APPENDIX A
SCOPE OF WORK FOR NUS/FIT REMEDIAL INVESTIGATION

D-583-5-4-15
Revision 4.0

SCOPE OF WORK
FOR A
REMEDIAL INVESTIGATION AT
WELLS G & H SITE
WOBURN, MASSACHUSETTS

TDD NO. F1-8405-02
NUS JOB NO. MA 11
EPA SITE NO. MAD 980 732 168
CONTRACT NO. 68-01-6699

FOR THE

REGION I
US EPA
MA/CT/VT SITE RESPONSE SECTION

October 19, 1984

NUS CORPORATION
SUPERFUND DIVISION

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1.0 INTRODUCTION

The NUS Region I Field Investigation Team (NUS/FIT) has been tasked by the Region I EPA MA/CT/VT Site Response Section (EPA) under Technical Directive Document (TDD) Nos. F1-8311-06 and F1-8405-02 to conduct a Remedial Investigation (RI) of the Wells G & H Site in Woburn, Massachusetts (Appendix A).

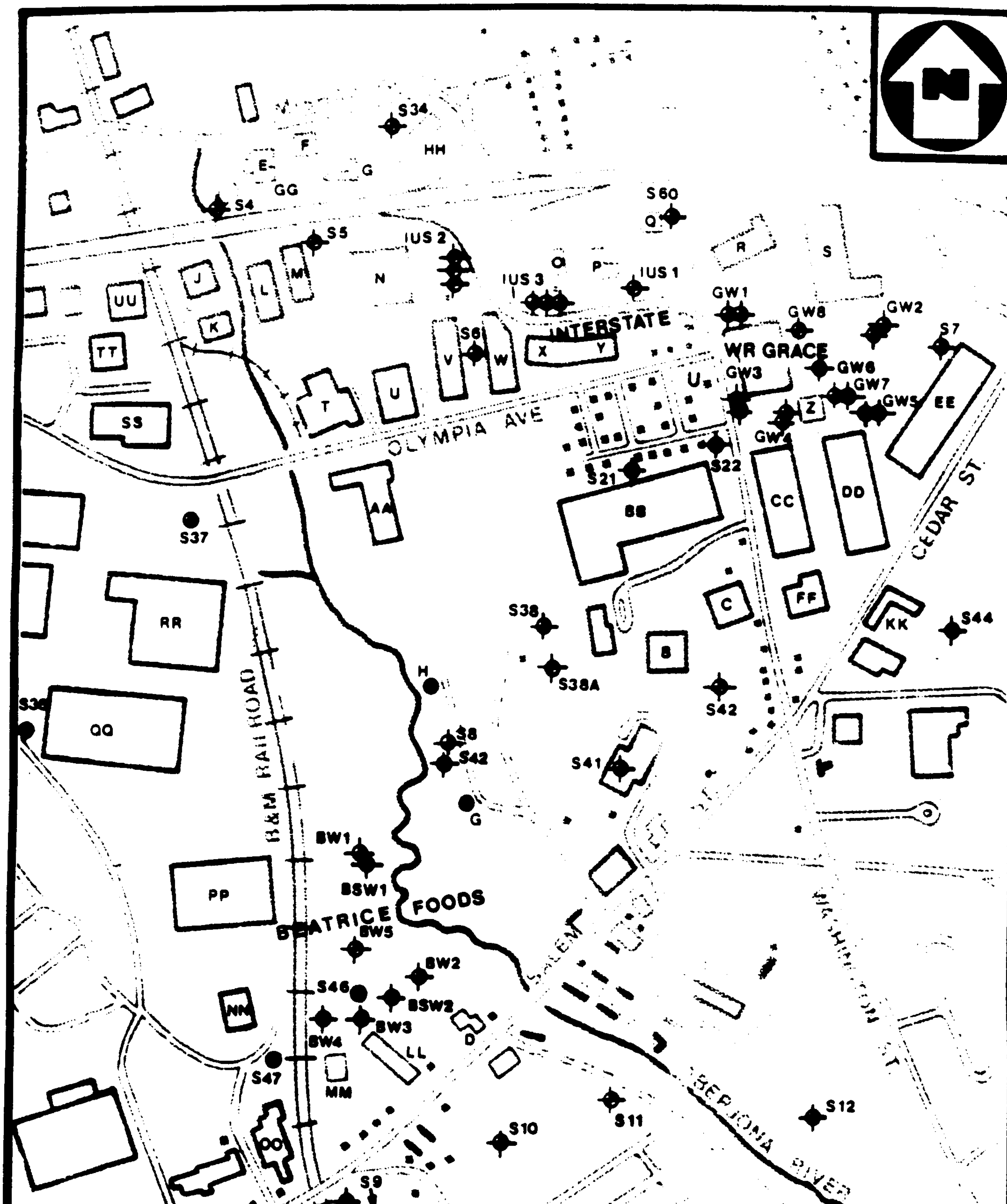
The Remedial Investigation will be in support of a Feasibility Study (FS) being conducted by GCA Corporation of Bedford, Massachusetts, under contract to EPA. This document presents the Scope of Work for the Remedial Investigation and incorporates extensive review by EPA and Massachusetts Division of Environmental Quality Engineering (DEQE).

1.1 Background

In May 1979, several chorinated volatile organic compounds (1,1,1-trichloroethane, 1,2-trans-dichlorethylene, tetrachloroethylene, trichloroethylene, chloroform, and trichlorotrifluoroethane) were detected at concentrations ranging from 1-400 parts per billion by the DEQE in the City of Woburn's municipal drinking water Wells G & H (Figure 1). Wells G & H were subsequently shut down, forcing the City of Woburn to use MDC water to supplement its other groundwater wells (1).

As a result of the detected contamination, the previous FIT contractor, Ecology and Environment Inc. (E & E), was tasked by EPA to conduct a hydrogeologic investigation and groundwater quality evaluation of a ten square mile portion of East and North Woburn (Figure 2, 3). E & E's work identified that the major groundwater problem within the study area was widespread contamination by chorinated volatile organic compounds. The volatile compounds found in highest concentration were trichloroethylene, 1,2-trans-dichloroethylene, 1,1,1-trichloroethane and tetrachloroethylene.

The highest concentrations (>300 ppb) of trichloroethylene and 1,2-trans-dichloroethylene were detected at well S-21 and well S-46 (Figure 1). Well S-46



0 500 1000

SCALE FEET

APPROXIMATE

LEGEND: Accessible wells

Inaccessible wells

Production wells

SITE PLAN

EAST WOBURN SITE

WOBURN, MASSACHUSETTS

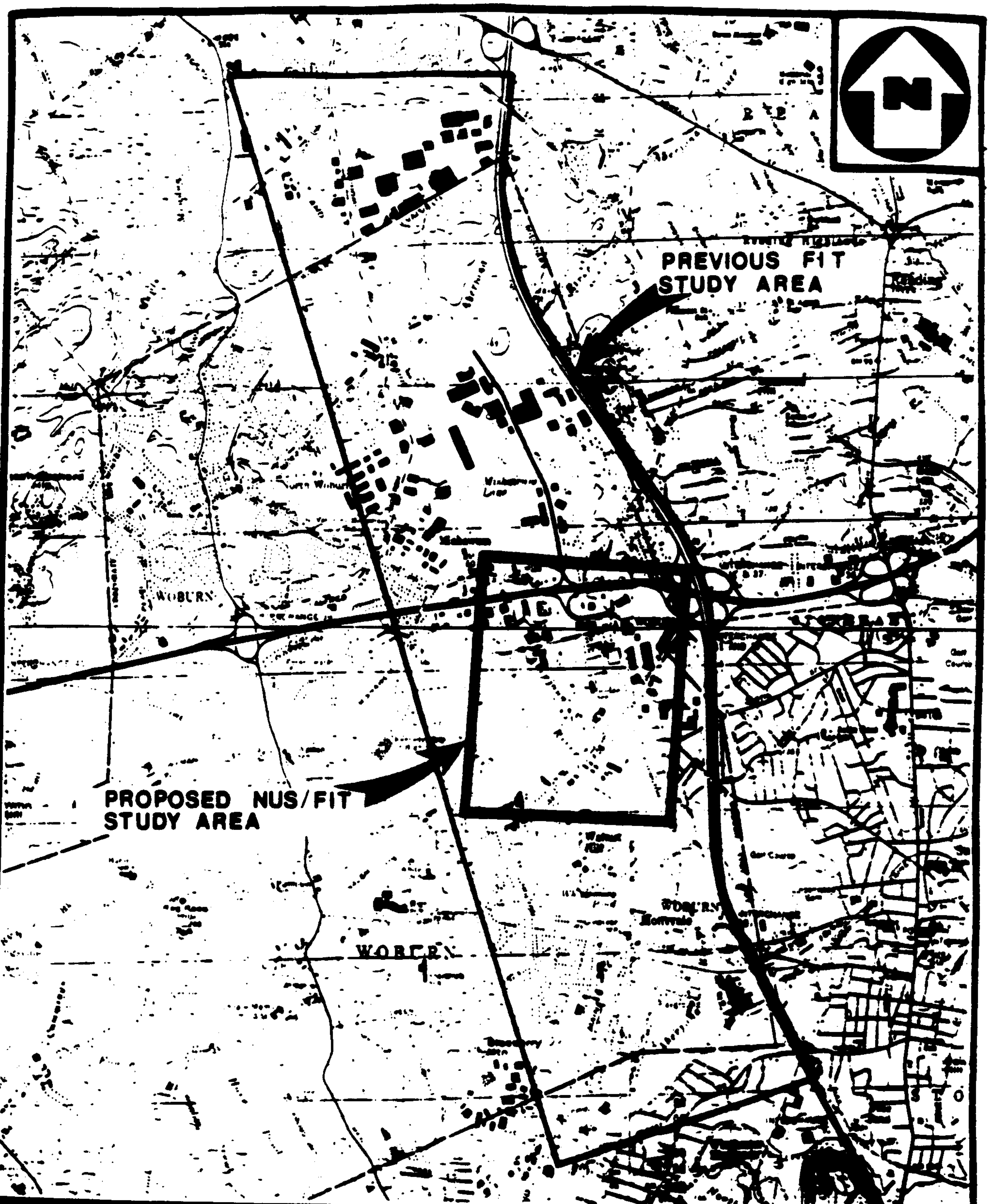
MAY 1984

NUS CORPORATION

A Halliburton Company

FIGURE 1

BASE MAP DERIVED FROM U.S.G.S. LEXINGTON, BOSTON NORTH, READING & WILMINGTON QUADRANGLES 1971,1979 & 1980 AERIAL PHOTOGRAPHS OF EAST WOBURN, MA



