

WORK PLAN ADDENDUM
for
**AREA B HYDROGEOLOGIC
INVESTIGATION**
NAWC Warminster, Pennsylvania



Northern Division
Naval Facilities Engineering Command

Contract No. N62472-90-D-1298

Contract Task Order 0134

October 1993

WORK PLAN ADDENDUM
FOR
AREA B HYDROGEOLOGIC INVESTIGATION
NAWC WARMINSTER, PENNSYLVANIA

COMPREHENSIVE LONG-TERM
ENVIRONMENTAL ACTION NAVY (CLEAN) CONTRACT

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1.0 INTRODUCTION

1.1 PURPOSE

Halliburton HNUS Corporation (HNUS) is submitting this work plan in response to Contract Task Order (CTO) No. 0134 under Navy Contract N62472-90-D-1298. This work is part of the Navy's Installation Restoration (IR) and CERCLA program, which is designed to identify contamination of Navy and Marine Corps facilities resulting from past operations and to institute corrective measures, as needed.

This work plan is part of continuing IR and CERCLA remedial investigation (RI) work at the Naval Air Warfare Center (NAWC) Warminster in Warminster, Pennsylvania (see Figure 1-1). In particular, this document describes additional RI work that will help further identify the nature and extent of groundwater contamination attributable to Area B (Sites 5, 6, and 7) and past activities that have occurred on NAWC Warminster property east of Area B. The statement of work outlining the proposed technical approach to this investigation was presented to a technical subgroup of the Technical Review Committee (TRC) on July 6, 1993 and to the entire TRC at the meeting of July 8, 1993. The scope of future CERCLA RI activities addressing groundwater associated with Area B and the vicinity of Area B, including groundwater in deep bedrock, shall be developed utilizing data generated by activities described in this work plan.

Upon completion of the Phase II RI for NAWC Warminster, an RI report for Operable Unit 1 (OU-1) was issued in April 1993. OU-1 has been defined as contaminated groundwater attributable to Areas A and B at NAWC Warminster in overburden and shallow bedrock aquifers. Findings of the Phase II RI for Area B included the detection of volatile organic compounds (VOCs) in overburden and shallow bedrock aquifers on NAWC Warminster property. In response to these findings, the United States Environmental Protection Agency (EPA) requested the Navy to conduct sampling of off-site residential wells within an approximate 3,000-foot radius of Area B. Sampling by the Navy in response to this request identified VOCs in approximately 30 residential wells above Maximum Contaminant Levels (MCLs) established under the Safe Drinking Water Act. The Area B hydrogeologic investigation for which this work plan has been prepared will further assess the potential impacts of Area B and past activities on NAWC property east of Area B on groundwater resources.

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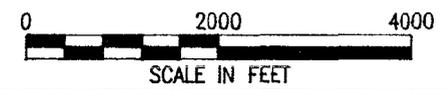
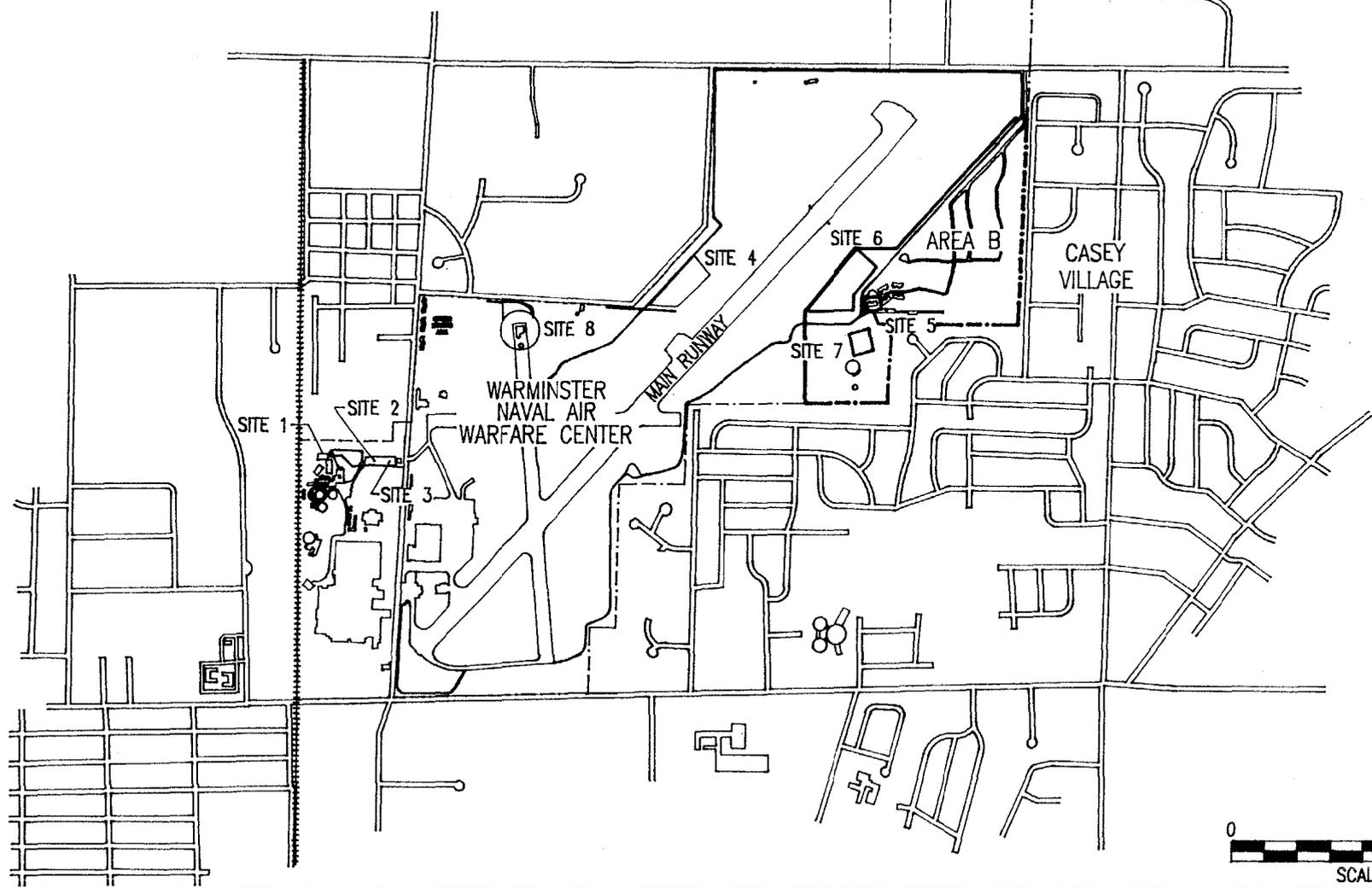


