# PROPOSED REMEDIAL ACTION PLAN

**Dewey Loeffel Landfill -Disposal Site**
**Operable Unit 02**
**Town of Nassau, Rensselaer County, New York**
**Site No. 442006**
**August 1999**

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## SECTION 1 PURPOSE OF THE PROPOSED PLAN

This Proposed Remedial Action Plan (PRAP) identifies the preferred remedy, summarizes the other alternatives considered, and discusses the rationale for this preference. The New York State Department of Environmental Conservation ("NYSDEC") will select a final remedy for the site only after careful consideration of all comments submitted during the public comment period.

The NYSDEC has issued this PRAP as a component of the citizen participation plan developed pursuant to the New York State Environmental Conservation Law and 6 NYCRR Part 375. This document summarizes the information that can be found in greater detail in the administrative record for the site available at the document repositories.

As more fully described in Sections 3 and 4 of this document (see pages 3 to 11), hazardous wastes were disposed at the Dewey Loeffel Site, # 442006. Hazardous wastes disposed include a wide variety of volatile organic compounds (VOCs), and polychlorinated biphenyls (PCBs), some of which has migrated from the site to the overburden and bedrock groundwater giving rise to significant threats to the public health and the environment, *viz.,*

- significant environmental damage associated with impacts of contaminants (PCBs & VOCs) on both the shallow overburden and bedrock aquifers beneath the site which has been used for human water consumption and is now unusable due to the presence of PCBs and VOCs above applicable standards.

In order to restore the Dewey Loeffel containment cell to eliminate or mitigate all significant threats to human health and/or the environment, the Department is proposing Alternative 9, Disposal Site Hydraulic Containment with Downgradient Groundwater Recovery and Treatment. The elements of the proposed remedy would be:

-installation within the landfill of an upgraded leachate collection system, intended to eliminate the disposal site as an ongoing source of groundwater contamination by achieving hydraulic containment of the leachate and groundwater associated with the disposal site;

-installation of groundwater extraction wells between the landfill and the residential wells to the south of the site. These recovery wells are intended to accelerate the restoration of the bedrock groundwater quality to achieve applicable standards, and to prevent the contamination of other nearby residential wells.

-construction and operation at the site of a water treatment facility to manage waste waters generated by the leachate management at the disposal site, and by the groundwater extraction system.

-maintenance of all existing residential well monitoring and treatment, to prevent exposures of people using water from the residential wells to the contaminants within the bedrock groundwater contaminant plume above applicable standards;

-design and implementation of a monitoring program to evaluate groundwater elevations and groundwater quality over the duration of the remedy;

-design and implementation of a monitoring and maintenance program for the disposal site to evaluate performance of the water and leachate management system.

-continuation of institutional controls at the site.

The above proposed remedy is intended to attain the remediation goals selected for this site in conformity with applicable standards, criteria, and guidance (SCGs). These remediation goals include:

- Eliminate, to the extent practicable, ingestion of groundwater affected by the site that does not attain NYSDEC Class GA Ambient Water Quality Criteria.
- Eliminate, to the extent practicable, off-site migration of groundwater that does not attain NYSDEC Class GA Ambient Water Quality Criteria.
- Eliminate, to the extent practicable, exceedances of applicable environmental quality standards related to releases of contaminants to the waters of the state.
- Eliminate, to the extent practicable, human exposures to groundwater containing contaminants in excess of applicable drinking water standards

The NYSDEC may modify the preferred alternative or select another alternative based on new information or public comments. Therefore, the public is encouraged to review and comment on all of the alternatives identified in this document.

To better understand the site and the alternatives evaluated, the public is encouraged to review the project documents which are available at the following repositories:

NYSDEC Central Office
50 Wolf Road, Room 228
Albany, New York
(518) 457-5637
Hours: M-F 8:30 am - 4:30 pm

Nassau Library
Church Street
Nassau, NY 12123
(518) 766-2715

Project Manager: James Ludlam, P.E.
NYSDEC
50 Wolf Road
Albany, NY 12233-7010
Phone (518) 457-5637.

Written comments on this PRAP can be submitted to Mr. Ludlam at the above address.

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**DATES TO REMEMBER:**

**November 8 - December 8, 1999: Public comment period on RI/FS Report, PRAP, and preferred alternative.**

**November 30, 1999: 3:00 pm to 5:00 pm, Availability Session (for informal question and answer); 7:00 pm, Public meeting at St. Mary's Parish Hall, Church Street, Nassau, New York.**

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## SECTION 2 SITE LOCATION AND DESCRIPTION

The Loeffel Site is an inactive hazardous waste disposal site located within a 19.6 acre permanent easement obtained by the NYSDEC in southwestern Rensselaer County, New York (Figure 1 ). The Village of Nassau, New York is approximately four miles to the southwest.

The Loeffel site is located in a low area between two wooded hills with peak elevations of 876 and 778 feet above mean sea level (MSL). Topography in the area generally slopes downward from east to west. Elevations in the immediate vicinity of the Site range from approximately 610 to 660 feet above MSL.

Current surface drainage on the Loeffel Site is controlled by a series of drainage swales built into the vegetated landfill cap and side drainage around the edge of the landfill cap. From the disposal site, surface water flows into tributaries and streams which are part of the Nassau Lake drainage basin, a subpart of the Valatie Kill drainage basin.

The majority of surface water drains from the Loeffel site to the northwest (the "Northwest Drainage System") toward Mead Road Pond (see Figure 1). Water exiting Mead Road Pond flows via a small stream, the T11A tributary, which in turn flows into the Valatie Kill. The Valatie Kill flows in a south westerly direction to Nassau Lake, approximately 2 miles downstream. Surface water flowing to the southeast (the "Southeast Drainage System") from the Loeffel Site flows to a low-lying area and to a small unnamed tributary (undesignated by New York State) and then into Valley Stream. Valley Stream flows through Smith Pond and discharges to Nassau Lake. Surface waters are described in detail in the "Loeffel Site Environs Feasibility Study Report: Surface Water, Sediment, and Biota" (BBL 1997a) and previously completed Loeffel Site environs RI documents (BBL, 1993, 1995, and 1997b). The issues related to the surface water and sediment PCB contamination will be addressed in a separate Proposed Remedial Action Plan.

Groundwater flow in the overburden soils in the vicinity of the site are generally to the west; in the bedrock, flows are both to the west and to the south. Groundwater flows to the south are influenced by the presence of a fracture zone associated with a previously unmapped fault beneath the site area.

## SECTION 3 SITE HISTORY

### 3.1 Operational/Disposal History

The Loeffel site was reportedly used from 1952 to 1968 by the Loeffel Waste Oil Removal and Service Company as a private scavenger service and disposal facility for waste materials and later as a waste oil transfer station. The disposal and oil transfer site facilities consisted of a lower (1 acre) and upper (5 acres) lagoon in the western and central portion of the site, a 25- by 150- foot, 6 foot deep oil pit in the east central part of the site, four above-ground oil storage tanks (30,000 gallons each), and a drum disposal area located in the southern and eastern portions of the Site (O'Brien & Gere), 1981) (see Figure 2). Miscellaneous drums, construction debris, and junk automobiles were also present along the southeastern end of the site (O'Brien & Gere, 1981).

During disposal operations, hazardous waste materials were reportedly collected in 55 gallon drums and transported to the Site (USEPA, 1981). The contents of reusable drums were dumped either into the oil pit or into the upper lagoon. Unusable drums were dumped either on the perimeter of the upper lagoon or in the drum burial area. Drums were later covered with soil. The pit was used to store and separate recyclable oily wastes. The non-recyclable contents were pumped into the lagoon or onto the ground surface (USEPA, 1981). Waste materials were reportedly also burned during facility operations.

NYSDEC has estimated that a total of 37,530 tons of waste materials were transported from General Electric (GE) manufacturing facilities to the Loeffel Waste Oil Removal and Service Company facility (NYSDEC, 1980). NYSDEC has estimated that 8,790 tons of waste materials were deposited at the site from other industrial sources, including Bendix Corporation (now a part of Allied Signal, Inc.) and Schenectady Chemicals, Inc. (now Schenectady International) (O'Brien & Gere, 1981). The waste materials disposed at the site included solvents, waste oils, PCBs, scrap materials, sludges, and solids.

In 1966, the State of New York initiated legal action against the Loeffel Waste Oil Removal and Service Company, leading to a 1968 New York State Supreme Court Order and Judgment against the company to stop discharges from the disposal facility and to perform remedial activities. In October 1970, the Loeffel Waste Oil Removal and Service Company retained an engineering firm, C.T. Male and Associates, to develop remedial measures for the Loeffel waste disposal facility (O'Brien & Gere, 1981). Remedial actions consisted of covering and grading the drum disposal area, oil pit, and lagoon with soil, and construction of a system of drainage channels around the facility to control surface water runoff entering the disposal facility area. These remedial measures were completed in 1974. Fill material was reportedly excavated from a borrow pit southwest of the disposal facility (see Figure 2). The Loeffel Waste Oil Removal and Service Company reportedly continued to use the Site from 1974 to 1980 as a transfer station for waste oils utilizing the four 30,000 gallon above-ground storage tanks. According to Mr. Dewey Loeffel, these waste oils were transported to the facility from operations owned by a number of industrial companies and other entities (BBL, 1992).

On September 23, 1980, GE entered into an agreement with the NYSDEC, known as the Seven Sites Agreement (Agreement). The Agreement required GE to perform field investigations to determine the conditions at the Loeffel Site and the nature and extent of hazardous wastes. Following these field investigations, GE submitted an engineering report, which included the data collected during the field investigations, identified alternative remedial programs, and recommended a remedial program from these alternatives. The report also included provisions for (1) maintenance and monitoring of the remediated site, (2) collection, treatment and disposal of any leachate generated at the remediated site, where appropriate, and, (3) the physical security of the remediated site (NYSDEC, 1980). Following approval of the final site remediation plan by NYSDEC, GE was required to pay NYSDEC $2.33 million, representing its estimated share of the costs of implementing the construction elements of the remedial program and the costs of operating, maintaining, and monitoring the Site.

The engineering report prepared by O'Brien & Gere Engineers, Inc. (O'Brien & Gere) on behalf of GE recommended an in-place containment alternative consisting of a low permeability cap with vegetative cover, surface water drainage swales, and a perimeter cutoff wall constructed to till or bedrock (O'Brien & Gere, 1981). During the design phase, it was determined that the cut-off wall should be extended to the bedrock and that a leachate collection system should be installed. The final remedial plans and specifications were submitted to NYSDEC in January 1983 for its subsequent use (O'Brien & Gere, 1983).

Approximately 500 surface drums were removed from the eastern end of the Site in preparation for the remedial program. The four 30,000 gallon above-ground storage tanks were also removed that year (CDM, 1985).

The NYSDEC approved remedy was constructed from September 1983 to November 1984. In October 1985, a final site inspection was conducted. Since the final inspection, operation, maintenance, and monitoring activities have been performed periodically by NYSDEC.

