soil vapor extraction
TPH............................total petroleum hydrocarbons
TtNUS........................Tetra Tech NUS, Inc.
USEPA.......................United States Environmental Protection Agency
UST............................underground storage tank
VOC...........................volatile organic compound

CLOSED-LOOP BIOREACTOR PILOT STUDY IMPLEMENTATION PLAN

1. GENERAL DESCRIPTION

1.1. Purpose and Scope

Locus Technologies (Locus) has prepared this Closed-Loop Bioreactor Pilot Study Implementation Plan to address soil and groundwater pilot study activities at the former Underground Storage Tanks (USTs) (Area of Concern [AOC] 22) south of Plant No. 3 Naval Weapons Industrial Reserve Plant (NWIRP) in Bethpage, New York, (see Figures 1-1 and 1-2). This report was prepared for the United States Navy (Navy) Engineering Field Activities Northeast (EFANE) Naval Facilities Engineering Command (NAVFAC) for the Naval Facilities Engineering Service Center (NFESC) broad agency announcement Contract Number N47408-04-C-7505.

This document provides the following items for the implementation of the selected pilot study to be conducted at AOC 22:

- A general description of the location and history of the site, the chemicals of concern (COC) to be remediated, and an overview of the selected pilot study technology
- An outline of the necessary design tasks
- A design summary highlighting the results of each of the design tasks performed to accomplish the objectives of the selected pilot study
- A summary of the construction strategy addressing critical components of construction activities required to implement the remedial design

- Requirements for health and safety, waste management, contamination control, decontamination, quality assurance, quality control inspections, performance verifications (sampling and analysis), post-construction operations, maintenance and institutional controls, project closeout, post-construction monitoring, and a forecast schedule for implementation of the corrective measures

1.2. General Description and History of the Unit

The NWIRP Bethpage is located on Long Island, New York, on a relatively flat, featureless, glacial outwash plain. The site and nearby vicinity are highly urbanized. Because of this, most of the natural physical features have been reshaped or destroyed. The topography of the activity is relatively flat with a gentle slope toward the south. Elevations range from greater than 140 feet above mean sea level (msl) in the north to less than 110 feet above msl at the southwest corner.

The USTs were reportedly removed sometime between 1980 and 1984. Environmental concerns for this area are based on the results of site investigations conducted in 1997 and 1999. The 1997 investigation found evidence of petroleum in the soils from near the bottom of the former USTs to depths near the water table (UST Nos. 03-01-1, 2, and 3). A second investigation conducted in 1999 included the installation of groundwater monitoring wells, and the subsequent discovery of free petroleum product on the groundwater table.

The NWIRP is approximately 108 acres in size. The dominant features at the site are Plant No. 3 (the manufacturing plant) and three groundwater recharge basins. The recharge basins are each approximately 1.5 to 2.5 acres in area and about 30 feet deep.

In 1997, Northrop Grumman conducted a soil investigation at the former UST location AOC 22. During this investigation soil borings were installed around and under the former tanks. Approximately 144 soil samples were collected in eight areas from depths of 8 to 65 feet below ground surface (bgs). This range represents soils from the bottom of the former USTs to the approximate water table. The samples were analyzed for petroleum-based volatile organic compounds (VOCs) and semi-volatile organic compounds (SVOCs) in accordance with the New York State Department of Environmental Conservation (NYSDEC)

Spill Technology and Remediation Series (STARS) Memorandum No. 1 – Petroleum-Contaminated Soil Guidance Policy (August 1992) and for Total Petroleum Hydrocarbons (TPH). Soil boring locations are indicated on Figure 1-2.

In 1999, 14 soil borings were drilled under the supervision of Tetra Tech NUS, Inc., to investigate the vertical and horizontal extent of potential free petroleum product within the area of concern. Five borings were converted to groundwater monitoring wells, based on field observations concerning the presence of free product. Groundwater was encountered at approximately 55 to 57 bgs during drilling. Two borings (MW01 and MW02) were installed in close proximity to the suspected source area. Monitoring Wells MW03 and MW04 were installed near the boundary of the area of concern, in soil borings that showed limited evidence of free product. Well MW-5 was installed inside Plant No. 3. Following installation, all of the wells were developed, and a top-of-casing elevation survey was completed. Soil boring locations are included on Figure 1-2. Monitoring well locations are indicated on Figure 1-3.

Rising-head slug tests were performed on three of the monitoring wells to determine hydraulic conductivity (K) values. Composite free product samples were collected from accumulated well development and purge water at the conclusion of field activities.

1.3. Nature and Extent of Contamination

The nature and extent of contamination at the site have been determined based on the laboratory analytical results of subsurface soil and groundwater samples collected from AOC 22 in previous investigations conducted by Tetra Tec NUS, Inc. (Figures 1-2, 1-3, and 1-4).

1.4. Soil and Groundwater Contamination

Laboratory analytical results from the 1997 investigation indicated TPH in soils at concentrations up to 18,000 milligrams per kilogram (mg/kg) and at depths near the groundwater table. The petroleum hydrocarbons were predominantly of the diesel range organics (DRO) that are consistent with the No. 4 and No. 6 fuel oils reportedly used at this location. VOCs were detected infrequently in the soil samples, and only benzene, at a maximum concentration of 150 micrograms per kilogram (µg/kg) exceeded the NYSDEC Technical and Administrative Guidance Memorandum (TAGM) #4046 soil remediation criteria. SVOCs were detected more frequently. The maximum reported SVOC concentration was pyrene at 32,000 μg/kg. Benzo(a)anthracene (4,300 μg/kg), benzo(a)pyrene (2,700 μg/kg), chrysene (7,500 μg/kg), and dibenzo(a,h)anthracene (450 μg/kg) exceeded the respective TAGM remediation criteria.

During the 1999 investigation, TPH concentrations were highest in samples collected at depths of 55 to 57 feet bgs from Borings SB01, SB02, SB03, and SB04, which are located in close proximity to the former UST location. TPH DRO concentrations were 1,900 mg/kg in Boring SB01, 21,000 mg/kg in Boring SB02, 13,000 mg/kg in Boring SB03, and 12,000 mg/kg in Boring SB04. DRO concentrations were also reported in Boring SB05, located inside Plant No 3, Boring SB12, located north of Plant No. 3, and Boring SB07, located approximately 60 feet southwest of the former UST area. Gasoline range hydrocarbon (GRO) concentrations were significantly lower, with concentrations ranging from non-detectable to a high concentration of 250 mg/kg in Boring SB04.

VOCs were detected only in Boring SB08 at a depth of 55 feet bgs. Acetone was reported at a concentration of 5.1 μg/kg, and methylene chloride was detected at 2.8 μg/kg. Both of these concentrations may be the result of laboratory contamination and likely do not represent actual site conditions.

SVOCs were reported in the soil sample collected from Boring SB05 at a depth of 55 feet bgs. The highest concentration was reported for 2-methylnaphthalene (3,200 μg/kg). Phenanthrene was reported at 2,800 μg/kg, and fluorene was detected at a concentration of 670 μg/kg. Chrysene and Pyrene were reported in a duplicate sample from Boring SB05 at concentrations of 980 μg/kg and 2,300 μg/kg, respectively. Phenanthrene was reported in Boring SB01 at a concentration of 3,000 μg/kg. Only the chrysene concentration exceeded the NYSDEC Technical and Administrative Guidance Memorandum Number 4046 (TAGMs) soil remediation criteria.

In general, petroleum hydrocarbon-impacted soils appear to be confined to an area within approximately 60 feet of the former UST area, with the primary COC being TPH in the diesel range. Volatile and semi-volatile compound concentrations are not wide spread, and do not appear to be a significant contaminant.

Maximum concentrations of detected constituents and their respective Remedial Action Goals are presented in Table 1. A complete list of soil sample laboratory analytical results is included in on Figure 1-4.

A complete list of analytical results for groundwater samples collected from the five monitoring wells is included in Appendix A. Maximum concentrations of detected constituents and their respective Remedial Action Goals are presented in Table 2. Results indicated benzene, ethylbenzene, total xylenes, and naphthalene concentrations exceeding the NYSDEC groundwater remediation criteria in well MW-01, located immediately downgradient (southwest) of the former UST area. Benzene, ethylbenzene, and naphthalene exceeded the remediation criteria in Well MW-02. Benzene also exceeded the remediation standard in downgradient Well MW-04. The highest concentrations for benzene (17 µg/L), ethylbenzene (18 µg/L), total xylenes (7.6 µg/L), and naphthalene (20 µg/L) were detected in Well MW-01. Although the maximum down gradient extent of contaminant concentrations exceeding the remediation criteria has not been determined, analytical results indicate that the contaminants of concern attenuate significantly in the down gradient direction. In Well MW-04, located approximately 50 feet down gradient of Well MW-01, benzene was reported at a concentration of 4.1 µg/L. Ethylbenzene and total xylenes did not exceed the laboratory reporting limits, and naphthalene was reported at a concentration of 2.5 µg/L.

Free petroleum product was reported in Wells MW-01 and MW-02 following installation of the monitoring wells. The maximum observed thickness was 0.02 feet.

In addition to the petroleum hydrocarbon constituents discussed above, several chlorinated solvents were reported in the monitoring wells. The highest concentrations of these compounds were reported in upgradient Wells MW-03 and MW-05, indicating that the chlorinated solvents are migrating into the AOC 22 area from another source.

1.5. Pilot Study Objectives

Pilot study objectives have been developed to address contaminated soil and groundwater at AOC 22. In general, Pilot study objectives identify COCs, receptors, pathways, and action levels relevant to the facility, and are based on the results of the site investigation.

The primary soil COC identified during the investigation is TPH. The pilot study objectives for contaminated soil are as follows:

- Mass removal of petroleum hydrocarbons
- Prevent human exposure to soil contaminated with SVOCs at concentrations greater than the NYSDEC TAGMs
- Prevent leaching of contaminants that would result in groundwater concentrations greater than the NYSDEC TAGMs

The attainment of the soil pilot study objectives will be accomplished through the removal of TPH mass by the method described in Sections 1.7. Based on the results of the previous investigations, Tetra Tech NUS, in a *RCRA Facility Assessment/Focused Feasibility Study (FA/FFS)* dated February 2002, estimated the volume of TPH and Polycyclic Aromatic Hydrocarbons (PAH) contaminated soil in the vadose zone to be 16,900 cubic yards. The estimated volume of contaminated soils in the saturated zone is 8,000 cubic yards. The total estimated mass of TPH between the depths of 8 and 66 feet bgs is 244,000 pounds.

Based on historical activities within the AOC 22 area and laboratory analytical results from the previous investigations, the following pilot study objectives for groundwater have been established:

- Prevent human exposure to groundwater having contaminants originating from AOC 22 at concentrations greater than the established remedial action levels
- Prevent further migration of contaminants originating from AOC 22

The maximum observed contaminant concentrations, and ultimate remedial action goals established for groundwater at AOC 22 are indicated in Table 2. VOCs detected in groundwater at concentrations exceeding the remedial action levels are benzene, cis-1,2-dichloroethene (cis-1,2-DCE), 1,2-dichloroethene (1,2-DCE), ethylbenzene, tetrachloroethene (PCE), trichloroethene (TCE), trichlorotrifluoroethane, vinyl chloride (VC), and xylenes. Cis-1,2-DCE, 1,2-DCE, ethylbenzene, PCE, and TCE were detected in upgradient monitoring wells. The maximum concentrations of PCE and TCE were reported in upgradient wells. Based on this, it does not appear the occurrence of these contaminants is related to activities at AOC 22. Although VC was not detected in upgradient wells, its occurrence is likely due to natural biodegradation of PCE and TCE. In addition, groundwater remediation for chlorinated solvents that are not related to activities at AOC 22 is being addressed in an unrelated facility-wide program under the auspices of the NYSDEC.

The only SVOC detected at a concentration above its respective remedial action goal is bis (2-ethylhexyl) phthalate, the maximum concentration of which was detected in an upgradient well. Thus, it appears that this contaminant is unrelated to activities at AOC 22. None of the PAHs detected in soil samples were present in the groundwater at concentrations exceeding the remedial action goals.

Attainment of the groundwater pilot study objectives will be achieved in two phases during the remedial process. Free product, if it still present within the AOC 22, will be removed from the treatment area within approximately 90 days following remedial system startup. It is anticipated that attainment of the soil pilot study objectives through removal of contaminant mass in the vadose zone will result in the protection of groundwater from further impact due to activities at AOC 22, and subsequent achievement of the groundwater pilot study objectives within a 12-month period.

1.5.1. Sensitive Receptors

The AOC 22 is located within the confines of the larger NWIRP. The local groundwater gradient beneath the site is toward the south-southwest (Figure 1-3) (TetraTech NUS, Inc., 2002). There are no sensitive receptors (drinking supply wells, schools, residential areas, hospitals, etc) located within 500 feet downgradient of the AOC 22. The nearest residential neighborhood is located approximately 600 feet west-northwest of the AOC 22.

1.5.2. Migration Pathways

Exposure to the COC could potentially occur through inhalation, ingestion, and dermal contact. Given the depth of contaminated soils (greater than 10 feet) and the nature of the contaminant (No. 4 and No. 6 fuel oil), it is highly unlikely that on-site or off-site receptors of vapor exist. The potential for ingestion and dermal contact would exist if groundwater impacted with fuel oil No. 4 or fuel oil No. 6 was pumped through a well for irrigation, municipal, or domestic use. However, no irrigation, municipal, or domestic use wells are located within 500 feet of AOC 22. Because the fuel oils are heavy molecular weight hydrocarbons and relatively insoluble in water, the COC emanating from the AOC 22 are not likely to migrate a great distance with groundwater, and, as such, do not represent a significant exposure hazard. These conditions could change in the future if the usage of the Site changes, or if domestic or irrigation wells are installed nearby.

1.6. Closed-Loop Bioreactor Pilot Study

Based on the evaluation of remedial alternatives in the AOC 22 Focused Feasability Study (Tetra Tech NUS, Inc., February 2002), a bioremediation technology, closed-loop bioreactor (CLB), was selected for a pilot study at AOC 22. The primary objective of the pilot study is the source removal of petroleum hydrocarbons from the vadose and saturated zones to prevent further leaching of contaminants into groundwater, and the removal of free petroleum product, if it occurs, from the groundwater surface. Dissolved-phase VOCs and SVOCs having concentrations exceeding the remedial action goals will subsequently be removed from the aqueous phase during the remedial process.

The selected pilot study methodology for the AOC 22 unit is CLB process. The CLB process is a combination of technologies, which includes vapor extraction (VE), air sparging (AS), vacuum enhanced product recovery, desorption of hydrocarbons from soil particles, and enhanced bio-degradation. The CLB process creates an in-situ bioreactor in vadose and saturated soils. The process design is a closed-loop system with a continual circulation of air from groundwater sparge points to vadose injection and vacuum extraction wells.

The CLB process uses a system of patented nutrients to accelerate the growth and biodegradation characteristics of existing indigenous bacteria. The process enhances the effectiveness of indigenous bacteria to biodegrade the COCs, **but does not utilize the inoculation of foreign or genetically engineered bacteria to degrade contaminants**.

At the start of the process, the technology uses a small surface bioreactor to initiate the growth of indigenous bacteria that are capable of destroying petroleum constituents. Within the bioreactor moisture, nutrients, and associated co-metabolites are used to accelerate the growth of the bacteria. Once biogrowth occurs, the vapor-based biomixture is then circulated into the vadose zone through a series of vapor extraction and injection wells, which forms a site-wide closed-loop system. Accordingly, the biomass vapor that is created and injected in the vadose zone is circulated through the subsurface to the appropriate extraction wells, and back to the small surface bioreactor for testing and re-stimulation.

This procedure occurs without any discharge to the atmosphere. Once this process is started, the bioreactor operation continues until an appropriate biomass is established in the vadose zone, which causes the vadose zone itself to act and operate as a larger site-wide bioreactor. This unique situation is maintained during the entire remediation process.

After free product is removed and the vadose zone bioreactor is fully established, groundwater air sparging is initiated. The design of the remedial program includes the installation of dual use air sparging and vapor extraction wells at each sparge point locations. The mechanical sparging action addresses volatile dissolved constituents that are in the groundwater. The air sparging action liberates the volatile petroleum fractions in the groundwater, which then migrate upward into the vadose zone bioreactor, where the constituents are consumed by vapor extraction and biodegradation.

The removal of contaminants from the groundwater is accelerated by bio-stimulation, in a process that is very similar to the biodegradation that occurs in wastewater treatment plants, in a process that further enhances the biodegradation of constituents in the groundwater. Any products that are introduced are also ultimately degraded as bacteria nutrient sources.

The CLB process is maintained and enhanced by an above ground mobile treatment system that includes the surface bioreactor, pump equipment, compressors, and instrumentation (Figure 1-6). The mobile treatment system equipment allows for the adjustment of air circulation rate, moisture control, and nutritional enhancement, which are necessary for a sustained bio-reaction process in the vadose zone.

A critical element of the CLB process is the mobilization of adsorbed chemical constituents. To accomplish this, patented biodegradable surfactants will be injected into the subsurface to enhance the mobilization process. The surfactant substrate is ionic and has the effect of increasing the permeability with respect to hydrocarbons trapped in the soil due to its ionic nature. The surfactant that will be used is completely biodegradable, and is processed from naturally occurring surfactants secreted by bacteria. Pulsing and low-pressure injection is applied so that preferential pathways and fingering of the surfactant through the soil does not occur. The surfactant is injected at a temperature of approximately 35^o Celsius (95^o Fahrenheit). The high temperature further increases the viscosity of the constituents to approximately that of water and allows the contaminants to become mobile. The mobilized/emulsified product is then transported and drawn into vacuum extraction/recovery wells where it is removed using skimmer pumps. **The removal of the trapped source is the key to the remediation process.** Once the source constituents are eliminated, groundwater cannot be re-contaminated by their presence. Subsequently, engineered biodegradation of dissolved groundwater contaminants can proceed without the problem of recontamination. The result is a linear (vs. asymptotic) contaminant reduction profile that is typical of the CLB process, and is the key element in a rapid cleanup schedule.

Vapor extraction (VE) is an important element of the closed loop process. The extracted vapor train is circulated through the surface bioreactor and is then injected back into the subsurface via groundwater sparge wells and nested vadose zone surfactant injection wells, as applicable. In this manner, the closed loop process does not produce air emissions to the atmosphere; therefore, no effluent destruction equipment or air quality permits will be necessary. Biodegradation is further enhanced by the VE process (via higher aerobic activity), which in turn accelerates both the soil and dissolved groundwater remediation concurrently.

Both No. 4 and No. 6 fuel oil are long-chain (i.e., heavy molecular weight) hydrocarbons. No. 6 fuel oil in particular is a high viscosity fuel oil. Because of its high molecular weight, biodegradation is likely to be slow. Therefore, the CLB process will be enhanced through the use of Fenton's Reagent. Fenton's Reagent is an iron-catalyzed hydrogen peroxide mixture that, when applied to a carbon source, breaks down the carbon compound through oxidation. As the oxidation reaction proceeds, heat is generated. Through the breaking down of the carbon chain and the creation of heat, the heavy fuel oils will become less viscous, and thus more mobile, in the subsurface.

1.7. Closed-Loop Bioreactor Pilot Study Implementation Schedule

A project schedule has been included in Appendix B. The schedule shows all major tasks as outlined in the scope of work, and activities associated with each tasks. The critical path method (CPM) will be used to schedule and control project related activities using Microsoft Project 2000. The schedule will be updated at monthly intervals. Each invoice submitted to NAVFAC will be accompanied by an updated project schedule that shows the progression of the remedial program.

1.8. Community Relations

Locus Technologies will participate in four (4) Restoration Advisory Board (RAB) meetings with EFANE, with the objective of describing the CLB technology, describing the pilot study approach, and reporting progress.

2. PILOT STUDY DESIGN

2.1. Design Strategy

The overall remedial design was developed by Locus in conjunction with AR Utility Specialists, Inc. (ARUSI). Locus has developed the remedial strategy to address the contaminated soil and groundwater at the AOC 22. ARUSI is responsible for remedial construction design and implementation, and will provide the proprietary biodegradation additives used to enhance the natural biodegradation of contaminants in the subsurface.