FIGURE 1-1

AREA B
NAVAL AIR WARFARE CENTER WARMINSTER, PENNSYLVANIA



This work plan is being prepared as an addendum to the work plan generated for the Phase II RI activities conducted at the NAWC Warminster under CTO 0022 (HNUS, 1992). The investigative field tasks described in this current work plan are similar in nature to those conducted during the previous field work. Therefore, the Phase II RI work plan will be referenced throughout this document.

The objectives of the Area B hydrogeologic investigation are summarized as follows:

- Further characterize the lateral and vertical extent of groundwater contamination underlying the vicinity of Area B eastward to the Shenandoah Woods area to the approximate subsurface depths of the Casey Village residential wells, or 150 feet.
- Determine the lateral and vertical components of groundwater flow in these areas to a subsurface depth of 150 feet.
- Collect information regarding aquifer characteristics (e.g., hydraulic conductivity, aquifer interconnection) to a subsurface depth of 150 feet.
- Develop an aquifer pumping test scope of work. The full scope and design of the pumping test is not included as part of this work plan.

The specific tasks to be performed under this work plan include

- Drilling and installing 27 on-base monitoring wells
- Sampling 36 monitoring wells (the 27 new wells plus nine existing wells)
- Obtaining nine subsurface soil samples from the soil/bedrock interface
- Conducting analytical data validation and interpretation
- Conducting long-term (three-week) groundwater-level monitoring

1.2 ORGANIZATION

This report consists of five sections. Section 1.0 is the introduction. Section 2.0 presents the site background information. Section 3.0 provides the scoping of the hydrogeologic investigation. Section 4.0 describes the specific tasks to be conducted to meet the Work Plan objectives. Section 5.0 provides the management structure and planned schedule of activities. The Quality Assurance Project Plan (QAPP) for these activities is issued as a separate document. The Health and Safety Plan (HASP) is included as a separate document.

2.0 SITE BACKGROUND INFORMATION

NAWC Warminster is situated on approximately 734 acres in the township of Warminster, Bucks County, Pennsylvania. The facility lies in a populated suburban area surrounded by private homes, various commercial and industrial activities, and a golf course. On-base areas include various buildings and other complexes connected by paved roads, the runway and ramp area, mowed fields, and a small wooded area.

Commissioned in 1944, NAWC Warminster's primary function is research, development, testing, and evaluation for naval aircraft systems. Historically, wastes were generated during aircraft maintenance and repair, pest control, firefighting training, machine and plating shop operations, spray painting, and various materials research and testing activities in laboratories. These wastes included paints, solvents, sludges from industrial wastewater treatment, and waste oils.

EPA officially recognized the possible need for investigation at NAWC Warminster in September 1979. NAWC Warminster was proposed for inclusion on the National Priorities List (NPL) in 1986 and was formally placed on the NPL on October 4, 1989. Numerous environmental investigations have occurred at the facility (see HNUS, 1993, Chapter 1, for a detailed listing and discussion of these investigations).

For the Phase II RI, HNUS (1993) combined Sites 5 (the south runway landfill), 6 (the waste pit no. 3), and 7 (the sludge pits) into the general heading of Area B due to the sites' geographic proximity. Groundwater samples from this area were obtained from overburden and shallow bedrock (generally less than 50 feet) monitoring wells. The findings of this RI indicated that

- Perchloroethene (PCE), trichloroethene (TCE), toluene, carbon tetrachloride, chloromethane, chloroform, and 1,1,1-trichloroethane (1,1,1-TCEA) were detected in the groundwater. The positive detections were of generally low level and were scattered throughout Area B. In general, the contaminant concentrations were higher in the shallow bedrock wells than the overburden wells.

- Lead, arsenic, cyanide, and manganese were detected in some unfiltered groundwater samples (the cyanide result was questionable but could not be proven to be a false positive). There did not appear to be an identifiable plume of metals contamination in the groundwater. Notably, many elements, including lead and arsenic, were not detected in filtered groundwater samples.

