Steven Scharf - Summary of DOH involvement with upgrades for American Water Seamen's Road Plant

From: John A Helmeset <jah20@health.state.ny.us>
To: <Kevin.Manz@dps.ny.gov>
Date: 5/22/2013 11:48 AM
Subject: Summary of DOH involvement with upgrades for American Water Seamen's Road Plant
CC: Brock Rogers <bxr06@health.state.ny.us>, "Craig D. Jackson" <cdj01@healt...
Attachments: BEEI_ Timeline for NY American Wa.pdf; ncdh timeline water supply review summary.pdf; Bethpage Plume Report 1-14-2012 reduced file size.pdf; rod.hw130003a.2001-03.grumman_aerospace_ou2.PDF

good morning Kevin;

NYSDOH involvement is a little complicated, as it reaches over three different program units. So please forgive the length and format; andy questions please feel free to call me.

In an executive summary sense:
I would respectfully request that PSC review and approve the required easement under their emergency protocols. This treatment upgrade and the larger project has been extensively reviewed by many agencies/entities, and has included extensive public comment. Notably, the Restoration Advisory Board which has held at least 26 meetings, including one on May 15, 2013. Additionally, there is an urgency to have the contractor complete the upgrades, to prevent the volatile organic contaminants from breaking through the temporary treatment when the peak demand period begins this summer.

In summary of the situation;
the referenced well field is impacted by a chlorinated solvent plume which originates from a site involving Grumman and the US Navy. This plume has impacted multiple well fields, and the Navy/Grumman have installed treatment at those well fields (see Navy web site for hazardous waste disposal site and plume details at: https://portal.navfac.navy.mil/portal/page/portal/navfac/navfac_ww_pp/navfac_hq_pp/navfac_env_pp/env_restoration_installations/lant/midlant/bethpage/site_descriptions)

DOH involvement:
As part of that remedial process, which began in 1983 when the site was first designated as a hazardous waste site, both Nassau County Health Department and NYS DOH Bureau of Environmental Exposure Investigation have been involved; with NYS Dept of Environmental Conservation (DEC) as lead agency. The result of that process,has involved many public meetings and reviewed/approved many documents. Again, please see materials from DEC and Navy web site, and one of the three Records of Decisions which is attached. In 1996, the investigation focus shifted to those impacted off site areas/groundwater as the on site investigation was largely defined and the contamination was conceptually understood.

The NYSDOH, has reviewed and approved of all key documents and milestones as part of that on site and off site remedial investigation process through our Bureau of Environmental Exposure Investigation, in conjuction with the Nassau County Department of Health. Please see the very lengthy site administrative record at: https://portal.navfac.navy.mil/portal/page/portal/navfac/navfac_ww_pp/navfac_hq_pp/navfac_env_pp/env_restoration_installations/arfsearch?p_instln_id=BETHPAGE_NWIRP

Specifically, to the NYSDOH involvement with the impacted public water systems:
In summary, there is a legal agreement between the Navy and the individual water suppliers dating back to 2001 which provides for the Navy to install treatment on public water supply well fields impacted by the chlorinated solvent plume from the site. This has occured several times to date, at various public water supply well heads involving the South Farmingdale and the Bethpage Water Districts. I would represent these upgrades as addressing immediate issues of public health and welfare, as they occur when the wellfields have increasing levels of volatile organic contamination.

In 2008, Aqua New York (ANY, American Water's predecessor) requested the Navy install treatment at the Seamen's road plant as chlorinated contaminants were being detected at levels approaching the drinking water standards. These are wells ANY -SNR 3S and 4S in the Bethpage Plume Report, see page 21 of 188 for a plume figure with the public water supply wells with treatment and those at risk. In 2009, the Navy investigated the plume with respect to the ANY wells. In 2010, the Navy designed the treatment system. Please see the attached PDF for details of the approximately 12 separate document reviews and approvals (with dates) completed by NCHD Water Supply Program.

In general; these water supply reviews/approvals were due to the presence of the volatile contaminants, and resulted in the temporary installation of carbon treatment on an emergency basis, and the need to upgrade this temporary measure by October 2012 with full treatment (packed air stripper tower with carbon polishing and carbon on air exhaust). The temporary carbon treatment was installed in April 2012 and approved by NCDH in May 2012. The permanent upgrades/current work at Seamen's Road plant were approved in December 2012 by NCDH).

All of these water treatment upgrades (both current upgrades and those temporary upgrades completed in 2012) were reviewed and approved per normal process, through the Nassau County Department of Health (which conducts drinking water treatment reviews/approvals on the behalf of the NYSDOH).

In 2013, the Navy mobilized their contractor to the Seamen's Road Plant and reportedly was informed at that time by American Water of the need for PSC approval for an easement. Thus triggering this current effort and the direct involvement Bureau of Water Supply Protection (BWSP) within the New York State Department of Health. This information is second hand, and would best be directly confirmed with the water supplier and the Navy contractor.

It is unclear to me why this easement approval issue did not appear during the previous work at the Seamen's Road Plant in 2012, when the temporary treatment was installed. This may be related to the current work involving a privately owned/PSC regulated water supplier, as the water suppliers the Navy has installed treatement to date with where municipal systems.

To the best of our knowledge, the currently planned upgrade work has all the relevent permits and approval of plans required (with the exception of PSC requirements). However, that question would best be placed to the engineer for the Navy (Tetra Tech Inc.)

I have copied others, who hopefully will weigh in if I have misrepresented or omitted anything.

Please let me know if you have any questions, or need any additional information. I apologize for the length and format, however, the amount of materials involved do not allow for a succinct and comprehensive email.

Thanks again for your help with this matter.

J

(See attached file: BEEI_ Timeline for NY American Wa.pdf)(See attached file: ncdh timeline water supply review summary.pdf)

(See attached file: Bethpage Plume Report 1-14-2012 reduced file size.pdf)(See attached file: rod.hw130003a.2001-03.grumman_aerospace_ou2.PDF)

Our office has relocated to the Corning Tower. My email and phone number has not changed, but please use the following mailing address.

John A. Helmeset, P.E.
Public Health Engineer 2/State Fluoridation Engineer/Small Systems Technical Assistance Coordinator/Fact Checker
Bureau of Water Supply Protection
New York State Department of Health
Corning Tower, Room 1119
Empire State Plaza
Albany, NY 12237

(518) 402 7654

Illegitimi non carborundum

Department of Environmental Conservation

Division of Environmental Remediation

Record of Decision

Operable Unit 2 Groundwater
Northrop Grumman and Naval Weapons Industrial Reserve Plant Sites
Nassau County
Site Numbers 1-30-003A & B

March 2001

New York State Department of Environmental Conservation
GEORGE E. PATAKI, *Governor* ERIN M. CROTTY, *Commissioner*

DECLARATION STATEMENT - RECORD OF DECISION

Operable Unit 2 Groundwater
Northrop Grumman and Naval Weapons Industrial Reserve Plant Sites
Inactive Hazardous Waste Disposal Sites
Town of Oyster Bay, Nassau County, New York
Site Nos. 1-30-003A & B

Statement of Purpose and Basis

The Record of Decision (ROD) presents the selected remedy for the Northrop Grumman and the Naval Weapons Industrial Reserve Plant Class 2 Inactive Hazardous Waste Disposal Sites Operable Unit 2 regional groundwater contaminant plume. This plan was chosen in accordance with the New York State Environmental Conservation Law. The remedy selected is not inconsistent with the National Oil and Hazardous Substances Pollution Contingency Plan of March 8, 1990 (40CFR300).

This decision is based on the Administrative Record of the New York State Department of Environmental Conservation (NYSDEC) for the Northrop Grumman and the Naval Weapons Industrial Reserve Plant Class 2 inactive hazardous waste disposal sites and upon public input to the Proposed Remedial Action Plan (PRAP) presented by the NYSDEC. A listing of the documents included as a part of the Administrative Record is included in Appendix B of the ROD.

Assessment of the Site

Actual or threatened release of hazardous waste constituents from this site, if not addressed by implementing the response action selected in this ROD, presents a current or potential significant threat to public health and the environment.

Description of Selected Remedy

Based on the results of the Remedial Investigation/Feasibility Study (RI/FS) for the Northrop Grumman and the Naval Weapons Industrial Reserve Plant (NWIRP) Class 2 Inactive Hazardous Waste Disposal Sites and the criteria identified for evaluation of alternatives, the NYSDEC has selected Alternative 3. The selected remedy includes a number of response measures which have been categorized into a Groundwater Remedial Program and a Public Water Supply Protection Program.

Groundwater Remedial Program

The selected remedy includes a groundwater remedial program to address the regional groundwater contaminant plume associated with the Northrop Grumman and NWIRP sites. The components of this program are as follows:

- continued operation of the on-site containment (ONCT) groundwater extraction and treatment system (formerly known as an Interim Remedial Measure) at Northrop Grumman's southern property line;

- an evaluation of the ONCT system to confirm that it is performing effectively;

- mass contaminant removal through groundwater extraction and treatment in an offsite area near the GM 38 monitoring well cluster;

- predesign investigation to determine the optimal groundwater extraction location(s) in the GM 38 offsite treatment area(s);

- long term operation and maintenance of all operating systems, including the ONCT (or former IRM) system and the GM 38 area remedy;

- additional groundwater investigation to better define the groundwater contaminant plume and to determine whether additional groundwater remediation is required under this ROD, under an amended OU2 ROD, and/or if an Operable Unit 3 Groundwater RI/FS is warranted;

- long term monitoring of the groundwater including a comprehensive monitoring of plume attenuation;

- the formation of a technical advisory committee (TAC) as deemed necessary by the NYSDEC, to be comprised at a minimum, of the involved Agencies, participating local water districts, Northrop Grumman and the Department of the Navy. The main purpose is to review and provide input on all materials relating to the implementation of the Northrop Grumman and NWIRP OU2 Groundwater remedy.

Public Water Supply Protection Program

The ROD recognizes the importance of continued provision of potable water to those communities/populations served by water supply wells that are or that become impacted by site-related contamination. To this end, the ROD requires that a public water supply protection program be implemented. The components of this program are as follows:

- continued public water supply wellhead treatment to meet appropriate drinking water quality performance objectives at wellfields already affected by the groundwater contaminant plume for as long as these affected wellfields are used as community water supply sources;

- public water supply wellhead treatment or comparable alternative measures, as necessary, for wellfields that become affected in the future; and

- long term monitoring of the groundwater contaminant plume including outpost monitoring wells upgradient of potentially affected water supply wells.

New York State Department of Health Acceptance

The New York State Department of Health concurs with the remedy selected for this site as being protective of human health.

Declaration

The selected remedy is protective of human health and the environment, complies with State and Federal requirements that are legally applicable or relevant and appropriate to the remedial action to the extent practicable, and is cost effective. This remedy utilizes permanent solutions and alternative treatment or resource recovery technologies, to the maximum extent practicable, and satisfies the preference for remedies that reduce toxicity, mobility, or volume as a principal element.

_____ _____

Date

Michael J. O'Toole, Jr., Director
Division of Environmental Remediation

TABLE OF CONTENTS

RECORD OF DECISION

Northrop Grumman and Naval Weapons Industrial Reserve Plant Sites
Town of Oyster Bay, Nassau County
Site Nos. 1-30-003A & B
March 2001

SECTION 1: SUMMARY OF THE RECORD OF DECISION

The New York State Department of Environmental Conservation (NYSDEC) in consultation with the New York State Department of Health has selected this remedy to address the significant threat to human health and/or the environment created by the presence of hazardous waste at the Northrop Grumman Bethpage Plant and the Naval Weapons Industrial Reserve Plant-Bethpage (NWIRP), both class 2, inactive hazardous waste disposal sites. In particular, this ROD addresses Operable Unit 2 (OU2), the regional groundwater contaminant plume associated with these sites. As more fully described in Sections 3 and 4 of this document, plant wastes were disposed directly into either drainage sumps, dry wells and/or on the ground surface resulting in the disposal of a number of hazardous wastes, including the volatile organic compounds (VOCs) perchloroethene (PCE) and trichloroethene (TCE), the semi-volatile organic compound (SVOC) polychlorinated bi-phenyls (PCBs) and the inorganics chromium and cadmium at the site. Some of these contaminants have migrated from the points of disposal to surrounding areas, including the soils of these sites and the groundwater beneath and down gradient of Northrop Grumman, NWIRP and the Grumman-Steel Los Plant 2 facilities. Contaminated groundwater originating from the Grumman-Steel Los Plant 2 Site, formerly part of the Northrop Grumman site, now a Class 4 site, is included within the scope of the Northrop Grumman and NWIRP OU2 groundwater remedial action and long-term management plan.

These disposal activities have resulted in the following significant threats to the public health and/or the environment:

- a significant threat to public health associated with contaminated soils, groundwater and drinking water;

- a significant threat to the environment associated with contaminated soils and groundwater;

In order to restore the Northrop Grumman and Naval Weapons Industrial Reserve Plant Site inactive hazardous waste disposal sites to pre-disposal conditions to the extent feasible and authorized by law, but at a minimum to eliminate or mitigate the significant threats to the public health and/or the environment that the hazardous waste disposed at the site has caused, the following remedy was selected:

Groundwater Remedial Program

- continued operation of the on-site containment (ONCT) groundwater extraction and treatment system (formerly known as an Interim Remedial Measure (IRM)) at Northrop Grumman's southern property line;

- an evaluation of the ONCT system to confirm that it is performing effectively;

- mass contaminant removal through groundwater extraction and treatment in an offsite area near the GM 38 monitoring well cluster;

- predesign investigation to determine the optimal groundwater extraction location(s) in the GM 38 offsite treatment area(s);

- long term operation and maintenance of all operating systems, including the ONCT (or former IRM) and the GM 38 area remedy;

- additional groundwater investigation to better define the groundwater contaminant plume and to determine whether additional groundwater remediation is required under this ROD, under an amended OU2 ROD, and/or if an Operable Unit 3 Groundwater RI/FS is warranted;

- long term monitoring of the groundwater including a comprehensive monitoring of plume attenuation;

- the formation of a technical advisory committee (TAC) as deemed necessary by the NYSDEC, to be comprised at a minimum, of the involved Agencies, participating local water districts, Northrop Grumman and the Department of the Navy. The main purpose is to review and provide input on all materials relating to the implementation of the Northrop Grumman and NWIRP OU2 Groundwater remedy.

Public Water Supply Protection Program

- continued public water supply wellhead treatment to meet appropriate drinking water quality performance objectives at wellfields already affected by the groundwater contaminant plume for as long as these affected wellfields are used as community water supply sources;

- public water supply wellhead treatment or comparable alternative measures, as necessary, for wellfields that become affected in the future; and

- long term monitoring of the groundwater contaminant plume including outpost monitoring wells upgradient of potentially affected water supply wells.

During the course of the OU2 remedial investigation certain actions, known as Interim Remedial Measures (IRMs), were undertaken by Northrop Grumman and/or the Department of the Navy in response to the threats identified above. An IRM is conducted at a site when a source of contamination or exposure

pathway can be effectively addressed before completion of the RI/FS. A major groundwater IRM undertaken at this site was installation of the onsite containment, or ONCT System, at Northrop Grumman's southern property line. This IRM is described in more detail in Section 4.

Additional response measures taken during the course of the OU2 investigation include installation of wellhead treatment systems at the Bethpage Water District (BWD) Wellfields 4, 5 and 6. This response measure is described in more detail in Section 4.

The selected remedy, discussed in detail in Section 8 of this document, is intended to attain the goals selected for this site in Section 6 of this Record of Decision (ROD), in conformity with applicable standards, criteria, and guidance (SCGs).

SECTION 2: SITE LOCATION AND DESCRIPTION

The Northrop Grumman and NWIRP inactive hazardous waste disposal sites are located in east-central Nassau County, Long Island (see Figures 1 and 2).

The entire Northrop Grumman site was initially more than 600 acres in area, but has been reduced in size through previous remedial activities and confirmatory sampling events. The portions of the former Northrop Grumman site that remain listed in the New York State Registry of Inactive Hazardous Waste Disposal Sites include the southern recharge basins, the NWIRP and the Grumman-Steel Los Plant 2 site (formerly the Grumman Plant 2 facility). The southern recharge basins and the Grumman-Steel Los Plant 2 facility currently total about 35 acres in size. The NWIRP site is approximately 105 acres in size. There are numerous groundwater industrial supply wells and recharge basins at these sites.

The RUCO Polymer site, site No. 1-30-004, (see figure 4) is located to the northwest of the Northrop Grumman Site and west-northwest of the NWIRP. There are other industrial and commercial facilities in the area along with several residential communities. There are several public supply wells within a two-mile radius of the sites.

SECTION 3: SITE HISTORY

3.1: Operational/Disposal History

Northrop Grumman Site No. 1-30-003A

The Grumman Aerospace Corporation was established in the early 1930s at the present site in Bethpage. Several naval aircraft were developed and manufactured at the site. Other activities at the site included the manufacturing of naval amphibious craft and the manufacturing of various satellites, etc. for the National Aeronautics and Space Administration (NASA).

From 1943 to 949, Grumman disposed of chromic acid wastes directly on the ground or in open seepage basins. In 1949, a chromic acid treatment system was put on-line at Plant 2. In addition to the chromic acid treatment system located at Plant 2, systems for treating phenols, oils, and other organic compounds, and for recovering silver were also used at Plant 2. Since the early 1950s, some of the wastes generated by Grumman were taken to the NWIRP property for treatment or storage before being taken off site by private haulers. These wastes included common organic solvents consisting of chlorinated hydrocarbons. There were several locations on the Grumman site where wastes were stored, treated, or disposed of. Trichloroethene (TCE) was stored in an above ground tank along the northeastern corner of Plant 2. A release of TCE from this tank (or the associated piping system) occurred and was discovered during the Grumman Remedial Investigation.

NWIRP Site No. 1-30-003B:

The NWIRP was established in 1933. The NWIRP is known as a government owned, contractor operated (GOCO) facility. Since its inception, the primary mission for the facility has been the research, prototyping, testing, design engineering, fabrication, and primary assembly of military aircraft.

The facilities at the NWIRP include four plants (No. 3, 5, and 20, used for assembly and prototype testing; and No. 10, which contains a group of quality control laboratories), two warehouse complexes, a salvage storage area, water recharge basins, an industrial wastewater treatment plant, and several smaller support buildings.

The following is a discussion of the waste handling practices at the three identified disposal areas at the NWIRP facility (see Figure 3 or area locations):

Area 1 - Former Drum Marshaling Area

From the early 1950's to 1978, drums containing liquid wastes were stored on a cinder covered area over a cesspool leach field. This leach field may have been used to discharge process wastewater. In 1978, the drum storage area was moved a few yards to the south to a 100- by 100-foot concrete pad. This pad did not have a cover or berms around it. In 1982, the drum storage area was moved to Area 3.

Various solvents were stored at Area 1. Cadmium and cyanide wastes were also stored in this area from the early 1950's through 1974. Approximately 200 to 300 drums were stored at these locations at any given time. Reportedly, all drums of waste which were stored at these areas were taken offsite by a private contractor for treatment and disposal.

Area 2 - Recharge Basin Area

Prior to 1984, some Plant 3 production-line rinse waters were discharged in the three on-site recharge basins. These waters were directly exposed to chemicals used in the industrial processes (rinsing of

manufactured parts). Only non-contact cooling water has been discharged into these basins since 1984. The source of this non-contact cooling water has been on-site production wells.

On at least one occasion (1956), hexavalent chromium was detected in the water in the recharge basins at concentrations in excess of allowable limits. This matter was discovered and handled by the Nassau County Department of Health.

Adjacent to and west of the recharge basins are the former sludge drying beds. Sludge from the Plant 2 Industrial Waste Treatment Plant (part of the Grumman Site as described above) was dewatered in these beds before being disposed of off-site.

Area 3 - Salvage Storage Area

The NWIRP salvage storage area is located to the west of Area 2. This area has been used for the storage of fixtures, tools, and metallic wastes such as aluminum and titanium scraps, since the early-1950's.

Located within the salvage storage area was a 100- by 100 foot area that was used for the storage of drummed waste. This 100 by 100-foot area was reportedly covered with coal ash cinders. Halogenated and non-halogenated waste solvents were stored in this area from the early-1950's through 1969. The exact location of this drum storage area is not known. Since 1982, drums have been stored in a covered area with a concrete pad and berms.

Grumman-Steel Los Plant 2, Site No. 1-30-003C (Groundwater Contamination):

In 1994, the Grumman Aerospace Corporation was purchased by the Northrop Corporation and became known as the Northrop Grumman Corporation. In December 1996, Northrop Grumman sold Plant 2 and the surrounding land to the Steel Los III Corporation (Steel Los). Steel Los refurbished the Plant 2 complex and now leases the former Plant 2 as commercial real estate.

The Plant 2 facility, listed as site No. 1-30-003C on the New York State Registry of Inactive Hazardous Waste Sites, was originally part of Site 1-30-003A, the Northrop Grumman Site. Now known as the Grumman Steel Los site, this site was addressed by the Operable Unit One (OU1) soils remedy for the Northrop Grumman Site. The OU1 ROD deferred groundwater contamination issues to this OU2 groundwater remedy. The Grumman Steel Los Site is now a class 4 site, and long term monitoring will be required, in part due to residual cadmium and chromium contamination beneath the site. A deed restriction for the property has been filed to minimize the potential for exposure to residual contamination and to minimize the potential for groundwater leaching of residual contaminants.

OXY Hooker Ruco, Site No. 1-30-004 (Not the Subject of this ROD):

The RUCO Polymer site (see figure 4) was originally the Rubber Corporation of America. The Hooker Chemical Corporation (now the Occidental Chemical Corporation, also known as OCC or OXY)

purchased the Rubber Corporation of America (RUCO) in 1965. The RUCO plant was sold to the employees in 1982. The site is now a subsidiary of the Sybron Corporation under the name RUCO Chemical Corporation (RUCO Site). OXY has retained the environmental liability for the past disposal practices.

Between 1956 and 1975, industrial process wastewater and storm water runoff from the facility was discharged to six (6) on-site recharge basins or sumps. This wastewater contained chlorinated hydrocarbons including PCE, TCE and vinyl chloride monomer (VCM), as well as other organic and inorganic wastes. These waste waters have contributed to the contamination of the Bethpage regional aquifer upgradient and beneath the Northrop Grumman, NWIRP and Grumman-Steel Los facilities. The OXY Hooker Ruco Site is listed on the National Priorities List (NPL) of the United States Environmental Protection Agency (USEPA). A separate remedial program is being carried out for the Ruco site under the oversight of the USEPA. Therefore, the Ruco site is not a direct focus of this ROD except inasmuch as it may affect the effectiveness of groundwater remedies (see for example Item D in Section 7.1).

3.2: Remedial History

Northrop Grumman and Grumman Steel Los Plant 2:

Grumman was reportedly notified in December 1947 that a sample collected from Well No. 3 of the Central Park Water District (predecessor of the Bethpage Water District) contained chromium at a concentration of 1.4 parts per million (ppm). As a result, the District's well No.s 1, 2 and 3, located on Jackson Avenue near the train station, were permanently closed. Eventually Grumman Aerospace reimbursed the District for these wells. Grumman installed a chromic acid treatment system for its Plant 2 waste waters. This system went on-line in 1949.

Odor and taste problems were discovered in water pumped from some of Grumman's on-site production wells in 1973. Several investigations into the source(s) of this problem were conducted from 1973 through the early 1980's. It was ultimately determined that these problems were due to chlorinated hydrocarbons in the groundwater.

The Northrop Grumman site was added to the New York State Department of Environmental Conservation's Registry of Inactive Hazardous Waste Disposal Sites in New York State (Registry) in 1983. At the time, the NWIRP-Bethpage site was considered part of the Northrop Grumman site. The site was initially listed as a Class 2a site because there was insufficient data to assign it a classification set forth in the Environmental Conservation Law (ECL).

Based on a subsequent review of existing data, the Grumman site was reclassified to a Class 2 site by the NYSDEC in December 1987. A Class 2 site is a site which poses a significant threat to human health and/or the environment, and for which action is required.

Northrop Grumman conducted a remedial investigation (RI) on site between October 1989 and September 1994. As a result of this investigation, two source areas were identified. The NYSDEC also divided the remedial programs at the Northrop Grumman Site and the NWIRP site into two operable units; site soils and the regional groundwater. An operable unit is designated to represent a portion of the site remedy which for technical or administrative reasons can be addressed separately to eliminate or mitigate a release, threat of release or exposure pathway resulting from contamination at a site.

The purpose of the Feasibility Studies on the Northrop Grumman and NWIRP sites was to develop and evaluate remedial alternatives for remediating the soils contamination defined during the RI(s). A Record of Decision (ROD) for operable unit one (OU1) for the Northrop Grumman site was issued in March 1995 and for the NWIRP site in July 1995.

A soil vapor extraction system was installed adjacent to a former storage tank that was used to store trichloroethene (TCE) at Plant 2. This system was shut down for a short period of time and was used to remediate a small area of contamination (perchloroethene or PCE) at Plant 15. The Plant 15 source area has been adequately remediated. The adequacy of the Plant 2 remediation will be determined after confirmatory sampling.

In addition to the hazardous waste remediation program, the parts and parcels of the former Grumman Aerospace facility have been regulated under the Resource, Conservation and Recovery Act, (RCRA), or active facility permitting program. Under the RCRA program, other remedial measures (sometimes called corrective actions), have been implemented by the NYSDECs RCRA program (also discussed in section 4) and under the USEPA's underground injection control (UIC) program.

Contaminated soil and dry well sediments, at known or potential source areas (such as various Northrop Grumman and NWIRP facilities), have been or are being addressed under OU 1 and/or appropriate RCRA and UIC closure programs.

Certain specific areas of the former Plant 2, or Steel Los property, have elevated levels of chromium and cadmium. The Steel Los Corporation opted to remove only the hazardous waste levels of contamination and then restrict access to the remainder of the soils with contamination above NYSDEC soil cleanup objectives. These areas are well below ground surface and have been deed restricted. The restriction requires maintenance of a cap or cover system at the site and special measures prior to and during ground intrusive activities. These provisions are intended to minimize the potential for leaching of residual contaminants and to minimize the potential for exposure to subsurface contaminants, respectively. The Steel Los property has been reclassified to a class 4, which means the remedial actions are in place and proper long term operation, maintenance and monitoring is required. Cadmium and chromium are included as analytes in the long term hydro-geologic monitoring plan.

NWIRP

An Initial Assessment Study was conducted at the NWIRP-Bethpage site in 1986. Based upon the results of this study, it was concluded that three areas at the site posed a threat to human health or the environment. A description of the Northrop Grumman and NWIRP sites is presented in Section 3.1. In March 1993, NYSDEC listed the NWIRP as a separate Class 2 Registry Site, distinct from the Northrop Grumman Site. The NWIRP site was excluded from the 1990 Northrop Grumman RI/FS Order on Consent and therefore, a separate investigation was required.

An RI/FS was conducted at the site from August 1991 through July 1995. The purpose of the RI was to determine the nature and extent of the contamination that was found during the Initial Assessment Study. The NWIRP ROD called for addressing soils contamination at the three areas of concern. The NWIRP remedies called for the excavation and removal of specific areas of PCB and solvent contamination and the reduction of soils to be excavated by the implementation of a soil vapor extraction system in conjunction with shallow groundwater remediation through air sparging.

OXY Hooker RUCO

The RUCO Site is broken into three operable units. OU 1 addresses site soils and adjacent groundwater, OU 2 addresses soils associated with a particular recharge basin, and OU 3 addresses the offsite migration of groundwater contaminated with VOCs including vinyl chloride and tentatively identified compounds, or TICs, that generally fall into the category of semi-volatile organic compounds (SVOCs). The USEPA issued a Record of Decision for the offsite groundwater contamination, or Operable Unit 3 (OU3) in September 2000. The USEPA OU 3 ROD remedy includes enhanced natural attenuation and long term monitoring of a concentrated groundwater contaminant plume known as "the vinyl chloride subplume" that is immediately northwest of the Northrop Grumman site. The USEPA OU 3 ROD remedy recognizes the importance of preventing the vinyl chloride subplume from adversely affecting the performance and regulatory compliance of Northrop Grumman's groundwater remedial systems and requires that RUCO will take necessary steps to protect the Northrop Grumman groundwater treatment system.

3.3: Enforcement History

Grumman

Grumman entered into a Consent Order with the NYSDEC on October 25, 1990 in which Grumman agreed to conduct a RI/FS at the Northrop Grumman site.

NWIRP

The United States Navy has undertaken their environmental studies pursuant to the Navy's Installation Restoration Program. The State of New York provided oversight of the work conducted by the Navy pursuant to a Memorandum of Understanding between the State and the Department of Defense.

Resource Conservation and Recovery Act

The purpose of this ROD is to set forth the groundwater remedial program and the public water supply protection program for the Northrop Grumman and NWIRP Sites as set forth in 6 NYCRR Part 375, "Inactive Hazardous Waste Disposal Sites." These two sites are also regulated under 6 NYCRR Part 373, commonly known as the Resource, Conservation and Recovery Act, (RCRA) program. This is the permitting and ultimately the closure process for active facilities that store, generate, and treat hazardous wastes over a certain quantity as defined under this regulation. The RCRA program as promulgated under NYSDEC regulations is authorized by the USEPA to issue RCRA permits.

SECTION 4: SITE CONTAMINATION

To evaluate the contamination present at the site and to evaluate alternatives to address the significant threat to human health and the environment posed by the presence of hazardous waste, the Northrop Grumman Corporation and the Navy have conducted two area-wide remedial investigation and feasibility studies (RI/FS's) and a smaller focused RI/FS on the Navy property.

The RCRA program is addressing the contaminated soils beneath the Northrop Grumman and NWIRP buildings. In addition, both Grumman and the Navy are working towards completing the remediation of large capacity underground fuel oil tanks that historically leaked. All the tanks have been removed and residual contaminants in these areas are being remediated under the NYSDEC Division of Environmental Remediation Underground Storage Tanks (UST) program.

4.1: Summary of the Remedial Investigation

The purpose of the RI was to define the nature and extent of any soil and groundwater contamination resulting from previous activities at the Site. The RI was conducted in two phases. The first phase was conducted between February, 1991 and October, 1991 and the second phase between August 1992 and September 1993. For the Northrop Grumman property, a report entitled "Remedial Investigation Report, Grumman Aerospace Corporation, Bethpage, New York, May 1994," has been prepared. For the NWIRP, two reports entitled "Final Remedial Investigation Report NWIRP, May 1992," and "Phase 2 Remedial Investigation Report, NWIRP, October 1993," describe the field activities and findings of the RIs in detail.

The first two FSs were for soils remedies covered under OU 1 RODs with the Navy and Northrop Grumman. The Focused RI/FS, being conducted by Northrop Grumman, is still ongoing for the two remaining PCB contaminated dry wells at the NWIRP. An additional FS, which is the subject of this PRAP, was prepared for offsite groundwater issues.

The following investigatory techniques were used in order to achieve the goals for the RIs:

- Soil gas surveys were conducted in various locations throughout the site in order to locate potential areas which could be sources of groundwater contamination.

- Soil samples were collected in various locations throughout the site to confirm the results of the soil gas surveys and to identify source areas that could not initially be located using the soil gas survey technique.

- Groundwater samples were collected from monitoring wells that were installed as part of the two Remedial Investigations and by other organizations (such as the United States Geological Survey).

To determine whether the groundwater is contaminated at levels of concern, the RI analytical data were compared to environmental Standards, Criteria, and Guidance values (SCGs). Groundwater, drinking water and surface water SCGs identified for the Northrop Grumman and NWIRP Sites are based on NYSDEC Ambient Water Quality Standards and Guidance Values and Part 5 of the New York State Sanitary Code. Based on the RI results, in comparison to the SCGs and potential public health and environmental exposure routes, the groundwater requires remediation. The RI results are summarized below. More complete information can be found in the RI Report on file in the document repositories.

Chemical concentrations are reported in parts per billion (ppb) or parts per million (ppm). For comparison purposes, where applicable, SCGs are provided for each medium.

4.1.1: Site Geology and Hydrogeology

The sites are underlain by five geologic/hydrogeologic formations (descending from ground surface):

- Pleistocene deposits (Upper Glacial Aquifer) consisting of various sands and gravels intermixed with discontinuous low permeability clay lenses, approximately 100 feet thick

- Magothy Formation (Magothy Aquifer) consisting of various sands and gravels varying in thickness interlaced with low permeabililty confining layers,

- Raritan Clay Formation

- Lloyd Sand Formation (Lloyd Aquifer)

- Bedrock

The Upper Glacial, Magothy and Lloyd aquifers are all important formations for the purposes of this ROD. Groundwater from the Upper Glacial aquifer in this area eventually percolates to the Magothy aquifer. The Magothy Aquifer is the aquifer that is utilized the most as a source of drinking water.

4.1.2: Regional Groundwater Study

The investigation of onsite and offsite groundwater contamination associated with the Northrop Grumman and NWIRP Sites is referred to as the regional groundwater study. The information gathered was used to screen alternatives in the Operable Unit 2 (OU 2) Groundwater Feasibility Study. The groundwater plume is estimated to extend over an area of more than 2,000 acres and to a depth of approximately 700 feet. Due to the magnitude of this contamination and the multiple sources of the contamination, a regional remedy for addressing the groundwater contamination was required. The process of developing a regional remedy began in October 1994 and originally included Northrop Grumman, the NWIRP and the RUCO Sites. Subsequently, in September 1998, the involved Agencies determined that the RUCO Site would be most appropriately addressed separately under the USEPA's RI/FS program for that site.

4.1.3: Nature of Contamination

As described in the RI report, numerous soil, soil gas, groundwater and sediment samples were collected at the site to characterize the nature and extent of contamination. The main categories of contaminants which exceed their SCGs are inorganics (metals), volatile organic compounds (VOCs), semivolatile organic compounds (SVOCs), pesticides and polychlorinated biphenyls (PCBs).

A summary of the groundwater analytical data generated during the RIs is presented in Table 1. Summaries of the soils analytical data are presented in the RODs for onsite soils that are referenced in Section 3.2. It is recognized that residual soil contaminants such as chromium and cadmium beneath the Plant 2 property could serve as a source of groundwater contamination in the future. Although this ROD addresses groundwater contaminants, this relationship between soils and groundwater is recognized throughout the ROD.

The sites are located in an area of deep aquifer recharge. Precipitation that percolates through the soil and enters the aquifer system travels vertically down through the aquifers thus replenishing the water that is pumped for potable uses. Pollutants in the unsaturated soils and upper reaches of the aquifer system also migrate downward with infiltrating water.

The primary groundwater contaminants are chlorinated VOCs which were either used and disposed of at the sites or are breakdown products of these chemicals. These compounds are:

- perchloroethene (PCE)
- trichloroethene (TCE)
- dichloroethenes (DCE)
- vinyl chloride
- 1,1,1-trichloroethane

Inorganic analytes (metals), specifically arsenic, cadmium and chromium were detected in groundwater samples that were collected at the sites. The arsenic, cadmium, and chromium were detected at

concentrations greater than the corresponding standards, though only in a small number of on-site monitoring wells.

4.1.4: Extent of Contamination

Groundwater

By current estimates, the groundwater plumes emanating from the two sites total more than 2,000 acres in area and are over 700 feet deep in places. An estimate of the areal extent of the plume, based on 1993 groundwater data, is presented on Figure 5. Recent groundwater Data from the Navy vertical profile borings indicates that Northrop Grumman contamination has migrated southward beyond the Hempstead Turnpike.

On-Site Groundwater Plume

The highest concentrations of VOCs in groundwater were detected in samples collected from on-site wells. The most contaminated on-site well was the intermediate depth well of the HN-24 well cluster (see Figure 6), located on the southwest corner of the Navy property, in which TCE was detected at a concentration of 58,000 ppb (the drinking water standard is 5 ppb). An attempt to isolate the source of this contamination was unsuccessful. Concentrations greater than 1,000 ppb have been detected in some of Grumman's and the Navy's production wells. Consistently high concentrations of VOCs have been detected in Grumman production well GP-1 for some time, and a treatment system has been installed to treat the water that is pumped from that well (see Section 4.2).

Off-Site Groundwater Plume

To date, the plume(s) emanating from the sites have impacted or threaten three public water supply wellfields operated by the Bethpage Water District (see Figure 5). There are treatment systems in place at each of these three impacted or threatened wellfields (see section 4.2). The water that is distributed to the community is tested on a monthly basis to ensure that the drinking water standards promulgated by the NYSDOH are met. In addition, the Bethpage Water District has a policy of providing its consumers with drinking water that contains no detectable concentrations of site-related contaminants. Given the proximity of the contaminants to the Bethpage Water District (BWD) well fields, nine (9) outpost or sentry wells were installed upgradient of the water supplies. These wells have been sampled on a quarterly basis since March 1995. The purpose of this quarterly sampling is to provide the BWD with the data necessary to ensure that the existing treatment systems are adequate to treat the level of contaminants that may impact their public supply wells. The data are also used to make decisions about the need for groundwater remediation.