2.2. Design Activities

The following is a list of design activities that are required prior to implementation of the remedial program:

- Pre-design meeting/site walk
- Development of this remedial documents which include the Pilot Study Work Plan, Sampling and Analysis Plan, and Health and Safety Plan
- Completion of remedial design drawings, to include remedial well locations, underground piping, and electrical design plans
- Procurement of construction, environmental, and drilling permits where applicable

2.3. Design Deliverables

Prior to implementation of the remedial activities, the following deliverables will be completed:

- Pilot Study Work Plan
- Pilot Study Sampling and Analysis Plan (Appendix C)

- Pilot Study Health and Safety Plan (Appendix D)
- Pilot Study Design Drawings
- Construction and Use permits, if necessary

2.4. Evaluation of Previous Data

Locus reviewed the FA/FFS prepared by Tetra Tech NUS. The FA/FFS included a brief review of the site history, and a detailed discussion of soil and groundwater analytical results from previous investigations conducted in 1997 and 1999. The report identified Applicable or Relevant and Appropriate Requirements (ARARs) in an effort to develop remedial alternatives. Six remedial alternatives were selected for review. Those alternatives are (1) no action; (2) cover and institutional controls; (3) excavation and off-site disposal; (4) bioremediation, institutional controls, and monitoring; (5) in-situ chemical oxidation; (6) thermally enhanced soil vapor extraction. This effort will serve as a pilot test of the remedial alternative Number 4 from tha FA/FFS.

The NYSDEC reviewed the FA/FFS and determined that active remediation of the AOC 22 source area soils is necessary to ensure protection of the groundwater beneath the site. The chosen remedial technology (CLB) described in this work plan will fulfill this requirement through the removal of contaminant mass at the source area.

2.5. Design Criteria

The CLB system proposed for this site consists of the remediation well infrastructure, which includes extraction and injection wells connected by lateral piping to the main treatment system; the mobile remedial equipment trailer housing the surface bioreactor and associated equipment; and the electrical power distribution system.

3. PERMITTING REQUIREMENTS

Locus understands that this remedial project is located on a federal facility and that no local permitting is required. However, all well and infrastructure and construction will be in accordance with all applicable regulatory and construction standards. If any permit are required, Locus will obtain them in a timely manner.

4. CONSTRUCTION

4.1. Construction Strategy

Construction of the CLB pilot system will begin with the installation of the remediation wells, the locations of which have been chosen based on previous soil and groundwater analytical results. A licensed drilling contractor will perform all well drilling and installation activities, under the supervision of Locus personnel. Following completion of the well installation phase, a licensed contractor will be retained to install all lateral underground piping, which will connect the remediation wells to the above-ground remedial equipment trailer. Once the lateral piping is in place, a licensed electrician will connect the electrical supply to the remedial system. All infrastructure construction activities will be under the supervision of ARUSI personnel. Local licensed contractors and businesses will be used to the maximum extent practicable to perform infrastructure construction tasks.

4.2. Construction Activities

4.2.1. Health and Safety Plan

Locus has prepared a site-specific Health and Safety Plan (HASP) which is included in Appendix D. The plan will include a description of the hazard assessment including level of safety protection to be used during field operations and exposure monitoring. The plan also addresses overhead and underground utilities and safety during trenching operations, equipment installation, equipment noise levels, heat stress and emergency response procedures. A copy of the HASP will be given to all integrated team partners (ITP) personnel and subcontractors working on the project.

4.2.2. Well Installation

An ARUSI and Locus field geologist or engineer will supervise the installation of 34 air sparging and injection/extraction cluster wells. Well locations have been chosen based on the site lithology, occurrence of phase separated hydrocarbons, and the boundaries of the dissolved phase hydrocarbon plume. All 34 wells will be installed on site property. Remediation well locations are included on the Remediation Site Plan (Figure 1-5).

Locus understands that underground utilities exist at AOC 22. The approximate locations of these utilities are as indicated in the electronic figures provided by the client and shown on Figure 1-5. Currently these utilities are shut down, but need to be preserved for future use. To avoid damaging the existing underground utilities, the well locations will be cleared prior to drilling by hand digging with a post-hole digger. The well locations may need to be adjusted during the field activities to avoid possible conflicts.

The remediation wells will be installed using a hollow-stem auger drill rig. Twenty-eight (28) deep-nested wells will be drilled to a depth of approximately 75 feet bgs, and will be constructed of 2-inch- and 4-inch-diameter polyvinylchloride (PVC) well casing and screen. The screened interval for the 2-inch sparge wells will extend from approximately 70 to 75 feet bgs, and will consist of 0.01-inch slotted high-flow screen. The screened interval for the 4-inch-diameter injection/extraction wells will extend from 20 to 65 feet bgs and will consist of 0.02-inch slotted high-flow screen. The proposed well construction diagrams are included on Figure 1-7.

Six shallow vapor extraction wells will be drilled to a depth of approximately 25 feet bgs and will be constructed of 4-inch-diameter PVC well casing and screen. The screened interval will extend from approximately 10 to 25 feet bgs and will consist of 0.02-inch slotted high flow screen. All 34 wellhead completions will be mounted flush to the ground surface within 24-inch-diameter traffic-rated well vaults.

During drilling, soil samples will be collected from selected wells at 10-foot depth intervals. The samples will be collected using a split-spoon sampler (either 18 or 24 inches long) containing 6-inch long brass sleeves. Upon reaching a chosen sampling depth, the sampler will be lowered into the borehole and driven a minimum of 18 inches into undisturbed soil. Upon retrieving the sampler, the brass sleeves will be removed. The lowermost sleeve will be retained for possible laboratory analysis. Soil in the remaining sleeves will be retained for lithologic description. Soil samples that are submitted to an analytical laboratory will be analyzed for TPH using United States Environmental Protection Agency (EPA)

Method 8015 and for SVOCs using EPA Method 8270. A detailed description of the sampling methodology is included in the Sampling and Analysis Plan (Appendix C).

4.2.3. Lateral Piping Installation

All injection/extraction wells will be connected to the CLB remedial system using 2-inch- and 4-inch-diameter Schedule 40 PVC piping. Lateral piping will be placed in trenches located greater than 3 feet below grade to avoid freezing conditions. A flow control valve will be installed at each connection of lateral piping and well head. All manifold piping will be routed to a manifold located near the system trailer.

4.2.4. Remedial System Enclosure and Electrical Service

The CLB remedial system and controls will be enclosed on the property within a secured trailer measuring approximately 8 feet by 25 feet. The trailer will be located within the GAC building, with the remaining floor space within the building being utilized as a field office.

ARUSI will supervise the construction of a below-ground electrical distribution line originating from existing electrical switch near the GAC Building. The new supply will be attached to a new electrical panel inside the GAC Building. A licensed electrician will coordinate the installation of the three-phase, 460-volt electrical service in the GAC Building, which will be inspected by the local utility and municipal inspectors, if necessary, prior to system start-up.

4.2.5. Waste Disposal and Transport

Drill cuttings generated during drilling activities will be stored on the property in Department of Transportation (DOT)-approved drums or covered roll-off bins, pending results of soil sample laboratory analyses. After the waste material has been characterized, it will be disposed of in an appropriate manner.

5. POST-CONSTRUCTION

5.1. Baseline Groundwater Sampling

Upon completion of the remedial system infrastructure, and prior to system start-up, a total of eight (8) groundwater samples will be collected from selected remediation wells and the existing monitoring wells. All groundwater samples will be submitted to a NYDEC and NAVFAC EFANE certified laboratory. Depth to groundwater measurements will be collected from the monitoring wells prior to sampling in order to confirm the current groundwater flow direction.

The purpose for the collection and analyses of groundwater samples from monitoring and remediation wells is to screen the groundwater for biological conditions and changes in contaminant concentrations. The results of groundwater sampling events will be compared to the previous sampling events and will be the basis for modifications to the CLB operation.

Groundwater samples will be submitted to the analytical laboratory for analysis of TPH using EPA Method 8015, SVOCs using EPA Method 8270, and for the VOCs benzene, toluene, ethylbenzene, and total xylenes (BTEX) using EPA Method 8021. In addition, selected samples will be analyzed for the bacteriological parameters of Petroleum Hydrocarbon Degraders (PHD), Heterotrophic Plate Count (HPC), and Pseudomonads. The biological parameters will be analyzed from a minimum of one well located at the upgradient edge of the contaminant plume, one well from the center of the plume, and one well at the downgradient edge of the plume. A detailed description of the sampling methodology is included in the Sampling and Analysis Plan (Appendix C).

Results from this sampling event will be used to establish a baseline of concentrations for both the contaminants and the native microorganisms that will be used to accelerate the bioremediation process.

5.2. Remedial System Start-up

Once the CLB system is mobilized to the site, injection and extraction well manifolds will be assembled, electrical connections will be completed, and a water supply will be connected. Upon initial start-up, system operation parameters will be inspected for proper operation.

5.3. Remedial System Operation and Maintenance

The initial 90 days of remedial system operation will focus on the removal of free product. Following installation of the remediation wells, a determination will be made as to which wells, if any, will require the installation of product skimmer pumps. It may be necessary to install and remove pumps from individual wells several times during this initial phase of the program. The CLB system will be operated in a closed loop with the aim of mobilizing free product toward the remediation and monitoring wells near the center of the treatment area, where it can be removed by pumping. During the initial phase, the remediation wells on the boundaries of the treatment area will be operated in air sparging mode, with vapor extraction being applied to wells nearer the center of the plume.

A project engineer or technician from ARUSI or Locus will initially be onsite daily during the system operation to monitor injection and extraction rates, add nutrients and surfactant to the system, and perform maintenance and any necessary repairs to system components.

During the course of operation, data will be compiled and analyzed to determine the effectiveness of the CLB system for reducing petroleum hydrocarbon concentrations in the soil and groundwater. Necessary adjustments will be made to the system and the results monitored.

During normal system operation vapors collected from the vacuum side of the CLB are passed through the absorption tank where approximately 80% of the volatile vapors are destroyed. The absorption tank is pressurized to two (2) to four (4) atmospheres causing the VOCs to be adsorbed into the liquid in the in the adsorption tank. The VOC-laden liquid is then circulated through the internal bioreactor where the VOCs are consumed. Oxygen is injected into the internal bioreactor to enhance the reaction rate and to ensure oxygen rich vapor for re-injection into the subsurface.

The remainder of the VOCs that are not destroyed in the absorption tank are re-injected into the subsurface, distributed throughout the subsurface and consumed in the CLB process. Although it highly unlikely that any vapor will be emitted from the CLB process, air monitoring around AOC 22 will be performed periodically to ensure that no vapors are being emitted to the atmosphere. Should vapor emissions be detected, the system will be repaired or operations modified such that no vapors are emitted.

5.4. Pilot Study System Monitoring

To monitor the progress of the remedial program, soil and groundwater samples will be periodically collected. Soil samples will be collected from new soil borings beginning approximately 60 days after starting the system. Groundwater samples will be collected monthly following system startup.

5.4.1. Verification Soil Sampling

Following system start-up, soil samples will be collected from borings on a bi-monthly basis (i.e., during months 2, 4, 6, 8, 10, and 12). Boring locations and sampling depths will be determined based on analytical results from the well installation program. The soil borings will be drilled using a hollow-stem auger drill rig. Samples will be submitted to an analytical laboratory for analysis of TPH using EPA Method 8015 and SVOCs using EPA Method 8270. Selected soil samples may also be analyzed for the listed biological parameters.

5.4.2. Groundwater Monitoring

The progress of remediation system will also be monitored through the monthly collection of depth to groundwater measurements and groundwater samples. A total of eight (8) groundwater samples will be collected from selected existing monitoring wells and selected remediation wells. Groundwater samples will be submitted to an analytical laboratory for analysis of TPH using EPA Method 8015, SVOCs using EPA Method 8270, and BTEX using EPA Method 8021.

5.4.3. Monthly Reporting

During the course of operation, data will be compiled and analyzed to determine the effectiveness of the CLB system to reduce fuel oil No. 4 and No. 6 contaminant concentrations in the soil and groundwater. Adjustments will be made to the system and the results monitored. We have estimated the need to submit monthly (or as required) remediation status reports to NAVFAC and the NYSDEC. The reports will include groundwater sampling analytical data, depth to groundwater and free product thickness measurements, and a summary of the operational/maintenance activities performed on the system.

6. PILOT STUDY EVALUATION REPORT

At completion of the verification sampling, the project team will prepare a final pilot study evaluation report for submittal to NYSDEC. This report will include a description of equipment and procedures used during the program, as well as laboratory analyses of soil and groundwater samples collected as part of the remediation. The report will also include tables showing baseline hydrocarbon concentrations in the soil and groundwater and the reduction in concentration over time. Upon acceptance of this report, the project team will schedule site restoration and system decommissioning activities.

7. SITE RESTORATION

The physical site condition shall be restored to the same or better condition prior to the start of the remedial program. This effort would include all necessary resurfacing efforts for trenching, remedial wells and vaults. In places where asphalt or surface cover or curbing has been affected, the project team will replace those areas so they conform to their original condition at the start of the program. If planters or any vegetation are disturbed or removed during the remedial effort, they will be restored to their original condition. The project team will also perform all relevant closeout requirements pursuant to project requirements. These services may include document return, file duplication, distribution and storage, file archiving (meeting superfund record requirements).

8. REFERENCES

Halliburton NUS Environmental Services, 1991. Final Remedial Investigation Quality Assuance Plan, Comprehensive Long-Term Environmental Action Navy (CLEAN) Program Naval, Weapons Industrial Reserve Plant, Bethpage, New York, August.

NYSDEC, 1992. Spill Technology and Remedial Series (STARS) Memorandum No. 1 – Petroleum–Contaminated Soil Guidance Policy, August.

NYSDEC, 1994. Division of Technical and Administrative Guidance Memorandum (TAGM) No. 4046, Determination of Soil Clean-up Objectives and Clean-up Levels, January 24.

TtNUS (Tetra Tech NUS, Inc.), 2002. RCRA Facility Assessment/Focused Feasibility Study for Former Underground Storage Tanks Plant No. 3Area of Concern (AOC) 22 (Tank Nos. 03-01-1, -2, and –3), Naval Weapons Industrial Reserve Plant (NWIRP), Bethpage, New York. Prepared for Northern Division Naval Facilities Engineering Command, February.

USEPA (U.S. Environmental Protection Agency) 1997. Test Methods for evaluating Solid Waste Physical/Chemical Methods (SW-846). Third Edition, Update 3, June.

TABLES

TABLE 2. Maximum Soil Contaminant Concentrations and Remedial Action Goals
NWIRP Bethpage AOC 22, Bethpage, New York

Chemical	Maximum Concentration (ug/kg)	Remedial Action Goal [1] (ug/kg)
Volatile Organic Compounds		
Acetone	12.0	100
Benzene	**150.0**	60
n-Butylbenzene	270.0	NE
sec-Butylbenzene	210.0	NE
Ethylbenzene	1,500.0	5,500
Isopropylbenzene	210.0	NE
p-Isopropyltoluene	120.0	NE
Methylene Chloride	8.0	93
n-Propylbenzene	610.0	NE
Toluene	6.3	1,500
1,3,5-Trimethylbenzene	500.0	NE
Total Xylenes	84.0	1,200
Semivolatile Organic Compounds		
Acenaphthene	4,100.0	50,000
Anthracene	5,100.0	50,000
Benzo(a)anthracene	**4,300.0**	330
Benzo(a)pyrene	**2,700.0**	330
Benzo(b)fluoranthrene	840.0	1,100
Benzo(g,h,i)perylene	1,500.0	50,000
Benzo(a)fluoranthrene	470.0	1,100
Chrysene	**7,500.0**	400
Dibenz(a,h)anthracene	**450.0**	330
Fluoranthene	4,200.0	50,000
Fluorene	8,600.0	50,000
Indeno(1,2,3-cd)pyrene	360.0	3,200
2-Methylnaphthalene	3,200.0	35,400
Naphthalene	310.0	13,000
Phenanthrene	27,000.0	50,000
Pyrene	32,000.0	50,000
Total Petroleum Hydrocarbons	21,000.0	NE

Notes:
ug/kg - micrograms per kilogram
bgs - below ground surface
[1] - New York State Department of Environmental Conservation Technical and Administrative Guidance Memorandum #4046 recommended clean-up objectives
NE - Not Established

TABLE 1. Maximum Groundwater Contaminant Concentrations and Remedial Action Goals

NWIRP Bethpage AOC 22, Bethpage, New York

Chemical	Maximum Concentration (ug/kg)	Remedial Action Goal [1] (ug/kg)
Volatile Organic Compounds		
Benzene	**17.0**	1 [1]
2-Butanone	3.4	50 [2]
Chloroethane	4.4	5 [1,2]
cis-1,2-Dichloroethene	**48.0**	5 [1,2]
1,1-Dichloroethane	4.1	5 [1,2]
1,2-Dichloroethene	**47.0**	5 [1,2]
Ethylbenzene	**18.0**	5 [1,2]
Tetrachloroethene	**12.0**	5 [1,2]
Toluene	1.4	5 [1,2]
Trichloroethene	**95.0**	5 [1,2]
Trichlorofluoroethane	**8.2**	5 [1,2]
Vinyl Chloride	**2.7**	2 [1,2,3]
Total Xylenes	**7.6**	5 [1,2]
Semivolatile Organic Compounds		
Acenaphthene	1.5	50 [2]
Bis(2-ethylhexyl)phthalate	43.0	6 [2,3]
Carbazole	**4.2**	50 [2]
Fluorene	2.1	50 [2]
2-Methylnaphthalene	41.0	50 [2]
Naphthalene	20.0	50 [2]
Phenanthrene	3.6	50 [2]
Total Petroleum Hydrocarbons	NA	NE

Notes:
ug/kg - micrograms per kilogram
bgs - below ground surface
[1] - New York State Groundwater Quality Standard
[2] - New York State Maximum Contaminant Level
[3] - Federal Maximum Contaminant Level
NA - Not Analyzed
NE - Not Established

Table 3. Summary of Bottle Requirements, Preservation Methods, and Holding Times
NWIRP Bethpage AOC 22, Bethpage, New York

Analytical Parameter	Analytical Method	Container Type		Sample Preservation	Sample Holding Time
		Soil	Groundwater		
Total Petroleum Hydrocarbons	EPA 8015	Brass Sleeve or Glass Jar	2 - 500 ml Glass Bottles	Soil - Cool 4oC Groundwater - Cool 4oC, HCl	Soil - 7 Days Groundwater - 14 Days
Semivolatile Organic Compour	EPA 8270	Brass Sleeve or Glass Jar	2 - 1 L Glass Bottles	Soil - Cool 4oC Groundwater - Cool 4oC	Soil - 7 Days Groundwater - 14 Days
Volatile Organic Compounds	EPA 8021	Brass Sleeve or Glass Jar	2 - 4- ml VOA's	Soil - Cool 4oC Groundwater - Cool 4oC, HCl	Soil - 14 Days Groundwater - 14 Days
Heterotropic Plate Counts	SM 9215C	Brass Sleeve or Glass Jar	1 - 500 ml Ploy Bottle	Soil - Cool 4oC Groundwater - Cool 4oC	Soil - 3 Days Groundwater - 3 Days
Petroleum Hydorcarbon Degra	JIM Vol. 10	Brass Sleeve or Glass Jar	1 - 500 ml Ploy Bottle	Soil - Cool 4oC Groundwater - Cool 4oC	Soil - 3 Days Groundwater - 3 Days

