LETTER WORK PLAN
PRE-DESIGN FIELD INVESTIGATION
OFF-SITE LOCATION GM-75 (PHASE II)
NAVAL WEAPONS INDUSTRIAL RESERVE PLANT
BETHPAGE, NEW YORK

1.0 INTRODUCTION

This letter work plan has been prepared by Tetra Tech NUS, Inc. (Tetra Tech) for the Naval Facilities Engineering Command Mid-Atlantic under Contract Task Order (CTO) 066 of the Comprehensive Long-Term Environmental Action Navy (CLEAN) contract number N62472-03-D-0057. This Work Plan outlines the approach for the installation of vertical profile borings (VPBs) and outpost monitoring wells, and outpost monitoring well repair. This investigation is being conducted to better define the extent of solvent-contaminated groundwater off site of the Naval Weapons Industrial Reserve Plant (NWIRP) Bethpage, Long Island, New York (Figure 1). Regional groundwater flow is south southeast, but is locally affected by the operation of recharge basins and public water supply wells.

This investigation will specifically address groundwater contamination in three areas as follows:

- South of GM-75 and GM-34 (GM-75 Area);
- North of Aqua New York's water supply wells on Seamans Neck Road (Aqua 9338/8480) (ANY Area); and
- North/northwest of South Farmingdale Water District water supply wells on Langdon Road (SFWD 7377/5148/4043)(SFWD Area)(Figure 2).

Delineation and potential remediation of groundwater in these areas are addressed under the Navy Operable Unit No. 2 Record of Decision.

1.1 SCOPE AND OBJECTIVE

The objectives of the pre-design field investigation are to better define the horizontal and vertical extent of groundwater contamination, evaluate migration, and determine concentrations of volatile organic compounds (VOCs) in groundwater that is south of the Navy/Northrop Grumman complex. This contamination is up-gradient of several potable water supply wells in the area and continues to migrate to the south southeast.

The program will consist of the installation of three vertical profile borings to a depth of approximately 800 feet below ground surface (bgs). During installation of the vertical profile borings, groundwater samples

will be collected on 20- to 50-foot intervals and analyzed for VOCs. Based on the groundwater sample results and screen intervals on existing public water supply wells, two permanent monitoring wells are anticipated to be installed at each vertical profile boring location. This program will also include the repair of an existing outpost monitoring well (BPOW 1-3), development, and installation of a dedicated sampling pump assembly.

1.2 SITE HISTORY

NWIRP Bethpage is located in east-central Nassau County, Long Island, New York, approximately 30 miles east of New York City (Figure 1). NWIRP Bethpage is in the Hamlet of Bethpage, Town of Oyster Bay, New York. Since its inception in 1941, the plant's primary mission was the research prototyping, testing, design engineering, fabrication, and primary assembly of military aircraft. The facilities at NWIRP included four plants used for assembly and prototype testing, a group of quality control laboratories, two warehouse complexes (north and south), a salvage storage area, water recharge basins, the Industrial Wastewater Treatment Plant, and several smaller support buildings.

The Navy's property originally totaled 109.5 acres and was formerly a Government-Owned Contractor-Operated (GOCO) facility that was operated by the Northrop Grumman Corporation (NGC) until September 1998. Prior to 2002, the NWIRP property was bordered on the north, west, and south by current or former Northrop Grumman facilities, and on the east by a residential neighborhood. By March 2008, approximately 100 acres of NWIRP property were transferred to Nassau County in three separate actions. The remaining 9 acres and access easements were retained by the Navy to continue remedial efforts at Installation Restoration (IR) Site 1 – Former Drum Marshalling Area and Site 4 – Former Underground Storage Tanks (Area of Concern [AOC] 22). A parcel of land connecting the two sites was also retained. Currently, the 9-acre parcel of NWIRP is bordered on the east by the residential neighborhood and on the north, south, and west by Nassau County property. Access to the NWIRP is from South Oyster Bay Road to the west.

1.3 VERTICAL PROFILE BORINGS/MONITORING WELLS

Vertical profile borings and monitoring wells will be installed in three areas, as follows:

- GM-75 Area
- ANY Area
- SFWD Area

1.3.1 GM-75 Area

Background: The GM-75 Area was first identified as a potential concern in 2003, when trichloroethene (TCE) at a concentration of 1,400 micrograms per liter (µg/L) was detected in a newly installed monitoring well GM-75D2 (Figure 2). The well is screened from 525 to 545 feet bgs. Since that time, the concentration of TCE in GM-75D2 has steadily decreased and by June 2008 was 180 µg/L. Two public water supply wells at Bethpage Water District (BWD) Plant 6 are located approximately 2,500 feet southeast of the GM-75 Area. The shallower BWD Plant 6 well (Well 6-1 screened from 328 to 381 feet bgs) has been impacted by VOCs, and VOC treatment (air stripping tower) is currently being conducted to protect the water supply.

A monitoring well (GM-35D2), which is screened at a depth of 330 feet bgs, is located between the GM-75 Area and BWD Plant 6 and contains 240 µg/L of TCE. However, this screen interval is too shallow to evaluate potential migration to the deeper BWD Plant 6 well (Well 6-2 screened from 710 to 770 feet). In 2009, a vertical profile boring (VPB-121) was installed near the location of monitoring well GM-35D2 to address this concern. TCE was detected in groundwater samples collected from VPB-121 at a maximum concentration of 14 µg/L at 391 bgs.

Since 2003, concentrations of TCE in groundwater in the area down gradient of the GM-75 Area (GM-34D and –34D2) have been increasing. These monitoring wells are located approximately 2,500 feet south of the GM-75 Area. For well GM-34D, which is screened at a depth of 309 to 319 feet bgs, TCE concentrations have increased from 210 µg/L in 2003 to 740 µg/L in June 2008. For well GM-34D2, which is screened at a depth of 510 to 520 feet bgs, TCE concentrations have also increased from 120 µg/L in 2003 to 250 µg/L in June 2008.

In 2009, VPB-122 was installed to better define the extent of groundwater contamination in the area of the GM-34 monitoring wells. VPB-122 was installed approximately 1,500 feet south of GM-34 wells, TCE was detected in groundwater samples at concentrations up to 215 µg/L at a depth of 411 feet bgs.

Proposed Actions: A vertical profile boring (VPB-129) and two monitoring wells (TT-101D and TT-101D2) will be installed south of the GM-34 monitoring well cluster, in the area of VPB-76 (installed in 2000). Monitoring well TT-101D will be screened at a depth interval similar to monitoring well GM-34D (310 to 325 feet bgs) and monitoring well TT-101D2 will be screened similarly to monitoring well GM-34D2 (480 to 500 feet bgs). Final screen intervals may be modified based on lithology and groundwater data collected from VPB-129.

