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FINAL WORK PLAN FOR WELL INSTALLATION AND GROUNDWATER SAMPLING OPERABLE UNIT 2 (OU 2) NTC ORLANDO FL

2/8/2002

TETRA TECH

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Rev. 1
02/08/02

WORK PLAN FOR WELL INSTALLATION AND GROUNDWATER SAMPLING

OPERABLE UNIT 2

Naval Training Center
Orlando, Florida

Southern Division
Naval Facilities Engineering Command
Contract Number N62467-94-D-0888
Contract Task Order 0024

FEBRUARY 2002

TETRA TECH NUS, INC.
800 Oak Ridge Turnpike, A-600 ▪ Oak Ridge, Tennessee 37830
(865) 483-9900 ▪ FAX: (865) 483-2014 ▪ www.tetratech.com

0202-A010

February 8, 2002

Commander, Southern Division
Naval Facilities Engineering Command
ATTN: Ms. Barbara Nwokike, Code ES33
P.O. Box 190010
2155 Eagle Drive
North Charleston, SC 29419-9010

Reference: CLEAN Contract No. N62467-94-D-0888
Contract Task Order No. 0024

Subject: Final Work Plan for Well Installation and Groundwater Sampling, Operable Unit 2
Former Naval Training Center, Orlando, Florida

Dear Ms. Nwokike:

Enclosed is the final Work Plan for Well Installation and Groundwater Sampling for Operable Unit 2. A second copy has been mailed to your attention at Southern Division's Orlando office.

Please contact me at (865) 220-4730 if you have any questions regarding the plan.

Sincerely,

Steven B. McCoy, P.E.
Task Order Manager

SBM:tko

Enclosure

c: Ms. Barbara Nwokike, Southern Division (Orlando Office)
Mr. David Grabka, FDEP
Mr. Gregory Fraley, USEPA Region 4
Mr. Michael Campbell, Tetra Tech NUS
Ms. Debbie Wroblewski, Tetra Tech NUS (cover letter only)
Mr. Mark Perry, Tetra Tech NUS (unbound)
Mr. Skip Barton, Tetra Tech NUS
Mr. Steve Tsangaris, CH2M Hill
Mr. Mark Salvetti, Harding ESE
File/db

WORK PLAN FOR WELL INSTALLATION AND GROUNDWATER SAMPLING

OPERABLE UNIT 2

NAVAL TRAINING CENTER ORLANDO, FLORIDA

COMPREHENSIVE LONG-TERM ENVIRONMENTAL ACTION NAVY (CLEAN) CONTRACT

Submitted to:

Department of the Navy, Southern Division
Naval Facilities Engineering Command
2155 Eagle Drive
North Charleston, South Carolina 29406

Submitted by:

Tetra Tech NUS, Inc.
661 Andersen Drive
Foster Plaza 7
Pittsburgh, Pennsylvania 15220

CONTRACT NO. N62467-94-D-0888
CONTRACT TASK ORDER 0024

FEBRUARY 2002

PREPARED UNDER THE SUPERVISION OF:

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APPROVED FOR SUBMITTAL BY:

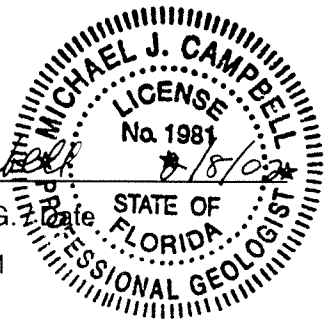
Debra M Wroblewski
DEBBIE WROBLEWSKI
PROGRAM MANAGER
TETRA TECH NUS, INC.
PITTSBURGH, PENNSYLVANIA

PROFESSIONAL GEOLOGIST CERTIFICATION

I hereby certify that this document, *Work Plan for Well Installation and Groundwater Sampling, Operable Unit 2,* Naval Training Center, Orlando, Florida, was prepared under my direct supervision in accordance with acceptable standards of geological practice.

Michael J. Campbell, P.G. Date

License No. PG-0001981



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ACRONYMS

ABB-ES	ABB Environmental Services
bgs	below ground surface
DO	dissolved oxygen
DOC	dissolved organic carbon
DQO	Data Quality Objective
FOC	fraction of organic carbon
FS	Feasibility Study
GOAA	Greater Orlando Aviation Authority
HASP	Health and Safety Plan
IDW	investigation-derived waste
MS	matrix spike
MSD	matrix spike duplicate
NA	natural attenuation
NFESC	Naval Facilities Engineering Service Center
NTC	Naval Training Center
NTU	Nephelometric Turbidity Unit
OPT	Orlando Partnering Team
ORP	oxidation reduction potential
OU	Operable Unit
POP	Project Operations Plan
PARCC	precision, accuracy, representativeness, comparability, and completeness
RI	Remedial Investigation
QA	quality assurance
QC	quality control
SOUTHDIV	Southern Division
SU	standard unit
TCL	Target Compound List
TOM	Task Order Manager
TtNUS	Tetra Tech NUS, Inc.
USEPA	U.S. Environmental Protection Agency
VOC	volatile organic compound

1.0 INTRODUCTION

The monitoring well installation and sampling activities described below will be conducted to evaluate the progress of natural attenuation (NA) of contaminants in groundwater at Operable Unit 2 (OU 2), a groundwater remedial alternative presented in the OU 2 Feasibility Study (FS) (TtNUS, 2001c). This evaluation will include sampling and analysis of groundwater to confirm the ability of NA to meet the remedial alternative goals.

1.1 SITE DESCRIPTION

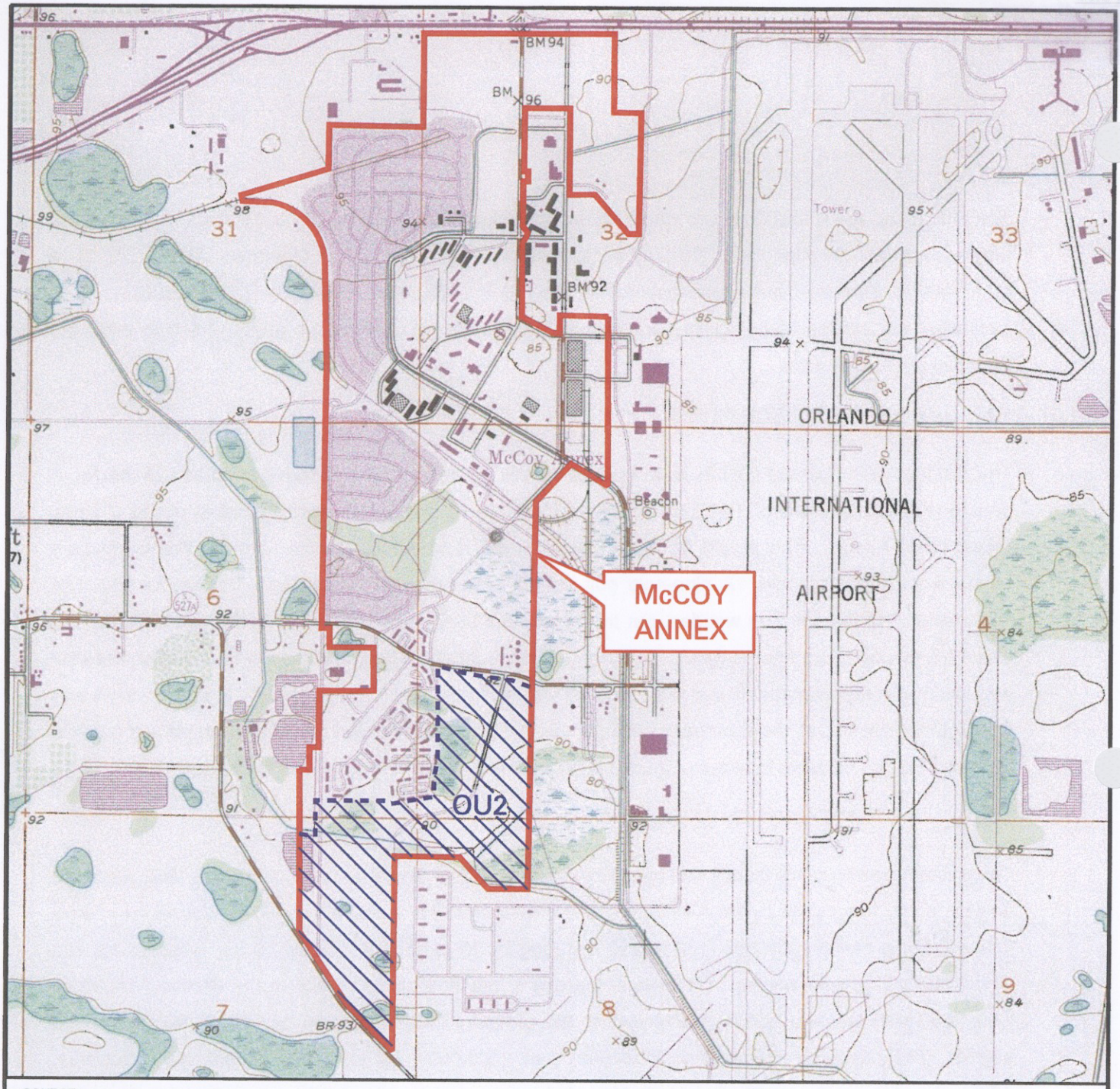
The McCoy Annex Landfill (OU 2) is an inactive landfill located in the southern part of McCoy Annex, a portion of the former Naval Training Center (NTC), Orlando that lies immediately west of the Orlando International Airport. The landfill occupies approximately 114 acres, and its relatively flat topography slopes from north to south. A nine-hole golf course now occupies the northern half of the site. The southern half of the site was wooded, but the trees have been removed and the area was covered with clean soil as part of an Interim Remedial Action (Bechtel, 2000). The golf course is bounded on the east and south by manmade canals that drain to Lake Gillooly to the south and eventually to Boggy Creek and Boggy Creek Swamp to the southeast. The golf course includes a number of water hazards and has two cypress swamps between fairways. Figure 1-1 shows the location of OU 2 at McCoy Annex.

1.2 SITE HISTORY

The western portion of the landfill was reportedly used by the Air Force from about 1960 to 1972, while the eastern portion was used by the Air Force and the Navy from 1972 until about 1978. Landfill operations consisted of excavating ditches (100 to 200 feet long by 20 to 25 feet wide by 10 by 15 feet deep) into which trucks disposed wastes. Occasional burning of the wastes took place in the ditches. Trenches were filled with waste to within 3 or 4 feet of the ground surface and then backfilled with topsoil and seeded. The estimated volume of waste is more than 1,000,000 cubic yards (C.C. Johnson & Associates, 1985). Landfill wastes reportedly included hospital wastes, paint and paint thinner, automobile batteries, airplane parts, and asbestos.

Previous investigations documented two groundwater contaminant plume areas and provided evidence that natural attenuation processes may be degrading the organic contaminants. Figure 1-2 shows the northern area of concern and Figures 1-3 and 1-4 show the southern areas of concern that were defined in the OU 2 Remedial Investigation (RI) Report (TtNUS, 2001a). The principal contaminants of concern are as follows:

- Northern Plume – Benzene, iron, and manganese.
- Two Southern Plumes – Benzene and chlorinated solvents.



SOURCE:
TAKEN FROM U.S.G.S. TOPOGRAPHIC QUADRANGLE
PINE CASTLE, FLORIDA (1980 EDITION).

