Department of Environmental Conservation

Division of Environmental Remediation

Record of Decision
Hexagon Laboratories Site
Operable Unit No. 2
Bronx County
Site Number 203003

July 2002

New York State Department of Environmental Conservation
GEORGE E. PATAKI, *Governor* JOHN P. CAHILL, *Commissioner*

DECLARATION STATEMENT - RECORD OF DECISION

Hexagon Laboratories Inactive Hazardous Waste Disposal Site
Bronx County, New York
Site No. 203003
Operable Unit No. 2

Statement of Purpose and Basis

This Record of Decision (ROD) presents the selected remedy for the Hexagon Laboratories Class 2 inactive hazardous waste disposal site which was chosen in accordance with the New York State Environmental Conservation Law. The selection of the remedial program is consistent with the National Oil and Hazardous Substances Pollution Contingency Plan of March 8, 1990 (the “NCP”) (40 CFR 300).

This decision is based on the Administrative Record of the New York State Department of Environmental Conservation (NYSDEC) for the Hexagon Laboratories inactive hazardous waste disposal site 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 Hexagon Laboratories site and the criteria identified for evaluation of alternatives, the NYSDEC has selected groundwater treatment using chemical oxidation or dual phase vapor extraction in conjunction with the remedy previously adopted for soils. The components of the remedy are as follows:

- A remedial design program including pilot tests 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. This will include a pilot test to verify whether or not fracturing of bedrock on site to allow greater access to contamination in the bedrock is required.

- Groundwater treatment using one of the following methods: installation of injection points on site and injection of Fenton's reagent, or similar oxidant, for the treatment of groundwater; or installation and operation of extraction wells on site to capture the source area of the contamination with dual phase vapor extraction and construction and operation of a treatment system for the extracted liquid and gas phases.

- The remedial program will also include institutional controls in the form of deed restrictions or notification. Either a restriction will be recorded in the chain of title of the property by the property owner or a notification will be sent to the county clerk and placed with the property's deed to limit the use of groundwater from the affected areas as a source of potable or process water without the necessary water quality treatment as determined by the local health department authority.

- The property owner will certify annually to the NYSDEC that these institutional controls are in place and that the site is in compliance with the institutional controls outlined in this ROD or the deed notification will be verified annually by the NYSDEC, to ensure that the institutional controls are in place and that the site is in compliance with the institutional controls outlined in this ROD.

- Since the remedy results in untreated hazardous waste residuals remaining at the site, a long term monitoring program will be instituted. This will include the collection and analysis of groundwater samples at the site and off site on a periodic basis. This program will allow the effectiveness of the groundwater treatment system to be monitored and will be a component of the operation and maintenance for the site.

The operation of the components of the remedy will continue until the remedial objectives have been achieved, or until NYSDEC determines that continued operation is technically impracticable or not feasible.

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.

July 9, 2002
Date

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

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RECORD OF DECISION

Hexagon Laboratories
Bronx County, New York
Site No. 203002
Operable Unit No. 2
July 2002

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 (NYSDOH) 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 Hexagon Laboratories Operable Unit No. 2 (OU2) Class 2, Inactive Hazardous Waste Disposal Site.

Operable Unit No. 2, which is the subject of this ROD, consists of the groundwater beneath the site. As more fully described in Sections 3 and 4 of this document, leaking tanks and mishandling of chemicals have resulted in the disposal of a number of hazardous wastes, including chlorinated and nonchlorinated solvents at the site, some of which have migrated from the site into the groundwater. The contamination of groundwater has resulted in the following significant threats to the public health and/or the environment:

- a potential threat to human health by ingestion of groundwater;

- a threat to the environment associated with the contamination of groundwater.

In order to eliminate or mitigate the significant threats to the public health and/or the environment that the contamination of groundwater with hazardous wastes at the Hexagon Laboratories has caused, the following remedy is proposed:

- groundwater treatment, performed either by injection of an oxidant such as Fenton's Reagent (in-situ treatment) or by dual phase vacuum extraction and ex-situ treatment.

The selected remedy, discussed in detail in Section 8 of this document, is intended to attain the remediation 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 Hexagon Laboratories Site is an approximately one-acre inactive chemical manufacturing facility located at 3536 Peartree Avenue in the Eastchester section of Bronx County, New York.

The site is bounded on the northwest by Boston Road (also referred to as Boston Post Road; US Route 1); on the northeast by Tufo's Wholesale Dairy and parking area (this being the former Bronx Auto Wrecking and Salvage) and Heathcote Avenue; on the southeast by used auto parts businesses and scrap yards; and on the southwest by Peartree Avenue. The surrounding area is generally a densely populated urban area. The northern edge of Co-op City, a large housing complex, is approximately 2,000 feet south of the site, and the New England Thruway (Interstate Route 95) is about 250 feet southeast of the site.

Pelham Bay Park is located less than one mile east of the site, on the east side of the Hutchinson River. Two tidal marsh areas are located in the Pelham Bay Park as is the Thomas Pell Wildlife Refuge and Sanctuary. At its nearest point, the Hutchinson River is less than 1,000 feet northeast of the site. The location of the site is shown on Figure 1.

SECTION 3: SITE HISTORY

3.1: Operational/Disposal History

Hexagon Laboratories made pharmaceuticals, pharmaceutical intermediates, and a large array of other organic chemicals from the mid-1940's through 1988. Products were primarily manufactured in batch-size quantities using batch reactors and distillation units. A wide array of raw materials and chemicals were used in manufacturing operations at the site and a wide variety of finished products and wastes were generated by those operations. Hexagon was also a hazardous waste generator, transporter, storage, and disposal facility.

Prior to demolition activities that took place in late 1997 there were three main buildings and several smaller structures on site as well as many aboveground and underground storage tanks. Removal of four of seven buildings and all tanks from the site as part of an Interim Remedial Measure (IRM) in late 1997, has left most of the site open with concrete floor slabs, footings, and pavement at the surface.

The facility had a history of chemical spillage as far back as the 1980's when there were complaints to local elected officials about dumping by Hexagon Laboratories. Complaints of strong odors and liquids seeping from the site along the Hexagon property line were first made to the NYSDEC by Bronx Auto Wrecking and Salvage, Inc. in 1980. The site was inspected several times by State and local environmental regulators in response to complaints. From 1981 through 1988 there were numerous violations of federal, State, and local laws at the site including missing EPA hazard codes, missing manifests, unlabeled waste drums, and spilled chemicals.

In 1986 the NYSDEC directed Hexagon to install monitoring wells and conduct groundwater sampling in response to past releases from their site. The plant was closed before a plan could be implemented.

3.2: Remedial History

In 1988, the site was first listed on the New York State Registry of Inactive Hazardous Waste Disposal Sites (the Registry) as a Class 2a site which is a temporary classification assigned to a site that has inadequate and/or insufficient data for inclusion in any of the other classifications.

New York City Department of Environmental Protection (NYCDEP) personnel inspected the site during February 1990 in response to a high pH discharge to the city sewer system. Samples were collected from three storage tanks and from the sewer system. The inspectors identified "extremely hazardous materials" on site. A follow-up inspection was conducted in July 1990. A previously unidentified chemical storage area was found adjacent to the laboratories in the New Plant in the western yard. Materials including explosives, water reactive metals, poisons, and compressed gas cylinders were subsequently removed from the site by the New York City Police Department Bomb Squad.

In 1992, the United States Environmental Protection Agency (EPA) conducted a $1,200,000 Emergency Removal Action at the site. All drums and containers that contained hazardous substances were removed from the site and almost all tanks and piping were emptied. The site was then secured by fencing around the perimeter of the site. EPA did not investigate soil or groundwater contamination during the emergency removal.

In December of 1993 the site was reclassified as a Class 2 site because of contaminated groundwater. A Class 2 site represents a significant threat to public health or the environment and action is required.

The NYSDEC attempted to get the potentially responsible parties (PRPs), the previous owners of Hexagon, to investigate and clean up the site. The PRPs refused to accept responsibility and the site was referred to the New York State Superfund in 1995. This means that the State is funding the investigation and will attempt to recover the costs at a later time.

The NYSDEC hired a consultant to assist with the Remedial Investigation/Feasibility Study (RI/FS) and work began at the site in December 1996. The field work took place in several stages and was completed in October 1998. RI field activities included a topographic survey; a geophysical survey; collection of surface soil and miscellaneous (oily material) samples; drilling of exploratory borings and collection of subsurface soil samples; collection of underground storage tank excavation sidewall samples; installation and sampling of six (6) groundwater monitoring wells, and an ecological investigation. During this time, the NYSDEC also performed an Interim Remedial Measure (IRM) which involved asbestos abatement, underground and aboveground tank removal, contaminated soil removal, and demolition of several of the buildings (including the Old Plant, New Plant, Hydrotherm No. 2 and Cylinder House).

Hexagon was divided into Operable Units 1 and 2 after the completion of the investigation in 1998; it was clear that soil contamination necessitated remediation. However, the extent of off-site groundwater contamination was not quantified. Given that the soil needed remediation and groundwater investigation would take additional time and effort, the NYSDEC decided to split the site administratively into two sections: one section is the entire site except for the groundwater and is referred to as Operable Unit No. 1 (OU1); the other section is the groundwater and is referred to as Operable Unit No. 2 (OU2). Dividing the site into two operable units allowed the NYSDEC to select a remedy for remediating the soil contamination without delay while additional investigation was conducted for the groundwater. The OU1 remedy requires the removal of approximately 6,400 cubic yards of contaminated soil from the property with proper disposal at an off-site facility.

The remedy selection process for OU1 was the same as the process being followed for OU2. An RI/FS was completed specifically addressing soil issues at the site and a PRAP for OU1 was prepared by the NYSDEC and released to the public for comment. A remedy was selected for OU1 in February 2000 and is currently being designed.

The additional investigative work for OU2 was completed in 2001. The results of that Remedial Investigation for the groundwater at the site are summarized below in Section 4.

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 NYSDEC has recently conducted a Remedial Investigation/Feasibility Study (RI/FS).

4.1: Summary of the Remedial Investigation

The purpose of the RI was to further define the nature and extent of groundwater contamination resulting from previous activities at the site.

The RI was conducted in one phase between April 2000 and January 2001. A report entitled "Remedial Investigation Report Operable Unit No. 2 Hexagon Laboratories" dated December 2001 has been prepared which describes the field activities and findings of the RI in detail. Additional analytical data was collected during the investigation of OU1 as discussed above and that data and a thorough discussion can be found in the report "Remedial Investigation Report, Operable Unit No. 1, Hexagon Laboratories, TAMS Consultants, May 1999."

The OU2 RI included the following activities:

- Installation of seven soil borings and six monitoring wells;
- analysis of groundwater; and
- assessment of physical properties of soil and hydrogeologic conditions.

To determine if groundwater is contaminated at levels of concern, the RI analytical data was compared to environmental standards, criteria, and guidance values (SCGs). Such standards and criteria constitute ARARs under federal law. Groundwater SCGs identified for the Hexagon Laboratories site are based on NYSDEC Ambient Water Quality Standards and Guidance Values and Part 5 of New York Sate Sanitary Code.

Based on the RI results, in comparison to the SCGs and potential public health and environmental exposure routes, the NYSDEC has determined that the groundwater requires remediation. These are summarized below. More complete information can be found in the RI Report. Chemical concentrations are reported in parts per billion (ppb) and parts per million (ppm). For comparison purposes, where applicable, SCGs are provided for each medium.

4.1.1: Site Geology and Hydrogeology

The geology of Hexagon includes near-surface glacial deposits and metamorphic bedrock. The unconsolidated deposits beneath the site consist of Upper Pleistocene glacial till. The till, which covers most of Bronx County, is poorly sorted and consists of brown, unsaturated clay, sand, and boulders. The overburden is underlain by the Manhattan Schist, a dark-green to black metamorphic rock. The thickness of overburden soils is typically between 2 feet and 6 feet across most of the site with the exception of the eastern corner of the South Yard where it is deeper, to about 16 feet. Groundwater flows in an easterly direction across the site and is generally between one foot deep near MW-5 and 10 feet deep at MW-11.

4.1.2: Nature of Contamination

As described in the RI Report groundwater samples were collected at the site to characterize the nature and extent of contamination.

Groundwater contaminants detected at the site are similar to those detected in the surface and subsurface soil. Observed contamination in the groundwater at the Hexagon Laboratories Site consists primarily of benzene, toluene, ethylbenzene, and xylenes (BTEX compounds), chlorinated volatile organics, chlorinated benzenes, acetone, phenolic compounds, and aniline compounds.

While the presence of SVOCs is less significant in the groundwater as compared to the surface and subsurface soil, several SVOCs (primarily phenolic compounds, 4-chloroaniline, and 1,2-dichlorobenzene) were detected at concentrations greater than the NYSDEC Class GA groundwater standards.

Various metals in the total (unfiltered) metals samples including antimony, barium, beryllium, chromium, copper, lead, mercury, nickel, selenium, thallium, and zinc were detected at concentrations greater than the NYSDEC Class GA groundwater standards. However, in the dissolved (filtered) samples, only antimony, barium, chromium, nickel, selenium, thallium, and zinc were detected at concentrations greater than the NYSDEC Class GA groundwater standards.

4.1.3: Extent of Contamination

Tables 1 - 4 summarize the extent of contamination for the contaminants of concern in groundwater and compares the data with the SCGs for the site. The following is a summary of the findings of the investigation.