1.3.2 ANY Area

Background: A public water well field (Aqua 8480 and 9338) is located northwest of the intersection of Seaford Oyster Bay Parkway and Southern State Parkway (Figure 2). Since 2006, TCE has been detected in water supply well samples at low-level detections. Currently, TCE concentrations are in the range of 0.9 to 1.6 µg/L. Outpost monitoring wells (BPOW 3-1 and 3-2) located 1,000 feet north and approximately up-gradient of the water supply wells have not detected these VOCs, indicating that the impacted groundwater may be flowing into the supply well from underneath or beside (east) the outpost monitoring wells. These public water supply wells are in the projected path of the GM-75 Area groundwater contamination; however, effects from that contamination were not anticipated for more than 10 years.

To better determine the magnitude and location of groundwater contamination in this area, three vertical profile borings were installed in 2009. VPB-124 was located approximately 1,400 feet east of the well field, VPB-125 was located approximately 2,000 feet northwest of the well field, and VPB-126 was located approximately 1,800 feet north of the well field. TCE was detected in only one groundwater sample collected from VPB-124 at a concentration of 4 µg/L at 312 feet bgs. VOCs were not detected in groundwater samples collected from VPB-125. TCE was detected in VPB-126 at a maximum concentration of 137 µg/L at a depth of 751 feet bgs.

Proposed Actions: A vertical profile boring (VPB-128) and two outpost monitoring wells (BPOW 3-3 and BPOW 3-4) will be installed in the area of VPB-50. It is anticipated that BPOW 3-3 will be screened at a depth interval similar to the ANY supply well (N-8480 [screen 568 to 654 feet bgs]). BPOW 3-4 is anticipated to be screened in a gravel layer which may be present at approximately 750 to 770 feet bgs. Final screen intervals of the outpost monitoring wells may be modified based on lithology and groundwater data collected from VPB-128.

1.3.3 SFWD Area

Background: Although no contamination has been detected in a SFWD public water well field (N-4093, -5148, and -7377) located northeast of the intersection of Langdon Road and Merritts Road (Figure 2), VOCs have been detected in Outpost Monitoring Wells BPOW 1-1 and 1-3 located to the west of the well field. Based on computer modeling results, groundwater from the area of the Outpost Monitoring Wells could be intercepted by the well field. Currently, groundwater directly upgradient of the well field is not being monitored.

Proposed Actions: A vertical profile boring (VPB-127) and two outpost monitoring wells (BPOW 1-4 and BPOW 1-5) will be installed north of the SFWD well field in the area of VPB-43. It is anticipated that

BPOW 1-4 will be screened at a depth interval similar to BPOW 1-3 (screen 375 to 420 feet bgs) and BPOW 1-5 screened at a depth interval similar to South Farmingdale well SFWD-7377 (610 to 760 feet bgs). Final screen intervals of the outpost monitoring wells may be modified based on lithology and groundwater data collected from VPB-127.

1.4 MONITORING WELL REPAIR AND WELL PUMP INSTALLATION

Groundwater samples collected from outpost monitoring wells BPOW 1-1 (screened 200 to 235 feet bgs) and 1-3 (screened 375 to 400 feet bgs) contained total VOCs of 3 and 10 µg/L, respectively; however VOCs were not detected in groundwater samples collected from outpost monitoring well BPOW 1-2 (screened 310 to 340 feet bgs) that is screened between the BPOW 1-1 and 1-3 screen intervals. Based on a review of groundwater results and evaluation of the condition of BPOW 1-3, it has been determined that the well casing may be cracked and has allowed shallower contaminated groundwater to be detected in BPOW 1-3. Therefore, this well should be sealed and a 2-inch monitoring well will be constructed inside of the existing 4-inch casing.

In 2007, dedicated sampling pump and packer assemblies in outpost monitoring wells BPOW 2-1 and BPOW 2-2 were removed to evaluate benzene detections in the monitoring wells. This evaluation concluded that the well casing for BPOW 2-1 was cracked. In 2009, the cracked casing in BPOW 2-1 was sealed and a 2-inch monitoring well was constructed within the 4-inch casing.

A new 2-inch pump assembly will be installed in BPOW 1-3 and BPOW 2-1 and the existing 4-inch pump and packer assembly will be re-installed in BPOW 2-2.

2.0 FIELD ACTIVITIES

The scope of work consists of the drilling, sampling, and soil/groundwater analysis of three vertical profile borings, installation and development of six outpost monitoring wells, rehabilitation of one existing outpost monitoring well, and development of three existing outpost monitoring wells. The specific activities to be conducted are as follows:

2.1 VERTICAL PROFILE BORINGS

The three planned vertical profile boring locations are presented on Figure 2. Vertical profile borings will be installed to the top of the Raritan Clay layer (approximately 800 feet bgs). Field activities are presented in Table 1. Cross sections depicting these locations are presented in Figures 3 through 5. Sample nomenclature and analysis are presented in Table 2. Groundwater grab samples will be collected from a hydropuch-type sampler at the following depth intervals:

- 50-Foot intervals from 50 to 200 feet bgs, (four samples per boring).
- 20-Foot intervals from 200 to 800 feet bgs, (30 samples per boring).

Two to five split spoon samples will be collected per vertical profile boring to confirm lithology. Up to two soil samples per boring will be submitted to a laboratory for Total Organic Carbon (TOC) analysis. These samples will represent a range of subsurface conditions, based on the progress of the drilling. The following provides the analytical program requirements for the vertical profile borings:

- Groundwater samples will be analyzed by a local laboratory (48 hour turnaround time [TAT]) that is New York State approved for VOC analysis. Trip blanks will also be collected and submitted on a daily basis for VOC analysis.
- Ten percent of the groundwater samples will be submitted to a Navy-approved laboratory for VOC analysis to confirm the quick-turn laboratory results (48 hour TAT).

During the collection of groundwater samples, typical field parameters will be measured (pH, temperature, specific conductivity, and turbidity) as volume permits. Gamma ray logging will be performed to determine lithology. A final split spoon sample may be collected at approximately 800 feet bgs to determine the presence of the Raritan Clay Unit. During drilling activities one air sample per boring will be collected and analyzed for VOCs to evaluate potential emissions.

2.2 MONITORING WELL INSTALLATION

Six outpost monitoring wells will be installed during this investigation (Figure 2). Cross sections illustrating the anticipated screen intervals of these wells are presented in Figures 3 through 5.

The monitoring wells will be installed using mud rotary. Table 3 provides a summary of the proposed wells and screen intervals. Final screen intervals will be determined from lithology and groundwater data collected from the vertical profile borings. A typical well construction detail is provided in Attachment 1.

The outpost monitoring wells will be constructed of 4-inch diameter, schedule 80 National Sanitation Foundation (NSF)-grade Polyvinyl Chloride (PVC) well casing and screen. Well screens will be 10 slot (0.010 inches). After setting the well screen and casing, the gravel pack (W.G. No. 1) will be placed within the boring annulus, to a depth as indicated in Table 3. The well gravel pack will be placed as follows:

- Well total depth (TD) 50 to 365 feet bgs: to a minimum of 10 feet above top of screen.
- Well TD 365 to 530 feet bgs: to a minimum of 20 feet above top of screen.
- Well TD 530 to 780 feet bgs: to a minimum of 25 feet above top of screen.