In 1989, the State of New York brought suit against GE in the U.S. District Court for the Northern District of New York seeking to hold GE liable for cleanup costs and natural resource damages relating to impacts of hazardous waste present outside of the disposal site after cap completion to the environs of the Loeffel site. Subsequently, an RI Work Plan, a Sampling and Analysis Plan, and a Health and Safety Plan were developed on GE's behalf by BBL and submitted for NYSDEC review (BBL, 1992). These documents were approved by NYSDEC in July 1992. On September 23, 1992, GE and the State of New York entered into a Judicial Stipulation, under which GE agreed to conduct an RI in accordance with the approved work plan. GE also agreed to conduct an FS to assess potential remedial alternatives.

In April 1994, an interim hydrogeologic investigation report was submitted describing initial RI hydrogeologic studies completed between fall 1993 through spring 1994 (GeoTrans, 1996b).

Phase II hydrogeologic studies included: reviewing and verifying the well construction of 34 residential wells; conducting a geophysical surveys south of the site to characterize bedrock structure; gathering additional groundwater data through installation, packer testing, and sampling of new monitoring wells; evaluating landfill hydraulic parameters and leachate collection system hydraulics; and obtaining data to evaluate natural attenuation and degradation of contaminants in groundwater. Phase II hydrogeologic field activities were completed February 1997 (HSI Geotrans, 1997).

Residential well monitoring in the vicinity of the Loeffel site has been performed by the New York State Department of Health (NYSDOH) periodically since November 1979. During the early phases of this monitoring program, only those wells immediately to the northwest of the site were sampled. In the early 1980s, wells to the south and farther from the site were also sampled. Currently, 22 residential wells are sampled on an annual basis and as of October 1997, eight of those wells will also be sampled on a semi-annual basis. BBL Environmental Services, Inc. (BBLES), on behalf of GE, assumed responsibility for residential well sampling from NYSDOH on an interim basis in November 1997.

In 1993, BBLES was retained by GE to design install, maintain, and monitor residential well treatment systems on an interim basis for two residential properties south of the disposal site along Central Nassau Road where water quality standards have been exceeded.

### 3.2 Remedial History

1974 - Remedial actions consisting of covering and grading the drum disposal area, oil pit and lagoon and construction of a system of drainage ditches were completed.

1982 - CECOS International, Inc. removed approximately 500 surface drums from the eastern portion of the site. The four 30,000 gallon above-ground tanks were also removed.

1984 - Construction of the containment system at the site is completed. The containment system consists of a slurry wall, a clay cap, and a leachate collection system.

The slurry wall is a trench, excavated from land surface down into unweathered bedrock, which was backfilled with a mixture of the excavated soil and bentonite clay. The slurry wall has a hydraulic conductivity which is significantly lower than the surrounding soils, which impedes groundwater flow into and out of the disposal site.

The clay cap was constructed over the entire disposal site, and ranges from 4.5 to 6 feet in thickness. The cap is designed to impede the recharge of rainfall and snowmelt into the disposal site.

The leachate collection system consists of a series of drainage pipes which were installed in the western third of the disposal site before the site was graded and capped. The pipes drain tp a collection tank. Periodically, leachate is removed from the tank by a state contractor for appropriate off-site disposal.

Other areas of this site currently being studied (by GE with State oversight) are the Loeffel Environs, the subject of the 1992 Judicial Stipulation. The Environs consist of various drainage ways: (1) low lying areas west of the site; (2) Mead Road Pond and spoil banks; (3) Tributary T-11A; (4) Valatie Kill; and (5) Nassau Lake. The principal contaminant for this part of the site is PCBs.

**SECTION 4 CURRENT STATUS**

In response to a determination that the disposal of hazardous waste at the site presents a significant threat to human health and the environment, GE has completed a Remedial Investigation and Feasibility Study (RI/FS). This latest RI/FS is a continuing investigation of the containment cell and groundwater, and supplements the RI/FS done in 1982-83. The need for a groundwater investigation arose from a 1992 finding that private wells were contaminated with site related chemicals.

A separate RI/FS program is ongoing for surface water drainage from the site to Nassau Lake, some four miles away. This aspect of the remedial program for this site will be addressed in a separate proposed remedial action plan.

The Commissioner may find that hazardous waste disposed at the site constitutes a significant threat to the environment if, after reviewing the available evidence and considering the factors the Commissioner deems relevant set forth in 6 NYCRR 375-1.4(b), the Commissioner determines that the hazardous waste disposed at the site or coming from the site results in, or is reasonably forseeable to result in,

(a) a determination by NYSDOH or by the Agency for Toxic Substances and Disease Registry, where the site is near private residences, recreational facilities, public buildings or property, school facilities, places of work or worship, or other areas where individuals or water supplies may be present, that the presence of hazardous waste on a site poses a significantly increased risk to the public health.

(b) significant environmental damage (6 NYCRR 375-1.4[a][2]).

In making a finding as to whether a significant threat to the environment exists, among others, the Commissioner may take into account any or all of the following matters, as may be appropriate under the circumstances of the particular situation:

- groundwater hydrogeology at and near the site (6 NYCRR 375-1.4[b][5]);
- location, nature, and size of surface waters at and near the site (6 NYCRR 375-1.4[b][6]);
- levels of contaminants in groundwater, surface water, air, and soils at and near the site and areas known to be directly affected or contaminated by waste from the site, including, but not limited to, contravention of: ambient surface water standards set forth in 6 NYCRR Part 701 or 702; ambient groundwater standards set forth in 6 NYCRR Part 703; drinking water standards set forth

in 10 NYCRR Subpart 5-1 and Part 170 (6 NYCRR 375-1.4[b][7])

- the extent to which hazardous waste and/or hazardous waste constituents have migrated or are reasonably anticipated to migrate from the site (6 NYCRR 375-1.4[b][9]);
- the proximity of the site to areas of critical environmental concern (as, wetlands or aquifers) (6 NYCRR 375-1.4[b][10]);
- the integrity of the mechanism, if any, that may be containing the hazardous waste to assess the probability of a release of the hazardous waste into the environment (6 NYCRR 375-1.4[b][12]); and
- the climatic and weather conditions at and in the vicinity of the site (6 NYCRR 375-1.4[b][13]).

(For a more detailed discussion respecting NYSDEC's "significant threat" determinations and the rationale for NYSDEC's use of the above, and other, factors, in its decisionmaking, see the Draft Regulatory Impact Statement for 6 NYCRR Part 375, dated April 1991, at pages 19 to 25; and the Hearing Report, Responsiveness Summary, and Revision to the Draft Regulatory Impact Statement for 6 NYCRR Part 375, dated March 1992, at pages II-7 to II-19.)

The bases for the determination that the site poses a significant threat to human health and the environment are founded on the following:

The hazardous wastes present contribute to or result in:

- contravention of ground water standards for PCBs and VOCs (for concentrations of contaminants in groundwater at the site, see Table 1 below; for Water Quality Standards, see 6 NYCRR Parts 701 and 702, attached)
- contraventions of drinking water standards for PCBs and VOCs (for concentrations of contaminants in groundwater at the site, see Table 1 below; for drinking water standards, see 10 NYCRR Subpart 5-1 and Part 170, attached)

The determination of significant threat associated with Operable Unit 2 of the Dewey Loeffel site is therefore based primarily on the significant environmental damage associated with impacts of contaminants (PCBs and VOCs) on both the shallow and deep bedrock aquifers beneath the site, which were usable for human water consumption in the past and is now unusable due to the presence of the PCBs and VOCs above applicable standards.

### 4.1 Summary of the Remedial Investigation

The purpose of the RI was to define the nature and extent of any contamination resulting from previous activities at the site. The results of the remedial investigations for the Dewey Loeffel site are described below.

The RI to address the disposal site and the associated groundwater contamination was conducted in two phases. The first phase was conducted between July 1995 and March 1996 and the second phase (which was done to fill in data gaps identified in the first phase) between April 1996 and January 1997. Reports has been prepared describing the field activities and findings of the RI in detail.

The RI included the following activities:

- Conducted a geophysical survey (Ground Penetrating Radar) to identify the exact location of portions of the previously installed 1984 slurry wall.
- Drilled soil borings to better interpret the soil stratigraphy at the site.
- Installed monitoring wells for collection of soil and groundwater samples, both on and offsite.
- Sampled and analyzed soil and groundwater, both on and off site.

- Evaluated deep bedrock groundwater conditions.
- Investigated for the presence of DNAPL at this site.
- Investigated the slurry wall for leakage.
- Prepared and submitted reports.

To determine which media (soil, groundwater, etc.) contain contamination at levels of concern, the RI analytical data were compared to environmental Standards, Criteria, and Guidance (SCGs). Groundwater and drinking water SCGs identified for the Dewey Loeffel containment cell site were based on NYSDEC Ambient Water Quality Standards and Guidance Values and Part V of New York State Sanitary Code. NYSDEC soil cleanup guidelines for the protection of groundwater (TAGM 4046), and background conditions were used as SCGs for soil.

Based on the results of the remedial investigation in relation to the SCGs and potential public health and environmental exposure routes, additional remediation work is required to supplement the previous remedial actions taken at the site . More complete information can be found in the Remedial Investigation (RI) reports for the site.

For results of chemical analyses of soil and water, see Table 1 (attached). Soil chemical concentrations are reported in in milligrams per kilogram (mg/kg, equivalent to parts per million, ppm). Concentrations in water are reported in parts per billion (ppb). For comparison purposes, SCGs are given for each medium as appropriate.

### 4.1.1 Nature of Contamination

**Dewey Loeffel Disposal Area**

The Dewey Loeffel site is contaminated with several types of chemical compounds, including PCBs, and volatile organic compounds (VOCs), which are typically industrial solvents and lubricants used during various manufacturing processes.

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

Soil samples collected from borings in the vicinity of the disposal site contained VOCs and PCBs. Some of the samples were collected from borings drilled at the site, and others as far to the southeast as Central Nassau Road.

Groundwater samples were collected from on-site and off-site monitoring wells. Groundwater samples from the overburden aquifer were found to contain VOCs and PCBs. The bedrock groundwater in the vicinity of the site, and to the south, had numerous contraventions of groundwater standards. The bedrock groundwater contaminant plume south of the site is primarily associated with a previously unmapped geologic fault in the bedrock, which extends from north of the site, beneath the site, and south beyond Central Nassau Road. The bedrock in the immediate vicinity of the fault has a higher degree of fracturing, which allows for a greater hydraulic conductivity along the fault axis. However, near the disposal site, bedrock groundwater contamination has been identified beyond the immediate vicinity of the fault.

The migration of contaminants from the disposal site has apparently continued, even after construction of the cap, slurry wall, and leachate collection system. The water levels in the bedrock to the east of the site are higher than the water levels within the landfill, so groundwater can enter the eastern portion of the site from the underlying bedrock. In the central portion of the site, water levels in the bedrock are lower than within the disposal site, and water bearing contaminants can migrate out of the disposal site into the underlying bedrock.