FIGURES

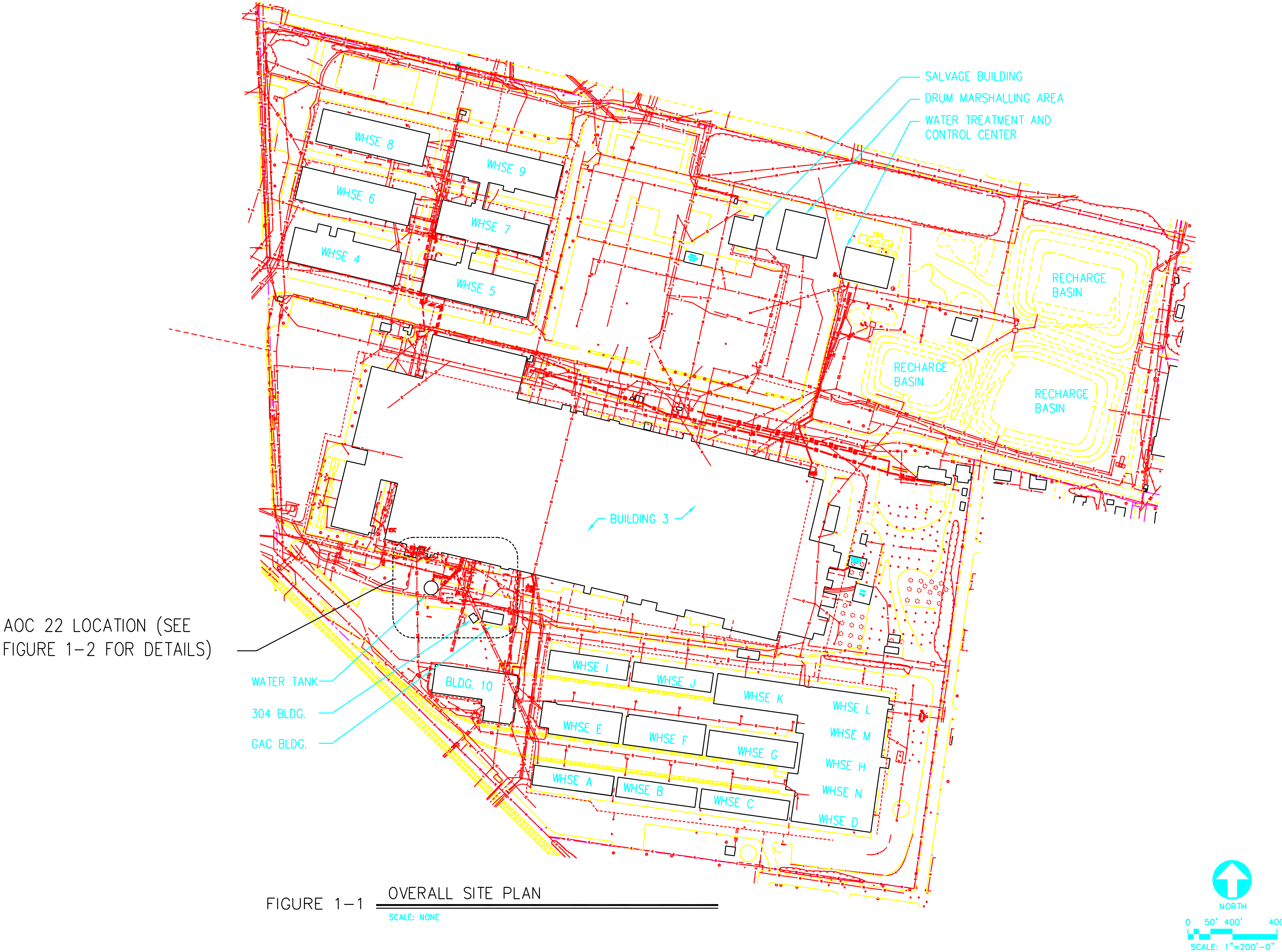

FIGURE 1-1 OVERALL SITE PLAN

SCALE: NONE

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PROJECT DESCRIPTION

CLOSED-LOOP BIOREMEDIATION PILOT DEMONSTRATION PLANT 3, AREA OF CONCERN 22

999 S. OYSTER BAY RD.
BETHPAGE, NY 11714

REVISIONS

NO.	DATE	DESCRIPTION	BY
A	5/13/04	ISSUED FOR SUBMITTAL	JE

PROJECT NO: N62472-04-C-XXX
DRAWN BY: JERRY E.
CHECKED BY: DAN L.
CAD DWG FILE: N62472-04-C-XXX
SIZE "D" IF SHEET IS LESS THAN "22x36" IT IS A REDUCED PRINT. SCALE REQUIRED REDUCED ACCORDINGLY

SHEET TITLE
OVERALL SITE PLAN

FIGURE 1-1
SHEET 1 OF 7

LEGEND

- TTNUS SOIL BORING SAMPLE LOCATIONS
- TTNUS SOIL BORING/MONITORING WELL SAMPLE LOCATIONS
- NORTHROP GRUMMAN SOIL BORING SAMPLE LOCATIONS
- COMPOSITE OF MULTIPLE BORING RESULTS
- PROPOSED PILOT STUDY WELLS

FIGURE 1–2 AREA OF CONCERN (AOC) 22 SITE PLAN & SOIL SAMPLE LOCATIONS

SCALE: 1"=20'-0"

NORTH

0 8' 16' 32'

SCALE: 1/16"=1'-0"

NOTE:
ALL DATA FROM "RCRA FACILITY ASSESSMENT/ FOCUS FEASIBILITY STUDY FOR FORMER UNDERGROUND STORAGE TANKS, PLANT NO. 3 AREA OF CONCERN (AOC) 22" FEBRUARY 2002. TETRA TECH NUS, INC.

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NO.	DATE	DESCRIPTION	BY
A	5/13/04	ISSUED FOR SUBMITAL	JE

PROJECT NO: N62472-04-C-XXX
DRAWN BY: JERRY E
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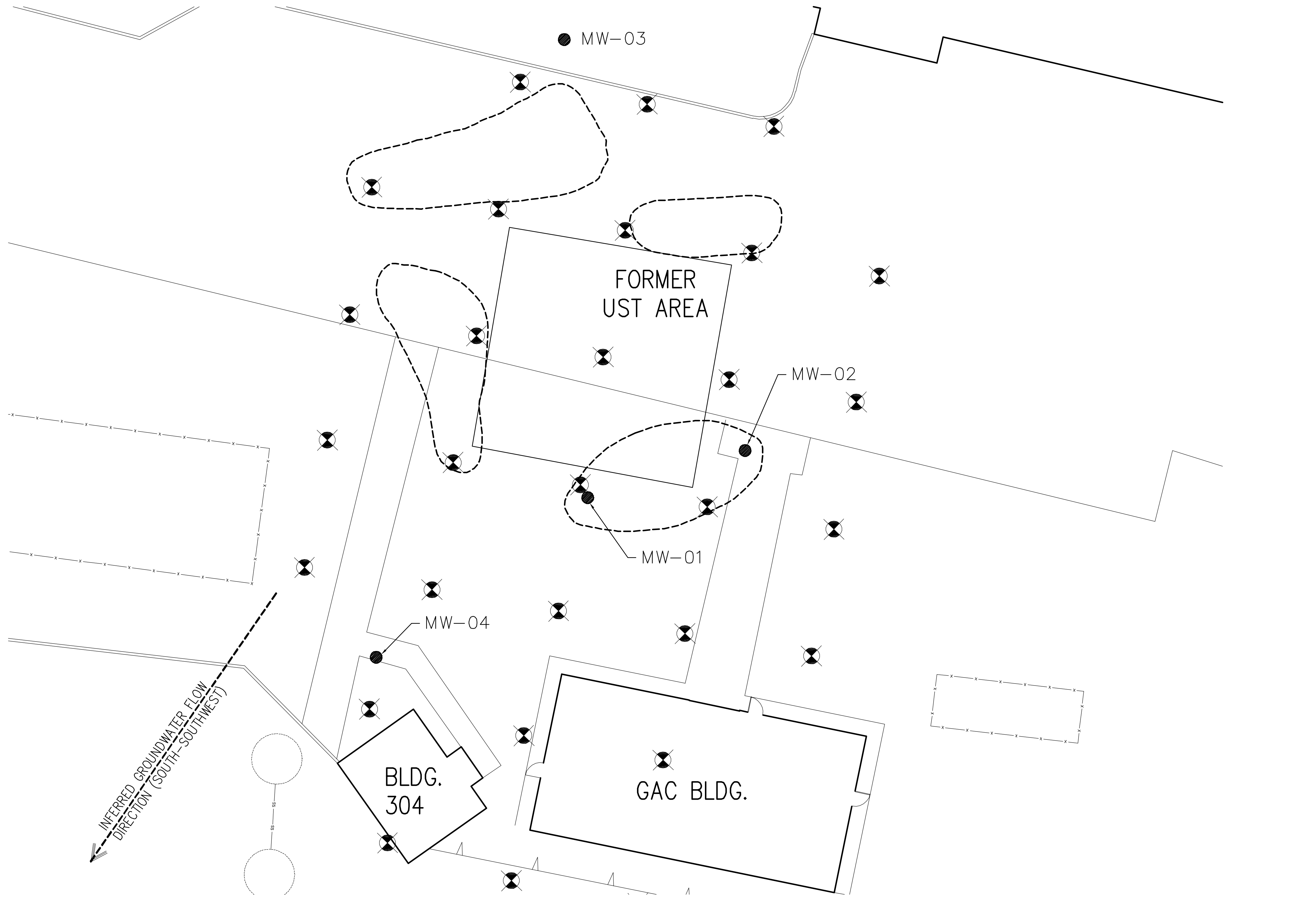
SHEET TITLE
SOIL ANALYTICAL RESULTS

FIGURE 1–2
SHEET 2 OF 7

May 14, 2004 - 11:36am - gilbertc - X:\F. Architectural CAD\B. Drawings\Environmental\New York\Bethpage\a-Pre Design\pdf FIGURES\FIGURE 1-2.dwg



LEGEND

- MW-# TTNUS SOIL MONITORING WELL LOCATIONS
- PROPOSED PILOT STUDY WELLS
- TTNUS ESTIMATED LIMITS OR IMPACTED SOIL
- INFERRED GROUNDWATER FLOW DIRECTION (SOUTH-SOUTHWEST) (FA/FFA, TtNUS INC., FEB. 2002)

FIGURE 1-3 MONITORING WELL LOCATIONS AND REMEDIATION

SCALE: NONE

NOTE:
ALL DATA FROM "RCRA FACILITY ASSESSMENT/ FOCUS FEASIBILITY STUDY FOR FORMER UNDERGROUND STORAGE TANKS, PLANT NO. 3 AREA OF CONCERN (AOC) 22" FEBRUARY 2002. TETRA TECH NUS, INC.

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NO.	DATE	DESCRIPTION	BY
A	3/26/04	ISSUED FOR SUBMITAL	JE

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SHEET TITLE
SOIL ANALYTICAL RESULTS

FIGURE 1-3
SHEET 3 OF 7

May 14, 2004 - 11:35am - gilbertc - x:\F. Architectural CAD\B. Drawings\Environmental\New York\Bethpage\o-Pre Design\pdf FIGURES\FIGURE 1-3.dwg

KEY NOTES:

1 BOREHOLE: SB-11

DEPTH INTERVAL FEET BGS	TOTAL PAHs UG/KG	TPH MG/KG	COORDINATES
53–55	N/A	ND	X = 0'–0" Y = 0'–0"

2 BOREHOLE: SB-10

DEPTH INTERVAL FEET BGS	TOTAL PAHs UG/KG	TPH MG/KG	COORDINATES
55–57	N/A	12	X = 135'–10" Y = –37'–8"

3 BOREHOLE: 16

DEPTH INTERVAL FEET BGS	TOTAL PAHs UG/KG	TPH MG/KG	COORDINATES
0–8	NA	NA	X = 95'–7" Y = 34'–4"
8–26	ND L	ND–17 L	
26–42	1.2–1.9 L	ND L	
42–54	1.0–2.2 L	NA	
54–67	3,810–89,520*	540–19,000	

4 BOREHOLE: SB-07

DEPTH INTERVAL FEET BGS	TOTAL PAHs UG/KG	TPH MG/KG	COORDINATES
55–57	N/A	1,300	X = 67'–8" Y = 34'–2"

5 BOREHOLE: SB-09

DEPTH INTERVAL FEET BGS	TOTAL PAHs UG/KG	TPH MG/KG	COORDINATES
55–57	N/A	ND	X = 27'–10" Y = 98'–2"

6 BOREHOLE: 01BS

DEPTH INTERVAL FEET BGS	TOTAL PAHs UG/KG	TPH MG/KG	COORDINATES
8–10	1.9	630	X = 83'–10" Y = 74'–7"
10–12	1091.2*	500	
12–14	4600*	2800	
14–16	N/A	49	
16–18	3800*	2300	
18–20	N/A	520 J	
20–22	960*	1400 J	
22–24	3080*	1300 J	
24–26	N/A	620 J	
28–30	530	2900 J	
30–32	2250*	3900 J	
32–34	N/A	1600 J	
34–36	N/A	4100 J	
36–38	N/A	1400 J	
38–40	N/A	2500 J	
40–42	N/A	5500 J	
45–46.5	2090*	1800 J	
50–51.5	7140*	3600 J	
55–57	28969*	5900 J	
60–62	58610*	18000 J	
65–67	4770	2800 J	

7 BOREHOLE: SB03

DEPTH INTERVAL FEET BGS	TOTAL PAHs UG/KG	TPH MG/KG	COORDINATES
55–57	N/A	13000	X = 83'–11" Y = 96'–11"

8 BOREHOLE: SB01B

DEPTH INTERVAL FEET BGS	TOTAL PAHs UG/KG	TPH MG/KG	COORDINATES
NO DATA AVAILABLE			

9 BOREHOLE: 01BW

DEPTH INTERVAL FEET BGS	TOTAL PAHs UG/KG	TPH MG/KG	COORDINATES
8–10	341.1	510	X = 74'–6" Y = 106'–2"
10–12	N/A	N/A	
12–14	610*	1000	
14–16	3600*	6800	
16–18	680*	2700	
18–20	1130*	1200	
20–22	1620*	5800	
22–24	159	260	
24–26	N/A	27	

10 BOREHOLE: 01

DEPTH INTERVAL FEET BGS	TOTAL PAHs UG/KG	TPH MG/KG	COORDINATES
18–20	N/A	4800	X = 85'–7" Y = 100'–8"

11 BOREHOLE: 01A

DEPTH INTERVAL FEET BGS	TOTAL PAHs UG/KG	TPH MG/KG	COORDINATES
8–10	1620	N/A	X = 85'–7" Y = 100'–8"
10–12	N/A	N/A	
12–14	N/A	N/A	

12 BOREHOLE: SB-13

DEPTH INTERVAL FEET BGS	TOTAL PAHs UG/KG	TPH MG/KG	COORDINATES
	N/A	ND	X = 11'–0" Y = 172'–3"

13 BOREHOLE: 2BW

DEPTH INTERVAL FEET BGS	TOTAL PAHs UG/KG	TPH MG/KG	COORDINATES
8–10	N/A	4.6	X = 68'–0" Y = 127'–9"
10–12	N/A	2200	
12–14	N/A	7	
14–16	2060	870	
16–18	830*	550	
18–20	310	310	
20–22	N/A	N/A	

14 BOREHOLE: 02A

DEPTH INTERVAL FEET BGS	TOTAL PAHs UG/KG	TPH MG/KG	COORDINATES
8–10	N/A	N/A	X = 102'–7" Y = 130'–7"
10–12	N/A	N/A	

15 BOREHOLE: 02

DEPTH INTERVAL FEET BGS	TOTAL PAHs UG/KG	TPH MG/KG	COORDINATES
14–16	N/A	2500	X = 102'–7" Y = 130'–7"

16 BOREHOLE: 02BN

DEPTH INTERVAL FEET BGS	TOTAL PAHs UG/KG	TPH MG/KG	COORDINATES
8–10	N/A	4.6	X = 103'–4" Y = 137'–8"
10–12	N/A	N/A	
12–14	N/A	630	
14–16	N/A	130	
16–18	451.2*	9.2	
18–20	N/A	430	
20–22	370*	1400	

17 BOREHOLE: 02B

DEPTH INTERVAL FEET BGS	TOTAL PAHs UG/KG	TPH MG/KG	COORDINATES
8–10	N/A	7.5	X = 107'–3" Y = 130'–3"
10–12	870*	490	
14–16	4510*	10000	
16–18	280	300	
18–20	87*	450	
20–22	400*	220	
22–24	530*	550	
24–26	2400*	2200	
26–28	19600*	7100	
28–30	10060*	5100	
30–32	480	330	
32–34	9890*	6400	
34–36	4070*	2400	
36–38	6970*	3900	

18 BOREHOLE: SB-05

DEPTH INTERVAL FEET BGS	TOTAL PAHs UG/KG	TPH MG/KG	COORDINATES
55–59	7,480*	5,400	X = 104'–2" Y = 154'–1"

19 BOREHOLE: SB-12

DEPTH INTERVAL FEET BGS	TOTAL PAHs UG/KG	TPH MG/KG	COORDINATES
58–60	N/A	99	X = 127'–3" Y = 191'–3"

20 BOREHOLE: 17

DEPTH INTERVAL FEET BGS	TOTAL PAHs UG/KG	TPH MG/KG	COORDINATES
0–8	NA	NA	X = 134'–0" Y = 142'–3"
8–26	ND–3.1 L	ND–11 L	
26–42	ND–2 L	ND L	
42–54	ND–1,320* L	ND–980 L	
54–67	ND–17,800*	32–6,400	

21 BOREHOLE: SB-05

DEPTH INTERVAL FEET BGS	TOTAL PAHs UG/KG	TPH MG/KG	COORDINATES
55–57	N/A	ND	X = 181'–9" Y = 150'–5"

22 BOREHOLE: 03

DEPTH INTERVAL FEET BGS	TOTAL PAHs UG/KG	TPH MG/KG	COORDINATES
16–18	N/A	11000	X = 121'–9" Y = 121'–9"

23 BOREHOLE: 03A

DEPTH INTERVAL FEET BGS	TOTAL PAHs UG/KG	TPH MG/KG	COORDINATES
8–10	N/A	N/A	X = 121'–9" Y = 121'–9"
10–12	5882*	N/A	
12–14	71.1	N/A	

24 BOREHOLE: 02

DEPTH INTERVAL FEET BGS	TOTAL PAHs UG/KG	TPH MG/KG	COORDINATES
57–59	N/A	21000	X = 121'–8" Y = 118'–0"

25 BOREHOLE: 04

DEPTH INTERVAL FEET BGS	TOTAL PAHs UG/KG	TPH MG/KG	COORDINATES
14–16	N/A	330	X = 136'–10" Y = 119'–9"

26 BOREHOLE: 04A

DEPTH INTERVAL FEET BGS	TOTAL PAHs UG/KG	TPH MG/KG	COORDINATES
8–10	637.2	N/A	X = 136'–10" Y = 119'–9"
10–12	N/A	N/A	
12–14	253	N/A	

27 BOREHOLE: 04B

DEPTH INTERVAL FEET BGS	TOTAL PAHs UG/KG	TPH MG/KG	COORDINATES
8–10	1316*	N/A	X = 141'–8" Y = 117'–8"
10–12	N/A	N/A	
12–14	NA	2900	

28 BOREHOLE: 06 AND 06A

DEPTH INTERVAL FEET BGS	TOTAL PAHs UG/KG	TPH MG/KG	COORDINATES
0–6	NA	NA	X = 118'–7" Y = 93'–6"
6–12	ND	NA	
14–16	ND	NA	
16–67	NA	NA	

29 BOREHOLE: 05B

DEPTH INTERVAL FEET BGS	TOTAL PAHs UG/KG	TPH MG/KG	COORDINATES
NO DATA AVAILABLE			

30 BOREHOLE: SB04

DEPTH INTERVAL FEET BGS	TOTAL PAHs UG/KG	TPH MG/KG	COORDINATES
55–57	N/A	12000	X = 139'–4" Y = 74'–3"

31 BOREHOLE: 05

DEPTH INTERVAL FEET BGS	TOTAL PAHs UG/KG	TPH MG/KG	COORDINATES
14–16	N/A	73	X = 123'–1" Y = 76'–10"

32 BOREHOLE: 06 AND 05A

DEPTH INTERVAL FEET BGS	TOTAL PAHs UG/KG	TPH MG/KG	COORDINATES
6–8	N/A	N/A	X = 123'–1" Y = 76'–10"
8–10	2.8	NA	
10–12	2063*	NA	

33 BOREHOLE: SB01

DEPTH INTERVAL FEET BGS	TOTAL PAHs UG/KG	TPH MG/KG	COORDINATES
54–56	3000	1900	X = 108'–9" Y = 65'–2"

34 BOREHOLE: 05BS

DEPTH INTERVAL FEET BGS	TOTAL PAHs UG/KG	TPH MG/KG	COORDINATES
8–10	669*	86	X = 120'–3" Y = 62'–3"
10–12	N/A	5.7	
12–14	1532*	18	
16–18	N/A	37	
18–20	3600*	4100	
20–22	N/A	3300	
22–24	1200*	5300	
24–26	450*	2000	
26–28	N/A	580	
28–30	N/A	1700	
30–32	N/A	720	
32–34	N/A	800	
34–36	N/A	2000	
36–38	N/A	4500	
38–40	N/A	620	
40–42	590	1600	
42–44	630*	770	
44–46	752*	2300	

35 BOREHOLE: SB-14

DEPTH INTERVAL FEET BGS	TOTAL PAHs UG/KG	TPH MG/KG	COORDINATES
57–59	N/A	2.8	X = 249'–7" Y = 99'–3"

36 BOREHOLE: 15

DEPTH INTERVAL FEET BGS	TOTAL PAHs UG/KG	TPH MG/KG	COORDINATES
0–8	NA	NA	X = 155'–10" Y = 57'–11"
8–26	ND L	ND–53 L	
26–42	ND–41 L	4–12 L	
42–54	ND L	22–680 L	
54–67	4,434–47,344*	1,000–14,000	

37 BOREHOLE: SB-08

DEPTH INTERVAL FEET BGS	TOTAL PAHs UG/KG	TPH MG/KG	COORDINATES
55–57	NO	ND	X = 178'–3" Y = 25'–9"

LEGEND:

1. TPH= TOTAL PETROLEUM HYDROCARBONS
2. PAHs = POLYAROMATIC HYDROCARBONS
3. NA = ANALYTE NOT ANALIZED
4. N/A = ANALYTE WAS NOT DETECTED

* = EXCEEDS TECHNICAL AND ADMINISTRATIVE GUIDANCE MEMORANDUM (TAGM) SOIL CLEANUP OBJECTIVE CRITERIA (NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATIVE (NYSDEC) JANUARY 24, 1994 REVISED)

FIGURE 1–4 SOIL ANALYTICAL RESULTS

SCALE: NONE

NOTE:
ALL DATA FROM "RCRA FACILITY ASSESSMENT/ FOCUS FEASIBILITY STUDY FOR FORMER UNDERGROUND STORAGE TANKS, PLANT NO. 3 AREA OF CONCERN (AOC) 22" FEBRUARY 2002. TETRA TECH NUS, INC.