VOCs were detected at concentrations greater than the NYSDEC Class GA groundwater standards in all six of the on-site monitoring wells, MW-1, MW-2, MW-3, MW-4, MW-5, and MW-8 (see Figure 2). The shallow wells (MW-1, MW-3, MW-4, MW-5, MW-6, MW-7, MW-9, and MW-11) are all screened between 2 and 6 feet to 12 to 16 feet deep. The deeper wells vary from MW-2 (screened from 40 to 50 feet below ground surface (bgs)) to MW-8 (75 to 85 feet bgs). Highest concentrations were observed in monitoring well MW-3 (South Yard), monitoring wells MW-4 and MW-8 (New Plant shallow and deep wells, respectively), and monitoring well MW-5 (Old Plant). The maximum concentration of 1,1-dichloroethene was found in MW-3 at 200 ppb [groundwater standard of 5 ppb]. Several chemicals were detected at their maximum on-site concentrations in MW-4: 1,1-dichloroethane at 16,000 ppb [5 ppb]; 1,2-dichloroethene at 30,000 ppb [5 ppb]; chloroform at 22,000 ppb [7 ppb]; 1,2-dichloroethane at 110,000 ppb [0.6 ppb]; 1,1,1-trichloroethane at 270 ppb [5 ppb]; trichloroethene at 10,000 ppb [5 ppb]; tetrachloroethene at 9,200 ppb [5 ppb]; toluene at 270,000 ppb [5 ppb]; ethylbenzene at 4,400 ppb [5 ppb]; and xylene at 19,000 ppb [5 ppb]. Styrene was detected at a maximum concentration of 24 ppb [5 ppb] in MW-5. Several chemicals were detected at their maximum concentrations in MW-8; vinyl chloride at 1,400 ppb [2 ppb]; methlyene chloride at 6,400 ppb [5 ppb]; acetone at 590,000 ppb [50 ppb]; and benzene at 45,000 ppb [0.7 ppb].

VOCs were detected at concentrations greater than the NYSDEC Class GA groundwater standards in four of six off-site monitoring wells (MW-6, MW-10, MW-11, MW-12, see Figure 2). In general, VOC concentrations were lower in off-site wells than in on-site wells, except for MW-10 (deep well east of site). VOC concentrations in MW-10 were comparable to on-site monitoring wells MW-1 and MW-2. The maximum off-site concentrations of volatile organic chemicals were found in MW-10: Chloroethane was found at 950 ppb [groundwater standard of 50 ppb]; 1,1-dichloroethane was found at 6 ppb [5 ppb]; 1,2-dichloroethane was found at 14 ppb [5 ppb]; benzene was found at a maximum off-site concentration of 560 ppb [0.7 ppb]; toluene at 65 ppb [5 ppb]; chlorobenzene at 1,600 ppb [50 ppb]; ethylbenzene at 20 ppb [5 ppb]; and xylene at 14 ppb [5 ppb].

As with VOCs, the highest concentrations of on-site SVOC contamination were observed in monitoring wells MW-3, MW-4, MW-5, and MW-8. Relatively low levels of SVOCs were detected in monitoring wells MW-1 and MW-2. Several chemicals were found at their maximum concentrations in MW-4 including 1,2-dichlorobenzene, found at 260 ppb [groundwater standard of 4.7 ppb]; nitrobenzene at 8,600 ppb [5 ppb]; and naphthalene at 710 ppb [10 ppb]. Several chemicals were found at their maximum concentrations in MW-8: phenol was found at 16,000 ppb [1 ppb]; bis(2-chloroethyl)ether was found at 3,000 ppb [1 ppb]; 2-methylphenol at 7,900 ppb [5 ppb]; 4-methylphenol at 150,000 ppb [50 ppb]; 4-chloroanaline at 360 ppb [5 ppb]; and diethylphthalate at 450 ppb [50 ppb].

For off-site wells, SVOCs were detected at concentrations greater than the NYSDEC Class GA groundwater standards in three of six off-site monitoring wells (MW-7, MW-10, and MW-12). SVOC concentrations were comparable in these three wells and much lower than in on-site wells.

Phenol was found at a maximum off-site concentration in MW-10 at 14 ppb [groundwater standard of 1 ppb]. MW-7 contained several SVOC chemicals at their maximum off-site concentrations: 3,3-dichlorobenzidine was estimated to be 10 ppb [5 ppb]; benzo (g,h,i)perylene was estimated to be 10 ppb [5 ppb]; benzo(a)anthracene was estimated to be 10 ppb [0.002 ppb]; chrysene was estimated to be 10 ppb [0.002 ppb]; benzo(b)fluoranthene was estimated to be 10 ppb [0.002 ppb]; benzo(k)fluoranthene was estimated to be 10 ppb [0.002 ppb]; benzo(a)pyrene was estimated to be 10 ppb [0.002 ppb]; and indeno(1,2,3-c,d)pyrene was estimated to be 10 ppb [0.002 ppb].

Pesticides were detected sporadically in all on-site wells; these detections are considered suspect due to significant matrix interference. PCBs were detected in samples collected from New Plant shallow monitoring well MW-4 at concentrations above the groundwater standard during four of six sampling events. PCBs were also detected in New Plant deep monitoring well MW-8 at concentrations above the groundwater standard during two of four sampling events. The range of PCB concentrations were from non-detectable to 34 ppb [groundwater standard 0.09 ppb]. Pesticides and PCBs were not detected in any off-site well.

Metals were detected in the total (unfiltered) metals samples from each on-site monitoring well at concentrations in excess of NYSDEC Class GA groundwater standards. These metals include antimony, barium, beryllium, chromium, copper, lead, mercury, nickel, selenium, thallium, and zinc. However, in the dissolved metals samples, only antimony, barium, chromium, nickel, selenium, thallium, and zinc were detected at concentrations greater than the groundwater standards. These exceedances were primarily in monitoring wells MW-1, MW-4, MW-5, and MW-8.

Maximum levels of antimony at 8.3 ppb in an unfiltered sample [groundwater standard of 3 ppb] and zinc at 2,500 ppb [300 ppb] were found in MW-1 on site. Maximum levels of selenium were in MW-3 at 26.8 ppb [10 ppb]. Maximum levels of several unfiltered metals were found in MW-4: beryllium at 3 ppb [3 ppb], chromium at 576 ppb [50 ppb]; copper at 1,580 ppb [200 ppb]; lead at 178 ppb [25 ppb]; mercury at 3.3 ppb [2 ppb]; and nickel at 1,010 ppb [100 ppb]. In MW-5 thallium was found at 9.2 ppb [4 ppb]. Maximum levels of barium were found in MW-8 at 2,160 ppb [1,000 ppb].

Dissolved (filtered) metals were found on site at these maximum concentrations: in MW-1 antimony at 18.3 ppb [3 ppb] and zinc at 2,200 ppb [300 ppb]; in MW-4 chromium at 212 ppb [50 ppb], nickel at 623 ppb [100 ppb], and selenium at 14.3 ppb [10 ppb]. In MW-5 thallium at 7.6 ppb [4 ppb]; and in MW-8 barium 2,000 ppb [1,000 ppb].

Antimony, lead, mercury, selenium, and zinc were detected in total metals samples in some off-site monitoring wells at concentrations in excess of NYSDEC Class GA groundwater standards. The exceedances were in monitoring well MW-7 and MW-9. However, in the dissolved metals samples, only antimony at 5.1 ppb in MW-9 was detected at a concentration greater than the NYSDEC Class GA groundwater standard of 3 ppb.

The potential for non-aqueous liquids to be present at the site is difficult to predict without knowing the history of the above ground and underground storage tanks including what compounds were stored in the tanks, what compounds were in the leaking underground storage tanks and what quantities were released. Historic information for the underground storage tanks indicated that in 1977, several tanks in the South yard were found to be leaking and were replaced. However, there was no information on the chemicals stored in these South Yard tanks, the potential amount of discharge, or whether any cleanup was performed.

An underground storage tank at the site was found to be leaking fuel oil when it was removed in 1997. This tank was located approximately 40 ft northwest of MW-4. The details of the removal were reported in the OU1 Remedial Investigation Report. This tank is a known source of light non-aqueous phase liquid (LNAPL).

During the installation and development of monitoring well MW-4 in 1997, LNAPL was not noted. During some sampling events an oily sheen and small oil globules were noted in the discharge water. During all four quarterly groundwater sampling events, the discharge water had a strong odor, was bluish-gray in color and produced foam in the discharge bucket.

During the installation of MW-8 in 1999, floating product was noted by the field inspector at 25 ft bgs. Small globules of free product were noted. During well development, NAPL was not noted in the discharge water. During groundwater sampling, NAPL was not noted in the discharge, however, there was a strong chemical odor, the water had a bluish gray color and produced foam in the discharge bucket.

Based on visual observations at monitoring wells, LNAPL is present in small quantities in the vicinity of monitoring wells MW-4 and MW-8. The horizontal extent of LNAPL contamination does not appear to extend beyond the area of these two wells.

Dense non-aqueous phase liquids (DNAPL) were noted during the installation of MW-8 approximately 25 ft bgs during coring. The vertical extent appears to be limited to the upper 30 to 40 ft of the bedrock based on visual observations during drilling. The lack of DNAPL present in well development and purge water would indicate that DNAPL is not present at or below the top of the well filter pack at 73 ft bgs. However, given the unpredictable nature of DNAPL movement through schist bedrock, its presence beyond MW-8 cannot be excluded. In MW-8 1,2-dichloroethane (1,2-DCA) was detected at moderately high concentrations (up to 14,000 ppb) in two of the groundwater monitoring events. While these concentrations are substantially lower than the theoretical solubility of 1,2-DCA (about 83,000 ppb), site records do indicate that this compound was stored in several on-site USTs; therefore, leaking USTs would have the potential for releases of free-phase 1,2-DCA and may account for the observed presence of DNAPL at this well. MW-4 also had moderately high concentrations of certain compounds that may form DNAPL: 1,2-dichloroethane at 110,000 ppb and perchloroethylene at 9,200 ppb.

4.2: <u>Summary of Human Exposure Pathways</u>:

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 1.26 of the Focused Feasibility Report (FFS).

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.

Pathways which are known to or may exist at the site include ingestion of groundwater.
Drinking water for Bronx County is obtained from the Croton Reservoir, located approximately 18 miles north of the site. In addition, according to a well search report provided by Environmental Data Resources (EDR), of Southport, Connecticut, the closest water supply wells are located between 0.5 and one mile to the north and northwest and are hydraulically upgradient from the Hexagon site (see Section 7 of this report). These wells are listed with an "unused" status. There are no known human exposures to groundwater contamination.

4.3: Summary of Environmental Exposure Pathways

This section summarizes the types of environmental exposures and ecological risks which may be presented by the site. The following pathway for environmental exposure and/or ecological risks has been identified: impact to the groundwater resource above standards.

The levels of contamination in the groundwater on site are significantly higher than the levels found in the groundwater immediately off the site. The Thomas Pell Wildlife Sanctuary located in Pelham Bay Park on the Hutchinson River is located over 1,000 feet away from the site and would not likely be affected by the contamination at Hexagon.

SECTION 5: ENFORCEMENT STATUS

Potentially Responsible Parties (PRPs) are those who may be legally liable for the costs of investigation and remediation of the contamination at a site. This may include past and present owners and operators, waste generators, and haulers.

The PRPs for the site, documented to date, include its former owners and operators, including parties related to the Boehringer Ingelheim Corporation and Hexagon Laboratories, as well as other chemical and pharmaceutical companies which entered into toll processing agreements and thereby generated hazardous wastes at the Site. A "toll processing agreement" is an agreement between two companies to engage in a type of manufacturing arrangement. Toll processing is any further processing performed on another party's product or materials for a fee.

The PRPs which were initially identified declined to implement the RI/FS at the site when requested by the NYSDEC. The PRPs are again being asked to assume responsibility for the remedial program. If an agreement cannot be reached with the PRPs, the NYSDEC will evaluate the site for further action under the State Superfund. The PRPs are subject to legal actions by the State for recovery of all response costs the State has incurred.

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 OU2 of this site are:

- *Eliminate, to the extent practicable, groundwater contamination on site that exceeds NYSDEC Class GA Ambient Water Quality Criteria;*

- *Eliminate, to the extent practicable, ingestion of groundwater affected by the site that does not attain NYSDOH Part 5 Water Quality Criteria;*

- *Eliminate, to the extent practicable, off-site migration of groundwater that does not attain NYSDEC Class GA Ambient Water Quality Criteria; and*

- *Eliminate, to the extent practicable, migration of NAPL.*

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 applicable laws and utilize permanent solutions, alternative technologies or resource recovery technologies to the maximum extent practicable. Potential remedial alternatives for OU2 of the Hexagon Laboratories site were identified, screened, and evaluated in the report entitled Hexagon Laboratories Focused Feasibility Study, December 2001.

A summary of the detailed analysis follows. As presented below, the time to implement reflects only the time required to implement the remedy, 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 Remedial Alternatives

The potential remedies are intended to address the contaminated groundwater at the site.

Alternative 1 - No Action

The No Action alternative is evaluated as a procedural requirement and as a basis for comparison. This alternative would require groundwater monitoring only. Alternative 1 would leave the site in its present condition and would not provide any additional protection to human health or the environment. The alternative includes annual sampling and analysis of monitoring wells on and off the site for thirty years. The costs associated with this option are presented below.

Present Worth:	*$ 484,000*
Capital Cost:	*$ 0*
Annual O&M:	*$ 30,100*
Time to Implement	*not applicable*

Alternative 2 - Biological Enhancement/ Monitored Natural Attenuation/ Institutional Controls

Alternative 2 consists of the following components:

- Bedrock fracture enhancement, if necessary
- In-situ chemical treatment of contamination with Hydrogen Release Compound (HRC) and Oxygen Release Compound (ORC)
- Long-term groundwater monitoring

In this alternative, an electron donor, such as methanol, ethanol, butyrate, lactate, acetate, or Hydrogen Release Compound (HRC) is added to groundwater to stimulate anaerobic fermentation and produce hydrogen which promotes the breakdown of chlorinated compounds such as perchloroethylene, trichloroethylene, and chlorobenzene by naturally occurring microbes. HRC is a proprietary, environmentally safe, food quality, polylactate ester. It is specially formulated for slow release of lactic acid upon hydration. HRC is applied to the subsurface via push-point injection or within dedicated wells. HRC is then left in place where it passively works to stimulate rapid contaminant degradation.