The off-site VOC plume has been traced (through the installation of monitoring wells, use of geophysics, and analysis of groundwater samples) to extend south of the disposal site to the vicinity of Central Nassau Road, a distance of approximately one-half mile. In the vicinity of Central Nassau Road, two properties were identified which had domestic wells impacted by contaminants from the site. (See Figure 3)

#### 4.1.2 Extent of Contamination

Table 1 summarizes the extent of contamination for the contaminants of concern in the soil and groundwater and compares the data with the applicable Standards, Criteria, and Guidelines (SCGs). The following are the media which were investigated and a summary of the findings of the investigation.

**Soil**

Soil samples were collected from borings drilled through the containment cell, adjacent to the slurry wall, in various locations and down gradient from the site. Virtually all of the samples were analyzed for VOCs and PCBs. See Table 1 for data summary.

**Overburden Groundwater**

In the vicinity of the containment cell, shallow groundwater is contaminated above Class GA groundwater standards for numerous chemicals, including benzene, toluene, xylene and trichloroethene, and PCB (Aroclor-1260). Generally, the groundwater standards for each of these chemicals is 5 ppb; PCBs have a standard of 0.09 ppb. See Figure 3 for a map showing the extent of contamination in the overburden and bedrock groundwater under and adjacent to the site and in the plume emanating from the site toward Central Nassau Road. See Table 1 for a data summary.

**Bedrock Groundwater**

Shallow (generally 45 to 75 feet below grade) bedrock groundwater is significantly contaminated. The highest detection of total volatile organic compounds (TVOCs) was 147,900 ppb at MW 201.

Off-site, to the south, well OMW-201 exhibited TVOCs at 77,350 ppb, while north of the site a value of 34 ppb was found in residential well 191-05-15. Monitoring wells OMW-221, 222, and 223, located south of the site along Central Nassau Road did not to show any concentrations of VOCs. However, three residential wells on two properties north of Central Nassau Road have been impacted by VOCs since 1992.

### 4.2 Interim Remedial Measures

Interim Remedial Measures (IRMs) are discrete sets of activities to address both emergency and non-emergency site conditions, which can be undertaken without extensive investigation or evaluation, to prevent, mitigate, or remedy environmental damage attributable to a site. One IRM has been completed at the site, which was the installation of the filters on the domestic water supplies at the two properties on Central Nassau Road in 1993, and their subsequent operation and maintenance.

### 4.3 Summary of Human Exposure Pathways

This section describes the types of human exposures that may present added health risks to persons at or around the site. A more detailed discussion of the health risks related to the disposal site and associated groundwater contamination can be found in Section 7 of the RI Report.

An exposure pathway is how an individual may come into 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.

Completed pathways which exist at the site include:

- Incidental Ingestion, Inhalation, and Dermal Contact: On-site workers could be exposed to contaminants in the soil and shallow groundwater while conducting intrusive operation and maintenance activities within the disposal site (i.e. under the cap)

- Direct Ingestion, Inhalation and Dermal Contact. Off-site groundwater is being used by downgradient homeowners (with treatment), for drinking, cooking, and bathing. Other common uses, as car washing and gardening, provide contact with the groundwater. Additional exposure occurs as on and off-site wells are sampled for data collection and assessment. Currently, exposures are managed by the operation and maintenance of the filters on the private wells.

### 4.4 Summary of Environmental Exposure Pathways

This section summarizes the types of environmental exposures presented by the site. There are no known pathways which result in exposure to environmental receptors associated with the groundwater contaminant plume. Environmental exposures related to past releases from the disposal site (related to the PCB contamination in the site drainage ways and the Nassau Lake/Valatie Kill surface water system) will be addressed in a separate plan.

## SECTION 5 ENFORCEMENT STATUS

The following is a chronology of the enforcement actions related to the Loeffel site.

In an agreement between GE and NYSDEC signed on September 24, 1980, and covering seven inactive hazardous waste disposal sites in northeastern New York State ("Seven Site Agreement"), among other things, GE committed to: (1) perform a field investigation at and around the Loeffel Site to determine the areal and vertical extent of contamination; (2) prepare an engineering report summarizing all data developed in the course of the field investigation and then recommending a remedial program; and (3) present a preliminary plan and schedule for implementation of the remedial program, and provide an estimate of the cost of such implementation.

GE subsequently hired a consulting engineering firm to conduct an investigation and prepare the various reports required by the Seven Site Agreement. After NYSDEC approved GE's final plan for implementation of a remedial program, GE paid NYSDEC $2.33 million towards remedial construction, monitoring and maintenance of the site, and obtained a qualified release from further legal liability. The State collected approximately $550,000 from two other entities whose wastes were disposed of at the site: Bendix Corporation, and Schenectady Chemicals, Inc.

In exchange for preparing the required reports and paying NYSDEC, GE was provided a release from any "claim, demand, remedy, or action whatsoever" against GE which NYSDEC may have "relating to or arising from GE's disposal of waste at the Loeffel site". However, the consent order included a "reservation of rights" clause which preserved NYSDEC's rights to sue GE with regard off-site impacts, as follows:

> Nothing herein shall be construed as barring, diminishing, adjudicating, and in any way affecting... [NYSDEC's] right to bring any action of any kind with respect to areas or resources that may have been affected as a result of the

release or migration of hazardous waste from such sites.

In 1989, relying on the above-referenced reservation of rights, the State filed suit against GE under the Comprehensive Environmental Response, Compensation and Liability Act, 42 U.S. C. 9601 *et seq.*, as amended (the federal Superfund law), and State common law, based on the State's determination that PCBs and other wastes had migrated from the Loeffel Site prior to its encapsulation. In 1992, the parties entered into a stipulation approved in Federal Court obligating GE to: (1) conduct an expansive investigation of the extent of contamination in the drainage ways leading away from the Loeffel Landfill; and then (2) recommend a remedial program.

## SECTION 6 SUMMARY OF THE REMEDIATION GOALS

Goals for the remedial program have been established through the remedy selection process stated in 6 NYCRR 375-1.10. The overall remedial goal is to restore the site to pre-disposal conditions, to the extent feasible and authorized by law. At a minimum, the selected remedy must eliminate, or mitigate to the extent practicable through the proper application of scientific and engineering principles, all significant threats to the public health and to the environment presented by the hazardous waste disposed at the site.

The goals selected for this site, in conformity with applicable Standards, Criteria, and Guidance (SCGs), are:

- Eliminate, to the extent practicable, ingestion of groundwater affected by the site that does not attain NYSDEC Class GA Ambient Water Quality Criteria.

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

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

- Eliminate, to the extent practicable, human exposures to groundwater containing contaminants in excess of applicable drinking water standards

## SECTION 7 SUMMARY OF THE EVALUATION OF ALTERNATIVES

The selected remedy must be protective of human health and the environment, be cost effective, comply with other statutory laws and utilize permanent solutions, alternative technologies or resource recovery technologies to the maximum extent practicable. Potential remedial alternatives for the Loeffel Containment cell were identified, screened, and evaluated in a Feasibility Study and addendum. These evaluations are presented in the report entitled "Loeffel Site Environs Groundwater Feasibility Study" (11/24/98) and "Loeffel Site Environs Groundwater Feasibility Study" (6/3/98).

### 7.1 Description of Alternatives

**<u>Alternative 1</u>**

**<u>No Further Action</u>**

This alternative recognizes remediation of the site conducted under previously completed remedial actions. Only continued monitoring is necessary to evaluate the effectiveness of the existing remedial program.

This alternative would leave the site in its present condition and would not provide any additional protection to human health or the environment.

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|---|---|
| Present Worth: | $1,096,000 |
| Capital Cost: | $0 |
| Annual O&M: | $71,300 |
| Time to Implement | Complete |

**Alternative 2**
**Hydraulic Control**

The existing leachate collection system would be used to manage migration of contaminated groundwater in the aquifer. Groundwater collected would continue to be treated offsite.

A site wide long-term groundwater monitoring system will be designed and implemented. All other aspects of alternative 1 will be retained.

The only benefit of this alternative over Alternative 1 is an expanded monitoring program. As such it does not address human health and environmental exposures nor provide for any hazardous waste cleanup.

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|---|---|
| Present Worth: | $2,931,000 |
| Capital Cost | $0 |
| Annual O&M: | $182,700 |
| Time to Implement | 1 year |

**Alternative 3A:**
**Enhanced Hydraulic Control with Off-site Leachate Disposal**

Alternative 3A is comprised of components described in Alternative 2 combined with use of the existing leachate collection system at its maximum yield of approximately 800,000 gallons per year. This alternative involves the continued transportation of the extracted leachate to an off-site treatment and disposal facility.

The existing leachate collection system within the landfill would be pumped to maximum yield. Based on testing conducted during the RI, this rate is estimated to be about 800,000 gallons per year. For Alternative 3A, the collected leachate would be transported off-site for proper treatment and disposal. The existing leachate collection system is not deep or extensive enough to provide hydraulic containment over the area of the landfill, even with leachate collection at the maximum yield. Increasing the leachate collection rate would, however, decrease the flux of contaminants from the disposal site.

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| Present Worth: | $4,551,800 |
| Capital Cost: | -0- |
| Annual O&M: | $296,100 |
| Time to Implement | 1 year |

**Alternative 3B:**
**Enhanced Hydraulic Control with Onsite Treatment**

Similar to Alternative 3A, Alternative 3B would achieve enhanced hydraulic control by the same extraction method. However, in this case, groundwater would be treated onsite to achieve discharge standards.

The leachate treatment system in Alternative 3B would address the contaminants of concern in the Loeffel Site leachate. Figure 4 is a process flow diagram depicting the anticipated treatment methods. The treatment process includes oil/water separation, with treatment of the aqueous fraction via coagulation/flocculation; chemical precipitation, filtration, dewatering of sludges produced by the treatment, and air stripping of the remaining aqueous fraction followed by carbon adsorption and discharge. The leachate treatment system would be sized to treat 10 gallons per minute (gpm) which is the minimum size at which most treatment components are available.

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| Present Worth: | $3,933,000 |
| Capital Cost: | $1,009,493 |
| Annual O&M: | $190,182 |
| Time to Implement | 1 year |

**Alternative 4:**

**Enhanced Hydraulic Control with Expanded Collection and On-Site Treatment and Disposal**

The existing leachate collection system within the landfill would be expanded and an on-site leachate treatment system would be constructed and operated with discharge of the treated leachate to surface water. The existing leachate collection system is not deep or extensive enough to provide hydraulic containment over the area of the landfill regardless of the pumping rate. The expanded system would create a laterally inward gradient in those areas of the landfill where outward gradients currently exist, and would control some migration of leachate from the containment system. The expanded leachate collection system may not, however, be able to create upward gradients over the entire landfill area, and some leachate migration away from the disposal site would likely continue to occur.