SCALE :
0 1/2
mile
APPROXIMATE

LOCATION MAP OF STUDY AREA

EAST WOBURN SITE
WOBURN, MASSACHUSETTS
MAY 1984

NUS CORPORATION
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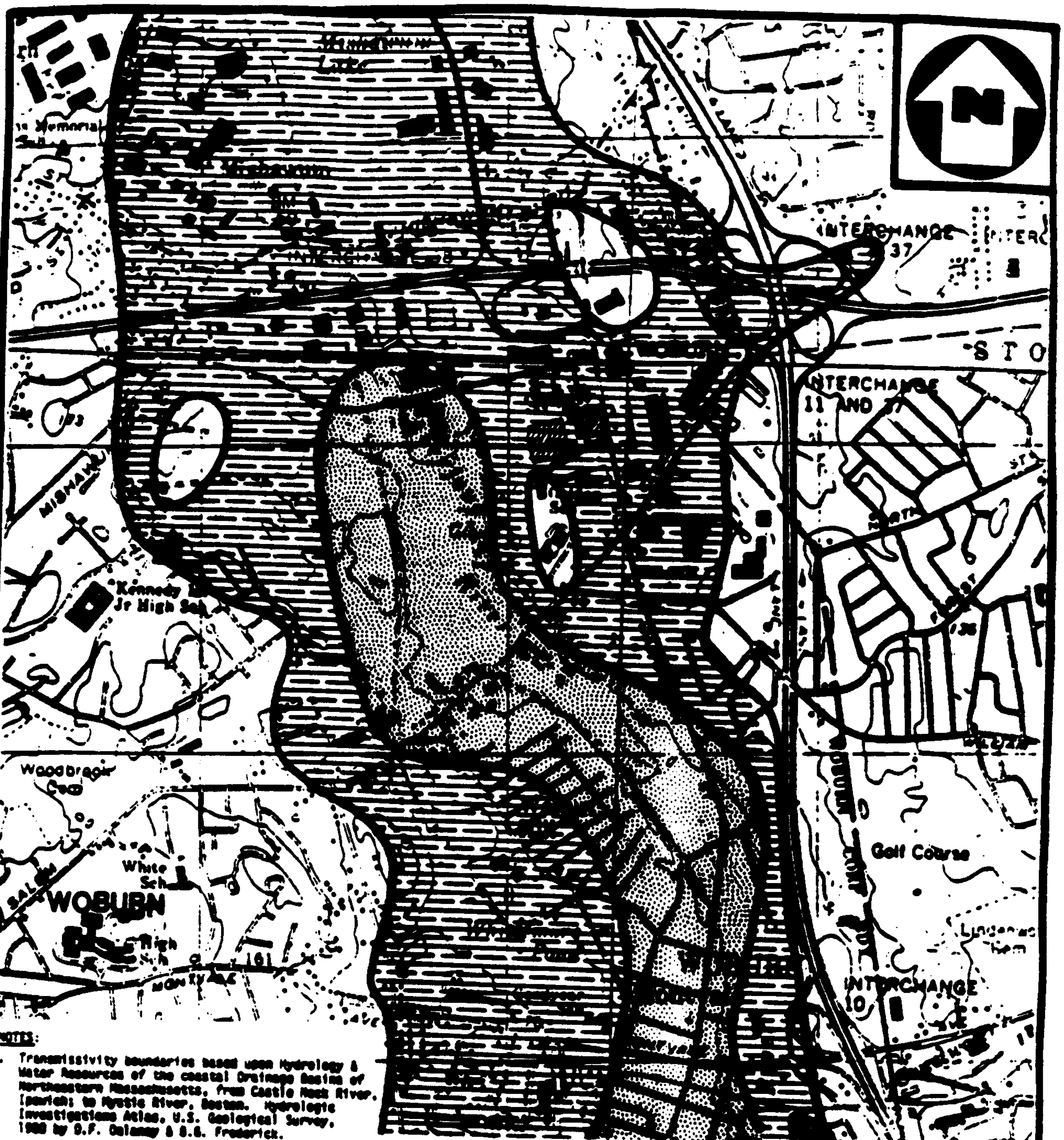
FIGURE 2

BASE MAP IS A PORTION OF THE U.S.G.S. LEXINGTON BOSTON NORTH READING & WILMINGTON QUADRANGLE (7.5' SERIES, 1971-1979)

KEY FOR FIGURE 1

A. AVA-Warehouse
B. Cummings Industrial Centers - Offices
C. Cummings Industrial Centers - Offices
D. Aberjona Auto Parts
E. Arlwood, Inc. - Wood/Metal doors, hardware
F. Brodie, Inc. - Industrial trucks, tractors
G. Brodie, Inc. - Industrial trucks, tractors
H. Post Office
I. Bradlee's - Commercial
J. Celotex Corporation - Warehouse
K. Economics Lab, Inc. - Distributor of soap and cleaning compounds
L. ADAP/Kamco. - Commercial, auto parts
M. Waterbed Warehouse - Commercial
N. Charrette - Commercial, art supplies
O. Woburn Foreign Motors
P. Hogan Tire Company - Tire distributor
Q. Bliss Marine - Boating equipment
R. Hurlbert Datsun - Automobile sales and repair
S. Cummings Industrial Centers - Offices
T. Northern Research and Engineering Corporation
U. Continental Metal Products - Hospital equipment
V. Cummings Industrial Centers - Offices
W. Cummings Industrial Centers - Offices
X. Interstate Industrial Uniform Rental
Y. Metro Siding and Roofing
Z. W.R. Grace - Food wrapping equipment
AA. Hemingway Transportation, Inc. - General commodities trucking
BB. Cummings Industrial Centers - Offices
CC. Cummings Industrial Centers - Offices
DD. Cummings Industrial Centers - Offices
EE. Cummings Industrial Centers - Offices
FF. McKesson and Robbins Drug Company
GG. 99 Restaurant
HH. Koala Inn
II. New England Plastics - Plastics manufacturing
JJ. Mirra Construction Company, Inc.
KK. Independent Tallow Company
LL. Whitney Barrell
MM. Murphy Waste Oil
NN. Bioassays Systems Corp.
OO. J.J. Riley Tannery
PP. Lechmere Corp Offices
QQ. United Stationers
RR. Rohtstein Corp.
SS. Weyerhaeuser
TT. Mass Crinc
UU. 7-Up Distributor



NOTES:

1. Transmissivity boundaries based upon Hydrology & Water Resources of the coastal Drainage Basins of Northeastern Massachusetts, from Castle Neck River, Ipswich; to Mystic River, Boston. Hydrologic Investigations Atlas, U.S. Geological Survey, 1980 by D.F. Delaney & B.G. Frederick.

LEGEND:

> 1400 FT^2/DAY (100 GAL/MIN)

> 4000 FT^2/DAY (300 GAL/MIN)

0 — ½ MILE
SCALE APPROXIMATE

TRANSMISSITY OF THE ABERJONA AQUIFER

EAST WOBURN SITE

WOBURN, MASSACHUSETTS

MAY 1984

NUS CORPORATION
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FIGURE 3

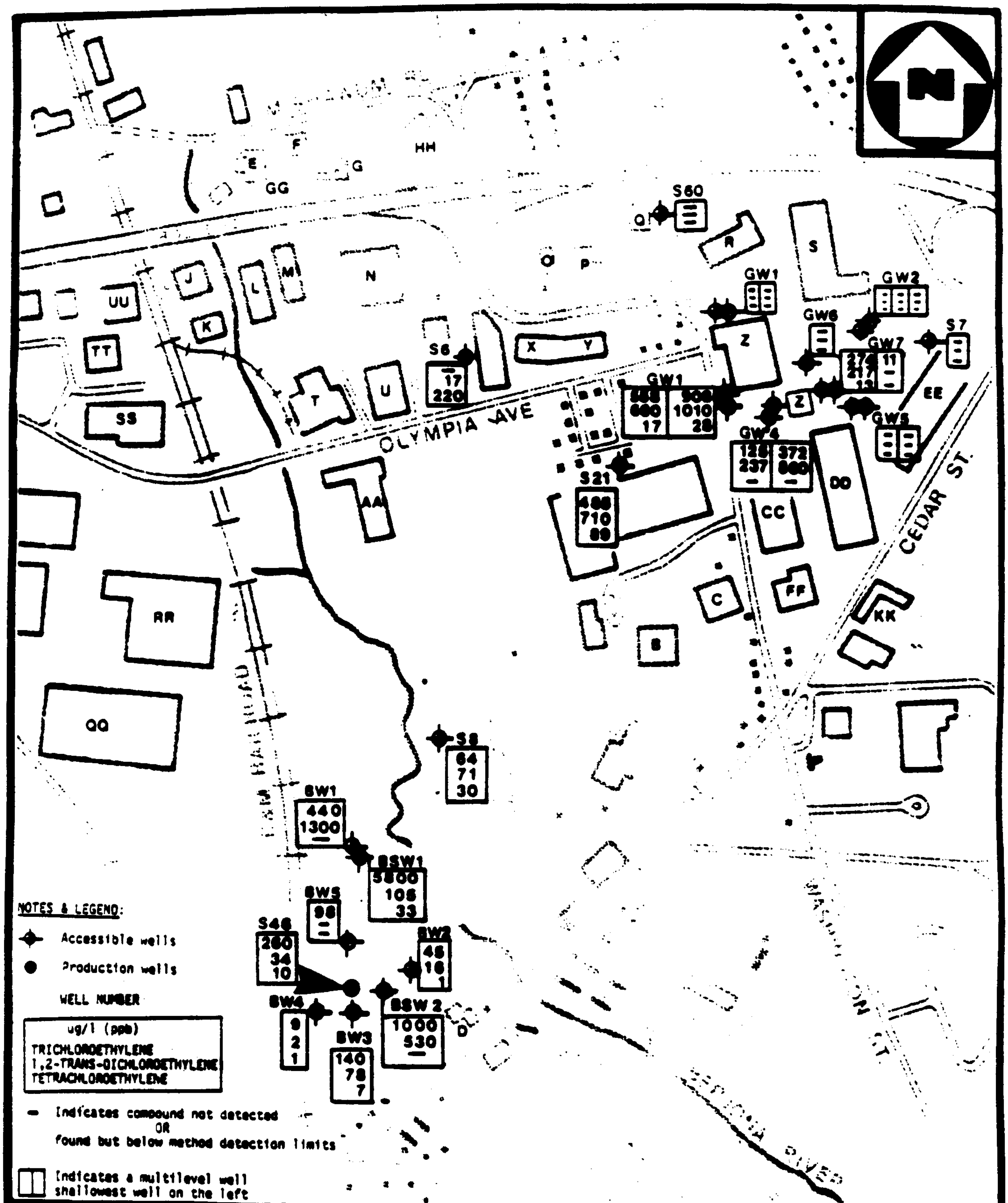
BASE MAP IS A PORTION OF THE U.S.G.S. LEXINGTON BOSTON NORTH READING & WILMINGTON QUADRANGLES (7.5' SERIES, 1971 1979) also contained high levels of 1,1,1,-trichloroethane (100-200 ppb). High levels of tetrachloroethylene (>200 ppb) were detected at Well S6, north of Wells G & H (Figure 1).