Oxygen enhancement technology consists of increasing groundwater oxygen concentrations to enhance the rate of aerobic degradation of contaminants by naturally occurring microbes. Oxygen concentration may be increased by injecting air under pressure below the water table, injecting a dilute solution of hydrogen peroxide, or injecting Oxygen Release Compound (ORC). ORC is a patented formulation of magnesium peroxide that time releases oxygen when hydrated. Oxygen is often the limiting factor for aerobic microbes capable of biologically degrading contaminants such as petroleum hydrocarbons. Without adequate oxygen, contaminant degradation will cease or proceed very slowly. Indigenous aerobic microbes benefit from the presence of an oxygen source thus accelerating natural attenuation of certain compounds.

Enhanced reductive dechlorination using HRC and enhanced aerobic degradation using ORC would be used sequentially to promote breakdown of the contaminants in the on-site groundwater. With this bioremediation technique HRC and ORC serve as nutrients for the naturally occurring microorganisms in the ground and enhance the breakdown of contaminants. These compounds would be injected directly into the bedrock, where they would commingle with the microorganisms, turning the contaminants into less harmful compounds. This groundwater treatment technology is effective for chlorinated and nonchlorinated organics; it does not treat metal contamination.

Before the chemicals are introduced into the ground the bedrock fractures at the site would be increased in size and number using pneumatic fracturing or another method, if determined to be necessary during a predesign pilot test. Fracture enhancement would be performed to enhance the delivery of the reagents. The pneumatic fracturing process may generally be described as the injection of gas into the subsurface at a pressure that exceeds the natural in situ stresses and at flow volumes exceeding the natural permeability of the formation. This creates a fracture network radiating from the injection point.

Prior to the design phase of the project, bench- and/or pilot-scale testing would be conducted to obtain site-specific design parameters.

The bioremediation would be implemented by installing a grid of injection wells, either across the source area, or upgradient and/or downgradient of its perimeter. The HRC and ORC would be injected at several different times so as to maximize the effectiveness of the treatment. For both HRC and ORC, the actual re-application requirement (i.e., frequency and area for treatment) would be determined based on groundwater monitoring results after the initial application. It is estimated that a total treatment time of about two and half years, including injection/re-injection well installation, and reagent application (including the waiting period between injection events), would be required.

Treatment verification monitoring would include collection of groundwater samples from wells upgradient, within and downgradient of the treatment areas. Samples would be analyzed for VOCs and other parameters to monitor the biodegradation processes. Results from the monitoring program would be used to determine whether or not additional rounds of reagent application are required to meet the treatment objectives and also to adjust reagent application rate, as required. Continued long-term groundwater monitoring would be conducted to evaluate the change in groundwater contamination at the site over time.

The alternative would also include institutional controls in the form of deed restrictions to be recorded in the chain of title of the property to limit the use of groundwater from the affected areas as a potable or process water without the necessary water quality treatment as determined by the local health department authority.

The property owner would certify annually to the NYSDEC that these institutional controls are in place and that long term monitoring is being conducted as would be required by the remedy.

Present Worth:	*$ 5,820,000*
Capital Cost:	*$ 5,500,000*
Annual O&M:	*$ 36,000*
Time to Implement	*2 ½ years*

Alternative 3 - Chemical Oxidation Using Fenton's Reagent/ Monitored Natural Attenuation/Institutional Controls

Alternative 3 consists of the following components:

- Bedrock fracture enhancement, if necessary
- In-situ oxidation using Fenton's reagent (or similar oxidant)
- Long-term groundwater monitoring

In this alternative, Fenton's reagent would be used to promote breakdown of the contaminants in the on-site groundwater. This reagent would be injected directly into the bedrock, where it would interact and react with the contamination, turning the contaminants into less harmful compounds.

Fenton's reagent is a combination of hydrogen peroxide [H_2O_2] and iron salts. Injecting this material into the ground at a low pH creates hydroxyl radicals. These strong, nonspecific oxidants readily oxidize a broad range of contaminants, including chlorinated solvents and other contaminants such as fuel oils and BTEX (benzene, toluene, ethylbenzene, and xylene). The Fenton's reagent reaction is very fast and much more efficient than H_2O_2 alone. A typical treatment scenario includes adjusting the groundwater to pH 3-5, adding the iron catalyst (as a solution of $FeSO_4$), and then adding the hydrogen peroxide slowly. It does not treat metal contamination.

Before the chemicals are introduced into the ground the bedrock fractures at the site would be increased in size and number using pneumatic fracturing or another method, if determined to be necessary during a predesign pilot test, as described above.

Prior to the design phase of the project, bench- and/or pilot-scale testing would be conducted to obtain site-specific design parameters.

The remediation would be implemented by installing a grid of injection wells across the source. It is estimated that the Fenton's reagent would be applied in the plume core area over a period of approximately eight weeks. Additional application of Fenton's reagent to the plume core area (frequency and area for treatment) would be determined based on groundwater monitoring results after the initial application. A total treatment time of about four to six months, including temporary injection point installation, and reagent application (including the waiting period between injection events), is anticipated.

Treatment verification monitoring would include collection of groundwater samples from wells upgradient, within and downgradient of the treatment areas. Samples would be analyzed for VOCs and other parameters to monitor the degradation processes. Results from the monitoring program would be used to determine whether or not additional rounds of reagent application are required to meet the treatment objectives and also to adjust the reagent application rate, as required. The duration of treatment is estimated to be three years. Continued long-term groundwater monitoring would be conducted to evaluate the change in groundwater contamination at the site over time.

The alternative would also include institutional controls in the form of deed restrictions to be recorded in the chain of title of the property to limit the use of groundwater from the affected areas as a potable or process water without the necessary water quality treatment as determined by the local health department authority.

The property owner would certify annually to the NYSDEC that these institutional controls are in place and that long term monitoring is being conducted as would be required by the remedy.

Present Worth:	*$ 3,130,000*
Capital Cost:	*$ 2,752,000*
Annual O&M:	*$ 36,000*
Time to Implement	*3 years*

<u>Alternative 4 - Dual-Phase Vapor Extraction/ Monitored Natural Attenuation/Institutional Controls</u>

Alternative 4 consists of the following components:

- Bedrock fracture enhancement, if necessary
- Dual-phase vapor extraction (DPVE)
- Groundwater and off-gas treatment
- Vapor treatment
- Off-site disposal
- Operation and maintenance
- Long-term groundwater monitoring

In this alternative a dual-phase extraction system would be utilized to remove the contaminant-laden groundwater and vapor from the aquifer and vadose zone under high vacuum. These two phases would be extracted simultaneously using the same extraction system. The extracted fluid would be separated at the surface into liquid and gas components, and treated in selected groundwater and vapor treatment systems to satisfy discharge requirements. Prior to implementation the effectiveness of this alternative would need to be tested and the design parameters selected via a pilot-scale field test at the site.

Prior to the installation of the dual phase extraction system, pneumatic fracturing or some other fracturing method would be used at the site to increase bedrock fractures in size and number to enhance the extraction and the flow of air, if determined to be necessary during a predesign pilot test, as described above.

Treatment of the extracted groundwater would include metals precipitation followed by air stripping. The metal precipitate would be removed from treated water by physical methods such as clarification (settling) and/or filtration. The settled solids would undergo necessary additional treatment to reduce moisture content prior to off-site disposal in a landfill. The next step in the groundwater treatment train would be air stripping, which would involve the transfer of volatile contaminants from water to air.

Off-gas from the air stripper and the vapor phase collected by DPVE would be treated by vapor phase carbon adsorption. Contaminated off-gas would be pumped through activated carbon and contaminants would adsorb to the carbon. Once breakthrough is observed, the carbon would be replaced. The spent carbon would be sent off-site for reactivation, regeneration or landfill disposal.

The treated groundwater following air stripping would be discharged into a storm sewer near the site if possible or properly disposed in some other way.

Treatment verification monitoring would include collection of groundwater samples from wells on and off site. It is estimated that the alternative would be implemented in a 7-year period. When the active remediation is complete, long-term groundwater monitoring would be conducted to evaluate the change in groundwater contamination at the site over time.

The alternative would also include institutional controls in the form of deed restrictions to be recorded in the chain of title of the property to limit the use of groundwater from the affected areas as a potable or process water without the necessary water quality treatment as determined by the local health department authority.

The property owner would certify annually to the NYSDEC that these institutional controls are in place and that long term monitoring is being conducted as would be required by the remedy.

Present Worth:	*$ 4,900,000*
Capital Cost:	*$ 2,511,000*
Annual O&M:	*$ 410,000*
Time to Implement	*7 years*

7.2 Evaluation of Remedial Alternatives

The criteria used to compare the 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) and in the NCP. 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 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 and ARARs.

Of the four alternatives evaluated, Alternatives 2, 3 and 4 would meet the New York State chemical-specific SCGs for the organic contaminants of concern (COCs) for groundwater on site. Alternative 4 would also meet the chemical-specific SCGs for metals in groundwater on site. Off-site contamination would be allowed to naturally attenuate once the source is removed. Alternative 1 would not meet the chemical-specific SCGs since the contaminated groundwater would not be treated.

Each of the alternatives evaluated is in compliance with action-specific SCGs; all permits (e.g., building and emissions control permits) and approvals necessary for implementing these alternatives would be obtained prior to initiating the remedial action. No location-specific SCGs were identified.

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

Alternative 1 is not considered to be protective of human health and the environment since, in this case, no remedial action would be implemented. This alternative does not reduce the potential for contact with unacceptable levels of contamination in the groundwater nor does it reduce the potential environmental impact associated with off-site migration of the contamination.

Alternatives 2, 3, and 4 would be protective of human health and the environment as they treat the organic COCs on site, thereby reducing the toxicity and mobility on site. In Alternative 2 the organic COCs would be destroyed using HRC and ORC. In Alternative 3, in-situ oxidation using Fenton's reagent would be used to treat the organic COCs. In Alternative 4, the extraction of contaminated groundwater would be effective in preventing further migration of the plume and organic and metal COCs would be removed.

At this time, the groundwater at the site and in the vicinity of the site is not used for human consumption. However, untreated groundwater at the site would not be suitable if exploited in the future for potable or industrial uses and could potentially impact the Hutchinson River.

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 are no significant short-term risks to the community or to the environment anticipated in the implementation of Alternative 1 since no construction activities are involved.

There are no significant short-term risks anticipated for Alternatives 2, 3, and 4. Intrusive activities during implementation of these alternatives would be limited to the installation of wells. With appropriate care, fracturing is not expected to cause difficulties at the site. Formation of fugitive dust during these activities is expected to be minimal and easily controlled. The oxidation reactions with Fenton's reagent (Alternative 3) are strongly exothermic in nature and may result in fugitive emissions of organic vapor. This potential problem can be mitigated through real-time air monitoring at the site and engineering controls.

With regard to Alternative 4, installation of the extraction wells and groundwater and off-gas treatment systems would be performed without significant risk to the community; there is sufficient space to locate a water and off-gas treatment system at the site. The vapor treatment system off-gas and the water treatment system effluent would be regularly monitored to achieve discharge limitations during the operation of these systems.

Site access would be restricted during the remediation activities and continuous air monitoring of particulate and organic vapor would be conducted during intrusive activities and operation of the treatment system as required under Alternatives 2, 3, and 4. Action levels would be set prior to any intrusive activities, and, if these action levels are exceeded, appropriate corrective measures would be implemented (e.g., wetting agents may be used to control fugitive dust). These control measures are reliable and easily implemented.

All of the alternatives can be implemented fairly quickly once approvals and permits are acquired.

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.

Because Alternative 1 does not include removal or treatment of the contaminated groundwater, the volume of contaminants in the groundwater, the risks associated with groundwater contamination, and the migration of the contaminants would remain essentially the same. Alternative 1 is not considered to be permanent since this alternative does not achieve a permanent reduction of the risk at the site.

Alternative 4 is considered to be a permanent remedy for both most organic and inorganic COCs at the site. The dual phase extraction system would remove contaminated groundwater from the aquifer for treatment. Alternatives 2 and 3 are considered to be permanent remedies for only organic COCs; the in-situ methods would destroy organic compounds permanently.

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.

Alternative 4 would be effective at reducing the toxicity, mobility, and volume of contaminants at the Hexagon Laboratories Site, since with this alternative the contaminated groundwater would be extracted and the plume of COCs would be captured. In Alternative 3 the in-situ oxidation process would break down most organic COCs to nontoxic byproducts such as carbon dioxide and water. Alternative 2 might be effective at destroying organic COCs if the reagents are applied appropriately. In Alternatives 2 and 3 the toxicity, mobility, and volume of organics would be reduced. These technologies would not reduce the volume of inorganic COCs. However, most of the inorganic groundwater contamination has not migrated from the site, indicating that the inorganic COCs are not very mobile.

In Alternative 4 the mobility of the contaminants in groundwater would be reduced because the contaminant-laden groundwater would be removed. The toxicity, mobility, and volume of the organic and metal COCs in extracted groundwater would be reduced through ex-situ treatment. The metals sludge collected during ex-situ treatment would be disposed of in a landfill where it would pose no threat to human health or the environment.

Alternative 1 would have no impact on the volume or mobility of contaminants at the site. This alternative would not effectively reduce the volume, mobility, or toxicity of the site groundwater contaminants. Natural attenuation processes would not reduce the toxicity and volume of residual contaminants during the evaluation period of 30 years. Institutional controls do not reduce the toxicity of contaminants but reduce the potential for human exposure to contaminated groundwater and thereby reduce risks.

6. Implementability. The technical and administrative feasibility of implementing each alternative are evaluated. Technical feasibility includes any 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 long-term monitoring associated with the No Action alternative (Alternative 1) would be readily implementable. No sophisticated equipment is required, and the necessary services and materials are readily available.

Alternative 2 might be implementable, although there are some uncertainties associated with this alternative which renders it less implementable than the alternatives discussed above. This alternative would involve the injection of HRC and ORC at the site. This could be achieved by the use of standard well installation methods and equipment. In addition, necessary materials and services would be readily available. However, there may be some difficulty in the injection of HRC and ORC in the bedrock aquifer. HRC would be injected into the center of the plume and it would be necessary to model the reaction kinetics very accurately to determine where and when to inject the ORC. The implementation of Alternative 2 would be complicated by adding different reagents at different times and different locations. Determining the best times and locations for reagent application could be difficult. Bench and pilot scale testing would be required prior to implementing biological enhancement.