A conceptual plan of the expanded leachate collection system would involve the installation of two or three drains positioned inside the cut-off wall extending an average of 25 feet below ground surface (BGS) to a level which will create an inward and, in the areas in the immediate vicinity of the drains, upward gradient when the drains are continuously evacuated. Preliminary calculations suggest a combined pumping rate of approximately 5 gpm would be needed.

The leachate treatment system would address the contaminants of concern in the Loeffel site leachate (e.g., in PCBs, VOCs, metals). The treatment process includes oil/water separation, with treatment of the aqueous fraction via coagulation/flocculation, chemical precipitation, filtration, dewatering of sludges produced by the treatment, and air stripping of the remaining aqueous fraction followed by carbon adsorption and discharge to surface water. The leachate treatment system would be sized to treat 10 gpm in order to handle peak flows.

All wells in the Loeffel Site environs and the leachate collection tanks at the Site would be enclosed and locked to prevent unauthorized access. The leachate treatment building would be locked and secured and, depending on location, may also be fenced. A Health and Safety Plan would be prepared for the remedial activities. In conformance with OSHA regulations, site workers would be trained, required to wear appropriate protective equipment, and, as applicable, would be enrolled in a medical monitoring program. Groundwater monitoring wells would be sampled to determine changes in the VOC plume. Residential wells would also be monitored, with contingencies for implementing point-of-use treatment systems for wells demonstrated to be impacted by VOCs from the Site.

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| Present Worth: | $6,558,905 |
| Capital Cost: | $1,725,622 |
| Annual O&M: | $314,411 |
| Time to Implement | 1 year |

**Alternative 5:**

**Near site Pump and Treat System**

The components of Alternative 5 include all components of Alternative 2. These include: (1) long-term groundwater monitoring in the Loeffel Site environs; (2) long-term residential well monitoring; (3) well head treatment for those residential wells impacted by VOCs from the Loeffel Site; and (4) five-year reviews to ensure continued protectiveness.

Additionally, a groundwater pump-and-treat system would be installed and operated immediately adjacent to the site to intercept contaminated groundwater and prevent further off-site migration of contaminants away from the immediate vicinity of the disposal site. Twenty bedrock recovery wells would be installed into bedrock hydraulically downgradient of the landfill to the south and west. Extracted groundwater would be treated onsite to meet the discharge standards.

Groundwater recovery wells would use submersible or pneumatic pumps to create hydraulic capture south and west of the landfill. Recovered water would be sent to a treatment system located on or near the Loeffel site through below-grade piping.

Groundwater treatment would address the contaminants of concern in the bedrock groundwater. The primary treatment operation will be air stripping for the removal by carbon adsorption and filtration. Air stripping with GAC polishing was deemed the most cost-effective, proven treatment train for this alternative.

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| Present Worth: | $4,403,200 |
| Capital Cost: | $976,100 |
| Annual O&M: | $223,000 |
| Time to Implement | 1 year |

**Alternative 6:**
**Increased Leachate Collection with Near site Groundwater Recovery and Treatment**

Alternative 6 is comprised of all the components of Alternative 2 combined with the pump and treat of Alternative 5, and the increased leachate collection as identified in Alternative 3B.

Alternative six would include 1) long-term groundwater monitoring; 2) long term residential monitoring; 3) wellhead treatment for residential wells impacted by VOCs from the Loeffel site, and five year reviews to ensure continual protectiveness. In addition, as in Alternative 5, groundwater recovery wells would be installed into the bedrock south and west of, and immediately adjacent to, the disposal site. All extracted leachate and groundwater would be treated as identified in Alternative 3B.

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| Present Worth: | $5,690,300 |
| Capitol Costs: | $1,695,700 |
| Annual O & M: | $260,000 |
| Time to Implement: | One Year |

**Alternative 7:**
**Disposal Site Hydraulic Containment**

Alternative 7 is comprised of components detailed in Alternative 2 as described earlier in this document combined with an expanded and deepened leachate collection system. This approach would maintain an inward and upward flow of groundwater from the overburden and bedrock adjacent to and underneath the landfill site. Collected leachate is treated on site with subsequent surface water discharge as identified in Alternative 3B.

The existing leachate collection system within the landfill would be expanded and deepened (to a greater extent that Alternative 4) and an on-site leachate and groundwater treatment system would be constructed and operated as in Alternative 3B). Neither the existing leachate collection system nor the system envisioned under Alternative 4 is not deep or extensive enough to provided hydraulic containment over the area of the landfill no matter how much pumping is done. A more laterally extensive and deeper leachate collection system would be necessary to establish an inward and upward gradient within the landfill boundaries. The expanded system would create an inward and upward gradient in those areas of the landfill where outward and downward gradients currently exist, and would control the migration of contaminants from the containment system.

Based on numerical simulations of groundwater flow in the vicinity of the Loeffel Site, this alternative involves the installation of four drains positioned inside the cutoff wall extending an average of 30 feet BGS to a level that will create an inward and upward gradient when the drains are continuously evacuated. Groundwater modeling results suggest a leachate extraction rate of approximately 10 gpm would result (Appendix A). This would draw down the water level to an elevation below the existing collection system.

Each drain would be comprised of slotted high density polyethylene (HDPE) pipe embedded in gravel and connected to a leachate collection sump equipped with a pump and associated controls. The drains could be installed by conventional or one-pass trenching technology. Deeper portions of the drains would be required to be excavated with a clam shell excavator. Leachate would be extracted from the sumps and transferred via subsurface piping to a building for subsequent treatment.

The leachate treatment system would address the contaminants of concern in the Loeffel Site leachate (e.g., in PCBs, VOCs, metals). Figure 3.2 is a process flow diagram displaying the anticipated treatment methods. The treatment process includes oil/water separation, with treatment of aqueous fraction via coagulation/flocculation, chemical precipitation, filtration, dewatering of sludges produced by the treatment, and air stripping of the remaining aqueous fraction followed by carbon adsorption and discharge surface water. To provide a factor of safety, the leachate treatment system would be sized to treat a flow rate of 20 gpm.

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| Present Worth: | $8,092,000 |
| Capitol Costs: | $3,002,000 |
| Annual O&M: | $331,000 |
| Time to Implement: | 1 year |

**Alternative 8**

**Leachate Extraction and Downgradient Groundwater Recovery and Treatment**

Alternative 8 is comprised of all components described in the FS for Alternative 5 combined with a groundwater pump-and-treat system in the downgradient portion of the bedrock contaminant plume. Extraction wells south and west of, and immediately adjacent to, the disposal site will intercept the contaminants in the bedrock groundwater as they leave the disposal site. Groundwater recovery wells in the bedrock to the south of the site would address VOC contamination in bedrock groundwater downgradient of the site. These wells would not capture all VOC contaminants but will intercept significant volumes of contaminants previously moving with the plume. This will eventually allow for a reduction in contaminant concentration of the forward edge of the plume.

The components of Alternative 8 include all components of Alternative 5 described previously. These include: (1) routine landfill operation, maintenance, and monitoring activities conducted by NYSDEC at the Loeffel Site; (2) long-term groundwater monitoring in the Loeffel Site environs; (3) long-term residential well monitoring; (4) wellhead treatment for those residential wells impacted by VOCs from the Loeffel site; and (5) five-year reviews to ensure continual protectiveness and (6) installation and operation of groundwater pump-and-treat system immediately adjacent to the disposal site to intercept contaminated bedrock groundwater and prevent further off-site migration of contaminants away from the immediate vicinity of the disposal site. Pumping wells would be installed into bedrock hydraulically downgradient of the landfill to the south and west within 200 feet of the landfill. Extraction may be optimized via use of blasted bedrock trenches. Extracted groundwater would be treated on site.

Well locations and yields were based on RI information and experience with installation of similar systems. A network of 20 wells pumping at a total yield of 22.5 gpm was estimated on the basis of current information. However, pump tests and other pre-design investigation activities should be performed prior to system design. Pumping from artificially-created fracture zones might also be considered during design and may be more cost effective. Vacuum-enhanced pumping might also be considered. Both would reduce the number of wells needed to effect containment.

Groundwater recovery wells would use submersible or pneumatic pumps to create hydraulic capture south and west of the landfill. Recovered water would be sent to a treatment system located on or near the disposal site through below-grade piping.

To address VOC contamination in groundwater downgradient of the proposed near site pump-and-treat system, downgradient extraction wells will be installed along the plume axis south of the disposal site.

Residential wells impacted by VOCs from the Loeffel Site would still require wellhead treatment.

Four recovery wells would be installed along the plume axis. Groundwater recovery wells would use submersible or pneumatic pumps to create hydraulic capture. Recovered water would be sent to a treatment system located on or near the Loeffel Site through below-grade piping.

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| Present Worth: | $4,891,175 |
| Capital Cost: | $1,305,539 |
| Annual O&M: | $253,250 |
| Time to Implement: | 1 year |

**Alternative 9:**

**<u>Disposal Site Hydraulic Containment with Downgradient Groundwater Recovery and Treatment</u>**

Alternative 9 would consist of the disposal site hydraulic containment component of Alternative 7, along with the downgradient groundwater recovery and treatment component of Alternative 8 and the monitoring and maintenance (including the residential monitoring and maintenance) components of Alternative 2.

A monitoring program would be developed and implemented to monitor groundwater elevations and groundwater quality in the vicinity of the disposal site, and in the area of the bedrock contaminant plume. The monitoring and maintenance of the residential treatment units would continue until the groundwater quality improves to allow for unrestricted use of groundwater from the residential wells.

The existing leachate collection system within the landfill would be expanded and deepened (to a greater extent that Alternative 4) and an on-site leachate treatment system would be constructed and operated with discharge of the treated leachate to surface water, (as in Alternative 3B). The existing leachate collection system is not deep or extensive enough to provided hydraulic containment over the area of the landfill no matter how much pumping is done. A more laterally extensive and deeper leachate collection system would be necessary to establish an inward and upward gradient within the landfill boundaries. The expanded system would create an inward and upward gradient in those areas of the landfill where outward and downward gradients currently exist, and would control the migration of leachate from the containment system.

To address VOC contamination in groundwater downgradient of the disposal site, downgradient extraction wells will be installed along the plume axis south of the disposal site.

Residential wells impacted by VOCs from the Loeffel Site would still require wellhead treatment.

Four recovery wells would be installed along the plume axis. Groundwater recovery wells would use submersible or pneumatic pumps to create hydraulic capture. Recovered water would be sent to a treatment system located on or near the Loeffel Site through below-grade piping.

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| Present Worth: | $8,609,583 |
| Capital Cost: | $3,331,049 |
| Annual O&M: | $343,431 |
| Time to Implement: | 1 year |

### 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). 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 presented below.

#### 7.2.1. 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.

Alternative 1
This alternative would not comply with SCGs, as the area currently not in compliance with groundwater standards would not be remediated.