A fine sand layer (finer than gravel pack) will be placed in the annulus on top of the gravel pack in the same manner as the gravel pack, as follows:

- Well TD 50 to 365 feet bgs: 5 feet thick above the top of the gravel pack.
- Well TD 365 to 530 feet bgs: 10 feet thick above the top of the gravel pack.
- Well TD 530 to 780 feet bgs: 15 feet thick above the top of the gravel pack.

The gravel pack and fine sand thickness may be changed based on subsurface conditions. A 4- to 8- foot thick bentonite seal will be installed above the fine sand layer. A bentonite/cement grout will be installed within the annular space above the bentonite seal. Wells will be completed at grade using a 12-inch diameter, locking curb box in place over the wells. A fine sand will be installed above the top of the box to drain. A 0.5 foot thick concrete apron measuring 2 feet by 2 feet square will be installed around each well. Well locks will be used to secure the wells.

2.3 MONITORING WELL REPAIR

The casing on outpost monitoring well BPOW 1-3 will be sealed and a 2-inch new monitoring well installed inside of it. The well construction log for BPOW 1-3 (existing) is included as Attachment 2. Requirements for installation are as follows.

- Remove the existing pump and packer system.
- Determine the presence of significant sediment (greater than 2 feet) within the existing well. If necessary, remove the sediment.
- Install a 425-foot (45 feet of screen and 375 feet riser) 2-inch schedule 80 PVC well.
- Install a No. 1 Silica Sand filter pack to a height of 20 feet above the top of the screen.
- Install 10 feet of No. 0 silica sand seal above the filter pack.
- Install approximately 4- to 8-foot bentonite seal above No. 0 silica sand. Allow to set up a minimum of 24-hours.
- Install bentonite/cement grout via tremie pipe method above the bentonite seal to ground surface.

2.4 Monitoring Well Development

Monitoring wells will be developed using a combination of air lift and mechanical surging. Field parameters, including pH, temperature, specific conductivity, and turbidity will be monitored and recorded throughout well development.

Well development will also include purging stagnant water from the well above the screen interval and rinsing the interior well casing above the water table using only water from that well. The well will be covered with a clean well cap.

In compliance with New York State Department of Environmental Conservation (NYSDEC) policy, wells will be developed until turbidity is less than 50 nephelometric turbidity units (NTU). However, in some instances, the 50 NTU standard may not be attainable. If after a "best well development effort", the 50 NTU standard cannot be attained and turbidity stabilizes (above the 50 NTU standard), the well will be considered acceptable.

2.5 SAMPLING PUMP INSTALLATION

A dedicated sampling pump system will be installed in nine monitoring wells (six newly installed, two repaired, and one existing well). These pumps will be 2- or 4-inch variable speed submersibles. The pumps will be installed to the depth of the screen interval.

2.6 INVESTIGATION DERIVED WASTE

Investigation Derived Waste (IDW) accumulated during drilling activities will be collected, containerized, accumulated at NWIRP Bethpage, and disposed off site.

2.7 DECONTAMINATION

A centrally located decontamination pad will be constructed at NWIRP Bethpage and be used for the collection of all decontamination-generated fluids. All decontamination fluids will be collected and staged for characterization and subsequent disposal.

2.8 SURVEYING

The location of each vertical profile boring and all newly installed and repaired monitoring wells will be surveyed by a New York State licensed surveyor.

2.9 DOCUMENTATION

A summary report will be developed to provide documentation of this investigation. Documentation required to support this project will consist of the following items:

- Field notebook
- Boring log for each boring
- Groundwater, soil, and air sample log sheets
- Well completion form for each well
- Well development record

TABLES

TABLE 1
VERTICAL PROFILE BORING SAMPLING PROGRAM
PRE-DESIGN FIELD INVESTIGATION ANALYSIS
OFF_SITE LOCATION GM-75 (2010)
NWIRP BETHPAGE, NEW YORK

Boring Number	Drilling Method	Total Depth (feet)[1]	Depth (feet)	Split Spoon Sampling	Groundwater Sampling	Gamma Log	Air Sample[2]
VPB-127	MR	800	50 to 200	0 to 1	50, 100, 150, and 200 feet (4 samples)	Yes	Yes
			220 to 600	1 to 2	20-foot intervals (20 samples)		
			620 to 780	1 to 2	20-foot intervals (9 samples)		
			800 to 840	Up to 5, at 10-foot intervals	Up to 3, at 20-foot intervals, if sand is encountered.		
VPB-128	MR	800	50 to 200	0 to 1	50, 100, 150, and 200 feet (4 samples)	Yes	Yes
			220 to 600	1 to 2	20-foot intervals (20 samples)		
			620 to 780	1 to 2	20-foot intervals (9 samples)		
			800 to 840	Up to 5, at 10-foot intervals	Up to 3, at 20-foot intervals, if sand is encountered.		
VPB-129	MR	800	50 to 200	0 to 1	50, 100, 150, and 200 feet (4 samples)	Yes	Yes
			220 to 600	1 to 2	20-foot intervals (20 samples)		
			620 to 780	1 to 2	20-foot intervals (9 samples)		
			800 to 840	Up to 5, at 10-foot intervals	Up to 3, at 20-foot intervals, if sand is encountered.		

1. Total depth will be to the top of the Raritan Clay Unit, at a depth of approximately 800 feet below ground surface.
2. Work area summa canister (6 to 8 hours).

VBP: Vertical profile boring.
MR: Mud rotary.

TABLE 2
VERTICAL PROFILE BORING ANALYTICAL SUMMARY
PRE-DESIGN FIELD INVESTIGATION ANALYSIS
OFF_SITE LOCATION GM-75 (2010)
NWIRP BETHPAGE, NEW YORK

Location	Sample ID	Matrix	Number of Samples			
			VOCs - Quick Turn[1]	VOCs - Confirmation[2]	TOC[3]	VOCs - TO 15A[4]
VPB-127	BP-VPB127-SB-XXX	Soil	--	--	0 to 2	--
	BP-VPB127-GW-XXX	Groundwater	33 to 36	4	--	--
	BP-VPB127-AIR- MMDDYY	Air	--	--	--	1
VPB-128	BP-VPB128-SB-XXX	Soil	--	--	0 to 2	--
	BP-VPB128-GW-XXX	Groundwater	33 to 36	4	--	--
	BP-VPB128-AIR- MMDDYY	Air	--	--	--	1
VPB-129	BP-VPB129-SB-XXX	Soil	--	--	0 to 2	--
	BP-VPB129-GW-XXX	Groundwater	33 to 36	4	--	--
	BP-VPB129-AIR- MMDDYY	Air	--	--	--	1

VOCs: Volatile organic compounds.
TOC: Total Organic Carbon.
XXX: Bottom of sample interval, in feet. For example, a groundwater sample collected in VPB 127 at 100 to 102 feet below ground surface would be BP-VPB127-GW-102.
MMDDYY: Sample date in month, day, and year. For example, June 29, 2010 would be 062910.