AR UTILITY SPECIALIST INC.
2840 S. 36TH STREET
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PROJECT DESCRIPTION

CLOSED–LOOP BIOREMEDIATION PILOT DEMONSTRATION PLANT 3, AREA OF CONCERN 22

999 S. OYSTER BAY RD.
BETHPAGE, NY 11714

REVISIONS

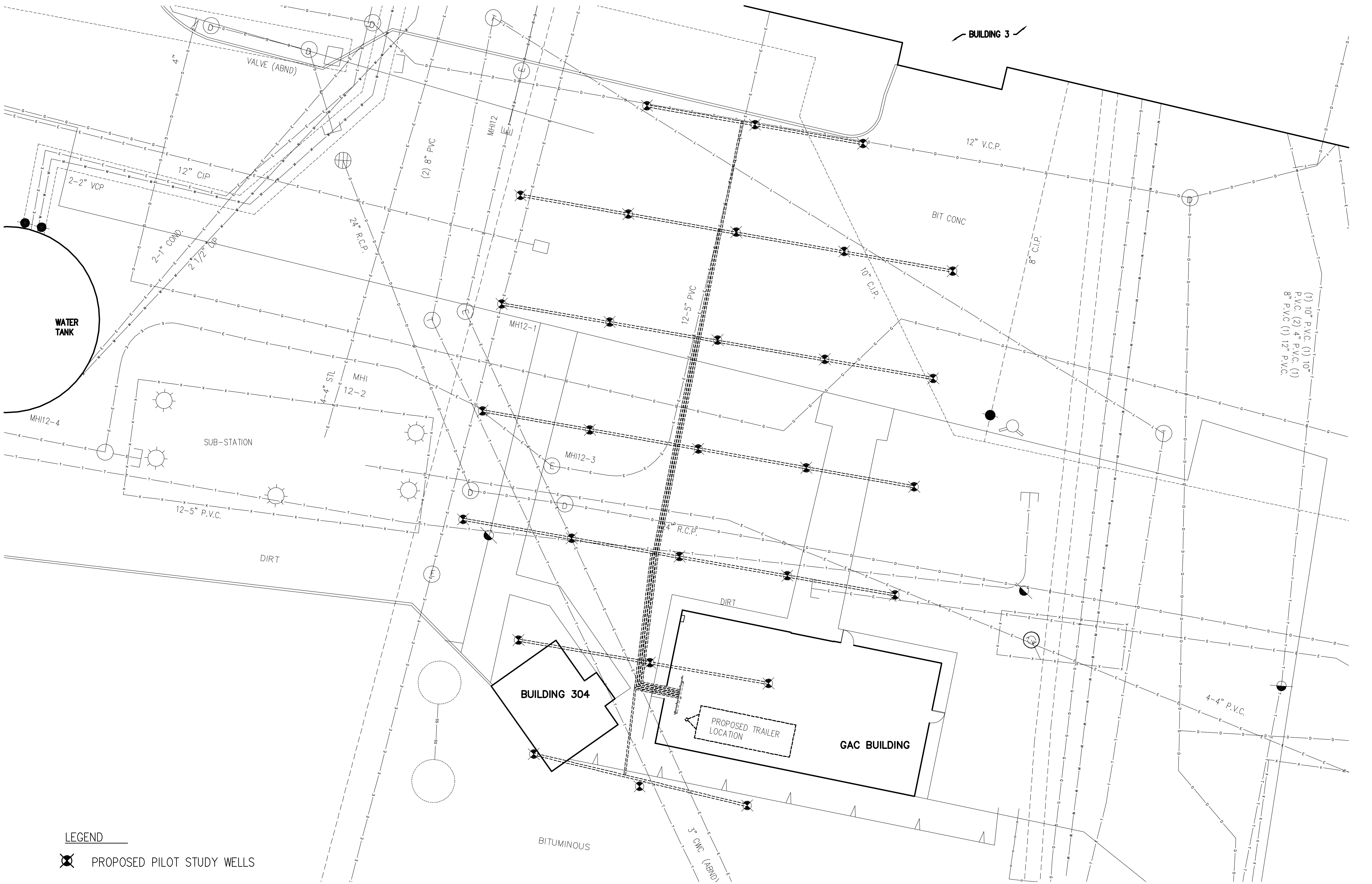
NO.	DATE	DESCRIPTION	BY
A	5/13/04	ISSUED FOR SUBMITAL	JE

PROJECT NO: N62472–04–C–XXX
DRAWN BY: JERRY E
CHECKED BY: DAN L.
CAD DWG FILE: 1C04BP0001–A4.0

SIZE "D" IF SHEET IS LESS THAN "22x36" IT IS A REDUCED PRINT. SCALE REQUIRED REDUCED ACCORDINGLY

SHEET TITLE
SOIL ANALYTICAL RESULTS

FIGURE 1–4
SHEET 4 OF 7



LEGEND

PROPOSED PILOT STUDY WELLS

------ PROPOSED INFRASTRUCTURE LAYOUT

FIGURE 1-5 REMEDIAL SITE PLAN

SCALE: 3/32"=1'-0"

NORTH

0 10' 20' 40'

SCALE: 1"=20'-0"

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PROJECT DESCRIPTION

CLOSED-LOOP BIOREMEDIATION PILOT DEMONSTRATION PLANT 3, AREA OF CONCERN 22

999 S. OYSTER BAY RD. BETHPAGE, NY 11714

REVISIONS

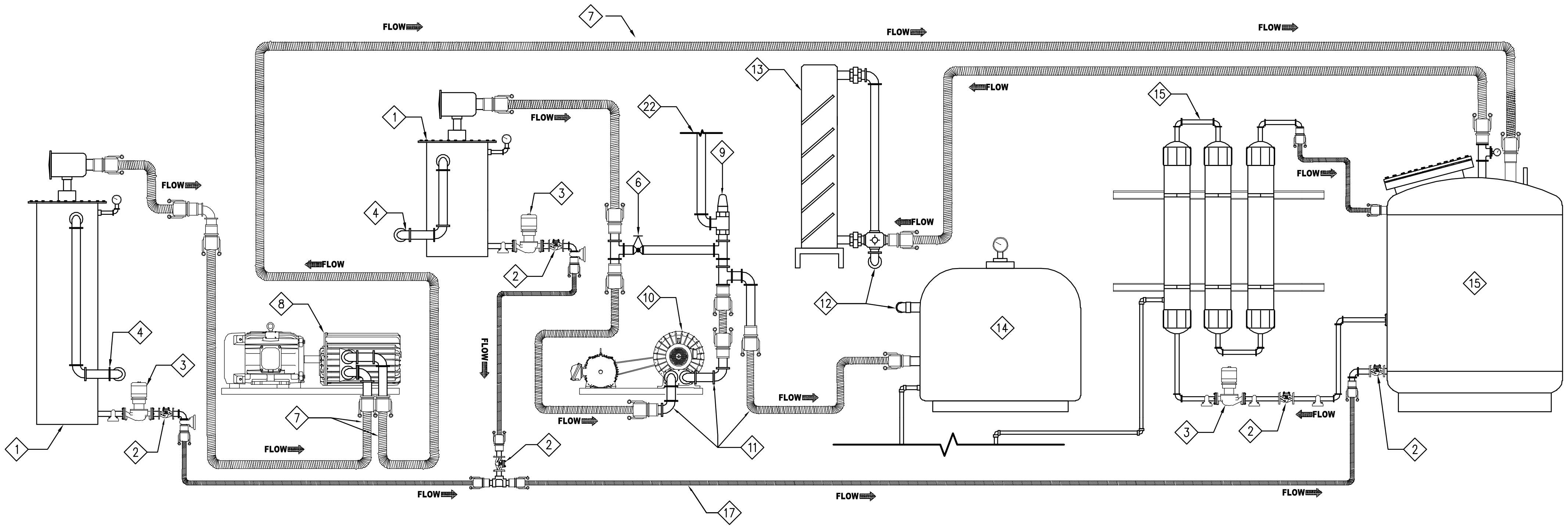
NO.	DATE	DESCRIPTION	BY
A	5/13/04	ISSUED FOR SUBMITAL	JE

PROJECT NO: N62472-04-C-XXX
DRAWN BY: JERRY E
CHECKED BY: DAN L.
CAD DWG FILE: DRAWING NUMBER

SIZE "D" IF SHEET IS LESS THAN "22x36" IT IS A REDUCED PRINT. SCALE REQUIRED REDUCED ACCORDINGLY

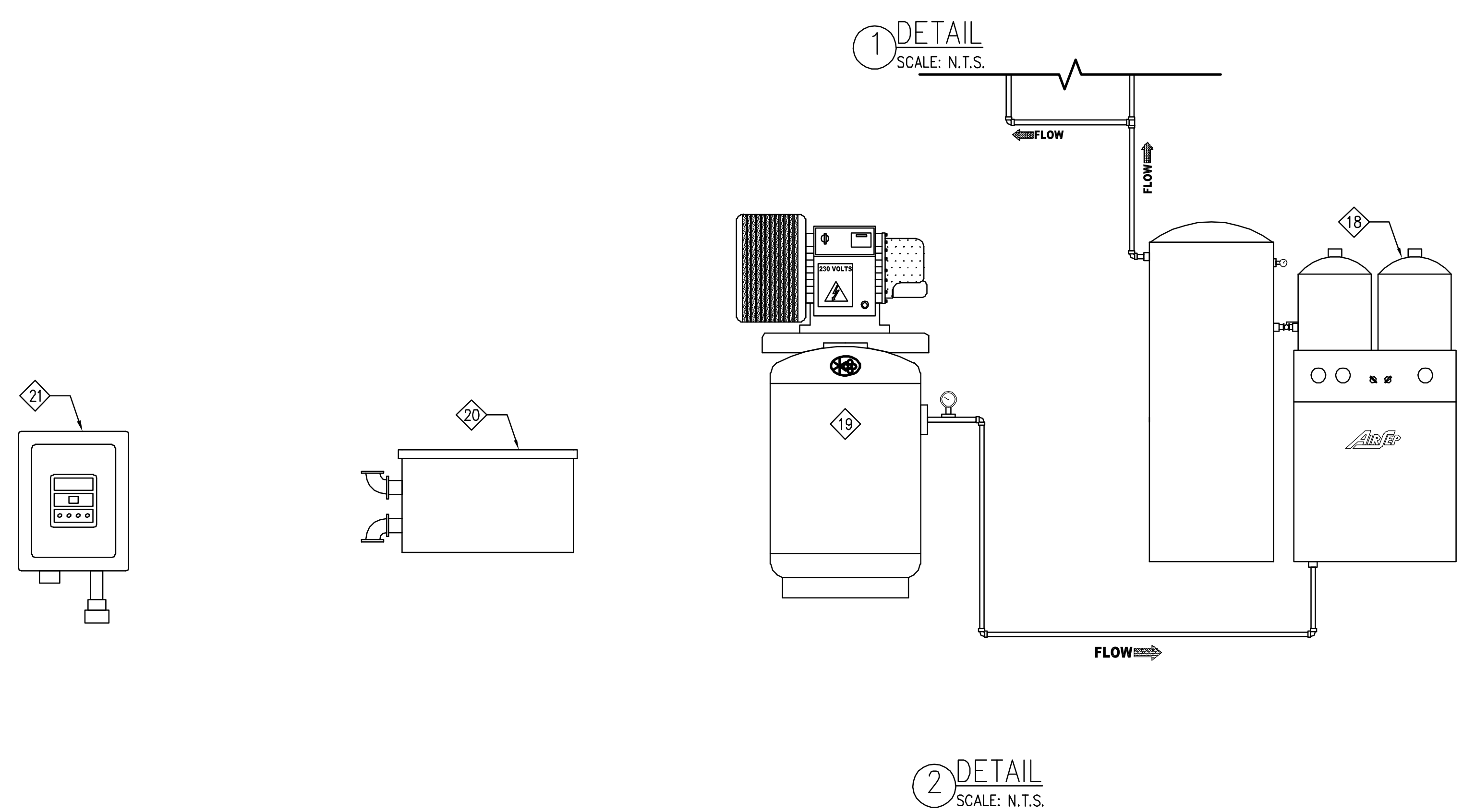
SHEET TITLE
ENLARGED SITE PLAN

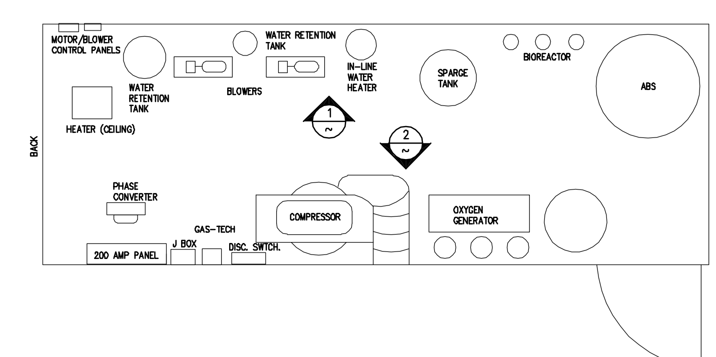
FIGURE 1-5



KEY NOTES:

1. WATER RETENTION TANK
2. CHECK VALVE
3. RECIRCULATING PUMP
4. FROM EXTRACTION LINE
5. CAM OPERATED COUPLING (QUICK DISCONNECT) TYP.
6. FLOW RECIRCULATION VALVE
7. 3" HOSE LINE
8. 30 HP BLOWER ASSEMBLY (ABS)
9. PRESSURE RELEASE VALVE
10. 15 HP BLOWER ASSEMBLY (SPARGE)
11. 2" HOSE LINES
12. TO INJECTION LINE
13. INLINE HEATER
14. SPARGE TANK
15. ABS TANK
16. BIOREACTOR
17. DRAIN TO ABS TANK HOSE LINE. MATCH TO PUMP SIZE
18. OXYGEN GENERATOR
19. AIR COMPRESSOR
20. PHASE CONVERTER 1ø TO 3ø
21. GAS-TECH MONITORING SYSTEM
22. EXIT THROUGH CEILING





TRAILER

FIGURE 1-6 PROCESS FLOW DIAGRAM

SCALE: N.T.S.

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PROJECT DESCRIPTION

CLOSED-LOOP BIOREMEDIATION PILOT DEMONSTRATION PLANT 3, AREA OF CONCERN 22

999 S. OYSTER BAY RD. BETHPAGE, NY 11714

REVISIONS

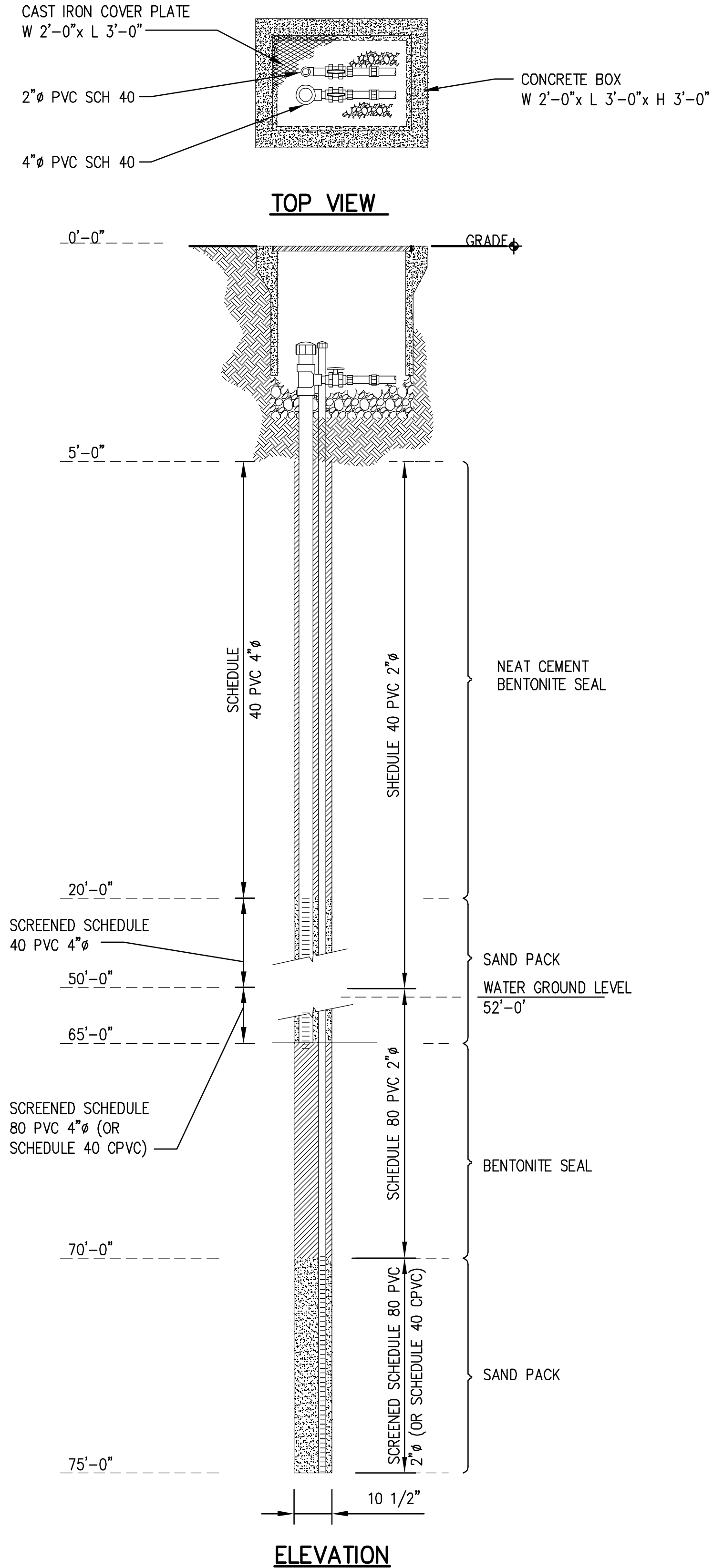
NO.	DATE	DESCRIPTION	BY
A	5/13/04	ISSUED FOR SUBMITAL	JE