Alternative 3 would be implementable but uncertainties about the use of Fenton's reaction-based in-situ oxidation in treating the COCs in the bedrock exist. The reagent might ooze out of the ground due to the shallow bedrock and injection interval. The oxidation reactions for Alternative 3 would be highly exothermic in nature and would need very close monitoring. Services and materials for implementation of most of this alternative would be readily available. However, the number of vendors capable of implementing in-situ oxidation is limited.

Alternative 4 would be implementable. The technology for DPVE as well as groundwater treatment technologies have been successfully used at other sites. The services and materials would be available.

The technical feasibility of in-situ oxidation using Fenton's reagent (Alternative 3), and DPVE (Alternative 4) has been established at other sites. Bench and pilot-scale studies may be required in order to design certain components of the ex-situ groundwater treatment system (i.e., metals removal).

Alternatives 2, 3, and 4 would undergo pilot-scale testing to verify their effectiveness prior to full-scale implementation at the site.

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 (capital, O&M, and total present worth) associated with implementation of each alternative are presented in Table 5.

Alternative 1 is the least expensive. With no capital costs and an annual O&M cost of $30,100, the present worth of this alternative is $484,000. As indicated in Table 5, Alternative 2, which includes in-situ bioenhancement using HRC and ORC, has the highest capital cost ($5,500,000) and the highest total present worth (approximately $5,820,000). Alternative 3 has a capital cost of $2,753,000, and annual O&M cost of $36,000, and a present worth of $3,130,000. Alternative 4, which includes long-term groundwater monitoring, water and off gas treatment plant has, the highest annual O&M cost ($410,000), capital cost of $2,511,000, and a total present worth of $4,900,000.

8. Community Acceptance - Concerns of the community regarding the RI/FS reports and the Proposed Remedial Action Plan have been evaluated. The "Responsiveness Summary" included as Appendix A presents the public comments received and NYSDEC's response to the concerns raised. In general the public comments received were supportive of the selected remedy. Several comments were received, however, pertaining to remedy that questioned the investigation and selected remedy.

SECTION 8: SUMMARY OF THE SELECTED REMEDY

Based on the results of the RI/FS, and the evaluation presented in Section 7, the NYSDEC is selecting either Alternative 3 or Alternative 4 as the remedy for this site; groundwater treatment performed either by injection of an oxidant such as Fenton's Reagent (in-situ treatment) or dual phase vacuum extraction and ex-situ treatment. A pilot test will be done to determine if bedrock fracturing is necessary to achieve the remedial goals in a reasonable amount of time. If NYSDEC determines that natural fracturing in the bedrock is not sufficient for an efficient cleanup, bedrock fracturing must be performed immediately prior to the implementation of the groundwater remedial treatment options.

This selection is based on the evaluation of the four alternatives developed for this site. With the exception of the No Action alternative, each of the alternatives will comply with the threshold criteria of being protective of human health and the environment. Alternatives 3 and 4 will satisfy the chemical-specific SCGs for organic groundwater contamination. Although metals will not be treated with Alternative 3, the concentrations of metals in groundwater are not indicative of a significant problem. Both Alternatives 3 and 4 are protective of human health and the environment, since they will effectively destroy the bulk of the contaminants.

There are no significant short term risks to the community or to the environment anticipated in the implementation of Alternatives 3, or 4. In either case the contaminated groundwater will be either treated on site or removed and treated ex-situ. Alternative 3 may be a vigorous chemical reaction and require careful monitoring but can be controlled. Alternatives 3, and 4 will involve the destruction of organic contamination in groundwater and will result in a permanent long-term solution to organic contamination.

Alternatives 3 and 4 will reduce the toxicity, mobility, and volume of the organic groundwater contaminants on the site with the in-situ or ex-situ treatment of contamination.

Alternatives 3 and 4 will be implementable. Bench and/or pilot scale studies will be necessary for Alternatives 3, and 4 prior to full scale implementation.

The seventh criteria used for comparison, cost, is the only criteria where a significant difference between Alternatives 3 and 4 is apparent. The estimated present worth cost to implement the remedy will be approximately $3 million or $4.8 million for Alternative 3 (Fenton's) or 4 (DPVE) . The cost to construct the Fenton's remedy is estimated to be $2.7 million and the estimated average annual operation and maintenance cost of $36,000. The cost to construct the DPVE remedy is estimated to be $2.5 million and the estimated average annual operation and maintenance cost for 7 years is $390,000.

Typically, if alternatives are compared against all criteria and the comparison indicates that more than one alternative will meet all of the criteria and be an effective remedy, and cost is the only difference, the less expensive alternative is selected. However, in this particular case, the responsible parties have indicated an interest in performing DPVE and NYSDEC wishes to leave this option open should the responsible parties perform the remediation.

The elements of the selected remedy are as follows:

1. A remedial design program including pilot tests 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. This will include a pilot test to verify whether or not fracturing of bedrock on site to allow greater access to contamination in the bedrock is required. Any uncertainties identified during the RI/FS will be resolved.

2. Groundwater treatment using one of the following methods: installation of injection points on site and injection of an oxidant such as Fenton's reagent for the treatment of groundwater; or installation and operation of extraction wells on site to capture the source area of the contamination with dual phase vapor extraction and construction and operation of a treatment system for the extracted liquid and gas phases.

3. The remedy will also include institutional controls in the form of deed restrictions or notification. Either a restriction will be recorded in the chain of title of the property by the property owner or a notification will be sent to the county clerk and placed with the property's deed to limit the use of groundwater from the affected areas as a potable or process water without the necessary water quality treatment as determined by the local health department authority.

4. The property owner will certify annually to the NYSDEC that these institutional controls are in place and that the site is in compliance with the institutional controls outlined in this ROD or the deed notification will be verified annually by the NYSDEC, to ensure that the

institutional controls are in place and that the site is in compliance with the institutional controls outlined in this ROD.

5. Since the remedy results in untreated hazardous waste residuals remaining at the site, a long term monitoring program will be instituted. This will include the collection and analysis of groundwater samples at the site and off site on a periodic basis. This program will allow the effectiveness of the groundwater treatment system to be monitored and will be a component of the operation and maintenance for the site.

The operation of the components of the remedy will continue until the remedial objectives have been achieved, or until NYSDEC determines that continued operation is technically impracticable or not feasible.

SECTION 9: HIGHLIGHTS OF COMMUNITY PARTICIPATION

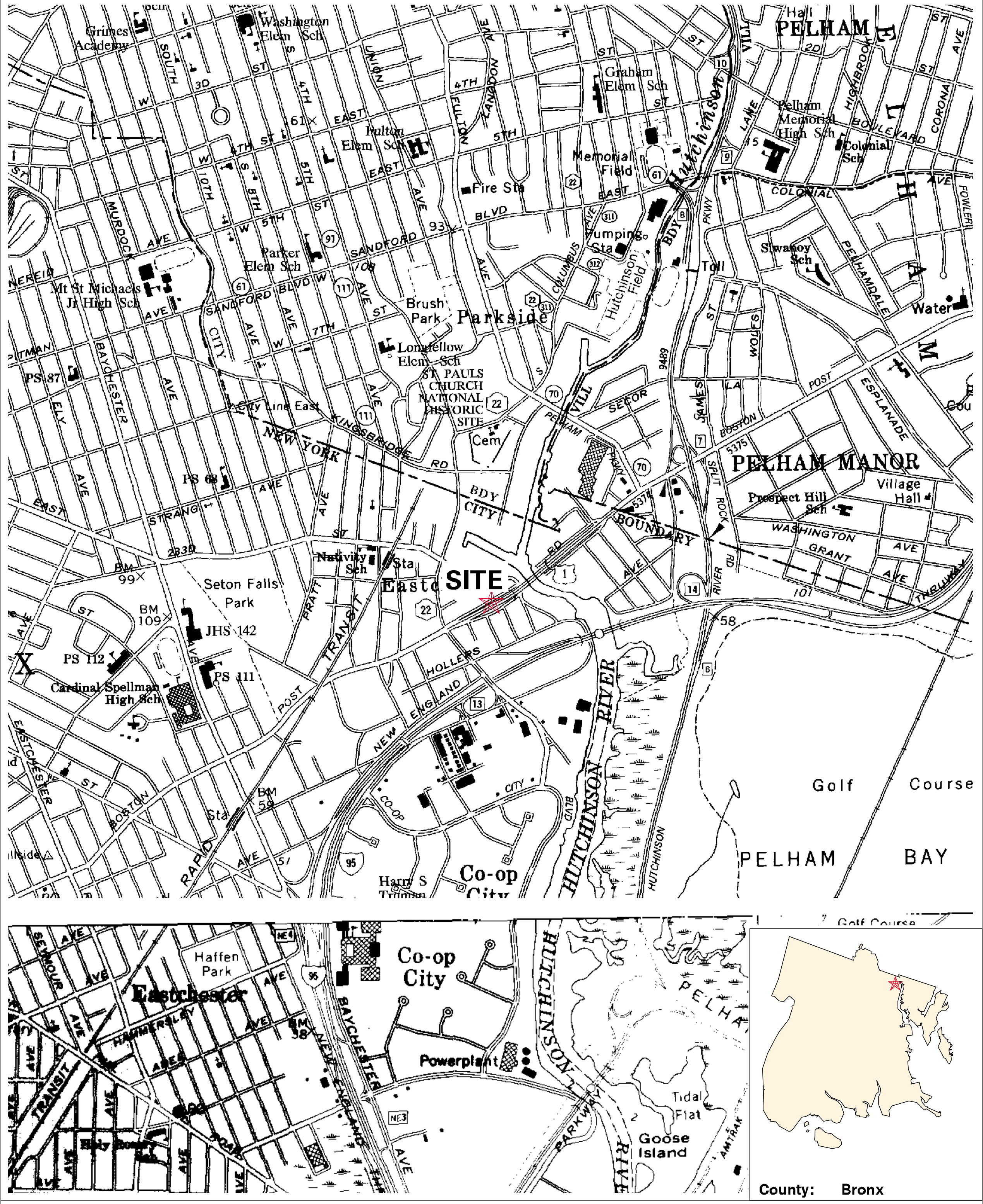
As part of the remedial investigation process, a number of Citizen Participation activities were undertaken in an effort to inform and educate the public about conditions at the site and the potential remedial alternatives. The following public participation activities were conducted for the site:

- 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.

- A public meeting was held on March 7, 2002 which included a presentation of the Remedial Investigation (RI) and the Feasibility Study (FS) as well as a discussion of the proposed remedy and fact sheets were sent to those on the site mailing list.

- In June 2002 a Responsiveness Summary was prepared and made available to the public, to address the comments received during the public comment period for the PRAP.



Site Location Map

203003 Hexagon Laboratories

NYSDOT Planimetric Quadrangle(s):

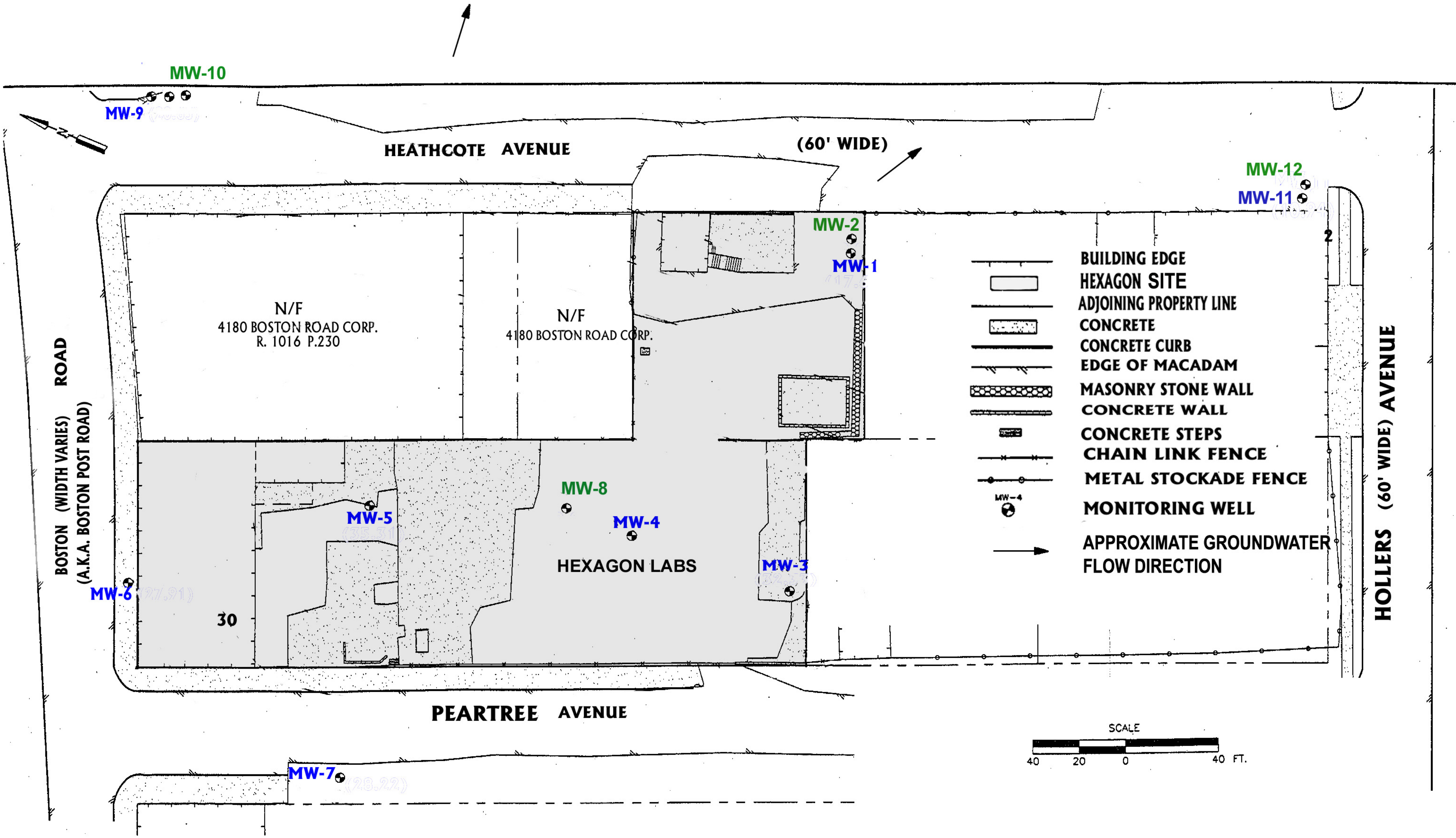
MOUNT VERNON, FLUSHING

N

0 500 1000 1500 2000

FEET

Scale 1:24,000



HEXAGON LABORATORIES
REMEDIAL INVESTIGATION
SAMPLING LOCATIONS
FIGURE 2

TABLE 1
HEXAGON LABORATORIES OPERABLE UNIT No. 2
CONCENTRATION RANGES OF ORGANIC COMPOUNDS IN GROUNDWATER ON SITE
Sampling Dates: April 2000 - January 2001