-N-

2000 0 2000
SCALE IN FEET

FIGURE 1-1
LOCATION OF OPERABLE UNIT 2
AT McCOY ANNEX

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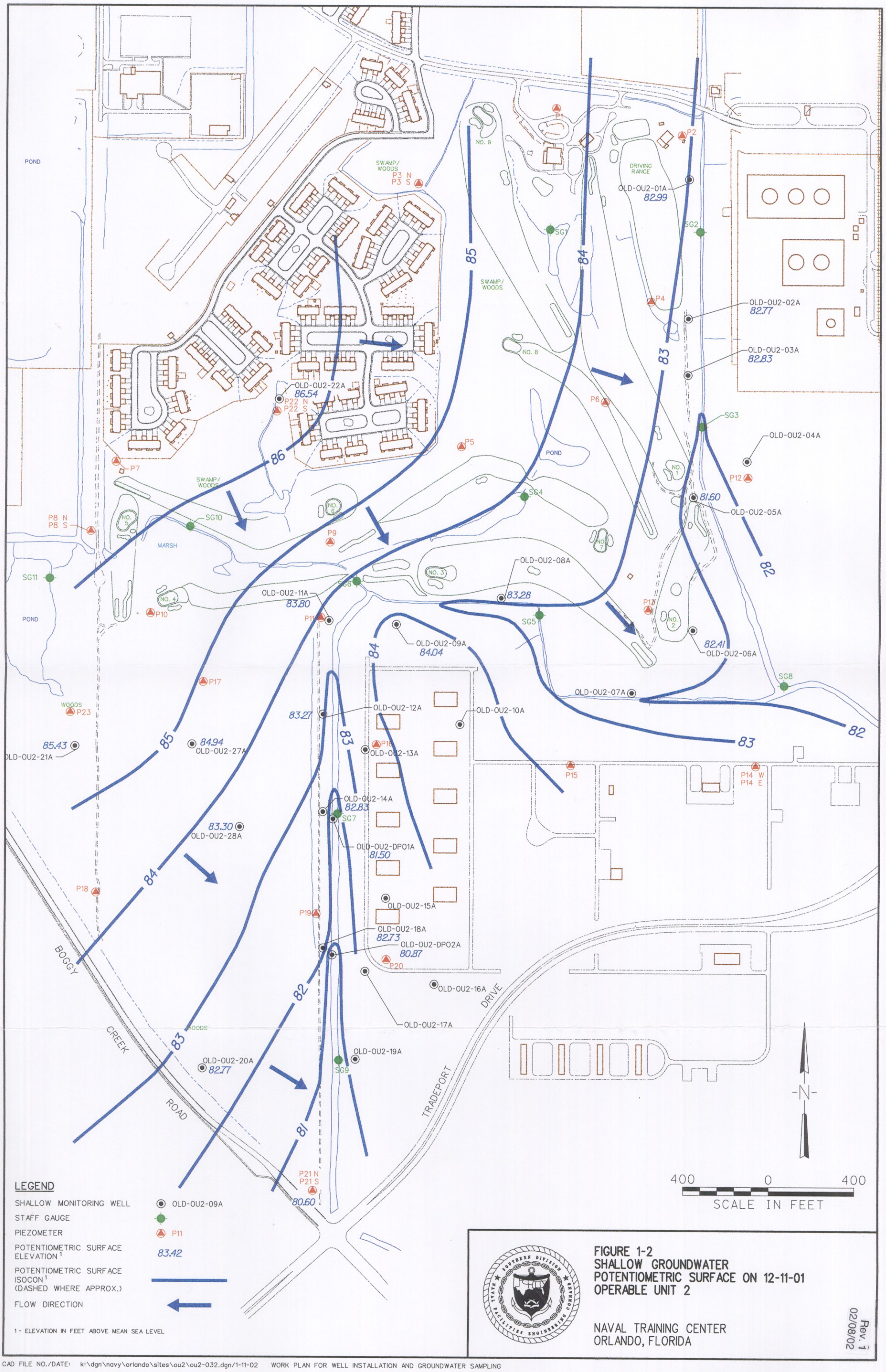

FIGURE 1-2
SHALLOW GROUNDWATER
POTENTIOMETRIC SURFACE ON 12-11-01
OPERABLE UNIT 2

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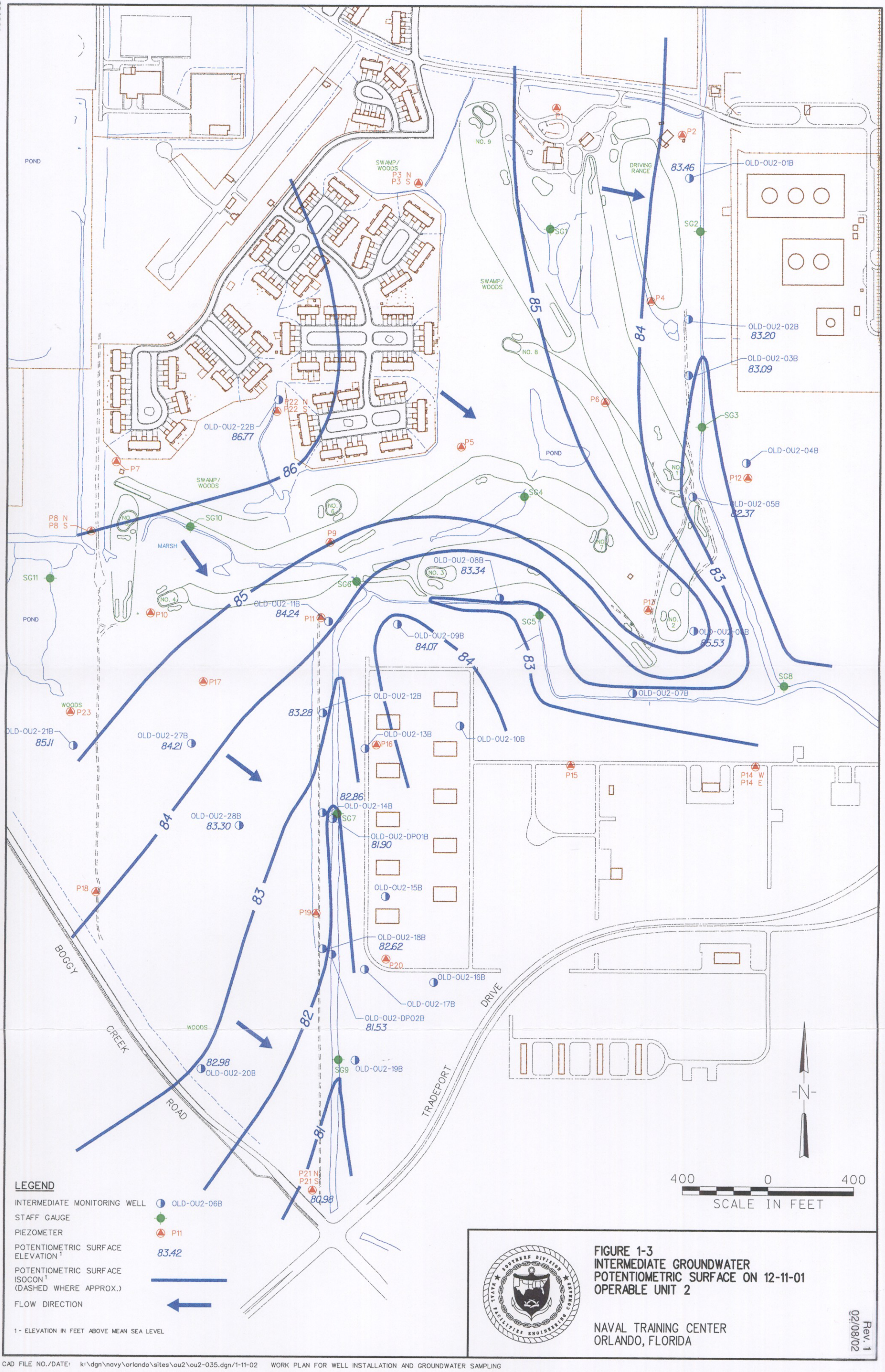

FIGURE 1-3
INTERMEDIATE GROUNDWATER
POTENTIOMETRIC SURFACE ON 12-11-01
OPERABLE UNIT 2

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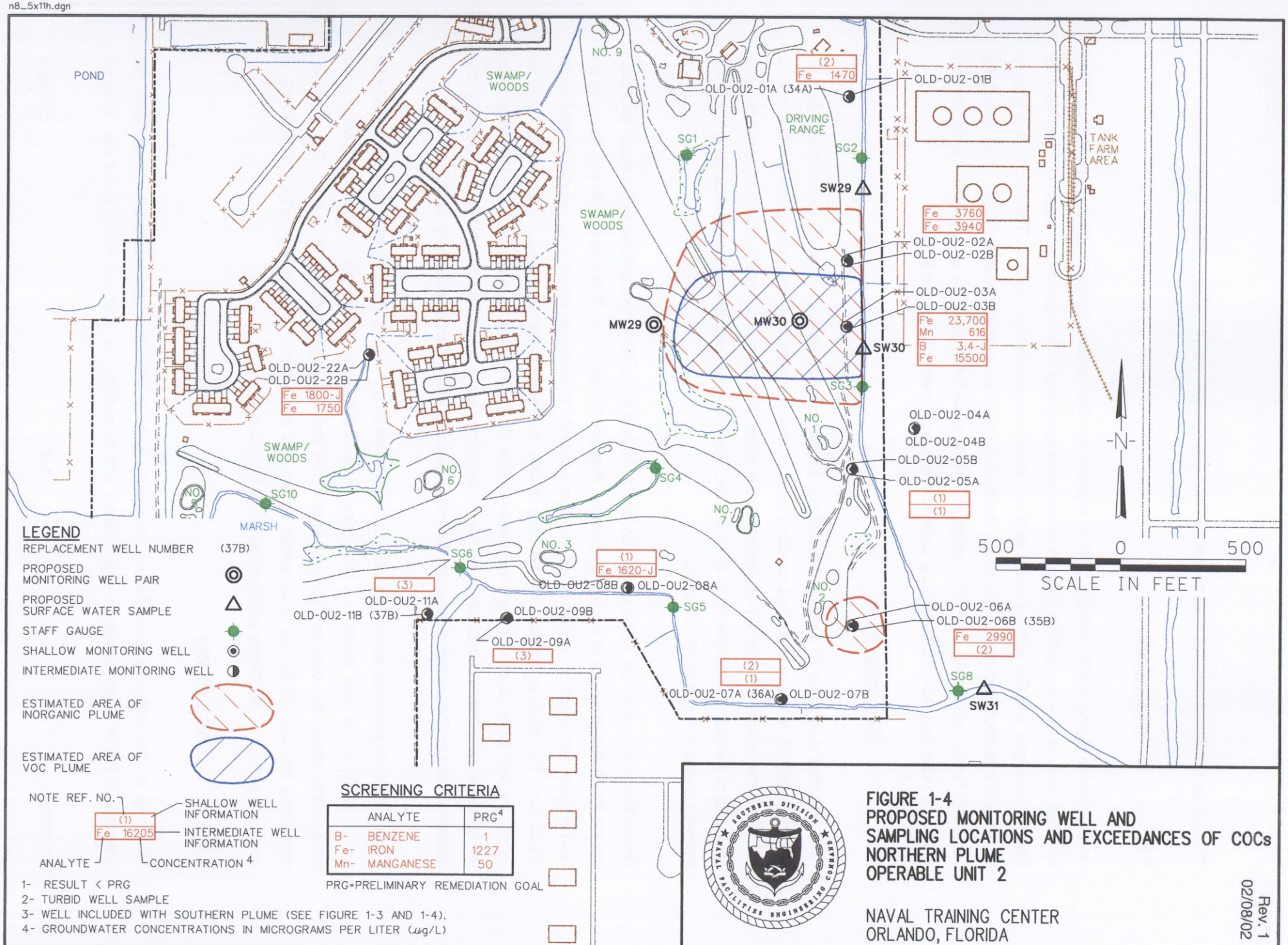

LEGEND

- REPLACEMENT WELL NUMBER (37B)
- PROPOSED MONITORING WELL PAIR
- PROPOSED SURFACE WATER SAMPLE
- STAFF GAUGE
- SHALLOW MONITORING WELL
- INTERMEDIATE MONITORING WELL
- ESTIMATED AREA OF INORGANIC PLUME
- ESTIMATED AREA OF VOC PLUME

NOTE REF. NO. — (1) Fe 16205 — SHALLOW WELL INFORMATION / INTERMEDIATE WELL INFORMATION

ANALYTE — CONCENTRATION [4]

SCREENING CRITERIA

ANALYTE		PRG[4]
B-	BENZENE	1
Fe-	IRON	1227
Mn-	MANGANESE	50

PRG=PRELIMINARY REMEDIATION GOAL

1- RESULT < PRG
2- TURBID WELL SAMPLE
3- WELL INCLUDED WITH SOUTHERN PLUME (SEE FIGURE 1-3 AND 1-4).
4- GROUNDWATER CONCENTRATIONS IN MICROGRAMS PER LITER (ug/L)

FIGURE 1-4
PROPOSED MONITORING WELL AND SAMPLING LOCATIONS AND EXCEEDANCES OF COCs NORTHERN PLUME OPERABLE UNIT 2

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There is an additional concern that the contaminant plumes may reach nearby surface water bodies.