The E & E reports, "Chlorinated Solvent Contamination of the Groundwater, East and Central Woburn" (2) and "Evaluation of the Hydrogeology of East and North Woburn" (1), identified potential source areas for these compounds based on being upgradient of a specific organic compound's groundwater plume, the direction of groundwater flow relative to that plume, and site inspections of seventeen active and inactive facilities within and around the study area (see Figure 2). E & E suggested that the contamination detected at Wells G & H likely emanated from property(ies) north and/or northeast of these wells. E & E did not, however, identify the source area for the contamination present at Well S-46. The reader is referred to the previously referenced Ecology & Environment reports for more detailed information.

In May, 1983, as a result of E & E's investigations and subsequent studies by the EPA and DEQE, three orders (under Section 3013 of the Resource Conservation and Recovery Act-RCRA) were issued to W.R. Grace and Co., Inc. (Cryovac), Interstate Uniform Services Corp., and Beatrice Foods Inc. These orders required submission of proposals for sampling, analysis, monitoring, and reporting in relation to possible groundwater contamination on or emanating from their properties.

Subsequent groundwater monitoring well installations by the three companies are denoted on Figure 1 as follows: W.R. Grace - GW; Beatrice Foods - BW, BSW; and Interstate Uniform - IUS.

The work performed as a result of EPA's orders has aided in further delineating possible source areas of contamination to Wells G & H. Recent analytical data from these sampling surveys conducted by the concerned parties and NUS sampling surveys are presented in Figure 4.



0 500 1000

SCALE FEET

APPROXIMATE

RECENT ANALYTICAL RESULTS

EAST WOBURN SITE

WOBURN, MASSACHUSETTS

MAY 1984

NUS CORPORATION

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FIGURE 4

BASE MAP DERIVED FROM U.S.G.S. LEXINGTON, BOSTON NORTH, READING & WILMINGTON ...

1.2 Purpose/Objectives

The purpose of the Remedial Investigation is to determine the nature and extent of groundwater contamination at the Wells G & H site and gather all necessary data to support the work conducted during the feasibility study. The Wells G & H Site will be referred to in this scope of work as the Wells G & H aquifer area. The scope of the investigation will be focused on collecting the type and amount of data required to determine the need for and extent of remedial action, and for development and evaluation of off-site remedial alternatives during the subsequent feasibility study phase. The data collected will be sufficiently relevant, technically sound and defensible to support possible future enforcement actions against responsible parties which may include source control and/or cost recovery.

The Remedial Investigation will provide sufficient information and interpretation to achieve the following objectives:

- describe the geohydrology of the Wells G & H aquifer area including surface water and groundwater movement; and identify contaminant source areas, and describe pathways and mechanisms of contaminant transport,

- develop a geohydrologic and chemical data base sufficient to support a subsequent remedial action feasibility study that will determine the need for and extent of remedial action and will identify and evaluate the most cost-effective remedial actions for mitigating the effects of groundwater contamination at the Wells G & H aquifer area, and

- investigate suspected contaminant source areas, identify properties that are contributing contamination to the Wells G & H aquifer area, and collect information that is adequate to support successful enforcement actions and source control remedial action.

The following sections describe, in detail, the work NUS proposes for this Remedial Investigation to achieve the above objectives.

2.0 PLANNING CONSIDERATIONS

2.1 Subcontracting

NUS/FIT plans to utilize subcontractors for the following tasks: surveying, drilling and installation of groundwater monitoring wells, performance of grain size analysis, and in-situ permeability testing.

The proposed schedule presented in this Scope of Work includes the efforts required to prepare bid specification for the activities noted above, as well as the efforts required to procure subcontractors. Additionally, this Scope of Work includes the efforts by NUS/FIT to direct and oversee subcontractor activities in the field and to review subcontractor performance and work products. All of these estimates for level of effort assume that subcontractors can be procured on a timely basis, and that they can perform the work outlined in the bid specifications. If difficulties arise in negotiating subcontracts or working with subcontractors, additional efforts may be required, resulting in potential schedule delays and increased costs. In the event that such problems become evident, NUS/FIT will revise the schedule estimates.

2.2 Site Access

There are two areas of concern regarding site access: logistics and legal access. Logistical concerns are mainly drilling equipment access to wet portions of the site near the Aberjona River. Delays until drier conditions or procurement of the necessary equipment to access these areas may result in increased subcontractor costs.

Field activities have been planned to take into account the physical accessibility of the areas involved.

In terms of groundwater sampling, this Scope of Work assumes that NUS/FIT personnel will have sampling access to all EPA wells installed by either the former

FIT contractor (Ecology & Environment) or by NUS/FIT. Access will have to be procured for the wells belonging to W.R. Grace Co., Interstate Uniform, and Beatrice Foods.

All schedule and budget estimates presented in this Scope of Work are predicated on the ability of NUS/FIT staff and subcontractors to obtain fairly unlimited access to the study area throughout the course of field activities. EPA will assist NUS/FIT in obtaining access to all parts of the study area.

2.3 Health and Safety

All field tasks will require a task specific health and safety plan. These tasks include the initial sampling round, groundwater monitoring wells installations, final sampling, permeability testing and pump tests. The health and safety plan will define appropriate field clothing, breathing zone monitoring requirements and corresponding action levels, and personal decontamination procedures. Emergency planning will also be addressed. Actions levels for respiratory equipment and other requirements will be dictated by NUS regional and corporate policies as well as by site-specific conditions to be addressed in the safety plans. General guidelines for the specific field tasks are described in section 3.0. These guidelines will be subject to approval by the NUS Health and Safety Officer at the initiation of fieldwork.

2.4 Quality Assurance and Quality Control

All TDD-specific tasks are defined initially in a Management Work Plan. The technical approach to each field task is described in detail in a specific Task Work Plan. NUS/FIT Standard Operating Guidelines are used as a basis for developing task-specific procedures. Deviations or modifications to any guideline are detailed in the task work plan technical approach. All management and task work plans are reviewed internally and approved before initiation of any work.

Upon initiation of field activities, a copy of all appropriate Standard Operating Guidelines will be provided to EPA and DEQE. All deviations and modifications to the guidelines will also be provided. Subsequent review and comment by EPA and DEQE will determine final Standard Operating Procedures for field work.

Standard Operating Guidelines will address, but not be limited to the following procedures: collection of quality control samples (duplicates and blanks), groundwater and surface water sampling, soil classification, monitoring well installation, and quality control review of analytical data. An overview of the Standard Operating Guidelines related to the major field tasks proposed in this study is presented in Appendix D. It is important to note that the guidelines presented are only an overview and are not all inclusive. Periodic audits of project files, field work or other elements will be conducted by the Region I Quality Assurance Officer to insure that divisional and regional quality assurance requirements are met.

All memos, trip reports and final reports require internal reviews and approval. A final draft report will be submitted to EPA and DEQE for internal review before a final report is issued. Quality Assurance will be achieved by adherence to Standard Operating Guidelines, internal audits and internal review.

3.0 PROPOSED SCOPE OF WORK

The boundaries of the Remedial Investigation study area will be Interstate I-95 (state route 128) to the north and Cedar/Salem Street to the south. The boundaries to the east and the west will be determined based on hydrologic factors (Figure 1). The areas beyond the study's northern and southern boundaries are within the Aberjona aquifer. In order to develop an extended data base for the feasibility study, groundwater samples will be collected from existing wells in these areas and studies conducted by responsible parties in North Woburn will be reviewed and evaluated.

In order to achieve the stated objectives, the Remedial Investigation will consist of the following activities conducted in three phases.

- Review existing data and conduct an initial groundwater and surface water sampling round to provide a current assessment of the extent, nature, and degree of contamination.

- Installation of over forty overburden and shallow bedrock groundwater monitoring wells in the study area to provide geologic and hydrologic data necessary in identifying pathways and mechanisms of contaminant transport and in identifying source areas of contamination.

- Conduct three rounds of surface water and groundwater sampling to include all newly installed monitoring wells in addition to those sampled in the first round, to contribute to the data base necessary to achieve the stated objectives.

- Conduct an aquifer test in the vicinity of Wells G & H to provide the data necessary to evaluate the feasibility and cost effectiveness of possible remedial actions.

- Presentation of all data and information in a final report that will describe the geohydrology of the Wells G & H aquifer area sufficient to support the feasibility study and identify those properties from which contamination to wells G & H emanates.

3.1 Phase I Activities

NUS/FIT was tasked on May 7, 1984 by EPA to begin Phase I activities under Technical Directive Document (TDD) Number F1-8405-02. Phase I activities include the following tasks:

- Task 01: Drafting Final Scope of Work
- Task 02: Review of Existing Data
- Task 03: Planning for Site Access
- Task 04: Preparation of a Base Map
- Task 05: Procurement of Subcontractors
- Task 06: Mobilization of Equipment
- Task 07: Performance of an Initial Round of Environmental Sampling

Awarding of subcontracts and initiation of Phase II activities will not occur until EPA has granted approval of the proposed scope of work. It is anticipated that approval could be granted within three weeks after receipt of the scope of work by EPA. Within this time, EPA must also determine whether any responsible parties are interested in conducting the Remedial Investigation. Each Phase I task is further described below.

Task 01 Drafting Final Scope of Work

An initial scope of work delivered to EPA on January 13, 1984 has been revised on the basis of comments received from EPA and DEQE. The revised (final) scope of work for a remedial investigation is presented in this document and represents the completion of this task.

Task 02 Review of Existing Data

NUS/FIT will review eight main areas of existing data:

- previous data collected by Ecology and Environment, the previous FIT contractor

- recent data collected during Whitman and Howard Inc.'s Infiltration/Inflow Analysis on the sewer line in the study area

- recent analytical and geohydrologic data collected in response to EPA 3013 orders by W.R. Grace, Beatrice Foods and Interstate Uniform

- boring data from construction of Cummings Park or other buildings, if available

- data collected during construction and initial exploratory testing of Wells G & H

- data collected concerning groundwater, surface water or soil contamination in North Woburn, north of state route 128, but within the hydrologic boundaries of the Aberjona aquifer

- data collected concerning groundwater, surface water or soil contamination south of Cedar/Salem Street, but within the hydrologic boundaries of the Aberjona aquifer

- surface water data collected from the study area by DEQE

The data from Ecology and Environment, local boring logs and the EPA 3013 orders will be used to aid in achieving the following study objectives: 1) describing the geohydrology of the Wells G & H aquifer area, 2) providing a geohydrologic basis for determining cost-effective remedial action and 3) identifying contaminant source areas contributing to contamination of the Wells G & H aquifer area.