Based upon a review of the sentry well data, there is an area surrounding monitoring well cluster GM-38 that contains high concentrations, in excess of 1,000 ppb, of site-related contamination. The outpost wells will continue to be monitored to determine the groundwater concentrations of these site-related contaminants.

Soil

The Northrop Grumman and NWIRP OU1 RODs dealt with soil contamination outside the areas of the site buildings at the Northrop Grumman and NWIRP sites. Contaminated soils beneath the site buildings are being addressed by the RCRA program, or active facilities permitting program. This is being accomplished by sampling, excavation and offsite disposal of contaminated soils.

Sediments

Sediments in some of the onsite recharge basins contained elevated levels of inorganics. All sediments that were removed from the recharge basins were characterized and sent offsite for disposal. The closure of the onsite storm drains was through the USEPA underground injection control (UIC) program.

4.1.5: Development of a Computer Groundwater Model

A groundwater computer model was developed as a tool for developing and evaluating remedial alternatives for addressing the groundwater contamination. The study area that is encompassed in the model is 24.1 square miles in area (see Figure 8). The model was constructed in order to simulate groundwater flow throughout the entire thickness of the Upper Glacial and Magothy aquifers. A detailed description of the model is presented in the Northrop Grumman Groundwater Feasibility Study Report, Appendix B, dated October, 2000. Copies of this report are on file at the document repositories listed on Page 2 of this document.

4.2: Interim Remedial Measures

An Interim Remedial Measure (IRM) is conducted at a site when a source of contamination or exposure pathway can be effectively addressed before completion of the RI/FS. Two major groundwater response actions, the ONCT IRM and the provision of wellhead treatment for impacted public supply wells, have been implemented over the past seven years and have been incorporated into the selected remedy for these sites.

On-Site Containment IRM

The On-Site Containment (ONCT) IRM was installed by Northrop Grumman. It was realized during the early stages of the feasibility study that one of the components of the final remedy for addressing the groundwater contamination was the containment of the portions of the plume(s) that are still beneath the sites (i.e. - prevent further migration of contaminants off site to the extent practicable). Pumping at the onsite production wells had helped contain much of the contamination onsite. However, as Northrop Grumman and the Navy began closing down their Bethpage operations, many of the on-site production wells were slated to be removed from service. Therefore, it was decided to implement a specific groundwater containment remedy as an Interim Remedial Measure (IRM) in advance of making a decision regarding the final groundwater remedy. This system went on-line in November 1997.

As designed, the ONCT IRM system consists of four extraction wells; one of which was pre-existing (GP-1), and three others that were installed in 1996-97 (see Figure 7). The bulk of the contaminant removal is predicted to occur in wells ONCT-1 and GP-1, with lesser amounts of contaminants extracted from

wells ONCT-2 and ONCT-3. The combined pumping rate for wells GP-1, ONCT-1, ONCT-2, and ONCT-3 is 3,375 gallons per minute.

The groundwater that is pumped from these wells is treated to remove VOC contaminants prior to being recharged back into the aquifer via on-site recharge basins. This combination of pumping, treating and recharge are the factors by which the on-site plumes will be contained ("hydraulic containment"). Eventually, most of the Northrop Grumman production (GP) wells that added additional pumping will be closed and only the ONCT system, consisting of GP-1 and ONCT extraction wells 1, 2 and 3 will be left in place. The closure of most of the production wells was incorporated into the design of the containment system.

Protection of the Bethpage Water District Public Supply Wells

Treatment systems have been installed at the three currently operated and impacted or threatened public supply wellfields operated by the BWD (see also section 4.1.2). The treatment systems at BWD Plants 4, 5 and 6 were installed by the district. Plant 4 and 6 costs were reimbursed by Grumman. The treatment system at BWD Plant 5 was reimbursed by the U.S. Navy as specified in the May 1995 OU 1 ROD for the NWIRP-Bethpage site.

4.3: Summary of Human Exposure Pathways:

This section describes the types of human exposures that may present added health risks to persons at or around the site. A more detailed discussion of the health risks can be found in Section 5 of the RI report entitled, "Contaminant Fate and Transport."

An exposure pathway is the manner by which an individual may come in contact with a contaminant. The five elements of an exposure pathway are; 1) the source of contamination; 2) the environmental media and transport mechanisms; 3) the point of exposure; 4) the route of exposure; and 5) the receptor population. These elements of an exposure pathway may be based on past, present, or future events.

Human exposure pathways, relative to this operable unit (groundwater), known to presently exist or that have historically existed at the site include:

- direct contact with (dermal absorption), ingestion of, and inhalation of vapor from contaminated onsite groundwater; and

- direct contact with (dermal absorption), ingestion of, and inhalation associated with contaminated groundwater through residential or commercial use.

Human exposures could occur by ingesting or coming into direct contact with untreated, contaminated groundwater pumped from a water supply well. Additionally, inhalation of VOCs could occur if contaminated water is used for cooking, cleaning or bathing. Several BWD public water supply wells were impacted by contamination from the Site. Water from the affected municipal wells is either no longer used or treated to remove the contaminants prior to distribution to the community. Routine monitoring of the

treated water supplies has demonstrated the effectiveness of these treatment systems in preventing exposures to groundwater contaminants.

There are no known private drinking water wells in use within the contaminated aquifer area. The nearest down gradient private well, a non-contact cooling water well at a hospital, was tested in 1998 and found to be free of site-related contaminants.

In summary, while human exposures to contaminated groundwater may have occurred in the past, there are no known exposures that are presently occurring due to the implementation of appropriate response measures.

It should be noted that exposures to contaminated soil, dry well sediments, and groundwater at known or potential source areas (such as various Northrop Grumman and NWIRP facilities) have been or are being addressed under OU1 and/or appropriate RCA and UIC closure programs.

4.4: Summary of Environmental Exposure Pathways

There are no surface water bodies or other environmentally sensitive areas within a two-mile radius of the sites. Therefore, it was concluded that there is a negligible risk to wildlife in the area from the disposal of hazardous wastes at the sites.

SECTION 5: ENFORCEMENT STATUS

Grumman entered into a Consent Order with the NYSDEC on October 25, 1990 in which Grumman agreed to conduct a RI/FS at the Northrop Grumman site.

Resource Conservation and Recovery Act

The purpose of this ROD is to set forth the groundwater remedial program for the Northrop Grumman and NWIRP Sites as set forth in 6 NYCRR Part 375, "Inactive Hazardous Waste Disposal Sites." These two sites are also regulated under 6 NYCRR Part 373, commonly known as the Resource, Conservation and Recovery Act, (RCRA) program. This is the permitting and ultimately the closure process for active facilities that store, generate, and treat hazardous wastes over a certain quantity as defined under this regulation. The RCRA program as promulgated under NYSDEC regulations is authorized by the USEPA to issue RCRA permits.

Potentially Responsible Parties (PRPs) are those who may be legally liable for contamination at a site. This may include past or present owners and operators, waste generators, and haulers. The NYSDEC and the Northrop Grumman Corporation (Grumman Aerospace) entered into a Consent Order on October 25, 1990. The Order obligated Northrop Grumman to implement an RI/FS.

NWIRP

The United States Navy has undertaken their environmental studies pursuant to the Navy's Installation Restoration Program. The State of New York provided oversight of the work conducted by the Navy pursuant to a Memorandum of Understanding (MOU) between the State and the Department of Defense.

The Department of the Navy entered into a Memorandum of Understanding (MOU) with the NYSDEC in 1993. The MOU brought the NYSDEC into the Department of the Navy's Installation Restoration (IR) program. Upon issuance of the Record of Decision for Operable Unit 2 (OU2) the NYSDEC will approach the Northrop Grumman Corporation and the Department of the Navy to implement the selected remedy under an Order on Consent and a Federal Facility Site Remediation Agreement respectively.

SECTION 6: SUMMARY OF THE REMEDIATION GOALS

Goals for the remedial program have been established through the remedy selection process stated in 6 NYCRR Part 375-1.10. The overall remedial goal is to meet all Standards, Criteria and Guidance (SCGs) and be protective of human health and the environment. At a minimum, the remedy selected must eliminate or mitigate all significant threats to public health and/or the environment presented by the hazardous waste disposed at the site through the proper application of scientific and engineering principles.

The goals selected for this site are:

- Eliminate, to the extent practicable, site-related contaminants from the affected public water supplies and to prevent, to the extent practicable, the future contamination of public water supplies through the implementation of the offsite groundwater remediation.

- Eliminate, to the extent practicable, exposures to contaminated groundwater.

- Eliminate, to the extent practicable, off-site migration of contaminated groundwater and, where practicable, to restore the groundwater to pre-disposal conditions.

- Eliminate, to the extent practicable, the offsite migration of soils contamination entering the groundwater.

- Eliminate, to the extent practicable, exceedances of applicable environmental quality standards related to releases of contaminants to the waters of the state.

SECTION 7: SUMMARY OF THE EVALUATION OF ALTERNATIVES

The selected remedy must be protective of human health and the environment, be cost effective, comply with other statutory laws and utilize permanent solutions, Alternative technologies or resource recovery technologies to the maximum extent practicable. Potential remedial alternatives for the Northrop Grumman and the NWIRP sites were identified, screened and evaluated in the Operable Unit 2 (OU2) Report entitled "Groundwater Feasibility Study, Northrop Grumman, Bethpage."

The On Site Containment System (ONCT) and the wellhead treatment for the BWD Wells are response actions that have already been implemented and that will be incorporated into the selected remedy for this

site. All of the alternatives contained in the OU2 Groundwater ROD include the continued operation, maintenance and monitoring (OM&M) of the ONCT system and the BWD wellhead treatment.

A summary of the detailed analysis follows. As presented below, the time to implement reflects only the time required to put the remedy in place, and does not include the time required to design the remedy, procure contracts for design and construction or to negotiate with responsible parties for implementation of the remedy.

7.1: Description of Alternatives

The following potential response actions are intended to address contaminated groundwater associated with the site and to protect affected or potentially affected public water supply systems.
For Alternatives 1 thru 8, the following Items A through F, are included in Some or All of the Alternatives:

A. On-Site Plume Containment (ONCT), Treatment, and Discharge to On-Site Recharge Basins via the On-going ONCT System (formerly called the ONCT IRM):

Under this component of each Alternative, the existing ONCT System will continue operating. The pumping rate from the ONCT system (See Figure 9) would continue at the approximate rate of 3,375 gallons per minute. The water would be recharged into the recharge basins located adjacent to Plant 5 and to the southern recharge basins. Costs for this option do not include the already completed design and construction but do include operation and maintenance.

B. Long Term Operation and Maintenance of VOC Removal Systems At Three Off-Site Bethpage Public Water Supply Well Fields:
A long-term agreement is being renegotiated between the BWD and Northrop Grumman to pay for the operation and maintenance of the treatment systems at BWD well fields 4, and 6. This agreement would be required to be effective for at least 30 years or until the treatment at a public supply well(s) is no longer necessary to meet appropriate remedial goals, or until BWD decides to shut down any given supply well. The Department of the Navy entered into a cash out agreement with the BWD for the installation, permanent operation and maintenance of a treatment system at BWD wellfield 5.

The Bethpage Water District has a policy of providing its consumers with drinking water that contains no detectable concentrations of VOC contaminants. As of the date of this ROD, Northrop Grumman through its agreement with the BWD for Plants 4 and 6 and the Department of the Navy for Plant 5 have paid for VOC removal treatment that is sufficient to meet this District policy.

C. Long-Term Operation Maintenance and Monitoring (OM&M) That Includes Comprehensive Monitoring of Plume Attenuation, Outpost Groundwater Monitoring with a Public Water Supply Protection Contingency, and Long-Term Operation and Maintenance of All Operating Treatment Systems On-site.

A long-term operation, maintenance and monitoring (OM&M) program would be designed and implemented and is included with each Alternative. This OM&M plan includes the installation of at least twenty new monitoring wells and specific vertical profile borings. The OM&M plan includes a specific task for verifying the Grumman Steel Los Plant 2 and the NWIRP source area contamination does not pass beyond the ONCT system.

Installation of vertical profile borings and/or monitoring wells in offsite areas would be included in the outpost monitoring, remedial design, and plume tracking programs. The OM&M vertical profile boring program has been expanded to cover areas south of Hempstead Turnpike. The goals for this OM&M program would be to monitor the groundwater plume(s) both on-site and off-site, monitor the effectiveness of the groundwater remedy or remedies and determine if wellhead treatment is necessary. Comprehensive monitoring of plume attenuation would also be used with respect to the fate and transport of site contamination. This component would also contain operation and maintenance provisions for all treatment systems.
The goals for the long term monitoring program would be to:

- monitor the groundwater plume(s) both on-site and off-site; and

- monitor the effectiveness of the groundwater remedy.

Samples will be collected on a quarterly, semi-annual or annual basis from a monitoring well network (approximately 20 - 40 wells). The specific sampling locations and the specific analyses would be based upon periodic reviews under the ongoing long term OM&M program. In addition, water level data would be collected on a regular basis. These results would be evaluated by means of periodic updating of the computer groundwater model that has been developed (see Section 4.1.3) for this site.

All the alternatives contain a contingency for public water supply wellhead treatment or comparable alternative measures. The treatment or alternative measures will be sufficient to meet the appropriate remedial goals for this project (see item F below). Outpost monitoring would indicate if VOC concentrations in the groundwater would potentially threaten a public supply well. A wellhead treatment system would be designed and installed or comparable alternative water supply measures would be implemented if outpost monitoring well data, as determined by the NYSDEC and State and County Health Departments, indicate that treatment of a public supply well or provision of an alternative water source is necessary to protect public health from exposure to site-related contamination. The determination of appropriate water supply protection measures will be made with input from the affected water district(s).

The ongoing ONCT system would require a long term operation and maintenance plan to be submitted to the Department for review, acceptance and periodic updates. The public supply wellhead treatment systems currently in place will also require an operation and maintenance plan both of which would be for the minimum of the thirty year CERCLA time frame or until the treatment systems are no longer required.

D. Vinyl Chloride Contingency Plan

The feasibility study does not include specific treatment for vinyl chloride. The RUCO site is upgradient of the Northrop Grumman Site and historically upgradient of the NWIRP Site due to large scale pumping by Northrop Grumman. The RUCO site discharged vinyl chloride, other chlorinated solvents and other organic compounds directly into the aquifer through on-site recharge basins. The USEPA has selected a remedy for the RUCO site vinyl chloride subplume. The existing ONCT system was not designed to treat vinyl chloride, a VOC that requires unique methods of treatment to meet stringent air discharge limits. Thus, the NYSDEC directed Northrop Grumman to develop a continency treatment plan. The USEPA OU 3 ROD remedy includes enhanced natural attenuation and long term monitoring of the vinyl chloride subplume. The USEPA OU 3 ROD remedy recognizes the importance of preventing the vinyl chloride subplume from adversely affecting the performance and regulatory compliance of Northrop Grumman's groundwater remedial systems. Vinyl chloride was recently detected in Northrop production well GP-3, suggesting continued migration of the vinyl chloride subplume. Northrop Grumman has notified the USEPA and OXY that the vinyl chloride treatment contingency plan must now be invoked.

E. Offsite GM 38 Area Remedy:

This offsite groundwater extraction and treatment remedy would be located in the monitoring well GM38 area. This remedial technology would address elevated concentrations of total volatile organic compounds (TVOCs) in groundwater because deep groundwater at the GM-38 well area has been identified as an off-site "hotspot". This process option would be operated as a mass removal option to prevent further degradation of the aquifer. The modeling data from the OU 2 Groundwater FS indicates 7,000 pounds of the contaminant mass could be removed at this location.

Capital Cost:	$ 4,390,000
Annual O&M Cost:	$ 220,000
Present Worth:	$ 6,673,000

F. Northrop Grumman and the Department of the Navy Implementation of "Non-Detect" Policy for Affected Public Water Supplies:

The State of New York, under its State Superfund Program, must ensure that all remedies selected for the remediation of inactive hazardous waste sites are protective of public health and the environment. With respect to the protection of drinking water supplies, the NYSDOH has promulgated Maximum Contaminant Levels (MCLs) for drinking water contaminants in Part 5 of the State Sanitary Code (10 NYCRR Part 5). For the most part, the respective MCLs for the VOC contaminants associated with the Northrop Grumman and Navy sites are 5 micrograms per liter (ug/L or parts per billion (ppb) for water).

Many Water Districts in the vicinity of the OU 2 regional groundwater contaminant plume have policies of providing their consumers with drinking water that contains no detectable concentrations of VOC contaminants. This is sometimes known as a "zero tolerance policy" with respect to VOCs. Northrop Grumman and the Department of the Navy have agreed to establish a goal for any given wellhead treatment or comparable alternative measures for affected drinking water supplies which will provide water that is

non-detect using USEPA Method 502.2 to a detection limit of 0.5 micrograms per liter (ug/l) with respect to VOCs for site related contamination as cited in the 2001 Water Quality Monitoring Requirements for Nassau County Public Water Systems. Additional costs to implement this policy relative to the Alternatives considered in the OU 2 FS, if any, fall within the plus fifty and minus thirty percent of CERCLA cost requirements, and therefore will not significantly change the cost estimates for Alternatives 2 through 8.

The Bethpage Water District has a policy that only non-detect water be provided with their treatment system. As of the date of this ROD, Northrop Grumman through its agreement with the Bethpage Water District has reimbursed the District for Plants 4 and 6 and the Department of the Navy has reimbursed BWD for Plant 5 with such treatment technology. It is anticipated that Northrop Grumman and the Department of the Navy will enter into future agreements to implement this policy, as detailed in bullet 9 of section 8 of this ROD, with all water districts affected by site-related contamination.

Alternative 1: No Further Action, A, B, C and D above: This Alternative is the baseline Alternative to which the other alternatives will be compared. Under this Alternative, no additional remedial actions would be incorporated into the existing on-site groundwater IRM which has been installed and is now operating. This Alternative would leave the site in its present condition and would not provide any additional protection to human health or the environment than that already provided. Under this Alternative, no additional remedial actions would be taken and the existing on-site groundwater IRM which has been installed and is now operating would continue to be operated over the next 30 years.

In order to maintain hydraulic containment of the groundwater plume(s), production well GP-1 has been included in the ONCT pump and treatment system design. The GP 1 water would be treated at the IRM treatment system located to the north of Plant 2 and discharged to recharge basins to the west of Plant 2. The ONCT wells are treated by a separate air stripper . The water would be recharged into the southern recharge basins located adjacent to Plant 1.

Capital Cost:	$ 3,670,000
O&M Cost:	$ 1,480,000
Present Worth:	$26,700,000

Alternative 2: A, B, C, D and F above, and HN-24 Area Treatment:
Alternative 2 would add treatment of the HN-24 area on the Navy Plant 3 property. Treatment at the HN-24 area would consist of the use of reactive iron powder injected into the impacted groundwater through a series of injection wells. After injection the reactive iron powder would become immobilized within the soil pore space and begin to react with the contaminants of concern (COCs).

Capital Cost:	$ 4,390,000
O&M Cost:	$ 1,506,000
Present Worth:	$ 28,830,000

Alternative 3: A, B, C, D, E and F above:

Alternative 3 contains the addition of groundwater extraction and treatment system at the GM-38 area. The purpose of the GM-38 groundwater extraction and treatment system would accelerate off-site contaminant mass removal and to restore the off-site portion of the impacted aquifer in the vicinity of BWD Supply Well fields 4, 5 and 6 to remedial action objectives (RAOs) in a shorter time frame than under Alternative 2. The GM-38 area is located approximately 4,500 feet southeast of the Northrop Grumman south recharge basin area, and is defined by the inferred 1 ppm TVOC contour line drawn around Well GM-38D2.

Capital Cost:	$	8,060,000
O&M Cost:	$	1,700,500
Present Worth:	$	33,600,000

Alternative 4: A, B, C, D, E and F above, with HN-24 Area Treatment:

Alternative 4 is the combination of Alternatives 2 and 3. Alternative 4, is undertaken in an attempt to accelerate on-site contaminant mass removal, and restore groundwater quality in these localized areas to RAOs in a shorter time frame than under Alternative 1.

Capital Cost:	$	9,290,000
O&M Cost:	$	1,725,500
Present Worth:	$	35,000,000

Alternative 5: A, B, C, D and F above, and Off-Site Plume Containment, Treatment, and Discharge to Off-Site Storm Sewers:

Alternative 5 would add six new off-site groundwater extraction wells to achieve containment of the full extent of the off-site portion of the TVOC plume. Alternative 5 would provide mass removal from the entire aquifer by the installation of a groundwater extraction and treatment system at the farthest downgradient edge of the plume, to contain the full extent (off-site as well as on-site portions) of the plume. The off-site wells would be installed south of the Northrop Grumman facility and north of Hempstead Turnpike (see Figure 7).

Under Alternative 5, the six new off-site extraction wells (OFCT-1, OFCT-2, OFCT-3, OFCT-4, OFCT-5, and OFCT-6) would be installed. Each off-site well would require an individual treatment system to remove VOCs from the pumped groundwater. Construction of one central treatment facility, in lieu of six individual systems, would be impractical due to the dense residential development in the area, the substantial distances between proposed off-site extraction well locations, and the large quantity of water to be discharged. It is estimated that the total quantity of water to be pumped from the proposed off-site extraction wells would be 3,635 gpm (equal to 5.2 million gallons per day, or MGD).

Where necessary, monitoring wells would be installed to supplement the existing monitoring well network. The number, location, and depth of wells to be installed will be evaluated during the remedial design phase of the project.

Capital Cost: $ 21,390,000
O&M Cost: $ 2,700,000
Present Worth: $ 62,800,000

Alternative 6: A, B, C, D and F above, Off-Site Plume Containment, Treatment, and Discharge to Off-Site Storm Sewers, and HN-24 Area Treatment:
Alternative 6 contains the elements of Alternative 5 as described above, with the addition of treatment at the HN-24 area, as described above in Alternative 3.

Alternative 6 would provide mass removal from the aquifer through groundwater extraction and treatment at the farthest downgradient edge of the plume, to contain the full extent (both off-site as well as on-site portions) of the plume. Furthermore, Alternative 6 would provide localized groundwater treatment of the HN-24 areas.

Capital Cost: $ 22,620,000
O&M Cost: $ 3,080,000
Present Worth: $ 64,100,000

Alternative 7: A, B, C, D, E and F above, Off-Site Plume Containment, Treatment, and Discharge to Off-Site Storm Sewers:
Alternative 7 contains the elements of Alternative 5 as described above, with the addition of treatment at the GM-38 area, as described in Item E and Alternative 3. Under Alternative 7, Well ONCT-6 would be relocated approximately 500 feet to the northwest and at this location serves the dual purpose of being a local extraction well for the GM-38 area and also being part of the off-site containment well system.

Alternative 7 would provide mass removal from the aquifer through groundwater extraction and treatment. Alterative 7 would also provide groundwater pumping at the farthest down gradient edge of the plume to contain the off-site as well as on-site portions of the plume. In addition, Alternative 7 would provide treatment of the GM-38 area.

Capital Cost: $ 21,860,000
O&M Cost: $ 3,200,000
Present Worth: $ 63,300,000

Alternative 8: A, B, C, D, E and F above, Off-Site Plume Containment, Treatment, and Discharge to Off-Site Storm Sewers and HN-24 Area Treatment:
Alternative 8 is the combination of Alternatives 6 and 7. This Alternative includes all of the remedial process options discussed above.

Capital Cost: $ 23,090,000
O&M Cost: $ 3,300,000
Present Worth: $ 64,700,000

7.2 Evaluation of Alternatives

The criteria used to compare potential remedial alternatives are defined in the regulation that directs the remediation of inactive hazardous waste sites in New York State (6 NYCRR Part 375). For each of the criteria, a brief description is provided, followed by an evaluation of the alternatives against that criterion. A detailed discussion of the evaluation criteria and comparative analysis is included in the Feasibility Study. The HN-24 treatment process will be carried through this evaluation of remedial alternatives even though it has now been deemed unnecessary given the substantial drop in the HN-24 area concentrations.

The first two evaluation criteria are termed threshold criteria and must be satisfied in order for an Alternative to be considered for selection.

1. **Compliance with New York State Standards, Criteria, and Guidance (SCGs).** Compliance with SCGs addresses whether or not a remedy will meet applicable environmental laws, regulations, standards, and guidance.

The most significant SCGs for this ROD are the New York State Water Quality Regulations: Part 5 Drinking Water Standards Title 10, New York Codes Rules and Regulations (10 NYCRR) and NYSDEC Groundwater Standards (6 NYCRR Part 700). Air Quality Regulations (6 NYCRR Part 200 series) are relevant to the air discharges from each groundwater treatment system.

Alternatives 1, 2, 3 and 4 would be compliant with SCGs for the portion of the groundwater plume addressed by each Alternative. Alternatives 5, 6, 7 and 8 would be compliant with SCGs for the entire groundwater plume.

The applicable SCGs for the drinking water are the State's maximum contaminant levels, or MCLs, as specified in Part 5 of the NYS Sanitary Code. These standards are currently being met for treated water at each of the affected public supply well fields in the area. In addition, Northrop Grumman and the Department of the Navy have agreed to a goal for this project, for any given wellhead treatment or comparable alternative implemented due to site-related contamination, to provide water that is non-detect using USEPA Method 502.2 to a detection limit of 0.5 micrograms per liter (ug/l) with respect to VOCs, as cited in the 2001 Water Quality Monitoring Requirements for Nassau County Public Water Systems.

The GM-38 area offsite remedy was added to the feasibility study in order to evaluate the reduction of future contaminant loading to the BWD well fields and any public wellfields downgradient. The groundwater treatment system(s) would be designed to be compliant with the NYSDEC Part 200 Air Quality Regulations.

The air treatment systems for the IRM wells were not designed to treat vinyl chloride and may need to be modified if the vinyl chloride concentrations in the air discharge exceeds state air discharge guidelines. The raw and treated groundwater at the ONCT system, as well as the effluent air stream, would need to be

monitored for vinyl chloride. If necessary, a vinyl chloride treatment component would be incorporated into existing treatment system.

The 5 ppb groundwater standard for principle organic contaminants would not be met with respect to full plume interception for alternatives 1 through 4, although natural attenuation should reduce site related contaminant concentrations to below 5 ppb over time.

2. <u>Protection of Human Health and the Environment</u>. This criterion is an overall evaluation of each Alternative's ability to protect public health and the environment.

The contaminant-specific SCGs are currently being met with respect to treated water at the municipal water supplies (specifically the BWD). This is being accomplished via VOC-removal treatment systems that are operating at the wellheads. In addition, Northrop Grumman and the Department of the Navy have agreed to a goal for this project, for any given wellhead treatment or comparable alternative implemented due to site-related contamination, to provide water that contains no detectable concentrations of site-related contaminants.

The plume(s) would be contained along the southern boundary of the Grumman site under each Alternative based upon the computer modeling work that was conducted as part of the Feasibility Study. By containing the portion of the plume(s) that are on-site, the future contaminant load to the downgradient public water supplies would be reduced.

It is anticipated that the extraction and treatment programs for the ONCT system that are incorporated into each of the eight remedial alternatives under consideration here would need to be operated for 30 years or more. At that point there would be residual contamination remaining in the aquifers. The amount of remaining contamination, however, would be incrementally less as additional remedies are implemented under the various alternatives. As contaminant mass loading decreases, the relative importance of reliance upon the wellhead controls also diminishes.

Deep groundwater at the GM-38 well area has been identified as an off-site "hotspot" because concentrations of TVOCs exceed 1,000 ppb (equal to 1 ppm) at that location. The main objective of the GM-38 well area remedy would be to reduce mass contaminant load in the aquifer in the vicinity of three public water supply wellfields. Depending upon placement of the extraction well(s) and system performance, this could also result in reduced loading to the public water supply wells. The remedy would also enhance the long-term natural process of aquifer restoration.

There could be incremental potentials for exposure to VOCs in air posed to downwind populations due to emissions from each additional groundwater treatment plant installed under the eight alternatives. Air pollution and monitoring controls would be implemented as necessary to ensure that the air emissions from these treatment facilities are within the criteria set by the regulatory agencies. Additional engineering controls could be used to further reduce the potential of exposure.

There is a potential for exposure to VOCs in air if the vinyl chloride plume(s) is captured in the ONCT extraction wells. The treatment systems for these wells were not designed to treat vinyl chloride and could result in air effluent concentrations of vinyl chloride that exceed state air discharge guidelines. This potential exposure pathway would be minimized by implementing the vinyl chloride contingency plan.

The next five "primary balancing criteria" are used to compare the positive and negative aspects of each of the remedial strategies.

> **3. Short-term Effectiveness.** The potential short-term adverse impacts of the remedial action upon the community, the workers, and the environment during the construction and/or implementation are evaluated. The length of time needed to achieve the remedial objectives is also estimated and compared against the other alternatives.

There could be short-term impacts to the community if Alternatives 2 through 4 were implemented. The impacts could be dust emissions, VOC emissions and noise during construction activities. Engineering controls would be employed to minimize these impacts.

No short-term impacts to the community or the environment would be expected to occur as the result of implementing Alternative 1. The HN24 area remedy short term impacts would be negligible as the Navy property is now vacant.

The GM38 area remedy would have slightly higher short term impacts. This groundwater extraction and treatment system would be located closer to residential areas. Potential impacts would be addressed under the site specific community health and safety plan through emission control technologies.

For Alternatives 5 through 8, the short term impacts would be much greater than alternatives 1 through 4. The offsite containment (OFCT) system would, in most if not all the locations, be placed on or near residential properties, streets and neighborhoods. In addition, it is envisioned that each OFCT location would require its own treatment system.

> **4. Long-term Effectiveness and Permanence.** This criterion evaluates the long-term effectiveness of the remedial alternatives after implementation. If wastes or treated residuals remain on site after the selected remedy has been implemented, the following items are evaluated: 1) the magnitude of the remaining risks, 2) the adequacy of the controls intended to limit the risk, and 3) the reliability of these controls.

The sources of the groundwater contamination are being addressed as operable units for the Northrop Grumman-Bethpage Facility, NWIRP-Bethpage, and the RUCO Inactive Hazardous Waste Disposal Sites. The long-term effectiveness of each of the source area remedial actions was addressed in the RODs previously issued for these sites.

The time required to remediate the aquifer system is a function of the quantity and location of groundwater that is pumped and treated. It is projected that it would take more than 30 years to remediate the aquifer system onsite for each of the eight Alternatives. However, the ONCT system will be operated, monitored, and enhanced as necessary to prevent any further migration of onsite contamination into the Bethpage regional aquifer.

The OFCT Containment extraction and treatment system that is incorporated into Alternatives 5 through 8 would likely be operated for 30 years or longer. Based on the groundwater modeling, after 30 years of operation, residual contamination would likely exist onsite at concentrations slightly greater than the current drinking water standards.

The GM 38 area remedy is a hot spot remedy that was evaluated in the FS for 15 years. The long term effectiveness for this remedy would be to potentially reduce the contamination loading to the BWD public supply wells on a permanent basis. Performance results from the ONCT IRM already demonstrate that TVOC concentrations in groundwater immediately down gradient from the ONCT system are diminishing. The GM 38 area remedy would enhance this permanent restoration of the natural resource.

5. Reduction of Toxicity, Mobility or Volume. Preference is given to alternatives that permanently and significantly reduce the toxicity, mobility or volume of the wastes at the site.

Reduction of toxicity, mobility, and volume for the onsite groundwater contamination would be realized by the ONCT groundwater extraction and treatment system for all eight alternatives. These reductions would be achieved as a result of the extraction (reduction of mobility and volume) and treatment (reduction of toxicity) components which are incorporated into the ONCT system.

The greatest reductions in toxicity, mobility and volume would be realized under Alternatives 5 through 8 with the OFCT system. Alternative 8 has the highest reduction in mobility with the HN 24 area treatment, GM 38 area remedy and the ONCT and OFCT systems. Alternative 1 has the least reduction in toxicity, mobility and volume because it targets the on-site contamination only via the ONCT system.

6. Implementability. The technical and administrative feasibility of implementing each Alternative are evaluated. Technical feasibility includes the difficulties associated with the construction and the ability to monitor the effectiveness of the remedy. For administrative feasibility, the availability of the necessary personnel and material is evaluated along with potential difficulties in obtaining specific operating approvals, access for construction, etc.

The HN 24 remedy of alternatives 2, 4, 6 and 8 would be fairly easy to implement technically and administratively. There are several vendors who could supply the treatment technologies which are incorporated into these alternatives. Alternatives 2, 3 and 4 are readily implementable with respect to the GM38 area remedy that would be located near an existing Nassau County recharge basin in an open space area. However, easements would have to be obtained from the municipal and private parties that own the property. Alternative 1 is already in place and therefore is the most easily implementable.

Alternatives 5, 6, 7 and 8 would be substantially more difficult to implement administratively with respect to the OFCT system. Private property would have to be purchased or accessed and potentially, zoning changes would be required in order to construct the off-site extraction wells and treatment plants. The permit-related tasks would be difficult to implement. In addition construction of one central treatment facility, in lieu of six individual systems, would be impractical due to the dense residential development in the area, the substantial distances between proposed off-site extraction well locations, and the large quantity of water to be discharged.

7. Cost. Capital and operation and maintenance costs are estimated for each Alternative and compared on a present worth basis. Although cost is the last balancing criterion evaluated, where two or more alternatives have met the requirements of the remaining criteria, cost effectiveness can be used as the basis for the final decision. The costs for each Alternative are presented in Table 2.

This final criterion is considered a modifying criterion and is taken into account after evaluating those above. It is evaluated after public comments on the PRAP have been received.

8. Community Acceptance. Concerns of the community regarding the RI/FS reports and the PRAP have been evaluated. A "Responsiveness Summary"has been prepared that describes public comments received and the manner in which the Department will address the concerns raised.

Members of the community at large, particularly in the BWD, have expressed their concerns about site contamination during the Remedial Advisory Board (RAB) meetings sponsored by the Department of the Navy, at the December 13, 2000 PRAP public meeting and in writing during the public comment period. A number of response actions included in this ROD will address community, local official, water district, and public health concerns. These include: the ONCT system, the GM38 area remedy, the outpost groundwater monitoring program, the public water supply contingency for wellhead treatment or comparable alternative measures, the Northrop Grumman and the Department of the Navy agreement to achieve no detectable concentrations of site contaminants in affected water supply wells, additional groundwater investigation to determine if an Operable Unit 3 is necessary, and the long term OM&M systems. It is noteworthy that the PRAP proposal for granular activated carbon (GAC) polishing at affected public water supply wells has been replaced by a contingency for wellhead treatment or comparable alternative measures, with recognition of Northrop Grumman's and the Department of the Navy's stated agreement to use "non-detect" levels as the design goal for the provision of such treatment or measures. Additionally, the selected remedy has been modified to incorporate groundwater remediation measures into a Groundwater Remedial Program whereas response measures related to public water supplies have been incorporated into a Public Water Supply Protection Program.

SECTION 8: SUMMARY OF THE SELECTED REMEDY

Based upon the results of the RI/FS, supplemental investigative data, the evaluation presented in section 7 and the reasons presented below, the NYSDEC is proposing selecting Alternative 3, as described in

detail in this ROD. The selected remedy, Alternative 3, consists of the following Groundwater Remedial Program components: the ongoing ONCT system (formerly known as the IRM), the off-site GM-38 area groundwater extraction and treatment system, a vinyl chloride treatment contingency plan for the ONCT system, long-term groundwater monitoring including monitored natural attenuation, and long-term operation and maintenance of all operating treatment systems onsite and off-site. Additionally, the selected Alternative includes the following Public Water Supply Protection Program components: the operation and maintenance of air strippers for BWD well fields 4, 5 and 6, and preparation of a contingency plan for wellhead treatment or comparable alternative measures for public supply wells not currently affected but that may become affected by site-related VOCs in the future.

The selection of Alternative 3 is based on the evaluation of each of the eight Alternatives developed for this site. It was determined that Alternative 3 will meet standards, criteria and guidance for the containment portion of the groundwater plume remedy, prevent exposure to site related contaminants in the groundwater, actively restore a natural resource (sole source aquifer), and prevent further deterioration of down gradient groundwater conditions. Alternative 3 was also chosen based on the fact that it is not economically or technically feasible to contain and treat all the contaminated groundwater that has migrated from the Northrop Grumman and NWIRP sites to groundwater quality standards.