1) 48-Hour results from local laboratory via method EPA 524.2 or equivalent method.
2) 21-Day results from Navy-approved laboratory via method SW-846 8260B.
3) 21-Day results from Navy-approved laboratory via Walkley-Black Method.
4) 21-Day results from Navy-approved laboratory via method TO-15A.

TABLE 3
OUTPOST MONITORING WELL
PROPOSED WELL CONSTRUCTION DETAILS
PRE-DESIGN FIELD INVESTIGATION
OFF-SITE LOCATION GM-75 (2010)
NWIRP BETHPAGE, NEW YORK

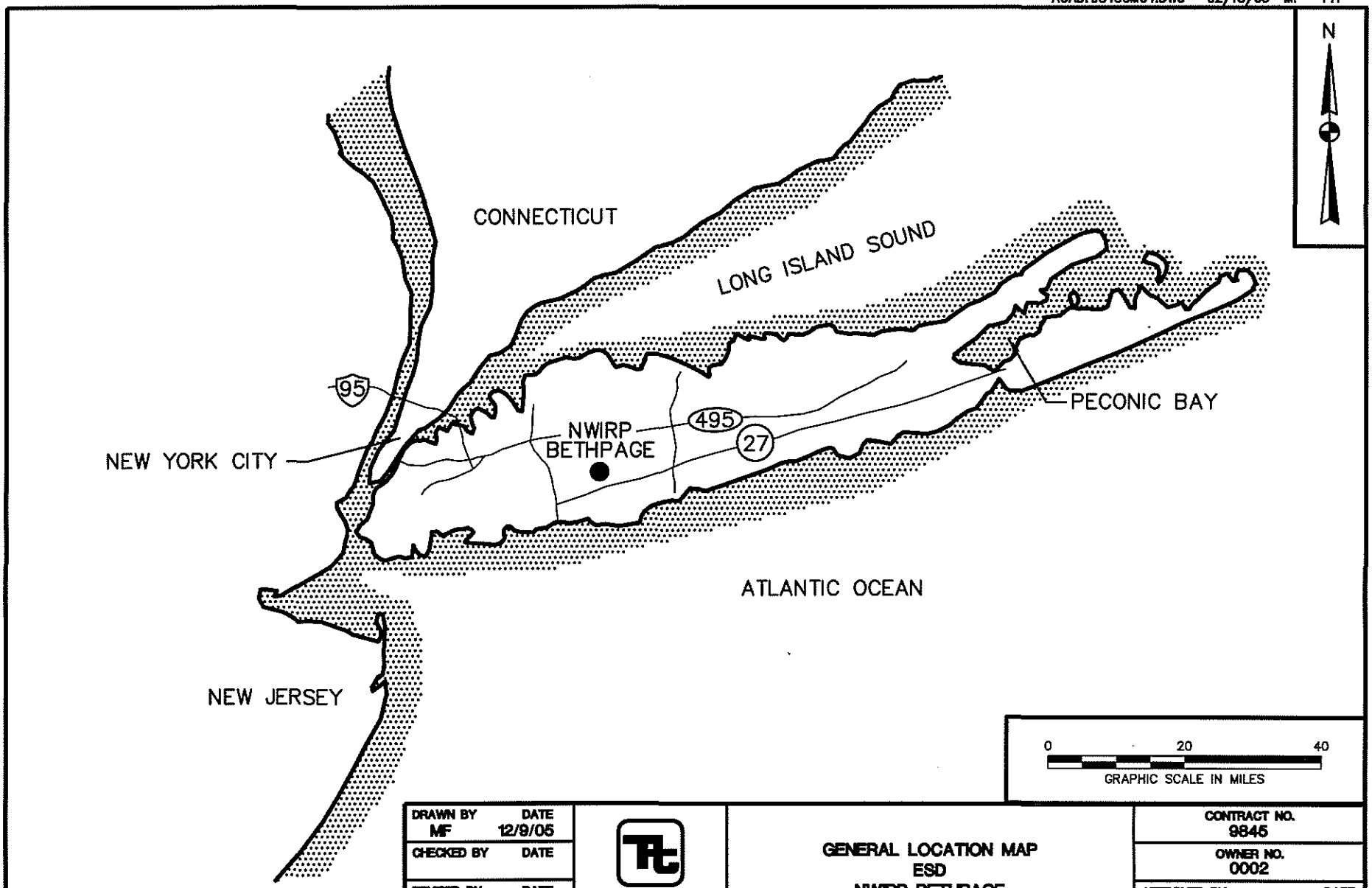
Outpost Monitoring Well Designation	VPB Associate with Well Cluster	Screend Interval (ft bgs) [1]	Total Well Depth (ft bgs) [1]	Height Gravel Pack (ft bgs) [2]	Height Fine Sand (ft bgs) [2]	Purpose
BPOW 1-4	VPB 127	375 to 420	420	355	345	Monitor groundwater upgradient of South Farmingdale Water District Supply Wells N-4043 and N-5148
BPOW 1-5		610 to 760	760	585	570	Monitor groundwater upgradient of South Farmingdale Water District Supply Well N-7377
BPOW 3-3	VPB 128	568 to 654	654	543	528	Monitor groundwater upgradient of Aqua New York Supply Well ANY-8480
BPOW 3-4		750 to 770	770	725	710	Monitor groundwater in a gravel zone if encountered during installation of VPB 128. Top of gravel zone anticipated at approximately 690 ft bgs.
TT 101D	VPB 129	310 to 325	325	300	295	Monitor concentration of VOCs downgradient from monitoring well GM-34D.
TT 101D2		510 to 525	525	490	480	Monitor concentration of VOCs downgradient from monitoring well GM-34D2.

VPB - vertical profile boring
bgs - below ground surface
ft - feet

[1] Based on the local USGS quad sheet, ground surface is assumed to range from 60 to 74 feet above mean sea level. Depth presented are approximate, final depths will be determined based on lithologhy and groundwater data collected from vertical profile borings.
[2] Height of gravel pack and fine sand layer will be determined by total well depth. Details are provided in Section 2.2 of the work plan.