Data collected by other parties from north of I-95 and south of Cedar/Salem Street, but within the hydrologic boundaries of the Aberjona aquifer will be used to support GCA's feasibility study. The primary focus of all review will be on data that provides the geohydrologic basis for determining the need for and extent of remedial action and the feasibility of various remedial alternatives.

Task 03 Planning for Site Access

Arrangements will be made to ensure that site access may be obtained for all NUS/FIT and subcontractor personnel. Since the NUS/FIT office is located nearby, there is no need to establish a separate project office on the site. Proposed groundwater and surface water sampling locations will be examined to verify that they can be utilized. Further discussion of site access is presented in Section 2.2.

Task 04 Preparation of Basemaps

Basemaps will be prepared, utilizing as a starting point the previous FIT Field Investigation basemap and aerial photos. A detailed basemap will depict the study area described in Sections 1.2 and 3.0. A general basemap that includes the hydrolgic boundaries of the aquifer will also be developed. The general basemap will include additional areas outside of the study area that will be addressed in support of the feasibility study (Section 3.0).

Task 05 Procurement of Subcontractors

Subcontractors capable of providing services for the Remedial Investigation will be identified. Subcontractors will be required for surveying, drilling and installation of groundwater monitoring wells, and performance of grain size analysis and in-situ permeability testing. Actual bid specifications will be prepared under Phase I, but will not be issued until authorization to proceed with the scope of work has been received.

Task 06 Mobilization of Equipment

Major pieces of equipment, such as dedicated project truck and OVA, will be obtained and prepared for field use. Disposable equipment will be ordered, and other equipment needs will be identified for the upcoming field activities.

Task 07 Performance of an Initial Round of Environmental Sampling

An initial sampling round will be conducted prior to the start of field activities. The purpose of this sampling round will be to assess the current extent of surface water and groundwater contamination. As currently envisioned, samples will be collected from approximately twenty-four groundwater sampling locations and four surface water sampling locations (Figure 5A & 5B). Sediment samples will also be collected at the surface water sampling locations. Samples will be analyzed through the Contract Laboratory Program for the thirty-one volatile priority pollutants (Appendix B).

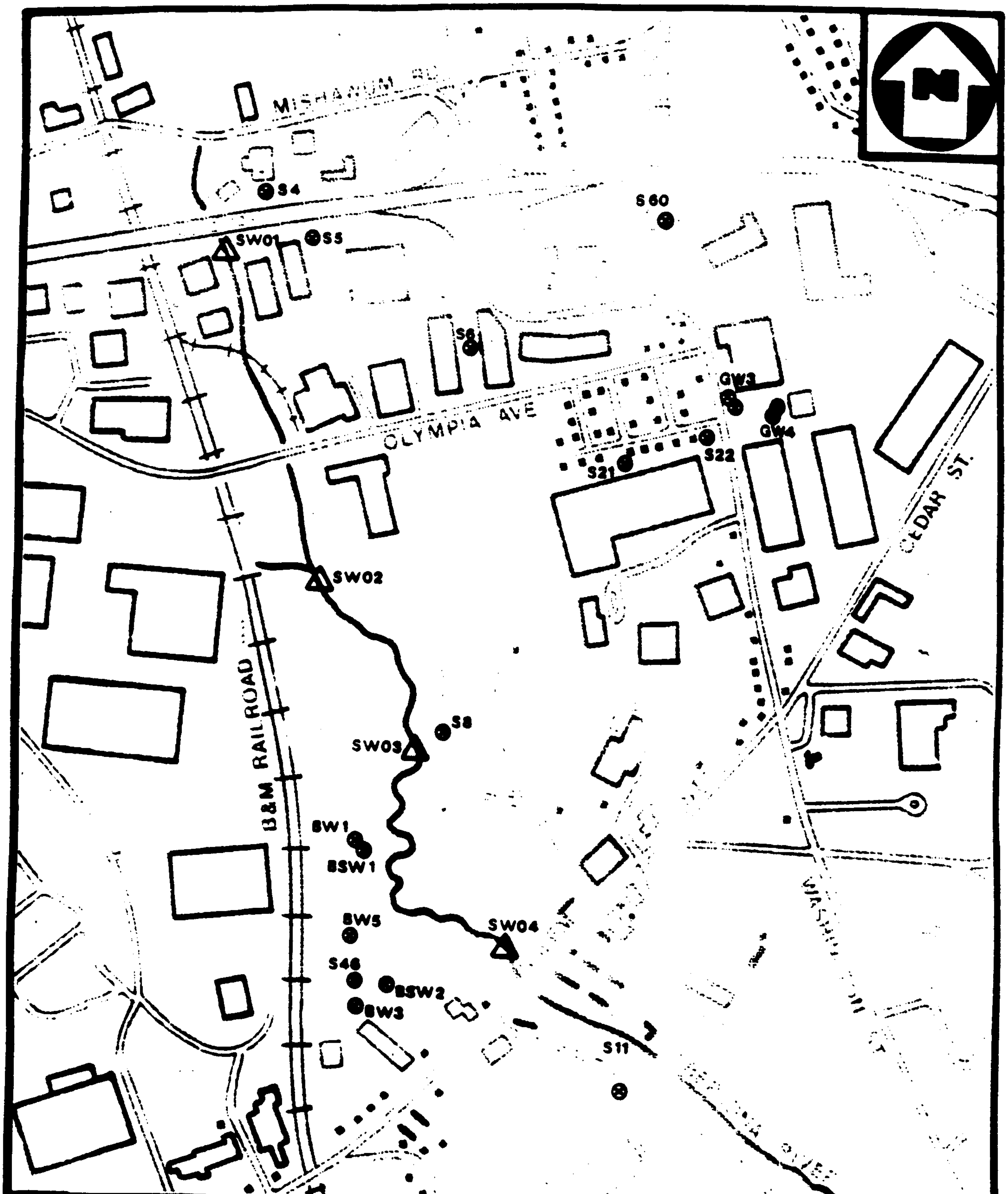
In addition, in-house screening on a Photovac gas chromatograph for volatile organics will be conducted on all samples. This screening data will provide qualitative information on a timely basis to aid in monitoring well placement.

Analytical information from this sampling round may modify groundwater montoring well locations. Any changes to well locations proposed in this scope of work will be discussed and approved by EPA. Groundwater, surface water and sediment sampling will adhere to the appropriate NUS Standard Operating Guidelines (Appendix D).

In addition to groundwater and surface water sampling, soil sampling will be conducted around sewer manholes suspected of experiencing periodic surcharging. Samples will be collected by hand augering and screened in-house for volatile organics. Manholes, which have experienced surcharging, will be identified by DEQE. If soil sampling around manholes produces a positive result, soil sampling (hand augering) will be conducted along some of the sewer lines in the study area (to be located later).

3.2 Phase II Activities

This section presents the scope of work for the field portion of the Remedial Investigation. Five major tasks are proposed as follows:



0 500 1000

SCALE FEET

APPROXIMATE

LEGEND:

● GROUNDWATER SAMPLE

△ SURFACE WATER SAMPLE

SAMPLING LOCATIONS

EAST WOBURN SITE

WOBURN, MASSACHUSETTS

MAY 1984

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FIGURE 5A

BASE MAP DERIVED FROM U.S.G.S. LEXINGTON, BOSTON NORTH, READING & WILMINGTON QUADRANGLES 1971,1979 & 1980 AERIAL PHOTOGRAPHS OF EAST WOBURN, MA

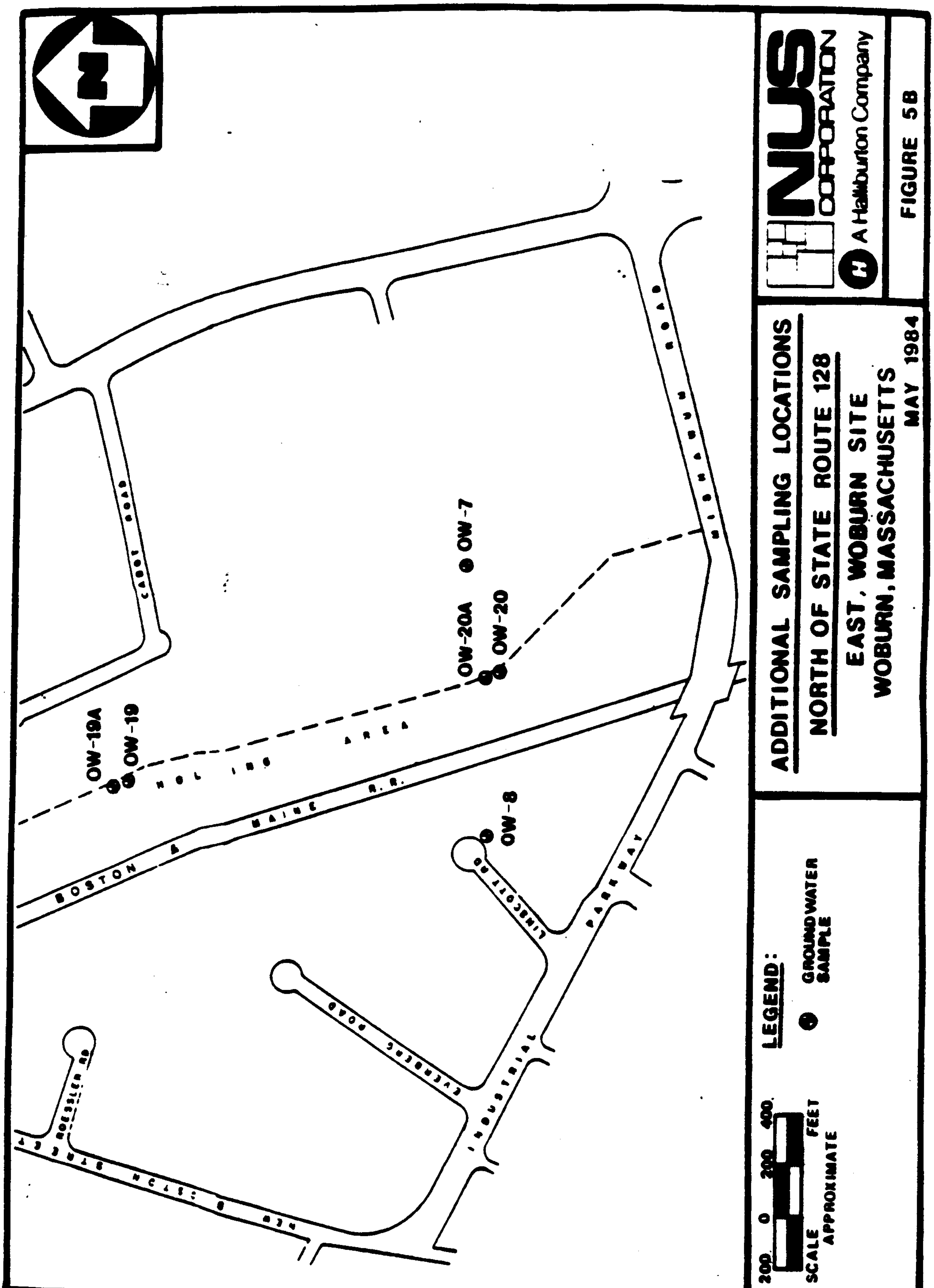
N
NUS CORPORATION
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FIGURE 5B
ADDITIONAL SAMPLING LOCATIONS
NORTH OF STATE ROUTE 128
EAST, WOBURN SITE
WOBURN, MASSACHUSETTS
MAY 1984
LEGEND:
GROUNDWATER SAMPLE
200 0 200 400
SCALE FEET
APPROXIMATE
OW-7
OW-20A
OW-20
OW-19A
OW-19
OW-8
CABOT ROAD
MISHAWUM ROAD
HOLLINS AREA
BOSTON & MAINE R.R.
PARKWAY
LINSCOTT RD
INDUSTRIAL
CUMMINGS ROAD
ROESSLER RD
NEW BOSTON STREET

