REPORT

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DIVISION OF ENVIRONMENTAL REMEDIATION

Feasibility Study
Rosen Site
Cortland, New York

Contributing Potentially
Responsible Parties

April 1997

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BLASLAND, BOUCK & LEE, INC.
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1. Introduction

1.1 General Discussion and Objectives

This section provides: an introduction to the Feasibility Study (FS) Report; an overview of the Rosen Site (Site) location, setting, and history; and a summary of the relevant results from the Remedial Investigation (RI) Report (BB&L, 1994a) and the Baseline Risk Assessment (Baseline RA) (BB&L, 1995a) for the Site. Post-RI Report activities are also summarized, including the Aquifer Test Program (ATP) conducted in January 1995 and the various ground-water sampling events conducted from March 1995 to August 1996.

The overall objective of the FS for the Site is to use the data from the previous investigations and Baseline RA (BB&L, 1995a) to evaluate potentially appropriate remedial measures, to the extent such measures may be necessary to protect human health and the environment, and to identify the appropriate remedial approach to the Site.

To achieve this objective, the FS Report is organized as follows:

Section	Content
Section 1 - Introduction	This section provides an introduction to the FS Report, and overview of the Site setting, a summary of the RI Report (BB&L, 1994a), a summary of the Baseline RA (BB&L, 1995a), and summaries of post-RI Report work efforts, including the January 1995 ATP, and the various ground-water sampling events.
Section 2 - Definition of Remedial Action Objectives (RAOs)	This section defines the RAOs based on constituents of interest, exposure pathways and receptors, and preliminary remediation goals (PRGs). This section also identifies federal, state, and local Applicable or Relevant and Appropriate Requirements/"To Be Considered" criteria (ARARs/TBCs) and defines PRGs from ARARs/TBCs and site-specific risk-based criteria.
Section 3 - Development and Screening of Remedial Alternatives	This section provides a discussion of process options and technology types to meet the RAOs, an initial screening based on technical feasibility, and a secondary screening based on effectiveness, implementability, and cost. The screening processes will determine the alternatives evaluated in subsequent sections.
Section 4 - Detailed Analysis of Remedial Alternatives	This section provides further definition of each alternative, including technologies and technology performance requirements, and an assessment of the alternatives with respect to the nine Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA)/National Contingency Plan (NCP) evaluation criteria.
Section 5 - Comparative Analysis of Remedial Alternatives	This section provides a comparative analysis between the alternatives with respect to the nine CERCLA/NCP criteria.
Section 6 - Identification of CPRP Group Recommended Alternative	This section sets forth the recommended alternative by the CPRP Group that best meets the CERCLA/NCP criteria.

1.2 Site Overview

The following provides an overview of the Site, including a description of the Site and the surrounding area in Section 1.2.1, an overview of the physical setting in Section 1.2.2, and the Site history in Section 1.2.3.

1.2.1 Site Location

The Site occupies approximately 20 acres on the southern side of the city of Cortland, Cortland County, New York (Figure 1-1). The Site is bordered on the north, east, and south by Perplexity Creek and Perplexity Creek tributary (Perplexity Creek and its tributary), and by a shallow swale on the west. The city of Cortland covers an area of approximately 4.1 square miles and, as of 1990, had an estimated population of approximately 20,000 individuals (United States Department of Commerce, 1990 and McComb, 1992).

Access to the Site (Figure 1-2) is restricted from the surrounding environs by a 7-foot high fence with two locked gates. Features within approximately 1,000 feet of the Site, such as surface waters, roads, schools, residential, commercial, and industrial areas, include:

- To the east, the parking lot of the former Kirby Company, Pendleton Street, a vacant lot, a small residential area consisting of approximately 13 apartment buildings, and GT Auto Finishers;
- To the west, a shallow swale, a vacant lot, several industries [GS Heavy Duty Electric (Dowzer Electric), JTS Lumber, Inc., and Cortland Wholesale Lumber and Plywood], and South Main Street;
- To the north, Perplexity Creek, railroad tracks associated with the former Lehigh Valley Railroad, several industries (Acorn Products Company, Injection Molded Plastics, Tuscarora Plastics of New York, and the Marietta Packaging Company, Inc.), Huntington Street, a small residential area consisting of approximately 20 houses, and the Randall Elementary School; and
- To the south, Perplexity Creek Tributary, a former city of Cortland dump site, Valley View Drive, and the Cortland City Junior and Senior High Schools.

The remainder of the city of Cortland lies further to the west, north, and east of the aforementioned features and comprises residential, commercial, and industrial areas. The southern limit of the city of Cortland and residential, agricultural, and forested areas lie further south of the junior and senior high schools (Miller et al., 1981).

1.2.2 Physical Setting

The city of Cortland occupies an area where five valleys meet. These valleys control the regional hydrology and hydrogeology of the area. Surface waters within these valleys converge east of the city and flow into the Tioughnioga River. Perplexity Creek and its tributary, which border the Site to the north, east, and south, flow into a storm water catch basin near the northeast corner of the Site. From this catch basin, the creek flows through an underground culvert that ends south of the city of Cortland Department of Public Works facilities. Upon emerging from the culvert, the creek flows into an open channel and then discharges into the Tioughnioga River, approximately 1.25 miles from the Site.

The 100-year and 500-year flood plains associated with the Tioughnioga River lie approximately one mile north and east of the Site. Based on information provided by New York State Department of Environmental Conservation (NYSDEC) (i.e., NYSDEC Freshwater Wetland Maps), the Site is not considered a regulated wetland or adjacent area. Field investigations indicate the Site does not support hydrologic wetland functions (BB&L, 1995a).

The NYSDEC classifies Perplexity Creek and its tributary as Class C water bodies and the Tioughnioga River as a Class B water body (6 NYCRR 930.1; State of New York, 1992). However, observations by the United States Geological Survey (USGS) indicate that the creeks are intermittent in nature and dry up over the summer. Due to the intermittent flow of Perplexity Creek and its tributary, these areas do not support populations of fish.

The ground water within the unconsolidated glacial sand and gravel geologic materials deposited in the five valleys comprises the 25-square mile Cortland-Homer-Preble Aquifer System (Miller et at., 1981). In this aquifer system, ground water flows from the edges of the valley toward the center part of the valley, where it then flows to the east (Figure 1-1). Subsequently, most of the ground water discharges into the Tioughnioga River. This aquifer system, designated by the USEPA as a sole-source aquifer in June 1988 and by the NYSDEC as a primary aquifer, serves as the supply of the city of Cortland's and the town of Cortlandville's potable water. However, the city of Cortland's and the town of Cortlandville's municipal ground-water supply wells are approximately two miles hydraulically upgradient of the Site (Miller et al.,1981) and, therefore, would not be impacted by the Site. Furthermore, ground-water use is highly unlikely at the Site and in the areas hydraulically downgradient of the Site, given the availability of the municipal water supply and the Cortland County regulations controlling well installation (Cortland County Sanitary Code; Cortland County Department of Health, 1986).

1.2.3 Site History

Until 1902, the area currently occupied by the Site was referred to as "Randall's vacant fields". In 1902, a brick foundry occupied a portion of the Site. From 1908 until 1971, Wickwire Brothers, Inc. Wire Mill (Wickwire) conducted industrial operations at and adjacent to the Site (the majority of Wickwire's industrial buildings and facilities were located in the western section of the Wickwire complex, west of the Site). Wickwire manufactured wire, insect screen, industrial-type screens, poultry netting, and nails. During its operations, Wickwire dammed the Perplexity Creek tributary to form a pond, known as the cooling pond. Wickwire ceased all operations in the spring of 1971 [Wehran Engineering, P.C. (Wehran), 1986].

From 1971 to 1980, Philip and Harvey Rosen (Rosen Brothers or Rosens) ran a scrap processing operation at the Site. The Rosen Brothers contracted to purchase the Site in 1971 and began the demolition of the Wickwire facility shortly after Wickwire closed. In 1979, the portion of the Wickwire facility west of the Site was developed for new industry (Cortland Standard, 1979). In 1980, the Rosens established a second business, Scrap King, Inc., which ran the scrap processing operation with the Rosen Brothers until 1985.

Operations at the Site during its use by the Rosens consisted mainly of crushing and recycling cars. According to a former Rosens employee and the Cortland County Health Department (CCHD), demolition debris and other waste materials from the Rosens operations were disposed of in the Wickwire cooling pond (Page, 1987; CCHD, 1972a and 1972b). In addition to scrap metal, the Rosens also disposed of municipal and industrial waste. Waste disposal practices conducted by the Rosens reportedly included: disposal of crushed drums in small pits, disposal of liquid wastes onto the ground, and disposal of wastes in the cooling pond such that the pond was completely filled (Wehran, 1986).

From 1972 to 1985, the CCHD, the New York State Department of Health (NYSDOH), and the NYSDEC assessed the Rosen Brothers disposal practices. In 1986, NYSDEC conducted a Phase II Investigation at the Site, which included a Site inspection, geophysical studies, installation of test borings and monitoring wells, and collection of ground-water, sediment, soil, and waste samples.

In 1987, the CCHD and the NYSDOH requested that the NYSDEC secure the Site with perimeter fencing and remove containers of hazardous wastes. In turn, the NYSDEC requested that the USEPA perform these security and removal efforts (Heerkens, 1987; Chen, 1987; and Nosenchuck, 1987). From July to November 1987, the USEPA completed a removal action at the Site that included sampling, securing, and temporary staging of drums, tanks, cylinders, capacitors, and visibly contaminated soil (USEPA, 1990c). In total, the USEPA documented 1,185 drums (309 drums contained solids, liquids, or sludges), 90 tanks (empty), 32 cylinders, four capacitors, and one 3,500 gallon underground storage tank (containing an estimated 1,000 gallons of fuel) that were sampled, secured,

and staged prior to final off-site disposal (USEPA, 1990c). In addition, the USEPA installed fencing around the Site where existing fencing was absent.

On March 30, 1989, the Site was added to the National Priority List (NPL) based on hazard ranking system (HRS) scores for migration (constituent concentrations in ground water have since decreased), fire and explosion hazard (from the former drums, since removed), and direct contact hazard (Site is now completely fenced). In 1988/1989, the USEPA issued a Unilateral Administrative Order to the following: Keystone Consolidated Industries, Inc., Monarch Machine Tool Company, Niagara Mohawk Power Corporation, and the Overhead Door Corporation to perform further removal actions. By April 1990, this group completed the removal and proper disposal of the materials previously staged by the USEPA. Further, in July 1990, this group installed a new section of 7-foot chain link fence along the northern and western perimeter of the Site to connect to the fencing installed by the USEPA and to replace an existing metal panel fence (USEPA, 1990c).

Overhead Door Corporation, Monarch Machine Tool Company, and Niagara Mohawk Power Corporation agreed to conduct an Remedial Investigation/Feasibility Study (RI/FS) in accordance with an Administrative Order on Consent, Index Number II CERCLA-00204 with the USEPA Region 2 effective January 7, 1990 (USEPA, 1990a). Cooper Industries, Inc., Keystone Consolidated Industries, Inc., and Potter Paint Company, Inc. agreed to conduct an RI/FS in compliance with the terms of a Unilateral Administrative Order, Index Number II CERCLA-00205 effective February 22, 1990 (USEPA, 1990b). The USEPA ordered three other respondents to participate in the RI/FS under Order No. 00205: Agway, Inc., Harvey M. Rosen, and Smith Corona Corporation. The USEPA later withdrew the Order to Agway, Inc; Harvey M. Rosen and the Smith Corona Corporation have failed to comply with the USEPA's Unilateral Administrative Order.

1.3 Summary of the RI

The RI was performed in accordance with: the USEPA-approved Work Plan dated December 1990 (Blasland & Bouck, 1990d); the ancillary plans to the Work Plan, including the Field Sampling Plan (FSP), the Quality Assurance Project Plan (QAPP), and the Health and Safety Plan (HSP) for the Site RI/FS dated December 1990 (Blasland & Bouck, 1990b, 1990a, and 1990c); and January 1992, November 1992, and October 1993 Addenda to the RI/FS Work Plan (Blasland & Bouck, 1992a, 1992b, and 1993).

This section summarizes the RI activities performed at the Site and the results of those activities, specifically, the characterization of potential source areas and hydrogeologic, hydrologic, and air migration pathways, as set forth in the RI Report (BB&L, 1994a). The RI Report was approved by the USEPA on November 29, 1994.

1.3.1 RI Activities

RI activities included:

- Reviews of background information, including historical documents, regulatory agency records, and regional hydrogeologic/hydrologic studies; and
- Field investigations, including planimetric survey, air investigation, source investigation, ground-water/subsurface investigation, and surface-water investigation.

A brief summary of the activities completed for the RI is provided below. Detailed descriptions and documentation of these RI activities are provided in the RI Report (BB&L, 1994a).

RI Activities	Work Efforts
Background Reviews	
Historic Review	Examining Sanborn Fire Insurance Atlases, aerial photographs, and information regarding cultural resources.
Agency Record Review	Contacting the following regulatory agencies to obtain information on the Site: USEPA, NYSDEC, CCHD, Cortland County Planning Department (CCPD), and USGS.
Regional Hydrogeologic/ Hydrologic Studies Review	Obtaining information on the hydrogeology of the Cortland-Homer-Preble aquifer system and hydrologic information on floodplains and wetlands near the Site.
Field Investigations	
Planimetric Survey	Completing a survey map of the Site and surrounding areas that extend to Pendleton Street to the east, to Valley View Drive to the south, to the western fence of the Site to the west, and to the railroad tracks to the north.
Air Investigation	Four work efforts: • Using portable organic vapor analyzer (OVA) to conduct a Site-wide monitoring survey to identify any locations from which volatile organic compounds (VOCs) were emanating at the Site. • During the OVA monitoring survey, collecting on-site meteorological data. The OVA and meteorological data were used to identify air sampling locations. • After the locations were identified, collecting two upwind and four downwind samples for VOC analysis using passivated stainless steel (PSS) Summa canisters. • Estimating particulate emissions from the Site using USEPA procedures and models.
Source Investigation	Including: a soil vapor survey at 217 sampling points, 10 test pit excavations, five test boring installations, soil and waste sampling and analysis, and a supplemental source characterization. The supplemental source characterization work efforts included: soil characterization of the potential PCB area via 13 borings and on-site PCB screening; supplemental source characterization near well W-06 consisting of the installation of three temporary wells and three test borings; supplemental subsurface source characterization consisting of a magnetometer survey and 12 additional test pit excavations; and supplemental surface soil sampling at 34 site locations plus six background locations.
Ground-Water/ Subsurface Investigation	Installing 12 perimeter and seven off-site soil borings, soil sampling and analysis, installing 10 on-site and nine off-site monitoring wells, installing three temporary wells, conducting five ground-water sampling and analysis events, and measuring physical characteristics of the ground-water flow system.
Surface Water Investigation	Performing both surface water and sediment sampling at a total of four locations in Perplexity Creek and its tributary. Two sediment sampling and analysis events were conducted at these locations. Supplemental sediment sampling consisted of sample collection at a total of six locations in Perplexity Creek and its tributary.

1.3.2 Site Characterization

The results of the RI were compiled into a comprehensive site characterization, including source, geologic, hydrogeologic, hydrologic, and air characterizations. These characterizations include both an evaluation of the physical and chemical characteristics (including the nature and extent of the constituents present) of potential source areas and of the migration pathways associated with the Site.

Source Characterization

Source areas contain chemical constituents that potentially pose a risk to human health and/or the environment. Potential risks may be associated with constituents present in the source areas or an associated migration pathway. As summarized in Section 1.5, the Baseline RA (BB&L, 1995a) for the Site evaluated risks based on the investigative data collected during the RI.

The RI included the sampling and analysis of 34 Site surface soil/fill samples and six background surface soil samples for semi-volatile organic compounds (SVOCs), and metals. PCB analyses were performed on six of the 34 surface soil samples along with the field screening of 13 boring locations. Two general types of organic constituents were detected in most samples: PAHs and phthalates. The PAHs are believed to be associated with petroleum products, coal, and/or combustion byproducts. The phthalates are believed to be associated with plastic.

Each Target Analyte List (TAL) metal was detected in at least one of the Site surface soil/fill samples. Each of the TAL metals was also detected in at least one of the background surface soil samples except for antimony, beryllium, selenium, silver, and thallium. Analytical results for background surface soil samples for arsenic and chromium were deemed unusable upon data validation; therefore, there is no information regarding the presence or absence of these constituents in the background surface soil samples. The metals present in the surface soils/fill at the Site may originate from the scrap metal at the Site, petroleum products (e.g., lead), or combustion byproducts at the Site. Further, many of these metals are also known to be naturally occurring in the environment, as evidenced by the presence of the metals in the background samples.

In total, 12 potential subsurface source areas were assessed during the RI: four associated with past Site operations; seven based on RI data; and one based on historical investigative data. The four potential subsurface source areas associated with past Site operations included: the former cooling pond area, the former oil pit, the former aboveground fuel oil storage tanks, and the alleged drum disposal pit area. Based on RI data, past operations at the former oil pit and former aboveground fuel oil storage tanks have not affected subsurface soils at the Site. In addition, no drums were observed in the area of alleged drum disposal in the southwestern section of the Site. However, a portion of the former cooling pond area, including the scrap pile adjacent to or on top of it (south of well W-06), may be a source area of TCA. A drum of "dry cleaning solvent" was observed in this area (removed in 1990) and may also be a source of TCA. BBL reviewed historical information relating to the investigation of this drum. This information showed that, upon discovery, the drum was lying on its side and contained a liquid. Information was not available regarding the amount of liquid present in the drum.

Regarding the seven potential subsurface source areas (in addition to the four discussed above), the types of fill/waste materials and the constituents associated with these areas are described below. In addition, a twelfth potential source area associated with a former leaking capacitor (since removed) was identified from historical investigation information. Overall, the subsurface is generally composed of fill, which was observed at each test pit, test boring, and soil boring installed at the Site. The fill varies in thickness from one to over 13 feet and is comprised of gravels, sands, and silts, mixed with various materials such as slag, cinders, and ash. Other materials observed included: metal, wire, brick, wood, glass, railroad ties, pipes, tar, plastics, and concrete.

Petroleum-related constituents (BTEX, PAHs, other petroleum hydrocarbon compounds, and lead) were present at several subsurface soils/fill areas. These constituents may have originated from crushed automobiles, petroleum-based products, and/or combustion by-products at the Site. PCBs were only detected in a limited area in the eastern portion of the Site in the vicinity of a former leaking capacitor (since removed) and in a small area near the center

of the Site. Solvents (chlorinated hydrocarbons) were present sporadically in only trace amounts in subsurface soils/fill, except for two potential TCA areas near the central portion of the Site.

Four VOCs (TCA, ethylbenzene, toluene, and xylenes) were present at three subsurface soils/fill areas of the Site at concentrations greater than 1 mg/kg. However, based on the ground-water analytical data, only TCA (and its degradation products) was detected in the ground water at these areas. The potential source areas of TCA are located near well W-06 and include: materials/soils within the scrap pile adjacent to and/or on top of the former cooling pond area; materials/soils associated with the drum of "dry cleaning solvent" (removed in 1990); and/or subsurface soils/fill near test pit T-02.

Several metals were detected in the subsurface soils/fill. These metals may originate from the scrap metal at the Site, petroleum products (e.g., lead), and combustion byproducts. Further, many of these metals are known to be naturally occurring in the environment, as evidenced by the presence of metals in the background samples, and based on regional soils data.

Off-site sources of organic and inorganic constituents, both upgradient of the Site, were identified in the RI. Upgradient of the Site lies property owned by the city of Cortland. Until 1959, the city of Cortland operated a municipal waste disposal site on this property, which is located due south of the Site. Further, numerous drums and debris are present on this property. Collectively, the former municipal disposal site, the drums, and the debris on the city property will be referred to as the city of Cortland dump site. Ground-water analytical results from wells placed hydraulically upgradient of the Site and hydraulically downgradient of the city of Cortland dump site indicate that this dump is a potential source of metals and VOCs to the ground water. It is recognized that some of the metals identified in the upgradient wells may be naturally occurring; however, the relative contribution of metals from the former city of Cortland dump site and from natural sources, is not known. Concentrations of metals and VOCs (including TCE) in the upgradient wells are at levels similar, if not higher, than downgradient of the Site.

In addition to the above considerations, industries and facilities downgradient of the Site (which are suspected to have used solvents) may have also contributed VOCs to the ground-water system downgradient to the Site.

The ground-water migration pathway at the Site is comprised of the upper outwash/collapsed kame terrace/lower sand and gravel hydrogeologic unit in the southern portion of the Site. Near the northern perimeter of the Site, the upper outwash and lower sand and gravel units become separated by a lacustrine unit and form two distinct hydrogeologic units. The upper outwash hydrogeologic unit, ranging from 39 to 45 feet in thickness, appears to be the primary unit within which constituent migration occurs from the Site. The geometric mean hydraulic conductivity for the upper outwash unit was calculated at 7.7×10^{-3} cm/sec (22 feet/day), which was revised based on the ATP to a geometric mean of 220 feet/day, as discussed in Section 1.4.1. In stratified deposits, the horizontal to vertical hydraulic conductivity ratios can be expected to be on the order of 10:1 to 100:1. In general, on-site horizontal hydraulic gradients ranged from 0.01 to 0.018 feet per feet (ft/ft). Horizontal ground-water flow within the upper outwash was generally towards the northeast (Figure 1-2). Based on an evaluation of ground-water velocity components, horizontal ground-water flow is inferred to predominate over vertical flow within the upper outwash unit.

The distribution of TCA and its degradation products [i.e., 1,1-dichloroethane (DCA) and chloroethane] hydraulically downgradient of the Site at the perimeter and off site suggests that TCA and its degradation products are migrating northeast from potential subsurface source areas with ground-water flow in the upper outwash above the lacustrine unit with some lateral dispersion to the northwest and to the east. The highest concentrations of TCA were observed at the Site, the S&B Roofing property, and at the city of Cortland Public Works Garage (Figure 1-1). While the latter two areas fall within the ground-water flow paths simulated from the Site by the USGS, the vertical distribution and concentrations of TCA detected at the S&B Roofing wells and the wells near the city of Cortland Public Works Garage suggest that potential sources of TCA to the ground-water migration pathway could be present at the S&B Roofing property and/or the city of Cortland Public Works Garage and/or adjacent areas. TCA and its degradation products have not been detected in the lacustrine unit nor the underlying lower sand and gravel

unit, indicating that the lacustrine unit acts to confine the migration of chemical constituents to the upper outwash hydrogeologic unit and defines the vertical extent of these VOCs in the ground water.

Although TCA and DCA have been detected in the downgradient ground water between the Site and the Tioughnioga River, there are no known drinking water users associated with the upper outwash hydrogeologic unit in this area of Cortland. This information is based on an extensive well database, presented in the RI Report, and data from the hydraulically upgradient locations of the municipal water supply wells (BB&L, 1994a).

TCE is also present throughout the upper outwash aquifer off-site and hydraulically downgradient of the Site. The distribution of this VOC suggests that potential sources of TCE to the ground-water migration pathway exist upgradient of the Site at the dump site, and downgradient of the Site at locations that include present and past industries along Huntington Street, the S&B Roofing property, or the city of Cortland Public Works Garage (Figure 1-1).

Other constituents were sporadically detected within the ground-water migration pathway; however, none of the constituents (tetrachloroethene, BTEX, PCBs, and metals) has been correlated with a specific potential source area at the Site. Rather, they are believed to originate from small, localized source areas at the Site (e.g., drums previously removed), and/or are naturally occurring elements. Benzene was only detected once at an on-site well and was also detected at hydraulically upgradient wells and temporary wells. Tetrachloroethene has only been consistently detected at one well. PCB (Aroclor 1254) detected at well W-07 can be correlated with PCBs detected in the soil immediately adjacent to this well. PCBs were not detected in any other Site or off-site wells. The metals potentially associated with the Site are generally associated with particulates in the ground water and have limited ability to dissolve in the ground water itself.

Hydrologic Characterization

The surface-water migration pathways at the Site consist of surface water and sediments associated with Perplexity Creek and its tributary. Aluminum, iron, lead, and zinc were detected in the surface waters. At Perplexity Creek, the source of these metals in surface water appears to be upstream of the Site; these metals may also be naturally occurring elements. At the Perplexity Creek Tributary, the source of these metals may be the Site, and/or other sources south of the Site, potentially including the city of Cortland dump site; these metals are also naturally occurring elements.

PAHs and several metals were detected in the upstream and downstream sediments of Perplexity Creek and its tributary. The presence of PAHs at both locations suggest upstream contributions of these constituents. The sediments in these streams appear to act as "sinks" for PAHs and, as a result, these constituents accumulate within the sediments. Numerous sources of these constituents could exist, other than the Site itself, such as the former petroleum storage facilities adjacent to the Site, the railroad tracks and spurs (treated ties and coal combustion by-products) adjacent to the Site, the city dump site, and road tars.

Low concentrations [less than 0.1 milligram/kilogram (mg/kg)] of PCBs were also detected in two sediment samples from Perplexity Creek Tributary. Arsenic, cadmium, chromium, copper, iron, lead, manganese, mercury (Perplexity Creek only), nickel, and zinc were detected in sediments from Perplexity Creek and its tributary both upstream and downstream of the Site. At Perplexity Creek, the concentrations of these metals were generally higher or approximately the same at the upstream sampling point in comparison to the concentrations at the downstream sampling point.

The significance of these compounds in sediments and surface waters was evaluated in the Baseline RA (BB&L, 1995a) as discussed in Section 1.5.

Air Characterization

To evaluate various air migration pathways, VOCs were measured downwind of the Site and the potential concentrations of constituents on dust particulates were estimated. Insignificant concentrations [as determined in the Baseline RA (BB&L, 1995a)] of the VOCs acetone, toluene, and TCA were detected at the perimeter of the Site. These constituents may have originated from the Site or adjacent industries along Huntington Street and/or Main Street. The significance of these compounds and the estimated concentrations of constituents on particulates were evaluated in the Baseline RA (BB&L, 1995a), as discussed in Section 1.5.

1.4 Post RI Activities

This section summarizes the additional field activities performed after completion of the RI Report. Specifically, Section 1.4.1 summarizes the activities associated with the completion of the ATP, Section 1.4.2 discusses the completion of an additional round of ground-water sampling and Section 1.4.3 discusses the geophysical investigation/test pit program.

1.4.1 Aquifer Test Program (ATP)

The ATP was conducted in accordance with the October 1994 Addendum to the RI/FS (BB&L, 1994b) to further determine the aquifer characteristics at the Site and to enhance the data available for the evaluation of potential remedial alternatives. A complete report of the ATP and associated field activities is presented as Appendix A. Analytical data from the ATP are presented as Appendix B. The activities associated with the implementation of the ATP include: the installation of a pumping well (W-25) and an observation well (W-26); preliminary aquifer testing; pre-test ground-water elevation monitoring; ground-water sampling during aquifer testing; recovery ground-water elevation monitoring; and aquifer test analysis and evaluation.

The ATP consisted of extracting ground water from the pumping well at a rate of 80 gallons per minute (gpm) for 8.2 hours, and monitoring water levels continuously at a logarithmic rate at three observation wells (W-02, W-11, and W-26) and the pumping well (W-25). In addition, ground-water levels were measured manually at other Site monitoring wells.

Ground-water samples were collected from the pumping well just prior to the initiation of pumping, after approximately 1.5 hours of pumping, and approximately 30 minutes prior turning off the pump. The ground-water samples were analyzed for VOCs; total and dissolved calcium, iron, lead, and magnesium; pH; total suspended solids; biological oxygen demand (BOD); chemical oxygen demand (COD); and total hardness as calcium carbonate. The analytical estimated results from this sampling are provided in Table 1-1. No constituents exceeded the federal MCLs and only filtered and unfiltered iron exceeded the secondary MCL. Other constituents detected above New York State ground-water standards included DCA (24 to 39 ug/L) and TCA (56 to 110 ug/L).

The ATP data were evaluated using several analytical methods to assess the transmissivity and hydraulic conductivity of the upper outwash aquifer. From the test data, the transmissivity calculated ranged from 4.8 to 12 square feet/minute, with a geometric mean of 7.1 square feet/minute, and the hydraulic conductivity calculated ranged from 150 to 350 feet/day with a geometric mean of 220 feet/day.

The mean hydraulic conductivity of the upper outwash hydrogeologic unit calculated from the results of the ATP was significantly higher than the mean hydraulic conductivity derived from the in-situ hydraulic conductivity test data collected during the RI. The mean hydraulic conductivity derived during the RI was 22 feet/day and ranged from 3 to 135 feet/day. The hydraulic conductivity values derived from the ATP are considered more representative of the hydraulic characteristics of the upper outwash than the hydraulic conductivity values derived from the in-situ tests. In general, an ATP would assess aquifer properties over a larger aquifer volume than an in-situ hydraulic conductivity test. Furthermore, in-situ tests utilize small diameter observation wells, which may have

disturbed the aquifer and its hydraulic properties during drilling and installation (Kruseman and Ridder, 1990). Thus, the ATP results described above are used in the evaluation of the remedial alternatives in this FS.

1.4.2 Ground-Water Sampling

Additional rounds of ground-water sampling were conducted at the Site in March 1995, August 1995, December 1995, March 1996, August 1996, and December 1996. These additional sampling rounds were conducted to evaluate spatial and temporal concentration trends of the VOCs and metals present in the ground water at the Site and upgradient and downgradient of the Site and to further evaluate the trends of TCA and TCE in order to calculate natural attenuation rates. For the purposes of this document, as identified in *Natural Attenuation at the Rosen Brothers Superfund Site* (Natural Attenuation Technical Memorandum; BBL, 1995b), natural attenuation processes occur in all ground water sources and plumes and include physical processes such as dispersion, volatilization, and sorption; and biological processes such as hydrolysis and dehydrohalogenation. The rates of natural attenuation depend on site specific conditions for the source(s); the vadose zone geology and geometry; the ground-water chemistry, geology, and hydrogeology; the nature of the contaminants; and the distance from the source(s) to the point of compliance. These sampling events were conducted in accordance with the FSP and QAPP developed for the RI (Blasland and Bouck, 1990b; 1990a). The ground water samples from select site wells were analyzed for Target Compound List (TCL) VOCs and filtered and unfiltered TAL metals (TAL metals analyses through August 1995). In addition, ground water from well W-07 was analyzed for filtered and unfiltered PCBs (March, August, and December 1995 only).

VOC analytical results for the additional sampling rounds are presented in Tables 1-2, 1-4, 1-6, 1-9, 1-11, and 1-13. VOC analytical results through March 1995 are depicted on Figure 1-3A, while TCE and TCA analytical results (including their degradation products) through August 1996 are presented on Figures 1-3B and 1-3C, respectively. Inorganic constituents analytical results for the additional sampling rounds are presented in Tables 1-3, 1-5, 1-8, 1-10, and 1-12. Inorganic analytical results through March 1995 are depicted in Figure 1-4A, while specific inorganic analytical results through August 1996 are presented on Figure 1-4B. Lastly, PCB analytical results for the December 1995 sampling round are presented in Table 1-6.

In these ground-water sampling events, the following VOCs were detected:

VOCs	Number of Times Detected/ Number of Samples				
Sample Date	3/95	8/95	12/95	3/96	8/96
Trichloroethene (TCE)	12/26	16/22	11/15	11/15	4/7
1,1-Dichloroethene	13/26	9/22	10/15	10/15	4/7
1,2-Dichloroethene	6/26	4/22	6/15	6/15	2/7
Vinyl Chloride	2/26	1/22	1/15	1/15	2/7
1,1,1-Trichloroethane (TCA)	18/26	18/22	13/15	13/15	5/7
Chloroethane	3/26	2/22	2/15	2/15	0/7
1,1-Dichloroethane (DCA)	16/26	15/22	13/15	13/15	5/7
Tetrachloroethene	1/26	NA	NA	NA	NA

TCA, TCE, and their degradation products (chloroethane, DCA, 1,1-dichloroethene, 1,2-dichloroethene, and vinyl chloride) were the primary VOCs detected at the Site. Specifically, 1,2-dichloroethene, 1,1-dichloroethene, and vinyl chloride are degradation products of TCE while chloroethane and DCA are degradation products of TCA.

The frequency of TCE detected in the ground water samples is provided in the above table. TCE concentrations range from an estimated concentration at 0.2 ug/L to 200 ug/L. The highest concentrations of TCE were detected in ground water from upgradient monitoring well W-24 at a concentration of 200 ug/L and in downgradient monitoring wells W-17 and W-18 at concentrations ranging from 3 to 19 ug/L. TCE has also been detected in well W-06 at concentrations ranging from 1.7 to 18 ug/l. The highest concentrations of the TCE degradation products 1,2-dichloroethene and vinyl chloride also were observed at well W-24. The frequency of 1,1-dichloroethene detected in the ground water samples is also shown above. The highest concentrations of 1,1-dichloroethene were observed at wells W-11 (7 ug/L), W-19 (8 ug/L), W-26 (7 ug/L), and at hydraulically upgradient well W-24 (3.2 ug/L).

The frequency of TCA detected in the ground water samples is summarized in the above table. TCA concentrations ranged from ND (1 ug/L) to 5000 ug/L. The highest concentrations of TCA and its degradation products (DCA and chloroethane) were detected in the ground-water samples from wells W-02, W-06, W-07, W-10, W-11, W-18, W-19, W-25, and W-26. In general, the higher concentrations of TCA are limited to the areas near and downgradient of well W-06. Thus, these data indicate that a localized source of TCA is present near the location of well W-06 and potentially near test pit T-02. These data also indicate that TCA is migrating towards the north to northeast. The observed increases of TCA and DCA in December 1995 were most likely the result of increased leaching of residual constituents in a localized source area near well W-06. The distribution and concentrations of the TCA degradation products (DCA and chloroethane) are similar to distribution of TCA in that the concentrations are highest at W-06 and the wells downgradient of W-06 (i.e., W-02, W-10, W-11, W-18, W-19, W-25, and W-26).

During the post-RI sampling activities, only three VOCs (tetrachloroethene, TCE and TCA) and two TCE degradation products (1,1-dichloroethene and vinyl chloride) were detected above federal MCLs. Tetrachloroethene was only detected above the MCL at one well, W-03. TCE was detected above the MCL at wells W-17 and W-19 hydraulically downgradient of the Site and at on-site well W-06; 1,1-Dichloroethene was detected at four wells, W-06, W-11, W-19, and W-26, at concentrations at or just above the MCL. In addition, the only detection of vinyl chloride above the MCL was at monitoring Well W-24, hydraulically upgradient of the Site. TCA has been detected above the MCL (200 ug/L) at four well locations: W-06, W-11, W-19, and W-25. The most recent ground-water sampling indicates that TCA is above the MCL only at well W-06. In addition, trace concentrations (1 ug/L or less) of chlorobenzene, chloroform, chloromethane, 1,2-dichloroethane, and toluene were detected. Acetone was only detected at well W-06 at a concentration of 4 ug/L.

New York State ground-water standards are the same as the federal MCLs for TCE, tetrachloroethene, and vinyl chloride and very similar for 1,1-dichloroethene. However, the New York State standards are more stringent than the federal MCLs for TCA, DCA, and 1,2-dichloroethene. Thus, in comparison to these more stringent standards, TCA was detected above the New York State standard in ground-water samples from 15 wells, and DCA was detected above the New York State standard in ground-water samples from 12 wells. In general, TCA, and DCA exceed the New York State standards in several of the monitoring wells located at or hydraulically downgradient of the Site. Concentrations of cis-1,2-dichloroethene in ground water exceeded the New York State standard at hydraulically downgradient well W-18 and at hydraulically upgradient well W-24.

The temporal variations in the concentrations of TCE and its degradation products (1,2-dichloroethene and vinyl chloride) and TCA and its degradation products (DCA and chloroethane) were reviewed to assess the source(s) of TCA and TCE, whether the source(s) were diminishing, and whether the concentrations of these VOCs that exceed ground-water standards were decreasing.

From May 1991 to August 1996, the VOC concentrations have generally decreased with time. However, in December 1995, VOC concentration increases were observed - most notably at well W-06 for TCA and at well W-

24 for TCE. Since December 1995, two ground-water sampling events have been conducted, the first in March 1996 and the second in August 1996. In both events, VOC concentrations at wells W-06 and W-24 were lower than those observed in December 1995 and similar to the other wells sampled. VOC concentration trends upgradient of the Site at impacted well W-24, on site at well W-06, at the downgradient perimeter at wells W-02 and W-11, and downgradient of the site at wells W-18 and W-19 are discussed below.

At upgradient well W-24, TCE and its degradation products have generally decreased in concentration from June 1993 (200 ug/L of TCE, 79 ug/L of 1,2-DCE, and 27 ug/L of vinyl chloride) to August 1995 (40 ug/L of TCE, 43.5 ug/L of 1,2-DCE, and 7 ug/L of vinyl chloride). In December 1995, TCE and its degradation products increased in concentration (200 ug/L of TCE, 108.4 ug/L of 1,2-DCE, and 19 ug/L of vinyl chloride). Since December 1995, concentrations of TCE and its degradation products have decreased as shown by the March 1996 (130 ug/L of TCE, 59 ug/L of 1,2-DCE, and 13 ug/L of vinyl chloride) and the August 1996 (57 ug/L of TCE, 27.3 ug/L of 1,2-DCE, and 6.3 ug/L of vinyl chloride) sampling events. From March 1996 to August 1996, TCE, 1,2-DCE, 1,1-DCE, and vinyl chloride concentrations decreased significantly.

At on-site well W-06, TCA and its degradation products have generally decreased in concentration from May 1991 (3,400 ug/L of TCA and 430 ug/L of DCA) to August 1995 (15 ug/L of TCA and 13 ug/L of DCA). In December 1995, TCA and its degradation products increased in concentration (5,000 ug/L of TCA and 390 ug/L of DCA). This increase in TCA during the December 1995 sampling event was likely due to higher than average precipitation during this period resulting in increased surface water infiltration. It is important to note that since December 1995, concentrations of TCA and its degradation products have decreased as measured in the March 1996 and August 1996 sampling events. In the March 1996 and August 1996 sampling events, TCA concentrations decreased (1,000 ug/L compared to 240 ug/L), and DCA concentrations remained similar (55 ug/L and 56 ug/L). At well W-06, TCE and its degradation products have generally decreased in concentration from May 1991 (45 ug/L of TCE and 56 ug/L of 1,2-DCE) to August 1995 (1.7 ug/L of TCE and 0.84 ug/L of 1,2-DCE). As shown by the March 1996 and August 1996 sampling events, concentrations of TCE and its degradation products have decreased since December 1995. From March 1996 to August 1996, TCE concentrations remained similar (5.7 ug/L to 9.4 ug/L); no TCE degradation products were detected in the August 1996 sampling event.

At perimeter wells W-02 and W-11, TCA and its degradation products have generally decreased in concentration from February 1992 (390 ug/L of TCA and 100 ug/L of DCA at well W-11 and 190 ug/L of TCA and 53 ug/L of DCA at well W-02) to August 1996. In the March 1996 and August 1996 sampling events, TCA and DCA concentrations remained similar (45 ug/L compared to 41 ug/L for TCA and 34 ug/L compared to 29 ug/L for DCA) at well W-11, and TCA and DCA concentrations at well W-02 remained similar (22 ug/L compared to 30 ug/L of TCA and 14 ug/L compared to 22 ug/L of DCA).

At downgradient wells W-18 and W-19, TCA and its degradation products have generally decreased in concentration from February 1992 [260 ug/L of TCA and 86 ug/L of DCA at well W-19 and 68 ug/L (March 1995) of TCA and 26 ug/L of DCA at well W-18] to August 1996. In the March 1996 and August 1996 sampling events, TCA and DCA concentrations remained approximately the same or increased slightly (62 ug/L compared to 83 ug/L of TCA and 26 ug/L compared to 38 ug/L of DCA) at well W-19, and TCA and DCA concentrations at well W-18 remained approximately the same (25 ug/L compared to 30 ug/L of TCA and 14 ug/L compared to 16 ug/L of DCA).

The observed VOC concentration increases in December 1995 were likely the result of increased leaching of residual constituents in existing source areas of TCA on site near well W-06 and of TCE off site and upgradient near well W-24. TCA concentrations at well W-06 appear to be more strongly correlated to precipitation than water table fluctuation, and TCE concentrations at well W-24 also appear to be correlated to precipitation events rather than water table fluctuations.

Results of the March and August 1995 PCB sampling at well W-07 (in the interior of the Site) indicate the presence of Aroclor 1254 at 0.9 ug/L and 0.6 ug/L, respectively, in the unfiltered ground-water samples, which slightly exceed the federal MCLs and New York State ground-water standards. PCBs were not detected in the filtered

samples, indicating that the observed concentrations of Aroclor 1254 are associated with the particulates in the ground water and are not associated with dissolved concentrations in the ground water. Historically, PCBs (Aroclor 1254) have been detected only at well W-07. PCBs have not been detected in any of the other Site wells, confirming that PCBs are not present in a dissolved state. Comparison of the results of two previous PCB analyses with the March and August 1995 analyses indicates a reduction with time in Aroclor 1254 in unfiltered ground water from this well.

Most metals were detected in unfiltered ground-water samples from wells at and hydraulically downgradient of the Site as well as hydraulically upgradient of the Site in the March and August 1995 sampling events. Analytical results indicate that (as expected) most metals were detected in the non-filtered ground-water samples and at lower concentrations in the filtered ground-water samples (using 0.45 micron filters). Metals in unfiltered ground water samples consist of suspended particulates, colloids, and dissolved metals, while the metals present in the filtered samples consist entirely of dissolved metals and small (less than 0.45 micron) colloids. Recent studies have shown that the concentration of particulates in a ground-water sample is often related to the sampling technique and not the amount of mobile colloids present (Backhus et al., 1993). Recent research also has shown that only dissolved metals and some inorganic colloids (less than 0.1 micron) are transported to any significant degree in ground-water (Hahn, 1995; Puls and Powell, 1992; and Buddemeier and Hunt, 1988). These inorganic colloids with significant transport potential easily pass through standard 0.45 micron ground water filters (Buddemeier and Hunt, 1988). The USEPA document, *Conducting Remedial Investigations/Feasibility Studies for CERCLA Municipal Landfill Sites* (USEPA, 1991a) also indicates that all contaminant-mobility estimates based on unfiltered ground-water samples are biased towards overestimation. Other studies indicate that only the filtered results provide consistent and reliable data about inorganic ground-water plumes (Watts, 1987). Thus, only the filtered results are considered to be useful in evaluating the inorganic data from the Site.

In comparison to federal MCLs and New York State ground-water standards, only iron, magnesium, manganese, and sodium were consistently present at concentrations above the standards in both upgradient and downgradient filtered ground-water samples. The most commonly detected dissolved metal was manganese, which was consistently detected in all upgradient wells (W-23, W-24, W-21, W-22, and temporary wells) during the sampling events completed in 1992 and 1995. Dissolved manganese was also detected at hydraulically downgradient wells (W-18 and W-19) and perimeter wells (W-25 and W-26), at levels comparable to those of the upgradient wells.

Historically, the metals aluminum, antimony, iron, chromium, manganese, magnesium, and sodium have been detected at dissolved concentrations above federal and/or state standards. Furthermore, most of these concentrations were detected in samples from wells hydraulically upgradient of the Site (between the Site and the city of Cortland dump site) and/or downgradient of the Site. Dissolved aluminum was detected above the standard only at wells W-21 (upgradient), W-17 (downgradient), and W-19 (downgradient) only in 1992. Additionally, the only detection of dissolved chromium above the standard was upgradient of the Site (W-21) in 1992. Dissolved antimony concentrations above the standard were only detected once each at wells W-11 and W-19 in 1992. Dissolved magnesium concentrations above the standard were only detected at upgradient wells (TW-2 and TW-3); at on site W-06; at perimeter well W-09; and at downgradient well W-20. The most commonly detected dissolved metal was manganese, which was consistently detected at all upgradient wells (W-21, W-22, W-23, W-24, and TW-2) in one or more sampling events conducted from 1992 to 1995. Dissolved iron was detected above the standard in both upgradient wells (W-21, TW-1), on-site well W-07, downgradient wells (W-17 and W-19), and perimeter wells (W-11, W-29 and W-26). From 1992 to 1995, concentrations of dissolved iron have decreased at wells W-17, W-19, and W-21 to below the state standard. In 1995, only dissolved iron concentrations detected at perimeter wells (W-11, W-25, and W-26) exceeded the state standard. Dissolved sodium was detected above the state standard during all sampling events upgradient, downgradient, and at the Site.

Oxidation-Reduction Potential (ORP) measurements generally have indicated that reducing conditions are present at the site. The ORP results from ground-water sampling events (August 1995, December 1995, and March 1996) are summarized below.

Well	ORP Value Range (mV)
W-04	87 to 153
W-06	-492 to 300
W-02	0.6 to 88
W-11	-11 to 12
W-18	34 to 120
W-19	78 to 314

Based on these ORP results, the environmental conditions at the Rosen site are conducive for the reduction of manganese oxides (ORP values in the 200 mV range) and iron oxides (ORP values in the 20 mV range) and possibly sulfate (ORP values in the -200 mV range). Manganese (IV), iron (III), and sulfate, which are generally present at the site, likely act as electron acceptors in microbial respiration. These electron acceptors can be used by a variety of microbes that have the capability to reductively dehalogenate chlorinated compounds (Bouwer, 1993). Figures 1-4A and 1-4B depict the concentrations of these inorganic constituents.

To evaluate the distribution of manganese both upgradient and downgradient of the Site, the Student's *t*-test (Davis, 1986) is used to judge the significance of deviations in sample data based on the *t* probability distribution. For this Site, the Student's *t*-test was performed at each of the three well groupings (upgradient, downgradient perimeter, and downgradient off-site) to determine if the mean concentrations of dissolved manganese were statistically different. (The difference in the standard deviation for each sample population is accounted for in the analysis.) The results of the *t*-test indicated that the means of dissolved manganese in ground water do not vary significantly from upgradient to downgradient perimeter or downgradient off-site. Therefore, there is not a distinct plume of dissolved manganese at the Site or attributable to the Site and there is no statistically discernible Site-related impact. Refer to the Natural Attenuation Technical Memorandum (BB&L, 1995b) regarding further information on the Student's *t*-test calculations.

1.4.3 Geophysical Investigation/Test Pit Excavation Program

On behalf of the CPRP Group, BB&L initiated a Test Pit Excavation Program from December 17, 1996 through December 20, 1996 to determine the presence or absence of buried drums at the Site, and to establish the probable sources of apparent geophysical anomalies.

The locations of these geophysical anomalies were identified by BB&L and USEPA based on the data presented in the Geophysical Investigation Report (GIR; BB&L, 1996). The initial areas of geophysical investigation proposed by the CPRP Group and BB&L were three test pits in the Former Scale House and Former Coal Bin West Area. These two areas were considered by BB&L to have the potential to contain multiple intact buried drums based on BB&L's interpretation of the geophysical data. Following review of the GIR and the proposed locations for test pits, the USEPA requested completion of an additional 13 test pits located in the following areas of the Site: center area, former coal bin east area, B-1 area, and the former cooling pond area. As described in the *Test Pit Excavation Program Report* (BB&L, 1997), a total of 16 test pits were excavated to determine the source of the geophysical anomalies. BB&L also excavated two test pits to investigate the source of TCA in the well W-06 area. The excavation effort into the source of TCA in ground water in well W-06 was conducted in a similar fashion to the geophysical anomaly excavations.

In total, five samples were analyzed in connection with the potential TCA source investigation. Two water samples were taken from the test pit just south of well W-06; one from seepage water at a depth of two feet below ground

level (bgl) (sample GSTP-6) and one from the bottom of the test pit at approximately 5 feet bgl (sample GSTP-6A). One composite soil sample (sample SBTP-6) was also taken at this test pit. One water sample was taken from the test pit south of well W-06 in the former cooling pond area (sample CPBS). One ground-water sample was taken from the monitoring well W-06. All samples were analyzed for TCA (Table 1-13).

All test pit excavations were conducted using backhoes to remove and then stockpile the excavated material adjacent to each test pit. The test pits ranged in size from 14 feet long by 3 feet wide to 41 feet long by 5 feet wide. Excavation depths ranged between 4 to 16 feet with the excavation effort terminated for a given test pit if natural soils were penetrated and/or the probable cause for the geophysical anomaly was established.

The findings of the Test Pit Excavation Program were as follows:

- No intact drums were found in any of the test pits during the excavation efforts.
- The geophysical anomalies in most cases are attributable to metallic, slag-like material present at depths ranging from 1 to 4 feet bgl. This slag-like material exhibited a high conductivity which was detected by the EM-31 conductivity instrument.
- The remaining geophysical anomalies were caused by miscellaneous scrap metals present in the fill materials (e.g., rebar in concrete footers, large steel plates, etc.).
- One crushed drum was found during the well W-06 excavations in the former cooling pond area. The drum contained a small amount of grey paper-like material, and was not labeled.
- The analytical results from well W-06 excavations indicate that the source of TCA was not within the former cooling pond area . The concentration of TCA in the former cooling pond test pit was less than 1 ppb.
- It is likely that the TCA originates from a localized source, located immediately south of well W-06. This determination is based on the presence of TCA in the shallow seepage water from the test pit excavated immediately south of well W-06.

1.5 Summary of Baseline RA

1.5.1 Overview

The USEPA, in a letter dated June 9, 1995, indicated that the Baseline RA (BB&L, 1995a) had been approved. The Baseline RA included assessments of both baseline human health and ecological risks associated with the Site. The objective of these assessments was to characterize and quantify potential risks to human health and the environment associated with exposure to constituents present at the Site under current and potential future (or hypothetical) conditions in the absence of remediation. These assessments have been prepared in accordance with USEPA requirements and utilize USEPA and NYSDEC guidances. These guidances required the evaluation of potential exposure scenarios, which are likely to overestimate actual risks, but are used by the agencies in a conservative review of the potential Site risks. The estimates of risk generated in these assessments are not predictors of actual disease or environmental damage but, rather, are tools used by risk managers to make decisions about the appropriateness of remediation at a given Site.

Utilizing current requirements and guidance to assess potential risks associated with the Site, no unacceptable risks to human health under current Site conditions were identified. Ecological risks to the limited number and species of animals that might currently inhabit the Site were more difficult to assess. The Baseline RA (BB&L, 1995a) indicated that current Site conditions may be associated with unacceptable risks to these animals (e.g., mice, raccoons). While the conservative screening-level nature of the assessment and the low

potential for exposure limit the usefulness of these conclusions for quantitative risk, they are useful in proposing risk management decisions.

Similarly, a hypothetical future use of the Site was evaluated assuming that no Site remediation is performed and that the Site is developed under one or more hypothetical scenarios (e.g., residences at the Site). As expected, use of the Site in some hypothetical scenarios (ingestion of soils/fill and inhalation of dust by potential future residents and/or industrial workers) could result in potentially unacceptable risks to human health for the individuals exposed. In addition, use of ground water at the Site, or immediately downgradient of the Site, for consumption purposes could result in unacceptable potential risks.

1.5.2 Human Health Risk Assessment

Constituents of interest were detected in ground water and surface and subsurface soils/fill materials associated with the Site, and in sediments and surface waters adjacent to the Site. The Site is fenced; thus, occasional on-site workers and trespassers are the only human receptors currently exposed to constituents of interest associated with the Site. If the Site were not remediated and were developed for residential or for commercial/industrial use, hypothetical residents or commercial/industrial workers could also be exposed. The risk assessment evaluated risks associated with:

- Current on-site workers exposed to surface soils/fill;
- Hypothetical current trespassers exposed to surface soils/fill, surface water, and sediment;
- Hypothetical future on-site residents exposed to ground water and surface soils/fill;
- Hypothetical future off-site residents exposed to ground water and particulates/volatiles released from soils/fill;
- Hypothetical future on-site commercial/industrial workers exposed to ground water and surface soils/fill; and
- Hypothetical future on-site excavation workers exposed to subsurface soils/fill.

The USEPA default assumptions were used to estimate reasonable maximum exposures for each of the above pathways. These estimated exposures were used, along with USEPA reference toxicity values, to quantify noncarcinogenic and carcinogenic risks. Carcinogenic risk is presented as an upper bound estimate on lifetime risk above background levels. The USEPA typically uses a target risk range of one-in-ten thousand to one-in-one million (i.e., 10^{-4} to 10^{-6}) for Superfund sites. Noncarcinogenic risks are presented in terms of hazard indices. A hazard index is the sum of ratios of chemical constituent intakes to chemical-specific toxicity threshold doses, where a hazard index in excess of one indicates the potential for adverse health effects.

Potential risks greater than 10^{-4} were not identified for the current pathways nor were hazard indices greater than one. Therefore, the current conditions at the Site do not cause an unacceptable risk to the evaluated receptors according to the USEPA - approved risk assessment. For the hypothetical future pathways, hazard indices greater than one were generated for hypothetical future commercial/industrial workers and hypothetical future on-site and off-site residents who might use ground water (upper outwash only) as a potable water supply, and the hypothetical future on-site residents who might be exposed to surface soils. Hazard indices of 2 and 3 were estimated for hypothetical on-site workers and residents respectively, due to inhalation of manganese in surface soil. However, the likelihood of a residential development at the Site is low; therefore, the likelihood of resident exposure to surface soils is likewise low.

Inorganic constituents, primarily antimony, arsenic, cadmium, and manganese, were responsible for hazard indices in excess of one associated with the hypothetical future use of ground water. Antimony, arsenic, and manganese were also detected in the ground water hydraulically upgradient of the Site. Arsenic, PCBs, and chlorinated ethenes and ethanes were primarily responsible for the carcinogenic risk estimates associated with potable use of ground

water (upper outwash only). PCBs have only been detected at one monitoring well, and chlorinated ethenes were also detected in the ground water hydraulically upgradient of the Site. PCBs, arsenic, chromium (assumed hexavalent), manganese, and PAHs were primarily responsible for the carcinogenic risk estimates associated with exposure to on-site surface soil. PCBs detected in the surface soils did not contribute significantly to the hazard indice value for on-site soils. Manganese in soils was primarily responsible for hazard indices of greater than one for on-site soils.

1.5.3 Ecological Risk Assessment

The ecological assessment for the Site describes the wildlife habitat and species associated with the Site, identifies special resources, and quantifies potential ecological risks. This assessment was conducted in accordance with NYSDEC guidelines for fish and wildlife impact assessments (FWIA) and USEPA guidance on ecological issues.

The wildlife species inhabiting or using the Site are likely to be limited to common species, which are typical of upstate New York and have minimal habitat requirements for survival and reproduction. Eastern cottontail rabbits have been observed within the boundaries, and the Site habitat is such that it probably supports a number of other small mammals (i.e., raccoons, woodchucks, mice, and moles). Since the Site is fenced, it is largely inaccessible to larger animals such as white-tail deer. Birds are present at the Site, although limited nesting habitat is available. In terms of usefulness/value for wildlife, the trees and shrubs at the Site provide some food and cover for nesting birds and small mammals. Low-growing vegetation may provide habitat for small mammals by providing food and cover.

Based on the vegetative cover at the Site and the general land use characteristics of the surrounding area, previous Site investigations have determined that the Site has low value as wildlife habitat, while surrounding areas provide some limited alternative, preferred habitat. The degree of human-made physical disturbance at the Site and lack of continuous quality habitat in the area are conditions which restrict the extent of use by wildlife. Perplexity Creek and its tributary generally provide low habitat value for aquatic biota due to the intermittent nature of streamflow and other considerations.

Based on information provided by the NYSDEC, the Site is not considered a regulated wetland nor are adjacent lands to the Site considered wetlands. Field investigations indicate that the Site does not support hydrologic wetlands functions. Surface waters associated with the Site are either channelized or flowing downslope such that wetlands do not form at the Site.

No threatened or endangered species were identified within a two-mile radius of the Site, either by the NYSDEC Natural Heritage Program information files or through Site visits by environmental scientists.

Ecological risks for aquatic and terrestrial receptors were estimated in the ecological assessment. For aquatic receptors, concentrations of constituents identified in sediments and surface water of Perplexity Creek and its tributary were compared with available draft sediment and surface-water criteria. Constituents of interest identified in sediments, including chromium, mercury, zinc, PCBs, and PAHs, had concentrations in excess of one or more of their associated draft criteria. Upstream samples of surface water and sediments contained similar constituents. Hence, potential upstream sources may be responsible for those constituents evaluated in the Baseline RA (BB&L, 1995a). Aluminum and zinc were the only constituents of interest in surface water that had concentrations in excess of their water quality criteria. However, these constituents were believed to be naturally occurring elements since they were detected in the background soil samples. The potential impacts to aquatic receptors are less significant, in light of the limited habitat provided by these intermittent surface waters.

Raccoons and deer mice were chosen to represent terrestrial receptors potentially exposed to Site-related constituents of interest. Using standard USEPA exposure factors, doses for constituents of interest in soil, sediment, and food items were calculated. The total dose of each chemical for each species was then compared with available No-Observed-Adverse-Effect-Levels (NOAELs) and Lowest-Observed-Adverse-Effect-Levels

(LOAELs). For raccoons, estimated doses of cadmium, mercury, and lead exceed the available LOAELs and NOAELs. Ingestion of food items was the primary route of exposure. For deer mice, estimated doses for mercury, nickel, lead, barium, and Aroclor 1254 exceed their respective NOAELs but not their LOAELs. Estimated doses of Aroclor 1242 and 1248 exceed their respective NOAELs but not their LOAELs. Except for barium, these exceedances are due almost entirely to ingestion of food items. The potential impacts to terrestrial receptors are less significant, in light of the limited habitat provided at the Site.

2. Definition of Remedial Action Objectives (RAOs)

2.1 General

As stated in USEPA guidance (USEPA, 1988), RAOs consist of medium-specific or operable-unit-specific goals for protecting human health and the environment. Further, the guidance indicates that constituents of interest, and PRGs based on chemical-specific federal, state, and local ARARs, TBCs, and/or site-specific risk-based criteria should be specified in the RAOs. Each of these RAO elements is described below, followed by the site-specific RAOs proposed for the Site.

2.2 Constituents of Interest

The constituents of interest by medium were selected from those constituents that contribute to potential risks to the hypothetical future human and environmental exposure pathways and receptors discussed in Section 2.3 and in the Baseline RA (BBL, 1995a) and those constituents detected at concentrations greater than chemical-specific federal and state ARARs. As set forth in the Baseline RA (BBL, 1995a), there are no current risks associated with constituents present at the Site for current exposure pathways and receptors.

Constituents of interest were selected for surface soils/fill, subsurface soils/fill, sediments, and ground water.

In surface soils/fill, the constituents contributing to the potential risks associated with the ingestion of and dermal contact with soils, and inhalation of soil-derived dusts/vapors by hypothetical future industrial workers are arsenic, benzo(a)pyrene, chromium (assumed hexavalent), manganese, and PCBs (BBL, 1995a). Benzo(a)pyrene and manganese were also detected in the background (off-site) surface soils (BBL, 1994a). Other PAHs and most TAL metals were also detected in the Site and industrial background surface soil samples (BBL, 1994a). The background detections of these metals indicate that they may be naturally occurring in the environment and/or these metals may be ubiquitous in an urban/industrial setting. Furthermore, these constituents did not contribute significantly to the potential risks to hypothetical future industrial workers, where data are available for risk quantification. However, for certain constituents, there are no toxicological data available. The USEPA reviewed the PAHs and metals detected and determined that lead should also be considered a constituent of interest for this site, based on the *Revised Interim Soil Lead Guidance for CERCLA sites and RCRA Corrective Action Facilities* (USEPA, 1994). Based on the ecological assessment of the Baseline RA (BBL, 1995a), risks to ecological receptors are difficult to quantitatively assess. However, the results of this conservative screening level assessment will be used in risk management decisions regarding remedial alternatives at the Site.

Per the request of the USEPA, constituents of interest were also developed for subsurface soils/fill. These constituents were selected using the constituents of interest consistently detected in the site ground water (multiple wells above ARARs) that were also detected in the subsurface soils/fill at concentrations that could partition to the ground water (above 1 mg/kg). TCA is the only constituent of interest for subsurface soils/fill.

Based on the ecological assessment section of the Baseline RA (BBL, 1995a), risks to ecological receptors from sediments are difficult to quantitatively assess. However, the results of this conservative screening level assessment will be taken into consideration in the evaluation of remedial alternatives. The following could be considered constituents of interest in sediments, based on potential risks to ecological receptors: chromium, mercury, zinc, PCBs, and PAHs. PAHs, chromium, mercury, and zinc were also detected in the sediments upstream of the Site, indicating that sources of these constituents are upstream of the Site and these constituents cannot be attributed solely to the Site.

In the ground water, the constituents contributing to potential risks associated with the ingestion of and dermal contact with upper outwash ground water by hypothetical future industrial workers are antimony, arsenic, cadmium, manganese, and PCBs (BBL, 1995a). The constituents contributing to potential risks associated with the ingestion, dermal contact, and inhalation of VOCs from upper outwash ground water by off-site hypothetical future residents are antimony, arsenic, manganese, 1,1-dichloroethene, 1,2-dichloroethane, and TCE. Antimony, arsenic, cadmium, manganese, 1,1-dichloroethene, and TCE have been detected in the ground water hydraulically upgradient of the Site, indicating sources of these constituents to the south of the Site and/or the metals are naturally occurring in the environment. Thus, the potential risks associated with the hypothetical use of ground water cannot be attributed

solely to the Site. Furthermore, in filtered ground-water samples, concentrations of arsenic and cadmium indicate these constituents are associated with particulates in the ground water and not dissolved in the ground water. PCBs have only been detected at one well (W-07). Concentrations of PCBs have decreased over time, and PCBs were not detected in farther hydraulically downgradient wells.

Federal and state ground-water standards (USEPA, 1991b, USEPA, 1995; NYSDEC, 1993a) are considered ARARs. Using these standards for comparison, the following are considered constituents of interest in ground water:

		TAL Metals	
VOCs	PCBs	Unfiltered	Filtered
Benzene	Aroclor 1254	Aluminum	Aluminum
Chloroethane		Antimony	Antimony
Chloroform		Arsenic	Iron
Chloromethane		Cadmium	Magnesium
1,1-Dichloroethene		Chromium	Manganese
1,1-Dichloroethane (DCA)		Copper	Sodium
1,2-Dichloroethane		Iron	
1,2-Dichloroethene (total)		Lead	
Ethylbenzene		Manganese	
Methylene Chloride		Mercury	
Tetrachloroethene		Nickel	
Toluene		Sodium	
1,1,1-Trichloroethane (TCA)		Zinc	
Trichloroethene			
Vinyl Chloride			
Xylenes			

Of these constituents, 1,1-dichloroethene, 1,2-dichloroethene, TCE, and all TAL metals were detected in the hydraulically upgradient ground water, indicating that there are sources of these constituents hydraulically upgradient of the Site and/or the metals could be naturally occurring. With respect to benzene, chloroform, chloromethane, ethylbenzene, methylene chloride, toluene, and xylenes, these constituents have only been detected sporadically. These constituents have generally not been detected in hydraulically downgradient wells above detection limits.

Most of the TAL metals were detected at comparable or higher concentrations in the unfiltered ground-water samples. Since any potable water supply would utilize a production well with a well-developed sand pack, the filtered or dissolved ground-water concentrations are most representative of future hypothetical ground-water use by an industrial worker or off-site resident.

2.3 Federal, State, and Local ARARs and TBCs

CERCLA, as amended by the Superfund Amendments and Reauthorization Act of 1986 (SARA), specifies that Superfund remedial actions must comply with the substantive requirements of federal, state, and local environmental laws and regulations or receive "waivers" from such laws and regulations.

These laws and regulations are termed ARARs, and may be either "Applicable" or "Relevant and Appropriate". ARARs are identified on a site-specific basis where it is first determined whether a given requirement is applicable, then, if it is not applicable, whether it is both relevant and appropriate. Applicable requirements are those standards, standards of control, or other substantive environmental protection requirements, criteria, or limitations promulgated under federal, state, or local law that specifically address a constituent, location, or action at a site. In contrast, relevant and appropriate requirements are promulgated environmental protection standards, requirements, criteria, or limitations which, while not directly applicable to a particular constituent, location, or action at a site may be sufficiently similar to warrant their use.

In addition to ARARs, federal, state, and local advisories and guidance documents exist which, although not binding regulations, may be considered under remedial actions at a CERCLA site. These criteria, referred to as TBCs, are regarded as aspirational goals for potential response actions. TBCs may be useful in determining what may be protective of a site and/or the approach in implementing certain actions or requirements.

The identification of site-specific ARARs is based on specific constituents at a site, the various response actions proposed, and the general characteristics of a site. As such, ARARs are classified into three general categories:

- Chemical-specific ARARs, which are specific to the type(s) of constituents present at a site;
- Action-specific ARARs, which are specific to the activities being considered and are usually technology or activity based; and/or
- Location-specific ARARs, which represent restrictions placed on actions based on the geographic location.

A list of potential federal, state, and local ARARs and TBCs for the Site is presented in Table 2-1. This list of ARARs/TBCs was developed based on appropriate guidance documents (USEPA 1989; 1990e), other Records of Decision (RODs) in USEPA Region 2, and BB&L's experience on other projects. Table 2-1 identifies potential ARARs/TBCs and provides a regulatory citation and brief description for each. The table also identifies whether the regulation applies to a portion of the constituents and potential activities/actions and, if so, whether it is a potential ARAR or TBC for the Site.

Site conditions or other constraints may inhibit the ability to satisfy all ARARs or TBCs. The ability to achieve ARARs or achieve TBCs, will be a consideration during both the development of response actions and the detailed analysis of remedial alternatives. CERCLA specifies six conditions under which ARARs may be waived, as follows:

- For interim measures;
- If ARAR compliance increases risk;
- If compliance is technically impractical;
- If an equivalent standard of performance can be attained through use of another method or approach;
- If a state ARAR has not been consistently applied; and
- In fund balancing cases.

In addition, once a remedial alternative has been selected, additional ARARs may be identified that will need to be addressed, to the extent possible, during the design and implementation phases.

2.4 Preliminary Remediation Goals

PRGs are based on risk-based criteria and/or ARARs/TBCs. USEPA guidance states that final remediation goals should be based on the results of the Baseline RA (BBL, 1995a) and the evaluation of the expected exposures and associated risks for each remedial alternative (USEPA, 1988). This is especially applicable for this Site, where redevelopment of the Site for industrial reuse is possible and where the ground water is not used as a potable water supply due to the presence of a municipal water supply and the Cortland County regulations that control the installation of domestic water supply wells. In that regard, chemical-specific ARARs, TBCs, and site-specific risk-based criteria are compared below to determine PRGs for soils/fill/sediment and ground water.

2.4.1 Soils/Fill and Sediment PRGs

In this section, PRGs for the constituents of interest in surface soils/fill, and subsurface soil/fill are set forth. The New York State Technical and Administrative Guidance Memorandum (TAGM) HWR-94-4046 (NYSDEC, 1994) provides recommended soil cleanup objectives, which are considered TBCs for the Site. The TAGM recommended soil cleanup objectives are based on generic pathways and residential receptors. Because the future site use is reasonably expected to be industrial, site-specific risk-based criteria were calculated for use as PRGs.

The site-specific risk-based criteria were calculated using a methodology described by the USEPA (1991a) and the reference toxicity factors presented in the Baseline RA (BBL, 1995a). These values assume that a 70-kg adult worker is exposed via ingestion and inhalation 250 days per year for 25 years (USEPA, 1991a). Cancer-based values are derived for constituents, which are classified as known (Group A), probable (Group B), or possible (Group C) human carcinogens, and have oral slope factors. Cancer-based criteria are based on a one-in-a-million (1×10^{-6}) risk. Non-cancer-based criteria are based on the reference dose for the constituent of interest. Calculations of site-specific criteria are presented in Appendix C. For constituents with both cancer- and non-cancer-based values, the lesser of the two values is the risk-based criterion.

In addition, two other USEPA documents provide ARARs for lead and PCBs. USEPA has set forth lead PRGs in the document *Revised Interim Soil Lead Guidance for CERCLA Sites and RCRA Corrective Action Facilities* (USEPA, 1994) and PCB PRGs in the document *Guidance on Remedial Actions for Superfund Sites with PCB Contamination* (USEPA, 1990d). The lead PRG for residential receptors is 400 mg/kg, while the lead PRG for industrial receptors is 1,200 mg/kg.

The site-specific risk-based criteria and the USEPA recommended PRGs are provided below.

Constituent	Site-Specific Risk-Based Criteria (mg/kg)	USEPA Recommended PRGs (mg/kg)	PRG (mg/kg)	PRG Selection Rationale/Source
Arsenic	3.8[1]	--	4	Risk-based criterion (rounded).
Chromium (assumed hexavalent)	9.3[1]	--	9	Risk-based criterion (rounded).
Manganese	2,000[2]	--	2,000	Risk-based criterion.
Lead	--	400[3]	400	USEPA PRG (residential).
Benzo(a)pyrene	0.8[1]	--	1	Risk-based criterion (rounded).
PCBs	--	10 - 25[4]	25	USEPA PRG (Industrial).

Notes:

– = Not applicable.

[1] Based on 1 x 10^{-6} risk per USEPA (1991b).

[2] Based on Hazard Quotient = 1 industrial exposure via inhalation.

$$PRG = \frac{RfC \times PEF \times 365}{250}$$

where : RfC = 5E-05 mg/m^3
PEF = Site-specific Particulate Emission
365 = Days/year
250 = Days per year worked on site

[3] USEPA, 1994. Per the request of the NYSDEC, the residential criterion is to be used as the PRG.

[4] USEPA, 1990d.

For subsurface soil/fill, only TBCs are available for consideration as PRGs: NYSDEC TAGM cleanup objectives (NYSDEC, 1994) and USEPA soil screening levels (SSLs) (USEPA, 1996). The TAGM objective and SSL based on migration to ground water for TCA are similar and equivalent to about 1 mg/kg. Therefore, a PRG of 1 mg/kg is selected for TCA in subsurfaces soil/fill.

2.4.2 Ground-Water PRGs

In this section, PRGs for the constituents of interest in ground water are set forth. In the Baseline RA (BBL, 1995a), potential risks were associated with the ingestion and dermal contact of upper outwash ground water by hypothetical future industrial workers and hypothetical future off-site residential ground-water users. Potable ground-water use at the Site and off site is unlikely, but required by the USEPA to be considered as potential future pathways in the Baseline RA (BBL, 1995a). The constituents contributing to the potential risks (cancer-based risks greater than 1 x 10^{-6} and non-cancer-based risks greater than one [hazard indices]) associated with these upper outwash ground-water exposure routes include: antimony, arsenic, cadmium, 1,2-dichloroethane, 1,1-dichloroethene, manganese, PCBs, and trichloroethene. For these constituents, PRGs were determined by comparing federal MCLs, which are considered ARARs, and New York State ground-water standards (NYSDEC, 1993a), which are considered ARARs. Prior to this comparison, a discussion of the basis for both the federal and state standards is set forth below. A discussion of the differences between federal MCLs and New York Sate ground-water standards is provided below.

Federal MCLs for drinking water apply to community and non-community water systems on the basis of their distribution size. MCLs are set to be health-protective to the extent practicable, but are also evaluated in terms of:

- Best available technology (BAT) for removing a constituent from a water supply;
- Feasibility and costs associated with implementing BAT; and
- Laboratory quantitation limits.

MCLs that are strictly health-based are based on water consumption at a rate of 2 liters per day for a 70-kg adult for life. They also reflect a relative source contribution of 20 percent (i.e., 20 percent of the "acceptable" daily dose of a given constituent can come from drinking water) unless constituent-specific information indicates that a different source contribution percentage is appropriate. Where BAT, cost, feasibility, and laboratory detection limits allow, the MCL is set at:

- A concentration associated with a one-in-a-million (1 x 10^{-6}) cancer risk for known or probable human carcinogens (Groups A and B, respectively);
- A concentration based on a non-cancer RfD divided by an uncertainty factor of 10 for possible human carcinogens (Group C); or

- Equivalent to a concentration based on the RfD for chemicals which are not carcinogens, or not classified with regard to carcinogenic potential (Groups D and E).

New York State ground-water standards (Class GA) are promulgated by the NYSDEC and are designed to protect ground water used as a drinking water source (NYSDEC, 1993a). These standards are derived by the NYSDEC from several sources including:

- 6NYCRR Part 703 (State of New York, 1991) standards derived in 1978 (Water Quality Regulations for Surface Waters and Ground Waters);
- Current 6NYCRR Part 700-705 (State of New York, 1991) methodology;
- 10NYCRR Part 5 (State of New York, 1993a) Drinking Water Standards; and
- 10NYCRR Part 170 (State of New York, 1993a) Drinking Water Supply Standards, New York State Department of Health (NYSDOH) ground-water standards under NYCRR Title 10, apply to both community and non-community water supply systems.

In general, NYSDOH criteria for inorganics are similar to federal MCLs. NYSDOH has chosen not to adopt federal MCLs for most organic compounds for two reasons:

- The NYSDOH believes that the available toxicity information for most organic constituents is insufficient to quantify potential risks to human health, and, consequently;
- The NYSDOH believes that it is prudent to minimize exposure to organic chemicals to the extent possible.

Although the NYSDEC standards are based on more conservative assumptions, both the federal MCLs and the NYSDEC standards are designed to be protective of human health where ground water is used as a drinking water supply.

For the constituents of interest that contributed to potential risks in the Baseline RA (BBL, 1995a), PRGs were determined by comparing federal MCLs and New York State standards and selecting the smaller of the two values as the PRG.

Constituent	Federal MCL (ug/L)	New York State Ground-Water Standard (ug/L)	PRG (ug/L)
Antimony	6	G	6
Arsenic	50	25	25
Cadmium	5	10	5
1,1-Dichloroethene	7	5	5
1,2-Dichloroethane	5	5	5
Manganese	S	500[1]	500
PCBs	0.5	0.1	0.1
Trichloroethene	5	5	5

Notes:
S = Only secondary MCL exists and was not considered in PRG selection.
G = Only New York State guidance value exists and was not considered in PRG selection.
[1] Applies to sum of iron and manganese.

For the organic constituents of interest in the ground water determined from the comparison to ARARs, PRGs were determined by comparing federal MCLs and New York State standards and selecting the smaller of the two values as the PRG.

Constituent	Federal MCL (ug/L)	New York State Ground-Water Standard (ug/L)	PRG (ug/L)
Benzene	5	0.7	0.7
Chloroethane	NA	5	5
Chloroform	100	7	7
Chloromethane	NA	5	5
1,1-Dichloroethane	NA	5	5
1,2-Dichloroethene (cis)	70	5	5
Ethylbenzene	700	5	5
Methylene Chloride	5	5	5
Toluene	1,000	5	5
Tetrachloroethene	5	5	5
TCA	200	5	5
Vinyl Chloride	2	2	2
Total Xylenes	10,000	5	5

Notes:

NA = Not available.

PRGs will not be developed for the other inorganic constituents of interest in the ground water discussed in Section 2.1 because:

- These constituents do not contribute to unacceptable cancer and non-cancer risks for future hypothetical residential and industrial ground-water users;
- These constituents are naturally occurring;
- These constituents are associated with particulates in the ground water (not dissolved) and, thus, would not be consumed due to potable well construction and filtration practices; and
- Of the filtered metals detected, aluminum, iron, magnesium, and sodium are essential nutrients.

2.5 RAOs

The RAOs for the Site in consideration of the constituents of interest, exposure pathways and receptors, and PRGs discussed are set forth below.

Environmental Media	Remedial Action Objectives (RAOs)
On-Site Soils/Fill	• Prevent ingestion/direct contact inhalation by hypothetical future industrial workers at the Site with soils/fill exceeding site-specific PRGs for constituents of interest. • Facilitate reasonably anticipated future land use. • Minimize surface soil/fill erosion and control surface water runoff. • Reducing or eliminating the migration of contaminants from soil/fill to groundwater.
On-Site Ground-Water	• Prevent ingestion by hypothetical future industrial workers of ground water exceeding site-specific PRGs for constituents of interest. • Reduce concentrations of organic constituents of interest in excess of site-specific PRGs. • Restoration of groundwater quality to levels which do not exceed state or federal drinking water standards. • The prevention of contact with contaminants in the ground water.
Off-Site Ground-Water	• Prevent ingestion by hypothetical future off-site residential ground-water users of ground water exceeding site-specific PRGs for constituents of interest. • Reduce concentrations of organic constituents of interest in excess of site-specific PRGs. • The mitigation of off-site migration of contaminated ground water. • The prevention of contact with contaminants in the groundwater.

These RAOs form the foundation for the development of general response actions (GRAs) that may be taken at the Site, followed by the identification and screening of technologies and process options, and finally the assembly of process options into appropriate alternatives. These items are further discussed in Section 3.0.

3. Development and Screening of Remedial Alternatives

3.1 General

The primary objective of this phase of the FS is to develop an appropriate range of management options for the primary constituents of interest (i.e., those that contribute to potentially unacceptable risks) with consideration to secondary constituents of interest that will be analyzed more fully in the detailed analysis phase of the FS (Section 4). In accordance with USEPA guidance (USEPA, 1988), appropriate management options that ensure the protection of human health and the environment may involve any or a combination of the following:

1. The elimination or destruction of hazardous substances;

2. The reduction of concentrations of hazardous substances to acceptable risk-based levels; and

3. The prevention of exposure to hazardous substances posing a risk to human health via engineering or institutional controls.

Remedial alternatives are then developed by assembling combinations of technologies or process options, and the media to which they would be applied, into alternatives that address constituents on a Site-wide basis or for a limited Site area. USEPA guidance (USEPA, 1988) describes this process which consists of the six following steps:

1. Development of RAOs, specifying the constituents of interest, exposure route(s) and receptor(s), and PRGs, which are developed on the basis of chemical-specific ARARs, Reference Doses (RfDs) for human health-based levels for systemic toxicants, and site-specific risk-related factors (Baseline RA; BB&L, 1995a).

2. Development of GRAs for each medium of interest (e.g., containment, treatment, etc.) that may be taken to satisfy the RAOs;

3. Identification of volumes or areas of media to which GRAs might be applied, taking into account protectiveness and the chemical/physical characterization of the Site;

4. Identification and screening of technologies applicable to each GRA to eliminate those that cannot be implemented technically at the Site;

5. Identification and evaluation of technology process options to select a representative process for each technology type retained; and

6. Assembly of the selected technology process options into appropriate alternatives representing a range of treatment and containment combinations.