PROJECT NO: N62472-04-C-XXX
DRAWN BY: GILBERT
CHECKED BY:
CAD DWG FILE:DRAWING NUMBER

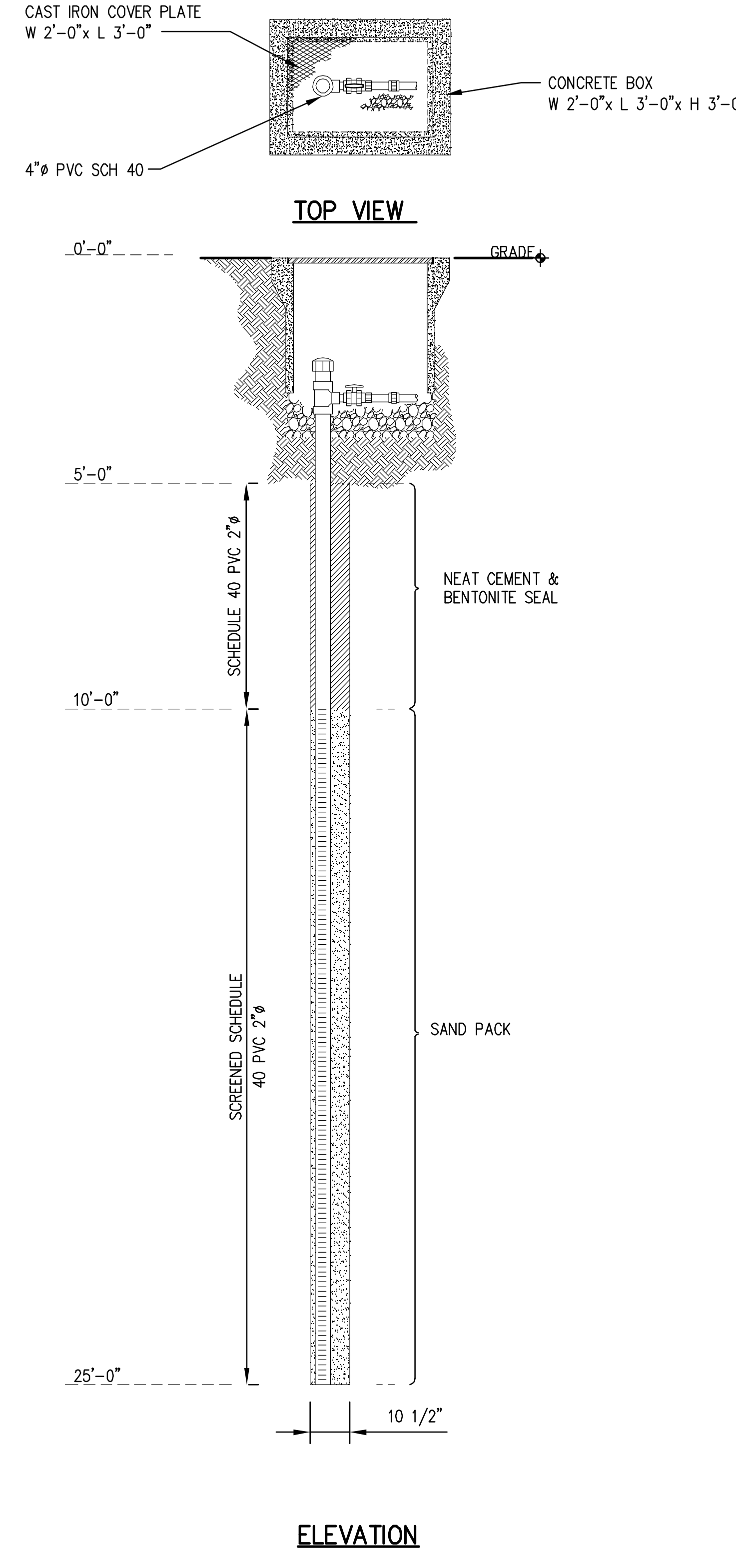
SIZE "D" IF SHEET IS LESS THAN "22x36" IT IS A REDUCED PRINT. SCALE REQUIRED REDUCED ACCORDINGLY

SHEET TITLE
PROCESS FLOW DIAGRAM

FIGURE 1-6



PILOT STUDY WELL



SHALLOW PILOT STUDY WELL

FIGURE 1-7 PILOT STUDY WELLS CONSTRUCTION DIAGRAM

SCALE: 3/32"=1'-0"

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PROJECT DESCRIPTION

CLOSED-LOOP
BIOREMEDIATION
PILOT DEMONSTRATION
PLANT 3, AREA OF
CONCERN 22

999 S. OYSTER BAY RD.
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REVISIONS

NO.	DATE	DESCRIPTION	BY
A	3/26/04	ISSUED FOR SUBMITAL	JE

PROJECT NO: N47408-04-C-7505
DRAWN BY: GILBERT C.
CHECKED BY: DAN L.
CAD DWG FILE:1C04BP0001-A6.0
SIZE "D" IF SHEET IS LESS THAN "22x36" IT IS A REDUCED PRINT. SCALE REQUIRED REDUCED ACCORDINGLY

SHEET TITLE
CONSTRUCTION DETAILS

FIGURE 1-7
SHEET 7 OF 7

May 14, 2004 - 11:36am - gilbertc - x:\F. Architectual CAD\B. Drawings\Environmental\New York\Bethpage\a-Pre Design\pdf FIGURES\FIGURE 1-7.dwg

APPENDIX A

COMPLETE LIST OF AOC 22 GROUNDWATER AND SOIL ANALYTICAL RESULTS

Beth Page
AOC 22
Summary of Analytical Results
Groundwater VOCs/SVOCs

matrix	GW	GW	GW	GW	GW	GW
nsample	TTNUS-22-MW-01	TTNUS-22-MW-02	TTNUS-22-MW-03	TTNUS-22-MW-03-D	TTNUS-22-MW-04	TTNUS-22-MW-05
sample	TTNUS-22-MW-01	TTNUS-22-MW-02	TTNUS-22-MW-03	TTNUS-22-MW-DUP-01	TTNUS-22-MW-04	TTNUS-22-MW-05
sacode	NORMAL	NORMAL	DUP	DUP	NORMAL	NORMAL
sample_dat	12-Aug-99	13-Aug-99	12-Aug-99	12-Aug-99	12-Aug-99	12-Aug-99
cto_proj	283	283	283	283	283	283
proj_manag	Brayack, D.	Brayack, D.	Brayack, D.	Brayack, D.	Brayack, D.	Brayack, D.
Volatile Organics (ug/L)						
1,1,1-TRICHLOROETHANE	5 U	5 U	5 U	5 U	5 U	5 U
1,1,2,2-TETRACHLOROETHANE	5 U	5 U	5 U	5 U	5 U	5 U
1,1,2-TRICHLOROETHANE	5 U	5 U	5 U	5 U	5 U	5 U
1,1-DICHLOROETHANE	**4.1 J**	**3.1 J**	**2.1 J**	**2.1 J**	**2 J**	**2.6 J**
1,1-DICHLOROETHENE	5 U	5 U	5 U	5 U	5 U	5 U
1,2,3-TRICHLOROPROPANE	5 U	5 U	5 U	5 U	5 U	5 U
1,2-DICHLOROETHANE	5 U	5 U	5 U	5 U	5 U	5 U
1,2-DICHLOROETHENE (TOTAL)	**7.9**	**47**	**11**	**11**	**2.9 J**	**25**
1,2-DICHLOROPROPANE	5 U	5 U	5 U	5 U	5 U	5 U
2-BUTANONE	20 U	**3.4 J**	20 U	20 U	20 U	20 U
2-HEXANONE	20 U	20 U	20 U	20 U	20 U	20 U
4-METHYL-2-PENTANONE	20 U	20 U	20 U	20 U	20 U	20 U
ACETONE	20 U	20 U	20 U	20 U	20 U	20 U
BENZENE	**17**	**12**	5 U	5 U	**4.1 J**	5 U
BROMODICHLOROMETHANE	5 U	5 U	5 U	5 U	5 U	5 U
BROMOFORM	5 U	5 U	5 U	5 U	5 U	5 U
BROMOMETHANE	10 U	10 U	10 U	10 U	10 U	10 U
CARBON DISULFIDE	5 U	5 U	5 U	5 U	5 U	5 U
CARBON TETRACHLORIDE	5 U	5 U	5 U	5 U	5 U	5 U
CHLOROBENZENE	5 U	5 U	5 U	5 U	5 U	5 U
CHLOROETHANE	10 U	**4.4 J**	10 U	10 U	10 U	10 U
CHLOROFORM	5 U	5 U	5 U	5 U	5 U	5 U
CHLOROMETHANE	10 U	10 U	10 U	10 U	10 U	10 U
CIS-1,2-DICHLOROETHENE	**7.9**	**48**	**11**	**12**	**2.9**	**25**
CIS-1,3-DICHLOROPROPENE	5 U	5 U	5 U	5 U	5 U	5 U
DIBROMOCHLOROMETHANE	5 U	5 U	5 U	5 U	5 U	5 U
ETHYLBENZENE	**18**	**11**	5 U	5 U	5 U	5 U
METHYLENE CHLORIDE	5 U	5 U	5 U	5 U	5 U	5 U
STYRENE	5 U	5 U	5 U	5 U	5 U	5 U
TETRACHLOROETHENE	**2.7 J**	**1.5 J**	**6**	**5.8**	**2 J**	**12**
TOLUENE	**1.4 J**	**1.1 J**	5 U	5 U	5 U	5 U
TRANS-1,2-DICHLOROETHENE	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U
TRANS-1,3-DICHLOROPROPENE	5 U	5 U	5 U	5 U	5 U	5 U
TRICHLOROETHENE	**25**	**67**	**95**	**95**	**17**	**86**
TRICHLOROTRIFLUOROETHANE	5 U	**8.2**	5 U	5 U	5 U	5 U
VINYL CHLORIDE	**2.9 J**	**27**	10 U	10 U	10 U	10 U
XYLENES, TOTAL	**7.6**	**4.7 J**	5 U	5 U	5 U	5 U
Semivolatile Organics (ug/L)						
1,2,4-TRICHLOROBENZENE	10 U	10 U	10 U	10 U	10 U	10 U
1,2-DICHLOROBENZENE	10 U	10 U	10 U	10 U	10 U	10 U
1,3-DICHLOROBENZENE	10 U	10 U	10 U	10 U	10 U	10 U
1,4-DICHLOROBENZENE	10 U	10 U	10 U	10 U	10 U	10 U
2,2'-OXYBIS(1-CHLOROPROPANE)	10 U	10 U	10 U	10 U	10 U	10 U
2,4,5-TRICHLOROPHENOL	10 U	10 U	10 U	10 U	10 U	10 U
2,4,6-TRICHLOROPHENOL	10 U	10 U	10 U	10 U	10 U	10 U
2,4-DICHLOROPHENOL	10 U	10 U	10 U	10 U	10 U	10 U
2,4-DIMETHYLPHENOL	10 U	10 U	10 U	10 U	10 U	10 U
2,4-DINITROPHENOL	50 U	50 U	50 U	50 U	50 U	50 U
2,4-DINITROTOLUENE	10 U	10 U	10 U	10 U	10 U	10 U
2,6-DINITROTOLUENE	10 U	10 U	10 U	10 U	10 U	10 U
2-CHLORONAPHTHALENE	10 U	10 U	10 U	10 U	10 U	10 U
2-CHLOROPHENOL	10 U	10 U	10 U	10 U	10 U	10 U
2-METHYLNAPHTHALENE	**41**	**34**	**1.9 J**	**2 J**	**2.4 J**	10 U
2-METHYLPHENOL	10 U	10 U	10 U	10 U	10 U	10 U
2-NITROANILINE	50 U	50 U	50 U	50 U	50 U	50 U
2-NITROPHENOL	10 U	10 U	10 U	10 U	10 U	10 U
3&4-METHYLPHENOL	20 U	20 U	20 U	20 U	20 U	20 U
3,3'-DICHLOROBENZIDINE	50 U	50 U	50 U	50 U	50 U	50 U
3-NITROANILINE	50 U	50 U	50 U	50 U	50 U	50 U
4,6-DINITRO-2-METHYLPHENOL	50 U	50 U	50 U	50 U	50 U	50 U
4-BROMOPHENYL PHENYL ETHER	10 U	10 U	10 U	10 U	10 U	10 U
4-CHLORO-3-METHYLPHENOL	10 U	10 U	10 U	10 U	10 U	10 U
4-CHLOROANILINE	10 U	10 U	10 U	10 U	10 U	10 U
4-CHLOROPHENYL PHENYL ETHER	10 U	10 U	10 U	10 U	10 U	10 U
4-NITROANILINE	50 U	50 U	50 U	50 U	50 U	50 U

from gw22_sam.dbf
from gw22_res.dbf
from gw22_res.xls

matrix	GW	GW	GW	GW	GW	GW
nsample	TTNUS-22-MW-01	TTNUS-22-MW-02	TTNUS-22-MW-03	TTNUS-22-MW-03-D	TTNUS-22-MW-04	TTNUS-22-MW-05
sample	TTNUS-22-MW-01	TTNUS-22-MW-02	TTNUS-22-MW-03	TTNUS-22-MW-DUP-01	TTNUS-22-MW-04	TTNUS-22-MW-05
sacode	NORMAL	NORMAL	DUP	DUP	NORMAL	NORMAL
sample_dat	12-Aug-99	13-Aug-99	12-Aug-99	12-Aug-99	12-Aug-99	12-Aug-99
cto_proj	283	283	283	283	283	283
proj_manag	Brayack, D.	Brayack, D.	Brayack, D.	Brayack, D.	Brayack, D.	Brayack, D.
4-NITROPHENOL	50 U	50 U	50 U	50 U	50 U	50 U
ACENAPHTHENE	**1.5 J**	**1.5 J**	10 U	10 U	10 U	10 U
ACENAPHTHYLENE	10 U	10 U	10 U	10 U	10 U	10 U
ANILINE	10 U	10 U	10 U	10 U	10 U	10 U
ANTHRACENE	10 U	10 U	10 U	10 U	10 U	10 U
BENZO(A)ANTHRACENE	10 U	10 U	10 U	10 U	10 U	10 U
BENZO(A)PYRENE	10 U	10 U	10 U	10 U	10 U	10 U
BENZO(B)FLUORANTHENE	10 U	10 U	10 U	10 U	10 U	10 U
BENZO(G,H,I)PERYLENE	10 U	10 U	10 U	10 U	10 U	10 U
BENZO(K)FLUORANTHENE	10 U	10 U	10 U	10 U	10 U	10 U
BENZOIC ACID	50 U	50 U	50 U	50 U	50 U	50 U
BIS(2-CHLOROETHOXY)METHANE	10 U	10 U	10 U	10 U	10 U	10 U
BIS(2-CHLOROETHYL)ETHER	10 U	10 U	10 U	10 U	10 U	10 U
BIS(2-ETHYLHEXYL)PHTHALATE	**3.5 J**	**7.7 J**	**13**	**16**	**7 J**	**43**
BUTYLBENZYL PHTHALATE	10 U	10 U	10 U	10 U	10 U	10 U
CARBAZOLE	**4.2 J**	**2.6 J**	10 U	10 U	**1.8 J**	10 U
CHRYSENE	10 U	10 U	10 U	10 U	10 U	10 U
DI-N-BUTYL PHTHALATE	10 U	10 U	10 U	10 U	10 U	10 U
DI-N-OCTYL PHTHALATE	10 U	10 U	10 U	10 U	10 U	10 U
DIBENZO(A,H)ANTHRACENE	10 U	10 U	10 U	10 U	10 U	10 U
DIBENZOFURAN	10 U	10 U	10 U	10 U	10 U	10 U
DIETHYL PHTHALATE	10 U	10 U	10 U	10 U	10 U	10 U
DIMETHYL PHTHALATE	10 U	10 U	10 U	10 U	10 U	10 U
FLUORANTHENE	10 U	10 U	10 U	10 U	10 U	10 U
FLUORENE	**2.1 J**	**2 J**	10 U	10 U	10 U	10 U
HEXACHLOROBENZENE	10 U	10 U	10 U	10 U	10 U	10 U
HEXACHLOROBUTADIENE	10 U	10 U	10 U	10 U	10 U	10 U
HEXACHLOROCYCLOPENTADIENE	50 U	50 U	50 U	50 U	50 U	50 U
HEXACHLOROETHANE	10 U	10 U	10 U	10 U	10 U	10 U
INDENO(1,2,3-CD)PYRENE	10 U	10 U	10 U	10 U	10 U	10 U
ISOPHORONE	10 U	10 U	10 U	10 U	10 U	10 U
N-NITROSO-DI-N-PROPYLAMINE	10 U	10 U	10 U	10 U	10 U	10 U
N-NITROSODIPHENYLAMINE	10 U	10 U	10 U	10 U	10 U	10 U
NAPHTHALENE	**20**	**20**	10 U	10 U	**2.5 J**	10 U
NITROBENZENE	10 U	10 U	10 U	10 U	10 U	10 U
PENTACHLOROPHENOL	50 U	50 U	50 U	50 U	50 U	50 U
PHENANTHRENE	**3.6 J**	**3.1 J**	10 U	10 U	10 U	10 U
PHENOL	10 U	10 U	10 U	10 U	10 U	10 U
PYRENE	10 U	10 U	10 U	10 U	10 U	10 U

from gw22_sam.dbf
from gw22_res.dbf
from gw22_res.xls

Beth Page
AOC 22
Summary of Analytic Results
Subsurface Soils

nsample	TTNUS-22-SB-01-5456	TTNUS-22-SB-02-5759	TTNUS-22-SB-03-5557	TTNUS-22-SB-04-5759	TTNUS-22-SB-05-5559	TTNUS-22-SB-05-9599	TTNUS-22-SB-06-5557	TTNUS-22-SB-07-5557
sample	TTNUS-22-SB-01-5456	TTNUS-22-SB-02-5759	TTNUS-22-SB-03-5557	TTNUS-22-SB-04-5759	TTNUS-22-SB-05-5559	TTNUS-22-SB-05-9599	TTNUS-22-SB-06-5557	TTNUS-22-SB-07-5557
sample_dat	03-Jun-99	07-Jun-99	08-Jun-99	09-Jun-99	22-Jun-99	22-Jun-99	23-Jun-99	24-Jun-99
coll_metho	GRAB	GRAB	GRAB	GRAB	GRAB	GRAB	GRAB	GRAB
cto_proj	283	283	283	283	283	283	283	283
proj_manag	Brayack, D.	Brayack, D.	Brayack, D.	Brayack, D.	Brayack, D.	Brayack, D.	Brayack, D.	Brayack, D.
Volatile Organics (ug/kg)								
1,1,1-TRICHLOROETHANE	350 U				5.1 U	260 U		
1,1,2,2-TETRACHLOROETHANE	350 U				5.1 U	260 U		
1,1,2-TRICHLOROETHANE	350 U				5.1 U	260 U		
1,1-DICHLOROETHANE	350 U				5.1 U	260 U		
1,1-DICHLOROETHENE	350 U				5.1 U	260 U		
1,2,3-TRICHLOROPROPANE	350 U				5.1 U	260 U		
1,2-DICHLOROETHANE	350 U				5.1 U	260 U		
1,2-DICHLOROETHENE (TOTAL)	350 U				5.1 U	260 U		
1,2-DICHLOROPROPANE	350 U				5.1 U	260 U		
2-BUTANONE	1400 U				20 U	1000 U		
2-HEXANONE	1400 U				20 U	1000 U		
4-METHYL-2-PENTANONE	1400 U				20 U	1000 U		
ACETONE	1400 U				20 U	1000 U		
BENZENE	350 U				5.1 U	260 U		
BROMODICHLOROMETHANE	350 U				5.1 U	260 U		
BROMOFORM	350 U				5.1 U	260 U		
BROMOMETHANE	700 UR				10 UR	520 U		
CARBON DISULFIDE	350 U				5.1 U	260 U		
CARBON TETRACHLORIDE	350 U				5.1 U	260 U		
CHLOROBENZENE	350 U				5.1 U	260 U		
CHLOROETHANE	700 UR				10 U	520 U		
CHLOROFORM	350 U				5.1 U	260 U		
CHLOROMETHANE	700 U				10 U	520 U		
CIS-1,2-DICHLOROETHENE	170 U				5.1 U	260 U		
CIS-1,3-DICHLOROPROPENE	350 U				5.1 U	260 U		
DIBROMOCHLOROMETHANE	350 U				5.1 U	260 U		
ETHYLBENZENE	350 U				5.1 U	260 U		
METHYLENE CHLORIDE	350 U				5.1 U	260 U		
STYRENE	350 U				5.1 U	260 U		
TETRACHLOROETHENE	350 U				5.1 U	260 U		
TOLUENE	350 U				5.1 U	260 U		
TRANS-1,2-DICHLOROETHENE	170 U				5.1 U	260 U		
TRANS-1,3-DICHLOROPROPENE	350 U				5.1 U	260 U		
TRICHLOROETHENE	350 U				5.1 U	260 U		
TRICHLOROTRIFLUOROETHANE	350 U				5.1 U	260 U		
VINYL CHLORIDE	700 U				10 U	520 U		
XYLENES, TOTAL	350 U				5.1 U	260 U		
Semivolatile Organics (ug/kg)								
1,2,4-TRICHLOROBENZENE	7000 U				1800 U	1800 U		
1,2-DICHLOROBENZENE	7000 U				1800 U	1800 U		
1,3-DICHLOROBENZENE	7000 U				1800 U	1800 U		
1,4-DICHLOROBENZENE	7000 U				1800 U	1800 U		
2,2'-OXYBIS(1-CHLOROPROPANE)	7000 U				1800 U	1800 U		
2,4,5-TRICHLOROPHENOL	7000 U				1800 U	1800 U		
2,4,6-TRICHLOROPHENOL	7000 U				1800 U	1800 U		