- Task 08: Installation of Groundwater Monitoring Wells
- Task 09: In-situ Permeability Testing/Grain Size Analysis
- Task 10: Final Sampling Rounds
- Task 11: Aquifer Test
- Task 12: Surveying

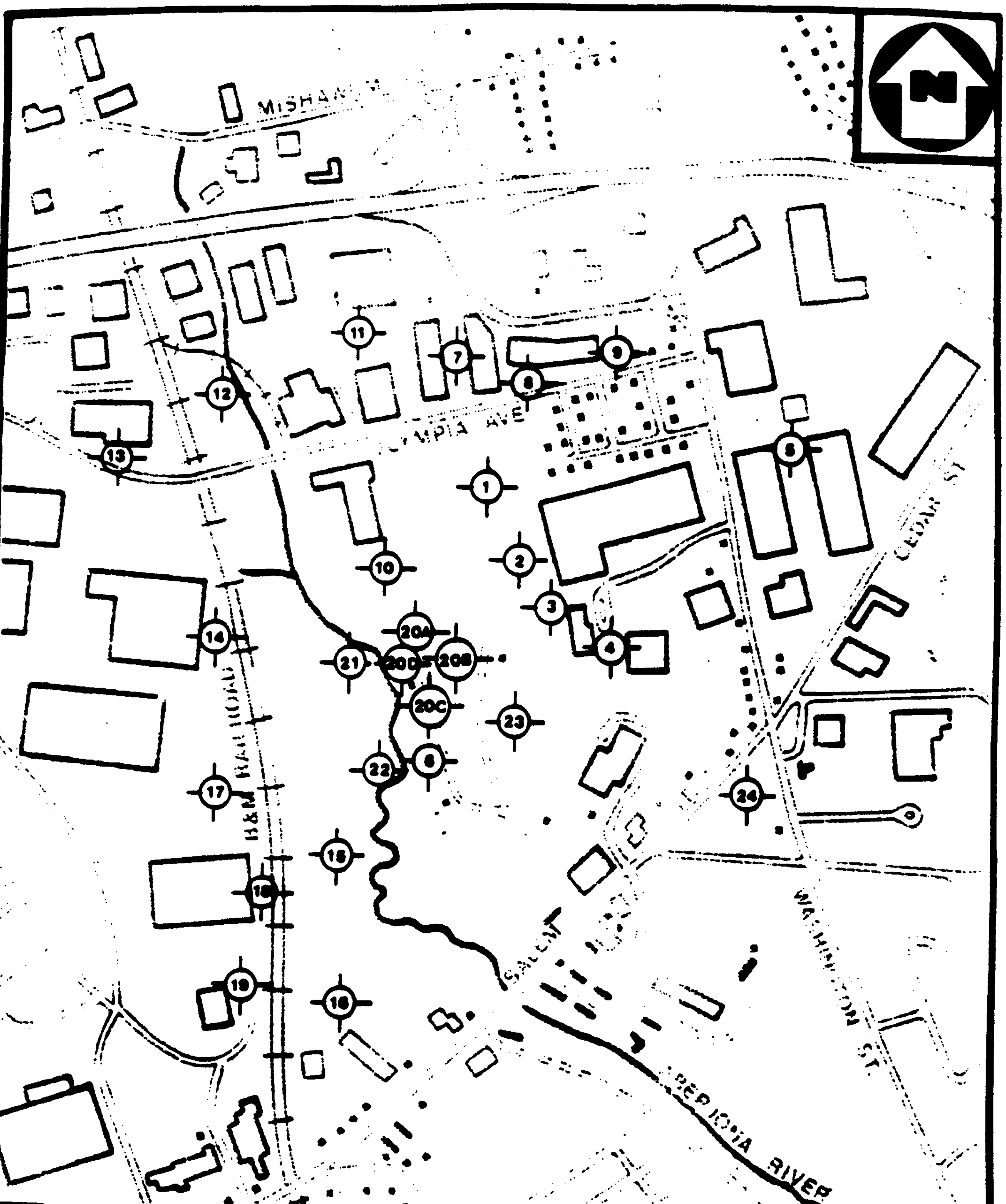
The field tasks have been planned to address the project objectives set forth in Section 1.2. Detailed task work plans for each task will be developed prior to the initiation of each field activity. Task work plans will address all relevant health and safety, quality assurance and technical requirements necessary to conduct the specified task. Task work plans will be subject to review and approval by EPA prior to initiation of work.

Task 08 Installation of Groundwater Monitoring Wells

The objectives of groundwater monitoring well installations are: to provide ground truthing for depth to bedrock and depth to groundwater; to provide surficial and bedrock geologic data for evaluation of groundwater movement in unconsolidated sediments and bedrock; provide data on vertical hydraulic gradients; provide data on vertical stratification of groundwater contamination; and to provide groundwater sampling locations for evaluation of drinking water quality and the extent of groundwater contamination.

The data will be used to describe the geohydrology of the Wells G & H aquifer area, to develop a geohydrologic data base sufficient to support subsequent remedial action feasibility study, to determine the need for and extent of remedial action, and to determine contaminant source areas.

The proposed groundwater monitoring well network is presented in Figure 6. Final well locations may change as data are obtained from the review of existing studies,



0 500 1000
SCALE FEET
APPROXIMATE

LEGEND:
PROPOSED WELL LOCATIONS

PROPOSED WELL LOCATIONS

EAST WOBURN SITE

WOBURN, MASSACHUSETTS

MAY 1984

NUS CORPORATION
A Halliburton Company

FIGURE 6

BASE MAP DERIVED FROM U.S.G.S. LEXINGTON, BOSTON NORTH, READING & WILMINGTON QUADRANGLES 1971,1979 & 1980 AERIAL PHOTOGRAPHS OF EAST WOBURN MA the initial sampling round and well installations. During monitoring well installations, daily progress will be discussed with EPA and DEQE and all changes will be reviewed and approved by EPA and DEQE.

Input from DEQE and EPA will be considered in determining the number, placement and construction of monitoring wells. In general, well construction will depend on OVA screening and the geologic strata encountered (Appendix D). Well screens will be placed in the geologic strata with the highest OVA readings and/or greatest permeability as predicted by visual grain size distribution. If a vertical distribution of volatile contamination is observed, well screens will be placed within each zone of contamination by means of nested wells. Criteria for determining what constituents different zones of contamination is detailed in Appendix D. Multi-level wells will also be installed to provide data concerning vertical hydraulic gradients.

After well installation and development, groundwater samples will be collected from each well for in-house screening on a Photovac gas chromatograph. Data from these samples will be used to decide if additional wells are needed in key areas as described below.

The remainder of this section describes the specific rationale for placement of each well location and possible well construction. The locations are discussed in the chronological order of installation.

- Well locations Nos. 1 to 4 - consists of nested multi-level wells. Each location will consist of a shallow bedrock well screened at least twenty feet into bedrock, an overburden well screened over the zone of the highest concentration of contamination (as determined by field screening techniques) and a shallow overburden well screened at the water table. Data from these wells will be used to determine vertical hydraulic gradients and vertical distribution of contamination. After well installation, the groundwater will be sampled from all wells and analyzed on a Photovac gas chromatograph for volatile organics. If contamination is detected at location No. 4, one to two additional wells will be installed to the east and southeast. The data from these additional wells will be used to determine if contamination detected at well No. 4 is part of a plume of contamination emanating from a northeastern or eastern source area.

- Well location No. 5 and 6 - will consist of nested multi-level wells. Location No. 5 will consist of a well screened in overburden and shallow bedrock. If, after sampling the newly installed well, contamination is detected, then one to two additional wells will be placed further to the northeast and southwest. Data from these wells will be used to determine the lateral extent of contamination found at Wells S-21 and S-22 and to determine contaminant source areas. Location No. 6 will consist of overburden wells screened at the zone of highest concentration of contamination and at the water table. Data from these wells will be used to determine vertical hydraulic gradients and vertical distribution of contamination. Well No. 6 may also serve as the location of a 6" diameter pumping well (Task 11).

- Well locations Nos. 7, 8, and 9 - data collected from these wells along with the recently installed wells, IUS-1,2, and 3, will be used to describe the vertical and horizontal extent of the tetrachloroethylene contamination found at well S-6 and to identify the source area of that contamination. Well location No. 7 will consist of shallow bedrock well at the same location as the existing overburden well S-6. Well locations 8 and 9 will either consist of single overburden wells or nested multi-level wells depending on the sampling results from well location No. 7. If a vertical stratification of contamination is detected, nested multi-level wells at locations 8 and 9 may be necessary to describe the extent of contamination and identify the property from which the contamination is emanating.

- Well location No. 10 - This location will consist of nested multi-level wells likely screened in overburden and shallow bedrock, again dependent on the result of field screening techniques. This well location is upgradient of the Wells G & H aquifer area and downgradient from the former location of various small industries (Figure 1). The purpose of this well location is to determine whether there is a northern source area of contamination to the Wells G & H aquifer area.