The first step, development of RAOs, was addressed in Section 2 of this report. The development of GRAs and the associated volumes or areas of media to which they may be applied are discussed in Section 3.2. The identification and screening of potential technologies and process options is discussed in Section 3.3, and the site-specific evaluation of potential process options is discussed in Section 3.4. Finally, the assembly of selected process options into alternatives is presented in Section 3.5. A summary of the analysis and screening of process options is presented in Table 3-1.

3.2 Development of GRAs

3.2.1 General

GRAs are developed to identify actions specific to each medium of interest (i.e., soils/fill and ground water) that would satisfy site-specific RAOs (Section 2.5). The environmental media identified for the Site include:

- On-Site Soils/fill;
- On-Site Ground Water; and
- Off-Site Ground Water.

To be considered a GRA, an action should satisfy at least one of the RAOs established for a specific medium. For example, No Action/Monitoring with Institutional Controls would be considered a GRA for the Site since it would satisfy the RAO associated with preventing the ingestion of ground water by hypothetical future industrial workers via use restrictions.

Following the development of GRAs (including an assessment of volume and/or area), technologies and process options need to be developed for each GRA to satisfy RAOs for the Site (Section 3.3).

3.2.2 GRA Development

Based on the results of the RI (BB&L, 1994a), the Baseline RA (BB&L, 1995a), and USEPA guidance (USEPA 1988), the following GRAs were developed for the Site:

Environmental Media	General Response Action
On-Site Soils/Fill	• No Action • Monitoring with Institutional Controls • In-Situ Containment • In-Situ Treatment • Removal/Relocation • Ex-Situ Treatment • Disposal
On-Site Ground-Water	• No Action • Monitoring with Institutional Controls • In-Situ Treatment • Extraction/Recovery (Containment) • Ex-Situ Treatment
Off-Site Ground-Water	• No Action • Monitoring with Institutional Controls • Extraction • Ex-Situ Treatment

The GRAs formulate the basis for the development and screening of potential technologies and process options (Section 3.3).

3.2.3 GRA Applications (Volumes/Areas)

As discussed above, two environmental media are identified for the Site. The two media and their associated volumes/areas of interest are summarized below.

3.2.3.1 On-Site Soils/Fill

On-site soils/fill encompass the extent of the Site (19.2 acres). Fill depths range from a few feet to over 25 feet, including the area of the Site in the vicinity of the former cooling pond. Based on the above estimated depth information, approximately 190,000 cy of fill exist at the Site, and of that volume, approximately 83,000 cy exist in the former cooling pond area. While fill and debris are found throughout the Site, the former cooling pond area was specifically used for the landfill disposal of demolition debris and other wastes.

Based on the results of the RI (BB&L, May 1994) and the development of PRGs (Section 2), discrete areas of the Site contain low levels of PCBs in the soils/fill. Two PCB "hot spot" areas were identified during the RI, along with two TCA "hot spot" areas. Based on existing Site analytical data, these hot spot areas comprise a maximum total volume of 5,000 cy.

Sediments and surface water in Perplexity Creek and its tributary were identified as low potential risks to ecological receptors (Baseline RA - BB&L, 1995a).

3.2.3.2 On-Site and Off-Site Ground Water

Based on the results of the Baseline RA (BB&L, 1995a), on-site and off-site ground water may have risks to hypothetical future industrial workers due to ingestion and/or dermal contact with ground water. However, based on results of the RI (BB&L, 1994a), these risks are restricted to the upper outwash aquifer. Furthermore, substantial volumes of ground water can be developed from either on-site or off-site locations based on the results of the ATP (Appendix A).

3.3 Identification and Screening of Potential Technologies and Process Options

In accordance with USEPA guidance (USEPA, 1988), the objective of developing and screening remedial process options is to compile a wide range of potentially applicable technology types and associated process options with respect to technical implementability. The USEPA guidance (USEPA, 1988) describes "technology types" as the general categories of technologies, (i.e., no-action, monitoring with institutional controls, in-situ containment/control, in-situ treatment, removal, ex-situ treatment and disposal). It also defines "process options" as specific processes associated with a general technologies type category. For example, capping/covering, erosion control, and hydraulic containment are considered process options under the general response action/technology type category In-Situ Containment/Control.

A list of process options and their corresponding preliminary assessment for consideration as part of the remedial action for the Site is summarized in Table 3-2. This list was developed by compiling one or more process options for each technology type used or considered for use at similar sites. Process options were screened based on a combination of Site- and technology-specific considerations. For example, process options were eliminated from further consideration if they:

- Were not sufficiently proven at pilot- or full-scale;
- Were not demonstrated at similar sites; and
- Were similar to other retained options.

An evaluation of the various process options was performed using published information, site-specific information, and BB&L's experience on similar projects. The process options retained as a result of the screening step are considered to be representative technology, and serve as the basis for the development of remedial alternatives for the Site. The process options that were retained for potential incorporation into remedial alternatives are indicated by shading on Table 3-2.

3.4 Site-Specific Evaluation of Potential Technologies and Process Options

3.4.1 General

The purpose of this section is to further evaluate and refine potential technologies and process options from the general response action/technology type categories discussed in the previous section. In accordance with USEPA guidance (USEPA, 1988), various technologies and process options, which could be utilized to reduce the potential unacceptable risks associated with this Site, are to be evaluated based on three criteria: effectiveness, implementability, and cost. Effectiveness criteria consider the following three aspects: (1) the potential effectiveness of technologies and process options in handling the estimated areas or volumes of media and meeting the remediation goals identified in the RAOs; (2) the potential impacts to human health and the environment during the construction and implementation phase; and (3) how proven and reliable the process is with respect to the constituents and conditions at the Site. Implementability considers both the technical and administrative feasibility of implementing a technology process. Finally, cost considerations for the screening of process options include relative capital and operation and maintenance (O&M) costs for each technology and process option without the development of detailed estimates.

In the following subsections, each specific technology and process option is evaluated for its effectiveness, implementability, and cost relative to other process options in the same technology type.

3.4.2 Site Soils/Fill Process Options

The results of the RI (BB&L, 1994a) indicated the presence of VOCs, PAHs, metals, PCBs, and phthalates in the surface and subsurface soils/fill. As discussed in Section 2.2, constituents of interest in the surface soils/fill include: arsenic, benzo(a)pyrene, lead, chromium, manganese, and PCBs.

Based on the results of the RI (BB&L, 1994a), PAHs and metals were detected in background and may be naturally occurring in the environment. Similar constituents were observed in the sediments associated with Perplexity Creek and its tributary.

In addition to the above considerations, the Site history information (Section 1.2.3) indicates that the former cooling pond area was used for the landfill disposal of waste materials and is (or was) potentially a source of TCA contributing to ground water.

The following subsections evaluate potential process options that may be utilized to: mitigate surface soils/fill constituents of interest; address applicable soils/fill guidance/criteria, including PRGs; and, reduce risks associated with future use of the Site.

Process options which have been identified to address on-site soils/fill include:

1. No Action;

2. Monitoring with Institutional Controls;

3. Site Capping/Covering; and

4. Excavation.

These process options will be evaluated for their effectiveness, implementability and cost in accordance with USEPA guidance (USEPA, 1988).

3.4.2.1 No Action

The No Action process option with regards to soils/fill at the Site provides a baseline for comparing other soils/fill technologies and process options. This approach assumes that no additional remedial activities would occur beyond the existing Site conditions (i.e., existing Site fencing).

Effectiveness:

Since no future activities would occur with this process option, RAOs and PRGs for the Site would not be met in the near future. However, in accordance with the Baseline RA (BB&L, 1995a), and since the Site currently has restricted access, the existing Site conditions do not pose an unacceptable risk to the current receptors. However, for hypothetical future commercial/industrial workers who might be exposed to Site soils/fill, conditions at the Site may cause an unacceptable level of risk. Based on this information, this process option possibly would not be "effective" for some hypothetical risk scenarios.

Implementability:

Technically, this option would be implementable since no actions would be completed other than monitoring.

Cost:
The no action process option would have an O&M cost associated with the long-term monitoring of the Site. This long-term monitoring would also include the sediments of Perplexity Creek and its tributary to confirm that constituent levels decrease after site remediation. The final long-term monitoring plan would be determined in the future.

Summary:

Although the No Action alternative has limited effectiveness due to unacceptable levels of risk for some future hypothetical risk scenarios, and may not be administratively acceptable, this process option will be retained for the Detailed Analysis of Remedial Alternatives (Section 4), in accordance with USEPA guidance (USEPA, 1988).

3.4.2.2 Monitoring with Institutional Controls

The Monitoring with Institutional Controls process option with regard to Site soils/fill would include periodic visual inspections, use restrictions (constraints placed on future use of the Site), and continued access restrictions (constraints placed on access) to the Site. Access restrictions have already been addressed at the Site by the installation of a fence with two locked gates surrounding the Site perimeter. Under this process option, the fencing would be visually inspected at regular intervals to identify signs of disrepair or unauthorized access. Use restrictions would also be placed such that unauthorized excavation of soils/fill and/or the unauthorized construction of any buildings or other Site developments would be restricted at the Site.

Effectiveness:

Through inspection, use restrictions, and access restrictions (i.e., fencing), this process option would reduce or eliminate possible exposures to soils/fill at the Site, and thus be effective. However, access restrictions may limit future redevelopment of the Site.

Implementability:

This process option would be technically and institutionally implementable since it would require minimal activities. However, it is likely that this process option would not be administratively acceptable since it does not address unacceptable future potential risks to hypothetical future commercial/industrial workers who may be exposed to Site soils/fill. In addition, the city of Cortland has expressed interest in the possibility that the Site could be redeveloped for industrial use, and Site access restrictions would impact such future redevelopment. Based on these considerations, this process option may not be administratively acceptable.

Cost:

Since this process option would require minimal activities, it would have a relatively low capital and O&M costs.

Summary:

Potential exposures to the soils/fill at the Site would continue to be reduced or eliminated through the implementation of use and continued access restrictions; however, future use of the Site may be limited based on access restrictions and potential risks associated with hypothetical future on-site workers. However, in accordance

with USEPA guidance (USEPA, 1988), this process option will be retained for the Detailed Analysis of Remedial Alternatives in Section 4.

3.4.2.3 Site Capping/Covering

There are two major considerations for establishing an appropriate capping/covering process option: 1) proper selection of construction materials and design requirements; and 2) identification of areas to be capped/covered.

For the cap/cover material and design requirements, four options were evaluated: (1) a clay cap; (2) a RCRA hazardous waste cap; (3) a 6 NYCRR Part 360 (Part 360) (State of New York, 1993b) cap; and (4) a surface cover system (e.g. asphalt, soil, or other material). For the capped/covered areas, both a site-wide (19.2-acre) cap/cover system and a partial-area (less than 19.2-acre) cap/cover system were evaluated.

Effectiveness:

Through consolidation, relocation, and capping/covering of surface debris and soils/fill, either a clay, RCRA, Part 360, or surface cover system would reduce and/or eliminate potential exposures to the hypothetical future commercial/industrial workers to within acceptable risk levels for these materials. Based on exposure pathways, each of the four cap/cover designs would have the same degree of effectiveness in reducing such risk levels due to exposure to Site soils/fill.

Since a "site-wide" cap/cover would cover the entire 19.2 acres of the Site, it would be more effective in terms of risk reduction than a partial (less than 19.2-acre) cap. However, in reducing exposure to soils/fill, a site-wide cap/cover would not necessarily have to be any one specific design type, but could be a combination of designs (i.e., Part 360 cap design over a portion of the Site where surface debris is relocated, and a surface cover system over the remaining yard area of the Site). Since each of the four cap/cover designs has the same degree of effectiveness in reducing exposure levels, a combination-design site-wide cap/cover would be equally effective in this regard.

As discussed in the RI Report, there is some correlation between the location of the potential source areas containing TCA and the isolated distribution of this constituent and its degradation products in the ground water migration pathway. Three potential on-site source areas of TCA were identified as follows: the contents/fill and scrap pile at or near the former cooling pond, a drum of solvent (since removed), and an area near test pit T-02.

Based on the historical information regarding Site use (Section 1.2.3), it appears that one of the likely sources of TCA impacts to the ground water is (or was) the former cooling pond area, which consists of a volume of approximately 83,000 cy of various fill materials. Although VOC concentrations directly downgradient of the former cooling pond area are decreasing due to the natural attenuation of constituents, it would be most effective to minimize surface water infiltration into the former cooling pond area. In addition, based on previous closure activities associated with the former cooling pond area and the proposed consolidation and relocation of existing surface debris to the former cooling pond area, this area of the Site would act as a "landfill" from an engineering design perspective. Due to these considerations, it would be most effective to relocate any site materials to beneath the cap on the former cooling pond area. This cap would be either a Part 360 or RCRA cap, since either of these cap systems would reduce infiltration to a greater degree than the clay or other material (asphalt, soil , or other material) designs would, and therefore, minimize constituent partitioning into the ground water beneath the Site.

In regards to the detection of PCBs in Site soils/fill, 13 field screening results indicated soil PCB concentrations ranging from less than 1 ppm to greater than 25 ppm in the northeastern portion of the Site. Based on sampling at six locations, laboratory analytical results indicated concentrations below 10 ppm in surface and subsurface soils. Based on this information, it would be most effective to cover the remaining portions (yard area) of the Site with an surface cover system, in order to reduce any future hypothetical risk exposures to on-site workers.

Finally, based on discussions with the city of Cortland, the city prefers a remedial alternative that supports the possibility of future redevelopment of this property. Tentative city plans envision a regional transportation terminal that would serve as a staging area for rail freight. Rail freight, primarily box cars and lumber, would be loaded and unloaded onto a new rail spur which would be built on the Site. This new terminal would replace the existing nearby transportation terminal. If the remaining yard area of the Site (approximately 16.2 acres) were to be covered, this remaining area would be suitable for this type of future development. Site development would not be possible over a Part 360, RCRA, or clay cap since this type of cap would have difficulty withstanding the loading which would be associated with this type of redevelopment. Beneficial reuse of this 16.2-acre yard area is an important consideration towards the determination of the effectiveness of this option.

Implementability:

Although each of the cap/cover designs and area considerations would be implementable from a technical and institutional feasibility perspective, each would differ from an administrative perspective.

Since wastes were disposed of at the Site prior to 1980 (i.e., not a RCRA Site), a Part 360 cap would be "applicable" according to New York State regulations; however, either a Part 360 cap or a RCRA cap could be "relevant and appropriate" (Novotny, 1994). Engineering controls and calculations would indicate that both caps would have similarly low infiltration rates due to the presence of an impermeable geomembrane liner in each cap's design requirements. In comparison, a clay or surface cover system would have somewhat higher infiltration rates than the Part 360 or RCRA caps, as discussed previously. Based on these considerations, a Part 360 cap would be "applicable, relevant, and appropriate" for the Site, while a RCRA cap would be "relevant and appropriate", but not "applicable". Therefore, a Part 360 cap would be the most administratively acceptable cap design.

In regards to area, it is unlikely that a partial-site cap/cover (i.e., some exposed areas without any cover) would be administratively acceptable. As a result, it is apparent that a Part 360 cap would be appropriate for the cooling pond area and for covering the relocated surface debris and PCB and TCA “hot spots”.

Cost:

The highest costs for this process option would be associated with a site-wide Part 360 cap design (19.2 acres); however, these costs could be reduced by using a combination-design site-wide cap/cover (utilizing a surface cover for a portion of the Site) while still achieving the same level of risk reduction. This process option has higher capital and O&M costs in comparison to the No Action or Monitoring with Institutional Controls options.

Summary:

A site cap/cover would be effective in reducing infiltration and potential hypothetical future exposure to soils/fill. In addition, a Part 360 cap would provide additional effectiveness by reducing surface water infiltration and subsequent migration of constituents to the ground water. A site-wide cap/cover would be technically/ institutionally implementable, and a Part 360 cap would be "applicable, relevant, and appropriate" for the Site.

Furthermore, the installation of a site-wide cap/cover would achieve compliance with RAOs and PRGs for the Site soils/fill.

By using a combination-design site-wide cap/cover with a surface cover as one of its components, the covered area could be beneficially reused in the future and be significantly more cost effective than a site-wide Part 360 cap, while still reducing the hypothetical future use risk scenarios (from Site soils/fill) to acceptable levels.

Based on the above considerations, a combination-design site-wide cap/cover (consisting of a 3-acre Part 360 cap over the former cooling pond area and a surface cover (e.g. asphalt, soil, or other material) over the remaining 16.2 acres) will be retained for the Detailed Analysis of Remedial Alternatives in Section 4.

3.4.2.4 Excavation of Site Soils/Fill

The excavation of Site soils/fill process option would include the excavation, hazardous characteristics screening, and disposal of soils/fill associated with potential source areas. Based on Site history information (included in Section 1.2.3) and results of the RI (BB&L, 1994a), the former cooling pond area, which consists of an approximate 3.0-acre area, is the primary area of interest for this process option. Also of interest are the PCB and TCA "hot spot" areas which consist of four areas.

As discussed in Section 3.2.3.1, the volume of Site soils/fill associated with the former cooling pond area is approximately 83,000 cy and an estimated total volume of less than 5,000 cy for the "hot spot" areas. The purpose of the soils/fill excavation would be to eliminate the potential source that is associated with the former cooling pond area and the "hot spot" areas. In addition to the cooling pond and "hot spot" area evaluations, a process option which excavated the top two feet of soil over the entire site was also considered as requested by the USEPA.

Excavation of soils/fill from the former cooling pond area is extremely difficult based on the following:

Risks and Associated Future Site Use Considerations -
Based on the Baseline RA, and the PRGs established for the Site, there are no risks to future commercial/industrial workers through capping/covering of the surface debris and soils/fill (Section 3.4.2.3). The Cortland County regulations control domestic water supply well installations (Cortland County Sanitary Code) hydraulically downgradient of the Site (Section 3.4.4.2). Therefore, it is improbable that domestic water supply wells could be installed that would put residents into a risk-exposure scenario.

Estimated Volume of Materials for Excavation -
Based on preliminary volume estimates, the volume of soils/fill within the former cooling pond area is approximately 83,000 cy. In accordance with USEPA guidance (USEPA, 1991a) "removal of contaminated soils at municipal landfill sites is generally limited to hot spots or, when practicable, to landfills with low to moderate volume of waste. Complete excavation of the municipal landfill contents is often not considered practicable because of the large volume of waste typically found at CERCLA municipal landfill sites." The former cooling pond area was used by the Rosen Site operators as a landfill for demolition debris and other wastes, and is analogous to a municipal landfill. As a result of this analogy, the cooling pond is not a definable "hot spot" and thus should be addressed with an in-situ remedial approach (i.e., capping or containment) rather than excavation. Therefore, the USEPA guidance (USEPA, 1991a) is relevant to this area. For the PCB and TCA "hot spot" areas, the total volume of materials to be excavated is estimated at less than 5,000 cy. Additional delineation would be necessary during any excavation effort to more thoroughly characterize these "hot spot" areas. The excavation of

the top two feet of soil over the entire site would generate approximately 124,000 cy of materials. This process option was discussed in detail in the April 1996 Memorandum by BB&L (Hale, 1996).

High Ground Water Considerations -
Ground water elevations in the vicinity of the former cooling pond area vary, but are at times within two feet of existing Site grade. This was observed and documented during the installation of test pits (e.g., Supplemental Test Pits TP-1 and TP-10) in and adjacent to the former cooling pond area as part of RI activities (BB&L, 1994a). Excavating below the ground-water table, coupled with the types of debris anticipated to be encountered (e.g., concrete foundation slabs), would make this process option extremely difficult (and costly).

***Effectiveness*:**

This process option assumes that excavation and sorting of Site soils/fill from the former cooling pond area would result in "source identification and removal" and a decrease in constituent levels within the ground water over time. As previously noted, the former cooling pond area is not presently a significant source of VOCs to ground water. Moreover, based on the source removal program previously conducted in 1990 (discussed in Section 1.2), reduced constituent levels continue to be observed in on-site and downgradient ground water. In addition, through the use of other site restrictions (e.g., drinking water restrictions) risks to future receptors are precluded.

The excavation of the PCB and TCA "hot spot" areas would result in the relocation of constituents beneath the Part 360 cap. The relocation of these constituents would further isolate these soils from the environment due to the decrease in permeability associated with a Part 360 cap in comparison to a surface cover.

As a result of this analysis, the effectiveness of this process option is limited with respect to the excavation of the cooling pond or the excavation of two feet of soil across the site. However, the excavation of "hot spot" areas is effective in the isolation of these constituents from the environment.

Implementability:

The excavation of the cooling pond area or two feet of soil across the site would be extremely difficult based on the extensive volume of materials to be encountered, in addition to the shallow ground water elevation conditions typically present at the Site. As previously discussed, source removal activities were conducted in 1990 which consisted of the removal of approximately 1,200 drums and other associated waste materials from the Site. Due to the limited volume of soil being excavated (less than 5,000 cy), the excavation of "hot spot" areas is implementable.

***Cost*:**

Assuming that soils/fill were excavated, screened, and tested as non-hazardous (based on characteristic analyses and assumed to remain on-site), costs would be $50 per cy at a minimum and likely would be much higher. Due to the shallow ground-water table (which could require dewatering), health and safety considerations, analytical sampling, and excavation sheeting, this document uses $100 per cy for the purpose of estimating costs. Based on an approximate volume of 83,000 cy for the former cooling pond area, this cost would exceed $8 million. Costs for off-site disposal of materials could exceed two or three times this amount. The cost associated with the two feet of soil excavation effort would exceed $6.2 million. Costs for the excavation of the "hot spot" areas are considerably lower due to the relatively low volume of material requiring excavation and its assumed close proximity to the surface of the Site.

Summary:

Based on the above considerations, the process option for the cooling pond excavation and the two foot soil excavation will not be retained for the Detailed Analysis of Remedial Alternatives in Section 4. The "hot spot" area excavation effort will be retained.

3.4.3 Ground-Water Process Options

The results of the ground-water investigations performed during the RI indicate the presence of volatile organic and inorganic compounds at the Site (and in upgradient ground water). As previously discussed in Section 1 and also presented in the RI Report (BB&L, 1994a), ground-water constituents are confined to the upper outwash hydrogeologic unit.

Based on the results of Post-RI activities (Section 1.4.2), only five VOCs (tetrachloroethene, TCE, TCA, 1,1-dichloroethene, and vinyl chloride) were detected above federal MCLs. The concentrations of trichloroethane and its degradation products generally decreased between May 1991 and August 1995. An increase in constituent concentrations during the December 1995 sampling event occurred in the vicinity of well W-06. This increase was most likely due to the higher than normal precipitation levels during this period resulting in increased surface water infiltration. However, constituent concentrations were generally found to decrease significantly after the December 1995 sampling event.

In addition to the above, the results of Post-RI activities (Section 1.4.2) indicated certain TAL metals (filtered and unfiltered) in ground water from wells hydraulically upgradient, downgradient, and at the Site.

For filtered ground water samples, only iron, magnesium, manganese, and sodium were consistently present above state criteria and federal MCLs. However, Site concentrations were consistent with upgradient concentrations, indicating an off-site, upgradient contribution of metals to the upper outwash aquifer. This was further documented by the Students *t*-test calculations presented in the Natural Attenuation Technical Memorandum (BB&L, 1995b).

The Baseline RA (BB&L, 1995a) identified potential carcinogenic and non-carcinogenic risk levels which exceed acceptable limits for both on-site upgradient and downgradient ground water should ground water be used for human consumption.

As a result of the analytical sampling conducted during the ATP in January 1995, filtered ground-water samples showed low levels of inorganic constituents. Furthermore, the round of monitoring well sampling conducted in March 1995 demonstrated that most inorganic constituents detected in the ground water appear to be associated with particulates in the ground water and are not in the aqueous (dissolved) form (refer to Appendix B).

The following subsections evaluate potential process options which may be utilized to: mitigate ground-water constituents of interest (with consideration to inorganic constituents); address applicable ground-water quality criteria, including PRGs; and reduce potential theoretical risks associated with on-site and off-site ground water within and downgradient of the Site. Process options which have been identified to address on-site ground water include:

1) No further action and continued natural attenuation of Site ground water;

2) Continued natural attenuation of Site ground water and Site monitoring with institutional controls;

3) On-site ground-water source recovery and discharge;

4) Downgradient perimeter ground-water recovery and treatment;

5) Downgradient on-site barrier wall; and

6) In-situ ground-water treatment-enhanced biodegradation.

Likewise, process options that have been identified to address downgradient off-site ground water include:

1) No further action and continued natural attenuation of off-site ground water;

2) Continued natural attenuation of off-site ground water and monitoring with institutional controls; and

3) On-site perimeter recovery/treatment and off-site downgradient recovery/treatment.

These process options will be evaluated for their effectiveness, implementability and cost in accordance with USEPA guidance (USEPA, 1988).

3.4.4 On-Site Ground-Water Process Options

3.4.4.1 No Action

The No Action process option with regards to on-site ground water provides a baseline for comparing other on-site ground-water process options. This option assumes that no further action would be taken at the Site to address on-site ground water.

Effectiveness:

While no further activities would occur for this process option, the RAOs and PRGs for the Site associated with ground water would be met through natural attenuation over time, as discussed in Section 1.4.2 and further detailed in the Natural Attenuation Technical Memorandum (BB&L, 1995b). Based on the ground-water monitoring which has been performed to date, natural attenuation would be an effective component of the No Action option.

Implementability:

Technically, this option would be easily implementable since no actions would be completed other than long-term monitoring.

Cost:

This option would have an O&M cost associated with the long-term monitoring of the Site.

Summary:

Since natural attenuation has been documented and is occurring at the Site, this option is effective. In accordance with USEPA guidance (USEPA, 1988), this process option will be retained for the Detailed Analysis of Remedial Alternatives, which is discussed in Section 4.

3.4.4.2 Monitoring With Institutional Controls

The Monitoring with Institutional Controls process option with regards to on-site ground water would include the monitoring of on-site ground water to facilitate: the evaluation of existing Site conditions; the monitoring of natural attenuation rates; and the placement of ground-water use restrictions on the Site. However, it should be noted that future ground-water use is highly unlikely at the Site and in areas hydraulically downgradient of the Site given the availability of the municipal water supply and the Cortland County regulations controlling domestic water supply well installations (Cortland County Sanitary Code).

The concentrations of volatile organic compounds in the upper outwash aquifer at the Site are decreasing over time as a result of natural attenuation. The decrease of the concentrations of the TCA and TCE "families" is evident based on comparison of concentrations detected in 1986, 1992, 1995, and 1996. These trends demonstrate that natural attenuation of the VOC sources is occurring at the Site. At on-site well W-06, TCA and its degradation products have generally decreased as shown by concentration from May 1991 (3,400 ug/L of TCA and 430 ug/L of DCA) to August 1995 (15 ug/L of TCA and 13 ug/L of DCA). In December 1995, TCA and its degradation products increased in concentration (5,000 ug/L of TCA and 390 ug/L of DCA). This increase in TCA during the December 1995 sampling event was likely due to higher than normal precipitation levels during this period, resulting in increased surface water infiltration - a phenomenon which is expected to be greatly reduced with the installation of a surface cover/cap. It is important to note that since December 1995, concentrations of TCA and its degradation products have decreased as shown by the March 1996 and August 1996 sampling events. In the March 1996 and August 1996 sampling events, TCA concentrations decreased (1,000 ug/L compared to 240 ug/L), and DCA concentrations remained similar (55 ug/L to 56 ug/L). It is also important to note that despite the December 1995 increase in TCA concentration, subsequent sampling events showed a significant decrease in TCA concentrations, similar to the natural attenuation and biodegradation rates predicted in the Natural Attenuation Technical Memorandum (BB&L, 1995b). Furthermore, considering the increase in TCA concentration at Well W-06, similar increases in constituent concentrations were not noted at the Site's perimeter, which support the concept that these constituents are rapidly being biodegraded and naturally attenuated immediately downgradient of any source areas. Specifically, at well W-06, TCE and its degradation products have generally decreased in concentration from May 1991 (45 ug/L of TCE and 56 ug/L of 1,2-DCE) to August 1995 (1.7 ug/L of TCE and 0.84 ug/L of 1,2-DCE) and again after the December 1995 sampling event. Since December 1995, concentrations of TCE and its degradation products have decreased as shown by the March 1996 and August 1996 sampling events. From March 1996 to August 1996, TCE concentrations remained similar (5.7 ug/L to 9.4 ug/L); no TCE degradation products were detected in the August 1996 sampling event.

At downgradient perimeter wells W-02 and W-11, TCA and its degradation products have generally decreased in concentration from February 1992 (390 ug/L of TCA and 100 ug/L of DCA at well W-11 and 190 ug/L of TCA and 53 ug/L of DCA at well W-02) to August 1996. In the March 1996 and August 1996 sampling events, TCA and DCA concentrations remained similar (45 ug/L compared to 41 ug/L for TCA and 34 ug/L compared to 29 ug/L for DCA) at well W-11, and TCA and DCA concentrations at well W-02 remained similar (22 ug/L compared to 30 ug/L of TCA and 14 ug/L compared to 22 ug/L of DCA).

At downgradient off-site wells W-18 and W-19, TCA and its degradation products have generally decreased in concentration from February 1992 (260 ug/L of TCA and 86 ug/L of DCA at well W-19 and 68 ug/L [March 1995] of TCA and 26 ug/L of DCA at well W-18) to August 1996. In the March 1996 and August 1996 sampling events, TCA and DCA concentrations remained approximately the same or increased slightly (62 ug/L compared to 83 ug/L of TCA and 26 ug/L compared to 38 ug/L of DCA) at well W-19, and TCA and DCA concentrations at well W-18 remained approximately the same (25 ug/L compared to 30 ug/L of TCA and 14 ug/L compared to 16 ug/L of DCA).

TCE and TCA in ground water at the Site are biodegrading, which is confirmed and quantified by the presence and relative distribution of the degradation products (daughter products) to the parent compound. The biodegradation of TCA under anaerobic conditions results in the formation of a 1,1-dichloroethane and chloroethane (McCarty et al., 1992) which has occurred at the Site. Similarly, the anaerobic biodegradation of TCE results in the formation of 1,2-dichloroethene, 1,1-dichloroethene, and vinyl chloride (McCarty et al., 1992). These degradation products have been identified in the ground water in several of the wells at the Site.

Summary of TCA Speciation Data
VOCs Detected in Ground Water

	W-06								W-11							W-19					
Compound	5/91	2/92	12/93	3/95	8/95	12/95	3/96	8/96	5/91	2/92	3/95	8/95	12/95	3/96	8/96	2/92	3.95	8/95	12/95	3/96	8/96
Trichloro-ethane (TCA)	3400	1100	100	110	15	5000	1000	240	270	380	160	84	65	45	41	260	210	140	54	62	83
Dichloro-ethane	430	340	23	23	13	390	55	56	100	100	67	46	37	34	29	86	61	63	33	26	38
Chloro-ethane		2	23	6	2	4.2	1	ND				.5	ND	ND	ND		0.3	ND	ND	ND	ND
Total TCA Family	3830	1442	146	139	30	5394	1056	296	370	480	227	130.5	102	79	70	346	271.3	203	87	88	121
TCA/TCA Family (%)	88.8	76.3	68.5	79.1	50.0	92.7	94.7	81.1	73.0	79.2	70.5	64.4	63.7	57.0	58.6	75.1	77.4	69.0	62.1	70.5	68.6
Average TCA/TCA Family (%)								78.9							66.6						70.5

Notes:
1. Data are shown for the wells associated with the TCA plume on-site.
2. Concentrations are shown in μg/L.

The reduction in the percent TCA from W-06 to W-19 provides an estimate of the biodegradation/attenuation rate for TCA in the plume. Biodegradation acts with other biological and physical processes to increase the rate of natural attenuation.

The rates of attenuation for the TCA and TCE families have been calculated based upon historical site data. TCA attenuation was calculated using data from wells W-06, W-11, and W-19 (the wells along the centerline of the plume). TCE attenuation was calculated using data from wells W-06, W-18, and W-24. The data trends can be evaluated using a first order linear decay rate (Harremeous, 1976) as follows:

$$(C_1/C_2) = exp\ (K\Delta t)$$

where:

C_1 = concentration (μg/L) at time 1;
C_2 = concentration (μg/L) at time 2;
K = first order rate constant (1/day); and
Δt = the time between sampling events 1 and 2.

Using the equation, the half lives of TCA and TCE range from less than 0.5 years to 3.3 years and 0.4 years to 1.6 years, respectively. These ranges are supported by published literature (Howard et al., 1991) that quantifies half lives in the range of 0.5 to 1.5 years for TCA and 0.9 to 4.5 years for TCE.

Using an average decay constant from the data evaluated and the initial concentrations of TCE and TCA as measured in March 1995, the following locations are projected to degrade to or below the New York standard of 5 μg/L within approximately five to ten years: MW-6, MW-11 and MW-19 (TCA), and MW-24 and MW-18 (TCE). MW-06 currently is below the standard for TCE. These predictions provide a realistic estimate of the timeframe needed to achieve compliance with the New York State standard.

While metals do not biodegrade to any significant degree, they do disperse and mineralize (Allen et al., 1993). The metals data for the Site indicate that the number and concentration of metals detected above state criteria and federal MCLs is decreasing with time. For dissolved metals, based on the post-RI sampling data collected through August 1996, only iron, magnesium, manganese, and sodium are above state criteria or federal ground-water MCLs. The concentrations of dissolved iron detected in previous samples (February 1992) have decreased in wells W-19, W-07, W-17, and W-21 to below the state standard. Furthermore, dissolved antimony (W-11 and W-19), dissolved chromium (W-21) and aluminum (W-21, W-17, and W-19) were no longer detected above state criteria or federal MCLs through August 1996. [Note that split samples analyzed by USEPA in March and August 1996 did indicate dissolved metals (aluminum, antimony, and chromium) concentrations above state criteria or federal MCLs.]

The only dissolved metal consistently detected above New York State criteria at the Site is naturally occurring manganese, which does not show any statistically significant changes between upgradient, downgradient, and off-site wells. The dissolved ground-water data for the other metals do not indicate the presence of any dissolved metal ground-water plumes, as these metals are not consistently detected.

Effectiveness:

Through monitoring and use restrictions, possible exposures to on-site ground water would be reduced, if not eliminated. By restricting the installation of drinking water supply wells within the ground-water aquifer (as is the case now), the potential for ingestion, dermal contact, and inhalation, as identified in the Baseline RA (BB&L, 1995a) would be eliminated. As previously stated, a reduction of primary and secondary constituents of interest would occur by continued natural attenuation such that RAOs and PRGs would be achieved in the ground water. Based on the above considerations, this process option is expected to be effective. In addition, since there would

be no exposure to ground water due to the restrictions mentioned, hypothetical future use of the Site for commercial/industrial workers would be within acceptable risk levels.

Implementability:

This process option would be technically implementable, since it would require only ground-water monitoring activities. It is likely that it would also be administratively acceptable.

Cost:

Since this process option would require minimal activities, the capital and O&M costs are low.

Summary:

Since it is unlikely that ground water beneath the Site will be used as a potable water supply in the near future (due to the presence of municipal water and existing regulations), continued natural attenuation would achieve effectiveness in approximately five to ten years [Natural Attenuation Technical Memorandum (BB&L, 1995b)]. Based on these considerations, and in accordance with USEPA guidance (USEPA, 1988), this process option will be retained for the Detailed Analysis of Remedial Alternatives in Section 4.

3.4.4.3 On-Site Ground Water Source Recovery and Discharge

This process option would include the recovery of on-site ground water in the vicinity of well W-06, which is downgradient of the former source of TCA in the vicinity of the former cooling pond area. For the purpose of developing this process option, it is assumed that one recovery well would be installed in the vicinity of well W-06 to intercept ground water within the upper outwash aquifer. The ground water pumped from this recovery well would then be discharged to the city of Cortland WWTP for treatment (the discharge options that were evaluated are discussed in Appendix D).

Effectiveness:

As stated above, the single recovery well would recover upper outwash ground water in the vicinity of well W-06 that would likely contain low levels of VOCs and metals. It is estimated that water in the vicinity of well W-06 would be recovered at a pumping rate of approximately 100 gpm.

Although implementation of this process option should reduce risk-based health hazards associated with ground water at the Site, it is unlikely that there is a future risk exposure, based on the existing regulations for the installation of drinking water wells and the availability of municipal water supply in the city of Cortland.

By implementing this option, the PRGs associated with ground water in the vicinity of well W-06 would be met over time. This option may not be effective as a "stand-alone", but may be effective if sequenced with continued natural attenuation.

Implementability:

Installing a ground-water recovery well, recovering on-site ground water in the vicinity of well W-06, and discharging the recovered water to the city of Cortland WWTP at an approximate flow rate of 100 gpm, is technically implementable (based on the discharge options evaluated in Appendix D). As part of remedial design, engineering calculations and treatability study testing would be required to confirm that the Site ground water would create no adverse impacts to the operation of the city's WWTP or its associated State Pollutant Discharge Elimination System (SPDES) permit. Based on the these considerations, ground water recovery would be administratively acceptable. While it is certainly possible to recover ground water at a rate greater than 100 gpm based on aquifer characteristics, the city has expressed reluctance in accepting greater flows due to the unknown potential impact on the WWTP. A flow study would have to be undertaken in order to identify the actual flow which could be accepted by the city's WWTP.

Cost:

Since this process option involves ground-water recovery, capital and O&M costs associated with implementation of this process option would be somewhat higher than natural attenuation, but significantly lower than downgradient perimeter ground-water recovery/treatment.

Summary:

It is unlikely that this process option provides any additional benefits over natural attenuation due to the existing and future regulations for the installation of domestic water supply wells and the availability of the city of Cortland municipal water supply. However, this process option is implementable at a 100 gpm flow rate and would supplement natural attenuation, and therefore, will be retained for the Detailed Analysis of Remedial Alternatives in Section 4.

3.4.4.4 Downgradient Perimeter Recovery and Treatment

This process option would include the recovery of on-site ground water along the northern (hydraulically downgradient) perimeter. This process option would be accomplished by installing a series of ground-water recovery wells along the northern property line of the Site to intercept the ground water within the upper outwash aquifer. The ground water pumped from these wells would then be treated for removal of VOCs and metals (via precipitation and flocculation, if necessary) prior to discharge to the Tioughnioga River (the discharge options that were evaluated are discussed in Appendix D).

Effectiveness:

As stated above, the downgradient perimeter recovery well system would intercept the upper outwash ground water prior to its migration off site. Based upon the results of the ATP, completed in January 1995 (Appendices A and B) and subsequent Quickflow™ modeling to estimate the pumping rate and well configuration necessary to obtain hydraulic containment at the northern property boundary of the Site, it was determined that ground water at the Site would be recovered at a total pumping rate of approximately 1,200 -1,500 gpm (Appendix E).

Although implementation of this process option would potentially reduce risk-based health hazards associated with ground water at the Site, it is unlikely that there is a future risk exposure, based on the existing regulations

restricting the installation of drinking water wells and the availability of a municipal water supply in the city of Cortland.

By implementing this option, the PRGs associated with ground water would be met over time, although it is unlikely that recovery and treatment would provide any additional benefits over natural attenuation.

Ground-water recovery technology is a known means of recovering constituents from a ground-water system. However, the results of the ATP and ground-water modeling indicate that ground-water recovery would be at a rate of approximately 1,200 -1,500 gpm. Based on the Baseline RA (BB&L, 1995a) it is highly unlikely that ground-water recovery/treatment provides an increased level of effectiveness over natural attenuation.

Implementability:

Installing ground-water recovery wells, recovering on-site ground water along the northern perimeter of the Site, treatment for VOC and metals removal (if necessary), and discharge to the Tioughnioga River would be unlikely with respect to technical implementability. The primary difficulty would be associated with treatment of such a large volume of water (over 4 billion gallons over a five-year period), the discharge of the treated water to the Tioughnioga River (based on the discharge options evaluated in Appendix D), and the disposal of significant sludge quantities (up to 6,500 cy per year) at an off-site landfill facility (based on metals treatment, if necessary). Installation of a dedicated pipeline to the Tioughnioga River would be technically difficult for the following reasons: unknown off-site subsurface conditions; utility crossings; right-of-way easements; and traffic considerations.

As part of remedial design, engineering calculations and treatability study testing would be required to confirm that Site ground water, which would be recovered and treated, would meet the requirements of the SPDES program. However, it is likely that ground water recovery/treatment would be administratively feasible.

Another major impact of this option's implementability is the potential adverse impact on future Site development. Recovery wells, forcemains, and treatment facilities all would need to be carefully designed in order to maximize the potential future use of the Site. Even with proper design, certain Site development restrictions would need to be considered.

Cost:

Since this process option involves on-site treatment, and potential off-site disposal of significant sludge quantities, capital, and O&M costs associated with implementation of this process option would be significantly higher in comparison to other process options, such as natural attenuation. In addition to the above considerations, downgradient perimeter recovery could potentially adversely impact some areas of the Site from future development efforts causing increased future development costs.

Summary:

It is highly unlikely that this process option is implementable or provides any additional benefits over natural attenuation due to the existing and future regulations for the installation of drinking water wells and the city of Cortland municipal water supply. However, since this process option would likely be administratively feasible and similar to natural attenuation (i.e., would achieve PRGs for the upper outwash aquifer over time), this process option will be retained for the Detailed Analysis of Remedial Alternatives in Section 4.

3.4.4.5 Downgradient On-Site Barrier

This process option would include the installation of an impermeable barrier wall (e.g., slurry wall) along the northern (hydraulically downgradient) perimeter of the Site. The barrier wall would be approximately 1,600 feet in length, and would span the entire northern property line adjacent to Perplexity Creek. Also, the barrier wall would be approximately 40 to 55 feet in depth, which is the approximate total depth of the upper outwash aquifer.

Effectiveness:

The purpose of the impermeable barrier wall would be to prevent the off-site migration of upper outwash aquifer ground water. However, installation of the wall along only the northern Site boundary would result in the diversion of ground water around the wall. Therefore, ground-water recovery would need to be constructed in conjunction with the barrier wall. Based on this information, the effectiveness of the impermeable barrier wall alone in reducing Site constituents would be limited, but could potentially be acceptable in conjunction with ground-water recovery.

Implementability:

A downgradient ground-water barrier wall would be technically, institutionally, and administratively implementable, but as discussed previously, would have to be used in combination with other options to be effective.

Cost:

The capital costs associated with the installation of a barrier wall (approximately 1,600 feet) would be significant in comparison to ground-water recovery options (Sections 3.4.4.3 and 3.4.4.4) or in-situ ground-water treatment (Section 3.4.4.6). A barrier wall, in all likelihood, would be used in conjunction with a ground-water recovery process option, further increasing capital costs and incurring O & M costs. Assuming proper installation, barrier walls usually have only limited O&M costs associated with their operation.

Summary:

Since this process option has limited effectiveness unless combined with ground water recovery, and since it would have significantly higher costs in comparison to other ground water recovery/treatment process options without providing any additional benefit, the barrier wall process option will not be retained for the Detailed Analysis of Remedial Alternatives in Section 4.

3.4.4.6 In-Situ Ground-Water Treatment - Enhanced Biodegradation

The in-situ ground-water treatment process option would involve the use of enhanced biodegradation to facilitate the natural destruction of VOCs at the Site. For the purpose of developing this process option, it is assumed that this treatment would be conducted via the injection of nutrients at existing well W-06. Treatment would consist of providing nutrient amendments (such as nitrogen and phosphorus) to enhance the growth of an indigenous anaerobic population of microorganisms to degrade chlorinated ethanes in the upper outwash aquifer.

Effectiveness:

Although bench- and pilot-scale testing would be required to determine the appropriate nutrient amendment(s), it is anticipated that enhanced biodegradation, which has been shown to be successful for similar chlorinated organics, would be effective for in-situ remediation of the Site ground water if sequenced with continued natural attenuation; specifically, achieving RAOs and PRGs for VOCs over time.

Implementability:

The construction and operation of in-situ treatment via enhanced biodegradation at the Site would be technically, institutionally, and administratively implementable.

Cost:

The capital and O&M costs associated with an in-situ ground-water treatment would be considerably less than the ground-water recovery/treatment option, but more than the natural attenuation only option.

Summary:

Since this process option has been demonstrated at other sites and due to the relatively low implementation costs, this process option will be retained for the Detailed Analysis of Remedial Alternatives in Section 4.

3.4.5 Downgradient Off-Site Ground-Water Process Options

3.4.5.1 No Action

The No-Action process option would involve taking no action to address off-site ground water and provides a baseline for comparison to other off-site ground water process options. Long-term monitoring would be included to evaluate Site conditions.

Effectiveness:

Similar to the No Action process option for on-site ground water, based on the constituents observed downgradient of the Site and the reductions of constituents observed to date, natural attenuation of off-site downgradient ground water is effective. Similar to the natural attenuation discussion in Section 3.4.4.2, off-site ground water would continue to undergo natural attenuation. As a result, potential off-site risks, due to hypothetical future ground-water consumption, would be reduced to acceptable risk levels in approximately five to ten years.

Implementability:

The No Action off-site ground-water process option is technically and institutionally feasible based on natural attenuation calculations.

Cost:

The No Action process option would have O&M costs associated with the long-term monitoring of the site.

Summary:

Based on the constituents observed downgradient of the Site and observed reductions of constituent concentrations, the No Action alternative would be effective in the long term. In accordance with USEPA guidance (USEPA, 1988) this process option will be retained for the Detailed Analysis of Remedial Alternatives discussed in Section 4.

3.4.5.2 Monitoring With Institutional Controls

This process option would include the monitoring of off-site ground water to facilitate the evaluation of existing off-site ground-water conditions. Monitoring of the ground-water downgradient of the Site would consist of the long-term ground-water monitoring of relevant existing off-site monitoring wells. However, it should be noted that future ground-water use is highly unlikely in areas hydraulically downgradient of the Site given the availability of the municipal water supply and the Cortland County regulations controlling domestic water supply well installations.

Based on ground-water analytical data taken from May 1991 to August 1996, decreased VOC concentrations were observed in downgradient off-site monitoring wells (refer to Figures 1-3A to 1-3C). Monitoring of the ground-water downgradient of the Site would include the long-term ground-water monitoring of existing off-site monitoring wells, followed by an evaluation to determine the effectiveness of natural attenuation. For the purpose of developing a cost estimate, monitoring has been assumed to occur on a semi-annual basis for a period of up to 10 years. The final monitoring program will be developed during the final design efforts.

Effectiveness:

For this process option, a reduction of constituents would occur by continued natural attenuation; therefore, PRGs would be achieved in the off-site ground water in the next five to ten years. As a result, the RAOs associated with ground water, including the reduction of constituents in off-site ground water, would also be achieved. Based on the observed decreases in VOC concentrations in the on-site ground water, natural attenuation is already occurring. This is further discussed in Section 3.4.4.2 and detailed in the Natural Attenuation Technical Memorandum (BB&L, 1995a). Therefore, this process option would be considered effective.

Implementability:

This process option would be technically implementable since it would require only ground-water monitoring activities. It is also likely to be administratively acceptable.

Cost:

Since this process option would require minimal activities, it would have relatively low capital and O&M costs.

Summary:

Similar to the No Action alternative, based on the constituents observed upgradient and downgradient of the Site and observed reductions of constituent concentrations, monitoring with institutional controls would be effective

in the long-term. In accordance with USEPA guidance (USEPA, 1988), this process option will be retained for the Detailed Analysis of Remedial Alternatives in Section 4.

3.4.5.3 Off-Site Downgradient Recovery/Treatment

This process option would include the off-site downgradient recovery of ground water that currently exceeds PRGs. The off-site ground-water recovery would be accomplished by placing a series of downgradient recovery wells within the upper outwash aquifer, between the Site and the Tioughnioga River.

To successfully collect ground water from off-site areas, a series of recovery wells would be installed between the Site and the Tioughnioga River. This would result in an off-site recovery of ground water at a rate that would be, at a minimum, greater than three to five times the rate generated by on-site ground-water recovery.

Effectiveness:

For this process option, a reduction of constituents would occur via recovery and treatment; therefore, PRGs would be achieved in the off-site ground water over time. However, it is highly unlikely that recovery and treatment of such significant volumes of water (over 12 to 20 billion gallons in the next five years) would provide any additional benefits over natural attenuation.

In addition to the above considerations, although this process option would potentially reduce risk-based health hazards associated with off-site ground water (i.e., hypothetical future residents) it is unlikely that there is a future risk exposure, based on the existing regulations for the installation of drinking water wells and the availability of a municipal water supply in the city of Cortland.

Implementability:

Technically, it would be difficult to effectively capture the off-site downgradient ground-water plume without generating an extremely large volume of ground water which would require treatment. Recovered ground water would be pumped from various recovery wells and transported via forcemain to the Site from potentially as far away as two miles, then transferred via pipeline to the Tioughnioga River. Multiple piping networks could travel such routes as city of Cortland's streets, industrial and commercial properties, and private residential properties. Administratively, the easements and permits required to complete the off-site recovery system may be difficult to obtain due to the potentially large number of easements required.

Technical feasibility is also limited due to treatment volume considerations. It is estimated that an off-site recovery system would, at a minimum, generate over three to five times the on-site recovery rate. Realistically, an on-site treatment system may consist of metals removal, aeration (e.g., air stripper), and potential off-gas carbon adsorption (based on loading rates) for VOCs would have to consist of several treatment units. The magnitude of such a treatment system for treating the extremely low levels of VOCs from off-site locations would be unprecedented for sites with similar lack of risks. Furthermore, as discussed in Section 3.4.2.3 (Site Capping/Covering), future Site use and the difficulties with ground-water discharge scenarios discussed in Appendix D would be further complicated by this significant volume of off-site ground water.

Cost:

Off-site ground-water recovery and subsequent treatment would incur the highest capital and O&M costs relative to the other ground-water process options. The high O&M costs are attributed continued maintenance and inspection activities associated with the recovery treatment systems.

Summary:

Based on the above information, the off-site recovery of ground water was not retained for the Detailed Analysis of Remedial Alternatives in Section 4.

3.5 Assembly of Process Options and Remedial Alternatives

Based on the evaluation of process options for the different media associated with the Site (soils/fill, on-site ground water, and off-site ground water), the following process options were retained for assembly into remedial alternatives for the Site:

- No Action;
- Continued Natural Attenuation of On-Site Ground Water and Monitoring with Institutional Controls;
- Continued Natural Attenuation of Off-Site Ground Water and Monitoring with Institutional Controls;
- Site Capping/Covering;
- Relocation of Select On-Site Soils/Fill (PCB and TCA source areas) with On-Site Capping (both cooling pond and yard areas);
- On-Site Ground-Water Source Recovery and Discharge;
- Downgradient Perimeter Ground-Water Recovery and Treatment; and
- In-Situ Ground-Water Treatment - Enhanced Biodegradation.

The above process options were assembled into a series of remedial alternatives that underwent detailed analysis (Section 4). The five remedial alternatives which were developed from the above process option are as follows:

Alternative 1 No Action (including long-term monitoring);

Alternative 2 A New York State Part 360 cap over the former cooling pond area, a surface cover (e.g. asphalt, soil, or other material) over the remainder of the Site, source removal (excavation of the PCB and TCA "hot spot" areas) and ground-water monitoring/institutional controls;

Alternative 3 A New York State Part 360 cap over the former cooling pond area, a surface cover (e.g. asphalt, soil, or other material) over the remainder of the Site, and in-situ biological treatment and ground-water monitoring/institutional controls;

Alternative 4 A New York State Part 360 cap over the former cooling pond area, and a surface cover (e.g. asphalt, soil, or other material) over the remainder of the Site, and ground-water recovery and discharge to the city of Cortland WWTP and ground-water monitoring/institutional controls; and

Alternative 5 A New York State Part 360 cap over the former cooling pond area, a surface cover (e.g. asphalt, soil, or other material) over the remainder of the Site, and perform downgradient perimeter ground-water recovery and treatment.

In Section 4, these alternatives will be evaluated in detail based on the nine NCP criteria, including an evaluation of the alternative based on capital and O&M costs.

4. Detailed Analysis of Remedial Alternatives

4.1 General

Following the Development and Screening of Remedial Alternatives (Section 3), a detailed analysis of each remedial alternative will be performed in this section.

Building on the evaluations conducted during the development and screening of alternatives, the detailed analysis phase incorporates any treatability study data and additional Site characterization information collected during the RI (e.g., ATP and/or additional ground water sampling results). The results of the detailed analysis provide the basis for identifying and recommending an alternative for the Site.

As stated in USEPA Guidance (USEPA, 1988), the specific statutory requirements for remedial actions that must be supported by the FS report are as follows:

- Be protective of human health and the environment;
- Attain ARARs (or provide grounds for invoking a waiver);
- Be cost-effective;
- Utilize permanent solutions and alternative treatment technologies or resource recovery technologies to the maximum extent practicable; and
- Satisfy the preference for treatment that reduces toxicity, mobility, or volume as a principal element or provide an explanation as to why it does not.

In addition, CERCLA places an emphasis on evaluating long-term effectiveness and related considerations for each of the alternative remedial actions [CERCLA Section 121(b)(1)(A)]. These statutory considerations include:

A) Long-term uncertainties associated with land disposal;
B) Goals, objectives, and requirements of the Solid Waste Disposal Act;
C) Persistence, toxicity, and mobility of hazardous substances and their constituents, and their propensity to bioaccumulate;
D) Short- and long-term potential for adverse health effects from human exposure;
E) Long-term maintenance costs;
F) Potential for future remedial action costs if the alternative remedial action in question were to fail; and
G) Potential threat to human health and the environment associated with excavation, transportation, and redisposal, or containment.

To address these CERCLA considerations and the additional technical and policy considerations that are important for differentiating among the various remedial alternatives, nine evaluation criteria have been developed. The nine evaluation criteria with their associated statutory considerations as identified above (i.e., A through G), are follows:

1. Overall protection of human health and the environment;

2. Compliance with ARARs (B);

3. Long-term effectiveness and permanence (A,B,C,D,F,G);

4. Reduction of toxicity, mobility, or volume (B,C);

5. Short-term effectiveness (D,G);

6. Implementability;

7. Cost (E,F);

8. State acceptance [relates to CERCLA Section 121(f)]; and

9. Community acceptance (relates to CERCLA Sections 113 and 117).

As the basis for conducting a detailed analysis, the nine evaluation criteria are divided into three categories to assist in the evaluation process.

Threshold:

The first evaluation category, which includes two of the nine evaluation criteria, is considered to be the threshold category because each potential alternative must satisfy these two criteria to be considered eligible for selection. The two criteria included within this category are:

1. Overall protection of human health and the environment - addresses whether or not a potential alternative would provide adequate protection to human health and the environment. This criterion also describes how risks posed through each exposure pathway would be eliminated, reduced, or controlled through treatment, engineering controls, or institutional controls.

2. Compliance with ARARs - addresses whether or not a potential alternative would meet all of the applicable ARARs, or provide grounds by which a waiver for a specific ARAR could be justified.

Primary:

The second category, which consists of five evaluation criteria, is considered to be the primary category. This category of criteria evaluations is used to make comparisons between the potential alternatives. The five criteria within this category are:

3. Long-term effectiveness and permanence - refers to the ability of a potential alternative to maintain reliable protection of human health and the environment over time, once PRGs have been achieved.

4. Reduction of toxicity, mobility, or volume through treatment - refers to a potential alternative's ability to reduce the toxicity, mobility, or volume of constituents at the Site.

5. Short-term effectiveness - refers to the ability of a potential alternative to maintain reliable protection of human health and the environment during the construction and implementation phase of an alternative (until the PRGs have been achieved). This criteria also evaluates the time period necessary to achieve risk protection at the Site.

6. Implementability - evaluates the technical and administrative feasibility of a potential alternative, including the availability of materials and services required to complete the potential alternative.

7. Cost - includes the evaluation of capital, O&M, and present-worth costs associated with a potential alternative.

Modifying:

The final category, which includes two evaluation criteria, is considered to be the modifying category. This category of evaluation criteria is typically completed following a formal public comment period on a proposed remedial plan and as a result will not be evaluated in this document. The two criteria within this category are:

8. State acceptance - indicates whether the state supports, opposes, and/or has identified any reservations associated with a potential alternative based on its review of the RI and FS reports.

9. Community acceptance - indicates whether the public community supports, opposes, and/or has identified any reservations associated with a potential alternative.

As a result of the initial screening of technologies and the subsequent screening of process options, a number of process options were retained and assembled into five remedial alternatives for the Site. These alternatives are summarized as follows:

Alternative 1 No Action (including long-term monitoring);

Alternative 2 A New York State Part 360 cap over the former cooling pond area, a surface cover (e.g. asphalt, soil, or other material) over the remainder of the Site, source removal (excavation of the PCB and TCA "hot spot" areas) and ground-water monitoring/institutional controls;

Alternative 3 A New York State Part 360 cap over the former cooling pond area, a surface cover (e.g. asphalt, soil, or other material) over the remainder of the Site, and in-situ biological treatment and ground-water monitoring/institutional controls;

Alternative 4 A New York State Part 360 cap over the former cooling pond area, and a surface cover (e.g. asphalt, soil, or other material) over the remainder of the Site, and ground-water recovery and discharge to the city of Cortland WWTP and ground-water monitoring/institutional controls; and

Alternative 5 A New York State Part 360 cap over the former cooling pond area, a surface cover (e.g. asphalt, soil, or other material) over the remainder of the Site, and perform downgradient perimeter ground-water recovery and treatment..

Each of the five alternatives is described in detail and assessed for seven of the nine evaluation criteria (two modifying criteria are not evaluated in this document) in the following subsections. A summary of the Detailed Analysis of Remedial Alternatives is included as Table 4-1. Inherent to each alternative is that the Site will be reviewed every five years by the USEPA as required under CERCLA.

4.2 Alternative 1 -No Action (including long-term monitoring)

4.2.1 General

The No Action alternative for the Site (Figure 4-1) provides a baseline for comparing other alternatives. Because no additional activities would be implemented for this alternative, certain RAOs, including PRGs for the Site would be met for ground water via natural attenuation. To evaluate continued natural attenuation of ground water, and its impact on residual site constituents, relevant existing monitoring wells including downgradient monitoring wells would be sampled at the Site. For the purpose of developing cost estimates, sampling followed by an evaluation to determine the effectiveness of natural attenuation, would be performed on a semi-annual basis for a period of up to ten years. Assuming successful natural attenuation with levels approaching PRGs for the Site, the frequency of monitoring the natural attenuation would be reduced to an annual basis for the next five years, and then every five years from year 16 through year 30. Laboratory analyses for ground-water monitoring considerations at the Site would include VOCs, inorganics (filtered), and chemical indicators of natural attenuation. In addition, existing monitoring well W-07, which has observed concentrations of PCBs (in unfiltered samples), would be analyzed for PCBs (filtered), on the same frequency as the other wells discussed above. The actual groundwater monitoring plan would be developed as part of the final design work efforts for the Site.

4.2.2 Criteria Assessment

4.2.2.1 Threshold Criteria

Overall Protection of Human Health and the Environment:

In accordance with the Baseline RA (BB&L, 1995a), there are no unacceptable risks to occasional on-site workers and hypothetical trespassers. However, the Baseline RA (BB&L, 1995a) identifies risks associated with hypothetical future commercial/industrial workers who might use ground water (upper outwash only) as a potable water supply and who may be exposed to surface soils/fill. There is also limited risk to ecological receptors due to contact with surface soils/fill.

Existing Site conditions include a 7-foot high chain link fence with locked gates at the Site perimeter to limit exposures to current trespassers. In addition, based on the availability of the Cortland municipal supply and the existing Cortland County regulations controlling domestic water supply well installations, future ground-water use is highly unlikely at and hydraulically downgradient of the Site. Risk to ecological receptors is also limited due to the lack of quality habitat for wildlife at the Site.

By restricting ground-water use at and downgradient of the Site, future risk exposures would be significantly reduced or eliminated. However, since the city of Cortland desires that the Rosen property be redeveloped for a new regional transportation terminal (as discussed in Section 3.4.2.3), access restrictions such as Site fencing would not be appropriate in order to avoid contact with Site soils/fill.

Based on future use Site considerations, implementation of the No Action alternative would result in an unacceptable hypothetical future use risk scenario for future commercial/industrial workers due to exposures to soils/fill at the Site. As a result, the overall protection of human health and the environment would not be achieved for the No Action alternative if the Site were to be redeveloped for future use. However, risk exposure would be minimized or eliminated assuming the Site remains securely fenced and ground-water use is restricted.

Compliance with ARARs:

Based on the site-specific PRGs established in Section 2 of this FS report, constituent concentrations within the on-site and off-site upper outwash ground-water aquifer would exceed the chemical-specific ARARs (i.e., state criteria or federal MCLs) for the Site. In addition, Site constituents within the soils/fill exceed the risk-based PRGs.

Based on existing Site data, natural attenuation continues to occur in the upper outwash aquifer; this is further documented in the Natural Attenuation Technical Memorandum (BB&L, 1995b). Using Site data, it is anticipated that ground-water constituents would achieve compliance with ARARs in approximately five to ten years. However, without monitoring considerations, the compliance with ARARs cannot be assessed.

To address chemical-specific ARARs and TBCs in the Site soils/fill, State agency approval may be required for constituents within on-site soils/fill that exceed risk-based PRGs.

4.2.2.2 Primary Criteria

Long-Term Effectiveness and Permanence:

Without Site access restrictions, Site soils/fill would not be in accordance with PRGs, and therefore, not be able to maintain reliable protection of human health and the environment especially if the Site were redeveloped.

Reduction of Toxicity, Mobility, or Volume through Treatment:

Through natural attenuation, the toxicity and volume of upper outwash aquifer constituents would be reduced in approximately five to ten years; however, without monitoring considerations, the reduction of toxicity and volume cannot be assessed. Site soils/fill risk would also remain relatively unchanged in the near-term with respect to toxicity, mobility, and volume.

Short-Term Effectiveness:

Since this alternative has no remedial action for Site soils/fill it is not considered effective for the short term. Of the five remedial alternatives developed for this document, the No Action alternative has the potentially longest remedial timeframe since no remedial actions would be performed at the Site.

Implementability:

While this alternative is implementable, it is likely that it would not be administratively feasible to the regulatory agencies due to the Site soils/fill and ground water exceeding risk-based PRGs.

Cost:

The No Action alternative has a capital cost of zero, and a 30-year present worth cost of $0.94 million. Detailed cost estimates are included in Appendix F.

4.2.2.3 Summary

The No Action alternative does not achieve compliance with the threshold or primary criteria.

4.3 Alternative 2 -A New York State Part 360 cap over the former cooling pond area, a surface (e.g. asphalt, soil, or other material) cover over the remainder of the Site, source removal (excavation of the PCB and TCA "hot spot" areas) and ground-water monitoring/ institutional controls

4.3.1 General

Alternative 2 (Figure 4-2) consists of the following:

- The consolidation and relocation of Site debris to the former cooling pond area;
- The removal of the PCB and TCA 'hot spot" source areas with relocation to the cooling pond area;
- The installation of a 3-acre, 6NYCRR Part 360 cap over the former cooling pond area;
- The placement of a surface cover over the remaining 16.2 acres (yard area) of the Site;
- The long-term monitoring of relevant ground-water wells;
- Institutional controls with continued use restrictions (future use restraints placed on Site ground water); and
- Continued Cortland County regulations restricting domestic water supply well installations downgradient of the Site.

This alternative includes excavating PCB-contaminated soil in the areas of concern which exceed NYSDEC Technical and Administrative Guidance Memorandum No. 94, HWR, 4046 (TAGM) limits (10 ppm). Those excavated soils which equal or exceed 50 mg/kg PCB would be sent off-site for treatment/disposal at a Toxic Substances Control Act (TSCA), compliant facility; excavated soils with PCB concentrations less than 50 mg/kg would be consolidated on the on-site landfill. A New York State 6 NYCRR Part 360 or equivalent closure cap would then be constructed over the relocated waste material, soil, and the landfill. On-site surface debris would be consolidated and also relocated under the Part 360 Cap. Clean material would be used as backfill in the excavated areas. At the former cooling pond area, the existing grade would be recontoured to maintain a side slope of at least four percent via fill addition (a minimum four percent slope is required by Section 2.13 of 6 NYCRR Part 360). Part of this fill would consist of recontouring the existing Site grade; remaining fill would be brought from off site, as necessary. In the event that any sediment must be removed from Perplexity Creek Tributary as part of final grading measures associated with the installation of the Part 360 cap, this excavated material would be relocated to the former cooling pond area.

In accordance with Section 2.13 of 6 NYCRR Part 360, the components of a Part 360 cap (from bottom to top) that would be installed at the 3-acre area over the former cooling pond area include the following:

- Filter layer: Placed directly above the fill, this layer would consist of a geosynthetic (geotextile) filter.

- Gas venting layer: This layer would consist of 12 inches of sand having a minimum coefficient of permeability of 1×10^{-3} centimeter per second (cm/sec). This layer would include gas vents which would be spaced at one vent per acre of final cover. (Note that a waiver would likely be applied for to preclude use of a gas venting layer for the Site, since the Site does not contain significant quantities of materials which would generate methane gas. This will be further evaluated during remedial design).

- Geomembrane (flexible membrane) liner layer: This liner would have a minimum thickness of 40 mils and a maximum water vapor transmission rate of 0.03 gram per square meter per day.

- Soil layer: This layer would consist of 30 inches of soil.

- Topsoil layer: This layer would consist of 6 inches of topsoil [thicknesses of the soil and topsoil layers (totaling 36 inches) based on an average frost thickness of 32 inches for the Cortland, New York area].

- Vegetative cover layer.

For the remaining 16.2 acres of the Site, any Site clearing and grading that was not accomplished during debris relocation would be completed. Also, a silt fence would be installed along Perplexity Creek on the northern boundary of the Site for erosion control. A surface cover would be installed over the 16.2-acre area. The installation of a pavement cover is described below as one potential surface cover:

- Compacting of the regraded surface to provide a suitable sub-base;

- Placing and compacting 12 inches of base crushed stone;

- Placing and compacting 3 inches of binder course; and

- Placing and compacting 1-½ inches of wearing course.

To prevent water from ponding and potential surface cover integrity loss, the surface cover (e.g. asphalt, soil, or other material) would be constructed with slopes and drainage swales to allow for stormwater runoff and to minimize the potential for infiltration.

To monitor site groundwater conditions, existing monitoring wells including downgradient monitoring wells would be sampled at the Site as discussed in Section 4.2.1.

Use restrictions would be placed on the Site such that contact with soils/fill would be restricted, and on-site ground water could not be used as a drinking water supply. Furthermore, the installation of domestic water supply wells immediately downgradient of the Site would continue to be precluded by Cortland County regulations.

Similar to the No Action alternative, the Site has future use potential with this alternative, whether it be for a new regional transportation terminal for the city of Cortland (as discussed in Section 3.4.2.3) or for other industrial reuse. Based on these considerations, access restrictions, such as Site fencing, would not be appropriate for redevelopment.

4.3.2 Criteria Assessment

4.3.2.1 Threshold Criteria

Overall Protection of Human Health and the Environment:

In accordance with the Baseline RA (BB&L, 1995a), there are no unacceptable risks to occasional on-site workers and hypothetical trespassers. However, the Baseline RA (BB&L, 1995a) identifies risks associated with hypothetical future commercial/industrial workers who might use ground water (upper outwash only) as a potable water supply and who may be exposed to surface soils/fill.

Ground-water use is unlikely both on Site and hydraulically downgradient of the Site due to the current availability of the municipal water supply and current Cortland County regulations controlling domestic water supply well installations. In conjunction with this, the source removal of the PCB and TCA "hot spot" areas and natural attenuation, which have been observed at the Site, are expected to reduce future potential risk exposures to ground water via constituent reduction to PRGs over time.

Based on future use considerations (i.e., fence removal and reuse of the Site for a regional transportation terminal or other industrial application), the installation of a combination, site-wide cap/cover (6NYCRR Part 360 cap over the former cooling pond area and surface cover over the remaining 16.2 acres of the Site) would result in an acceptable hypothetical future use risk scenario for commercial/industrial workers at the Site, and would further reduce any risks to ecological receptors.

Based on the implementation of a combination site-wide cap/cover to reduce surface soils/fill risks to acceptable levels to human and ecological receptors and natural attenuation of the ground water with monitoring controls, Alternative 2 achieves compliance with Overall Protection of Human Health and the Environment.

Compliance with ARARs:

Based on the site-specific PRGs established in Section 2 of this FS report, the on-site and off-site upper outwash aquifer would be in compliance with chemical-specific ARARs (i.e., state criteria or federal MCLs) at the completion of the remedial action for the Site. Using existing Site data, it is anticipated that ground-water constituents would achieve compliance with ARARs via continued natural attenuation in approximately five to ten years. At that time, the remedial action would be considered complete when the monitoring results confirm that Site PRGs have been met.

4.3.2.2 Primary Criteria

Long-Term Effectiveness and Permanence:

Since Alternative 2 includes site-wide capping/covering of soils/fill and ground-water use restrictions (via use restrictions, Cortland County regulations, and the availability of the public water supply), risks at the Site would be within acceptable levels over time. In addition, since capping/covering and natural attenuation with ground-water monitoring are considered adequate and reliable control technologies, this alternative would achieve compliance with long-term effectiveness permanence criteria.

Reduction of Toxicity, Mobility, or Volume through Treatment:

Through the use of a site-wide cap/cover, the mobility of constituents within Site soils/fill would be reduced. Through continued natural attenuation, constituents in the upper outwash aquifer would be reduced over time. Monitoring controls would be capable of assessing this reduction in toxicity. In addition, Site capping/covering would significantly reduce surface water infiltration, thus further reducing the mobility of the constituents of interest.

Short-Term Effectiveness:

Due to the worker exposure to Site soils/fill during cap and cover placement activities, potential increased risks could occur in the short term should health and safety protocols not be properly implemented. In addition, due to Site remedial activities, increased concentrations of airborne constituents could be observed, increasing risks to the local community in the short term. However, this could be mitigated through dust suppression techniques during remedial construction activities.

Based on Site capping/covering considerations, Alternative 2 would be effective in the short term by achieving RAOs and PRGs associated with Site soils/fill. In addition, through ground-water use restrictions, natural attenuation of the ground water would be effective in the short term.

Timeframes for Site remediation are difficult to predict; however, qualitative analysis suggests that constituent concentrations would decrease more rapidly via Alternative 2 than Alternative 1 due to site capping/covering. Capping/covering would eliminate or minimize infiltration through any residual materials which may be still located on site and thus may impact the ground water.

Implementability:

Since the materials and services required to install the site-wide cap/cover and monitoring controls are readily available, this alternative is technically feasible. Materials such as sand, topsoil, geotextile liner, and pavement courses, which are required as part of the cap/cover components for the Site, are available locally.

In addition, since risks would be reduced to acceptable levels for both Site soils/fill and ground water, this alternative is administratively feasible.

Cost:

Alternative 2 has a capital cost of $2.32 million and a total 30-year present worth cost of $3.24 million. Detailed cost estimates are included in Appendix F.

4.3.2.3 Summary

Alternative 2 is in compliance with the threshold criteria (overall protection of human health and the environment and compliance with ARARs) and, is in compliance with the primary criteria (long-term effectiveness, reduction in toxicity, mobility, or volume, short-term effectiveness, implementability, and cost). In addition, this alternative is preferred (informally) by the city of Cortland.

4.4 Alternative 3 - A New York State Part 360 cap over the former cooling pond area, a surface (e.g. asphalt, soil, or other material) cover over the remainder of the Site, and in-situ biological treatment and ground-water monitoring/institutional controls

4.4.1 General

Alternative 3 (Figure 4-3) consists of the following:

- The consolidation and relocation of Site debris to the former cooling pond area;
- The installation of a 3-acre, 6NYCRR Part 360 cap over the former cooling pond area;
- The placement of a surface cover (e.g. asphalt, soil, or other material) over the remaining 16.2 acres of the Site;
- The long-term monitoring of relevant ground-water wells;
- Institutional controls with continued use restrictions (future use restraints placed on Site ground water);
- Continued Cortland County regulations restricting domestic water supply well installations downgradient of the Site; and
- In-situ ground-water biological treatment to supplement natural attenuation through biodegradation of VOC constituents in ground-water.

This alternative includes the implementation of in-situ biological treatment, in the event that natural attenuation rates do not continue as anticipated. As conceptually envisioned, it is assumed that in-situ biological treatment would be initiated to enhance natural attenuation rates if a statistical continued rate of decline for VOCs in the upper outwash aquifer does not occur. Well W-06 would be used as an injection well for nutrient delivery to the upper outwash aquifer. The well would be utilized to supply nutrient amendments (such as nitrogen and phosphorus) and potentially an electron donor to the aquifer to ensure that microbial activity is not limited. The purpose of the electron donor addition would be to create a chemical reaction (electron transfer) to break chlorinated hydrocarbon bonds, and transform TCA to its associated degradation products (DCA and chloroethane).

Due to the relatively high hydraulic conductivities and associated ground-water flow rates across the Site, advection would be the primary transport mechanism for the nutrients and electron donor. Similar to the treatability testing that would be required to assess the effectiveness of the ground water treatment system in Alternative 4, a bench- and pilot-scale testing program would be warranted to evaluate nutrient amendments and rates that would be most effective for site-specific conditions.

In addition to the above, ground-water monitoring, as discussed in Section 4.2.1, would be incorporated into Alternative 3. The monitoring of ground water at the Site would primarily be used to determine how the RAOs and PRGs have been achieved in upper outwash aquifer ground water and to evaluate the effectiveness of enhanced biodegradation.

Based on the use of in-situ ground-water treatment (in addition to continued natural attenuation and Site capping/covering), the Site would not be restricted from future use considerations for hypothetical future commercial/industrial workers.

4.4.2 Criteria Assessment

4.4.2.1 Threshold Criteria

Overall Protection of Human Health and the Environment:

In accordance with the Baseline RA (BB&L, 1995a), there are no unacceptable risks to occasional on-site workers and hypothetical trespassers. However, the Baseline RA (BB&L, 1995a) identifies risks associated with hypothetical future commercial/industrial workers who might use ground water (upper outwash only) as a potable water supply and who may be exposed to surface soils/fill.

As with Alternative 2, the installation of a combination, site-wide cap/cover (6NYCRR Part 360 cap over the former cooling pond area and surface cover over the remaining 16.2 acres of the Site) would result in an acceptable hypothetical future use risk scenario for commercial/industrial workers at the Site and would further reduce any risk to ecological receptors.

Although ground-water use at and hydraulically downgradient of the Site is highly unlikely due to the current availability of the municipal water supply and current Cortland County regulations controlling well domestic water supply installations, Alternative 3 includes an in-situ ground-water treatment to reduce VOC constituents by enhancing natural biodegradation within the upper outwash aquifer.

Based on the implementation of a combination site-wide cap/cover to reduce risks to acceptable levels to human and ecological receptors, and enhanced biodegradation of the ground water, Alternative 3 is expected to achieve compliance with overall protection of human health and the environment. This would be confirmed through installation and operation of the in-situ bioremediation system over a short time period while implementing monitoring controls to evaluate its overall effectiveness.

Compliance with ARARs:

Based on the site-specific PRGs established in Section 2 of this FS report, the on-site and off-site upper outwash aquifer would be in compliance with chemical-specific ARARs (i.e., state criteria or federal MCLs) at the completion of the remedial action for the Site. At that time, the remedial action would be considered complete when the monitoring results confirm that Site PRGs have been met.

Based on the above consideration, pilot-scale testing would be required prior to or during remedial design to determine the most appropriate electron donor/nutrient additions. Similar to Alternative 2, state agency approval may be required for on-site soils/fill constituents that exceed PRGs. However, due to the acceptable risks to future on-site commercial/industrial workers via installation of a site-wide cap/cover, this approval notice requirement may be precluded.

4.4.2.2 Primary Criteria

Long-Term Effectiveness and Permanence:

Since Alternative 3 includes site-wide capping/covering of soils/fill, the magnitude of the residual risk in Site soils/fill is within acceptable levels.

The long-term effectiveness of enhanced biodegradation would be further assessed following bench- and pilot-scale testing. Due to ground-water use restrictions, the availability of public water supply, and natural attenuation conditions, it appears that Alternative 3 would otherwise achieve long-term effectiveness and permanence.

Reduction of Toxicity, Mobility, or Volume through Treatment:

Through the use of a site-wide cap/cover, the mobility of constituents within Site soils/fill would be reduced over time.

Through in-situ ground water treatment, the toxicity and volume of constituents in the upper outwash aquifer would be reduced over time (through treatment). Monitoring controls would be capable of assessing the reduction of toxicity and volume of constituents through biodegradation and attenuation.

Short-Term Effectiveness:

Similar to Alternative 2, due to the worker exposure to Site soils/fill during cap and cover placement activities, increased risks would occur in the short-term should health and safety protocols not be properly implemented. In addition, due to Site remedial activities, increased concentrations in particulate airborne constituents could be observed, increasing risks to the local community in the short term. However, these risks could be mitigated through dust suppression techniques during remedial construction activities.

Based on Site capping/covering considerations, Alternative 3 would be effective in the short term by achieving RAOs and PRGs associated with Site soils/fill at the conclusion of remedial construction activities. In addition, through ground-water use restrictions, natural attenuation of the ground water would be effective in the short term.

Timeframes for site remediation are difficult to predict but it is reasonable to assume that remediation would occur at least as rapidly as Alternative 2 and is anticipated to occur more rapidly due to the enhanced bioremediation effort.

Implementability:

Materials and services required to install the site-wide cap/cover and the in-situ ground-water treatment system are readily available. However, bench- and pilot-scale testing would likely be necessary to confirm that enhanced biodegradation is technically feasible, beyond natural attenuation of constituents. Administratively, this alternative is implementable.

Cost:

Alternative 3 has a capital cost of $2.44 million and a total 30-year present worth cost of $3.67 million. Detailed cost estimates are included in Appendix F.

4.4.2.3 Summary

Alternative 3 is in compliance with both threshold criteria (overall protection of human health and the environment and compliance with ARARs) and, is in compliance with all of the five primary criteria (long-term effectiveness, short-term effectiveness, reduction in toxicity, implementability, and cost, subject to pilot testing) and is projected to receive state and community acceptance (modifying criteria).