1.2.1 Site Geology

Data collected during the RI (TtNUS, 2001a) indicate that the surficial deposits generally consist of three separate units of fine- to medium-grained sands, varying in color. The uppermost unit, 2 to 3 feet thick, is typically dark gray and the second unit, 4 to 5 feet thick, is generally dark brown. The third unit is gray to brown and was encountered to a maximum depth of 44 feet below ground surface (bgs). The underlying Hawthorn Group was found at depths ranging from 28 to 44 feet bgs. The unit generally consists of a gray-green clay layer about 20 feet thick underlain by a gray-green phosphatic sand.

1.2.2 Site Hydrogeology

Data collected during the RI showed the surficial aquifer to be unconfined. Its saturated thickness was approximately 25 feet and consisted predominantly of fine- to medium-grained quartz sand. The bottom of the surficial aquifer is a laterally extensive, dense, greenish clay at a depth of typically 30 feet bgs. The thickness of the clay unit ranges from 10 to 20 feet. The clay also acts to confine an underlying sand unit that was shown to be up to 35 feet thick.

Groundwater was generally found at a depth of 5 to 10 feet bgs and generally flows to the south and east toward the drainage canals at the site boundaries (Figures 1-2 and 1-3). The water table was found to be fairly regular with a gentle slope except in close proximity to recharge areas (i.e., ponds) or discharge areas (i.e., the drainage canal), where fairly steep gradients were observed. The water levels in monitoring well pairs, closely spaced wells screened at different depths, also demonstrate that away from the drainage canal there is typically a downward flow component in the surficial aquifer. Additionally, the data show that as the aquifer encounters the drainage canal there is an upward flow component.

Monitoring wells screened across the water table (shallow zone) in the surficial aquifer are designated with an "A" suffix in the well identifier. Monitoring wells screened at the bottom of the upper sand units immediately above the clay unit (intermediate zone) are designated with a "B" suffix. For example, monitoring well OLD-OU2-14A is screened across the water table. Monitoring well OLD-OU2-14B is screened just above the clayey unit that lies about 30 feet bgs.

1.3 OBJECTIVES

The goal of the proposed groundwater monitoring is to provide the data necessary to evaluate the progress of NA of contaminants in groundwater and to confirm the ability of NA to meet the remedial

alternative goals. Additional groundwater monitoring at OU 2 is necessary to obtain the data needed to characterize the seasonal and hydrological variations of the groundwater plumes and their potential surface water impacts. Additionally, these data will supplement the understanding of the NA mechanisms that have been documented by previous sampling.

Tetra Tech NUS, Inc. (TtNUS) will conduct the following field activities to acquire the needed data:

- Perform synoptic water elevation measurements in all on-site wells and selected staff gauges in the canals. Selected piezometers and off-site wells may be included to provide more comprehensive data for the installation of new wells.

- Install new monitoring well pairs in the surficial aquifers (A and B depths). Five well pairs are planned, as shown in Figures 1-4 through 1-6. The number of well pairs and their locations may be changed after investigators evaluate the new water level data.

- Replace four existing monitoring wells that have historically produced high-turbidity samples. Replacement wells are shown in Figures 1-4 through 1-6.

- Conduct one year of quarterly sampling of monitoring wells and surface water locations.

  - **Comprehensive quarterly sampling** (first and third quarters) will include a water elevation survey and sampling of most on-site monitoring wells, selected off-site wells, and selected surface water locations. All samples will be analyzed for volatile organic compounds (VOCs), iron, and manganese. Selected samples will also be analyzed for NA parameters.

  - **Routine quarterly sampling** (second and fourth quarters) will include a water elevation survey and sampling of selected on-site monitoring wells and surface water locations. All samples will be analyzed for VOCs, iron, manganese, and NA parameters.

If turbidity cannot be reduced to levels below 10 nephelometric turbidity units (NTUs) in any of the existing wells scheduled to be sampled, those wells will be removed from the list.

1.4 GUIDANCE

Wells will be constructed in accordance with procedures and practices detailed in *Monitoring Well Design, Installation, Construction, and Development Guidelines* (Interim Final) (SOUTHDIV, 1997). Sampling and related field activities will be conducted in accordance with the *Project Operations Plan* [POP] *for Site Investigations and Remedial Investigations* (ABB-ES, 1997) and the *Health and Safety Plan* [HASP] *for Performing Investigative Work and Data Sampling* (TtNUS, 2001b).

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1-11

MARSH

NO. 3

NO. 4

SG11

SG6

POND

WOODS

OLD-OU2-11A
OLD-OU2-11B (37B)

SW32

OLD-OU2-09B
OLD-OU2-09A

P5	
PCE	4-J
TCE	7
VC	209-D

P6	
CB	114-D
B	26
VC	40

P4	
TCE	5

P7	
B	20
PCE	6
TCE	10

P3	
B	11

P2	
B	2-J

P14

P13

P12

P11

P10

OLD-OU2-12B
OLD-OU2-12A

P9	
DCE	7
VC	11

OLD-OU2-27B

P1 P2 P3 P4 P5 P6 P7 P8 P9

OLD-OU2-27A

OLD-OU2-13B

OLD-OU2-13A

MW31

SW33

OLD-OU2-21B
OLD-OU2-21A

P44	
PCE	43-J
TCE	5-J

P44

P43

P42

P41

P40

P39

P38

P37

P36

P35

UNABLE TO COLLECT
INTERMEDIATE ZONE SAMPLE
AT P41 DUE TO REFUSAL

P28

P27

OLD-OU2-28B

OLD-OU2-28A

P26

P25

P24

P23

P15 P16 P17 P18 P19 P20 P21 P22

OLD-OU2-14A
OLD-OU2-14B

SG7

OLD-OU2-DP01A
OLD-OU2-DP01B

OLD-OU2-15B
OLD-OU2-15A

MW32

P23	
TCE	4-J

SW34

OLD-OU2-18A
OLD-OU2-18B
OLD-OU2-DP02A
OLD-OU2-DP02B

SW35

P29	
PCE	5-J
TCE	27

P29 P30 P31 P32 P33

MW33

P30	
TCE	5-J

OLD-OU2-17B
OLD-OU2-17A

P31	
TCE	5-J

DP02A	
TCE	19

P32	
TCE	5

P33	
PCE	4-J
TCE	76-D
VC	4-J

WOODS

BOGGY CREEK ROAD

SG9

OLD-OU2-19A
OLD-OU2-19B

SW36

OLD-OU2-20A
OLD-OU2-20B

LEGEND

- REPLACEMENT WELL NUMBER (37B)
- PROPOSED MONITORING WELL PAIR
- PROPOSED SURFACE WATER SAMPLE
- STAFF GAUGE
- DPT SAMPLE LOCATION
- SHALLOW MONITORING WELL
- INTERMEDIATE MONITORING WELL
- MICROWELL (APPROX. LOCATION)
- ESTIMATED AREA OF PRG EXCEEDANCE

SAMPLE ID

P29	
PCE	5-J
TCE	27

ANALYTE — ANALYTE CONCENTRATION [1]

DILUTION D

ESTIMATED VALUE J

-N-

200 0 200

SCALE IN FEET

SCREENING CRITERIA

ANALYTE	PRG[1]
B- BENZENE	1
CB- CHLOROBENZENE	100
PCE- TETRACHLOROETHENE	3
TCE- TRICHLOROETHENE	3
VC- VINYL CHLORIDE	1

PRG-PRELIMINARY REMEDIATION GOAL

1-GROUNDWATER CONCENTRATIONS IN MICROGRAMS PER LITER (ug/L)

NOTE:

DPT RESULTS FROM P1 THROUGH P24 AND P29 THROUGH P34 ARE FIELD GC ANALYSIS; ALL OTHER RESULTS ARE FIXED-BASE LABORATORY.

FIGURE 1-5
PROPOSED MONITORING WELLS, SAMPLING LOCATIONS, AND EXCEEDANCES OF VOC COCs IN SHALLOW DEPTH GROUNDWATER SOUTHERN PLUME - OPERABLE UNIT 2

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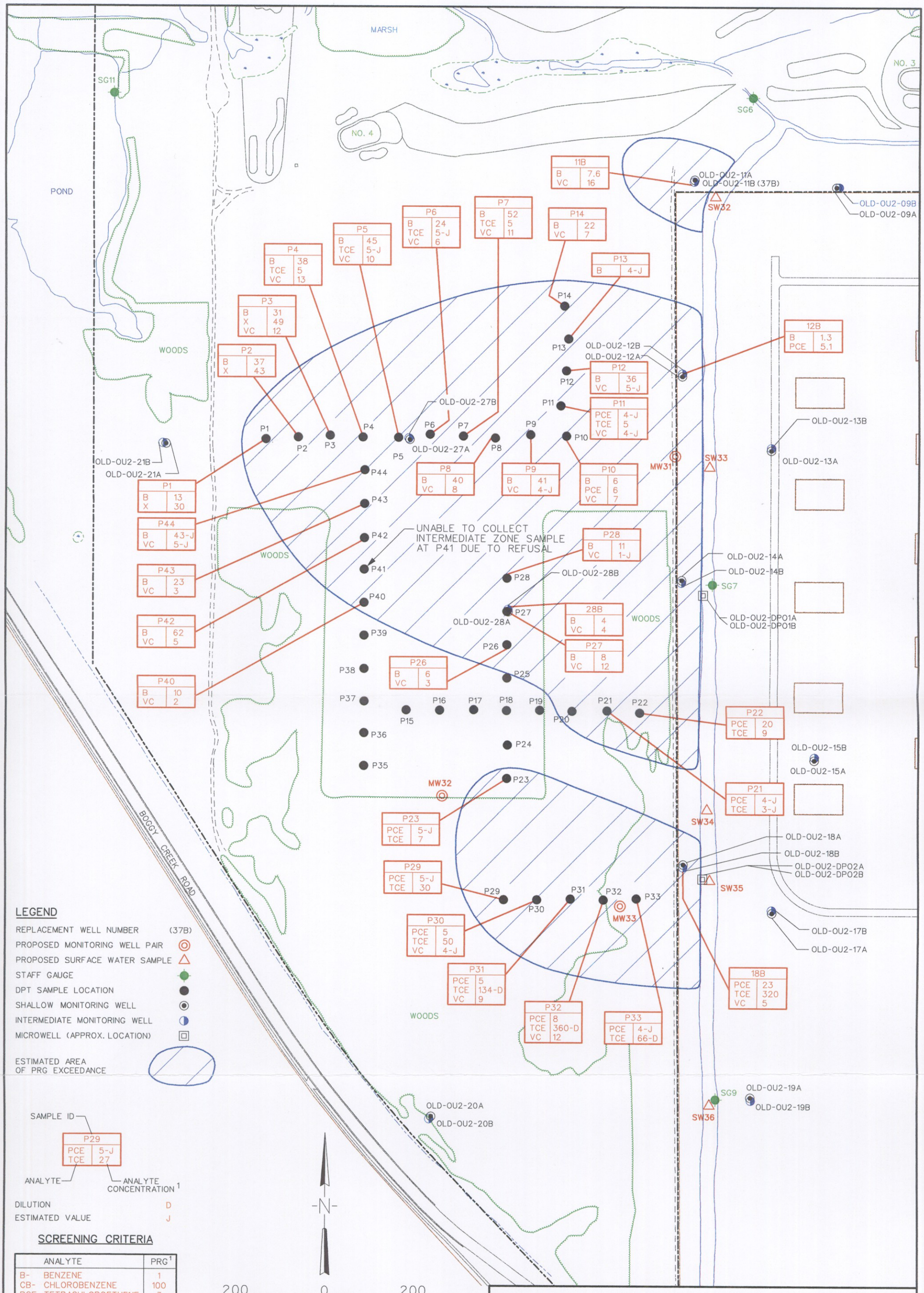

LEGEND

- REPLACEMENT WELL NUMBER (37B)
- PROPOSED MONITORING WELL PAIR
- PROPOSED SURFACE WATER SAMPLE
- STAFF GAUGE
- DPT SAMPLE LOCATION
- SHALLOW MONITORING WELL
- INTERMEDIATE MONITORING WELL
- MICROWELL (APPROX. LOCATION)

ESTIMATED AREA OF PRG EXCEEDANCE

SAMPLE ID

P29	
PCE	5-J
TCE	27

ANALYTE — ANALYTE CONCENTRATION [1]

DILUTION D

ESTIMATED VALUE J

-N-

200 0 200

SCALE IN FEET

SCREENING CRITERIA

ANALYTE	PRG[1]
B- BENZENE	1
CB- CHLOROBENZENE	100
PCE- TETRACHLOROETHENE	3
TCE- TRICHLOROETHENE	3
VC- VINYL CHLORIDE	1

PRG-PRELIMINARY REMEDIATION GOAL

1-GROUNDWATER CONCENTRATIONS IN MICROGRAMS PER LITER (ug/L)

NOTE:

DPT RESULTS FROM P1 THROUGH P24 AND P29 THROUGH P34 ARE FIELD GC ANALYSIS; ALL OTHER RESULTS ARE FIXED-BASE LABORATORY.