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from sb22_res.xls

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AOC 22
Summary of Analytic Results
Subsurface Soils

nsample	TTNUS-22-SB-01-5456	TTNUS-22-SB-02-5759	TTNUS-22-SB-03-5557	TTNUS-22-SB-04-5759	TTNUS-22-SB-05-5559	TTNUS-22-SB-05-9599	TTNUS-22-SB-06-5557	TTNUS-22-SB-07-5557
sample	TTNUS-22-SB-01-5456	TTNUS-22-SB-02-5759	TTNUS-22-SB-03-5557	TTNUS-22-SB-04-5759	TTNUS-22-SB-05-5559	TTNUS-22-SB-05-9599	TTNUS-22-SB-06-5557	TTNUS-22-SB-07-5557
sample_dat	03-Jun-99	07-Jun-99	08-Jun-99	09-Jun-99	22-Jun-99	22-Jun-99	23-Jun-99	24-Jun-99
coll_metho	GRAB	GRAB	GRAB	GRAB	GRAB	GRAB	GRAB	GRAB
cto_proj	283	283	283	283	283	283	283	283
proj_manag	Brayack, D.	Brayack, D.	Brayack, D.	Brayack, D.	Brayack, D.	Brayack, D.	Brayack, D.	Brayack, D.
2,4-DICHLOROPHENOL	7000 U				1800 U	1800 U		
2,4-DIMETHYLPHENOL	7000 U				1800 U	1800 U		
2,4-DINITROPHENOL	34000 U				8500 U	8500 U		
2,4-DINITROTOLUENE	7000 U				1800 U	1800 U		
2,6-DINITROTOLUENE	7000 U				1800 U	1800 U		
2-CHLORONAPHTHALENE	7000 U				1800 U	1800 U		
2-CHLOROPHENOL	7000 U				1800 U	1800 U		
2-METHYLNAPHTHALENE	7000 U				**3200**	**1700 J**		
2-METHYLPHENOL	7000 U				1800 U	1800 U		
2-NITROANILINE	34000 U				8500 U	8500 U		
2-NITROPHENOL	7000 U				1800 U	1800 U		
3&4-METHYLPHENOL	7000 U				1800 U	1800 U		
3,3'-DICHLOROBENZIDINE	34000 U				8500 U	8500 U		
3-NITROANILINE	34000 U				8500 U	8500 U		
4,6-DINITRO-2-METHYLPHENOL	34000 U				8500 U	8500 U		
4-BROMOPHENYL PHENYL ETHER	7000 U				1800 U	1800 U		
4-CHLORO-3-METHYLPHENOL	7000 U				1800 U	1800 U		
4-CHLOROANILINE	7000 U				1800 U	1800 U		
4-CHLOROPHENYL PHENYL ETHER	7000 U				1800 U	1800 U		
4-NITROANILINE	34000 U				8500 U	8500 U		
4-NITROPHENOL	34000 U				8500 U	8500 U		
ACENAPHTHENE	7000 U				1800 U	1800 U		
ACENAPHTHYLENE	7000 U				1800 U	1800 U		
ANILINE	7000 U				1800 U	1800 U		
ANTHRACENE	7000 U				1800 U	1800 U		
BENZO(A)ANTHRACENE	7000 U				1800 U	1800 U		
BENZO(A)PYRENE	7000 U				1800 U	1800 U		
BENZO(B)FLUORANTHENE	7000 U				1800 U	1800 U		
BENZO(G,H,I)PERYLENE	7000 U				1800 U	1800 U		
BENZO(K)FLUORANTHENE	7000 U				1800 U	1800 U		
BENZOIC ACID	34000 U				8500 U	8500 U		
BIS(2-CHLOROETHOXY)METHANE	7000 U				1800 U	1800 U		
BIS(2-CHLOROETHYL)ETHER	7000 U				1800 U	1800 U		
BIS(2-ETHYLHEXYL)PHTHALATE	7000 U				1800 U	1800 U		
BUTYLBENZYL PHTHALATE	7000 U				1800 U	1800 U		
CARBAZOLE	7000 U				1800 U	1800 U		
CHRYSENE	7000 U				1800 U	**980 J**		
DI-N-BUTYL PHTHALATE	7000 U				1800 U	1800 U		
DI-N-OCTYL PHTHALATE	7000 U				1800 U	1800 U		
DIBENZO(A,H)ANTHRACENE	7000 U				1800 U	1800 U		
DIBENZOFURAN	7000 U				1800 U	1800 U		
DIETHYL PHTHALATE	7000 U				1800 U	1800 U		
DIMETHYL PHTHALATE	7000 U				1800 U	1800 U		
FLUORANTHENE	7000 U				1800 U	1800 U		
FLUORENE	7000 U				**670 J**	1800 U		
HEXACHLOROBENZENE	7000 U				1800 U	1800 U		

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nsample	TTNUS-22-SB-01-5456	TTNUS-22-SB-02-5759	TTNUS-22-SB-03-5557	TTNUS-22-SB-04-5759	TTNUS-22-SB-05-5559	TTNUS-22-SB-05-9599	TTNUS-22-SB-06-5557	TTNUS-22-SB-07-5557
sample	TTNUS-22-SB-01-5456	TTNUS-22-SB-02-5759	TTNUS-22-SB-03-5557	TTNUS-22-SB-04-5759	TTNUS-22-SB-05-5559	TTNUS-22-SB-05-9599	TTNUS-22-SB-06-5557	TTNUS-22-SB-07-5557
sample_dat	03-Jun-99	07-Jun-99	08-Jun-99	09-Jun-99	22-Jun-99	22-Jun-99	23-Jun-99	24-Jun-99
coll_metho	GRAB	GRAB	GRAB	GRAB	GRAB	GRAB	GRAB	GRAB
cto_proj	283	283	283	283	283	283	283	283
proj_manag	Brayack, D.	Brayack, D.	Brayack, D.	Brayack, D.	Brayack, D.	Brayack, D.	Brayack, D.	Brayack, D.
HEXACHLOROBUTADIENE	7000 U				1800 U	1800 U		
HEXACHLOROCYCLOPENTADIENE	34000 U				8500 U	8500 U		
HEXACHLOROETHANE	7000 U				1800 U	1800 U		
INDENO(1,2,3-CD)PYRENE	7000 U				1800 U	1800 U		
ISOPHORONE	7000 U				1800 U	1800 U		
N-NITROSO-DI-N-PROPYLAMINE	7000 U				1800 U	1800 U		
N-NITROSODIPHENYLAMINE	7000 U				1800 U	1800 U		
NAPHTHALENE	7000 U				1800 U	1800 U		
NITROBENZENE	7000 U				1800 U	1800 U		
PENTACHLOROPHENOL	34000 U				8500 U	8500 U		
PHENANTHRENE	**3000 J**				**2800**	**2500**		
PHENOL	7000 U				1800 U	1800 U		
PYRENE	7000 U				1800 U	**2300**		
Petroleum Hydrocarbons (mg/kg)								
DIESEL RANGE ORGANICS	**1900**	**21000**	**13000**	**12000**	**5400**		3.3 U	**1300 J**
GASOLINE RANGE ORGANICS	**78**	**300**	**140**	**250**	**44**		0.11 U	**23**

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AOC 22
Summary of Analytic Results
Subsurface Soils

nsample	TTNUS-22-SB-08-5557	TTNUS-22-SB-09-5557	TTNUS-22-SB-10-5557	TTNUS-22-SB-11-5355	TTNUS-22-SB-12-5860	TTNUS-22-SB-13-5759	TTNUS-22-SB-14-5759
sample	TTNUS-22-SB-08-5557	TTNUS-22-SB-09-5557	TTNUS-22-SB-10-5557	TTNUS-22-SB-11-5355	TTNUS-22-SB-12-5860	TTNUS-22-SB-13-5759	TTNUS-22-SB-14-5759
sample_dat	28-Jun-99	29-Jun-99	19-Jul-99	20-Jul-99	22-Jul-99	21-Jul-99	22-Jul-99
coll_metho	GRAB	GRAB	GRAB	GRAB	GRAB	GRAB	GRAB
cto_proj	283	283	283	283	283	283	283
proj_manag	Brayack, D.	Brayack, D.	Brayack, D.	Brayack, D.	Brayack, D.	Brayack, D.	Brayack, D.
Volatile Organics (ug/kg)							
1,1,1-TRICHLOROETHANE	5.6 U						
1,1,2,2-TETRACHLOROETHANE	5.6 U						
1,1,2-TRICHLOROETHANE	5.6 U						
1,1-DICHLOROETHANE	5.6 U						
1,1-DICHLOROETHENE	5.6 U						
1,2,3-TRICHLOROPROPANE	5.6 U						
1,2-DICHLOROETHANE	5.6 U						
1,2-DICHLOROETHENE (TOTAL)	5.6 U						
1,2-DICHLOROPROPANE	5.6 U						
2-BUTANONE	22 U						
2-HEXANONE	22 U						
4-METHYL-2-PENTANONE	22 U						
ACETONE	**5.1 J**						
BENZENE	5.6 U						
BROMODICHLOROMETHANE	5.6 U						
BROMOFORM	5.6 U						
BROMOMETHANE	11 U						
CARBON DISULFIDE	5.6 U						
CARBON TETRACHLORIDE	5.6 U						
CHLOROBENZENE	5.6 U						
CHLOROETHANE	11 U						
CHLOROFORM	5.6 U						
CHLOROMETHANE	11 U						
CIS-1,2-DICHLOROETHENE	2.8 U						
CIS-1,3-DICHLOROPROPENE	5.6 U						
DIBROMOCHLOROMETHANE	5.6 U						
ETHYLBENZENE	5.6 U						
METHYLENE CHLORIDE	**2.8 J**						
STYRENE	5.6 U						
TETRACHLOROETHENE	5.6 U						
TOLUENE	5.6 U						
TRANS-1,2-DICHLOROETHENE	2.8 U						
TRANS-1,3-DICHLOROPROPENE	5.6 U						
TRICHLOROETHENE	5.6 U						
TRICHLOROTRIFLUOROETHANE	5.6 U						
VINYL CHLORIDE	11 U						
XYLENES, TOTAL	5.6 U						
Semivolatile Organics (ug/kg)							
1,2,4-TRICHLOROBENZENE	370 U						
1,2-DICHLOROBENZENE	370 U						
1,3-DICHLOROBENZENE	370 U						
1,4-DICHLOROBENZENE	370 U						
2,2'-OXYBIS(1-CHLOROPROPANE)	370 U						
2,4,5-TRICHLOROPHENOL	370 U						
2,4,6-TRICHLOROPHENOL	370 U						

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AOC 22
Summary of Analytic Results
Subsurface Soils

nsample	TTNUS-22-SB-08-5557	TTNUS-22-SB-09-5557	TTNUS-22-SB-10-5557	TTNUS-22-SB-11-5355	TTNUS-22-SB-12-5860	TTNUS-22-SB-13-5759	TTNUS-22-SB-14-5759
sample	TTNUS-22-SB-08-5557	TTNUS-22-SB-09-5557	TTNUS-22-SB-10-5557	TTNUS-22-SB-11-5355	TTNUS-22-SB-12-5860	TTNUS-22-SB-13-5759	TTNUS-22-SB-14-5759
sample_dat	28-Jun-99	29-Jun-99	19-Jul-99	20-Jul-99	22-Jul-99	21-Jul-99	22-Jul-99
coll_metho	GRAB	GRAB	GRAB	GRAB	GRAB	GRAB	GRAB
cto_proj	283	283	283	283	283	283	283
proj_manag	Brayack, D.	Brayack, D.	Brayack, D.	Brayack, D.	Brayack, D.	Brayack, D.	Brayack, D.
2,4-DICHLOROPHENOL	370 U						
2,4-DIMETHYLPHENOL	370 U						
2,4-DINITROPHENOL	1800 U						
2,4-DINITROTOLUENE	370 U						
2,6-DINITROTOLUENE	370 U						
2-CHLORONAPHTHALENE	370 U						
2-CHLOROPHENOL	370 U						
2-METHYLNAPHTHALENE	370 U						
2-METHYLPHENOL	370 U						
2-NITROANILINE	1800 U						
2-NITROPHENOL	370 U						
3&4-METHYLPHENOL	370 U						
3,3'-DICHLOROBENZIDINE	1800 U						
3-NITROANILINE	1800 U						
4,6-DINITRO-2-METHYLPHENOL	1800 U						
4-BROMOPHENYL PHENYL ETHER	370 U						
4-CHLORO-3-METHYLPHENOL	370 U						
4-CHLOROANILINE	370 U						
4-CHLOROPHENYL PHENYL ETHER	370 U						
4-NITROANILINE	1800 U						
4-NITROPHENOL	1800 U						
ACENAPHTHENE	370 U						
ACENAPHTHYLENE	370 U						
ANILINE	370 U						
ANTHRACENE	370 U						
BENZO(A)ANTHRACENE	370 U						
BENZO(A)PYRENE	370 U						
BENZO(B)FLUORANTHENE	370 U						
BENZO(G,H,I)PERYLENE	370 U						
BENZO(K)FLUORANTHENE	370 U						
BENZOIC ACID	1800 U						
BIS(2-CHLOROETHOXY)METHANE	370 U						
BIS(2-CHLOROETHYL)ETHER	370 U						
BIS(2-ETHYLHEXYL)PHTHALATE	370 U						
BUTYLBENZYL PHTHALATE	370 U						
CARBAZOLE	370 U						
CHRYSENE	370 U						
DI-N-BUTYL PHTHALATE	370 U						
DI-N-OCTYL PHTHALATE	370 U						
DIBENZO(A,H)ANTHRACENE	370 U						
DIBENZOFURAN	370 U						
DIETHYL PHTHALATE	370 U						
DIMETHYL PHTHALATE	370 U						
FLUORANTHENE	370 U						
FLUORENE	370 U						
HEXACHLOROBENZENE	370 U						

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from sb22_res.dbf
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Beth Page
AOC 22
Summary of Analytic Results
Subsurface Soils

nsample	TTNUS-22-SB-08-5557	TTNUS-22-SB-09-5557	TTNUS-22-SB-10-5557	TTNUS-22-SB-11-5355	TTNUS-22-SB-12-5860	TTNUS-22-SB-13-5759	TTNUS-22-SB-14-5759
sample	TTNUS-22-SB-08-5557	TTNUS-22-SB-09-5557	TTNUS-22-SB-10-5557	TTNUS-22-SB-11-5355	TTNUS-22-SB-12-5860	TTNUS-22-SB-13-5759	TTNUS-22-SB-14-5759
sample_dat	28-Jun-99	29-Jun-99	19-Jul-99	20-Jul-99	22-Jul-99	21-Jul-99	22-Jul-99
coll_metho	GRAB	GRAB	GRAB	GRAB	GRAB	GRAB	GRAB
cto_proj	283	283	283	283	283	283	283
proj_manag	Brayack, D.	Brayack, D.	Brayack, D.	Brayack, D.	Brayack, D.	Brayack, D.	Brayack, D.
HEXACHLOROBUTADIENE	370 U						
HEXACHLOROCYCLOPENTADIENE	1800 U						
HEXACHLOROETHANE	370 U						
INDENO(1,2,3-CD)PYRENE	370 U						
ISOPHORONE	370 U						
N-NITROSO-DI-N-PROPYLAMINE	370 U						
N-NITROSODIPHENYLAMINE	370 U						
NAPHTHALENE	370 U						
NITROBENZENE	370 U						
PENTACHLOROPHENOL	1800 U						
PHENANTHRENE	370 U						
PHENOL	370 U						
PYRENE	370 U						
Petroleum Hydrocarbons (mg/kg)							
DIESEL RANGE ORGANICS	3.3 U	3.3 U	**12**	17 U	**99**	3.4 U	**2.8 J**
GASOLINE RANGE ORGANICS	0.11 U	0.11 U	0.12 U	0.096 U	0.13 U	0.100 U	0.110 U

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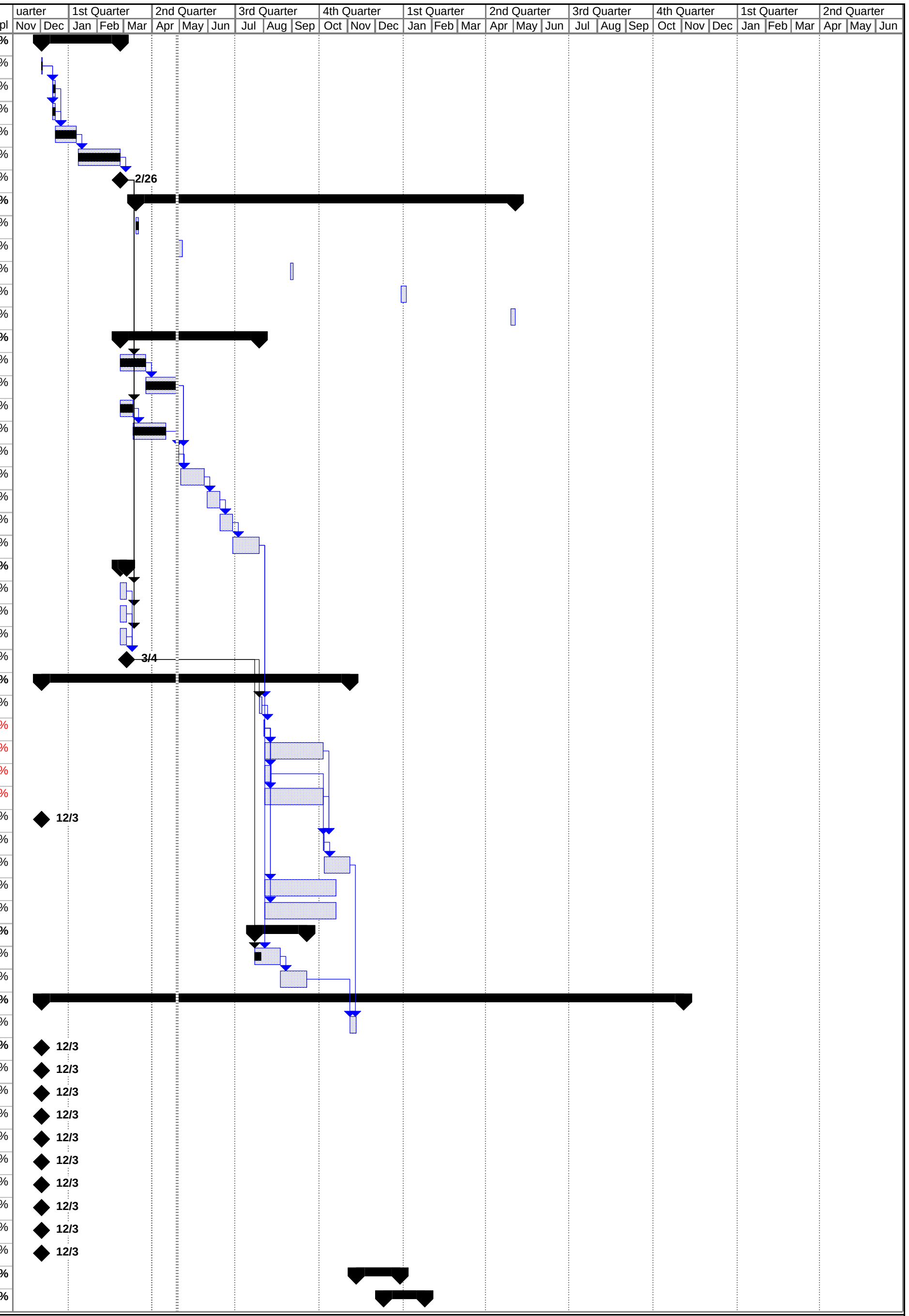
APPENDIX B