4.5 Alternative 4 - A New York State Part 360 cap over the former cooling pond area, and a surface cover (e.g. asphalt, soil, or other material) over the remainder of the Site, ground-water recovery and discharge to the city of Cortland WWTP and ground-water monitoring/ institutional controls

4.5.1 General

Alternative 4 (Figure 4-4) consists of the following:

- The consolidation and relocation of Site debris to the former cooling pond area;
- The installation of a 3-acre, 6NYCRR Part 360 cap over the former cooling pond area;
- The placement of a surface cover over the remaining 16.2 acres (yard area) of the Site;
- Institutional controls including continued use restrictions (future use restraints placed on Site ground water);
- Continued Cortland County regulations restricting domestic water supply well installations downgradient of the Site;
- The installation and operation of a ground-water recovery system at the TCA source areas to supplement natural attenuation; and
- The long-term monitoring of relevant ground-water wells to evaluate the effectiveness of the ground-water recovery system.

Although the current data confirm that natural attenuation is continuing at the Site, and would reduce Site ground-water constituents below state standards in approximately five to ten years, this alternative includes implementation of ground-water recovery, in the event that natural attenuation rates do not continue as anticipated. As conceptually envisioned, it is assumed that ground-water recovery would be initiated at the TCA "hot-spot" areas. For the purpose of evaluating this alternative, a single recovery well would be installed. Ground water would be recovered at a rate of approximately 100 gpm from this well and discharged to the city of Cortland WWTP for treatment. The discharge location would be sewer manhole N2, located near the northeast portion of the Site, along Pendleton Street. Further details regarding the evaluation of discharge options are included in Appendix D.

It is anticipated that the pumping rate of one recovery well in the vicinity of well W-06 would result in a ground water recovery rate of approximately 100 gpm continuously. This recovery rate would be used to recover ground water downgradient of the former cooling pond area (i.e., well W-06), which was an identified as a potential source of TCA in the upper outwash aquifer.

In addition to the above, ground-water monitoring as discussed in Section 4.3.1 would be incorporated into Alternative 4. The monitoring of ground water at the Site would primarily be used to determine when the RAOs and PRGs have been achieved in the on-site and off-site upper outwash aquifer and to evaluate the effectiveness of the system. Since the recovered ground water would be discharged to the WWTP without treatment, the city has requested a treatability study be performed before the city would consent to accept ground water from the Site. The purpose of the treatability study testing would be to confirm that the recovered ground water from the Site does not adversely affect the city's WWTP. In addition, future capacity would need to be reserved for the city's acceptance of the recovered ground water.

Based on the use of limited ground-water recovery (in addition to continued natural attenuation and site capping/covering), the Site would not be restricted from future use considerations for hypothetical future commercial/industrial workers.

4.5.2 Criteria Assessment

4.5.2.1 Threshold Criteria

Overall Protection of Human Health and the Environment:

In accordance with the Baseline RA (BB&L, 1995a), there are no unacceptable risks to occasional on-site workers and hypothetical trespassers. However, the Baseline RA (BB&L, 1995a) identifies risks associated with hypothetical future commercial/industrial workers who might use ground water (upper outwash only) as a potable water supply and who may be exposed to surface soils/fill.

As with Alternatives 2 and 3, the installation of a combination, site-wide cap/cover [6NYCRR Part 360 cap over the former cooling pond area and surface cover (e.g. asphalt, soil, or other material) over the remaining 16.2 acres of the Site] would result in an acceptable hypothetical future use risk scenario for commercial/industrial workers at the Site, and would further reduce any risk to ecological receptors.

Although ground-water use at and hydraulically downgradient of the Site is highly unlikely due to the current availability of the municipal water supply and current Cortland County regulations controlling domestic water supply well installations, Alternative 4 includes limited ground-water recovery in the vicinity of well W-06 to enhance the natural attenuation which is already occurring at the Site.

Based on the implementation of a combination site-wide cap/cover to reduce risks to acceptable levels to human and ecological receptors, and the implementation of ground-water recovery to enhance natural attenuation of the ground water with monitoring controls, Alternative 4 achieves compliance with Overall Protection of Human Health and the Environment.

Compliance with ARARs:

Based on the site-specific PRGs established in Section 2 of this FS report, the on-site and off-site upper outwash aquifer would be in compliance with chemical-specific ARARs (i.e., state criteria or federal MCLs) at the completion of the remedial action for the Site. At that time, the remedial action would be considered complete when the monitoring results confirm that the Site PRGs have been met.

Based on the above considerations, treatability testing must be performed prior to the city's acceptance of recovered ground water at the WWTP. The testing would be conducted to ensure that there are no adverse effects to the operation of the WWTP.

State agency approval may be required for on-site soils/fill constituents that exceed PRGs to remain in place. However, due to the acceptable risks to future on-site commercial/industrial workers via installation of a site-wide cap/cover, this approval notice requirement may be precluded.

4.5.2.2 Primary Criteria

Long-Term Effectiveness and Permanence:

Since Alternative 4 includes site-wide capping/covering of soils/fill and the implementation of ground-water recovery considerations, the magnitude of the residual risk at the Site is within acceptable levels. In addition, since capping/covering and ground-water recovery with monitoring are considered adequate and reliable control technologies, this alternative achieves compliance with long-term effectiveness permanence criteria.

Reduction of Toxicity, Mobility, or Volume through Treatment:

Through the use of a site-wide cap/cover, the mobility of constituents within Site soils/fill would be reduced over time. Through ground-water recovery and subsequent treatment by the city WWTP, the toxicity and volume of constituents in the upper outwash aquifer would be reduced through treatment, resulting in an overall reduction of toxicity and volume. Monitoring controls would be capable of assessing the treatment of constituents.

Short-Term Effectiveness:

Similar to Alternative 3, due to the worker exposure associated with Site soils/fill during cap and cover placement activities, increased risks would occur in the short term should health and safety protocols not be properly implemented. In addition, due to Site remedial activities, increased concentrations in particulate airborne constituents could be observed, increasing risks to the local community in the short term. However, this could be mitigated through dust suppression techniques during remedial construction activities.

Short-term effectiveness of ground-water recovery and discharge to the city WWTP is currently unknown, and would be subject to treatability testing. During negotiations with the city of Cortland, the city has verbally agreed, in principle, to accept 100 gpm from the Site following the performance of a treatability study which obtains favorable results. However, the city has expressed concern regarding flows in excess of 100 gpm due to hydraulic capacity limitations and treatment efficiency concerns. Specifically, the city's WWTP serves both residential and industrial customers and the addition of significant recovered ground-water flow would use the excess design capacity intended for these future customers. The city has also expressed other concerns as detailed in Appendix D.

Based on Site capping/covering considerations, Alternative 4 would be effective in the short term by achieving RAOs and PRGs associated with Site soils/fill at the conclusion of remedial construction activities. In addition, through the use of ground-water recovery and discharge to the city WWTP, this alternative would be effective in the short term.

Timeframes for remediation are difficult to predict but it is reasonable to assume that remediation via Alternative 4 would occur at least as rapidly as Alternative 2 and perhaps more rapidly due to the active recovery of ground water.

Implementability:

Since the materials and services required to install the site-wide cap/cover, and install the ground water recovery system are readily available, this alternative is technically feasible. Materials such as sand, topsoil, geotextile liner, and pavement courses, which are required as part of the cap and cover components for the Site, are available locally. Other materials, such as the components for the recovery system are available locally, or could be obtained by nationwide vendors/suppliers.

In addition, since Site risks would be reduced to acceptable levels for both the Site soils/fill and ground water, this alternative is administratively feasible.

Cost:

Alternative 4 has a capital cost of $2.37 million and a total 30-year present worth cost of $4.37 million. Detailed cost estimates are included in Appendix F. The O&M costs, and subsequently the total 30-year present worth cost, are somewhat higher for Alternative 4 than Alternatives 1 or 2, but are similar to Alternative 3.

4.5.2.3 Summary

Alternative 4 achieves both threshold criteria (overall protection of human health and the environment and compliance with ARARs), and is in compliance with the five primary criteria (reduction of toxicity, mobility, and volume, long-term effectiveness, short-term effectiveness, implementability, and cost).

4.6 Alternative 5 - A New York State Part 360 cap over the former cooling pond area, a surface cover (e.g. asphalt, soil, or other material) over the remainder of the Site and perform downgradient perimeter ground-water recovery and treatment.

4.6.1 General

Alternative 5 (Figure 4-5) consists of the following:

- The consolidation and relocation of Site debris to the former cooling pond area;
- The installation of a 3-acre, 6NYCRR Part 360 cap over the former cooling pond area;
- The placement of a surface cover over the remaining 16.2 acres (yard area) of the Site;
- The long-term monitoring of relevant ground-water wells to evaluate the effectiveness of the ground-water recovery/treatment system;
- Institutional controls with continued use restrictions (future use restraints placed on Site ground water);

- Continued Cortland County regulations restricting domestic water supply well installations downgradient of the Site; and

- The installation and operation of a ground-water recovery/treatment system along the downgradient periphery of the Site.

Ground-water recovery/treatment would include the installation of approximately six pumping recovery wells along the northern (hydraulically downgradient boundary of the Site (just south of Perplexity Creek). The recovered ground water from these wells would be transferred via underground forcemain piping to an air stripper for VOCs treatment and a metals treatment system (if necessary) prior to discharge to the Tioughnioga River. This alternative also includes the disposal of sludge at an off-site landfill facility (based on metals treatment, if necessary). Further details regarding the discharge options evaluation are included in Appendix D.

As part of Post-RI activities, an ATP was conducted in January 1995. Based on the results of the ATP (further detailed in Section 1.4.1 and Appendices A and B), it is anticipated that the combined pumping rate of six recovery wells along the downgradient Site perimeter well result in a ground-water recovery rate of approximately 1,200-1,500 gpm, continuously. This recovery rate would be required to ensure a ground-water capture zone sufficient to prevent the off-site migration of constituents from the Site (Appendix E).

In addition to the above, ground-water monitoring as discussed in Section 4.3.1 would be incorporated into Alternative 5. The monitoring of ground water at the Site would primarily be used to determine when the RAOs and PRGs have been achieved in the upper outwash aquifer and to evaluate the effectiveness of the downgradient perimeter recovery/treatment system. Since the treated water would be discharged to the Tioughnioga River, additional monitoring considerations, which may include frequent sampling and analysis of treated ground water (i.e., quarterly influent and monthly effluent analyses for VOCs, BOD, COD, and pH) would be required to evaluate the effective operation of the treatment system.

Based on the use of on-site recovery/treatment, portions of the Site (in addition to the Part 360 capped area that includes the former cooling pond area) would be restricted from future use considerations. The extent that future Site use would be limited due to the treatment system components (and associated air/water discharges from such components) would need to be further assessed in the future.

4.6.2 Criteria Assessment

4.6.2.1 Threshold Criteria

Overall Protection of Human Health and the Environment:

In accordance with the Baseline RA (BB&L, 1995a), there are no unacceptable risks to occasional on-site workers and hypothetical trespassers. However, the Baseline RA (BB&L, 1995a) identifies risks associated with hypothetical future commercial/industrial workers who might use ground water (upper outwash only) as a potable water supply and who may be exposed to surface soils/fill.

As with Alternatives 2 through 4, the installation of a combination, site-wide cap/cover (6NYCRR Part 360 cap over the former cooling pond area and surface cover over the remaining 16.2 acres of the Site) would result in an

acceptable hypothetical future use risk scenario for commercial/industrial workers at the Site, and would further reduce any risk to ecological receptors.

Although ground-water use at and hydraulically downgradient of the Site is highly unlikely due to the current availability of the municipal water supply and current Cortland County regulations controlling domestic water supply well installations, Alternative 5 includes ground-water recovery and treatment to remove constituents from the upper outwash aquifer.

Based on the implementation of a combination site-wide cap/cover to reduce risks to acceptable levels to human and ecological receptors, and the implementation of ground-water recovery/treatment with monitoring controls, Alternative 5 achieves compliance with overall protection of human health and the environment.

Compliance with ARARs:

Based on the site-specific PRGs established in Section 2 of this FS Report, constituent concentrations within the on-site and off-site upper outwash aquifer would be in compliance with chemical-specific ARARs (i.e., state criteria or federal MCLs) at the completion of the remedial action for the Site. At that time, the remedial action would be considered complete when the monitoring results confirm that Site PRGs have been met.

Based on the above considerations, the air discharge and water discharge from the ground-water treatment system would be required to meet the intent of state air regulations and SPDES requirements, respectively. Further pilot-scale testing and engineering calculations may be required prior to or during remedial design to ensure compliance of these two media (i.e., air and water) with ARARs; however, at this time, it appears that engineering control technologies would be available for corrective measures. In the event a control technology cannot be identified as being suitable for site-specific considerations, a waiver from chemical-specific ARARs may be applicable.

State agency approval may be required for on-site soils/fill constituents that exceed PRGs. However, due to the acceptable risks to future on-site commercial/industrial workers via installation of a site-wide cap/cover, this approval notice requirement may be precluded.

4.6.2.2 Primary Criteria

Long-Term Effectiveness and Permanence:

The magnitude of the residual risk at the Site would be within acceptable levels following implementation of Alternative 5, and therefore, would be effective in the long term.

Reduction of Toxicity, Mobility, or Volume through Treatment:

Through the use of a Site-wide cap/cover, the mobility of constituents within Site soils/fill would be reduced over time.

Through ground-water recovery and treatment, the toxicity and volume of constituents in the upper outwash aquifer would be reduced through treatment; however, constituent mass would be transferred (e.g., volatilization) from one media (ground water) to another (air and surface water), without an overall reduction of constituents, toxicity, or volume. Monitoring controls would be capable of assessing the transfer of constituents from one media to another.

Furthermore, emission controls could be installed on various treatment processes to prevent uncontrolled releases into the environment.

In addition to the above, metals treatment (if necessary) would result in a significant volume of precipitated sludge requiring off-site landfill disposal. This treatment also results in a transfer of constituents from one media to another.

Short-Term Effectiveness:

Due to the worker exposure associated with Site soils/fill during cap and cover placement activities, increased risks would occur in the short term should health and safety protocols not be properly implemented. In addition, due to Site remedial activities, increased concentrations in particulate airborne constituents could be observed, increasing risks to the local community and Site workers in the short term. However, this could be mitigated through dust suppression techniques during remedial construction activities.

Similar to Alternative 4, timeframes for remediation may be accelerated in comparison to Alternatives 1 and 2, due to the active recovery of ground water.

Implementability:

Although materials and services are readily available to install the site-wide cap/cover, the technical implementability to install the ground- water treatment system and associated discharge pipeline may be difficult. Issues that would need to be addressed include: easements/access for the pipeline system, underground utility locations, and other uncertainties associated with the condition and types of subsurface materials to be encountered during construction of the pipeline system. In addition to the above, this alternative is technically difficult based on the disposal of significant sludge quantities (up to 7,800 tons per year) at an off-site landfill facility (based on metals treatment, if necessary).

Since Site risks would be reduced to acceptable levels for both the Site soils/fill and ground water, this alternative is administratively feasible.

Cost:

Alternative 5 has a capital cost of $11.33 million and a total 30-year present worth cost of $41.61 million. Detailed cost estimates are included in Appendix F. It should be noted that due to the addition of ground-water treatment components, the O&M costs, and subsequently the total 30-year present worth cost, are significantly higher than Alternatives 1 through 4. In addition, based on a verbal request by USEPA, Attachment F-1 was developed (see Appendix F) for the comparative analysis of ground-water treatment costs (does not include capping costs) versus varying flow rates.

4.6.2.3 Summary

Alternative 5 achieves compliance with the two threshold criteria (overall protection of human health and the environment and compliance with ARARs), and is in compliance with two of the five primary criteria (long-term effectiveness and reduction of toxicity, mobility, or volume). Short-term effectiveness, implementability and cost threshold primary criteria are not achieved.

5. Comparative Analysis of Remedial Alternatives

5.1 General

In accordance with USEPA guidance (USEPA, 1988), once the alternatives have been described and individually assessed against the nine USEPA evaluation criteria (Section 4), a comparative analysis is conducted to evaluate the relative performance of each alternative in relation to each specific evaluation criteria. The purpose of the comparative analysis is to identify the advantages and disadvantages of each alternative relative to one another, so that the key tradeoffs for selecting a Site remedial action can be identified.

5.2 Criteria Assessment

5.2.1 Threshold Criteria

Overall Protection of Human Health and the Environment:

Alternatives 2 through 5 would achieve general protection of human health and the environment in regards to soils/fill at the Site since each provides a mechanism (i.e., a redevelopment option which includes capping/covering) to reduce and maintain human health risk exposures to within acceptable levels. Alternative 1 (No Action) would only accomplish this protection through Site fencing measures that were previously completed. However, based on the potential for future use of the Site, Alternative 1 would not achieve overall protection of human health and the environment with regards to Site soils/fill.

Alternatives 2 through 5 provide a greater level of protection than Alternative 1 with respect to Site soils/fill due to installation of a combination site-wide cap/cover (consisting of a 6 NYCRR Part 360 cap over a 3-acre area that includes the former cooling pond area and a surface cover over the remaining portions of the Site), which would allow dismantling of the Site fence and allow redevelopment of the Site (i.e. future use).

All five alternatives would achieve general protection of human health and the environment in regards to upper outwash ground water at the Site. Alternatives 1 and 2 would achieve protection via natural attenuation at the Site with Alternative 2 also including the isolation of PCB and TCA "hot spot" materials. The current restrictions for domestic water supply well installations in Cortland County and the availability of the public water supply, result in ground water conditions which are protective to overall human health and the environment. Alternative 3 is similar to Alternatives 1 and 2 in its level of overall protection, and provides treatment of the VOCs in ground water through enhanced biodegradation in addition to natural attenuation. Alternative 4 uses conventional ground-water recovery in the vicinity of well W-06 followed by direct discharge of 100 gpm to the WWTP in order to reduce VOC constituents in ground water. Alternative 5, which includes recovery/treatment (of VOCs and metals, if necessary), uses traditional "pump and treat" mechanisms to remove constituents.

Based on the above considerations, Alternatives 2, 3, and 4 provide slightly more or equal overall protection to human health and the environment than Alternative 1. Alternatives 1, 2, 3, and 4 provide more overall protection than Alternative 5.

Compliance with ARARs:

For Alternatives 2 through 5, constituent concentrations within the on-site and off-site upper outwash aquifer would be in compliance with chemical-specific ARARs (i.e., state or federal MCLs) for the Site at the conclusion of the remedial action. The remedial action will be considered complete when monitoring indicates that the constituents in the downgradient upper outwash aquifer are in accordance with PRGs established for the Site. Alternative 1 does not achieve compliance with ARARs due to the Site PRGs associated with surface soil/fill constituents.

For each of the five alternatives, state approval may be required for on-site soils/fill constituents that exceed PRGs. However, as stated in the Baseline RA (BB&L, 1995a), there are no unacceptable human health risks at the Site under current conditions (applicable to Alternative 1). In addition, the remaining alternatives (Alternatives 2 through 5) include redevelopment of the Site via the installation of a combination site-wide cap/cover to obtain acceptable risks to future on-site commercial/industrial workers. Based on the above considerations, an approval requirement for Site soils/fill may be precluded.

5.2.2 Primary Criteria

Long-Term Effectiveness and Permanence:

Alternative 1 would only achieve long-term effectiveness and permanence for Site soils/fill if the fencing remains in-place to restrict trespassers from entering the Site (i.e., no future use of the Site). The long-term effectiveness and permanence of Alternative 1 is unknown with regards to ground water since Alternative 1 does not include monitoring controls to evaluate the timeframe to achieve PRGs in ground water via natural attenuation.

Since the magnitude of the residual risk at the site for soils/fill would be within acceptable levels for future use by commercial/industrial workers, Alternatives 2 through 5 would provide for site redevelopment utilizing site-wide capping/covering of soils/fill and relocation of surface debris (and PCB and TCA-containing soils for Alternative 2.) In addition, since Alternatives 2 through 5 include, at a minimum, continued natural attenuation, each would be considered acceptable for long-term effectiveness and permanence criteria.

Reduction of Toxicity, Mobility, or Volume through Treatment:

Through the use of a site-wide cap/cover in Alternatives 2 through 5, the mobility of constituents within Site soils/fill would be reduced. Through continued natural attenuation, the toxicity and volume of upper outwash ground water aquifer constituents would be reduced for Alternatives 1 through 4.

Through ground-water recovery/treatment (either by use of enhanced biodegradation, recovery and discharge to the city WWTP, or air stripping and metals treatment - if necessary), the toxicity and volume of VOCs and metals in the upper outwash ground water aquifer is expected to be reduced for Alternatives 3 through 5. However, it should be noted that the air stripping and metals treatment components of Alternative 5 result in a mass transfer of constituents from one media to another, without an overall reduction of the toxicity or volume of constituents.

Based on the above considerations, Alternatives 1 through 4 achieve overall reductions in toxicity and volume via natural attenuation. Alternatives 3 and 4 also achieve overall reduction of toxicity and volume through treatment.

Short-term effectiveness:

Due to the desire for future Site redevelopment, Alternative 1 would not meet the short-term effectiveness criteria, since unacceptable risks would be anticipated for future Site workers exposed to soils/fill. Due to the installation of a combination site-wide cap/cover, Alternatives 2 through 5 would be considered effective in the short term with regards to Site soils/fill.

As discussed in Section 3, quantitative analysis of the remedial timeframes are difficult to predict without modeling; however, qualitative analysis suggests that Alternative 1 has the longest remedial timeframe in comparison to Alternatives 2 through 5. This is due to the lack of a surface cover system which would eliminate or minimize infiltration through any residual materials which may be located on site and thus may impact ground

water. Previous analytical results from well W-06 and other wells suggest a strong correlation between precipitation events and increases in ground-water constituent concentrations.

Alternative 2 incorporates a Part 360 cap over the cooling pond area and a surface cover system over the yard area. These design components would eliminate or minimize infiltration through any residual on-site materials allowing for an accelerated remedial timeframe in comparison to Alternative 1.

Alternative 3 is anticipated to occur at least as rapidly and potentially more rapidly than Alternatives 1 and 2 due to the enhanced bioremediation effort.

The remedial timeframes for Alternative 4 and 5 are anticipated to be accelerated in comparison to Alternatives 1 through 3 due to the active recovery of ground water. However, the possibility exists that the actual remedial timeframes may be similar to Alternatives 2 and 3 and not accelerated due to site specific conditions. Recovery well locations, recovery rates, source area locations, constituent concentrations, precipitation events, and other parameters may all influence remedial timeframes. Furthermore, the active recovery of ground water may not be the rate-limiting step in determining a remedial timeframe. Off-site and upgradient sources may continue to contribute constituents to the ground water for an extended period of time and thus the actual removal of groundwater will have negligible impact on remedial timeframes. As a result, the actual remedial timeframes would be similar to Alternative 2.

Implementability:

Alternative 1 would be considered implementable.

Alternatives 2 through 4 would be considered implementable based on the availability of materials and services, technical feasibility, and administrative feasibility. However, for Alternative 5, the technical feasibility to install the pipeline to the Tioughnioga River and the generation of sludge (approximately 6,500 cy per year) requiring off-site disposal is extremely difficult to implement in comparison to the other alternatives.

Cost:

Based on the cost considerations detailed in Section 4, with the exception of Alternative 1 (no capital costs), Alternatives 2 through 4 have the lowest capital and 30-year present worth costs of the four remaining alternatives. Alternative 5 has the highest capital and 30-year present worth costs. Below is a summary table of the capital and present worth costs for all five alternatives.

Alternative	Capital Costs	30-Year Present Worth Cost
Alternative 1	$0	$0.94 million
Alternative 2	$2.32 million	$3.24 million
Alternative 3	$2.44 million	$3.67 million
Alternative 4	$2.37 million	$4.37 million
Alternative 5	$11.33 million	$41.61 million

Thirty-year present worth costs are included herein in accordance with USEPA guidance (USEPA, 1988); however, the actual timeframe subject to present worth analysis for Alternatives 2 through 5 is variable.

6. Identification of CPRP Group Recommended Alternative

6.1 Recommended Alternative

The purpose of this section is to identify the CPRP Group recommended remedial action for the Site and the rationale behind the recommendation. Recommendation of this alternative is based upon the individual analysis of effectiveness, implementability, and cost presented in Section 3, the detailed evaluation of remedial alternatives in Section 4, as well as the comparative analysis of remedial alternatives presented in Section 5. Additional considerations include the potential for modification and/or combination of particular alternatives based upon the identification of key tradeoffs.

As a result of those analyses, the CPRP Group recommended remedial action for the Site is the implementation of Alternative 2 [A New York State Part 360 cap over the former cooling pond area, a surface (e.g. asphalt, soil, or other material) cover over the remainder of the Site, source removal (excavation of the PCB and TCA "hot spot" areas) and ground-water monitoring/institutional controls].

Alternative 2 was the recommended alternative based on the following considerations:

1. **Human Health and Ecological Risks** - The Baseline RA (BB&L, 1995a) was prepared to assess the current site conditions associated with the Site. The USEPA has indicated that the Baseline RA has been approved. The Baseline RA indicates no current risks to human health, and based on a conservative screening-level approach, only a low potential for exposure to small mammals (e.g., raccoons and mice) which may inhabit the Site. Remediation would be focused on precluding, or minimizing the contact of Site occupants with soils/fill.

   Risks to human health associated with ground-water exposure are limited due to the existing city drinking water supply wells, which are located hydraulically upgradient of the Site. Furthermore, ground-water exposure from either on-site or downgradient sources is not a concern since drinking water supply wells do not exist in these areas.

   Human health and ecological risks were determined to be limited since the Site is currently fenced and provides marginal wildlife habitat due to the previous industrial use of the Site. Future Site redevelopment could result in theoretical risks to human health and would require risk reduction measures such as site capping/covering and prohibiting the on-site installation of drinking water supply wells.

2. **Source Removal Activities** - The CPRP Group performed a removal action at the Site in 1990, in conjunction with USEPA contractors, to remove approximately 1,200 drums, 90 tanks, and other materials from the Site. This removal action has resulted in observed declines in ground-water constituent levels. This decline is in all likelihood attributed to the removal of source materials (during the previously performed removal action), as well as natural attenuation conditions.

3. **Natural Attenuation Conditions for Site Ground Water** - An evaluation of the ground-water sampling data demonstrates that the constituents of interest at the Site are undergoing natural attenuation. As a result, constituents of interest are expected to continue to decrease in concentration over time. This conclusion is supported by the site-specific attenuation rate constants developed for TCA and TCE that show predicted compliance with ground-water standards in five to ten years [refer to Natural Attenuation Technical Memorandum (BB&L, 1995b) regarding further documentation of natural attenuation rates].

4. **Desire for Future Site Redevelopment** - The city of Cortland, like many other cities, has experienced residential and commercial/industrial growth up to the city limits. As a result, vacant land for future growth is limited within the city. The Site is reportedly one of only a few remaining areas zoned industrial within the city limits where future industrial expansion could occur. The city envisions the property being

redeveloped as a transportation terminal where materials would be stockpiled before and after shipment by railroad, and is presently seeking "brownfield" redevelopment funding. Redevelopment of the Site for industrial re-use is a goal of the CPRPs, as well as the city of Cortland. Additionally, the railroad, which is in close proximity to the Site, is highly interested in a portion of the Site. It is the CPRP Group's understanding that this brownfield construction effort proposed by the railroad would involve Site grading, bringing in clean fill and gravel. These work efforts and materials of construction closely parallel those efforts necessary to install a surface cover system proposed for the yard area. As a result, this Site achieves the goal of a brownfields development program by eliminating Site risks due to surface soils/fill while facilitating reuse of the covered area as a transportation terminal.

5. **Recovering Site Ground Water for Treatment** - The quantity of ground water passing beneath the Site which would be removed under a "pump and treat" scenario (Alternative 5) is significant (approximately 1,200 to 1,500 gpm). Recovery of this ground water in an attempt to treat the water (and in theory expedite ground-water restoration) would be technically difficult due to the large volume of treated ground water, substantial project costs, and adverse impacts on future Site development. Furthermore, the city of Cortland has expressed concerns (see Appendix D, Attachment D-1) regarding the discharge of treated ground water into Perplexity Creek due to the potential to aggravate flooding during specific storm events. Due to these valid considerations, other discharge options were also evaluated but were determined to have limited implementability or technical difficulties.

In summary, redevelopment of the Site for industrial re-use can be accomplished by containing the Site soils/fill as part of the redevelopment plan. Such a plan would require restrictions on future use of the property, which can be accomplished using institutional controls. Capping/covering of the Site as part of its redevelopment would eliminate or significantly reduce potential risks to human health due to Site soils/fill. In addition, the Site cap/cover would reduce surface water infiltration through the Site soils/fill thus further reducing any contribution the Site soils/fill would have on ground water beneath the Site.

Natural attenuation of the chemical constituents in the ground water have been documented over the last five years, and additional reduction in ground-water constituents are expected in the future.

Furthermore, the installation of a surface cover and Part 360 cap would facilitate the redevelopment of the Site for future industrial use. The incorporation of the Part 360 cap component of the remedial approach would also facilitate the relocation of miscellaneous Site debris and PCB and TCA materials beneath the cap, effectively isolating these constituents from potential migration pathways.

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Tables

TABLE 1-1

SUMMARY OF GROUND-WATER ANALYTICAL RESULTS
AQUIFER TEST PROGRAM
JANUARY 1995

ROSEN SITE
CORTLAND, NEW YORK

Compound	W-25-1	W-25-2	W-25-3	New York State Standard/ Guidance Value	MCL/MCLG
Volatile Organics (ug/L)					
Acetone	**1,100 (D)**	39	10 (U)	50 (Q)	–
Chlorobenzene	0.4 (J)	5 (U)	5 (U)	5	100/100 (G)
1,1-Dichloroethane	**24**	**34**	**39**	5	–
1,2-Dichloroethane	5 (U)	0.6 (J)	0.5 (J)	5	5/0 (G)
1,1-Dichloroethene	0.8 (J)	2 (J)	3 (J)	5	7/7 (G)
Toluene	0.3 (J)	5 (U)	5 (U)	5	1,000/1,000 (G)
1,1,1-Trichloroethane	**56**	**100**	**110**	5	200/200 (G)
Trichloroethene	0.6 (J)	0.6 (J)	0.6 (J)	5	5/0 (G)
Inorganics (ug/L)					
Calcium, Total	120,000	170,000	177,000	–	–
Calcium, Dissolved	124,000	171,000	183,000	–	–
Iron, Total	**5,080**	**2,900**	**2,970**	300	300 (S)
Iron, Dissolved	**5,250**	**2,940**	**2,990**	300	300 (S)
Lead, Total	6.0	2 (U)	3.0	25	15
Lead, Dissolved	2 (U)	2 (U)	2 (U)	25	15
Magnesium, Total	20,700	18,200	17,600	35,000 (Q)	
Magnesium, Dissolved	20,500	18,200	18,100	35,000 (Q)	
Wet Chemistry (mg/L)					
Biochemical Oxygen Demand (BOD)	740	2 (U)	2 (U)	–	–
Chemical Oxygen Demand (COD)	1,500	60	34.2	–	–
Non-filterable residue (103 C)	34.7	7.4	6.8	–	–
pH (standard units)	6.96	7.07	7.16	–	6.5-8.5 (S)
Total hardness	406	525	563	–	

Notes:

1. All samples were analyzed for Target Compound List (TCL) Volatile Organic Compounds (VOCs) by USEPA Method 8240; however, only those parameters detected are listed on this table.
2. Bold indicates NYSDEC standards exceeded; shading indicates federal MCLs exceeded.
3. W-25-1 was collected just prior to the initiation of pumping, W-25-2 was collected after pumping at 80 gallons per minute (gpm) for approximately 1.5 hours, W-25-3 was collected approximately 0.5 hours prior to turning off the pump.

Data Qualifiers:

(J) = Indicates an estimated value.
(D) = Indicates all compounds identified in an analysis at a secondary dilution factor.
– = Indicates no existing New York State Standards/Guidance values or MCLs/MCLGs.
(Q) = Ambient Water Quality Standard or Guidance Value.
(G) = Maximum Contaminant Level Goal (MCLG).
(S) = Secondary Maximum Contaminant Level (SMCL).
(U) = Identifies compounds that were not detected. The value presented is the detection limit.

References:

Standard and guidance values are according to New York State Department of Environmental Conservation (NYSDEC), Division of Water Technical and Operation Guidance Series (1.1.1), Ambient Water Quality Standards and Guidance Values, October 1993.

MCLs (Maximum Contaminant Levels), MCLGs , and SMCLs , according to the Code of Federal Regulations, Protection of Environment 40, Part 141, July 1, 1991, and the Drinking Water Regulations and Health Advisories, Office of Water, U.S. Environmental Protection Agency, May, 1995.

TABLE 1-2

SUMMARY OF GROUND-WATER ANALYTICAL RESULTS
VOLATILE ORGANIC COMPOUNDS
MARCH 1995

ROSEN SITE
CORTLAND, NEW YORK

Compound	W-01	W-01DL	W-02	W-03	W-03DL	W-04	W-05	W-05DL	New York State Standard/Guidance Value	MCL/MCLG
Chloromethane	0.06 (J)	4 (U)	8 (U)	1 (U)	2 (U)	1 (U)	1 (U)	2 (U)	5	--
Vinyl Chloride	1 (U)	4 (U)	8 (U)	1 (U)	2 (U)	1 (U)	1 (U)	2 (U)	2	2/0(G)
Chloroethane	1 (U)	4 (U)	8 (U)	1 (U)	2 (U)	1 (U)	1 (U)	2 (U)	5	--
Acetone	5 (U)	20 (U)	40 (U)	5 (U)	10 (U)	5 (U)	6 (U)	10 (U)	50(Q)	--
1,1-Dichloroethene	0.09 (J)	4 (U)	0.7 (J)	1 (U)	2 (U)	1 (U)	1 (U)	2 (U)	5	7/7(G)
1,1-Dichloroethane	12	8 (D)	28	2	1 (DJ)	1 (U)	1	1 (DJ)	5	--
cis-1,2-Dichloroethene	1 (U)	4 (U)	8 (U)	1 (U)	2 (U)	1 (U)	1 (U)	2 (U)	5	70/70(G)
trans-1,2-Dichloroethene	1 (U)	4 (U)	8 (U)	1 (U)	2 (U)	1 (U)	1 (U)	2 (U)	5	100/100(G)
1,2-Dichloroethane	1	4 (U)	8 (U)	1 (U)	2 (U)	1 (U)	1	0.7 (DJ)	5	5/0(G)
Chloroform	1 (U)	4 (U)	8 (U)	1 (U)	2 (U)	1 (U)	1 (U)	2 (U)	7	100(a)/100(G)
1,1,1-Trichloroethane	59 (E)	41 (DJ)	120 (J)	1 (U)	5 (D)	1 (U)	34 (E)	24 (DJ)	5	200/200(G)
Trichloroethene	0.2 (J)	4 (U)	1 (J)	1 (U)	2 (U)	1 (U)	1	1 (DJ)	5	5/0(G)
Tetrachloroethene	1 (U)	4 (U)	8 (U)	27 (E)	20 (D)	1 (U)	1 (U)	2 (U)	5	5/0(G)
Toluene	1 (U)	4 (U)	8 (U)	1 (U)	2 (U)	1 (U)	0.2 (J)	2 (U)	5	1,000/1,000(G)
Chlorobenzene	1 (U)	4 (U)	8 (U)	1 (U)	2 (U)	1 (U)	1 (U)	2 (U)	5	100/100(G)
Total TICs	(NA)	(NA)	(NA)	(NA)	(NA)	(NA)	(NA)	(NA)	--	--

See Notes on Page 5.

TABLE 1-2 (Cont'd)

SUMMARY OF GROUND-WATER ANALYTICAL RESULTS
VOLATILE ORGANIC COMPOUNDS
MARCH 1995

ROSEN SITE
CORTLAND, NEW YORK

Compound	W-06	W-06 (DUP)	W-06DL	W-06DL (DUP)	W-07	W-08	W-08DL	W-09	W-10	W-10DL	W-11	New York State Standard/ Guidance Value	MCL/ MCLG
Chloromethane	1 (U)	1 (U)	10 (U)	8 (U)	1 (U)	0.08 (J)	2 (U)	1 (U)	1 (U)	5 (U)	8 (U)	5	--
Vinyl Chloride	1 (U)	1 (U)	10 (U)	8 (U)	1 (U)	1 (U)	2 (U)	1 (U)	1 (U)	5 (U)	8 (U)	2	2/0(G)
Chloroethane	6	5	4 (DJ)	4 (DJ)	1 (U)	1 (U)	2 (U)	1 (U)	0.4 (J)	5 (U)	8 (U)	5	--
Acetone	4 (J)	5 (U)	50 (U)	40 (U)	5 (U)	5 (U)	12 (U)	5 (U)	5 (U)	25 (U)	40 (U)	50(Q)	--
1,1-Dichloroethene	0.1 (J)	0.1 (J)	10 (U)	8 (U)	1 (U)	0.4 (J)	0.2 (DJ)	1 (U)	1	0.7 (DJ)	7 (J)	5	7/7(G)
1,1-Dichloroethane	30 (E)	23	19 (D)	20 (D)	2	11	7 (D)	1 (U)	42 (E)	36 (D)	67	5	--
cis-1,2-Dichloroethene	1	1	10 (U)	0.6 (DJ)	1 (U)	1 (U)	2 (U)	1 (U)	1 (U)	5 (U)	8 (U)	5	70/70(G)
trans-1,2-Dichloroethene	1 (U)	1 (U)	10 (U)	8 (U)	1 (U)	1 (U)	2 (U)	1 (U)	1 (U)	5 (U)	8 (U)	5	100/100(G)
1,2-Dichloroethane	1 (U)	1 (U)	10 (U)	8 (U)	1	1	2 (U)	0.6 (J)	1	5 (U)	8 (U)	5	5/0(G)
Chloroform	0.03 (J)	1 (U)	10 (U)	8 (U)	1 (U)	1 (U)	2 (U)	1 (U)	1 (U)	5 (U)	8 (U)	7	100(a)/100(G)
1,1,1-Trichloroethane	**210 (E)**	130 (E)	110 (DJ)	120 (DJ)	18 (J)	59 (E)	32 (DJ)	1 (U)	120 (E)	110 (DJ)	160 (J)	5	200/200(G)
Trichloroethene	4	3	2 (DJ)	2 (DJ)	1 (U)	1 (U)	2 (U)	1 (U)	0.7 (J)	5 (U)	8 (U)	5	5/0(G)
Tetrachloroethene	0.1 (BJ)	1 (U)	10 (U)	8 (U)	1 (U)	1 (U)	2 (U)	1 (U)	1 (U)	25 (U)	8 (U)	5	5/0(G)
Toluene	1 (U)	1 (U)	10 (U)	8 (U)	1 (U)	1 (U)	2 (U)	1 (U)	1 (U)	5 (U)	8 (U)	5	1,000/1,000(G)
Chlorobenzene	1 (U)	1 (U)	10 (U)	8 (U)	1 (U)	1 (U)	2 (U)	1 (U)	1 (U)	5 (U)	8 (U)	5	100/100(G)
Total TICs	(NA)	(NA)	(NA)	(NA)	(NA)	(NA)	(NA)	3 (J)	(NA)	(NA)	(NA)	--	--

e Notes on Page 5.

TABLE 1-2 (Cont'd)

SUMMARY OF GROUND-WATER ANALYTICAL RESULTS
VOLATILE ORGANIC COMPOUNDS
MARCH 1995

ROSEN SITE
CORTLAND, NEW YORK

Compound	W-12	W-13	W-14	W-15	W-16	W-17	W-18	W-18 (DUP)	W-18DL	W-18DL (DUP)	W-19	New York State Standard/Guidance Value	MCL/MCLG
Chloromethane	4 (U)	1 (U)	1 (U)	1 (U)	1 (U)	1 (U)	2 (U)	2 (U)	4 (U)	4 (U)	1 (U)	5	--
Vinyl Chloride	4 (U)	1 (U)	1 (U)	1 (U)	1 (U)	1 (U)	0.4 (J)	0.5 (J)	0.4 (DJ)	0.4 (DJ)	1 (U)	2	2/0(G)
Chloroethane	4 (U)	1 (U)	1 (U)	1 (U)	1 (U)	1 (U)	2 (U)	2 (U)	4 (U)	4 (U)	0.3 (J)	5	--
Acetone	20 (U)	5 (U)	5 (U)	5 (U)	5 (U)	5 (U)	10 (U)	10 (U)	20 (U)	20 (U)	5 (U)	50(Q)	--
1,1-Dichloroethene	2 (J)	1 (U)	1 (U)	1 (U)	0.3 (J)	1 (U)	2	2	2 (DJ)	2 (DJ)	8	5	7/7(G)
1,1-Dichloroethane	12	1 (U)	1 (U)	1 (U)	5	1	29	30	29 (D)	28 (D)	67 (E)	5	--
cis-1,2-Dichloroethene	4 (U)	1 (U)	1 (U)	1 (U)	0.09 (J)	0.4 (J)	6	7	6 (D)	6 (D)	0.1 (J)	5	70/70(G)
trans-1,2-Dichloroethene	4 (U)	1 (U)	1 (U)	1 (U)	1 (U)	1 (U)	2 (U)	2 (U)	4 (U)	4 (U)	1 (U)	5	100/100(G)
1,2-Dichloroethane	4 (U)	1 (U)	1 (U)	1 (U)	1 (U)	1 (U)	0.6 (J)	0.7 (J)	1 (DJ)	4 (U)	1	5	5/0(G)
Chloroform	4 (U)	1 (U)	1 (U)	1 (U)	1 (U)	1 (U)	2 (U)	2 (U)	4 (U)	4 (U)	1 (U)	7	100(a)/100(G)
1,1,1-Trichloroethane	38	1 (U)	4	1 (U)	23	4	69 (E)	70 (E)	68 (DJ)	61 (DJ)	140 (E)	5	200/200(G)
Trichloroethene	10	1 (U)	1 (U)	1 (U)	3	10	10	11	9 (D)	9 (D)	0.7 (J)	5	5/0(G)
Tetrachloroethene	4 (U)	1 (U)	1 (U)	1 (U)	1 (U)	1 (U)	2 (U)	2 (U)	4 (U)	4 (U)	1 (U)	5	5/0(G)
Toluene	4 (U)	1 (U)	1 (U)	1 (U)	1 (U)	1 (U)	2 (U)	2 (U)	4 (U)	4 (U)	1 (U)	5	1,000/1,000(G)
Chlorobenzene	4 (U)	1 (U)	0.06(BJ)	1 (U)	1 (U)		2 (U)	2 (U)	4 (U)	4 (U)	1 (U)	5	100/100(G)
Total TICs	(NA)	(NA)	(NA)	(NA)	(NA)	(NA)	(NA)	(NA)	(NA)	(NA)	2 (J)	--	--

See Notes on Page 5.

TABLE 1-2 (Cont'd)

SUMMARY OF GROUND-WATER ANALYTICAL RESULTS
VOLATILE ORGANIC COMPOUNDS
MARCH 1995

ROSEN SITE
CORTLAND, NEW YORK

Compound	W-19DL	W-20	W-21	W-22	W-23	W-24	W-24DL	W-25	W-25DL	W-26	New York State Standard/ Guidance Value	MCL/MCLG
Chloromethane	10 (U)	1 (U)	1 (U)	1 (U)	1 (U)	1 (U)	5 (U)	5 (U)	10 (U)	8 (U)	5	--
Vinyl Chloride	10 (U)	1 (U)	1 (U)	1 (U)	1 (U)	8	9 (D)	5 (U)	10 (U)	8 (U)	2	2/0(G)
Chloroethane	10 (U)	1 (U)	1 (U)	1 (U)	1 (U)	1 (U)	5 (U)	5 (U)	10 (U)	8 (U)	5	--
Acetone	50 (U)	5 (U)	5 (U)	5 (U)	5 (U)	5 (U)	25 (U)	25 (U)	50 (U)	40 (U)	50(Q)	--
1,1-Dichloroethene	6 (DJ)	1 (U)	1 (U)	1 (U)	1 (U)	1	1 (DJ)	2 (J)	3 (DJ)	7 (J)	5	7/7(G)
1,1-Dichloroethane	61 (DJ)	1 (U)	1 (U)	1 (U)	1 (U)	1 (U)	5 (U)	37	41 (D)	66	5	--
cis-1,2-Dichloroethene	10 (U)	1 (U)	1 (U)	1 (U)	1 (U)	39 (E)	37 (D)	5 (U)	10 (U)	8 (U)	5	70/70(G)
trans-1,2-Dichloroethene	10 (U)	1 (U)	1 (U)	1 (U)	1 (U)	4	3 (DJ)	5 (U)	10 (U)	8 (U)	5	100/100(G)
1,2-Dichloroethane	10 (U)	1 (U)	0.5 (J)	1 (U)	0.6 (J)	0.7 (J)	5 (U)	5 (U)	10 (U)	0.9 (J)	5	5/0(G)
Chloroform	10 (U)	1 (U)	1 (U)	1 (U)	1 (U)	1 (U)	5 (U)	5 (U)	10 (U)	8 (U)	7	100(a)/100(G)
1,1,1-Trichloroethane	210 (DJ)	1 (U)	1 (U)	1 (U)	1 (U)	1 (U)	0.8 (DJ)	150 (E)	210 (D)	140 (J)	5	200/200(G)
Trichloroethene	10 (U)	1 (U)	1 (U)	4	1 (U)	150 (E)	93 (D)	5 (U)	10 (U)	8 (U)	5	5/0(G)
Tetrachloroethene	10 (U)	1 (U)	1 (U)	1 (U)	1 (U)	1 (U)	5 (U)	5 (U)	10 (U)	8 (U)	5	5/0(G)
Toluene	10 (U)	1 (U)	1 (U)	1 (U)	1 (U)	1 (U)	5 (U)	5 (U)	10 (U)	8 (U)	5	1,000/1,000(G)
Chlorobenzene	10 (U)	1 (U)	1 (U)	1 (U)	1 (U)	1 (U)	5 (U)	5 (U)	10 (U)	8 (U)	5	100/100(G)
Total TICs	(NA)	(NA)	9 (J)	(NA)	(NA)	(NA)	(NA)	(NA)	(NA)	(NA)	--	--

See Notes on Page 5.

TABLE 1-2 (Cont'd)

SUMMARY OF GROUND-WATER ANALYTICAL RESULTS
VOLATILE ORGANIC COMPOUNDS
MARCH 1995

ROSEN SITE
CORTLAND, NEW YORK

Notes:
1. All concentrations, detection levels, standard values, guidance values and MCLs/MCLGs are reported as micrograms per liter (ug/L) equivalent to parts per billion (ppb).
2. Bold indicates NYSDEC standards exceeded; shading indicates federal MCLs exceeded.
3. (DUP) = Duplicate.

4. The following parameters were also analyzed for, but were not detected:

1,1,2-Trichloroethane	2-Hexanone	cis-1,3-Dichloropropene
1,1,2,2-Tetrachloroethane	4-Methyl-2-pentanone	trans-1,3-Dichloropropene
1,2-Dibromomethane	Benzene	Dibromochloromethane
1,2-Dichloropropane	Bromochloromethane	Ethylbenzene
1,3-Dibromo-3-chloropropane	Bromodichloromethane	Methylene Chloride
1,2-Dichlorobenzene	Bromoform	Styrene
1,3-Dichlorobenzene	Bromomethane	Total Xylenes
1,4-Dichlorobenzene	Carbon Disulfide	
2-Butanone	Carbon Tetrachloride	

Data Qualifiers:
(B) = Analyte found in blank as well as sample.
(D) = Identifies compounds identified in an analysis at a secondary dilution factor.
(E) = Identifies compounds whose concentrations exceed the calibration range of the GC/MS instrument for that specific analysis.
(J) = Indicates an estimated value.
TICs = Tentatively Identified Compounds.
(Q) = Ambient Water Quality Standard or Guidance Value.
(G) = Maximum Contaminant Level Goal (MCLG).
(S) = Secondary Maximum Contaminant Level (SMCL).
-- = No existing New York State Standard/Guidance Values or MCL/MCLGs.
(a) = Applies to the total of trihalomethanes.
(b) = The standard value of 5 ug/L applies to each isomer individually.
(NA) = Compound not analyzed.
(U) = Identifies compounds that were not detected. The value presented is the detection limit.

References:
Standard and Guidance values are according to the New York State Department of Environmental Conservation, Division of Water Technical and Operation Guidance Series (1.1.1), Ambient Water Quality Standards and Guidance Values, October 1993.

MCLs [Maximum Contaminant Levels], MCLGs, and SMCLs according to the Code of Federal Regulations, Protection of Environment 40, Part 141, July 1991, and the Drinking Water Regulations and Health Advisories, Office of Water, U.S. Environmental Protection Agency, May, 1995.

TABLE 1-3

SUMMARY OF GROUND-WATER ANALYTICAL RESULTS
INORGANIC CONSTITUENTS
MARCH 1995

ROSEN SITE
CORTLAND, NEW YORK

Constituent	Total W-01	Soluble W-01	Total W-02	Soluble W-02	Total W-03	Soluble W-03	Total W-03 (Dup)	New York State Standard/Guidance Value	MCL/MCLG SMCL
Aluminum	**7,310**	90.0(U)	**4,940**	90.0(U)	**3,200**	90.0(U)	**2,490**	--	50 to 200(S)
Antimony	**47.0 (B)**	30.0 (U)	30.0 (U)	30.0 (U)	30.0 (U)	30.0 (U)	30.0 (U)	3(Q)	6/6(G)
Arsenic	4.0 (U)	4.0 (U)	5.0 (B)	4.0 (U)	4.0 (NJ)	4.0 (U)	4.0 (NJ)	25	50
Barium	67.0 (B)	40.0 (U)	90.0 (B)	40.0 (U)	40.0 (U)	40.0 (U)	40.0 (U)	1,000	2,000/2,000 (G)
Beryllium	3.0 (U)	3.0 (U)	3.0 (U)	3.0 (U)	3.0 (U)	3.0 (U)	3.0 (U)	3(Q)	4/4(G)
Cadmium	5.0 (U)	5.0 (U)	5.0 (U)	5.0 (U)	5.0 (U)*	5.0 (U)	5.0 (U)*	10	5/5 (G)
Calcium	50,300 (EJ)	51,000	155,000 (EJ)	124,000	70,800	60,900	67,000	--	--
Chromium	13	10 (U)	11	10 (U)	10 (U)	10 (U)	10 (U)	50	100
Cobalt	40.0 (U)	40.0 (U)	40.0 (U)	40.0 (U)	40.0 (U)	40.0 (U)	40.0 (U)	--	--
Copper	24.0 (B)	10 (U)	13.0 (B)	10 (U)	10 (U)	10 (U)	10 (U)	200	1,000(S)
Iron	**13,000**	40.0 (U)	**26,000**	40.0 (U)	**5,280**	42.0 (B)	**360**	300	300(S)
Lead	9	2.0 (JU)	8	2.0 (JU)	2.8 (B)*	2.0 (JU)	2.4 (B)*	25	15
Magnesium	11,300	8,900	27,400	22,600	13,400	9,050	12,500	35,000(Q)	--
Manganese	**794**	5.0 (U)	**2,280**	289	214	100	209	500(a)/300	50(S)
Mercury	0.20 (U)	0.20 (U)	0.21	0.20 (U)	0.20 (U)	0.20 (U)	0.20 (U)	2	2/2 (G)
Nickel	20.0 (U)	20.0 (U)	20.0 (U)	20.0 (U)	20.0 (U)	20.0 (U)	20.0 (U)	--	100/100(G)
Potassium	3,320 (B)	1,940 (B)	4,200 (B)	3,540 (B)	2,600 (B)	1,790 (B)	2,450 (B)	--	--
Selenium	5.0 (WJU)	3.0 (WJU)	5.0 (WJU)	5.0 (WJU)	1.0 (U)*	3.0 (U)	1.0 (U)*	10	50/50 (G)
Silver	10 (NU)	10 (JU)	10 (NJU)	10 (JU)	10 (NJU)	10 (JU)	10 (NJU)	50	100 (S)
Sodium	16,500	17,100	25,500	24,700	15,200	15,300	14,600	20,000	--
Thallium	4.0 (U)	4.0 (U)	4.0 (U)	4.0 (U)	4.0 (U)	4.0 (U)	4.0 (WJU)	4(Q)	2/0.5(G)
Vanadium	14.0 (B)	10 (U)	11.0 (B)	10 (U)	10 (U)	10 (U)	10 (U)	--	--
Zinc	124	23	57	15.0 (U)	317	56	253	300	5,000(S)

See Notes on Page 9.

TABLE 1-3 (Cont'd)

SUMMARY OF GROUND-WATER ANALYTICAL RESULTS
INORGANIC CONSTITUENTS
MARCH 1995

ROSEN SITE
CORTLAND, NEW YORK

Constituent	Total W-04	Soluble W-04	Total W-05	Soluble W-05	Total W-06	Soluble W-06	Total W-06 (Dup)	New York State Standard/Guidance Value	MCL/MCLG SMCL
Aluminum	**16,800**	90.0 (U)	**21,900**	90.0 (U)	**5,050**	90.0 (U)	**6,760**	--	50 to 200(S)
Antimony	30.0 (U)	30.0 (U)	30.0 (U)	30.0 (U)	30.0 (U)	30.0 (U)	30.0 (U)	3(Q)	6/6(G)
Arsenic	4.0 (B)	4.0 (U)	5.0 (B)	4.0 (U)	4.0 (WU)	4.0 (U)	4.0 (NJU)	25	50
Barium	143 (B)	40.0 (U)	325	42.0 (BU)	88.0 (B)	40.0 (U)	94.0 (B)	1,000	2,000/2,000 (G)
Beryllium	3.0 (U)	3.0 (U)	3.0 (U)	3.0 (U)	3.0 (U)	3.0 (U)	3.0 (U)	3(Q)	4/4(G)
Cadmium	5.0 (U)	5.0 (U)	**6.0 (J)**	5.0 (U)	5.0 (U)	5.0 (U)	5.0 (U)*	10	5/5 (G)
Calcium	73,700 (EJ)	51,700	65,400 (EJ)	53,400	70,000 (EJ)	66,300	65,700	--	--
Chromium	19	10 (U)	**81**	10 (U)	**327**	10 (U)	**376**	50	100
Cobalt	40.0 (U)	40.0 (U)	40.0 (U)	40.0 (U)	40.0 (U)	40.0 (U)	40.0 (U)	--	--
Copper	62	10 (U)	114	10 (U)	49	10 (U)	49	200	1,000(S)
Iron	**28,700**	40.0 (U)	**54,400**	40.0 (U)	**15,700**	40.0 (U)	**16,600**	300	300(S)
Lead	**24**	2.0 (JU)	**60**	2.0 (JU)	14.5 (J)+	2.0 (JU)	12.0 *	25	15
Magnesium	21,600	8,200	20,000	9450	14,100	11,800	13,300	35,000(Q)	--
Manganese	**944**	5.0 (U)	**4,120**	5.0 (U)	**856**	8.0 (B)	**874**	500(a)/300	50(S)
Mercury	0.23	0.20 (U)	0.61	0.20 (U)	0.21	0.20 (U)	0.20 (U)	2	2/2 (G)
Nickel	20.0 (U)	20.0 (U)	53	20.0 (U)	77	26.0 (B)	77	--	100/100(G)
Potassium	3,950 (B)	560 (B)	5,440	2,450 (B)	2,410 (B)	1,300 (B)	2,800 (B)	--	--
Selenium	5.0 (WJU)	5.0 (U)	5.0 (WJU)	5.0 (WJU)	5.0 (U)	5.0 (U)	3.5 (BJ)*	10	50/2 (G)
Silver	10 (NJU)	10 (JU)	10 (NJU)	10 (JU)	10 (NJU)	10 (JU)	10 (NJU)	50	100 (S)
Sodium	38,900	39,500	28,500	26,100	27,600	26,100	26,200	20,000	--
Thallium	4.0 (WU)	4.0 (WJU)	4.0 (WJU)	4.0 (U)	4.0 (WJU)	4.0 (U)	4.0 (U)	4(Q)	2/0.5(G)
Vanadium	29.0 (B)	10 (U)	198	25.0 (B)	14.0 (B)	10 (U)	15.0 (B)	--	--
Zinc	124	15.0 (U)	377	15.0 (B)	621	23	136	300	5,000(S)

See Notes on Page 9.

TABLE 1-3 (Cont'd)

SUMMARY OF GROUND-WATER ANALYTICAL RESULTS
INORGANIC CONSTITUENTS
MARCH 1995

ROSEN SITE
CORTLAND, NEW YORK

Constituent	Total W-07	Soluble W-07	Total W-08	Soluble W-08	Total W-09	Soluble W-09	Total W-10	Soluble W-10	New York State Standard/Guidance Value	MCL/MCLG SMCL
Aluminum	**1,860**	90.0 (U)	**15,700**	90.0 (U)	90.0 (U)	90.0 (U)	**18,800**	90.0 (U)	--	50 to 200(S)
Antimony	30.0 (U)	30.0 (U)	30.0 (U)	30.0 (U)	30.0 (U)	30.0 (U)	30.0 (U)	30.0 (U)	3(Q)	6/6(G)
Arsenic	4.0 (U)	4.0 (U)	6.0 B	4.0 (U)	4.0 (U)	4.0 (U)	4.0 (NJU)	4.0 (U)	25	50
Barium	40.0 (U)	40.0 (U)	323	128 (B)	321	328	198 (B)	43.0 (B)	1,000	2,000/2,000 (G)
Beryllium	3.0 (U)	3.0 (U)	3.0 (U)	3.0 (U)	3.0 (U)	3.0 (U)	3.0 (U)	3.0 (U)	3(Q)	4/4(G)
Cadmium	5.0 (U)	5.0 (U)	**5.0 (J)**	5.0 (U)	5.0 (U)	5.0 (U)	5.0 (U)*	5.0 (U)	10	5/5 (G)
Calcium	47,500 (EJ)	46,600	180,000 (EJ)	127,000	140,000 (EJ)	140,000	150,000	85,000	--	--
Chromium	**55**	10 (U)	42	10 (U)	10 (U)	10 (U)	**140**	10 (U)	50	100
Cobalt	40.0 (U)	40.0 (U)	40.0 (U)	40.0 (U)	40.0 (U)	40.0 (U)	40.0 (U)	40.0 (U)	--	--
Copper	15.0 (B)	10 (U)	36	10 (U)	10 (U)	10 (U)	85	10 (U)	200	1,000(S)
Iron	**5,790**	40.0 (U)	**32,100**	40.0 (U)	107	51.0 (B)	**41,700**	87.0 (B)	300	300(S)
Lead	6	2.0 (JU)	**25**	2.0 (WJU)	2.0 (U)	2.0 (WJU)	**29.7***	2.0 (WJU)	25	15
Magnesium	11,600	10,600	**47,400**	32,000	**40,900**	**41,300**	**39,700**	12,800	35,000(Q)	--
Manganese	**163**	14.0 (B)	**1,530**	**391**	**229**	**229**	**2,690**	**487**	500(a)/300	50(S)
Mercury	0.20 (U)	0.20 (U)	0.29	0.20 (U)	0.20 (U)	0.20 (U)	0.35	0.20 (U)	2	2/2 (G)
Nickel	20.0 (U)	20.0 (U)	36.0 (B)	20.0 (U)	0.20 (U)	0.20 (U)	**103**	0.20 (U)	--	100/100(G)
Potassium	2,860 (B)	2,410 (B)	4,450 (B)	1,570 (B)	1,560 (B)	1,510 (B)	4,770 (B)	2,140 (B)	--	--
Selenium	5.0 (WJU)	5.0 (WJU)	5.0 (WJU)	3.0 (WJU)	5.0 (U)	3.0 (WJU)	1.0 (U)*	3.0 (WJU)	10	50/2 (G)
Silver	10 (NJU)	10 (JU)	10 (NJU)	10 (JU)	10 (NJU)	10 (JU)	10 (NJU)	10 (JU)	50	100 (S)
Sodium	15,200	13,600	81,800	86,900	108,000	110,000	22,700	23,100	20,000	--
Thallium	4.0 (U)	4.0 (U)	4.0 (WJU)	4.0 (WJU)	4.0 (WJU)	4.0 (WJU)	4.0 (WJU)	4.0 (U)	4(Q)	2/0.5(G)
Vanadium	10 (U)	10 (U)	24.0 (B)	10 (U)	10 (U)	10 (U)	33.0 (B)	10 (U)	--	--
Zinc	44	15.0 (U)	131	15.0 (U)	15.0 (U)	20	176	23	300	5,000(S)

See Notes on Page 9.

TABLE 1-3 (Cont'd)

SUMMARY OF GROUND-WATER ANALYTICAL RESULTS
INORGANIC CONSTITUENTS
MARCH 1995

ROSEN SITE
CORTLAND, NEW YORK

Constituent	Total W-11	Soluble W-11	Total W-12	Soluble W-12	Total W-13	Soluble W-13	Total W-14	Soluble W-14	New York State Standard/Guidance Value	MCL/MCLG SMCL
Aluminum	**14,000**	90.0 (U)	**4,600**	90.0 (U)	**2,960**	90.0 (U)	**1,850**	90.0 (U)	--	50 to 200(S)
Antimony	30.0 (U)	30.0 (U)	30.0 (U)	30.0 (U)	30.0 (U)	30.0 (U)	30.0 (U)	30.0 (U)	3(Q)	6/6(G)
Arsenic	7.0 (B)	4.0 (U)	4.0 (NJU)	4.0 (U)	4.0 (NJU)	4.0 (U)	4.0 (U)	4.0 (U)	25	50
Barium	175 (B)	40.0 (U)	65.0 (B)	40.0 (U)	40.0 (U)	40.0 (U)	56.0 (B)	41.0 (B)	1,000	2,000/2,000 (G)
Beryllium	3.0 (U)	3.0 (U)	3.0 (U)	3.0 (U)	3.0 (U)	3.0 (U)	3.0 (U)	3.0 (U)	3(Q)	4/4(G)
Cadmium	5.0 (U)	5.0 (U)	5.0 (U)*	5.0 (U)	5.0 (U)*	5.0 (U)	5.0 (U)	5.0 (U)	10	5/5 (G)
Calcium	423,000 (EJ)	376,000	218,000	211,000	40,200	41,100	107,000 (EJ)	104,000	--	--
Chromium	**57**	10 (U)	10 (U)	10 (U)	**305**	10 (U)	**59**	10 (U)	50	100
Cobalt	40.0 (U)	40.0 (U)	40.0 (U)	40.0 (U)	40.0 (U)	40.0 (U)	40.0 (U)	40.0 (U)	--	--
Copper	44	10 (U)	10 (B)	10 (U)	23.0 (B)	10 (U)	19.0 (B)	10 (U)	200	1,000(S)
Iron	**36,400**	**6,120**	**8,430**	40.0 (U)	**8,050**	40.0 (U)	**4,240**	40.0 (U)	300	300(S)
Lead	20	2.0 (JU)	5.7 *	2.0 (WJU)	3.8 *	2.0 (WJU)	4	2.0 (JU)	25	15
Magnesium	32,100	15,500	22,500	17,600	5,910	5,350	13,900	13,200	35,000(Q)	--
Manganese	**1,330**	**904**	**1,010**	**813**	**109**	5.0 (U)	**82**	5.0 (U)	500(a)/300	50(S)
Mercury	0.21	0.20 (U)	0.20 (U)	0.20 (U)	0.20 (U)	0.20 (U)	0.20 (U)	0.20 (U)	2	2/2 (G)
Nickel	46	22.0 (B)	20.0 (U)	20.0 (U)	20.0 (U)	20.0 (U)	20.0 (U)	20.0 (U)	--	100/100(G)
Potassium	4,830 (B)	2,150 (B)	2,220 (B)	1,100 (B)	1,680 (B)	1,280 (B)	1,480 (B)	2,320 (B)	--	--
Selenium	5.0 (WJU)	5.0 (WJU)	1.0 (U)*	3.0 (WJU)	1.0 (JU) *	5.0 (WJU)	5.0 (U)	5.0 (JU)	10	50/2 (G)
Silver	10 (NJU)	10 (JU)	10 (NJU)	10 (JU)	10 (NJU)	10 (JU)	10 (NJU)	10 (JU)	50	100 (S)
Sodium	24,200	23,000	21,800	21,000	13,500	12,600	29,800	30,600	20,000	--
Thallium	4.0 (U)	4.0 (U)	4.0 (WJU)	4.0 (U)	4.0 (U)	4.0 (U)	4.0 (U)	4.0 (U)	4(Q)	2/0.5(G)
Vanadium	22.0 (B)	10 (U)	10 (U)	10 (U)	10 (U)	10 (U)	10 (U)	10 (U)	--	--
Zinc	103	15.0 (U)	47	18.0 (B)	37	15.0 (U)	45	15.0 (U)	300	5,000(S)

See Notes on Page 9.

TABLE 1-3 (Cont'd)

SUMMARY OF GROUND-WATER ANALYTICAL RESULTS
INORGANIC CONSTITUENTS
MARCH 1995

ROSEN SITE
CORTLAND, NEW YORK

Constituent	Total W-15	Soluble W-15	Total W-16	Soluble W-16	Total W-17	Soluble W-17	Total W-18	Soluble W-18	New York State Standard/Guidance Value	MCL/MCLG SMCL
Aluminum	2,670	90.0 (U)	1,280	90.0 (U)	147,000	90.0 (U)	48,600	90.0 (U)	--	50 to 200(S)
Antimony	30.0 (U)	30.0 (U)	30.0 (U)	30.0 (U)	45.0 (B)	30.0 (U)	30.0 (U)	30.0 (U)	3(Q)	6/6(G)
Arsenic	4.0 (NJU)	4.0 (U)	4.0 (U)	4.0 (U)	4.0 (B)	4.0 (U)	10	4.0 (U)	25	50
Barium	41.0 (B)	40.0 (U)	66.0 (B)	57.0 (B)	943	40.0 (U)	459	43.0 (B)	1,000	2,000/2,000 (G)
Beryllium	3.0 (U)	3.0 (U)	3.0 (U)	3.0 (U)	5	3.0 (U)	3.0 (U)	3.0 (U)	3(Q)	4/4(G)
Cadmium	5.0 (U)*	5.0 (U)	5.0 (U)	5.0 (U)	44	5.0 (U)	13	5.0 (U)	10	5/5 (G)
Calcium	123,000	131,000	139,000 (EJ)	136,000	546,000 (EJ)	95,000	505,000 (EJ)	158,000	--	--
Chromium	10 (U)	10 (U)	64	10 (U)	12,800	10 (U)	338	10 (U)	50	100
Cobalt	40.0 (U)	40.0 (U)	40.0 (U)	40.0 (U)	231	40.0 (U)	57	40.0 (U)	--	--
Copper	20.0 (B)	10 (U)	240	10 (U)	410	10 (U)	105	10 (U)	200	1,000(S)
Iron	4,040	77.0 (B)	3,100	40.0 (U)	339,000	40	88,200	40.0 (U)	300	300(S)
Lead	1.7 (B)*	2.0 (WJU)	8	2.0 (JU)	140	2.0 (JU)	105 (S)	2.0 (JU)	25	15
Magnesium	31,400	31,500	25,000	23,400	189,000	12,700	113,000	17,400	35,000(Q)	--
Manganese	318	316	165	13.0 (B)	8,620	5.0 (U)	6,780	601	500(a)/300	50(S)
Mercury	0.20 (U)	0.20 (U)	0.20 (U)	0.20 (U)	0.83	0.20 (U)	0.41	0.20 (U)	2	2/2 (G)
Nickel	20.0 (U)	20.0 (U)	36.0 (B)	20.0 (U)	1,600	20.0 (U)	165	20.0 (U)	--	100/100(G)
Potassium	1,860 (B)	1,210 (B)	1,440 (B)	1,090 (B)	16,900	1,540 (B)	8,040	2,000 (B)	--	--
Selenium	1.0 (U)*	5.0 (WJU)	7	5.0 (WJU)	50.0 (WJU)	5.0 (WJU)	5.0 (WJU)	5.0 (WJU)	10	50/2 (G)
Silver	10 (NJU)	10 (JU)	10 (NJU)	10 (JU)	10 (NJU)	10 (JU)	10 (NJU)	10 (JU)	50	100 (S)
Sodium	32,300	32,000	24,400	23,800	21,800	19,600	29,500	30,400	20,000	--
Thallium	4.0 (U)	4.0 (U)	4.0 (U)	4.0 (U)	4.0 (U)	4.0 (U)	4.0 (U)	4.0 (U)	4(Q)	2/0.5(G)
Vanadium	10 (U)	10 (U)	10 (U)	10 (U)	264	10 (U)	69	10 (U)	--	--
Zinc	29	15.0 (B)	90	15.0 (U)	2,460	18.0 (B)	407	15.0 (U)	300	5,000(S)

See Notes on Page 9.

TABLE 1-3 (Cont'd)

SUMMARY OF GROUND-WATER ANALYTICAL RESULTS
INORGANIC CONSTITUENTS
MARCH 1995

ROSEN SITE
CORTLAND, NEW YORK

Constituent	Total W-18 Dup.	Total W-19	Soluble W-19	Total W-20	Soluble W-20	Total W-21	Soluble W-21	New York State Standards/Guidance Values	MCLs/MCLGs SMCLs
Aluminum	**83,200**	**22,000**	90.0 (U)	**9,580**	90.0 (U)	**14,700**	90.0 (U)	--	50 to 200(S)
Antimony	30.0 (U)	30.0 (U)	30.0 (U)	30.0 (U)	30.0 (U)	30.0 (U)	30.0 (U)	3(Q)	6/6(G)
Arsenic	10	12	4.0 (U)	6.0 (BNJ)	4.0 (U)	10	4.0 (U)	25	50
Barium	512	167 (B)	40.0 (U)	115 (B)	40.0 (U)	136 (B)	40.0 (U)	1,000	2,000/2,000 (G)
Beryllium	3.0 (U)	3.0 (U)	3.0 (U)	3.0 (U)	3.0 (U)	3.0 (U)	3.0 (U)	3(Q)	4/4(G)
Cadmium	**17**	**10 (J)**	5.0 (U)	5.0 (U)*	5.0 (U)	**16**	5.0 (U)	10	5/5 (G)
Calcium	501,000 (E)	452,000 (EJ)	373,000	226,000	163,000	69,300 (EJ)	21,900	--	--
Chromium	**512**	45	10 (U)	40	10	**269**	14	50	100
Cobalt	84	40.0 (U)	40.0 (U)	40.0 (U)	40.0 (U)	40.0 (U)	40.0 (U)	--	--
Copper	167	73	10 (U)	24.0 (B)	10 (U)	119	10 (U)	200	1,000(S)
Iron	**151,000**	**42,400**	40.0 (U)	**17,800**	126	**29,700**	40.0 (U)	300	300(S)
Lead	**145 (S)**	**29**	2.0 (JU)	9.1 *	2.0 (WJU)	**23**	2.0 (JU)	25	15
Magnesium	154,000	49,600	21,500	48,400	37,500	19,700	9,160	35,000(Q)	--
Manganese	**8,200**	**2,990**	**2,390**	**1,490**	**866**	**934**	28	500(a)/300	50(S)
Mercury	0.51	0.33	0.20 (U)	0.29	0.20 (U)	0.27	0.20 (U)	2	2/2 (G)
Nickel	242	50	25.0 (B)	33.0 (B)	20.0 (U)	71	20.0 (U)	--	100/100(G)
Potassium	12,700	5,360	1,630 (B)	3,050 (B)	1,260 (B)	27,200	26,600	--	--
Selenium	5.0 (WU)	5.0 (WJU)	5.0 (WJU)	1.0 (U) *	5.0 (WJU)	5.0 (WJU)	5.0 (WJU)	10	50/2 (G)
Silver	10 (NU)	10 (NJU)	10 (JU)	10 (NJU)	10 (JU)	10 (NJU)	10 (JU)	50	100 (S)
Sodium	30,800	25,000	25,600	28,700	28,100	171,000	174,000	20,000	--
Thallium	4.0 (U)	4.0 (U)	4.0 (U)	4.0 (U)	4.0 (U)	4.0 (U)	4.0 (U)	4(Q)	2/0.5(G)
Vanadium	121	36.0 (B)	10 (U)	16.0 (B)	10 (U)	29.0 (B)	10 (U)	--	--
Zinc	619	171	15.0 (U)	97	30	122	15.0 (U)	300	5,000(S)

See Notes on Page 9.

TABLE 1-3 (Cont'd)

SUMMARY OF GROUND-WATER ANALYTICAL RESULTS
INORGANIC CONSTITUENTS
MARCH 1995

ROSEN SITE
CORTLAND, NEW YORK

Constituent	Total W-22	Soluble W-22	Total W-23	Soluble W-23	Total W-24	Soluble W-24	Total W-25	Soluble W-25	New York State Standards/Guidance Values	MCLs/MCLGs SMCLs
Aluminum	42,500	90.0 (U)	737	90.0 (U)	18,200	90.0 (U)	90.0 (U)	90.0 (U)	--	50 to 200(S)
Antimony	30.0 (U)	30.0 (U)	30.0 (U)	30.0 (U)	30.0 (U)	30.0 (U)	30.0 (U)	30.0 (U)	3(Q)	6/6(G)
Arsenic	4.0 (NJU)	4.0 (U)	4.0 (U)	4.0 (U)	6.0 (B)	4.0 (U)	4.0 (NJU)	4.0 (NU)	25	50
Barium	960	115 (B)	478	483	292	40.0 (U)	40.0 (U)	40.0 (U)	1,000	2,000/2,000 (G)
Beryllium	3.0 (U)	3.0 (U)	3.0 (U)	3.0 (U)	3.0 (U)	3.0 (U)	3.0 (U)	3.0 (U)	3(Q)	4/4(G)
Cadmium	16.0*	5.0 (U)	5.0 (U)	5.0 (U)	5.0 (U)	5.0 (U)	5.0 (U)*	5.0 (U)	10	5/5 (G)
Calcium	232,000	118,000	114,000 (EJ)	110,000	165,000 (EJ)	146,000	139,000	143,000	--	--
Chromium	4,270	10 (U)	10 (U)	10 (U)	42	10 (U)	10 (U)	10 (U)	50	100
Cobalt	113	40.0 (U)	40.0 (U)	40.0 (U)	40.0 (U)	40.0 (U)	40.0 (U)	40.0 (U)	--	--
Copper	168	10 (U)	37	10 (U)	33	40.0 (U)	10 (U)	10 (U)	200	1,000(S)
Iron	111,000	40.0 (U)	1,070	40.0 (U)	36,800	50.0 (B)	2,340	2,270	300	300(S)
Lead	45.4*	2.0 (WJU)	3.0 (W)	2.0 (JU)	23	2.0 (JU)	1.0 (U)*	2.0 (WJU)	25	15
Magnesium	61,100	20,100	28,100	26,800	41,100	32,100	17,000	17,200	35,000(Q)	--
Manganese	2,650	14.0 (B)	173	136	2,610	776	485	574	500(a)/300	50(S)
Mercury	0.65	0.20 (U)	0.20 (U)	0.21	0.20 (U)	0.27	0.20 (U)	0.20 (U)	2	2/2 (G)
Nickel	1,500	90	20.0 (U)	20.0 (U)	38.0 (B)	20.0 (U)	20.0 (U)	20.0 (U)	--	100/100(G)
Potassium	8,850	1,600 (B)	1,600 (B)	1,290 (B)	4,780 (B)	2,520 (B)	2,330 (B)	2,300 (B)	--	--
Selenium	1.0 (U)*	5.0 (U)	5.0 (WJU)	5.0 (WJU)	5.0 (WJU)	5.0 (U)	1.2 (BJ)*	5.0 (WJU)	10	50/2 (G)
Silver	10 (NJU)	10 (JU)	10 (NJU)	10 (JU)	10 (NJU)	10 (JU)	10 (JU)	10 (JU)	50	100 (S)
Sodium	132,000	132,000	72,800	72,000	64,200	64,600	30,400	29,300	20,000	--
Thallium	4.0 (WJU)	4.0 (WJU)	4.0 (WJU)	4.0 (WJU)	4.0 (U)	4.0 (WJU)	4.0 (U)	4.0 (U)	4(Q)	2/0.5(G)
Vanadium	81	10 (U)	10 (U)	10 (U)	29.0 (B)	10 (U)	10 (U)	10 (U)	--	--
Zinc	269	15.0 (U)	36	15.0 (U)	142	15.0 (U)	15.0 (U)	20	300	5,000(S)

See Notes on Page 9.

TABLE 1-3 (Cont'd)

SUMMARY OF GROUND-WATER ANALYTICAL RESULTS
INORGANIC CONSTITUENTS
MARCH 1995

ROSEN SITE
CORTLAND, NEW YORK

Constituent	Total W-26	Soluble W-26	New York State Standards/Guidance Values	MCLs/MCLGs SMCLs
Aluminum	1,540	90.0 (U)	--	50 to 200(S)
Antimony	30.0 (U)	30.0 (U)	3(Q)	6/6(G)
Arsenic	4.0 (U)	4.0 (U)	25	50
Barium	40.0 (U)	40.0 (U)	1,000	2,000/2,000 (G)
Beryllium	3.0 (U)	3.0 (U)	3(Q)	4/4(G)
Cadmium	5.0 (U)	5.0 (U)	10	5/5 (G)
Calcium	416,000 (J)	26,000	--	--
Chromium	10 (U)	10 (U)	50	100
Cobalt	40.0 (U)	40.0 (U)	--	--
Copper	88	10 (U)	200	1,000(S)
Iron	10,100	6,880	300	300(S)
Lead	3	2.0 (JU)	25	15
Magnesium	15,800	14	35,000(Q)	--
Manganese	679	701	500(a)/300	50(S)
Mercury	0.20 (U)	0.20 (U)	2	2/2 (G)
Nickel	20.0 (U)	20.0 (U)	--	100/100(G)
Potassium	2,530 (B)	2,310 (B)	--	--
Selenium	5.0 (WJU)	5.0 (WJU)	10	50/2 (G)
Silyer	10 (NJU)	10 (JU)	50	100 (S)
Sodium	20,600	20,100	20,000	--
Thallium	4.0 (U)	4.0 (U)	4(Q)	2/0.5(G)
Vanadium	10 (U)	10 (U)	--	--
Zinc	69	15.0 (U)	300	5,000(S)

See Notes on Page 9.

TABLE 1-3 (Cont'd)

SUMMARY OF GROUND-WATER ANALYTICAL RESULTS
INORGANIC CONSTITUENTS
MARCH 1995

ROSEN SITE
CORTLAND, NEW YORK

Notes:
1. All concentrations, detection levels, standard values, guidance values and MCLs/MCLGs, are reported as micrograms per liter (ug/L) equivalent to parts per billion (ppb).
2. Bold indicates NYSDEC Standards exceeded; shading indicates federal MCLs exceeded.
3. (DUP) = Duplicate.