FIGURE 1-6
PROPOSED MONITORING WELLS, SAMPLING LOCATIONS, AND EXCEEDANCES OF VOC COCs IN INTERMEDIATE DEPTH GROUNDWATER SOUTHERN PLUME - OPERABLE UNIT 2

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2.0 MONITORING WELL INSTALLATION

2.1 WELL PLACEMENT

Additional monitoring wells will be placed at strategic locations to provide (in conjuction with existing wells) upgradient, in-plume, and downgradient sampling points for the northern and two southern groundwater plumes shown in Figures 1-2 and 1-3. A shallow and intermediate depth well pair (i.e., A and B wells) will be installed at each location. The locations of these wells will be based on groundwater flow directions determined by historical data and a pre-installation round of synoptic water elevations in all existing on-site monitoring wells, selected surface water stations, and selected piezometers and off-site wells.

2.2 SOIL SAMPLING

Soil sampling and analysis for fraction of organic carbon (FOC) will be conducted to support analysis of the fate and transport of contaminants in the surficial aquifer. Soil samples will be collected from separate soil borings installed specifically for that purpose. The samples will be collected from the approximate screen intervals (10 – 15 and 25 – 30 feet bgs) at each upgradient well pair location, and samples will be analyzed at the laboratory for FOC.

2.3 WELL CONSTRUCTION PROCEDURES

Changes in well construction procedures will be implemented to reduce turbidity problems encountered at the site. Specific changes to the procedures for this purpose include:

- Use of 1-inch prepacked wells with additional filter pack installed in the annulus around the prepacked wells.
- Use of hollow stem augers with an auger flight plug to reduce inflow of aquifer material into the augers.
- Use of potable water during drilling and well installation to provide head and thereby reduce inflow of aquifer materials after the plug is knocked out.
- Use of a sand pack (U.S. Standard Sieve Size No. 30/45) expected to better match the formation material.

Because of the potential for heaving sands, an auger flight plug will be used during drilling and potable water will be used to maintain a hydraulic head inside the augers during well construction. The depth of

the borehole must be measured prior to installing the well string to ensure that heaving sands have not entered the borehole and it is open to the required depth. If aquifer material has heaved into the borehole, the driller will be directed to clear the borehole (e.g., bail out the loose material). Monitoring wells will be installed through the augers upon completion of each well boring.

Monitoring wells installed in the shallow and intermediate zones will be constructed of Schedule 40, flush-joint threaded, 1-inch inner diameter polyvinyl chloride riser pipe and flush-joint threaded, factory-slotted well screen with a prepacked filter pack and a flush-threaded end cap. All well screens will be factory-slotted to 0.010-inch size. Each section of well casing and screen will be National Sanitation Foundation approved. Well screens will be 10 feet long for the shallow (A depth) wells and 5 feet long for intermediate (B depth) wells. The bottoms of the well screens will be placed a minimum of 6 inches, but no more than 3 feet, above the bottom of the drilled boreholes. Solvents or glues will not be permitted during construction of monitoring or observation wells.

A clean silica sand pack of U.S. Standard Sieve Size No. 30/45 sand will be installed through the augers as the augers are removed from the boring. The sand pack will be extended from 0.5 foot below the well screen to 2.0 feet above the top of the well screen. The top of the sand pack will be sounded to verify its depth during placement. The well will be gently surged with a surge block for approximately 10 minutes to ensure that no bridging of the sand pack has occurred. If after surging the well the sand level subsides, additional sand will be placed into the annulus to return the top of the sand to 2 feet above the top of the screen. In that case, the well will be gently surged again for an additional 10 minutes and, if necessary, sand will be added again to bring the level to 2 feet above the top of the screened interval.

Water table wells (A depth) will be installed with very fine sand above the filter pack because bentonite will not remain hydrated. A minimum 2-foot-thick bentonite pellet seal will be installed above the sand pack for the intermediate wells (B depth) and allowed to hydrate as recommended by the manufacturer. The remaining annulus above the hydrated bentonite seal (or fine sand) will be backfilled to the surface, using a tremie pipe, with a 20:1 cement/bentonite grout.

2.4 PROTECTIVE CASING AND WELL PADS

2.4.1 Completion Above Grade

A protective steel casing (minimum 4-inch diameter) equipped with a locking steel cap will be installed around each well. A temporary metal identification tag will be placed on the outside of the protective casing. Protective casings will be grouted at least 3 feet into the ground and will have at least one drain hole immediately above the concrete pad. Pea gravel will be placed in the annular space from the ground

surface to approximately 6 inches below the top of the well riser. Approximately 3 inches of clearance will be left between the lid of the well cover and the top of the well riser. Prior to installation of the protective casing, a 1/8-inch vent hole will be drilled or slotted in the well riser approximately 2 inches below the well cap. A locking "J-plug type" cap will be placed and secured on top of each well riser to protect from tampering/opening. All locks on all wells (caps and/or casing covers) will be keyed alike with heavy-duty, brass, weather-resistant locks.

A 3-foot by 3-foot by 6-inch-thick concrete apron with a 1-inch per foot slope from the center will be constructed around each well. Where possible, pad edges will be squared to surrounding structures, other concrete pads in the area, and/or property lines. For wells in high traffic areas, four marker posts (4-inch nominal diameter, 5-foot-long steel pipe filled with cement) will be cemented approximately 2 feet into the ground around the outside of the concrete apron.

2.4.2 Flush-Mount Wells

In some areas, such as parking lots or high-traffic areas such as golf fairways, flush-mount, sealing well covers will be installed. Vent holes will not be used for flush-mounted well completions. The flush-mount cover will be an 8-inch-round security vault provided with sealing gasket to reduce the water infiltration. Approximately 4 inches of clearance will be left between the lid of the well cover and the top of the well riser. A 2-foot by 2-foot (saw-cut or saw-scored and jack-hammered hole in paved areas) by 6-inch-thick concrete apron will be constructed around each flush-mount well. The flush-mounted casings will be completed 2 inches above existing grade and the apron tapered to be flush with existing grade at the edges so water will run off the apron.

2.5 WELL DEVELOPMENT

New monitoring wells will be developed no sooner than 24 hours after well installation. Wells will be developed by bailing and low-stress surging, and/or by pumping, as determined by the field geologist. Because of the fine-grained formation and the potential for loosely compacted sediment (i.e., heaving sands), excessive stress during development must be avoided. The wells will be developed until the discharge water is visibly clear or stable as determined by the field geologist. The field geologist will obtain a minimum of three sequential, stable measurements of field parameters (pH, temperature, specific conductance, and turbidity) recorded near the end of development processes. At a minimum, development must remove twice the volume of water from the well that was used during well construction. Development will be performed in accordance with Section 4.4.6.7 of the POP (ABB-ES, 1997).

2.6 WELL REPLACEMENT

Four monitoring wells at OU 2 (MW01A, MW06B, MW07A, and MW11B) that have historically produced high turbidity samples (>100 NTUs) will be replaced. Efforts to obtain groundwater samples with low turbidity in these wells have included redevelopment, extended purging, and resampling. All attempts to obtain low turbidity samples were unsuccessful. Replacement wells will be constructed using the methods described in the previous sections for new wells.

2.7 STAFF GAUGE REPLACEMENT

If any of the staff gauges that are identified for elevation measurements have been destroyed, they will be replaced prior to the initial comprehensive water elevation survey. The staff gauges will be fixed and will be designed to last for a period of at least 2 years.

2.8 MONITORING WELL AND STAFF GAUGE SURVEYING

All existing staff gauges (identified for water elevation measurements), the newly installed monitoring wells, and any newly installed staff gauges will be surveyed by a Florida licensed land surveyor. Accuracy will be to the nearest 0.1 foot horizontally and to the nearest 0.01 foot vertically. A sufficient number of pre-existing wells will also be surveyed to confirm that the existing survey data are consistent with the new data.

3.0 GROUNDWATER AND SURFACE WATER SAMPLING

TtNUS will perform the following tasks:

- Synoptic water elevation survey prior to well installation including all on-site wells, selected staff gauges in the canals, and selected piezometers and off-site wells (Table 3-1). Well caps will be removed at least one half-hour before the first round of water level measurements is collected. A second round of water levels will be collected a minimum of one half-hour after the initial round. If the difference in the water levels in a given well is greater than ~~0.1~~ 0.05 MAC/ATJ 3/26/02 foot, that well will continue to be measured every half-hour until the water level stabilizes. Well construction information is presented in Table 3-2.
- One year of quarterly sampling of monitoring wells and surface water locations.
  - **Comprehensive quarterly sampling** (first and third quarters) will include a synoptic water elevation survey (Table 3-1) and sampling of most on-site monitoring wells, selected off-site wells, and selected surface water locations (Table 3-3 and Figure 3-1). All samples will be analyzed for VOCs, iron, and manganese. Selected samples will also be analyzed for NA parameters. Surface water samples will also be analyzed for chloride, dissolved oxygen (DO), and conductivity. The off-site wells (and additional on-site wells) will be sampled to confirm the plume geometry and evaluate the list of wells to be sampled during subsequent events.
  - **Routine quarterly sampling** (second and fourth quarters) will include a synoptic water elevation survey (Table 3-1) and sampling of selected on-site monitoring wells and surface water locations. All samples will be analyzed for VOCs, iron, manganese, and NA parameters (Table 3-3 and Figure 3-2). Surface water samples will also be analyzed for chloride, DO, and conductivity.

All off-site wells are on property controlled by the Greater Orlando Aviation Authority (GOAA). The appropriate contact at GOAA (see Section 9.0) will be notified prior to performing any water elevation survey or sampling activities on GOAA property.

If turbidity levels cannot be reduced to 10 NTUs or below in any of the existing wells, they will be removed from the list of wells to be sampled during subsequent events. The Orlando Partnering Team (OPT) will evaluate the data and may change the sampling locations and/or frequency if appropriate.

Unless otherwise specified herein, all work will be performed following guidance detailed in the POP (ABB-ES, 1997) and the HASP (TtNUS, 2001b). In addition, purging and sampling procedures will meet or exceed the guidance provided in *Environmental Investigations, Standard Operating Procedures and Quality Assurance Manual* (USEPA, 1996).