PROJECT SCHEDULE

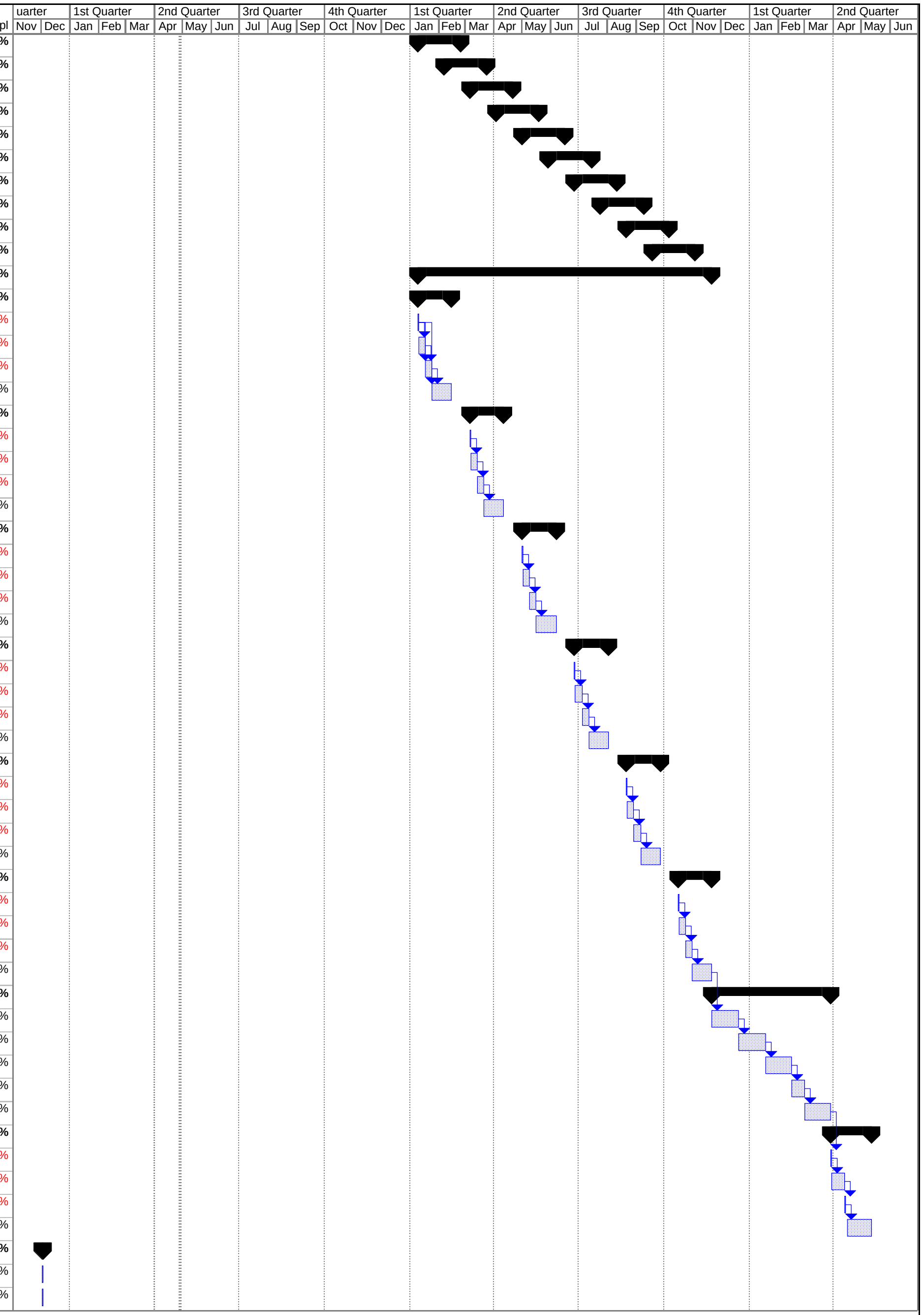
ID	Indicators	Phase	ID	Task Name	Duration	Start	Finish	% Compl
1	✓	**1000**	**1**	**Task 1 - Pre Design Meeting / Site Walk**	**56 days**	**Wed 12/3/03**	**Thu 2/26/04**	**100%**
2	✓	1010	2	Fact Finding Conference Call	1 day	Wed 12/3/03	Wed 12/3/03	100%
3	✓	1020	3	Pre Design Meeting	3 days	Mon 12/15/03	Wed 12/17/03	100%
4	✓	1030	4	Site Walk	3 days	Mon 12/15/03	Wed 12/17/03	100%
5	✓	1040	5	Project Proposal	11 days	Thu 12/18/03	Fri 1/9/04	100%
6	✓	1050	6	Customer Review and Negotiations	34 days	Mon 1/12/04	Thu 2/26/04	100%
7	✓	1060	7	Project Award	0 days	Thu 2/26/04	Thu 2/26/04	100%
8		**1500**	**8**	**Task 1.5 CLB Technology Introductions and Presentation**	**290 days**	**Mon 3/15/04**	**Tue 5/3/05**	**20%**
9	✓	1510	9	Technology Introduction to NYSDEC	3 days	Mon 3/15/04	Wed 3/17/04	100%
10		1520	10	RAB Meeting 1 (August 2004)	3 days	Fri 4/30/04	Tue 5/4/04	0%
11		1530	11	RAB Meeting 2 (December 2004)	3 days	Tue 8/31/04	Thu 9/2/04	0%
12		1540	12	RAB Meeting 3 (April 2005)	3 days	Thu 12/30/04	Tue 1/4/05	0%
13		1550	13	RAB Meeting 4 (August 2005)	3 days	Fri 4/29/05	Tue 5/3/05	0%
14		**2000**	**14**	**Task 2 - Develop RAP, HASP, System Design Drawings**	**106 days**	**Fri 2/27/04**	**Tue 7/27/04**	**58%**
15	✓	2010	15	Develop Remedial Action Plan, Health & Safety Plan 50% Drafts	20 days	Fri 2/27/04	Thu 3/25/04	100%
16	✓	2020	16	Complete Remedial Action Plan, Health & Safety Plan Draft	25 days	Fri 3/26/04	Thu 4/29/04	100%
17	✓	2030	17	Develop System Design	10 days	Fri 2/27/04	Thu 3/11/04	100%
18	✓	2040	18	Develop System Design & Drawings	26 days	Fri 3/12/04	Fri 4/16/04	100%
19	✓	2050	19	RAP, HASP, Design Presentation	1 day	Fri 4/30/04	Fri 4/30/04	100%
20		2060	20	NAVFAC, NYSDEC Review of Drafts	20 days	Mon 5/3/04	Fri 5/28/04	0%
21		2070	21	Response to NAVFAC, NYSDEC	10 days	Tue 6/1/04	Mon 6/14/04	0%
22		2080	22	Final Draft Submission	10 days	Tue 6/15/04	Mon 6/28/04	0%
23		2090	23	Final Draft - Client Approval (not to exceed 45 days)	20 days	Tue 6/29/04	Tue 7/27/04	0%
24		**3000**	**24**	**Task 3 - Site Construction, Environmental, and Drilling Permits**	**5 days**	**Fri 2/27/04**	**Thu 3/4/04**	**0%**
25		3010	25	Site Construction Permits (if Necessary)	5 days	Fri 2/27/04	Thu 3/4/04	0%
26		3020	26	Environmental Permits (if Necessary)	5 days	Fri 2/27/04	Thu 3/4/04	0%
27		3030	27	Drilling Permits (if Necessary)	5 days	Fri 2/27/04	Thu 3/4/04	0%
28		3040	28	Site Cleared for Work	0 days	Thu 3/4/04	Thu 3/4/04	0%
29		**4000**	**29**	**Task 4 - CLB Well and Piping Infrastructure Installation**	**232 days**	**Wed 12/3/03**	**Wed 11/3/04**	**0%**
30		4010	30	Utility Location (Potholing)	3 days	Wed 7/28/04	Fri 7/30/04	0%
31		4020	31	Drilling Mobilization	1 day	Mon 8/2/04	Mon 8/2/04	0%
32		4030	32	Drilling and Installation of 28 Deep Treatment Wells	45 days	Tue 8/3/04	Tue 10/5/04	0%
33		4040	33	Drilling and Installation of 6 Shallow Treatment Wells	5 days	Tue 8/3/04	Mon 8/9/04	0%
34		4060	34	Decontamination, Collection and Disposal of IDW	45 days	Tue 8/3/04	Tue 10/5/04	0%
35		4070	35	Drilling and Installation, Decon, IDW 50% Complete Milestone	0 days	Wed 12/3/03	Wed 12/3/03	0%
36		4080	36	Demobilization	1 day	Wed 10/6/04	Wed 10/6/04	0%
37		4090	37	Trenching and Infrastructure Installation	20 days	Thu 10/7/04	Wed 11/3/04	0%
38		4100	38	Soil Analytical	55 days	Tue 8/3/04	Tue 10/19/04	0%
39		4110	39	Groundwater Analytical	55 days	Tue 8/3/04	Tue 10/19/04	0%
40		**4500**	**40**	**Task 4.5 - Overhead Power Distribution System**	**40 days**	**Fri 7/23/04**	**Fri 9/17/04**	**13%**
41		4510	41	Design Coordination and Approval	20 days	Fri 7/23/04	Thu 8/19/04	25%
42		4520	42	Installation	20 days	Fri 8/20/04	Fri 9/17/04	0%
43		**5000**	**43**	**Task 5 - Start Up and Operation of the CLB System**	**486 days**	**Wed 12/3/03**	**Thu 11/3/05**	**0%**
44		5005	44	Mobilization and System Start Up	5 days	Thu 11/4/04	Wed 11/10/04	0%
45		**5010**	**45**	**System Performance (Sliding Scale)**	**0 days**	**Wed 12/3/03**	**Wed 12/3/03**	**0%**
46		5015	46	First Milestone 10% Reduction	0 days	Wed 12/3/03	Wed 12/3/03	0%
47		5020	47	Second Milestone 20% Reduction	0 days	Wed 12/3/03	Wed 12/3/03	0%
48		5025	48	Third Milestone 30% Reduction	0 days	Wed 12/3/03	Wed 12/3/03	0%
49		5030	49	Fourth Milestone 40% Reduction	0 days	Wed 12/3/03	Wed 12/3/03	0%
50		5035	50	Fifth Milestone 50% Reduction	0 days	Wed 12/3/03	Wed 12/3/03	0%
51		5040	51	Sixth Milestone 60% Reduction	0 days	Wed 12/3/03	Wed 12/3/03	0%
52		5045	52	Seventh Milestone 70% Reduction	0 days	Wed 12/3/03	Wed 12/3/03	0%
53		5050	53	Eighth Milestone 80% Reduction	0 days	Wed 12/3/03	Wed 12/3/03	0%
54		5055	54	Ninth Milestone 90% Reduction	0 days	Wed 12/3/03	Wed 12/3/03	0%
55		**5060**	**55**	**1st Treatment Cycle**	**31 days**	**Wed 11/10/04**	**Tue 12/28/04**	**0%**
74		**5155**	**74**	**2nd Treatment Cycle**	**29 days**	**Fri 12/10/04**	**Mon 1/24/05**	**0%**



Project: Bethpage CLB Pilot Demo
Date: Wed 4/28/04

Task | Progress | Summary | External Tasks | Deadline
Split | Milestone | Project Summary | External Milestone

ID		Phase	ID	Task Name	Duration	Start	Finish	% Compl
93		**5250**	**93**	**3rd Treatment Cycle**	**34 days**	**Sun 1/9/05**	**Thu 2/24/05**	**0%**
106		**5315**	**106**	**4th Treatment Cycle**	**34 days**	**Sun 2/6/05**	**Thu 3/24/05**	**0%**
119		**5380**	**119**	**5th Treatment Cycle**	**34 days**	**Sun 3/6/05**	**Thu 4/21/05**	**0%**
132		**5445**	**132**	**6th Treatment Cycle**	**34 days**	**Sun 4/3/05**	**Thu 5/19/05**	**0%**
145		**5510**	**145**	**7th Treatment Cycle**	**33 days**	**Sun 5/1/05**	**Thu 6/16/05**	**0%**
158		**5575**	**158**	**8th Treatment Cycle**	**33 days**	**Sun 5/29/05**	**Fri 7/15/05**	**0%**
171		**5640**	**171**	**9th Treatment Cycle**	**33 days**	**Sun 6/26/05**	**Thu 8/11/05**	**0%**
184		**5705**	**184**	**10th Treatment Cycle**	**34 days**	**Sun 7/24/05**	**Fri 9/9/05**	**0%**
197		**5770**	**197**	**11th Treatment Cycle**	**33 days**	**Sun 8/21/05**	**Thu 10/6/05**	**0%**
210		**5835**	**210**	**12th Treatment Cycle**	**34 days**	**Sun 9/18/05**	**Thu 11/3/05**	**0%**
223		**6000**	**223**	**Task 6 - Confirmation Borings**	**223 days**	**Mon 1/10/05**	**Mon 11/21/05**	**0%**
224		**6010**	**224**	**Soil Confirmation Boring 1**	**26 days**	**Mon 1/10/05**	**Mon 2/14/05**	**0%**
225		6020	225	Drilling Mobilization	1 day	Mon 1/10/05	Mon 1/10/05	0%
226		6030	226	Drilling and Sample Collection	5 days	Tue 1/11/05	Mon 1/17/05	0%
227		6040	227	IDW Collection, Transportation, and Disposal	5 days	Tue 1/18/05	Mon 1/24/05	0%
228		6050	228	Soil Analytical	15 days	Tue 1/25/05	Mon 2/14/05	0%
229		**6060**	**229**	**Soil Confirmation Boring 2**	**26 days**	**Mon 3/7/05**	**Mon 4/11/05**	**0%**
230		6070	230	Drilling Mobilization	1 day	Mon 3/7/05	Mon 3/7/05	0%
231		6080	231	Drilling and Sample Collection	5 days	Tue 3/8/05	Mon 3/14/05	0%
232		6090	232	IDW Collection, Transportation, and Disposal	5 days	Tue 3/15/05	Mon 3/21/05	0%
233		6100	233	Soil Analytical	15 days	Tue 3/22/05	Mon 4/11/05	0%
234		**6110**	**234**	**Soil Confirmation Boring 3**	**26 days**	**Mon 5/2/05**	**Tue 6/7/05**	**0%**
235		6120	235	Drilling Mobilization	1 day	Mon 5/2/05	Mon 5/2/05	0%
236		6130	236	Drilling and Sample Collection	5 days	Tue 5/3/05	Mon 5/9/05	0%
237		6140	237	IDW Collection, Transportation, and Disposal	5 days	Tue 5/10/05	Mon 5/16/05	0%
238		6150	238	Soil Analytical	15 days	Tue 5/17/05	Tue 6/7/05	0%
239		**6160**	**239**	**Soil Confirmation Boring 4**	**26 days**	**Mon 6/27/05**	**Tue 8/2/05**	**0%**
240		6170	240	Drilling Mobilization	1 day	Mon 6/27/05	Mon 6/27/05	0%
241		6180	241	Drilling and Sample Collection	5 days	Tue 6/28/05	Tue 7/5/05	0%
242		6190	242	IDW Collection, Transportation, and Disposal	5 days	Wed 7/6/05	Tue 7/12/05	0%
243		6200	243	Soil Analytical	15 days	Wed 7/13/05	Tue 8/2/05	0%
244		**6210**	**244**	**Soil Confirmation Boring 5**	**26 days**	**Mon 8/22/05**	**Tue 9/27/05**	**0%**
245		6220	245	Drilling Mobilization	1 day	Mon 8/22/05	Mon 8/22/05	0%
246		6230	246	Drilling and Sample Collection	5 days	Tue 8/23/05	Mon 8/29/05	0%
247		6240	247	IDW Collection, Transportation, and Disposal	5 days	Tue 8/30/05	Tue 9/6/05	0%
248		6250	248	Soil Analytical	15 days	Wed 9/7/05	Tue 9/27/05	0%
249		**6260**	**249**	**Soil Confirmation Boring 6**	**26 days**	**Mon 10/17/05**	**Mon 11/21/05**	**0%**
250		6270	250	Drilling Mobilization	1 day	Mon 10/17/05	Mon 10/17/05	0%
251		6280	251	Drilling and Sample Collection	5 days	Tue 10/18/05	Mon 10/24/05	0%
252		6290	252	IDW Collection, Transportation, and Disposal	5 days	Tue 10/25/05	Mon 10/31/05	0%
253		6300	253	Soil Analytical	15 days	Tue 11/1/05	Mon 11/21/05	0%
254		**7000**	**254**	**Task 7 - Final Report and Petition for Site Closure**	**90 days**	**Tue 11/22/05**	**Wed 3/29/06**	**0%**
255		7010	255	Final Report - 50% Draft	20 days	Tue 11/22/05	Tue 12/20/05	0%
256		7020	256	Final Report - Draft	20 days	Wed 12/21/05	Wed 1/18/06	0%
257		7030	257	NAVFAC, NYSDEC Review of Drafts	20 days	Thu 1/19/06	Wed 2/15/06	0%
258		7040	258	Final Draft Submission	10 days	Thu 2/16/06	Wed 3/1/06	0%
259		7050	259	Final Draft - Client Approval (not to exceed 45 days)	20 days	Thu 3/2/06	Wed 3/29/06	0%
260		**8000**	**260**	**Task 8 - Site Restoration**	**32 days**	**Thu 3/30/06**	**Fri 5/12/06**	**0%**
261		8010	261	Drill Rig Mobilization	1 day	Thu 3/30/06	Thu 3/30/06	0%
262		8020	262	Well Abandonment	10 days	Fri 3/31/06	Thu 4/13/06	0%
263		8030	263	Drill Rig Demobilization	1 day	Fri 4/14/06	Fri 4/14/06	0%
264		8040	264	Site Restoration	20 days	Mon 4/17/06	Fri 5/12/06	0%
265		**8050**	**265**	**Optional**	**1 day?**	**Wed 12/3/03**	**Wed 12/3/03**	**0%**
266		4050	266	Two Shallow Treatment Well Installation	1 day?	Wed 12/3/03	Wed 12/3/03	0%
267		8060	267	Two Shallow Treatment Well Abandonment	1 day?	Wed 12/3/03	Wed 12/3/03	0%



Project: Bethpage CLB Pilot Demo
Date: Wed 4/28/04

Task		Progress		Summary		External Tasks	
Split		Milestone		Project Summary		External Milestone	

Deadline

APPENDIX C

SAMPLING ANALYSIS PLAN

TABLE OF CONTENTS

SAMPLING AND ANALYSIS PLAN

1. PURPOSE

The purpose of the sampling and analysis plan is to evaluate the effectiveness of the closed-loop bioreactor (CLB) pilot study in Area of Concern (AOC) 22. The data will be compared to PRGs presented in Table 1 and to historical target compound list (TCL), soil and groundwater sampling results, presented on Figure 3. Historical TCL VOC soil data is summarized in Tables 2 through 5. Proposed sampling locations are provided on Figures 4 and 5.