There is a possibility of site-related contamination impacting additional public water supply wells. These wells will be protected by a long term monitoring program that includes sampling of wells upgradient of the public water supply wells and by a contingency to provide wellhead treatment or comparable alternative measures, if necessary.

The preference to permanently and significantly reduce the toxicity, mobility or volume of VOCs in groundwater is satisfied by the selected remedy since it will reduce the mass of VOCs in the groundwater by recovering, treating and discharging groundwater contaminated by the Northrop Grumman and NWIRP sites plume(s). The remedial goal for attainment of the 5 ppb groundwater standard will be met in the treated aquifer segment, to the extent practicable.

Part of the remedy may address contamination that has not been conclusively attributable to Northrop Grumman and/or the NWIRP. In the same manner, not all of the contamination attributable to Northrop Grumman and the NWIRP will be actively addressed by the selected groundwater remedy. Therefore, the public water supply contingency plan will be necessary to address the potential of future exposure to site-related VOCs.

As more data become available, other PRPs may be identified (for example, the RUCO Site). The USEPA has concluded the RI/FS process for the RUCO OU 3 project and has selected a groundwater remedy for the RUCO Site that will address the additional VOC loading, including vinyl chloride, to the Bethpage regional aquifer.

The estimated present worth cost to implement the remedy proposed in this ROD is $33,600,000. The cost to construct the remedy is estimated to be $8,060,000 and the estimated average annual operation and maintenance cost for 30 years is $1,660,700.

The elements of the selected remedy are as follows:

Groundwater Remedial Program

1. A remedial design program to verify the components of the conceptual design and provide the details necessary for the construction, operation and maintenance, and monitoring of the remedial program. Any uncertainties identified during the RI/FS will be resolved.

   Since the remedy results in untreated hazardous waste remaining at the site, a long term monitoring program, including comprehensive monitoring of plume attenuation will be instituted. This monitoring will evaluate the effectiveness of the ONCT groundwater extraction and treatment system, monitor the levels of select inorganics (e.g., chromium and cadmium) and volatile organic compound (VOC) contaminants in the groundwater upgradient and downgradient of the ONCT system, monitor the effectiveness of the offsite component of this remedy and the wellhead treatment systems, and better define and track the offsite groundwater contaminant plume. This combined monitoring effort will allow the effectiveness of this remedy to be monitored and will be a component of the operation, maintenance and monitoring (OM&M) program for the site.

2. Continued operation of the Onsite Containment (ONCT) IRM groundwater extraction system to address the onsite TVOC groundwater contamination emanating from the former and current onsite source areas. This system must be sufficient to intercept the width and depth of the entire TVOC plume migrating from the Northrop Grumman Site.

3. A study to confirm the hydrogeologic effectiveness of the onsite containment (ONCT) system. This will, if necessary, include, but not necessarily be limited to, the installation of any required monitoring wells, piezometric measurements, a groundwater modeling effort and a hydrogeologic report, independent of any quarterly monitoring report on the ONCT system predesign study findings.

4. a. A predesign investigation to determine the optimum location(s) for the GM38 area groundwater extraction well(s). This predesign investigation will derive the data necessary to determine the screen zone of the extraction well(s). In addition, the number of extraction wells will be substantiated and the potential need to cluster these wells will be determined.

   b. The installation of at least one groundwater extraction well, or comparable remedial technology, at the approximate location of the GM38 area, depicted on Figure 7 and as detailed in the Northrop Grumman OU2 FS, with all necessary piping to install the wells and properly run the discharge to the groundwater treatment systems.

c. Utilization an existing storm water collection and groundwater recharge system for discharge of treated groundwater. If one is not available, then a suitable method of system discharge and groundwater recharge will be developed.

d. The installation of the necessary air stripping systems or comparable remedial technology designed to remove VOCs from all the extracted groundwater to meet the State Pollutant Discharge Elimination System (SPDES) discharge limitations.

5. The installation of air emission controls, if required, to comply with the NYSDEC air regulations.

6. The long-term operation, maintenance and monitoring (OM&M) of the ONCT and GM-38 area extraction well(s). Monitoring will include the installation and use of upgradient and downgradient groundwater shallow, intermediate, deep and very deep monitoring wells. Testing will be done, at a minimum, on a quarterly basis unless otherwise approved by the NYSDEC, to verify the system performance. Additionally, monitoring of groundwater elevations will be done, initially on a quarterly basis (unless otherwise approved by the NYSDEC) to determine the groundwater capture zone in different seasons, and annually thereafter.

7. A specific investigative task will include current work and potentially include, but is not necessarily limited to, installation of additional groundwater monitoring wells, vertical profile borings (VPBs), and groundwater sampling to determine if there are any other areas of elevated groundwater contamination that warrant additional remediation under OU2 and/or creation of an Operable Unit 3. This task, which includes the recent and ongoing installation of VPBs, will be documented in a report to the NYSDEC. The NYSDEC will then, based on the report, make a final determination.

8. The formation of a technical advisory committee (TAC) as deemed necessary by the NYSDEC, to be comprised at a minimum, of the involved Agencies, participating local water districts, Northrop Grumman and the Department of the Navy. The main purpose is to review and provide input on all materials relating to the implementation of the Northrop Grumman and NWIRP OU2 Groundwater Remedial Program and Public Water Supply Protection Program.

Public Water Supply Protection Program

9. The installation and/or quarterly monitoring for VOCs of outpost monitoring wells installed with respect to potentially affected public and private water supply wells, including BWD well fields 4, 5 and 6. The remedial design will evaluate and determine the best locations for any additional outpost wells required for this program. Outpost monitoring wells will be sampled quarterly.

10. A public water supply contingency plan for the design, construction, operation and maintenance of wellhead treatment systems and/or the evaluation of comparable alternative measures, if necessary. If evaluation of the long term groundwater monitoring or the outpost well data indicates

that a public supply well has been or is in imminent danger of being impacted by Northrop Grumman/NWIRP site-related contaminants, then wellhead treatment or comparable alternative measure(s) for the impacted public water supply well(s) will be necessary. This determination will be made by NYSDEC, NYSDOH, and the Nassau County Department of Health in conjunction with the potentially impacted water district. The treatment system or comparable alternative measure(s) to produce potable water will be designed and constructed with input from the affected water district. Alternatively, if Northrop Grumman/NWIRP reaches a cash settlement with an affected Water District, then each settling District will be responsible for its respective monitoring and implementation of, as necessary, wellhead treatment, or comparable alternative measures. Operation and maintenance of all public supply well treatment systems, or comparable alternative measures, will be assumed, at a minimum, to operate for the required 30 year time frame as required by the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA). At a minimum, the NYSDOH Part 5 drinking water standards will always be met.

Northrop Grumman and the Department of the Navy have agreed to establish a goal for any given wellhead treatment or comparable technology for affected drinking water supplies which will provide water that is non-detect using USEPA Method 502.2 to a detection limit of 0.5 micrograms per liter (ug/l) with respect to VOCs for site related contamination as cited in the 2001 Water Quality Monitoring Requirements for Nassau County Public Water Systems.

11. a. Any repeated detection of 1 ppb or more of Northrop Grumman/NWIRP Site-related contamination in the outpost or long term groundwater monitoring wells upgradient of a public supply well will "trigger" Northrop Grumman or the Department of the Navy to notify the NYSDEC and the potentially impacted water district and to evaluate the rate of movement of the Northrop Grumman/NWIRP contaminants towards the public supply wells.

    b. If VOC concentrations in the outpost well(s) approach or exceed a predetermined, outpost well-specific action level, a minimum of one and a maximum of three confirmatory samples will be collected within 30 days and the results evaluated by the NYSDEC and the State and County Health Departments with input from the affected water district(s). If the NYSDEC's and the Health Departments' evaluation indicates that treatment is necessary, the design and construction phase of the water treatment system(s) or comparable alternative measure will begin.

12. The BWD public supply wells and any other supply wells determined to be impacted or potentially impacted based on the long term OM&M, would be sampled on a monthly basis for total volatile organic compounds.

13. The provision of public water to residential or commercial structures that have private drinking water wells determined to be affected or potentially affected by the offsite migration of the Northrop Grumman and NWIRP groundwater plume(s).

Elements Common to Both Programs

14. A long term operation, maintenance and monitoring plan will be prepared that details all of the specific operation and maintenance of the ONCT and the GM 38 area systems and all the monitoring requirements and contingency aspects of this project.

15. A performance evaluation conducted at least once a year to determine whether the remedial goals and performance objectives of all systems have been or can be achieved, and whether the monitoring should continue.

16. A plan to properly close all monitoring wells associated with the Northrop Grumman and NWIRP sites at such time that the wells are no longer necessary.

SECTION 9: HIGHLIGHTS OF COMMUNITY PARTICIPATION

As part of the remedial investigation process, a number of Citizen Participation activities were undertaken in an effort to inform and educate the public about conditions at the site and the potential remedial alternatives. The following public participation activities were conducted for the site:

- A repository for documents pertaining to the site was established.

- A site mailing list was established which included nearby property owners, local political officials, local media and other interested parties.

- In October 2000, the NYSDEC sent out a mailing the public. NYSDEC also announcing the finalized OU2 feasibility study was available to the public.

- In November 2000, issued a press release and a mailing was sent out to the public, announcing the to address ed the release of the OU2 PRAP.

- In March 2001, a Responsiveness Summary was prepared and made available to the public, to address the comments received during the public comment period for the PRAP.

Table 1
Nature and Extent of Contamination

MEDIUM	CATEGORY	CONTAMINANT OF CONCERN	CONCENTRATION RANGE (ppb)	FREQUENCY of EXCEEDING SCGs	SCGs (ppb)
Groundwater (On-Site Monitoring and production Wells)	Volatile Organic Compounds (VOCs)	Perchloroethene	ND-3,600	39/121	5
		Trichloroethene	ND-58,000	55/121	5
		1,1-Dichloroethene	0.38-620	11/121	5
		1,2-Dichloroethene	ND-3,850	21/121	5
		Vinyl Chloride	ND-6,400	11/121	2
		1,1-Dichloroethane	ND-880	8/121	5
		1,1,1-Trichloroethane	ND-10,000	21/121	5
Groundwater (On-Site Monitoring and production Wells)	Inorganic Analytes (Metals)	arsenic	ND(1)-68	7/82	25
		barium	ND(2)-164	0/82	1,000
		cadmium	ND(1)-130	3/82	10
		chromium	ND(1)-160	4/82	50
		lead	ND(1)-7.2	0/82	25
		mercury	ND(0.2)-1.2	0/82	2
		selenium	ND(1)-4	0/82	10
		silver	ND(1)-6	0/82	50
Groundwater Outpost Monitoring Wells for the BWD September 1997		Perchloroethene	ND(0.5)-10	1/9	5
		Trichloroethene	ND(1)-1,300	5/9	5
		1,1-Dichloroethene	ND(0.5)-5.1	1/9	5
		1,2-Dichlorethene	ND(0.5)-1	0/9	5
		Vinyl Chloride	ND(0.5)-1	0/9	2
		1,1-Dichloroethane	ND(0.5)-12	1/9	5
		1,1,1-Trichloroethane	ND(.5)-7	1/9	5

MEDIUM	CATEGORY	CONTAMINANT OF CONCERN	CONCENTRATION RANGE (ppb)	FREQUENCY of EXCEEDING SCGs/Background	SCG/ Bkgd. (ppb)
Groundwater Long Term Monitoring Data 1997-Present		Trichloroethene	ND-15,000	25/106	5
		Tetrachloroethene	ND-44	11/106	5
		1,1-Dichloroethene	ND–39	3/106	5
		1,2-Dichlorethene	ND-6	3/106	5
		Vinyl Chloride	ND-2,000	3/106	2
		1,1-Dichloroethane	ND-10	3/106	5

Table 2
Remedial Alternative Costs

Remedial Alternative	Capital Cost	Annual O&M	Total Present Worth
1. Alternative 1:	$3,670,000	$1,480,000	$26,700,000
2. Alternative 2:	$4,390,000	$1,480,000	$28,200,000
3. Alternative 3:	$8,060,000	$1,700,500	$33,600,000
4. Alternative 4:	$9,290,000	$1,725,400	$35,000,000
5. Alternative 5:	$21,390,000	$2,980,000	$62,800,000
6. Alternative 6:	$22,620,000	$3,080,000	$64,100,000
7. Alternative 7:	$21,860,000	$3,200,000	$63,300,000
8. Alternative 8:	$23,090,000	$3,300,000	$64,700,000

GLOSSARY OF TERMS

ARAR: Applicable or relevant and appropriate requirement.

BWD: Bethpage Water District.

Capital Cost: Refers to the up front cost of constructing a remedial Alternative.

CERCLA: Comprehensive Environmental Response, and Comprehensive Liability Act (USEPA).

Chromium: An inorganic element used in various manufacturing processes.

DCE: Dichloroethene.

ECL: Environmental Conservation Law.

FS: Feasibility study.

GM: Refers to monitoring wells installed for Northrop Grumman by Geraghty and Miller.

Groundwater Contours: Equipotential lines of groundwater elevation above mean sea level.

Glacial: Refers the Glacial or shallow aquifer associated with Long Island.

GOCO: Government owned, contractor operated facility.

HN: Refers to monitoring wells installed for the Navy by Halliburtan NUS.

IRM: Initial Remedial Measure.

Magothy: Refers to the section of the Long Island aquifer below the Glacial and above the Lloyd.

MPS: The Main Plant Site, or the former Fairchild Republic Aircraft manufacturing facility**.**

MCLs: Maximum contaminant levels.

MGD: Million gallons per day, refers to daily rate of pumping groundwater.

MNA: Monitored natural attenuation.

NASA: National Aeronautics and Space Administration

ND: Non-detect or below the detection limit of the analytical equipment.

NWIRP: Naval weapons Industrial Reserve Plant.

NYCRR: New York State Codes, Rules and Regulations.

NYSDEC: New York State Department of Environmental Conservation.

NYSDOH: New York State Department of Health.

OFCT: Offsite containment system.

ONCT: Onsite containment system.

O,M&M: Refers to operation, maintenance and monitoring, of remedial alternatives.

OU: Operable unit. Refers to portions of the remedial program divided into sections.

PCB: Poly-chlorinated Bi-phenyl.

PCE: (Perchloroethylene or tetrachloroethylene) A chlorinated, aliphatic organic solvent

Plume: Contaminant dispersion in the groundwater.

POTW: Publicly owned treatment works or sewage treatment plant

PPB: Part per billion. For water samples also termed micrograms per liter (ug/l) and for soil samples termed micrograms per kilogram (ug/kg).

PPM: Part per million. For water samples also termed milligrams per liter (mg/l) and for soil samples termed milligrams per kilogram (mg/kg).

PPMV: Part per million volume, used for air samples.

PRAP: Proposed Remedial Action Plan. This is a document listing the remedy(s) proposed to mitigate the threat of hazardous waste disposal to human health and the environment.

PRP: Potential Responsible Party.

RAOs: Remedial Action Objectives, or the goals established to remedy a site based on findings of the RI (CERCLA).

RCRA: Resource Conservation and Recovery Act.

RI/FS: Remedial Investigation an Feasibility Study.

ROD: Record of Decision.

RUCO: Rubber Corporation of America.

SCGs: Standards, Criteria and guidance.

SVOCs: Semi-volatile organic compounds. Semivolatile Compounds- compounds amenable to analysis by extraction of the sample with an organic solvent. Used synonymously with Base/Neutral/Acid (BNA) compounds. Also, organic compounds with boiling points above 150 degrees Celsius.

TAGM: Technical Assistance and Guidance Memorandum. These guidance documents are used by the NYSDEC.

TCA: (Trichloroethane) A chlorinated aliphatic organic solvent.

TCLP: Toxicity Characteristic Leaching Procedure, is one test used to determine if hazardous waste is present.

TCE: (Trichloroethylene) A chlorinated, aliphatic organic solvent.

TVOC: Total volatile organic compounds.

ug/l: Micrograms per liter. See also PPB.

UIC: Underground Injection Control Program.

UST: Underground Storage Tank.

VCM: Vinyl chloride monomer.

VOC: Volatile organic compound. Amenable to identification by gas chromatography analysis. Also, an organic compound that is readily vaporizable at a relatively low temperature.

APPENDIX A

Responsiveness Summary

Northrop Grumman and Naval Weapons Industrial Reserve Plant Sites
Record of Decision
Town of Oyster Bay, Nassau County
Site Nos. 1-30-003A & B

The Proposed Remedial Action Plan (PRAP) for the Northrop Grumman and Naval Weapons Industrial Reserve Plant Sites (NWIRP), was prepared by the New York State Department of Environmental Conservation (NYSDEC) and issued to the local document repository on October 24, 2000. This Plan outlined the preferred remedy proposed for the remediation of contaminated groundwater associated with these two sites and for the protection of nearby public water supplies. The preferred remedy was based, for the most part, on the results of the Operable Unit 2 (OU2) Remedial Investigation/Feasibility Study (RI/FS) for the Northrop Grumman and the Naval Weapons Industrial Reserve Plant Class 2 inactive hazardous waste disposal sites. Based upon the criteria identified for evaluation of alternatives, comments received during the PRAP public comment period, recent supplemental investigative data from areas downgradient of the sites, and several discussions with affected and potentially affected water districts, the NYSDEC has selected Alternative 3 of the Operable Unit 2 Groundwater Feasibility Study, with some modification. The modifications, based primarily on comments received from the public and water districts, are noted in Section 7.2.8 ("Community Acceptance") of the Record of Decision (ROD). The modifications and other comments, where applicable, have been incorporated into the ROD. The selected remedy includes a number of response measures which have now been categorized into a Groundwater Remedial Program and a Public Water Supply Protection Program.

The components of the remedy are as follows:

Groundwater Remedial Program

The selected remedy includes a groundwater remedial program to address the regional groundwater contaminant plume associated with the Northrop Grumman and NWIRP sites. The components of this program are as follows:

- continued operation of the on-site containment (ONCT) groundwater extraction and treatment system (formerly known as an Interim Remedial Measure) at Northrop Grumman's southern property line;

- an evaluation of the ONCT system to confirm that it is performing effectively;

- mass contaminant removal through groundwater extraction and treatment in an offsite area near the GM 38 monitoring well cluster;

- predesign investigation to determine the optimal groundwater extraction location(s) in the GM 38 offsite treatment area(s);

- long term operation and maintenance of all operating systems, including the ONCT (or former IRM) system and the GM 38 area remedy;

- additional groundwater investigation to better define the groundwater contaminant plume and to determine whether an Operable Unit 3 Groundwater RI/FS is warranted;

- long term monitoring of the groundwater including a comprehensive monitoring of plume attenuation; and

- the formation of a technical advisory committee (TAC) as deemed necessary by the NYSDEC, to be comprised at a minimum, of the involved Agencies, participating local water districts, Northrop Grumman and the Department of the Navy. The main purpose is to review and provide input on all materials relating to the implementation of the Northrop Grumman and NWIRP OU2 Groundwater remedy.

Public Water Supply Protection Program

The ROD recognizes the importance of continued provision of potable water to those communities/populations served by water supply wells that are or that become impacted by site-related contamination. To this end, the ROD requires that a public water supply protection program be implemented. The components of this program are as follows:

- continued public water supply wellhead treatment to meet appropriate drinking water quality performance objectives at wellfields already affected by the groundwater contaminant plume for as long as these affected wellfields are used as community water supply sources;

- public water supply wellhead treatment or comparable alternative measures, as necessary, for wellfields that become affected in the future; and

- long term monitoring of the groundwater contaminant plume including outpost monitoring wells upgradient of potentially affected water supply wells.

The release of the PRAP was announced via a public notice to the mailing list, informing the public of the PRAP's availability.

A public availability/poster session featuring a walk-through presentation of the RI/FS (upon which the PRAP was based) with representatives of government, Northrop Grumman, and the Navy, was held on December 8, 2000. A public meeting was held on December 13, 2000 which included an overview of the Remedial Investigation (RI) and the Feasibility Study (FS) as well as a discussion of the proposed remedy. The meeting provided an opportunity for citizens to discuss their concerns, ask questions and comment on the proposed remedy. These comments have become part of the Administrative Record for this site. Written comments were received from Water Districts south of the Northrop Grumman Site, from Northrop Grumman Corporation, from the U.S. Department of the Navy, and from the OXY Corporation. Two letters and one telephone inquiry from individual citizens of the community were also received.

The public comment period for the PRAP ended on **February 5, 2001**. This Responsiveness Summary responds to all questions and comments raised at the December 13, 2001 public meeting and to the written comments received.

The following are the comments received at the public meeting, with the NYSDEC/NYSDOH responses:

Question No. 1:

a. The groundwater problem took place in the mid 70s, is that not correct?

b. Why did it take the time from the mid 70s, to date, to come up with an answer that was already answered in 1992, but the Board of Health did nothing for the people?

c. How could they have taken care of it if they only picked it up in the mid-70s, which it took at least 15 years for it to be detected, and it's still now ongoing, and this is 2000?

Response No. 1: It is not known when groundwater contamination with volatile organic compounds (VOCs) first occurred at the Grumman Aerospace and Naval Weapons Industrial Reserve Plant (NWIRP) sites. It is correct that VOC contamination problems with some of the groundwater production wells on the Grumman and NWIRP properties were first identified in the 1970s. Northrop Grumman (former Grumman Aerospace) and the Navy had identified groundwater problems within their site. In response, Northrop Grumman added treatment to their non-contact cooling water discharges. Initially, this was in the form of aeration basins. As the problem was evaluated in more detail, Northrop Grumman and the Navy eventually added air strippers to the treatment system.

With respect to the Nassau County Department of Health ("Board of Health"), starting in about 1977, a systematic program was implemented in conjunction with the New York State Department of Health (NYSDOH) to test all public water supply wells in Nassau County for the type of contaminants associated with the Northrop Grumman and NWIRP sites. The first downgradient public supply well discovered to be impacted by VOC contaminants in the groundwater was one of the two wells at Bethpage Water District (BWD) Plant 6. When Plant 6 began to show trace levels of contaminants, BWD took the well offline. BWD subsequently paid for VOC removal treatment at Plant 6 that was sufficient to decrease the contaminant levels to non-detectable concentrations in treated water. Only then was the well put back on line. The BWD was later reimbursed by Northrop Grumman for installation of the treatment system, operational expenses of the treatment system, and a subsequent upgrade of the system. A similar scenario and sequence of events occurred at BWD's Plant 4. More recently, the Department of the Navy paid for VOC removal treatment at BWD's Plant 5 after groundwater modeling suggested that the Plant 5 wellfield might eventually be impacted by VOC contamination.

The Nassau County Department of Health (NCDOH) continued to monitor public water supply wells for VOC contamination during the 1980s, and NYSDOH promulgated a requirement for quarterly VOC monitoring beginning in 1989 along with maximum contaminant levels (MCLs) for VOCs in drinking water (10 NYCRR Part 5). NCDOH requires monthly monitoring for VOCs in public supply wells, such as those at BWD Plants 4, 5, and 6, that are affected by VOC contamination.

Question No. 2: There's 400 superfund sites on Long Island, and each one of those superfund sites has the same chemicals and compounds that only the Navy is and was allowed to use, as only 50 companies in all of United States, including Alaska and Hawaii, could use this chemical. Isn't that the reason why the Lloyd Aquifer is now polluted?

Response No. 2: It's not clear what chemicals are being referred to in the question. The chemicals at the Northrop Grumman and NWIRP sites are volatile organic chemicals, such as trichloroethylene (TCE). These chemicals are fairly common in industry and commerce, are used throughout the country, and are not limited to just 50 companies. Under a federal program called the Installation Restoration (IR) Program, the Navy and other Defense Department branches are required to identify the contamination at their facilities and address it.

Long Island groundwater is a sole source aquifer for drinking water. Therefore, over the course of time, as the agencies became aware of groundwater contamination, it became a priority to identify the hazardous waste sites that exist. These sites are then characterized and, as required, remediated. If these sources are affecting the groundwater, we also address the groundwater contamination.

Question No. 3: The Constitution clearly states if the Navy or the Army or any one of those agencies did cause any kind of contamination they must correct the problem and pay compensation to each of the families or home owners that have loss, whatever the loss may be.

Response No. 3: The Department of the Navy, along with Northrop Grumman, has stepped in to correct the problems associated with these sites under NYSDEC and NYSDOH review and approval. Several corrective measures have been implemented, including the treatment systems added to the Bethpage Water District wells, the ongoing onsite containment (ONCT) system and the source removals completed at the plant sites. Both the Department of the Navy and Northrop Grumman have verbally committed to implement the remed(ies) detailed in the Proposed Plan.

With respect to the Department of the Navy compensating families and/or homeowners for any losses they have incurred, that issue is beyond the scope of this project. It is noteworthy, however, that offsite sampling of residential yards in the area did not indicate significant offsite impacts via aerial transport/deposition of contaminants. With respect to contaminated groundwater, the route of potential exposure would be through the water supply. Because of VOC monitoring and regulatory involvement, the Water Districts were able to detect the contaminants in the water supply wells and implement appropriate controls in a timely manner.

Question No. 4: Regarding the chemicals that were found in the water and in the soil, why doesn't the PRAP have the specific breakdown of the chemicals that were found, the material safety data sheets (MSDS) associated with them, and the permissible exposure levels that OSHA has set on these chemicals. Grumman and the Navy should provide these as they are not exempt from the Right-to-Know requirements.

Response No. 4: The chemicals found at the site are listed in Table 1in the PRAP; which lists the concentration ranges of chemicals for the environmental sample results. For a more detailed evaluation of the site, information can be found in the remedial investigation and additional sampling reports on file in the document repository located in the Bethpage Community Library on Powell Avenue. With respect to the MSDS sheets, NYSDEC does not normally require that these be included in document repositories; some responsible parties provide these, others don't. These would be

available to workers at the facility where in use. Between 1980 and 1986, under the New York State Right-to-Know Law employers were required to provide information on workplace exposures to employees. After this time, OSHA required the provision of similar information under the federal Hazard Communication Standard. Under these rules, employers were required to inform employees of any hazardous materials they were potentially exposed to in the performance of their job as well as potential health effects, appropriate protective equipment, and spill remediation methods.

Material Safety Data Sheets (MSDSs) for chemical products are available from the manufacturers of the respective chemicals. With respect to health effects information on common chemicals, interested readers may access toxicological profile reports at the following website: www.atsdr.cdc.gov/tfacts.

Regarding the OSHA Permissible Exposure Limits (PELs), these are air levels that pertain to occupational exposures and are not applicable to the subject groundwater investigation.

Question No. 5: Is the chemical data available in one place in the FS Report that's available in the Bethpage Library? Why isn't this very important information more accessible to the homeowners? Shouldn't it be part of a group mailing since it does have the potential to affect all of us?

Response No. 5: All of the information gathered from the groundwater sampling under this project is available at the document repository located in the Bethpage Community Library on Powell Avenue. The reports are too voluminous to supply the thousands of local residences with an independent copy. Under New York State Law, specifically Title 6 NYCRR Part 375, the NYSDEC has to meet specific citizen participation requirements. One of those requirements is to make site information available to the general public at such document repositories. NYSDEC has sent several thousand fact sheets to area residents notifying them about the sites, the environmental issues, the proposed remedial action plan, and directing the interested citizen to the document repositories and/or NYSDEC and NYSDOH toll-free numbers (NYSDEC: 1-800-342-9296; NYSDOH: 1-800-458-1158) for additional information.

Question No. 6: a) Where is the breakdown of the exact chemicals that were found, what are the hazards associated with each and every chemical that has been found, and what were the specific levels that were found in ground soil and groundwater? b) If there is any discharge or contaminated discharge from these air stripping water purification systems, and who is monitoring the air discharge from this, since it's air based, what type of filtration, are there any levels of exposure we should know about regarding the discharge from these units?

Response No. 6:

a) With respect to the breakdown of chemicals and specific levels in various media and the hazards associated with each and every chemical found, please refer to the response to question 5 above.

b) The groundwater that Grumman is extracting for both production purposes and now the onsite containment system is treated on-site with an air stripper. The air discharge from these air strippers, due to the elevated levels of contamination in some of the onsite groundwater at the site, is treated with activated carbon. This removes the volatile organic compounds from the airstream before it is released into the air. The carbon is then periodically steam stripped,

the product is recovered and sent offsite for disposal. Northrop Grumman is required to test the air discharges, among other things, and submit regular monitoring reports to the NYSDEC.

Question No. 7: Is there any monitoring of the discharge that goes through the activated charcoal filters?

Response No. 7: As noted above, Grumman monitors the discharge(s) to evaluate system effectiveness and for compliance with air quality standards.

Question No.8: Shouldn't there be an independent third party monitoring?

Response No. 8: . Grumman has professional engineers working for them in a consulting capacity whom are obligated to submit certified data used for site characterization. The State of New York uses the same types of certified consultants to take environmental samples. Similarly, Grumman must use analytical laboratories that are certified under NYSDOH's Environmental Laboratory Approval Program (ELAP).

Question No.9: Most hazardous waste situations do require the hiring of an dependent third party monitor, and that's true with lead abatements and asbestos abatements.

Response No. 9: Northrop Grumman is monitored by professional staff at the NYSDEC, the NYSDOH and various officials from Nassau County. These agencies periodically take independent samples to check the reliability of (Northrop Grumman's) samples. The labs used to analyze the samples are are required to produce quality assurance (QA) reports on the accuracy and precision of their analytical equipment. Additionally, NYSDEC often requires that independent laboratories review all the data, reports, and QA programs of the analytical laboratory.

Question No. 10: So if a bad report does come back, and let's say your engineers do detect a higher than normal level, or possible contamination level, are we to get a phone call? That's what I'm looking for, a little more freedom of information here and a free flow of information and having it more accessible to the homeowners; it's the 25,000 other people that couldn't make it here tonight.

Response No. 10: Potential routes of exposure from site-related contamination have been evaluated and the State has not found any ongoing exposures to the site-related contamination. If significant exposures are discovered, programs and requirements do exist to notify affected individuals. The water that the local water districts provide to consumers meets the NYSDOH drinking water quality standards. With respect to drinking water, consumers do have to be notified about the quality of their water whether or not there is an exposure. Customers receive an annual water supply statement, called a Consumer Confidence Report, which summarizes the water quality. Any violation of the State's drinking water regulations pertaining to maximum contaminant levels would require prompt notification through radio and the printed media.

Question No. 11: Is there an upcoming website that's going to be available for the residents of Bethpage, or someplace where this information is more accessible?

Response No. 11: Forming a website is feasible since the consultants for Northrop Grumman and the Navy have most data in tabular form and/or on disks from different sources. Establishing a website is not required, but it is something that can be further considered.

Question No. 12: What I would like to know, one question is has the chromium been speciated?

Response No. 12: Specific groundwater samples that were taken as part of the remedial investigation were analyzed for the varying states of chromium. This information is available in the remedial investigation report(s) for the two sites at the document repository.

Question No. 13: My main concern is the offsite contamination, the tremendous area of contamination, and what is being done. I heard tonight about wells on Central Avenue, but it is my understanding, from having read quite a bit on the site, that this contamination is falling south of Hempstead Turnpike. That's quite an area. What is being done in that area, anything?

Response No. 13: As groundwater in the Upper Glacial and Magothy aquifers moves towards those areas south of Hempstead Turnpike, the concentrations drop off dramatically compared to what they are in onsite groundwater. The FS evaluated full containment of all of the groundwater contamination associated with the site, but found that it was technically infeasible. Although NYSDEC's goal is to restore the site to pre-disposal conditions to the extent feasible and authorized by law, this goal is very difficult to achieve. The Navy is conducting additional investigation south of the Hempstead Turnpike to better determine the extent of contamination in that area and to place outpost monitoring wells upgradient of potentially affected water supply wells.

Question No. 14: Could you give me, for instance, what I'm trying to get for some of the people here, rather than say 3,000 feet wide, could you tell me like there's an area of contamination from Wantagh Avenue to past the high school? Could you tell me where the plume exists?

Response No. 14: The contaminant plume is roughly bounded by Cherry Avenue to the North, the Oyster Bay Expressway to the East, New South Road and Massapequa-Hicksville Road /Route 107 to the West, and some point South of the Hempstead Turnpike. It was already known that the projected edge of the groundwater plume was approaching Hempstead Turnpike from the information detailed in remedial investigation reports. Therefore, the NYSDEC directed Northrop Grumman and the Navy to install a number of off-site monitoring wells to begin looking further down gradient, south of Hempstead Turnpike.

The Navy took the lead on this portion of the project and began with the installation of groundwater profiles. They went to areas thought to be the end of the plume. However, this current data generated by the Navy indicated contamination has gone beyond Hempstead Turnpike. In response to this, the Navy agreed to install additional borings to delineate the leading edge and locate outpost monitoring wells before the Record of Decision is signed.

In terms of contaminant mass, approximately 75 percent of volatile organic contamination is still underneath the two sites. The volatile organic concentrations down gradient are, for the most part, an order of magnitude lower, with the exception of the highly elevated concentrations around monitoring well GM-38-D2.

Question No. 15: How about cadmium and chromium?

Response No. 15: Chromium, and to a less extent cadmium and arsenic, in groundwater is limited to specific areas beneath the Northrop Grumman and Navy Sites. These contaminants will be tested for under the long term Hydrogeologic Monitoring Plan.

Question No. 16: It does not exist off-site at all?

Response No. 16: Only in a few shallow groundwater wells in the area near Plant 2. The concentrations were only slightly above groundwater standards.

Question No. 17: You mentioned that Grumman had (to) have long-term operation, and, you know, oversight monitoring and maintenance. What exactly does that mean?

Response No. 17: As part of the remedy implementation, groundwater recovery systems are being operated by Northrop Grumman to contain the plume on the site. There are four wells pumping close to 4,000 gallons a minute to an air stripper and an air treatment system. Groundwater will have to be monitored to a) confirm the containment system is working, b) track the leading edges of the plume and c) indicate whether any municipal well will be impacted. An approved plan must be established that will cover these items and all the other aspects of the long term operation, maintenance and monitoring required for the remedial systems at these two sites.

Question No. 18: Would you let us know exactly what "long-term" means, does it mean somebody is going to come there once a year, etc?

Response No. 18: Long-term, under the CERCLA process, is a thirty year time frame. Thirty years is used to estimate the cost, In all likelihood, in 30 years those on-site containment wells will still be necessary based on the time rate of travel of contamination present at his site.

Question No. 19: How deep is the plume?

Response No. 19: It varies in different parts of the study area. Not all groundwater data points are on a continuous plane. In some areas the affected groundwater is as deep as six hundred feet. Also the volatile organic contamination, mainly trichloroethylene, is heavier than water. These volatile organic compounds therefore tend to sink in the aquifer as they move down gradient. However at lower concentrations it has some degree of solubility, so it moves slower than the groundwater, and tends to sink as it moves.

Question No. 20: Which is where our wells are?

Response No. 20: Some of the municipal wells are screened at some of the similar depths the site related contamination. This explains the need for the wellhead treatment contingency plan, to make ensure that a treatment system will be put in place before any there are any affects on any of the municipal wells.

Question No. 21: I bought a house in Levittown 17 years ago, I guess before this whole thing became a festering problem or people heard about it. I live two blocks away from the BOCES school that you mentioned, a half a mile or 11 blocks away from the Grumman and Navy facility, and naturally I'm concerned about what I have been ingesting in one way or another during the past 17 years. Just as an example, I love to grow vegetables and fruit trees on my property, and I thought I was doing a great job of keeping myself free of contaminants, and the question is what have I been absorbing through my produce as a result of this?

Response No. 21: The volatile organic compounds associated with this site tend to sink in the aquifer as they move down gradient. Therefore, this is not a route of potential exposure. Local residential areas next to and near the Grumman Site were tested for any surficial soil impacts by the NYSDOH and found that there were none.

Question No. 22: My basic question is, when I bought the house nobody told me that there was any problem. Now if I want to sell my house, how does that affect what I am going to be able to sell it for, and naturally I will have to explain to buyers that there is a problem.

Response No. 22: Technically speaking, there is no defect in your property. The plume, for the sake of argument, may be passing in the groundwater, beneath your house. However, there's no exposure pathway for you to come in contact with the dissolved contamination that's more than fifty feet below in the groundwater.

Question No. 23: The gentleman who spoke before mentioned, for example, BOCES school. Now, I can throw a baseball from my house and land it in the BOCES school yard, and I know water doesn't really adhere to county lines or state lines or any kind of lines that are drawn by planners, water just flows. So that it's hard for me to agree that I have no contamination on my property, unless a test is made. And so I wonder whether the town, the county, somebody, could arrange that, before a sale is made, or when it's contemplated, that a test is made of the property and an affidavit issued that it is or is not contaminated that the homeowner has to give to the potential buyer. I think that would be fair.