Alternative 2
This alternative would not provide any measure of benefit over Alternative 1 (No Further Action), and would not comply with SCGs

Alternative 3A
This alternative would not comply with SCGs, as the disposal site would continue to act as a source of contamination to the groundwater, which would not be addressed and continue to violate applicable standards. All SCGs related to operation and discharge from the water treatment units at the site would be met.

Alternative 3C
This alternative would not comply with SCGs, as the disposal site would continue to act as a source of contamination to the groundwater, which would not be addressed and continue to violate applicable standards.

Alternative 4
This alternative would not comply with SCGs, as the disposal site would continue to act as a source of contamination to the groundwater, which would not be addressed and continue to violate applicable standards. All SCGs related to operation and discharge from the water treatment units at the site would be met.

Alternative 5
This alternative would comply with SCGs after a long period of time. The disposal site would continue to act as a source of contaminants to the groundwater, which would only be addressed in the immediate vicinity of the disposal site. The portion of the bedrock groundwater contaminant plume to the south of the disposal site would be expected to achieve groundwater standards over a long period of time after implementation of this alternative, as the near site recovery system would not allow contaminants to migrate south within the bedrock. All SCGs related to operation and discharge from the water treatment units at the site would be met.

Alternative 6
This alternative would comply with SCGs after a long period of time. The disposal site would continue to act as a source of contaminants to the groundwater, which would only be addressed in the immediate vicinity of the disposal site. The portion of the bedrock groundwater contaminant plume to the south of the disposal site would be expected to achieve groundwater standards over a long period of time after implementation of this alternative, as the near site bedrock groundwater recovery system would not allow contaminants to migrate south within the bedrock. All SCGs related to operation and discharge from the water treatment units at the site would be met.

Alternative 7
This alternative would comply with SCGs after a long period of time. The disposal site would no longer act as a source of contaminants to the groundwater. The portion of the bedrock

groundwater contaminant plume to the south of the disposal site would be expected to achieve groundwater standards over a long period of time after implementation of this alternative, as the disposal site hydraulic containment system would not allow contaminants to migrate out of the disposal site. All SCGs related to operation and discharge from the water treatment units at the site would be met.

Alternative 8
This alternative would comply with SCGs after a long period of time. The portion of the bedrock groundwater contaminant plume to the south of the disposal site would be expected to achieve groundwater standards over a long period of time after implementation of this alternative, as the near site bedrock recovery wells would likely not allow contaminants to migrate away from the disposal site. The disposal site would continue to act as a source of contaminants to the groundwater, which would be addressed in the immediate vicinity of the disposal site, and by bedrock groundwater recovery and treatment south of the disposal site. All SCGs related to operation and discharge from the water treatment units at the site would be met.

Alternative 9
This alternative would comply with SCGs after a long period of time. It is anticipated that this alternative, which combines source control with active remediation of the bedrock groundwater contaminant plume, would take the shortest time to meet SCGs of the alternatives evaluated. The disposal site would no longer act as a source of contaminants to the groundwater. The portion of the bedrock groundwater contaminant plume to the south of the disposal site would be addresses by the downgradient bedrock groundwater recovery and treatment system. All SCGs related to operation and discharge from the water treatment units at the site would be met.

**7.2.2. Protection of Human Health and the Environment.**

This criterion is an overall evaluation of the health and environmental impacts to assess whether each alternative is protective.

Alternative 1
This alternative would not be protective of human health and the environment, as releases from the disposal site would continue, the bedrock groundwater contaminant plume would persist, and the potential for unacceptable human health exposures associated with the bedrock groundwater contaminant plume would continue.

Alternative 2
This alternative would not be protective of the environment, as releases from the disposal site would continue, and the bedrock groundwater contaminant plume would not be abated. The potential for unacceptable human health exposures associated with the bedrock groundwater contaminant plume would be addressed by monitoring and treatment as needed.

Alternative 3A
This alternative would not be protective of the environment, as releases from the disposal site would continue, and the bedrock groundwater contaminant plume would not be abated. The potential for unacceptable human health exposures associated with the bedrock groundwater contaminant plume would be addressed by monitoring and treatment as needed.

Alternative 3B
This alternative would not be protective of the environment, as releases from the disposal site would continue, and the bedrock groundwater contaminant plume would not be abated. The potential for unacceptable human health exposures associated with the bedrock groundwater contaminant plume would be

addressed by monitoring and treatment as needed.

Alternative 4
This alternative would not be protective of the environment, as releases from the disposal site would continue, and the bedrock groundwater contaminant plume would not be abated. The potential for unacceptable human health exposures associated with the bedrock groundwater contaminant plume would be addressed by monitoring and treatment as needed.

Alternative 5
This alternative would be protective of human health and the environment. The bedrock groundwater contaminant plume south of the site would persist over a long period of time, and the potential for unacceptable human health exposures associated with the bedrock groundwater contaminant plume would continue over a long period of time, but would eventually abate. Potential human health exposures to the contaminated groundwater in the interim would be avoided by water treatment and monitoring.

Alternative 6
This alternative would be protective of human health and the environment over the long term. Although the bedrock groundwater contaminant plume south of the site would persist over a long period of time, it would eventually abate. Potential human health exposures to the contaminated groundwater in the interim would be avoided by water treatment and monitoring.

Alternative 7
This alternative would be protective of human health and the environment over the long term. Although the bedrock groundwater contaminant plume south of the site would persist over a long period of time, it would eventually abate. Potential human health exposures to the contaminated groundwater in the interim would be avoided by water treatment and monitoring.

Alternative 8
This alternative would be protective of human health and the environment over the long term. Although the bedrock groundwater contaminant plume south of the site would persist over a long period of time, it would eventually abate. Potential human health exposures to the contaminated groundwater in the interim would be avoided by water treatment and monitoring.

Alternative 9
This alternative would be protective of human health and the environment over the long term. Although the bedrock groundwater contaminant plume south of the site would persist over a long period of time, it would eventually abate. Potential human health exposures to the contaminated groundwater in the interim would be avoided by water treatment and monitoring.

**7.2.3. 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.

Alternative 1
Implementation of this alternative would have no short-term adverse impacts. Leachate management would be ongoing for the forseeable future. This alternative could be implemented immediately.

Alternative 2
Implementation of this alternative would have no short-term adverse impacts. Leachate management, as well as residential well monitoring and maintenance would be ongoing for the forseeable future. This alternative could be implemented immediately.

Alternative 3A
Implementation of this alternative would have no short-term adverse impacts. Leachate management, as well as residential well monitoring and maintenance would be ongoing for the forseeable future. This alternative could be implemented immediately.

Alternative 3B
Implementation of this alternative would have no short-term adverse impacts. Leachate management, as well as residential well monitoring and maintenance would be ongoing for the forseeable future. This alternative could be implemented immediately.

Alternative 4
Normal construction hazards would be associated with the construction of the treatment plant; a higher degree of risk would be present to construction workers during excavation within the disposal site. Controls are available to minimize risks associated with on-site worker exposures. Monitoring would be performed to determine if unacceptable exposures would be generated by site work, and controls are available to minimize off-site impacts. The duration of construction is estimated to be less than one year; the leachate management, groundwater monitoring, and residential well monitoring and maintenance would be ongoing for the forseeable future.

Alternative 5
Normal construction hazards would be associated with the construction of the treatment plant, and installation of the nearsite bedrock groundwater recovery wells. Controls are available to minimize risks associated with on-site worker exposures. Monitoring would be performed to determine if unacceptable exposures would be generated by site work, and controls are available to minimize off-site impacts. The duration of construction is estimated to be less than one year; the leachate management, groundwater monitoring, and residential well monitoring and maintenance would be ongoing for the forseeable future.

Alternative 6
Normal construction hazards would be associated with the construction of the treatment plant, and installation of the nearsite bedrock groundwater recovery wells. Controls are available to minimize risks associated with on-site worker exposures. Monitoring would be performed to determine if unacceptable exposures would be generated by site work, and controls are available to minimize off-site impacts. The duration of construction is estimated to be less than one year; the leachate management, groundwater monitoring, and residential well monitoring and maintenance would be ongoing for the forseeable future.

Alternative 7
Normal construction hazards would be associated with the construction of the treatment plant; a higher degree of risk would be present to construction workers during excavation within the disposal site. Controls are available to minimize risks associated with on-site worker exposures. Monitoring would be performed to determine if unacceptable exposures would be generated by site work, and controls are available to minimize off-site impacts. The duration of construction is estimated to be less than one year; the leachate management, groundwater monitoring, and residential well monitoring and maintenance would be ongoing for the forseeable future.

Alternative 8
Normal construction hazards would be associated with the construction of the treatment plant, and installation of the bedrock groundwater recovery wells. Controls are available to minimize risks associated with on-site worker exposures. Monitoring would be performed to determine if unacceptable exposures would be generated by site work, and controls are available to minimize off-site impacts. The duration of construction is estimated to be less than one year; the leachate management, groundwater monitoring, and residential well monitoring and maintenance would be ongoing for the forseeable future.

Alternative 9
Normal construction hazards would be associated with the construction of the treatment plant; a higher degree of risk would be present to construction workers during excavation within the disposal site. Controls are available to minimize risks associated with on-site worker exposures. Monitoring would be performed to determine if unacceptable exposures would be generated by site work, and controls are available to minimize off-site impacts. The duration of construction is estimated to be less than one year; the leachate management, groundwater monitoring, and residential well monitoring and maintenance would be ongoing for the forseeable future.

**7.2.4. 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.

Alternative 1
This alternative would have poor long-term effectiveness. The remaining risks would be significant, as the potential exposures to contaminants within the bedrock groundwater plume would persist. The only control on these risks would be the removal of leachate from the disposal site.

Alternative 2
This alternative would have poor long-term effectiveness. The remaining risks would be significant, as the potential exposures to contaminants within the bedrock groundwater plume would persist. The controls on these risks would be increased removals of leachate from the disposal site, monitoring of the bedrock groundwater contaminant plume and the monitoring and maintenance of the residential well systems. These controls are only partially effective.

Alternative 3A
This alternative would have poor long-term effectiveness. The remaining risks would be significant, as the potential exposures to contaminants within the bedrock groundwater plume would persist. The controls on these risks would be increased removals of leachate from the disposal site, monitoring of the bedrock groundwater contaminant plume and the monitoring and maintenance of the residential well systems. These controls are only partially effective.

Alternative 3B
This alternative would have poor long-term effectiveness. The remaining risks would be significant, as the potential exposures to contaminants within the bedrock groundwater plume would persist. The controls on these risks would be increased removals of leachate from the disposal site, monitoring of the bedrock groundwater contaminant plume and the monitoring and maintenance of the residential well systems. These controls are only partially effective.

Alternative 4
This alternative would have poor long-term effectiveness. The remaining risks would be significant, as the potential exposures to contaminants within the bedrock groundwater plume would persist. The controls on these risks would be increased removals of leachate from the disposal site, monitoring of the bedrock groundwater contaminant plume and the monitoring and maintenance of the residential well systems. These controls are only partially effective.