Data Qualifiers:
(B) = Indicates a value greater than or equal to the instrument detection limit but less than the contract required detection limit.
(E) = Indicates a value estimated or not reported due to the presence of interference.
(N) = Spiked sample recovery not within control limits.
(S) = Indicates a value determined by the Method of Standard Addition.
(W) = Post-digestion spike out of control limits.
+ = Correlation coefficient for the MSA is less than 0.995.
* = Indicates result is outside QC limit.
(a) = Applies to the total of iron (maximum 300 ug/L) and manganese.
(J) = Indicates an estimated concentration below the sample quantitation limit.
(Q) = Ambient Water Quality Standard or Guidance Value.
(G) = Maximum Contaminant Level Goal (MCLG).
(S) = Secondary Maximum Contaminant Level (SMCL).
-- = No existing New York State Standard/Guidance Values or MCL/MCLGs.
(U) = Identifies compounds that were not detected. The value presented is the detection limit.

References:
Standard and Guidance values are according to the New York State Department of Environmental Conservation, Division of Water Technical and Operation Guidance Series (1.1.1), Ambient Water Quality Standards and Guidance Values, October 1993.

MCLs [Maximum Contaminant Levels], MCLGs, and SMCLs are according to the Code of Federal Regulations, Protection of Environment 40, Part 141, July 1991, and the Drinking Water Regulations and Health Advisories, Office of Water, U.S. Environmental Protection Agency, May, 1995.

TABLE 1-4

SUMMARY OF GROUND-WATER ANALYTICAL RESULTS
VOLATILE ORGANIC COMPOUNDS
AUGUST 1995

ROSEN SITE
CORTLAND, NEW YORK

Compound	W-01	W-02	W-03	W-05	W-06	W-06P	W-07	W-07DL	New York State Standard/Guidance Value	MCL/MCLG
Vinyl Chloride	4.0 (U)	2.0 (U)	1.0 (U)	1.0 (U)	1.0 (U)	1.0 (U)	1.0 (U)	10 (U)	2	2/0 (G)
Chloroethane	4.0 (U)	2.0 (U)	1.0 (U)	1.0 (U)	2.0	1.5	1.0 (U)	10 (U)	5	--
1,1-Dichloroethene	4.0 (U)	0.51 (J)	1.0 (U)	1.0 (U)	1.0 (U)	1.0 (U)	1.2	10 (U)	5	7/7 (G)
1,1-Dichloroethane	**17**	**11**	2.6	1.0 (U)	**13**	**11**	**37 (E)**	**35 (D)**	5	--
cis-1,2-Dichloroethene	4.0 (U)	2.0 (U)	0.68 (J)	1.0 (U)	0.84 (J)	0.76 (J)	1.0 (U)	10 (U)	5	70/70 (G)
trans-1,2-Dichloroethene	4.0 (U)	2.0 (U)	1.0 (U)	1.0 (U)	1.0 (U)	1.0 (U)	1.0 (U)	10 (U)	5	100/100 (G)
1,1,1-Trichloroethane	**66**	**26**	0.78 (J)	2.0	**15**	**12**	**150 (E)**	**160 (D)**	5	200/200 (G)
Trichloroethene	4.0 (U)	0.94 (J)	2.0	2.5	1.7	1.3	0.81 (J)	10 (U)	5	5/0 (G)
Tetrachloroethene	4.0 (U)	2.0 (U)	3.5 (B)	1.0 (U)	0.24 (J)	1.0 (U)	1.0 (U)	10 (U)	5	5/0 (G)
Toluene	4.0 (U)	2.0 (U)	1.0 (U)	1.0 (U)	1.0 (U)	1.0 (U)	1.0 (U)	10 (U)	5	1,000/1,000 (G)

See Notes on Page 5.

TABLE 1-4 (Cont'd)

SUMMARY OF GROUND-WATER ANALYTICAL RESULTS
VOLATILE ORGANIC COMPOUNDS
AUGUST 1995

ROSEN SITE
CORTLAND, NEW YORK

Compound	W-08	W-08 (DUP)	W-09	W-10	W-10DL	W-11	W-11DL	W-12	New York State Standard/Guidance Value	MCL/MCLG
Vinyl Chloride	2.0 (U)	2.0 (U)	1.0 (U)	5.0 (U)	10 (U)	1.0 (U)	5.0 (U)	1.0 (U)	2	2/0 (G)
Chloroethane	2.0 (U)	2.0 (U)	1.0 (U)	5.0 (U)	10 (U)	0.52 (J)	5.0 (U)	1.0 (U)	5	--
1,1-Dichloroethene	2.0 (U)	2.0 (U)	1.0 (U)	5.0 (U)	10 (U)	**7.4**	**5.7 (D)**	0.58 (J)	5	7/7 (G)
1,1-Dichloroethane	4.8	4.9	1.0 (U)	**28**	**22 (D)**	**57 (E)**	**46 (D)**	3.6	5	--
cis-1,2-Dichloroethene	2.0 (U)	2.0 (U)	1.0 (U)	5.0 (U)	10 (U)	1.0 (U)	5.0 (U)	1.0 (U)	5	70/70 (G)
trans-1,2-Dichloroethene	2.0 (U)	2.0 (U)	1.0 (U)	5.0 (U)	10 (U)	1.0 (U)	5.0 (U)	1.0 (U)	5	100/100 (G)
1,1,1-Trichloroethane	**26**	**27**	1.0 (U)	**130 (E)**	**100 (D)**	**110 (E)**	**84 (DJ)**	**18**	5	200/200 (G)
Trichloroethene	2.0 (U)	2.0 (U)	1.0 (U)	0.81 (J)	10 (U)	0.23 (J)	5.0 (U)	**20**	5	5/0 (G)
Tetrachloroethene	2.0 (U)	2.0 (U)	1.0 (U)	5.0 (U)	10 (U)	1.0 (U)	5.0 (U)	1.0 (U)	5	5/0 (G)
Toluene	2.0 (U)	2.0 (U)	1.0 (U)	5.0 (U)	10 (U)	1.0 (U)	5.0 (U)	1.0 (U)	5	1,000/1,000 (G)

See Notes on Page 5.

TABLE 1-4 (Cont'd)

SUMMARY OF GROUND-WATER ANALYTICAL RESULTS
VOLATILE ORGANIC COMPOUNDS
AUGUST 1995

ROSEN SITE
CORTLAND, NEW YORK

Compound	W-13	W-14	W-16	W-16DL	W-17	W-18	W-19	W-21	New York State Standard/Guidance Value	MCL/MCLG
Vinyl Chloride	1.0 (U)	1.0 (U)	1.0 (U)	2.0 (U)	1.0 (U)	2.5 (U)	10 (U)	1.0 (U)	2	2/0 (G)
Chloroethane	1.0 (U)	1.0 (U)	1.0 (U)	2.0 (U)	1.0 (U)	2.5 (U)	10 (U)	1.0 (U)	5	--
1,1-Dichloroethene	1.0 (U)	1.0 (U)	1.0 (U)	2.0 (U)	1.0 (U)	1.7 (J)	**6.7 (J)**	1.0 (U)	5	7/7 (G)
1,1-Dichloroethane	1.0 (U)	1.0 (U)	**5.6**	**5.9 (D)**	1.0	**24**	**63**	1.0 (U)	5	--
cis-1,2-Dichloroethene	1.0 (U)	1.0 (U)	1.0 (U)	2.0 (U)	1.0 (U)	**5.7**	10 (U)	1.0 (U)	5	70/70 (G)
trans-1,2-Dichloroethene	1.0 (U)	1.0 (U)	1.0 (U)	2.0 (U)	1.0 (U)	2.5 (U)	10 (U)	1.0 (U)	5	100/100 (G)
1,1,1-Trichloroethane	2.6	3.5	**37 (E)**	**38 (D)**	**11**	**38**	**140**	1.0 (U)	5	200/200 (G)
Trichloroethene	1.0 (U)	1.0 (U)	2.5	2.8 (D)	**16**	**11**	10 (U)	0.25 (J)	5	5/0 (G)
Tetrachloroethene	1.0 (U)	1.0 (U)	1.0 (U)	2.0 (U)	0.80 (J)	2.5 (U)	10 (U)	1.0 (U)	5	5/0 (G)
Toluene	1.0 (U)	1.0 (U)	1.0 (U)	2.0 (U)	1.0 (U)	2.5 (U)	10 (U)	1.0 (U)	5	1,000/1,000 (G)

See Notes on Page 5.

TABLE 1-4 (Cont'd)

SUMMARY OF GROUND-WATER ANALYTICAL RESULTS
VOLATILE ORGANIC COMPOUNDS
AUGUST 1995

ROSEN SITE
CORTLAND, NEW YORK

Compound	W-22	W-24	W-24DL	W-25	W-25 (DUP)	W-25DL (DUP)	W-26	W-26DL	New York State Standard/Guidance Value	MCL/MCLG
Vinyl Chloride	1.0 (U)	**7.0**	**3.3 (DJ)**	4.0 (U)	1.0 (U)	4.0 (U)	1.0 (U)	5.0 (U)	2	2/0 (G)
Chloroethane	1.0 (U)	1.0 (U)	4.0 (U)	4.0 (U)	1.0 (U)	4.0 (U)	1.0 (U)	5.0 (U)	5	--
1,1-Dichloroethene	1.0 (U)	0.69 (J)	4.0 (U)	4.0 (U)	1.3	0.89 (DJ)	**5.7**	4.2 (DJ)	5	7/7 (G)
1,1-Dichloroethane	1.0 (U)	1.0 (U)	4.0 (U)	**18**	**23**	**19 (D)**	**56 (E)**	**43 (D)**	5	--
cis-1,2-Dichloroethene	1.0 (U)	**39 (E)**	**42 (D)**	4.0 (U)	1.0 (U)	4.0 (U)	1.0 (U)	5.0 (U)	5	70/70 (G)
trans-1,2-Dichloroethene	1.0 (U)	3.3	1.7 (DJ)	4.0 (U)	1.0 (U)	4.0 (U)	1.0 (U)	5.0 (U)	5	100/100 (G)
1,1,1-Trichloroethane	1.0 (U)	1.0 (U)	4.0 (U)	**42 (J)**	**56 (E)**	**42 (D)**	**110 (E)**	**77 (DJ)**	5	200/200 (G)
Trichloroethene	4.2	**49 (E)**	**40 (D)**	4.0 (U)	0.58 (J)	4.0 (U)	1.4	0.81 (DJ)	5	5/0 (G)
Tetrachloroethene	1.0 (U)	1.0 (U)	4.0 (U)	4.0 (U)	1.0 (U)	4.0 (U)	1.0 (U)	5.0 (U)	5	5/0 (G)
Toluene	1.0 (U)	1.0 (U)	2.1 (DJ)	4.0 (U)	1.0 (U)	4.0 (U)	1.0 (U)	5.0 (U)	5	1,000/1,000 (G)

See Notes on Page 5.

TABLE 1-4 (Cont'd)

SUMMARY OF GROUND-WATER ANALYTICAL RESULTS
VOLATILE ORGANIC COMPOUNDS
AUGUST 1995

ROSEN SITE
CORTLAND, NEW YORK

Notes:

1. All concentrations, detection levels, standard values, guidance values, and MCLs/MCLGs are reported as micrograms per liter (ug/L) equivalent to parts per billion (ppb).
2. Bold indicates NYSDEC standards exceeded; shading indicates federal MCLs exceeded.
3. W-06P sample was collected with a peristaltic pump.
4. (DUP) = Duplicate.

5. The following parameters were also analyzed for, but were not detected in the ground-water samples:

1,1,2-Trichloroethane	2-Hexanone	Chlorobenzene
1,1,2,2-Tetrachloroethane	4-Methyl-2-pentanone	Chloroform
1,2-Dibromomethane	Acetone	Chloromethane
1,2-Dichloroethane	Benzene	cis-1,3-Dichloropropene
1,2-Dichloropropane	Bromochloromethane	trans-1,3-Dichloropropene
1,3-Dibromo-3-chloropropane	Bromodichloromethane	Dibromochloromethane
1,2-Dichlorobenzene	Bromoform	Ethylbenzene
1,3-Dichlorobenzene	Bromomethane	Methylene Chloride
1,4-Dichlorobenzene	Carbon Disulfide	Styrene
2-Butanone	Carbon Tetrachloride	Total Xylenes

Data Qualifiers:

(B) = Analyte found in blank as well as sample.
(D) = Identifies compounds identified in an analysis at a secondary dilution factor.
(E) = Identifies compounds whose concentrations exceed the calibration range of the GC/MS instrument for that specific analysis.
(J) = Indicates an estimated value.
(G) = Maximum Contaminant Level Goal (MCGL).
– = No existing MCL or MCGL.
(U) = Identifies compounds that were not detected. The value presented is the detection limit.

References:

Standard and Guidance values are according to the New York State Department of Environmental Conservation, Division of Water Technical and Operation Guidance Series (1.1.1), Ambient Water Quality Standards and Guidance Values [designated by (G)], October 1993.

MCLs [Maximum Contaminant Levels] and MCLGs are according to the Code of Federal Regulations, Protection of Environment 40, Part 141, July 1, 1991, and the Drinking Water Regulations and Health Advisories, Office of Water, U.S. Environmental Protection Agency, May 1995.

TABLE 1-5

SUMMARY OF GROUND-WATER ANALYTICAL RESULTS
INORGANIC CONSTITUENTS
AUGUST 1995

ROSEN SITE
CORTLAND, NEW YORK

Constituent	Total W-01	Soluble W-01	Total W-02	Soluble W-02	Total W-03	Soluble W-03	Total W-05	Soluble W-05	New York State Standard/Guidance Value	MCL/MCLG
Aluminum	200 (U)	200 (U)	200 (U)	200 (U)	200 (U)	200 (U)	(NA)	(NA)	--	50 to 200 (S)
Antimony	5.0 (U)	5.0 (U)	5.0 (U)	5.0 (U)	5.0 (U)	5.0 (U)	(NA)	(NA)	3 (Q)	6/6 (G)
Arsenic	5.0 (U)	5.0 (U)	5.0 (U)	5.0 (U)	5.0 (U)	5.0 (U)	(NA)	(NA)	25	50
Barium	46.8 (B)	46.9 (B)	52.4 (B)	51.8 (B)	40.4 (B)	41.1 (B)	(NA)	(NA)	1,000	2,000/2,000 (G)
Beryllium	3.0 (U)	3.0 (U)	3.0 (U)	3.0 (U)	3.0 (U)	3.0 (U)	(NA)	(NA)	3 (Q)	4/4 (G)
Cadmium	5.0 (U)	5.0 (U)	5.0 (U)	5.0 (U)	5.0 (U)	5.0 (U)	(NA)	(NA)	10	5/5 (G)
Calcium	85,300	85,000	163,000	163,000	59,200	57,500	(NA)	(NA)	--	--
Chromium	10 (U)	10 (JU)	10 (U)	10 (JU)	10 (U)	10 (JU)	(NA)	(NA)	50	100
Cobalt	10 (U)	10 (U)	10 (U)	10 (U)	10 (U)	10 (U)	(NA)	(NA)	--	--
Copper	5.0 (U)	5.0 (U)	5.0 (U)	5.0 (U)	5.0 (U)	5.0 (U)	(NA)	(NA)	200	1,000 (S)
Iron	73 (BJ)	40 (JU)	**2,530 (J)***	271 (J)	145 (J)	87 (BJ)	**2,400**	100	300	300 (S)
Lead	3.0 (U)	3.0 (U)	3.0 (U)	3.0 (U)	3.0 (U)	3.0 (U)	(NA)	(NA)	25	15/0
Magnesium	12,600	12,500	16,800	16,500	7,470	7,380	(NA)	(NA)	35,000 (Q)	--
Manganese	211	170	**1,360**	**1,240**	**422**	**347**	**370**	40	500 (a)/300	50 (S)
Mercury	0.20 (U)	0.20 (U)	0.20 (U)	0.20 (U)	0.20 (U)	0.20 (U)	(NA)	(NA)	2	2/2 (G)
Nickel	10 (U)	10 (U)	10 (U)	10 (U)	10 (U)	10 (U)	(NA)	(NA)	--	100/100 (G)
Potassium	3,570 (B)	4,130 (B)	4,120 (B)	4,260 (B)	2,540 (B)	2,200 (B)	(NA)	(NA)	--	--
Selenium	5.0 (U)	4.0 (U)	5.0 (U)	4.0 (U)	5.0 (U)	4.0 (U)	(NA)	(NA)	10	50/50 (G)
Silver	10 (JNU)	10 (U)	10 (JNU)	10 (U)	10 (JNU)	10 (U)	(NA)	(NA)	50	100 (S)
Sodium	**23,700**	**23,800**	**21,600**	**21,800**	17,300	17,700	(NA)	(NA)	20,000	--
Thallium	5.0 (U)	5.0 (U)	5.0 (U)	5.0 (U)	5.0 (U)	5.0 (U)	(NA)	(NA)	4 (Q)	2/0.5 (G)
Vanadium	10 (U)	10 (U)	10 (U)	10 (U)	10 (U)	10 (U)	(NA)	(NA)	--	--
Zinc	13.1 (B)	10 (U)	10 (U)	10 (U)	108	87.6	(NA)	(NA)	300	5,000 (S)

See Notes on Page 7.

TABLE 1-5 (Cont'd)

SUMMARY OF GROUND-WATER ANALYTICAL RESULTS
INORGANIC CONSTITUENTS
AUGUST 1995

ROSEN SITE
CORTLAND, NEW YORK

Constituent	Total W-06	Soluble W-06	Total W-07	Soluble W-07	Total W-08	Soluble W-08	Total W-08 (Dup)	Soluble W-08 (Dup)	New York State Standard/Guidance Value	MCL/MCLG
Aluminum	90 (U)	200 (U)	(NA)	(NA)	200 (U)	200 (U)	334	200 (U)	--	50 to 200 (S)
Antimony	5.0 (U)	5.0 (U)	(NA)	(NA)	5.0 (U)	5.0 (U)	5.0 (U)	5.0 (U)	3 (Q)	6/6 (G)
Arsenic	5.0 (U)	5.0 (U)	(NA)	(NA)	5.0 (U)	5.0 (U)	5.0 (U)	5.0 (U)	25	50
Barium	66.0 (B)	72.8 (B)	(NA)	(NA)	134 (B)	131 (B)	142 (B)	140 (B)	1,000	2,000/2,000 (G)
Beryllium	3.0 (U)	3.0 (U)	(NA)	(NA)	3.0 (U)	3.0 (U)	3.0 (U)	3.0 (U)	3 (Q)	4/4 (G)
Cadmium	5.0 (U)	5.0 (U)	(NA)	(NA)	5.0 (U)	5.0 (U)	5.0 (U)	5.0 (U)	10	5/5 (G)
Calcium	115,000	113,000	(NA)	(NA)	126,000	122,000	130,000	128,000	--	--
Chromium	**67.0 (JN)***	10 (JU)	(NA)	(NA)	10 (U)	10 (JU)	10 (U)	10 (JU)	50	100
Cobalt	10 (U)	10 (U)	(NA)	(NA)	10 (U)	10 (U)	10 (U)	10 (U)	--	--
Copper	10 (U)	5.0 (U)	(NA)	(NA)	5.0 (U)	5.0 (U)	5.0 (U)	5.0 (U)	200	1,000 (S)
Iron	**652**	40 (JU)	**3,200**	**1,400**	**171 (JU)**	40 (JU)	**488 (J)**	40 (JU)	300	300 (S)
Lead	3.0 (U)	3.0 (U)	(NA)	(NA)	3.0 (U)	3.0 (U)	3.0 (U)	3.0 (U)	25	15/0
Magnesium	17,900	16,600	(NA)	(NA)	31,300	29,500	32,700	31,400	35,000 (Q)	--
Manganese	**15**	5.0 (U)	**440**	**440**	**405**	**369**	**400**	**362**	500 (a)/300	50 (S)
Mercury	0.20 (U)	0.20 (U)	(NA)	(NA)	0.20 (U)	0.20 (U)	0.20 (U)	0.20 (U)	2	2/2 (G)
Nickel	56.0	29.4 (B)	(NA)	(NA)	10 (U)	10 (U)	10 (U)	10 (U)	--	100/100 (G)
Potassium	2,020 (B)	3,080 (B)	(NA)	(NA)	3,690 (B)	2,000 (U)	3,310 (B)	3,200 (B)	--	--
Selenium	4.0 (U)	**18**	(NA)	(NA)	5.0 (U)	4.0 (U)	5.0 (U)	4.0 (U)	10	50/50 (G)
Silver	10 (JNU)	10 (U)	(NA)	(NA)	10 (JNU)	10 (U)	10 (JNU)	10 (U)	50	100 (S)
Sodium	**68,000**	**66,000**	(NA)	(NA)	**83,100**	**81,800**	**88,600**	**89,300**	20,000	--
Thallium	5.0 (U)	5.0 (U)	(NA)	(NA)	5.0 (U)	5.0 (U)	5.0 (U)	5.0 (U)	4 (Q)	2/0.5 (G)
Vanadium	10 (U)	10 (U)	(NA)	(NA)	10 (U)	10 (U)	10 (U)	10 (U)	--	--
Zinc	**11 (B)**	10 (U)	(NA)	(NA)	10 (U)	10 (U)	10 (U)	10 (U)	300	5,000 (S)

See Notes on Page 7.

TABLE 1-5 (Cont'd)

SUMMARY OF GROUND-WATER ANALYTICAL RESULTS
INORGANIC CONSTITUENTS
AUGUST 1995

ROSEN SITE
CORTLAND, NEW YORK

Constituent	Total W-09	Soluble W-09	Total W-10	Soluble W-10	Total W-11	Soluble W-11	Total W-12	Soluble W-12	New York State Standard/Guidance Value	MCL/MCLG
Aluminum	(NA)	(NA)	200 (U)	200 (U)	200 (U)	200 (U)	274	200 (U)	--	50 to 200 (S)
Antimony	(NA)	(NA)	5.0 (U)	5.0 (U)	5.0 (U)	5.0 (U)	5.0 (U)	5.0 (U)	3 (Q)	6/6 (G)
Arsenic	(NA)	(NA)	5.0 (U)	5.0 (U)	5.0 (U)	5.0 (U)	5.0 (U)	5.0 (U)	25	50
Barium	(NA)	(NA)	47.4 (B)	47.6 (B)	20 (U)	20 (U)	21.7 (B)	20 (U)	1,000	2,000/2,000 (G)
Beryllium	(NA)	(NA)	3.0 (U)	3.0 (U)	3.0 (U)	3.0 (U)	3.0 (U)	3.0 (U)	3 (Q)	4/4 (G)
Cadmium	(NA)	(NA)	5.0 (U)	5.0 (U)	5.0 (U)	5.0 (U)	5.0 (U)	5.0 (U)	10	5/5 (G)
Calcium	(NA)	(NA)	85,300	82,400	354,000	354,000	130,000	123,000	--	--
Chromium	(NA)	(NA)	10 (U)	10 (JU)	10 (U)	10 (JU)	10 (U)	10 (JU)	50	100
Cobalt	(NA)	(NA)	10 (U)	10 (U)	10 (U)	10 (U)	10 (U)	10 (U)	--	--
Copper	(NA)	(NA)	5.0 (U)	5.0 (U)	5.0 (U)	5.0 (U)	5.0 (U)	5.0 (U)	200	1,000 (S)
Iron	50	30 (U)	**113 (J)**	40 (JU)	**5,690 (J)***	**6,080 (J)**	(R)	40 JU)	300	300 (S)
Lead	(NA)	(NA)	3.0 (U)	3.0 (U)	3.0 (U)	3.0 (U)	3.0 (U)	3.0 (U)	25	15/0
Magnesium	(NA)	(NA)	12,400	12,100	15,200	15,200	11,700	11,100	35,000 (Q)	--
Manganese	220	20 (U)	**485**	**432**	**930**	**858**	**546**	**448**	500 (a)/300	50 (S)
Mercury	(NA)	(NA)	0.20 (U)	0.20 (U)	0.20 (U)	0.20 (U)	0.20 (U)	0.20 (U)	2	2/2 (G)
Nickel	(NA)	(NA)	10 (U)	10 (U)	10 (U)	10 (U)	10 (U)	10 (U)	--	100/100 (G)
Potassium	(NA)	(NA)	3,550 (B)	2,000 (U)	3,520 (B)	2,270 (B)	3,570 (B)	2,890 (B)	--	--
Selenium	(NA)	(NA)	5.0 (U)	4.0 (U)	5.0 (U)	4.0 (U)	5.0 (U)	4.0 (U)	10	50/50 (G)
Silver	(NA)	(NA)	10 (JNU)	10 (U)	10 (JNU)	10 (U)	10 (JNU)	10 (U)	50	100 (S)
Sodium	(NA)	(NA)	**22,300**	**22,500**	**21,200**	**21,900**	17,900	18,100	20,000	--
Thallium	(NA)	(NA)	5.0 (U)	5.0 (U)	5.0 (U)	5.0 (U)	5.0 (U)	5.0 (U)	4 (Q)	2/0.5 (G)
Vanadium	(NA)	(NA)	10 (U)	10 (U)	10 (U)	10 (U)	10 (U)	10 (U)	--	--
Zinc	(NA)	(NA)	10 (U)	10 (U)	10 (U)	10 (U)	10 (U)	10 (U)	300	5,000 (S)

See Notes on Page 7.

TABLE 1-5 (Cont'd)

SUMMARY OF GROUND-WATER ANALYTICAL RESULTS
INORGANIC CONSTITUENTS
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ROSEN SITE
CORTLAND, NEW YORK

Constituent	Total W-13	Soluble W-13	Total W-14	Soluble W-14	Total W-16	Soluble W-16	Total W-17	Soluble W-17	New York State Standard/Guidance Value	MCL/MCLG
Aluminum	(NA)	(NA)	(NA)	(NA)	(NA)	(NA)	(NA)	(NA)	--	50 to 200 (S)
Antimony	(NA)	(NA)	(NA)	(NA)	(NA)	(NA)	(NA)	(NA)	3 (Q)	6/6 (G)
Arsenic	(NA)	(NA)	(NA)	(NA)	(NA)	(NA)	(NA)	(NA)	25	50
Barium	(NA)	(NA)	(NA)	(NA)	(NA)	(NA)	(NA)	(NA)	1,000	2,000/2,000 (G)
Beryllium	(NA)	(NA)	(NA)	(NA)	(NA)	(NA)	(NA)	(NA)	3 (Q)	4/4 (G)
Cadmium	(NA)	(NA)	(NA)	(NA)	(NA)	(NA)	(NA)	(NA)	10	5/5 (G)
Calcium	(NA)	(NA)	(NA)	(NA)	(NA)	(NA)	(NA)	(NA)	--	--
Chromium	(NA)	(NA)	(NA)	(NA)	(NA)	(NA)	(NA)	(NA)	50	100
Cobalt	(NA)	(NA)	(NA)	(NA)	(NA)	(NA)	(NA)	(NA)	--	--
Copper	(NA)	(NA)	(NA)	(NA)	(NA)	(NA)	(NA)	(NA)	200	1,000 (S)
Iron	30	30 (U)	80	30 (U)	1,600	30 (U)	90	30 (U)	300	300 (S)
Lead	(NA)	(NA)	(NA)	(NA)	(NA)	(NA)	(NA)	(NA)	25	15/0
Magnesium	(NA)	(NA)	(NA)	(NA)	(NA)	(NA)	(NA)	(NA)	35,000 (Q)	--
Manganese	40	40	20 (U)	20 (U)	60	20 (U)	20 (U)	20 (U)	500 (a)/300	50 (S)
Mercury	(NA)	(NA)	(NA)	(NA)	(NA)	(NA)	(NA)	(NA)	2	2/2 (G)
Nickel	(NA)	(NA)	(NA)	(NA)	(NA)	(NA)	(NA)	(NA)	--	100/100 (G)
Potassium	(NA)	(NA)	(NA)	(NA)	(NA)	(NA)	(NA)	(NA)	--	--
Selenium	(NA)	(NA)	(NA)	(NA)	(NA)	(NA)	(NA)	(NA)	10	50/50 (G)
Silver	(NA)	(NA)	(NA)	(NA)	(NA)	(NA)	(NA)	(NA)	50	100 (S)
Sodium	(NA)	(NA)	(NA)	(NA)	(NA)	(NA)	(NA)	(NA)	20,000	--
Thallium	(NA)	(NA)	(NA)	(NA)	(NA)	(NA)	(NA)	(NA)	4 (Q)	2/0.5 (G)
Vanadium	(NA)	(NA)	(NA)	(NA)	(NA)	(NA)	(NA)	(NA)	--	--
Zinc	(NA)	(NA)	(NA)	(NA)	(NA)	(NA)	(NA)	(NA)	300	5,000 (S)

See Notes on Page 7.

TABLE 1-5 (Cont'd)

SUMMARY OF GROUND-WATER ANALYTICAL RESULTS
INORGANIC CONSTITUENTS
AUGUST 1995

ROSEN SITE
CORTLAND, NEW YORK

Constituent	Total W-18	Soluble W-18	Total W-19	Soluble W-19	Total W-21	Soluble W-21	Total W-22	Soluble W-22	New York State Standard/Guidance Value	MCL/MCLG
Aluminum	(NA)	(NA)	(NA)	(NA)	**559**	200 (U)	200 (U)	200 (U)	--	50 to 200 (S)
Antimony	(NA)	(NA)	(NA)	(NA)	5.0 (U)	5.0 (U)	5.0 (U)	5.0 (U)	3 (G)	6/6 (G)
Arsenic	(NA)	(NA)	(NA)	(NA)	5.0 (U)	5.0 (U)	5.0 (U)	5.0 (U)	25	50
Barium	(NA)	(NA)	(NA)	(NA)	22.4 (B)	20 (U)	121 (B)	118 (B)	1,000	2,000/2,000 (G)
Beryllium	(NA)	(NA)	(NA)	(NA)	3.0 (U)	3.0 (U)	3.0 (U)	3.0 (U)	3 (Q)	4/4 (G)
Cadmium	(NA)	(NA)	(NA)	(NA)	5.0 (U)	5.0 (U)	5.0 (U)	5.0 (U)	10	5/5 (G)
Calcium	(NA)	(NA)	(NA)	(NA)	26,000	20,300	113,000	113,000	--	--
Chromium	(NA)	(NA)	(NA)	(NA)	18 (J)	10 (JU)	**279**	10 (JU))	50	100
Cobalt	(NA)	(NA)	(NA)	(NA)	10 (U)	10 (U)	10 (U)	10 (U)	--	--
Copper	(NA)	(NA)	(NA)	(NA)	16.9 (B)	5.0 (U)	11.2 (B)	5.0 (U)	200	1,000 (S)
Iron	170	30 (U)	210	30	**1,200 (J)***	40 (JU)	**2,920 (J)***	112 (J)	300	300 (S)
Lead	(NA)	(NA)	(NA)	(NA)	3.0 (U)	3.0 (U)	3.0 (U)	3.0 (U)	25	15/0
Magnesium	(NA)	(NA)	(NA)	(NA)	8,210	7,370	19,400	19,200	35,000 (Q)	--
Manganese	**700**	**690**	**2,100**	**2,000**	**106**	40.1	21.8	5.0 (U)	500 (a)/300	50 (S)
Mercury	(NA)	(NA)	(NA)	(NA)	0.20 (U)	0.20 (U)	0.20 (U)	0.20 (U)	2	2/2 (G)
Nickel	(NA)	(NA)	(NA)	(NA)	10 (U)	10 (U)	80.8	33.8 (B)	--	100/100 (G)
Potassium	(NA)	(NA)	(NA)	(NA)	18,500	17,600	2,810 (B)	2,000 (U)	--	--
Selenium	(NA)	(NA)	(NA)	(NA)	5.0 (U)	4.0 (U)	5.3 (J)	4.0 (U)	10	50/50 (G)
Silver	(NA)	(NA)	(NA)	(NA)	10 (JNU)	10 (U)	10 (JNU)	10 (U)	50	100 (S)
Sodium	(NA)	(NA)	(NA)	(NA)	**154,000**	**156,000**	**122,000**	**127,000**	20,000	--
Thallium	(NA)	(NA)	(NA)	(NA)	5.0 (U)	5.0 (U)	5.0 (U)	5.0 (U)	4 (Q)	2/0.5 (G)
Vanadium	(NA)	(NA)	(NA)	(NA)	10 (U)	10 (U)	10 (U)	10 (U)	--	--
Zinc	(NA)	(NA)	(NA)	(NA)	10 (U)	10 (U)	10 (U)	10 (U)	300	5,000 (S)

See Notes on Page 7.

TABLE 1-5 (Cont'd)

SUMMARY OF GROUND-WATER ANALYTICAL RESULTS
INORGANIC CONSTITUENTS
AUGUST 1995

ROSEN SITE
CORTLAND, NEW YORK

Constituent	Total W-24	Soluble W-24	Total W-25	Soluble W-25	Total W-25 (Dup)	Soluble W-25 (Dup)	Total W-26	Soluble W-26	New York State Standard/Guidance Value	MCL/MCLG
Aluminum	200 (U)	200 (U)	200 (U)	200 (U)	200 (U)	200 (U)	200 (U)	200 (U)	--	50 to 200 (S)
Antimony	5.0 (U)	5.0 (U)	5.0 (U)	5.0 (U)	5.0 (U)	5.0 (U)	5.0 (U)	5.0 (U)	3 (Q)	6/6 (G)
Arsenic	5.0 (U)	5.0 (U)	5.0 (U)	5.0 (U)	5.0 (U)	5.0 (U)	5.0 (U)	5.0 (U)	25	50
Barium	27.6 (B)	20 (U)	35.3 (B)	35.6 (B)	36.5 (B)	35.8 (B)	20 (U)	20 (U)	1,000	2,000/2,000 (G)
Beryllium	3.0 (U)	3.0 (U)	3.0 (U)	3.0 (U)	3.0 (U)	3.0 (U)	3.0 (U)	3.0 (U)	3 (Q)	4/4 (G)
Cadmium	5.0 (U)	5.0 (U)	5.0 (U)	5.0 (U)	5.0 (U)	5.0 (U)	5.0 (U)	5.0 (U)	10	5/5 (G)
Calcium	118,000	123,000	261,000	265,000	265,000	263,000	409,000	405,000	--	--
Chromium	10 (U)	10 (JU)	**51**	24 (J)	**75**	10 (JU)	10 (U)	10 (JU)	50	100
Cobalt	10 (U)	10 (U)	10 (U)	10.7 (B)	10 (U)	26 (B)	10 (U)	10 (U)	--	--
Copper	5.0 (U)	5.0 (U)	5.0 (U)	5.0 (U)	5.0 (U)	5.0 (U)	5.0 (U)	5.0 (U)	200	1,000 (S)
Iron	228 (J)	40 (JU)	**4,620 (J)***	**4,540 (J)**	**4,870 (J)***	40 (JU)	**6,810 (J)***	**7,190 (J)**	300	300 (S)
Lead	3.0 (U)	3.0 (U)	3.0 (U)	3.0 (U)	3.0 (U)	3.0 (U)	3.0 (U)	3.0 (U)	25	15/0
Magnesium	26,500	27,100	16,700	16,900	17,000	16,900	13,100	13,100	35,000 (Q)	--
Manganese	208	133	**688**	**651**	**698**	**647**	**690**	**646**	500 (a)/300	50 (S)
Mercury	0.20 (U)	0.20 (U)	0.20 (U)	0.20 (U)	0.20 (U)	0.20 (U)	0.20 (U)	0.20 (U)	2	2/2 (G)
Nickel	10 (U)	10 (U)	10 (U)	10 (U)	10 (U)	10 (U)	10 (U)	10 (U)	--	100/100 (G)
Potassium	2,280	3,830 (B)	4,810	3,630 (B)	3,850 (B)	2,720 (B)	3,520 (B)	3,670 (B)	--	--
Selenium	5.0 (U)	4.0 (U)	5.0 (U)	4.0 (U)	5.0 (U)	4.0 (U)	5.0 (U)	4.0 (JWU)	10	50/50 (G)
Silver	10 (JNU)	10 (U)	10 (JNU)	10 (U)	10 (JNU)	10 (U)	10 (JNU)	10 (U)	50	100 (S)
Sodium	**55,900**	**58,800**	**21,900**	**22,500**	**22,100**	**22,800**	19,500	19,600	20,000	--
Thallium	5.0 (U)	5.0 (U)	5.0 (U)	5.0 (U)	5.0 (U)	5.0 (U)	5.0 (U)	5.0 (U)	4 (Q)	2/0.5 (G)
Vanadium	10 (U)	10 (U)	10 (U)	10 (U)	10 (U)	10 (U)	10 (U)	10 (U)	--	--
Zinc	10 (U)	10 (U)	10 (U)	10 (U)	10 (U)	10 (U)	11.8 (B)	10 (U)	300	5,000 (S)

See Notes on Page 7.

TABLE 1-5 (Cont'd)

SUMMARY OF GROUND-WATER ANALYTICAL RESULTS
INORGANIC CONSTITUENTS
AUGUST 1995

ROSEN SITE
CORTLAND, NEW YORK

Notes:

1. All concentrations, detection levels, standard values, guidance values, and MCLs/MCLGs are reported as micrograms per liter (ug/L) equivalent to parts per billion (ppb).
2. Bold indicates NYSDEC standards exceeded; shading indicates federal MCLs exceeded.
3. Total and soluble iron and manganese results for the following wells were analyzed by Upstate Laboratories, Inc.: W-05, W-07, W-09, W-13, W-14, W-16, W-17, W-18, W-19. All other analyses were performed by Recra Environmental, Inc.
4. Data validation was performed on Recra Environmental, Inc., ground-water data only.
5. Dup = Duplicate.

Data Qualifers:

(B) = Indicates a value greater than or equal to the instrument detection limit but less than the contract required detection limit.
(E) = Indicates a value estimated or not reported due to the presence of interference.
(J) = Indicates an estimated value.
(N) = Spiked sample recovery not within control limits.
(R) = The sample results are rejected.
(W) = Post digestion spike for Furnace-AA Analysis is out of control limits, while sample absorbance is less than 50% of spike absorbance.
(NA) = Not analyzed.
* = Duplicate analysis not within control limits.
– = No New York State Standard/Guidance Value or MCL/MCLG
(a) = Applies to the total of iron (maximum 300 ug/L) and manganese.
(Q) = Ambient Water Quality Standard or Guidance Value.
(G) = Maximum Contaminant Level Goal (MCLG).
(S) = Secondary Maximum Contaminant Level (SMCL).
(U) = Identifies compounds that were not detected. The value presented is the detection limit.

References:

Standard and Guidance values are according to the New York State Department of Environmental Conservation, Division of Water Technical and Operation Guidance Series (1.1.1), Ambient Water Quality Standards and Guidance Values [designated by (G)], October 1993.

MCLs [Maximum Contaminant Levels], MCLGs and SMCLs are according to the Code of Federal Regulations, Protection of Environment 40, Part 141, July 1, 1991, and the Drinking Water Regulations and Health Advisories, Office of Water, U.S. Environmental Protection Agency, May 1995.

TABLE 1-6

SUMMARY OF GROUND-WATER ANALYTICAL RESULTS
VOLATILE ORGANIC COMPOUNDS
DECEMBER 1995

ROSEN SITE
CORTLAND, NEW YORK

Compound	W-01	W-02	W-03	W-04	W-06	W-06 (DUP)	W-07	W-08	New York State Standard/Guidance Value	MCL/MCLG
1,1,1-Trichloroethane	3.7	**16**	**9.4**	1.0 (U)	**5,000 (D)**	**4,900 (D)**	**27 (D)**	**59 (D)**	5	200/200 (G)
1,1-Dichloroethane	1.2	**12**	2.3	1.0 (U)	**390 (D)**	**380 (D)**	**34 (D)**	**11**	5	--
1,1-Dichloroethene	1.0 (U)	0.41 (J)	1.0 (U)	1.0 (U)	**5.5**	5.0 (J)	0.54 (J)	0.90 (J)	5	7/7 (G)
Chloroethane	1.0 (U)	1.0 (U)	1.0 (U)	1.0 (U)	4.2	4.1 (J)	0.41 (J)	1.0 (U)	5	--
Chloroform	1.0 (U)	1.0 (U)	1.0 (U)	1.0 (U)	0.68 (J)	10 (U)	1.0 (U)	1.0 (U)	7	100(a) / 0 (G)
cis-1,2-Dichloroethene	1.0 (U)	1.0 (U)	1.0 (U)	1.0 (U)	**8.6**	**9.3 (J)**	1.0 (U)	1.0 (U)	5	70/70 (G)
Methylene chloride	2.0 (U)	2.0 (U)	2.0 (U)	2.0 (U)	1.3 (J)	3.6 (J)	2.0 (U)	2.0 (U)	5	5/0 (G)
Tetrachloroethene	1.0 (U)	1.0 (U)	**17**	1.0 (U)	1.1	10 (U)	1.0 (U)	1.0 (U)	5	5/0 (G)
trans-1,2-Dichloroethene	1.0 (U)	1.0 (U)	1.0 (U)	1.0 (U)	1.0 (U)	10 (U)	1.0 (U)	1.0 (U)	5	100/100 (G)
Trichloroethene	1.0 (U)	0.33 (J)	0.46 (J)	1.0 (U)	**18**	**18**	0.4 (J)	1.0 (U)	5	5/0 (G)
Vinyl chloride	1.0 (U)	1.0 (U)	1.0 (U)	1.0 (U)	1.0 (U)	10 (U)	1.0 (U)	1.0 (U)	2	2/0 (G)

Compound	W-10	W-11	W-12	W-16	W-17	W-18	W-19	W-24	New York State Standard/Guidance Value	MCL/MCLG
1,1,1-Trichloroethane	**46**	**65**	**15**	**23**	2.3	3.6	**54**	1.0 (U)	5	200/200 (G)
1,1-Dichloroethane	**13**	**37**	3.0	3.5	0.66 (J)	**5.6**	**33**	1.0 (U)	5	--
1,1-Dichloroethene	0.59 (J)	**5.4**	0.53 (J)	0.21 (J)	1.0 (U)	1.0 (U)	2.7	3.2	5	7/7 (G)
Chloroethane	2.5 (U)	4.0 (U)	1.0 (U)	1.0 (U)	1.0 (U)	1.0 (U)	2.5 (U)	1.0 (U)	5	--
Chloroform	2.5 (U)	4.0 (U)	1.0 (U)	1.0 (U)	1.0 (U)	1.0 (U)	2.5 (U)	1.0 (U)	7	100(a) / 0 (G)
cis-1,2-Dichloroethene	2.5 (U)	4.0 (U)	0.23 (J)	1.0 (U)	0.89 (J)	**7.2**	2.4 (J)	**99 (D)**	5	70/70 (G)
Methylene chloride	5.0 (U)	8.0 (U)	2.0 (U)	2.0 (U)	2.0 (U)	2.0 (U)	5.0 (U)	2.0 U	5	5/0 (G)
Tetrachloroethene	2.5 (U)	4.0 (U)	1.0 (U)	1.0 (U)	2.7	0.39 (J)	2.5 (U)	1.0 (U)	5	5/0 (G)
trans-1,2-Dichloroethene	2.5 (U)	4.0 (U)	1.0 (U)	1.0 (U)	1.0 (U)	1.0 (U)	2.5 (U)	**9.4**	5	100/100 (G)
Trichloroethene	0.58 (J)	4.0 (U)	**21**	3.1	4.8	3.0	4.3	**200 (D)**	5	5/0 (G)
Vinyl chloride	2.5 (U)	4.0 (U)	1.0 (U)	1.0 (U)	1.0 (U)	1.0 (U)	2.5 (U)	**19**	2	2/0 (G)

See Notes on Page 2.

TABLE 1-6

SUMMARY OF GROUND-WATER ANALYTICAL RESULTS
VOLATILE ORGANIC COMPOUNDS
DECEMBER 1995

ROSEN SITE
CORTLAND, NEW YORK

Notes:
1. All concentrations are reported in micrograms per liter (ug/L) equivalent to parts per billion (ppb).
2. Bold indicates NYSDEC standards exceeded; shading indicates federal MCLs exceeded.
3. (DUP) = Duplicate.

4. The following volatile organic compounds were also analyzed, but were not detected in the ground-water samples:

1,1,2,2-Tetrachloroethane	1,4-Dichlorobenzene	Bromodichloromethane	cis-1,3-Dichloropropene
1,1,2-Trichloroethane	2-Butanone	Bromoform	Dibromochloromethane
1,2-Dibromo-3-chloropropane	2-Hexanone	Bromomethane	Ethyl benzene
1,2-Dibromoethane	4-Methyl-2-pentanone	Carbon Disulfide	Styrene
1,2-Dichlorobenzene	Acetone	Carbon Tetrachloride	Toluene
1,2-Dichloroethane	Benzene	Chlorobenzene	Total Xylenes
1,2-Dichloropropane	Bromochloromethane	Chloromethane	trans-1,3-Dichloropropene
1,3-Dichlorobenzene			

Data Qualifers:
(D) = Identifies compounds identified in an analysis at a secondary dilution factor.
(J) = Indicates an estimated value.
(U) = Identifies compounds that were not detected. The value presented is the detection limit.
(a) = Applies to the total of trihalomethanes.
(G) = Maximum Contaminant Level Goal (MCLG).
-- = Indicates no existing New York State Standard/Guidance Value or MCL/MCLG.

References:
Standard and Guidance values are according to the New York State Department of Environmental Conservation, Division of Water Technical and Operation Guidance Series (1.1.1), Ambient Water Quality Standards and Guidance Values, October 1993.

MCLs [Maximum Contaminant Levels] and MCLGs are according to the Code of Federal Regulations, Protection of Environment 40, Part 141, July 1, 1991, and the Drinking Water Regulations and Health Advisories, Office of Water, U.S. Environmental Protection Agency, May 1995.

TABLE 1-7

SUMMARY OF GROUND-WATER ANALYTICAL RESULTS
PCB COMPOUNDS
DECEMBER 1995

ROSEN SITE
CORTLAND, NEW YORK

Compound	W-07	New York State Standard/ Guidance Value	MCL/MCLG
Aroclor 1016	1 (U)	0.1	0.5 / 0 (G)
Aroclor 1221	2.1 (U)	0.1	0.5 / 0 (G)
Aroclor 1232	1 (U)	0.1	0.5 / 0 (G)
Aroclor 1242	1 (U)	0.1	0.5 / 0 (G)
Aroclor 1248	1 (U)	0.1	0.5 / 0 (G)
Aroclor 1254	**0.27 (JN)**	0.1	0.5 / 0 (G)
Aroclor 1260	1 (U)	0.1	0.5 / 0 (G)

Notes:
1. All concentrations in micrograms per liter (ug/L) equivalent to parts per billion (ppb).
2. Bold indicates NYSDEC standards exceeded; shading indicates federal MCLs exceeded.

Data Qualifiers:
(JN) = Indicates the presence of a compounds for which there is presumptive evidence to make a tentative identification. The associated numerical value is an estimated concentration only.
(U) = Identifies compounds that were not detected. The value presented is the detection limit.
(G) = Maximum Contaminant Level Goal (MCLG)

References:
Standard and Guidance values are according to the New York State Department of Environmental Conservation, Division of Water Technical and Operation Guidance Series (1.1.1), Ambient Water Quality Standards and Guidance Values, October 1993.

MCLs [Maximum Contaminant Levels] and MCLGs are according to the Code of Federal Regulations, Protection of Environment 40, Part 141, July 1, 1991, and the Drinking Water Regulations and Health Advisories, Office of Water, U.S. Environmental Protection Agency, May 1995.

TABLE 1-8

SUMMARY OF GROUND-WATER ANALYTICAL RESULTS
INORGANIC CONSTITUENTS
DECEMBER 1995

ROSEN SITE
CORTLAND, NEW YORK

Constituent	W-01	W-02	W-03	W-04	W-06	W-07	W-08	New York State Standard/Guidance Value	MCL/MCLG SMCL
Iron, Total	170	60	190	**320**	**910**	**4,900**	270	300	300 (S)
Iron, Dissolved	70	40	160	90	90	**4,400**	100	300	300 (S)
Manganese, Total	20 (U)	**540**	**540**	20 (U)	20 (U)	**750**	**470**	500(a)/300	50 (S)
Manganese, Dissolved	20 (U)	**540**	**460**	20 (U)	20 (U)	**590**	**430**	500(a)/300	50 (S)
Ammonia-Nitrogen	500 (U)	500 (U)	500 (U)	500 (U)	500 (U)	500 (U)	500 (U)	--	--
Nitrate-Nitrogen	800	200 (U)	200 (U)	700	200 (U)	200 (U)	200 (U)	--	--
Ortho-Phosphorus	50 (U)	50 (U)	50 (U)	50 (U)	50 (U)	50 (U)	50 (U)	--	--
Sulfate	14,000	100,000	22,000	18,000	41,000	120,000	45,000	250,000	250,000
Sulfide	100 (U)	100 (U)	100 (U)	100 (U)	100 (U)	100 (U)	100 (U)	--	--

See Notes on Page 2.

TABLE 1-8 (Cont'd)

SUMMARY OF GROUND-WATER ANALYTICAL RESULTS
INORGANIC CONSTITUENTS
DECEMBER 1995

ROSEN SITE
CORTLAND, NEW YORK

Constituent	W-10	W-11	W-12	W-16	W-17	W-18	W-19	W-24	New York State Standard/Guidance Value	MCL/MCLG SMCL
Iron, Total	80	**5,000**	50	160	280	40	60	130	300	300 (S)
Iron, Dissolved	80	**5,400**	30 (U)	60	170	40	(NA)	110	300	300 (S)
Manganese, Total	50	**820**	**410**	20	20 (U)	**590**	**1,600**	**430**	500(a)/300	50 (S)
Manganese, Dissolved	50	**910**	**400**	20	20 (U)	**320**	(NA)	**320**	500(a)/300	50 (S)
Ammonia-Nitrogen	500 (U)	500 (U)	500 (U)	500 (U)	500 (U)	500 (U)	500 (U)	500 (U)	--	--
Nitrate-Nitrogen	200 (U)	200 (U)	200 (U)	1,100	600	400	200 (U)	200 (U)	--	--
Ortho-Phosphorus	50 (U)	50 (U)	50 (U)	50 (U)	50 (U)	50 (U)	50 (U)	50 (U)	--	--
Sulfate	37,000	**620,000**	100,000	130,000	69,000	73,000	**540,000**	130,000	250,000	250,000
Sulfide	100 (U)	100 (U)	100 (U)	100 (U)	100 (U)	100 (U)	100 (U)	100 (U)	--	--

Notes:

1. All concentrations in micrograms per liter (ug/L) equivalent to parts per billion (ppb).
2. Bold indicates NYSDEC standards exceeded; shading indicates federal MCLs exceeded.

Data Qualifers:

(U) = Indicates that the constituent was not detected. The value reported is the detection limit.
(NA) = Indicates that the analysis was not performed.
(a) = Applies to the total of iron (maximum 300 ug/L) and manganese.
(S) = Secondary Maximum Contaminant Level (SMCL)

References:

Standard and Guidance values are according to the New York State Department of Environmental Conservation, Division of Water Technical and Operation Guidance Series (1.1.1), Ambient Water Quality Standards and Guidance Values, October 1993.

MCLs [Maximum Contaminant Levels], MCLGs [Maximum Contaminant Level Goals], and SMCLs are according to the Code of Federal Regulations, Protection of Environment 40, Part 141, July 1, 1991, and the Drinking Water Regulations and Health Advisories, Office of Water, U.S. Environmental Protection Agency, May 1995.

TABLE 1-9

SUMMARY OF GROUND-WATER ANALYTICAL RESULTS
VOLATILE ORGANIC COMPOUNDS
MARCH 1996

ROSEN SITE
CORTLAND, NEW YORK

Compound	W-01 03/14/96	W-02 03/14/96	W-03 03/15/96	W-04 03/13/96	W-06 03/14/96	W-06 (DUP) 03/14/96	W-07 03/15/96	W-08 03/14/96	W-10 03/15/96	New York State Standard/ Guidance Value	MCL/MCLG
Volatiles											
1,1,1-Trichloroethane	7.4	22 (D)	8.5	1 (U)	700 (D)	1,000 (D)	130 (D)	75 (D)	88	5	200/200 (G)
1,1-Dichloroethane	3.6	14	3.9	1 (U)	46 (DJ)	55	42 (D)	21	26	5	--
1,1-Dichloroethene	1 (U)	0.39 (J)	1 (U)	1 (U)	1.2	10 (U)	1.8	1.4	1.1 (J)	5	7/7 (G)
Chloroethane	1 (U)	1 (U)	1 (U)	1 (U)	1	10 (U)	0.94 (J)	1 (U)	4 (U)	5	--
cis-1,2-Dichloroethene	1 (U)	1 (U)	0.53 (J)	1 (U)	1.3	10 (U)	1 (U)	1 (U)	4 (U)	5	70/70 (G)
Methylene chloride	2 (U)	2 (U)	2 (U)	2 (U)	0.35 (J)	20 (U)	2 (U)	2 (U)	8 (U)	5	5/0 (G)
Tetrachloroethene	1 (U)	1 (U)	4.7	1 (U)	0.29 (J)	10 (U)	1 (U)	1 (U)	4 (U)	5	5/0 (G)
Toluene	1 (U)	0.37 (J)	1 (U)	0.26 (J)	0.24 (J)	10 (U)	1 (U)	1 (U)	4 (U)	--	--
trans-1,2-Dichloroethene	1 (U)	1 (U)	1 (U)	1 (U)	1 (U)	10 (U)	1 (U)	1 (U)	4 (U)	5	100/100 (G)
Trichloroethene	1 (U)	0.47 (J)	0.97 (J)	1 (U)	5.7	3.8 (J)	0.81 (J)	0.46 (J)	4 (U)	5	5/0 (G)
Vinyl chloride	1 (U)	1 (U)	1 (U)	1 (U)	1 (U)	10 (U)	1 (U)	1 (U)	4 (U)	2	2/0 (G)
Other											
Total Organic Carbon	(NA)	2,700	(NA)	1,000 (U)	2,200	(NA)	(NA)	(NA)	3,300	--	--

See Notes on Page 3.

TABLE 1-9 (Cont'd)

SUMMARY OF GROUND-WATER ANALYTICAL RESULTS
VOLATILE ORGANIC COMPOUNDS
MARCH 1996

ROSEN SITE
CORTLAND, NEW YORK

Compound	W-11 03/14/96	W-11 (Bailer) 03/14/96	W-11 (Pump) 03/14/96	W-12 03/15/96	W-16 03/19/96	W-17 03/13/96	W-18 03/15/96	W-19 03/13/96	W-24 03/13/96	New York State Standard/ Guidance Value	MCL/MCLG
Volatiles											
1,1,1-Trichloroethane	**45 (D)**	**49**	**52**	**16**	**22**	**5.2**	**25**	**62**	1 (U)	5	200/200 (G)
1,1-Dichloroethane	**34**	**30**	**36**	3.2	3.8	0.69 (J)	**14**	**26**	1 (U)	5	--
1,1-Dichloroethene	**5.4**	**5**	**5.7**	0.47 (J)	0.33 (J)	1 (U)	1.4	3.5 (J)	2.3	5	7/7 (G)
Chloroethane	2 (U)	2.5 (U)	2.5 (U)	1 (U)	1 (U)	1 (U)	1 (U)	4 (U)	1 (U)	5	--
cis-1,2-Dichloroethene	2 (U)	2.5 (U)	2.5 (U)	0.21 (J)	1 (U)	0.32 (J)	**7.2**	4 (U)	**52 (D)**	5	70/70 (G)
Methylene chloride	4 (U)	5 (U)	5 (U)	2 (U)	2 (U)	1 (U)	2 (U)	8 (U)	1 (U)	5	5/0 (G)
Tetrachloroethene	2 (U)	2.5 (U)	2.5 (U)	1 (U)	1 (U)	2	0.29 (J)	4 (U)	1 (U)	5	5/0 (G)
Toluene	0.55 (J)	2.5 (U)	2.5 (U)	1 (U)	1 (U)	1 (U)	1 (U)	4 (U)	1 (U)	--	--
trans-1,2-Dichloroethene	2 (U)	2.5 (U)	2.5 (U)	1 (U)	1 (U)	1 (U)	1 (U)	4 (U)	**7**	5	100/100 (G)
Trichloroethene	2 (U)	2.5 (U)	2.5 (U)	**22**	2.7	**5.7**	**8**	1.4 (J)	**130 (D)**	5	5/0 (G)
Vinyl chloride	2 (U)	2.5 (U)	2.5 (U)	1 (U)	1 (U)	1 (U)	0.6 (J)	4 (U)	**13**	2	2/0 (G)
Other											
Total Organic Carbon	2,200	(NA)	(NA)	(NA)	(NA)	(NA)	1,300	1,100	1,800	--	--

See Notes on Page 3.

TABLE 1-9 (Cont'd)

SUMMARY OF GROUND-WATER ANALYTICAL RESULTS
VOLATILE ORGANIC COMPOUNDS
MARCH 1996

ROSEN SITE
CORTLAND, NEW YORK

Notes:
1. All concentrations in micrograms per liter (ug/L); equivelent to parts per billion (ppb).
2. Bold indicates NYSDEC standards exceeded; shading indicates federal MCLs exceeded.
3. (DUP) = Duplicate.

4. The following volatile organic compounds were also analyzed, but were not detected in the ground-water samples:

1,1,2,2-Tetrachloroethane	Bromodichloromethane	Chloroform	1,4-Dichlorobenzene
1,1,2-Trichloroethane	Bromoform	Chloromethane	2-Butanone
1,2-Dibromo-3-chloropropane	Bromomethane	cis-1,3-Dichloropropene	2-Hexanone
1,2-Dibromoethane	Carbon disulfide	Ethylbenzene	4-Methyl-2-pentanone
1,2-Dichlorobenzene	Carbon tetrachloride	Styrene	Acetone
1,2-Dichloroethane	Chlorobenzene	trans-1,3-Dichloropropene	Benzene
1,2-Dichloropropane	Chlorodibromomethane	Xylenes, Total	Bromochloromethane
1,3-Dichlorobenzene			

Data Qualifiers:
(D) = Identifies compounds identified in an analysis at a secondary dilution factor.
(U) = Identifies compounds that were not detected. The value presented is the detection limit.
(NA) = Not Analyzed.
(J) = Indicates an estimated value.
(G) = Maximum Contaminant Level Goal (MCLG).
– = No New York State Standard/Guidance Value or MCL/MCLG.

References:
Standard and Guidance values are according to the New York State Department of Environmental Conservation, Division of Water Technical and Operation Guidance Series (1.1.1), Ambient Water Quality Standards and Guidance Values [designated by (G)], October 1993.

MCLs [Maximum Contaminant Levels], MCLGs [Maximum Contaminant Level Goals, designated by (G)], and SMCLs [Secondary Maximum Contaminant Levels, designated by (S)], are according to the Code of Federal Regulations, Protection of the Environment 40, Part 141, July 1, 1991, and the Drinking Water Regulations and Health Advisories, Office of Water, U.S. Environmental Protection Agency, May 1995.

TABLE 1-10

SUMMARY OF GROUND-WATER ANALYTICAL RESULTS
INORGANIC CONSTITUENTS
MARCH 1996

ROSEN SITE
CORTLAND, NEW YORK

Constituent	W-02 03/14/96	W-04 03/13/96	W-06 03/14/96	W-10 03/15/96	W-11 03/14/96	W-18 03/15/96	W-19 03/13/96	W-24 03/13/96	New York State Standard/ Guidance Value	MCL/MCLG
Iron, Total	250	**300**	110	40	**5,600**	50	140	120	300	300 (S)
Iron, Dissolved	110	30	30 (U)	40	**5,500**	30 (U)	30 (U)	30 (U)	300	300 (S)
Manganese, Total	**500**	20 (U)	20 (U)	280	**930**	410	**1,900**	**580**	500(a)/300	50 (S)
Manganese, Dissolved	**500**	20 (U)	20 (U)	290	**960**	400	**1,800**	440	500(a)/300	50 (S)
Sulfate	90,000	16,000	35,000	100,000	**620,000**	140,000	**550,000**	150,000	250,000	250,000

Notes:
1. All concentrations in micrograms per liter (ug/L); equivalent to parts per billion (ppb).
2. Bold indicates NYSDEC standards exceeded; shading indicates federal MCLs exceeded.

Data Qualifiers:
(U) = Identifies compounds that were not detected. The value presented is the detection limit.
(a) = Applies to the total of iron (maximum 300 ug/L) and manganese.
(S) = Secondary Maximum Contaminant Level (SMCL).

References:
Standard and Guidance values are according to the New York State Department of Environmental Conservation, Division of Water Technical and Operation Guidance Series (1.1.1), Ambient Water Quality Standards and Guidance Values, October 1993.

MCLs [Maximum Contaminant Levels], MCLGs [Maximum Contaminant Level Goals], and SMCLs are according to the Code of Federal Regulations, Protection of the Environment 40, Part 141, July 1, 1991, and the Drinking Water Regulations and Health Advisories, Office of Water, U.S. Environmental Protection Agency, May 1995.

TABLE 1-11

SUMMARY OF GROUND-WATER ANALYTICAL RESULTS
VOLATILE ORGANIC COMPOUNDS
AUGUST 1996

ROSEN SITE
CORTLAND, NEW YORK

Compound	W-02 08/21/96	W-04 08/21/96	W-06 08/22/96	W-06 (DUP) 08/22/96	W-11 08/21/96	W-18 08/21/96	W-19 08/22/96	W-24 08/22/96	New York State Standard/ Guidance Value	MCL/MCLG
Volatiles										
1,1,1-Trichloroethane	**30 (D)**	1 (U)	**240**	**840**	**41**	**30 D**	**83**	4 (U)	5	200/200 (G)
1,1-Dichloroethane	**22**	1 (U)	**56**	**190**	**29**	**16**	**38**	4 (U)	5	--
1,1-Dichloroethene	1.4	1 (U)	10 (U)	50 (U)	4.1	1.8	**6.2**	4 (U)	5	7/7 (G)
cis-1,2-Dichloroethene	1 (U)	1 (U)	10 (U)	50 (U)	4 (U)	**5.8**	4 (U)	**25**	5	70/70 (G)
Tetrachloroethene	1 (U)	1 (U)	10 (U)	50 (U)	4 (U)	0.33 (J)	4 (U)	4 (U)	5	5/0 (G)
trans-1,2-Dichloroethene	1 (U)	1 (U)	10 (U)	50 (U)	4 (U)	1 (U)	4 (U)	2.3 (J)	5	100/100 (G)
Trichloroethene	0.48 (J)	1 (U)	**9.4 (J)**	**22 (J)**	4 (U)	**10**	4 (U)	**57**	5	5/0 (G)
Vinyl chloride	1 (U)	1 (U)	10 (U)	50 (U)	4 (U)	0.39 (J)	4 (U)	**6.3**	2	2/0 (G)
Other:										
Total Organic Carbon	2,900	1,800	2,700	(NA)	2,400	2,000	2,600	2,500	--	--

Notes:
1. All concentrations in micrograms per liter (ug/L); equivalent to parts per billion (ppb).
2. Results presented represent the best result from the original and dilution runs.
3. Bold indicates NYSDEC standards exceeded; shading indicates federal MCLs exceeded.
4. DUP = Duplicate sample.

5. The following volatile organic compounds were also analyzed, but were not detected in the ground-water samples:

1,1,2,2-Tetrachloroethane	1,4-Dichlorobenzene	Bromoform	Chloromethane
1,1,2-Trichloroethane	2-Butanone	Bromomethane	cis-1,3-Dichloropropene
1,2-Dibromo-3-chloropropane	2-Hexanone	Carbon disulfide	Ethylbenzene
1,2-Dibromoethane	4-Methyl-2-pentanone	Carbon tetrachloride	Methylene chloride
1,2-Dichlorobenzene	Acetone	Chlorobenzene	Styrene
1,2-Dichloroethane	Benzene	Chlorodibromomethane	Toluene
1,2-Dichloropropane	Bromochloromethane	Chloroethane	trans-1,3-Dichloropropene
1,3-Dichlorobenzene	Bromodichloromethane	Chloroform	Xylenes, Total

Data Qualifiers:
(D) = Identifies compounds identified in an analysis at a secondary dilution factor.
(J) = Indicates an estimated value.
(U) = Identifies compounds that were not detected. The value presented is the detection limit.
(NA) = Not Analyzed.
(G) = Maximum Conaminant Level Goal (MCLG).
-- = No New York State Standard/Guidance Value or MCL/MCLG.

References:
Standard and Guidance values are according to the New York State Department of Environmental Conservation, Division of Water Technical and Operation Guidance Series (1.1.1). Ambient Water Quality Standards and Guidance Values, October 1993.

MCLs [Maximum Contaminant Levels] and MCLGs are according to the Code of Federal Regulations, Protection of the Environment 40, Part 141, July 1, 1991, and the Drinking Water Regulations and Health Advisory, Office of Water, U.S. Environmental Protection Agency, May 1995.

TABLE 1-12

SUMMARY OF GROUND-WATER ANALYTICAL RESULTS
INORGANIC CONSTITUENTS
AUGUST 1996

ROSEN SITE
CORTLAND, NEW YORK

Constituent	W-02 08/21/96	W-04 08/21/96	W-06 08/22/96	W-11 08/21/96	W-18 08/21/96	W-19 08/22/96	W-24 08/22/96	New York State Standard/Guidance Value	MCL/MCLG
Iron, Total	**5,300**	250	**1,300**	**5,900**	100 (U)	100 (U)	120	300	300 (S)
Iron, Dissolved	280	100 (U)	200 (U)	**5,600**	100 (U)	100 (U)	200 (U)	300	300 (S)
Manganese, Total	**950**	10 (U)	12	**940**	**540**	**1,600**	460	500(a)/300	50 (S)
Manganese, Dissolved	**1,000**	10 (U)	10 (U)	**940**	**540**	**1,600**	**540**	500(a)/300	50 (S)
Sulfate	128,000	110,000	68,300	**348,000**	128,000	**654,000**	132,000	250,000	250,000
Total Alkalinity	240,000	240,000	300,000	210,000	230,000	250,000	300,000	--	--
Total Suspended Solids	26,000	8,000	4,000 (U)	13,000	4,000 (U)	4,000 (U)	4,000 (U)	--	--

Notes:
1. All concentrations in micrograms per liter (ug/L); equivalent to parts per billion (ppb).
2. Bold indicates NYSDEC standards exceeded; shading indicates federal MCLs exceeded.

Data Qualifiers:
(U) = The constituent was not detected above the reported detection limit.
(a) = Applies to the total of iron (maximum 300 ug/L) and manganese.
(S) = Secondary Maximum Contaminant Level (SMCL).
-- = No New York State Standard/Guidance Value or MCL/MCLG.

References:
Standard and Guidance values are according to the New York State Department of Environmental Conservation, Division of Water Technical and Operation Guidance Series (1.1.1), Ambient Water Quality Standards and Guidance Values, October 1993.

MCLs [Maximum Contaminant Levels], MCLGs [Maximum Contaminant Level Goals], and SMCLs are according to the Code of Federal Regulations, Protection of the Environment 40, Part 141, July 1, 1991, and the Drinking Water Regulations and Health Advisories, Office of Water, U.S. Environmental Protection Agency, May 1995.

TABLE 1-13

SUMMARY OF ANALYTICAL RESULTS
TCA SOURCE ASSESSMENT IN THE WELL W-06 AREA
TEST PIT EXCAVATION PROGRAM
DECEMBER 1996

ROSEN SITE
CORTLAND, NEW YORK

Sample Designation	SBTP6	GSTP-6	GSTP-6A	W-06	CPBS
Matrix	soil	water	water	water	water
Location	Test pit south of W-06	Test pit south of W-06 (seepage)	Test pit south of W-06 (pit)		Test pit south of W-06 in Cooling Pond Area
Compound					
1,1,1-Trichloroethane	14 (U)	94 (D)	167 (D)	3	0.40 (J)
1,1-Dichloroethane	19	19	24	2	0.30 (J)
1,1-Dichloroethene	14 (U)	0.20 (J)	0.20 (J)	1 (U)	1 (U)
1,2-Dichloroethene (total)	8 (J)	3 (J)	5 (J)	10 (U)	10 (U)
2-Butanone	92	5 (U)	5 (U)	5 (U)	5 (U)
Acetone	151	5 (U)	5 (U)	5 (U)	5 (U)
Chloroethane	6 (J)	1 (U)	0.80 (J)	5	1 (U)
cis-1,2-Dichloroethene	(NA)	6	10	1 (U)	1 (U)
Ethylbenzene	60	1 (U)	7	1 (U)	1 (U)
Methylene Chloride	6 (J)	2 (U)	2 (U)	2 (U)	2 (U)
Tetrachloroethene	14 (U)	0.10 (J)	1 (U)	1 (U)	1 (U)
Toluene	1228 (D)	0.30 (J)	65 (D)	1 (U)	0.70 (J)
trans-1,2-Dichloroethene	(NA)	1 (U)	0.50 (J)	1 (U)	1 (U)
trans-1,3-Dichloropropene	6 (J)	1 (U)	1 (U)	1 (U)	1 (U)
Trichloroethene	4 (J)	6	7	1 (U)	0.10 (J)
Xylene (total)	4057 (D)	1	29	1 (U)	0.80 (J)

Notes:
1. Soil concentrations are in micrograms per kilogram (ug/kg) equivalent to parts per billion (ppb).
2. Water concentrations are in micrograms per liter (ug/L) equivalent to parts per billion (ppb).
3. Samples were collected on 12/19/96 in conjunction with test pitting activities and were analyzed by Buck Environmental Labs.

Data Qualifiers:
(J) = Indicates an estimated value.
(D) = Concentration was quantified at a secondary dilution factor.
(U) = Constituent was not detected above the detection limit.
(NA) = Not analyzed.

TABLE 2-1

ROSEN SITE
CORTLAND, NEW YORK

FEDERAL AND STATE ARARs AND TBCs

Regulation	Citation	Description	ARAR/TBC	Rationale
FEDERAL ACTION-SPECIFIC ARARs AND TBCs				
Clean Water Act (CWA) Discharge to Waters of the United States (NPDES)	40 CFR 122 40 CFR 125 40 CFR 403 40 CFR 230	Establishes site-specific limitations and performance standards that are designed to protect surface water quality. Discharge of ground water to the Tioughnioga River is regulated under the CWA.	ARAR	May be relevant and appropriate for remedial alternatives that include the discharge of recovered ground water from the Site to the Tioughnioga River.
Resource Conservation and Recovery Act (RCRA)	40 CFR 261 40 CFR 268	Establishes site-specific regulations for the management of hazardous wastes.	TBC	The Site is not a RCRA site, although some RCRA criteria may still be considered when evaluating remedial alternatives.
Clean Air Act (CAA)	40 CFR Part 61 40 CFR Part 50	Establishes National Emission Standards for Hazardous Air Pollutants (NESHAPs) and National Ambient Air Quality Standards (NAAQS)	ARAR	Air emissions must be evaluated for potential remedial actions associated with excavation/relocation of materials and the air stripping of ground-water constituents.
RCRA	40 CFR 264.228 (a) 40 CFR 264.258 (b) 40 CFR 264.310 (a)	Establishes guidelines for placement of a cap over waste (e.g., closing a landfill, or closing a surface impoundment or waste pile as a landfill, or similar action).	TBC	The Site is not a RCRA site, although some RCRA criteria may still be considered when evaluating remedial alternatives.
STATE ACTION-SPECIFIC ARARS AND TBCs				
Solid Waste Management Facilities	6 NYCRR Part 360	Establishes regulations for solid waste management facilities.	ARAR	Relevant and appropriate for Site remedial alternatives which include containment of existing surface and subsurface soils/fill.
New York Clean Water Regulations	6 NYCRR 750	Establishes regulations regarding discharge of wastewater to a WWTP or directly into a surface water body.	ARAR	May be applicable for remedial alternatives that include the discharge of recovered ground water from the Site to Tioughnioga River.
Clean Air Act (CAA) and Amendments (CAAA)	6 NYCRR Part 200-221 and Part 257, Air Guide 1	Establishes regulatory requirements regarding air emissions, permits, and compliance.	ARAR	Air emissions must be evaluated for potential remedial actions associated with excavation/relocation of materials and the air stripping of ground-water constituents.

TABLE 2-1 (Cont'd)

ROSEN SITE
CORTLAND, NEW YORK

FEDERAL AND STATE ARARs AND TBCs

Regulation	Citation	Description	ARAR/TBC	Rationale
New York State Department of Transportation	6 NYCRR Part 364	Establishes regulations and permitting requirements for waste transportation from the site of generation to the site of treatment, storage, or disposal.	TBC	May be used as a guidance for off-site disposal of Site debris.
Identification and Listing of Hazardous Wastes	6 NYCRR Part 371	Establishes the procedures for identifying those solid wastes which are subject to regulation as hazardous waste in New York State.	TBC	May be used as guidance for those remedial alternatives that include relocation of soils/fill.
LOCAL ACTION-SPECIFIC ARARs AND TBCs				
Cortland County Sanitary Code	Article XII	Prohibits the installation of drinking water supply wells without the approval of the Cortland County Health Department.	TBC	Limits potential for future ground-water usage through requirements for water well certification.
FEDERAL CHEMICAL-SPECIFIC ARARS AND TBCs				
Public Health Service Act, as amended by Safe Drinking Water Act	40 CFR 141.11-141.16 40 CFR 141.60-141.63	Establishes MCLs for organics inorganics, turbidity, radioactivity, and microbiological contaminants in drinking water.	ARAR	Applicable for remedial alternatives that include treatment of ground water; establishes baseline cleanup criteria.
CWA	40 CFR 136.1-136.4 40 CFR 122.41 (i)	Established monitoring requirements for the discharge of waste treatment effluent to waters of the United States.	ARAR	Applicable for remedial alternatives that would include discharge of treated ground water to the Tioughnioga River.
TSCA	40 CFR 761.60-761.79	Establishes requirements for handling, storage, and disposal of PCBs and PCB items.	ARAR	ARAR for any TSCA regulated soils/fill that are removed, managed, confined, or contained in place.
TSCA	40 CFR 761.120-761.139	Spill cleanup policy establishes cleanup criteria for spills after 5/4/87; soil cleanup levels: unrestricted access - 10 mg/kg, restricted access - 25 mg/kg, disposal - 50 mg/kg.	TBC	Although the presence of PCBs at the Site is not believed to be due to a spill that occurred after 5/4/87, the cleanup criteria may still be considered when evaluating remedial alternatives.

TABLE 2-1 (Cont'd)

ROSEN SITE
CORTLAND, NEW YORK

FEDERAL AND STATE ARARs AND TBCs

Regulation	Citation	Description	ARAR/TBC	Rationale
STATE CHEMICAL-SPECIFIC ARARS AND TBCs				
New York Public Water Supply Regulations	NYCRR Title 10 Part 5-1	Establishes MCLs for constituents in a public water supply.	ARAR	Not considered an ARAR for ground water at the Site since the Site is hydraulically downgradient and outside of the capture zone for the city of Cortland water supply.
New York Water Classifications and Quality Standards	NYCRR Title 6 Parts 701-703	Establishes water quality standards, guidance value, or ground-water effluent standards for the discharge of sewage, industrial waste or other wastes to surface water, ground water, or unsaturated zones.	ARAR	ARAR for remedial actions that include but are not limited to natural attenuation or discharge of treated ground water to the Tloughnioga River.
STATE CHEMICAL SPECIFIC ARARs AND TBCs				
New York Sediment Criteria (Draft)	Technical Guidance for Screening Contaminated Sediments (1993)	Establishes draft sediment criteria for the purpose of identifying contaminated sediments.	TBC	These draft criteria are used to identify contaminated sediments; however, they may be used as guidance for sediments from Perplexity Creek or its tributary.
New York State Soil Cleanup Objectives and Cleanup Levels	TAGM HWR-94-4046 (1994)	Establishes guidelines for the determination of soil cleanup objectives and levels.	TBC	Although not a regulation, these cleanup objectives and levels may be used in the development of PRGs for the Site.

TABLE 2-1 (Cont'd)

ROSEN SITE
CORTLAND, NEW YORK

FEDERAL AND STATE ARARs AND TBCs

Regulation	Citation	Description	ARAR/TBC	Rationale
FEDERAL LOCATION-SPECIFIC ARARs AND TBCs				
Endangered Species Act	16 USC 1531 et seq. 50 CFR 200 50 CFR 402	Requires federal agencies to ensure that the continued existence of any endangered or threatened species and their habitats will not be jeopardized by a site action.	Not an ARAR for the Site	There are no known endangered species associated with the Site.
National Historic Preservation Act	16 USC 470 et seq. 36 CFR 800	Requires federal agencies to ensure the preservation of historic properties and the planning of action to minimize harm to National Historic Landmarks.	Not an ARAR for the Site	The Site is not included in or eligible for the National Register of Historic Places.
Fish and Wildlife Coordination Act	16 USC 661 et seq. 40 CFR 6.302	Requires the protection of fish or wildlife that may be affected during the diversion, channeling, or other activity associated with modification of a stream or river.	ARAR	Modification activities associated with Perplexity Creek and its tributary would not affect fish or wildlife since these are intermittent water courses consisting primarily of surface water runoff.
Wild and River Scenic Rivers Act	16 USC 1271 et seq. Section 7(a); 40 CFR 6.302 (e)	Requires the avoidance of an action that will have a direct adverse effect on a scenic river.	Not an ARAR for the Site	Perplexity Creek and its tributary and the Tioughnioga River are not classified under the Wild and Scenic Rivers Act.
NEPA-Procedures on Floodplain Management and Wetlands Protection	40 CFR Part 6 Appendix A	Requires the preservation and enhancement of wetlands to the extent possible including actions to avoid adverse effects and minimizing potential harm thereof.	Not an ARAR for the Site	There are no known designated wetlands associated with the Site.
CWA - Section 404	40 CFR Part 320, 30 CFR Parts 230-330	Dredging or filling activities in wetlands are regulated by a permit.	Not an ARAR for the Site	None of the remedial actions involve dredging or filling activities in wetlands.