Analytical testing for volatile organic compounds of all residential wells located within 3,000 feet of the base boundary began in June 1993 and is still proceeding as of August 1993. The results of the testing in the Casey Village neighborhood revealed that, while many home wells have either a non-detection of volatile organic contamination or are below the MCL, other home wells are at or above the MCL for various compounds (including TCE and PCE) and some are above federal action levels. Water treatment systems and bottled water have been supplied to some of the residents. Plans have been initiated to hook the affected homes up to a public water supply.

NAWC Warminster is underlain by siltstones interbedded with fine- to coarse-grained sandstone. The sandstones encountered during the Phase II (shallow bedrock) drilling program appeared to be extensively fractured. The thickness of the individual rock units ranged from five to 20 feet. The bedrock strikes to the northeast and dips six to 10 degrees to the northwest.

The water table beneath Area B was encountered at depths ranging between 27 and 42 feet. Groundwater flow through secondary porosity (fractures) appears to be the dominant mechanism for groundwater transport, although some evidence of flow through the rock matrix was observed. Groundwater in the shallow bedrock flows in a general south to southeastward direction in areas investigated by the RI to date.

The lithology and hydrogeologic characteristics of the bedrock below a depth of about 50 feet are not known and will be determined by this investigation. Similarly, the direction of groundwater flow in the deeper aquifers has not been determined. It is possible that groundwater in the deeper aquifer(s) may flow in different direction(s) than the shallow aquifer.

3.0 SCOPE OF WORK

This Work Plan Addendum has been developed to present the technical scope of additional activities required for the hydrogeological investigation of Area B at NAWC Warminster.

This section presents the current data gaps and requirements for the hydrogeological investigation.

3.1 FIELD AND ANALYTICAL DATA REQUIREMENTS

The primary purpose of this investigation is to determine to what extent, if any, the on- and off-base contamination in the vicinity of Area B and the southeastern portion of the facility is attributable to NAWC Warminster. In particular, this investigation will attempt to determine if the off-base groundwater contamination discovered during the recent residential well testing in the Casey Village area is attributable to NAWC Warminster.

The Phase II RI report for OU-1 (HNUS, 1993) forms the basis of this investigation. This report identified several significant data gaps for Area B, including

- The upgradient extent of contamination for the shallow bedrock aquifer in the vicinity of Site 6.
- The potential source of contamination for the shallow bedrock aquifer within Site 6.
- The degree to which the shallow bedrock recharges deeper bedrock aquifers in this area.
- The extent of groundwater contamination for the deeper aquifers underlying the general vicinity of Area B and whether any such contamination is due to releases from the facility.

To address these data gaps, the report suggested that additional work be conducted, including

- The installation of additional monitoring wells as needed to define the upgradient extent of shallow bedrock contamination and the extent of deeper aquifer contamination.

- Additional groundwater investigation to characterize flow in the shallow bedrock aquifer beneath Area B and the hydraulic interconnections between the shallow and deeper aquifers.

The Area B hydrogeologic investigation will address the data gaps identified in the Phase II RI report by conducting the suggested field investigations listed above. By further defining the nature and extent of groundwater contamination in the shallower and deeper (to subsurface depths of 150 feet) bedrock aquifers in the southeastern part of the base and by determining the groundwater flow patterns within and between these aquifers, reasonable conclusions should be possible concerning the relationship of the on- and off-base contamination.

The specific field tasks to be performed under this work plan are summarized as follows:

- The drilling and geophysical logging of 10 test boreholes (one at each cluster location). The boreholes will be drilled to a subsurface depth of 150 feet at clusters A through I and to 250 feet at cluster J. The suite of geophysical logs will be used to determine hydrogeological data such as lithology and water-bearing fracture zones and will be used to identify the intervals to be screened in the test borehole and the other wells in that cluster.
- The installation of 27 additional monitoring wells in the vicinity of Area B. These wells will be placed in clusters of shallow (less than 50 feet), intermediate (50 to 100 feet), and deep (100 to 150 feet) wells.
- The sampling of the new wells and existing shallow bedrock wells (a total of 36 wells). All wells will be sampled for low-concentration volatiles, and 16 wells will be sampled for target analyte list (TAL) metals (both filtered and unfiltered). Three wells will be analyzed for engineering parameters. Nine wells will be sampled for target compound list (TCL) semivolatiles, polychlorinated biphenyls (PCBs), and pesticides.

- Soil sampling at the overburden/bedrock interface at each cluster location (a total of 10 samples) in order to evaluate each location as a potential source of the groundwater contamination.
- Long-term (three-week) water-level monitoring at selected locations and depths to gather data needed for the design of an aquifer pumping test.

4.0 WORK PLAN TASKS

This work plan is divided into 11 tasks to address the technical scope of work. The specific tasks are as follows:

- Task 1: Subcontracting
- Task 2: Mobilization and Demobilization
- Task 3: Monitoring Well Installation and Construction
- Task 4: Media Sampling
- Task 5: Site Survey
- Task 6: Laboratory Analyses
- Task 7: Data Validation
- Task 8: Data Storage
- Task 9: Reporting
- Task 10: Aquifer Testing
- Task 11: Waste Disposal

TASK 1 - SUBCONTRACTING

Several site investigation activities will be conducted by subcontractors. The subcontracts to be awarded will include those for monitoring well installation, site surveying activities, and laboratory analytical testing.