Alternative 5
This alternative would have moderate long-term effectiveness. The remaining risks would be significant, as the potential exposures to contaminants within the bedrock groundwater plume would persist over a long period of time.

The controls on these risks would be increased removals of leachate from the disposal site, recovery of bedrock groundwater in the vicinity of the site (which would allow for declines in contaminant levels in the plume to the south of the site), monitoring of the bedrock groundwater contaminant plume and the monitoring and maintenance of the residential well systems. These controls are somewhat effective.

Alternative 6
This alternative would have moderate long-term effectiveness. The remaining risks would be significant, as the potential exposures to contaminants within the bedrock groundwater plume would persist over a long period of time. The controls on these risks would be increased removals of leachate from the disposal site, recovery of bedrock groundwater in the vicinity of the site (which would allow for declines in contaminant levels in the plume to the south of the site), monitoring of the bedrock groundwater contaminant plume and the monitoring and maintenance of the residential well systems. These controls are somewhat effective.

Alternative 7
This alternative would have moderate long-term effectiveness. The remaining risks would be significant, as the potential exposures to contaminants within the bedrock groundwater plume would persist over a long period of time. The controls on these risks would be the elimination of contaminant releases from the disposal site (which would allow for declines in contaminant levels in the plume to the south of the site), monitoring of the bedrock groundwater contaminant plume and the monitoring and maintenance of the residential well systems. The controls on migration of contaminants from the disposal site are the most effective, as the disposal site would no longer act as a source of contaminants to the groundwater; overall, the controls are somewhat effective.

Alternative 8
This alternative would have moderate long-term effectiveness. The remaining risks would be significant, as the potential exposures to contaminants within the bedrock groundwater contaminant plume would persist over a long period of time. The controls on these risks would be the removals of leachate from the disposal site, bedrock groundwater recovery and treatment to the south of the site (which would prevent further migration of the plume to additional residential wells), monitoring of the bedrock groundwater contaminant plume, and the monitoring and maintenance of the residential well systems. These controls are somewhat effective.

Alternative 9
This alternative would have good long-term effectiveness. The remaining risks would be significant, as the potential exposures to contaminants within the bedrock groundwater contaminant plume would persist over a period of time. However, the period of time necessary for the risks to be abated would be less for this alternative than for any of the above alternatives. The controls on these risks would be the elimination of contaminant releases from the disposal site, bedrock groundwater recovery and treatment to the south of the site, monitoring of the bedrock groundwater contaminant plume, and the monitoring and maintenance of the residential well systems. The controls on migration of contaminants from the disposal site are the most effective, as the disposal site would no longer act as a source of contaminants to the groundwater; overall, the controls are somewhat effective.

**7.2.5. 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 1
Reduction of toxicity, mobility, or volume of wastes at the site would be through utilization of the containment system at the site, which would impede the movement of contaminants from the

disposal site, and by the treatment of the leachate removed from the site.

Alternative 2
Reduction of toxicity, mobility, or volume of wastes at the site would be through utilization of the containment system at the site, which would impede the movement of contaminants from the disposal site, and by the treatment of the leachate removed from the site.

Alternative 3A
Reduction of toxicity, mobility, or volume of wastes at the site would be through utilization of the containment system at the site, which would impede the movement of contaminants from the disposal site, and by the treatment of the leachate removed from the site.

Alternative 3B
Reduction of toxicity, mobility, or volume of wastes at the site would be through utilization of the containment system at the site, which would impede the movement of contaminants from the disposal site, and by the treatment of the leachate removed from the site.

Alternative 4
Reduction of toxicity, mobility, or volume of wastes at the site would be through utilization of the enhanced containment system at the site, which would impede the movement of contaminants from the disposal site, and by the treatment of the leachate removed from the site.

Alternative 5
Reduction of toxicity, mobility, or volume of wastes at the site would be through utilization of the containment system at the site, and the nearsite groundwater recovery wells , which would impede the movement of contaminants from the disposal site, and by the treatment of the leachate removed from the site.

Alternative 6
Reduction of toxicity, mobility, or volume of wastes at the site would be through maximum utilization of the containment system at the site, and the nearsite groundwater recovery wells, which would impede the movement of contaminants from the disposal site, and by the treatment of the leachate removed from the site.

Alternative 7
Reduction of toxicity, mobility, or volume of wastes at the site would be through utilization of the hydraulic containment system at the site, which would prevent the movement of contaminants from within the disposal site, and by the treatment of the leachate removed from the site.

Alternative 8
Reduction of toxicity, mobility, or volume of wastes at the site would be through utilization of the containment system at the site, which would impede the movement of contaminants from the disposal site, and by the treatment of the leachate removed from the site as well as treatment of the bedrock groundwater recovered south of the disposal site.

Alternative 9
Reduction of toxicity, mobility, or volume of wastes at the site would be through utilization of the hydraulic containment system at the site, which would prevent the movement of contaminants from the disposal site, and by the treatment of the leachate removed from the site, as well as treatment of the bedrock groundwater recovered south of the disposal site.

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

Alternative 1
This alternative is implementable, as no additional work would be done.

Alternative 2
This alternative is implementable, no construction work would be done, the remedy would be monitorable, and personnel/materials are readily available.

Alternative 3A
This alternative is implementable. Standard construction techniques and water treatment processes would be used. The remedy would be monitorable, and personnel/materials are readily available. Authorization for discharge of treated waters would not be difficult to obtain.

Alternative 3B
This alternative is implementable, no construction work would be done, the remedy would be monitorable, and personnel/materials are readily available.

Alternative 4
This alternative is implementable. Standard construction techniques and water treatment processes would be used in the water treatment facility. Specialized techniques would be required for construction of the enhanced leachate collection system. Personnel and materials would be readily available, and the remedy would be monitorable. Authorization for discharge of treated waters would not be difficult to obtain.

Alternative 5
This alternative is implementable. Standard construction techniques and water treatment processes would be used. The remedy would be monitorable, and personnel/materials are readily available. Authorization for discharge of treated waters would not be difficult to obtain.

Alternative 6
This alternative is implementable. Standard construction techniques and water treatment processes would be used. The remedy would be monitorable, and personnel/materials are readily available. Authorization for discharge of treated waters would not be difficult to obtain.

Alternative 7
This alternative is implementable. Standard construction techniques and water treatment processes would be used in the water treatment facility. Specialized techniques would be required for construction of the enhanced leachate collection system. Personnel and materials would be readily available, and the remedy would be monitorable. Authorization for discharge of treated waters would not be difficult to obtain.

Alternative 8
This alternative is implementable. Standard construction techniques and water treatment processes would be used. The remedy would be monitorable, and personnel/materials are readily available. Authorization for discharge of treated waters would not be difficult to obtain. Access agreements for implementation of the bedrock groundwater recovery system would be required.

Alternative 9
This alternative is implementable. Standard construction techniques and water treatment processes would be used. Specialized techniques would be required for construction of the enhanced leachate collection system. The remedy would be monitorable, and personnel/materials are readily available. Authorization for discharge of treated waters would not be difficult to obtain. Access agreements for implementation of the bedrock groundwater recovery system would be required.

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

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

**7.2.8.** Community Acceptance - Concerns of the community regarding the RI/FS reports and the Proposed Remedial Action Plan are evaluated. A "Responsiveness Summary" will be prepared that describes public comments received and how the Department will address the concerns raised. If the selected remedy differs significantly from the proposed remedy, notices to the public will be issued describing the differences and reasons for the changes.

## SECTION 8: SUMMARY OF THE PROPOSED REMEDY

Based upon the results of the RI/FS, and the evaluation presented in Section 7, the NYSDEC is proposing Alternative 9, Disposal Site Hydraulic Containment with Downgradient Groundwater Recovery and Treatment, as the remedy for this site.

This selection is based upon the Department's findings that Alternative 9 would be most protective of human health and the environment, would comply with SCGs more quickly, has good short-term effectiveness, has the highest long-term effectiveness, and is implementable.

Alternatives 1, 2, 3A, 3B, and 4 are not protective of human health and the environment, as the disposal site would continue to act as a continuing source of contamination to the groundwater beneath the site, and the bedrock groundwater contaminant plume would not be addressed.

Alternatives 5, 6 and 8 have a lesser long-term effectiveness and permanence.

Alternative 7 would result in the disposal site no longer acting as a source of contaminants to the groundwater; however, no additional controls would be implemented to address the contaminants within the plume in the bedrock to the south of the site.

Alternative 9 would allow for the shortest time period to achieve SCGs (groundwater and drinking water standards).

Alternative 9 also has the highest degree of reduction in toxicity, mobility and volume of contaminants. This results in alternative 9 being the most likely to prevent additional homeowner wells from being impacted by the bedrock groundwater contaminant plume.

The estimated present worth cost to implement the remedy is $8.6 million. The cost to construct the remedy is estimated to be $3.33 million, and the estimated average annual operation and maintenance cost is $344,000.

The elements of the proposed remedy are as follows:

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

2. Installation and operation of a new leachate collection system within the disposal site to allow for hydraulic containment of waters within the disposal site.

3. Construction and operation of a new wastewater treatment facility at the site to manage leachate and groundwater generated as part of the site remedy.

4. Installation and operation of a bedrock groundwater recovery well system south of the site to control migration of the contaminant plume and to accelerate the time needed to meet groundwater and drinking water standards in the bedrock groundwater.

5. Monitoring and maintenance of the residential well treatment systems until the groundwater in the vicinity of the residences consistently meets groundwater and drinking water standards.

6. Maintenance of the disposal site, including mowing of the cap, fence inspection and repairs as needed, cap inspection and repairs as needed, and drainageway inspection and repairs as needed.

7. Since the remedy results in untreated hazardous waste remaining at the disposal site, a long term monitoring program would be continued. There would be several elements to the monitoring program. They are:

   - monitoring of water levels within and in the vicinity of the disposal site to evaluate the effectiveness of the new leachate collection system in achieving hydraulic containment of the disposal site;

   - monitoring of the groundwater quality in the vicinity of the disposal site and in the vicinity of the bedrock groundwater contaminant plume, to allow for evaluations of the effectiveness of the remedial program;

   - monitoring of nearby residential wells in the vicinity of the bedrock groundwater contaminant plume, to allow for identification of potential exposures to the contaminants within the bedrock contaminant plume.

This program would allow the effectiveness of the remedy to be monitored and would be a component of the operation and maintenance for the site.

## Appendix A: Development of Alternative 9

Introduction:

Upon reviewing the alternatives developed in the Feasibility Study (FS) and Feasibility Study Addendum (FSA), it was noted that there was no alternative developed which both achieved hydraulic control of the disposal site, and actively remediated the off-site groundwater contaminant plume in the bedrock south of the site. An alternative is developed below which would address both issues in a single alternative.