Sample Location	Groundwater Standards	MW-1	MW-2	MW-3	MW-4	MW-5	MW-8
VOLATILE ORGANIC COMPOUNDS - units in parts per billion (ppb)							
Vinyl Chloride	**2**	ND	ND	310 - 970	ND - 580J	ND-8J	ND - 1,400
Chloroethane	**50**	ND - 220	49 - 130	ND	ND	ND-150J	ND
Methylene Chloride	**5**	ND	ND	ND	ND - 3,200J	ND	ND - 6,400J
Acetone	**50**	ND	ND	ND - 130J	ND - 1,400	ND-47	ND - 560,000
1,1-Dichloroethene	**5**	ND	ND	ND - 200J	ND	ND	ND
1,1-Dichloroethane	**5**	ND	ND - 1J	ND - 160J	ND - 16,000	ND	ND - 130J
1,2-Dichloroethene (Total)	**5**	ND	ND	61J - 9,400	7,800J - 30,000	ND-750J	ND - 680J
Chloroform	**7**	ND	ND	ND - 8,900	ND - 22,000	ND-1,200J	ND
1,2-Dichloroethane	**0.6**	ND	ND	ND	ND - 110,000	ND-38	ND - 14,000J
1,1,1-Trichloroethane	**5**	ND	ND	ND	ND - 270J	ND	ND
Trichloroethene	**5**	ND	ND	68J - 4,300	4,400J - 10,000J	ND-210J	ND
Benzene	**0.7**	ND - 470	ND - 120J	600J - 1,700	ND - 3,000J	ND-310J	29,000J - 45,000J
Tetrachloroethene	**5**	ND	ND	ND - 7,300	3,500J - 9,200	ND-210J	ND - 200J
Toluene	**5**	ND	ND - 2J	ND - 43J	200,000 - 270,000	8,500-31,000	18,000J - 65,000
Chlorobenzene	**50**	ND - 1,800J	5J - 450J	ND - 1,000	ND - 2,700J	ND-390J	ND - 7,600J
Ethylbenzene	**5**	ND - 10J	ND - 7J	ND - 180J	2,400J - 4,400	510J-1,300	ND - 330J
Styrene	**5**	ND	ND	ND	ND	ND - 24	ND
Xylene (Total)	**5**	ND - 19J	ND - 24	ND - 160	13,000 - 19,000J	2,000 - 6,200	ND - 1,200J
SEMI-VOLATILE ORGANIC COMPOUNDS - units in parts per billion (ppb)							
Phenol	**1**	ND - 7J	ND - 8J	14 - 88	4,000 - 8,000	65 - 94	2,900 - 16,000
bis(-2-Chloroethyl)Ether	**1**	ND	ND	ND	ND	ND	ND - 3,000
1,2-Dichlorobenzene	**4.7**	ND - 16	ND - 4J	16,316	ND - 260J	6J - 14J	ND - 51J
2-Methylphenol	**5**	ND - 1J	ND	ND-23	950J - 1,800	400 - 620	1,500 - 7,900J
4-Methylphenol	**50**	ND	ND - 4J	ND - 370D	12,000 - 23,000	360 - 580	14,000 - 150,000
Nitrobenzene	**5**	ND	ND	ND	ND - 8,600	ND	ND
Naphthalene	**10**	ND - 2J	ND - 2J	3J - 16J	ND - 710	ND - 1J	ND
4-Chloroaniline	**5**	ND - 12	ND	13,789	ND - 240J	59 - 140	ND - 360J
Diethylphthalate	**50**	ND	ND	ND	ND - 110J	ND - 2J	ND - 450J
Butylbenzylphthalate	**50**	ND	ND	ND - 1J	ND	ND	ND
3,3-Dichlorobenzidine	**5**	ND	ND	ND	ND	ND	ND
Benzo(a)anthracene	**0.002**	ND	ND	ND	ND	ND	ND
Chrysene	**0.002**	ND	ND	ND	ND	ND	ND
Benzo(b)fluoranthene	**0.002**	ND	ND	ND	ND	ND	ND
Benzo(k)fluoranthene	**0.002**	ND	ND	ND	ND	ND	ND
Benzo(a)pyrene	**0.002**	ND	ND	ND	ND	ND	ND
Indeno(1,2,3-cd)pyrene	**0.002**	ND	ND	ND	ND	ND	ND
Benzo(g,h,i)perylene	**5**	ND	ND	ND	ND	ND	ND

Note:
J - estimated value
ND - not detected

TABLE 2
HEXAGON LABORATORIES OPERABLE UNIT No. 2
CONCENTRATION RANGES OF ORGANIC COMPOUNDS IN GROUNDWATER OFF SITE
Sampling Dates: April 2000 - January 2001

Sample Location	Groundwater Standards	MW-6	MW-7	MW-9	MW-10	MW-11	MW-12
VOLATILE ORGANIC COMPOUNDS - units in parts per billion (ppb)							
Vinyl Chloride	**2**	ND	ND	ND	ND	ND	ND
Chloroethane	**50**	ND	ND	ND	430-950	ND	ND
Methylene Chloride	**5**	ND	ND	ND	ND	ND	ND
Acetone	**50**	ND	ND-13J	ND	ND-45J	ND-21J	ND-12
1,1-Dichloroethene	**5**	ND	ND	ND	ND	ND	ND
1,1-Dichloroethane	**5**	ND	ND	ND	ND-6J	ND	ND-4J
1,2-Dichloroethene (Total)	**5**	ND	ND	ND	ND	ND	ND-2J
Chloroform	**7**	ND-4J	ND-1J	ND	ND	ND	ND-2J
1,2-Dichloroethane	**0.6**	ND	ND	ND	ND-14	ND	ND-2J
1,1,1-Trichloroethane	**5**	ND	ND	ND	ND	ND	ND
Trichloroethene	**5**	ND	1J-3J	ND	ND	ND	ND
Benzene	**0.7**	ND	ND	ND	400-560	ND-7J	ND-1J
Tetrachloroethene	**5**	ND	ND	ND	ND	ND	ND
Toluene	**5**	ND-3J	ND	ND	ND-65J	ND	ND-2J
Chlorobenzene	**50**	ND-4J	ND-1J	ND	1,000-1,600	22-32	8J-25
Ethylbenzene	**5**	ND	ND	ND	17J-20J	ND-1J	ND
Styrene	**5**	ND	ND	ND	ND	ND	ND
Xylene (Total)	**5**	ND	ND	ND	ND-14J	ND-3J	ND
SEMI-VOLATILE ORGANIC COMPOUNDS - units in parts per billion (ppb)							
Phenol	**1**	ND	ND	ND	ND-14	ND	ND
bis(-2-Chloroethyl)Ether	**1**	ND	ND	ND	ND	ND	ND
1,2-Dichlorobenzene	**4.7**	ND-4J	ND	ND	ND	ND	ND
2-Methylphenol	**5**	ND	ND	ND	ND	ND	ND
4-Methylphenol	**50**	ND	ND	ND	ND-2J	ND	ND-1J
Nitrobenzene	**5**	ND	ND	ND	ND	ND	ND
Naphthalene	**10**	ND	ND	ND	ND	ND	ND
4-Chloroaniline	**5**	ND	ND	ND	ND	ND	ND
Diethylphthalate	**50**	ND	ND	ND	6J-7J	ND	ND
Butylbenzylphthalate	**50**	ND	ND-10J	ND	ND	ND	ND-1J
3,3-Dichlorobenzidine	**5**	ND	ND-10J	ND	ND	ND	ND
Benzo(a)anthracene	**0.002**	ND	ND-10J	ND	ND	ND	ND
Chrysene	**0.002**	ND	ND-10J	ND	ND	ND	ND
Benzo(b)fluoranthene	**0.002**	ND	ND-10J	ND	ND	ND	ND
Benzo(k)fluoranthene	**0.002**	ND	ND-10J	ND	ND	ND	ND
Benzo(a)pyrene	**0.002**	ND	ND-10J	ND	ND	ND	ND
Indeno(1,2,3-cd)pyrene	**0.002**	ND	ND-10J	ND	ND	ND	ND
Benzo(g,h,i)perylene	**5**	ND	ND-10J	ND	ND	ND	ND

Note:
J - estimated value
ND - not detected

TABLE 3
HEXAGON LABORATORIES - OPERABLE UNIT No. 2
CONCENTRATION RANGES OF UNFILTERED METALS IN GROUNDWATER ON SITE
Sampling Dates: April 2000 - January 2001

Sample Location	Groundwater Standard	MW-1	MW-2	MW-3	MW-4	MW-5	MW-8
TOTAL METALS - units are in parts per billion (ppb)							
Antimony	**3**	ND-8.3	ND	ND-3.4	ND	ND	ND-3.5
Barium	**1,000**	109-388	189-408	31.8-101	7.4-590	43-241	918J-2160
Beryllium	**3**	ND-2.1	ND	ND	ND-3	ND-0.53	ND-0.3
Chromium	**50**	7.1-125	2.3-7.4	14.2-72.5J	209J-576	139J-303	19.1J-64.2
Copper	**200**	12.4-129	ND-2.8	ND-91.6J	97.9J-1,580	6.2J-87.4	11.9-31.7J
Lead	**25**	12.2-71.1	ND-8.8	6.9J-10.5	ND-178	ND-12.6J	ND-3.8
Mercury	**2**	ND-0.28	ND	ND	ND-3.3	ND-0.29	ND-0.28J
Nickel	**100**	24.8-178	8.4-16.1	30.8J-67.3J	541J-1,010	24.5-83.1	127J-343
Selenium	**10**	ND-10J	ND-10J	ND-26.8J	ND-14.9J	ND-15.5J	ND-8
Thallium	**4**	ND	ND	ND-8J	ND-4J	ND-9.2J	ND
Zinc	**300**	830-2,500	17-44	54J-233J	104J-501	50.6-305J	11.4-2,230J
Cyanide	**100**	ND	ND	ND	51.6J-190	2ND-2	ND-21.5

Notes:
J- estimated value
ND - not detected

TABLE 4
HEXAGON LABORATORIES - OPERABLE UNIT No. 2
CONCENTRATION RANGES UNFILTERED METALS IN GROUNDWATER OFF SITE
Sampling Dates: April 2000 - January 2001

Sample Location	Groundwater Standard	MW-6	MW-7	MW-9	MW-10	MW-11	MW-12
TOTAL METALS - units are in parts per billion (ppb)							
Antimony	**3**	ND-4.6	ND	ND-5.3	ND-4.3	ND	ND
Barium	**1,000**	42.2-70	106-214	119-268	250-297	102-152	263J-349
Beryllium	**3**	ND	ND-0.44	ND	ND	ND-0.41	ND
Chromium	**50**	7.3-16.6	2.4-16.2	4.6-18.8	ND-8.1	3.1-27.9	ND-1.3
Copper	**200**	9.5-13.8	9.9-78.2	7.7-9.6	4.6-8.7	23.9-158	ND-3.5
Lead	**25**	ND-5.7	ND-26.6	ND-5.4	2.4-9.4J	4-21.2	ND-3.1
Mercury	**2**	ND-0.75	ND-2.6	ND	ND	ND	ND
Nickel	**100**	8.5-13.6	13.2-30.6J	47.5-48.8J	44.5-53.5	12.9-34.2	2.1-5.2
Selenium	**10**	ND-7.6J	ND-13.7J	ND	ND	ND	ND
Thallium	**4**	ND	ND	ND	ND	ND	ND
Zinc	**300**	39J-58.J	188-319J	ND-10.4	ND-14J	36.7-94J	ND-161J
Cyanide	**100**	ND-24.6	ND-3.2	ND-4.8	ND-3.3	ND	ND

Notes:
J- estimated value
ND - not detected

TABLE 5
HEXAGON LABORATORIES OPERABLE UNIT No. 2
REMEDIAL ALTERNATIVE COSTS

Remedial Alternative	Capital Cost	Annual O&M	Total Present Worth
1. No Action	$0	$30,100	$484,000
2. Bedrock Fracturing/Biological Enhancement/Monitored Natural Attenuation/Institutional Controls	$5,500,000	$36,000	$5,820,000
3. Bedrock Fracturing/Chemical Oxidation Using Fenton's Reagent/Monitored Natural Attenuation/Institutional Controls	$2,753,000	$36,000	$3,130,000
4. Bedrock Fracturing/Dual-Phase Vapor Extraction/ Monitored Natural Attenuation/Institutional Controls	$2,511,000	$410,000*	$4,900,000

* Annual O&M costs for duration of the operation of the remedy. O&M costs decrease t0 $36,000 after the remedy is complete.