TASK 2 - MOBILIZATION AND DEMOBILIZATION

Mobilization involves the preparation for field activities. Equipment and expendable materials will be collected and checked prior to shipment to NAWC Warminster. Field personnel will review the project planning documents. Site-specific health and safety training will be provided to HNUS and subcontractor personnel as part of this task.

TASK 3 - MONITORING WELL INSTALLATION AND CONSTRUCTION

A projected total of 27 new monitoring wells will be installed. The projected wells at clusters A through I will be installed to monitor groundwater at depths of zero to 50 feet from the ground surface (shallow wells), 50 to 100 feet from the ground surface (intermediate wells), and 100 to 150 feet from the ground surface (deep wells). The target depths for the projected wells at Cluster J are zero to 75 feet, 75 to 150 feet, and 150 to 250 feet. Clusters of three monitoring wells (shallow, intermediate, and deep) will be installed (and have been proposed) at certain locations where appropriate. The approximate locations and depths of the new wells are depicted in Figures 4-1 and 4-2. The number and approximate depths of the wells to be drilled at each cluster location are listed in Table 4-1. The actual location of each well will be agreed to by the Navy and EPA before the well is drilled. Existing residential well sampling data and fracture trace analysis results will be considered in selecting final well locations. The actual locations of new monitoring wells will complement the network of existing monitoring wells as necessary. Shallow wells already exist at three proposed cluster locations.

The locations and depths of these wells will allow for the delineation of the horizontal and vertical extent of contamination in the vicinity of Area B. The lateral and vertical distribution of hydraulic head as measured by the wells will allow for the delineation of the local groundwater flow patterns.

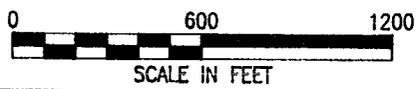
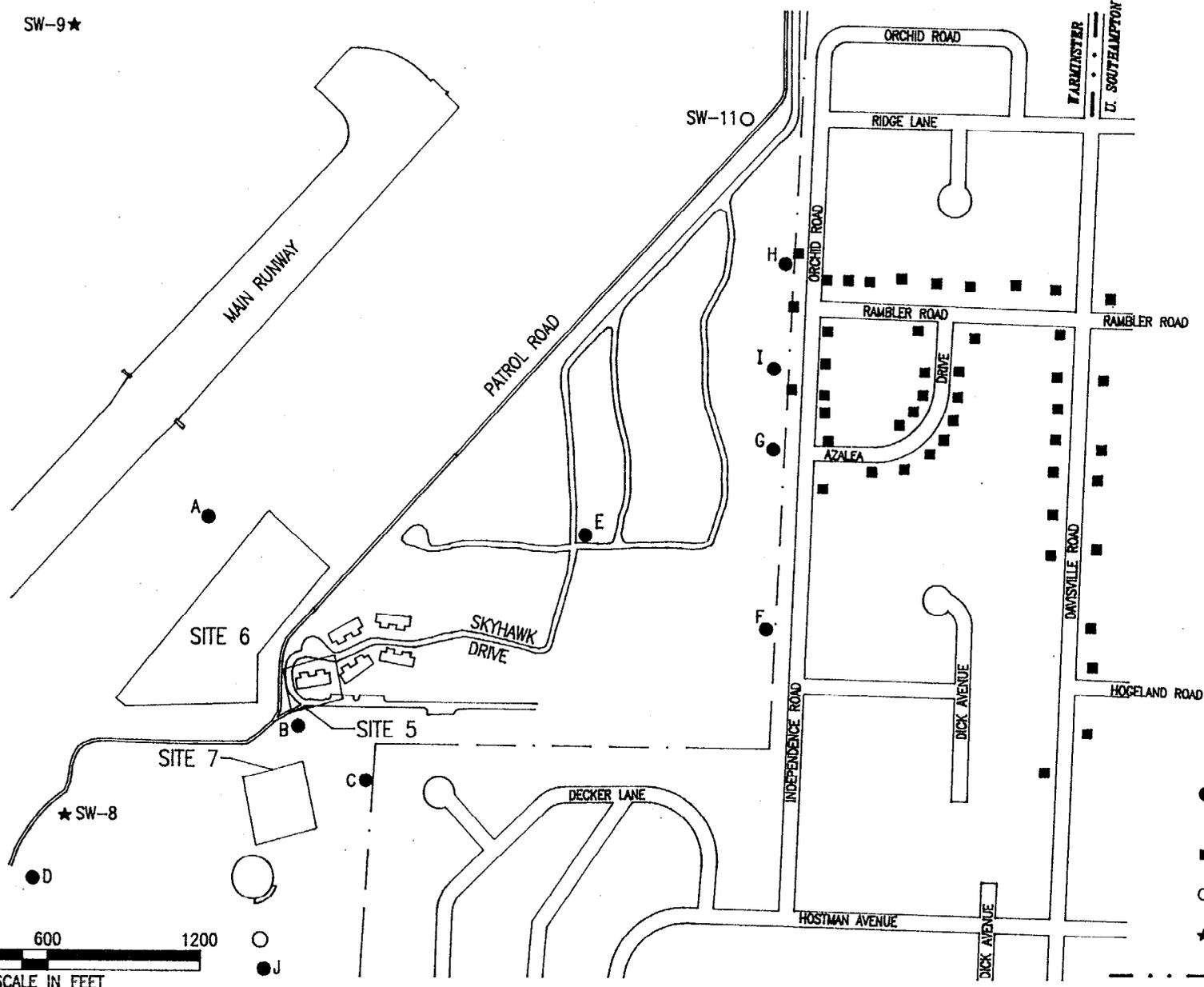
The rationale behind the placement of each proposed well cluster and sampling location is given in Table 4-2.