FIGURES

ACAD: 9845CM04.DWG 02/15/06 MF PIT



DRAWN BY MF DATE 12/9/05	Tetra Tech NUS, Inc.	GENERAL LOCATION MAP ESD NWIRP BETHPAGE BETHPAGE, NEW YORK	CONTRACT NO. 9845
CHECKED BY DATE			OWNER NO. 0002
REVISED BY DATE			APPROVED BY DATE
SCALE AS NOTED			DRAWING NO. FIGURE 1 / REV. 0

FORM CADD NO. TTNUS-AH.DWG - REV 1 -9/10/98

112G00662\0510\112G00662GM01-2.dwg 03/16/10 MKB

N

HWD (10208)
HWD (8779)
BWD (8768)
BWD (8767)
BWD (9591)
Dry_Well_20-08
HN-24I
HN-24S
Dry_Well_34-07
FW-03
FW-01
TTNUSMW29IR
HN-29I
HN-29D
HN-42S
HN-42I
VPB-106
VPB-107
VPB-105
VPB-108
VPB-102
GM-13D
GM-16I
GM-16SR
HN-40I
HN-40S
VPB-100
VPB-115
N-10597
MW-1GF
GM-32S
GM-17SR
GM-17I
GM-17D
GP-3 Well 3
GP-1 Well 1
VPB-109R
VPB-101
VPB-109
MW-4
GM-19I
GM-19S
MW-5
MW-6
GM-15S
GM-15I
GM-15D
GM-15D2
MW-2
VPB-110R
MW-3
VPB-110
VPB-113
MW-2GF
GM-18S
GM-18I
GM-18D
GM-39D(A)
GM-39D(B)
GM-73D
GM-73D2
GM-33D2
N-10631
MW-3R
Well 17
Well 18
GM-74I
Well 19
GM-74D
GM-74D2
VPB-111
N-10600
GM-78S
GM-78I
GM-20I
GM-20D
GM-21S
GM-21I
GM-21D
N-10633
GM-79S (N-10628)
GM-79D
N-10628
GM-79I
VPB-103
VPB-49C
VPB-114
GM-37D
GM-37D2
N-9921
GM-75D2
N-10624
N-10627
N-10634
GM-70D2
GM-71D2
VPB-104
VPB-121
GM-35D2
VPB-42
GM-36D2
GM-36D
VPB-112
BWD_4 (6915)
BWD_4 (6916)
VPB-51
N-10821
VPB-116
GM-38D2
GM-38D
VPB-123
GM-34D
GM-34D2
BWD_6 (8491)
BWD_6 (3876)
VPB-48
VPB-38
VPB-47
BWD_5 (8004)
VPB-40
TOH_(LWD) (7076)
VPB-122
VPB-77
VPB-78
VPB-129
TT-101S
TT-101DS
VPB-127
BPOW 1-4
BPOW 1-5
VPB-43
SFWD (7377)
BPOW 1-2
BPOW 1-1
BPOW 1-3
SFWD (4043)
SFWD (5148)
VPB-45
VPB-46
BPOW 4-2
BPOW 4-1
VPB-44
TOH_(LWD) (5303)
VPB-50
VPB-128
BPOW 3-3
BPOW 3-4
BPOW2-2_(D2)
BPOW2-1_(D)
SFWD_3 (6150)
VPB-126
BPOW 3-2
BPOW 3-1
VPB-125
AQUA (9338)
AQUA (8480)
VPB-124
SFWD_6
A
A'
B
B'
C
C'

0 1,800 3,600
SCALE IN FEET

TETRA TECH NUS, INC.

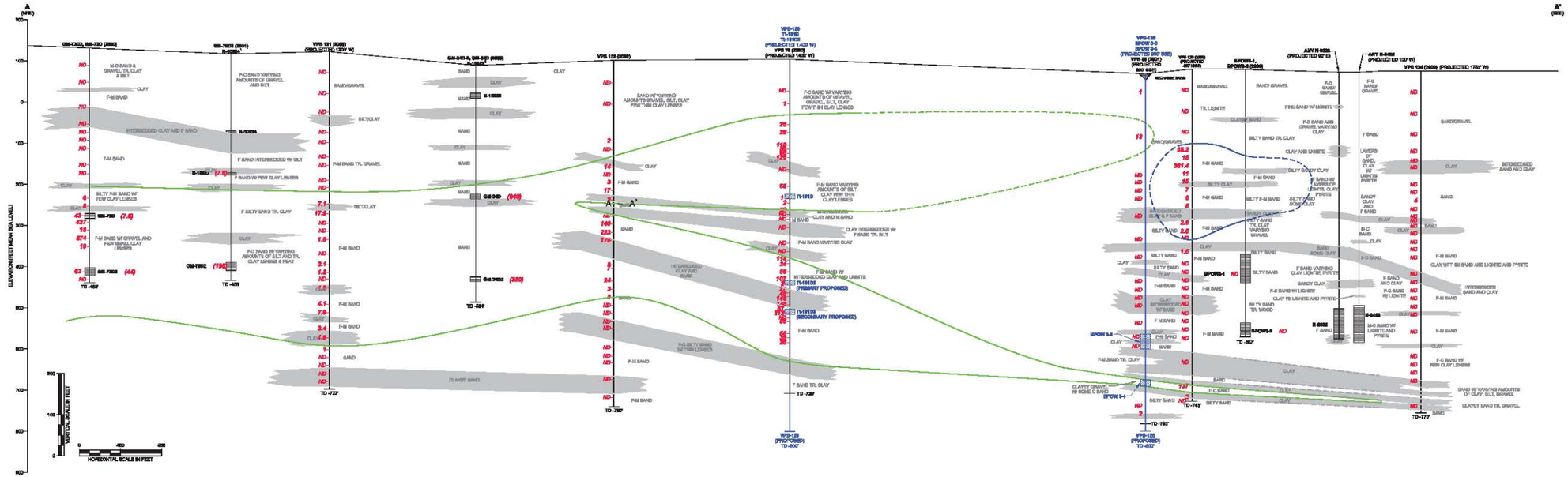
LEGEND

- GROUNDWATER SAMPLING LOCATION
- VERTICAL PROFILE BORING
- WATER SUPPLY WELL
- PROPOSED VERTICAL PROFILE BORING AND OUTPOST MONITORING WELL LOCATION
- BUILDING
- HIGHWAY
- MAJOR LOCAL ROAD
- MINOR LOCAL ROAD
- 1997 NORTHROP-GRUMMAN BETHPAGE BOUNDARY
- 1997 NWIRP BETHPAGE BOUNDARY