TABLE 3-1

SUMMARY OF ANALYSIS OF PROCESS OPTIONS

ROSEN SITE
CORTLAND, NEW YORK

Media	Process Option	Screening Criteria			Retained for Detailed Analysis
		Effectiveness	Implementability	Cost	
Site Soils/ Fill Process Options	No Action	Limited	Not administratively acceptable	- No cost	✓
	Monitoring with Institutional Controls	Limited	Not administratively acceptable	- Low capital costs - Low O&M costs	✓
	Site Capping/Covering	✓	✓	- Moderate capital costs - Moderate O&M costs	✓
	Excavation of Select Soils/Fill	✓	✓	- Moderate capital costs - No O&M costs	✓
	Excavation of Entire Site Soils/Fill (2-foot Depth)	✓	✓	- Extremely high capital costs - No O&M costs	No
On-Site Ground-Water Process Options	No Action	✓	Not administratively acceptable	- No cost	No
	Continued Natural Attenuation and Monitoring with Inst. Controls (with natural attenuation)	✓	✓	- Low capital costs - Low O&M costs	✓
	Source Recovery & Discharge	✓ (with natural attenuation)	✓	- Moderate capital costs - Moderate O&M costs	✓
	Downgradient Perimeter Recovery and Treatment	Limited	Administratively Feasible	- Very high capital costs - Very high O&M costs	✓
	Downgradient On-Site Barrier Wall	Limited	✓ (with other options)	- High capital costs - No O&M costs	No
	In-Situ Ground-Water Treatment/Enhanced Biodegradation	✓	✓	- Moderate capital costs - Moderate O&M costs	✓
Downgradient Off-Site Ground-Water Process Options	No Action	✓	Not administratively acceptable	- Low O&M costs	✓
	Continued Natural Attenuation and Monitoring with Inst. Controls	✓	✓	- Low capital costs - Low O&M costs	✓
	Off-Site Downgradient Recovery/Treatment	Limited	✓	- Extremely high capital costs - Extremely high O&M costs	No

✓ = Achieves Criterion.
No = Does not achive criterion.

TABLE 3-2

PRELIMINARY SCREENING OF POTENTIAL REMEDIAL TECHNOLOGIES
(shading denotes general process option retained)

ROSEN SITE
CORTLAND, NEW YORK

General Response Action/Technology Type	General Process Option	Process Description	Preliminary Assessment
A. No Action/Monitoring with Institutional Controls			
	Monitoring	Periodic visual inspections and/or field sampling to track continuation of natural attenuation conditions.	Potentially applicable.
	Use Restrictions	Constraints are placed on future use of the site.	Potentially applicable.
	Access Restrictions	Constraints are placed on access to the Site.	Potentially applicable.
B. In-Situ Containment/Control			
	Capping	Layers of materials (e.g., granular materials, clay, concrete, asphalt, synthetic materials, grout or cement filled geotextile, etc.) are placed to isolate and contain constituents.	Potentially applicable.
	Erosion Control	Prevention of erosion (and subsequent transport) of materials by velocity control measures or barrier mechanisms.	Potentially applicable.
	Hydraulic Containment	Use of a physical barrier (i.e., slurry wall) to prevent migration of ground water.	Potentially applicable.
C. In-Situ Treatment			
I. Attenuation	Natural	Degradation of organics based on respective half lives of constituents.	Potentially applicable.
II. Biodegradation	Natural	Degradation of organics using naturally occurring micro organisms.	Potentially applicable.
	Enhanced	Degradation of organics assisted by nutrient addition, biological seeding, and/or environmental controls (i.e., aerobic/ anaerobic).	Potentially applicable.
III. Immobilization	Solidification/ Stabilization	Consists of chemically immobilizing media by injecting and mixing a stabilization/solidification agent into the soils/fill.	Not practical due to Site conditions.
IV. Extraction	Soil Flushing	Continuous utilization of extraction and injection wells to remove, treat, and inject groundwater to flush constituents from soils/fill.	Not practical due to Site conditions and the chemical characteristics of the subsurface soils/fill.
	Vacuum Extraction	Apply vacuum to media to remove pore space air and volatile constituents. Can be used in conjunction with steam injection to facilitate removal of less volatile compounds.	Not practical due to Site conditions and the chemical characteristics of the subsurface soils/fill.

TABLE 3-2

PRELIMINARY SCREENING OF POTENTIAL REMEDIAL TECHNOLOGIES
(shading denotes general process option retained)
(Cont'd)
ROSEN SITE
CORTLAND, NEW YORK

General Response Action/Technology Type	General Process Option	Process Description	Preliminary Assessment
V. Other	Chemical Treatment	Use of chemical agents to change the nature of the constituents through oxidation, reduction, or neutralization. May include use of a "treatment wall barrier".	Not practical due to Site conditions and the chemical characteristics of the subsurface soils/fill.
	Air Sparging	Use of pressurized air to transfer volatile constituents from ground water to air medium.	May not be practical due to the Site conditions and the chemical characteristics of the subsurface soils/fill.
D. Removal			
I. Excavation	Mechanical	Physical removal of waste constituents by typical excavation equipment.	Technical feasibility questionable; however, will be assessed further.
II. On-Site Ground Water Removal	Recovery Wells	Collection of on-site source area and/or downgradient perimeter ground water for subsequent treatment.	Technical feasibility questionable; however, will be assessed further.
III. Off-Site Ground Water Removal	Recovery Wells	Collection of off-site ground water for subsequent treatment.	Technical feasibility questionable; however, will be assessed further.
E. Ex-Situ Treatment			
I. Thermal Destruction	On-Site Incineration	Media is thermally treated in an on-site permitted incinerator.	Not applicable due to the limited volume of materials exceeding risk-based objectives for the Site.
F. Disposal			
I. On-Site Containment	On-Site Containment	On-site relocation of debris followed by capping in order to minimize migration of constituents.	Technical feasibility questionable based on volume of soils/fill; however, will be assessed further.
II. Off-Site Disposal	CERCLA Landfill	Disposal of solids at an existing CERCLA permitted landfill facility.	Technical feasibility questionable; significant volume of materials may have to be transported at significant costs.
	Local CERCLA Landfill	Construction of a new, local landfill for the disposal of solids.	Potentially applicable. However, permitting of a local landfill at an off-site location would be difficult.
	Solid Waste Landfill	Disposal of solids (containing low levels of constituents) in an existing off-site permitted solid waste landfill.	Potentially applicable.

TABLE 3-2

PRELIMINARY SCREENING OF POTENTIAL REMEDIAL TECHNOLOGIES
(shading denotes general process option retained)
(Cont'd)
ROSEN SITE
CORTLAND, NEW YORK

General Response Action/Technology Type	General Process Option	Process Description	Preliminary Assessment
III. Water Treatment and Discharge	Aeration/Air Stripping, Carbon Adsorption	Used to reduce concentrations of volatile organics in ground water.	Potentially applicable.
	Discharge to municipal sewer system	Route untreated or treated recovered ground water to municipal sewer system.	May be applicable for limited ground-water flow rate applications (i.e., 100 gpm); however, not applicable for the significant volume of water anticipated to be generated by on-site downgradient ground-water recovery (i.e., 1,200-1,500 gpm).
	Discharge to surface water	Discharge treated ground water directly to surface water.	Potentially applicable with SPDES Permit (intent of permit for CERCLA NPL site) for treated water discharge to the Tioughnioga River.
	Industrial Reuse	Discharge treated ground water to local industry for use as process water.	Potentially applicable. However, no industrial user has been positively identified to receive treated ground water.
	Reinjection	Discharge treated ground water into aquifer system.	Potentially applicable. However, discharge requirements would be similar to "Discharge to Surface Water" option.

TABLE 4-1

SUMMARY OF DETAILED ANALYSIS OF REMEDIAL ALTERNATIVES

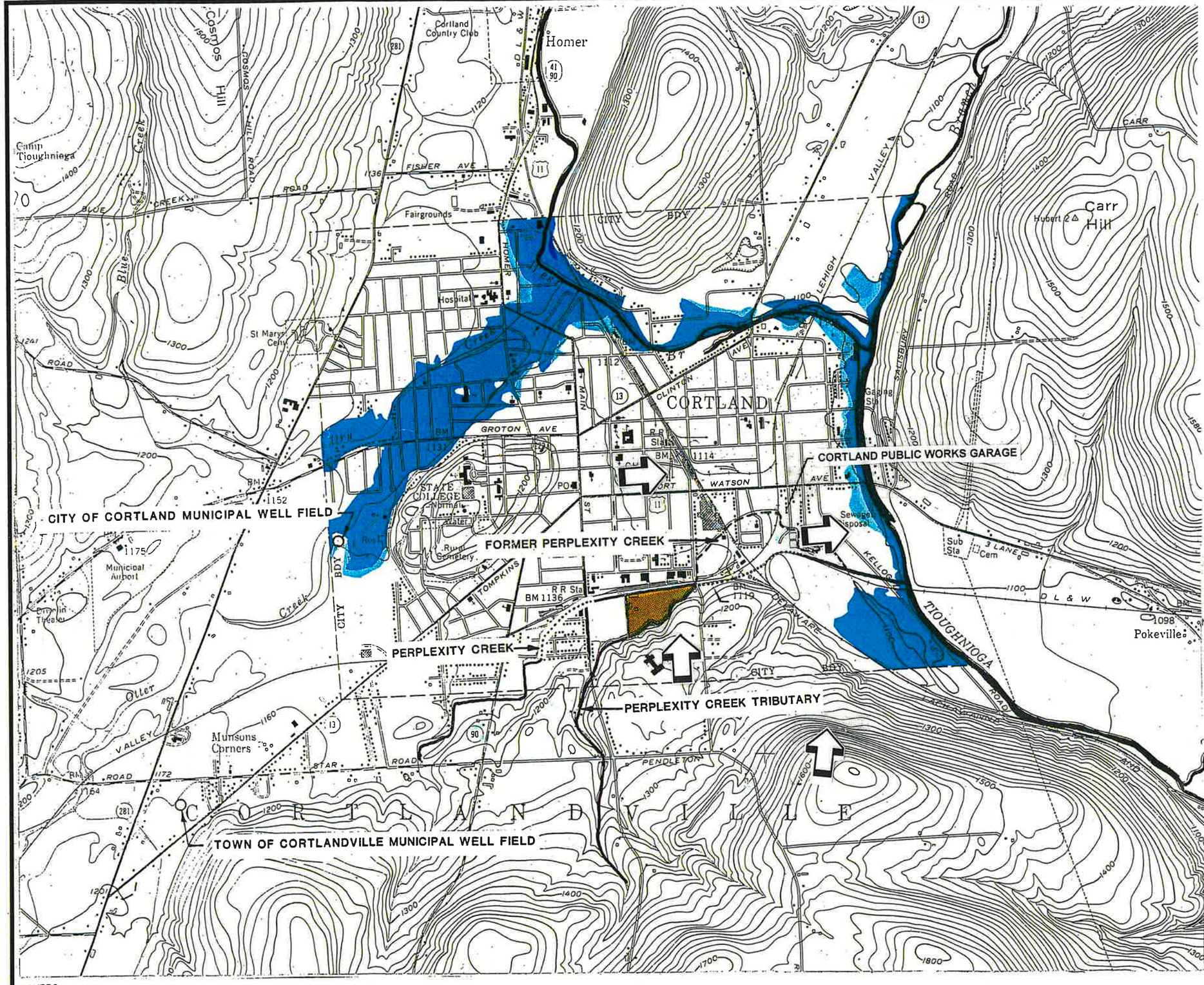
ROSEN SITE
CORTLAND, NEW YORK

		Alternative 1	Alternative 2	Alternative 3	Alternative 4	Alternative 5
		No Action (including long-term monitoring)	A New York State Part 360 cap over the former cooling pond area, a surface (e.g. asphalt, soil, or other material) cover over the remainder of the Site, excavation of the PCB and TCA "hot spot" areas with the excavated material placed beneath the Part 360 cap and continued Biological Degradation and Natural Attentuation of Site Ground Water	A New York State Part 360 cap over the former cooling pond area, a surface (e.g. asphalt, soil, or other material) cover over the remainder of the Site, and continued Biological Degradation and Natural Attentuation of Site Ground Water with In-Situ Biological Treatment	A New York State Part 360 cap over the former cooling pond area, a surface (e.g. asphalt, soil, or other material) cover over the remainder of the Site, and continued Biological Degradation and Natural Attentuation of Site Ground Water Ground-Water Recovery and Discharge to the City of Cortland WWTP (if necessary)	A New York State Part 360 cap over the former cooling pond area, a surface (e.g. asphalt, soil, or other material) cover over the remainder of the Site, and Downgradient Perimeter Ground-Water Recovery and Treatment
Threshold Criteria	Overall protection of human health and the environment	No (assuming future use)	✓	✓	✓	✓
	Compliance with ARARs	No (cannot be assessed)	✓	✓	✓	✓
Primary Criteria	Long-term effectiveness and permanence	No - soils/fill; (cannot be assessed for ground water)	✓	✓	✓	✓
	Reduction of toxicity, mobility, or volume	No (cannot be assessed)	✓	✓	✓	✓
	Short-term effectiveness	No	✓	✓	✓	✓
	Implementability	✓	✓	✓	✓	✓ (administrative only)
	Capital Cost: 30-Year Present Worth:	0 $0.94 million	$2.32 million $3.24 million	$2.44 million $3.67 million	$2.37 million $4.22 million	$11.33 million $41.61 million
Modifying Criteria	State acceptance	No	✓	✓ (conditional acceptance)	✓ (conditional acceptance)	✓ (conditional acceptance)
	Community acceptance	No	✓	✓ (conditional acceptance)	✓	Uncertain

✓ = achieves criterion

No = Does not achieve criterion

Figures



LEGEND

- SITE LIMITS
- STREAM OR RIVER
- 48" DIA. STORM DRAIN
- FORMER STREAM OR RIVER
- 100 YEAR FLOOD AREA
- 500 YEAR FLOOD AREA
- GENERALIZED GROUND-WATER FLOW DIRECTION

NOTE:
BASEMAP FROM CORTLAND USGS 7½ MIN. TOPOGRAPHIC QUAD., DATED 1955 @ 1"=2000'.
100 AND 500 YEAR FLOOD AREAS FROM FEDERAL EMERGENCY MANAGEMENT AGENCY MAPS, CITY OF CORTLAND, #360178 0001 C, DATED AUGUST 15, 1983.

APPROXIMATE SCALE IN FEET
2000' 0 2000'

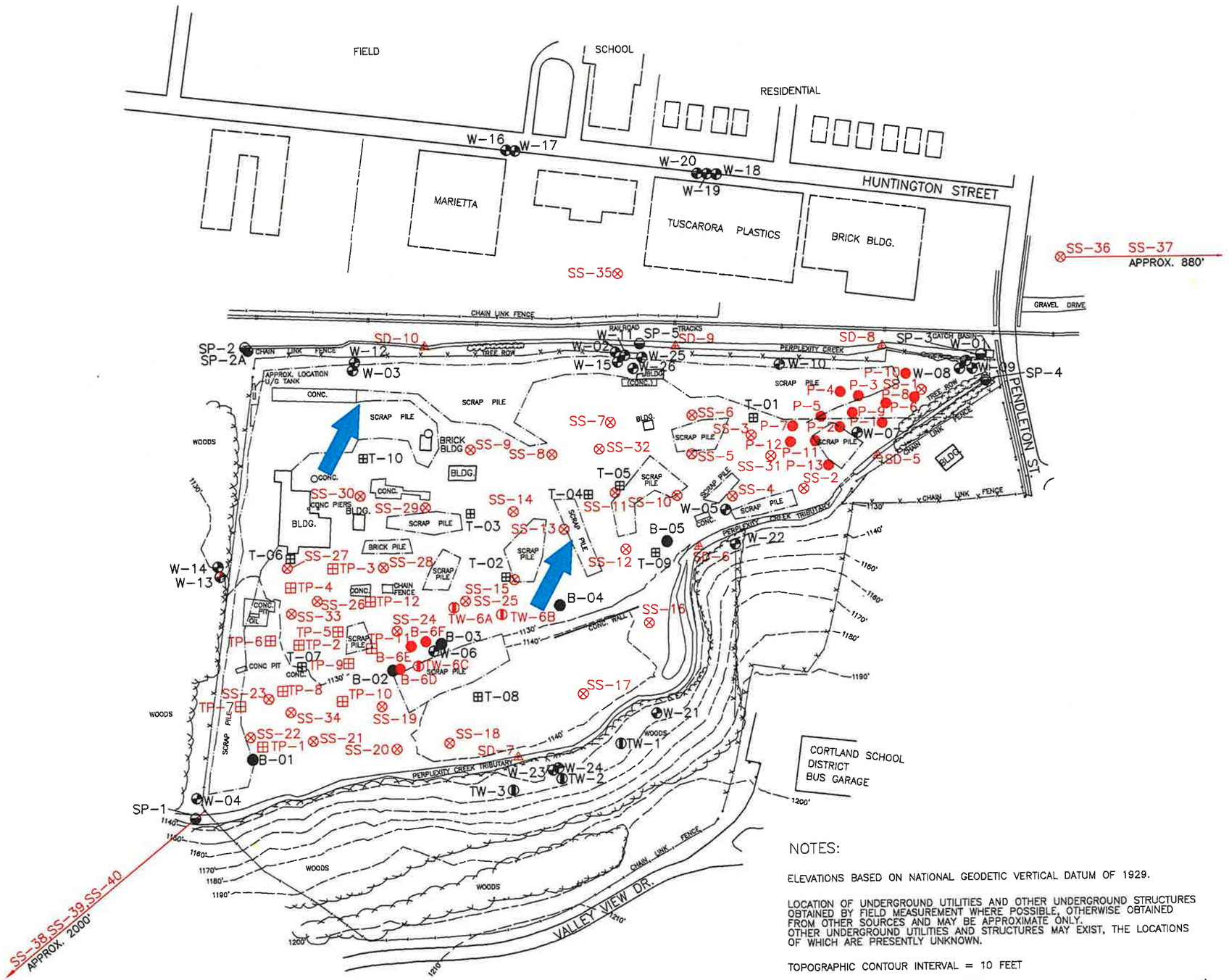
ROSEN SITE
CORTLAND, NEW YORK
FEASIBILITY STUDY REPORT

SITE LOCATION AND FLOOD PLAIN MAP

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

FIGURE 1-1

LAYERS:
4/29/94 54-RCB
F:/RCB/projects.dgn/wlp/4940208r/49404BD.DGN



LEGEND

- MONITORING WELL
- STREAM MONITORING POINT
- TEST BORING
- SUPPLEMENTAL TEST BORING
- TEST PIT
- SUPPLEMENTAL TEST PIT
- TEMPORARY WELL
- SUPPLEMENTAL TEMPORARY WELL
- SUPPLEMENTAL SEDIMENT SAMPLE
- SUPPLEMENTAL SURFACE SOIL SAMPLE
- GENERALIZED GROUND-WATER FLOW DIRECTION

SCALE

200' 0 200'

NOTES:

ELEVATIONS BASED ON NATIONAL GEODETIC VERTICAL DATUM OF 1929.

LOCATION OF UNDERGROUND UTILITIES AND OTHER UNDERGROUND STRUCTURES OBTAINED BY FIELD MEASUREMENT WHERE POSSIBLE, OTHERWISE OBTAINED FROM OTHER SOURCES AND MAY BE APPROXIMATE ONLY. OTHER UNDERGROUND UTILITIES AND STRUCTURES MAY EXIST, THE LOCATIONS OF WHICH ARE PRESENTLY UNKNOWN.

TOPOGRAPHIC CONTOUR INTERVAL = 10 FEET

LOCATIONS OF BACKGROUND SURFICIAL SOIL SAMPLES (SS-35 THROUGH SS-40) ARE APPROXIMATE.

ROSEN SITE
CORTLAND, NEW YORK

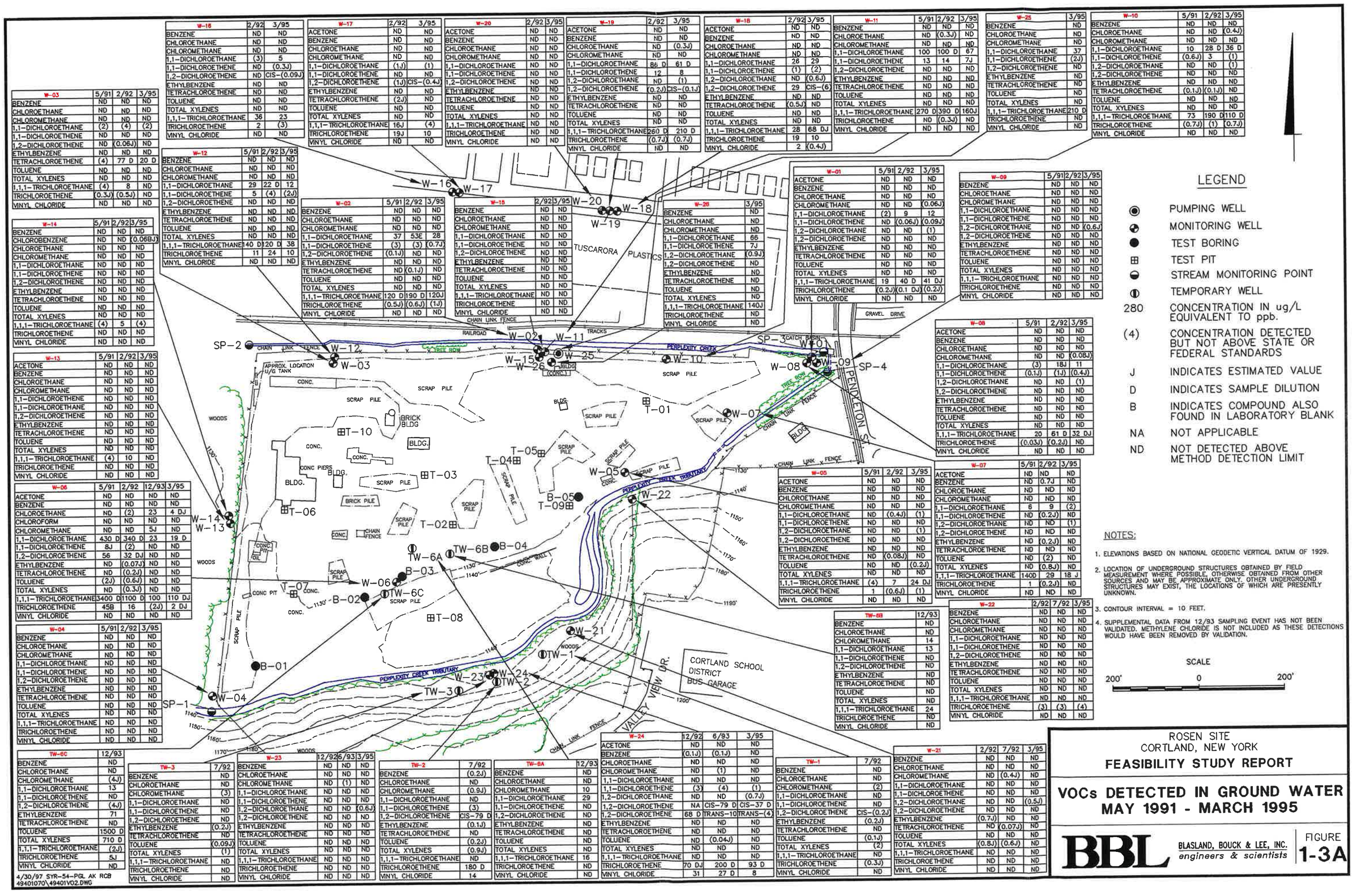
FEASIBILITY STUDY REPORT

SITE MAP

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

FIGURE 1-2

FSR
4/28/97 54-PGL.DWW
49401070/49401G01.DWG



W-16	2/92	3/95
BENZENE	ND	ND
CHLOROETHANE	ND	ND
CHLOROMETHANE	ND	ND
1,1-DICHLOROETHANE	(3)	5
1,1-DICHLOROETHENE	ND	(0.3J)
1,2-DICHLOROETHENE	ND	CIS-(0.09J
ETHYLBENZENE	ND	ND
TETRACHLOROETHENE	ND	ND
TOLUENE	ND	ND
TOTAL XYLENES	ND	ND
1,1,1-TRICHLOROETHANE	36	23
TRICHLOROETHENE	2	(3)
VINYL CHLORIDE	ND	ND

W-17	2/92	3/95
ACETONE	ND	ND
BENZENE	ND	ND
CHLOROETHANE	ND	ND
CHLOROMETHANE	ND	ND
1,1-DICHLOROETHANE	(1J)	(1)
1,1-DICHLOROETHENE	ND	ND
1,2-DICHLOROETHENE	(1J)	CIS-(0.4J)
ETHYLBENZENE	ND	ND
TETRACHLOROETHENE	(2J)	ND
TOLUENE	ND	ND
TOTAL XYLENES	ND	ND
1,1,1-TRICHLOROETHANE	16J	(4)
TRICHLOROETHENE	19J	10
VINYL CHLORIDE	ND	ND

W-20	2/92	3/95
ACETONE	ND	ND
BENZENE	ND	ND
CHLOROETHANE	ND	ND
CHLOROMETHANE	ND	ND
1,1-DICHLOROETHANE	ND	ND
1,1-DICHLOROETHENE	ND	ND
1,2-DICHLOROETHENE	ND	ND
ETHYLBENZENE	ND	ND
TETRACHLOROETHENE	ND	ND
TOLUENE	ND	ND
TOTAL XYLENES	ND	ND
1,1,1-TRICHLOROETHANE	ND	ND
TRICHLOROETHENE	ND	ND
VINYL CHLORIDE	ND	ND

W-19	2/92	3/95
ACETONE	ND	ND
BENZENE	ND	ND
CHLOROETHANE	ND	(0.3J)
CHLOROMETHANE	ND	ND
1,1-DICHLOROETHANE	86 D	61 D
1,1-DICHLOROETHENE	12	8
1,2-DICHLOROETHANE	ND	(1)
1,2-DICHLOROETHENE	(0.2J)	CIS-(0.1J)
ETHYLBENZENE	ND	ND
TETRACHLOROETHENE	ND	ND
TOLUENE	ND	ND
TOTAL XYLENES	ND	ND
1,1,1-TRICHLOROETHANE	260 D	210 D
TRICHLOROETHENE	(0.7J)	(0.7J)
VINYL CHLORIDE	ND	ND

W-18	2/92	3/95
ACETONE	ND	ND
BENZENE	ND	ND
CHLOROETHANE	ND	ND
CHLOROMETHANE	ND	ND
1,1-DICHLOROETHANE	26	29
1,1-DICHLOROETHENE	(1)	(2)
1,2-DICHLOROETHANE	ND	(0.6J)
1,2-DICHLOROETHENE	29	CIS-(6)
ETHYLBENZENE	ND	ND
TETRACHLOROETHENE	(0.5J)	ND
TOLUENE	ND	ND
TOTAL XYLENES	ND	ND
1,1,1-TRICHLOROETHANE	28	68 DJ
TRICHLOROETHENE	19	10
VINYL CHLORIDE	2	(0.4J)

W-11	5/91	2/92	3/95
BENZENE	ND	ND	ND
CHLOROETHANE	ND	(0.3J)	ND
CHLOROMETHANE	ND	ND	ND
1,1-DICHLOROETHANE	100	100 D	67
1,1-DICHLOROETHENE	13	14	7J
1,2-DICHLOROETHANE	ND	ND	ND
ETHYLBENZENE	ND	ND	ND
TETRACHLOROETHENE	ND	ND	ND
TOLUENE	ND	ND	ND
TOTAL XYLENES	ND	ND	ND
1,1,1-TRICHLOROETHANE	270 D	390 D	160J
TRICHLOROETHENE	ND	(0.3J)	ND
VINYL CHLORIDE	ND	ND	ND

W-25	3/95
BENZENE	ND
CHLOROETHANE	ND
CHLOROMETHANE	ND
1,1-DICHLOROETHANE	37
1,1-DICHLOROETHENE	(2J)
1,2-DICHLOROETHANE	ND
ETHYLBENZENE	ND
TETRACHLOROETHENE	ND
TOLUENE	ND
TOTAL XYLENES	ND
1,1,1-TRICHLOROETHANE	210 D
TRICHLOROETHENE	ND
VINYL CHLORIDE	ND

W-10	5/91	2/92	3/95
BENZENE	ND	ND	ND
CHLOROETHANE	ND	ND	(0.4J)
CHLOROMETHANE	ND	ND	ND
1,1-DICHLOROETHANE	10	28 D	36 D
1,1-DICHLOROETHENE	(0.6J)	3	(1)
1,2-DICHLOROETHANE	ND	ND	(1)
1,2-DICHLOROETHENE	ND	ND	ND
ETHYLBENZENE	ND	ND	ND
TETRACHLOROETHENE	(0.1J)	(0.1J)	ND
TOLUENE	ND	ND	ND
TOTAL XYLENES	ND	ND	ND
1,1,1-TRICHLOROETHANE	73	190 D	110 D
TRICHLOROETHENE	(0.7J)	(1)	(0.7J)
VINYL CHLORIDE	ND	ND	ND

W-03	5/91	2/92	3/95
BENZENE	ND	ND	ND
CHLOROETHANE	ND	ND	ND
CHLOROMETHANE	ND	ND	ND
1,1-DICHLOROETHANE	(2)	(4)	(2)
1,1-DICHLOROETHENE	ND	ND	ND
1,2-DICHLOROETHENE	ND	(0.06J)	ND
ETHYLBENZENE	ND	ND	ND
TETRACHLOROETHENE	(4)	77 D	20 D
TOLUENE	ND	ND	ND
TOTAL XYLENES	ND	ND	ND
1,1,1-TRICHLOROETHANE	(4)	8	ND
TRICHLOROETHENE	(0.3J)	(0.5J)	ND
VINYL CHLORIDE	ND	ND	ND

W-12	5/91	2/92	3/95
BENZENE	ND	ND	ND
CHLOROETHANE	ND	ND	ND
CHLOROMETHANE	ND	ND	ND
1,1-DICHLOROETHANE	29	22 D	12
1,1-DICHLOROETHENE	5	(4)	(2J)
1,2-DICHLOROETHENE	ND	ND	ND
ETHYLBENZENE	ND	ND	ND
TETRACHLOROETHENE	ND	ND	ND
TOLUENE	ND	ND	ND
TOTAL XYLENES	ND	ND	ND
1,1,1-TRICHLOROETHANE	40 D	20 D	38
TRICHLOROETHENE	11	24	10
VINYL CHLORIDE	ND	ND	ND

W-02	5/91	2/92	3/95
BENZENE	ND	ND	ND
CHLOROETHANE	ND	ND	ND
CHLOROMETHANE	ND	ND	ND
1,1-DICHLOROETHANE	37	53E	28
1,1-DICHLOROETHENE	(3)	(3)	(0.7J)
1,2-DICHLOROETHENE	(0.1J)	ND	ND
ETHYLBENZENE	ND	ND	ND
TETRACHLOROETHENE	ND	(0.1J)	ND
TOLUENE	ND	ND	ND
TOTAL XYLENES	ND	ND	ND
1,1,1-TRICHLOROETHANE	120 D	190 D	120J
TRICHLOROETHENE	(0.5J)	(0.6J)	(1J)
VINYL CHLORIDE	ND	ND	ND

W-15	2/92	3/95
BENZENE	ND	ND
CHLOROETHANE	ND	ND
CHLOROMETHANE	ND	ND
1,1-DICHLOROETHANE	ND	ND
1,1-DICHLOROETHENE	ND	ND
1,2-DICHLOROETHENE	ND	ND
ETHYLBENZENE	ND	ND
TETRACHLOROETHENE	ND	ND
TOLUENE	ND	ND
TOTAL XYLENES	ND	ND
1,1,1-TRICHLOROETHANE	ND	ND
TRICHLOROETHENE	ND	ND
VINYL CHLORIDE	ND	ND

W-26	3/95
BENZENE	ND
CHLOROETHANE	ND
CHLOROMETHANE	ND
1,1-DICHLOROETHANE	66
1,1-DICHLOROETHENE	7J
1,2-DICHLOROETHANE	(0.9J)
1,2-DICHLOROETHENE	ND
ETHYLBENZENE	ND
TETRACHLOROETHENE	ND
TOLUENE	ND
TOTAL XYLENES	ND
1,1,1-TRICHLOROETHANE	140J
TRICHLOROETHENE	ND
VINYL CHLORIDE	ND

W-01	5/91	2/92	3/95
ACETONE	ND	ND	ND
BENZENE	ND	ND	ND
CHLOROETHANE	ND	ND	ND
CHLOROMETHANE	ND	ND	(0.06J)
1,1-DICHLOROETHANE	(2)	9	12
1,1-DICHLOROETHENE	ND	(0.06J)	(0.09J)
1,2-DICHLOROETHANE	ND	ND	(1)
1,2-DICHLOROETHENE	ND	ND	ND
ETHYLBENZENE	ND	ND	ND
TETRACHLOROETHENE	ND	ND	ND
TOLUENE	ND	ND	ND
TOTAL XYLENES	ND	ND	ND
1,1,1-TRICHLOROETHANE	19	40 D	41 DJ
TRICHLOROETHENE	(0.2J)	(0.1 DJ)	(0.2J)
VINYL CHLORIDE	ND	ND	ND

W-09	5/91	2/92	3/95
BENZENE	ND	ND	ND
CHLOROETHANE	ND	ND	ND
CHLOROMETHANE	ND	ND	ND
1,1-DICHLOROETHANE	ND	ND	ND
1,1-DICHLOROETHENE	ND	ND	ND
1,2-DICHLOROETHANE	ND	ND	(0.6J)
1,2-DICHLOROETHENE	ND	ND	ND
ETHYLBENZENE	ND	ND	ND
TETRACHLOROETHENE	ND	ND	ND
TOLUENE	ND	ND	ND
TOTAL XYLENES	ND	ND	ND
1,1,1-TRICHLOROETHANE	ND	ND	ND
TRICHLOROETHENE	ND	ND	ND
VINYL CHLORIDE	ND	ND	ND

W-14	5/91	2/92	3/95
BENZENE	ND	ND	ND
CHLOROBENZENE	ND	ND	(0.06BJ)
CHLOROETHANE	ND	ND	ND
CHLOROMETHANE	ND	ND	ND
1,1-DICHLOROETHANE	ND	ND	ND
1,1-DICHLOROETHENE	ND	ND	ND
1,2-DICHLOROETHENE	ND	ND	ND
ETHYLBENZENE	ND	ND	ND
TETRACHLOROETHENE	ND	ND	ND
TOLUENE	ND	ND	ND
TOTAL XYLENES	ND	ND	ND
1,1,1-TRICHLOROETHANE	(4)	5	(4)
TRICHLOROETHENE	ND	ND	ND
VINYL CHLORIDE	ND	ND	ND

W-13	5/91	2/92	3/95
ACETONE	ND	ND	ND
BENZENE	ND	ND	ND
CHLOROETHANE	ND	ND	ND
CHLOROMETHANE	ND	ND	ND
1,1-DICHLOROETHENE	ND	ND	ND
1,1-DICHLOROETHANE	ND	ND	ND
1,2-DICHLOROETHENE	ND	ND	ND
ETHYLBENZENE	ND	ND	ND
TETRACHLOROETHENE	ND	ND	ND
TOLUENE	ND	ND	ND
TOTAL XYLENES	ND	ND	ND
1,1,1-TRICHLOROETHANE	(4)	10	ND
TRICHLOROETHENE	ND	ND	ND
VINYL CHLORIDE	ND	ND	ND

W-06	5/91	2/92	12/93	3/95
ACETONE	ND	ND	ND	ND
BENZENE	ND	ND	ND	ND
CHLOROETHANE	ND	(2)	23	4 DJ
CHLOROFORM	ND	ND	ND	ND
CHLOROMETHANE	ND	ND	5J	ND
1,1-DICHLOROETHANE	430 D	340 D	23	19 D
1,1-DICHLOROETHENE	8J	(2)	ND	ND
1,2-DICHLOROETHENE	56	32 DJ	ND	ND
ETHYLBENZENE	ND	(0.07J)	ND	ND
TETRACHLOROETHENE	ND	(0.2J)	ND	ND
TOLUENE	(2J)	(0.6J)	ND	ND
TOTAL XYLENES	ND	(0.3J)	ND	ND
1,1,1-TRICHLOROETHANE	3400 D	1100 D	100	110 DJ
TRICHLOROETHENE	45B	16	(2J)	2 DJ
VINYL CHLORIDE	ND	ND	ND	ND

W-04	5/91	2/92	3/95
BENZENE	ND	ND	ND
CHLOROETHANE	ND	ND	ND
CHLOROMETHANE	ND	ND	ND
1,1-DICHLOROETHANE	ND	ND	ND
1,1-DICHLOROETHENE	ND	ND	ND
1,2-DICHLOROETHENE	ND	ND	ND
ETHYLBENZENE	ND	ND	ND
TETRACHLOROETHENE	ND	ND	ND
TOLUENE	ND	ND	ND
TOTAL XYLENES	ND	ND	ND
1,1,1-TRICHLOROETHANE	ND	ND	ND
TRICHLOROETHENE	ND	ND	ND
VINYL CHLORIDE	ND	ND	ND

W-08	5/91	2/92	3/95
ACETONE	ND	ND	ND
BENZENE	ND	ND	ND
CHLOROETHANE	ND	ND	ND
CHLOROMETHANE	ND	ND	(0.08J)
1,1-DICHLOROETHANE	(3)	18J	11
1,1-DICHLOROETHENE	(0.1J)	(1J)	(0.4J)
1,2-DICHLOROETHANE	ND	ND	(1)
1,2-DICHLOROETHENE	ND	ND	ND
ETHYLBENZENE	ND	ND	ND
TETRACHLOROETHENE	ND	ND	ND
TOLUENE	ND	ND	ND
TOTAL XYLENES	ND	ND	ND
1,1,1-TRICHLOROETHANE	20	61 D	32 DJ
TRICHLOROETHENE	(0.03J)	(0.2J)	ND
VINYL CHLORIDE	ND	ND	ND

W-07	5/91	2/92	3/95
ACETONE	ND	ND	ND
BENZENE	ND	0.7J	ND
CHLOROETHANE	ND	ND	ND
CHLOROMETHANE	ND	ND	ND
1,1-DICHLOROETHANE	6	9	(2)
1,1-DICHLOROETHENE	ND	(0.2J)	ND
1,2-DICHLOROETHANE	ND	ND	(1)
1,2-DICHLOROETHENE	ND	ND	ND
ETHYLBENZENE	ND	(0.2J)	ND
TETRACHLOROETHENE	ND	ND	ND
TOLUENE	ND	(2)	ND
TOTAL XYLENES	ND	(0.8J)	ND
1,1,1-TRICHLOROETHANE	1400	29	18 J
TRICHLOROETHENE	1	(0.2J)	ND
VINYL CHLORIDE	ND	ND	ND

W-05	5/91	2/92	3/95
ACETONE	ND	ND	ND
BENZENE	ND	ND	ND
CHLOROETHANE	ND	ND	ND
CHLOROMETHANE	ND	ND	ND
1,1-DICHLOROETHANE	ND	(0.4J)	(1)
1,1-DICHLOROETHENE	ND	ND	ND
1,2-DICHLOROETHANE	ND	ND	(1)
1,2-DICHLOROETHENE	ND	ND	ND
ETHYLBENZENE	ND	ND	ND
TETRACHLOROETHENE	ND	(0.08J)	ND
TOLUENE	ND	ND	(0.2J)
TOTAL XYLENES	ND	ND	ND
1,1,1-TRICHLOROETHANE	(4)	7	24 DJ
TRICHLOROETHENE	1	(0.6J)	(1)
VINYL CHLORIDE	ND	ND	ND

W-22	2/92	7/92	3/95
BENZENE	ND	ND	ND
CHLOROETHANE	ND	ND	ND
CHLOROMETHANE	ND	ND	ND
1,1-DICHLOROETHANE	ND	ND	ND
1,1-DICHLOROETHENE	ND	ND	ND
1,2-DICHLOROETHANE	ND	ND	ND
1,2-DICHLOROETHENE	ND	ND	ND
ETHYLBENZENE	ND	ND	ND
TETRACHLOROETHENE	ND	ND	ND
TOLUENE	ND	ND	ND
TOTAL XYLENES	ND	ND	ND
1,1,1-TRICHLOROETHANE	ND	ND	ND
TRICHLOROETHENE	(3)	(3)	(4)
VINYL CHLORIDE	ND	ND	ND

TW-6B	12/93
BENZENE	ND
CHLOROETHANE	ND
CHLOROMETHANE	14
1,1-DICHLOROETHANE	13
1,1-DICHLOROETHENE	ND
1,2-DICHLOROETHANE	ND
1,2-DICHLOROETHENE	ND
ETHYLBENZENE	ND
TETRACHLOROETHENE	ND
TOLUENE	ND
TOTAL XYLENES	ND
1,1,1-TRICHLOROETHANE	24
TRICHLOROETHENE	ND
VINYL CHLORIDE	ND

TW-6C	12/93
BENZENE	ND
CHLOROETHANE	ND
CHLOROMETHANE	(4J)
1,1-DICHLOROETHANE	13
1,1-DICHLOROETHENE	ND
1,2-DICHLOROETHANE	(4J)
ETHYLBENZENE	71
TETRACHLOROETHENE	ND
TOLUENE	1500 D
TOTAL XYLENES	710 D
1,1,1-TRICHLOROETHANE	(2J)
TRICHLOROETHENE	5J
VINYL CHLORIDE	ND

TW-3	7/92
BENZENE	ND
CHLOROETHANE	ND
CHLOROMETHANE	(3)
1,1-DICHLOROETHANE	ND
1,1-DICHLOROETHENE	ND
1,2-DICHLOROETHANE	ND
ETHYLBENZENE	(0.2J)
TETRACHLOROETHENE	ND
TOLUENE	(0.09J)
TOTAL XYLENES	(1)
1,1,1-TRICHLOROETHANE	ND
TRICHLOROETHENE	ND
VINYL CHLORIDE	ND

W-23	12/92	6/93	3/95
BENZENE	ND	ND	ND
CHLOROETHANE	ND	ND	ND
CHLOROMETHANE	ND	(1)	ND
1,1-DICHLOROETHANE	ND	ND	ND
1,1-DICHLOROETHENE	ND	ND	ND
1,2-DICHLOROETHANE	ND	ND	(0.6J)
1,2-DICHLOROETHENE	ND	ND	ND
ETHYLBENZENE	ND	ND	ND
TETRACHLOROETHENE	ND	ND	ND
TOLUENE	ND	ND	ND
TOTAL XYLENES	ND	ND	ND
1,1,1-TRICHLOROETHANE	ND	ND	ND
TRICHLOROETHENE	ND	ND	ND
VINYL CHLORIDE	ND	ND	ND

TW-2	7/92
BENZENE	(0.2J)
CHLOROETHANE	ND
CHLOROMETHANE	(0.9J)
1,1-DICHLOROETHANE	ND
1,1-DICHLOROETHENE	(3)
1,2-DICHLOROETHENE	CIS-79 D
ETHYLBENZENE	(0.1J)
TETRACHLOROETHENE	ND
TOLUENE	(0.2J)
TOTAL XYLENES	(0.9J)
1,1,1-TRICHLOROETHANE	ND
TRICHLOROETHENE	180 D
VINYL CHLORIDE	14

TW-6A	12/93
BENZENE	ND
CHLOROETHANE	ND
CHLOROMETHANE	10
1,1-DICHLOROETHANE	29
1,1-DICHLOROETHENE	ND
1,2-DICHLOROETHANE	ND
ETHYLBENZENE	ND
TETRACHLOROETHENE	ND
TOLUENE	ND
TOTAL XYLENES	ND
1,1,1-TRICHLOROETHANE	16
TRICHLOROETHENE	ND
VINYL CHLORIDE	ND

W-24	12/92	6/93	3/95
ACETONE	ND	ND	ND
BENZENE	(0.1J)	(0.1J)	ND
CHLOROETHANE	ND	ND	ND
CHLOROMETHANE	ND	(1)	ND
1,1-DICHLOROETHANE	ND	ND	ND
1,1-DICHLOROETHENE	(3)	(4)	(1)
1,2-DICHLOROETHANE	ND	ND	(0.7J)
1,2-DICHLOROETHENE	NA	CIS-79 D	CIS-37 D
ETHYLBENZENE	68 D	TRANS-10	TRANS-(4)
TETRACHLOROETHENE	ND	ND	ND
TOLUENE	ND	(0.04J)	ND
TOTAL XYLENES	ND	ND	ND
1,1,1-TRICHLOROETHANE	ND	ND	ND
TRICHLOROETHENE	70 DJ	200 D	93 D
VINYL CHLORIDE	31	27 D	8

TW-1	7/92
BENZENE	ND
CHLOROETHANE	ND
CHLOROMETHANE	(2)
1,1-DICHLOROETHANE	ND
1,1-DICHLOROETHENE	ND
1,2-DICHLOROETHANE	CIS-(0.2J)
1,2-DICHLOROETHENE	ND
ETHYLBENZENE	(0.2J)
TETRACHLOROETHENE	ND
TOLUENE	(0.1J)
TOTAL XYLENES	(2)
1,1,1-TRICHLOROETHANE	ND
TRICHLOROETHENE	(0.3J)
VINYL CHLORIDE	ND

W-21	2/92	7/92	3/95
BENZENE	ND	ND	ND
CHLOROETHANE	ND	ND	ND
CHLOROMETHANE	ND	(0.4J)	ND
1,1-DICHLOROETHANE	ND	ND	ND
1,1-DICHLOROETHENE	ND	ND	ND
1,2-DICHLOROETHANE	ND	ND	(0.5J)
1,2-DICHLOROETHENE	ND	ND	ND
ETHYLBENZENE	(0.7J)	ND	ND
TETRACHLOROETHENE	ND	(0.07J)	ND
TOLUENE	ND	ND	ND
TOTAL XYLENES	(0.8J)	(0.6J)	ND
1,1,1-TRICHLOROETHANE	ND	ND	ND
TRICHLOROETHENE	ND	ND	ND
VINYL CHLORIDE	ND	ND	ND

LEGEND

- PUMPING WELL
- MONITORING WELL
- TEST BORING
- TEST PIT
- STREAM MONITORING POINT
- TEMPORARY WELL
- 280 — CONCENTRATION IN ug/L EQUIVALENT TO ppb.
- (4) — CONCENTRATION DETECTED BUT NOT ABOVE STATE OR FEDERAL STANDARDS
- J — INDICATES ESTIMATED VALUE
- D — INDICATES SAMPLE DILUTION
- B — INDICATES COMPOUND ALSO FOUND IN LABORATORY BLANK
- NA — NOT APPLICABLE
- ND — NOT DETECTED ABOVE METHOD DETECTION LIMIT

NOTES:

1. ELEVATIONS BASED ON NATIONAL GEODETIC VERTICAL DATUM OF 1929.
2. LOCATION OF UNDERGROUND STRUCTURES OBTAINED BY FIELD MEASUREMENT WHERE POSSIBLE, OTHERWISE OBTAINED FROM OTHER SOURCES AND MAY BE APPROXIMATE ONLY. OTHER UNDERGROUND STRUCTURES MAY EXIST, THE LOCATIONS OF WHICH ARE PRESENTLY UNKNOWN.
3. CONTOUR INTERVAL = 10 FEET.
4. SUPPLEMENTAL DATA FROM 12/93 SAMPLING EVENT HAS NOT BEEN VALIDATED. METHYLENE CHLORIDE IS NOT INCLUDED AS THESE DETECTIONS WOULD HAVE BEEN REMOVED BY VALIDATION.

SCALE

200' 0 200'

ROSEN SITE
CORTLAND, NEW YORK

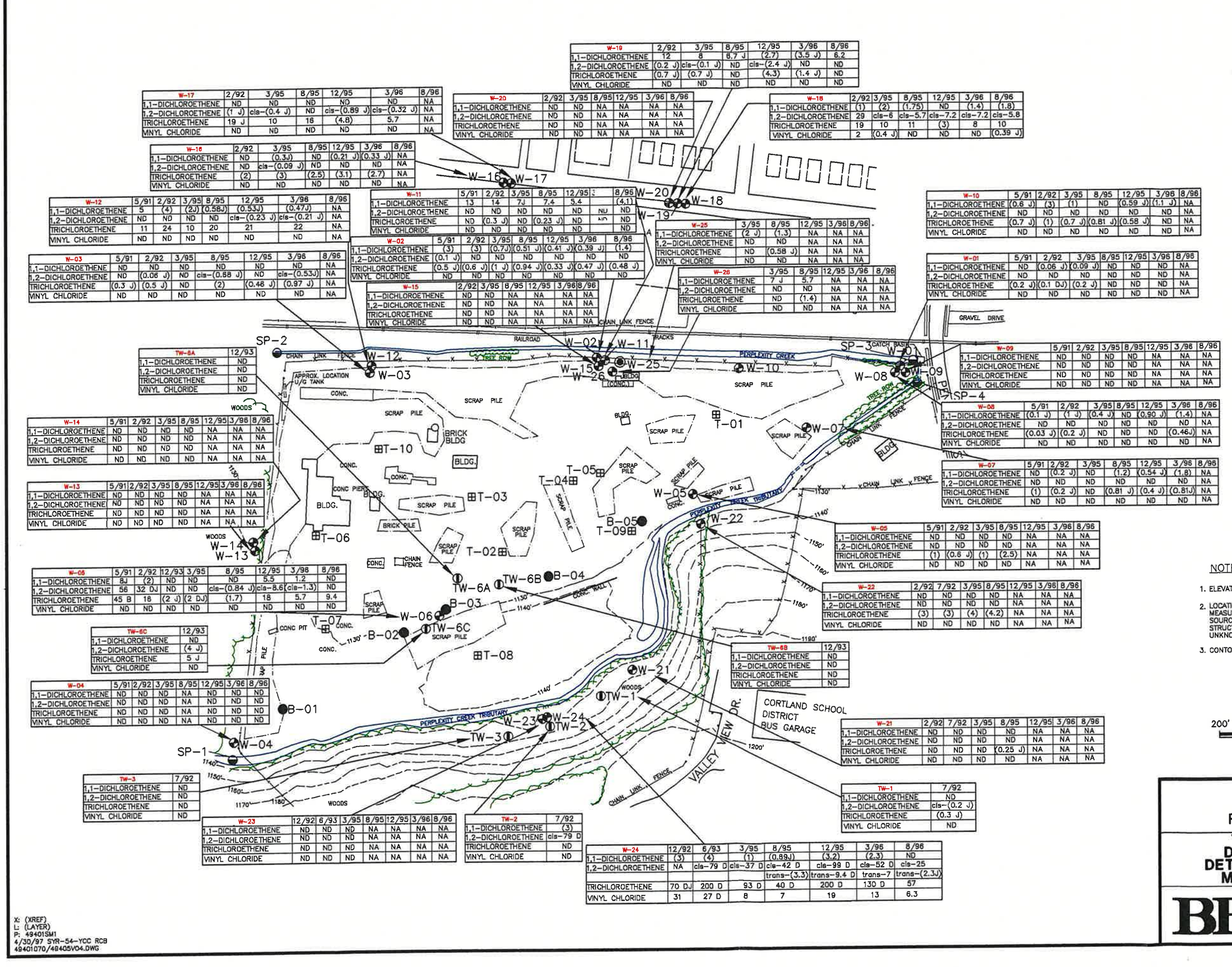
FEASIBILITY STUDY REPORT

VOCs DETECTED IN GROUND WATER MAY 1991 - MARCH 1995

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

FIGURE **1-3A**

4/30/97 SYR-54-PGL AK RCB
49401070\49401V02.DWG



W-19	2/92	3/95	8/95	12/95	3/96	8/96
1,1-DICHLOROETHENE	12	8	6.7 J	(2.7)	(3.5 J)	6.2
1,2-DICHLOROETHENE	(0.2 J)	cis-(0.1 J)	ND	cis-(2.4 J)	ND	ND
TRICHLOROETHENE	(0.7 J)	(0.7 J)	ND	(4.3)	(1.4 J)	ND
VINYL CHLORIDE	ND	ND	ND	ND	ND	ND

W-17	2/92	3/95	8/95	12/95	3/96	8/96
1,1-DICHLOROETHENE	ND	ND	ND	ND	ND	NA
1,2-DICHLOROETHENE	(1 J)	cis-(0.4 J)	ND	cis-(0.89 J)	cis-(0.32 J)	NA
TRICHLOROETHENE	19 J	10	16	(4.8)	5.7	NA
VINYL CHLORIDE	ND	ND	ND	ND	ND	NA

W-20	2/92	3/95	8/95	12/95	3/96	8/96
1,1-DICHLOROETHENE	ND	ND	NA	NA	NA	NA
1,2-DICHLOROETHENE	ND	ND	NA	NA	NA	NA
TRICHLOROETHENE	ND	ND	NA	NA	NA	NA
VINYL CHLORIDE	ND	ND	NA	NA	NA	NA

W-18	2/92	3/95	8/95	12/95	3/96	8/96
1,1-DICHLOROETHENE	(1)	(2)	(1.75)	ND	(1.4)	(1.8)
1,2-DICHLOROETHENE	29	cis-6	cis-5.7	cis-7.2	cis-7.2	cis-5.8
TRICHLOROETHENE	19	10	11	(3)	8	10
VINYL CHLORIDE	2	(0.4 J)	ND	ND	ND	(0.39 J)

W-16	2/92	3/95	8/95	12/95	3/96	8/96
1,1-DICHLOROETHENE	ND	(0.3J)	ND	(0.21 J)	(0.33 J)	NA
1,2-DICHLOROETHENE	ND	cis-(0.09 J)	ND	ND	ND	NA
TRICHLOROETHENE	(2)	(3)	(2.5)	(3.1)	(2.7)	NA
VINYL CHLORIDE	ND	ND	ND	ND	ND	NA

W-12	5/91	2/92	3/95	8/95	12/95	3/96	8/96
1,1-DICHLOROETHENE	5	(4)	(2J)	(0.58J)	(0.53J)	(0.47J)	NA
1,2-DICHLOROETHENE	ND	ND	ND	ND	cis-(0.23 J)	cis-(0.21 J)	NA
TRICHLOROETHENE	11	24	10	20	21	22	NA
VINYL CHLORIDE	ND	ND	ND	ND	ND	ND	NA

W-11	5/91	2/92	3/95	8/95	12/95	3	8/96
1,1-DICHLOROETHENE	13	14	7J	7.4	5.4		(4.1)
1,2-DICHLOROETHENE	ND	ND	ND	ND	ND	ND	ND
TRICHLOROETHENE	ND	(0.3 J)	ND	(0.23 J)	ND		ND
VINYL CHLORIDE	ND	ND	ND	ND	ND		ND

W-25	3/95	8/95	12/95	3/96	8/96
1,1-DICHLOROETHENE	(2 J)	(1.3)	NA	NA	NA
1,2-DICHLOROETHENE	ND	ND	NA	NA	NA
TRICHLOROETHENE	ND	(0.58 J)	NA	NA	NA
VINYL CHLORIDE	ND	ND	NA	NA	NA

W-10	5/91	2/92	3/95	8/95	12/95	3/96	8/96
1,1-DICHLOROETHENE	(0.6 J)	(3)	(1)	ND	(0.59 J)	(1.1 J)	NA
1,2-DICHLOROETHENE	ND	ND	ND	ND	ND	ND	NA
TRICHLOROETHENE	(0.7 J)	(1)	(0.7 J)	(0.81 J)	(0.58 J)	ND	NA
VINYL CHLORIDE	ND	ND	ND	ND	ND	ND	NA

W-02	5/91	2/92	3/95	8/95	12/95	3/96	8/96
1,1-DICHLOROETHENE	(3)	(3)	(0.7J)	(0.51 J)	(0.41 J)	(0.39 J)	(1.4)
1,2-DICHLOROETHENE	(0.1 J)	ND	ND	ND	ND	ND	ND
TRICHLOROETHENE	(0.5 J)	(0.6 J)	(1 J)	(0.94 J)	(0.33 J)	(0.47 J)	(0.48 J)
VINYL CHLORIDE	ND	ND	ND	ND	ND	ND	ND

W-26	3/95	8/95	12/95	3/96	8/96
1,1-DICHLOROETHENE	7 J	5.7	NA	NA	NA
1,2-DICHLOROETHENE	ND	ND	NA	NA	NA
TRICHLOROETHENE	ND	(1.4)	NA	NA	NA
VINYL CHLORIDE	ND	ND	NA	NA	NA

W-01	5/91	2/92	3/95	8/95	12/95	3/96	8/96
1,1-DICHLOROETHENE	ND	(0.06 J)	(0.09 J)	ND	ND	ND	NA
1,2-DICHLOROETHENE	ND	ND	ND	ND	ND	ND	NA
TRICHLOROETHENE	(0.2 J)	(0.1 DJ)	(0.2 J)	ND	ND	ND	NA
VINYL CHLORIDE	ND	ND	ND	ND	ND	ND	NA

W-15	2/92	3/95	8/95	12/95	3/96	8/96
1,1-DICHLOROETHENE	ND	ND	NA	NA	NA	NA
1,2-DICHLOROETHENE	ND	ND	NA	NA	NA	NA
TRICHLOROETHENE	ND	ND	NA	NA	NA	NA
VINYL CHLORIDE	ND	ND	NA	NA	NA	NA

W-03	5/91	2/92	3/95	8/95	12/95	3/96	8/96
1,1-DICHLOROETHENE	ND	ND	ND	ND	ND	ND	NA
1,2-DICHLOROETHENE	ND	(0.06 J)	ND	cis-(0.68 J)	ND	cis-(0.53J)	NA
TRICHLOROETHENE	(0.3 J)	(0.5 J)	ND	(2)	(0.48 J)	(0.97 J)	NA
VINYL CHLORIDE	ND	ND	ND	ND	ND	ND	NA

W-09	5/91	2/92	3/95	8/95	12/95	3/96	8/96
1,1-DICHLOROETHENE	ND	ND	ND	ND	NA	NA	NA
1,2-DICHLOROETHENE	ND	ND	ND	ND	NA	NA	NA
TRICHLOROETHENE	ND	ND	ND	ND	NA	NA	NA
VINYL CHLORIDE	ND	ND	ND	ND	NA	NA	NA

TW-6A	12/93
1,1-DICHLOROETHENE	ND
1,2-DICHLOROETHENE	ND
TRICHLOROETHENE	ND
VINYL CHLORIDE	ND

W-14	5/91	2/92	3/95	8/95	12/95	3/96	8/96
1,1-DICHLOROETHENE	ND	ND	ND	ND	NA	NA	NA
1,2-DICHLOROETHENE	ND	ND	ND	ND	NA	NA	NA
TRICHLOROETHENE	ND	ND	ND	ND	NA	NA	NA
VINYL CHLORIDE	ND	ND	ND	ND	NA	NA	NA

W-08	5/91	2/92	3/95	8/95	12/95	3/96	8/96
1,1-DICHLOROETHENE	(0.1 J)	(1 J)	(0.4 J)	ND	(0.90 J)	(1.4)	NA
1,2-DICHLOROETHENE	ND	ND	ND	ND	ND	ND	NA
TRICHLOROETHENE	(0.03 J)	(0.2 J)	ND	ND	ND	(0.46J)	NA
VINYL CHLORIDE	ND	ND	ND	ND	ND	ND	NA

W-13	5/91	2/92	3/95	8/95	12/95	3/96	8/96
1,1-DICHLOROETHENE	ND	ND	ND	ND	NA	NA	NA
1,2-DICHLOROETHENE	ND	ND	ND	ND	NA	NA	NA
TRICHLOROETHENE	ND	ND	ND	ND	NA	NA	NA
VINYL CHLORIDE	ND	ND	ND	ND	NA	NA	NA

W-07	5/91	2/92	3/95	8/95	12/95	3/96	8/96
1,1-DICHLOROETHENE	ND	(0.2 J)	ND	(1.2)	(0.54 J)	(1.8)	NA
1,2-DICHLOROETHENE	ND	ND	ND	ND	ND	ND	NA
TRICHLOROETHENE	(1)	(0.2 J)	ND	(0.81 J)	(0.4 J)	(0.81J)	NA
VINYL CHLORIDE	ND	ND	ND	ND	ND	ND	NA

W-05	5/91	2/92	3/95	8/95	12/95	3/96	8/96
1,1-DICHLOROETHENE	ND	ND	ND	ND	NA	NA	NA
1,2-DICHLOROETHENE	ND	ND	ND	ND	NA	NA	NA
TRICHLOROETHENE	(1)	(0.6 J)	(1)	(2.5)	NA	NA	NA
VINYL CHLORIDE	ND	ND	ND	ND	NA	NA	NA

W-05	5/91	2/92	12/93	3/95	8/95	12/95	3/98	8/96
1,1-DICHLOROETHENE	8J	(2)	ND	ND	ND	5.5	1.2	ND
1,2-DICHLOROETHENE	56	32 DJ	ND	ND	cis-(0.84 J)	cis-8.6	cis-1.3)	ND
TRICHLOROETHENE	45 B	18	(2 J)	(2 DJ)	(1.7)	18	5.7	9.4
VINYL CHLORIDE	ND	ND	ND	ND	ND	ND	ND	ND

W-22	2/92	7/92	3/95	8/95	12/95	3/96	8/96
1,1-DICHLOROETHENE	ND	ND	ND	ND	NA	NA	NA
1,2-DICHLOROETHENE	ND	ND	ND	ND	NA	NA	NA
TRICHLOROETHENE	(3)	(3)	(4)	(4.2)	NA	NA	NA
VINYL CHLORIDE	ND	ND	ND	ND	NA	NA	NA

TW-6C	12/93
1,1-DICHLOROETHENE	ND
1,2-DICHLOROETHENE	(4 J)
TRICHLOROETHENE	5 J
VINYL CHLORIDE	ND

TW-6B	12/93
1,1-DICHLOROETHENE	ND
1,2-DICHLOROETHENE	ND
TRICHLOROETHENE	ND
VINYL CHLORIDE	ND

W-04	5/91	2/92	3/95	8/95	12/95	3/96	8/96
1,1-DICHLOROETHENE	ND	ND	ND	NA	ND	ND	ND
1,2-DICHLOROETHENE	ND	ND	ND	NA	ND	ND	ND
TRICHLOROETHENE	ND	ND	ND	NA	ND	ND	ND
VINYL CHLORIDE	ND	ND	ND	NA	ND	ND	ND

W-21	2/92	7/92	3/95	8/95	12/95	3/96	8/96
1,1-DICHLOROETHENE	ND	ND	ND	ND	NA	NA	NA
1,2-DICHLOROETHENE	ND	ND	ND	ND	NA	NA	NA
TRICHLOROETHENE	ND	ND	ND	(0.25 J)	NA	NA	NA
VINYL CHLORIDE	ND	ND	ND	ND	NA	NA	NA

TW-3	7/92
1,1-DICHLOROETHENE	ND
1,2-DICHLOROETHENE	ND
TRICHLOROETHENE	ND
VINYL CHLORIDE	ND

TW-1	7/92
1,1-DICHLOROETHENE	ND
1,2-DICHLOROETHENE	cis-(0.2 J)
TRICHLOROETHENE	(0.3 J)
VINYL CHLORIDE	ND

W-23	12/92	6/93	3/95	8/95	12/95	3/96	8/96
1,1-DICHLOROETHENE	ND	ND	ND	NA	NA	NA	NA
1,2-DICHLOROETHENE	ND	ND	ND	NA	NA	NA	NA
TRICHLOROETHENE	ND	ND	ND	NA	NA	NA	NA
VINYL CHLORIDE	ND	ND	ND	NA	NA	NA	NA

TW-2	7/92
1,1-DICHLOROETHENE	(3)
1,2-DICHLOROETHENE	cis-79 D
TRICHLOROETHENE	ND
VINYL CHLORIDE	ND

W-24	12/92	6/93	3/95	8/95	12/95	3/96	8/96
1,1-DICHLOROETHENE	(3)	(4)	(1)	(0.89J)	(3.2)	(2.3)	ND
1,2-DICHLOROETHENE	NA	cis-79 D	cis-37 D	cis-42 D	cis-99 D	cis-52 D	cis-25
				trans-(3.3)	trans-9.4 D	trans-7	trans-(2.3J)
TRICHLOROETHENE	70 DJ	200 D	93 D	40 D	200 D	130 D	57
VINYL CHLORIDE	31	27 D	8	7	19	13	6.3

LEGEND

- PUMPING WELL
- MONITORING WELL
- TEST BORING
- TEST PIT
- STREAM MONITORING POINT
- TEMPORARY WELL
- 280 — CONCENTRATION IN ug/L EQUIVALENT TO ppb.
- (4) — CONCENTRATION DETECTED BUT NOT ABOVE STATE OR FEDERAL STANDARDS
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- D — INDICATES SAMPLE DILUTION
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- NA — NOT ANALYZED
- ND — NOT DETECTED ABOVE METHOD DETECTION LIMIT

NOTES:

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SCALE

200' 0 200'

ROSEN SITE
CORTLAND, NEW YORK

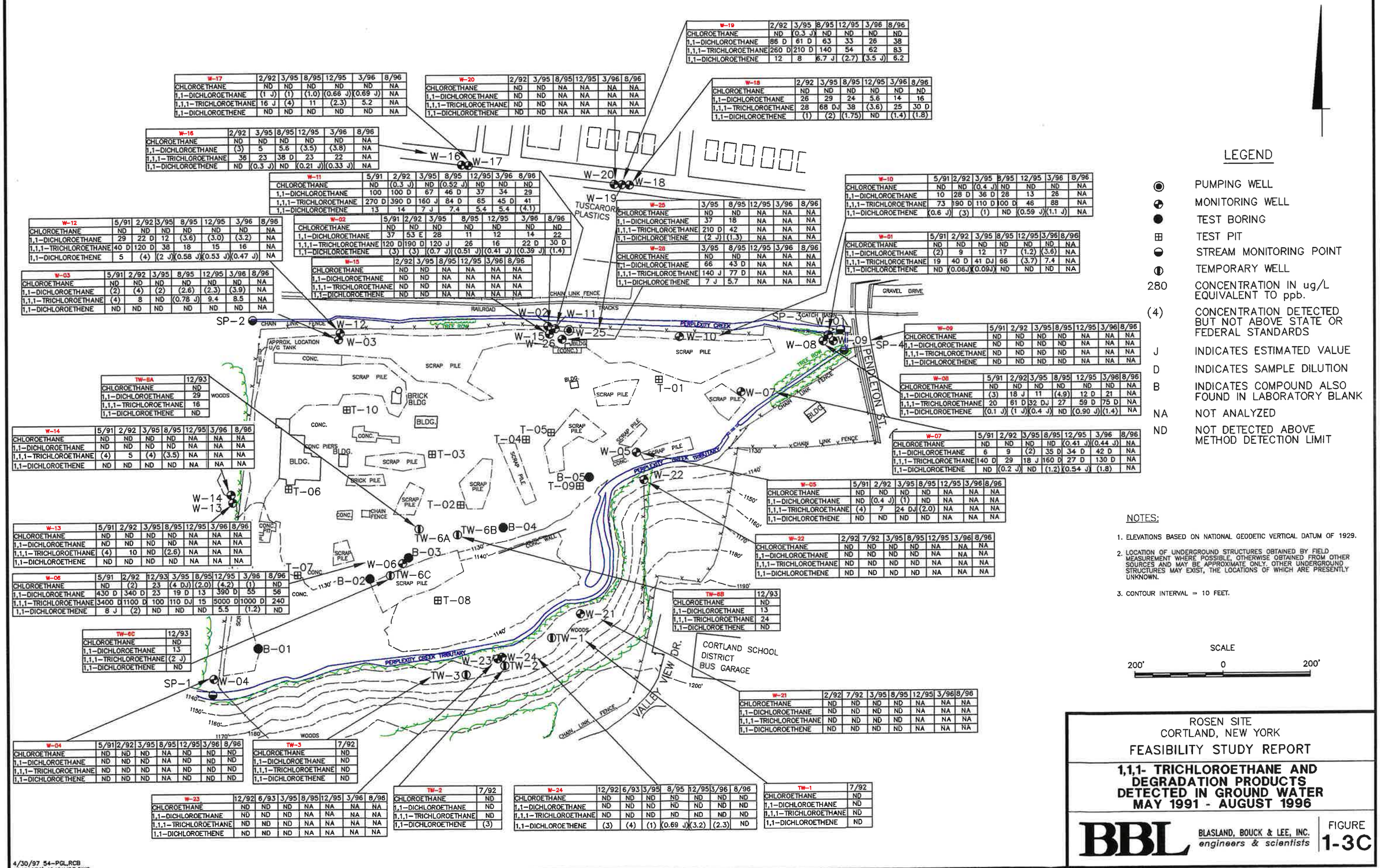
FEASIBILITY STUDY REPORT

TRICHLOROETHENE AND DEGRADATION PRODUCTS DETECTED IN GROUND WATER MAY 1991 - AUGUST 1996

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

FIGURE 1-3B

X: (XREF)
L: (LAYER)
P: 49401SM1
4/30/97 SYR-54-YCC RCB
49401070/49405V04.DWG



W-19	2/92	3/95	8/95	12/95	3/96	8/96
CHLOROETHANE	ND	(0.3 J)	ND	ND	ND	ND
1,1-DICHLOROETHANE	86 D	61 D	63	33	26	38
1,1,1-TRICHLOROETHANE	260 D	210 D	140	54	62	83
1,1-DICHLOROETHENE	12	8	6.7 J	(2.7)	(3.5 J)	6.2

W-17	2/92	3/95	8/95	12/95	3/96	8/96
CHLOROETHANE	ND	ND	ND	ND	ND	NA
1,1-DICHLOROETHANE	(1 J)	(1)	(1.0)	(0.66 J)	(0.69 J)	NA
1,1,1-TRICHLOROETHANE	16 J	(4)	11	(2.3)	5.2	NA
1,1-DICHLOROETHENE	ND	ND	ND	ND	ND	NA

W-20	2/92	3/95	8/95	12/95	3/96	8/96
CHLOROETHANE	ND	ND	NA	NA	NA	NA
1,1-DICHLOROETHANE	ND	ND	NA	NA	NA	NA
1,1,1-TRICHLOROETHANE	ND	ND	NA	NA	NA	NA
1,1-DICHLOROETHENE	ND	ND	NA	NA	NA	NA

W-18	2/92	3/95	8/95	12/95	3/96	8/96
CHLOROETHANE	ND	ND	ND	ND	ND	ND
1,1-DICHLOROETHANE	26	29	24	5.6	14	16
1,1,1-TRICHLOROETHANE	28	68 DJ	38	(3.6)	25	30 D
1,1-DICHLOROETHENE	(1)	(2)	(1.75)	ND	(1.4)	(1.8)

W-16	2/92	3/95	8/95	12/95	3/96	8/96
CHLOROETHANE	ND	ND	ND	ND	ND	NA
1,1-DICHLOROETHANE	(3)	5	5.6	(3.5)	(3.8)	NA
1,1,1-TRICHLOROETHANE	36	23	38 D	23	22	NA
1,1-DICHLOROETHENE	ND	(0.3 J)	ND	(0.21 J)	(0.33 J)	NA

W-11	5/91	2/92	3/95	8/95	12/95	3/96	8/96
CHLOROETHANE	ND	(0.3 J)	ND	(0.52 J)	ND	ND	ND
1,1-DICHLOROETHANE	100	100 D	67	46 D	37	34	29
1,1,1-TRICHLOROETHANE	270 D	390 D	160 J	84 D	65	45 D	41
1,1-DICHLOROETHENE	13	14	7 J	7.4	5.4	5.4	(4.1)

W-25	3/95	8/95	12/95	3/96	8/96
CHLOROETHANE	ND	ND	NA	NA	NA
1,1-DICHLOROETHANE	37	18	NA	NA	NA
1,1,1-TRICHLOROETHANE	210 D	42	NA	NA	NA
1,1-DICHLOROETHENE	(2 J)	(1.3)	NA	NA	NA

W-28	3/95	8/95	12/95	3/96	8/96
CHLOROETHANE	ND	ND	NA	NA	NA
1,1-DICHLOROETHANE	66	43 D	NA	NA	NA
1,1,1-TRICHLOROETHANE	140 J	77 D	NA	NA	NA
1,1-DICHLOROETHENE	7 J	5.7	NA	NA	NA

W-10	5/91	2/92	3/95	8/95	12/95	3/96	8/96
CHLOROETHANE	ND	ND	(0.4 J)	ND	ND	ND	NA
1,1-DICHLOROETHANE	10	28 D	36 D	28	13	26	NA
1,1,1-TRICHLOROETHANE	73	190 D	110 D	100 D	46	88	NA
1,1-DICHLOROETHENE	(0.6 J)	(3)	(1)	ND	(0.59 J)	(1.1 J)	NA

W-01	5/91	2/92	3/95	8/95	12/95	3/96	8/96
CHLOROETHANE	ND	ND	ND	ND	ND	ND	NA
1,1-DICHLOROETHANE	(2)	9	12	17	(1.2)	(3.6)	NA
1,1,1-TRICHLOROETHANE	19	40 D	41 DJ	66	(3.7)	7.4	NA
1,1-DICHLOROETHENE	ND	(0.06J)	(0.09J)	ND	ND	ND	NA

W-12	5/91	2/92	3/95	8/95	12/95	3/96	8/96
CHLOROETHANE	ND	ND	ND	ND	ND	ND	NA
1,1-DICHLOROETHANE	29	22 D	12	(3.6)	(3.0)	(3.2)	NA
1,1,1-TRICHLOROETHANE	40 D	120 D	38	18	15	16	NA
1,1-DICHLOROETHENE	5	(4)	(2 J)	(0.58 J)	(0.53 J)	(0.47 J)	NA

W-02	5/91	2/92	3/95	8/95	12/95	3/96	8/96
CHLOROETHANE	ND	ND	ND	ND	ND	ND	ND
1,1-DICHLOROETHANE	37	53 E	28	11	12	14	22
1,1,1-TRICHLOROETHANE	120 D	190 D	120 J	26	16	22 D	30 D
1,1-DICHLOROETHENE	(3)	(3)	(0.7 J)	(0.51 J)	(0.41 J)	(0.39 J)	(1.4)

W-15	2/92	3/95	8/95	12/95	3/96	8/96
CHLOROETHANE	ND	ND	NA	NA	NA	NA
1,1-DICHLOROETHANE	ND	ND	NA	NA	NA	NA
1,1,1-TRICHLOROETHANE	ND	ND	NA	NA	NA	NA
1,1-DICHLOROETHENE	ND	ND	NA	NA	NA	NA

W-03	5/91	2/92	3/95	8/95	12/95	3/96	8/96
CHLOROETHANE	ND	ND	ND	ND	ND	ND	NA
1,1-DICHLOROETHANE	(2)	(4)	(2)	(2.6)	(2.3)	(3.9)	NA
1,1,1-TRICHLOROETHANE	(4)	8	ND	(0.78 J)	9.4	8.5	NA
1,1-DICHLOROETHENE	ND	ND	ND	ND	ND	ND	NA

W-09	5/91	2/92	3/95	8/95	12/95	3/96	8/96
CHLOROETHANE	ND	ND	ND	ND	NA	NA	NA
1,1-DICHLOROETHANE	ND	ND	ND	ND	NA	NA	NA
1,1,1-TRICHLOROETHANE	ND	ND	ND	ND	NA	NA	NA
1,1-DICHLOROETHENE	ND	ND	ND	ND	NA	NA	NA

W-08	5/91	2/92	3/95	8/95	12/95	3/96	8/96
CHLOROETHANE	ND	ND	ND	ND	ND	ND	NA
1,1-DICHLOROETHANE	(3)	18 J	11	(4.9)	12 D	21	NA
1,1,1-TRICHLOROETHANE	20	61 D	32 DJ	27	59 D	75 D	NA
1,1-DICHLOROETHENE	(0.1 J)	(1 J)	(0.4 J)	ND	(0.90 J)	(1.4)	NA

W-07	5/91	2/92	3/95	8/95	12/95	3/96	8/96
CHLOROETHANE	ND	ND	ND	ND	(0.41 J)	(0.44 J)	NA
1,1-DICHLOROETHANE	6	9	(2)	35 D	34 D	42 D	NA
1,1,1-TRICHLOROETHANE	140 D	29	18 J	160 D	27 D	130 D	NA
1,1-DICHLOROETHENE	ND	(0.2 J)	ND	(1.2)	(0.54 J)	(1.8)	NA

TW-6A	12/93
CHLOROETHANE	ND
1,1-DICHLOROETHANE	29
1,1,1-TRICHLOROETHANE	16
1,1-DICHLOROETHENE	ND

WOODS

W-14	5/91	2/92	3/95	8/95	12/95	3/96	8/96
CHLOROETHANE	ND	ND	ND	ND	NA	NA	NA
1,1-DICHLOROETHANE	ND	ND	ND	ND	NA	NA	NA
1,1,1-TRICHLOROETHANE	(4)	5	(4)	(3.5)	NA	NA	NA
1,1-DICHLOROETHENE	ND	ND	ND	ND	NA	NA	NA

W-13	5/91	2/92	3/95	8/95	12/95	3/96	8/96
CHLOROETHANE	ND	ND	ND	ND	NA	NA	NA
1,1-DICHLOROETHANE	ND	ND	ND	ND	NA	NA	NA
1,1,1-TRICHLOROETHANE	(4)	10	ND	(2.6)	NA	NA	NA
1,1-DICHLOROETHENE	ND	ND	ND	ND	NA	NA	NA

W-06	5/91	2/92	12/93	3/95	8/95	12/95	3/96	8/96
CHLOROETHANE	ND	(2)	23	(4 DJ)	(2.0)	(4.2)	(1)	ND
1,1-DICHLOROETHANE	430 D	340 D	23	19 D	13	390 D	55	56
1,1,1-TRICHLOROETHANE	3400 D	1100 D	100	110 DJ	15	5000 D	1000 D	240
1,1-DICHLOROETHENE	8 J	(2)	ND	ND	ND	5.5	(1.2)	ND

TW-6C	12/93
CHLOROETHANE	ND
1,1-DICHLOROETHANE	13
1,1,1-TRICHLOROETHANE	(2 J)
1,1-DICHLOROETHENE	ND

TW-6B	12/93
CHLOROETHANE	ND
1,1-DICHLOROETHANE	13
1,1,1-TRICHLOROETHANE	24
1,1-DICHLOROETHENE	ND

W-22	2/92	7/92	3/95	8/95	12/95	3/96	8/96
CHLOROETHANE	ND	ND	ND	ND	NA	NA	NA
1,1-DICHLOROETHANE	ND	ND	ND	ND	NA	NA	NA
1,1,1-TRICHLOROETHANE	ND	ND	ND	ND	NA	NA	NA
1,1-DICHLOROETHENE	ND	ND	ND	ND	NA	NA	NA