TABLE 3-1

LOCATIONS FOR WATER ELEVATION SURVEY

OPERABLE UNIT 2
NTC, ORLANDO

ON-SITE WELLS
Surficial Aquifer
MW01A (MW34A)[a]
MW01B
MW02A
MW02B
MW03A
MW03B
MW05A
MW05B
MW06A
MW06B (MW35B)[a]
MW07A (MW36A)[a]
MW07B
MW08A
MW08B
MW11A
MW11B (MW37B)[a]
MW12A
MW12B
MW14A
MW14B
MW18A
MW18B
MW20A
MW20B
MW21A
MW21B
MW22A
MW22B
MW27A
MW27B
MW28A
MW28B
MW29A[b]
MW29B[b]
MW30A[b]
MW30B[b]
MW31A[b]
MW31B[b]
MW32A[b]
MW32B[b]
MW33A[b]
MW33B[b]
P1
P3N
P3S
P5
P6
P7
P8N
P8S
P9
P10
P17
P18
P21N
P21S
Hawthorn Aquifer
MW23C
MW26C
MW25C

OFF-SITE WELLS
Surficial Aquifer
MW04A
MW04B
MW09A
MW09B
MW10A
MW10B
MW13A
MW13B
MW15A
MW15B
MW16A
MW16B
MW17A
MW17B
MW19A
MW19B
P14E
P14W
P15
Hawthorn Aquifer
MW24C

SURFACE WATER
Canals
SG2
SG3
SG5
SG8
SG7
SG9

[a]Replacement well numbers are shown in parentheses.

[b]Indicates new monitoring wells to be installed following the first synoptic water level survey.

TABLE 3-2

WELL CONSTRUCTION DATA

OPERABLE UNIT 2
NTC, ORLANDO

Well Number	Date Installed	Well Type	Boring Depth[a] (ft bgs)	Boring Diameter (in.)	Well Depth[a] (ft bgs)	Casing			Riser			Screen		
						Diameter (in.)	Length (ft)	Interval (ft)	Diameter (in.)	Length[a] (ft)	Interval[a] (ft)	Diameter (in.)	Length (ft)	Interval[a] (ft)
OLD-OU2-01A	6/01/98	II/ Flush Mount	15	10	15				2	4.5	0-4.5	2	10	4.5-14.5
OLD-OU2-01B	6/01/98	II/ Flush Mount	29.5	10	29.5				2	24	0-24	2	5	24-29
OLD-OU2-02A	6/01/98	II	18	10	18				2	10.5	0-7.5	2	10	7.5-17.5
OLD-OU2-02B	6/01/98	II	32.5	10	32.5				2	30	0-27	2	5	27-32
OLD-OU2-03A	6/02/98	II	18	10	18				2	10.5	0-7.5	2	10	7.5-17.5
OLD-OU2-03B	6/02/98	II	33	10	33				2	30.5	0-27.5	2	5	27.5-32.5
OLD-OU2-04A	6/03/98	II	18	10	18				2	10.5	0-7.5	2	10	7.5-17.5
OLD-OU2-04B	6/03/98	II	33	10	33				2	30.5	0-27.5	2	5	27.5-32.5
OLD-OU2-05A	6/03/98	II	18.5	10	18.5				2	11	0-8	2	10	8-18
OLD-OU2-05B	6/04/98	II	46	10	46				2	43.5	0-40.5	2	5	40.5-45.5
OLD-OU2-06A	6/04/98	II	18	10	18				2	20.5	0-17.5	2	10	7.5-17.5
OLD-OU2-06B	6/04/98	II	42	10	42				2	39.5	0-36.5	2	5	36.5-41.5
OLD-OU2-07A	6/04/98	II	17	10	17				2	9	0-6.5	2	10	6.5-16.5
OLD-OU2-07B	6/05/98	II	32	10	32				2	29	0-26.5	2	5	26.5-31.5
OLD-OU2-08A	6/03/98	II	18.5	10	18.5				2	11	0-8	2	10	8-18
OLD-OU2-08B	6/04/98	II	40	10	40				2	37.5	0-34.5	2	5	34.5-39.5
OLD-OU2-09A	6/09/98	II	17.5	10	17.5				2	10	0-7	2	10	7-17
OLD-OU2-09B	6/09/98	II	41	10	41				2	38.5	0-35.5	2	5	35.5-40.5
OLD-OU2-10A	6/08/98	II/ Flush Mount	15.5	10	15.5				2	15	0-15	2	10	5-15
OLD-OU2-10B	6/08/98	II/ Flush Mount	36.5	10	36.5				2	31	0-31	2	5	31-36
OLD-OU2-11A	6/03/98	II	18	10	18				2	10.5	0-7.5	2	10	7.5-17.5
OLD-OU2-11B	6/02/98	II	35	10	35				2	32.5	0-29.5	2	5	29.5-34.5
OLD-OU2-12A	6/17/1998	II/ Flush Mount	15.5	10	15.5				2	5	0-5	2	10	5-15
OLD-OU2-12B	6/17/1998	II/ Flush Mount	35.5	10	35.5				2	30	0-30	2	5	30-35
OLD-OU2-13A	6/06/98	II/ Flush Mount	14.5	10	14.5				2	4	0-4	2	10	4-14
OLD-OU2-13B	6/07/98	II/ Flush Mount	31	10	31				2	25.5	0-25.5	2	5	25.5-30.5
OLD-OU2-14A	6/17/1998	II/ Flush Mount	15.5	10	15.5				2	5	0-5	2	10	5-15
OLD-OU2-14B	6/16/1998	II/ Flush Mount	34.5	10	34.5				2	29	0-29	2	5	29-34
OLD-OU2-15A	6/08/98	II/ Flush Mount	15.5	10	15.5				2	5	0-5	2	10	5-10
OLD-OU2-15B	6/08/98	II/ Flush Mount	40.5	10	40.5				2	35	0-35	2	5	35-40
OLD-OU2-16A	6/07/98	II	14.5	10	14.5				2	4	0-4	2	10	4-14
OLD-OU2-16B	6/07/98	II	37	10	37				2	31.5	0-31.5	2	5	31.5-36.5

TABLE 3-2

WELL CONSTRUCTION DATA

OPERABLE UNIT 2
NTC, ORLANDO

Well Number	Date Installed	Well Type	Boring Depth[a] (ft bgs)	Boring Diameter (in.)	Well Depth[a] (ft bgs)	Casing			Riser			Screen		
						Diameter (in.)	Length (ft)	Interval (ft)	Diameter (in.)	Length[a] (ft)	Interval[a] (ft)	Diameter (in.)	Length (ft)	Interval[a] (ft)
OLD-OU2-17A	6/17/1998	II	14.5	10	14.5				2	4	0-4	2	10	4-14
OLD-OU2-17B	6/17/1998	II	34.5	10	34.5				2	29	0-29	2	5	29-34
OLD-OU2-18A	6/18/1998	II/ Flush Mount	14.5	10	14.5				2	4.5	0-4.5	2	10	4.5-14.5
OLD-OU2-18B	6/18/1998	II/ Flush Mount	34	10	34				2	28.5	0-28.5	2	5	28.5-33.5
OLD-OU2-19A	6/20/1998	II/ Flush Mount	15	10	15				2	4.5	0-4.5	2	10	4.5-14.5
OLD-OU2-19B	6/20/1998	II/ Flush Mount	36.5	10	36.5				2	31	0-31	2	5	31-36
OLD-OU2-20A	6/24/1998	II	15.5	10	15.5				2	8	0-5	2	10	5-15
OLD-OU2-20B	6/23/1998	II	40.5	10	40.5				2	38	0-35	2	5	35-40
OLD-OU2-21A	6/22/1998	II	17.5	10	17.5				2	10	0-7	2	10	7-17
OLD-OU2-21B	6/22/1998	II	32.5	10	32.5				2	30.5	0-27.5	2	5	27.5-32.5
OLD-OU2-22A	6/18/1998	II	18	10	18				2	10.5	0-7	2	10	7.5-17.5
OLD-OU2-22B	6/18/1998	II	33	10	33				2	30	0-27	2	5	27-32
OLD-OU2-23C	6/24/1998	II	55	10	55	6	31	0-31	2	49	0-49	2	5	49-54
OLD-OU2-24C	6/22/1998	II	64.5	10	64.5	6	37	0-37	2	59	0-59	2	5	59-64
OLD-OU2-25C	6/22/1998	II	72.5	10	72.5	6	36	0-36	2	67.5	0-67.5	2	4	67.5-71.5
OLD-OU2-26C	6/23/1998	II	60.5	10	60.5	6	36	0-36	2	55	0-55	2	5	55-60
OLD-OU2-27A	2/06/01	II	17	8.5	17				2	9	0-6	2	10	6-16
OLD-OU2-27B	2/06/01	II	32	8.25	32				2	30	0-27	2	5	27-32
OLD-OU2-28A	2/07/01	II	17	8.25	17				2	8.5	0-6	2	10	6-16
OLD-OU2-28B	2/09/01	II	32	8.25	32				2	29.5	0-27	2	5	27-32

[a] Rounded to nearest 0.5 foot.

TABLE 3-3

PRELIMINARY QUARTERLY SAMPLING LOCATIONS AND ANALYTICAL PARAMETERS

OPERABLE UNIT 2
NTC, ORLANDO

	Location	Analytical Parameters	Rationale Code
E	OLD-OU2-01B	VOCs, Fe, Mn	7
x	OLD-OU2-02A	VOCs, Fe, Mn, NA	1
	OLD-OU2-02B	VOCs, Fe, Mn, NA	1
i	OLD-OU2-03A	VOCs, Fe, Mn, NA	1
	OLD-OU2-03B	VOCs, Fe, Mn, NA	1
s	OLD-OU2-05A	VOCs, Fe, Mn	7
	OLD-OU2-05B	VOCs, Fe, Mn	7
t	OLD-OU2-06A	VOCs, Fe, Mn	7
	OLD-OU2-07B	VOCs, Fe, Mn	7
i	OLD-OU2-08A	VOCs, Fe, Mn	7
	OLD-OU2-08B	VOCs, Fe, Mn	7
n	OLD-OU2-09A[(a)]	VOCs, Fe, Mn	7
	OLD-OU2-09B[(a)]	VOCs, Fe, Mn	7
g	OLD-OU2-11A	VOCs, Fe, Mn	7
	OLD-OU2-12A	VOCs, Fe, Mn	7
	OLD-OU2-12B	VOCs, Fe, Mn	7
	OLD-OU2-13A[(a)]	VOCs, Fe, Mn	7
	OLD-OU2-13B[(a)]	VOCs, Fe, Mn	7
	OLD-OU2-14A	VOCs, Fe, Mn	7
	OLD-OU2-14B	VOCs, Fe, Mn	7
	OLD-OU2-17A[(a)]	VOCs, Fe, Mn	7
	OLD-OU2-17B[(a)]	VOCs, Fe, Mn	7
	OLD-OU2-18A	VOCs, Fe, Mn	7
	OLD-OU2-18B	VOCs, Fe, Mn, NA	1
	OLD-OU2-20A	VOCs, Fe, Mn	7
	OLD-OU2-20B	VOCs, Fe, Mn	7
	OLD-OU2-21A	VOCs, Fe, Mn, NA	3
	OLD-OU2-21B	VOCs, Fe, Mn, NA	3
	OLD-OU2-22A	VOCs, Fe, Mn	7
	OLD-OU2-22B	VOCs, Fe, Mn	7
	OLD-OU2-27A	VOCs, Fe, Mn, NA	2
	OLD-OU2-27B	VOCs, Fe, Mn, NA	2
	OLD-OU2-28A	VOCs, Fe, Mn	7
	OLD-OU2-28B	VOCs, Fe, Mn	7
	OLD-OU2-DP01A	VOCs, Fe, Mn	7
	OLD-OU2-DP01B	VOCs, Fe, Mn	7
	OLD-OU2-DP02A	VOCs, Fe, Mn	7
	OLD-OU2-DP02B	VOCs, Fe, Mn, NA	1

TABLE 3-3

PRELIMINARY QUARTERLY SAMPLING LOCATIONS AND ANALYTICAL PARAMETERS

OPERABLE UNIT 2
NTC, ORLANDO

Proposed

Location	Analytical Parameters	Rationale Code
OLD-OU2-29A	VOCs, Fe, Mn, NA	3
OLD-OU2-29B	VOCs, Fe, Mn, NA	3
OLD-OU2-30A	VOCs, Fe, Mn, NA	2
OLD-OU2-30B	VOCs, Fe, Mn, NA	2
OLD-OU2-31A	VOCs, Fe, Mn, NA	1
OLD-OU2-31B	VOCs, Fe, Mn, NA	1
OLD-OU2-32A	VOCs, Fe, Mn, NA	3
OLD-OU2-32B	VOCs, Fe, Mn, NA	3
OLD-OU2-33A	VOCs, Fe, Mn, NA	2
OLD-OU2-33B	VOCs, Fe, Mn, NA	2
OLD-OU2-34A[(b)]	VOCs, Fe, Mn	7
OLD-OU2-35B[(b)]	VOCs, Fe, Mn	7
OLD-OU2-36A[(b)]	VOCs, Fe, Mn	7
OLD-OU2-37B[(b)]	VOCs, Fe, Mn	7
OLD-OU2-SW29	VOCs, Fe, Mn, Cl^-, DO, Cond[(c)]	4
OLD-OU2-SW30	VOCs, Fe, Mn, Cl^-, DO, Cond[(c)]	5
OLD-OU2-SW31	VOCs, Fe, Mn, Cl^-, DO, Cond[(c)]	6
OLD-OU2-SW32	VOCs, Fe, Mn, Cl^-, DO, Cond[(c)]	4
OLD-OU2-SW33	VOCs, Fe, Mn, Cl^-, DO, Cond[(c)]	5
OLD-OU2-SW34	VOCs, Fe, Mn, Cl^-, DO, Cond[(c)]	4
OLD-OU2-SW35	VOCs, Fe, Mn, Cl^-, DO, Cond[(c)]	5
OLD-OU2-SW36	VOCs, Fe, Mn, Cl^-, DO, Cond[(c)]	6

Note: This location table may be updated following installation of proposed monitoring well pairs and subsequent sampling events.