Response No. 23 : There is no reason to do that, with respect to your particular site. The areas around the facility that were thought to have the potential to be impacted, for instance, from a surface deposition of contaminants, were tested and there was no problem found. The area where you live is too far from the plant site itself to have any surface contamination from operations at the facility, and there's absolutely no way for your property to be contaminated by groundwater 100 or 200 or 400 feet below, it's just not possible.

Question No. 24: How come you're not talking about the Levittown water and you're only talking about Bethpage? Because Levittown is like right there, too.

Response No. 24: The Bethpage Water District is foremost in the plan because they already have treatment in place that was made a requirement of this project and that was paid for by Grumman and the Navy. The groundwater in the far eastern parts of Levittown is also down gradient of the site. However, one of the integral parts of this project is the long-term monitoring and wellhead treatment contingency program. This program also covers outpost monitoring for any down gradient municipal supply well(s) that might be affected in the future. This program wants to make sure that

any municipal well that might be affected will have treatment in place before the contamination reaches the supply wells. In addition, all the water supplies in Nassau County are sampled on a routine basis.

Question No. 25: But Levittown hasn't been treated at all yet is what you're saying?

Response No. 25: The Town of Hempstead municipal supply wells located in Levittown have not been impacted by site related contamination.

Question No. 26: You (NYSDOH) were saying statistics on adults, how many adults get cancer in their life. How about kids under 18; do you have any statistics on that? And you should have some statistics about our area. Because I could tell you, we have a very small school district, I can tell you five kids off the top of my head right now being treated, and that's a scary thought. We have a very small school district, under 16 years old. So that's what my concern is.

Response No. 26: All the cancers have to be reported To the NYSDOH regardless of age. Statistics are available on a county-wide, and in some cases, a zip code basis. The NYSDOH has recently published cancer maps for New York State. This information and these maps are accessible at the NYSDOH website: /www.health.state.ny.us. Individuals may also call the NYSDOH toll free number (1-800-458 -1158 ext. 27950) to inquire about local area cancer incidence investigations.

Question No. 27: And how do we get those (maps)?

Response No. 27: They're on the web, they are at www.health.state.ny.us. At the toll free number, enter extension 27950, and you can ask about specific studies, local area, small area studies where there's unusual disease patterns where the NYSDOH has looked into those areas.

Question No. 28: And so our area in Levittown has not even been addressed to try to decontaminate yet. So we're long-term?

Response No. 28: The onsite groundwater contamination is being addressed with the containment systems. Groundwater wells are now being monitored quarterly. The municipal wells are also sampled on a regular basis to insure that the wells have not been impacted. Groundwater is approximately 50 to 60 feet below the ground surface in the area adjacent to the two facilities. The groundwater contamination flows downgradient and gets deeper as it migrates from the Sites and does not move upward towards the residences.

The width of the plume is going to be studied further and action will be taken accordingly, but right now Levittown wells have not had any contamination detected.

Question No. 29: The NYSDOH just said that Levittown is not affected, as the plume is not moving in that direction. I assume you're talking about the vinyl chloride plume is that correct?

Response No. 29: What's being discussed are the flow components of the Northrop Grumman-Navy groundwater contaminant plume. The vinyl chloride plume is associated with the OXY Hooker Ruco site, which is under the United States Environmental Protection Agency (USEPA) control.

Question No. 30: If the contaminants go down to 800 feet, isn't it true that the Lloyd's Aquifer, which extends from Queens to Montauk, is being contaminated with these chemicals?

Response No. 30: It is possible that, at some point in the future, the Lloyd Aquifer in this area might be impacted. However, even the most recent vertical profiles to 800 feet show no contamination. There are also various layers and lenses of clays that tend to isolate parts of the aquifer from other parts of the aquifer. Further, at that depth there is a Raritan clay unit which prohibits the transfer of contaminants into the Lloyd Aquifer.

Question No. 31: Isn't the Lloyd's Aquifer one contiguous aquifer which extends from Queens to Montauk?

Response No. 31: The Lloyd Aquifer does not exist in the eastern part of Long Island. The groundwater direction in the area of the site, and on Long Island in general, are north and south in the Upper Glacial, Magothy and the Lloyd Aquifer. There's no east-west flow component in the aquifer system.

Question No. 32: This transparency, which is your own figure 4.2 (Hooker RUCO OU3 RI Report), which shows the Lloyd's Aquifer extending from one area to the other.

Response No. 32: The figure you have shows the north-south hydro geologic cross-section from the Long Island Sound south to the Atlantic Ocean.

Question No. 33: And you are saying that contaminants have gone down to the Lloyd's Aquifer in some areas that have been tested; is that correct?

Response No. 34: What the testing to date has indicated is that contamination has not penetrated the Raritan clay in this area. In addition, given the known flow patterns of site related contamination and the fact that the Lloyd Aquifer is a confined aquifer, site related contamination from the Northrop Grumman site is not expected to impact the Lloyd.

Question No. 35: All of Long Island is contaminated, contaminated by Grumman and the Navy.

Response No. 35: That's absolutely untrue.

Question No. 36: Is the only chemical being addressed presently the vinyl chloride, which is being addressed by the biosparging which you've been proposing in the newspaper, etc.?

Response No. 36:. Much more than VCM, or vinyl chloride, is being addressed here. The RUCO polymers facility discharged pure vinyl chloride in the recharge basins from the late '50s to the early '70s. It was mixed in with their other wastewater discharges out to their recharge basins located on-site. And that's in the location of the RUCO Polymers

Site; to the north-northwest. What was read in the newspaper about the RUCO Site is what the USEPA is doing to remediate that site.

Most of the RUCO contamination has migrated off-site from the RUCO facility onto the Navy and the Grumman property. During their high period of production, the groundwater wells on the Grumman property drew groundwater over to the east, so it commingled the plume. The proposed plan being referred to was issued by the EPA. This proposed plan subsequently became a Record of Decision and covers the off-site groundwater component of the Ruco facility. The USEPA ROD selected biosparging. This technology enhances the bacterial break down the vinyl chloride found in the groundwater on the Northrop Grumman and Navy Sites. In addition, the offsite migration of contamination from RUCO will be addressed by the Northrop Grumman ONCT system.

Question No. 37: So you're containing them, but you're not getting rid of them, the other chemicals. Would you let me just mention some of them. Trichloroethylene, tetrachloroethylene, dichloroethylene, dichloroethene, trichloroethene, dichloroethelene, hydrocarbons, polychlorinated biphenyls and semi-volatile organic compounds. These are all listed in your own report as contaminants which are in the water, they all cause cancer. Why is not more than containment being done?

Response No. 37: The word "containment" is being used to describe the fact that no more of those chemicals are being allowed to migrate off site in the groundwater regime. They are being removed from the groundwater, treated through a stripper system, and the vapor phase of that stripper is being further treated with activated carbon so that none of those chemicals are being discharged to the environment. Some of the other contaminants mentioned were only a problem at the source areas on site, and have been addressed through the various soils remediation programs.

Question No. 38: I'd like to know-- well, actually, what I wanted to get to before, throughout the program before, 50 parts per billion was considered the risk, the permissible exposure level back 25 years ago, and since then the number has been moved down to five parts per billion. How do we know in five more years it's not going to be down to one part per billion, and exactly how many different toxic chemicals are we talking about the water being contaminated with? I hear so many numbers being thrown around tonight, and everybody likes that catchall VOCs, which seems kind of harmless, but how many different chemicals are we talking about in the water?

Response No. 38: As far as the offsite groundwater plume, the main concern is tetrachloroethylene, trichloroethylene, dichloroethylene (cis and trans) and vinyl chloride. These compounds are very similar and are outlined in the table in the PRAP. Standards are always under review, and there is no guarantee that they will not go lower in the future. Certainly it's always a possibility. The current technology has resulted in the current standard of 5 micrograms per liter or 5 parts per billion for those VOC's present at the site.

Question No. 39: Again, if it is only 5 that are in the drinking water, then why hasn't the information on these five chemicals been provided in more detailed form, including, while the level might be below the 5 parts per billion, is it 4, 4-1/2?Any one of the five different chemicals that you say are in the water (supply)?

Response No. 39: The water supply is continually monitored and is non-detect. That information comes from the water suppliers, and can be made available to you as a consumer.

Question No. 40: You're saying there's only approximately five chemicals that are contaminating the water supply within this plume area?

Response No. 40: We're dealing primarily with TCE, or trichloroethylene. There are lesser concentrations of some related contaminants, dichlorethenes, ethanes and perchloroethene.

Question No. 41: How far exactly has this plume moved since you began tracking it back in the '70s, and to date, and how much further is it expected to move before you actually enact some of these plans that you're talking about?

Response No. 41: Figure 5 of the Proposed Plan shows the approximate extent of the plume from 1993 data. This does not detail all the all the groundwater concentrations vertically, much of which is non-detect, but basically the horizontal extent. Recent vertical profile sampling from the Navy has shown that the leading edge of the plume is now past Hempstead Turnpike. The Navy has submitted a new work plan to add additional profile borings to locate the edge of the plume.

Through the use of IRM's, much of the proposed remedy is already in place. The Navy has also agreed to begin the predesign work for the monitoring well GM38 D2 groundwater extraction remedy. Once the Record of Decision is signed, the wellhead treatment contingency plan will be put into effect. In the meantime, if groundwater monitoring indicates that a municipal water supply well is threatened, the NYSDEC will still require Northrop Grumman and the Navy to install treatment.

Question No. 42: Is it moving a mile a year, 500 yards a year?

Response No. 42: The shallow groundwater is moving at about a foot and a half a day. However, most of the contamination is deeper and this part of the aquifer is moving at approximately .25 feet per day.

Question No. 43: Actually I asked about the contaminated area, and is it spreading beyond this (Northrop Grumman Site)?

Response No. 43: Yes. There is a portion of the groundwater pume that has moved beyond the ONCT system.

Question No. 44: Can you guarantee that it's not spreading, and are these wells and test wells being moved out accordingly with the rate of movement (groundwater).

Response No.44: The Navy has agreed to begin installing these wells even before we get a Record of Decision that will require installation of outpost monitoring wells to track the plume. They're submitting a work plan to install wells further down gradient beyond the current edge of the plume. The proposed remedy will require treatment of contaminated groundwater at the site boundary, treatment of the elevated concentrations of groundwater in the GM 38 D2 monitoring well location, and natural attenuation. The progress of natural attenuation will be verified through a comprehensive monitoring plan.

Question No. 45: That's just our neighboring communities will have to worry?

Response No. 45: We have to monitor groundwater, outpost and municipal wells and make sure, up gradient to the supply wells, they won't be affected, and that's what all the different monitoring programs are involved in. The pathways of exposure are being monitored and people are not being exposed to the site related contamination in the groundwater.

Question No. 46: I want to show the public what the water line divide is on my slide. Right in the center, you see the highest point of the line that runs right from the top down into the bottom lower green. That's called the water line divide. That's approximately, supposedly, according to the record, a mile and a quarter away from the study site. Now, the study site, which we're talking about right now, is a place where there are chemicals, as the Board of Health just acknowledged that. It is correct in saying that there were other chemicals in there, approximately 113. Now, we'll go one step further. Being one mile and one quarter away from the waterline divide, which is the replenishing system for all of Long Island's Lloyd's Aquifer, is now being, as they say, polluted due to the fact that the heavy compounds, as they start to move, they lay and they lay flat, they start to move out. And as they drive outward in a circular area, as it rains, these contaminants run down into the waterline divide, there is nothing to stop it, as this gentleman over here says, there is a wall.

Response No. 46: The deep groundwater recharge area being referred to is about a mile and one half north of the site. Beneath and down gradient of the Northrop Grumman Site, The groundwater moves, by orders of magnitude, horizontally. However, the main contaminants of concern do tend to sink in the aquifer as they move out horizontally from the site. In addition, due to the numerous production wells used by Northrop Grumman, contamination was drawn down deeper before moving offsite.

Question No. 47: My question is why, number one, didn't the Board of Health, in 1992, put out an advisory to pregnant women and women who get breast cancer, when they had the complete study, and that study was dropped, put into the hands of the people, you people, when it clearly stated 100 percent that there were eleven chemicals that causes cancer, and each cancer, these cancer-causing elements, which has been proven in laboratory rodents, okay, was never given to the general public to go buy bottled water. But bottled water can't help; can it, sir, because they take showers. And when you take a shower, your skin opens up, and you know what, when your skin opens up, all those chemicals go inside of you, because your pores are now opened up, that's why you say breast cancer; a woman stands in front of a shower with their breasts first.

Response No. 47: Both the New York State Department of Health and the Nassau County Department of Health have been closely monitoring the situation whereby public water supplies could potentially have been impacted by groundwater contamination. The State and the County require routine monitoring to ensure that contaminants are detected and appropriate action taken promptly. If groundwater contamination has been determined to potentially impact a public water supply well, then the respective water district typically initiates their own response, most notably taking the well offline, so that people are not exposed to any contamination. The NYSDOH has promulgated maximum contaminant levels for drinking water in 10 NYCRR Part 5. These levels are based on conservative assumptions and consideration of exposures via ingestion, contact and inhalation. Thus, exposures related to cooking, showering and bathing are reflected in the standards. The standards also reflect available toxicologic data for the contaminants with respect to potential carcinogenicity (i.e. cancer causing) and non-carcinogenic (e.g. systemic) health effects. The standards also reflect consideration of differences, if any, with respect to gender, race and age.

Question No. 48: The question is why was it not reported to the people on Long Island that there were chemicals inside this water that causes cancer for each and every one of the people on Long Island.

Response No. 48: To the extent that any water supply on Long Island has chemicals in it, those results are routinely available to the public. Individuals can request copies of these results from their respective water district. This information is also provided to consumers by the water districts on a routine basis.

Question No. 49: Long-term is equivalent, then, equivalent to walking into a situation and getting one good hit of anything; long-term exposure, and it takes long-term exposure to show and prove; doesn't it, sir? The question is if you're taking these chemicals, these contaminants and you're wearing them by going into the shower and it gets into your system, does it not take long term to get into your system before you get sick?

Response No. 49: The maximum contaminant levels referred to above are based upon the assumption of long term exposure to the chemical(s) in question. This is usually seventy years for an adult. Shorter durations, as in the case of childhood exposure, are also reflected in the drinking water standards.

Question No. 50: Do you know how many times water companies have told everyone that there is a problem, please boil your water? You know when you boil that water it makes those chemicals more intense, they cannot come out?

Response No. 50: Boiling the water has nothing to do with chemical contamination. When a pipe breaks, or a water main needs repair it may temporarily impair what is known as the break point chlorination. Break point chlorination is the ability of the water district to provide potable water that is free of water borne diseases. Therefore, the water supplier requests people to boil water to attenuate any pathogens until breakpoint chlorination can be re-established.

Question No. 51: The question I have is, has Northrop Grumman and/or the Navy fully disclosed any and all contamination, storage of chemicals that they are aware of and sent it to the DEC?

Response No. 51: There are the two different programs administered by the NYSDEC which regulates to the use and storage of chemicals and the clean-up of those chemicals if they happen to get into the environment. The program that regulate the use and storage of those chemicals under is called the Resource, Conservation and Recovery Act or RCRA program. That program has evaluated this Grumman facility and the Navy facility with respect to the buildings where the chemicals are used. All of the various chemical use areas have been investigated and, as of now, closed.

In addition, under the New York State Superfund program areas of soil contamination have been identified and remediated. Northrop Grumman and/or the Department of the Navy have identified areas where chemicals were used and all areas have been cleaned up properly.

Question No. 52: The only other question I would have then is why, as recently as three months ago, the new construction that's going on in those sites that have been sold, etc. have there been discoveries of in excess of 200 fifty-five gallon drums of contaminated materials and toxic waste that one of Grumman's representatives show up at the site, they show up with paperwork indicating, oh, yes, there's 200 buried over here and there's a sewage treatment plant that was abandoned, buried over there. If full disclosure was given, then why haven't those chemicals been removed out of

the ground, which are now still seeping into the ground water? Not only drums. There were numerous sites, numerous different area locations. On the Grumman's property, or what was owned by the Grumman or part of the Grumman property.

Response No. 52: The NYSDEC is not aware of that occurring. But if Northrop Grumman uncovered any drums during any construction activities, they would have notified this Department. Any contractors for any of the new property owners would do the same.

Question No. 53: I'm talking about construction that is underway right now on sites that were sold by Grumman to individuals, that as they excavate they are bringing up contaminants.

Response No. 53: Again, the NYSDEC is not aware of any sites that were sold to individuals that are encountering drums as excavation occurs. Before Northrop Grumman sold any of the property (ies), they did their own environmental assessments to determine what was there, and if there was anything that was there, to address the problem. Some properties were sold with the understanding that if any work was required, the new owner fully understood the terms of the property transfer and agreed to assume the remedial work that would be required.

In addition, when Northrop Grumman knew there was a groundwater contamination problem, they wanted to know where this groundwater contamination was coming from. They did source area investigations all across the property,. thousands of soil samples have been collected from the Northrop Grumman and the Navy parcels. If contaminated areas were found, they were addressed. When these areas were cleaned up, then endpoint samples were taken to ensure that the soil had been completely cleaned up.

Question No. 54: The Lloyd Aquifer, you did say that it was contaminated. I was led to believe by members of the EPA that if the Lloyd Aquifer is contaminated, there is no remediation, that's it. We cannot remediate the Lloyd Aquifer. If that's the case, all of our water is doomed.

Response No. 54: An important aspect of this project is acquiring an understanding about the hydro geology of Long Island. What you state is not the case. In certain places in Nassau County it is believed that there is contamination in the Lloyd Aquifer. However, where the Lloyd does exist in the area of these sites, there is a very thick clay unit, known as the Raritan clay separating the Lloyd form the Magothy. This would, for the most part, prevent the contaminant plume from migrating to the Lloyd Aquifer.

Question No. 54: Well, is it true that--can it be remediated? Let me ask that question.

Response No. 55: Anything can be re remediated. If the contamination does reach the Lloyd Aquifer, it usually is in very, very minute quantities , because of confining material, makes it difficult for contaminants to migrate through.

The Lloyd Aquifer is what's known as a confined aquifer, there is an aquitard or aquiclude, which is another name for clay, over the top of the Lloyd Aquifer which pretty well protects it from above. It is true that it does get recharged from water above at a very, very slow rate; in the order of 4,000 years for the water to get down into the Lloyd

Aquifer. By contrast, the Glacial Aquifer is young. It takes a matter of decades, that water comes down and runs to the Sound or to the Atlantic.

Question No. 56: We know that the Magothy has been contaminated, that we know from other sites that I've worked on. But I have been told time and time again is that the Lloyd Aquifer has not been contaminated, and if it ever is contaminated, we're in trouble. Where, in fact, one man said we're doomed, and that scares the hell out of me, so I'm going to check this out.

Response No. 56: The statement about the Lloyd being contaminated has to do with certain wells in Nassau County here and there that are showing extremely minute traces, and the likelihood is that those traces of contamination have come from the well itself in its penetration down through all those layers. Since the casing itself is not always a perfect seal, sometimes the well will draw contaminants down along the casing.

There are no drinking water wells in the Lloyd Aquifer in the area of the sites, so even if it did become contaminated, that's not where the drinking water is coming water from. There are only a few wells on the south shore and a few on the north shore that get their water from the Lloyd.

Bethpage has made it a policy not to supply water to their customers that has any detectable contamination of VOCs. With respect to Levittown, no contamination has reached the Levittown wells yet.

Question No. 57: Why are there no PCBs listed in the water? There's no pesticides listed in the water. Why is it in your own Federal Report it states that?

Response No. 57: PCBs, or polychlorinated biphenyls, are highly insoluble compounds. The remedial investigation did not find PCB contamination from site soils was impacting offsite groundwater. With respect to pesticides, these compounds were eliminated as site related contamination. However, groundwater for Nassau County is monitored on a County-wide basis for pesticide contamination.

Question No. 58: The statement that I would like to have for the record is I do not agree with the phase that's being proposed. I do not feel the public has been given sufficient time to review a compilation of approximately 25 years worth of records and testing when it was just brought to our attention that they were available for review last week, and in order to comment intelligently, we've only had approximately seven days to review those documents, which, at the Bethpage Public Library, are kept in the basement in numerous, numerous boxes, which I viewed.

Response No. 58: Unfortunately, there is a lot of historic material associated with the Northrop Grumman and NWIRP sites. Most of this material has been on file for several years or more. This OU2 proposed remedial action plan (PRAP) was first released in October 2000. At that time, many people first became aware of this project. As part of the Navy Remedial Advisory Board meeting in October, the NYSDEC issued a 4,000 piece community mailing and a notice was published in Newsday. A press release was issued in November 2000 to get the local media to publish the information available at the Bethpage library. The NYSDEC makes the best attempt possible to get the word out about the PRAP and other site related documents. However, doing a mailing to the entire communities of Bethpage, Levittown and Hicksville is beyond the scope of this project.

Question No. 59: I believe that the situation is a little out of control and there's an easy way to fix the situation, and it would be the intake of everybody's home water system, a computerized water system. You guys want to take 15 or 30 years to fix and repair it, it can be repaired one, two, three, cheaper and at a lesser cost by doing this. It costs us a lot of money to have filtering systems put in, aerators, air strippers put in, that the public has to pay for, that they are now using to say that it is going to clean the water of the chemicals.

Response No. 59: There is no need to place an activated carbon filter on every individual residence. The water supply is sampled at the source to ensure that it meets drinking water standards. It is much easier and more cost effective to analyze water from several wellhead points than from several thousand plus individual homes. Additionally, the presence of thousands of government provided homeowner filters would necessitate an ambitious bacteriological monitoring plan to control the risk associated with the unregulated filters. If an individual resident wants to add a carbon filter to their residence system, then that is their personal choice.

Question No. 60: I'm a water commissioner with the Massapequa Water District. We just, in brief, this morning for the first time, although my fellow Commissioner, Frank Flood, and I have served on the Nassau County Department of Public Works and are thoroughly familiar with the plume, we at the Massapequa Water District do not agree with any kind of wellhead treatment. We agree that the plume can be confined to the site which it's on; we believe that you should recover the plume and flow that are now probably down near Jerusalem Avenue and close to our northwest wellfield. We've gone through a similar problem with the Liberty site, and our position is clear on this.

And we also believe that there hasn't been enough modeling or testing done. We think that you must take your model to another extent, as we discussed this morning. And we also want you to know that in the 1980s, I am old enough to remember that, we had to clean up the Purex site, which was very similar to this site. We did the on-site confinement, we did not allow the plume to migrate to Hempstead Turnpike, we recovered the plume, the cost in those days was 30 million.

Response No. 60: Based on the extent of the Northrop Grumman contamination, full plume containment is not a feasible option. This is even more evident given the recent vertical profile data received by the NYSDEC from the Department of the Navy and referred to in your Statement.

The remedial investigation for the Northrop Grumman and Naval Weapons Industrial Reserve Plant Sites began almost 10 years ago. Since then, numerous samples have been taken of the site soils and groundwater for the full range of analytes. This information was compiled into a number of independent groundwater models and have been run more than once by Northrop Grumman, the Navy and the Occidental Chemical Corporation (as former owners of the RUCO site). Even without including the 2000 vertical profile data, it is clear that full plume containment wold be too extensive in nature, and is just not feasible.

With respect to wellhead treatment, there are approximately 48 treatment systems for VOC removal for 72 public water supply wells that have been contaminated with VOCs. This technology is widely available and is used as appropriate at the locations to ensure that human health is protected by preventing human exposures to potentially harmful chemicals.

Written Comments Received by the NYSDEC

This section responds to the following letters that were received by the NYSDEC from technical and legal representatives of water districts located in the vicinity and downgradient of the Northrop Grumman and the Naval Weapons Industrial Reserve Plant (NWIRP) Sites, from the Northrop Grumman Corporation, from the Department of the Navy, and from OXY Glenn Springs Holdings, Inc.:

1. A letter dated November 3, 2000 was received from Anthony Sabino, Attorney and Board member of the Bethpage Water District.

2. A letter dated January 11, 2001 was received from Gary Loesch, P.E. of the H2M Group, representing The South Farmingdale Water District and the New York Water Service.

3. A letter dated January 16, 2001 was received from William Carmen, Attorney for the South Farmingdale Water District.

4. A letter dated January 17, 2001 from Frank Flood, Jr., John Caruso and Vincent Guardino, Commissioners for the Massapequa Water District.

5. A letter dated January 19, 2001 received from John Molloy, P.E. of the H2M Group, representing the Bethpage Water District.

6. A letter dated January 19, 2001 was received from Steve Whyte of the OXY Glenn Springs Holdings Inc.

7. A letter dated January 29, 2001 was received from John H. Young of the Northrop Grumman Corporation.

8. A letter dated January 31, 2001 was received from Frank Flood, Jr., John Caruso and Vincent Guardino, Commissioners for the Massapequa Water District.

9. A letter dated February 2, 2001 was received from Arcadis Geraghty and Miller, Inc., on behalf of the Northrop Grumman Corporation.

10. A letter dated February 2, 2001 was received from James Colter, for the Department of the Navy, Naval Facilities Engineering Command, Northern Division.

11. A letter dated February 5, 2001 received from Arnold Palleschi, Commissioner, Town of Hempstead Water District.

As many of the comments and the questions raised in the above referenced comment letters have a common theme, responses have been grouped by category.

General Responses

One of the cornerstones of the operable unit 2 (OU2) groundwater selected remedy is the comprehensive groundwater monitoring program. This includes outpost monitoring for public water supply wells, monitoring of the onsite containment (ONCT) system, overall groundwater quality monitoring for comprehensive evaluation of plume attenuation and the performance monitoring of the treatment system of the GM 38 area groundwater remediation. Along with the outpost monitoring is a public water supply contingency consisting of addition of wellhead treatment systems or comparable technology, or other comparable alternative measures, for impacted public water supply wells.

There were a number of concerns raised by the water districts affected or potentially affected by the groundwater contamination. Foremost, any costs associated with implementation of the selected remedy will be borne by the potential responsible parties. Also, public water supply wells are never considered part of any groundwater remediation strategy. When appropriate treatment is necessary for continued operation, that operation is strictly for the purposes of providing potable water to the public, and not part of any groundwater remediation strategy. This has been clarified in the ROD by separating those measures addressing public water supply issues from those measures addressing groundwater remediation.

Historically, public water supplies affected by volatile organic compound (VOC) contamination have been protected by the provision of wellhead treatment for VOC removal at the impacted wells. This treatment has consisted of packed tower aeration (also known as "air stripping"), granular activated carbon (GAC) filtration or, in select cases, some combination of both. In the subject ROD, comparable technology and alternative measures have been added to the public water supply contingency to address the concerns of the local water districts that they are able to select the most appropriate course of action for affected wells in their district. This will provide the affected water districts with the option of, within the limits of reasonable cost, designing and constructing a comparable technology or selecting an alternative measure, including well replacement or relocation, to produce potable water. The measure selected will be sufficient to reflect the policies of the districts that all water provided to their customers contain no detectable levels of VOC contaminants.

There were concerns raised regarding an adequate time to review technical materials related to and including the PRAP. In order to address this, the public comment period was extended from December 22, 2000 to February 5, 2001. Concerns were also raised by the water districts about not being copied on all test results and pumpage data generated by Northrop Grumman and the Navy. The NYSDEC will ensure that the interested water districts are given copies of pertinent materials. With respect to prompt access to relevant information and corresponding input to decisions made, a number of the potentially affected water districts have requested the formation of a Technical Advisory Committee (TAC). NYSDEC has, therefore, reconvened a previous TAC (most recently dormant) for these sites, expanding its members to include potentially affected water districts south of the Hempstead Turnpike.

Most Water Districts wanted greater involvement in decisions made with respect to groundwater remedial decisions and public water supply protection. The ROD includes water district input as a factor in such decisions. Additionally, the re-constitution of the TAC will provide a forum for such input on an ongoing basis.

Specific Responses

I. Remedial Investigation and Feasibility Study.

Comments were raised during the public meeting and in writing questioning the completeness of the remedial investigation (RI) with respect to the regional groundwater. In responding to these questions, the following site history is presented. The RI for the Northrop Grumman and NWIRP Sites dates back to 1990 when the RI/FS order on consent was first signed with what was then Grumman Aerospace and a memorandum of understanding (MOU) was entered into between the NYSDEC and the Department of the Navy.

A number of groundwater monitoring wells, at varying depths, both onsite and down-gradient offsite were installed during the RI to supplement previously installed monitoring wells. Several monitoring wells had been installed earlier by Nassau County and the U.S. Geological Survey (USGS) during investigations of VOC contamination in the aquifer near Bethpage. In addition, over the course of time, several discrete quarterly groundwater monitoring programs, that also included rounds of well installations, were initiated to monitor specific portions of groundwater related to interim remedial measures (IRMs) being conducted at the sites. Numerous analytical data results and geologic cross sections, combined with groundwater modeling efforts from Northrop Grumman, the Department of the Navy and the Occidental Chemical Corporation (OXY) for the nearby Hooker RUCO site, were used to estimate the lateral and vertical extent of the groundwater contamination. This information was used to identify Interim Remedial Measures (IRMs) for site soils and groundwater. This information was also used to assemble, screen and evaluate remedial alternatives in the Northrop Grumman "Regional Groundwater Feasibility Study" (RGWFS)

After the execution of the 1995 OU 1 Soils Records of Decision for the Northrop Grumman and Navy Sites, the NYSDEC and the USEPA attempted to produce one RGWFS Report concerning the Northrop Grumman Corporation, the Department of the Navy and OXY (Hooker RUCO Site) co-mingled regional VOC contaminant groundwater plume. Ultimately, it was determined that separate groundwater feasibility studies would facilitate conclusion of the RI/FS process for these sites.

The offsite portion of the Northrop Grumman plume was always seen as extensive, based on the RI data. The RI also identified an offsite location, known as the GM 38 monitoring well area, that contained significantly elevated concentrations of site-related groundwater contaminants.

Recent vertical, hydrogeological profile borings completed by the Department of the Navy, indicated that the leading edge of contaminated groundwater is beyond those areas originally identified and/or projected during the RI/FS process. The latest groundwater data generated by the vertical profile borings shows the extent of the plume is beyond Hempstead Turnpike in the deeper parts of the Magothy aquifer. Therefore, a rigorous vertical profiling program has been initiated, with each boring being installed to the Raritan Clay (approximately 750 to 800 feet below ground surface), to define the limits of the groundwater contaminant plume.

The groundwater profiling data indicates offsite contaminant concentrations much less than the range of the concentrations found in the GM 38 monitoring well area. The OU2 groundwater remedy does not include full plume containment due to the technical infeasibility of implementing such a program in the extensive and diffuse offsite plume. This is based on the sheer width, depth, and overall area of the plume and on comparison of this plume information with

ONCT extraction system data and data from other sites on Long Island where groundwater extraction and treatment is being implemented. In addition, the area is densely developed and finding the necessary locations to implement total plume containment would be difficult at best and, more likely, infeasible to implement.

As part of the selection of this remedy, the NYSDEC will implement specific tasks, covered in more detail in the following sections, to ensure that the selected remedy is protective of human health and the environment.

II. Interim Remedial Measures

a. Onsite Containment (ONCT) System: The groundwater IRM, or ONCT system, has been designed to intercept contaminated groundwater at the downgradient edge of the Grumman/Navy property, thereby preventing continued offsite migration of site-related contaminants. As part of the startup of the ONCT system, Northrop Grumman began to routinely sample a number of groundwater wells in the area to monitor the ONCT effectiveness. Analytical results generated by this program indicated the ONCT system is achieving it's primary goals. Subsequently, the NYSDEC directed Northrop Grumman to assemble an overall hydrogeologic monitoring plan to cover all the various quarterly sampling events and install additional wells necessary to complete this task.

As part of the implementation of the final remedy for this site, Northrop Grumman will be required to do a comprehensive evaluation of the ONCT system to demonstrate that it is effective in containing the plume from the site, or whether any modifications are necessary to ensure hydraulic containment onsite. Northrop Grumman has acknowledged that there were some initial start up issues with down time that unavoidably occurs with mechanical equipment. At one point, the new owners of Plant 2 inadvertently severed the fiber optic control cables during construction activities. The ONCT system must be operated to the satisfaction of the NYSDEC. Accordingly it is expected that, as time progresses, the ONCT system will approach 100 percent operating time.

b. Treatment for the Bethpage Water District Wells: Treatment systems for VOC removal at BWD Plants 4, 5 and 6 were installed either before or during the RI/FS phase of this project. Therefore, in order to document this wellhead treatment as being included in this remedy, these systems are being termed IRMs with respect to their design, construction and initial operation and ongoing maintenance. The outpost monitoring wells for these Plants are already in place and operation, maintenance and monitoring will be covered for the duration of these systems. Public water supply wells are not a part of groundwater remediation, they are being treated solely because they have been impacted by the site.

III. Record of Decision (ROD): The ROD presents the selected remedy for the Northrop Grumman and NWIRP site. However, given the complexity of this site, there is a contingency to create an Operable Unit 3 (OU 3) in the event that the groundwater evaluation conducted as part of this ROD indicates further remediation is required. Additional groundwater remediation may also be carried out under the OU2 ROD. An updated groundwater model will be run to select additional locations that need outpost monitoring wells using data gathered during the implementation of the OM&M plan and the vertical profile borings.

Once the ROD is executed, the NYSDEC will approach Northrop Grumman to enter into an order on consent, and approach the Department of the Navy to enter into a consent order or memorandum of understanding to implement the

selected remedy. A remedial action work plan will be prepared listing all the work that needs to be done, including a project schedule. The NYSDEC has already directed Grumman and the Navy to finalize and implement the hydrogeologic monitoring plan and the installation of the outpost monitoring wells. The vertical profile borings are a subpart of this hydro-geologic plan which, in turn, is part of the overall operation, maintenance and monitoring program.

A. Operation, Maintenance and Monitoring (OM&M) Plan: Part of the final remedy will include an operation maintenance and monitoring (OM&M) plan. Monitoring requirements for any and all the water districts will be covered as part of the monitoring requirements of this project. This Plan will include the following subcategories:

1. Onsite Containment System: The monitoring requirements for the ONCT system have been included in the hydrogeologic monitoring plan. Northrop Grumman will also undertake a specific task of evaluating the performance of the ONCT system to ensure that hydraulic containment of the site is being achieved.

2. Hydrogeologic Monitoring Plan: Plume tracking will be made a requirement of the Hydrogeologic monitoring program. This will more accurately monitor the fate and transport of the groundwater contamination not specifically addressed by active remediation through comprehensive monitoring of plume attenuation. Another requirement of the ROD is periodically re-run the groundwater model with all of the updated information. This information will be evaluated along with other aspects of the long term monitoring program.

This plan also includes the existing outpost monitoring wells for the BWD, specific groundwater monitoring for inorganic contamination and performance monitoring of the ONCT system. The Plan will include additional outpost monitoring wells as these are installed. The hydrogeologic monitoring plan has already been approved and is being implemented by Northrop Grumman. It is a living document that can be modified as current information directs.

3. Vinyl Chloride Contingency Plan: Vinyl chloride is a volatile organic compound (VOC) that has a vapor pressure higher than trichloroethylene (TCE) or perchlorethylene (PCE). Using current air stripper technology, vinyl chloride can be safely removed from groundwater. Vinyl chloride is related to the OXY Hooker RUCO site and has not been found anywhere downgradient of Northrop Grumman property. The vinyl chloride has been identified in the upgradient portions of the Northrop Grumman and Navy Sites. Recent sampling of Northrop Grumman production well 3 (GP-3) indicates that vinyl chloride is now approaching the ONCT system and that additional air emissions treatment will soon be required. The subject ROD includes a contingency for this treatment and the US EPA ROD for the RUCO site contains a similar provision.

4. Public Water Supply Contingency for Wellhead Treatment or Comparable Alternative Measures: The public water supply contingency for wellhead treatment or comparable alternative measures, as detailed in the selected remedy section of the ROD, will be implemented if outpost monitoring indicates treatment, or a comparable alternative, is necessary. The selected remedy section of the ROD addresses the process for implementing the wellhead treatment.

The Department of the Navy is currently implementing a vertical profile boring program to locate adequate outpost monitoring well locations and to close any data gaps from the RI. This work is being done now to better delineate the leading edge of the Northrop Grumman and Navy contamination plume and to find appropriate locations for outpost wells. This will give ample time to identify if any given public supply well is in danger of being affected.