W-21	2/92	7/92	3/95	8/95	12/95	3/96	8/96
CHLOROETHANE	ND	ND	ND	ND	NA	NA	NA
1,1-DICHLOROETHANE	ND	ND	ND	ND	NA	NA	NA
1,1,1-TRICHLOROETHANE	ND	ND	ND	ND	NA	NA	NA
1,1-DICHLOROETHENE	ND	ND	ND	ND	NA	NA	NA

W-04	5/91	2/92	3/95	8/95	12/95	3/96	8/96
CHLOROETHANE	ND	ND	ND	NA	ND	ND	ND
1,1-DICHLOROETHANE	ND	ND	ND	NA	ND	ND	ND
1,1,1-TRICHLOROETHANE	ND	ND	ND	NA	ND	ND	ND
1,1-DICHLOROETHENE	ND	ND	ND	NA	ND	ND	ND

TW-3	7/92
CHLOROETHANE	ND
1,1-DICHLOROETHANE	ND
1,1,1-TRICHLOROETHANE	ND
1,1-DICHLOROETHENE	ND

W-23	12/92	6/93	3/95	8/95	12/95	3/96	8/96
CHLOROETHANE	ND	ND	ND	NA	NA	NA	NA
1,1-DICHLOROETHANE	ND	ND	ND	NA	NA	NA	NA
1,1,1-TRICHLOROETHANE	ND	ND	ND	NA	NA	NA	NA
1,1-DICHLOROETHENE	ND	ND	ND	NA	NA	NA	NA

TW-2	7/92
CHLOROETHANE	ND
1,1-DICHLOROETHANE	ND
1,1,1-TRICHLOROETHANE	ND
1,1-DICHLOROETHENE	(3)

W-24	12/92	6/93	3/95	8/95	12/95	3/96	8/96
CHLOROETHANE	ND	ND	ND	ND	ND	ND	ND
1,1-DICHLOROETHANE	ND	ND	ND	ND	ND	ND	ND
1,1,1-TRICHLOROETHANE	ND	ND	ND	ND	ND	ND	ND
1,1-DICHLOROETHENE	(3)	(4)	(1)	(0.69 J)	(3.2)	(2.3)	ND

TW-1	7/92
CHLOROETHANE	ND
1,1-DICHLOROETHANE	ND
1,1,1-TRICHLOROETHANE	ND
1,1-DICHLOROETHENE	ND

LEGEND

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- ◕ MONITORING WELL
- ● TEST BORING
- ⊞ TEST PIT
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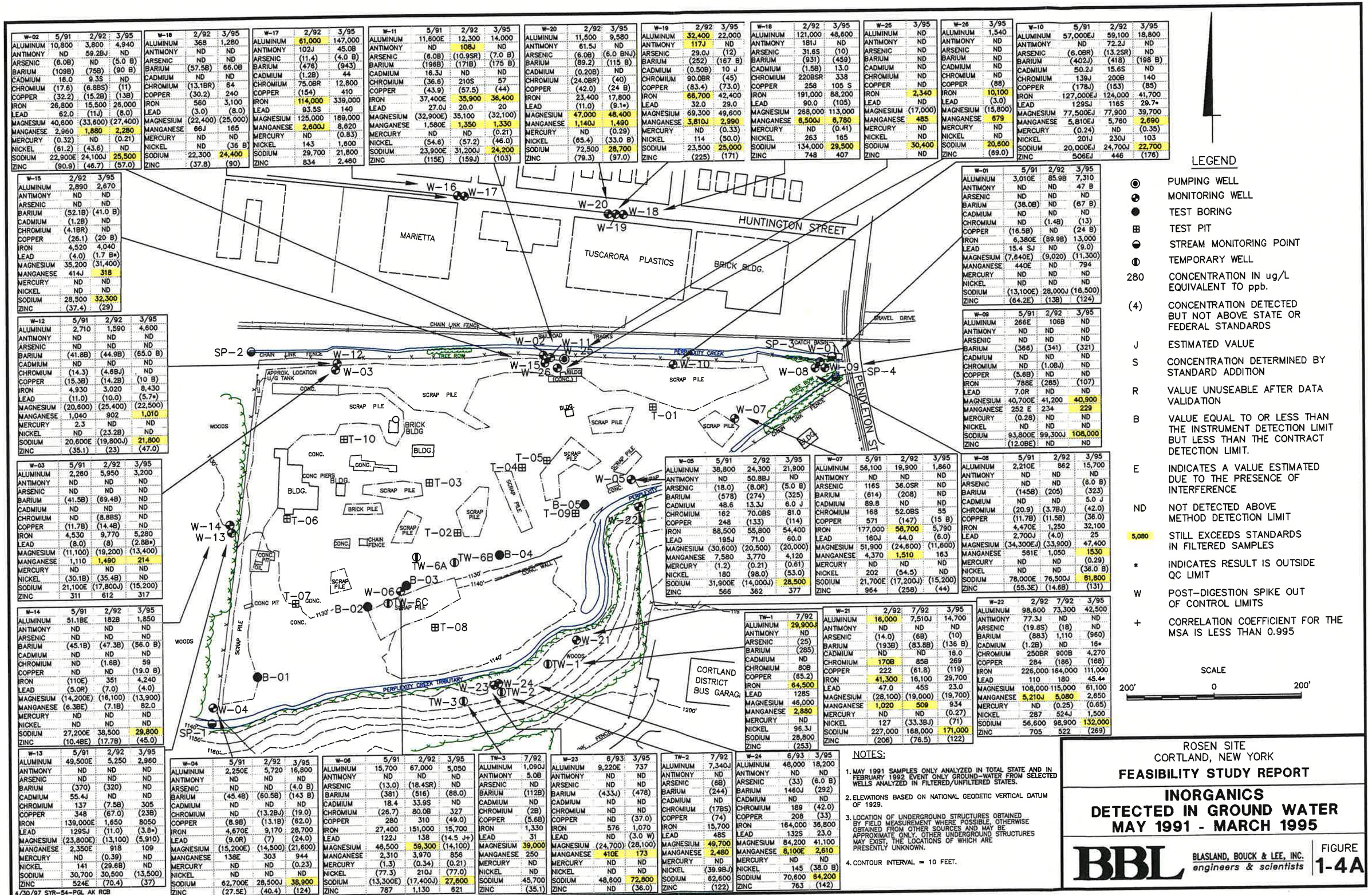
FEASIBILITY STUDY REPORT

1,1,1- TRICHLOROETHANE AND DEGRADATION PRODUCTS DETECTED IN GROUND WATER MAY 1991 - AUGUST 1996

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

FIGURE 1-3C

4/30/97 54-PGL.RCB
49401070\49401V03.DWG



W-02	5/91	2/92	3/95
ALUMINUM	10,800	3,800	4,940
ANTIMONY	ND	59.2BJ	ND
ARSENIC	(6.0B)	ND	(5.0 B)
BARIUM	(109B)	(75B)	(90 B)
CADMIUM	16.0	9.3S	ND
CHROMIUM	(17.6)	(6.8BS)	(11)
COPPER	(32.2)	(15.2B)	(13B)
IRON	26,800	15,500	26,000
LEAD	62.0	(11J)	(8.0)
MAGNESIUM	40,600	(33,600)	(27,400)
MANGANESE	2,960	1,880	2,280
MERCURY	(0.32)	ND	(0.21)
NICKEL	(61.2)	(43.6)	ND
SODIUM	22,900E	24,100J	25,500
ZINC	(90.9)	(46.7)	(57.0)

W-18	2/92	3/95
ALUMINUM	368	1,280
ANTIMONY	ND	ND
ARSENIC	ND	ND
BARIUM	(57.5B)	66.0B
CADMIUM	ND	ND
CHROMIUM	(13.1BR)	64
COPPER	(30.2)	240
IRON	580	3,100
LEAD	(3.0)	(8.0)
MAGNESIUM	(22,400)	(25,000)
MANGANESE	86J	165
MERCURY	ND	ND
NICKEL	ND	(36 B)
SODIUM	22,300	24,400
ZINC	(37.8)	(90)

W-17	2/92	3/95
ALUMINUM	61,000	147,000
ANTIMONY	102J	45.0B
ARSENIC	(11.4)	(4.0 B)
BARIUM	(476)	(943)
CADMIUM	(1.2B)	44
CHROMIUM	75.0BR	12,800
COPPER	(154)	410
IRON	114,000	339,000
LEAD	83.5S	140
MAGNESIUM	125,000	189,000
MANGANESE	2,600J	8,620
MERCURY	ND	(0.83)
NICKEL	143	1,600
SODIUM	29,700	21,800
ZINC	834	2,460

W-11	5/91	2/92	3/95
ALUMINUM	11,600E	12,300	14,000
ANTIMONY	ND	108J	ND
ARSENIC	(6.0B)	(10.9SR)	(7.0 B)
BARIUM	(198B)	(171B)	(175 B)
CADMIUM	16.3J	ND	ND
CHROMIUM	(36.8)	210S	57
COPPER	(43.9)	(57.5)	(44)
IRON	37,400E	35,900	36,400
LEAD	27.0J	20.0	20
MAGNESIUM	(32,900E)	35,100	(32,100)
MANGANESE	1,580E	1,350	1,330
MERCURY	ND	ND	(0.21)
NICKEL	(54.8)	(57.2)	(46.0)
SODIUM	23,900E	31,200J	24,200
ZINC	(115E)	(159J)	(103)

W-20	2/92	3/95
ALUMINUM	11,500	9,580
ANTIMONY	61.5J	ND
ARSENIC	(6.0B)	(6.0 BNJ)
BARIUM	(89.2)	(115 B)
CADMIUM	(0.20B)	ND
CHROMIUM	(24.0BR)	(40)
COPPER	(42.0)	(24 B)
IRON	23,400	17,800
LEAD	(11.0)	(9.1*)
MAGNESIUM	47,000	48,400
MANGANESE	1,140J	1,490
MERCURY	ND	(0.29)
NICKEL	(65.4)	(33.0 B)
SODIUM	72,500	28,700
ZINC	(79.3)	(97.0)

W-19	2/92	3/95
ALUMINUM	32,400	22,000
ANTIMONY	117J	ND
ARSENIC	29.0J	(12)
BARIUM	(252)	(167 B)
CADMIUM	(0.50B)	10 J
CHROMIUM	90.0BR	(45)
COPPER	(83.4)	(73.0)
IRON	66,700	42,400
LEAD	32.0	29.0
MAGNESIUM	69,300	49,600
MANGANESE	3,810J	2,990
MERCURY	ND	(0.33)
NICKEL	114	(50.0)
SODIUM	23,500	25,000
ZINC	(225)	(171)

W-18	2/92	3/95
ALUMINUM	121,000	48,600
ANTIMONY	181J	ND
ARSENIC	31.6S	(10)
BARIUM	(931)	(459)
CADMIUM	(1.5B)	13.0
CHROMIUM	220BSR	338
COPPER	258	105 S
IRON	191,000	88,200
LEAD	90.0	(105)
MAGNESIUM	268,000	113,000
MANGANESE	8,500J	6,780
MERCURY	ND	(0.41)
NICKEL	263	185
SODIUM	134,000	29,500
ZINC	748	407

W-25	3/95
ALUMINUM	ND
ANTIMONY	ND
ARSENIC	ND
BARIUM	ND
CADMIUM	ND
CHROMIUM	ND
COPPER	ND
IRON	2,340
LEAD	ND
MAGNESIUM	(17,000)
MANGANESE	485
MERCURY	ND
NICKEL	ND
SODIUM	30,400
ZINC	ND

W-26	3/95
ALUMINUM	1,540
ANTIMONY	ND
ARSENIC	ND
BARIUM	ND
CADMIUM	ND
CHROMIUM	ND
COPPER	(88)
IRON	10,100
LEAD	(3.0)
MAGNESIUM	(15,800)
MANGANESE	879
MERCURY	ND
NICKEL	ND
SODIUM	20,800
ZINC	(69.0)

W-10	5/91	2/92	3/95
ALUMINUM	57,000EJ	59,100	18,800
ANTIMONY	ND	72.2J	ND
ARSENIC	(6.0BR)	(13.2SR)	ND
BARIUM	(402J)	(418)	(198 B)
CADMIUM	50.2J	15.6S	ND
CHROMIUM	139J	200B	140
COPPER	(178J)	(153)	(85)
IRON	127,000EJ	124,000	41,700
LEAD	129SJ	116S	29.7*
MAGNESIUM	77,500EJ	77,900	39,700
MANGANESE	5,810EJ	5,780	2,690
MERCURY	(0.24)	ND	(0.35)
NICKEL	201J	230J	103
SODIUM	20,000EJ	24,700J	22,700
ZINC	506EJ	446	(176)

W-15	2/92	3/95
ALUMINUM	2,890	2,670
ANTIMONY	ND	ND
ARSENIC	ND	ND
BARIUM	(52.1B)	(41.0 B)
CADMIUM	(1.2B)	ND
CHROMIUM	(4.1BR)	ND
COPPER	(26.1)	(20 B)
IRON	4,520	4,040
LEAD	(4.0)	(1.7 B*)
MAGNESIUM	35,200	(31,400)
MANGANESE	414J	318
MERCURY	ND	ND
NICKEL	ND	ND
SODIUM	28,500	32,300
ZINC	(37.4)	(29)

W-12	5/91	2/92	3/95
ALUMINUM	2,710	1,590	4,600
ANTIMONY	ND	ND	ND
ARSENIC	ND	ND	ND
BARIUM	(41.8B)	(44.9B)	(65.0 B)
CADMIUM	ND	ND	ND
CHROMIUM	(14.3)	(4.6BJ)	ND
COPPER	(15.3B)	(14.2B)	(10 B)
IRON	4,930	3,020	8,430
LEAD	(11.0)	(10.0)	(5.7*)
MAGNESIUM	(20,600)	(25,400)	(22,500)
MANGANESE	1,040	902	1,010
MERCURY	2.3	ND	ND
NICKEL	ND	(23.2B)	ND
SODIUM	20,600E	(19,800J)	21,800
ZINC	(35.1)	(23)	(47.0)

W-03	5/91	2/92	3/95
ALUMINUM	2,260	5,950	3,200
ANTIMONY	ND	ND	ND
ARSENIC	ND	ND	ND
BARIUM	(41.5B)	(69.4B)	ND
CADMIUM	ND	ND	ND
CHROMIUM	ND	(8.8BS)	ND
COPPER	(11.7B)	(14.4B)	ND
IRON	4,530	9,770	5,280
LEAD	(8.0)	(8)	(2.8B*)
MAGNESIUM	(11,100)	(19,200)	(13,400)
MANGANESE	1,110	1,490	214
MERCURY	ND	ND	ND
NICKEL	(30.1B)	(35.4B)	ND
SODIUM	21,100E	(17,800J)	(15,200)
ZINC	311	612	317

W-14	5/91	2/92	3/95
ALUMINUM	51.1BE	182B	1,850
ANTIMONY	ND	ND	ND
ARSENIC	ND	ND	ND
BARIUM	(45.1B)	(47.3B)	(56.0 B)
CADMIUM	ND	ND	ND
CHROMIUM	ND	(1.6B)	59
COPPER	ND	ND	(19.0 B)
IRON	(110E)	351	4,240
LEAD	(5.0R)	(7.0)	(4.0)
MAGNESIUM	(14,200E)	(16,100)	(13,900)
MANGANESE	(6.3BE)	(7.1B)	82.0
MERCURY	ND	ND	ND
NICKEL	ND	ND	ND
SODIUM	27,200E	38,500	29,800
ZINC	(10.4BE)	(17.7B)	(45.0)

W-13	5/91	2/92	3/95
ALUMINUM	49,500E	5,250	2,960
ANTIMONY	ND	ND	ND
ARSENIC	ND	ND	ND
BARIUM	(370)	(320)	ND
CADMIUM	55.4J	ND	ND
CHROMIUM	137	(7.5B)	305
COPPER	348	(67.0)	(23B)
IRON	139,000E	1,650	8050
LEAD	129SJ	(11.0)	(3.8*)
MAGNESIUM	(23,800E)	(13,100)	(5,910)
MANGANESE	2,350E	918	109
MERCURY	ND	(0.39)	ND
NICKEL	141	(29.6B)	ND
SODIUM	30,700	30,500	(13,500)
ZINC	524E	(70.4)	(37)

W-04	5/91	2/92	3/95
ALUMINUM	2,250E	5,720	16,800
ANTIMONY	ND	ND	ND
ARSENIC	ND	ND	(4.0 B)
BARIUM	(45.4B)	(60.5B)	(143 B)
CADMIUM	ND	ND	ND
CHROMIUM	ND	(13.2BJ)	(19.0)
COPPER	(8.9B)	(13.1B)	(62.0)
IRON	4,670E	9,170	28,700
LEAD	(9.0R)	(7)	(24.0)
MAGNESIUM	(15,200E)	(14,500)	(21,600)
MANGANESE	138E	303	944
MERCURY	ND	ND	(0.23)
NICKEL	ND	ND	ND
SODIUM	62,700E	28,500J	38,900
ZINC	(27.5E)	(40.4)	(124)

W-06	5/91	2/92	3/95
ALUMINUM	15,700	67,000	5,050
ANTIMONY	ND	ND	ND
ARSENIC	(13.0)	(18.4SR)	ND
BARIUM	(381)	(516)	(88.0)
CADMIUM	18.4	33.9S	ND
CHROMIUM	(26.7)	80.0B	327
COPPER	280	310	(49.0)
IRON	27,400	151,000	15,700
LEAD	122J	138	(14.5 J+)
MAGNESIUM	46,500	59,300	(14,100)
MANGANESE	2,310	3,970	856
MERCURY	(1.3)	(0.34)	(0.21)
NICKEL	(77.3)	210J	(77.0)
SODIUM	(13,300E)	(17,400J)	27,800
ZINC	787	1,130	621

TW-3	7/92
ALUMINUM	1,090J
ANTIMONY	5.0B
ARSENIC	ND
BARIUM	(112B)
CADMIUM	ND
CHROMIUM	(2B)
COPPER	(5.6B)
IRON	1,330
LEAD	31
MAGNESIUM	39,000
MANGANESE	250
MERCURY	ND
NICKEL	ND
SODIUM	45,700
ZINC	(35.1)

W-23	8/93	3/95
ALUMINUM	9,220E	737
ANTIMONY	ND	ND
ARSENIC	ND	ND
BARIUM	(433J)	(478)
CADMIUM	ND	ND
CHROMIUM	ND	ND
COPPER	ND	(37.0)
IRON	576	1,070
LEAD	ND	(3.0 W)
MAGNESIUM	(24,700)	(28,100)
MANGANESE	410E	173
MERCURY	ND	ND
NICKEL	ND	ND
SODIUM	48,800	72,800
ZINC	ND	(36.0)

TW-2	7/92
ALUMINUM	7,340J
ANTIMONY	ND
ARSENIC	(6B)
BARIUM	(244)
CADMIUM	ND
CHROMIUM	(17BS)
COPPER	(74)
IRON	15,700
LEAD	48S
MAGNESIUM	49,700
MANGANESE	2,480
MERCURY	ND
NICKEL	(39.9BJ)
SODIUM	62,600
ZINC	(122)

W-24	6/93	3/95
ALUMINUM	48,000	18,200
ANTIMONY	ND	ND
ARSENIC	(33)	(6.0 B)
BARIUM	1460J	(292)
CADMIUM	ND	ND
CHROMIUM	189	(42.0)
COPPER	208	(33)
IRON	164,000	36,800
LEAD	132S	23.0
MAGNESIUM	84,200	41,100
MANGANESE	8,100E	2,610
MERCURY	ND	ND
NICKEL	145	(38.0 B)
SODIUM	70,600	84,200
ZINC	763	(142)

W-05	5/91	2/92	3/95
ALUMINUM	38,800	24,300	21,900
ANTIMONY	ND	50.8BJ	ND
ARSENIC	(18.0)	(8.0R)	(5.0 B)
BARIUM	(578)	(274)	(325)
CADMIUM	48.6	13.3J	6.0 J
CHROMIUM	162	70.0BS	81.0
COPPER	248	(133)	(114)
IRON	88,500	55,800	54,400
LEAD	195J	71.0	60.0
MAGNESIUM	(30,600)	(20,500)	(20,000)
MANGANESE	7,580	3,770	4,120
MERCURY	(1.2)	(0.21)	(0.61)
NICKEL	180	(98.0)	(53.0)
SODIUM	31,900E	(14,000J)	28,500
ZINC	566	362	377

W-07	5/91	2/92	3/95
ALUMINUM	56,100	19,900	1,860
ANTIMONY	ND	ND	ND
ARSENIC	116S	36.0SR	ND
BARIUM	(614)	(208)	ND
CADMIUM	89.8	ND	ND
CHROMIUM	168	52.0BS	55
COPPER	571	(147)	(15 B)
IRON	177,000	56,700	5,790
LEAD	160J	44.0	(6.0)
MAGNESIUM	51,900	(24,600)	(11,600)
MANGANESE	4,370	1,510	163
MERCURY	ND	ND	ND
NICKEL	202	(54.5)	ND
SODIUM	21,700E	(17,200J)	(15,200)
ZINC	964	(258)	(44)

W-08	5/91	2/92	3/95
ALUMINUM	2,210E	862	15,700
ANTIMONY	ND	ND	ND
ARSENIC	ND	ND	(6.0 B)
BARIUM	(1458)	(205)	(323)
CADMIUM	ND	ND	5.0 J
CHROMIUM	(20.9)	(3.7BJ)	(42.0)
COPPER	(11.7B)	(11.5B)	(36.0)
IRON	4,470E	1,250	32,100
LEAD	2,700J	(4.0)	25
MAGNESIUM	(34,300EJ)	(33,900)	47,400
MANGANESE	581E	1,050	1530
MERCURY	ND	ND	(0.29)
NICKEL	ND	ND	(38.0 B)
SODIUM	78,000E	76,500J	81,800
ZINC	(55.3E)	(14.6B)	(131)

TW-1	7/92
ALUMINUM	29,900J
ANTIMONY	ND
ARSENIC	(25)
BARIUM	(285)
CADMIUM	ND
CHROMIUM	80B
COPPER	(65.2)
IRON	64,500
LEAD	128S
MAGNESIUM	46,000
MANGANESE	2,880
MERCURY	ND
NICKEL	96.3J
SODIUM	28,800
ZINC	(253)

W-21	2/92	7/92	3/95
ALUMINUM	16,000	7,510J	14,700
ANTIMONY	ND	ND	ND
ARSENIC	(14.0)	(6B)	(10)
BARIUM	(193B)	(83.8B)	(136 B)
CADMIUM	ND	ND	16.0
CHROMIUM	170B	85B	269
COPPER	222	(61.8)	(119)
IRON	41,300	16,100	29,700
LEAD	47.0	45S	23.0
MAGNESIUM	(28,100)	(19,000)	(19,700)
MANGANESE	1,020	509	934
MERCURY	ND	ND	(0.27)
NICKEL	127	(33.3BJ)	(71)
SODIUM	227,000	168,000	171,000
ZINC	(206)	(76.5)	(122)

W-22	2/92	7/92	3/95
ALUMINUM	98,600	73,300	42,500
ANTIMONY	77.3J	ND	ND
ARSENIC	(19.8S)	(18)	ND
BARIUM	(883)	1,110	(960)
CADMIUM	(1.2B)	ND	16*
CHROMIUM	250BR	900B	4,270
COPPER	284	(186)	(168)
IRON	226,000	164,000	111,000
LEAD	110	180	45.4*
MAGNESIUM	108,000	115,000	61,100
MANGANESE	5,210J	5,080	2,650
MERCURY	ND	(0.25)	(0.65)
NICKEL	287	524J	1,500
SODIUM	56,600	98,900	132,000
ZINC	705	522	(269)

W-01	5/91	2/92	3/95
ALUMINUM	3,010E	85.9B	7,310
ANTIMONY	ND	ND	47 B
ARSENIC	ND	ND	ND
BARIUM	(38.0B)	ND	(67 B)
CADMIUM	ND	ND	ND
CHROMIUM	ND	(1.4B)	(13)
COPPER	(16.5B)	ND	(24 B)
IRON	6,380E	(89.9B)	13,000
LEAD	15.4 SJ	ND	(9.0)
MAGNESIUM	(7,640E)	(9,020)	(11,300)
MANGANESE	440E	ND	794
MERCURY	ND	ND	ND
NICKEL	ND	ND	ND
SODIUM	(13,100E)	28,000J	(16,500)
ZINC	(64.2E)	(138)	(124)

W-09	5/91	2/92	3/95
ALUMINUM	266E	106B	ND
ANTIMONY	ND	ND	ND
ARSENIC	ND	ND	ND
BARIUM	(366)	(341)	(321)
CADMIUM	ND	ND	ND
CHROMIUM	ND	(1.0BJ)	ND
COPPER	(5.6B)	ND	ND
IRON	788E	(285)	(107)
LEAD	7.0R	ND	ND
MAGNESIUM	40,700E	41,200	40,900
MANGANESE	252 E	234	229
MERCURY	(0.28)	ND	ND
NICKEL	ND	ND	ND
SODIUM	93,800E	99,300J	108,000
ZINC	(12.0BE)	ND	ND

LEGEND

- PUMPING WELL
- MONITORING WELL
- TEST BORING
- TEST PIT
- STREAM MONITORING POINT
- TEMPORARY WELL
- 280 — CONCENTRATION IN ug/L EQUIVALENT TO ppb.
- (4) — CONCENTRATION DETECTED BUT NOT ABOVE STATE OR FEDERAL STANDARDS
- J — ESTIMATED VALUE
- S — CONCENTRATION DETERMINED BY STANDARD ADDITION
- R — VALUE UNUSEABLE AFTER DATA VALIDATION
- B — VALUE EQUAL TO OR LESS THAN THE INSTRUMENT DETECTION LIMIT BUT LESS THAN THE CONTRACT DETECTION LIMIT.
- E — INDICATES A VALUE ESTIMATED DUE TO THE PRESENCE OF INTERFERENCE
- ND — NOT DETECTED ABOVE METHOD DETECTION LIMIT
- 5,080 — STILL EXCEEDS STANDARDS IN FILTERED SAMPLES
- * — INDICATES RESULT IS OUTSIDE QC LIMIT
- W — POST-DIGESTION SPIKE OUT OF CONTROL LIMITS
- + — CORRELATION COEFFICIENT FOR THE MSA IS LESS THAN 0.995

NOTES:

1. MAY 1991 SAMPLES ONLY ANALYZED IN TOTAL STATE AND IN FEBRUARY 1992 EVENT ONLY GROUND-WATER FROM SELECTED WELLS ANALYZED IN FILTERED/UNFILTERED STATES.
2. ELEVATIONS BASED ON NATIONAL GEODETIC VERTICAL DATUM OF 1929.
3. LOCATION OF UNDERGROUND STRUCTURES OBTAINED BY FIELD MEASUREMENT WHERE POSSIBLE, OTHERWISE OBTAINED FROM OTHER SOURCES AND MAY BE APPROXIMATE ONLY. OTHER UNDERGROUND STRUCTURES MAY EXIST, THE LOCATIONS OF WHICH ARE PRESENTLY UNKNOWN.
4. CONTOUR INTERVAL = 10 FEET.

ROSEN SITE
CORTLAND, NEW YORK

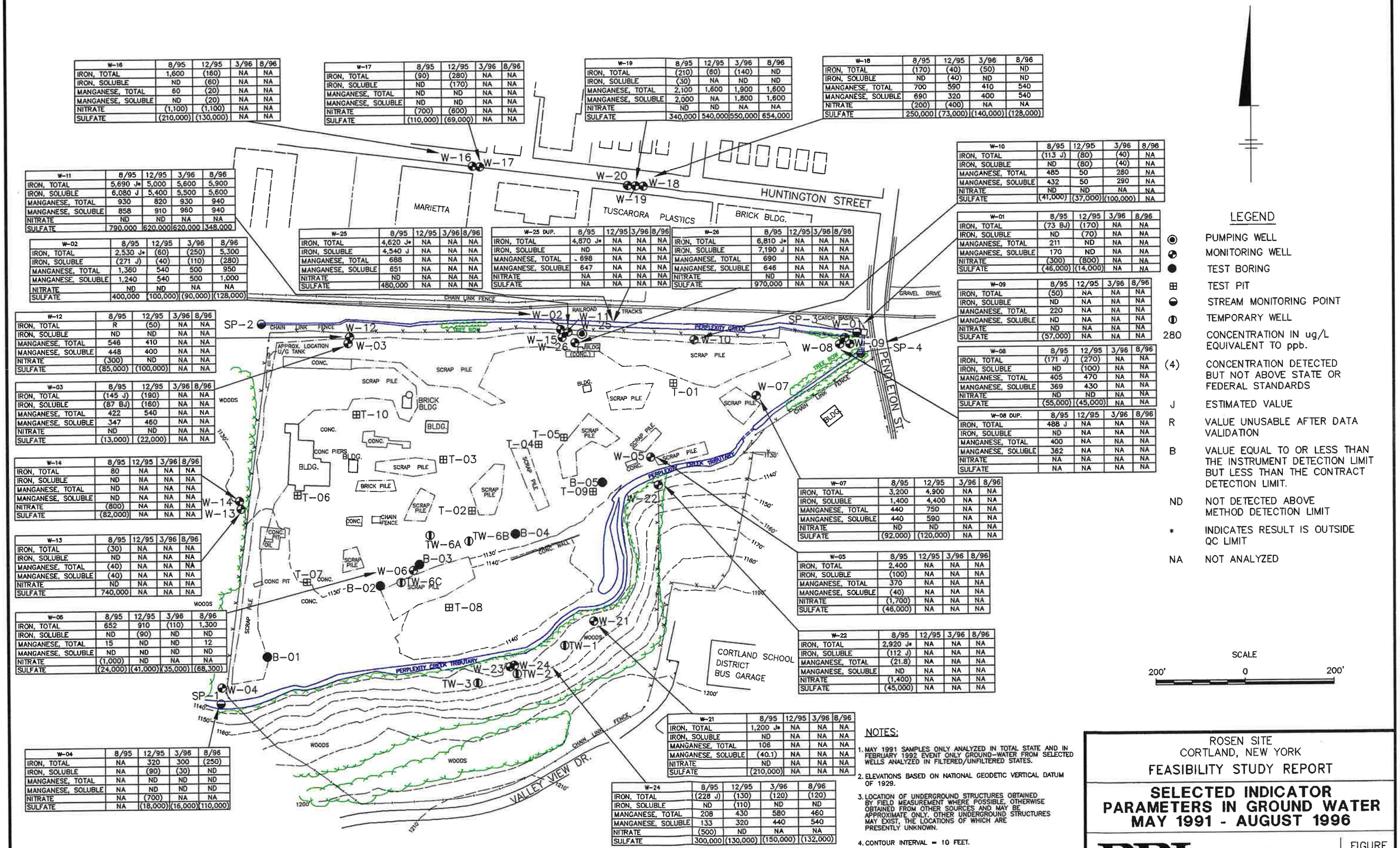
FEASIBILITY STUDY REPORT

INORGANICS DETECTED IN GROUND WATER MAY 1991 - MARCH 1995

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

FIGURE 1-4A

4/30/97 SYR-54-PGL AK RCB
49401070\49401G02.DWG



W-16	8/95	12/95	3/96	8/96
IRON, TOTAL	1,600	(160)	NA	NA
IRON, SOLUBLE	ND	(60)	NA	NA
MANGANESE, TOTAL	60	(20)	NA	NA
MANGANESE, SOLUBLE	ND	(20)	NA	NA
NITRATE	(1,100)	(1,100)	NA	NA
SULFATE	(210,000)	(130,000)	NA	NA

W-17	8/95	12/95	3/96	8/96
IRON, TOTAL	(90)	(280)	NA	NA
IRON, SOLUBLE	ND	(170)	NA	NA
MANGANESE, TOTAL	ND	ND	NA	NA
MANGANESE, SOLUBLE	ND	ND	NA	NA
NITRATE	(700)	(600)	NA	NA
SULFATE	(110,000)	(69,000)	NA	NA

W-19	8/95	12/95	3/96	8/96
IRON, TOTAL	(210)	(60)	(140)	ND
IRON, SOLUBLE	(30)	NA	ND	ND
MANGANESE, TOTAL	2,100	1,600	1,900	1,600
MANGANESE, SOLUBLE	2,000	NA	1,800	1,600
NITRATE	ND	ND	NA	NA
SULFATE	340,000	540,000	550,000	654,000

W-18	8/95	12/95	3/96	8/96
IRON, TOTAL	(170)	(40)	(50)	ND
IRON, SOLUBLE	ND	(40)	ND	ND
MANGANESE, TOTAL	700	590	410	540
MANGANESE, SOLUBLE	690	320	400	540
NITRATE	(200)	(400)	NA	NA
SULFATE	250,000	(73,000)	(140,000)	(128,000)

W-11	8/95	12/95	3/96	8/96
IRON, TOTAL	5,690 J*	5,000	5,600	5,900
IRON, SOLUBLE	6,080 J	5,400	5,500	5,600
MANGANESE, TOTAL	930	820	930	940
MANGANESE, SOLUBLE	858	910	960	940
NITRATE	ND	ND	NA	NA
SULFATE	790,000	620,000	620,000	348,000

W-02	8/95	12/95	3/96	8/96
IRON, TOTAL	2,530 J*	(60)	(250)	5,300
IRON, SOLUBLE	(271 J)	(40)	(110)	(280)
MANGANESE, TOTAL	1,360	540	500	950
MANGANESE, SOLUBLE	1,240	540	500	1,000
NITRATE	ND	ND	NA	NA
SULFATE	400,000	(100,000)	(90,000)	(128,000)

W-25	8/95	12/95	3/96	8/96
IRON, TOTAL	4,620 J*	NA	NA	NA
IRON, SOLUBLE	4,540 J	NA	NA	NA
MANGANESE, TOTAL	688	NA	NA	NA
MANGANESE, SOLUBLE	651	NA	NA	NA
NITRATE	ND	NA	NA	NA
SULFATE	480,000	NA	NA	NA

W-25 DUP.	8/95	12/95	3/96	8/96
IRON, TOTAL	4,870 J*	NA	NA	NA
IRON, SOLUBLE	ND	NA	NA	NA
MANGANESE, TOTAL	698	NA	NA	NA
MANGANESE, SOLUBLE	647	NA	NA	NA
NITRATE	NA	NA	NA	NA
SULFATE	NA	NA	NA	NA

W-26	8/95	12/95	3/96	8/96
IRON, TOTAL	6,810 J*	NA	NA	NA
IRON, SOLUBLE	7,190 J	NA	NA	NA
MANGANESE, TOTAL	690	NA	NA	NA
MANGANESE, SOLUBLE	646	NA	NA	NA
NITRATE	ND	NA	NA	NA
SULFATE	970,000	NA	NA	NA

W-10	8/95	12/95	3/96	8/96
IRON, TOTAL	(113 J)	(80)	(40)	NA
IRON, SOLUBLE	ND	(80)	(40)	NA
MANGANESE, TOTAL	485	50	280	NA
MANGANESE, SOLUBLE	432	50	290	NA
NITRATE	ND	ND	NA	NA
SULFATE	(41,000)	(37,000)	(100,000)	NA

W-01	8/95	12/95	3/96	8/96
IRON, TOTAL	(73 BJ)	(170)	NA	NA
IRON, SOLUBLE	ND	(70)	NA	NA
MANGANESE, TOTAL	211	ND	NA	NA
MANGANESE, SOLUBLE	170	ND	NA	NA
NITRATE	(300)	(800)	NA	NA
SULFATE	(46,000)	(14,000)	NA	NA

W-09	8/95	12/95	3/96	8/96
IRON, TOTAL	(50)	NA	NA	NA
IRON, SOLUBLE	ND	NA	NA	NA
MANGANESE, TOTAL	220	NA	NA	NA
MANGANESE, SOLUBLE	ND	NA	NA	NA
NITRATE	ND	NA	NA	NA
SULFATE	(57,000)	NA	NA	NA

W-08	8/95	12/95	3/96	8/96
IRON, TOTAL	(171 J)	(270)	NA	NA
IRON, SOLUBLE	ND	(100)	NA	NA
MANGANESE, TOTAL	405	470	NA	NA
MANGANESE, SOLUBLE	369	430	NA	NA
NITRATE	ND	ND	NA	NA
SULFATE	(55,000)	(45,000)	NA	NA

W-08 DUP.	8/95	12/95	3/96	8/96
IRON, TOTAL	488 J	NA	NA	NA
IRON, SOLUBLE	ND	NA	NA	NA
MANGANESE, TOTAL	400	NA	NA	NA
MANGANESE, SOLUBLE	362	NA	NA	NA
NITRATE	NA	NA	NA	NA
SULFATE	NA	NA	NA	NA

W-07	8/95	12/95	3/96	8/96
IRON, TOTAL	3,200	4,900	NA	NA
IRON, SOLUBLE	1,400	4,400	NA	NA
MANGANESE, TOTAL	440	750	NA	NA
MANGANESE, SOLUBLE	440	590	NA	NA
NITRATE	ND	ND	NA	NA
SULFATE	(92,000)	(120,000)	NA	NA

W-05	8/95	12/95	3/96	8/96
IRON, TOTAL	2,400	NA	NA	NA
IRON, SOLUBLE	(100)	NA	NA	NA
MANGANESE, TOTAL	370	NA	NA	NA
MANGANESE, SOLUBLE	(40)	NA	NA	NA
NITRATE	(1,700)	NA	NA	NA
SULFATE	(46,000)	NA	NA	NA

W-22	8/95	12/95	3/96	8/96
IRON, TOTAL	2,920 J*	NA	NA	NA
IRON, SOLUBLE	(112 J)	NA	NA	NA
MANGANESE, TOTAL	(21.8)	NA	NA	NA
MANGANESE, SOLUBLE	ND	NA	NA	NA
NITRATE	(1,400)	NA	NA	NA
SULFATE	(45,000)	NA	NA	NA

W-12	8/95	12/95	3/96	8/96
IRON, TOTAL	R	(50)	NA	NA
IRON, SOLUBLE	ND	ND	NA	NA
MANGANESE, TOTAL	546	410	NA	NA
MANGANESE, SOLUBLE	448	400	NA	NA
NITRATE	(300)	ND	NA	NA
SULFATE	(85,000)	(100,000)	NA	NA

W-03	8/95	12/95	3/96	8/96
IRON, TOTAL	(145 J)	(190)	NA	NA
IRON, SOLUBLE	(87 BJ)	(160)	NA	NA
MANGANESE, TOTAL	422	540	NA	NA
MANGANESE, SOLUBLE	347	460	NA	NA
NITRATE	ND	ND	NA	NA
SULFATE	(13,000)	(22,000)	NA	NA

W-14	8/95	12/95	3/96	8/96
IRON, TOTAL	80	NA	NA	NA
IRON, SOLUBLE	ND	NA	NA	NA
MANGANESE, TOTAL	ND	NA	NA	NA
MANGANESE, SOLUBLE	ND	NA	NA	NA
NITRATE	(800)	NA	NA	NA
SULFATE	(82,000)	NA	NA	NA

W-13	8/95	12/95	3/96	8/96
IRON, TOTAL	(30)	NA	NA	NA
IRON, SOLUBLE	ND	NA	NA	NA
MANGANESE, TOTAL	(40)	NA	NA	NA
MANGANESE, SOLUBLE	(40)	NA	NA	NA
NITRATE	ND	NA	NA	NA
SULFATE	740,000	NA	NA	NA

W-06	8/95	12/95	3/96	8/96
IRON, TOTAL	652	910	(110)	1,300
IRON, SOLUBLE	ND	(90)	ND	ND
MANGANESE, TOTAL	15	ND	ND	12
MANGANESE, SOLUBLE	ND	ND	ND	ND
NITRATE	(1,000)	ND	NA	NA
SULFATE	(24,000)	(41,000)	(35,000)	(68,300)

W-04	8/95	12/95	3/96	8/96
IRON, TOTAL	NA	320	300	(250)
IRON, SOLUBLE	NA	(90)	(30)	ND
MANGANESE, TOTAL	NA	ND	ND	ND
MANGANESE, SOLUBLE	NA	ND	ND	ND
NITRATE	NA	(700)	NA	NA
SULFATE	NA	(18,000)	(16,000)	110,000

W-21	8/95	12/95	3/96	8/96
IRON, TOTAL	1,200 J*	NA	NA	NA
IRON, SOLUBLE	ND	NA	NA	NA
MANGANESE, TOTAL	106	NA	NA	NA
MANGANESE, SOLUBLE	(40.1)	NA	NA	NA
NITRATE	ND	NA	NA	NA
SULFATE	(210,000)	NA	NA	NA

W-24	8/95	12/95	3/96	8/96
IRON, TOTAL	(228 J)	(130)	(120)	(120)
IRON, SOLUBLE	ND	(110)	ND	ND
MANGANESE, TOTAL	208	430	580	460
MANGANESE, SOLUBLE	133	320	440	540
NITRATE	(500)	ND	NA	NA
SULFATE	300,000	(130,000)	(150,000)	(132,000)

LEGEND

◉	PUMPING WELL
◒	MONITORING WELL
●	TEST BORING
⊞	TEST PIT
◒	STREAM MONITORING POINT
◐	TEMPORARY WELL
280	CONCENTRATION IN ug/L EQUIVALENT TO ppb.
(4)	CONCENTRATION DETECTED BUT NOT ABOVE STATE OR FEDERAL STANDARDS
J	ESTIMATED VALUE
R	VALUE UNUSABLE AFTER DATA VALIDATION
B	VALUE EQUAL TO OR LESS THAN THE INSTRUMENT DETECTION LIMIT BUT LESS THAN THE CONTRACT DETECTION LIMIT.
ND	NOT DETECTED ABOVE METHOD DETECTION LIMIT
*	INDICATES RESULT IS OUTSIDE QC LIMIT
NA	NOT ANALYZED

SCALE
200' 0 200'

NOTES:

1. MAY 1991 SAMPLES ONLY ANALYZED IN TOTAL STATE AND IN FEBRUARY 1992 EVENT ONLY GROUND-WATER FROM SELECTED WELLS ANALYZED IN FILTERED/UNFILTERED STATES.
2. ELEVATIONS BASED ON NATIONAL GEODETIC VERTICAL DATUM OF 1929.
3. LOCATION OF UNDERGROUND STRUCTURES OBTAINED BY FIELD MEASUREMENT WHERE POSSIBLE, OTHERWISE OBTAINED FROM OTHER SOURCES AND MAY BE APPROXIMATE ONLY. OTHER UNDERGROUND STRUCTURES MAY EXIST, THE LOCATIONS OF WHICH ARE PRESENTLY UNKNOWN.
4. CONTOUR INTERVAL = 10 FEET.

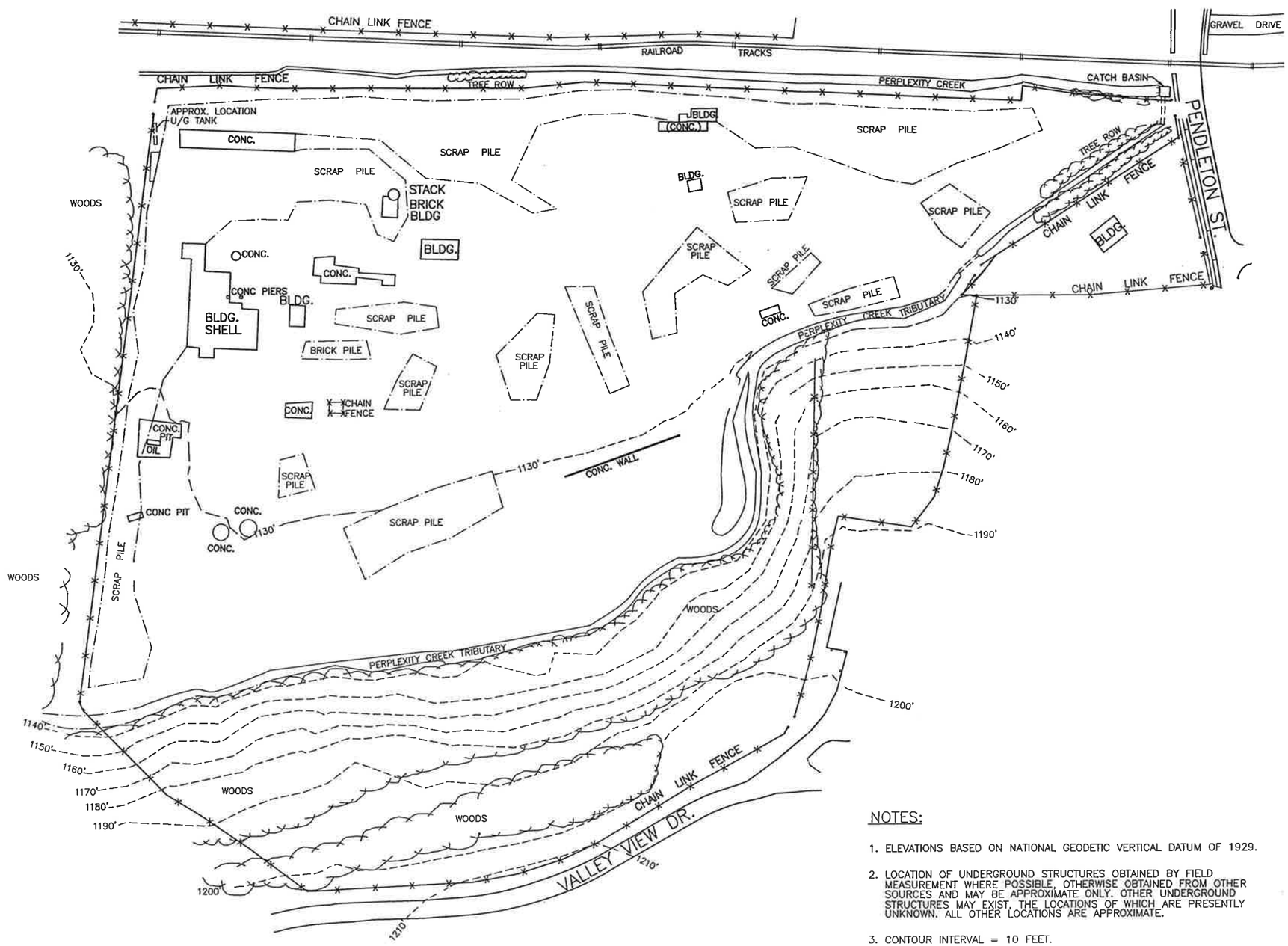
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CORTLAND, NEW YORK
FEASIBILITY STUDY REPORT

SELECTED INDICATOR PARAMETERS IN GROUND WATER MAY 1991 - AUGUST 1996

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

FIGURE 1-4B

X: (XREF)
L: (LAYER)
P: 49401SM1
4/30/97 SYR-54- RCB
49401070/49401N01.DWG



SITE ACTIVITIES:

1. LONG TERM MONITORING

SCALE

150' 0 150'

NOTES:

1. ELEVATIONS BASED ON NATIONAL GEODETIC VERTICAL DATUM OF 1929.
2. LOCATION OF UNDERGROUND STRUCTURES OBTAINED BY FIELD MEASUREMENT WHERE POSSIBLE, OTHERWISE OBTAINED FROM OTHER SOURCES AND MAY BE APPROXIMATE ONLY. OTHER UNDERGROUND STRUCTURES MAY EXIST, THE LOCATIONS OF WHICH ARE PRESENTLY UNKNOWN. ALL OTHER LOCATIONS ARE APPROXIMATE.
3. CONTOUR INTERVAL = 10 FEET.
4. CONCEPTUAL DRAWING – FOR PURPOSES OF FEASIBILITY STUDY DOCUMENT ONLY. FINAL LOCATIONS OF ITEMS ASSOCIATED WITH REMEDIAL ACTIONS (e.g., STRUCTURES, WELLS, PIPING) TO BE DETERMINED DURING REMEDIAL DESIGN.

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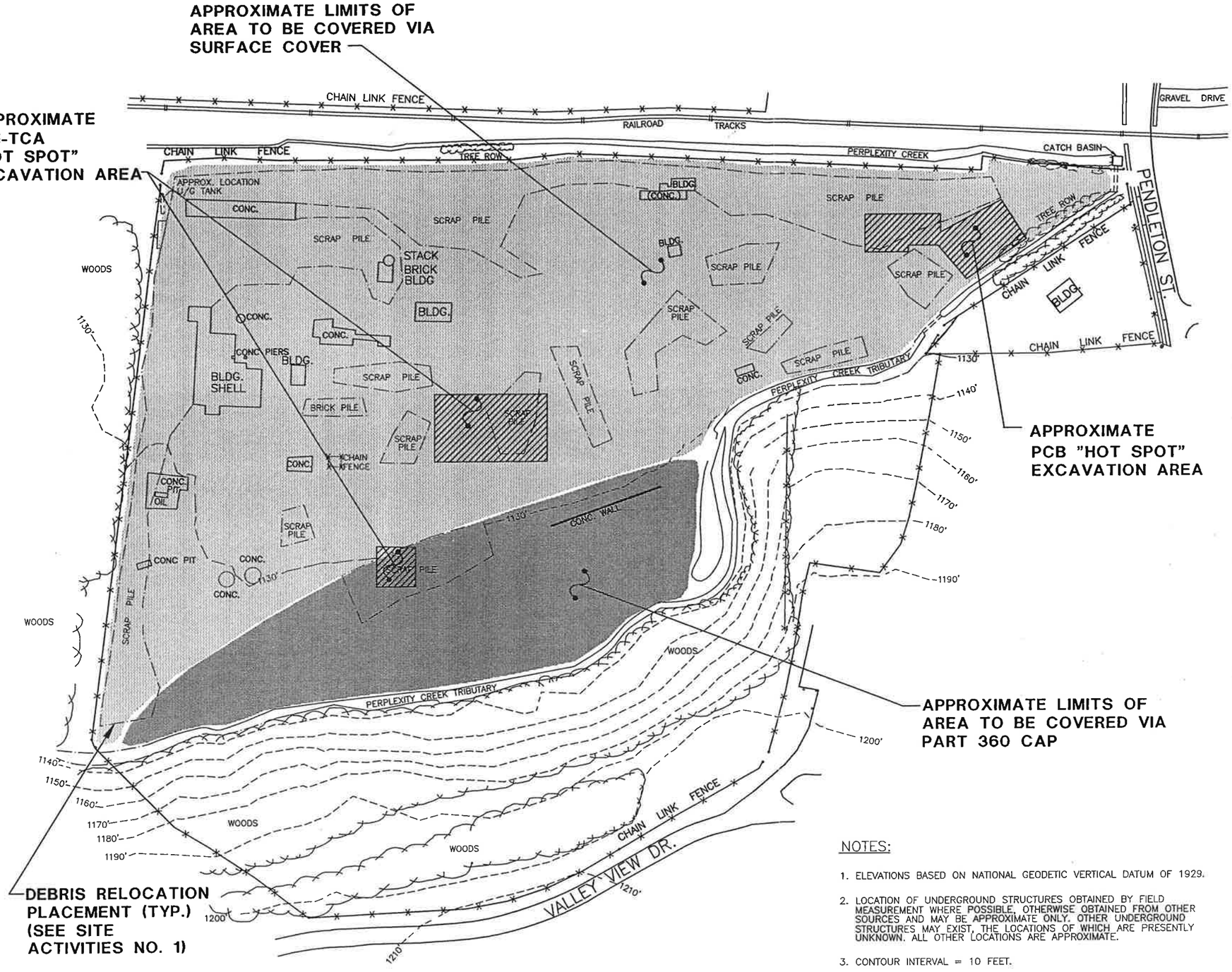
FEASIBILITY STUDY REPORT

ALTERNATIVE 1

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FIGURE 4-1

L: ON=*; OFF=252SHADE,254SHADE,ALT2,ALT3,ALT3T,ALT4,ALT4T,ALT5,ALT8,CREXSHAD
4/28/97 54-PGL RCB DMW
49401070\49401PR2.DWG



SITE ACTIVITIES:

1. ON-SITE RELOCATION OF SURFACE DEBRIS BENEATH PART 360 CAPPED AREA.
2. PLACE 6NYCRR PART 360 CAP OVER FORMER COOLING POND AREA (APPROXIMATELY 3 ACRES).
3. COVER REMAINING SURFACE AREA OF SITE (APPROXIMATELY 16.2 ACRES) WITH SURFACE COVER.
4. EXCAVATION OF PCB AND TCA "HOT SPOT" AREAS AND SUBSEQUENT RELOCATION UNDER THE PART 360 CAP.

SCALE
150' 0 150'

NOTES:

1. ELEVATIONS BASED ON NATIONAL GEODETIC VERTICAL DATUM OF 1929.
2. LOCATION OF UNDERGROUND STRUCTURES OBTAINED BY FIELD MEASUREMENT WHERE POSSIBLE. OTHERWISE OBTAINED FROM OTHER SOURCES AND MAY BE APPROXIMATE ONLY. OTHER UNDERGROUND STRUCTURES MAY EXIST, THE LOCATIONS OF WHICH ARE PRESENTLY UNKNOWN. ALL OTHER LOCATIONS ARE APPROXIMATE.
3. CONTOUR INTERVAL = 10 FEET.
4. CONCEPTUAL DRAWING – FOR PURPOSES OF FEASIBILITY STUDY DOCUMENT ONLY. FINAL LOCATIONS OF ITEMS ASSOCIATED WITH REMEDIAL ACTIONS (e.g., STRUCTURES, WELLS, PIPING) TO BE DETERMINED DURING REMEDIAL DESIGN.

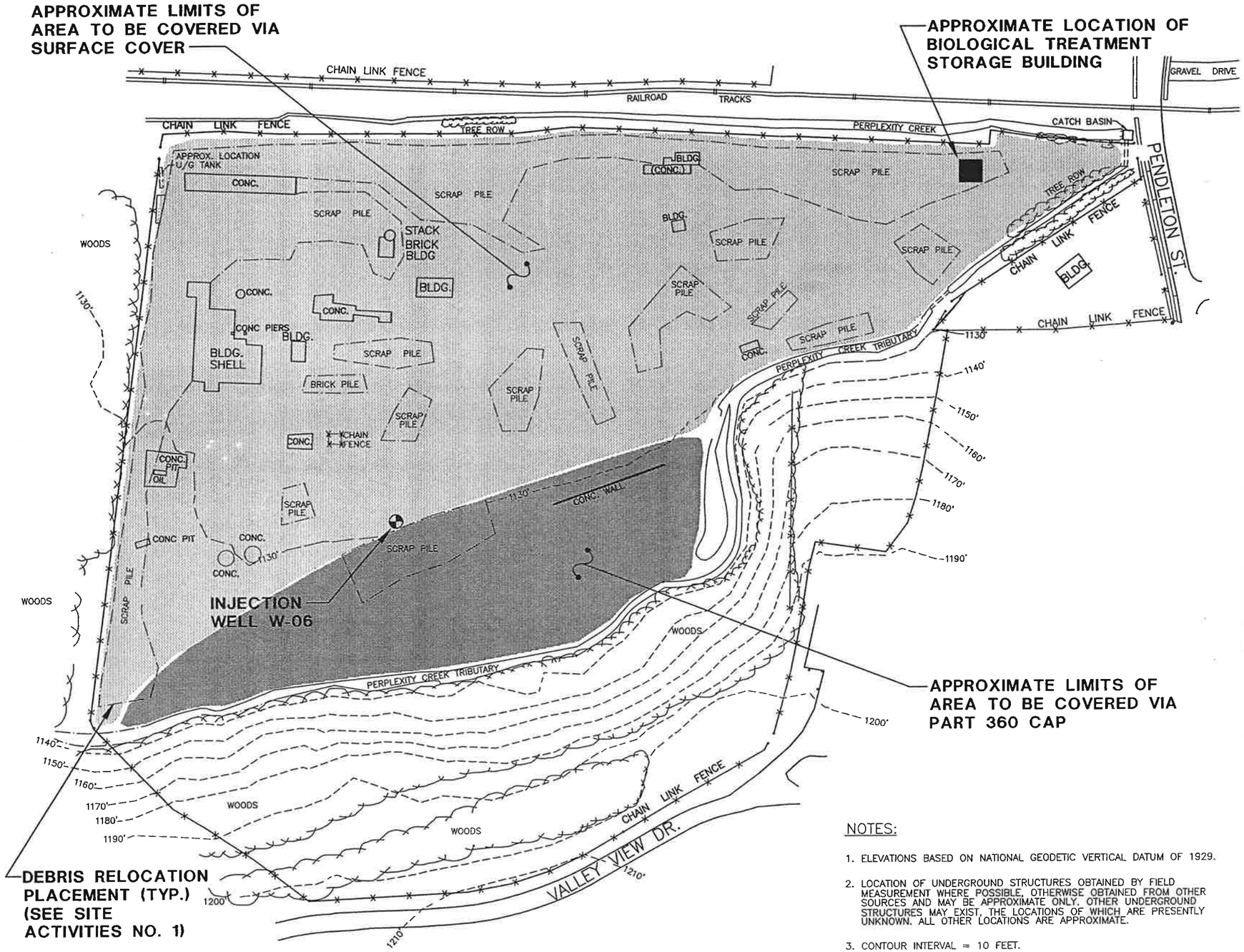
ROSEN SITE
CORTLAND, NEW YORK
FEASIBILITY STUDY REPORT

ALTERNATIVE 2

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

FIGURE 4-2

P: FSR
L: ON=*; OFF=ALT1,ALT2,ALT4,ALT4T,ALT5,ALT8
4/28/97 54-POL RCB DMW
49401070\49401PR4.DWG



SITE ACTIVITIES:

1. ON-SITE RELOCATION OF SURFACE DEBRIS BENEATH PART 360 CAPPED AREA.
2. PLACE 6NYCRR PART 360 CAP OVER FORMER COOLING POND AREA (APPROXIMATELY 3 ACRES).
3. COVER REMAINING SURFACE AREA OF SITE (APPROXIMATELY 16.2 ACRES) WITH SURFACE COVER.
4. INSTALL BIOLOGICAL TREATMENT SYSTEM (CONSTRUCT STORAGE BUILDING AND USE EXISTING WELL W-06 AS AN INJECTION WELL).

SCALE
150' 0 150'

NOTES:

1. ELEVATIONS BASED ON NATIONAL GEODETIC VERTICAL DATUM OF 1929.
2. LOCATION OF UNDERGROUND STRUCTURES OBTAINED BY FIELD MEASUREMENT WHERE POSSIBLE, OTHERWISE OBTAINED FROM OTHER SOURCES AND MAY BE APPROXIMATE ONLY. OTHER UNDERGROUND STRUCTURES MAY EXIST, THE LOCATIONS OF WHICH ARE PRESENTLY UNKNOWN. ALL OTHER LOCATIONS ARE APPROXIMATE.
3. CONTOUR INTERVAL = 10 FEET.
4. CONCEPTUAL DRAWING – FOR PURPOSES OF FEASIBILITY STUDY DOCUMENT ONLY. FINAL LOCATIONS OF ITEMS ASSOCIATED WITH REMEDIAL ACTIONS (e.g., STRUCTURES, WELLS, PIPING) TO BE DETERMINED DURING REMEDIAL DESIGN.

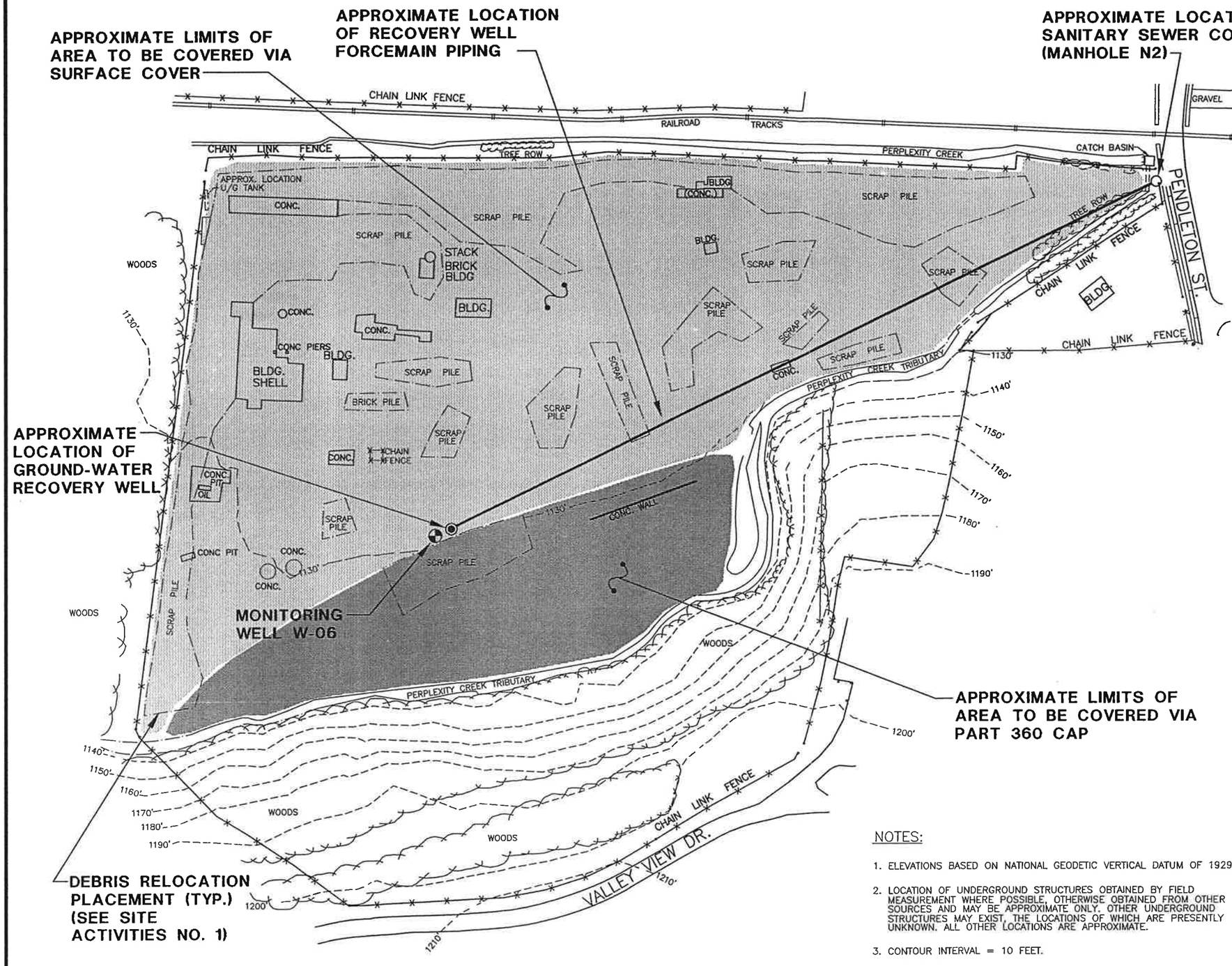
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FEASIBILITY STUDY REPORT

ALTERNATIVE 3

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FIGURE **4-3**

L: ON=*; OFF=ALT1,ALT2,ALT3T,ALT4,ALT4T,ALT6
4/28/97 54-PGL RCB DMW
49401070\49401PR5.DWG



SITE ACTIVITIES:

1. ON-SITE RELOCATION OF SURFACE DEBRIS BENEATH PART 360 CAPPED AREA.
2. PLACE 6NYCRR PART 360 CAP OVER FORMER COOLING POND AREA (APPROXIMATELY 3 ACRES).
3. COVER REMAINING SURFACE AREA OF SITE (APPROXIMATELY 16.2 ACRES) WITH SURFACE COVER.
4. INSTALL GROUND-WATER RECOVERY WELL NEAR MONITORING WELL W-06 AND INSTALL RECOVERY WELL DISCHARGE FORCEMAIN PIPING TO CITY OF CORTLAND WWTP SANITARY SEWER.

SCALE
150' 0 150'

NOTES:

1. ELEVATIONS BASED ON NATIONAL GEODETIC VERTICAL DATUM OF 1929.
2. LOCATION OF UNDERGROUND STRUCTURES OBTAINED BY FIELD MEASUREMENT WHERE POSSIBLE, OTHERWISE OBTAINED FROM OTHER SOURCES AND MAY BE APPROXIMATE ONLY. OTHER UNDERGROUND STRUCTURES MAY EXIST, THE LOCATIONS OF WHICH ARE PRESENTLY UNKNOWN. ALL OTHER LOCATIONS ARE APPROXIMATE.
3. CONTOUR INTERVAL = 10 FEET.
4. CONCEPTUAL DRAWING – FOR PURPOSES OF FEASIBILITY STUDY DOCUMENT ONLY. FINAL LOCATIONS OF ITEMS ASSOCIATED WITH REMEDIAL ACTIONS (e.g., STRUCTURES, WELLS, PIPING) TO BE DETERMINED DURING REMEDIAL DESIGN.

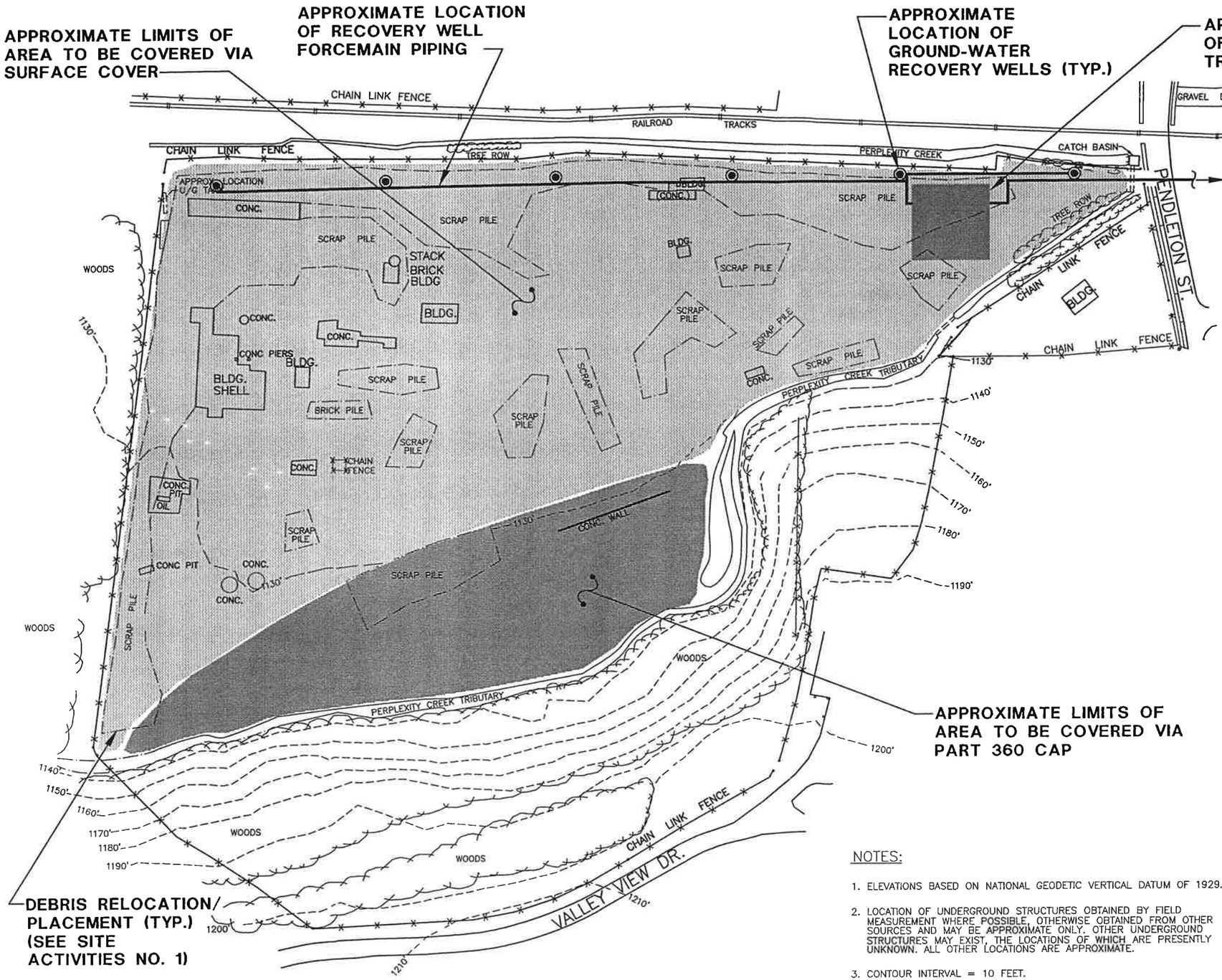
ROSEN SITE
CORTLAND, NEW YORK
FEASIBILITY STUDY REPORT

ALTERNATIVE 4

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

FIGURE 4-4

P: FSR
L: ON=*; OFF=ALT1,ALT2,ALT3T,ALT5,ALT6
4/28/97 54-PGL RCB DMW
49401070\49401PR3.DWG



SITE ACTIVITIES:

1. ON-SITE RELOCATION OF SURFACE DEBRIS BENEATH PART 360 CAPPED AREA.
2. PLACE 6NYCRR PART 360 CAP OVER FORMER COOLING POND AREA (APPROXIMATELY 3 ACRES).
3. COVER REMAINING SURFACE AREA OF SITE (APPROXIMATELY 16.2 ACRES) WITH SURFACE COVER.
4. INSTALL SIX GROUND-WATER RECOVERY WELLS, RECOVERY WELL FORCEMAIN PIPING, TREATMENT SYSTEM (AIR STRIPPING, METALS REMOVAL AND DISCHARGE PUMP STATION), AND DISCHARGE FORCEMAIN PIPING TO TIOUGHNIOGA RIVER.

SCALE
150' 0 150'

NOTES:

1. ELEVATIONS BASED ON NATIONAL GEODETIC VERTICAL DATUM OF 1929.
2. LOCATION OF UNDERGROUND STRUCTURES OBTAINED BY FIELD MEASUREMENT WHERE POSSIBLE, OTHERWISE OBTAINED FROM OTHER SOURCES AND MAY BE APPROXIMATE ONLY. OTHER UNDERGROUND STRUCTURES MAY EXIST, THE LOCATIONS OF WHICH ARE PRESENTLY UNKNOWN. ALL OTHER LOCATIONS ARE APPROXIMATE.
3. CONTOUR INTERVAL = 10 FEET.
4. CONCEPTUAL DRAWING – FOR PURPOSES OF FEASIBILITY STUDY DOCUMENT ONLY. FINAL LOCATIONS OF ITEMS ASSOCIATED WITH REMEDIAL ACTIONS (e.g., STRUCTURES, WELLS, PIPING) TO BE DETERMINED DURING REMEDIAL DESIGN.

ROSEN SITE
CORTLAND, NEW YORK
FEASIBILITY STUDY REPORT

ALTERNATIVE 5

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

FIGURE **4-5**

L: ON=*; OFF=ALT1,ALT2,ALT3T,ALT4T,ALT5
4/28/97 54-PGL AK RCB DMW
49401070\49401PR6.DWG

Appendices

Appendix A

Appendix A

BLASLAND, BOUCK & LEE, INC.
engineers & scientists

Aquifer Test Program (ATP)

Appendix A - Aquifer Test Program (ATP)

A.1 Introduction

An ATP was conducted as an addendum to the RI to estimate Site aquifer hydraulic coefficients.

This appendix presents the results of an ATP at the Site. The primary objective of the ATP was to estimate the aquifer hydraulic coefficients at the Site for use in the FS and, if necessary, remedial design. The following work efforts were associated with the ATP:

- Installation of a pumping well and an observation well;
- Preliminary aquifer testing;
- Pre-test ground-water elevation monitoring;
- Aquifer performance testing;
- Recovery ground-water elevation monitoring; and
- Aquifer test analysis and reporting.

The ATP was conducted in accordance with the project documents prepared for the RI/FS, including the October 1994 Addendum to the Work Plan RI/FS (BB&L, October 1994), Sampling and Analysis Plan (SAP, Blasland & Bouck, December 1990), and the Health and Safety Plan (HSP, Blasland & Bouck, December 1990). The October 1994 Addendum set forth the work efforts associated with the ATP. The SAP is comprised of two documents: the Field Sampling Plan (FSP), and the Quality Assurance Project Plan (QAPP). The FSP contains detailed procedures to implement the RI field investigations. Attachment A-1 specifies the additional procedures required to implement the ATP. The QAPP contains the quality assurance/quality control (QA/QC) procedures necessary to achieve the project data quality objectives (DQOs). The HSP contains the procedures and plans that were followed during the ATP to protect on-site worker health and safety.

Wells from the existing monitoring network and two new wells installed for the ATP provided the data acquisition locations for the aquifer performance testing. A 6-inch diameter pumping well (W-25) and a 2-inch diameter observation well (W-26) were installed. While ground-water elevations were monitored throughout the Site during the ATP, the data from the new wells (W-25 and W-26) and two existing monitoring wells (W-02 and W-11) were the most useful potentiometric-response data recorded during the aquifer performance test.

Prior to aquifer performance testing, ground-water elevations were monitored to establish background potentiometric conditions. A preliminary aquifer test was conducted to identify the appropriate pumping rate for the aquifer performance testing. After the appropriate pumping rate was established, the aquifer test was conducted. Ground-water elevations were also monitored during the recovery period to check the results of the pumping phase of the aquifer test.

Aquifer transmissivity, hydraulic conductivity, storativity, and specific yield were estimated using the methods of Hantush and Jacob (1955), Neuman (1975), and Cooper-Jacob (1944). In addition, the results of the aquifer coefficient estimation are described in Attachment A-2.

A detailed description of the ATP is presented below.

A.2 Background Information

The ATP was designed to test the response to pumping and to better estimate the hydraulic coefficients of the upper outwash aquifer.

The hydrogeologic system at the Site is comprised of the upper outwash water table aquifer, the lacustrine confining unit, the fully saturated lower sand and gravel aquifer, and the saturated kame terrace aquifer. These deposits are underlain by glacial till and shale bedrock. Ground water within these deposits at the Site generally flows to the northeast. The lacustrine unit is not present in the southern (upgradient) portion of the Site. In this area, the upper outwash, collapsed kame terrace deposits, and the lower sand and gravel unit may be considered one hydrogeologic unit. Near the northern perimeter and downgradient of the Site, the outwash unit and lower sand and gravel unit are hydrogeologically separated by the lacustrine unit.

The ATP was designed to primarily test the response of the upper outwash unit to pumping to estimate the hydraulic coefficients of the upper outwash. The upper outwash saturated thickness, measured from the water table to the top of the lacustrine unit, varies from approximately 39 to 47 feet, depending on ground-water flow conditions.

Results of in-situ hydraulic conductivity testing ("slug testing") conducted during the RI yielded hydraulic conductivity estimates of 4.8×10^{-2} centimeters per second (cm/sec) (134.8 feet/day) to 1.2×10^{-3} cm/sec (3.3 feet/day) for the upper outwash. The geometric mean of slug test hydraulic conductivity estimates was 7.7×10^{-3} cm/sec, or 22 feet/day. The slug test data may be interpreted as a first-order assessment of the horizontal hydraulic conductivity in the immediate vicinity of each tested well. The purpose of the ATP, therefore, was to quantify the hydraulic coefficients of the upper outwash on a larger scale, that may be considered more representative of site-wide ground-water hydraulics.

Additional background information is provided in Sections 3.2 Geologic Characterization and

3.3 Hydrogeologic Characterization of the RI Report (BB&L, May 1994).

A.3 Installation of Pumping Well W-25 and Observation Well W-26

One new pumping well and one new observation well were installed near the center of the VOC plume near the northern perimeter of the Site.

Based on review of available data, and the requirement that the ATP provide further definition of aquifer characteristics for remedial alternative comparisons, two new wells were installed. One 6-inch-diameter well (W-25) was installed approximately 35 feet east of the W-02/W-11/W-15 well cluster to serve as the pumping well for the aquifer test. The aquifer test location was selected because it is near the northern perimeter of the Site and near the center of the VOC plume in the upper outwash. In addition, placement of the pumping well near the W-02/W-11/W-15 well cluster provided nearby observation wells in the upper and lower part of the upper outwash and the lower sand and gravel unit. One new observation well (W-26) was also installed approximately 26 feet southwest of new pumping well W-25. Observation well W-26 was installed near pumping well W-25 to allow better monitoring of early drawdown data. Figure A-1 presents the location of the observation well network and the new well locations. These well installations generally followed the procedures outlined in Appendix G of the FSP (BB&L, December 1990).

Well logs for the two new wells (W-25 and W-26) are presented in Attachment A-3. Drilling operations were conducted using 4.25-inch inner diameter (ID) hollow-stem augers for the 2-inch well and 10.25-inch ID hollow-stem augers for the 6-inch pumping well. The drill rig and associated augers and hand tools were cleaned according to the procedures in Appendix E of the FSP (BB&L, December 1990). Split-spoon samplers were cleaned with an

Alconox wash and control water rinse. Field screening of soils/fill samples was performed using a photo-ionization detector (PID). All soils/fill cuttings were contained and stored on-site for subsequent disposal.

Standard split-spoon sampling at approximately 5-foot intervals was conducted at the W-26 location from 0 to 14 feet below ground surface (bgs), and continuous sampling was conducted from 14 to 58 feet bgs. The lacustrine unit was encountered at W-26 at approximately 57 feet bgs. To minimize the potential problems associated with drilling the large diameter borehole (e.g., running sands) at W-25, bentonite slurry was added to the borehole. In addition, all soils/fill sampling was conducted at the W-26 location. Drilling progress was slow at the W-25 location due to the presence of coarser-grained soils/fill from approximately 17 to 35 feet. This was evidenced in the field by the sound of the drill rig and the occasional plugging of the bottom of the augers with cobbles or boulders.

Five soils/fill samples were submitted to Recra Environmental for leachable TOC analysis performed according to USEPA Method 9060M. Soils/fill samples were selected to provide representative TOC values throughout the sampled interval. Analytical results are presented in Appendix B.

One 6-inch ID Schedule 80 PVC pumping well (W-25) was installed on December 22, 1994, to approximately 51 feet bgs with a 35-foot-long, 0.020-inch slotted well screen. An 8-inch-diameter, locking, protective steel casing was installed over the pumping well to approximately 2.5 feet above ground surface (ags).