Shading indicates wells that formerly produced turbid samples and may not yield acceptable samples.

(a) Off-site well.

(b) Replacements for wells historically producing high turbidity samples. Wells 34A, 35B, 36A, and 37B replace wells 01A, 06B, 07A, and 11B, respectively.

(c) Dissolved oxygen (DO) and conductivity (Cond) will be determined in the field using test kit, field instrument, and/or in-line flow-through cell data.

Rationale Code

1. Downgradient well (i.e., groundwater discharge area along canal).
2. In-plume well (groundwater flow in or beneath known or suspected landfill area).
3. Upgradient control well (i.e., groundwater recharge area).
4. Up-stream surface water control location.
5. In-stream groundwater plume discharge area.
6. Down-stream surface water location (i.e., monitor for off-site impacts).
7. Wells included in comprehensive sampling events only.

n11x17v.dgn

POND
SWAMP/ WOODS
P3 N
P3 S
NO. 9
P2
DRIVING RANGE
OLD-OU2-01B
OLD-OU2-01A(34A)
SG1
SG2
SW29
SWAMP/ WOODS
P4
OLD-OU2-02A
OLD-OU2-02B
NO. 8
OLD-OU2-03A
OLD-OU2-03B
MW30
MW29
SW30
OLD-OU2-22A
P22 N
P22 S
P6
SG3
OLD-OU2-22B
OLD-OU2-23C
P5
OLD-OU2-04A
OLD-OU2-04B
POND
NO. 1
OLD-OU2-24C
P12
P7
SWAMP/ WOODS
SG4
NO. 6
OLD-OU2-05B
OLD-OU2-05A
P8 N
P8 S
NO. 5
SG10
P9
MARSH
NO. 7
OLD-OU2-08B
OLD-OU2-08A
NO. 3
SG11
SG6
OLD-OU2-11A
OLD-OU2-11B(37B)
NO. 4
P10
P11
P17
SG5
POND
SW32
OLD-OU2-09B
OLD-OU2-09A
NO. 2
OLD-OU2-06B (35B)
OLD-OU2-06A
SG8
SW31
OLD-OU2-07A (36A)
OLD-OU2-07B
P17
WOODS
P23
OLD-OU2-12B
OLD-OU2-12A
OLD-OU2-10A
OLD-OU2-10B
OLD-OU2-21B
OLD-OU2-27B
OLD-OU2-13B
P16
OLD-OU2-27A
MW31
SW33
OLD-OU2-13A
OLD-OU2-21A
P15
P14 W
P14 E
OLD-OU2-14A
OLD-OU2-14B
OLD-OU2-28B
SG7
OLD-OU2-28A
OLD-OU2-DP01A
OLD-OU2-DP01B
OLD-OU2-15B
OLD-OU2-15A
P18
OLD-OU2-26C
P19
SW34
OLD-OU2-18A
OLD-OU2-18B
MW32
OLD-OU2-25C
SW35
OLD-OU2-DP02A
OLD-OU2-DP02B
P20
MW33
OLD-OU2-16B
OLD-OU2-16A
OLD-OU2-17B
OLD-OU2-17A
BOGGY
CREEK
ROAD
WOODS
SW36
OLD-OU2-19A
OLD-OU2-20A
SG9
OLD-OU2-19B
OLD-OU2-20B
TRADEPORT
DRIVE
P21 N
P21 S
-N-
400 0 400
SCALE IN FEET

LEGEND

LOCATIONS TO BE SAMPLED	✳
PROPOSED MONITORING WELL PAIR	◎
PROPOSED SURFACE WATER SAMPLE	△
SHALLOW MONITORING WELL	OLD-OU2-09A
INTERMEDIATE MONITORING WELL	OLD-OU2-08B
DEEP MONITORING WELL	OLD-OU2-26C
STAFF GAUGE	SG6
PIEZOMETER	P11
REPLACEMENT WELL NUMBER	(34A)

FIGURE 3-1
COMPREHENSIVE QUARTERLY SAMPLING LOCATIONS
OPERABLE UNIT 2 - McCOY ANNEX

NAVAL TRAINING CENTER
ORLANDO, FLORIDA

Rev. 1
02/08/02

CAD FILE NO./DATE: k:\dgn\navy\orlando\sites\ou2\ou2-029.dgn/2-8-02 WORK PLAN FOR NEW WELL INSTALLATION AND GROUNDWATER SAMPLING

POND
SWAMP/ WOODS
P3 N
P3 S
NO. 9
P1
P2
DRIVING RANGE
OLD-0U2-01B
OLD-0U2-01A(34A)
SG1
SG2
SW29
SWAMP/ WOODS
P4
OLD-0U2-02A
OLD-0U2-02B
NO. 8
OLD-0U2-03A
OLD-0U2-03B
MW30
MW29
SW30
OLD-0U2-22A
P22 N
P22 S
P6
SG3
OLD-0U2-22B
OLD-0U2-23C
P5
OLD-0U2-04A
OLD-0U2-04B
POND
NO. 1
OLD-0U2-24C
P12
P7
SWAMP/ WOODS
SG4
NO. 6
OLD-0U2-05B
OLD-0U2-05A
P8 N
P8 S
NO. 5
SG10
P9
MARSH
NO. 7
OLD-0U2-08B
OLD-0U2-08A
NO. 3
SG11
SG6
OLD-0U2-11A
OLD-0U2-11B(37B)
NO. 4
P10
P11
P13
SG5
NO. 2
OLD-0U2-06B (35B)
OLD-0U2-06A
POND
SW32
OLD-0U2-09B
OLD-0U2-09A
P17
SG8
SW31
OLD-0U2-07A (36A)
OLD-0U2-07B
OLD-0U2-12B
OLD-0U2-12A
OLD-0U2-10A
WOODS
P23
OLD-0U2-10B
OLD-0U2-21B
OLD-0U2-27B
OLD-0U2-13B
P16
OLD-0U2-27A
MW31
SW33
OLD-0U2-13A
OLD-0U2-21A
P15
P14 W
P14 E
OLD-0U2-14A
OLD-0U2-14B
OLD-0U2-28B
SG7
OLD-0U2-28A
OLD-0U2-DP01A
OLD-0U2-DP01B
OLD-0U2-15B
OLD-0U2-15A
P18
OLD-0U2-26C
MW32
P19
SW34
OLD-0U2-18A
OLD-0U2-18B
OLD-0U2-25C
SW35
OLD-0U2-DP02A
OLD-0U2-DP02B
P20
MW33
OLD-0U2-16B
OLD-0U2-16A
OLD-0U2-17B
OLD-0U2-17A
BOGGY CREEK ROAD
WOODS
TRADEPORT DRIVE
SW36
OLD-0U2-19A
OLD-0U2-20A
SG9
OLD-0U2-19B
OLD-0U2-20B
P21 N
P21 S
-N-
400 0 400
SCALE IN FEET

LEGEND

LOCATIONS TO BE SAMPLED	✳
PROPOSED MONITORING WELL PAIR	◎
PROPOSED SURFACE WATER SAMPLE	△
SHALLOW MONITORING WELL	OLD-0U2-09A
INTERMEDIATE MONITORING WELL	OLD-0U2-08B
DEEP MONITORING WELL	OLD-0U2-26C
STAFF GAUGE	SG6
PIEZOMETER	P11
REPLACEMENT WELL NUMBER	(34A)

FIGURE 3-2
ROUTINE QUARTERLY SAMPLING LOCATIONS
OPERABLE UNIT 2 - McCOY ANNEX

NAVAL TRAINING CENTER
ORLANDO, FLORIDA

Rev. 1
02/08/02

3.1 PURGING PROCEDURES FOR MONITORING WELLS

Peristaltic pumps using dedicated Teflon® or Teflon®-lined discharge tubing will be used for both purging and sampling of the wells. In-line flow-through cells will be used for real-time groundwater parameter monitoring. The monitoring wells will be purged using micro-flow purging techniques prior to sampling. The steps listed below are to be followed for the purging procedure.

1. The water level will be measured and recorded prior to placing the tubing into the well.
2. The discharge tubing will be lowered into the well as slowly as possible to minimize disturbance to the water in the well.
3. The end of the tubing will be positioned at the midpoint of the saturated screen length. The end of the tubing will be kept at least 2 feet above the bottom of the well to minimize mobilization of any particulates present (where practical).
4. The water level will be measured and recorded before starting the pump.
5. Purging will begin with the pump at the lowest setting. The operator will slowly increase the pump speed until discharge occurs.
6. The water level will be checked again. The pumping rate will be adjusted until there is little or no water level drawdown. Drawdown should be less than 0.3 foot unless site conditions warrant a change. If the least drawdown that can be achieved exceeds 0.3 foot but remains stable, the purging procedure will continue.
7. The water level and pumping rate will be monitored and recorded every 3 to 5 minutes during purging. Pumping rate adjustments will be recorded (both time and flow rate). Adjustments are best made during the first 15 minutes of pumping to minimize purging time. During pump start-up, drawdown may exceed the 0.3 foot target and then recover as pump flow adjustments are made. Unless site conditions warrant a change, purging will proceed at a maximum of 100 mL/min.
8. Field parameters will be monitored and recorded every 3 to 5 minutes to document stabilization. Note that during the early phase of purging, emphasis will be placed on minimizing and stabilizing pumping stress and recording those adjustments.
9. Purging will be considered complete when temperature, specific conductance, pH, oxidation reduction potential (ORP), and DO have stabilized and turbidity has either stabilized or is below 10 NTUs (USEPA, 1996). Stabilization is considered to be achieved when three consecutive readings, taken at 3- to 5-minute intervals, are within the limits listed below. If turbidity is greater than 10 NTUs and has

not decreased significantly after 60 minutes, purging will be discontinued and sample collection may be performed at the discretion of the TOM.

Parameter	Unit	Limit
Temperature	Degrees Fahrenheit or Celsius (°F or °C)	± 5%
Specific Conductance	Micro-siemens/centimeter (µs/cm)	± 5%
pH	Standard Unit (SU)	± 0.1
Oxidation Reduction Potential (ORP)	Millivolts (mV)	± 5%
Dissolved Oxygen (DO)	Milligrams per liter (mg/L)	± 5%
Turbidity	Nephelometric Turbidity Unit (NTU)	± 5% for values > 7 ± 10% for values < 7

3.2 SAMPLING PROCEDURES

Both monitoring well and surface water samples will be collected during the sampling events identified in this work plan. Samples are to be collected and analyzed in accordance with the guidance and instructions provided in the following sections.