All boreholes will be drilled by the air rotary drilling method. The cuttings will be spread around the borehole and the ground will be reseeded at the conclusion of the field activities. If the cuttings are visually observed to be contaminated or if photoionization (HNU) readings indicate significant contamination, then the cuttings will be collected, containerized, and staged in a secure location designated by the activity.

The monitoring wells will be constructed in such a manner that water from only a very limited vertical section will enter the well and be sampled. The rest of the borehole will be grouted. The reasons for selecting this construction method are that the vertical distribution of any contaminants will be better defined, the possibility of cross-contamination due to intra-borehole flow will be eliminated, and depth-specific hydraulic heads will be obtained.

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- LEGEND**
- PROPOSED MONITORING WELL CLUSTER
 - RESIDENTIAL WELL
 - BASE OBSERVATION WELL
 - ★ BASE WATER SUPPLY WELL
 - . . - TOWNSHIP BOUNDARY

PROPOSED MONITORING WELL LOCATION MAP
AREA B HYDROGEOLOGIC INVESTIGATION
NAVAL AIR WARFARE CENTER, WARMINSTER, PENNSYLVANIA

FIGURE 4-1



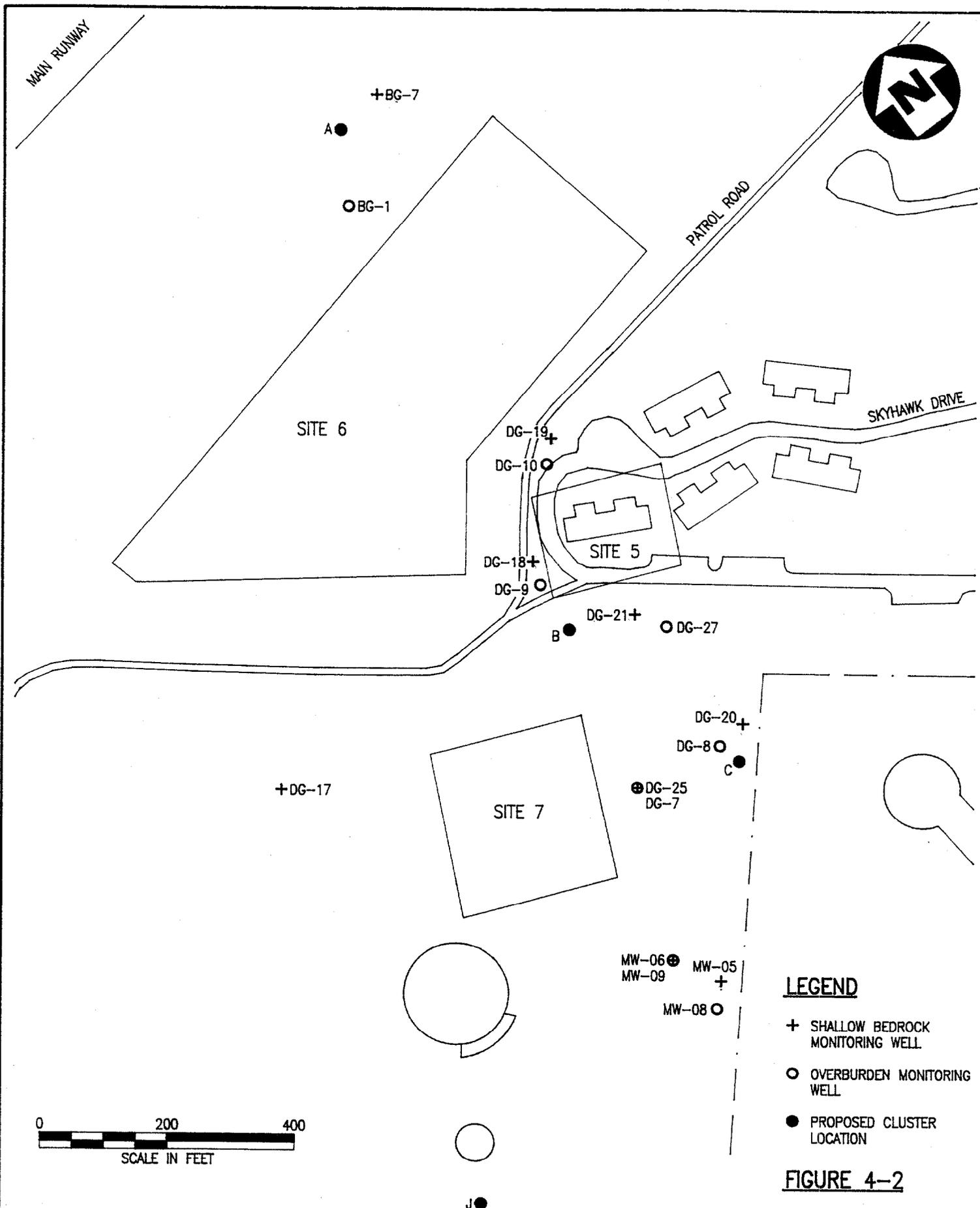


FIGURE 4-2

EXISTING (PROPOSED) MONITORING WELL LOCATION MAP
AREA B HYDROGEOLOGIC INVESTIGATION
 NAVAL AIR WARFARE CENTER, WARMINSTER, PENNSYLVANIA