- Well locations Nos. 11, 12, 13 and 14 - These locations are in areas upgradient of Wells G & H where few groundwater sampling points exist. Data from these wells plus existing wells north of I-95 will be used to determine upgradient water quality in support of the feasibility study and to determine whether there are northwestern source areas of contamination to the Wells G & H aquifer area. Any nested wells will further provide data on vertical hydraulic gradients.

  Well location No. 12 will also consist of a nested multi-level well. As stated, this construction will provide water quality data and data on vertical hydraulic gradients in support of the feasibility study. Field screening techniques will determine the construction of the wells at locations Nos. 11, 13 and 14. If an unidentified source area is indicated by field screening techniques during installation of wells at locations Nos. 11, 13, and 14, these wells will not by themselves identify the property from which the contamination emanates. Additional wells would be necessary; these additional wells would only be installed after consultation with EPA in order to determine priorities for and approval of any changes in direction of the Remedial Investigation.

- Well location Nos. 15 and 16 - will consist of shallow bedrock wells as pairs to the existing overburden wells Nos. BSW-1 and BSW-2. The data from these wells will be used to describe the vertical distribution of contamination. They will also serve as water level measuring points during a aquifer test of Wells G & H (described further under Task 11).

- Well locations Nos. 17, 18 and 19 - will consist of wells located upgradient of Well No. S-46. The data collected from these wells will be used to locate any unidentified source areas of contamination and will also provide water quality data (in support of the feasibility study) in areas where none exists. The number and construction of wells at these locations will depend entirely on results of field screening techniques and subsequent groundwater sampling. Possible contingencies include nested multi-level wells and additional wells upgradient of these locations. Again, EPA will be informed daily of progress and will review and approve of all field decisions as to final location and construction of wells.

- Wells locations Nos. 20A-D - will be installed to provide water level measurement points for a aquifer test of Wells G & H in support of the feasibility study. The aquifer test will be further described under Task 11. Location No. 20 will consist of four wells located fifty feet north, south, east and west of the pumping well. Choice of a pumping well will also be discussed further under Task 11. These four wells will be single wells screened from the top of the water table to fifteen feet within the saturated zone. The data collected from these wells will be used to determine vertical hydraulic gradient, drawdown and recovery associated with the Wells G & H aquifer area during an aquifer test.

- Location Nos. 21 and 22 - will each consist of three nested multi-level wells screened at the following levels: the water table, at some depth in the saturated zone, and in shallow bedrock. These well locations will be placed as close to river as logistically possible. Data collected from these wells during the aquifer test will be used to establish the zone of influence associated with Wells G & H and to evaluate the hydraulic relationships between the Aberjona River and underlying aquifer.

- Well location No. 23 will consist of nested multi-level wells screened in the overburden and bedrock. This location will also provide data on vertical hydraulic gradients and rates and extent of drawdown and recovery during the pump test.

- Well location No. 24 will consist of a single well fully screened to intercept the water table and will provide data on the hydrologic boundaries associated with pumping of Wells G & H.

If permission and/or permits for a aquifer test are not obtained, as will be discussed under Task 11, then some of these final locations will be abandoned. However, location Nos. 21, 22, and 23 will still be installed because they also provide data as to the vertical distribution of contamination, vertical hydraulic gradients and sampling points where few previously existed.

A summary of well locations and the possible number of wells is presented in Table 1.

Task 09 In-situ Permeability Testing/Grain Size Analysis

The objective of conducting in-situ permeability testing and collecting samples for grain size analysis is to provide quantitative data on hydraulic conductivity of the major surficial units through which groundwater (and contamination) is migrating within the study area.

In-situ permeability tests will be performed on selected surficial geological units encountered beneath the site during the remedial investigation. Samples will be chosen based on geologic strata encountered and on OVA readings. This activity will help provide quantitative information on hydraulic conductivity (permeability) of each surficial unit. Location of permeability tests will be determined based on boring log data collected in the field so that permeabilities of the different materials may be estimated. Tests will likely be conducted at nested

Table 1

Summary of Well Locations

Well locations	Type	Number	Contingencies	Possible additional wells
1	nested multi-level	3		
2	nested multi-level	3		
3	nested multi-level	3		
4	nested multi-level	3	If contamination present	2
5	nested multi-level	2	If contamination present	2
6	nested multi-level	2		
7	bedrock	1		
8	overburden	1	If contamination found in bedrock	1
9	overburden	1	If contamination found in bedrock	1
10	nested multi-level	2	If contamination found	?
11	to be determined*	1	If contamination found	?
12	nested multi-level	2	If contamination found	?
13	nested multi-level	1	If contamination found	?
14	nested multi-level	1	If contamination found	?
15	bedrock	1		
16	bedrock	1		
17	to be determined	1	If contamination found	?
18	to be determined	1	If contamination found	?
19	to be determined	1	If contamination found	?
20A	screened at water table	1		
20B	screened at water table	1		
20C	screened at water table	1		
20D	screened at water table	1		
21	nested multi-level	3		
22	nested multi-level	3		
23	to be determined	2		
24	to be determined	1		
Total		44		6+

* To be determined based on field observations.

well locations after one well has been installed and the geologic strata have been identified. Either falling head or rising head tests along with recovery tests will be performed based on the particular geologic unit being addressed and on degree of saturation at the depth being evaluated. The tests will be conducted by the drilling contractors within the drilled borehole just prior to installation of the well. In addition to the in-situ permeability tests, grain size analyses will be performed on selected samples of material taken from the boring in the interval(s) being evaluated. The findings of these tests will be reviewed in light of the permeability test results. Details of the procedures will be included in the task work plan for groundwater monitoring well installation.

Task 10 Final Sampling Round

The objective of collecting groundwater and surface water samples are: to provide drinking water quality data, to evaluate the physical extent (both horizontally and vertically) of groundwater contamination, to determine the chemical nature of groundwater contamination, to provide data to evaluate surface water quality, and to provide data to determine source areas of groundwater contamination.

Three final sampling rounds, a month apart from each other, will be conducted after the well installation task is completed. All newly installed wells will be sampled in addition to all sample locations from the initial sampling round. All groundwater samples will be analyzed for the thirty-one volatile priority pollutants plus tentative identification and quantitation of the next ten most abundant compounds by EPA method 624. An additional ten percent of the samples will be analyzed for all organic and inorganic priority pollutants.

Aqueous samples collected for inorganic analysis will be filtered to provide data on dissolved constituents. Dissolved concentrations of inorganic parameters will provide data on drinking water quality in support of the feasibility study. Sample locations for priority pollutant analysis will be chosen based on field screening results and/or areas where little information exists on water quality. This data will be used to determine the chemical nature and physical extent of groundwater contamination that currently limits the production of potable drinking water from Wells G & H.

In support of the feasibility study, the samples collected from the wells at location Nos. 11, 12, 14, 21, 23 and well Nos. S8 and S21 will also be analyzed for Federal Primary and Secondary Drinking Water Standards and the standards set by the Commonwealth of Massachusetts (Appendix C). The locations were selected to represent general groundwater quality in different areas and depths in the aquifer. The data obtained from these analyses will provide additional information on the aquifer water quality not attributed to volatile organic contamination. Review of historical data indicates that other water quality problems may exist and must be considered in determining the feasibility of aquifer treatment for volatile organics only. In addition, the concentration of certain parameters such as iron and manganese must be quantified in order to properly design any treatment facility. Groundwater and surface water and sediment sampling will be conducted according to the appropriate NUS Standard Operating Guideline. The technical approach, quality assurance requirements and health and safety considerations will be detailed in a task work plan. The general approach will follow that described in Appendix D.

Task 11 Aquifer Test

The objectives of the aquifer test are to provide data on: aquifer hydraulic conductivity, specific yield, zone of influence associated with pumping Wells G & H, and hydraulic connection between the Aberjona River and Wells G & H aquifer area. The data will be used to determine the method of groundwater treatment, design pumping capacities, operating life of the facility and ultimately the feasibility of this remedial option.

GCA's initial screening of remedial technologies for Wells G & H has determined that one likely remedial option will be groundwater treatment (well head treatment) and discharge. This option requires extensive data concerning aquifer characteristics such as concentration and spatial distribution for each contaminant of concern, and aquifer physical and hydraulic properties.

As previously discussed, well locations and sampling will be adequate to provide the necessary data on the concentration and spatial distribution of each contaminant of concern. Geologic classification of soils during well installations and in-situ permeability tests will provide additional data on the physical properties of the aquifer surrounding Wells G & H. However, an aquifer test will be necessary to provide the following data: aquifer hydraulic conductivity, specific yield, zone of influence associated with pumping Wells G & H, and hydraulic connection between the Aberjona River and the portion of the aquifer associated with Wells G & H.

The hydraulic relationship between the Aberjona River and Wells G & H was discussed in the Remedial Action Master Plan (RAMP) (3). The RAMP suggested that surface water quality could have impacted groundwater quality at Wells G & H under pumping conditions and vice versa under non-pumping conditions. The pump test is designed to establish whether there is a hydraulic connection.

Data collected during the pump test will be used to evaluate the effects of well head treatment on changes in concentration overtime at the treatment facility, downgradient receptors such as the Aberjona River, ponds, and other pumping wells, and migration behavior of upgradient sources of contamination.

GCA recommends a 48-hour pump test (at a pumping rate of 500-800 gallons/minute) to determine physical properties and hydraulic boundaries of Wells G & H. The 48-hour test is a preliminary estimation; a longer test may be required. The final design of the aquifer test will be described in the task work plan subject to approval by EPA and will follow in an addendum. GCA recommends the following data collection program:

1) <u>static water levels</u> - Prior to the initiation of a pump test, water level measurements should be obtained from all wells included in GCA's proposed monitoring network. Information obtained from the fully screened wells can be used to develop static water table contours; data obtained from the nested piezometers will be used to evaluate vertical gradients prior to the onset of pumping.

2) time-drawdown measurements - GCA suggests a non-equilibrium analysis of time-drawdown measurements in determining aquifer properties. This test should include a test well pumping at a specified constant rate, and the newly installed observation wells described in Section 3.2 (Task 07). This test requires early time-drawdown data. For observation wells situated close to the test well, water level measurements must be obtained at very close intervals during the first few hours. As the pump test progress, the interval between measurements increases until a change in drawdown is no longer evident at the observation well furthest from the test well. Measurements will also be made of the level of the river at gaging stations located upstream and downstream of the pumping well.

3) steady-state measurements - Based upon an estimate of the hydraulic conductivity for the stratified sands and gravel of the aquifer, GCA believes steady-state will be reached at those observation wells outlined above within the 48-hour test period. Prior to cessation of the pump test, water level measurements should be taken at all fully screened wells and nested piezometers of the monitoring network. Water table elevations measured at fully screened wells will be used in developing contour maps depicting the resulting cone of depression. The remaining water level data will be used to determine hydrologic boundaries and vertical gradients.