APPENDIX A

Responsiveness Summary

RESPONSIVENESS SUMMARY

Hexagon Laboratories Operable Unit No. 2
Proposed Remedial Action Plan
Bronx County
Site No. 203003

The Proposed Remedial Action Plan (PRAP) for the Hexagon Laboratories Site (Hexagon), Operable Unit No. 2 (OU2), was prepared by the New York State Department of Environmental Conservation (NYSDEC) and issued to the local document repository on February 18, 2002. This Plan outlined the preferred remedial measure proposed for the remediation of the contaminated groundwater at Hexagon. The preferred remedy is groundwater treatment using in-situ chemical oxidation or dual phase vapor extraction.

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

A public meeting was held on March 7, 2002 which included a presentation 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 Carmen Angueira, District Manager of the Bronx Community Board #12; Loree Shelko and Eric Rothenberg of Morgan, Lewis, and Bockius LLP; and Robert Johnston and Bruce Nelson of Malcolm Pirnie. The public comment period for the PRAP ended on April 17, 2002. The comment period was extended to this date because the NYSDEC received a written request for a reasonable extension of the comment period.

This Responsiveness Summary responds to all questions and comments raised at the March 7, 2002 public meeting and to the written comments received.

The following are the comments received at the public meeting, with the NYSDEC's responses:

Comment 1: What is a "remedial program?" Are we going to do anything about the Hexagon site? It seems like we hear proposals, but nothing gets done at Hexagon.

Response 1: The "remedial program" described at the public meeting is the process that NYSDEC follows to investigate and remediate an inactive hazardous waste disposal site. Some remediation has already taken place at Hexagon and further remediation is planned. NYSDEC completed an Interim Remedial Measure at the site which included the removal of aboveground and underground tanks, soil removal, asbestos abatement and demolition of several buildings. The NYSDEC is in the process of designing a soil cleanup at Hexagon and the groundwater at

Hexagon will be remediated using one of the technologies discussed in this ROD.

Comment 2: Is money allocated to implement this plan?

Response 2: The money to implement this plan can be obtained either by reaching agreement with the responsible parties to perform the remediation, or by the State legislature reappropriating money for the State Superfund Program.

Comment 3: Who are the responsible parties?

Response 3: The Potentially Responsible Parties (PRPs) for the site, documented to date, include its former owners and operators, including parties related to the Boehringer Ingelheim Corporation and Hexagon Laboratories, as well as other chemical and pharmaceutical companies which entered into toll processing agreements and thereby generated hazardous wastes at the Site. A "toll processing agreement" is an agreement between two companies to engage in a type of manufacturing arrangement. Toll processing is any further processing performed on another party's product or materials for a fee.

Comment 4: Is the contaminated groundwater on site going to impact Eastchester Creek?

Response 4: The site is about 1000 feet from the Hutchinson River (Eastchester Creek). Given that the concentrations of groundwater contamination drop significantly immediately off site, it is unlikely that the groundwater contamination at the site will migrate that far before the cleanup is implemented.

Comment 5: The proposed remedy looks expensive. Looking at the high costs, who is going to pay for it?

Response 5: Either the State Superfund Program will pay for the remedy and the State will pursue cost recovery from the responsible parties or the responsible parties will pay for the remedy.

Comment 6: If the city demolishes the building, would it interfere with the remedy?

Response 6: No, the demolition of the building would not interfere with the remedy.

Comment 7: Is there anything the community can do to persuade the Governor or legislature to pass State Superfund Reauthorization?

Response 7: Community members, whenever they want any legislation passed, can contact their legislators and the Governor and express their support of the legislative bill.

Comment 8: What is total cost to clean up the site (OU1 & OU2 combined)?

Response 8: The cost of the remedial investigations, feasibility studies, and Interim Remedial Measures at the site is approximately $2.8 million. The proposed cost of the OU1 soil remedy is approximately $2.35 million. The estimated costs of cleaning up the groundwater (OU2 remedy) are between $3 and $4.9 million. The total cost of remediating the site would be between $8.15 million and $10.05 million.

Comment 9: Should the Community Board pressure the Housing Preservation and Development (HPD) to take remaining buildings at Hexagon down?

Response 9: The money available from the State Superfund cannot be used to demolish buildings unless they interfere with a remedial investigation or remedial action. If the Community Board wants the remaining buildings at Hexagon demolished it is an issue that could be dealt with by HPD or the property owner.

Comment 10: What priority has the State given to the Hexagon Laboratories cleanup?

Response 10: All Class 2 Inactive Hazardous Waste Disposal Sites listed on the New York State Registry are ranked according to priority. Sites are ranked from 1 to 3. Priority 1 sites are the highest priority and remediation of these sites should take precedence over all other Class 2 sites. Hexagon Labs has been ranked a Priority 1 site.

Comment 11: What was the danger posed by the site and chemicals to the community BEFORE the United States Environmental Protection Agency (USEPA) and NYSDEC performed the cleanups to date?

Response 11: When the site was inspected by the EPA in 1990, prior to any removal actions, there were numerous hazards due to the abandoned chemicals left on site. The dangers included fire hazards, explosion hazards, and health hazards due to possible exposure to any number of the materials left on site. There was significantly more potential for environmental damage if those abandoned chemicals were spilled onto the ground . Virtually all abandoned freestanding chemicals were removed during the course of the New York City Bomb Squad's and EPA's removal actions in 1991 and 1992.

Any remaining concentrated chemicals were removed during the NYSDEC's Interim Remedial Measure which was carried out between July 1997 and January 1998.

Comment 12: I think the site is a hazard to the community, especially to the homeless. The buildings should be demolished in order to rid the hazard to the homeless.

Response 12: NYSDEC, in conjunction with the New York City Dept. of Health (NYCDOH), has made numerous unsuccessful attempts,, to persuade the homeless to leave the site and to barricade the site to prevent trespassers. As a result of the removal actions completed at the site the remaining buildings and surface soil no longer pose an imminent health hazard to the homeless. New York State laws prevent NYSDEC from spending any Superfund money to tear down buildings that do not interfere with hazardous waste investigations or remediations.

Comment 13: Last year Senator Malcolm Smith proposed an addendum to the State Superfund bill to refinance State Superfund. The legislature was trying to address the State Superfund, but with no budget and the tragedy of September 11, 2001, the bill was never passed.

Response 13: Comment noted. See Comment 7 above.

Comment 14: Which would be the most protective alternative, 2, 3, or 4?

Response 14: Alternatives 3 and 4 would both be protective of human health and the environment. These two alternatives would treat the organic contaminants of concern (COCs) on site, thereby reducing their toxicity and mobility on site. In Alternative 3, in-situ oxidation using Fenton's reagent would be used to treat the organic COCs. In Alternative 4, the extraction of contaminated groundwater would be effective in preventing further migration of the plume and organic and metal COCs would be removed. Alternative 2, enhanced biological degradation of organic COCs, would not be as protective because it would not treat all of the organic COCs, which are the most mobile contaminants.

Comment 15: What is the sequence of the remediation?

Response 15: After the Record of Decision (ROD) is issued, either a consent order will be signed with the responsible parties requiring them to design and construct the selected remedy, or the site will again be referred to the State Superfund program for implementation of the remedy. Then, regardless of who is paying for the work (State or responsible party), a work plan will be developed, followed by a detailed design of the remediation system, including pilot testing of bedrock fracturing and groundwater treatment systems. The design will include such information as number of wells to be installed, pump size, size and length of piping, and other technical requirements. That information will be used to develop bid documents. The job will be put out to bid, the contracts will be awarded and the contractor will build, startup, and operate the groundwater treatment system.

Comment 16: Have you tested the Fentons yet?

Response 16: Although Fentons has not been tested at this site in particular, it has been successfully used at many other inactive hazardous waste sites. The purpose of the pilot testing mentioned in this ROD is to develop the final engineering parameters needed to construct the remedy.

Comment 17: Can the site be developed with the dual phase extraction alternative or Fentons alternative?

Response 17: If the dual phase extraction alternative was implemented, it is possible that the rest of the site could be developed in an alternate manner, as long as enough space was available for the waste water treatment system. It would not be appropriate to concurrently develop the site while the Fentons was being used because of the possibility of fugitive emissions. Fenton's reagent generates gas as part of the chemical reactions taking place and will be carefully monitored during the remediation.

Comment 18: The Community Board meets on the 21st of March 2002 but the comment period closes on March 18. Can we submit comments from the Community Board after the 21st?

Response 18: The comment period was extended because of public interest until April 17, 2002.

Comment 19: Why are there less than thirty days between the date of the public meeting (March 7) and the close of the comment period (originally March 18)?

Response 19: The date of the public comment period begins with the public release of the PRAP; for this PRAP that date was February 18, 2002. NYSDEC purposely schedules the meeting during the middle of the comment period so that people have the opportunity to review the documents in the repositories before the public meeting is held, and then allow people time after the meeting to compose and submit additional comments.

Comment 20: Which alternative (3 or 4) would get more contamination out of the site?

Response 20: The treatment capabilities of the two alternatives are very comparable. Both alternatives will treat the organic contaminants of concern at the site. Alternative 4 will also treat metals in the groundwater. However, the metals contamination at the site is limited and would not warrant groundwater treatment by itself.

Comment 21: Do we know, that as we speak, if the groundwater is contained at the site?

Response 21: The groundwater is not contained on site; it is slowly moving beneath the site. Based on the lack of significant contamination in off-site groundwater it is clear that contaminated groundwater is not moving very quickly from the site.

Comment 22: Has NYSDOH been monitoring hospital admissions from 1988 to date, to see if cancer rates (e.g., lung cancer) in this area are higher due to this site?

Response 22: The NYSDOH does monitor the incidence of cancer across the state and that information is available on their Website http://www.health.state.ny.us/nysdoh/cancer/csii/nyscsii.htm. However, the NYSDOH has not specifically studied the incidence of cancer in relationship to the Hexagon site;.

Comment 23: How dangerous is this site right now?

Response 23: The NYSDOH has stated that under existing unremediated conditions, trespassers could be exposed to site contaminants. However, in an effort to limit exposures the site is fenced to prevent trespassing and signs are posted that say "Do Not Enter". Also, untreated groundwater at the site could potentially impact the Hutchinson River and would not be suitable for potable or industrial use.

Comment 24: We have found toxins in soil and groundwater. Did these toxins leach into the ground? Do we know how they got there?

Response 24: It appears that the site was contaminated by leaking underground storage tanks and sloppy operational practices that allowed chemicals to be spilled on the ground and seep into the soil and groundwater.

Comment 25: Are there any signs that say “Do Not Enter” at the site?

Response 25: Yes, there are several signs that warn people not to enter.

Comment 26: Several years ago, the State had security guards at the site. Why aren’t they there now?

Response 26: The State Superfund program can be used to fund work that is directly related to site investigations or cleanup. The State hired security guards to protect the equipment on the site at night while we were investigating and doing an interim remedial measure. Superfund law would not allow us to pay to maintain security at the site continuously.

Comment 27: What is the $480,000 for Alternative 1 (No Action) for?

Response 27: That dollar figure is based on the costs associated with annual groundwater monitoring for 30 years at the site.

Comment 28: At the last public meeting we were told that there were underground tanks still in place. Now you are telling us they are not? When were they removed?

Response 28: Prior to the last Hexagon public meeting (October 1999), all of the underground tanks at the site had been removed. They were removed during the interim remedial measure which took place from July 1997 to January 1998.

Comment 29: Shouldn’t you test the creek to see if it is impacted by groundwater?

Response 29: NYSDEC chose not to investigate the creek (Hutchinson River) because the levels of contamination found directly off site were significantly lower than those found on site.

Comment 30: How fast is contamination moving in groundwater from the site?

Response 30: The groundwater is moving at the rate of a few feet per year through the site.

Comment 31: A neighbor has a well that she uses for her dogs and to wash the sidewalk on Prospect St. Is it safe for her to use?

Response 31: Groundwater at the Hexagon site flows in the direction opposite from her house. NYSDEC did not test water in that direction as it would not be affected by the site.

A letter dated April 15, 2002 was received from Carmen Angueira, District Manager of Bronx Community Board No. 12, which included the following comment:

Comment 32: The members of Bronx Community Board No. 12, present at their March 21, 2002 meeting voted unanimously to recommend to the NYSDEC the acceptance of alternative 4 for the remediation/cleanup of Hexagon Laboratories, since it will cleanup both inorganic and organic contaminants of concern.

Response 32: NYSDEC has not chosen Alternative 4 (dual phase vapor extraction) over Alternative 3 (Fenton's Reagent) because the metals contamination at the site is minor and does not appear to have gone off site. In the dissolved metals samples, only antimony, barium, chromium, nickel, selenium, thallium, and zinc were detected at concentrations greater than the groundwater standards.

The highest concentrations of the above-mentioned dissolved (filtered) metals were found on site in the following wells: MW-1 contained antimony at 18.3 ppb [groundwater standard of 3 ppb] and zinc at 2,200 ppb [300 ppb]; MW-4 contained chromium at 212 ppb [50 ppb], nickel at 623 ppb [100 ppb], and selenium at 14.3 ppb [10 ppb]. In MW-5 thallium was found at 7.6 ppb [4 ppb]; and in MW-8 barium 2,000 ppb [1,000 ppb]. Off-site the only dissolved metals sample above standard was in MW-9; antimony at 5.1 ppb [3 ppb].

A letter dated April 17, 2002 was received from Robert Johnston and Bruce Nelson of Malcolm Pirnie which included the following comments:

Comment 33: A review of the above referenced report indicates that six new monitoring wells were installed (MW-7 through MW-12) during the remedial investigation for OU2 along with associated groundwater quarterly sampling in April 2000, July 2000, October 2000, and January 2001. The monitoring wells installed during this scope of work included: MW-7, located on the western side of Peartree Avenue near the intersection of Boston Road: MW-8, located onsite about 20 feet north of MW-4; MW-9/MW-10, located on the eastern section of Heathcote Road near the intersection of Boston Road; and MW-11/MW-12, located on the western side of Heathcote Road near the intersection of Hollers Avenue.