**TABLE 4-1
SUMMARY OF DRILLING ACTIVITIES
AREA B HYDROGEOLOGIC INVESTIGATION
NAWC WARMINSTER, PENNSYLVANIA**

LOCATION	SHALLOW WELL (< 50 FEET)	INTERMEDIATE WELL (50 TO 100 FEET)	DEEP WELL (100 TO 150 FEET)
A		X	X
B		X	X
C		X	X
D	X	X	X
E	X	X	X
F	X	X	X
G	X	X	X
H	X	X	X
I	X	X	X
J	X (< 75 feet)	X (75 to 150 feet)	X (150 to 250 feet)

TABLE 4-2
WELL LOCATIONS AND RATIONALE
AREA B HYDROGEOLOGIC INVESTIGATION
NAWC WARMINSTER, PENNSYLVANIA

WELL CLUSTER	LOCATION AND RATIONALE
A	Intermediate and deep bedrock wells will be installed near the existing shallow bedrock well BG-7. These wells are hydraulically upgradient of Area B for the shallow bedrock aquifer and will be used to assess the background quality of the groundwater for this aquifer in this vicinity. This location is geologically downdip of Area B and, as discussed, may be hydraulically downgradient of Area B at the depths of the deeper aquifers. The determination of upgradient and downgradient for each aquifer is one of the objectives of the hydrogeologic investigation.
B	Intermediate and deep bedrock wells will be installed near the existing shallow bedrock well DG-9. This is the location where the highest concentrations of volatile organic contamination were discovered in the shallow bedrock aquifer during the Phase II RI. If there is a strong downward vertical hydraulic gradient here and/or if dense non-aqueous phase liquid (DNAPL) conditions exist(ed), this would be a likely area of contamination of the deeper bedrock aquifers.
C	Intermediate and deep bedrock wells will be installed near the existing shallow bedrock well DG-20. These wells are hydraulically downgradient of Area B for the shallow bedrock aquifer and will be used to assess the impact of Area B on the groundwater quality of the shallow aquifer in this vicinity. This location is geologically updip of Area B and, as discussed, may be hydraulically upgradient of Area B at the depths of the deeper aquifers. The determination of the groundwater flow direction for each aquifer is one of the objectives of the hydrogeologic investigation.
D	This cluster (three wells) will be installed northwest of and geologically downdip of Area B. Like the clusters discussed above, this cluster may be either hydraulically upgradient or downgradient of Area B. This location is geologically downdip of Area B. If any contaminant occurred as a DNAPL at Area B, it would tend to have migrated in this direction should it encounter a low-permeability bed that impeded its progress.
E	This cluster (three wells) will be installed approximately midway between Area B and the Shenandoah Woods neighborhood. These wells will monitor the groundwater quality for the various aquifers in this area and are necessary to establish the horizontal and vertical groundwater flow patterns between Area B and the off-base locations.
F, G, H, and I	These clusters (three wells at each cluster) will be installed on NAWC Warminster property along the eastern border of the facility at its boundary with the Shenandoah Woods neighborhood. These wells will be used to establish the on-base boundary conditions and will monitor groundwater quality for the various aquifers in this area and are necessary to establish groundwater flow directions between the base and the residential area.
J	This cluster (three wells) will be installed between Area B and former WTMA well no. 12. These wells will be used to establish the boundary conditions along this portion of the base boundary to the south and west of Area B and will monitor groundwater quality for the various aquifers in this area and are necessary to establish groundwater flow directions between the base and the residential area.

The deep monitoring well at each cluster will be drilled and logged in the following manner. An eight-inch test borehole will be drilled at each cluster location to the maximum anticipated monitoring depth (150 to 250 feet). If no significant water-bearing zones are encountered to the target depth, the borehole will be deepened until significant water is found or to a maximum depth of 50 additional feet. A suite of geophysical logs will be run within each test borehole to gather hydrogeologic information and to identify the significant water-bearing intervals at each location. The interpretation of these logs will yield hydrogeologic data such as lithology, structure, fracture distribution, and recharge and/or discharge zones. The suite of logs to be run includes natural gamma, caliper, single-point electrical resistance, fluid temperature, and fluid resistivity. Fluid velocity (brine trace) tests may be performed on selected wells. In addition, a television (camera) survey will be performed in each test borehole.

The test borehole will be converted into the deepest monitoring well to be installed at that cluster location. Therefore, the screened interval will occur between 100 and 150 feet. The remaining wells at each cluster will be constructed and screened across the most significant water-bearing zone identified in the test borehole for their target interval.

For all monitoring wells, a four-inch-diameter by 15-foot-length polyvinyl chloride (PVC) well screen will be installed to such a depth that the selected water-bearing zone is centered in the screen. An appropriately sized sand pack will be installed around the screened interval of each well. The annulus between the borehole wall and the riser pipe above the screen shall be sealed with a bentonite plug and a five-percent bentonite/cement grout. In the test boreholes, the open borehole below the screen (if any) shall also be sealed with a 50/50 bentonite-chip and sand mix.

Note that the hydrogeological conditions may dictate that less than three wells be installed at any particular cluster. For instance, if the depth to bedrock at a cluster location is greater than 50 feet, or if groundwater is not encountered in the bedrock at a depth less than 50 feet below the ground surface, then no shallow bedrock monitoring well will be installed at the location.