Soil samples will be collected and analyzed for TPH using United States Environmental Protection Agency (EPA) Method 8015 and SVOCs using EPA Method 8270. Groundwater samples will be analyzed for TPH using United States Environmental Protection Agency (EPA) Method 8015, for SVOCs using EPA Method 8270, and for the VOCs benzene, toluene, ethylbenzene, and total xylenes (BTEX) using EPA Method 8021, heterotropic plate counts, and petroleum hydrocarbon degraders. Laboratory analyses of the environmental samples will be conducted in accordance with NYSDEC Analytical Services Protocol-Contract Laboratory Program (ASP-CLP) or U.S. Environmental Protection Agency (EPA) SW-846 methodologies. *Table 6* summarizes the field sampling programs.

The newly collected data will then be compared to previous sampling results and PRGs, and will be used to perform the following:

- Monitor the effectiveness of the CLB process
- Make adjustments/modifications to the CLB process
- Compare concentrations in soil to PRGs

This sampling and analyses plan (SAP) presents the procedures to be followed during the soil and groundwater sampling activities. Specifically, the SAP addresses:

- Technical approach
- Sampling program
- Quality assurance/quality control (QA/QC)

2. TECHNICAL APPROACH

To monitor the progress of the remedial program, soil and groundwater samples will be periodically collected. Soil samples will be collected from new soil borings beginning approximately 60 days after starting the system. Groundwater samples will be collected monthly following system startup. Prior to soil and groundwater sample collection, the CLB equipment will be shut down for 48 hours prior to sample collection. This should be a sufficient amount of time for the subsurface environment to come to equilibrium. After sampling has been completed, the CLB system will be restarted.

2.1. Soil Sampling Program

The soil sampling program will consist of the initial soil sampling performed during the well installation and subsequent soil samples events collected from borings on a bi-monthly basis (i.e., during months 2, 4, 6, 8, 10, and 12). The initial soil sampling event will serve as baseline data for this remedial program. Boring locations and sampling depths will be determined based on analytical results from the well installation program. Four (4) soil borings will be drilled using a hollow-stem auger drill rig during each sampling event. Samples will be collected every 10 feet from 20 to 60 feet below ground surface (bgs).

The soil boring program is designed based on historical soil data as well as the data that will be collected during the well infrastructure installation, combined with data collected in the field during O&M, and real-time results that will be obtained during implementation of this program. Samples will be submitted to an analytical laboratory for analysis of TPH and SVOCs. Selected soil samples may also be analyzed for the listed biological parameters.

2.2. Groundwater Sampling Program

The purpose for the collection and analyses of groundwater samples from monitoring and remediation wells is to screen the groundwater for biological conditions and changes in contaminant concentrations, not for the collection of long term monitoring data. The results of groundwater sampling events will be compared to the previous sampling events and will be the basis for modifications to the CLB operation.

Prior to the startup of the CLB system, an initial round of groundwater samples will be collected from selected wells. The initial groundwater sampling event will serve as baseline data for this remedial program. The progress of remediation system will also be monitored through the monthly collection of depth to groundwater measurements and groundwater samples from existing monitoring wells and selected remediation wells. A total of eight (8) groundwater samples will be collected during each of the monthly sampling events. The groundwater samples will be submitted to an analytical laboratory for analysis of TPH, SVOCs, BTEX, heterotropic plate counts, and petroleum hydrocarbon degraders.

3. SAMPLE PROCEDURES AND EQUIPMENT

The following sections provide the sampling procedures and equipment required to conduct the necessary field activities:

- Mobilization and demobilization
- Subsurface soil sampling
- Groundwater sampling
- Waste characterization and soil sampling
- Decontamination water sampling
- QA/QC samples

3.1. Mobilization and Demobilization

This subtask consists of field personnel orientation, equipment mobilization, and the staking of sampling locations. Each field team member will attend an on-site orientation meeting to become familiar with the history of the site, health and safety requirements, and field investigation procedures.

3.2. Subsurface Soil Sampling

Drilling will be performed with a truck-mounted hollow-stem auger drill rig to perform standard split-spoon sampling. Soil samples will be collected from designated locations in AOC 22. Soil borings, soil sampling and well constructions will be performed using a drill rig in accordance with the standard operation procedures (SOPs) presented in Section 5.

3.3. Groundwater Sampling

Eight groundwater samples per sampling event will be collected using disposable bailers. Groundwater samples will be collected in accordance with the SOPs presented in Section 5.

3.4. Waste Characterization Soil Sampling

An adequate number of composite soil sample of drill cuttings will be collected and submitted for analysis. The sample will be analyzed for TCLP, PCBs, ignitability, corrosively, and reactivity as shown in Table 3.

3.5. Decontamination Water Sampling

Decontamination water will be containerized in 55-gallon drums for on-site storage. One composite sample will be collected from the drums and analyzed for TCL VOCs, TCL SVOCs, and TAL Metals, as shown in Table 3.

3.6. QA/QC Samples

In addition to the environmental samples collected, quality assurance/quality control (QA/QC) samples will also be collected during the operational sampling program. Duplicate samples will be collected to provide an evaluation of the laboratory's performance by comparing analytical results of two samples from the same location. QA/QC procedures will be in accordance with the existing Quality Assurance Plan, *Final Remedial Investigation Quality Assurance Plan*, dated August 1991. The procedures detailed in this document will be more than adequate to ensure proper QA/QC.

Field blanks will be collected to provide an evaluation of field decontamination procedures and laboratory supplied water. Trip blanks will be submitted to the laboratory for TCL VOC analysis during the groundwater sampling. Trip blanks are reagent water samples, generated at the laboratory, and used to determine volatile organic analytes. Trip blanks are carried to the sampling site, through sampling conditions, without being opened, and shipped to the laboratory with other samples. The trip blank results are used to identify VOC artifacts arising from bottle preparation and sample handling activities.

3.6.1. Sample Preservation and Analytical Methods

Representative sampling of environmental matrices for chemical analysis depends on proper collection, preservation, shipping, custody, and preparation techniques. Improper preservation and/or shipping may jeopardize sample integrity and reduce data quality. The following sections provide information on the types and sizes of the sample containers, the preservation requirements, and the analytical methods to be used in this investigation.

3.6.2. Sample Containers and Preservation Requirements

Pre-cleaned sample containers will be provided and certified clean by the laboratory performing the analyses. Trip blanks will be used to evaluate the cleanliness of sample containers and the potential for contamination during transport of the field samples. A summary of container sizes, preservation requirements, and holding times for the Operational sampling program is provided in Table 3.

3.6.3. Analytical Methods

All analyses will be performed using standard USEPA and NYSDEC approved methods. Any modification to the standard methods will be identified and documented and the reason for the modification will be explained. All analyses will meet the requirements of the specific analytical method, including percent recoveries and method detection limit. At a minimum, the laboratory will have to achieve the quantitation limits for organic compounds. The methods to be used to analyze the samples collected are presented in Table 3.

4. QUALITY ASSURANCE/QUALITY CONTROL

Representative samples of environmental matrices for chemical analyses depend on proper collection, preservation, shipping, custody, and preparation techniques. Soil sampling is described in the Sampling Program section of this document, including the rationale, sampling locations, sampling procedures, and equipment. QA/QC procedures will be in accordance with the existing Quality Assurance Plan, *Final Remedial Investigation Quality Assurance Plan* dated August 1991, Halliburton NUS Environmental Corporation. The procedures detailed in this document will be more than adequate to ensure proper QA/QC.

4.1. Field Documentation

Field activities, including all sample handling activities, will be documented in the field logbook and chain of custody forms. All pertinent field activities performed, or observations made, will be recorded in bound field logbooks with sequentially numbered pages using waterproof ink. The documentation in the field logbooks will be sufficient to reconstruct the field activity. Information recorded in the logbook will include all aspects of sample collection, field measurements taken, site personnel, health and safety documentation, and selected aspects of field management. In addition to to the field log book, weekly progress reports summarizing progress for the week will be prepared and sumitted to EFANE NAVFAC.

4.2. Sample Identification

Proper sample documentation is important. All samples will be identified with a sample label before leaving the site. The sample label will be a white label with black lettering and waterproof adhesive backing. A sample label will be attached to each sample container. The label will be completed in waterproof ink using a Sharpie pen or similar marking device. Each sample will be designated by an alpha-numeric code that will identify the site and contain a sequential sample number. The following information will be included on the sample labels:

- Site name

- Field identification or sample station number
- Date and time of collection
- Name/signature of sampler
- General type of analysis to be performed

4.3. Sample Designation

A sample numbering system will be used to identify each sample, provide a tracking procedure to allow retrieval of information about a particular sample, and assure that each sample is uniquely numbered. The sample identification will consist of four components as described below. Duplicate samples will be designated with the next consecutive sample number. Identification that this is a duplicate sample will be made in the field logbook:

- **Site Identification -** The first component consists of a two letter designation which identifies the site. For this remedial action, the designation "BP" will be used as the identification for Bethpage.
- **Sample Type -** The second, which identifies the sample type, will consist of a four-letter/digit code which identifies the sampling location as follows:
  - SB-01 - Subsurface Soil Sample
  - GW-01 - Groundwater Sample
  - CW-01– Waste Classification Sample
- **Sample Location -** The third component identifies the sample interval, or identifies if the sample is a trip blank or field blank. A four digit number will be used to identify each sampling location. TB will be used to identify a trip blank and FB will be used to identify a field blank. An example of sample designation is: BP-SB-10-20, which represents the subsurface soil

sample collected from 20 to 22 feet bgs from Soil Boring 10 at the Bethpage Site AOC 22 facility.

4.4. Quality Assurance Samples

Quality control procedures will be employed to ensure that sampling and transport activities do not bias sample chemical quality. Trip blanks, field blanks, and duplicate samples will provide a quantitative basis for evaluation and validation of the data reported.

4.5. Sample Custody

The objectives of sample custody, identification, and control are:

- All samples scheduled for collection are uniquely identified
- The correct samples are tested and are traceable to their records
- Important sample characteristics are preserved
- Samples are protected from loss or damage
- A record of sample integrity is established

Each sample collected and shipped to an analytical laboratory will be listed on a chain of custody record. The purpose of the chain of custody is to document possession of the samples from collection through analysis. The following information will be supplied to complete the chain of custody record:

- Project name
- Signature of sampler
- Sampling location, date and time of collection

- Signature of individual involved in sample transfer (i.e., relinquishing or accepting samples). Individual receiving samples will sign, date, and note the time that they receive the samples on the form

- Particular analyses requested for each sample

Chain of custody forms will become permanent records of all sampling, handling, and shipping. Following sample collection and documentation, all sample containers will be prepared for shipment to the laboratory.

5. STANDARD OPERATING PROCEDURES

5.1. Standard Operating Procedure No. 1

5.1.1. Mobilization and Demobilization

This remedial activity consists of field personnel orientation, equipment mobilization, infrastructure installation, system operation and maintenance, confirmation sampling, and demobilization. Each field team member will attend an on-site orientation meeting to become familiar with the logistics of the site, health and safety requirements, and remediation and related field procedures.

- Equipment mobilization will entail the ordering, purchase, and if necessary, fabrication of all sampling supplies and equipment needed for any and all field activities. An inventory of available supplies/equipment will be conducted prior to initiating field activities, and all additional equipment required will be secured.

- Infrastructure installation mobilization will consist of staking all well and piping locations, prior to initiation of the work. All onsite subsurface utilities will be located and drilling locations will be potholed. After a location has been cleared, infrastructure installation in that area may begin.

- Equipment and personnel will be demobilized at the completion of each phase of field activities as necessary. Demobilization will also consist of site-area clean-up, staging and inventory of investigation-derived wastes, and organization of investigation records.

5.2. Standard Operating Procedure No. 2

5.2.1. Deep Subsurface Soil Boring Sampling (Split-Spoon)

All borings will be drilled with a Central Mining Equipment Company Model 75 hollow-stem auger drilling rig or equivalent. The auger flights to be used on this rig are 5 feet long, 8.5 inches inside diameter (ID), and 13.25 inches outside diameter (OD). The borehole diameter was approximately 13.5 inches.

Soil samples will be collected using a split-spoon sampler consisting of an outer two-piece sample barrel lined with four 6-inch-long, or six 4-inch-long brass sleeves (1.95 inches OD and 1.9 inches ID), placed end-to-end. When the desired sampling depth is reached, the sampler is lowered through the casing and driven into the undisturbed soil 12 to 18 inches. The sampler is then retrieved and the rings removed.

Soil contained in the lower ring(s) is retained for laboratory analysis. The ends of the lower ring(s) are sealed with Teflon tape and covered with plastic end caps which are secured with duct tape. The ends will be secured immediately following sample retrieval to maintain sample integrity. Soil in the remaining rings will be used for physical examination and lithologic description.

Soil samples will be labeled with sample identification number, name of sampler, date and time of sampling, and analysis required. The samples will then be placed on ice in a cooler for preservation of sample integrity during transportation. Soil sample information will be recorded the field notebook. CHAIN OF CUSTODY documentation will be completed for transport of the samples to the laboratory. Soil sample collection and CHAIN OF CUSTODY documentation procedures followed protocol accepted by federal, state, and local regulatory agencies.

5.3. Standard Operating Procedure No. 3

5.3.1. Water Level Measurement

Depth-to-water level will be measured using an electric water level measuring device or interface probe. The measuring device will be equipped with lighted and audio indicators for detection of water and oil. The depth of the water/oil in the well is then measured by noting the point on the graduated probe cable that corresponds to the measuring point of the well casing at the top when the electronic circuit is first completed. The accuracy of the probe is considered to be ± 0.01 foot.

Water/oil level measurements shall be recorded on the well sampling log. Entries on the form shall include, but are not limited to, the date and time the water/oil level measurements are taken, the individuals accomplishing the task, the well identification number or designation, the elevation of the top of the casing, the serial number or other identification number of the water level measuring device being utilized, and the depth to water level, recorded as the depth from the measuring point at the top of the casing to the water level surface. Entries shall be signed by the person conducting the water level measurements.

5.3.2. Field Procedures

1. Check the meter by turning on the indicator signal switch. The buzzer should sound and, if present, the indicator light should illuminate. If the water level indicator signal(s) is not functioning properly, check the batteries and/or use a different meter.

2. Decontaminate the probe and graduated cable as directed in SOP 6. The cable should be decontaminated only if the bottom of the well will be sounded. The length of cable to be decontaminated is determined by the distance between the water level and the bottom of the casing. This distance can be estimated from the completion log.

3. Holding the device at the top of the casing, lower the cable gradually into the well or piezometer until the indicator contacts the water surface.

4. Note the point on the graduated cable that corresponds to the measuring point at the top of the casing when the electronic circuit is first completed.

5. Record the value on the cable as the depth to water surface (to the nearest 0.01-foot).

6. Draw the cable part of the way up the casing, then lower it again, repeating the third through fifth steps. If these readings differ by more than 0.02 feet, repeat until the measured readings stabilize.

7. Remove the cable from the well.

8. To locate the bottom of the well, lower the cable slowly from the center of the casing. When the probe is felt to hit the bottom, or the cable slacks noticeably, draw the cable up very slowly until it is taut again.

9. Note the cable reading at the measuring point. Record this value as the well depth to the nearest 0.01-foot.

10. Repeat the final three steps to ensure the accuracy of the reading.

*5.3.3. **Maintenance***

Carry spare batteries for the water level measuring device at all times. Check the operation in the field before use by dipping the probe into a beaker of clean water. If the indicator does not function properly when tested, the device shall either be repaired and retested before further use, or shall be returned to the manufacturer for repairs and another measuring device substituted.

Clean the cable between measurements, as appropriate, by rinsing with distilled water and wiping dry with paper towels. In addition, clean the cable any time solids adhere to it.

Measure the cable monthly to determine if use of the instrument has caused the cable to stretch and, thereby, induce errors in measurements. The graduated cable shall be compared against a steel tape and discrepancies, if any, noted in a logbook.

*5.3.4. **Calculations***

The absolute water table elevation is calculated by subtracting the measured depth-to-water from the surveyed measuring point.

5.4. Standard Operating Procedure No. 4

5.4.1. Groundwater Sampling (Field Parameter Measurement)

Where more than one monitoring/remediation well within a specific well field or site is to be sampled, the sampling sequence will begin with the well expected to have the lowest analyte concentration, based on previous analytical results. Successive samples will be obtained from wells of increasing analyte concentration.

If the relative degree of suspected concentrations at the wells to be sampled cannot be reasonably assumed, sampling will proceed from the perimeter of the site toward the center of the site.

Groundwater samples will be collected by sending a new, disposable bailer down the well and filling the bailer and collecting a “grab sample” (due to the dynamic nature of the CLB process, well purging is not necessary). This sampling procedure will be performed until an adequate volume of sample has been obtained to fill all of the required sample bottles and analyze the sample for field parameters.

Field parameters (temperature, pH, specific conductance, and/or dissolved oxygen) will be monitored during sampling of the monitoring wells. Measurements will be conducted in accordance with the manufacturer's instructions and the following procedure:

1. Calibrate the water quality meter as per manufacturer’s instructions.

2. Collect a water sample from the well using a new disposable bailer and place sample in an appropriate container.

3. All water quality measurements will be recorded in the appropriate field logbook.

4. The water quality meters will be decontaminated between wells by rinsing with deionized water (see Decontamination – field instrumentation).

After the field parameters have been collected and recorded in the field book, groundwater samples will be collected in appropriate sample bottles. Sample bottle filling and preservation procedures will be:

- **VOCs -** Fill each container with sample to just overflowing so that no air bubbles are entrapped inside. If effervescence occurs, submit the sample without preservative and note on the chain of custody form.

- **Other Parameters -** Fill each container and preserve immediately as required. To test for pH, pour a minimal portion of sample onto broad range pH paper to verify that the appropriate pH level has been obtained.

5.5. Standard Operating Procedure No. 5

5.5.1. Decontamination (Drilling Equipment)

Prior to the beginning of the drilling program and after each well completion, the drill rigs, tools, and associated drilling and development equipment, will be steam-cleaned with tap water. Well construction materials will be decontaminated prior to installation. Steam cleaning will be conducted within the designated decontamination area. Any decontamination fluids that result from steam cleaning operations will be stored in appropriate Department of Transportation (DOT)-approved 55-gallon drum until disposal.

Drill rods, bits, collars, augers, pipe wrenches, any other tools, and well construction materials will be placed on clean metal sawhorses or other supports and steam-cleaned until all visible sign of grease, oil, mud, or other material is removed. All equipment will be placed on clean plastic sheeting following decontamination. Brushes will be used as necessary to assist in the removal of extraneous materials or soil. New down-hole equipment will be decontaminated before utilization on-site. Drillers will wear new, cotton work gloves while handling cleaned drill rig equipment. The Health and Safety Plan (HASP) will dictate any additional protective measures.

5.6. Standard Operating Procedure No. 6

5.6.1. Decontamination (Field Instrumentation - Probes, Water Quality Meters, etc.)

Field instrumentation (such as interface probes, water quality meters, etc.) will be decontaminated between sample locations by rinsing with deionized water. If visible contamination still exists on the equipment after the rinse, an Alconox detergent scrub will be added, and the probe thoroughly rinsed again. Decontamination of sampling equipment will be kept to a minimum in the field and wherever possible, dedicated disposable sampling equipment will be used. Any decontamination fluids generated will be stored in U.S. DOT-approved 55-gallon drums or in an on-site storage tank (liquids only) until disposal. Personnel directly involved in equipment decontamination will wear appropriate protective clothing, as stated in the SHSP.

Decontamination of non-disposable sampling equipment used to collect samples for chemical analyses (i.e., scoops, trowels, bowls, split-spoons, etc.) will be conducted as described below:

1. Alconox detergent and potable water scrub
2. Potable water rinse
3. Deionized water rinse
4. Air dry
5. Wrap or cover exposed ends of equipment with aluminum foil for transport and handling. Decontamination of sampling equipment will be kept to a minimum in the field and wherever possible, dedicated disposable sampling equipment will be used if applicable.

APPENDIX D

HEALTH AND SAFETY PLAN