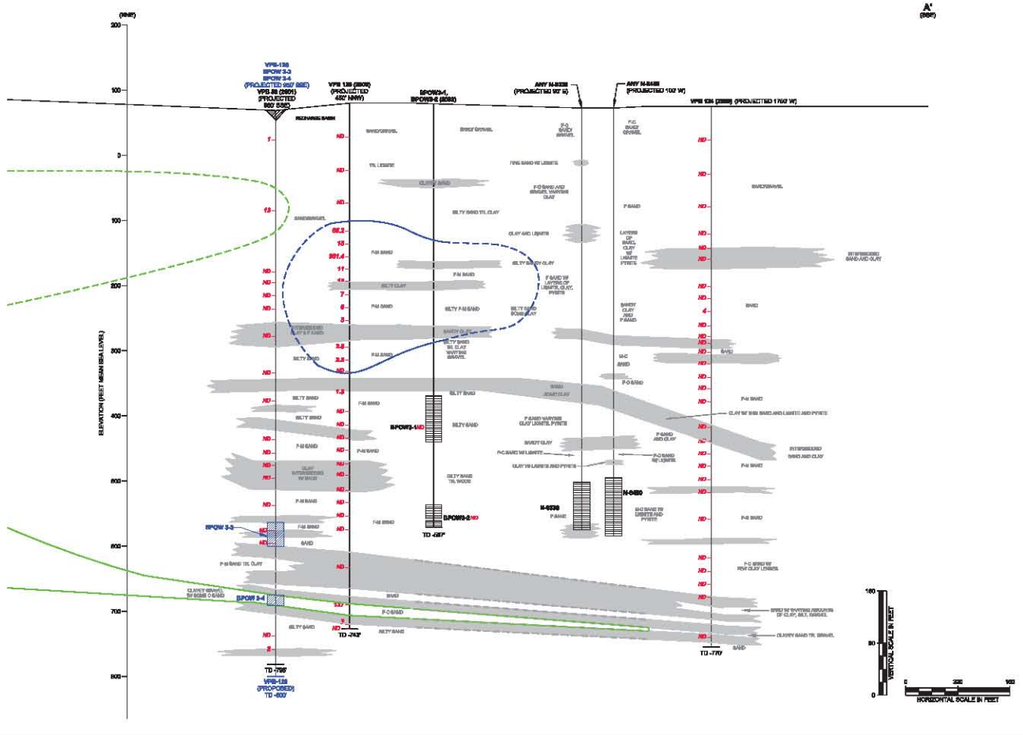
OPERABLE UNIT 2 (SITE 1)
2010 PROPOSED VERTICAL PROFILE BORING AND OUTPOST MONITORING WELLS
NAVAL WEAPONS INDUSTRIAL RESERVE PLANT
BETHPAGE, NEW YORK

FILE	SCALE
112G00662GM01-2	AS NOTED
FIGURE NUMBER: FIGURE 2	REV: 0 / DATE: 03/16/10

A – A'



VPB 50 TO VPB 124 DETAIL



LEGEND

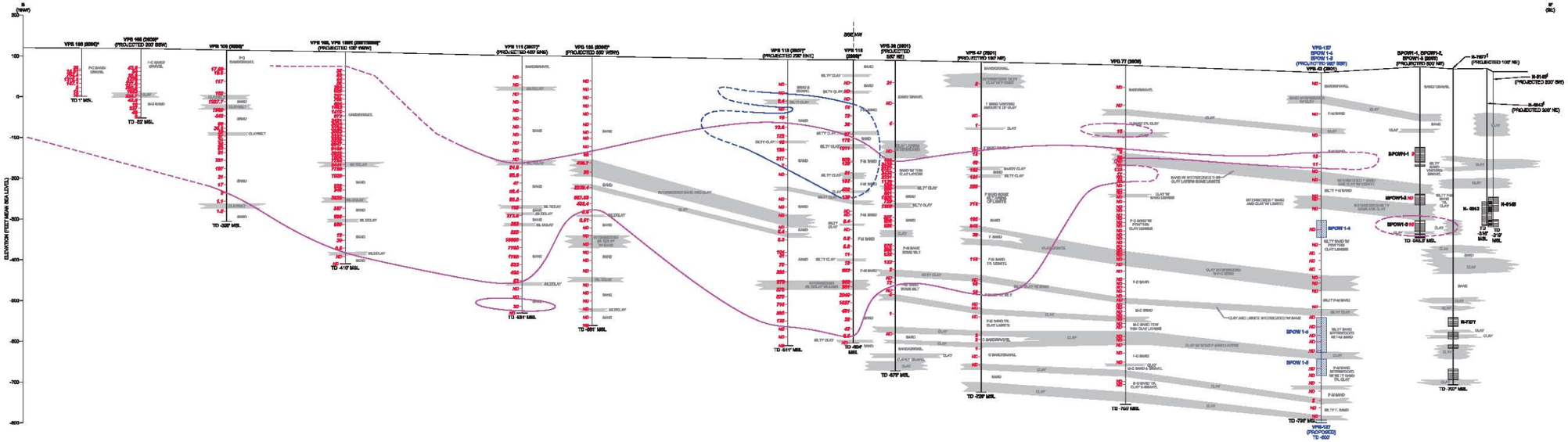
- MONITORING WELL VERTICAL PROFILE BORING (INSTALLATION YEAR)
- GROUND SURFACE
- RECHARGE BASIN
- LITHOLOGY
- CONFINING UNIT
- VERTICAL PROFILE BORING TVOC RESULTS IN ug/L
- ND = NOT DETECTED
- TCE PLUME (5 ug/L CONTOUR LINE)
- PCE PLUME (5 ug/L CONTOUR LINE)
- MONITORING WELL SCREEN (TOTAL VOC DATA FROM 2009 SAMPLING EVENT IN ug/L)
- TD -###' = TOTAL DEPTH FEET (MEAN SEA LEVEL)
- TVOC DATA FROM ARCADIS
- VPB-### = PROPOSED VERTICAL PROFILE BORING
- TI-##(I) = PROPOSED OUTPOST MONITORING WELL
- TI-1P##(S) = PROPOSED MONITORING WELL SCREEN
- TD -###' = PROPOSED MONITORING WELL SCREEN

NOTE:
FINAL MONITORING WELL SCREEN INTERVALS WILL BE DETERMINED FROM LITHOLOGY AND ANALYTICAL DATA COLLECTED FROM VERTICAL PROFILE BORINGS.

TETRA TECH NUS, INC.

GEOLOGIC CROSS-SECTION
A – A' AND VPB 50 TO VPB 124 DETAIL
NAVAL WEAPONS INDUSTRIAL RESERVE PLANT
BETHPAGE, NEW YORK

FILE	SCALE
112G06622GX03.DWG	AS NOTED
FIGURE NUMBER: FIGURE 3	REV: 0 DATE: 03/16/10



LEGEND

SB-7308 (2000)	MONITORING WELL VERTICAL PROFILE BORING (INSTALLATION YEAR)
	GROUND SURFACE
SAND	LITHOLOGY
SILT	CONFINING UNIT
574	VERTICAL PROFILE BORING TVOC RESULTS IN ug/L
ND	NOT DETECTED
	MIXED VOC PLUME (5 ug/L CONTOUR LINE)
	PCE PLUME (5 ug/L CONTOUR LINE)
GM-730 (74)	MONITORING WELL SCREEN (TOTAL VOC DATA FROM 2009 SAMPLING EVENT IN ug/L)
TD -68'	TOTAL DEPTH FEET (MEAN SEA LEVEL)
*	ARCADIS CROSS-SECTION (2004)
+	TVOC DATA FROM ARCADIS
VPS-128	PROPOSED VERTICAL PROFILE BORING
BPOW 1-4	PROPOSED OUTPOST MONITORING WELL
BPOW 1-6	PROPOSED MONITORING WELL SCREEN
TD -600'	PROPOSED MONITORING WELL SCREEN