All wells will be developed with a surge block and by pumping/overpumping. Development will continue until three consecutive pH and conductivity measurements do not vary by more than 10 percent and the water turbidity is less than 10 nephelometric turbidity units (NTUs), or for a maximum of three hours. Development water will be diverted away from the borehole and discharged to the ground surface.

TASK 4 - MEDIA SAMPLING

1. Groundwater

All newly installed monitoring wells and all existing shallow bedrock wells will be sampled. The well locations are illustrated in Figures 4-1 and 4-2. The number of wells at each location to be sampled, the depths of the wells, and the parameters to be analyzed are summarized in Table 4-3. All samples will be analyzed in the field for temperature, pH, Eh, conductivity, and turbidity.

All groundwater samples will be analyzed for low-concentration volatile organic compounds. In addition, 18 wells from seven cluster locations will be sampled for TAL metals. Both filtered and unfiltered samples will be analyzed. Nine wells from five clusters will be analyzed for TCL semivolatiles, pesticides, and PCBs.

Three groundwater samples will be analyzed for engineering parameters [chemical oxygen demand (COD), biological oxygen demand (five-day) [BOD(5)], total organic carbon (TOC), total suspended solids (TSS), total dissolved solids (TDS), pH, alkalinity, and hardness]. The three samples will be obtained from the shallow, intermediate, and deep bedrock wells of a single cluster in order to determine the vertical variability of these parameters. These analyses may be useful for the remedial design.

2. Soils

10 subsurface soil samples will be obtained and analyzed for TCL volatile organics and TAL metals during the drilling program. The number of samples to be taken and the parameters to be analyzed are summarized in Table 4-4. The soil samples will be obtained from the soil/bedrock interface; one sample will be taken at each new cluster location. The purpose of these samples is to evaluate each location as a potential source of the off-base contamination identified in the residential well sampling program.

TABLE 4-3A
GROUNDWATER SAMPLING SUMMARY
AREA B HYDROGEOLOGIC INVESTIGATION
NAWC WARMINSTER, PENNSYLVANIA

LOCATION	NUMBER OF WELLS	LOW-CONCENTRATION VOLATILE ORGANICS			TAL METALS (FILTERED AND UNFILTERED)			ENGINEERING PARAMETERS		
		SHALLOW	INTERMEDIATE	DEEP	SHALLOW	INTERMEDIATE	DEEP	SHALLOW	INTERMEDIATE	DEEP
"A" (BG-7)	3	X	X	X		X	X			
"B" (DG-18)	3	X	X	X		X	X	X	X	X
"C" (DG-20)	3	X	X	X		X	X			
"D"	3	X	X	X						
"E"	3	X	X	X	X	X	X			
"F"	3	X	X	X						
"G"	3	X	X	X	X	X	X			
"H"	3	X	X	X						
"I"	3	X	X	X	X	X	X			
"J"	3	X	X	X	X	X	X			
DG-17	1	X								
DG-19	1	X								
DG-21	1	X								
DG-25	1	X								
MW-05	1	X								
MW-06	1	X								
TOTAL	36	16	10	10	4	7	7	1	1	1

**TABLE 4-3B
GROUNDWATER SAMPLING SUMMARY
AREA B HYDROGEOLOGIC INVESTIGATION
NAWC WARMINSTER, PENNSYLVANIA**

	LOCATION	NUMBER OF WELLS	TCL SEMI-VOLATILES			PESTICIDES/PCBs		
			SHALLOW	INTERMEDIATE	DEEP	SHALLOW	INTERMEDIATE	DEEP
1	"A" (BG-7)	3		X	X		X	X
2	"B" (DG-18)	3		X	X		X	X
3	"C" (DG-20)	3						
4	"D"	3						
5	"E"	3		X	X		X	X
6	"F"	3						
7	"G"	3		X	X		X	X
8	"H"	3						
9	"I"	3		X			X	
10	"J"	3						
	DG-17	1						
	DG-19	1						
	DG-21	1						
	DG-25	1						
	MW-05	1						
	MW-06	1						
	TOTAL	36	0	5	4	0	5	4

**TABLE 4-4
SOIL SAMPLING SUMMARY
AREA B HYDROGEOLOGIC INVESTIGATION
NAWC WARMINSTER, PENNSYLVANIA**

LOCATION	NUMBER OF SAMPLES	TCL VOLATILES	TAL METALS
A	1	X	X
B	1	X	X
C	1	X	X
D	1	X	X
E	1	X	X
F	1	X	X
G	1	X	X
H	1	X	X
I	1	X	X
J	1	x	x

The samples will be obtained with a standard two-inch by 24-inch, stainless-steel split-spoon sampler. The depth to bedrock at each cluster location will be determined during the drilling of the first borehole at each cluster. The soil sample will be obtained during the drilling of the ensuing borehole.

TASK 5 - SITE SURVEY

The newly installed monitoring wells will be surveyed for horizontal location and elevation by a Pennsylvania-licensed surveyor. Class B surveying will be achieved; this will allow a horizontal closure of 1:10,000 and a high vertical accuracy (to be determined once the surveyor is in the field). Elevations for wells will include the ground surface at the well and a designated point on the uncapped well casing.