3.2.1 Monitoring Well Sampling

When purging is complete, the flow-through cell will be disconnected and sample bottles will be filled directly from the Teflon® or Teflon®-lined tubing. Samples for iron and manganese analyses will be collected first by allowing the pump discharge to flow into the sample bottle. Samples for Target Compound List (TCL) VOCs will be collected last, using the tube evacuation method.

3.2.2 Surface Water Sampling

Surface water sampling will begin at the location farthest downstream and proceed upstream. The samples will be collected by first rinsing the sample bottles with the surface water, then immersing the inverted sample bottles below the surface of the water to avoid collecting floating debris. The inverted bottles will be turned upright and pointed upstream. The sampling equipment and sampling personnel will be positioned downstream of the sampling location. Only unpreserved bottles will be used and samples will be preserved as required in the field following collection.

3.2.3 Sample Shipping

VOC samples, with accompanying trip blanks, and inorganic samples will be shipped via overnight courier on a daily basis to the subcontract fixed-base analytical laboratory. The shipping address and contact information will be provided in the Field Instruction to be prepared for each field event.

3.3 SAMPLE NUMBERING

The monitoring well samples will be numbered as follows:

NTCOU2*TDDDRR*

where: NTC = Naval Training Center
OU2 = Operable Unit 2 designation (OU2)
T = sample type ("G" for groundwater, "D" for duplicate)
DDD = well location and screen depth designation (e.g., 18B)
RR = sampling round number (e.g., 10)

For example, the sample collected from monitoring well OLD-OU2-18B will be designated as NTCOU2G18B10 (assuming the sampling round is number 10). Dashes will not be used in the sample numbers. Samples for field duplicates will be identified with a "blind" number (e.g., for round 10 the first duplicate would be NTCOU2D00110, the second would be NTCOU2D00210). The corresponding environmental sample will be noted in the field logbook. The TOM will identify the appropriate sampling round number.

The surface water samples will be numbered as follows:

NTCOU2TTDDRR

where: NTC = Naval Training Center
OU2 = Operable Unit 2 designation (OU 2)
TT = sample type ("SW" for surface water, "D" for duplicate)
DD = sample location (e.g., 16)
RR = sampling round number (e.g., 10)

For example, the sample collected from surface water sample location 16 will be designated as NTCOU2SW1610 (assuming the sampling round is number 10). Dashes will not be used in the sample numbers. Samples for field duplicates will be identified with a "blind" number as indicated above. The corresponding environmental sample will be clearly identified in the field logbook. The TOM will identify the appropriate sampling round number.

3.4 QUALITY CONTROL SAMPLES

Quality control (QC) samples will be collected at the frequencies listed below.

- One field duplicate per 10 environmental samples.
- One trip blank per cooler containing samples for VOC analysis.
- One matrix spike/matrix spike duplicate (MS/MSD) per 20 environmental samples.
- One field blank of each potable water source used during well construction.

"MS/MSD" will be added to the sample number on the labels and the chain-of-custody. New sample numbers will not be created for these samples. MS/MSD samples will be collected in the field and will require 3X sample volume for each set (1X for environmental sample, 1X for MS sample, and 1X for MSD sample).

If any nondisposable sampling equipment is used and decontaminated, the additional QC samples listed below will be collected.

- One rinsate blank per 10 environmental samples.
- One field blank from each water source used for decontamination.

3.5 CHEMICAL ANALYSES AND BOTTLE REQUIREMENTS

The analytical laboratory, specific analyses, methods, bottle requirements, and preservatives for the groundwater and surface water sampling will be provided in the Field Instruction to be prepared for each field event.

3.6 SAMPLING FOR NATURAL ATTENUATION PARAMETERS

NA parameters of interest will be collected during each quarterly sampling event. The analyses to be conducted, analytical methods, and other technical guidance regarding this sampling are provided in Table 3-5. The samples to be analyzed for biogenic gases will be shipped via overnight courier to the subcontract biogenic gases laboratory. The shipping address and contract information will be provided in the Field Instruction to be prepared for each field event.

The samples will be collected using gas strippers and containers supplied by the subcontract biogenic gases laboratory. Liquid samples will be packed in ice-chilled coolers. Vapor samples may be included with liquid samples or shipped separately in containers without ice.

TABLE 3-4

NATURAL ATTENUATION PARAMETERS AND METHODS FOR GROUNDWATER SAMPLING

OPERABLE UNIT 2 NTC, ORLANDO

ANALYTICAL PARAMETER	METHOD	GUIDANCE
SAMPLES TO BE SHIPPED TO ANALYTICAL LABORATORY		
Alkalinity	Laboratory	USEPA Method E310.1
Iron and manganese (dissolved)	Laboratory	Filter in the field (0.45μ)
Cations and anions: NO_2, NO_3, NH_4, Cl, PO_4, SO_4	Laboratory	USEPA 300 series; 48-hour hold time for nitrate and nitrite
Dissolved organic carbon (DOC)	Laboratory	USEPA 415.1; sample from one or more clean, upgradient well(s). Filter in the field (0.45μ)
Fraction of organic carbon (FOC) in soil[(a)]	Laboratory	SW-846 Method 9060 modified; sample of aquifer matrix from one or more clean, upgradient location(s)
SAMPLES TO BE SHIPPED TO BIOGENIC GASES LABORATORY		
Biogenic gases: H_2, DO, CO_2, N_2, ethene, ethane, methane	Field gas extraction; laboratory analysis of fixed gases and light hydrocarbons	Extraction and analysis using biogenic gases laboratory proprietary methodology
FIELD ANALYSES		
pH, conductivity, ORP, temperature, turbidity	Flow-through cell	Recorded during well purging
Carbon dioxide	Field Test Kit	HACH kit CA-DT; to confirm biogenic gas results
Dissolved oxygen (DO)	Field Meter and Field Test Kit	Previous data show DO <1 mg/L; will verify with CHEMetrics field kits K-7501 (<1 mg/L) and K7512 (>1 mg/L); to confirm biogenic gas results
$Iron^{+2}$ (ferrous)	Field Test Kit	Filter in the field if NTU >20 HACH kit IR-18C
Sulfide	Field Test Kits for Hydrogen Sulfide and Total Sulfide	HACH kits HS-C and HS-WR

[(a)] Samples for FOC analysis are to be collected during drilling for monitoring well installation.

4.0 DECONTAMINATION

Decontamination of any nondedicated sampling equipment used will be performed in accordance with procedures specified in the POP (ABB-ES, 1997) unless otherwise specified herein.

Dedicated Teflon® or Teflon®-lined tubing will be used for sampling organic parameters and dedicated polyethylene tubing may be used for all other analyte sample collection. Peristaltic pumps will be used for the well purging and sampling. If redevelopment is required for problematic monitoring wells, centrifugal pumps will be used down hole. Downhole pumps, if used, will be decontaminated using the following steps:

1. Decontaminate the outside of the pump using the procedure listed below for miscellaneous equipment.

2. Pump approximately 5 gallons of potable water and Alconox through the pump and discharge tubing.

3. Pump approximately 1 gallon of analyte-free water through the pump and discharge tubing.

4. Wrap decontaminated downhole equipment in aluminum foil to prevent contamination during storage or transport.

All other sampling tools and miscellaneous sampling equipment will be decontaminated using the following steps:

1. Wash with potable water and Alconox.
2. Rinse thoroughly with potable water.
3. Rinse with deionized water or analyte-free water.
4. Rinse with isopropanol.
5. Rinse with analyte-free water and air dry.
6. Wrap with aluminum foil.

5.0 DATA QUALITY

5.1 DATA QUALITY OBJECTIVES (DQOs)

DQOs are qualitative or quantitative statements developed by the data user to specify the quality of data needed from a particular data activity to support specific decisions. The DQOs are the starting point in the design of an investigation. The DQO development process matches sampling and analytical capabilities to the data targeted for specific uses and ensures that the quality of the data satisfies project requirements.

The DQOs for laboratory analyses (other than for NA parameters) will be characterized by rigorous quality assurance (QA)/QC protocols and documentation, providing technically defensible analytical data. The intended uses of the data are to evaluate the progress of NA of contaminants in groundwater and to confirm the ability of NA to meet the remedial alternative goals.

Field test kit analyses are sufficiently reliable for NA parameters. Fixed-base laboratory analyses will be used for NA parameter analyses that cannot be easily or accurately performed in the field. These data will be used to evaluate the progress of NA at OU 2.

The objective of the hydrogeologic and analytical data collected will be to evaluate groundwater migration, flow gradients, and geochemistry to determine if exposure potential from contaminant plumes exists and to predict if contaminant migration will occur in the future. NA parameters are collected to provide an accurate estimate of the potential for natural processes such as biodegradation to reduce contaminant concentrations in groundwater.

5.2 DATA VALIDATION

The approach to providing reliable data that meet the DQOs will include QA/QC requirements for each of the VOC and inorganic analytical data types generated during the field investigation. The QA/QC efforts for laboratory analyses will include collection and submittal of QC samples and the assessment and validation of data from the subcontract laboratory.

Data quality indicators include the precision, accuracy, representativeness, comparability, and completeness (PARCC) parameters. These parameters will be used within the data validation process to evaluate data quality. The data will be validated in accordance with the U.S. Environmental Protection Agency (USEPA) *Contract Laboratory Program National Functional Guidelines for Organic Data Review*

(USEPA, 1999) and the Naval Facilities Engineering Service Center (NFESC) guidelines contained in *Navy Installation Restoration Chemical Data Quality Manual* (NFESC, 1999).

Limited data validation will be performed on all laboratory data and will evaluate data completeness, holding time compliance, calibration compliance, laboratory blank contamination, and detection limits. This type of validation will be performed primarily to eliminate false positives and false negatives. No validation will be performed for field test kit data.

6.0 INVESTIGATION-DERIVED WASTE (IDW) MANAGEMENT

Drill cuttings, development water, and decontamination fluids will be drummed separately in containers provided by the drilling subcontractor. Field personnel will use a paint stick or other permanent marker to label the drums with the following information:

- Identification Number (TtNUS-OU2-XXX). Example TtNUS-OU2-18B for wastes derived from monitoring well 18B
- Company name (Tetra Tech NUS)
- Base contact (Barbara Nwokike) and phone number (407-895-6714)
- Site (OU2)
- Material contained in the drum (e.g., soil cuttings or decontamination fluids)
- Date the IDW was produced

Upon completion of activities, field personnel will assure that drum lids and bungs are secure and have the drums moved to the McCoy Annex drum storage area. Miscellaneous sampling materials (gloves, tubing, and plastic) will be bagged and disposed of as refuse in dumpsters located outside the NTC field office.

7.0 LOGBOOKS AND FORMS

7.1 SITE LOGBOOK

The site logbook is a hard-bound, paginated, controlled-distribution record book in which all major on-site activities are documented. The following information will be recorded in the site logbook in real time on a daily basis:

- Study Area, Operable Unit, or tank site.
- All field personnel present.
- Arrival/departure of site visitors.
- Arrival/departure of major equipment.
- Start/completion of borehole/monitoring well installation or sampling event.
- Weather conditions.
- Health and safety issues including daily safety meetings.
- Problems encountered.
- Deviations from standard operating procedures and documentation explaining rationale.
- Record of pertinent phone calls.
- Sampling information including sample number, date and time of collection, analyses to be performed, and the chain-of-custody number.
- Documentation of decontamination activities.
- Documentation of sample storage and shipping information, including all sample numbers and the shipper's airbill number used for each shipment.
- IDW information (location where IDW originated, material in the drums, date produced, and location where drums were left).
- Signature and date at the completion of daily entries.

7.2 FIELD FORMS

All pertinent information gathered during the monitoring well installation and sampling activities -- including installation, development, water elevation surveys, purging, and sampling -- will be written in detail on boring logs, well construction logs, water elevation survey logs, and purging/sampling logs. In addition to the general entries placed into the logbook, detailed entries will be made on the purge/sample forms and will include (at a minimum) those items listed below:

- Date of purging/sampling.
- Personnel performing the purging/sampling.
- Groundwater elevation measurements (depths below top of well casings) prior to placing the tubing in the well and again prior to pump startup.
- Time, water level, and flow rate during purging (at 3- to 5-minute intervals, or as appropriate).
- Time and values of field parameters during purging (at 3- to 5-minute intervals after drawdown stabilization, or as appropriate).
- Estimated volume of purge water, time, sample number, and all analytical parameters during sampling.
- Duplicate sample numbers.