Once steady-state is reached during a pump test at a given discharge rate, hydrologic boundaries can be established. Observation wells situated relatively far from the test well will exhibit negligible drawdown. Such wells are indicative of the aquifers boundaries, because their piezometric head is not impacted by pumping.

4) recovery measurements - Finally, water level measurements during recovery of the aquifer to static conditions will provide additional data on hydraulic conductivity of the Wells G & H aquifer area.

The data collected during the pump test will also be used to determine hydrologic connections between the Wells G & H aquifer area and source areas of contamination. It will determine vertical gradients under pumping conditions and thus contaminant movement.

The minimum number of wells, in GCA's proposed aquifer test, to be used in defining the hydrologic influence of the Wells G & H are:

Well locations	20A, B, C, and D
	2, 3, 10, and 15
	21, 22, 23, and 24
Wells:	S8, S43

It is likely that more wells will be included to be specified in the task work plan. Choice of pumping well will be determined during Phase I of the Remedial Investigation. There are two alternatives: rehabilitate Well H or construct a new well. Well G has experienced a great amount of vandalism and NUS/FIT believes it would not be cost-effective to repair. A new well capable of pumping 150-300 gallon/minute would require a 6" diameter well casing, gravel packing and an adequate screen slot size to permit easy withdrawal of water. It would be screened from the top of the water table to a lower less permeable stratum. It is currently unknown whether it is feasible to bring Well H on line again. This determination will be made during Phase I of the Remedial Investigation.

A number of costs would be incurred in rehabilitating well H; these costs include:

- Determination of screen length.
- Examination of all mechanical equipment to determine if it is in working order.
- Examinaton and possible repair of all electrical equipment.

A final decision would be made after costs associated with rehabilitating Well H versus constructing a new 6" gravel packed well and purchasing or renting a pump that can draw 150-300 gallons/minute are determined.

Permission and/or permits to conduct an aquifer test will be procured during Phase I. Through discussions with EPA and DEQE, NUS/FIT believes the greatest obstacle to obtaining the necessary permits and/or permission will be the disposition of pumped water. There are two primary options: treatment with discharge to some downgradient point or discharge without treatment to some downgradient point. Treatment may be cost prohibitive and the right to discharge may be denied.

NUS will make every effort to see that these problems are resolved early in the study, as both NUS/FIT and GCA feel a pump test is critical to the Remedial Investigation.

Task 12 Surveying

Following the field activities, the locations and elevations of all new monitoring wells, sampling locations, and important existing monitoring wells will be surveyed and an updated basemap will be prepared. This map will serve as the basemap for the draft report. Prior to the aquifer test, the level of the Aberjona River will be surveyed and calibrated staff gages will be placed upstream and downstream of Well H. These measuring points will be used to determine whether pumping a well in the vicinity of Wells G & H has a draw down effect on the river.

3.3 Phase III Activities

Upon completion of all tasks and requirements for this investigation, a Draft Report will be prepared and submitted to the Region I EPA Site Manager and DEQE for review and comments. EPA and DEQE review and comments will be taken into consideration when preparing the final report.

The report will accomplish the following:

- describe the geohydrology of the Wells G & H aquifer area, including surface water and groundwater movement, and identify contaminant source areas and describe pathways and mechanisms of contaminant transport,

- present geohydrologic and chemical data sufficient to support a subsequent feasibility study which will determine the need for and extent of remedial action and will identify and evaluate the most cost-effective remedial actions for mitigating the effects of groundwater contamination at the Wells G & H aquifer area, and

- identify contaminant source areas and properties that are contributing contamination to the Wells G & H aquifer area, and collect information that is adequate to support successful future enforcement actions and source control remedial action.

4.0 REFERENCES

1. Ecology and Environment, Inc. Evaluation of the Hydrogeology of East and North Woburn, Massachusetts: Volume I. 25 June 1982. EPA Contract No. 68-01-6056, TDD No. F1-8109-02.

2. Ecology and Environment, Inc. Chlorinated Solvent Contamination of the Groundwater, East Central Woburn, Massachusetts. 8 March 1982. EPA Contract No. 68-01-6056, TDD No. F1-8203-01.

3. Camp Dresser & McKee, Inc. Draft Remedial Action Plan for East Woburn, Woburn Massachusetts. 21 January 1983. EPA Contract No. 68-03-1612, Work Assignment 2-1-12.

APPENDIX A

TECHNICAL DIRECTIVE DOCUMENTS F1-8311-06 AND F1-8405-02

1. COST CENTER:	REM/FIT ZONE CONTRACT TECHNICAL DIRECTIVE DOCUMENT (TDD)	2. NO. F1-8311-06
ACCOUNT NO.:		

3. PRIORITY:	4. ESTIMATE OF TECHNICAL HOURS:	5. EPA SITE ID:	6. COMPLETION DATE	7. REFERENCE INFO.:
[x] HIGH [ ] MEDIUM [ ] LOW	100	MAD 980 732 168	12/15/83	[ ] YES [ ] NO [ ] ATTACHED [ ] PICK UP
	4A. ESTIMATE OF SUBCONTRACT COST:	5A. EPA SITE NAME: Woburn Wells G & H		

8. GENERAL TASK DESCRIPTION: Develop a Scope of Work for a hydrogeologic investigation of East Woburn. This investigation should be aimed at delineating the source or sources of contamination to Wells G & H.

9. SPECIFIC ELEMENTS: The Scope of Work should include but not be limited to the following:

- Objective
- Site Description
- Well location & installation
- Groundwater sampling
- Analytical results
- Recommendations

10. INTERIM DEADLINES:

11. DESIRED REPORT FORM: FORMAL REPORT [x] LETTER REPORT [ ] FORMAL BRIEFING [ ]

OTHER (SPECIFY):

12. COMMENTS: Coordinate with Dave Delaney

13. AUTHORIZING RPO: David R. Smith
(SIGNATURE)

14. DATE: 11-28/83

15. RECEIVED BY: [x] ACCEPTED [ ] ACCEPTED WITH EXCEPTIONS [ ] REJECTED

Paul F. Clay
(CONTRACTOR RPM SIGNATURE)

16. DATE: 11/29/83

Sheet 1 White – FITL Copy
Sheet 2 Canary – DPO Copy
Sheet 3 Pink – Contracting Officer's Copy (Washington, D. C.)
Sheet 4 Goldenrod – Project Officer's Copy (Washington, D. C.)

1. COST CENTER:	REM/FIT ZONE CONTRACT TECHNICAL DIRECTIVE DOCUMENT (TDD)	2. NO. F1-8405-02
ACCOUNT NO.:		

3. PRIORITY:	4. ESTIMATE OF TECHNICAL HOURS:	5. EPA SITE ID:	6. COMPLETION DATE:	7. REFERENCE INFO.:
☒ HIGH ☐ MEDIUM ☐ LOW	500	MAD 980-732-168	7-15-84	☐ YES ☒ NO ☐ ATTACHED ☐ PICK UP
	4A. ESTIMATE OF SUBCONTRACT COST: — — —	5A. EPA SITE NAME: Woburn Wells G + H		

8. GENERAL TASK DESCRIPTION: Develop a scope of work that will be used to direct a remedial investigation (RI) at the Woburn G + H wells. Begin Phase I activities.

9. SPECIFIC ELEMENTS: The RI should support the feasibility study, identification of a responsible party (parties) and successful cost recovery enforcement action(s). Phase I activities include review of existing data, planning for site access, preparation of a base map, procurement of subcontractors, mobilization of equipment + performance of an initial round of environmental sampling.

10. INTERIM DEADLINES:

11. DESIRED REPORT FORM: FORMAL REPORT ☒ LETTER REPORT ☐ FORMAL BRIEFING ☐

OTHER (SPECIFY):

12. COMMENTS: Coordinate activities with Richard Leighton, EPA

13. AUTHORIZING RPO:

(SIGNATURE)

Donald R. Smith

14. DATE: 5-15-84

15. RECEIVED BY: ☒ ACCEPTED ☐ ACCEPTED WITH EXCEPTIONS ☐ REJECTED

(CONTRACTOR RPM SIGNATURE)

Richard G. DiNitto

16. DATE: 5-16-84

Sheet 1 White – FITL Copy
Sheet 2 Canary – DPO Copy
Sheet 3 Pink – Contracting Officer's Copy (Washington, D. C.)
Sheet 4 Goldenrod – Project Officer's Copy (Washington, D. C.)

APPENDIX B

LIST OF VOLATILE PRIORITY POLLUTANTS

VOLATILE COMPOUNDS

PP #	CAS #	
(2V)	107-02-8	acrolein
(3V)	107-13-1	acrylonitrile
(4V)	71-43-2	benzene
(6V)	56-23-5	carbon tetrachloride
(7V)	108-90-7	chlorobenzene
(10V)	107-06-2	1,2-dichloroethane
(11V)	71-55-6	1,1,1-trichloroethane
(13V)	75-34-3	1,1-dichloroethane
(14V)	79-00-5	1,1,2-trichloroethane
(15V)	79-34-5	1,1,2,2-tetrachloroethane
(16V)	75-00-3	chloroethane
(19V)	110-75-8	2-chloroethylvinyl ether
(23V)	67-66-3	chloroform
(29V)	75-35-4	1,1-dichloroethene
(30V)	156-60-5	trans-1,2-dichloroethene
(32V)	78-87-5	1,2-dichloropropane
(33V)	10061-02-6	trans-1,3-dichloropropene
(38V)	100-41-4	ethylbenzene
	10061-01-05	cis-1,3-dichloropropene
(44V)	75-09-2	methylene chloride
(45V)	74-87-3	chloromethane
(46V)	74-83-9	bromomethane
(47V)	75-25-2	bromoform
(48V)	75-27-4	bromodichloromethane
(49V)	75-69-4	fluorotrichloromethane
(50V)	75-71-8	dichlorodifluoromethane
(51V)	124-48-1	chlorodibromomethane
(85V)	127-18-4	tetrachloroethene
(86V)	108-88-3	toluene
(87V)	79-01-6	trichloroethene
(88V)	75-01-4	vinyl chloride

Non-Priority Pollutant Hazardous Substances List Compounds

VOLATILES

CAS #		ug/l or ug/kg (circle one)
67-64-1	acetone	
78-93-3	2-butanone	
75-15-0	carbon disulfide	
519-78-6	2-hexanone	
108-10-1	4-methyl-2-pentanone	
100-42-5	styrene	
108-05-4	vinyl acetate	
95-47-6	o-xylene	

APPENDIX C

LIST OF DRINKING WATER STANDARDS

FEDERAL DRINKING WATER STANDARDS FOR PUBLIC WATER SUPPLIES

Parameter

I. Inorganic

Primary Standards[1]	**Maximum Contaminant Levels for Inorganic Chemicals (mg/l)**
Arsenic	0.05
Barium	1
Cadmium	0.010
Chromium	0.05
Lead	0.05
Mercury	0.002
Nitrate as N	10.
Selenium	0.01
Silver	0.05
Fluoride	1.4 - 2.4[2]
Sodium	20.(5)

II. Organic

a)

Contaminant	**Level (mg/l)**
Endrin	0.0002
Lindane	0.0004
Methoxychlor	0.1
Toxaphene	0.005
2,4-D	0.1
2,4,5-TP Silvex	0.01

b) Total Trihalomethanes (TTHM)
TTHM = sum of the organohalogen compounds
MCL = 0.10 mg/l

Secondary Standards[3]	Recommended Maximum Contaminant Levels (mg/l)
Chloride	250
Color	15 color units
Copper	1.0
Corrosivity[4]	non-corrosive
Iron	0.3
Manganese	0.05
Odor	3 threshold odor number
pH	6.5-8.5 s.u.
Sulfate	250
Zinc	5.0
Total Dissolved Solids	500
Foaming agents	0.5

(1) 40 CFR Part 141 (Federal Register, Vol. 40, No. 248, December 24, 1975)

(2) Maximum allowable concentration depends on annual average of maximum daily air temperatures at site of supply.