A review of Figure 2-4 of the above referenced report indicates that the screen lengths are set at different elevations in the underlying Manhattan Schist. MW-5 and MW-6 are both set with the tops of the screen below the top of the Manhattan Schist, while MW-3 and MW-4 are set with the tops of the well screen above the top of the Manhattan Schist. The locations of the well screens have the potential to provide a pathway for contaminant migration by the connection of fractures within the bedrock with impacted groundwater on top of the bedrock. This is particularly significant in MW-3 and MW-4, where the higher concentrations of volatile organic compounds (VOCS) including halogenated volatile compounds, were measured. Cohen and Mercer, two leading authorities in the field of groundwater remediation (Cohen, Robert M. and Mercer, James W., DNAPL Site Evaluation C.K. Smokey Press 1993) state that there is a strong potential of mobilizing dense non-aqueous phase liquids (DNAPL) during site investigation activities. Conventional drilling activities and wells screened across the bedrock/soil interface have a high potential to mobilize and promote vertical DNAPL movement by connecting fractures that were otherwise isolated. This is particularly significant where the remediation focus requires identification of the fracture zones for remediation and/or monitoring.

Response 33: Care was taken to ensure that the drilling process did not cause any cross-contamination. Based upon the results of the borehole investigation, NYSDEC does not believe that there existed any natural impediment, such as a confining layer, that would have prevented downward vertical flow of contaminants between the overburden and bedrock beneath the site.

Comment 34: Cohen and Mercer recommend first developing a "Conceptual Model" of the site, preferably through research, non-invasive geophysical techniques, and "outside-in" investigative techniques to minimize the potential for promoting DNAPL migration during the site investigation. It is unclear if a conceptual model of fate and transport was developed for the Hexagon site. If those precautions were not taken at the Hexagon site, the site investigation itself may have exacerbated the spread of groundwater contamination.

Response 34: NYSDEC prepared a work plan prior to conducting investigations at the site. This work plan considered all pertinent site-specific information related to the subsurface geology, hydrogeology, and waste disposal history at the site. The methods used to investigate the site and to install monitoring wells are well accepted amongst experts in the field. There is no evidence that the State's investigation spread groundwater contamination.

Comment 35: MW-8 is the only deep well with elevated concentrations of VOCs. As discussed above, the location of MW-8 is approximately 20 feet north of MW-4. The well was drilled using hollow stem auger techniques through the overburden (approximately 4.5 feet below the surface). A strong chemical odor was noticed during the drilling activities; however, drilling continued beyond the depth at which the odor was detected. The initial coring could not keep a mud seal, and the coring was moved over 2 feet and drilled with a tri-cone bit to 5 feet below the ground surface. The rock was cored to a depth of 10 feet below the ground surface, and then reamed using an approximate 12 inch diameter bit the following day to set the conductor casing. The drilling activities had the potential to promote migration of DNAPL through fractures in the upper 10 feet prior to the installation of the conductor casing, and to subsequent depths as the drilling proceeded.

Response 35: There are three other deep wells associated with this investigation and there is contamination above groundwater standards in all of those wells. In MW-8 the well was sealed with casing. After the installation of MW-8, it was developed and then sampled four times over the course of a year, each sampling event required the purging of several well volumes. Contaminant concentrations did not change significantly at all during that time. If contamination had been brought down during drilling, the repeated purging and sampling of the well would have reduced concentrations over time. There is no reason to suspect that the contamination in MW-8 is from the surface.

Comment 36: It is unclear why the well was extended to a depth of 100 feet and grouted with bentonite pellets to a depth of 85 feet for final well installation. Observations of impacts were made at depths of 25 to 30 feet below the ground surface; however, the drilling continued in an open (below a depth of 10 feet) borehole. Cohen and Mercer state that downward migration of DNAPL may occur in "an open borehole during drilling and prior to well installation."

The basis for the establishment of the well screen at depths of 75 to 85 feet below the ground surface is also not provided; it appears that borehole geophysics were not performed to attempt to identify fractures and orientation that would likely facilitate DNAPL and VOC migration. The EPA report, The State of the Practice of Characterization and Remediation of Contaminated Groundwater at Fractured Rock Sites (EPA 542-R-01-010, July 2001), indicates that it is the discrete fracture pathways not the total fracture network, that is of critical importance in understanding contaminant migration. The fractures must be conductive to the contaminant and be inter connected to be a migration pathway. The EPA report indicates that drilling and coring are typically followed by geophysical borehole logging to provide more information on fracture zones. Geophysical logging is often complemented by hydraulic testing (cross-hole tests, etc.) to confirm fracture interconnection.

Response 36: The depth of the borehole was selected by examining the cores collected while coring and looking for what appeared to be the most conductive zone. This is a very effective and widely practiced method for selecting screen depths in bedrock wells. The references referred to provide general information about DNAPLs and site investigations. NYSDEC used site-specific information when deciding how and where to install monitoring wells.

Comment 37: Figure 2-4 depicts a downward vertical gradient, assuming that the fractures which transmit groundwater in the shallow wells are also connected to the fracturing encountered at 75 to 85 feet below the ground surface in MW-8. This downward vertical gradient may explain the presence of high concentrations of acetone at depth in MW-8; however, it is still unclear whether the groundwater measured in MW-8 is consistent with the shallow groundwater. No geochemical testing was performed to confirm that the groundwater measured in MW-3 and MW-4 is consistent with MW-8. Additionally, the pumping rate in MW-8 is considerably higher than the other wells, suggesting a connection to a different water-bearing fracture system. Extensive pumping at depth can also mobilize contaminants in a downward vertical direction: this may have exacerbated the vertical migration of the contamination measured in MW-8.

The current contamination measured in MW-8 cannot be attributed to a specific fracture system and depth. It is clear from the results of the shallow groundwater monitoring wells that impacted groundwater is present on top of the Manhattan Schist bedrock. However, it is unknown if the groundwater impacts measured are representative of fracture impacts from higher elevation (10 feet, 25 to 30 feet and other elevations) that were introduced into the well during drilling activities.

The lack of information on the fracture system and the migration pathways makes it difficult to quantify what depths and which fractures actually contain the contaminants, which in turn complicates the development of a recommendation for remedial action to mitigate their impacts. The significance of the likelihood that the measured impacts in MW-8 are the result of the drilling activities cannot be understated, and must be considered in planning the remedial strategy.

Therefore it is unknown if the vertical drilling of MW-8, performed in contravention to the Cohen and Mercer recommendations for investigations at fractured bedrock sites with potential DNAPL, allowed contamination to migrate downward to where it had not previously been present. Geophysical techniques were not performed, which would have assisted in delineating potential water-bearing fractures to evaluate for groundwater impact, and would have assisted in screening the wells at depths to understand the contamination distribution in a “top down” manner.

Without an understanding of where the potential VOC mass resides (i.e., at what depth and in which fractures), implementing a remediation program consisting of injections at depths of 80 feet may mobilize contaminants in fractures and exacerbate the spread of contamination, both horizontally and vertically. This risk is discussed in further detail below.

Response 37: NYSDEC used accepted methods to investigate soils and groundwater and to install monitoring wells at the site. Comparing the average concentrations in MW-8 and MW-4 over the four rounds of sampling from April 2000 until January 2001, MW-8 contains, on average, 332,500 ppb acetone, MW-4 contains 350 ppb; MW-8 contains 170 ppb 1,2 dichloroethene, MW-4 contains 18,450 ppb; MW-8 contains no trichloroethene, MW-4 contains 7,225 ppb; MW-8 contains 32,259 ppb benzene, MW-4 contains 2,175 ppb~~;~~. This would not indicate that the groundwater in MW-4 flowed directly into MW-8. Having carefully reviewed this and other site-specific data, including the results of soils and groundwater sampling, NYSDEC has no reason to believe that cross-contamination has occurred.

NYSDEC believes that more than enough information was gathered during the RI for OU1 and OU2 to select an appropriate remedy for the groundwater. Additional information will be collected during pre-design studies for the remedy.

Comment 38: Source identification was discussed in the Phase I investigation at the site. A service station was present at the site between the mid 1930's until at least 1950. This service station was located at the corner where the existing office/warehouse presently is. Details concerning the removal of underground storage tanks or other activities at the site are unknown. In addition, numerous auto wrecking/salvage yards with apparent liquid disposal to the ground are present adjacent to the site and in the surrounding areas. A large operational service station is situated approximately three blocks from the site with numerous monitoring wells on and off site. These stations are not discussed in the above documents.

The proportional presence of benzene, toluene, ethylbenzene and xylene (BTEX) compounds at the site show a close resemblance to the proportions associated with gasoline liquids. NYSDEC has not investigated the potential for on site (per Hexagon Laboratories) or off-site facilities as potential BTEX sources, however, BTEX compounds are considered as part of the remedial goal stated above. Additional information is required to quantify the extent to which such off-site sources of VOCs and BTEX represent continuing sources.

Response 38 : It is clear from the site history, the soil contamination present on site, and the number and condition of the tanks found that Hexagon Laboratories caused serious soil and groundwater contamination at the site. Although some wells do have the four constituents listed above, it is not clear that the ratios are indicative of BTEX. MW-8 has a much higher level of benzene than would be predicted by contamination by gasoline. Beyond those four compounds, most of the wells on site have high levels of chlorinated and non-chlorinated solvents, which are known to have been used on site and which are not related to petroleum compounds.

There are other businesses in the area which may have contributed to area wide groundwater contamination. The RI results show that groundwater flows in the eastern direction. The auto salvage yards mentioned above are downgradient of the site. The operational service station is also downgradient of the site. The wells on the upgradient portion of the property have little or no contamination in them, indicating that impacted groundwater is not flowing onto the site.

Comment 39: The PRAP selects four remedial goals for the project: Eliminate to the extent practicable, groundwater contamination on-site that exceeds NYSDEC Class GA ambient water quality criteria.; Eliminate, to the extent practicable, extraction of groundwater impacted at the site that does not meet New York State Department of Health(NYSDOH) water quality criteria.; Eliminate, to the extent practicable, off-site migration of groundwater that does not meet NYSDEC Class GA ambient water quality criteria.; Eliminate, to the extent practicable, migration of Non Aqueous Phase Liquids (NAPL)

Although these goals are conditioned by the language, to the extent practicable, they are over broad because the site groundwater is unlikely to be considered a viable drinking water source. This area is currently served by the New York City Department of Environmental Protection (NYCDEP) Public Water Supply System; therefore, there is no need for consumption of on-site drinking water.

Response 39: See response below, response 55.

Comment 40: The PRAP should also emphasize that the scientific potential of meeting NYSDEC Class GA ambient water quality criteria is low to non-existent. This is further supported by the above-referenced EPA report and other documents that indicate that the remediation of groundwater to drinking water standards, within a fractured bedrock regime is unattainable. Additionally, the resource value of such water is low to nominal, since the fractures typically cannot yield enough groundwater flow for sustained consumptive or beneficial use.

Response 40: The proposed remedy will significantly lower the levels of contaminants found in on-site groundwater. NYSDEC recognizes that attaining groundwater standards in all the groundwater affected by Hexagon Laboratories is not likely. This does not obviate the need for groundwater remediation at the site to the extent practical. The PRAP does note that the contamination not removed by the remedy would naturally attenuate over time.

Comment 41: The PRAP should also state the basis for the assumption of the remedial alternatives. For example, two of the alternatives (Fenton's reagent and dual phase vapor extraction) assume that natural attenuation would reduce concentrations to drinking water levels after a portion of the remedy is completed. This is based on very optimistic degradation rates with no basis for determining whether such rates could be achieved on the site. A comparison of the alternatives indicates that slower rates were used for the natural attenuation alternative, which is inconsistent.

Response 41: The PRAP does not contain all the assumptions listed in the feasibility study report. The PRAP's description of the various alternatives is only meant to be a summary. For those that wish to examine the alternatives in more detail the FS report is available for public review.

Rates of natural attenuation are chosen using available analytical data and are estimates only. Regardless of the natural attenuation rates that were used in the FS, the groundwater will be cleaner much sooner if the high contaminant concentrations in groundwater are remediated now as opposed to not implementing an active remedy at all.

Comment 42: Inherent difficulties and impracticabilities are also associated with attempting to induce an oxidant into the bedrock fractures. For example, it is necessary to know where the fractures are that contain contaminated groundwater, and to understand the interconnection with other fractures that may result in the mobilization of contaminated groundwater by the physical process of oxidant injection. The PRAP indicates that mitigation of NAPL movement is a primary goal; however, the remedial alternatives may increase the potential for migration of NAPL during the injection process. The attainment of the first three remedial goals, even to the extent practicable, requires an understanding of where the contaminated groundwater is present in the bedrock fractures.

Response 42: NYSDEC recognizes that injecting oxidants in a fractured formation requires careful design and engineering. As stated above, this has been successfully done at several hazardous waste sites in New York State. After conducting a careful analysis of site-specific conditions, NYSDEC has no reason to believe that fracturing and injection could not be conducted successfully at the Hexagon site. When the remedy is implemented, if fracturing is done, engineering controls will be implemented to ensure contamination doesn't move away from the site. For example, wells could be installed in and around the perimeter of the site prior to fracturing and could be pumped while the fracturing is occurring to ensure contamination is captured at the perimeter.

The Manhattan Schist at this site is a tight formation and it will be difficult to remediate contaminated groundwater and pockets of NAPL without fracturing of the bedrock.

Comment 43: As discussed above, given the amount of information provided, the location of the impacted water within and beyond the limits of MW-8 cannot be determined.

Response 43: The contamination at MW-8 has been well documented. The contaminant levels beyond MW-8 can be determined during the pre-design study of the remediation. This will not affect the selection of the remedy.

Comment 44: Based on the above information, the selection of a remedy to mitigate the site to the above referenced goals is premature and arbitrary at this time, considering the limitations of the remedies (as discussed below), the uncertainty of the location of the fractures located that contain the contamination and the risk that the implementation of remediation will exacerbate the spread of contamination.

Response 44: See responses above and below, including but not limited to, responses 37, 48, 51, and 52..