As part of any treatment system, to address the concerns of local water districts, Northrop Grumman and the Department of the Navy have agreed to establish as a goal for this remedy, to the extent practicable, for any given wellhead treatment, or comparable technology, to provide water that is non-detect for site related contamination for the affected drinking water supplies, to the current analytical standards of non-detect as of the date of this ROD. This is of paramount importance to all of the water districts involved with this project. This also replaces the PRAP carbon polishing contingency since having the goal of attaining non-detect with wellhead treatment or comparable technology replaces the need for specifically requiring this technology.

The option of "comparable alternative measures" addresses the concern of replacing an existing supply well with a new well at a different location, or providing some other means to maintain a suitable potable water supply. If, at the time treatment is deemed necessary at a public supply well, a justification can be made to replace a well rather than add treatment to an existing well. Then a new well location will fall under "comparable alternative measure." This justification would include feasibility and comparable cost.

Offsite Groundwater Treatment Additional to the GM 38 Monitoring Well Area: The predesign investigation work and the offsite long term monitoring may identify areas that have similar contaminant concentrations that were found at the GM 38 area. If such information comes to light, the NYSDEC will evaluate this information and determine if treatment is required in a similar manner as the GM 38 area remedy.

Remedial Design: The Navy has undertaken a geo-technical program of installing vertical profile borings in the Bethpage, Levittown, Farmingdale and Massapequa areas. Profile borings include the collection of groundwater samples for VOC analysis at discrete intervals from the shallow groundwater all the way to the Raritan Clay. The information obtained from this fieldwork is part of the long term monitoring and plume tracking, outpost monitoring for the public water supply contingency program and the remedial design for operable unit 2.

The Navy borings will verify the hydrogeology and those areas that are contaminant free. For the purposes of the public water supply contingency program, the borings will locate the proper place for installing outpost monitoring wells. An additional task of the Navy program is to initiate the predesign study necessary to implement the GM 38 area remedy. All the other aspects of remedial design are based on contingency plans. If any part of the long term OM&M identifies the need to implement a remedial design program, then such a program will be implemented.

Miscellaneous Water District Comments

A number of water districts suggested that full containment of the groundwater contaminant plume should be the preferred remedy or, at a minimum, interception of contamination before it impacts downgradient public supply wells. Based on the extent of the Northrop Grumman contamination, full plume containment is not a technically feasible nor cost effective option. This option was evaluated in detail in the OU 2 FS. The option of full containment has since been rendered less feasible given the recent vertical profile data received by the NYSDEC from the Department of the Navy. The above assessment notwithstanding, the ROD does contain a provision for additional "hot spot" remediation of localized areas if the data indicate such action is warranted. The use of groundwater extraction wells to "intercept" contaminant plumes upgradient of public supply wells, where feasible, could be considered during the evaluation of comparable alternative measures under the public water supply contingency program.

Some water districts asked that metals, particularly chromium, be included in groundwater tests. One district also asked for radiologic testing. Inorganic constituents will be included as analytes for samples from select monitoring wells under the long-term Hydrogeologic Monitoring Plan; radiologic parameters will be considered. The districts are encouraged to comment on the locations and numbers of such samples via future TAC reviews.
One water district requested that public water connections be provided if private wells that are used for potable water are discovered. Although no such wells are known to exist, this provision has been included in the ROD.

Miscellaneous Northrop Grumman Comments

Northrop Grumman submitted some additional comments that are not addressed above.

Grumman opposes the specification of "trigger values" within the ROD, favoring the development of these in subsequent work plans and contingency plans. The ROD retains one "trigger value," that of the 1 ppb repeated detection in the outpost monitoring wells to begin the process of groundwater modeling and projected impacts specific to the threatened well. This "trigger" is also expected to begin the process of evaluating wellhead treatment options and comparable alternative measures for the threatened supply well(s). Practically speaking, the modeling will be ongoing up to that point and minimal revisions/reruns would be likely. The commencement of alternatives evaluation is considered to be a prudent step at such time. It is noted that outpost well-specific action levels are expected to be developed within work plans and contingency plans with input from the TAC and potentially affected water districts.

Grumman generally opposed the use of language in the PRAP that suggested redundant engineering controls offered additional protection of public health. Some of this language had been part of the PRAP discussion on the carbon polishing option for affected public supply wells. The carbon polishing option has been deleted from the ROD along with the disputed language. This option was removed in favor of Northrop Grumman's and the Navy's stated agreement to use "non-detect" as the design goal for treatment systems installed at affected wellheads. One section of the PRAP had suggested that the GM-38 well area remedy offered additional protection of public health by decreasing the contaminant mass that would pass through public supply wells, even though such wells had VOC removal treatment. The statement hinged on the concept that the magnitude of exposure would be less in the event of system (treatment and monitoring) failure if lower VOC concentrations were present in the source water. The language has been changed in the ROD to simply state that the GM-38 well area remedy may result in reduced loading to nearby public water supply wells.

Responses to Written Comments from Citizens

Written Comment Letter Re: Cancer and Occupational Exposure

Two written comment letters/submittals were received from individual citizens. One expressed concern about a relative who was a former employee at Grumman and was subsequently diagnosed with cancer of the kidney. The writer suggested that the cancer may have resulted from occupational exposure to VOCs at Grumman. The writer also implied that Grumman showed negligence in allowing employees to be exposed to VOCs in water used at the site and to VOC vapors in the plant.

At this time, the causes of kidney cancer are not well understood. Although scientists do not know exactly why kidney cancer develops, they have learned that some things, called risk factors, increase a person's chance of getting this disease. For kidney cancer, these risk factors are believed to include smoking, use of the pain-killing drug phenacetin (no longer available in the United States), historic exposure to thorium dioxide via diagnostic X-rays, long-term kidney dialysis, and being overweight. With regard to occupational risk factors, some studies suggest above-average rates of kidney cancer among coke oven and insulation/asbestos workers. Other studies show that workers in the rubber, leather, petroleum, dye, textile, and plastics industries have an increased risk of at least one type of kidney cancer.

Unfortunately, cancer is a very common disease. One in two men and one in three women will be diagnosed with cancer at some time during their lives. Cancer is a group of more than 100 different types of cancer, each with different risk factors. Tumors originating in different organs (sites) are considered to be different diseases because of variation in cause, type of abnormal cells, course of the disease, prognosis and treatment. Cancers develop in people of all ages but most often in the middle-aged and the elderly. The number of cancer cases has risen dramatically over the past 40 years, but much of this increase reflects the increase in the population, especially in older age groups. Cancers of the prostate, lung, and colon are the most common among adult men. Breast, lung, and colon cancer are the most common among adult women. Kidney cancer affects men about twice as often as women, although doctors could seldom explain why one woman might get it while another wouldn't. Most people who get kidney cancer are between the ages of 50 and 70.

As noted above, the exact causes of kidney cancer are not yet known. Adult kidney cancers are more common in urban, industrialized areas. While exposure to chemicals on the job may have had an effect on the inquirer's relative, it cannot be conclusively pinpointed as the source of cancer, from information NYSDOH has at this time.

With respect to contaminated groundwater at the site, VOCs were detected in production wells used for non-potable purposes. Consequently, workers did not drink water from these contaminated wells. Potable water at the facilities is provided by the Bethpage Water District. Whether or not workers were exposed to contaminated water in the past via incidental contact during plant processes is unknown. Generally, such incidental exposures, if any, tend to be less significant than other occupational exposures, particularly those from actual use of the chemicals in question. With respect to these occupational exposures, regulatory requirements to minimize workplace exposures have increased as knowledge of the potential for adverse health effects has increased. Most prominent in this regard was Congress' enactment of the Occupational Safety and Health Act and the subsequent formation of the Occupational Safety and Health Administration (OSHA). Many such work exposures are regulated by OSHA.

Between 1980 and 1986, under the New York State Right-to-Know Law employers were required to provide information on workplace exposures to employees. After this time, OSHA required the provision of similar information under the federal Hazard Communication Standard. Under these rules, employers were required to inform employees of any hazardous materials they were potentially exposed to in the performance of their job as well as potential health effects, appropriate protective equipment, and spill remediation methods. Enforcement of the Right-to-Know Law was the responsibility of the New York State Department of Labor and enforcement of the Hazard Communication Standard is the responsibility of OSHA. Individuals with concerns about past or present exposures to VOCs at Grumman Aerospace or NWIRP may contact the NYSDOH Center for Environmental Health at 1-800-458-1158 to discuss their concerns.

Written Comment Package from Mr. Joseph Sadowski and Dr. Rebecca Carley:

The referenced package contains comments that cover a number of different subjects. For the most part, this comment letter is a copy of the one submitted to the USEPA on the OXY Hooker RUCO Site and some of the material contained does not pertain to the Northrop Grumman and TWIRP Operable Unit 2 PAP. Therefore, some statements and questions made in the 35 page comment letter and 57 pages of attachments are not part of this responsiveness summary. The OXY Hooker RUCO Site Operable Unit 3 "Offsite Groundwater Remedy Record of Decision" and Responsiveness Summary, dated September 29, 2001, can be viewed at the USEPA document repository for this site at the following location:

Hicksville Public Library
169 Jerusalem Avenue
Hicksville, New York

Many of the responses to comments contained in Mr. Sadowski's package can be found in the above responsiveness summary from the public meeting. Health related subjects concerning exposure and toxicity of site related chemicals have been responded to by the NYSDOH.

A major concern raised by Mr. Sadowski is the sites' location in relation to the Long Island groundwater divide. The groundwater divide is at least 1.5 miles to the north of the Site. The general groundwater flow in the area of the Northrop Grumman and TWIRP is south from the groundwater divide. During the years that Grumman was in operation, pumping from its production wells exerted an influence on the groundwater inducing a localized east/west component of flow only in the study area. During the various investigations, a series of monitoring wells have been placed around the two sites. Measurements from those wells confirm that the direction of ground water flow in the area is to the south-southeast. This has been reinforced now that Northrop Grumman has reduced, to a large degree, the total amount of water pumped. Water entering the ground at the Northrop Grumman and NWIRP sites moves downward until it reaches the water table, then migrates in a south-southeasterly direction. The groundwater movement as depicted in the FS report has been reviewed by EPA, NYSDEC, and the United States Geological Survey (USGS). All reviewers have concluded that the interpretation of the groundwater flow depicted in the FS Report is valid.

A number of questions were raised regarding the Lloyd aquifer. This has been addressed in the main body of the responsiveness summary from the public meeting. However, the deepest monitoring wells at the Northrop Grumman and NWIRP sites are completed in the Magothy Aquifer. The Magothy Aquifer is separated from the Lloyd Aquifer by an extensive layer of clay (the Raritan Confining Unit). The are no wells in the study area that have entered the Lloyd Aquifer. Therefore, contamination cannot enter the Lloyd by traveling down well casings. The Magothy Aquifer extends deeper than 600 ft. in the area of the Site where the contaminants are at their deepest. Below the Magothy lies a layer of low permeability material known as the Raritan Confining Unit that averages 175 ft thick that would act as a barrier to prevent contaminants from moving from the Magothy to the Lloyd.

A number of the Sadowski/Carley comments referenced the hydrogeologic groundwater model used in the FS and the output figures from these model runs. The comments also referenced Figure H.2.8 from the OXY RUCO OU3 Groundwater FS. The concern stated in the comment letter is that Northrop Grumman, NWIRP and OXY Hooker RUCO contamination is affecting the Hicksville water supply wells, including Plant 9. The lines on the figure represent

hydraulic head for a subsurface "layer" of the study area. Groundwater flows perpendicular to the lines of equal head from the higher numbers to the lower. These equipotential lines indicate the groundwater flows to the south. The regional figure shows the influence of pumping wells, including the Hicksville wells. Figure H.2.8 indicates that the groundwater influence of the Hicksville wells does not extend to any of the three hazardous waste sites noted above. In addition, the study area depicted on this figure includes an area much larger than the area impacted by the sites. By simply locating the Hicksville wellfield on the same figure as the OXY Hooker RUCO, Northrop Grumman and NWIRP sites does not imply that these sites are impacting the Hicksville Plant 9 wellfield, which they are not.

The water provided to residents of Hicksville meets NYSDOH drinking water standards, is tested on a routine basis, and is free of site-related contaminants. Gases are not being released from groundwater into the soils, nor are gases migrating into private residences and places of business. The groundwater table in this area is at least 50 feet below the ground surface. Additionally, the VOCs in question tend to migrate deeper in groundwater with distance from the site.

Sadowski/Carley made a number of statements regarding cancer. As noted above (see the previous response to written comments), cancer is a fairly common diagnosis. There are many different types of cancer and many different risk factors associated with cancer. The relationship of cancer incidence to environmental factors, such as chemical exposure, is the subject of ongoing scientific inquiry. NYSDOH has been involved with cancer surveillance activities in New York State for many years. More recently, NYSDOH has been involved with cancer mapping and incidence investigation activities. Information about these activities is available on the Department's website: w.w.w.health.state.ny.us.

Telephone Inquiry Re: Drinking Water Quality

One telephone inquiry was received by NYSDOH during the PRAP public comment period. A resident in the Bethpage Water District expressed concern that her drinking water was being contaminated by the Grumman and Navy facilities. Water provided to consumers within the Bethpage Water District is monitored routinely and is in compliance with the New York State drinking water regulations specified in 10 NYCRR Part 5. Additionally, the water supplied to consumers meets the more stringent policy established by the District of "non-detectable" concentrations of volatile organic contaminants. The monitoring frequency for these contaminants is also more stringent (than the State requirement) per the local Bethpage Water District policy.

APPENDIX B: ADMINISTRATIVE RECORD FOR OPERABLE UNIT 2
NORTHROP GRUMMAN AND NAVAL WEAPONS INDUSTRIAL RESERVE PLANT

Documents that are part of Operable Unit 2 (OU 2) Administrative Record that have been placed the Grumman Aerospace Operable Unit 1 (OU 1) Administrative Record:

1. Interim Remedial Measure, Pilot Test Report, Grumman Aerospace Corporation, prepared by Geraghty and Miller, Inc., January 1994.

2. Remedial Investigation Report, Grumman Aerospace Corporation, Bethpage, New York, prepared by Geraghty and Miller, Inc., September 1994, Volume I.

3. Remedial Investigation Report, Grumman Aerospace Corporation, Bethpage, New York, prepared by Geraghty and Miller, Inc., September 1994, Volume II.

4. Remedial Investigation Report, Grumman Aerospace, Bethpage, New York, prepared by Geraghty and Miller, Inc., September 1994, Volume III.

5. Remedial Investigation Report, Volume 1, Final, Naval Weapons Industrial Reserve Plant, Bethpage, New York, prepared by Halliburton NUS Environmental Corporation, May 1992

6. Remedial Investigation Report, Volume 2, Final, Naval Weapons Industrial Reserve Plant, Bethpage, New York, prepared by Halliburton NUS Environmental Corporation, May 1992

7. Remedial Investigation Report, Volume 3, Final, Naval Weapons Industrial Reserve Plant, Bethpage, New York, prepared by Halliburton NUS Environmental Corporation, May 1992

8. Remedial Investigation Report, Volume 4, Final, Naval Weapons Industrial Reserve Plant, Bethpage, New York, prepared by Halliburton NUS Environmental Corporation, May 1992

9. Phase 2 Remedial Investigation Report, Volume , Final, Naval Weapons Industrial Reserve Plant, Bethpage, New York, prepared by Halliburton NUS Environmental Corporation, May 1992

10. Phase 2 Remedial Investigation Report, Volume , Final, Naval Weapons Industrial Reserve Plant, Bethpage, New York, prepared by Halliburton NUS Environmental Corporation, May 1992

11. Feasibility Study Report, Volume 1, Final, Naval Weapons Industrial Reserve Plant, Bethpage, New York, prepared by Halliburton NUS Environmental Corporation, March 1994

12. Feasibility Study Report, Volume 2, Final, Naval Weapons Industrial Reserve Plant, Bethpage, New York, prepared by Halliburton NUS Environmental Corporation, March 1994

Documents that are part of this Administrative Record:

Grumman Aerospace OU1 Record of Decision March 1995

Naval Weapons Industrial Reserve Plant OU1 Record of decision, March 1995

New York State Site Registry Delisting Petition, Headquarters Complex, Bethpage, N.Y. March 1995.

Technical Specifications, Groundwater IRM, Grumman Aerospace Corporation, March 1996.

Soil Vapor Extraction, Operation and Maintenance, May, 1996.

Supplemental Phase II Environmental Assessment, Eagles Nest Site, 500 Central Ave, Bethpage, August 1996

Phase II Site Assessment, North Runway- Parcel L2, Northrop Grumman- March 1997.

Northrop Grumman Onsite Containment System (Interim Remedial Measure) Final Design Documents, 1997

IRM VPGAC System, Source Testing, Northrop Grumman Corporation, February, 1998.

Groundwater Feasibility Study, Grumman Aerospace Corporation, October 2000.

Northrop Grumman and Naval Weapons Industrial Reserve Plant Sites Operable Unit 2 Groundwater Proposed Remedial Action Plan, October, 2000.

Correspondence file from the beginning to March 2001.

Naval Weapons Industrial Reserve Plant Vertical Profile Borings report, January 2001 TTNUS

Baseline Sampling Report and Quarterly Sampling Reports for the ONCT system through March 2001.

Comment Letters in the PRAP Referenced in Appendix A.

Comments On The OU 2 PRAP- Submitted by Joseph Sadowski and Rebecca Carley January 20, 2000.

STUDY OF ALTERNATIVES FOR MANAGEMENT OF IMPACTED GROUNDWATER AT BETHPAGE

Prepared by
Tetra Tech

For

Naval Facilities Engineering Command
Mid-Atlantic

JANUARY 2012

TABLE OF CONTENTS

TABLES

APPENDICES

FIGURES

ACRONYMS

ANY-SNR	Aqua New York-Seamans Neck Road
bgs	below ground surface
BWD	Bethpage Water District
DCA	1,1-dichloroethane
EPA	Environmental Protection Agency
GAC	granular activated carbon
gpm	gallons per minute
CLEAN	Comprehensive Long-Term Environmental Action Navy
CTO	Contract Task Order
IRM	Interim remedial Measure
MCL	maximum contaminant level
MGD	million gallons per day
MG/YR	million gallons per year
NAVFAC	Naval Facilities Engineering Command
NWIRP	Naval Weapons Industrial Reserve Plant
NYSDEC	New York State Department of Environmental Conservation
NYSDOH	New York State Department of Health
O&M	operation and maintenance
OMB	Office of Management and Budget
ONCT	onsite containment
OU	operable unit
PCE	tetrachloroethene
ppm	parts per million
PV	present value
ROD	Record of Decision
SFWD	South Farmingdale Water District
TCA	1,1,1-Trichloroethane
TCE	trichloroethene
VOC	volatile organic compound
VPB	vertical profile boring
µg/L	microgram per liter

1.0 INTRODUCTION

Tetra Tech with support from Naval Facilities Engineering Command (NAVFAC) Atlantic prepared this *Study of Alternatives for Management of Impacted Groundwater at Bethpage* (Study Report) to evaluate remedial alternatives for the Bethpage Plume under Contract Task Order (CTO) WE06 for NAVFAC Mid-Atlantic under the Comprehensive Long-Term Environmental Action Navy (CLEAN) contract number N62470-08-D-1001. This report evaluates various alternatives for managing the groundwater downgradient of the former Northrop Grumman and Navy properties, known as Operable Unit 2 (OU-2), in Bethpage New York. NAVFAC Mid-Atlantic is conducting environmental investigations and remedial activities associated with the Naval Weapons Industrial Reserve Plant (NWIRP) Bethpage (see Figures 1-1 and 1-2).

This Study Report was prepared to fulfill one of the recommendations of the *Remedy Optimization Team Report for the Bethpage Groundwater Plume Remedy* (Harre et. al., 2011). This Team consisted of third-party technical experts from H2M Group, United States Geological Survey, GSI Environmental Inc., Battelle Memorial Institute, Virginia Polytechnic Institute and State University, and Navy. This Team concluded that the general strategy of on-site source containment and off-site plume monitoring has succeeded in reducing the impacts to downgradient water supply wells. However, as a follow up to the optimization process, the Team recommended an evaluation of the technical and economic feasibility of plume containment at the leading edge and other plume management alternatives. This Study Report was prepared by the Navy to address this recommendation. Other recommendations from the Remedy Optimization Team Report are being addressed under separate actions by either the Navy or Northrop Grumman.

1.1 SCOPE AND OBJECTIVE

The objective of this report is to develop and evaluate the technical feasibility and budget-type cost estimates of alternatives for addressing volatile organic compound (VOC) impacts in groundwater that is hydraulically downgradient of the Former Northrop Grumman, Navy, and other properties. These groundwater impacts have been collectively referred to as the Bethpage Plume. The evaluation in this report draws upon the current and growing understanding of the impacted aquifer at Bethpage, as well as upon costs incurred by the Navy at the site in the recent past on various components (e.g., extraction well installation at GM-38, VOC treatment plant installation at GM-38 and Aqua New York, etc.) of the ongoing remedy in the 2003 Record of Decision (ROD)(U.S. Navy, 2003). These recent site experiences and costs incurred at Bethpage provide a good basis for the evaluation. Also considered was the experience of other sites across the country with similar situations (deeper aquifers, large and complex plumes, and impacted public water supplies). The report also considers other parties or sites that are known to be or are potentially contributing to the Bethpage Plume.

1.2 BACKGROUND

The Navy and Northrop Grumman have been implementing a remedy identified in the New York State Department of Environmental Conservation (NYSDEC) 2001 ROD and the Navy 2003 ROD for OU-2. The RODs call for on-site containment of impacted groundwater from source areas and off-site monitoring of the impacted groundwater plume. According to the RODs, a wellhead treatment system would be designed and installed or comparable alternative water supply measures would be implemented if outpost monitoring well data were to indicate that a trigger value has been exceeded and that a determination has been made that treatment of a public supply well or provision of an alternative water source is necessary to protect public health from exposure to site related impacts. The primary components and current status of the OU-2 ROD remedies are summarized as follows (the specific areas referenced in this text are highlighted in Figure 1-3):

- Onsite containment of VOC-impacted groundwater at the southern (down gradient) edge of the OU-2 source areas. Northrop Grumman has been operating the OU-2 on-site containment (ONCT) system since 1998. The ONCT consists of five extraction wells (GP3 Well 3, GP-1 Well 1, Well 17, Well 18, and Well 19). The containment system is currently being evaluated to determine its effectiveness for capturing VOC-impacted groundwater. Northrop Grumman is preparing a work plan to evaluate the containment system.
- Hot spot treatment to address VOCs greater than 1 part per million (ppm) in groundwater. The Navy has installed and is operating the GM-38 Area groundwater extraction and treatment system since 2009. This system was built to address a hot spot in the eastern portion of the plume and its effectiveness is currently being evaluated by the Navy. Recent reports of elevated VOCs in Bethpage Water District (BWD) Plant 6 (namely, BWD Well 6-2) may indicate another possible hot spot north of this plant.
- Outpost monitoring well program. Outpost wells (monitoring wells closer to water supply wells) were installed in 2004 and have been monitored since that time. In 2010 and 2011, six additional outpost wells were installed and two or three additional outpost wells are planned for early 2012.
- Wellhead treatment. Wellhead treatment systems were installed in the 1990s at three water supply plants operated by BWD, namely BWD Plant Nos. 4, 5, and 6. In 2011, wellhead treatment was installed at a water supply plant operated by South Farmingdale Water District (SFWD), namely SFWD Plant 1. Design is in progress for treatment at two additional water supply plants, namely Aqua New York (ANY) Seamans Neck Road (SNR) and SFWD Plant 3.
- Continuing plume delineation. Quarterly and annual groundwater sampling and analysis of the OU-2 plume are being conducted by Northrop Grumman. Six vertical profile borings were installed by the Navy in 2008 and 2009 to determine the boundaries of the eastern and western extents of the off-site plume in the GM-75 Area. Four additional vertical profile borings and three monitoring wells were installed in this area in 2010 and 2011. Also, three vertical profile borings and approximately four

new monitoring wells are planned by the Navy for early 2012. An evaluation of currently anticipated activities for continued implementation of the remedy is presented in Appendix A as Alternative 1.

There are other (non-OU-2) sources that contribute to the groundwater impacts in the Bethpage Plume. Northrop Grumman has been investigating impacted groundwater downgradient of the Bethpage Community Park (Operable Unit 3 or OU-3). The Bethpage Community Park Site is located on former Northrop Grumman property and includes the Former Grumman Settling Ponds, which are the suspected source of the OU-3 plume. Since 2009, Northrop Grumman has been operating a pump-and-treat system called the Interim Remedial Measure (IRM) to contain identified OU-3 source areas. In addition, Northrop Grumman has submitted to NYSDEC a draft feasibility study for addressing an off-site VOC hot spot associated with OU-3. Additional sources contributing to the Bethpage Plume include the Hooker/Ruco Superfund Site and American Drive-In Cleaners Site. For discussion purposes only, this study report attempts to evaluate management alternatives for the groundwater impacts generally referred to as the Bethpage Plume and considers contributions from OU-2 and, as needed, other potential sources.

1.3 CURRENT SITE CONDITIONS

Although the VOC impacted groundwater south of the Northrop Grumman and Navy properties is generally called the Bethpage Plume, the conceptual site model identifies three major plumes: the shallow plume (Figure 1-4) and the deep western and eastern plumes (Figure 1-5). The maps for these plumes were developed from a conservative interpretation of vertical profile boring and monitoring well data and represent the maximum trichloroethene (TCE) and other site-related VOC concentrations detected in samples collected at different depths at a given location. Although TCE is the primary site-related VOC, some portions of the plume are defined by other VOCs. In many vertical profile borings, VOCs were detected at some depths, but not others, indicating a very heterogeneous plume profile. Available groundwater VOC data in the downgradient portion of the plume (south of Hempstead Turnpike) are presented in Appendix B. Regional groundwater flow is normally to the south and southeast, but can be affected locally by extraction wells, including the ONCT and GM-38 remediation wells, as well as recharge basins and water supply wells operated BWD, SSFWD, and ANY-SNR. Figure 1-6 shows the locations of on-site containment and public water supply wells. Some vertical component of groundwater flow is possible and is likely to be driven by the presence/absence of low-permeability geological units and the operation of extraction wells. A cross section location map is presented in Figure 1-6 and cross-sections of the impacted groundwater plume (A-A', B-B', and C-C') are provided in Figures 1-7, 1-8, and 1-9, respectively. A brief conceptual description of the Bethpage Plume is provided below:

- The shallow plume is approximately 9,700 feet wide and at least 17,000 feet long (covering approximately 3,800 acres of area). The eastern and western deep plumes appear to be relatively narrow (2,000 feet or less wide), relatively continuous, and migrate in the south-southeastern

direction. The down gradient edges of the plumes are not fully defined and the Navy is currently conducting additional investigations to better define them.

- The shallow plume generally occurs at depths between 100 and 300 feet below ground surface (bgs), and consists of a mixture of TCE, tetrachloroethene (PCE), 1,1,1-trichloroethane (TCA) and degradation products (Figures 1-4 and 1-9). VOC concentrations in the shallow plume are typically less than 50 micrograms per liter (µg/L). Other sources, such as the Hooker/Ruco and American Drive-In Cleaners Sites, have shallow plumes that are within or extend into the Bethpage Plume footprint.
- The deep western plume generally occurs between 300 and 750 feet bgs, and consists primarily of TCE (Figures 1-5 and 1-7). TCE concentrations are typically greater than 50 µg/L. Other VOCs are present, but their concentrations are typically less than 10 µg/L. This plume is believed to have originated from OU-2 source areas. Vertically, the plume is not uniform; it consists of one or more bands of high-VOC-concentration groundwater within a broader aquifer cross-section that has little or no VOC impacts. The downgradient extent of this plume is approximately 12,000 feet south of the OU-2 source areas. The Navy is currently installing additional borings to better define the southern extent of this plume. An isolated PCE plume was identified within this part of the Bethpage Plume and has potentially originated from non-OU-2 sources. In addition, more pockets of contamination may be present.
- The deep eastern plume is believed to have originated from the Former Grumman Settling Ponds Site (also known as Bethpage Community Park and OU-3). This plume is currently reported to be 300 to 650 feet bgs, and consists of a mixture of TCE, PCE, TCA, and degradation products (Figures 1-5 and 1-8). VOC concentrations in this plume are typically greater than 50 µg/L. Vertically, the plume is not uniform and consists of one or more bands of high-VOC-concentration groundwater within a broader aquifer cross-section that has little or no VOC impacts. The downgradient extent of this plume is not well defined. One or two isolated PCE plumes from other sources (non-OU-2 and non-OU-3 sources) are also present in this portion of the aquifer.
- Other potential VOC sources in the vicinity of the Bethpage Plume include the Old Bethpage Landfill Site, Wantagh Cleaners Site, Liberty Industrial Finishing Site, and several other Superfund sites, dry cleaners, and maintenance garages/gas stations (see Figure 1-10). Dry cleaner and gas station locations shown on Figure 1-10 were identified from facilities that currently advertise services in the area and do not necessarily represent all such current or past facilities.

The OU-2 ROD chemicals of concern, maximum concentration detected (excluding OU-3 groundwater and the GM-38 Hot Spot Area), and the New York State Department of Health (NYSDOH) maximum contaminant levels (MCLs – 5 µg/L) are shown in Table 1-1. Several of the water districts in the area have stated a goal of providing water to customers that do not contain detectable concentrations of VOCs (0.5 µg/L detection limit for the analytical method used).

1.4 GEOLOGY AND HYDROGEOLOGY

NWIRP Bethpage is underlain by approximately 1,100 feet of unconsolidated sediments that overlie crystalline bedrock (Isbister, 1966). The unconsolidated sediments consist of four distinct geologic units: (in descending order) Upper Glacial Formation, Magothy Formation, Raritan Clay, and Lloyd Sand Formation. The 30- to 45-foot-thick Upper Glacial Formation consists chiefly of coarse sands and gravels. The Upper Magothy Formation consists primarily of coarse sands to a depth of approximately 100 feet, below which finer sands, silts, and clay predominate. The clay is common but laterally discontinuous; no individual clay horizon of regional extent underlies the facility in the Magothy. The 100- to 150-foot-thick Raritan Clay underlies the Magothy Formation at a depth of approximately 700 to 800 feet bgs. The underlying Lloyd Sand Formation is approximately 300 feet thick.

Table 1-1 Chemicals of Concern at Bethpage Site

Chemical of Concern	Maximum Detected Offsite Concentration Excluding OU-3 Plume and GM-38 Hot Spot (µg/L)	Maximum Contaminant Level (µg/L)
1,1,1-Trichloroethane	17	5
1,1,2,2-Tetrachloroethane	Not Detected	5
1,1,2-Trichloroethane	0.51	5
1,1-Dichloroethane	32	5
1,1-Dichloroethene	9	5
1,2-Dichloroethane	10	5
Carbon Tetrachloride	2.1	5
Chlorobenzene	2	5
Chloroform	4	5
cis-1,2-Dichloroethene	6	5
Freon 113	30	5
Tetrachloroethene	378	5
trans-1,2-Dichloroethene	2	5
Trichloroethene	500	5

Most of Long Island is bisected by an east-west-trending regional groundwater divide. NWIRP Bethpage occupies an area of recharge, lying to the south of the divide. Groundwater is in contact with the Upper Glacial and Upper Magothy Formations beneath the facility, and may be considered a common unconfined aquifer. The glacial deposits are characterized by a high primary porosity (exceeding 30 percent) and high permeability. The high permeability of the glacial deposits allows for the rapid recharge of precipitation to the underlying Magothy (Isbister, 1966; McClymonds and Franke, 1972). The number and thickness of clay lenses increase with depth in the Magothy Formation; however, the horizontally

discontinuous nature of these units prevents any one of them from functioning as an aquitard or semi-confining unit.

Groundwater is encountered at a depth of approximately 50 feet bgs at the facility. Historically, because of the extensive pumping and recharge at the facility, groundwater depths have been measured ranging from 40 to 60 feet bgs. Regional groundwater generally flows in a southerly direction toward the Atlantic Ocean. Across the NWIRP Bethpage, the horizontal hydraulic gradient and groundwater velocity in the unconfined common aquifer averages 5.3 feet per mile and 0.3 foot per day, respectively [Halliburton NUS (HNUS), 1993]. Subtle vertical hydraulic gradients occur in a downward direction. Groundwater in the deeper portion of the Magothy is the primary source of potable water in Nassau County.

Prior to 1998, the groundwater flow beneath the Navy and Northrop Grumman properties was subject to several influences. A total of 16 deep production wells (7 on the NWIRP and 9 on Grumman property) existed and were set in the Magothy. Each well yielded approximately 1,200 gallons per minute (gpm). All of the production wells on the Navy's property have been decommissioned. The extracted water was mostly used for non-contact single pass cooling and then discharged into recharge basins located on Navy and Northrop Grumman property. In addition, the production wells extracted groundwater from depths of approximately 500 feet bgs and the water was recharged in the basins near grade (ONCT System). The extraction from the production wells and near surface recharge resulted in vertical gradients at the site. Northrop Grumman continues to operate production wells (as well as a groundwater containment system) south of NWIRP Bethpage. The production wells and groundwater containment system operate with a combined flow rate of approximately 3,800 gpm (5.5 million gallons per day [MGD]). Groundwater flow downgradient of the ONCT system is to the south and southeast, which is consistent with the orientation of the long axis of the Bethpage Plume.

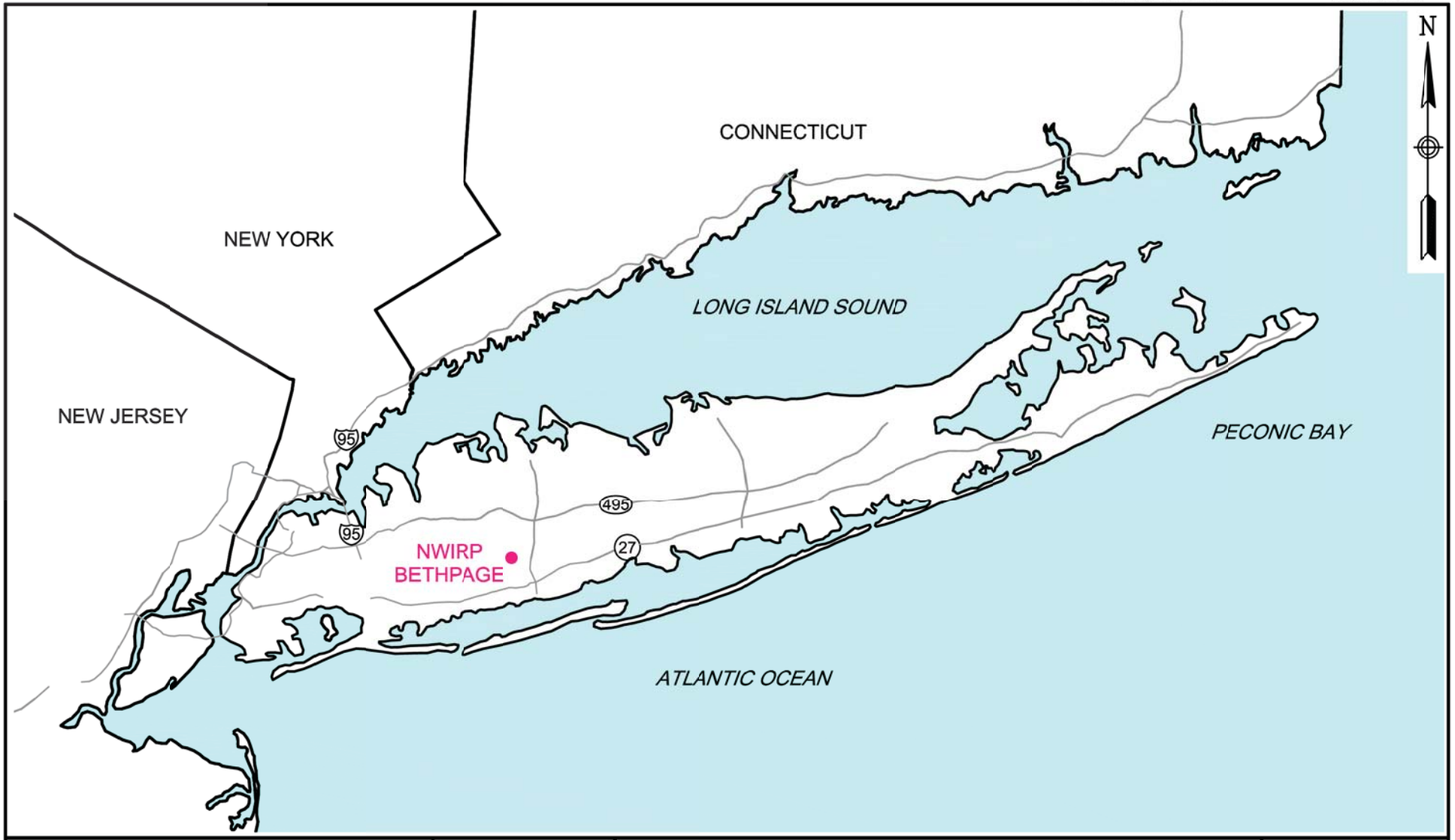
1.5 GROUNDWATER EXTRACTION AND RECHARGE

Water supply wells that extract groundwater in the current Bethpage Groundwater Plume footprint and in potentially downgradient areas are presented in Table 1-2. Also presented is the current status of installed treatment facilities for VOCs at the water supply wells. Groundwater is extracted to provide potable water, industrial process water, and remediation. Potable water is used by local residents and businesses for drinking water, sanitary purposes, and general outdoor purposes (lawn watering). Sanitary wastewaters are discharged to the Nassau County Water Pollution Control Plant located approximately 5.5 miles south and west of OU-2 source areas and the treated sanitary wastewater is discharged to the Bay/Ocean (resulting in a net loss from the local aquifer). Other residential water uses would result in infiltration to the groundwater or evaporation into the air. Water from industrial and remediation operations would mostly be recharged to the groundwater via basins. Some of this water would be lost through evaporation.