Grain-size analysis results from a sample previously collected from monitoring well W-11 were used to determine the appropriate slot size for the pumping well screen. This sample was collected from approximately 44 to 46 feet bgs, near the base of the upper outwash. In accordance with production-well design principles, a No. 0 graded sand filter pack and the 0.020-inch slotted screen were selected to allow approximately 95 percent of the sandpack to be retained during development (Driscoll, 1986).

One 2-inch ID Schedule 40 PVC well (W-26) was installed on December 20, 1994. The base of the screen was set to approximately 50 feet bgs, near the base of the upper outwash. Consistent with the other monitoring wells at the Site, this well was installed with a 10-foot-long, 0.010-inch slotted well screen. A 4-inch diameter, locking, protective steel casing was installed over this observation well to approximately 2 feet ags.

A Morie No. 0 washed silica sand pack, used for wells W-25 and W-26, was installed to at least 2 feet above the top of the well screen. The sandpack on the pumping well (W-25) was installed to approximately 8.5 feet above the top of the screen, which corresponds to the water table observed during drilling. Effectively, this sandpack installation extends the hydraulic connection between the well and the aquifer to the water table. An approximately 2-foot bentonite chip seal was emplaced above each sandpack. The remainder of the annular space was filled with a 5-to-1 mixture of Portland Cement and bentonite to within approximately 1.5 feet of ground surface. A cement surface seal, extending at least 6 inches beyond the protective casing, was installed at each new well location. Keyed-alike brass locks were placed on both wells.

Development of the two new wells occurred on December 23 and 27, 1994. The new pumping well (W-25) was developed by first surging the well screen with a surge block attached to drilling rods. The surging of both new wells began at the bottom of the well screen and moved gradually to the top of the screen, using two-foot strokes. About 20 gallons of water was removed from W-25 during surging. After approximately two hours of surging, a decontaminated PVC bailer was used to remove 90 gallons of water. An inertial pump with dedicated high-density polyethylene (HDPE) tubing (i.e., Waterra pump) was then used to remove approximately 80 gallons of water in 1.5 hours. Finally, after turbidity had been reduced enough to allow introduction of a submersible pump, a 4-inch diameter pump was used to remove an additional 470 gallons of water in approximately 5 hours. A total of approximately 660 gallons of water (11 well volumes) was removed and about 11 hours of development was performed on well W-25. The new observation well (W-26) was developed by first surging the well screen with a decontaminated PVC bailer for approximately two hours, and removing a total of 105 gallons of water (17 well volumes) with either the PVC bailer or an inertial pump with dedicated tubing. Water generated during drilling and development activities was contained on-site for subsequent disposal.

Survey location elevations, referenced to the National Geodetic Vertical Datum (NGVD) of 1929 and the existing Site survey, were obtained for the top of protective casing, top of inner casing, and grade for both new wells (W-25 and W-26). Elevations and coordinates of a replacement stream reference point for SP-2 and a new stream reference point SP-5 were also surveyed at this time. SP-5 was located north of the pumping well (W-25) to monitor the water level elevation of Perplexity Creek during aquifer performance testing.

A.4 Preliminary Aquifer Testing

The preliminary aquifer testing indicated that a pumping rate of at least 30 gpm was necessary. A rate of 80 gpm was selected to more substantially stress the aquifer and provide more reliable drawdown data during the testing period.

A preliminary drawdown test was conducted on December 28, 1994 to support an empirical assessment of the magnitude of drawdown achievable during constant-rate pumping. The purpose of this preliminary test was to identify the appropriate pumping rate for the aquifer test. Pressure transducers and an automatic data logger system were installed to monitor the drawdown in the pumping well (W-25) and three observation wells (W-02, W-11, and W-26) during the preliminary drawdown test, pre-test ground-water elevation monitoring, and the actual aquifer performance testing. These wells were selected due to their close proximity to pumping well (W-25) and to provide monitoring points at various intervals in the upper outwash. Well W-02 is screened in the upper section of the upper outwash, while W-11 and W-26 are screened near the base of the upper outwash. The pumping well (W-25) is essentially fully-penetrating, as it screens 35 feet of the 47 feet of saturated thickness of the upper outwash. As previously discussed, the sandpack of the pumping well extends to the water table, thereby effectively increasing the hydraulic connection to 43.5 feet of the 47 feet of saturated thickness observed at that location. It was not possible to screen the lower 3.5 feet of the aquifer due to drilling difficulties.

A nominal 4-inch diameter, 1-horsepower Grundfos submersible pump was temporarily installed in well W-25 for the purpose of the preliminary drawdown test. The pumping rate was initially maintained at approximately 15 gpm for 2.4 hours. At the end of this first step of the preliminary drawdown test, 0.51 feet of drawdown was observed in the pumping well, and 0.13 feet of drawdown was observed at the closest observation well, W-26. A second step of the preliminary drawdown test was initiated at 30 gpm. After 1.4 hours of pumping at 30 gpm, 1.03 feet of drawdown was measured in the pumping well, and 0.27 feet of drawdown was measured in well W-26. A Sensus in-line totalizing flow meter was used to measure the discharge during pumping. Approximately 4,700 gallons of water were pumped from well W-25 during the preliminary drawdown test. No measurable precipitation was recorded during the duration of the preliminary drawdown test. Based on the results of the preliminary pumping evaluation, a pumping rate of at least 30 gpm was deemed necessary during the aquifer performance test. A rate of 80 gpm was selected to more substantially stress the aquifer and provide reliable drawdown data during the aquifer performance test.

A.5 Pre-Test Ground-Water Elevation Monitoring

Pre-test monitoring included three weeks of automatic water level recording at three observation wells and the pumping well and four complete manual water level recording rounds.

The pre-test monitoring was initiated on December 29, 1994, after the new wells were developed and ground-water levels had fully recovered. Pressure transducers were installed in three observation wells (W-02, W-11, W-26) and the pumping well (W-25) to record water level changes on a data logger system. Originally this monitoring period was intended to last only for three days, but due to postponement of aquifer performance testing, this monitoring was conducted for three weeks prior to the actual aquifer test. The data logger system recorded the water levels in the four wells at two-hour intervals. The water level fluctuations measured in these select wells are presented on Figure A-2. On January 15, 1995 and toward the end of the pre-test monitoring period, the ground-water elevation at well W-25 was beyond the pressure range of the well. This condition is indicated on Figure A-2 where the graph of the water level fluctuation at W-25 becomes a flat line.

In conjunction with the continuous monitoring, ground-water levels were measured at all Site monitoring wells, including upgradient and downgradient off-site wells. A total of four rounds of water levels were obtained on December 28, 1994; December 29, 1994; January 4, 1995; and January 19, 1995. These data are presented in Table A-1. Figure A-3 presents the configuration of the water table on January 19, 1995, prior to pumping for the aquifer test. Manual water level measurements were obtained according to the procedures presented in Appendix H of the FSP (BB&L, December 1990).

Pre-test monitoring was interrupted on January 4, 1995, to allow installation of a nominal 5.5-inch diameter, 5-horsepower Grundfos submersible pump. Well W-25 was pumped for approximately 17 minutes to establish the 80-gpm flow rate and to correlate it with in-line pressure gauge readings. During this trial run, a maximum drawdown of 3.60 feet was observed in the pumping well. After water levels had recovered from this brief pumping event, the pre-test monitoring was continued.

The background monitoring data presented on Figure A-2 and in Table A-1 indicate that the ground-water elevations were initially decreasing. On January 12, 1995, water levels began increasing likely due to precipitation events.

A.6 Aquifer Performance Testing

Well W-25 was pumped at 80 gpm for 8.2 hours with manual and automatic water level measurements made at three primary observation wells and the pumping well. Manual water level measurements were also obtained periodically at other Site wells.

Three ground-water samples were collected from the pumping well during the ATP and analyzed for VOCs, select metals, and other analyses.

Recovery monitoring included 12.9 hours of automatic water level measurements at three primary observation wells and the pumping well.

Based on the results of the preliminary drawdown test, a pumping rate of 80 gpm was selected for the actual aquifer test. Water generated during all phases of the ATP was contained in one 21,000-gallon capacity Baker Tank, and five 5,000-gallon capacity, lined roll-offs. Aquifer testing was conducted according to the procedures detailed in Attachment A-1. The following paragraphs describe the implementation of the aquifer performance testing.

The aquifer performance testing test consisted of extracting ground water from the pumping well at 80 gpm for 8.2 hours, and monitoring water levels continuously at a logarithmic rate with the data logger system at the three observation wells (W-02, W-11, W-26) and pumping well (W-25). In addition, manual water level measurements were obtained at these wells and at selected wells and stream reference points periodically throughout the aquifer test. A Grundfos nominal 5.5-inch diameter, 5-horsepower submersible pump was set near the bottom of the pumping well (W-25), with the intake at approximately 44 feet bgs. Pumping was initiated at 80 gpm on January 19, 1995. The data logger was set to begin recording at the initiation of pumping. Manual measurements were also obtained frequently in the pumping well (W-25) and the three closest observation wells (W-02, W-11, and W-26) during the first hour of the test. Manual water level measurements were obtained at secondary observation wells, as the cone of depression was observed to expand.

A Sensus totalizing flow meter and in-line pressure gauge were used to continually monitor the discharge during pumping. Approximately 39,000 gallons of water were pumped from well W-25 during aquifer performance testing. The discharge remained constant throughout the test, except for a five minute period of time when the discharge line was reduced in length to switch from the Baker Tank to the roll-offs. For those five minutes the discharge rate varied from 80 to 92 gpm, to average approximately 85 gpm. This occurred approximately four hours into the test, while the recording frequency of the data logger was one measurement every 15 minutes. Due to the magnitude, short duration, and the timing of this pumping variation, it had no measurable impact on the test.

The pumping well and the primary observation wells showed relatively rapid response during pumping. After one minute of pumping, 2.62 feet of drawdown was observed at the pumping well (W-25), 0.33 feet at the closest observation well (W-26), 0.21 feet at W-11, and 0.02 feet at W-02. The maximum observed drawdown in the pumping well (W-25) was 3.24 feet after 5.2 hours of pumping. The maximum drawdown in the closest observation well (W-26) was 0.76 feet at 4.2 hours. A complete round of water level measurements was obtained after approximately six hours of pumping. Based on the manual measurements from the secondary observations wells and the complete round of water levels, the cone of depression during pumping extended up to 400 feet in a north-south direction and approximately 550 feet in an east-west direction from the pumping well (W-25). After the 8.2 hours of pumping, the pump was turned off and recovery ground-water elevation monitoring was performed.

Precipitation data were recorded at least every three hours during the pumping phase of the test. No measurable precipitation was observed during aquifer performance testing.

Ground-water samples were collected from pumping well W-25 during the pumping phase of the test. The first sample was collected with a disposable bailer prior to the initiation of pumping. Samples were also obtained directly from a sampling port in the discharge pipe after approximately 1.5 hours of pumping and approximately 30 minutes prior to turning off the pump. The ground-water samples were submitted to Recra Environmental for the following analyses: TCL VOCs by USEPA Method 8240; total and dissolved calcium, iron, lead, and magnesium by USEPA Methods 6010/7000; pH by Method 9040, TSS by Method 160.2, BOD by Method 405.1, COD by Method 410.1, and total hardness as calcium carbonate by Method 130.2. These methodologies are not the same as the contract laboratory program (CLP) methodologies specified in the QAPP, but are sufficient for use in this evaluation. Analytical results are presented in Appendix B.

During the recovery period, water levels were also measured by the data logger system at a logarithmic rate in the wells with the pressure transducers (W-02, W-11, W-25, and W-26). The recovery monitoring continued for 12.9 hours. From these data, the pumping well (W-25) recovered to the water level observed prior to pumping in approximately two hours. The primary observation wells screened near the base of the upper outwash (W-11 and W-26) recovered to pre-test water levels in approximately 1.5 hours. The remaining primary observation well (W-02), screened near the top of the upper outwash, recovered in 2.7 hours. The overall ground-water trend appears to have been continuing to rise during the aquifer performance test. This is evidenced by the continuation of rising water levels after the wells monitored by the pressure transducers had recovered to the pre-pumping water levels.

Manual water level measurements were obtained during the first 1.5 hours of recovery monitoring from selected wells. Specifically, the recovery of the closest secondary observation wells, W-10, W-03, and W-12 was monitored. Well W-10, which is located approximately 260 feet east of the pumping well (W-25) and screened in the upper outwash/collapsed kame unit, showed a maximum drawdown of 0.23 feet after approximately seven hours of pumping. This well recovered to within 65 percent of the static water level after 44 minutes of recovery monitoring. Wells W-03 and W-12, screened in the upper and lower portions of the upper outwash, respectively, are located in a cluster approximately 560 feet west of the pumping well (W-25). Well W-03 showed apparent drawdown of 0.04 feet, but during 27 minutes of recovery monitoring, showed no measurable recovery. Well W-12 showed maximum drawdown of 0.36 feet after approximately two hours of pumping, which did not increase in subsequent manual measurement taken at approximately one hour intervals. This well recovered to within 92 percent of the static water level after 25 minutes of recovery monitoring. Well W-15, screened in the lower sand and gravel unit and located approximately 41 feet west of the pumping well (W-25), showed a maximum drawdown of 0.32 feet after approximately six hours of pumping. This well was fully recovered in less than 41 minutes of recovery monitoring.

A.7 Aquifer Test Analysis

Aquifer hydraulic coefficients of transmissivity, hydraulic conductivity, and short-term storativity were calculated using AQTESOLV software.

The aquifer test data were evaluated analyzed using the AQTESOLV aquifer-test data analysis software package. The following methods were used to calculate transmissivity, hydraulic conductivity, and short-term storativity of the aquifer: Neuman (1975), Hantush-Jacob (1955), and Cooper-Jacob (1946).

The results of these analyses are presented in Attachment A-2, Aquifer Performance Test Data Analysis.

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TABLE A-1

GROUND-WATER/SURFACE-WATER ELEVATIONS
AQUIFER TEST PROGRAM

ROSEN SITE
CORTLAND, NEW YORK

Well	Top of Well Elevation 1	Water Elevation (ft.)				
		12/28/94	12/29/94	01/04/95	01/19/95	01/19/95-p
W-01	1124.30	1110.14	1110.24	1110.01	1111.65	1111.63
W-02	1125.69	1114.25	1114.09	1113.93	1115.17	1114.92
W-03	1128.44	NA	1116.68	1117.09	1119.45	1119.42
W-04	1138.12	NA	1134.76	1134.42	1135.13	1135.15
W-05	1130.84	1116.65	1116.51	1116.39	1119.18	1119.18
W-06	1131.43	1123.54	1123.31	1123.10	1126.54	1126.57
W-07	1125.87	1113.70	1113.68	1113.56	1115.61	1115.57
W-08	1123.61	1109.06	1108.99	1108.81	1109.82	1109.77
W-09	1123.57	1109.66	1109.60	1109.43	1110.50	1110.45
W-10	1123.36	1112.70	1112.64	1112.51	1113.86	1113.63
W-11	1124.47	1111.48	1111.24	1111.10	1111.99	1111.49
W-12	1127.63	1113.08	1113.06	1112.92	1114.02	1113.66
W-13	1132.21	1123.43	1123.22	1122.81	1129.09	1129.09
W-14	1132.19	1122.39	1122.23	1122.08	1124.58	1124.55
W-15	1125.02	1111.42	1111.31	1111.18	1112.06	1111.74
W-16	1122.63	1110.44	1110.26	1110.18	1110.71	1110.59
W-17	1122.28	1109.99	1109.95	1109.83	1110.43	1110.41
W-18	1120.86	1108.52	1108.42	1108.29	1109.04	1109.01
W-19	1120.67	1108.24	1108.12	1108.00	1108.54	1108.46
W-20	1120.63	1108.24	1108.08	1107.98	1108.41	1108.44
W-21	1144.42	1130.55	1130.27	1130.13	1131.08	1131.23
W-22	1135.35	1117.75	1117.70	1117.36	1120.40	1120.43
W-23	1137.44	1128.32	1128.14	1127.44	1128.37	1128.45
W-24	1137.16	1127.23	1127.16	1126.36	1127.22	1127.32
W-25	1124.50	1112.73	1112.60	1112.50	1113.67	1110.51
W-26	1124.60	1111.96	1111.85	1111.69	1112.75	1112.00
Stream Point	Top of Stream Point Elevation	12/28/94	12/29/94	1/11/95	01/19/95	01/19/95
SP-1	1136.3	NA	NA	NA	NA	NA
SP-2	1120.8	NA	NA	NA	NA	NA
SP-3	1117.7	NA	NA	NA	NA	NA
SP-4	1117.2	NA	NA	NA	NA	NA
SP-2A	1124.16	NA	NA	1120.56	1121.68	1121.82
SP-3A	1120.01	NA	NA	1118.46	NA	NA
SP-5	1121.8	NA	NA	1119.05	1119.26	1119.29

Notes:

Elevations are in feet above mean sea level based on National Geodetic Vertical Datum of 1929.

NA - Indicates water elevations were not measured.

1Top of inner casing.

An aquifer test was performed on 1/19/95 by pumping W-25 at 80 gpm for approximately 8 hours. The first round of water levels for that date represents the static water conditions prior to pumping. The second round of water levels was collected after approximately 6 hours of pumping W-25 at 80 gpm.

TABLE A-2

GROUND-WATER ANALYTICAL RESULTS

JANUARY 19, 1995

ROSEN SITE AQUIFER TEST PROGRAM

CORTLAND, NEW YORK

Compound	W-25-1	W-25-2	W-25-3	New York State Standard/ Guidance Values	MCL/MCLG/ SMCL
Volatile Organics (ug/L)					
Acetone	**1,100 D**	39	< 10	50 (G)	
Chlorobenzene	0.4 J	< 5	< 5	5	100/100 (G)
1,1-Dichloroethane	**24**	**34**	**39**	5	
1,2-Dichloroethane	< 5	0.6 J	0.5 J	5	5/0 (G)
1,1-Dichloroethene	0.8 J	2 J	3 J	5	7/7 (G)
Toluene	0.3 J	< 5	< 5	5	1,000/1,000 (G)
1,1,1-Trichloroethane	**56**	**100**	**110**	5	200/200 (G)
Trichloroethene	0.6 J	0.6 J	0.6 J	5	5/0 (G)
Inorganics (ug/L)					
Calcium, unfiltered	120,000	170,000	177,000		
Calcium, filtered	124,000	171,000	183,000		
Iron, unfiltered	**5,080**	**2,900**	**2,970**	300	300 (S)
Iron, filtered	**5,250**	**2,940**	**2,990**	300	300 (S)
Lead, unfiltered	6.0	< 2	3.0	25	15
Lead, filtered	< 2	< 2	< 2	25	15
Magnesium, unfiltered	20,700	18,200	17,600	35,000 (G)	
Magnesium, filtered	20,500	18,200	18,100	35,000 (G)	
Wet Chemistry (mg/L)					
Biochemical Oxygen Demand (BOD)	740	< 2	< 2		
Chemical Oxygen Demand (COD)	1,500	60	34.2		
Non-filterable residue (103 C)	34.7	7.4	6.8		
pH (standard units)	6.96	7.07	7.16		6.5-8.5 (S)
Total hardness	406	525	563		

Notes:

All samples were analyzed for Target Compound List (TCL) Volatile Organic Compounds (VOCs) by USEPA Method 8240; however, only those parameters detected are listed on this table.

J - Indicates an estimated value.

D - Indicates all compounds identified in an analysis at a secondary dilution factor.

The < sign indicates the compound was analyzed for but not detected.

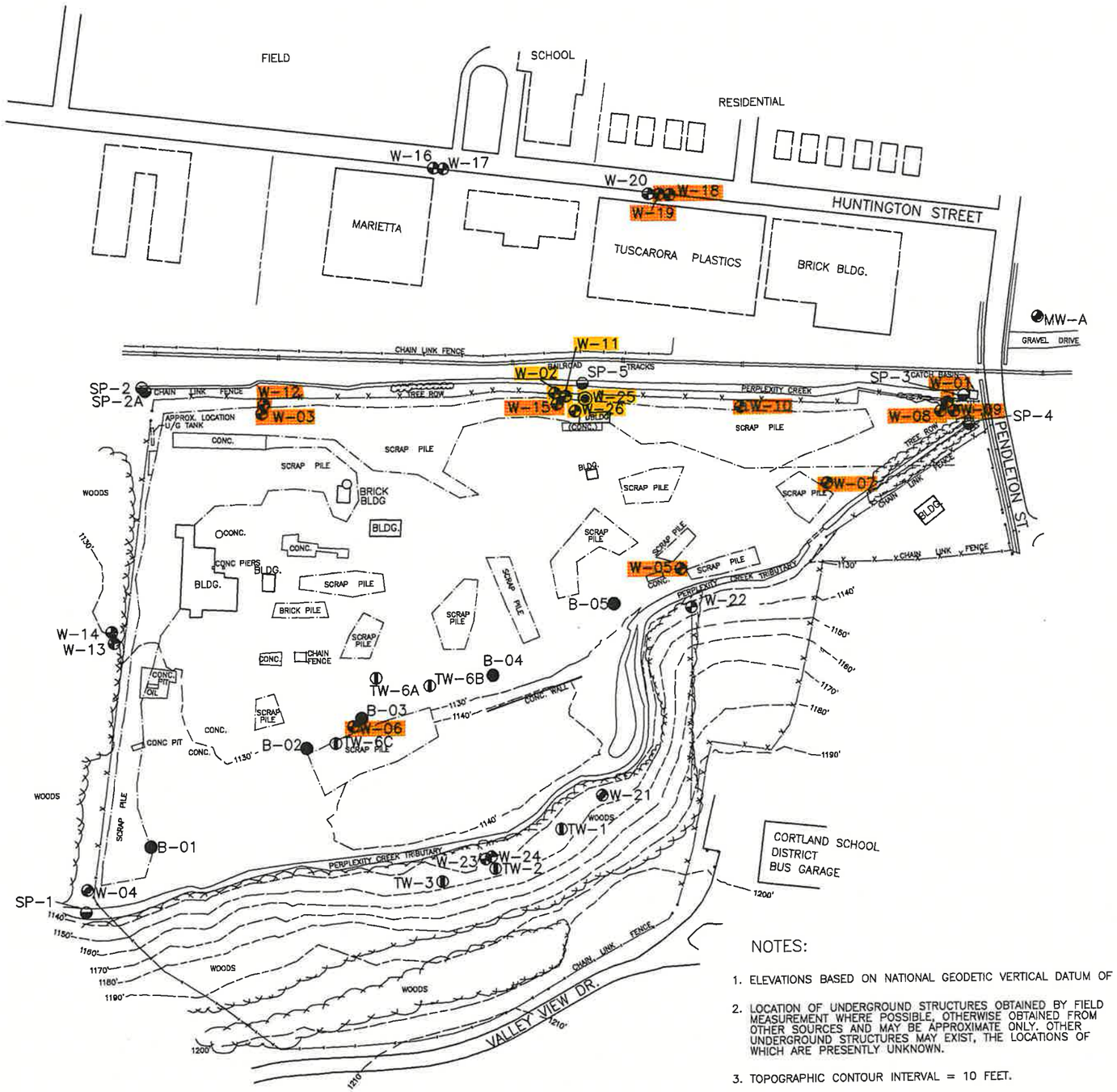
Bold indicates standards exceeded.

W-25-1 was collected just prior to the initiation of pumping, W-25-2 was collected after pumping at 80 gallons per minute (gpm) for approximately 1.5 hours, W-25-3 was collected approximately 0.5 hours prior to turning off the pump.

References:

Standard and guidance values are according to New York State Department of Environmental Conservation (NYSDEC), Division of Water Technical and Operation Guidance Series (1.1.1), Ambient Water Quality Standards and Guidance Values [designated by (G)], October 1993.

MCLs (Maximum Contaminant Levels), MCLGs [Maximum Contaminant Level Goals, designated by (G)], and SMCLs [Secondary Maximum Contaminant Levels, designated by (S)], according to the Code of Federal Regulations, Protection of Environment 40, Part 141, July 1, 1991, and the Drinking Water Regulations and Health Advisories, Office of Water, U.S. Environmental Protection Agency, December 1993.



LEGEND

- MONITORING WELL
- TEST BORING
- PUMPING WELL
- TEMPORARY WELL
- STREAM MONITORING POINT
- PRIMARY OBSERVATION WELL
- SECONDARY OBSERVATION WELL

SCALE

200' 0 200'

NOTES:

1. ELEVATIONS BASED ON NATIONAL GEODETIC VERTICAL DATUM OF 1929.
2. LOCATION OF UNDERGROUND STRUCTURES OBTAINED BY FIELD MEASUREMENT WHERE POSSIBLE, OTHERWISE OBTAINED FROM OTHER SOURCES AND MAY BE APPROXIMATE ONLY. OTHER UNDERGROUND STRUCTURES MAY EXIST, THE LOCATIONS OF WHICH ARE PRESENTLY UNKNOWN.
3. TOPOGRAPHIC CONTOUR INTERVAL = 10 FEET.

ROSEN SITE
CORTLAND, NEW YORK

FEASIBILITY STUDY REPORT

AQUIFER TEST PROGRAM OBSERVATION WELL NETWORK

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

FIGURE **A-1**

P: FSR
SITEMAP,TWNEW ON; BLOCKS; OS THEN MWLAYER; TESTHOLE, FROZEN L OFF
4/28/97 SYR-54-PGL AK DMW
49401070\49401G03.DWG

Rosen Site Aquifer Test Program

BACKGROUND WATER-LEVEL MONITORING 12/19/94 - 1/19/95

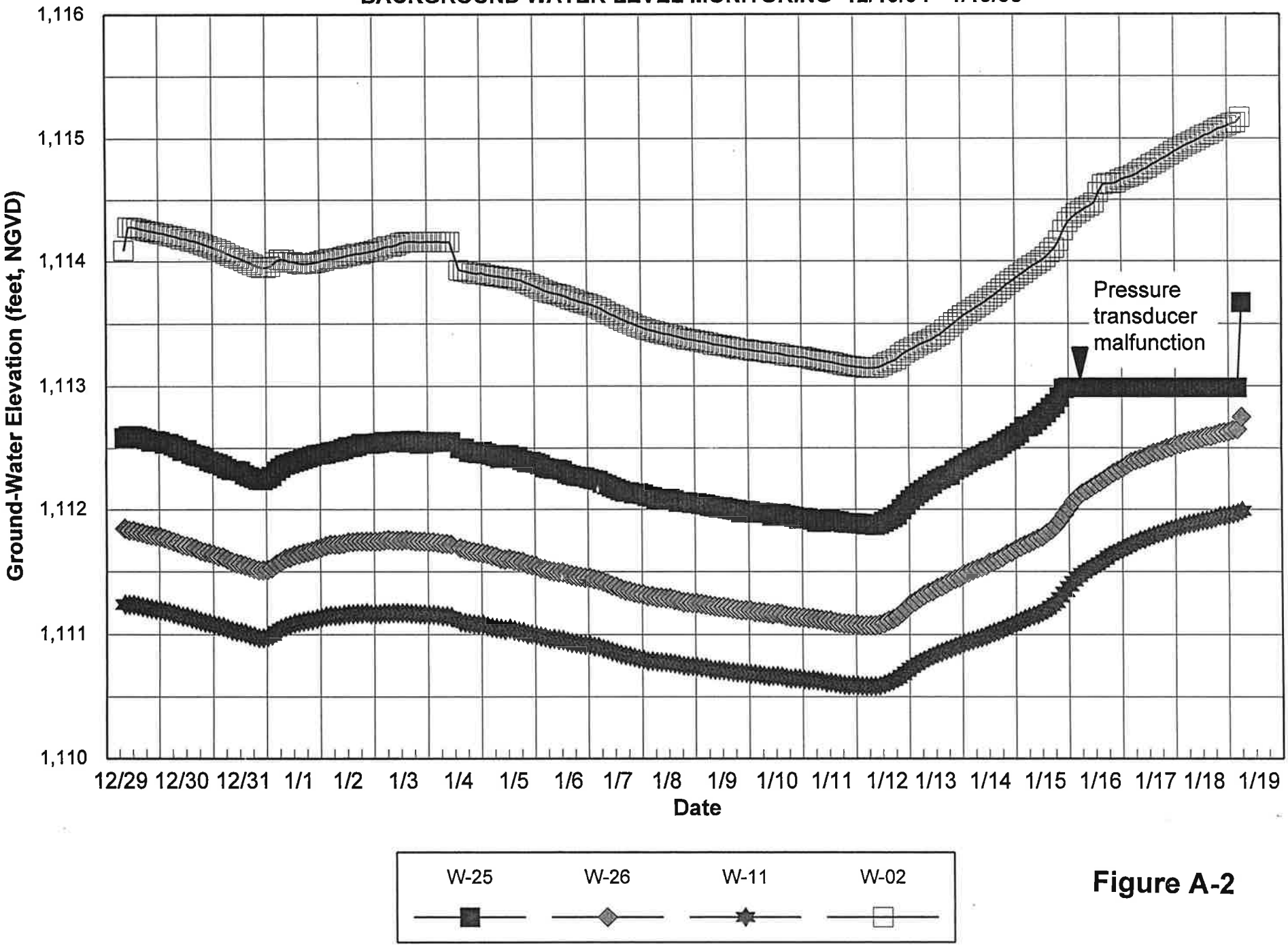
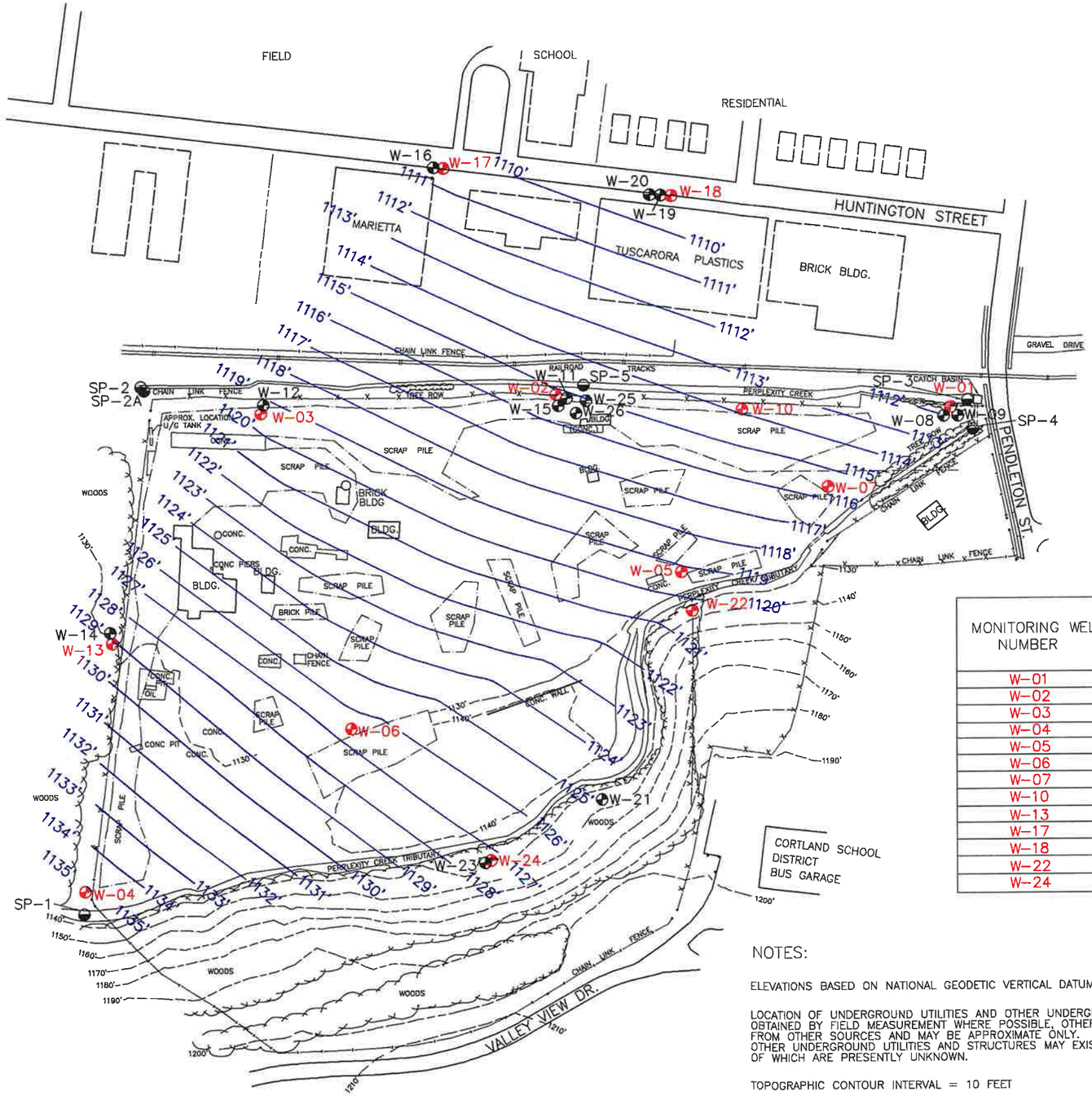


Figure A-2



LEGEND

- MONITORING WELL
- 1113' GROUND-WATER ELEVATION CONTOUR LINE
- STREAM MONITORING POINT

MONITORING WELL NUMBER	GROUND-WATER ELEVATION STATIC 1/19/95
W-01	1111.65
W-02	1115.17
W-03	1119.45
W-04	1135.13
W-05	1119.18
W-06	1126.54
W-07	1115.61
W-10	1113.86
W-13	1129.09
W-17	1110.43
W-18	1109.04
W-22	1120.40
W-24	1127.22

SCALE
200' 0 200'

NOTES:

ELEVATIONS BASED ON NATIONAL GEODETIC VERTICAL DATUM OF 1929.

LOCATION OF UNDERGROUND UTILITIES AND OTHER UNDERGROUND STRUCTURES OBTAINED BY FIELD MEASUREMENT WHERE POSSIBLE, OTHERWISE OBTAINED FROM OTHER SOURCES AND MAY BE APPROXIMATE ONLY. OTHER UNDERGROUND UTILITIES AND STRUCTURES MAY EXIST, THE LOCATIONS OF WHICH ARE PRESENTLY UNKNOWN.

TOPOGRAPHIC CONTOUR INTERVAL = 10 FEET

AN AQUIFER TEST WAS CONDUCTED 1/19/95. WELL W-25 WAS PUMPED FOR 8 HOURS AT 80 GALLONS PER MINUTE (gpm).

ROSEN SITE
CORTLAND, NEW YORK
FEASIBILITY STUDY REPORT

GROUND-WATER TABLE CONTOUR MAP PRIOR TO AQUIFER TEST 1/19/95

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

FIGURE A-3

P: FSR
GWSO* ON, 01*,1*,1*,A*,BA*,CONN*,CONT,CS,CU*,DC*,E*,FI*,G*,MW*,NOR*,PATH OFF
J*,T*,SMP2,SO*,PCB,PH*,PO*,REF,ST*,TC*,TES*,TITLE,TP*,TR*,TW*,SS*,SA*,SI*,L*,UT*,V*,WA*,WE* OFF
4/28/97 SYR-54-PGL DMW
49401070/49401G04.DWG

ATTACHMENT A-1

Aquifer Test Procedures

ATTACHMENT A-1

Aquifer Test Procedures

Introduction

The purpose of conducting an aquifer test is to quantify the bulk hydrogeologic parameters (e.g., transmissivity and storativity) of the saturated zone in the vicinity of a pumping well. An aquifer test entails removing ground water from a pumping well at a constant rate and measuring the change in fluid levels in the pumping well and, if possible, in one or more other (observation) wells proximal to the pumping well. Pumping rate and fluid-level data gathered during a test are used to characterize the aquifer hydraulic parameters to help quantify ground-water flow conditions.

A preliminary drawdown test of limited duration is typically implemented prior to the actual aquifer test to identify a suitable pumping rate for the drawdown portion of the actual aquifer test.

Materials

The following materials and equipment should be available, as needed, for use during completion of the aquifer test:

- Submersible pump equipped with check valve and discharge line;
- In-line totalizing flow meter and/or calibrated bucket;
- Generator (if electric power source is not available);
- Supply of fuel for generator;
- Several water level probes (number depending on site);
- Data logger and pressure transducers;
- Barometric pressure gage;
- Rainfall gage;
- Aquifer test data sheets;
- Field notebook;
- Flashlights;
- Stopwatches;
- Engineer's scale rulers;
- Suitable protective clothing and gear (as specified in the Health & Safety Plan);
- Extension cords;
- Equipment cleaning supplies; and
- Clean 55-gallon steel drums, other suitable containers, or ground-water treatment system (if needed).

Preliminary Drawdown Testing

Preliminary drawdown testing should be conducted prior to the actual aquifer test to determine the pumping rate required to stress the aquifer without causing the pumping well to go dry. The preliminary drawdown test is implemented by pumping the well at several (at least three) successively higher pumping rates, each for the same duration (typically 30 minutes to 2 hours), and recording the increased depth to water (drawdown) inside the pumping well. The preliminary drawdown test typically lasts between two and eight hours depending on site conditions. From the preliminary drawdown test data, preliminary aquifer properties can be estimated and the well efficiency can be calculated. The results of these analyses can then be used to identify an appropriate pumping rate for the subsequent aquifer test.

Aquifer Test Procedures

1. Select an array of observation wells at various distances from the pumping well, including one or more wells distant from the pumping well. These distant wells indicate the "background" fluctuations of the aquifer during the test. Alternately, if only wells proximal to the pumping well are available, water levels data may be obtained several times per day for a few days prior to the aquifer test to determine the background trend of water-level changes. For the Rosen Site aquifer test, pressure transducers will be installed in the upper-outwash monitoring wells W-02, W-11, the new observation well, and the pumping well. Background fluctuations will be recorded on an automatic data logger for at least three days prior to the drawdown test. Additionally, three complete rounds of background water-level measurements will be collected from all accessible wells in the site monitoring-well network.

2. Decontaminate all pumping and monitoring equipment prior to the test.

3. Measure static water levels in all of the wells in the aquifer test monitoring array including the pumping well immediately before beginning the drawdown phase.

4. Prepare water-level monitoring equipment to be operational when pumping is initiated. The following water-level recording frequency will apply if manual, electronic water level probes are exclusively utilized:

Time Interval	Recording Frequency
0 to 2 minutes	as rapidly as possible
2 to 5 minutes	every 30 seconds
5 to 10 minutes	every minute
10 to 30 minutes	every 5 minutes
30 to 100 minutes	every 10 minutes
100 to 200 minutes	every 20 minutes
200 to 400 minutes	every 30 minutes
400 + minutes	every 1 hour

5. If automatic transducers/data loggers are used to record water levels, data can be recorded more frequently. Transducers should be matched with wells appropriately such that the full range of potential drawdown can be monitored without placing the transducer at an inappropriate initial depth. The depth of a transducer below the top of fluid in the well should be less than 2.31 times the transducer PSI rating, in feet. Following transducer installation, obtain a transducer reading using the data logger to ensure proper transducer connection and installation depth, plus a manual water level measurement for cross-referencing water-level fluctuations recorded by the transducer during the aquifer test. Prepare the datalogger to initiate data acquisition from all transducers at the instant pumping begins, or immediately prior to the commencement of pumping. For the Rosen Site ATP, pressure transducers will be installed in the same wells during the aquifer test as they were for background water-level monitoring (i.e., W-02, W-11, the new observation well, and the pumping well).

6. Initiate the drawdown phase of the aquifer test by starting the pump at the aquifer test discharge rate (Q) identified based on the preliminary drawdown testing results. Monitor and record the discharge rate according to the same schedule listed above for manual water-level measurements. Adjust the pumping rate as needed to maintain as constant a discharge rate as possible. Record the pumping rate, the time, and adjustments to the pumping rate in the field notebook.

7. For each well monitored using a manual water-level indicator, record the following data in the field notebook: clock time, depth to water, and initials of person taking measurement. In addition to the measurements automatically recorded on the data logger, manual measurements will be obtained from selected wells during the aquifer test. This data will be used for field analysis and to monitor water levels at distant wells. Manual measurements will be obtained most frequently at the primary observation wells (W-02, W-11, and the new observation well) and the pumping well. Manual measurements will be obtained at secondary observation wells at a less-frequent rate, and more frequently if water-level variations are observed. The exact frequency of measurement will be field determined. The secondary observation wells and the approximate radial distance from the pumping well are presented below:

Well	Unit Screened	Approximate Radial Distance from Pumping Well (ft)
W-01	Upper Outwash	620
W-03	Upper Outwash	560
W-05	Upper Outwash/Collapsed Kame	335
W-06	Upper Outwash/Collapsed Kame	690
W-07	Upper Outwash/Collapsed Kame	440
W-08	Lower part of Upper Outwash/Collapsed Kame	620

Well	Unit Screened	Approximate Radial Distance from Pumping Well (ft)
W-09	Lower part of Upper Outwash/Collapsed Kame/Lower Sand and Gravel	620
W-10	Upper Outwash/Collapsed Kame	260
W-12	Lower part of Upper Outwash	560
W-15	Lower Sand and Gravel	40
W-18	Upper Outwash	380
W-19	Lower part of Upper Outwash	380

8. At each well monitored using transducers, several manual water-level measurements should also be obtained to verify proper calibration of the transducers.

9. Record the on-site barometric pressure and cumulative rainfall measurements at the initiation of pumping and every 2 hours thereafter throughout the drawdown and recovery phases of the test. These data will help in the interpretation of the potentiometric responses measured at the pumping well, monitoring wells, and piezometers.

10. The drawdown phase may be terminated after sufficient data has been acquired to characterize the aquifer parameters and boundary conditions, typically after 12 hours to one week of pumping. Immediately prior to the end of pumping, prepare for the recovery phase by re-setting the data logger, if one is used during the task, to rapidly obtain data.

11. At the instant the pump is shut off, commence the recovery phase data acquisition by recording water level data according to the same measurement frequency used during the drawdown phase. The recovery phase should continue until the water level in the pumping well has recovered approximately 75% of the drawdown incurred during pumping.

12. Decontaminate all equipment at the end of the test.

Data Analysis

Several methods of data interpretation may be used to estimate aquifer properties from a aquifer test. The assumptions and limitations pertaining to each method of data analysis and the site-specific geology must be carefully considered to select an appropriate method of analysis. Prior to use in parameter calculations, drawdown and recovery data may need to be corrected for background water-level changes. Background fluctuations data may be obtained from a distant observation well or deduced from a period of water-level monitoring prior to the initiation of the aquifer test. Barometric pressure data measured on site or at the weather station nearest the site may be applied to drawdown and recovery data as appropriate, based on the measured barometric efficiency of the pertinent well(s).

Water-level data obtained from a test in an unconfined aquifer may be used to estimate the aquifer transmissivity and short-term storativity by the Neuman (1975) method. Alternately, drawdown data from unconfined aquifers may be modified by the Jacob (1944) correction for plotting and analysis according to the methods listed below for confined aquifers. Long-term storativity, or specific yield, of an unconfined aquifer may be underestimated using the Neuman method or the confined-aquifer methods. Under favorable conditions the Theis (1935) Method and other confined methods may be used to determine transmissivity using early or late aquifer test data. The specific yield of an unconfined aquifer may be evaluated by calculating the ratio of the total volume of water pumped during the drawdown phase to the total volume of aquifer material dewatered, or the "cone of depression" (Nwankwor et al., 1984).

Data from a aquifer test in a confined aquifer may be plotted and analyzed according to the methods of Theis (1935) or Cooper & Jacob (1946) to calculate the transmissivity and storativity of the aquifer. Data from a test in a leaky-confined aquifer may be plotted and analyzed according to the Walton (1962) or Hantush-Jacob (1955) method aquifer analysis may be used to calculated the aquifer transmissivity and storativity as well as the aquitard leakance.

The Geraghty and Miller Software, AQTESOLV, may be used for interpretation of the aquifer test data and determination of aquifer characteristics. This program allows rapid determination and comparisons of aquifer parameters obtained from several different methods.

References

Cooper, H.H., and C.E. Jacob (1946), "A Generalized Graphical Method for Evaluating Formation Constants and Summarizing Well Field History," Transactions, American Geophysical Union, Vol. 27, pp. 526 - 534.

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AQUIFER TEST DATA

SITE: _____ PROJECT NUMBER: _____

LOCATION: _____ PUMPING WELL: _____

WELL NUMBER: _____ PERSONNEL: _____

MEASURING EQUIPMENT: _____ DISTANCE FROM PUMPING WELL: _____

Time Data	Water Level Data	Discharge Data	Comments
Pump on: Date_____ Time_____	Static Water Level: _____	Measurement Technique: ____	*(Describe factors such*
Pump off: Date_____ Time_____	Final Water Level: _____	Depth to Intake: _____	*as weather, traffic, etc.,*
Pumping Duration: _____	Reference Point: _____	Previous Pumping?: _____	*that may affect test)*
Recovery Duration: _____	Reference Point Elevation: ____	Duration: ____Rate: _____	

Date	Clock Time	Elapsed Time	Water Level	Water Level Change (s or s')	Discharge Measurement	Rate	

ATTACHMENT A-2

Aquifer Performance Test Data Analysis

ATTACHMENT A-2

Aquifer Performance Test Data Analysis

An aquifer performance test was conducted at well W-25 (Figure B-3) on January 19, 1995, to provide a representative determination of flow-system hydraulic parameters in the upper outwash, unconfined aquifer underlying the area in and around the northern property boundary at the Site.

In the vicinity of the north property boundary of the Site, hydraulic coefficients of transmissivity (T), horizontal hydraulic conductivity (K_h or K_r), vertical hydraulic conductivity (K_v or K_z), specific yield/water-table storage (S_y), and the (elastic) storage coefficient (S) were determined from the analyses of the pumping test conducted at pumping well W-25.

Pumping Test

An aquifer performance (pumping) test was conducted at pumping well W-25 using a continuous discharge rate of 80 gallons per minute (gpm) for 8.2 hours. Wells W-02, W-11, and W-26 served as the water-level observation wells. Water-level measurements were monitored in both the pumping well and the observation wells throughout the duration of the pumping test.

For the analysis of the pumping test, the drawdown (decline in ground-water level) data observed at pumping well W-25, and observation wells W-02, W-11, and W-26, were plotted versus time. Pumping test site conditions and drawdown were conducive to the analysis of the time versus drawdown data.

The pumping test analytical methods included the following:

1) The Neuman analysis of pumping test data from anisotropic unconfined aquifers considering delayed gravity response and partially penetrating wells (W-02);

2) The Hantush and Jacob analysis of pumping test data under unsteady flow to a well in a leaky aquifer with no storage in the aquitard (W-11 and W-26); and

3) The Cooper-Jacob method, modified for unconfined aquifers using the Jacob drawdown correction.

A description of each analytical technique is provided below.

Neuman Delayed Gravity Response and Partial Penetration Method

Neuman developed an analytical model for the delayed response process characterizing flow to a pumping well in an unconfined aquifer. This technique is used to develop methods for determining the hydraulic properties of an anisotropic water-table aquifer from time versus drawdown data collected during a pumping test (Neuman, 1975).

This method was employed for the analysis of the pumping test data utilizing the type curve matching technique whereby time versus drawdown data collected during the pumping test is matched to type curves. However, for this particular pumping test, partially penetrating wells (pumping and monitoring) were used, which necessitated the use of a special set of type curves to be developed for the pumping well and monitoring well configurations.

To facilitate the Neuman analysis of the time versus drawdown data from partially penetrating wells, the aquifer test analysis software package (computer program) AQTESOLV™ (Duffield and Rumbaugh 1989) was employed. AQTESOLV™ provides the analyst with the option to interactively match type curves to aquifer test data directly on the screen while providing instantaneous quantification of T, S, and S_y, as well as the value of beta (β) corresponding to the type curve.

Prior to performing the type curve matching on the computer screen, AQTESOLV™ calculates the well-specific partial penetration type curves for $\beta = 0.001$ to $\beta = 7.0$ (see Neuman 1975, Figure 1) using the equations accounting for partially penetrating wells (see Neuman 1975, Equations 26, 27, and 28).

When the type curve option of AQTESOLV™ is used, water-level drawdown data collected from an observation well is plotted versus time on a logarithmic scale on the computer screen. Time versus drawdown data is first matched to the Type B curves (see Neuman 1975, Figure 1), and the value of β corresponding to this type curve is displayed along with the calculated values for T and S_y. For the same value of β, the time versus drawdown data is then matched to the Type A curves (see Neuman 1975, Figure 1), and the calculated values for T and S_y are displayed. The order of type curving the later data to the Type B curve first, followed by the early data to the Type A curve, is discussed by Neuman (1975).

The values for T and S_y are calculated using the following equations from Neuman (1975).

$$T = Qs_D^{\bullet}/s^{\bullet}$$

and

$$S_y = Tt^{\bullet}/r^2t_y^{\bullet}$$

where:

T	=	transmissivity of the aquifer [L^2T^{-1}]
Q	=	discharge rate of the pumping well [L^3T^{-1}]
$s_D^{\bullet}$	=	dimensionless drawdown match point value from the type B Neuman type curves, equal to $4\pi Ts/Q$
$s^{\bullet}$	=	drawdown match point value from the time versus drawdown plot corresponding to the type B Neuman type curves [L]

S_y = specific yield/water-table storage coefficient [dimensionless]
t^* = time match point value from the time versus drawdown plot corresponding to the type B Neuman type curves [T]
r = radial distance from the observation well to the pumping well [L]
t_y^* = dimensionless time match point value from the type B Neuman type curves with respect to S_y, equal to Tt/S_yr^2.

The value for S is calculated using the following equation from Neuman (1975):

$$S = Tt^*/r^2t_s^*$$

where:
T = transmissivity of the aquifer [L^2T^{-1}]
t^* = time match point value from the time versus drawdown plot corresponding to the Type A Neuman type curves [T]
r = radial distance from the observation well to the pumping well [L]
t_s^* = dimensionless time match point value from the type B Neuman type curves with respect to S, equal to Tt/Sr^2.

Finally, the degree of anisotropy and the vertical hydraulic conductivity are calculated using the following equations from Neuman (1975):

$$K_D = \beta b^2/r^2$$

and

$$K_z = K_D K_r$$

where:
K_D = degree of anisotropy, equal to K_z/K_r [dimensionless]
β = the value of beta corresponding to the type curve [dimensionless]
b = saturated thickness of the aquifer [L]
r = radial distance from the observation well to the pumping well [L]
K_z = vertical hydraulic conductivity of the aquifer [LT^{-1}]
K_r = horizontal hydraulic conductivity of the aquifer [LT^{-1}]

Hantush and Jacob Analysis, Non-Steady Flow, Leaky Aquifer, No Aquitard Storage

Hantush and Jacob developed a type curve matching technique for non-steady state radial flow in a semiconfined aquifer. Variation of drawdown with time and distance caused by a well of constant discharge in a confined aquifer of uniform thickness and hydraulic conductivity is obtained. Well discharge is supplied through elastic storage, and also by leakage through the aquitard. Leakage is proportional to drawdown, and storage of water in the aquitard in neglected (Hantush and Jacob, 1955).

To facilitate the Hantush and Jacob analysis of the time versus drawdown data, AQTESOLV™ (Duffield and Rumbaugh, 1989) was again employed to interactively match type curves to aquifer test data directly on the screen while providing instantaneous quantification of T and S values based upon the degree of leakage (leakage type curve).

The solution to the Hantush and Jacob leaky aquifer condition with no storage in the aquitard is calculated using the following equations.

$$s = Q/4\pi T\ W(u,r/B);$$

$$u = r^2S/4Tt;$$

and

$$B = (Tb'/K')^{1/2}$$

where:

T	=	transmissivity of the aquifer [L^2T^{-1}]
Q	=	discharge rate of the pumping well [L^3T^{-1}]
s	=	drawdown match point value from time versus drawdown plot corresponding to the Hantush and Jacob type curves [L]
$W(u,r/B)$	=	Hantush well function [dimensionless]
S	=	storage coefficient [dimensionless]
t	=	time match point value from the time versus drawdown plot corresponding to the Hantush and Jacob type curves [T]
r	=	radial distance from the observation well to the pumping well [L]
b'	=	thickness of the aquitard [L]
K'	=	vertical hydraulic conductivity of the aquitard [L/T]

Cooper-Jacob Analysis, Modified with Jacob Drawdown Correction for Unconfined Aquifers

Cooper and Jacob developed a generalized, modified graphical method (straight-line matching technique) for non-steady state radial flow in a confined aquifer. This technique is used to determine the hydraulic properties of a confined aquifer from time versus drawdown data collected during a pumping test, but can be modified by means of the Jacob correction for an unconfined aquifer.

Under unconfined conditions, observed drawdown values must be adjusted for the decrease in saturated thickness before the data can be used to ascertain the hydraulic coefficients T and S. As presented in Walton (1962), the following equation (Jacob correction) is used to adjust drawdown data for the decrease in saturated thickness

$$s' = s-(s^2/2m)$$

where:

s'	=	drawdown that would occur in an equivalent confined aquifer [L]
s	=	observed drawdown under unconfined conditions [L]
m	=	initial saturated thickness of the unconfined aquifer [L].

When the Cooper - Jacob analytical method is chosen under unconfined solutions using AQTESOLV™ (Duffield and Rumbaugh 1989), the correction is calculated automatically, and a plot of corrected drawdown verses time is displayed for the straight-line match.

The Cooper-Jacob method was used to supplement, rather than supersede, other methods (Cooper and Jacob, 1946). Again, AQTESOLV™ (Duffield and Rumbaugh, 1989) was employed to facilitate the Cooper-Jacob analysis of the time versus drawdown data by interactively matching the best straight-line match to aquifer test data directly on the screen while providing instantaneous quantification of T and S values.

The values for T and S are calculated using the following equations from Cooper and Jacob (1946).

$$T = Q/4\pi\Delta s$$

and

$$S = Tt_0/r_2$$

where:

T	=	transmissivity of the aquifer [L^2T^{-1}]
Q	=	discharge rate of the pumping well [L^3T^{-1}]
Δs	=	drawdown difference per log cycle of time [L]
S	=	storage coefficient [dimensionless]
r	=	radial distance from the observation well to the pumping well [L]
t_0	=	intersection of the straight-line slope with the zero drawdown axis [T].

The horizontal hydraulic conductivity is calculated from the relationship that the horizontal hydraulic conductivity (K_r) is equal to the transmissivity (T) divided by the saturated thickness of the aquifer (b), i.e., $K_r = T/b$.

Pumping Test Results

Time versus drawdown data collected in pumping well W-25, and observation wells W-02, W-11, and W-26, were analyzed using one or more of the above-referenced analytical techniques to determine the hydraulic coefficients for the upper outwash (water-table) aquifer.

Pumping Well W-25

Results of Cooper-Jacob analysis for pumping well W-25 are presented on Figure 1. A transmissivity (T) value of 5.4 feet squared per minute (ft^2/min), or approximately 7,700 feet squared per day (ft^2/d), is calculated. Because the screen of pumping well W-25 essentially penetrated the entire saturated thickness of the water table aquifer, or about 47 feet, flow was essentially horizontal during the pumping test. The K_h is calculated to be approximately 160 ft/d (i.e., $K_h = T/b$ -- $K_h = 7{,}700\ ft^2/d / 47\ ft$).

The storativity (S) cannot be determined with any degree of accuracy from data for the pumped well because the effective radius of the pumped well is seldom known and

drawdown in the pumped well are often affected by well losses which cannot be determined precisely (Walton, 1962). Thus, the S value on Figure 1 is not considered representative of the water-table aquifer, and can be ignored. Analytical methods utilizing logarithmic-logarithmic type-curve matching (e.g., Neuman, Hantush, and Theis, 1935) are not applicable to a single well pumping test (Kruseman and de Ridder, 1990), and were used only for the data from observation wells, as discussed below.

Observation Well W-02

Observation well W-02 is screened at the top of the water-table aquifer. Thus, it was anticipated that drawdown data measured at this well would be affected by gravity drainage (delayed yield). This conceptualization proved correct, as evidenced in the plot of time versus drawdown (Figure 2). Thus, time versus drawdown data collected at observation well W-02 was analyzed using the Neuman (1975) analysis of pumping test data from anisotropic unconfined aquifers considering delayed gravity response measured at partially penetrating wells.

Results of the Neuman analysis for observation well W-02 are presented in Figure 2. A transmissivity (T) value of approximately 11 ft^2/min, or approximately 15,000 ft^2/d, is calculated. The corresponding horizontal K is estimated as 340 ft/day.

Although the late data are just beginning to return to Neuman Type B curve, an estimate of specific yield (S_y) and *B* are possible and values of 0.30 and 0.01, respectively, are calculated. From the match of early time versus drawdown to the Neuman Type A curve, an elastic storativity value (S) of 0.019 was calculated (Figure 2).

When these data are substituted into the appropriate equations to solve for K_r, the degree of anisotropy, and for K_z, values of 330 ft/d, 0.012 (i.e., 84:1 ratio for K_r:K_z), and 3.9 ft/d (approximately 4 ft/d), respectively, are calculated. This preliminary estimate of anisotropy (84:1 ratio for K_r:K_z) based upon the initial return the drawdown data to the Neuman Type B curve falls within the general range of anisotropy values that may be expected in a stratified formation (10:1 to 100:1; Todd, 1980).

For a comparative estimate of the T and S values obtained from the Neuman (1975) analysis, time versus drawdown data collected in observation well W-02 were also analyzed using the Cooper-Jacob (1946) method. Results of the Cooper-Jacob analysis for observation well W-02 are presented on Figure 3. A transmissivity (T) value of 12 ft^2/min, or approximately 17,000 ft^2/d, is calculated. The calculated elastic storativity (S) value is 0.017. With a saturated thickness of 47 feet, the K_h is calculated to be 350 ft/d.

The values of T, S, and K_h from the Neuman and the Cooper-Jacob methods, based on the drawdown response at well W-02, compare favorably.

Observation Well W-11

Observation well W-11 is screened near the bottom of the water-table aquifer. Thus, it was anticipated that drawdown data measured at W-11 might be subject to leakage from the underlying lacustrine unit (aquitard). This conceptualization proved correct as evidenced in the plot of time versus drawdown (Figure 4). Time versus drawdown data measured at observation well W-11 were analyzed using the Hantush and Jacob (1944) analysis of pumping test data under unsteady flow to a well in a leaky aquifer with no storage in the aquitard.

Results of the Hantush and Jacob analysis for observation well W-11 are presented on Figure 4. With a *r/B* value of 0.15, a transmissivity value of 6.5 ft^2/min, or approximately 9,300 ft^2/d, is calculated. Based upon a saturated thickness of about 47 feet, the K_h is calculated to be 200 ft/d (i.e., K_h = T/b -- K_h = 15,000 ft^2/d / 47 ft). The corresponding S from the Hantush and Jacob analysis is calculated as 0.0028.

Based upon a *r/B* value of 0.15, a T of 9,300 ft^2/d, a radial distance of 35 feet (from pumping well W-25) and an aquitard thickness of approximately 24 feet (see BB&L, 1994, Figure 25), the K_v of the aquitard is calculated to be approximately 4 ft/d.

For a comparative estimate of the T and S values obtained from the Hantush and Jacob (1944) analysis, time versus drawdown data measured at observation well W-11 were also analyzed using the Cooper-Jacob (1946) method. Results of the Cooper-Jacob analysis for well W-11 are presented in Figure 5. A transmissivity value of 8.6 ft^2/min, or approximately 12,000 ft^2/d, is calculated. The calculated S value is 0.0020. With a saturated thickness of 47 feet, the K_h is calculated to be 260 ft/d.

The values of T, S, and K_h from the Hantush and Cooper-Jacob methods, based on the drawdown response at well W-11, compare favorably.

Observation Well W-26

Observation well W-26 is also screened near the bottom of the water-table aquifer. Again, it was anticipated that drawdown data measured at W-26 may be affected by leakage from the underlying aquitard. This conceptualization proved correct as evidenced in the plot of time versus drawdown (Figure 6). Time versus drawdown data measured at observation well W-26 were analyzed using the Hantush and Jacob (1944) analysis of pumping test data under unsteady flow to a well in a leaky aquifer with no storage in the aquitard.

Results of the Hantush and Jacob analysis for observation well W-26 are presented on Figure 6. With a *r/B* value of 0.15, a transmissivity value of 4.8 ft^2/min, or approximately 6,900 ft^2/d, is calculated. Based upon a saturated thickness of about 47 feet, the K_h is calculated to be 150 ft/d (i.e., K_h = T/b -- K_h = 6,900 ft^2/d / 47 ft). The corresponding elastic storativity (S) from the Hantush and Jacob analysis was calculated to be 0.0025.

Based upon a *r/B* value of 0.15, a T of 6,900 ft^2/d, a radial distance of 26 feet (from pumping well W-25), and an aquitard thickness of approximately 24 feet (see BB&L, 1994, Figure 25), the K_v of the aquitard is calculated as approximately 5 ft/d.

For a comparative estimate of the T and S values obtained from the Hantush and Jacob (1944) analysis, time versus drawdown data measured at observation well W-26 were also analyzed using the Cooper-Jacob (1946) method. Results of the Cooper-Jacob analysis for observation well W-26 are presented on Figure 7. A transmissivity value of 6.5 ft^2/min, or approximately 9,400 ft^2/d, is calculated. The calculated S value is 0.0018. With a saturated thickness of 47 feet, the K_h is calculated to be 200 ft/d.

The values of T, S, and K_h from the Hantush and Jacob as well as the Cooper-Jacob methods, based on the drawdown response at well W-26.

Summary of Estimated Hydraulic Parameters

Transmissivity and horizontal hydraulic conductivity values from wells W-25, W-02, W-11, and W-26, including their geometric mean values, are summarized in Table 1.

References

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TABLE 1

SUMMARY OF TRANSMISSIVITY AND HYDRAULIC CONDUCTIVITY PUMPING TEST AT WELL W–25, JANUARY 19, 1995

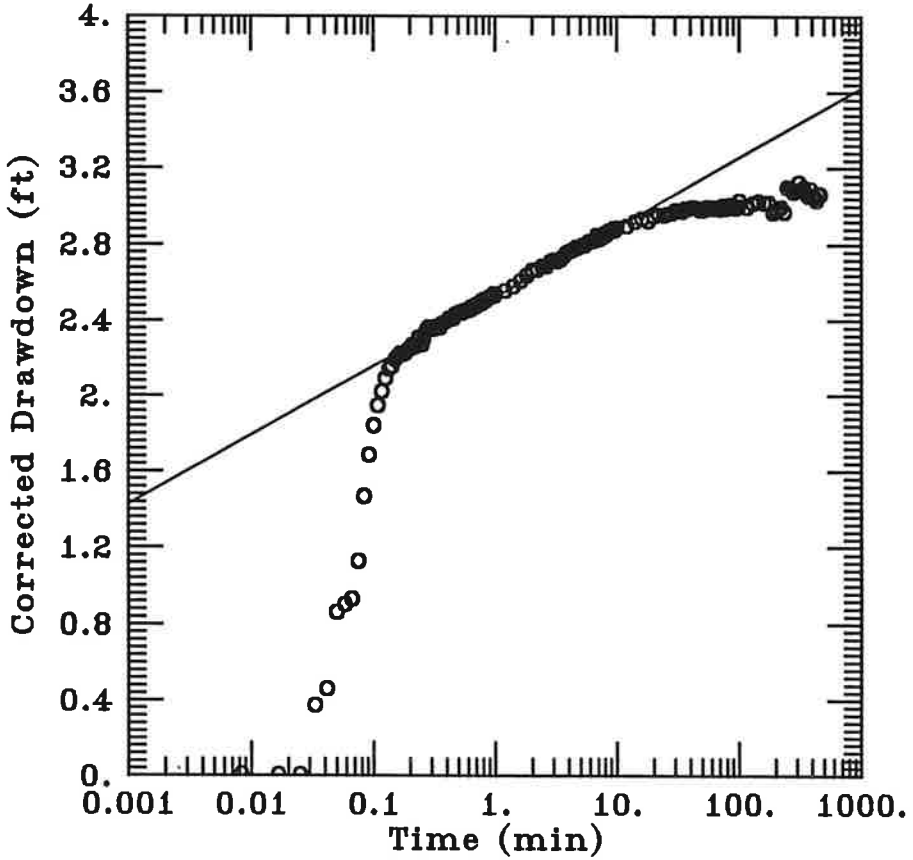
ROSEN SITE
CORTLAND, NEW YORK

TRANSMISSIVITY (SQFT/MIN)				
Well	Method			
	Neuman	Hantush–Jacob	Cooper–Jacob	Average
W–25 (Pumping Well)			5.4	5.4
W–2	11		12	11
W–11		6.5	8.6	7.6
W–26		4.8	6.5	5.7
Geometric Mean	11	5.6	7.7	7.1

HYDRAULIC CONDUCTIVITY (FT/DAY)				
Well	Method			
	Neuman	Hantush–Jacob	Cooper–Jacob	Average
W–25 (Pumping Well)			160	160.0
W–2	340		350	345
W–11		200	260	230
W–26		150	200	175
Geometric Mean	340	170	230	220

BB&L, Inc.	Client: **Rosen Site**
Project No.: **494.10**	Location: **Cortland, New York**

PUMPING TEST ANALYSIS – WELL W-25



DATA SET:
25d.prn
01/20/95

AQUIFER TYPE:
Unconfined
SOLUTION METHOD:
Cooper-Jacob
TEST DATE:
19-Jan-95
TEST WELL:
W-25
OBS. WELL:
W-25

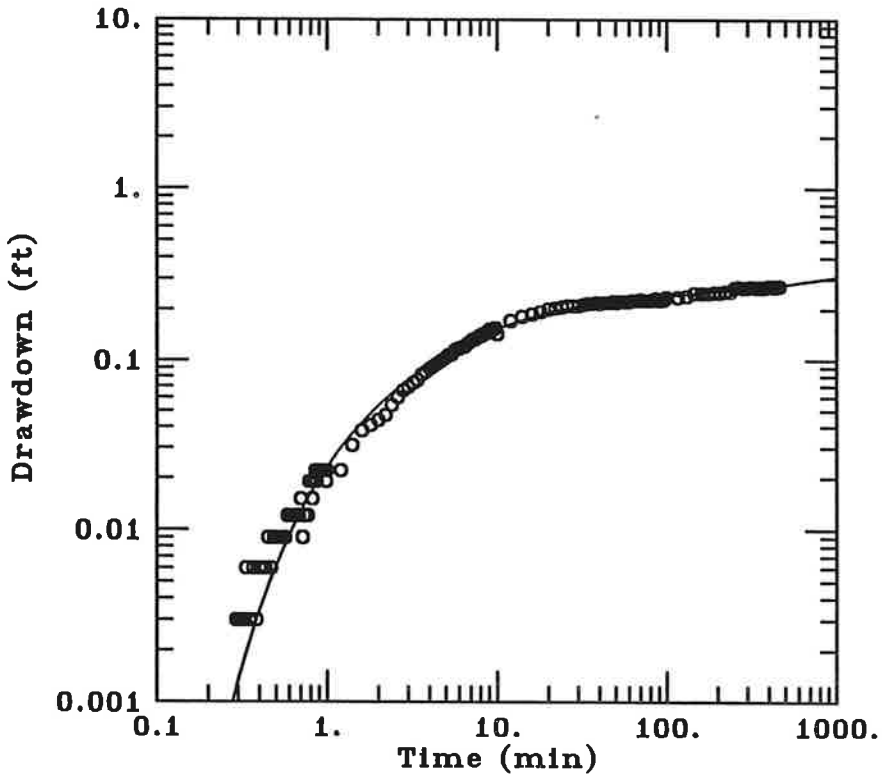
ESTIMATED PARAMETERS:
T = 5.356 ft^2/min
S = 6.0883E-06

TEST DATA:
Q = 10.7 ft^3/min
r = 0.5 ft
rc = 0.5 ft
rw = 750. ft
b = 47. ft

FIGURE 1

BB&L, Inc.	Client: **Rosen Site**
Project No.: **494.10**	Location: **Cortland, New York**

PUMPING TEST ANALYSIS – WELL W-2



DATA SET:
2d-n.in
01/25/95

AQUIFER TYPE:
Unconfined
SOLUTION METHOD:
Neuman
TEST DATE:
19-Jan-95
TEST WELL:
W-25
OBS. WELL:
W-2

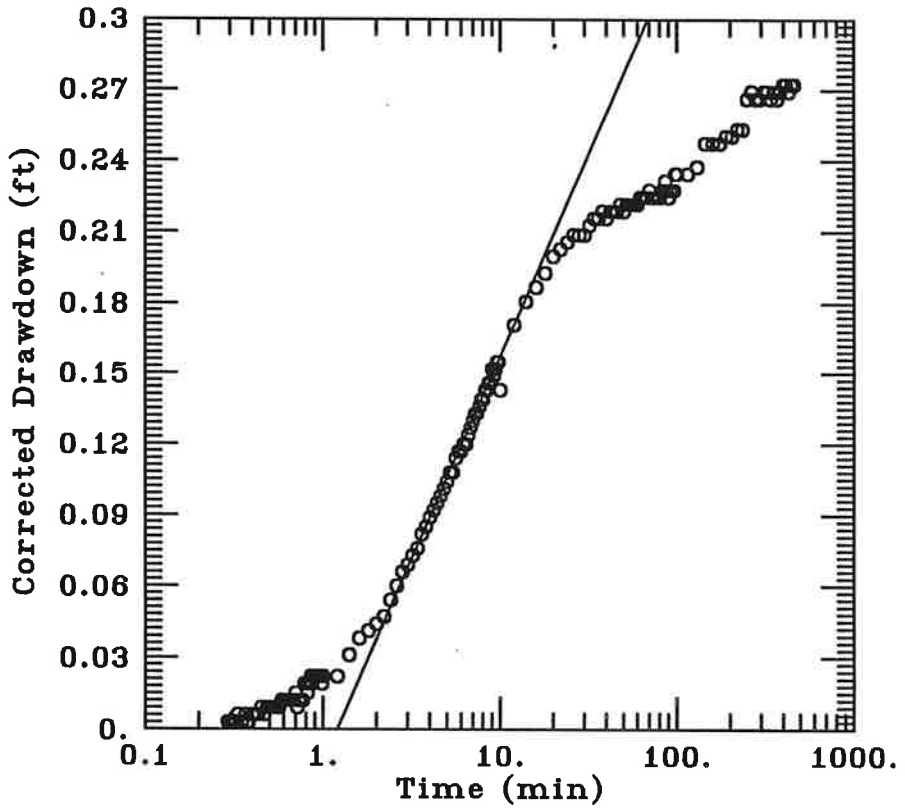
ESTIMATED PARAMETERS:
T = 10.71 ft^2/min
S = 0.01929
Sy = 0.3014
β = 0.01

TEST DATA:
Q = 10.7 ft^3/min
r = 43.2 ft
rc = 0.5 ft
rw = 1. ft
b = 47. ft
TEST WELL:
t.o.s. = 9.5 ft
b.o.s. = 32.8 ft
OBS. WELL:
t.o.s. = 2. ft
b.o.s. = 17. ft

FIGURE 2

BB&L, Inc.	Client: **Rosen Site**
Project No.: **494.10**	Location: **Cortland, New York**

PUMPING TEST ANALYSIS – WELL W-2



DATA SET:
2d.prn
01/20/95

AQUIFER TYPE:
Unconfined
SOLUTION METHOD:
Cooper-Jacob
TEST DATE:
19-Jan-95
TEST WELL:
W-25
OBS. WELL:
W-2

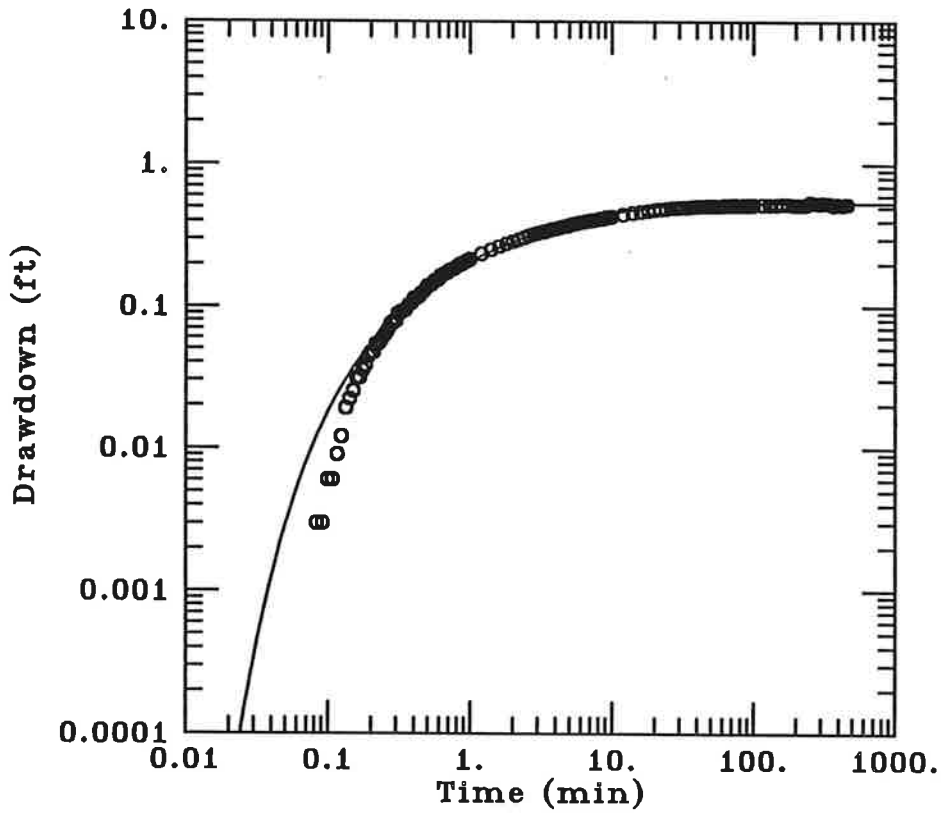
ESTIMATED PARAMETERS:
T = 11.47 ft^2/min
S = 0.01659

TEST DATA:
Q = 10.7 ft^3/min
r = 43.2 ft
rc = 0.5 ft
rw = 750. ft
b = 47. ft

FIGURE 3

BB&L, Inc.	Client: **Rosen Site**
Project No.: **494.10**	Location: **Cortland, New York**

PUMPING TEST ANALYSIS – WELL W-11



DATA SET:
11d-h.in
01/24/95

AQUIFER TYPE:
Leaky
SOLUTION METHOD:
Hantush
TEST DATE:
19-Jan-95
TEST WELL:
W-25
OBS. WELL:
W-11

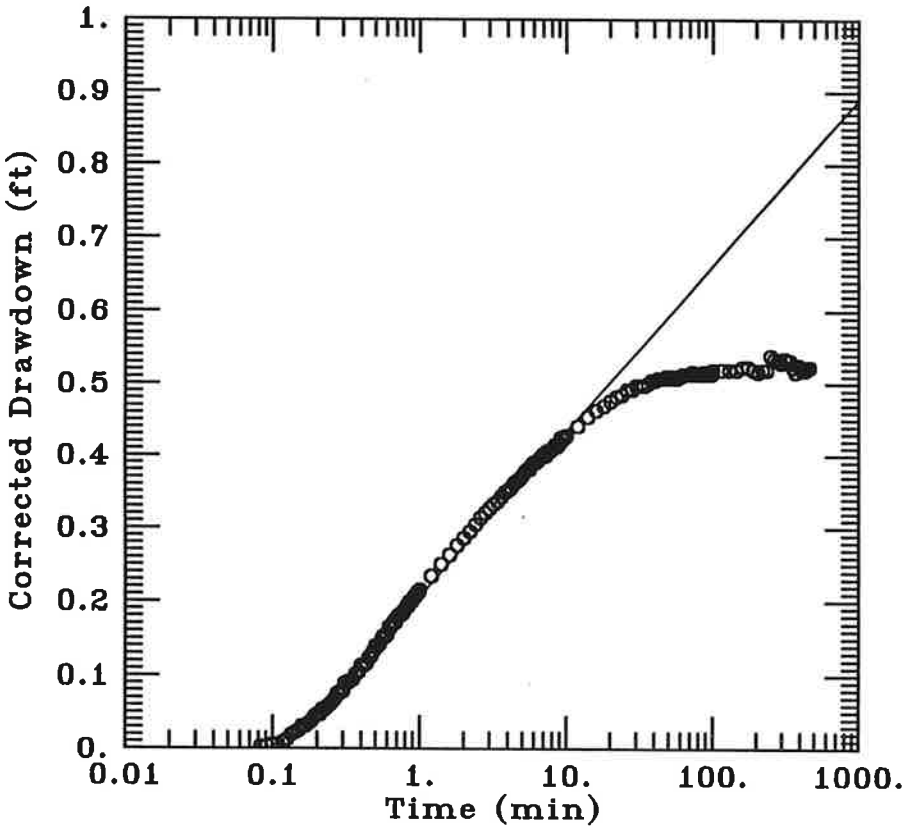
ESTIMATED PARAMETERS:
T = 6.46 ft^2/min
S = 0.002755
r/B= 0.15

TEST DATA:
Q = 10.7 ft^3/min
r = 34.8 ft
rc = 0.5 ft
rw = 1. ft

FIGURE 4

BB&L, Inc.	Client: **Rosen Site**
Project No.: **494.10**	Location: **Cortland, New York**

PUMPING TEST ANALYSIS – WELL W-11



DATA SET:
11d.prn
01/20/95

AQUIFER TYPE:
Unconfined
SOLUTION METHOD:
Cooper-Jacob
TEST DATE:
19-Jan-95
TEST WELL:
W-25
OBS. WELL:
W-11

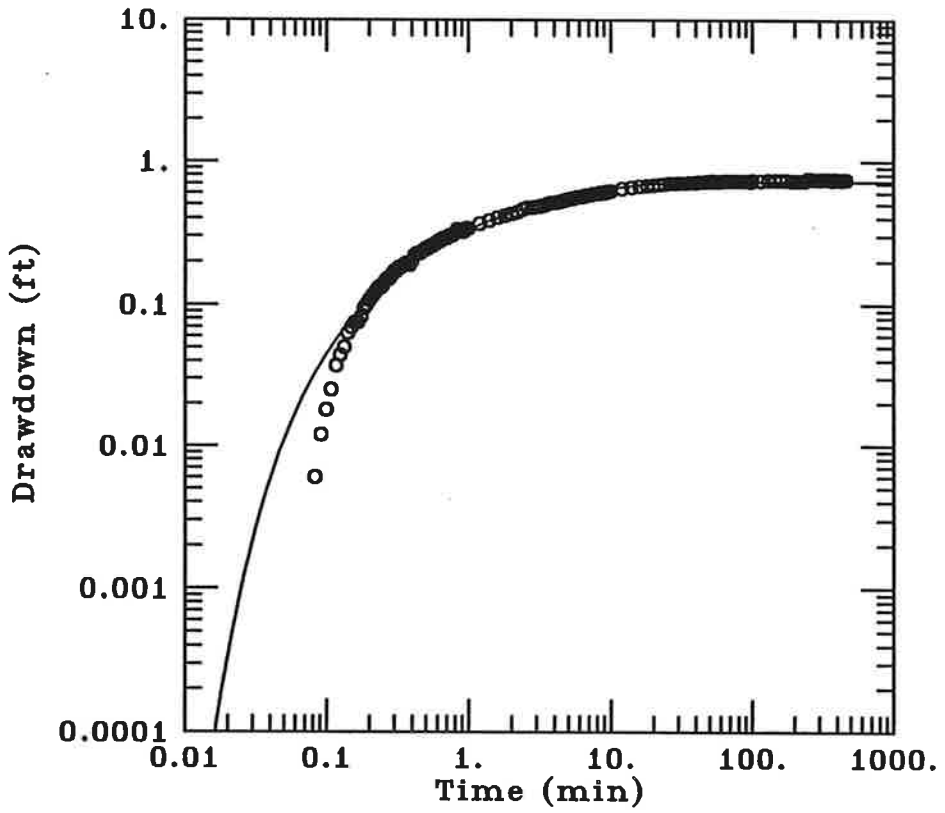
ESTIMATED PARAMETERS:
T = 8.607 ft^2/min
S = 0.001984

TEST DATA:
Q = 10.7 ft^3/min
r = 34.8 ft
rc = 0.5 ft
rw = 750. ft
b = 47. ft

FIGURE 5

BB&L, Inc.	Client: **Rosen Site**
Project No.: **494.10**	Location: **Cortland, New York**

PUMPING TEST ANALYSIS – WELL W-26



DATA SET:
26d-h.in
01/24/95

AQUIFER TYPE:
Leaky
SOLUTION METHOD:
Hantush
TEST DATE:
19-Jan-95
TEST WELL:
W-25
OBS. WELL:
W-26

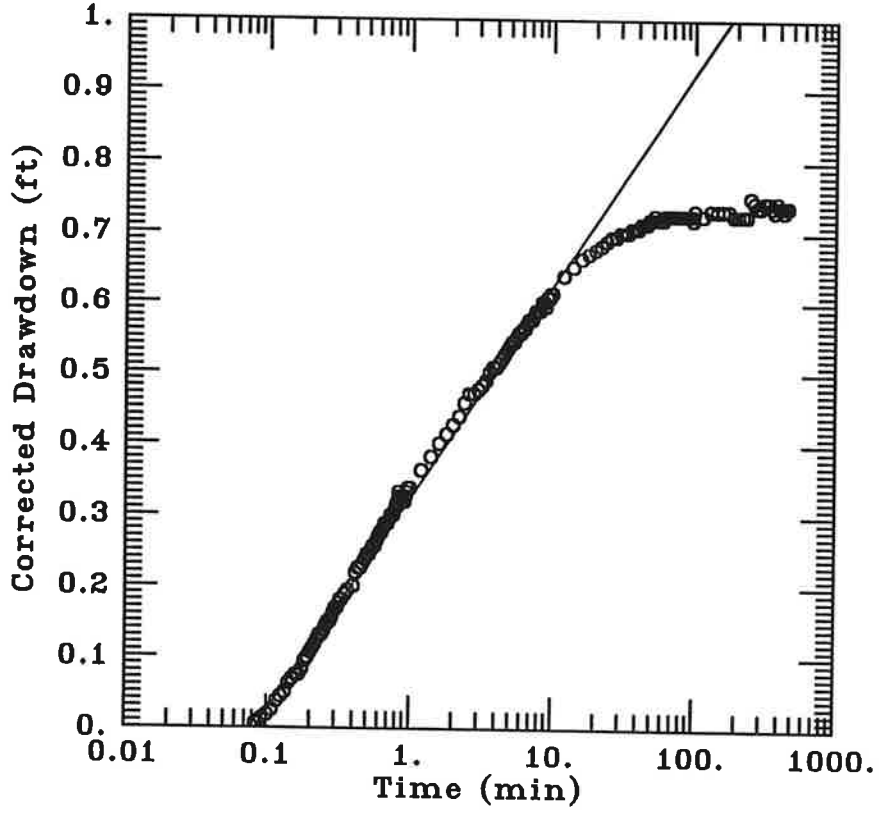
ESTIMATED PARAMETERS:
T = 4.792 ft^2/min
S = 0.00253
r/B= 0.15

TEST DATA:
Q = 10.7 ft^3/min
r = 26.3 ft
rc = 0.5 ft
rw = 1. ft

FIGURE 6

BB&L, Inc.	Client: **Rosen Site**
Project No.: **494.10**	Location: **Cortland, New York**

PUMPING TEST ANALYSIS – WELL W-26



DATA SET:
26d.prn
01/20/95

AQUIFER TYPE:
Unconfined
SOLUTION METHOD:
Cooper-Jacob
TEST DATE:
19-Jan-95
TEST WELL:
W-25
OBS. WELL:
W-26

ESTIMATED PARAMETERS:
T = 6.537 ft^2/min
S = 0.001776

TEST DATA:
Q = 10.7 ft^3/min
r = 26.3 ft
rc = 0.5 ft
rw = 750. ft
b = 47. ft

FIGURE 7

ATTACHMENT A-3

Well Logs

Date Start/Finish: 12/20/94 - 12/22/94
Drilling Company: Parratt-Wolff, Inc.
Driller's Name: Bill Rice
Drilling Method: Hollow Stem Auger
Bit Size: N/A-in. **Auger Size :** 10.25-in.
Rig Type: CME 75
Spoon Size: 2-in.
Hammer Weight: 140-lb.
Height of Fall: 30-in.