TASK 6 - LABORATORY ANALYSES

All analytical testing will be conducted at a Navy-approved laboratory. CEIMIC Corporation will do all the analytical testing. Data quality objective (DQO) Level D quality control and Contract Laboratory Program (CLP) methods and protocols will be used. Naval Energy and Environmental Support Activity (NEESA) guidance requires Level D DQO for sites that are on the NPL.

TASK 7 - DATA VALIDATION

HNUS will validate 100 percent of the analytical data collected during the field work for Area B. The data validation packages will include the appropriate summary tables and spreadsheets. HNUS will submit to the Navy all analytical data in paper and electronic formats. In addition, the data validation packages will contain sample descriptions, the analytes/compounds investigated in each sample, the analytical methods used, and parties responsible for validating the data and performing analyses and will identify the EPA Region III amendments to the EPA Functional Guidelines that were used during the data validation.

TASK 8 - DATA STORAGE

HNUS will submit all analytical data generated during the site investigation to the Navy on an IBM-compatible floppy disk (5.25-inch) after data validation in a Navy-approved spreadsheet format.

TASK 9 - REPORTING

The deliverable under this task will consist of a letter report summarizing the findings of the Area B hydrogeologic investigation. A briefing highlighting the letter report will be presented at a TRC meeting. The briefing, at a minimum, will discuss the results and findings for

- nature and extent of groundwater contamination
- nature of subsurface soil contamination
- aquifer characteristics

The results of the Area B hydrogeologic investigation, including the boring logs, sample logs, water-level measurements, and analytical data base, will also be incorporated into a larger hydrogeologic report for NAWC Warminster.

TASK 10 - AQUIFER TESTING

The aquifer testing program to be conducted as part of the Area B hydrogeologic investigation will consist of groundwater-level monitoring and, ultimately, an aquifer pumping test. This work plan only addresses the groundwater-level monitoring. The results of this monitoring and the unvalidated (for expediency) analytical results from the media sampling will be used for the design of the aquifer pumping test. The pumping test will be performed as part of the larger hydrogeologic investigation.

The groundwater-level monitoring program will be conducted in selected well clusters. Water levels will be measured by pressure transducers and recorded by automatic data loggers connected to the transducers. Measurement locations will include all wells at the selected clusters, including the overburden wells where they exist and contain water. The clusters to be monitored will be selected after the completion of the drilling program. Selection criteria will include the number of wells (and depths) at the cluster, the analytical results, and geographic location. The duration of the groundwater-level monitoring program is expected to be three weeks. Readings will be taken at regular intervals not to exceed 60 minutes.

TASK 11 - WASTE DISPOSAL

At the conclusion of the field activities, the areas that have been disturbed will be restored to their former conditions. All field-generated expendables will be properly bagged and disposed in on-site disposal facilities. The only residues that may remain on site are significantly contaminated drill cuttings from the monitoring well boreholes that have not been spread onto the ground. The eventual fate of these materials will be determined based on analytical results and guidance from the Navy. If necessary, these materials will be stored in drums or covered with plastic as a temporary measure.

5.0 PROJECT STAFFING AND SCHEDULING

5.1 MANAGEMENT APPROACH

The HNUS project manager for this work is Jeffrey Orient. Mr. Orient is located in the HNUS Pittsburgh, Pennsylvania office and can be reached at 412-921-8778 by telephone and at 412-921-4040 by telecopy. Mr. Orient will be assisted by other members of the HNUS technical staff as necessary, including a field operations leader (FOL), geologists, and chemists.

The project manager is responsible for the day-to-day contact with the Navy's remedial project manager, Lonnie Monaco, and for maintaining the project's scope, schedule, and budget.

5.2 SCHEDULE

The project schedule for the Area B hydrogeologic investigation, including the due dates for deliverables, is presented in Figure 5-1. The project is anticipated to take approximately 30 weeks.

Figure 5-1: Area B Hydrogeologic Investigation - Project Schedule

ID	Name	Duration	Scheduled Start	Scheduled Finish	4th Quarter			1st Quarter			2nd Quarter			3rd Quarter			4th Quarter		
					Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	Field Mobilization	5d	10/8/93	10/14/93	█														
2	Well Installation	42d	10/15/93	12/13/93	█	█	█												
3	Well Sampling	5d	12/13/93	12/17/93			█												
4	Aquifer Testing	20d	12/20/93	1/14/94			█												
5	Data Validation	10d	1/24/94	2/4/94				█											
6	Draft Report	30d	2/7/94	3/18/94				█	█										
7	Draft Report Review	15d	3/21/94	4/8/94						█									
8	Final Report	5d	4/11/94	4/15/94							█								

Figure 5-1: Area B Hydrogeologic Investigation - Project Schedule

REFERENCES

Halliburton NUS Corporation, 1992a. Remedial Investigation/Feasibility Study Final Phase II Work Plan; Part I - Work Plan. Comprehensive Long-Term Environmental Action Navy (CLEAN) Contract, Naval Air Warfare Center, Warminster, Pennsylvania. Contract N62472-90-D-1298, CTO 0022, May 1992.

Halliburton NUS Corporation, 1992b. Remedial Investigation/Feasibility Study Final Phase II Work Plan; Part II - Sampling Plan Addendum. Comprehensive Long-Term Environmental Action Navy (CLEAN) Contract, Naval Air Warfare Center, Warminster, Pennsylvania. Contract N62472-90-D-1298, CTO 0022, May 1992.

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