Table 1-2. Supply Wells in the Vicinity of the Bethpage Site

Well ID	Well Depth (feet bgs)	Rated Well Capacity (gpm)	Status of VOC Treatment at Wellhead
ANY # 4D (5767)	385	1,935	No
ANY # 6M (7414)	530	1,667	No
ANY # 7M (8603)	893	1,607	No
ANY # 3S (8480)	680	2,100	In progress
ANY # 5D (8837)	680	1,154	No
ANY # 4S (9338)	650	2,100	In progress
ANY # 6D (9910)	780	1,667	No
ANY # 8M (10,863)	685	1,879	No
Well # 4-1 (BWD-6915)	608	1,400	Yes
Well # 4-2 (BWD-6916)	611	1,400	Yes
Well # 5-1 (BWD-8004)	740	1,400	Yes
Well # 6-1 (BWD-3876)	386	1,400	Yes
Well # 6-2 (BWD-8941)	775	1,200	Yes
Well # 4 (MWD-6442	618	1,400	No
Well # 5 (MWD-6443)	825	1,400	No
Well # 6 (MWD-6866)	626	1,400	No
Well # 7 (MWD-6867)	492	1,400	No
Well # 9 (MWD-13,338)	645	1,400	No
Well # 1-2 (SFWD-4043)	382	1,200	Yes
Well # 1-3 (SFWD-5148)	369	1,200	Yes
Well # 1-4 (SFWD-7377)	758	1,400	No
Well # 3-1 (SFWD-6150)	612	1,400	In progress
Well # 4-1 (SFWD-6148)	566	1,200	No
Well # 6-1 (SFWD-8664)	610	1,400	No
Well # 6-2 (SFWD-8665)	560	1,400	No
	Total All Wells	37,109	
	Total Wells Without Treatment	22,309	

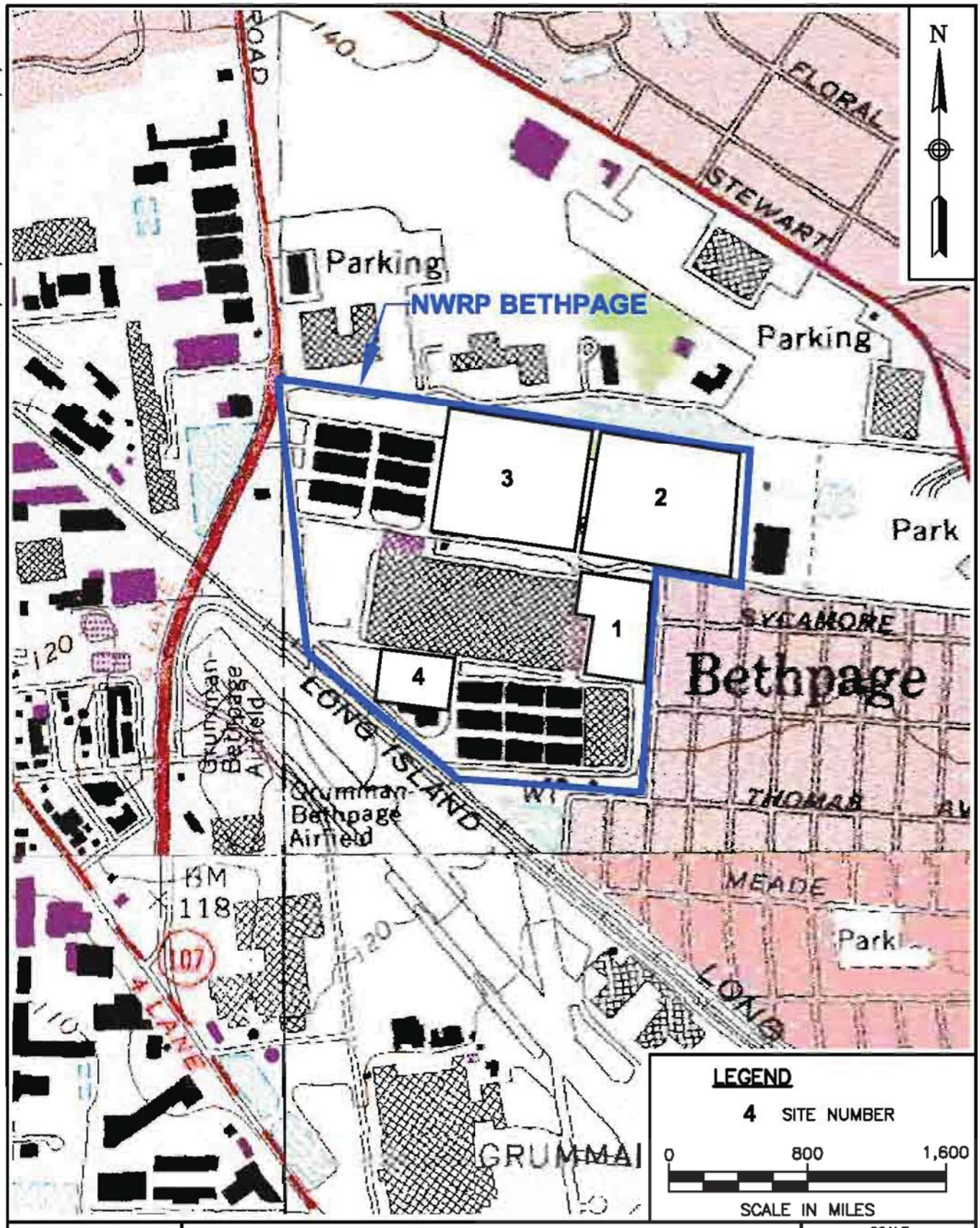
112G00622\0510\112G00622CM01.DWG 08/02/10 MKB



TETRA TECH NUS, INC.

GENERAL LOCATION MAP
NWIRP BETHPAGE
BETHPAGE, NEW YORK

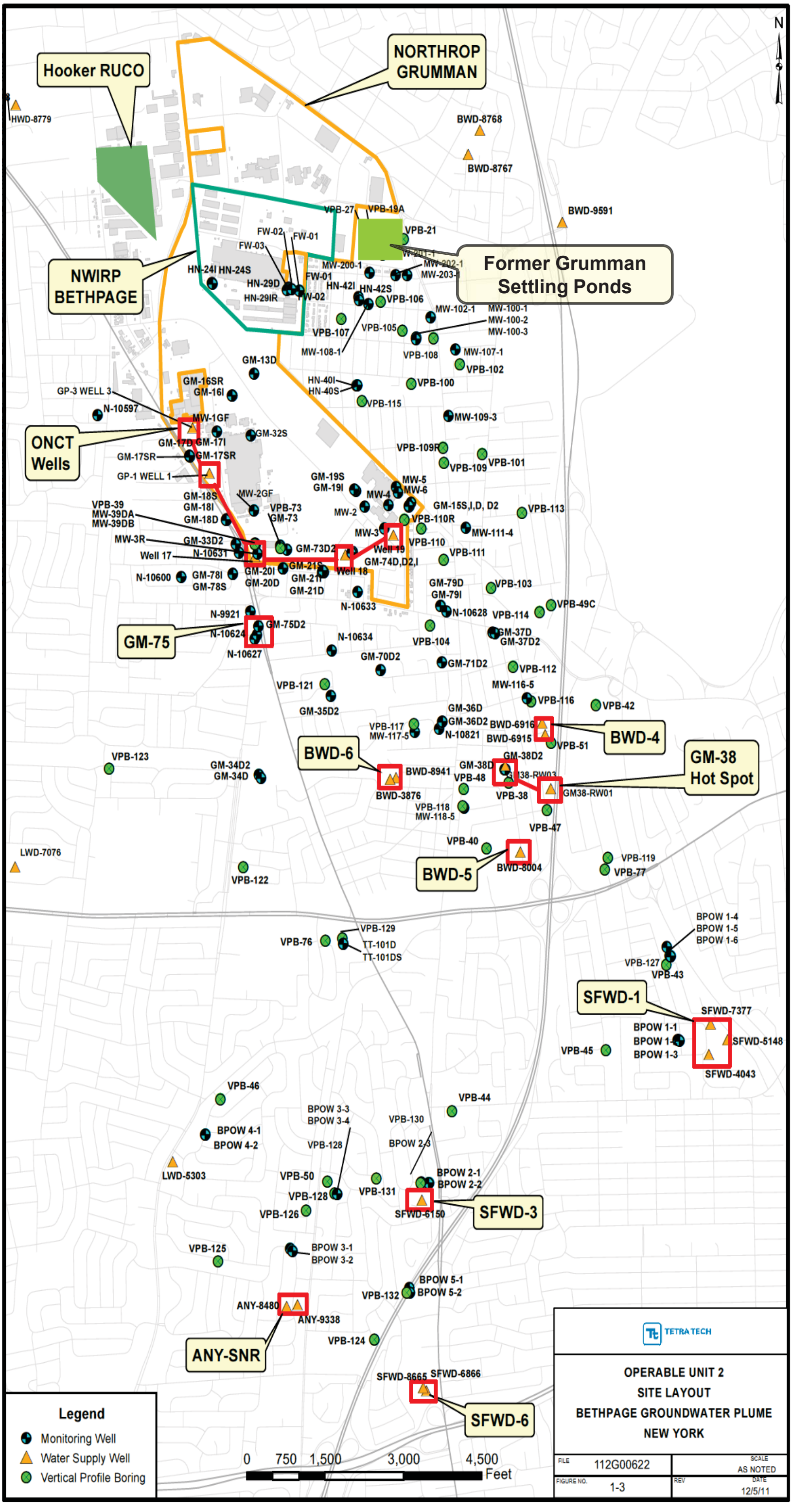
SCALE	NOT TO SCALE
FILE	112G00622CM01
REV	0
DATE	08/02/10
FIGURE NUMBER	FIGURE 1-1

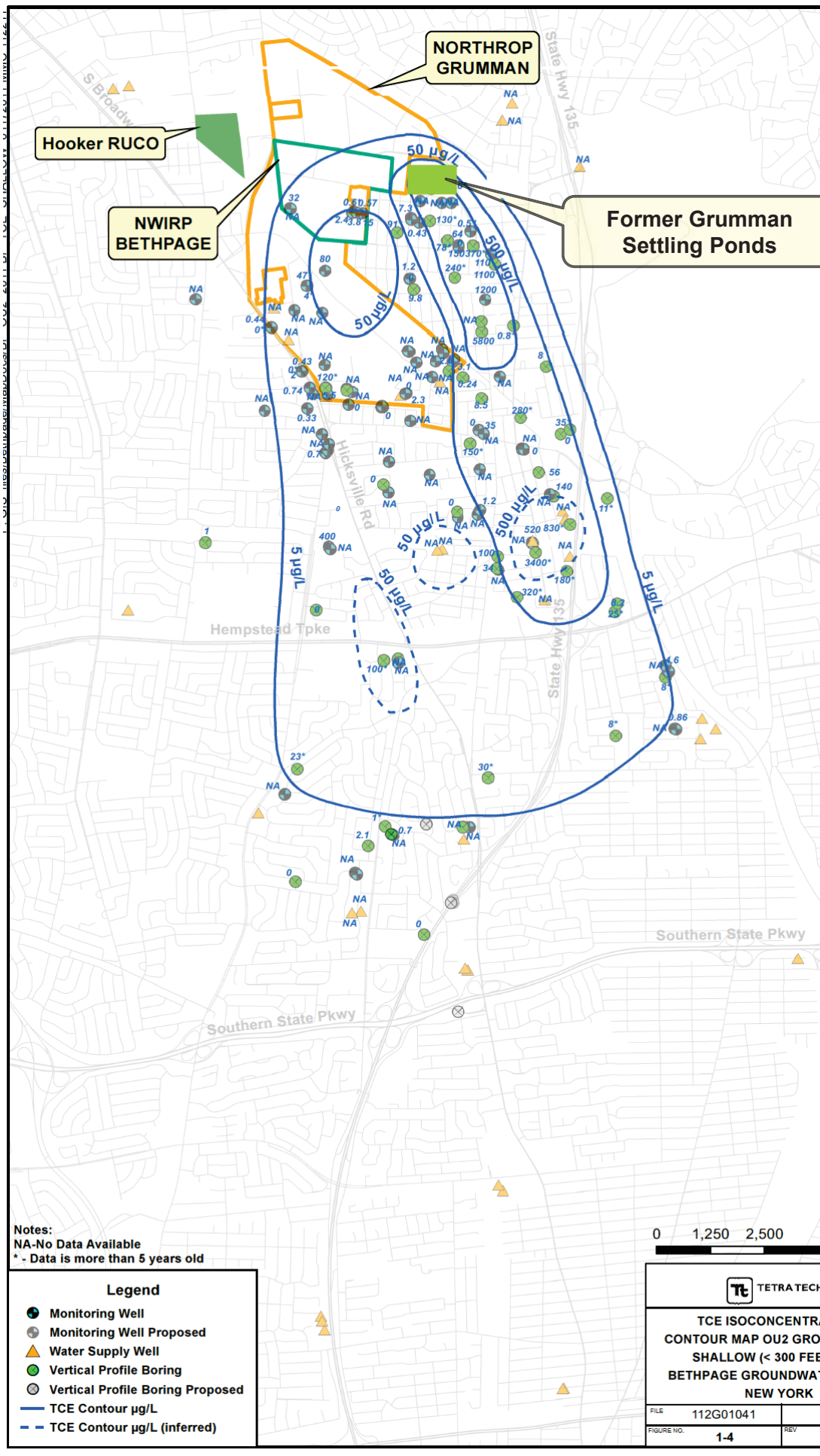


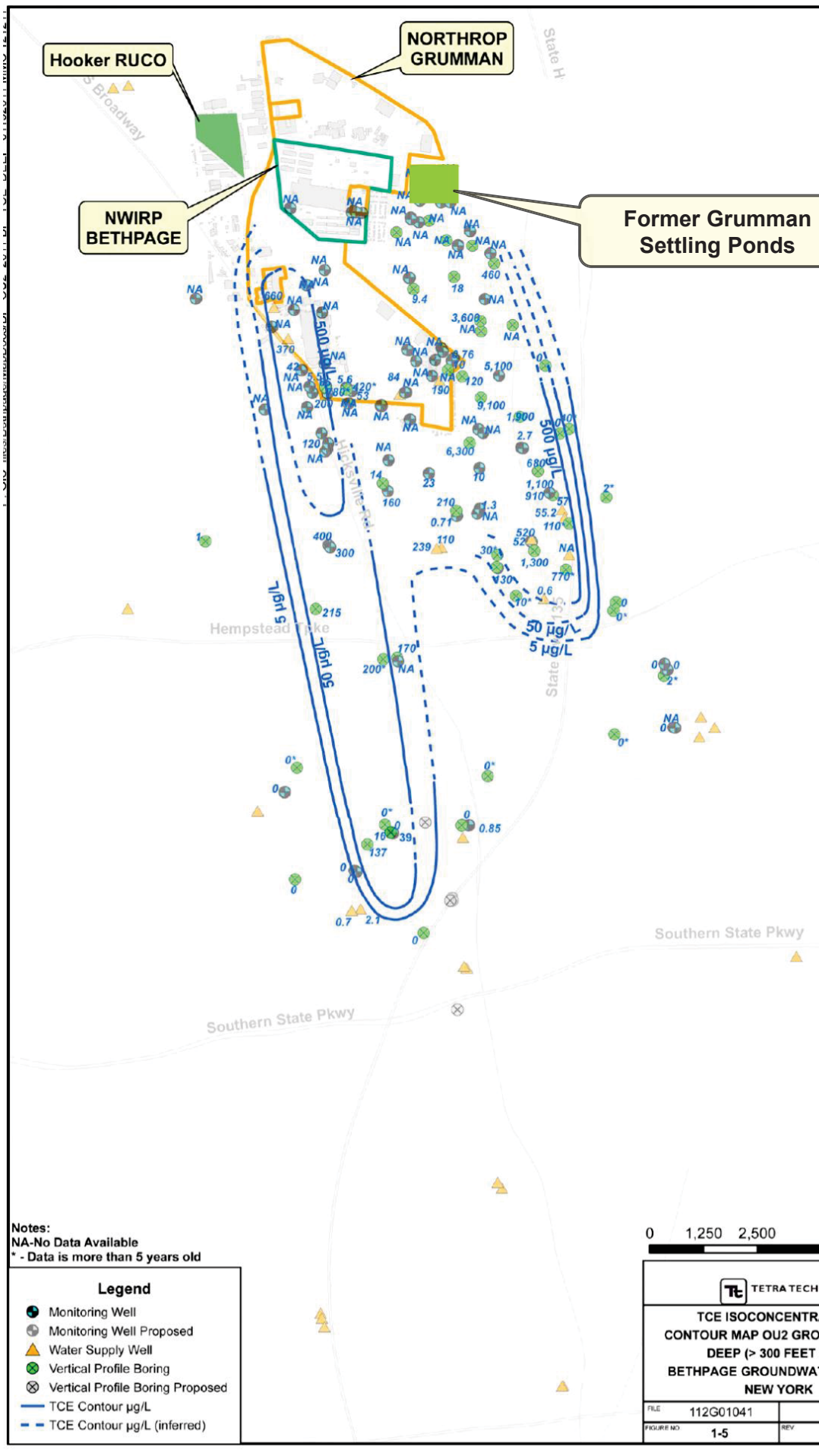
TETRA TECHNUS, INC.

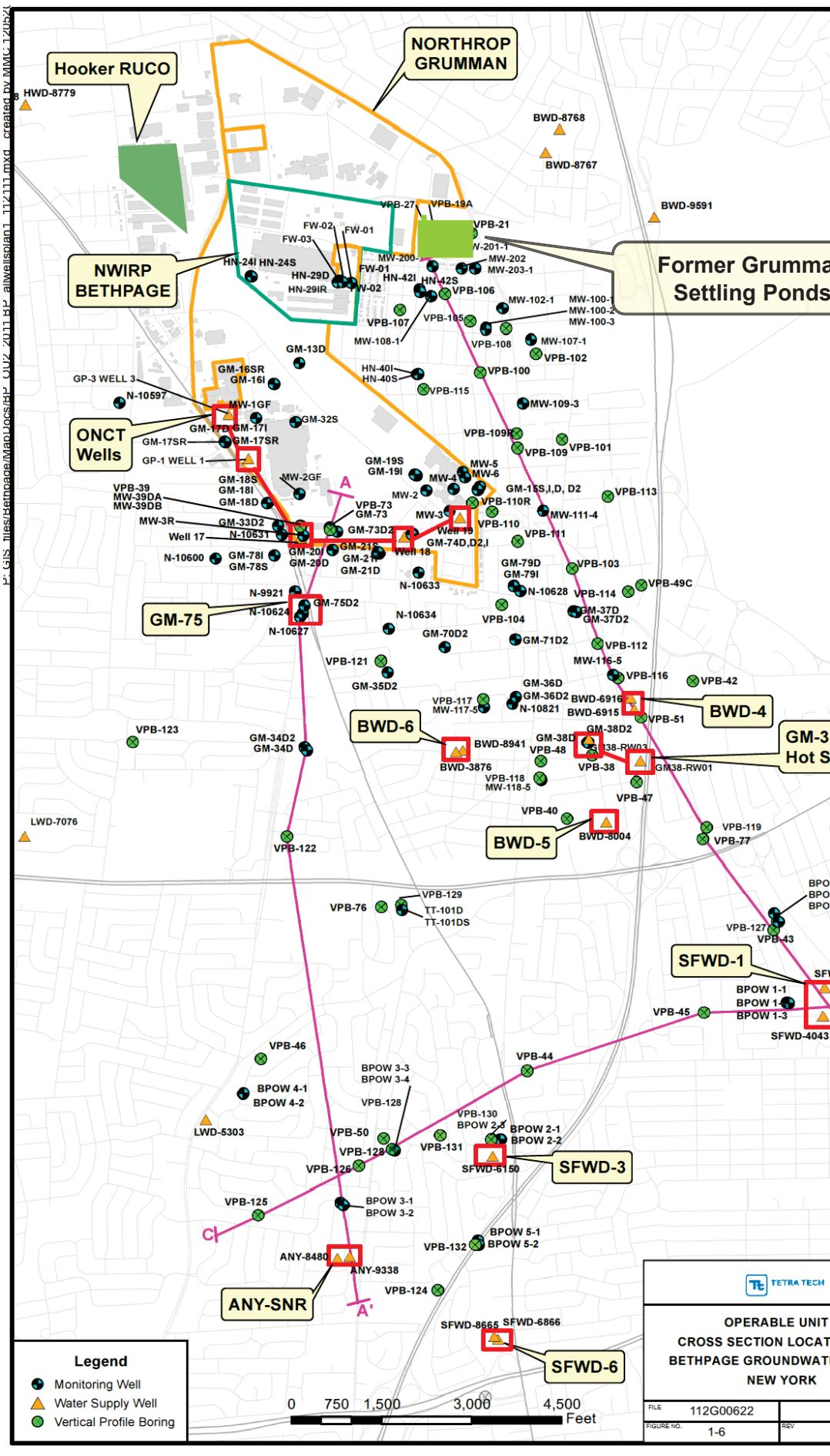
SITE LOCATION MAP
SITE 1
NWIRP
BETHPAGE, NEW YORK

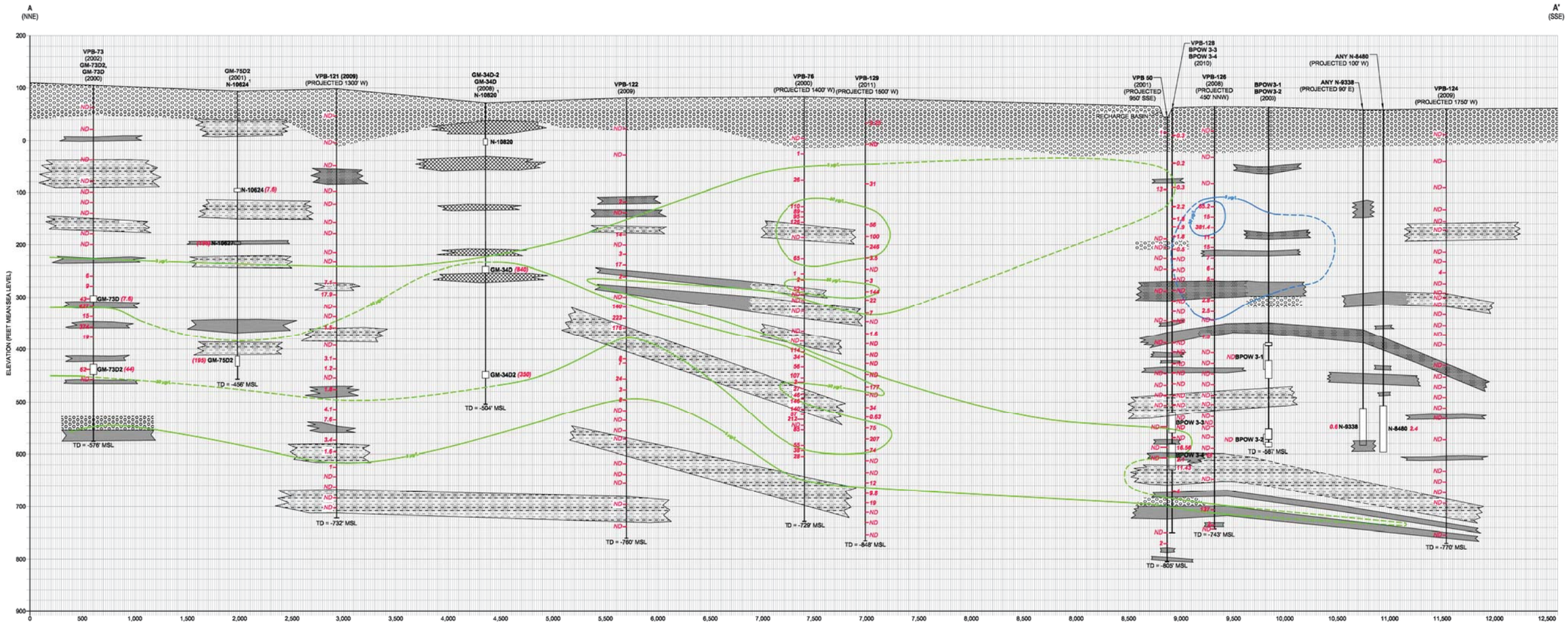
SCALE	AS NOTED
FILE	112G01687CM02
REV	0
DATE	04/14/09
FIGURE NUMBER	FIGURE 1-2

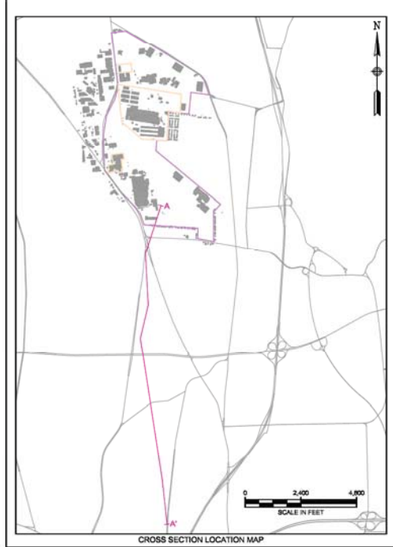

N
Hooker RUCO
NORTHROP GRUMMAN
NWIRP BETHPAGE
Former Grumman Settling Ponds
ONCT Wells
GM-75
BWD-6
BWD-4
GM-38 Hot Spot
BWD-5
SFWD-1
SFWD-3
ANY-SNR
SFWD-6
HWD-8779
BWD-8768
BWD-8767
BWD-9591
LWD-7076
LWD-5303
VPB-27
VPB-19A
VPB-21
FW-02
FW-01
FW-03
HN-24I
HN-24S
HN-29D
HN-29IR
MW-200-1
MW-202-1
MW-203-1
HN-42I
HN-42S
VPB-106
VPB-107
VPB-105
MW-102-1
MW-100-1
MW-100-2
MW-100-3
MW-108-1
VPB-108
MW-107-1
VPB-102
GM-13D
HN-40I
HN-40S
VPB-100
VPB-115
MW-109-3
GM-16SR
GM-16I
GP-3 WELL 3
N-10597
MW-1GF
GM-32S
GM-17D
GM-17I
GM-17SR
GM-17SR
GP-1 WELL 1
VPB-109R
VPB-109
VPB-101
GM-19S
GM-19I
MW-5
MW-6
MW-4
MW-2
GM-15S,I,D, D2
VPB-113
VPB-110R
MW-111-4
GM-18S
GM-18I
GM-18D
MW-2GF
VPB-73
GM-73
VPB-39
MW-39DA
MW-39DB
MW-3R
GM-33D2
N-10631
Well 17
MW-3
Well 19
VPB-110
GM-73D2
GM-74D,D2,I
VPB-111
GM-21S
Well 18
GM-20I
GM-20D
GM-21I
GM-21D
N-10600
GM-78I
GM-78S
N-10633
GM-79D
GM-79I
VPB-103
N-10628
VPB-114
VPB-49C
N-9921
GM-75D2
N-10624
N-10627
N-10634
VPB-104
GM-37D
GM-37D2
GM-70D2
GM-71D2
VPB-112
VPB-121
GM-35D2
MW-116-5
VPB-116
VPB-42
GM-36D
GM-36D2
N-10821
VPB-117
MW-117-5
BWD-6916
BWD-6915
VPB-51
VPB-123
GM-34D2
GM-34D
BWD-8941
BWD-3876
GM-38D
GM-38D2
VPB-48
VPB-38
GM38-RW01
VPB-118
MW-118-5
VPB-47
VPB-40
BWD-8004
VPB-119
VPB-77
VPB-122
VPB-129
VPB-76
TT-101D
TT-101DS
BPOW 1-4
BPOW 1-5
BPOW 1-6
VPB-127
VPB-43
SFWD-7377
BPOW 1-1
BPOW 1-2
BPOW 1-3
SFWD-5148
SFWD-4043
VPB-45
VPB-46
VPB-44
BPOW 3-3
BPOW 3-4
VPB-130
BPOW 4-1
BPOW 4-2
VPB-128
BPOW 2-3
VPB-50
VPB-131
BPOW 2-1
BPOW 2-2
VPB-128
SFWD-6150
VPB-126
VPB-125
BPOW 3-1
BPOW 3-2
BPOW 5-1
BPOW 5-2
VPB-132
ANY-8480
ANY-9338
VPB-124
SFWD-8665
SFWD-6866
Legend
Monitoring Well
Water Supply Well
Vertical Profile Boring
0
750
1,500
3,000
4,500
Feet
TETRA TECH
OPERABLE UNIT 2
SITE LAYOUT
BETHPAGE GROUNDWATER PLUME
NEW YORK
FILE 112G00622
SCALE AS NOTED
FIGURE NO. 1-3
REV
DATE 12/5/11


NORTHROP GRUMMAN
Hooker RUCO
NWIRP BETHPAGE
Former Grumman Settling Ponds
50 µg/L
500 µg/L
5 µg/L
Hicksville Rd
Hempstead Tpke
Southern State Pkwy
State Hwy 135
Notes:
NA-No Data Available
* - Data is more than 5 years old
Legend
Monitoring Well
Monitoring Well Proposed
Water Supply Well
Vertical Profile Boring
Vertical Profile Boring Proposed
TCE Contour µg/L
TCE Contour µg/L (inferred)
0 1,250 2,500
TETRA TECH
TCE ISOCONCENTRA
CONTOUR MAP OU2 GRO
SHALLOW (< 300 FEE
BETHPAGE GROUNDWA
NEW YORK
FILE 112G01041
FIGURE NO. 1-4
REV


Hooker RUCO
NORTHROP GRUMMAN
NWIRP BETHPAGE
Former Grumman Settling Ponds
500 µg/L
50 µg/L
5 µg/L
Hempstead Lake
Southern State Pkwy
Notes:
NA-No Data Available
* - Data is more than 5 years old
Legend
Monitoring Well
Monitoring Well Proposed
Water Supply Well
Vertical Profile Boring
Vertical Profile Boring Proposed
TCE Contour µg/L
TCE Contour µg/L (inferred)
0 1,250 2,500
TETRA TECH
TCE ISOCONCENTR
CONTOUR MAP OU2 GRO
DEEP (> 300 FEET
BETHPAGE GROUNDWA
NEW YORK
FILE 112G01041
FIGURE NO 1-5
REV


Hooker RUCO
NORTHROP GRUMMAN
NWIRP BETHPAGE
Former Grumma Settling Ponds
ONCT Wells
GM-75
BWD-6
BWD-4
BWD-5
SFWD-1
SFWD-3
SFWD-6
ANY-SNR
GM-3 Hot S
HWD-8779
BWD-8768
BWD-8767
BWD-9591
LWD-7076
LWD-5303
BWD-6916
BWD-6915
BWD-8941
BWD-3876
BWD-8004
SFWD-4043
SFWD-6150
SFWD-8665
SFWD-6866
ANY-8480
ANY-9338
A
A'
Legend
Monitoring Well
Water Supply Well
Vertical Profile Boring
0 750 1,500 3,000 4,500 Feet
TETRA TECH
OPERABLE UNIT
CROSS SECTION LOCAT
BETHPAGE GROUNDWAT
NEW YORK
FILE 112G00622
FIGURE NO. 1-6
REV





CROSS SECTION LOCATION MAP

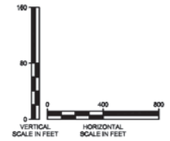
LEGEND

- SAND AND GRAVEL
- F-M SAND WITH VARYING AMOUNTS OF SILT, CLAY, AND C. SAND

CONFINING UNITS

- INTERBEDDED CLAY AND SAND
- SANDY CLAY
- CLAY
- CONFINING UNIT FROM ARCADIS CROSS-SECTION, NO SPECIFIC LITHOLOGY GIVEN
- 1 ARCADIS CROSS SECTION (2004)
- * TVOC DATA FROM ARCADIS

BPOW 3-2 — MONITORING WELL ID
(2003) — INSTALLATION YEAR
(PROJECTED 450'ESE) — PROJECTION
CONFINING UNIT (DASHED WHERE INFERRED)
MONITORING WELL SCREEN
374 — VERTICAL PROFILE BORING TVOC RESULTS IN ug/L
ND — NOT DETECTED
TOTAL VOC PLUME CONTOUR LINE
PCE PLUME CONTOUR LINE
TOTAL DEPTH (MEAN) SEA LEVEL

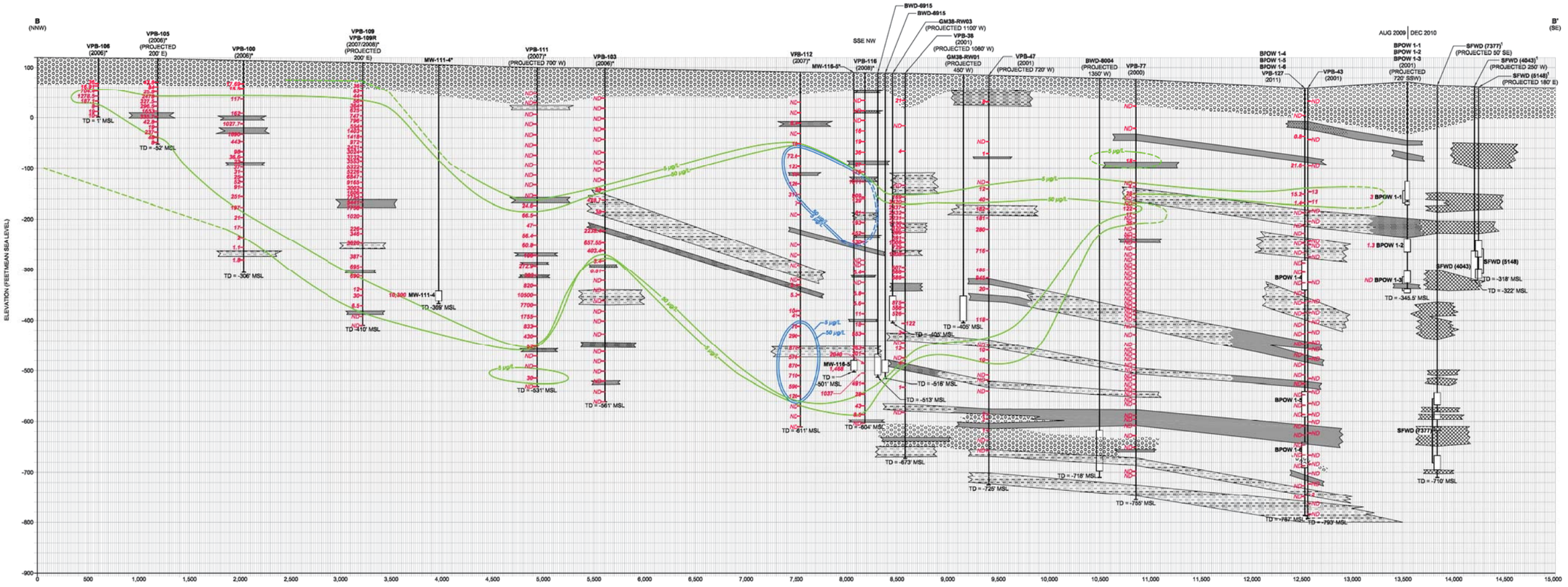


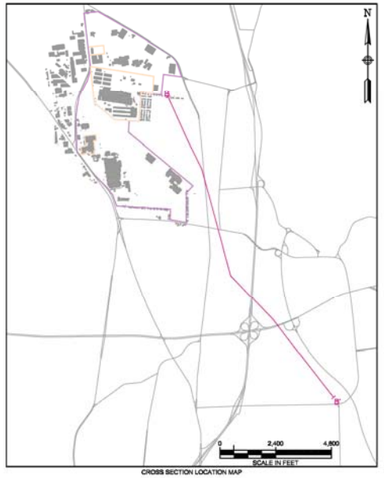
TETRA TECH NUS, INC.