Comment 45: Alternatives 2, 3, and 4 include "bedrock fracture enhancement" coupled with biological enhancement Alternative 2, with *in situ* oxidation using Fenton's reagent [sic]. Bedrock fracture enhancement might use pneumatic fracturing or other means of bedrock fracturing. The PRAP specifies that bench and/or pilot scale testing would be conducted prior to full-scale implementation of this alternative. However, there is no vendor information to suggest that the Manhattan Schist can be pneumatically fractured. This alternative also specifies that the Fenton's reagent injection would be applied via a grid of injection wells across the source.

Because the PRAP includes a bench- and/or pilot scale test and the installation of a "grid" of injection points, the selected remedy should allow evaluation of whether using a grid of injection points without fracturing would be effective. For example, cross-borehole methods can be used to demonstrate the hydraulic connectivity of adjacent boreholes. If cross-boreholes testing shows connections among bedrock fractures in the source area, then bedrock fracturing is not necessary and the potential for creating or enhancing off-site migration would be eliminated. This should be done in a top-down process to attempt to identify fracture zones within proximity to the shallow sources. Such a process should also proceed only after the majority of the OU1 remediation is implemented, to reduce the potential for vertical contamination of fracture zones.

Thus, the focus is to have oxidants injected in the boreholes travel along the same fractures that originally allowed the migration of the VOCs. This would place the oxidants in direct contact with the highest concentrations of the VOCs. There is no evidence presented in the RI/FS to show that significant diffusion of the constituents into the bedrock matrix has occurred. Based on the low bulk permeability and the low organic content of the Schist, matrix diffusing may be minimal. Therefore, the mass of constituents would be in the existing fracture.

It is requested that, in light of the PRAP's inclusion of the requirement for a bench-and/or pilot scale testing, the explicit requirement for bedrock fracture enhancement be removed from the proposed Record of Decision (ROD). As discussed above, the results of the additional investigations have not demonstrated at what depths and in what fracture zones the higher concentrations of various VOCs are present at the site. Conversely, the concentration of these same VOCs in groundwater sampled at off-site locations are significantly lower. While the enhancement of bedrock fractures can be controlled to some extent, it is not a predictable science. As such, there is the real potential that pneumatic or other fracturing methods could create or enhance groundwater migration pathways that extend from the on-site source areas to off-site areas. This could increase the concentrations of the VOCs that are currently measured off-site. As presented in the PRAP, active remediation of groundwater beyond the site boundaries is not included in any of the considered remedial alternatives.

Response 45: The PRAP does not contain all the details of the Feasibility Study but is meant to be a summary. The State's consultant did consult several vendors, including blasting contractors, when developing the alternatives in the FS.

If it is demonstrated to NYSDEC's satisfaction that sufficient capture of groundwater/NAPL contamination is possible without fracturing the bedrock, the fracturing component of this remedy may be eliminated.

Comment 46: Due to the unproven nature of the use of pneumatic fracturing techniques under these circumstances and the risk of spreading contamination that may result, the Defendants fear that the requirement to perform pneumatic fracturing may render the remedy unworkable. At the very least, NYSDEC should indemnify the PRPs for any increase in off-site contamination levels resulting from pneumatic fracturing. This is because such an unproven and risky technique is likely to be uninsurable. The Defendants cannot state strongly enough that the risk of spreading contamination is unacceptably high, and that pneumatic fracturing should be an option to be evaluated during bench and pilot scale testing, rather than a mandatory part of the remedy.

Response 46: As previously stated, pneumatic fracturing is simply one fracturing option, and the remedy now allows the possibility of eliminating fracturing, if it can be demonstrated to NYSDEC that other techniques are viable. In addition, if fracturing is used, various engineering controls can be used to minimize any risk of spreading contamination. Finally, NYSDEC does not indemnify any PRPs for work which is undertaken to remediate contamination at any site.

Comment 47: The PRAP also specifies the use of Fenton's reagent for Alternative 3. While Fenton's reagent is a commonly used oxidant for the types of groundwater contaminants present at the site, it is not the only oxidant that may be feasible. Sodium persulfate, ozone, or other oxidants may be appropriate. For example, we have previously provided to the NYSDEC an abstract form the *First International Conference on Oxidation and Reduction Technologies for In-site Treatment for Soil and Groundwater (Brown, et al., 2001)* that discusses the use of sodium per sulfate. The suitability of such alternate oxidants could be evaluated during the bench- and /or pilot study required by the PRAP. Accordingly, it is recommended that the ROD provide for the use of an oxidant but allow for the selection of the specific oxidant, or combination of oxidants, to be made following the completion of bench- and/or pilot studies.

Response 47: The ROD allows for the use of an alternate oxidant.

Comment 48: The PRAP states that dual phase vapor extraction is a potential alternative; however, it provides no studies or documentation regarding sites where dual phase vapor extraction has worked for fractured rock similar to Manhattan Schist. Additionally, it is critical to understand that the effectiveness of such a technique will require a complete understanding of the conceptual site model, the ability to quantify the amount of fluid at different elevations within the bedrock, and the ability to measure the impacts of groundwater within such fractures. As discussed above, this information has not been quantified to date.

Response 48: Dual Phase vapor extraction (DPVE) has been performed successfully in New York in bedrock. Also, one of the useful aspects of DPVE is that it does not require an intimate knowledge of the formation. If a vacuum is pulled on the formation, water and vapor will be extracted even though the pathway of every molecule is not known.

Comment 49: The remedy specified in the PRAP would require discharge of groundwater to storm sewers. The storm sewers in the area typical of New York City and are combined sanitary and storm water systems. This means that during wet weather periods, some of the precipitation is discharged first to the sanitary treatment system after which system capacity is achieved, resulting in an untreated discharge to local surface waters. In general, New York City ordinances prohibit the discharge of groundwater to the storm sewer systems.

Response 49: It is not required by the ROD that the DPVE treated groundwater be discharged to the storm sewers. This is one option that may be possible. Treated groundwater may be disposed of by other means if it is more appropriate.

Comment 50: The ROD for OU1 states that the remedy for groundwater will be proposed within "1 year after the remedy for soil (OU1) is completed and its effect on groundwater quality can be observed." Completing the ROD for OU2 should be done in accordance with OU1 ROD, taking into account the remediation-specific comments provided herein.

Response 50: The OU1 ROD states that “the remedy for the groundwater will be proposed within a year after the remedy for the soil is complete and its effect on groundwater quality can be observed.” The implementation of the remedy for OU1 was delayed to give the responsible parties an opportunity to do the work. Also, at the time of the writing of the OU1 ROD the extent of the groundwater contamination was not fully understood. At this point it would be counterproductive to postpone the remediation yet another year. Groundwater treatment should begin as soon as possible and would likely occur after the OU1 remedy has been implemented, due to the pre-design bench and/or pilot studies that are needed prior to implementing the remedy for OU2. If substantial changes in groundwater contamination occurred due to the completion of the OU1 remedy such that the OU2 remedy required significant modification, that could be done through the ROD amendment process.

Comment 51: Based on the above information, the selection of the remedies outlined in the PRAP is arbitrary and premature at this time due to the following: the Remedial Investigation Report does not provide a clear picture of the location and connection of contaminated groundwater in the fracture zone; Inadequate site characterization and the significant potential for exacerbation of the spread of the contamination in the bedrock groundwater system; lack of basis for effectiveness of each of the alternatives and the arbitrary use of contaminant degradation rates that enhance the chosen remedy and bias the selection process against monitored natural attenuation; risk that pneumatic fracturing and injection of oxidants may mobilize contaminants, causing exacerbation of the spread of contaminants, in a vertical and horizontal direction; inability to attain class GA standards is not directly addressed in the PRAP, nor is it made clear that the standards can never be achieved. Moreover, these standards are clearly not applicable to this site; and groundwater resource value is nominal due to salinity and yield.

Response 51: NYSDEC has performed the investigation and collected enough data to confidently select a remedy for OU2. NYSDEC understands that the remedial investigation does not provide all the information needed to complete a remedial design. This will be completed as part of the pre-design study.

Comment 52: NYSDEC should indicate that the proposed remedial techniques are an attempt to mitigate the mass concentrations at the Site, and the oxidation should be limited to depths where the known concentrations have been measured. This requires the selection of a single remedy, a basis for the reduction of VOC mass for that remedy, and a basis for confirming that such a remedy will not increase the spread of contamination but will reduce and mitigate the measured contamination at the site.

Response 52: It is clear that the remedies are being selected to reduce contaminant concentration at Hexagon Laboratories. As stated in Section 8 of the ROD, the operation of the components of the remedy will continue until the remedial objectives have been achieved, or until NYSDEC determines that continued operation is technically impracticable or not feasible.

As pointed in the above comments, the full extent of the contamination is not known, since not all bedrock fractures on site have been found. However, the remedies proposed do not require that all bedrock fractures on site be found for these remedies to be effective. Oxidation will be limited to the on site areas that are found to be contaminated, including additional contamination if it is found during the pre-design study.

NYSDEC is confident that either selected remedy, properly implemented with appropriate controls, will contribute to the cleanup of the groundwater in the Hexagon site area and not exacerbate the situation. When two alternatives would each satisfy the remedy selection criteria, it is possible and appropriate for NYSDEC to propose either remedy for a site. For this Hexagon OU2 Record of Decision, the RPs specifically asked NYSDEC to consider the dual phase extraction remedy in its Feasibility Study. Since the dual phase extraction remedy and the in situ oxidation remedy would both satisfy the remedy selection criteria, NYSDEC is justified in proposing either for the Hexagon OU2 remedy.

A letter dated April 17, 2002 was received from Loree Shelko and Eric Rothenberg of Morgan, Lewis, and Bockius LLP which included the following comments:

Comment 53: The Class 1 PRPs [Potentially Responsible Parties] have several serious concerns with the proposed remedy as set forth in the PRAP and supporting documents. The Remedial Investigation Report (RI) prepared for OU2 does not provide a clear picture of groundwater contamination at the Hexagon Laboratories, Inc. site (the Site), especially within the fracture zone.

Response 53: See responses above, including but not limited to, responses 37, 48, 51, and 52.

Comment 54: Indeed, the RI employed groundwater monitoring techniques that may have caused contamination of groundwater. Doubt must necessarily be cast upon any remedy designed to treat contamination without an adequate understanding of that contamination.

Response 54: See responses above, including but not limited to, responses 33 and 35.

Comment 55: Furthermore, the PRAP refers to drinking water standards. Drinking water criteria are entirely inapplicable to the groundwater at the Site, which is not now and will likely never be a source of drinking water. The plain truth is, the brackish groundwater in this densely populated urban area, an area that was filled with gas stations and industrial operation for more than a century, will never be used for drinking water.

Response 55:	The groundwater standards used for comparison to groundwater contaminant levels are applicable to the site. The best usage of groundwater is drinking water and therefore drinking water standards apply as well. NYS has consistently applied these criteria to all groundwater in the state. The State has consistently applied these criteria to saline groundwater as well. The water at the site is not "brackish." The criterion for saline is >1000 mg/L TDS which is not exceeded for a large portion of the groundwater samples collected. Chloride is used to define saline groundwater as well, however chloride was not tested for at the site. Also, the past use of an area or the groundwater yields do not affect the groundwater classification of an aquifer.
Comment 56:	Additionally, and perhaps most significantly, as explained in the enclosed letter and detailed below, the remedy specified in the PRAP has significant potential to exacerbate, not improve, the groundwater at and around the Site. This defect is so serious that it may prohibit any responsive PRP from acquiring the necessary insurance that is a prerequisite to undertaking any fieldwork.
Response 56:	See responses above, including but not limited to, responses 37, 48, 51, and 52.
Comment 57:	No evidence whatsoever has been provided to demonstrate that pneumatic fracturing of Manhattan Schist is safe, effective, or even feasible. Due to lack of experience in performing this type of work in Manhattan Schist and the grave risk of mobilizing contaminants, thereby exacerbating the problems at and around the Site, pneumatic featuring should by no means be considered as a remedy at this Site. Pumping in Fenton's reagent or other oxidants poses a similar risk of spreading contamination. These techniques are too risky to be seriously considered as remediation alternatives at the Site.
Response 57:	The PRAP does not specify the method of fracturing to be used, it simply describes pneumatic fracturing as one option. Fracturing of bedrock is a technique that has been very successfully employed at several hazardous waste sites in NYS for the remediation of hazardous waste. The fracturing of bedrock is a well-established technique, experienced competent blasting contractors are available, and there is no reason it cannot be applied to this site. Well established engineering controls and monitoring methods are practiced to limit the fracturing and those will be used in the application of this remedy. The injection of oxidants in situ is a technique that has been successfully used at many sites without increasing the area of contamination. The amount and rate of oxidant injected will be carefully controlled.

Comment 58: In short, the proposed remedy will do more harm than good. We strongly recommend that if NYSDEC feels compelled to issue a ROD based on these studies, the ROD should set forth a flexible approach that allows for the evaluation and, if appropriate, removal of certain remedial alternatives.

Response 58: The investigation was completed in a manner that provides enough information to select the appropriate remedy. The selected remedies are appropriate and technically feasible and will greatly reduce the contamination in the bedrock. NYSDEC selected two remedies with the intention of allowing some flexibility in remedy choice.

APPENDIX B

Administrative Record

1. Proposed Remedial Action Plan, Hexagon Laboratories OU2, NYSDEC, June 2002.

2. Remedial Investigation Report, Hexagon Laboratories OU2, TAMS Consultants, December 2001.

3. Focused Feasibility Study Report, Hexagon Laboratories OU2, TAMS Consultants, December 2001.

4. Letter addressed to the NYSDEC dated April 15, 2002, received from Carmen Angueira, District Manager of Bronx Community Board No. 12.

5. Letter addressed to the NYSDEC dated April 17, 2002, received from Loree Shelko and Eric Rothenberg of Morgan, Lewis, and Bockius LLP.

6. Letter addressed to the NYSDEC dated April 17, 2002, received from Robert Johnston and Bruce Nelson of Malcolm Pirnie.