Alternative Development:

Alternative 9 is composed of elements found within alternatives 2, 7 and 8. Alternative 9 consists of the residential well monitoring, residential well treatment, groundwater monitoring, and 5-year review described in alternative 2, along with the upgrading of the leachate collection system with onsite treatment described in alternative 7, and the downgradient bedrock groundwater extraction and treatment described in alternative 8.

Costs of Alternative 9:

The costs associated with alternative 9 are defined in Table 1, below. As the elements of alternative 9 are the same as those presented as part of alternatives 2, 7, and 8, the cost estimates for those alternatives are the basis for the cost of alternative 9.

Evaluation of Alternative 9:

Alternative 9 is evaluated, along with the other remedial alternatives, in the text of the PRAP.

**Table A.1: Alternative 9 Cost Estimate**

| Elements of Alternative | Quantity | Units | Unit Cost | Capital Cost | Annual O&M Cost | Source |
|---|---|---|---|---|---|---|
| Residential Well Monitoring | 1 | LS | NA | $0 | $19,200 | FS reports |
| Residential Well Treatment | 1 | LS | NA | $0 | $45,000 | FS reports |
| Groundwater Monitoring | 1 | LS | NA | $0 | $47,200 | FS reports |
| Leachate Drains | | | | | | FS reports |
| • 1000 ft. long at 30 ft. depth w/ 8" HPDE and gravel | 30000 | SF | $25 | $750,000 | $2,770 | FS reports |
| • 2000 ft. long at avg. 25 ft. depth w/ 8" HDPE and gravel | 50000 | 22 | $22 | $1,100,000 | $5,540 | FS reports |
| • Construction Oversight | 1 | LS | NA | $64,750 | $0 | FS reports |
| On-site Treatment of Leachate | 1 | LS | NA | $1,043,869 | $191,827 | FS reports |
| Discharge | 1 | LS | NA | $42,993 | $11,582 | FS reports |
| Downgradient Extraction | | | | | | |
| • Extraction wells/piping | 4 | EA | $17,677 | $70,708 | $2,072 | FS reports |
| • Electrical Distribution and Control | 3325 | LF | $30 | $99,750 | $0 | FS reports |
| • Extraction Header Piping | 3325 | LF | $10 | $33,250 | $0 | FS reports |
| • Access Road (clearing, 3700 ft long/12 ft wide, 12 in gravel) | 4933 | SY | $11.40 | $56,236 | $2,240 | FS reports<br>FS reports |
| • Construction Oversight | 1 | LS | NA | $32,493 | | FS reports |
| Groundwater Treatment | 1 | LS | NA | $37,000 | $8,000 | FS reports |
| Five Year Review | 1 | LS | NA | $0 | $8,000 | FS reports |
| Totals | | | | $3,331,049 | $343,431 | |
| **Total Present Worth Cost** | (30 yrs/5%) | | | | **$8,609,583** | |

Table 1
Nature and Extent of Contamination

| MEDIA | CLASS | CONTAMINANT OF CONCERN | CONCENTRATION RANGE (ppb for water, ppm for soil) | SCG (ppb for water, ppm for soils) |
|---|---|---|---|---|
| Groundwater | Polychlorinated Biphenyls (PCBs) | Aroclor 1242 | ND to 0.25 | 0.09 |
| | | Aroclor 1260 | ND to 0.35 | 0.09 |
| Groundwater | Volatile Organic Compounds (VOCs) | Benzene | ND to 52,000 | 1 |
| | | Chlorobenzene | ND to 8600 | 5 |
| | | Chloroform | ND to 24 | 7 |
| | | 1,3-Dichlorobenzene | ND to 4.3 | 3 |
| | | 1,2-Dichloroethane | ND to 240 | 0.6 |
| | | cis-(1,2) Dichloroethene | ND to 22,000 | 5 |
| | | 1,4-Dichlorobenzene | ND to 7.6 | 3 |
| | | 1,2-Dichlorobenzene | ND to 4.8 | 3 |
| | | Ethyl Benzene | ND to 28 | 5 |
| | | Methylene Chloride | ND to 3300 | 5 |
| | | Toluene | ND to 56,000 | 5 |
| | | Trichloroethene | ND to 1200 | 5 |
| | | Vinyl Chloride | ND to 47 | 2 |
| | | Total xylenes | ND to 2100 | 5 |
| Groundwater | Semivolatile Organic Compounds (SVOCs) | Phenol | ND to 1300 | 1* |
| | | 2-chlorophenol | ND to 65 | 1* |
| | | 2-methyl phenol | ND to 340 | 1* |
| | | 4-methyl phenol | ND to 3500 | 1* |
| | | 2,4-dimethyl phenol | ND to 140 | 1* |

* applies to the sum of phenolic compounds

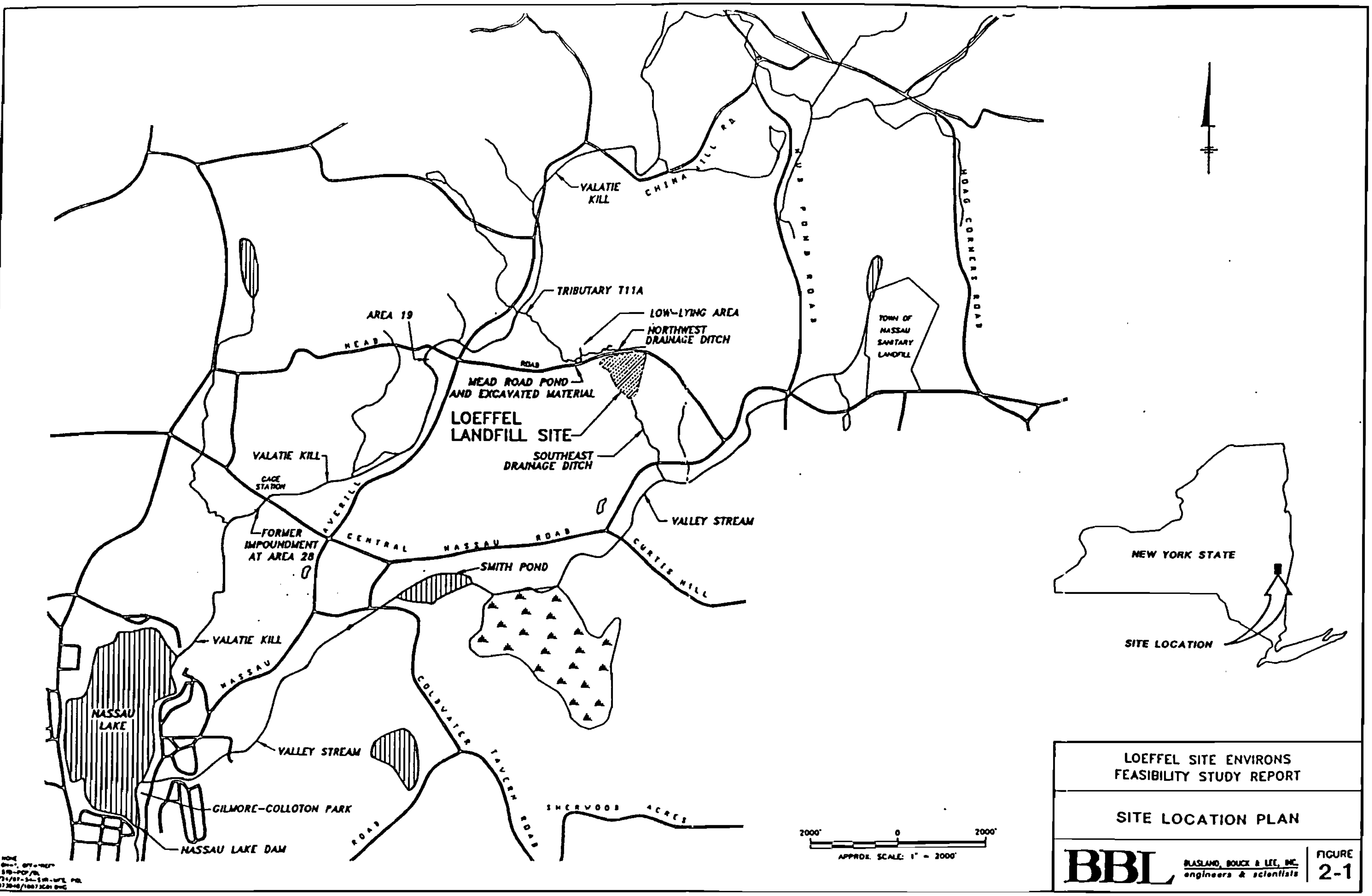
Table 2
Remedial Alternative Costs
(Costs in dollars)

| Remedial Alternative | Capital Cost | Annual O&M | Total Present Worth |
|---|---|---|---|
| Alternative 1: No Further Action | 0 | 71,300 | 1,096,000 |
| Alternative 2: Hydraulic Control | 0 | 182,700 | 2,931,000 |
| Alternative 3A: Enhanced Hydraulic Control with Off-Site Leachate Disposal | 0 | 296,000 | 4,551,000 |
| Alternative 3B: Enhanced Hydraulic Control with On-Site Treatment | 1,009,493 | 190,182 | 3,933,000 |
| Alternative 4: Enhanced Hydraulic Control with Expanded Collection and On-Site Treatment and Disposal | 1,725,622 | 314,411 | 6,558,905 |
| Alternative 5: Near Site Pump and Treat System | 976,100 | 223,000 | 4,403,200 |
| Alternative 6: Increased Leachate Collection with Near Site Groundwater Recovery and Treatment | 1,695,700 | 260,000 | 5,690,300 |
| Alternative 7: Disposal Site Hydraulic Containment | 3,002,000 | 331,000 | 8,092,000 |
| Alternative 8: Leachate Extraction and Downgradient Groundwater Recovery and Treatment | 1,305,539 | 253,350 | 4,891,175 |
| Alternative 9: Disposal Site Hydraulic Containment with Downgradient Groundwater Recovery and Treatment | 3,331,049 | 343,431 | 8,609,583 |

Figure 1:

Site Location

Major Drainage Pathways




LOEFFEL SITE ENVIRONS
FEASIBILITY STUDY REPORT

SITE LOCATION PLAN

BBL BLASLAND, BOUCK & LEE, INC. engineers & scientists

FIGURE 2-1

Figure 2:

Site Area Layout

Disposal Areas


TITLE:
**LOEFFEL SITE AND DISPOSAL FACILITY LAYOUT**

REPORT:
Loeffel Site Environs Groundwater Feasibility Study

| | | | |
|---|---|---|---|
| HSI GEOTRANS A TETRA TECH COMPANY | CHECKED: | CS | FIGURE: |
| | DRAFTED: | CP | 1.2 |
| | FILE: | N039049A.DSF | |
| | DATE: | 10-14-97 | |

Figure 3:

Well Locations

Monitoring and Residential Wells

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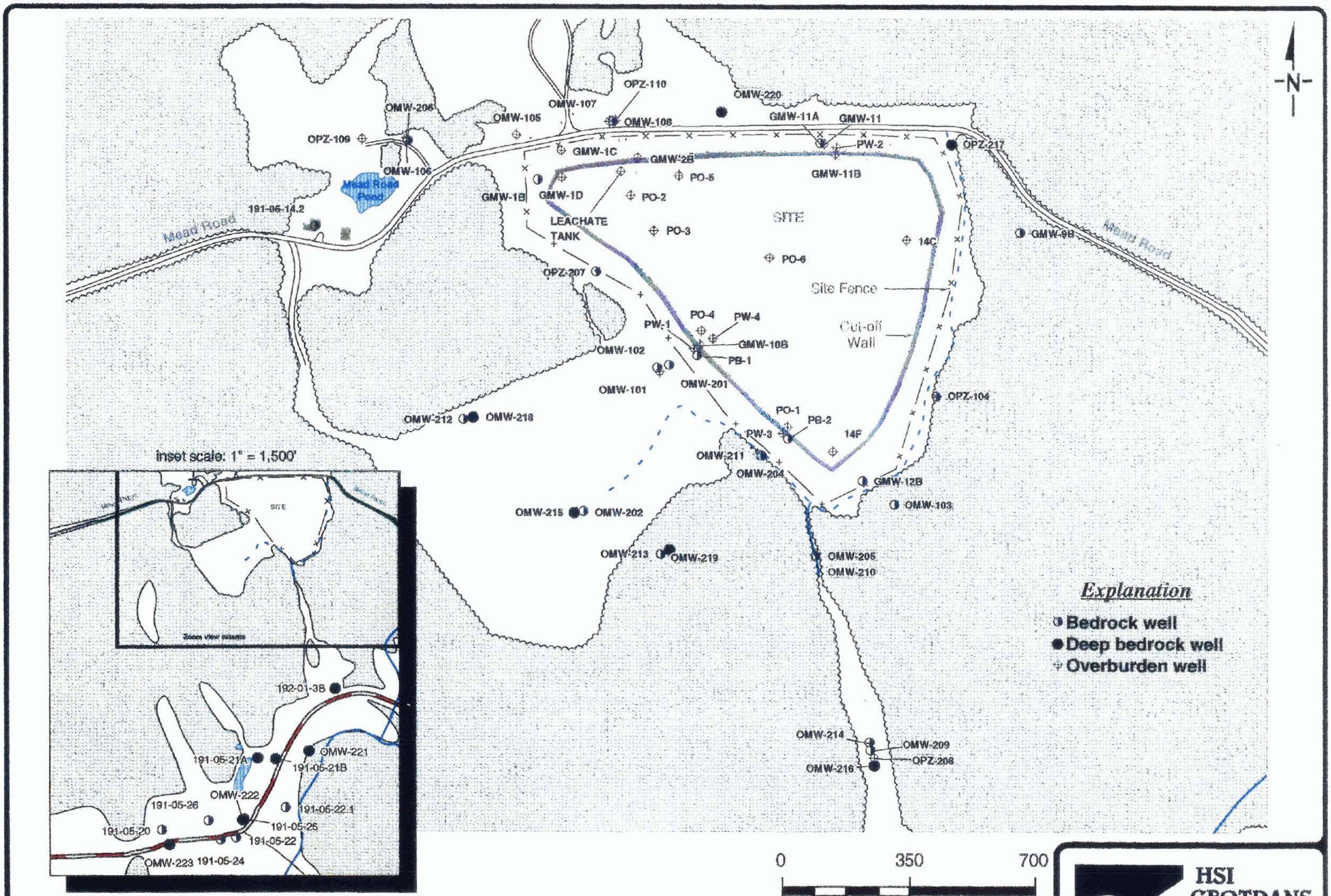


**Figure 1.3 Loeffel Site and environs monitoring well network.**

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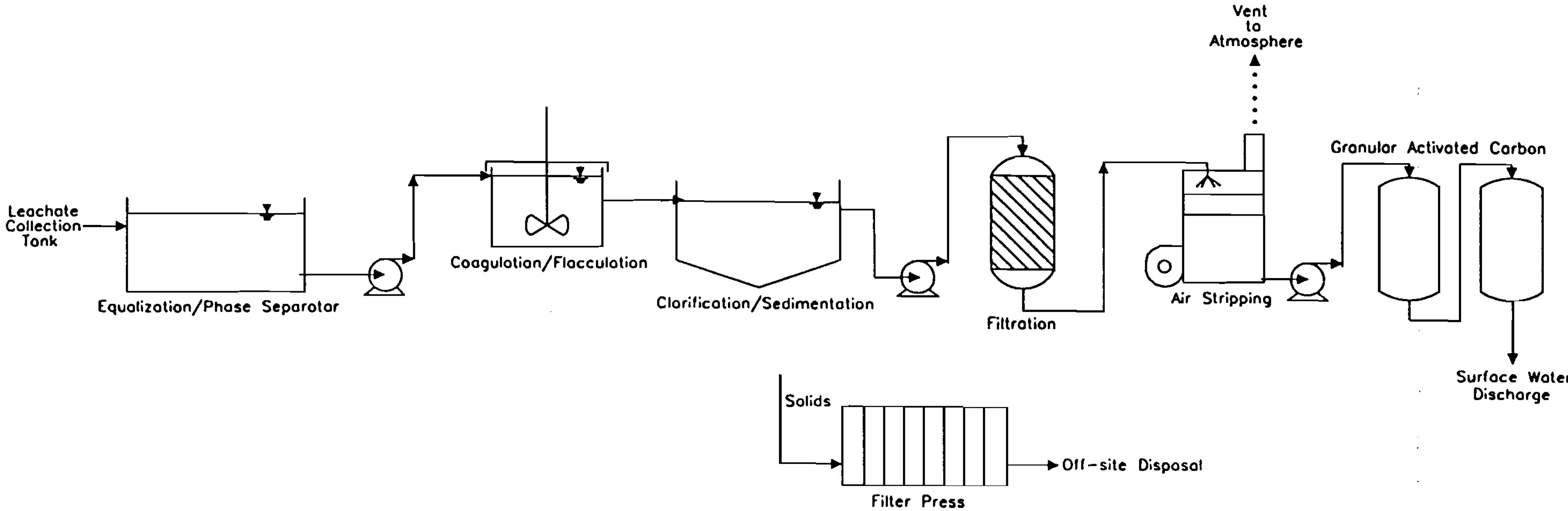
Figure 4:

Anticipated Water Treatment Process Diagram




TITLE: **Leachate Process Flow (On-site Treatment)**

LOCATION: Loeffel Site, Nassau, NY

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| | |
|---|---|
| CHECKED: | CPS |
| DRAFTED: | CMP |
| FILE: | N872001A.DWG |
| DATE: | 5-5-98 |

FIGURE: 3.2

Figure 5:

Conceptual Location of Bedrock Recovery Wells

N872001A.DSF

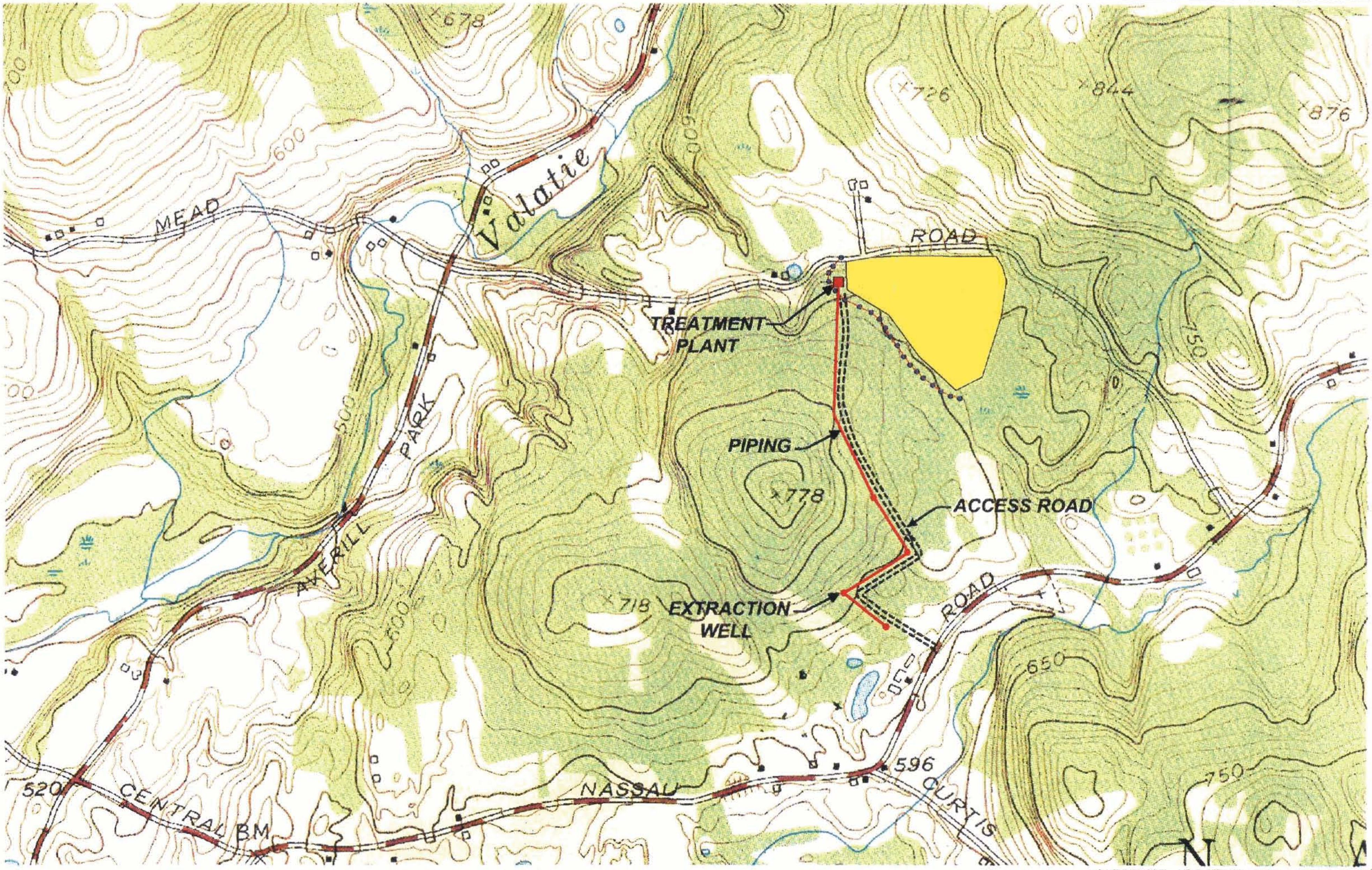


**Figure 3.3 Conceptual location of downgradient bedrock extraction wells, roads, and piping network.**

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