CROSS SECTION A – A'
BETHPAGE GROUNDWATER PLUME
BETHPAGE, NEW YORK

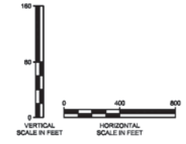
FILE	SCALE
112G01041GS24	AS NOTED
FIGURE NUMBER: FIGURE 1–7	REV: 0 — DATE: 12/21/11

112G01041/0275/112G01041GB37.dwg 12/06/11 MKB





CROSS SECTION LOCATION MAP



LEGEND

- SAND AND GRAVEL
- F-M SAND WITH VARYING AMOUNTS OF SILT, CLAY, AND C. SAND

CONFINING UNITS

- INTERBEDDED CLAY AND SAND
- SANDY CLAY
- CLAY
- CONFINING UNIT FROM ARCADIS CROSS-SECTION, NO SPECIFIC LITHOLOGY GIVEN

1 ARCADIS CROSS SECTION (2004)

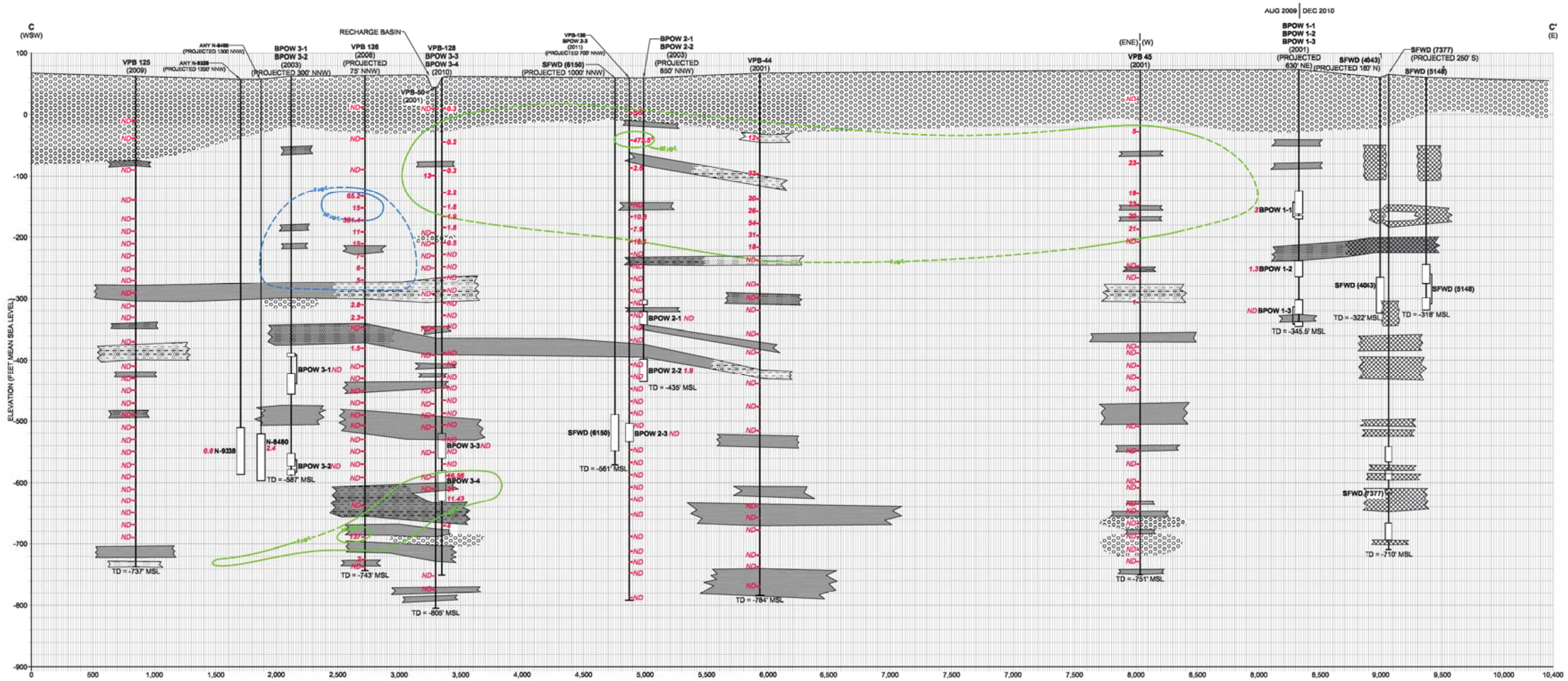
* TVOC DATA FROM ARCADIS

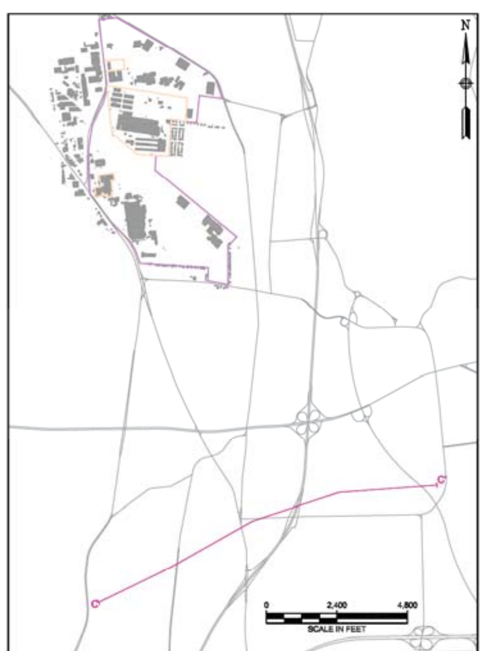
BPOW 3-2 — MONITORING WELL ID
(2003) — INSTALLATION YEAR
(PROJECTED 450 ESE) — PROJECTION
CONFINING UNIT (DASHED WHERE INFERRED)
MONITORING WELL SCREEN
374 — VERTICAL PROFILE BORING TVOC RESULTS IN ug/L
ND — NOT DETECTED
TOTAL VOC PLUME CONTOUR LINE
PCE PLUME CONTOUR LINE
TD = -743' MSL. — TOTAL DEPTH (MEAN) SEA LEVEL.

TETRA TECH NUS, INC.

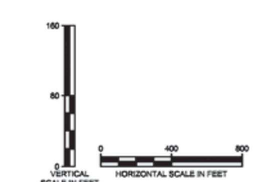
CROSS SECTION B – B'
BETHPAGE GROUNDWATER PLUME
BETHPAGE, NEW YORK

FILE	SCALE
112G01041GS37	AS NOTED
FIGURE NUMBER: FIGURE 1–8	REV: 0 — DATE: 12/15/11





CROSS SECTION LOCATION MAP



LEGEND

- SAND AND GRAVEL
- F-M SAND WITH VARYING AMOUNTS OF SILT, CLAY, AND C. SAND

CONFINING UNITS

- INTERBEDDED CLAY AND SAND
- SANDY CLAY
- CLAY
- CONFINING UNIT FROM ARCADIS CROSS-SECTION, NO SPECIFIC LITHOLOGY GIVEN
- 1 ARCADIS CROSS SECTION (2004)
- • TVOC DATA FROM ARCADIS

BPOW 3-2	MONITORING WELL ID
(2003)	INSTALLATION YEAR
(PROJECTED 450' ESE)	PROJECTION
	CONFINING UNIT (DASHED WHERE INFERRED)
BPOW 3-2	MONITORING WELL SCREEN
374	VERTICAL PROFILE BORING TVOC RESULTS IN µg/L
ND	NOT DETECTED
473.5 [2]	BENZENE DETECTED AT 440 µg/L
	TOTAL VOC PLUME CONTOUR LINE
	PCE PLUME CONTOUR LINE
TD = -743' MSL	TOTAL DEPTH (MEAN) SEA LEVEL

TETRA TECH NUS, INC.

CROSS SECTION C – C'
BETHPAGE GROUNDWATER PLUME
BETHPAGE, NEW YORK

FILE	SCALE	
112G01041GS25	AS NOTED	
FIGURE NUMBER: FIGURE 1–9	REV: 0	DATE: 12/15/11

P: GIS files/Bethpage/MapDocs/BP_OU2_2011/BP_alt3_110911 created by MMC 12072011

N

Suffolk County
Nassau County

I-495

Anchor Chemicals

Northrop Grumman

Former Grumman Settling Ponds

State Hwy 135

Claremont Polychemical

Old Bethpage Landfill

Hooker Ruco

NWIRP Bethpage

TBG Cogen Partners

Liberty Industrial Finishing

Kenmark Textile Corp

LWD

BWD No. 6 - 6-1, 6-2

BWD No. 4 - 10,11

TCE Shallow

Farmingdale Plaza Cleaners

BWD No. 5 5-1

Hempstead Tpke

American Drive-In Cleaners

LWD

SFWD No. 1 - 1-2, 1-3, 1-4

SFWD No. 3 - 3-1

ANY-SNR 3S, 4S

SFWD No. 6 - 6-1, 6-2

Southern State Pkwy

SFWD No. 4 - 4-1

Wantagh Cleaners

TCE Deep

MWD - 4, 5

ANY - 4D, 5D, 6D

ANY - 6M, 7M, 8M

MWD - 6, 7

MWD - 9

Sunrise Hwy

SOUTH OYSTER BAY

Legend

- Dry Cleaner
- Gas Station
- Water Supplies that may be impacted
- Water Supplies with treatment pending
- Water Supplies with treatment in place
- Other Public Water Supply Well
- Major Streets
- TCE DEEP 5 µg/L
- TCE SHALLOW 5 µg/L
- Recharge_Basins
- Superfund/NPL
- Other Plumes
- Water Districts
- 1997 Northrop Grumman
- 1997 NWIRP Bethpage

0 0.5 1 2 Miles

TETRA TECH

OTHER POTENTIAL SOURCES OF GROUNDWATER CONTAMINATION BETHPAGE GROUNDWATER PLUME NEW YORK

FILE	112G02019	SCALE	AS NOTED
FIGURE NO.	1-10	REV	DATE 12/7/11

2.0 EVALUATION OF ALTERNATIVES

In this study, the range of options for managing the Bethpage Plume are outlined as follows:

- Alternative 1 – Continued implementation of OU-2 ROD Remedy (on-site source containment, off-site hot-spot treatment, off-site plume monitoring, and wellhead treatment at impacted supply wells)
- Alternative 2A – Continued implementation of OU-2 ROD remedy and sustained pumping in strategic supply wells (year-round pumping in BWD 6-2 and ANY-SNR, especially in winter months)
- Alternative 2B – Plume containment near its downgradient edge (capture of VOC-impacted groundwater by a new pump-and-treat system)
- Alternative 2C – Hydraulic containment near downgradient edge of the plume (capture of all groundwater within eastern and western boundaries of plume by a new pump-and-treat system)
- Alternative 3 – Continued implementation of OU-2 ROD remedy and accelerated implementation of wellhead treatment at potentially impacted supply wells in the projected path of the plume.

These alternatives were examined with respect to their technical feasibility and cost. Under technical feasibility, each alternative was examined with respect to its expected outcome for the protection of water supplies, its advantages, and its disadvantages. For the cost estimates, only the incremental costs (costs incurred beyond this point in time) were accounted in each alternative. Remediation costs incurred in the past were not included in this study. This assumption is consistent with the study objective, which is to facilitate path-forward decisions based on a comparison of the alternatives. Also not included are the costs of continued operation and maintenance (O&M) of the ONCT (OU-2), the ongoing OU-2 groundwater monitoring, the ongoing GM-38 treatment, the already-installed or already-in-progress wellhead treatment (in BWD Plants 4, 5, and 6, in ANY-SNR, and in SFWD Plants 1 and 3), and any source or plume control measures in non-OU-2 sources (e.g., the IRM in OU-3, the OU-3 hot-spot treatment being evaluated by NYSDEC, etc.), as these costs are common across all the alternatives.

Both total (undiscounted) and present value (PV) costs were calculated. A discount rate of 2.3% based on current Office of Management and Budget (OMB) guidelines was used. Costs were modeled over 50 years for each alternative. The Remedy Optimization Team (Harre, 2011) had estimated that VOC impacts to downgradient supply wells could occur sometime between the next 10 to 40 years, assuming the plume continues to migrate at the same rate it has in the past. A 50-year time period allows the Navy to capture this range of time in the PV analysis.

A related option for local groundwater management unrelated to plume containment was identified, but not fully evaluated in this study. This option involves the feasibility of replacing the water supply from VOC-impacted wells with water from other water resources in the area. This could potentially be done

either by tapping into other existing (but un-impacted) water supplies or by installing new water supply wells in un-impacted portions of the aquifer. Conceptually, new water supply wells could be installed in surrounding areas and the water piped to central hubs located close to the existing water supply plants. However, an examination of the areas surrounding the Bethpage Plume (see Figure 1-10 in Section 1) could not clearly identify a portion of the aquifer that was potentially un-impacted by contaminants and likely to remain so, given the large number and wide distribution of actual and potential contaminant sources (such as Superfund sites, dry cleaners, gas stations, etc.). It was not evident that areas likely to remain un-impacted over the longer term could be located for new water supply wells. A much more extensive and intensive study of this issue would be required to determine if this alternative would even be feasible.

2.1 ALTERNATIVE 1 – CONTINUED IMPLEMENTATION OF OU-2 ROD REMEDY

2.1.1 Description

In Alternative 1, the current OU-2 ROD remedy would continue. The main elements of the ongoing remedy are:

- Continued operation of existing ONCT System for containment of OU-2 source areas. The ONCT would be evaluated and modified, if necessary, to further control offsite migration of VOC-impacted groundwater.
- Consideration of off-site hot-spot treatment, if feasible, for portions of the plume that consistently exceed 1 ppm of total VOCs. Currently the Navy is evaluating the need for off-site hot spot treatment for OU-2 (upgradient of BWD 6-2) and this item is included in the cost for Alternative 1.
- Continued plume delineation to monitor plume migration and attenuation, using additional vertical profile borings and monitoring wells. Continued installation and monitoring of outpost wells, as necessary, to assess impending impacts to supply wells. For cost estimation purposes, a total of 24 additional vertical profile borings and 44 additional monitoring wells are assumed in the next 3 years.
- Installation of wellhead treatment at water supply wells, based on outpost monitoring well results and comparison to trigger values,
- Additional detail on the development of this Alternative is presented in Appendix A.

Figure 2-1 shows the currently understood extent of the VOC-impacted groundwater, the water supply wells that currently have wellhead treatment for VOCs, the water supply wells with wellhead treatment systems in the design phase, and the water supply wells that could potentially be impacted in the future.

The cost estimation for Alternative 1 assumes that wellhead treatment for VOCs would eventually be required for each of the 8 downgradient well fields and 15 wells that are currently un-impacted and do not

have VOC treatment currently installed or in progress. This alternative conservatively assumes that three well fields (four supply wells) would be impacted in 10 years, two well fields (five supply wells) would be impacted in 15 years, and three well fields (six wells) would be impacted in 25 years. Backup groundwater test results and estimated long-term mean concentrations of VOCs in the groundwater are presented in Appendix B. A typical treatment process flow diagram and layout using liquid vapor granular activated carbon (GAC) is provided in Figures 2-2 and 2-3, respectively.

2.1.2 Technical Feasibility

With Alternative 1, the expected outcomes would be as follows:

- On-site pump-and-treat systems (ONCT and IRM) would continue to contain migration of VOCs from upgradient source areas to the off-site plume.
- The off-site hot spot treatments (in OU-2 and OU-3) would further reduce migration of the off-site plume by removing VOC mass from the aquifer.
- Fortuitous capture of VOC mass in BWD and ANY-SNR supply wells would further reduce migration of the off-site plume by removing VOC mass from the aquifer.
- The strength of the off-site plume would continue to attenuate with distance through various mechanisms, such as advection-dispersion, diffusion into clay lenses, and degradation. Attenuation of plume strength with distance is apparent in wells along the length of the plume. Cross-section C-C' (Figure 1-9) shows a much weakened profile of VOC mass, compared to profiles of the plume near the BWD supply wells or, further upgradient, near the on-site containment wells.
- The above four outcomes will reduce (but not eliminate) the probability and/or the strength of impacts to downgradient supply wells. Wellhead treatment may still be required in downgradient (currently unimpacted) supply wells, if the low stated goal (0.5 µg/L) is exceeded in these wells, at some time in the future. The Remedy Optimization Team estimated that impacts to the nearest water supply wells (downgradient from the current leading edge of the plume) could occur in approximately 20 years (or in a range of 10 to 40 years) if the plume were to continue to migrate at the rate it has in the past. Although this is a simple calculation, sophisticated modeling has not provided any more reliable estimates in the past, either at this site or at other sites (Konikow, 2010; Eggleston and Rojstaczer, 2000; Payne et al., 2008). An additional 15 supply wells in the projected path of the plume may require wellhead treatment (in addition to wellhead treatment that is already installed or in progress).
- The Remedy Optimization Team has recommended additional vertical profile borings and new monitoring wells near the leading edge of the plume and in further downgradient areas. Eventually, this additional characterization would form the basis of an improved early warning system for plume migration through more monitoring and outpost wells.
- The Remedy Optimization Team has recommended that outpost wells be screened at multiple depths. This would increase the probability of detecting plume migration.

- The Remedy Optimization team has recommended additional delineation and aggressive containment of the off-site OU-3 hot spot. This would further mitigate the impacts to the downgradient plume.
- The Remedy Optimization Team has recommended additional investigation of VOC impacts immediately downgradient of the on-site containment systems at OU-2 and OU-3 to evaluate the possibility of impacted groundwater flow under or around the current containment. This investigation and any resulting strengthening of the on-site containment would further mitigate the impacts to the downgradient plume.

The advantages of Alternative 1 would be as follows:

- All water supplies (upgradient and downgradient of the plume's leading edge) would remain protected by wellhead treatment.
- Improvements recommended by the Remedy Optimization Team would lead to improvements in plume tracking and early warning of impending impacts.
- The on-site containment systems are already capturing substantial VOC mass and considerably reducing VOC migration to the off-site aquifer. The hot spot treatment systems that are in place or are being evaluated in OU-2 and OU-3 are likely to further capture VOC mass and reduce plume migration. There is also fortuitous and substantial plume capture already occurring in impacted supply wells and their associated treatment plants. All this capture substantially reduces the risk of downgradient migration.
- Under Alternative 1, the response appears commensurate with the spatial distribution of risk. Spatially, the majority of the VOC impacts in the plume profile at its leading edge (Figure 1-9) are in the shallower aquifer zones (less than 300 feet bgs), mostly in the central and eastern portions of the plume. Except for supply well ANY-4D (5767), which is screened to a depth of 385 feet bgs and is potentially to the west of a possible plume migration pathway, all supply wells downgradient of the current leading edge of the plume are screened in much deeper zones (492 feet bgs and deeper). At these greater depths, the only known VOC impacts at the leading edge are one or two small plume fingers of low to moderate concentrations near ANY-SNR (approximately 650-750 feet bgs) (Figure 2-1). Therefore, under Alternative 1, the risk to downgradient supply wells is currently understood to be limited primarily to relatively low concentrations of VOCs in a small portion of the deeper aquifer zone near ANY-SNR.
- For a large and deep plume where relatively high costs are involved in every incremental remedial action, Alternative 1 represents a measured approach that is commensurate with the nature and timing of the risk posed by the plume to downgradient supply wells. Given the relatively low concentrations of VOCs seen in vertical profile borings near the current leading edge of the plume and the ongoing capture in on-site containment and supply wells, Alternative 1 provides the flexibility to allocate resources commensurate with a series of uncertain outcomes (uncertainty whether or not [or when] any given downgradient supply well will be impacted).

- Alternative 1 is consistent with the strategy followed by many other sites across the U.S. for similarly large and deep plumes (see Section 3.2). Containment of on-site sources, monitoring of off-site plume migration, and wellhead treatment at impacted supply wells are a common strategy for addressing large, deep, and complex plumes at similar sites across the U.S. Examples of such sites include the City of Las Cruces site in New Mexico, City of Pasadena site in California, and the City of New Brighton in Minnesota. Experiences at these sites are discussed in Section 3.2. The uncertainties in the outcomes and high costs of other remedial options have led many similar sites to some variation of the Alternative 1 remedy. The Bethpage Plume is deeper, wider, longer, and more complex than the other "deep" sites studied (see Section 3.2).

Potential disadvantages of Alternative 1 would be as follows:

- The plume may continue to migrate downgradient, although in a much weakened state (weakened by on-site containment, off-site hot spot treatment, fortuitous capture by currently impacted supply wells, and attenuation with distance).
- Although the fortuitous capture occurring in the impacted supply wells substantially reduces plume migration, these wells don't operate continuously through the year. During winter months, when customer demand is low, strategic supply wells stop operating.
- Alternative 1 would not eliminate the need for future enhancements to the ongoing on-site containment, if additional investigations (as recommended by the Remedy Optimization Team), indicate that flow bypass is occurring.
- Alternative 1 does not eliminate the need for off-site hot spot treatment, if required and feasible, as seen from efforts underway at GM-38 and OU-3.

2.1.3 Cost

The cost estimation process for Alternative 1 is described in Appendix D. Assumptions and backup calculations are provided in Appendix A. Alternative 1 has an estimated total cost of $254,000,000 and present value of $151,000,000, as summarized in Table 2-1. The three major cost drivers in this scenario are the wellhead treatment that may be required in downgradient supply wells, the off-site hot spot treatment being evaluated for OU-2, and the additional characterization that will be required for tracking plume migration.

Table 2-1. Cost Estimates for Alternative 1

Cost Item	Cost	Notes
Capital investment • Additional monitoring wells installed, $7,300,000 • Off-site hot spot treatment, extraction well upgradient of BWD 6-2 and associated treatment plant and water discharge infrastructure, $19,000,000 • Wellhead treatment at 15 downgradient supply wells, $77,000,000	$103,000,000	Additional monitoring infrastructure installed over 3 years (24 VPBs and 44 MWs). Off-site hot spot treatment infrastructure installed in 2 years Wellhead treatment installed at 4 wells after 10 years, another 5 wells after 15 years, and remaining 6 wells after 25 years.
Annual O&M • Additional monitoring, for 50 years • Off-site hot spot treatment in OU-2 upgradient of BWD 6-2, for 48 years • Wellhead treatment, 25 to 40 years	$141,000/year $702/000/year $204,000 to $475,000/year - unit	Costs are variable based on activities conducted in each year. Depending on influent VOC concentrations, well head treatment costs consist of GAC or a combination of GAC and Air Stripping
Total Cost (50 years, undiscounted)	**$254,000,000**	
Present Value (50 years, discount rate of 2.3%)	**$151,000,000**	

Table 2-1 does include estimates for the treatment being evaluated for a hot-spot upgradient of supply well BWD 6-2. The cost estimates do not include costs associated with operation, maintenance, and monitoring of the existing ONCT, GM-38 hot spot, currently installed or in progress VOC treatment plants at supply wells (BWD Plants 4, 5, and 6, SFWD Plant 1 and 3, and ANY-SNR), and the existing monitoring well network. They also do not include potential costs associated with any future upgrades at the ONCT. In addition, they do not include the costs incurred in addressing other (non-OU-2) sources (e.g., the IRM at OU-3, the hot-spot treatment being evaluated for the OU-3 plume, etc.). These are all assumed to be cost items common to all the alternatives.

2.2 ALTERNATIVE 2A– CONTINUED IMPLEMENTATIONOF OU-2 ROD REMEDY AND SUSTAINED PUMPING IN STRATEGIC SUPPLY WELLS

2.2.1 Description

Alternative 2A is similar to Alternative 1, but also includes the following items aimed at opportunistic pumping in strategic supply wells (see Figure 2-4) to enhance plume capture:

- Operation of BWD Plant 6, Well 6-2 (8941) would be sustained year round to further reduce downgradient migration of VOCs. Currently, BWD Well 6-2 (completed to 775 feet bgs, 1,200 gpm or 630 million gallons per year [MG/Yr] capacity) operates in an on- or off-mode. It is turned on mostly

in the summer and is turned off (or operated less frequently) in winter, when customer demand falls. In Alternative 2A, this supply well would continue to operate all year, representing an annual volume pumped equal to approximately 90% of its total annual capacity, instead of the current 30%. There would be the equivalent of a net increase of 380 MG/Yr of pumping over the current estimated capacity utilization of 190 MG/Yr for customer demand. For cost estimation, Alternative 2A assumes that the excess water (above customer demand) would be purchased from the water district and discharged to local recharge basins located within the BWD distribution network. Optionally, the possibility of the water district using the excess production from BWD Well 6-2 to fulfill customer demand by cutting production in other wells can be explored. With TCE concentrations reported by BWD to be approaching or exceeding 1 ppm in this well in recent monitoring, maximizing its pumping rate would be an opportunity to enhance the capture of a strategic section of the plume. Preliminary calculations (see Appendix C) show that BWD 6-2, which has a rated capacity of 1,200 gpm, can exert a relatively wide capture zone (potentially as much as 5,000 feet wide, based on Appendix C calculations) and may be in a position to capture groundwater from both OU-2 and OU-3 plumes. Completed to a depth of 775 feet bgs, this well is the deepest of the supply wells in the current plume footprint and is therefore in a position to capture any VOCs migrating through the highly conductive gravel zone, identified at the base of the Magothy in recent borings.

- Operation of ANY-SNR would be sustained year round to further reduce downgradient migration of VOCs. Supply well cluster ANY-SNR consists of two wells ANY #3S (8480; 680 feet bgs, 2,100 gpm capacity) and ANY#4S (9338, 650 feet bgs, 2,100 gpm capacity), with a total capacity of 4,200 gpm (2,200 MG/Yr). This well cluster currently withdraws approximately 30% of its total capacity in a year to meet customer demand (660 MG/Yr). In Alternative 2A, Well #3S would be pumped year round, representing an increase in total annual water volume withdrawn to approximately 50% of its annual capacity (1,100 MG/Yr). This could be done by pumping one of the two wells 100% of the time and is the equivalent of pumping the ANY-SNR at an additional 420 MG/Yr above the assumed average customer demand. Alternative 2A assumes that the excess water (above customer demand) would be purchased from the water district and discharged to a combination of recharge basins and reinjection wells. Optionally, the possibility of the water district using the excess production from ANY-SNR to fulfill customer demand by cutting production in other wells can be explored. Additional characterization and flow modeling would be required to see which of the two wells in this cluster is better positioned to capture the deep plume fingers apparent in Figures 2-4 and 1-9. Additional detail on the development of this Alternative is presented in Appendix A.

Figure 2-4 shows these two water supply wells. Potential discharge points for excess water would occur in suitable existing recharge basins that are in areas served by BWD or ANY and that are far enough cross-gradient from the extraction well (outside the influence of the extraction). Selection of the recharge basins would have to consider the capacity of the existing distribution piping and basins and the potential for recharge to affect plume capture and migration. In essence, Alternative 2A would opportunistically increase plume capture during winter months, which is the time of the year when plume capture by

strategic supply wells is otherwise low. Treatment of the captured VOCs would occur through investments in wellhead treatment that have already been made under the current ROD. It is possible that the ANY-SNR facility would have to be upgraded with pre-treatment by air stripping for Well No. 3S in Year 10, a cost estimation assumption under Alternative 2A. Unlike Alternative 1, Alternative 2A does not include hot spot treatment in OU-2, upgradient of BWD 6-2 because sustained pumping in BWD 6-2 would fulfill that role.

For present value cost estimates, Alternative 2A assumes that three well fields (four wells) would be impacted in 10 years, two well fields (five wells) would be impacted in 20 years, and three well fields (six wells) would be impacted in 30 years. By comparison, in Alternative 1, the impacts were assumed to occur in 10 years (four wells), 15 years (five wells), and 25 years (six wells). The difference in timing reflects the reduced probability of impacts to downgradient supply wells in Alternative 2A due to the increased plume capture in strategic supply wells.

2.2.2 Technical Feasibility

With Alternative 2A, the expected outcomes would be as follows:

- Several outcomes from Alternative 2A would be similar to the ones from Alternative 1:
  - On-site pump-and-treat systems (ONCT and IRM) would continue to contain migration of VOCs from upgradient source areas to the off-site plume.
  - Off-site hot spot containment being evaluated in OU-3 would further reduce migration of the off-site plume by removing VOC mass from the aquifer.
  - Impacted supply wells (in BWD and ANY-SNR) would continue to fortuitously capture portions of the plume, although under current conditions, capture is limited during winter months.
  - The strength of the off-site plume would continue to attenuate with distance through various mechanisms.
  - The Remedy Optimization Team's recommendations for an improved early warning system, screening of outpost wells at multiple depths, additional investigation of the effectiveness of the on-site containment systems at OU-2 and OU-3, and more aggressive containment of the off-site OU-3 hot spot would further mitigate the impacts to the downgradient plume.
- Increased and fortuitous capture of VOC mass in BWD 6-2 and ANY-SNR supply wells (especially during winter months) would further reduce migration of the off-site plume (compared to Alternative 1) by more efficiently reducing VOC migration.
- The above two outcomes would reduce (but not eliminate) the probability and/or the strength of impacts to downgradient supply wells. Wellhead treatment may still be required in downgradient (currently un-impacted) supply wells, if the low stated goal (0.5 µg/L) is exceeded at some time in the future. For discussion purposes in this study, VOC impacts are assumed to be delayed compared to Alternative 1, and would occur after 10 years in four of the downgradient supply wells, after 20 years

in another five supply wells, and after 30 years in the remaining six wells (as compared to 10, 15, and 25 years, respectively, in Alternative 1).

The advantages of Alternative 2A would be as follows:

- As with Alternative 1, there would be several similar advantages with Alternative 2A:
  - All water supplies (upgradient and downgradient of the plume's leading edge) would remain protected by wellhead treatment.
  - Improvements recommended by the Remedy Optimization Team would lead to improvements in plume tracking and early warning of impending impacts.
- The additional plume capture in strategic supply wells would further reduce the probability of VOC impacts to downgradient supply wells, as compared to Alternative 1. Considerable and fortuitous capture of the plume is already occurring under Alternative 1, except during winter months, when customer demand is low and key supply wells can be shutdown. Alternative 2A would fill this temporal gap in the fortuitous capture by the supply wells. In conjunction with ongoing plume capture in the on-site containment systems and hot-spot treatment, the increased plume capture in strategically located supply wells would represent a substantial reduction in the probability of impacts to downgradient supply wells.
- Enhanced capture of the plume in strategic water supply wells is a measure that could be deployed fairly rapidly because much of the infrastructure (namely, wellhead treatment) has already been installed under the current ROD. This part of the Alternative 2A remedy is the quickest action possible among all the enhanced containment options (2A, 2B, and 2C) evaluated in this study and potentially provides the greatest incremental benefit (reduced probability of VOC impacts to downgradient water supply wells) for the incremental costs incurred. Other sites too have recognized this speed of deployment and favorable cost-benefit tradeoff. For example, the City of North Hollywood (California), estimated that additional characterization, planning, modeling, design, installation, and deployment of a new plume containment system would take 4 years from the time of the decision (ROD) and therefore opted for plume capture in water supply wells as an immediate action that would reduce downgradient migration and make beneficial use of the water by treating it down to MCLs and supplying it to customers (EPA Region 9, 2009; EPA Region 9, 2008).
- No additional real estate would have to be purchased to house the components of 2A. Piping for discharge of excess water pumped in BWD 6-2 and ANY-SNR will be run through public land.
- Sustained pumping in BWD-6-2 has the potential to increase the capture of substantial portions of deeper VOCs emanating from OU-2, OU-3, or both; especially any VOCs migrating through the higher permeability gravel zone at the base of the Magothy. Additional characterization and flow modeling would be required to determine the source of VOCs in BWD 6-2, to determine more exactly the horizontal and vertical capture zones of BWD 6-2, and to determine the capture zones of GM-38 and RW-21 (new extraction well being evaluated by NYSDEC for OU-3 hot spot containment).

Together, these three wells (BWD 6-2, GM-38, and RW-21) have the potential to capture substantial VOC mass in multiple horizontal and vertical segments of the plume.

- Alternative 2A is a measured response to the risk currently apparent at the plume's leading edge in cross-section C-C' (Figure 1-9). Spatially, the majority of the VOC impacts in the plume profile at its leading edge (Figure 1-9) appear to be in the shallower aquifer zones (less than 300 feet bgs), mostly in the central and eastern portions of the plume. Except for supply well ANY-4D (5767), which is screened to a depth of 385 feet bgs and is potentially to the west of a possible downgradient plume migration pathway, all supply wells downgradient of the current leading edge of the plume are screened in much deeper zones (492 feet bgs and deeper). At these greater depths, the only known VOC impacts at the leading edge are one or two small plume fingers of low to moderate concentrations near ANY-SNR (approximately 650-750 feet bgs) (Figure 2-4). Therefore, the risk to downgradient supply wells is currently understood to be limited to relatively low concentrations of VOCs in a small portion of the deeper aquifer zone near ANY-SNR. Alternative 2A targets this risk in an efficient manner.
- For a large and deep plume where substantial costs are involved in every incremental remedial action, Alternative 2A represents a measured incremental action over Alternative 1 that is commensurate with the nature and timing of the risk posed by the plume to downgradient supply wells. Alternative 2A enhances the ongoing plume capture in already impacted wells, using existing extraction well and treatment plant infrastructure. The capital investment in installing VOC treatment in BWD 6-2 and ANY-SNR has already been made under the current ROD and Alternative 2A leverages this existing infrastructure for protecting downgradient wells. Therefore, Alternative 2A represents a measured incremental response in the face of uncertain outcomes (uncertainty whether or not [or when] any given downgradient supply well will be impacted).
- The use of wellhead treatment at impacted supply wells to enhance plume capture is consistent with the strategy for addressing large, deep, and complex plumes adopted at similar sites across the U.S. Examples of such sites include the City of Las Cruces site in New Mexico, the City of Pasadena site in California, and the City of New Brighton in Minnesota. Experiences at these sites are discussed in Section 3.2. The uncertainties in the outcomes and high costs of other remedial options have led many similar sites to some variation of the Alternative 2A remedy. In comparison to these sites, the Bethpage Plume is deeper, wider, longer, and more complex. At all the above mentioned sites, the pumping and wellhead treatment in existing supply wells is the major or only plume migration control employed. For the last several years, the water withdrawn at these sites is being treated to meet MCLs (typically 5 µg/L for TCE or PCE) and then distributed to customers directly or after blending with water from un-impacted wells (see Section 3.2 for a description of these sites).
- The added cost of the piping infrastructure for excess water disposal and the operation and maintenance (O&M) involved in longer operation of BWD 6-2 and ANY-SNR (and disposal of the excess water) could theoretically be offset, if the probability of VOC impacts to downgradient supply wells would get reduced or if the impacts would get pushed back in time.

Potential disadvantages of Alternative 2A would be as follows:

- The plume could continue to migrate downgradient, although in a much weakened state (weakened due to the on-site containment, off-site hot spot treatment, the enhanced capture by currently impacted supply wells, and attenuation with distance). New plume fingers could develop over time along the current leading edge of the plume (C-C' cross-section) and could go undetected and/or un-captured over time.
- Added cost (capital investment and O&M) would be involved in the piping and other infrastructure associated with discharge of excess water withdrawn from BWD 6-2 and ANY-SNR.
- Alternative 2A does not eliminate the need for future enhancements to the ongoing on-site containment, if additional investigations (as recommended by the Remedy Optimization Team), indicate that flow bypass is occurring.
- Alternative 2A may not eliminate the need for off-site hot spot treatment in some parts of the plume, such as GM-38 and OU-3.

2.2.3 Cost

The cost estimation process for Alternative 2A is described in Appendix D. Assumptions and backup calculations are provided in Appendix A. Alternative 2A has an estimated total cost of $229,000,000 and a present value of $130,000,000, as summarized in Table 2-2. The two major cost drivers in this scenario are the wellhead treatment that may be required in downgradient supply wells and the additional characterization that will be required for tracking plume migration. If the water districts involved (BWD and ANY) could use the excess water pumped during winter months by balancing this excess with cuts in production elsewhere, it would reduce some of the annual O&M costs associated with the purchase and discharge of this water. It would also reduce the disruption in the aquifer of recharging or re-injecting 380 MG/Yr of water near BWD Plant 6 and 420 MG/Yr near ANY-SNR, as local mounding could influence plume movement.