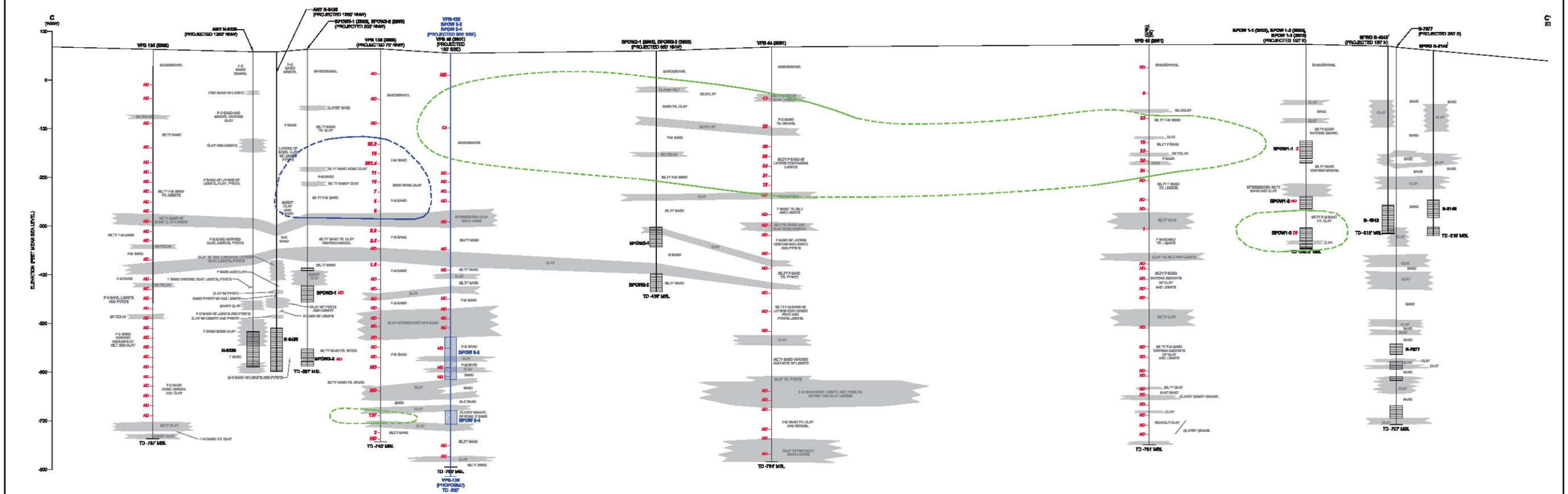
VERTICAL SCALE IN FEET: 250, 150, 0

HORIZONTAL SCALE IN FEET: 0, 400, 800

TETRA TECH NUS, INC.

GEOLOGIC CROSS-SECTIONS
B – B'
NAVAL WEAPONS INDUSTRIAL
RESERVE PLANT
BETHPAGE, NEW YORK

FILE	SCALE
112000522GX02.DWG	AS NOTED
FIGURE NUMBER: FIGURE 4	REV: 0 DATE: 03/16/10



LEGEND

- MONITORING WELL VERTICAL PROFILE BORING (INSTALLATION YEAR)
- GROUND SURFACE
- LITHOLOGY
- CONFINING UNIT
- VERTICAL PROFILE BORING TVOC RESULTS IN ug/L
- NOT DETECTED
- TCE PLUME (5 ug/L CONTOUR LINE)
- PCE PLUME (5 ug/L CONTOUR LINE)
- MONITORING WELL SCREEN (TOTAL VOC DATA FROM 2006 SAMPLING EVENT IN ug/L)
- TOTAL DEPTH FEET (MEAN SEA LEVEL)
- ARCADIS CROSS SECTION (2004)
- ARCADIS CROSS SECTION (2004)
- PROPOSED VERTICAL PROFILE BORING
- PROPOSED OUTPOST MONITORING WELL
- PROPOSED MONITORING WELL SCREEN
- PROPOSED MONITORING WELL SCREEN

TETRA TECH NUS, INC.

GEOLOGIC CROSS-SECTIONS
C – C'
NAVAL WEAPONS INDUSTRIAL
RESERVE PLANT
BETHPAGE, NEW YORK

FILE	SCALE
112G00822GX04.DWG	AS NOTED
FIGURE NUMBER	REV / DATE
FIGURE 5	0 / 03/15/10

ATTACHMENT 1
TYPICAL MONITORING WELL
CONSTRUCTION DETAIL

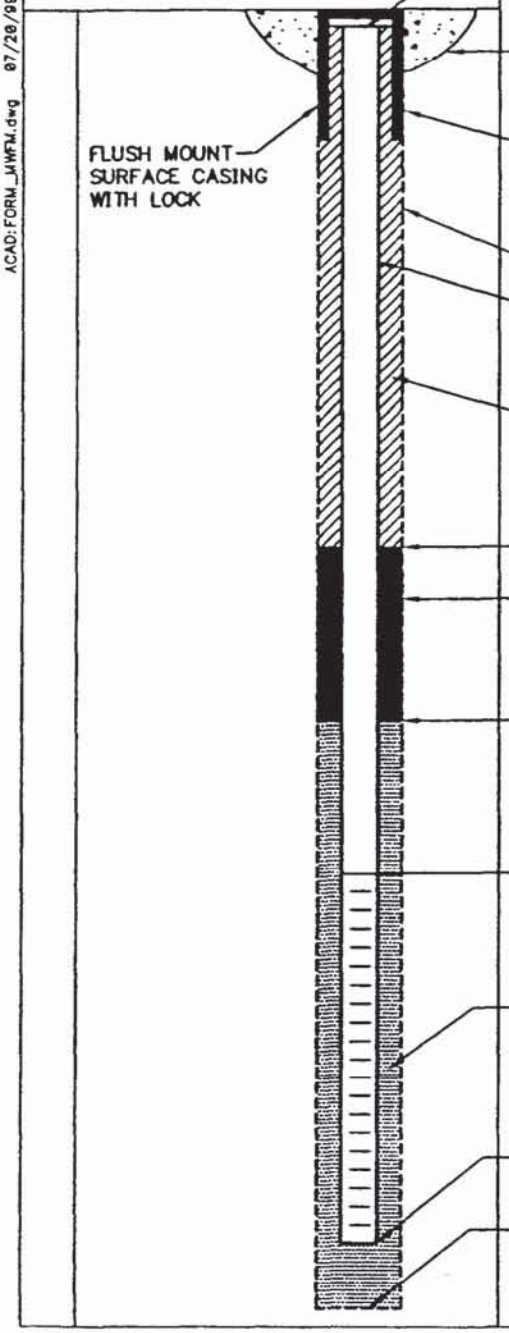
FIGURE 4
TYPICAL MONITORING WELL CONSTRUCTION

WELL NO.: _____

Tetra Tech NUS, Inc.