Copies of the required forms are enclosed as Appendix A.

8.0 REPORTING

Letter reports will be provided quarterly unless otherwise directed by the OPT. The reports will include tables to provide water level and analytical results. Water level maps will be prepared for the shallow and intermediate zones of the surficial aquifer. Maps will also be provided to show the results of the groundwater and surface water sampling.

An evaluation of NA and an analysis of trends in contamination concentrations will be included. Sampling forms and other applicable field information will also be provided.

9.0 CONTACTS

The following personnel are approved contacts for their respective project areas.

Project Area	Responsible Personnel	Phone Number
Base Contact	Barbara Nwokike (SOUTHDIV/Charleston)	407-895-6714 or 843-820-5566
Task Order Management	Steve McCoy	865-220-4730
Technical Issues	Michael Campbell or Allan Jenkins	865-220-4714 or -4724
Health & Safety	Matt Soltis	412-921-8912
Procurement	Sandy D'Alessandris	412-921-8435
Laboratory Services	(a)	(a)
Analytical Issues	Joe Samchuck	412-921-8510
Drilling Contractor	(a)	(a)
Off-site Well Access	Steve Pue, GOAA	407-825-3463

(a)To be provided in the Field Instruction for each field event.

REFERENCES

ABB-ES (ABB Environmental Services), 1997. *Project Operations Plan for Site Investigations and Remedial Investigations, Volume I*, Naval Training Center, Orlando, Florida, Unit Identification Code N65928, Navy CLEAN District 1, Contract No. N62467-89-D-0317/017, August.

Bechtel (Bechtel Environmental, Inc.), 2000. *Completion Report for Site OU2, McCoy Annex, Naval Training Center, Orlando, Florida*, March 3.

Johnson, C.C., & Associates, 1985. *Initial Assessment Study*, Naval Training Center, Orlando, Florida. Prepared for Navy Assessment and Control of Installation Pollutants Program, Naval Energy and Environmental Support Activity, Port Heuneme, California, September 29.

NFESC (Naval Facilities Engineering Service Center), 1999. *Navy Installation Restoration Chemical Data Quality Manual*, September.

SOUTHDIV (Southern Division), Naval Facilities Engineering Command, 1997. *Monitoring Well Design, Installation, Construction, and Development Guidelines* (Interim Final), Rev. 0, March 27.

Tetra Tech NUS, Inc. (TtNUS), 2001a. *Remedial Investigation Report for Operable Unit 2*, McCoy Annex Landfill, Naval Training Center, Orlando, Florida, Rev. 2, March.

TtNUS, 2001b. *Health and Safety Plan for Performing Investigative Work and Data Sampling,* Naval Training Center, Orlando, Florida, Contract No. N62467-94-D-0888, April.

TtNUS, 2001c. *Feasibility Study for Operable Unit 2*, McCoy Annex Landfill, Naval Training Center, Orlando, Florida, August.

USEPA (U.S. Environmental Protection Agency), 1996. *Environmental Investigations, Standard Operating Procedures and Quality Assurance Manual* including 1997 revisions. Region 4 Science and Ecosystem Support Division, Enforcement and Investigation Branch, May.

USEPA, 1999. *Contract Laboratory Program National Functional Guidelines for Organic Data Review.* EPA/540/R-99/008. Office of Solid Waste and Emergency Response, Washington, D.C., October.

APPENDIX A

FIELD FORMS

Tetra Tech NUS, Inc.

WELL COMPLETION FORM

JOB NAME:

JOB NUMBER:	PROJECT MANAGER:
LOGGED BY:	EDITED BY:
WELL NAME:	DATE:
DRILLING COMPANY:	
EQUIPMENT:	DRILLER:

☐ ____ INCH HOLLOW STEM AUGER

☐ ____ INCH ROTARY WASH

HOURS DRILLED:

GALLONS OF WATER USED DURING DRILLING:

METHOD OF DECONTAMINATION PRIOR TO DRILLING:

DEVELOPMENT

METHOD OF DEVELOPMENT:

DEVELOPMENT BEGAN DATE: TIME:

YEILD: ____ GPM	TIME: FROM	TO	DATE:
YEILD: ____ GPM	TIME: FROM	TO	DATE:
YEILD: ____ GPM	TIME: FROM	TO	DATE:

TOTAL WATER REMOVED DURING DEVELOPMENT: GALLONS

DESCRIPTION OF TURBIDITY AT END OF DEVELOPMENT: ☐ CLEAR ☐ SLIGHTLY CLOUDY ☐ MOD. TURBID ☐ VERY MUDDY

ODOR OF WATER:

WATER DISCHARGED TO: ☐ GROUND SURFACE ☐ TANK TRUCK ☐ STORM SEWERS ☐ STORAGE TANK ☐ DRUMS ☐ OTHER

MATERIALS USED

____ SACKS OF ____ SAND

____ SACKS OF ____ CEMENT

____ GALLONS OF GROUT USED

____ SACKS POWDERED BENTONITE

____ POUNDS OF BENTONITE PELLETS

____ FEET OF ____ INCH PVC BLANK CASING

____ FEET OF ____ INCH PVC SLOTTED SCREEN

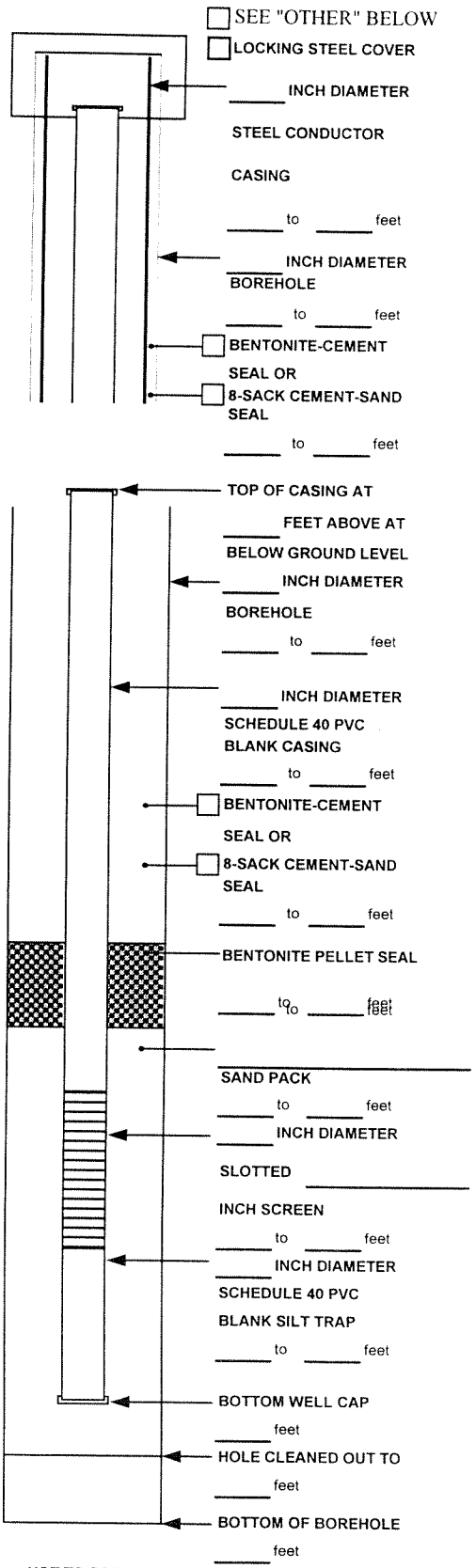
____ YARD3 CEMENT-SAND (REDI-MIX) ORDERED

____ YARDS3 CEMENT-SAND (REDI-MIX) USED

CONCRETE PUMPER USED? ☐ NO ☐ YES

NAME

WELL COVER USED: ☐ LOCKING STEEL COVER ☐ CHRISTY BOX ☐ OTHER



NOT TO SCALE

ADDITIONAL INFORMATION:

Tetra Tech NUS, Inc.

MONITORING WELL DEVELOPMENT RECORD

Well: _____ Depth to Bottom (ft.): _____ Responsible Personnel: _____
Site: _____ Static Water Level Before (ft.): _____ Drilling Co.: _____
Date Installed: _____ Static Water Level After (ft.): _____ Project Name: _____
Date Developed: _____ Screen Length (ft.): _____ Project Number: _____
Dev. Method: _____ Specific Capacity: _____
Pump Type: _____ Casing ID (in.): _____

Time	Estimated Sediment Thickness (Ft.)	Cumulative Water Volume (Gal.)	Water Level Readings (Ft. below TOC)	Temperature (Degrees C)	pH	Specific Conductance (Units _____)	Turbidity (NTU)	Remarks (odor, color, etc.)

Tetra Tech NUS, Inc.

GROUNDWATER SAMPLE LOG SHEET

Project Site Name: _____
Project No.: _____

[] Domestic Well Data
[] Monitoring Well Data
[] Other Well Type: _____
[] QA Sample Type: _____

Sample ID No.: _____
Sample Location: _____
Sampled By: _____
C.O.C. No.: _____
Type of Sample:
[] Low Concentration
[] High Concentration

SAMPLING DATA:

Date: / Time: / Method:	Color (Visual)	pH (S.U.)	S.C. (mS/cm)	Temp. (^{0}C)	Turbidity (NTU)	DO (mg/l)	Salinity (%)	Other

PURGE DATA:

Date:	Volume	pH	S.C.	Temp.	Turbidity	DO	Salinity	Other
Method:								
Monitor Reading (ppm):								
Well Casing Diameter & Material								
Type:								
Total Well Depth (TD):								
Static Water Level (WL):								
One Casing Volume(gal/L):								
Start Purge (hrs):								
End Purge (hrs):								
Total Purge Time (min):								
Total Vol. Purged (gal/L):								

SAMPLE COLLECTION INFORMATION:

Analysis	Preservative	Container Requirements	Collected

OBSERVATIONS / NOTES:

Circle if Applicable:

MS/MSD	Duplicate ID No.:

Signature(s):

Tetra Tech NUS, Inc.

GROUNDWATER LEVEL MEASUREMENT SHEET

Project Name: _____ **Project No.:** _____

Location: _____ **Personnel:** _____

Weather Conditions: _____ **Measuring Device:** _____

Tidally Influenced: Yes ____ No ____ **Remarks:** _____

Well or Piezometer Number	Date	Time	Elevation of Reference Point (feet)*	Total Well Depth (feet)*	Water Level Indicator Reading (feet)*	Thickness of Free Product (feet)*	Groundwater Elevation (feet)*	Comments

* All measurements to the nearest 0.01 foot

CALIBRATION FORM

Project Name _____ **Instrument Make** _____

Site Name: _____ **Instrument Model** _____

Project No.: _____ **Serial # (probe/meter)** _____ /

Date	Time	Name	PH	Conductivity	Dissolved O_2	ORP	Temp	Other	Comments

Tetra Tech NUS, Inc.

BORING LOG

PROJECT NAME: _____ BORING No.: _____

PROJECT NUMBER: _____ DATE: _____

DRILLING COMPANY: _____ GEOLOGIST: _____

DRILLING RIG: _____ DRILLER: _____

Sample No. and Type or RQD	Depth (Ft.) or Run No.	Blows / 6" or RQD (%)	Sample Recovery / Sample Length	Lithology Change (Depth/Ft.) or Screened Interval	MATERIAL DESCRIPTION: Soil Density/ Consistency or Rock Hardness	MATERIAL DESCRIPTION: Color	MATERIAL DESCRIPTION: Material Classification	USCS *	Remarks	PID/FID Reading (ppm): Sample	PID/FID Reading (ppm): Sampler BZ	PID/FID Reading (ppm): Borehole**	PID/FID Reading (ppm): Driller BZ**

* When rock coring, enter rock brokeness.

** Include monitor reading in 6 foot intervals @ borehole. Increase reading frequency if elevated reponse read.

Drilling Area Background (ppm): ____

Remarks: _____

Converted to Well: Yes _____ No _____ Well I.D. #: _____