(3) 40 CFR Part 143 (Federal Register, Vol. 44, No. 140, July 19, 1979)

(4) Requires Calcium Hardness Alkalinity, TDS.

(5) currently being considered

Massachusetts Requirements

- Demand, such as COD, BOD, TOC, chlorine residual.
- Pesticides, Herbicides, and other Organics, such as hydrocarbons, carbamates and organo-phosphorus compounds.
- Microbiological Analyses. this discipline shall be led into the following categories:

  (A) Total Coliform by the Membrane Filter Method.

  (B) Fecal Coliform by the Membrane Filter Method.

  (C) Total Coliform by the Fermentation Tube Method.

  (D) Fecal Coliform by the Fermentation Tube Method.

  (E) Standard Plate Count.

- Radiological Analyses.

Additional Requirements

- Chloroform - Trihalomethane formation potential
- Temperature

APPENDIX D

OVERVIEW OF STANDARD OPERATING GUIDELINES

CONTENTS

SECTION		PAGE
1.0	GROUNDWATER, SURFACE WATER AND SEDIMENT SAMPLING	D-2
2.0	GROUNDWATER MONITORING WELL INSTALLATIONS	D-3

1.0 GROUNDWATER, JRFACE WATER AND SEDIMENT SAMPLING

Each well to be sampled will be purged a minimum of three well volumes to a maximum of five well volumes prior to sampling. Specific conductance and pH will be monitored following the purging of each well volume. Samples will be taken following the evacuation of at least three well volumes with the stabilization of pH and specific conductance. Conductivity and pH measurements should not exceed $\pm$ 0.03 pH units and $\pm$ 10% relative conductivity between successive measurements. Regardless of the allowed tolerances on pH and conductivty, static water purging will not exceed five well volumes. The wells will be purged by pumping or hand bailing. Each well sample will be collected from clean stainless steel/teflon bailer after purging is complete and the water level has risen to at least 75% of its greatest drawdown.

Water level measurements will be taken prior to sample collection, periodically during purging and periodically after sampling as the water level returns to static conditions. Collected samples will immediately be labelled and packed in ice prior for removal from the site.

Health and safety requirements will be detailed in a task work plan. Sampling activities will likely require protective clothing (tyveks, inner disposable gloves, outer nitrile gloves, neoprene boots) and use of general decontamination procedures. Periodic ambient air monitoring during well purging will dictate respiratory protection. Careful attention will be paid to the decontamination of purging and sample collection equipment to prevent cross contamination between wells.

Surface water samples will be collected by submerging sample bottles directly into the water. Sediment samples will be collected with a remote stainless steel sampling device. Quality control samples, duplicates and blanks, will be incorporated into the sampling plan.

An additional 44 ml glass vial of each sample will be collected for in-house screening on the Photovac gas chromatograph. Chain of Custody and preservation methods will adhere to the appropriate NUS Standard Operating Guidelines (not discussed here).

2.0 GROUNDWATER MONITORING WELL INSTALLATIONS

Drilling and well installation work to be performed will be subcontracted and will adhere to NUS and EPA approved task work plan specifications.

Drilling will utilize hollow-stem auger or drive casing of hardened steel with a minimum four inch inside diameter. Soil samples will be collected with a 24-inch long, two-inch outside diameter (O.D.) split-spoon sampler at five foot intervals. The split-spoon sampler will be driven with a 140 pound drive weight falling thirty inches. The driving resistance (blow counts) will be recorded for each six inches (6") the sampler is driven. A representative soil sample will be recovered from the sampler with a stainless steel trowel and stored in at least one wide-mouthed eight ounce glass jar for geologic characterization. In addition, one 44ml septum sealed glass vial will be partially filled with soil for OVA headspace analysis. When obstructions cause less than twelve inches (12") per 100 blows, or less than one inch (1") per 50 blows of a standard split-spoon sampler when driven with a 140 pound weight free-falling thirty inches (30"), the driller will attempt to penetrate the obstruction by the use of a roller bit (in dense material) or by coring (for boulders). If the obstruction can not be penetrated, the original location may be abandoned and a new well location will be chosen by the NUS field geologist.

The monitoring well casing will consist of Schedule 80, threaded flush-joint PVC with a nominal pipe size of one and one-half inches inside diameter (1.5" ID).

The screened portion of the casing will consist of slotted PVC with a slot size of not less than 0.010 inches and will have a minimum length of ten feet.

Because split spoon soil samples will be collected at five foot intervals, a ten foot minimum for the well screen is necessary to intercept a zone of contamination detected by OVA field screening.

In shallow bedrock monitoring wells, a minimum of twenty feet (20') will be cored using standard ASTM methods for diamond core drilling. A minimum of twenty feet of bedrock coring was selected because data from previous studies indicated that ten feet of bedrock coring was inadequate to intercept the full zone of surficial bedrock fracturing.

Installation of deep bedrock wells is not anticipated in this study.

For shallow overburden wells, the annular space between the well casing and overburden shall be backfilled with a 60/40 Ottawa sand, or similarly graded sand, to a level approximately one foot (1') above the top of the screen, which will be followed by two foot (2') bentonite seal. For deeper overburden wells, the same procedure will be followed except the Ottawa sand backfill will be followed by a ten foot (10') injected bentonite slurry seal (using a 3:1 ratio of bentonite to cement). The amount of Ottawa sand needed to adequately cover screens will be calculated and then measured as it is installed. Backfill will be placed in the annulus so that a minimum of one inch (1") of backfill material is between the casing and the natural overburden material.

For wells screened in shallow bedrock, the annular space between the well casing and bedrock shall be backfilled, with the same material used in overburden wells, to a level approximately four feet (4') below the bedrock surface or one foot (1') above the top of the well screen. The Ottawa sand backfill will be followed by a ten foot (10') injected bentonite slurry seal (using a 3:1 ratio of bentonite to cement).

To provide well security, a six inch (6") diameter black steel casing five feet (5') in length painted with a rust preventative paint shall be placed around the PVC casing and set into a two foot (2') depth of concrete grout. The top of the steel casing shall extend above the inner casing to allow for ease of access, and shall be threaded and fitted with a cap with a 1/4" side vent hole. A hardened steel clasp shall be welded on one side of each steel casing so that the cap may be secured with a hardened steel lock. The lock identification number will be scratched off. All security casing and caps must be free of all oil or solvents.

Placement of groundwater monitoring well screens will be determined in the field based on the stratigraphy encountered and the vertical distribution of volatile organic compounds (as determined by field and in-house screening).

Organic vapor concentrations will be determined with a Century Systems Organic Vapor Analyzer (OVA) 128. Headspace analysis will be performed on soil and drilling wash water samples collected during well installation. Injection of headspace vapors will be made with a gas tight syringe onto an OVA G-24 column. Two modes of operation will be utilized: total organic vapors and gas chromatography. If the initial screen of total organic vapors gives a positive result, a chromatogram will be run and recorded on a strip chart recorder. Organic vapor measurements will be made in the field during drilling and will be part of the health and safety procedures and corresponding action levels. Further detail of the OVA procedure will be provided in a complete operating guideline package at a later date. Whenever possible, soil, groundwater and drilling wash water samples will be collected for volatile headspace analysis on a Photovac gas chromatograph located at EPA-Lexington. Due to its greater sensitivity, this analysis will provide additional data on which to base field decisions.

In those locations where a vertical stratification of organic contamination is apparent, multi-level wells will be installed. Multi-level wells will consist of a cluster of wells screened at appropriate intervals.

Stratification of organic contamination will be defined as the presence of contamination as detected by OVA field screening techniques in zones at least twenty feet apart. Contamination detected in soils less than twenty feet apart (i.e. in split spoon samples ten feet apart) will not necessarily indicate different plumes contamination but rather the same plume of contamination unevenly distributed in the overburden according to the variation in permeability of the materials encountered. Multi-level wells will also be installed in areas where data concerning vertical hydraulic gradients is needed and will consist of two, three or more individual wells depending on geologic strata encountered, field screening results and study objectives.

After well installation, the drillers will be required to develop the well by purging the well until clear silt-free water is obtained or until recharge is insufficient to continue pumping. Following development and well recovery, the groundwater will be sampled the following day for in-house screening on a photovac gas chromatograph. The screening results will be used to decide whether additional wells need to be installed in key areas as detailed in Section 3.2 (Task 08).

It is anticipated that two drilling rigs will be employed simultaneously to complete the installation of groundwater monitoring within a reasonable time frame. Therefore, the NUS field team will consist of two on-site geologists, each supervising one of the drilling rigs. They will be responsible for collecting and logging split spoon soil samples and overseeing all aspects of well installation. The on-site geologist will also collect soil, drilling wash water and groundwater samples for OVA screening.

An on-site chemist will locate an OVA screening station at a central location to both drilling rigs. The chemist will be responsible for conducting headspace volatile analysis on all samples collected by the on-site geologists. All split spoon soil samples will be screened for volatile contaminants. Additional samples will be screened at the discretion of the supervising geologist. The on-site chemist will also be responsible for ambient air monitoring for health and safety concerns. An additional field technician will be responsible for groundwater sampling after well installation and assisting the rest of the work crew.

Protective clothing during groundwater well installations will typically include hard hats, neoprene boots, tyveks, inner disposable gloves and outer nitrile gloves. The results of ambient monitoring and OVA headspace analysis will dictate respiratory protection and the need for butyl rubber aprons or other protective equipment.