OVERBURDEN
MONITORING WELL SHEET
FLUSH - MOUNT

PROJECT NWIRP Bethpage	LOCATION	DRILLER
PROJECT NO. N4037	BORING	DRILLING METHOD Mud Rotary
DATE BEGUN	DATE COMPLETED	DEVELOPMENT METHOD Air Lift / Pump
FIELD GEOLOGIST		
GROUND ELEVATION	DATUM	



ELEVATION TOP OF RISER: _____

TYPE OF SURFACE SEAL: 2'x2' Cement Pad

TYPE OF PROTECTIVE CASING: Steel

I.D. OF PROTECTIVE CASING: 12"

DIAMETER OF HOLE: 8"

TYPE OF RISER PIPE: PVC-Sch. 80

RISER PIPE I.D.: 3.8

TYPE OF BACKFILL/SEAL: Bent / Cement to 100' below ground surface

ELEVATION/DEPTH TOP OF SEAL: /

TYPE OF SEAL: Bentonite

ELEVATION/DEPTH TOP OF SAND: /

5' to 15' Fine Sand (WG00)
10' to 25' Coarse Sand (WG#1) above Screen

ELEVATION/DEPTH TOP OF SCREEN: /

TYPE OF SCREEN: PVC-Sched. 80

SLOT SIZE x LENGTH: No 10 Slot, ~40'

TYPE OF SAND PACK: WG #1 Silica Sand

ELEVATION / DEPTH BOTTOM OF SCREEN: /

ELEVATION / DEPTH BOTTOM OF SAND: /

ELEVATION/DEPTH BOTTOM OF HOLE: /

BACKFILL MATERIAL BELOW SAND: _____

ACAD:FORM_MWFM.dwg 07/20/99 INL

ATTACHMENT 2

OUTPOST MONITORING WELL BPOW 1-3

WELL CONSTRUCTION DETAIL

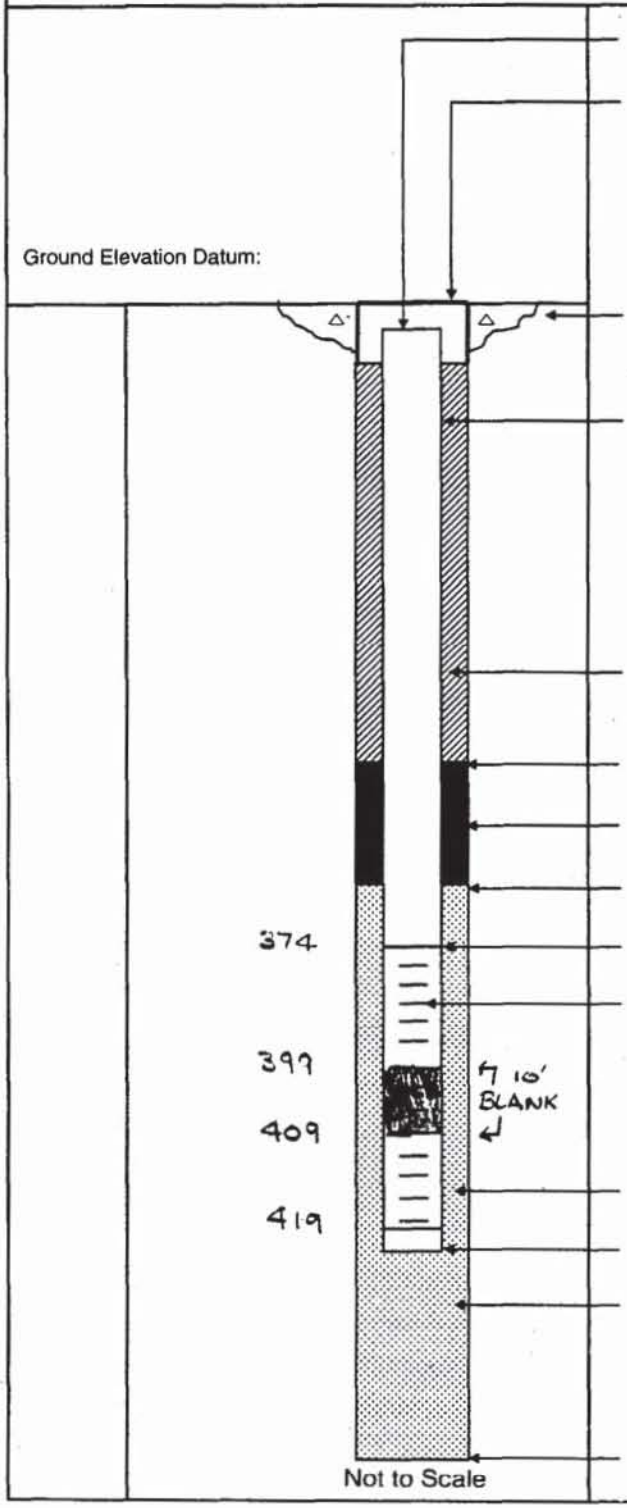
Tetra Tech NUS, Inc.

WELL No.: BPOW1-3

MONITORING WELL SHEET

PERMIT No:

PROJECT:	NWIRP	DRILLING Co.:	UTD	BORING No.:	BPOW1-3
PROJECT No.:	N4037	DRILLER:	BLEMINGS	DATE COMPLETED:	10/29/03
SITE:	BETHPAGE	DRILLING METHOD:	MUD ROT	NORTHING:	
GEOLOGIST:	CONTI	DEV. METHOD:	AIR LIFT/PUMP	EASTING:	



Elevation / Depth of Top of Riser:		/
Elevation / Height of Top of Surface Casing:		/
I.D. of Surface Casing:	12" ϕ	
Type of Surface Casing:	STEEL	
Type of Surface Seal:	CONCRETE PAD 3'x3'x6"	
I.D. of Riser:	3 13/16"	
Type of Riser:	SCH 80 PVC	
Borehole Diameter:	8"	
Type of Backfill:	VOLCLAY GROUT	
Elevation / Depth of ~~Seal~~:	F. SAND	/ 359
Type of Seal:	NA	
Elevation / Depth of Top of Filter Pack:		/ 364
Elevation / Depth of Top of Screen:		/ 374
Type of Screen:	PVC SCH 80	
Slot Size x Length:	10 SL	
I.D. of Screen:	3 13/16"	
Type of Filter Pack:	#1 SILICA SAND	
Elevation / Depth of Bottom of Screen:		/ 419
Elevation / Depth of Bottom of Filter Pack:		/ 420
Type of Backfill Below Well:	SAND	
Elevation / Total Depth of Borehole:		/ 430

REV. 2/12/04