Table 2-2. Cost Estimates for Alternative 2A

Cost Item	Cost	Notes
Capital investment • Additional monitoring wells installed, $7,300,000 • Air Stripper Upgrade at ANY, $7,800,000 • Wellhead treatment at 15 downgradient supply wells, $77,000,000 • Basin Tie-ins, $300,000	$79,000,000	Additional monitoring infrastructure installed over 3 years (24 VPBs and 44 MWs). Off-site hot spot treatment infrastructure installed in 2 years Wellhead treatment installed at 4 wells after 10 years, another 5 wells after 20 years, and remaining 6 wells after 30 years.
Annual O&M • Additional monitoring, for 50 years • Water Purchase and Discharge, for 50 years • Air Stripper Operation at ANY • Wellhead treatment, for 20 to 40 years	$142,000/year $751,000/year $439,000/year $204,000/year-unit	Costs are variable based on activities conducted in each year.
Total Cost (50 years, undiscounted)	**$229,000,000**	
Present Value (50 years, discount rate of 2.3%)	**$130,000,000**	

2.3 ALTERNATIVE 2B – PLUME CONTAINMENT

2.3.1 Description

Alternative 2B would include several elements of Alternative 1, as well as a new plume containment, system installed near the leading edge of the plume to mitigate further downgradient migration. Using cross-section C-C' (Figure 1-9) as a guide, the new extraction system would target the large shallow plume finger (less than 300 feet bgs) and the known deep plume fingers (greater than 300 feet bgs). In addition, this alternative assumes that at least one additional deep plume finger will be found in the eastern portion of the aquifer, during more detailed pre-design characterization along the cross-section C-C'. Therefore, one shallow and two deep groundwater extraction systems (one each in the eastern and western portions of the deep plume) are assumed to be installed with the goal of containing the plume. The plume in cross-section C-C' is defined by TCE and other site-related VOC concentrations that exceed its MCL of 5 µg/L. For discussion purposes, it is assumed that plume containment would occur along cross-section C-C'. If ongoing characterization shows portions of the plume to be further downgradient than shown in current plume maps, one or more of the containment wells could be installed further south.

Figures 2-5 and 2-6 highlight potential extraction wells, treatment plant locations, and discharge points for the shallow and deep groundwater systems, respectively. Calculations supporting estimated groundwater extraction rates required for plume capture are presented in Appendix C. To capture the shallow and

deep plume fingers evident in cross-section C-C' (Figure 1-9), preliminary calculations (Appendix C) show that extraction of a total of 10,800 gpm (5,680 MG/Yr) of water flowing through the impacted parts of the aquifer would be required. This target volume could be extracted with nine shallow extraction wells each pumping 1,000 gpm (total 9,000 gpm) and four deep extraction wells each pumping 450 gpm (total 1,800 gpm). Two deep extraction wells would be located on the west side, near ANY-SNR. In addition, two deep wells would be located on the east side to capture an assumed deep plume finger that will be discovered during additional characterization. These preliminary calculations assume a homogeneous aquifer. Detailed flow modeling, supported by additional characterization and calibration of the model to the complex geologic setting of the impacted aquifer at Bethpage, would be required to design the plume containment.

Estimates of VOC concentrations in the extracted groundwater are presented in Table A-2 and supporting calculations are presented in Appendix B. It is assumed that VOC concentrations in the extracted shallow groundwater would increase but remain less than 10 µg/L, and air stripping would not be required. A process flow diagram for this system is presented in Figure 2-7. Each GAC unit would require a floor space of approximately 400 square feet, plus an additional 800 square feet for common components, including a backwash hold tank, storage, and controls. For the deep extraction wells, the VOC concentrations might exceed 50 µg/L in the future and therefore this groundwater would be pre-treated by air stripping. A process flow diagram for the air stripping is presented in Figure 2-8. Each air stripping system will require an additional floor space of 3,600 square feet. To minimize transport of the higher VOC-contaminated groundwater (greater than 50 µg/L) over long distances, three separate wellhead VOC treatment plants would be constructed in the area. One VOC treatment plant each would be located near the western and eastern deep groundwater extraction well systems. The third treatment plant would be located between the line of nine shallow extraction wells and the discharge points further south.

Similar to Alternative 2A, Alternative 2B assumes that three downgradient supply well fields (four wells) would be impacted in 10 years, two well fields (five wells) would be impacted in 20 years, and three well fields (six wells) would be impacted in 30 years. By comparison, in Alternative 1, the impacts were assumed to occur in 10 years (four wells), 15 years (five wells), and 25 years (six wells). The difference in timing reflects the reduced probability of impacts to downgradient supply wells in Alternatives 2A and 2B due to the plume containment system. Unlike in Alternative 1, no off-site hot spot treatment in OU-2 (upgradient of BWD 6-2) is assumed. All additional off-site plume containment would be focused at the leading edge of the plume. Additional detail on the development of this Alternative is presented in Appendix A.

2.3.2 Technical Feasibility

With Alternative 2B, the expected outcomes would be as follows:

- Some expected outcomes would be similar to those for Alternative 1:

    - On-site pump-and-treat systems (ONCT and IRM) would continue to contain migration of VOCs from upgradient source areas to the off-site plume.
    - The off-site hot spot containment being evaluated in OU-3 would further reduce migration of the off-site plume by removing VOC mass from the aquifer.
    - The strength of the off-site plume would continue to attenuate with distance through various mechanisms.
    - The Remedy Optimization Team's recommendations on an improved early warning system, screening of outpost wells at multiple depths, more aggressive containment of the off-site OU-3 hot spot, and additional investigation of VOC impacts immediately downgradient of the on-site containment systems at OU-2 and OU-3 would further mitigate the impacts to the downgradient plume.
- Increased capture of VOC mass in the new plume containment system would further reduce migration of the off-site plume (compared to Alternative 1) by removing VOC mass from the aquifer.
- Plume containment in the shallow wells would mitigate migration of the large shallow plume finger in cross-section C-C'. It is unclear whether or not this reduces the probability of impacts to downgradient supply wells. Except for ANY #4D, which is screened at 385 feet bgs and may be west of the potential plume migration pathway, none of the other downgradient supply wells are screened in or near the shallow aquifer zone (where impacts appear to be between 100 and 300 feet bgs).
- The above three outcomes would reduce (but not eliminate) the probability and/or the strength of impacts to downgradient supply wells. Wellhead treatment may still be required in downgradient (currently un-impacted) supply wells, if the low stated goal (0.5 µg/L) is exceeded at some time in the future. It is assumed that an additional 15 supply wells in the projected path of the plume would require wellhead treatment (in addition to wellhead treatment that is already installed or in progress in BWD wells, SFWD Plants 1 and 3, and ANY-SNR). For discussion purposes in this study, VOC impacts are assumed to occur after 10 years in four of the downgradient supply wells, after 20 years in another five supply wells, and after 30 years in the remaining six wells.

The advantages of Alternative 2B would be as follows:

- As with Alternative 1, there are several similar advantages with Alternative 2B:
    - All water supplies (upgradient and downgradient of the plume's leading edge) would remain protected by wellhead treatment.
    - Improvements recommended by the Remedy Optimization Team would lead to improvements in plume tracking and early warning of impending impacts.
- Just as with Alternative 2A, the probability of VOC impacts to downgradient supply wells would be further reduced (but not eliminated) by Alternative 2B, as compared to Alternative 1
- Unlike Alternative 2A, Alternative 2B would target all the known plume fingers (shallow and deep) at the current leading edge of the plume.

Potential disadvantages of Alternative 2B would be as follows:

- The plume could continue to migrate downgradient, although in a much weakened state (weakened due to the on-site containment, off-site hot spot treatment, the enhanced capture by currently impacted supply wells, attenuation with distance, and the new plume containment system at the current leading edge). New plume fingers could develop over time along the current leading edge of the plume (C-C' cross-section) and could go undetected and/or un-captured over time.
- In the past, plume containment at other sites, especially in relatively deep aquifers, has often succeeded in capturing a substantial portion of the plume, but not all of it. The Bethpage Plume is deeper and more complex than most other sites that have often been considered as "deep". For example, at the relatively "deep" Aerojet Superfund Site, where a ROD for a pump-and-treat remedy for plume containment was recently signed (Aerojet, 2011), the plume is 300 to 350 feet bgs. At Bethpage, this depth is considered as the "shallow" portion of the impacted aquifer. As aquifer depth and plume length increase, the plume encounters increasingly complex geology and undergoes more complex dispersion patterns (reflecting the increasingly complex source distribution upgradient and the geologic heterogeneities encountered along the flow path). Figure 2-9 is a conceptual depiction of this phenomenon (Payne et al., 2008). Figure 2-10 focuses on the deep western portion of the cross-section C-C' (in Figure 1-9) along the leading edge of the plume and shows some of the shallow and deep fingers dispersed through the aquifer, migrating in between narrowly spaced clay layers. As additional pre-design characterization is conducted along the leading edge, as part of Alternative 2B, additional plume fingers and geologic complexities may become evident. It is unclear how effectively pumping can recover these fingers from between closely spaced clay layers.
- As the plume evolves, additional plume fingers may appear at the current leading edge. These new fingers may elude the installed plume containment system. There is no certainty that these new fingers would be discovered through ongoing monitoring, until they are well past the containment system. At a stated downgradient trigger of 0.5 µg/L, a new plume finger could remain undiscovered for many years. If and when any new fingers are identified, the plume containment system would have to be reinforced with more extraction wells and associated infrastructure (treatment plants, re-injection wells, piping, etc.), resulting in growing cost. At many relatively deep sites despite the initial containment system being progressively reinforced with additional extraction wells (e.g., Otis Air Force Base between 1999-2007 and Aeroject Superfund Site between 1983 and 2009), five-year reviews of remedy performance showed that the pump-and-treat systems succeeded in weakening the plume, rather than in completely eliminating bypass and downgradient migration (EPA Region 1, 2008; EPA Region 1, 2011; Aerojet, 2009; EPA Region 9, 2011). At many sites (see Section 3.2), the goal of plume containment has been to contain the more concentrated parts of the plume, not the entire plume defined at the boundaries by MCLs (or lower targets).
- In terms of spatial emphasis and volumes of water, much of the plume containment efforts (in Alternative 2B) at Bethpage would be focused on the "shallow" portion of the aquifer, where C-C' shows the greatest spatial impact (9,000 gpm of the total of 10,800 gpm of water extracted in

Alternative B would be from the shallow aquifer). However, all of the downgradient supply wells (except one that is potentially to the west of the plume migration pathway) are completed in the deeper portion of the aquifer. On the other hand, at other sites, such as Aerojet (Aerojet, 2009; EPA Region 9, 2011), the water supply wells are at similar depths as the plume and the pump-and-treat system wells, thus making the capture attempts relevant. At the Bethpage site, much of the plume containment effort in Alternative 2B at the leading edge would likely be directed towards the large shallow portion of the plume that probably poses less risk to downgradient water supplies, while deep narrow plume fingers remain undiscovered because of the limits of finding these fingers through characterization.

- Procurement of properties to house the VOC treatment systems (air strippers and carbon) could be a challenge. Three separate treatment systems would have to be constructed. Each treatment system would have to be housed within an approximate 70-foot by 80-foot building and placed on an approximate two-acre lot. These properties are not currently available and will need to be procured. The availability of two-acre areas for treatment plants in this densely-developed urban region is uncertain. Prospective locations for the treatment plants are already developed, and may require the taking of private or commercial property. It is assumed that groundwater extraction wells and conveyance piping can be placed on existing public right-of-ways. Piping runs would require long-term construction activities and disrupt transportation and commerce in the construction areas.
- Much of the groundwater extracted is likely to contain low levels of VOCs (see calculations in Appendix B), similar to the less than 5 µg/L currently being extracted in ANY-SNR. Some of the new pump-and-treat system's extraction wells, especially in the shallower portions of the plume, may extract water containing VOCs at levels below MCLs or below detection. Therefore, the efficiency of resource utilization (and cost efficiency) of Alternative 2B is low, with respect to VOC mass recovery, as compared to the existing upgradient containment systems. At some extraction wells, it is likely that the water would simply be extracted and discharged to the recharge basins or injection wells, without requiring treatment, because influent VOC concentrations are below detection.
- Full deployment of the plume containment system would likely occur five years after the decision. For example, the City of North Hollywood (California), estimated that planning, additional characterization, modeling, design, property procurement, installation, and deployment of a new plume containment system would take 4 years from the time of the decision (ROD) and therefore opted for plume capture in the water supply wells as an immediate action that would reduce downgradient migration and make beneficial use of the water by treating it down to MCLs and supplying it to customers (EPA Region 9, 2009; EPA Region 9, 2008). Based on past experience, at Bethpage, it would likely take 5 years after a decision before a plume containment system becomes fully operational.
- Because the large volume of water extracted in Alternative 2B would be returned to the aquifer at a downgradient location, there is no net loss of water from the overall watershed and the impacts to the regional water table and regional hydrology are expected to be minimal. However, there could be considerable local impacts to the aquifer near the rows of extraction and reinjection wells, where sizeable groundwater depression and mounding, respectively, would be created. These local impacts

may affect the extraction rates in nearby water supply wells and also the movement of the plume itself. Exact impacts are difficult to predict without a fairly extensive field investigation and detailed modeling effort.

- Additional disadvantages of Alternative 2B are similar to those for Alternative 2A:
  - Alternative 2B would not eliminate the need for future enhancements to the ongoing on-site containment, if additional investigations (as recommended by the Remedy Optimization Team), were to indicate that flow bypass is occurring.
  - Alternative 2B may not eliminate the need for off-site hot spot treatment in some parts of the plume, such as GM-38 and OU-3.
  - Alternative 2B would reduce the probability of, but does not eliminate the need for, wellhead treatment in downgradient supply wells.

2.3.3 Cost

The cost estimation process for Alternative 2B is described in Appendix D. Assumptions and backup calculations are provided in Appendix A. Alternative 2B has an estimated total cost of $458,000,000 and a present value of $296,000,000, as summarized in Table 2-3. The three major cost drivers in Alternative 2B are the new extraction wells, reinjection wells, and treatment plants associated with plume containment, wellhead treatment that may be required in downgradient wells, and additional monitoring for plume migration.

Table 2-3. Cost Estimates for Alternative 2B

Cost Item	Cost	Notes
Capital investment • Additional monitoring wells installed, $7,300,000 • Groundwater Extraction Wells, $14,000,000 • Treated Groundwater Discharge, $9,900,000 • New groundwater Treatment Systems, $65,100,000 • Wellhead treatment at 15 downgradient supply wells, $64,000,000	$160,000,000	Additional monitoring infrastructure installed over 3 years (24 VPBs and 44 MWs). 10,800 GPM groundwater treatment system will be installed over 5 years. Wellhead treatment installed at 4 wells after 10 years, another 5 wells after 20 years, and remaining 6 wells after 30 years.
Annual O&M • Additional monitoring, for 50 years • Groundwater treatment, for 47 years • Wellhead treatment, for 20 to 40 years	 $142,000/year $4,320,000/year $204,000/year-unit	Costs are variable based on activities conducted in each year.
Total Cost (50 years, undiscounted)	**$458,000,000**	
Present Value (50 years, discount rate of 2.3%)	**$296,000,000**	

2.4 ALTERNATIVE 2C – HYDRAULIC CONTAINMENT

2.4.1 Description

Alternative 2C would be similar to Alternative 2B, except that full containment of all groundwater flowing near the downgradient edge of the plume (between the eastern and western boundaries of the plume) would be the goal, regardless of whether portions of the aquifer are currently contaminated or not. In Alternative 2C, all the elements of Alternative 1 would be implemented. However, little effort would be made to further characterize the leading edge of the plume except to determine its eastern and western boundaries. Total hydraulic control would be undertaken with a pump-and-treat system to capture all the groundwater flowing between these boundaries and at depths ranging from the water table to the base of the Magothy at 850 feet bgs. The objectives of Alternative 2C are:

- To reduce uncertainties associated with characterization of the plume at its leading edge; this is an essential deficiency of all targeted plume containment options. In a deep and complex aquifer, a row of several vertical profile borings along the plume's current leading edge could fail to identify vertically thin or horizontally narrow plume fingers (or future fingers that may develop). Alternative 2C would avoid this uncertainty.
- To reduce the probability of VOC impacts to downgradient water supply wells to the maximum extent feasible.

Figure 2-11 highlights potential locations of extraction wells, the associated treatment plants, and discharge points for the extracted water. Based on ongoing plume delineation, if portions of the shallow plume are found to be further downgradient than shown in current plume maps, one or more of the shallow containment wells would be shifted to the south. Preliminary calculations supporting estimated groundwater extraction rates required for plume capture are presented in Appendix C. These calculations show that a total of 14,000 gpm (7,360 MG/Yr) of groundwater flow would need to be captured to attempt total hydraulic control. This compares well with the calculated 12,000 gpm (6,300 MG/Yr) of precipitation-related recharge expected in the portion of the watershed encompassing the southern boundary of the plume.

To capture the shallow plume and deep plumes, ten shallow extraction wells, each pumping 1,000 gpm (total 10,000 gpm) and ten deep extraction wells each pumping 400 gpm (total 4,000 gpm) will be required. Except as identified at some locations (e.g., near ANY-SNR), the shallow and deep extraction wells would normally be co-located. The total volume of groundwater extracted through the shallow wells is much greater than the total volume extracted through the deep wells because there is much greater flow occurring through the high-permeability sands and gravels of the Upper Glacial Formation near the water table (at depths between approximately 50 to 100 feet bgs) than in the rest of the aquifer. These

preliminary calculations assume that flow is occurring through relatively homogeneous aquifer zones (Upper Glacial, Magothy, and gravel zone at the base of the Magothy) and does not account for intermittent clay layers and other heterogeneities. Detailed flow modeling, supported by additional characterization and calibration of the model to the complex geologic setting of the impacted aquifer at Bethpage, will be required to design the hydraulic containment.

Estimates of VOC concentrations in the extracted groundwater are presented in Appendix A and supporting calculations are presented in Appendix B. It is estimated that VOC concentrations in the extracted shallow groundwater would increase but remain less than 10 µg/L, and air stripping will not be required. A process flow diagram for this system is presented in Figure 2-7. Each GAC unit would require a floor space of approximately 400 square feet, plus an additional 1,200 square feet for common components, including a backwash hold tank, storage, and controls. It is assumed that four or five of the ten deep extraction wells with a total flow rate of 1,800 gpm would intercept higher concentrations of VOCs that would need to be pretreated with air stripping. Each air stripping system (two are assumed here) would require additional floor space of 3,600 square feet. To minimize transport of VOC-contaminated groundwater over long distances, two separate VOC treatment plants would be constructed to treat the extracted water. Unlike in Alternative 1, no off-site hot spot treatment in OU-2 (upgradient of BWD 6-2) is assumed. All additional off-site plume containment would be focused at the leading edge of the plume. Additional detail on the development of this Alternative is presented in Appendix A.

2.4.2 Technical Feasibility

With Alternative 2C, the expected outcomes would be as follows:

- As with Alternative 2B, the following outcomes may be expected:
  - On-site pump-and-treat systems (ONCT and IRM) would continue to contain migration of VOCs from upgradient source areas to the off-site plume.
  - The off-site hot spot containment for OU-3 would further reduce migration of the off-site plume by removing VOC mass from the aquifer. The strength of the off-site plume would continue to attenuate with distance through various mechanisms.
  - The Remedy Optimization Team's recommendations on an improved early warning system, screening of outpost wells at multiple depths, more aggressive containment of the off-site OU-3 hot spot, and additional investigation of VOC impacts immediately downgradient of the on-site containment systems at OU-2 and OU-3 will further mitigate the impacts to the downgradient plume.
- Increased capture of VOC mass in the new hydraulic containment system would further reduce migration of the off-site plume (compared to Alternatives 1, 2A, and 2B) by removing VOC mass from the aquifer to the maximum extent possible. Of all the plume containment options, Alternative 2C would probably extract the most VOC mass at the leading edge of the plume, simply because it would extract the most groundwater.

- The above two outcomes would considerably reduce (but not eliminate) the probability and/or the strength of impacts to downgradient supply wells. Wellhead treatment may still be required in downgradient (currently un-impacted) supply wells, if the low stated goal (0.5 µg/L) is exceeded at some time in the future. For this study, delayed VOC impacts are assumed to occur after 15 years in five of the downgradient supply wells, after 25 years in another five supply wells, and after 35 years in the remaining six wells (compared to 10, 15, and 25 years for Alternative 1 and 10, 20, and 30 years for Alternatives 2A and 2B, respectively). Any impacts to downgradient wells would probably be pushed back in time compared to the other alternatives.

The advantages of Alternative 2C would be as follows:

- As with Alternative 1, there would be several similar advantages with Alternative 2B:
  - All water supplies (upgradient and downgradient of the plume's leading edge) would remain protected by wellhead treatment.
  - Improvements recommended by the Remedy Optimization Team would lead to improvements in plume tracking and early warning of impending impacts.
- The probability of VOC impacts to downgradient supply wells would be greatly reduced (but not eliminated), as compared to Alternatives 1, 2A, and 2B. Alternative 2C potentially provides the biggest reduction in the probability of impacts to downgradient supply wells, as compared to Alternatives 1, 2A, and 2B for several reasons. Although total hydraulic capture could be made more difficult by aquifer heterogeneities (e.g., clay layers) that appear to increase with depth, Alternative 2B has the potential to capture more of the plume simply because it captures more of the groundwater flowing through the leading edge of the plume. In addition, total hydraulic containment is less reliant on the limitations of additional characterization of the plume, compared to the other alternatives. Also, Alternative 2C is less reliant on how the plume evolves in the future within its current eastern and western boundaries (appearance of new plume fingers in cross-section C-C' will not matter as much, as long as they are within the eastern and western boundaries of the current plume).

Potential disadvantages of Alternative 2C would be as follows:

- Some of the disadvantages of Alternative 2C are similar to those for the plume containment system in Alternative 2B:
  - Full deployment of the hydraulic containment system could take five years after the decision. For example, the City of North Hollywood (California), estimated that planning, additional characterization, modeling, design, procurement of required land, construction, and deployment of a plume containment system would take four years from the time of the decision (ROD) and therefore opted for plume capture in the water supply wells as an immediate action that would reduce downgradient migration and make beneficial use of the water by treating it down to MCLs

and supplying it to customers (EPA Region 9, 2009; EPA Region 9, 2008). Based on past experience, at Bethpage, it would likely take 5 years between a decision to system operation.

- Because all the water extracted in the hydraulic containment system will be returned to the aquifer at a downgradient location, there is no net loss of water from the watershed and the impacts to the regional water table and hydrology are expected to be minimal. However, there could be significant local impacts to supply wells and plume movement in the aquifer near the new extraction and discharge wells. These impacts could be difficult to predict even with a fairly extensive and detailed modeling effort.
- Alternative 2C would not eliminate the need for future enhancements to the ongoing on-site containment, if additional investigations (as recommended by the Remedy Optimization Team), indicate that flow bypass is occurring.
- Alternative 2C may not eliminate the need for off-site hot spot treatment in some parts of the plume, such as GM-38 and OU-3.
- Alternative 2C reduces the probability of, but does not eliminate the need for, wellhead treatment in downgradient supply wells. One outcome of this reduced probability could be a delayed impact on downgradient supply wells, as a weakened plume could take longer to reach some of these wells.

- A significant disadvantage of total hydraulic containment in Alternative 2C is that resources (and costs) would be directed by plume boundaries, not necessarily by the presence or significance of VOC mass or risk. Spatially, much of the groundwater flow captured would be in the shallow zone (10,000 gpm), not in the deep zone (4,000 gpm). This is because there is much greater groundwater flow occurring in the highly permeable Upper Glacial sands and gravels in the shallow aquifer. However, the plume in the shallow zone consists of relatively lower concentrations of VOCs. Also, all the downgradient supply wells (except one that is potentially west of the plume migration pathway) are screened in the deeper aquifer. Therefore, much of the effort and cost of the hydraulic containment in Alternative 2C would get directed towards portions of the aquifer that contain little VOC mass and pose lower risk.
- The plume could continue to migrate downgradient, although in a much weakened state despite the addition of the new hydraulic containment system at the current leading edge. In the past, hydraulic containment at other sites, especially in deeper aquifers, has often succeeded in capturing a substantial portion of the plume, but not all of it. The impacted aquifer at Bethpage is deeper and more complex than most other sites that have often been considered as “deep” in the past. For example, at the Otis Air Force Base Superfund site, Figure 2-12 shows that after a few years of hydraulic containment at the CS-10 site boundary, the plume grew unexpectedly along the western edge and started bypassing the containment system (EPA Region 1, 2008; EPA Region 1, 2011). At many relatively deep sites despite the initial containment system being progressively reinforced with additional extraction wells (e.g., Otis Air Force Base between 1999-2007 and Aeroject Superfund Site between 1983 and 2009), five-year reviews of remedy performance show that the pump-and-treat systems succeeded in weakening the plume, rather than in completely eliminating bypass and

downgradient migration (EPA Region 1, 2008; EPA Region 1, 2011; Aerojet, 2009; EPA Region 9, 2011).

- Procurement of properties to house the VOC treatment systems (air strippers and carbon) could be a challenge. Two separate properties would be needed for the two treatment systems that would be constructed. Each treatment system would be housed within an approximate 90-foot by 100-foot building and placed on an approximate three-acre lot. These properties are not currently available and will need to be procured. The availability of three-acre areas for treatment plants in this highly-developed urban region is uncertain. Prospective locations for the treatment plants are largely developed, and could require the taking of private or commercial property. It is assumed that groundwater extraction wells and conveyance piping could be placed on existing public right-of-ways. Piping runs would require long-term construction activities and disrupt transportation and commerce in the construction areas.

2.4.3 Cost

The cost estimation process for Alternative 2C is described in Appendix D. Assumptions and backup calculations are provided in Appendix A. Alternative 2C has an estimated total cost of $484,000,000 and a present value of $309,000,000, as summarized in Table 2-4. The three major cost drivers in Alternative 2C are the new extraction wells, reinjection wells, and treatment plants associated with hydraulic containment, wellhead treatment that may be required in downgradient wells, and additional monitoring for plume migration.

Table 2-4. Cost Estimates for Alternative 2C

Cost Item	Cost	Notes
Capital investment • Additional monitoring wells installed, $2,100,000 • Groundwater Extraction Wells, $19,000,000 • Treated Groundwater Discharge, 11,800,000 • Groundwater Treatment System, $71,200,000 • Wellhead treatment at 15 downgradient supply wells, $64,000,000	$167,000,000	Additional monitoring infrastructure installed over 3 years (6 VPBs and 12 MWs). 14,000 GPM groundwater treatment system will be installed over 5 years. Wellhead treatment installed at 4 wells after 15 years, another 5 wells after 25 years, and remaining 6 wells after 35 years.
Annual O&M • Additional monitoring, for 50 years • Groundwater treatment, for 47 years • Wellhead treatment, for 15 to 35 years	$41,000/year $5,140,000/year $204,000/year-unit	Costs are variable based on activities conducted in each year. Depending on influent VOC concentrations, well head treatment costs consist of GAC treatment or a combination of GAC and Air Stripping treatment.
Total Cost (50 years, undiscounted)	**$484,000,000**	
Present Value (50 years, discount rate of 2.3%)	**$309,000,000**	

2.5 ALTERNATIVE 3 – CONTINUED IMPLEMENTATION OF OU-2 ROD REMEDY AND ACCELERATED IMPLEMENTATION OF WELLHEAD TREATMENT

2.5.1 Description

Alternative 3 is similar to Alternative 1, except that wellhead treatment would be installed far in advance on all potentially impacted water supplies in the projected path of the plume. Consequently, efforts for tracking off-site plume migration and the use of outpost monitoring wells would be considerably reduced. Emphasis will be on monitoring VOC levels on a quarterly basis in downgradient water supply wells. The treatment systems would be in place to provide protection of the water supply in the event that these wells are impacted by VOCs.

Figure 1-4 provides the currently estimated extent of the VOC-contaminated groundwater, water supply wells that currently have treatment for VOCs, water supply wells with treatment systems in the design phase, and water supply wells that may be impacted in the future. VOC treatment would be installed in all 8 downgradient well fields (including all 15 un-impacted supply wells) in the next 10 years. The PV analysis assumes that wellhead treatment would be installed in 4 wells after 5 years, another 5 wells after 7 years, and remaining 6 wells after 10 years. Additional detail on the development of this Alternative is presented in Appendix A.

2.5.2 Technical Feasibility

The expected outcome from Alternative 3 would be as follows:

- On-site pump-and-treat systems (ONCT and IRM) would continue to contain migration of VOCs from upgradient source areas to the off-site plume.
- The off-site hot spot containment systems being evaluated for OU-2 and OU-3 would further reduce migration of the off-site plume by removing VOC mass from the aquifer.
- Downgradient water supplies would be protected in advance by wellhead treatment systems that would be on standby, if and when the plume reaches a supply well.
- The extensive plume characterization and tracking efforts currently planned in Alternative 1 would be greatly reduced.

The advantages of Alternative 3 would be as follows:

- Water supplies in downgradient supply wells would remain protected by wellhead treatment.

- Wellhead treatment systems on downgradient supply wells would be installed sooner, rather than later. This would greatly reduce the reliance on plume migration tracking to trigger the installation of wellhead treatment systems at supply wells.
- A portion of the costs associated with early wellhead treatment installation could be offset by reducing or avoiding the need for extensive plume tracking and/or off-site plume containment (although on-site source containment and hot-spot treatment would continue to be investigated and upgraded, if required).
- Installation of wellhead treatment far in advance of plume migration would remove much of the uncertainty associated with the limitations of plume tracking and containment.

The disadvantages of Alternative 3 would be as follows:

- Considerable resources would be expended in wellhead treatment far in advance of plume migration, whether the treatment ultimately is required or not. In addition to this uncertain cost-benefit aspect of Alternative 3, the legal feasibility of pre-emptive spending would have to be examined more closely. There could be fiscal constraints on spending without a demonstrated need.
- It is currently unclear as to how many and which of the downgradient supply wells (if any) might be impacted in the future. Cross-section C-C' at the leading edge shows a much weakened plume, weakened first by the on-site containment, then by the off-site hot spot treatment wells, then by the upgradient supply wells, and finally by attenuation over distance. Therefore, costs could be incurred without the need ever materializing in many downgradient supply wells.

2.5.3 Cost

The cost estimation process for Alternative 3 is described in Appendix D. Assumptions and backup calculations are provided in Appendix A. Alternative 3 has an estimated total cost of $277,000,000 and a present value of $177,000,000, as summarized in Table 2-5. The two major cost drivers in Alternative 3 are wellhead treatment in downgradient supply wells and hot spot treatment in OU-2.

Table 2-5. Cost Estimates for Alternative 3

Cost Item	Cost	Notes
Capital investment • Additional monitoring wells installed, $2,500,000 • Off-site hot spot treatment, extraction well upgradient of BWD 6-2 and associated treatment plant and water discharge infrastructure, $19,000,000 • Wellhead treatment at 15 downgradient supply wells, $77,000,000	$98,000,000	Additional monitoring infrastructure installed over 3 years (6 VPBs and 18 MWs). Off-site hot spot treatment infrastructure installed in 2 years. Wellhead treatment installed at 4 wells after 5 years, another 5 wells after 7 years, and remaining 6 wells after 10 years.
Annual O&M • Additional monitoring, for 50 years • Off-site hot spot treatment in OU-2 upgradient of BWD 6-2, for 48 years • Wellhead treatment, 40 to 46 years	$60,000/year $702/000/year $204,000 to $475,000/year - unit	Costs are variable based on activities conducted in each year. Depending on influent VOC concentrations, well head treatment costs consist of GAC treatment or a combination of GAC and Air Stripping treatment.
Total Cost (50 years, undiscounted)	**$277,000,000**	
Present Value (50 years, discount rate of 2.3%)	**$177,000,000**	

RE: Urgent request from NYSDOH regarding NY American Water, Merrick Seaman Neck VOC treatment upgrades
Alarcon, Michael J (NASSAU)
to:
Helmeset, John (DOH)
05/21/2013 06:25 PM
Cc:
"Irwin, Donald P (NASSAU)", "DeFranco, Joseph (NASSAU)", "Ramirez, Patricia (NASSAU)"
Show Details

Mr. Helmeset:

As requested by Mr. DeFranco this afternoon, I am providing a chronology of plan review and dates for VOC treatment at the New York American Water – Merrick (Formerly Aqua New York) Seaman's Neck Road VOC Removal Plant:

NCDH File No: 3325-10: Engineering Report: VOC (GAC) Removal for Seaman's Neck Road Well 3S&4S

Submitted: December 30, 2010 Resubmitted: May 20, 2011
NCDH Comments: January 7, 2011 NCDH Comments: June 10, 2011

Resubmitted: July 8, 2011
Approved: August 1, 2011

NCDH File No. 3425-11: Full Scale Plans: VOC Removal for Seaman's Neck Road Wells 3S and 4S

Submitted: October 11, 2011 Conference: December 14, 2011
Comments: October 31, 2011

Resubmitted: March 14, 2012 Resubmitted: April 10, 2012
Comments: March 30, 2012 Comments: April 24, 2012

Resubmitted: June 15, 2012 Resubmitted: September 6, 2012
Comments: June 25, 2012 Comments: September 21, 2012 (Plans Satisfactory: Awaiting Revision of Chemical Storage Drawings)
Resubmitted: November 7, 2012 Resubmitted: December 10, 2012
Comments: November 30, 2012 Approved: December 20, 2012

NCDH File No. 3438-11: Engineering Report (ER) & Full Scale (FS) Drawings: Emergency GAC Treatment for Seaman's Neck Road Well 3S

ER Submitted: December 22, 2011 ER Resubmitted: January 31, 2012
NCDH Comments: January 24, 2012 ER Approved: February 29, 2012

NCDH: FS Plan Comments: March 1, 2012
FS Plans Resubmitted: March 8, 2012
FS Plans Approved: March 16, 2012

Completed Works Request: April 17, 2012
NCDH Inspection: April 25, 2012
Water Quality Data Submitted: April 25, 2012
NCDH Sample Collection: April 30, 2012
NCDH Chemical Storage Comments: May 2, 2012
Completed Works Approval: May 11, 2012

Please call me if you have any questions or if I can be of further assistance. I will on vacation beginning tomorrow May 22 in the afternoon and will return on Wednesday May 29th. During that time you may call Patricia Ramirez at 516-227-9468 for assistance.

Thank you.

Michael J. Alarcon, P.E., M.S.C.E., Director
Bureau of Environmental Engineering
516-227-9714

From: DeFranco, Joseph (NASSAU)
Sent: Tuesday, May 21, 2013 3:07 PM
To: Alarcon, Michael J (NASSAU); Ramirez, Patricia (NASSAU)
Cc: Irwin, Donald P (NASSAU); Helmeset, John (DOH)
Subject: Urgent request from NYSDOH regarding NY American Water, Merrick Seaman Neck VOC treatment upgrades

Mike/Patty,

I received a request from John Helmeset, NYSDOH Bureau of Water Supply for a chronology of events (plan submittals and review dates for voc treatment). John is acting on behalf of the Public Service Commission (PSC). Apparently, due to the water company being a corporation, a PSC review process was triggered by the recent treatment upgrades and some sort of waiver of the review process will now be necessary otherwise, a waiting period will be mandated that may ultimately delay the implementation of this treatment. John needs this information by tomorrow, 5/22/13 and can be reached at: 518.402.7650 or by email at: jah20.health.state.ny.us

Thanks,
Joe DeFranco

Fw: Timeline for NY American Water Treatment Plant Issue - NWIRP (#130003B), Bethpage, Nassau Co.

Jacqueline E. Nealon to: John A Helmeset 05/22/2013 08:52 AM
Cc: Charlotte M. Bethoney, Steven Karpinski

Jacqueline E. Nealon Fw: Timeline for NY American Water Treatment Plant Issue - NWIRP (#130003B

John,
This is the quick timeline I was able to gather from the info. we had:

2008 Aqua NY makes 1st request to Navy for a treatment system for the Wells (3) and (4); no treatment in place at that time, levels of TCE detected < or = to 1.0.

2009 Navy inspects water supply TCE issues, puts together treatment system design.

2010 Navy's final design for a temporary and permanent treatment system for the wells.

2011 Navy went to TOB to get approvals/waivers.

2011-2012 NY American Water acquires Aqua NY PWSWs.

Early 2012 Navy went to DOH to get permits to develop the new treatment plant.

04/12 - 12/12 Navy puts temporary treatment (carbon filter) on wells - TCE conc. as high as 3.0 are being detected in raw water.

Mid 2012 NY American Water denies access agreement to Navy, requests easement petition from Navy to develop the permanent treatment plant. The temporary carbon filter system is still in place - has not been designed to be used long term for treating TCE exceedences.

If you have any questions, please let me know.