Northing: 99951.123
Easting: 500703.297
Well Casing Elev.: 1124.50 ft.
Corehole Depth:
Borehole Depth: 51.5 ft.
Ground Surface Elev.: 1122.3 ft.
Development Date: 12/27/95

Geologist: Lynette B. Mokry

Well No. W-25
Client:
CPRP Group
Location:
Rosen Site
Cortland, New York
Project:
Aquifer Test Program (ATP)

DEPTH / ELEVATION	Analytical ID Number	Sample/Int/Type	Blows/6 In.	N	Recovery (ft.)	PID/FID (ppm) Field Screening	Geologic Column	Stratigraphic Description	Well Construction
gs elevation 1122.3 ft.								**GROUND SURFACE**	8-inch locking protective casing.
1120 / 5								Dark brown SILT, some fine to coarse Sand, some fine Gravel, moist, firm (FILL). Dark brown fine to coarse SAND, some fine to coarse Gravel, little Silt, moist, firm (FILL).	Cement pad to 1.5' Below Ground Surface (BGS).
1115								Dark brown Clayey SILT, some fine to coarse SAND, some fine to coarse Gravel (subangular, moderately hard), moist, firm (FILL). *Hard Drilling from 5 to 12'.*	6-inch schedule 80 PVC (+2.2'- 17.25' BGS) Cement/Bentonite Grout (1.5'- 6.2' BGS) Bentonite seal (6.2'- 8.7' BGS)
10 / 1110								Brown coarse to medium GRAVEL (subangular, moderately hard), little Silt, moist, slight organic odor, compact (FILL).	Morie No. 0 Sand Pack (8.7' - 51.5' BGS)
15									

BLASLAND, BOUCK & LEE
ENGINEERS & SCIENTISTS

Remarks:
Soil descriptions from 0 to 51.5' were obtained from sampling conducted at W-26, located approximately 26' southwest of W-25. W-25 was the pumping well for an aquifer test on January 19, 1995 (80 gpm for 8 hours).

Water Levels

Date / Time	Elevation	Depth
12/28/94/0830	1112.73	9.57 ↧
01/04/95/1051	1112.50	9.80 ↧
01/19/95/0822	1113.67	8.63 ▽

Client: CPRP Group

Location: Rosen Site, Cortland, New York

Project: Aquifer Test Program (ATP)

Well No. W-25

Total Depth = 51.5 ft.

DEPTH	ELEVATION	Analytical ID Number	Sample/Int/Type	Blows/6 In.	N	Recovery (ft.)	PID/FID (ppm) Field Screening	Geologic Column	Stratigraphic Description	Well Construction
	1105								Gray brown coarse to medium GRAVEL (subangular), and medium to fine SAND, little Clay & Silt, slight organic odor, saturated, compact to very compact.	
20									@20.0', grades to gray brown coarse to fine SAND, and coarse to medium GRAVEL (subangular shale and sandstone), little Clayey Silt, saturated, compact.	Well Screen, 0.02" Slot (17.25' to 50.13' BGS)
	1100									
25										
	1095								@28.0', grades to gray brown coarse to fine SAND, some coarse to fine Gravel, trace Clayey Silt, saturated, compact to firm.	
30										
	1090								@32.0', grades to gray brown coarse to fine SAND, little coarse to fine Gravel, trace Silt, saturated, very compact.	
35									*See next page*	

BLASLAND, BOUCK & LEE
ENGINEERS & SCIENTISTS

Remarks:

Water Levels

Date / Time	Elevation	Depth
12/28/94/0830	1112.73	9.57 ▼
01/04/95/1051	1112.50	9.80 ▼
01/19/95/0822	1113.67	8.63 ▽

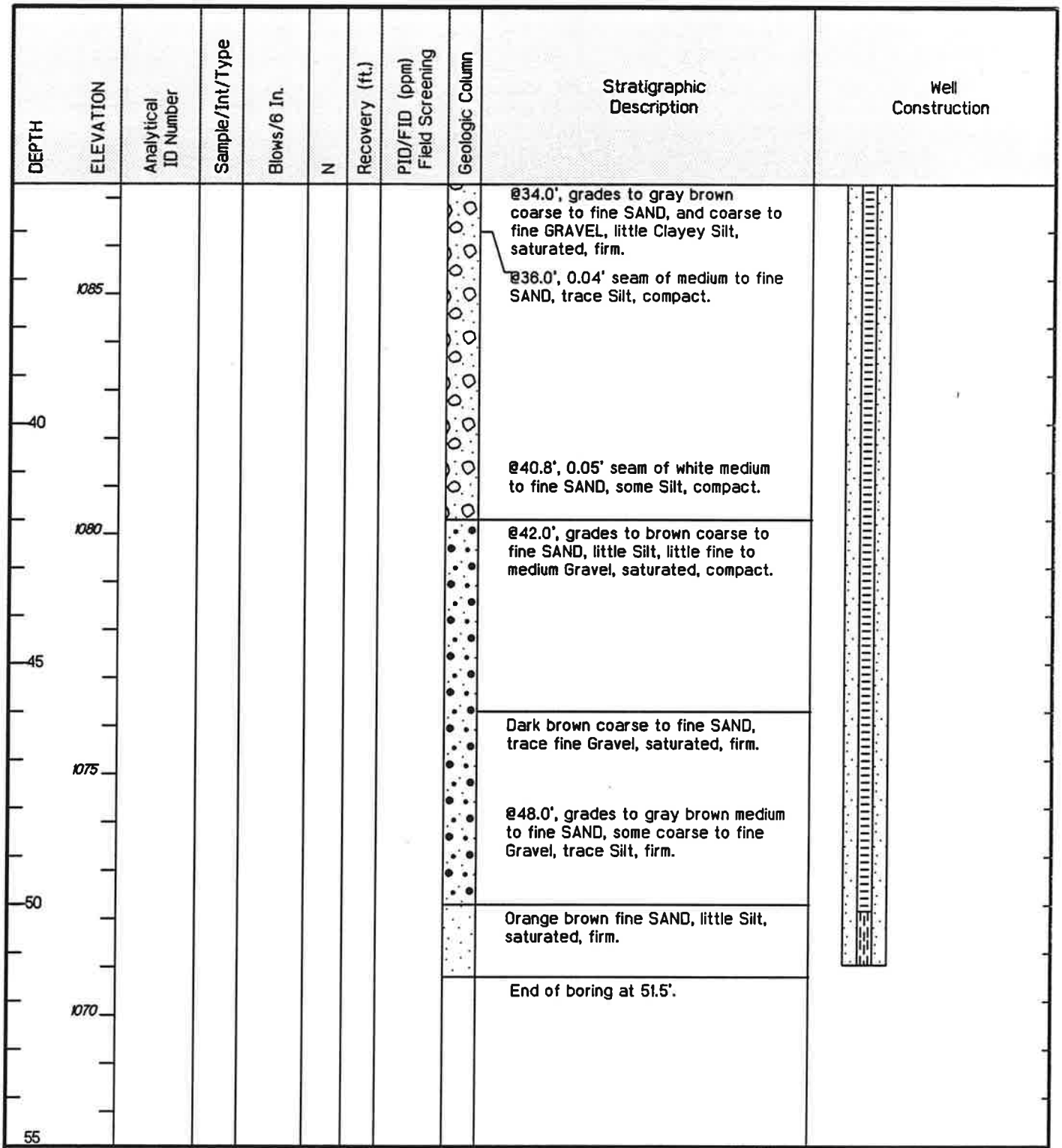
Client: CPRP Group

Location: Rosen Site, Cortland, New York

Project: Aquifer Test Program (ATP)

Well No. W-25

Total Depth = 51.5 ft.



BLASLAND, BOUCK & LEE
ENGINEERS & SCIENTISTS

Remarks:

Water Levels

Date / Time	Elevation	Depth
12/28/94/0830	1112.73	9.57
01/04/95/1051	1112.50	9.80
01/19/95/0822	1113.67	8.63

Date Start/Finish: 12/19/94 - 12/20/94
Drilling Company: Parratt-Wolff, Inc.
Driller's Name: Bill Rice
Drilling Method: Hollow Stem Auger
Bit Size: N/A-in. **Auger Size :** 4.25-in.
Rig Type: CME 75
Spoon Size: 2-in.
Hammer Weight: 140-lb.
Height of Fall: 30-in.

Northing: 99930.852
Easting: 500686.941
Well Casing Elev.: 1124.60 ft.
Corehole Depth:
Borehole Depth: 58 ft.
Ground Surface Elev.: 1122.7 ft.
Development Date: 12/27/95

Geologist: Lynette B. Mokry

Well No. W-28
Client:
CPRP Group
Location:
Rosen Site
Cortland, New York
Project:
Aquifer Test Program (ATP)

DEPTH / ELEVATION	Analytical ID Number	Sample/Int/Type	Blows/6 In.	N	Recovery (ft.)	PID/FID (ppm) Field Screening	Geologic Column	Stratigraphic Description	Well Construction
gs elevation 1122.7 ft.								**GROUND SURFACE**	4-inch locking protective casing.
0			5 9 9 8	18	2.0	0.3		Dark brown SILT, some fine to coarse Sand, some fine Gravel, moist, firm (FILL).	Cement pad to 1.5' Below Ground Surface (BGS).
1120								Dark brown fine to coarse SAND, some fine to coarse Gravel, little Silt, moist, firm (FILL).	
5			8 8 6 8	14	1.0	0.3		Dark brown Clayey SILT, some fine to coarse SAND, some fine to coarse Gravel (subangular, moderately hard), moist, firm (FILL). *Hard Drilling from 5 to 12'.*	2-inch schedule 40 PVC (+1.9'- 39.80' BGS) Cement/Bentonite Grout (1.5'- 34.0' BGS)
1115									
10			19 14 19 14	33	0.6	0.3		Brown coarse to medium GRAVEL (subangular, moderately hard), little Silt, moist, slight organic odor, compact (FILL).	▽ ▼ ▽
1110									
15			5 30	46	0.6	1.8			

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Remarks:
Grain size analysis from 16' to 52'.

Water Levels

Date / Time	Elevation	Depth
12/28/94/0840	1111.98	10.74 ▼
01/04/95/1051	1111.69	11.01 ▽
01/19/95/0824	1112.75	9.95 ▽

Client: CPRP Group

Location: Rosen Site, Cortland, New York

Project: Aquifer Test Program (ATP)

Well No. W-26

Total Depth = 58 ft.

DEPTH	ELEVATION	Analytical ID Number	Sample/Int/Type	Blows/6 In.	N	Recovery (ft.)	PID/FID (ppm) Field Screening	Geologic Column	Stratigraphic Description	Well Construction
				16 11	46	0.6	1.8			
				8 16 32 26	48	1.0	1.8		Gray brown coarse to medium GRAVEL (subangular), and medium to fine SAND, little Clay & Silt, slight organic odor, saturated, compact to very compact.	
	1105			12 18 49 16	67	1.1	1.6			
20				13 22 24 27	46	1.2	1.1		@20.0', grades to gray brown coarse to fine SAND, and coarse to medium GRAVEL (subangular shale and sandstone), little Clayey Silt, saturated, compact.	
	1100	W-26 (22-24)		20 52 32 27	64	1.0	0.8			
				12 17 16 13	33	0.8	0.6			
25				10 12 21 20	33	1.0	0.2		@26.0', grades to gray brown coarse to fine SAND, some coarse to fine Gravel, trace Clayey Silt, saturated, compact to firm.	
	1095			28 32 16 21	48	1.2	1.3			
30				4 11 13 16	24	1.3	1.2			
	1090			45 32 25 22	57	1.2	30.5		@32.0', grades to gray brown coarse to fine SAND, little coarse to fine Gravel, trace Silt, saturated, very compact.	
35		W-26 (34-36)		27 3	18	1.2	1.6		*see next page*	

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ENGINEERS & SCIENTISTS

Remarks:

Analytical IDs correspond to Total Organic Carbon (TOC) sample intervals.

Water Levels

Date / Time	Elevation	Depth
12/28/94/0840	1111.96	10.74 ↧
01/04/95/1051	1111.69	11.01 ↧
01/19/95/0824	1112.75	9.95 ▽

Client: CPRP Group

Location: Rosen Site, Cortland, New York

Project: Aquifer Test Program (ATP)

Well No. W-26

Total Depth = 58 ft.

DEPTH	ELEVATION	Analytical ID Number	Sample/Int/Type	Blows/6 In.	N	Recovery (ft.)	PID/FID (ppm) Field Screening	Geologic Column	Stratigraphic Description
		W-26 (34-36)		15 10	18	1.2	1.6		@34.0', grades to gray brown coarse to fine SAND, and coarse to fine GRAVEL, little Clayey Silt, saturated, firm.
	1085			10 13 19 19	32	1.3	39.4		@36.0', 0.04' seam of medium to fine SAND, trace Silt, compact.
40				14 17 19 18	36	1.1	7.3		
		W-26 (40-42)		15 15 17 19	32	1.0	17.3		@40.8', 0.05' seam of white medium to fine SAND, some Silt, compact.
	1080			13 21 12 13	33	0.4	10.3		@42.0', grades to brown coarse to fine SAND, little Silt, little fine to medium Gravel, saturated, compact.
45				7 11 11 20	22	0.7	1.1		
		W-26 (46-48)		12 14 13 12	27	0.3	1.0		Dark brown coarse to fine SAND, trace fine Gravel, saturated, firm.
	1075			4 10 10 11	20	0.4	0.9		@48.0', grades to gray brown medium to fine SAND, some coarse to fine Gravel, trace Silt, firm.
50				4 5 6 5	11	0.4	0.9		Orange brown fine SAND, little Silt, saturated, firm.
	1070			11 11 11 11	22	1.0	0.7		Gray brown coarse to fine SAND, some coarse to fine Gravel, little Clayey Silt, saturated, firm.
55				35 18	40	0.4	1.5		

Well Construction

- Bentonite seal (34.0'- 36.0' BGS)
- Morie No. 0 Sand Pack (36.0' - 58.0' BGS)
- Well Screen, 0.01" Slot (39.80' to 49.30' BGS)
- Formation Collapse (49.6'-58.00' BGS)

BLASLAND, BOUCK & LEE
ENGINEERS & SCIENTISTS

Remarks:

Water Levels

Date / Time	Elevation	Depth
12/28/94/0840	1111.96	10.74
01/04/95/1051	1111.69	11.01
01/19/95/0824	1112.75	9.95

Client: CPRP Group

Location: Rosen Site, Cortland, New York

Project: Aquifer Test Program (ATP)

Well No. W-26

Total Depth = 58 ft.

DEPTH / ELEVATION	Analytical ID Number	Sample/Int/Type	Blows/6 In.	N	Recovery (ft.)	PID/FID (ppm) Field Screening	Geologic Column	Stratigraphic Description	Well Construction
			22 21	40	0.4	1.5			
1065	W-26 (56-58)		15 58 14 16	72	1.0	0.8		Orange brown fine SAND, little to trace Silt, saturated, compact to very compact.	
60								End of boring at 58.0'.	
1060									
65									
1055									
70									
1050									
75									

BLASLAND, BOUCK & LEE
ENGINEERS & SCIENTISTS

Remarks:

Water Levels

Date / Time	Elevation	Depth
12/28/94/0840	1111.96	10.74 ↧
01/04/95/1051	1111.69	11.01 ⊽
01/19/95/0824	1112.75	9.95 ▽

Project: 494.04

Script: MON-well
Date: 05/05/95

Appendix B

Appendix B

BLASLAND, BOUCK & LEE, INC.
engineers & scientists

ATP Analytical Data

RECRA ENVIRONMENTAL INC.

Chemical and Environmental Analysis Services

December 29, 1994

Ms. Lynette B. Mokry
Blasland & Bouck Engineers
6723 Towpath Road
Syracuse, New York 13214-0066

Dear Ms. Mokry:

Please find enclosed the results of the analyses of the sample(s) submitted by your firm.

Quote #: NY94-116	Project Name : Rosen Site
Project #: NY4A4838	Matrix : Soil
Task #: 1	Samples Rec'd : 12/21/94
	Sample Date : 12/19,20/94

Methodology:

___ 40 CFR 136
_X_ SW 846, 3rd EDITION
___ 40 CFR 261 (TCLP)
___ NIOSH Other

If you have any questions concerning these data, please contact me at (716) 691-2600. We look forward to serving you in the future.

Sincerely,

RECRA ENVIRONMENTAL, INC.

Robert M. Kissel
Program Manager

KPK/klc

I.D.#A94-7514
#NY4A4838

INORGANIC DATA COMMENT PAGE

0021

Laboratory Name RECRA ENVIRONMENTAL, INC.

USEPA Defined Inorganic Data Qualifiers:

B - Indicates a value greater than or equal to the instrument detection limit but less than the contract required detection limit.

U - Indicates element was analyzed for but not detected. Report with the detection limit value (e.g., 100).

E - Indicates a value estimated or not reported due to the presence of interference.

S - Indicates value determined by Method of Standard Addition.

N - Indicates spike sample recovery is not within control limits.

* - Indicates duplicate analysis is not within control limits.

+ - Indicates the correlation coefficient for method of standard addition is less than 0.995.

M - Indicates duplicate injection results exceeded control limits.

W - Post digestion spike for Furnace AA analysis is out of control limits (85-115%), while sample absorbance is less than 50% of spike absorbance.

G - The TCLP Matrix Spike recovery was greater than the upper limit of the analytical method.

L - The TCLP Matrix Spike recovery was lower than the lower limit of the analytical method.

BLASLAND & BOUCK ENGINEER

METHOD 9060 - LEACHABLE TOTAL ORGANIC CARBON

Laboratory: Recra Environmental, Inc. - RECNY
Lab Job No: A94-7514

Units: UG/G

Client Sample ID	Laboratory Sample ID	Matrix	Method	Sample Date	Analysis Date	Dilution	Result	Q
MATRIX SPIKE BL DUP	A4B0420705	Soil	9060	-	12/27/94	1	1820	
MATRIX SPIKE BLANK	A4B0420703	Soil	9060	-	12/27/94	1	1720	
METHOD BLANK	A4B0420701	Soil	9060	-	12/27/94	1	200	U
W-26 (22-23')	A4751401	Soil	9060	12/19/94	12/27/94	1	682	
W-26 (34-36')	A4751402	Soil	9060	12/20/94	12/27/94	1	343	
W-26 (40-42')	A4751403	Soil	9060	12/20/94	12/27/94	1	444	
W-26 (46-48')	A4751404	Soil	9060	12/20/94	12/27/94	1	520	
W-26 (56-58')	A4751405	Soil	9060	12/20/94	12/27/94	1	438	

NY4A483E

RECRA ENVIRONMENTAL, INC.

CHAIN OF CUSTODY RECORD

PROJECT NO: 494.0118

SITE NAME: ROSEN BROS. - Cortland

SAMPLERS (SIGNATURE): Lynette B. Mckay

STATION NO	DATE	TIME	COMP.	GRAB	STATION LOCATION	NO OF CONTAINERS	TOC 9060M						REMARKS
	12/16/94	1530		✓	W-26 (22-23')	1	1						
	12/20/94	0835		✓	W-26 (34-36)	1	1						
	12/21/94	0915		✓	W-26 (40-42)	1	1						
	12/21/94	0955		✓	W-26 (46-48')	1	1						
	12/21/94	1035		✓	W-26 (56-58')	1	1						

RELINQUISHED BY (SIGNATURE)	DATE/TIME	RECEIVED BY (SIGNATURE)	RELINQUISHED BY (SIGNATURE)	DATE/TIME	RECEIVED BY (SIGNATURE)
Lynette B. Mckay	12/21/94 1730	FedEx			
RELINQUISHED BY (SIGNATURE)	DATE/TIME	RECEIVED BY (SIGNATURE)	RELINQUISHED BY (SIGNATURE)	DATE/TIME	RECEIVED BY (SIGNATURE)
RELINQUISHED BY (SIGNATURE)	DATE/TIME	RECEIVED FOR LABORATORY BY (SIGNATURE)	DATE/TIME	REMARKS	
			12/21/94 10	Cooler 4°C	send results to: Lynette B. Mckay 6723 Tuspath Rd Syracuse, N.Y. 13214-0006

Distribution: Original accompanies shipment / copy to coordinator field files

SAMPLE DATA SUMMARY PACKAGE

RECRA
ENVIRONMENTAL
INC.

ANALYTICAL RESULTS

Prepared for

Blasland & Bouck Engineers
6723 Towpath Road
Box 166
Syracuse, NY 13214-0066

Prepared by

Recra Environmental, Inc.
10 Hazelwood Drive, Suite 106
Amherst, New York 14228-2298

METHODOLOGY

The specific methodology employed in obtaining the enclosed analytical results are indicated on the specific data tables. The method number presented refers to the following reference.

* "Test Methods for Evaluating Solid Waste, Physical/Chemical Methods" (SW-846), Third Edition, August 1993, U.S. Environmental Protection Agency Office of Solid Waste.

* 40 CFR Part 136 "Guidelines Establishing Test Procedures for the Analysis of Pollutants", U.S. Environmental Protection Agency.

COMMENTS

Results are reported using standard qualifiers (Q) as defined on the Organic and Inorganic Data Comment Pages.

VOLATILE DATA

Volatile sample and standard areas are listed on the corresponding data system printouts.

Volatile data was processed utilizing Finnigan Autoquantitation and Recra Environmental's Analytical Information Management System software. All compounds determined to be present by the computer-generated autoquantitation were subjected to a manual ion search for secondary and tertiary ions. Unedited quantitation reports have been submitted with this analytical package.

Sample W-25-1 required a dilution factor of 20 due to a high concentration of Acetone. The sample was diluted 4 times, but exhibited concentrations in the dilutions that were not linear for Acetone, therefore, the initial and final dilution are reported in this package.

METALS DATA

Sample identifications have been abbreviated due to the character limitations of the software.

WET CHEMISTRY

No deviations from protocol were observed during analyses.

"I certify that this data package is in compliance with the terms and conditions detailed above. Release of the data contained in this hardcopy data package and in the computer-readable data submitted on floppy diskette has been authorized by the Laboratory Director or designee, as verified by the following signature."

KE Kasperek

Kenneth E. Kasperek
Laboratory Manager

1/31/95
Date

RECRA
ENVIRONMENTAL
INC.

ORGANIC DATA COMMENT PAGE

Laboratory Name: Recra Environmental, Inc.

USEPA Defined Organic Data Qualifiers:

U - Indicates compound was analyzed for but not detected.

J - Indicates an estimated value. This flag is used either when estimating a concentration for tentatively identified compounds where a 1:1 response is assumed, or when the mass spectral data indicates the presence of a compound that meets the identification criteria but the result is less than the sample quantitation limit but greater than zero.

C - This flag applies to pesticide results where the identification has been confirmed by GC/MS.

B - This flag is used when the analyte is found in the associated blank as well as in the sample.

E - This flag identifies compounds whose concentrations exceed the calibration range of the GC/MS instrument for that specific analysis.

D - This flag identifies all compounds identified in an analysis at a secondary dilution factor.

G - The TCLP Matrix Spike recovery was greater than the upper limit of the analytical method.

L - The TCLP Matrix Spike recovery was lower than the lower limit of the analytical method.

T - This flag is used when the analyte is found in the associated TCLP extraction as well as in the sample.

N - Indicates presumptive evidence of a compound. This flag is only used for tentatively identified compounds, where the identification is based on a mass spectral library search. It is applied to all TIC results.

P - This flag is used for a pesticide/Aroclor target analyte when there is greater than 25% difference for detected concentrations between the two GC columns. The lower of the two values is reported on the Form I and flagged with a "P".

A - This flag indicates that a TIC is a suspected aldol-condensation product.

INORGANIC DATA COMMENT PAGE

Laboratory Name: Recra Environmental, Inc.

USEPA Defined Inorganic Data Qualifiers:

B	-	**Indicates a value greater than or equal to the instrument detection limit, but less than the contract required detection limit.**
U	-	**Indicates element was analyzed for but not detected. Report with the detection limit value (e.g., 100).**
E	-	**Indicates a value estimated or not reported due to the presence of interference.**
S	-	**Indicates value determined by Method of Standard Addition.**
N	-	**Indicates spike sample recovery is not within control limits.**
*	-	**Indicates duplicate analysis is not within control limits.**
+	-	**Indicates the correlation coefficient for Method of Standard Addition is less than 0.995.**
M	-	**Indicates duplicate injection results exceeded control limits.**
W	-	**Post digestion spike for Furnace AA analysis is out of control limits (85-115%), while sample absorbance is less than 50% of spike absorbance.**

BLASLAND & BOUCK ENGINEER
METHOD 8240 - TCL VOLATILE ORGANICS
ANALYSIS DATA SHEET

0096
Client No.

W-25-1

Lab Name: Recra Environmental Contract: _____

Lab Code: RECNY Case No.: _____ SAS No.: _____ SDG No.: _____

Matrix: (soil/water) WATER Lab Sample ID: A5038201

Sample wt/vol: 5.00 (g/mL) ML Lab File ID: K6149.MSO

Level: (low/med) LOW Date Samp/Recv: 01/19/95 01/20/95

% Moisture: not dec. _____ Heated Purge: N Date Analyzed: 01/23/95

GC Column: DB-624 ID: 0.53 (mm) Dilution Factor: 1.00

Soil Extract Volume: _____ (uL) Soil Aliquot Volume: _____ (uL)

CAS NO.	COMPOUND	CONCENTRATION UNITS: (ug/L or ug/Kg) UG/L	Q
67-64-1	Acetone	380	E
71-43-2	Benzene	5	U
75-27-4	Bromodichloromethane	5	U
75-25-2	Bromoform	5	U
74-83-9	Bromomethane	10	U
78-93-3	2-Butanone	10	U
75-15-0	Carbon Disulfide	5	U
56-23-5	Carbon Tetrachloride	5	U
108-90-7	Chlorobenzene	0.4	J
75-00-3	Chloroethane	10	U
67-66-3	Chloroform	5	U
74-87-3	Chloromethane	10	U
124-48-1	Dibromochloromethane	5	U
75-34-3	1,1-Dichloroethane	24	
107-06-2	1,2-Dichloroethane	5	U
75-35-4	1,1-Dichloroethene	0.8	J
540-59-0	1,2-Dichloroethene (Total)	5	U
78-87-5	1,2-Dichloropropane	5	U
10061-01-5	cis-1,3-Dichloropropene	5	U
10061-02-6	trans-1,3-Dichloropropene	5	U
100-41-4	Ethyl benzene	5	U
591-78-6	2-Hexanone	10	U
75-09-2	Methylene chloride	5	U
108-10-1	4-Methyl-2-pentanone	10	U
100-42-5	Styrene	5	U
79-34-5	1,1,2,2-Tetrachloroethane	5	U
127-18-4	Tetrachloroethene	5	U
108-88-3	Toluene	0.3	J
71-55-6	1,1,1-Trichloroethane	56	
79-00-5	1,1,2-Trichloroethane	5	U
79-01-6	Trichloroethene	0.6	J
108-05-4	Vinyl acetate	10	U
75-01-4	Vinyl chloride	10	U
1330-20-7	Total Xylenes	5	U

BLASLAND & BOUCK ENGINEER
METHOD 8240 - TCL VOLATILE ORGANICS
ANALYSIS DATA SHEET

Client No.: W-25-1DL

Lab Name: Recra Environmental Contract: _____

Lab Code: RECNY Case No.: _____ SAS No.: _____ SDG No.: _____

Matrix: (soil/water) WATER Lab Sample ID: A5038201DL

Sample wt/vol: 5.00 (g/mL) ML Lab File ID: K6195.MSQ

Level: (low/med) LOW Date Samp/Recv: 01/19/95 01/20/95

% Moisture: not dec. _____ Heated Purge: N Date Analyzed: 01/25/95

GC Column: DB-624 ID: 0.53 (mm) Dilution Factor: 20.00

Soil Extract Volume: _____ (uL) Soil Aliquot Volume: _____ (uL)

CAS NO.	COMPOUND	CONCENTRATION UNITS: (ug/L or ug/Kg) UG/L	Q
67-64-1	Acetone	1100	D
71-43-2	Benzene	100	U
75-27-4	Bromodichloromethane	100	U
75-25-2	Bromoform	100	U
74-83-9	Bromomethane	200	U
78-93-3	2-Butanone	200	U
75-15-0	Carbon Disulfide	100	U
56-23-5	Carbon Tetrachloride	100	U
108-90-7	Chlorobenzene	100	U
75-00-3	Chloroethane	200	U
67-66-3	Chloroform	100	U
74-87-3	Chloromethane	200	U
124-48-1	Dibromochloromethane	100	U
75-34-3	1,1-Dichloroethane	14	DJ
107-06-2	1,2-Dichloroethane	100	U
75-35-4	1,1-Dichloroethene	100	U
540-59-0	1,2-Dichloroethene (Total)	100	U
78-87-5	1,2-Dichloropropane	100	U
10061-01-5	cis-1,3-Dichloropropene	100	U
10061-02-6	trans-1,3-Dichloropropene	100	U
100-41-4	Ethyl benzene	100	U
591-78-6	2-Hexanone	200	U
75-09-2	Methylene chloride	100	U
108-10-1	4-Methyl-2-pentanone	200	U
100-42-5	Styrene	100	U
79-34-5	1,1,2,2-Tetrachloroethane	100	U
127-18-4	Tetrachloroethene	100	U
108-88-3	Toluene	100	U
71-55-6	1,1,1-Trichloroethane	44	DJ
79-00-5	1,1,2-Trichloroethane	100	U
79-01-6	Trichloroethene	100	U
108-05-4	Vinyl acetate	200	U
75-01-4	Vinyl chloride	200	U
1330-20-7	Total Xylenes	100	U

BLASLAND & BOUCK ENGINEER
METHOD 8240 - TCL VOLATILE ORGANICS
ANALYSIS DATA SHEET

0098

Client No.

W-25-2

Lab Name: Recra Environmental Contract: _____

Lab Code: RECNY Case No.: _____ SAS No.: _____ SDG No.: _____

Matrix: (soil/water) WATER Lab Sample ID: A5038202

Sample wt/vol: 5.00 (g/mL) ML Lab File ID: K6150.MSO

Level: (low/med) LOW Date Samp/Recv: 01/19/95 01/20/95

% Moisture: not dec. _____ Heated Purge: N Date Analyzed: 01/23/95

GC Column: DB-624 ID: 0.53 (mm) Dilution Factor: 1.00

Soil Extract Volume: _____ (uL) Soil Aliquot Volume: _____ (uL)

CONCENTRATION UNITS: (ug/L or ug/Kg) UG/L

CAS NO.	COMPOUND		Q
67-64-1	Acetone	39	
71-43-2	Benzene	5	U
75-27-4	Bromodichloromethane	5	U
75-25-2	Bromoform	5	U
74-83-9	Bromomethane	10	U
78-93-3	2-Butanone	10	U
75-15-0	Carbon Disulfide	5	U
56-23-5	Carbon Tetrachloride	5	U
108-90-7	Chlorobenzene	5	U
75-00-3	Chloroethane	10	U
67-66-3	Chloroform	5	U
74-87-3	Chloromethane	10	U
124-48-1	Dibromochloromethane	5	U
75-34-3	1,1-Dichloroethane	34	
107-06-2	1,2-Dichloroethane	0.6	J
75-35-4	1,1-Dichloroethene	2	J
540-59-0	1,2-Dichloroethene (Total)	5	U
78-87-5	1,2-Dichloropropane	5	U
10061-01-5	cis-1,3-Dichloropropene	5	U
10061-02-6	trans-1,3-Dichloropropene	5	U
100-41-4	Ethyl benzene	5	U
591-78-6	2-Hexanone	10	U
75-09-2	Methylene chloride	5	U
108-10-1	4-Methyl-2-pentanone	10	U
100-42-5	Styrene	5	U
79-34-5	1,1,2,2-Tetrachloroethane	5	U
127-18-4	Tetrachloroethene	5	U
108-88-3	Toluene	5	U
71-55-6	1,1,1-Trichloroethane	100	
79-00-5	1,1,2-Trichloroethane	5	U
79-01-6	Trichloroethene	0.6	J
108-05-4	Vinyl acetate	10	U
75-01-4	Vinyl chloride	10	U
1330-20-7	Total Xylenes	5	U

BLASLAND & BOUCK ENGINEER
METHOD 8240 - TCL VOLATILE ORGANICS
ANALYSIS DATA SHEET

0099
Client No.

W-25-3

Lab Name: Recra Environmental Contract: _____

Lab Code: RECNY Case No.: _____ SAS No.: _____ SDG No.: _____

Matrix: (soil/water) WATER Lab Sample ID: A5038203

Sample wt/vol: 5.00 (g/mL) ML Lab File ID: K6151.MSO

Level: (low/med) LOW Date Samp/Recv: 01/19/95 01/20/95

% Moisture: not dec. _____ Heated Purge: N Date Analyzed: 01/23/95

GC Column: DB-624 ID: 0.53 (mm) Dilution Factor: 1.00

Soil Extract Volume: _____ (uL) Soil Aliquot Volume: _____ (uL)

CAS NO.	COMPOUND	CONCENTRATION UNITS: (ug/L or ug/Kg) UG/L	Q
67-64-1	Acetone	10	U
71-43-2	Benzene	5	U
75-27-4	Bromodichloromethane	5	U
75-25-2	Bromoform	5	U
74-83-9	Bromomethane	10	U
78-93-3	2-Butanone	10	U
75-15-0	Carbon Disulfide	5	U
56-23-5	Carbon Tetrachloride	5	U
108-90-7	Chlorobenzene	5	U
75-00-3	Chloroethane	10	U
67-66-3	Chloroform	5	U
74-87-3	Chloromethane	10	U
124-48-1	Dibromochloromethane	5	U
75-34-3	1,1-Dichloroethane	39	
107-06-2	1,2-Dichloroethane	0.5	J
75-35-4	1,1-Dichloroethene	3	J
540-59-0	1,2-Dichloroethene (Total)	5	U
78-87-5	1,2-Dichloropropane	5	U
10061-01-5	cis-1,3-Dichloropropene	5	U
10061-02-6	trans-1,3-Dichloropropene	5	U
100-41-4	Ethyl benzene	5	U
591-78-6	2-Hexanone	10	U
75-09-2	Methylene chloride	5	U
108-10-1	4-Methyl-2-pentanone	10	U
100-42-5	Styrene	5	U
79-34-5	1,1,2,2-Tetrachloroethane	5	U
127-18-4	Tetrachloroethene	5	U
108-88-3	Toluene	5	U
71-55-6	1,1,1-Trichloroethane	110	
79-00-5	1,1,2-Trichloroethane	5	U
79-01-6	Trichloroethene	0.6	J
108-05-4	Vinyl acetate	10	U
75-01-4	Vinyl chloride	10	U
1330-20-7	Total Xylenes	5	U

BLASLAND & BOUCK

COVER PAGE - INORGANIC ANALYSES DATA PACKAGE

Lab Name: RECRA_ENVIRONMENTAL_INC._ Contract: NY94-116__

Lab Code: RECNY_ Case No.: 4838_ SAS No.: _____ SDG No.:0382__

SOW No.: SW846 3rd.Ed.

Sample No.	Lab Sample ID
_W-25-1_____	_3512_____
_W-25-2_____	_3513_____
_W-25-3_____	_3514_____
_W251_____	_A5038201_____
_W252_____	_A5038202_____
_W253_____	_A5038203_____

Were ICP interelement corrections applied ? Yes/No YES

Were ICP background corrections applied ? Yes/No YES

If yes - were raw data generated before application of background corrections ? Yes/No NO_

Comments:

I certify that this data package is in compliance with the terms and conditions of the contract, both technically and for completeness, for other than the conditions detailed above. Release of the data contained in this hardcopy data package has been authorized by the Laboratory Manager or the Manager's designee, as verified by the following signature.

Signature: KE Kasperek Name: Kenneth E. Kasperek_____

Date: 1/31/95 Title: Laboratory Director_____

BLASLAND & BOUCK

1

INORGANIC ANALYSES DATA SHEET

SAMPLE NO.

W-25-1

Lab Name: RECRA_ENVIRONMENTAL_INC._ Contract: NY94-116__

Lab Code: RECNY_ Case No.: 4838__ SAS No.: _____ SDG No.: 0382__

Matrix (soil/water): WATER Lab Sample ID: 3512

Level (low/med): LOW__ Date Received: 01/20/95

% Solids: __0.0

Concentration Units (ug/L or mg/kg dry weight): UG/L_

CAS No.	Analyte	Concentration	C	Q	M
7429-90-5	Aluminum_		_		NR
7440-36-0	Antimony_		_		NR
7440-38-2	Arsenic__		_		NR
7440-39-3	Barium___		_		NR
7440-41-7	Beryllium		_		NR
7440-43-9	Cadmium__		_		NR
7440-70-2	Calcium__	120000	_		P_
7440-47-3	Chromium_		_		NR
7440-48-4	Cobalt___		_		NR
7440-50-8	Copper___		_		NR
7439-89-6	Iron_____	5080	_		P_
7439-92-1	Lead_____	6.0	_		F_
7439-95-4	Magnesium	20700	_		P_
7439-96-5	Manganese		_		NR
7439-97-6	Mercury__		_		NR
7440-02-0	Nickel___		_		NR
7440-09-7	Potassium		_		NR
7782-49-2	Selenium_		_		NR
7440-22-4	Silver___		_		NR
7440-23-5	Sodium___		_		NR
7440-28-0	Thallium_		_		NR
7440-62-2	Vanadium_		_		NR
7440-66-6	Zinc_____		_		NR
_____	Cyanide__		_		NR
_____	_____		_		__

Color Before: COLORLESS Clarity Before: CLEAR_ Texture: _____

Color After: COLORLESS Clarity After: CLEAR_ Artifacts: _____

Comments:

LAB_SAMPLE_ID:_A5038201

CLIENT_SAMPLE_ID:_W-25-1

BLASLAND & BOUCK

1

INORGANIC ANALYSES DATA SHEET

SAMPLE NO.

W-25-2

Lab Name: RECRA_ENVIRONMENTAL_INC._ Contract: NY94-116__

Lab Code: RECNY_ Case No.: 4838__ SAS No.: _____ SDG No.: 0382__

Matrix (soil/water): WATER Lab Sample ID: 3513

Level (low/med): LOW__ Date Received: 01/20/95

% Solids: __0.0

Concentration Units (ug/L or mg/kg dry weight): UG/L_

CAS No.	Analyte	Concentration	C	Q	M
7429-90-5	Aluminum_		_		NR
7440-36-0	Antimony_		_		NR
7440-38-2	Arsenic__		_		NR
7440-39-3	Barium___		_		NR
7440-41-7	Beryllium		_		NR
7440-43-9	Cadmium__		_		NR
7440-70-2	Calcium__	170000	_		P_
7440-47-3	Chromium_		_		NR
7440-48-4	Cobalt___		_		NR
7440-50-8	Copper___		_		NR
7439-89-6	Iron_____	2900	_		P_
7439-92-1	Lead_____	2.0	U		F_
7439-95-4	Magnesium	18200	_		P_
7439-96-5	Manganese		_		NR
7439-97-6	Mercury__		_		NR
7440-02-0	Nickel___		_		NR
7440-09-7	Potassium		_		NR
7782-49-2	Selenium_		_		NR
7440-22-4	Silver___		_		NR
7440-23-5	Sodium___		_		NR
7440-28-0	Thallium_		_		NR
7440-62-2	Vanadium_		_		NR
7440-66-6	Zinc_____		_		NR
_____	Cyanide__		_		NR
_____	_____		_		__

Color Before: COLORLESS Clarity Before: CLEAR_ Texture: _____

Color After: COLORLESS Clarity After: CLEAR_ Artifacts: _____

Comments:

LAB_SAMPLE_ID:_A5038202_____

CLIENT_SAMPLE_ID:_W-25-2_____

BLASLAND & BOUCK

1

INORGANIC ANALYSES DATA SHEET

SAMPLE NO.

W-25-3

Lab Name: RECRA_ENVIRONMENTAL_INC._ Contract: NY94-116__

Lab Code: RECNY_ Case No.: 4838__ SAS No.: _____ SDG No.: 0382__

Matrix (soil/water): WATER Lab Sample ID: 3514

Level (low/med): LOW__ Date Received: 01/20/95

% Solids: __0.0

Concentration Units (ug/L or mg/kg dry weight): UG/L_

CAS No.	Analyte	Concentration	C	Q	M
7429-90-5	Aluminum_		_		NR
7440-36-0	Antimony_		_		NR
7440-38-2	Arsenic__		_		NR
7440-39-3	Barium___		_		NR
7440-41-7	Beryllium		_		NR
7440-43-9	Cadmium__		_		NR
7440-70-2	Calcium__	177000	_		P_
7440-47-3	Chromium_		_		NR
7440-48-4	Cobalt___		_		NR
7440-50-8	Copper___		_		NR
7439-89-6	Iron_____	2970	_		P_
7439-92-1	Lead_____	3.0	_		F_
7439-95-4	Magnesium	17600	_		P_
7439-96-5	Manganese		_		NR
7439-97-6	Mercury__		_		NR
7440-02-0	Nickel___		_		NR
7440-09-7	Potassium		_		NR
7782-49-2	Selenium_		_		NR
7440-22-4	Silver___		_		NR
7440-23-5	Sodium___		_		NR
7440-28-0	Thallium_		_		NR
7440-62-2	Vanadium_		_		NR
7440-66-6	Zinc_____		_		NR
_____	Cyanide__		_		NR
_____	_____		_		__

Color Before: COLORLESS Clarity Before: CLEAR_ Texture: _____

Color After: COLORLESS Clarity After: CLEAR_ Artifacts: _____

Comments:

LAB_SAMPLE_ID:_A5038203

CLIENT_SAMPLE_ID:_W-25-3

BLASLAND & BOUCK

1

INORGANIC ANALYSES DATA SHEET

SAMPLE NO.

W251

Lab Name: RECRA_ENVIRONMENTAL_INC._ Contract: NY94-116__

Lab Code: RECNY_ Case No.: 4838__ SAS No.: _____ SDG No.: 0382__

Matrix (soil/water): WATER Lab Sample ID: A5038201

Level (low/med): LOW__ Date Received: 01/20/95

% Solids: __0.0

Concentration Units (ug/L or mg/kg dry weight): UG/L_

CAS No.	Analyte	Concentration	C	Q	M
7429-90-5	Aluminum_		_		NR
7440-36-0	Antimony_		_		NR
7440-38-2	Arsenic__		_		NR
7440-39-3	Barium___		_		NR
7440-41-7	Beryllium		_		NR
7440-43-9	Cadmium__		_		NR
7440-70-2	Calcium__	124000	_		P_
7440-47-3	Chromium_		_		NR
7440-48-4	Cobalt___		_		NR
7440-50-8	Copper___		_		NR
7439-89-6	Iron_____	5250	_		P_
7439-92-1	Lead_____	2.0	U		F_
7439-95-4	Magnesium	20500	_		P_
7439-96-5	Manganese		_		NR
7439-97-6	Mercury__		_		NR
7440-02-0	Nickel___		_		NR
7440-09-7	Potassium		_		NR
7782-49-2	Selenium_		_		NR
7440-22-4	Silver___		_		NR
7440-23-5	Sodium___		_		NR
7440-28-0	Thallium_		_		NR
7440-62-2	Vanadium_		_		NR
7440-66-6	Zinc_____		_		NR
_____	Cyanide__		_		NR
_____	_____		_		__

Color Before: _____ Clarity Before: _____ Texture: _____

Color After: _____ Clarity After: _____ Artifacts: _____

Comments:

LAB_SAMPLE_ID:_A5038201_____

CLIENT_SAMPLE_ID:_W-25-1_____

ALL_RESULTS_ARE_SOLUBLE_____

_____

BLASLAND & BOUCK

1

INORGANIC ANALYSES DATA SHEET

SAMPLE NO.

W252

Lab Name: RECRA_ENVIRONMENTAL_INC._ Contract: NY94-116__

Lab Code: RECNY_ Case No.: 4838__ SAS No.: _____ SDG No.: 0382__

Matrix (soil/water): WATER Lab Sample ID: A5038202

Level (low/med): LOW__ Date Received: 01/20/95

% Solids: __0.0

Concentration Units (ug/L or mg/kg dry weight): UG/L_

CAS No.	Analyte	Concentration	C	Q	M
7429-90-5	Aluminum_		_		NR
7440-36-0	Antimony_		_		NR
7440-38-2	Arsenic__		_		NR
7440-39-3	Barium___		_		NR
7440-41-7	Beryllium		_		NR
7440-43-9	Cadmium__		_		NR
7440-70-2	Calcium__	171000	_		P_
7440-47-3	Chromium_		_		NR
7440-48-4	Cobalt___		_		NR
7440-50-8	Copper___		_		NR
7439-89-6	Iron_____	2940	_		P_
7439-92-1	Lead_____	2.0	U		F_
7439-95-4	Magnesium	18200	_		P_
7439-96-5	Manganese		_		NR
7439-97-6	Mercury__		_		NR
7440-02-0	Nickel___		_		NR
7440-09-7	Potassium		_		NR
7782-49-2	Selenium_		_		NR
7440-22-4	Silver___		_		NR
7440-23-5	Sodium___		_		NR
7440-28-0	Thallium_		_		NR
7440-62-2	Vanadium_		_		NR
7440-66-6	Zinc_____		_		NR
_____	Cyanide__		_		NR
_____	_____		_		__

Color Before: _____ Clarity Before: _____ Texture: _____

Color After: _____ Clarity After: _____ Artifacts: _____

Comments:

LAB_SAMPLE_ID:_A5038202_____

CLIENT_SAMPLE_ID:_W-25-2_____

ALL_RESULTS_ARE_SOLUBLE_____

_____

BLASLAND & BOUCK

1

INORGANIC ANALYSES DATA SHEET

SAMPLE NO.

W253

Lab Name: RECRA_ENVIRONMENTAL_INC._ Contract: NY94-116__

Lab Code: RECNY_ Case No.: 4838__ SAS No.: _____ SDG No.: 0382__

Matrix (soil/water): WATER Lab Sample ID: A5038203

Level (low/med): LOW__ Date Received: 01/20/95

% Solids: __0.0

Concentration Units (ug/L or mg/kg dry weight): UG/L_

CAS No.	Analyte	Concentration	C	Q	M
7429-90-5	Aluminum_		_		NR
7440-36-0	Antimony_		_		NR
7440-38-2	Arsenic__		_		NR
7440-39-3	Barium___		_		NR
7440-41-7	Beryllium		_		NR
7440-43-9	Cadmium__		_		NR
7440-70-2	Calcium__	183000	_		P_
7440-47-3	Chromium_		_		NR
7440-48-4	Cobalt___		_		NR
7440-50-8	Copper___		_		NR
7439-89-6	Iron_____	2990	_		P_
7439-92-1	Lead_____	2.0	U		F_
7439-95-4	Magnesium	18100	_		P_
7439-96-5	Manganese		_		NR
7439-97-6	Mercury__		_		NR
7440-02-0	Nickel___		_		NR
7440-09-7	Potassium		_		NR
7782-49-2	Selenium_		_		NR
7440-22-4	Silver___		_		NR
7440-23-5	Sodium___		_		NR
7440-28-0	Thallium_		_		NR
7440-62-2	Vanadium_		_		NR
7440-66-6	Zinc_____		_		NR
_____	Cyanide__		_		NR
_____	_____		_		__

Color Before: _____ Clarity Before: _____ Texture: _____

Color After: _____ Clarity After: _____ Artifacts: _____

Comments:

LAB_SAMPLE_ID:_A5038203_____

CLIENT_SAMPLE_ID:_W-25-3_____

ALL_RESULTS_ARE_SOLUBLE_____

_____

BLASLAND & BOUCK ENGINEER
Wet Chemistry Analysis

Client Sample No.
W-25-1 .

Lab Name: Recra Environmental, Inc. Contract: _____

Lab Code: RECNY Case No.: _____ SAS No.: _____ SDG No.: _____

Matrix (soil/water): WATER Lab Sample ID: A5038201

% Solids: 0.0 Date Samp/Recv: 01/19/95 01/20/95

Parameter Name	Units of Measure	Result	C	Q	M	Method Number	Analyzed Date
Biochemical Oxygen Demand	MG/L	740				405.1	01/20/95
Chemical Oxygen Demand	MG/L	1500				410.1	01/30/95
Non-Filterable Residue (103°C)	MG/L	34.7				160.2	01/24/95
pH	S.U.	6.96				150.1	01/20/95
Total Hardness	MG/L*	406				130.2	01/24/95

Comments:

BLASLAND & BOUCK ENGINEER
Wet Chemistry Analysis

Client Sample No.
W-25-2

Lab Name: Recra Environmental, Inc. Contract: _____

Lab Code: RECNY Case No.: _____ SAS No.: _____ SDG No.: _____

Matrix (soil/water): WATER Lab Sample ID: A5038202

% Solids: 0.0 Date Samp/Recv: 01/19/95 01/20/95

Parameter Name	Units of Measure	Result	C	Q	M	Method Number	Analyzed Date
Biochemical Oxygen Demand	MG/L	2.0	U			405.1	01/20/95
Chemical Oxygen Demand	MG/L	60.0				410.1	01/27/95
Non-Filterable Residue (103°C)	MG/L	7.4				160.2	01/24/95
pH	S.U.	7.07				150.1	01/20/95
Total Hardness	MG/L*	525				130.2	01/24/95

Comments:

BLASLAND & BOUCK ENGINEER
Wet Chemistry Analysis

10019

Client Sample No.: W-25-3

Lab Name: Recra Environmental, Inc. Contract: _____

Lab Code: RECNY Case No.: _____ SAS No.: _____ SDG No.: _____

Matrix (soil/water): WATER Lab Sample ID: A5038203

% Solids: 0.0 Date Samp/Recv: 01/19/95 01/20/95

Parameter Name	Units of Measure	Result	C	Q	M	Method Number	Analyzed Date
Biochemical Oxygen Demand	MG/L	2.0	U			405.1	01/20/95
Chemical Oxygen Demand	MG/L	34.2				410.1	01/30/95
Non-Filterable Residue (103°C)	MG/L	6.8				160.2	01/24/95
pH	S.U.	7.16				150.1	01/20/95
Total Hardness	MG/L*	563				130.2	01/24/95

Comments:

BLASLAND & BOUCK ENGINEER
METHOD 8240 - TCL VOLATILE ORGANICS
WATER SURROGATE RECOVERY

Lab Name: Recra Environmental Contract: _____

Lab Code: RECNY Case No.: ____ SAS No.: _____ SDG No.: _____

	Client Sample ID	TOL %REC	#	BFB %REC	#	DCE %REC	#						TOT OUT
1	MATRIX SPIKE BLANK	99		98		92							0
2	MATRIX SPIKE BLANK	98		102		97							0
3	VBLK50	98		98		87							0
4	VBLK52	93		102		97							0
5	W-25-1	101		97		79							0
6	W-25-1DL	96		102		98							0
7	W-25-2	99		98		84							0
8	W-25-3	98		99		85							0

QC LIMITS

TOL = Toluene-D8 (88-110)
BFB = p-Bromofluorobenzene (86-115)
DCE = 1,2-Dichloroethane-D4 (76-114)

\# Column to be used to flag recovery values
* Values outside of contract required QC limits
D Surrogates diluted out

BLASLAND & BOUCK ENGINEER
METHOD 8240 - TCL-VOLATILE ORGANICS
WATER MATRIX SPIKE BLANK RECOVERY

Lab Name: Recra Environmental, Inc. Contract: _____ Lab Samp ID: A5B0058102

Lab Code: RECNY Case No.: _____ SAS No.: _____ SDG No.: _____

Matrix Spike - Client Sample No.: ~~VBLK50~~ MSBlank
mTy 1/30/95

COMPOUND	SPIKE ADDED UG/L	MSB CONCENTRATION UG/L	MSB % REC #	QC LIMITS REC.
1,1-Dichloroethene	50	54	108	61 - 145
Trichloroethene	50	57	114	71 - 120
Benzene	50	49	98	76 - 127
Toluene	50	50	100	76 - 125
Chlorobenzene	50	56	112	75 - 130

Column to be used to flag recovery and RPD values with an asterisk

* Values outside of QC limits

Spike recovery: 0 out of 5 outside limits

Comments: _____

BLASLAND & BOUCK ENGINEER
METHOD 8240 - TCL VOLATILE ORGANICS
WATER MATRIX SPIKE BLANK RECOVERY

Lab Name: Recra Environmental, Inc. Contract: _____ Lab Samp ID: A5B0058106

Lab Code: RECNY Case No.: _____ SAS No.: _____ SDG No.: _____

Matrix Spike - Client Sample No.: ~~VBLK52~~ MSBlank

MB 11/30/95

COMPOUND	SPIKE ADDED UG/L	MSB CONCENTRATION UG/L	MSB % REC #	QC LIMITS REC.
1,1-Dichloroethene	50	45	90	61 - 145
Trichloroethene	50	44	88	71 - 120
Benzene	50	52	104	76 - 127
Toluene	50	50	100	76 - 125
Chlorobenzene	50	45	90	75 - 130

Column to be used to flag recovery and RPD values with an asterisk

* Values outside of QC limits

Spike recovery: 0 out of 5 outside limits

Comments: _____

Client Sample ID: METHOD BLANK
Lab Sample ID: A5B0046101 A5031102 A5031103

Analyte	Units of Measure	Concentration		Spike Amount		% Recovery			%	QC LIMITS	
		Spike Blank	Spike Blank Dup	SB	SBD	SB	SBD	Avg	RPD	RPD	REC.
WET CHEMISTRY ANALYSIS METHOD 405.1 - BIOCHEMICAL OXYGEN DEMA	MG/L	238	232	200	200	119	116	118	2	20.0	73-147

* Indicates Result is outside QC Limits
NC = Not Calculated ND = Not Calculated

NO23

Client Sample ID: METHOD BLANK MATRIX SPIKE BLANK MATRIX SPIKE BL DUP
Lab Sample ID: A5B0055001 A5B0055002 A5B0055003

Analyte	Units of Measure	Concentration		Spike Amount		% Recovery			% RPD	QC LIMITS	
		Spike Blank	Spike Blank Dup	SB	SBD	SB	SBD	Avg		RPD	REC.
WET CHEMISTRY ANALYSIS METHOD 410.1 - CHEMICAL OXYGEN DEMAND	MG/L	135	135	125	125	108	108	108	0	20.0	64-125

* Indicates Result is outside QC Limits
NC = Not Calculated ND = Not Calculated

10924

Date : 01/30/95 18:35

BLASLAND & BOUCK ENGINEER
SAMPLE DATE

Rept: AN0364

Client Sample ID: METHOD BLANK
Lab Sample ID: A5038204

MATRIX SPIKE BLANK
A5B0053401

MATRIX SPIKE BL DUP
A5B0053402

Analyte	Units of Measure	Concentration		Spike Amount		% Recovery			% RPD	QC LIMITS	
		Spike Blank	Spike Blank Dup	SB	SBD	SB	SBD	Avg		RPD	REC.
WET CHEMISTRY ANALYSIS METHOD 130.2 - TOTAL HARDNESS	MG/L*	78.7	79.8	80.0	80.0	98	100	99	2	20.0	82-114

* Indicates Result is outside QC Limits
NC = Not Calculated ND = Not Calculated

Recra Environmental, Inc.

BLASLAND & BOUCK ENGINEER
METHOD 8240 - TCL VOLATILE ORGANICS
METHOD BLANK SUMMARY

0926
Client No.

VBLK50

Lab Name: Recra Environmental Contract: _____

Lab Code: RECNY Case No.: _____ SAS No.: _____ SDG No.: _____

Lab File ID: K6142.MSQ Lab Sample ID: A5B0058102

Date Analyzed: 01/23/95 Time Analyzed: 11:45

GC Column: DB-624 ID: 0.53 (mm) Heated Purge: (Y/N) N

Instrument ID: I50K

THIS METHOD BLANK APPLIES TO THE FOLLOWING SAMPLES, MS AND MSD:

	CLIENT SAMPLE NO.	LAB SAMPLE ID	LAB FILE ID	TIME ANALYZED
1	MATRIX SPIKE BLANK	A5B0058101	K6140.MSQ	10:40
2	W-25-1	A5038201	K6149.MSQ	15:33
3	W-25-2	A5038202	K6150.MSQ	16:06
4	W-25-3	A5038203	K6151.MSQ	16:39

Comments: _____

BLASLAND & BOUCK ENGINEER
METHOD 8240 - TCL VOLATILE ORGANICS
ANALYSIS DATA SHEET

10027

Client No.

VBLK50

Lab Name: Recra Environmental Contract: _____

Lab Code: RECNY Case No.: _____ SAS No.: _____ SDG No.: _____

Matrix: (soil/water) WATER Lab Sample ID: A5B0058102

Sample wt/vol: 5.00 (g/mL) ML Lab File ID: K6142.MSO

Level: (low/med) LOW Date Samp/Recv: _____ _____

% Moisture: not dec. _____ Heated Purge: N Date Analyzed: 01/23/95

GC Column: DB-624 ID: 0.53 (mm) Dilution Factor: 1.00

Soil Extract Volume: _____ (uL) Soil Aliquot Volume: _____ (uL)

CAS NO.	COMPOUND	CONCENTRATION UNITS: (ug/L or ug/Kg) UG/L	Q
67-64-1	Acetone	10	U
71-43-2	Benzene	5	U
75-27-4	Bromodichloromethane	5	U
75-25-2	Bromoform	5	U
74-83-9	Bromomethane	10	U
78-93-3	2-Butanone	10	U
75-15-0	Carbon Disulfide	5	U
56-23-5	Carbon Tetrachloride	5	U
108-90-7	Chlorobenzene	5	U
75-00-3	Chloroethane	10	U
67-66-3	Chloroform	5	U
74-87-3	Chloromethane	10	U
124-48-1	Dibromochloromethane	5	U
75-34-3	1,1-Dichloroethane	5	U
107-06-2	1,2-Dichloroethane	5	U
75-35-4	1,1-Dichloroethene	5	U
540-59-0	1,2-Dichloroethene (Total)	5	U
78-87-5	1,2-Dichloropropane	5	U
10061-01-5	cis-1,3-Dichloropropene	5	U
10061-02-6	trans-1,3-Dichloropropene	5	U
100-41-4	Ethyl benzene	5	U
591-78-6	2-Hexanone	10	U
75-09-2	Methylene chloride	5	U
108-10-1	4-Methyl-2-pentanone	10	U
100-42-5	Styrene	5	U
79-34-5	1,1,2,2-Tetrachloroethane	5	U
127-18-4	Tetrachloroethene	5	U
108-88-3	Toluene	5	U
71-55-6	1,1,1-Trichloroethane	5	U
79-00-5	1,1,2-Trichloroethane	5	U
79-01-6	Trichloroethene	5	U
108-05-4	Vinyl acetate	10	U
75-01-4	Vinyl chloride	10	U
1330-20-7	Total Xylenes	5	U

BLASLAND & BOUCK ENGINEER
METHOD 8240 - TCL VOLATILE ORGANICS
METHOD BLANK SUMMARY

10028
Client No.

VBLK52

Lab Name: Recra Environmental Contract: _____

Lab Code: RECNY Case No.: _____ SAS No.: _____ SDG No.: _____

Lab File ID: K6188.MSQ Lab Sample ID: A5B0058106

Date Analyzed: 01/25/95 Time Analyzed: 10:40

GC Column: DB-624 ID: 0.53 (mm) Heated Purge: (Y/N) N

Instrument ID: I50K

THIS METHOD BLANK APPLIES TO THE FOLLOWING SAMPLES, MS AND MSD:

	CLIENT SAMPLE NO.	LAB SAMPLE ID	LAB FILE ID	TIME ANALYZED
1	MATRIX SPIKE BLANK	A5B0058105	K6186.MSQ	09:35
2	W-25-1DL	A5038201DL	K6195.MSQ	15:04

Comments: _____

BLASLAND & BOUCK ENGINEER
METHOD 8240 - TCL VOLATILE ORGANICS
ANALYSIS DATA SHEET

Client No.: VBLK52

Lab Name: Recra Environmental Contract: _____

Lab Code: RECNY Case No.: _____ SAS No.: _____ SDG No.: _____

Matrix: (soil/water) WATER Lab Sample ID: A5B0058106

Sample wt/vol: 5.00 (g/mL) ML Lab File ID: K6188.MSQ

Level: (low/med) LOW Date Samp/Recv: _____ _____

% Moisture: not dec. _____ Heated Purge: N Date Analyzed: 01/25/95

GC Column: DB-624 ID: 0.53 (mm) Dilution Factor: 1.00

Soil Extract Volume: _____ (uL) Soil Aliquot Volume: _____ (uL)

CAS NO.	COMPOUND	CONCENTRATION UNITS: (ug/L or ug/Kg) UG/L	Q
67-64-1	Acetone	10	U
71-43-2	Benzene	5	U
75-27-4	Bromodichloromethane	5	U
75-25-2	Bromoform	5	U
74-83-9	Bromomethane	10	U
78-93-3	2-Butanone	10	U
75-15-0	Carbon Disulfide	5	U
56-23-5	Carbon Tetrachloride	5	U
108-90-7	Chlorobenzene	5	U
75-00-3	Chloroethane	10	U
67-66-3	Chloroform	5	U
74-87-3	Chloromethane	10	U
124-48-1	Dibromochloromethane	5	U
75-34-3	1,1-Dichloroethane	5	U
107-06-2	1,2-Dichloroethane	5	U
75-35-4	1,1-Dichloroethene	5	U
540-59-0	1,2-Dichloroethene (Total)	5	U
78-87-5	1,2-Dichloropropane	5	U
10061-01-5	cis-1,3-Dichloropropene	5	U
10061-02-6	trans-1,3-Dichloropropene	5	U
100-41-4	Ethyl benzene	5	U
591-78-6	2-Hexanone	10	U
75-09-2	Methylene chloride	5	U
108-10-1	4-Methyl-2-pentanone	10	U
100-42-5	Styrene	5	U
79-34-5	1,1,2,2-Tetrachloroethane	5	U
127-18-4	Tetrachloroethene	5	U
108-88-3	Toluene	5	U
71-55-6	1,1,1-Trichloroethane	5	U
79-00-5	1,1,2-Trichloroethane	5	U
79-01-6	Trichloroethene	5	U
108-05-4	Vinyl acetate	10	U
75-01-4	Vinyl chloride	10	U
1330-20-7	Total Xylenes	5	U

BLASLAND & BOUCK

3
BLANKS

Lab Name: RECRA_ENVIRONMENTAL_INC._ Contract: NY94-116__

Lab Code: RECNY_ Case No.: 4838__ SAS No.: _____ SDG No.: 0382__

Preparation Blank Matrix (soil/water): WATER

Preparation Blank Concentration Units (ug/L or mg/kg): UG/L_

Analyte	Initial Calib. Blank (ug/L)	C	Continuing Calibration Blank (ug/L) 1	C	2	C	3	C	Prepa-ration Blank	C	M
Aluminum											NR
Antimony											NR
Arsenic											NR
Barium											NR
Beryllium											NR
Cadmium											NR
Calcium	1000.0	U	1000.0	U	1000.0	U	1000.0	U	1000.000	U	P
Chromium											NR
Cobalt											NR
Copper											NR
Iron	40.0	U	40.0	U	40.0	U	40.0	U	40.000	U	P
Lead	-2.0	B	2.0	U	2.0	U	-2.0	B	2.000	U	F
Magnesium	300.0	U	300.0	U	300.0	U	300.0	U	300.000	U	P
Manganese											NR
Mercury											NR
Nickel											NR
Potassium											NR
Selenium											NR
Silver											NR
Sodium											NR
Thallium											NR
Vanadium											NR
Zinc											NR
Cyanide											

BLASLAND & BOUCK

3
BLANKS

Lab Name: RECRA_ENVIRONMENTAL_INC._ Contract: NY94-116__

Lab Code: RECNY_ Case No.: 4838__ SAS No.: _____ SDG No.: 0382__

Preparation Blank Matrix (soil/water): _____

Preparation Blank Concentration Units (ug/L or mg/kg): _____

Analyte	Initial Calib. Blank (ug/L)	C	Continuing Calibration Blank (ug/L) 1	C	2	C	3	C	Prepa-ration Blank	C	M
Aluminum											NR
Antimony											NR
Arsenic											NR
Barium											NR
Beryllium											NR
Cadmium											P
Calcium			1000.0	U	1000.0	U	1000.0	U			NR
Chromium											NR
Cobalt											NR
Copper											P
Iron			40.0	U	40.0	U	40.0	U			F
Lead			2.0	U	2.0	U					P
Magnesium			300.0	U	300.0	U	300.0	U			NR
Manganese											NR
Mercury											NR
Nickel											NR
Potassium											NR
Selenium											NR
Silver											NR
Sodium											NR
Thallium											NR
Vanadium											NR
Zinc											NR
Cyanide											

BLASLAND & BOUCK

3
BLANKS

Lab Name: RECRA_ENVIRONMENTAL_INC._ Contract: NY94-116__

Lab Code: RECNY_ Case No.: 4838__ SAS No.: _____ SDG No.: 0382__

Preparation Blank Matrix (soil/water): _____

Preparation Blank Concentration Units (ug/L or mg/kg): _____

Analyte	Initial Calib. Blank (ug/L)	C	Continuing Calibration Blank (ug/L) 1	C	2	C	3	C	Prepa-ration Blank	C	M
Aluminum											NR
Antimony											NR
Arsenic											NR
Barium											NR
Beryllium											NR
Cadmium											NR
Calcium			1000.0	U	1000.0	U					P
Chromium											NR
Cobalt											NR
Copper											NR
Iron			40.0	U	40.0	U					P
Lead											NR
Magnesium			300.0	U	300.0	U					P
Manganese											NR
Mercury											NR
Nickel											NR
Potassium											NR
Selenium											NR
Silver											NR
Sodium											NR
Thallium											NR
Vanadium											NR
Zinc											NR
Cyanide											NR

BLASLAND & BOUCK ENGINEER
WET CHEMISTRY
METHOD BLANK SUMMARY

10033
Client No.

METHOD BLANK

Lab Name: Recra Environmental Contract: _____

Lab Code: RECNY Case No.: _____ SAS No.: _____ SDG No.: _____

Lab Sample ID: A5B0046101 Lab File ID: _____

Matrix: (soil/water) WATER Instrument ID (1): _____

Date Analyzed (1): 01/20/95 Time Analyzed (1): _____

THIS METHOD BLANK APPLIES TO THE FOLLOWING SAMPLES, MS AND MSD:

	CLIENT SAMPLE NO.	LAB SAMPLE ID	DATE ANALYZED 1	TIME ANALYZED
1	MATRIX SPIKE BL DUP	A5B0046103	01/20/95	
2	MATRIX SPIKE BLANK	A5B0046102	01/20/95	
3	W-25-1	A5038201	01/20/95	
4	W-25-2	A5038202	01/20/95	
5	W-25-3	A5038203	01/20/95	

Comments: _____

BLASLAND & BOUCK ENGINEER
Wet Chemistry Analysis

00034

Client Sample No.
METHOD BLANK

Lab Name: Recra Environmental, Inc. Contract: _____

Lab Code: RECNY Case No.: _____ SAS No.: _____ SDG No.: _____

Matrix (soil/water): WATER Lab Sample ID: A5B0046101

% Solids: 0.0 Date Samp/Recv: _____ _____

Parameter Name	Units of Measure	Result	C	Q	M	Method Number	Analyzed Date
Biochemical Oxygen Demand	MG/L	2.0	U			405.1	01/20/95

Comments:

FORM I - WC

BLASLAND & BOUCK ENGINEER
WET CHEMISTRY
METHOD BLANK SUMMARY

10035
Client No.

METHOD BLANK

Lab Name: Recra Environmental Contract: _____

Lab Code: RECNY Case No.: _____ SAS No.: _____ SDG No.: _____

Lab Sample ID: A5038204 Lab File ID: _____

Matrix: (soil/water) WATER Instrument ID (1): _____

Date Analyzed (1): 01/24/95 Time Analyzed (1): _____

THIS METHOD BLANK APPLIES TO THE FOLLOWING SAMPLES, MS AND MSD:

	CLIENT SAMPLE NO.	LAB SAMPLE ID	DATE ANALYZED 1	TIME ANALYZED
1	MATRIX SPIKE BL DUP	A5B0053402	01/24/95	
2	MATRIX SPIKE BLANK	A5B0053401	01/24/95	
3	W-25-1	A5038201	01/24/95	
4	W-25-2	A5038202	01/24/95	
5	W-25-3	A5038203	01/24/95	

Comments: _____

BLASLAND & BOUCK ENGINEER
Wet Chemistry Analysis

10036

Client Sample No.

METHOD BLANK

Lab Name: Recra Environmental, Inc. Contract: _____

Lab Code: RECNY Case No.: _____ SAS No.: _____ SDG No.: _____

Matrix (soil/water): WATER Lab Sample ID: A5038204

% Solids: 0.0 Date Samp/Recv: _____ _____

Parameter Name	Units of Measure	Result	C	Q	M	Method Number	Analyzed Date
Total Hardness	MG/L*	1.0	U			130.2	01/24/95

Comments:

BLASLAND & BOUCK ENGINEER
WET CHEMISTRY
METHOD BLANK SUMMARY

Client No.

METHOD BLANK

Lab Name: Recra Environmental Contract: _____

Lab Code: RECNY Case No.: _____ SAS No.: _____ SDG No.: _____

Lab Sample ID: A5B0053301 Lab File ID: _____

Matrix: (soil/water) WATER Instrument ID (1): _____

Date Analyzed (1): 01/24/95 Time Analyzed (1): _____

THIS METHOD BLANK APPLIES TO THE FOLLOWING SAMPLES, MS AND MSD:

	CLIENT SAMPLE NO.	LAB SAMPLE ID	DATE ANALYZED 1	TIME ANALYZED
1	W-25-1	A5038201	01/24/95	
2	W-25-2	A5038202	01/24/95	
3	W-25-3	A5038203	01/24/95	

Comments: _____

BLASLAND & BOUCK ENGINEER
Wet Chemistry Analysis

0038

Client Sample No.

METHOD BLANK

Lab Name: Recra Environmental, Inc. Contract: _____

Lab Code: RECNY Case No.: _____ SAS No.: _____ SDG No.: _____

Matrix (soil/water): WATER Lab Sample ID: A5B0053301

% Solids: 0.0 Date Samp/Recv: _____ _____

Parameter Name	Units of Measure	Result	C	Q	M	Method Number	Analyzed Date
Non-Filterable Residue (103°C)	MG/L	4.0	U			160.2	01/24/95

Comments:

BLASLAND & BOUCK ENGINEER
WET CHEMISTRY
METHOD BLANK SUMMARY

0039
Client No.

METHOD BLANK

Lab Name: Recra Environmental Contract: _____

Lab Code: RECNY Case No.: _____ SAS No.: _____ SDG No.: _____

Lab Sample ID: A5B0055001 Lab File ID: _____

Matrix: (soil/water) WATER Instrument ID (1): _____

Date Analyzed (1): 01/27/95 Time Analyzed (1): _____

THIS METHOD BLANK APPLIES TO THE FOLLOWING SAMPLES, MS AND MSD:

	CLIENT SAMPLE NO.	LAB SAMPLE ID	DATE ANALYZED 1	TIME ANALYZED
1	MATRIX SPIKE BL DUP	A5B0055003	01/27/95	
2	MATRIX SPIKE BLANK	A5B0055002	01/27/95	
3	W-25-2	A5038202	01/27/95	

Comments: _____

BLASLAND & BOUCK ENGINEER
Wet Chemistry Analysis

Client Sample No.
METHOD BLANK

Lab Name: Recra Environmental, Inc. Contract: _____

Lab Code: RECNY Case No.: _____ SAS No.: _____ SDG No.: _____

Matrix (soil/water): WATER Lab Sample ID: A5B0055001

% Solids: 0.0 Date Samp/Recv: _____ _____

Parameter Name	Units of Measure	Result	C	Q	M	Method Number	Analyzed Date
Chemical Oxygen Demand	MG/L	5.0	U			410.1	01/27/95

Comments:

BLASLAND & BOUCK ENGINEER
WET CHEMISTRY
METHOD BLANK SUMMARY

Client No.

METHOD BLANK

Lab Name: Recra Environmental Contract: _____

Lab Code: RECNY Case No.: _____ SAS No.: _____ SDG No.: _____

Lab Sample ID: A5B0067401 Lab File ID: _____

Matrix: (soil/water) WATER Instrument ID (1): _____

Date Analyzed (1): 01/30/95 Time Analyzed (1): _____

THIS METHOD BLANK APPLIES TO THE FOLLOWING SAMPLES, MS AND MSD:

	CLIENT SAMPLE NO.	LAB SAMPLE ID	DATE ANALYZED 1	TIME ANALYZED
1	W-25-1	A5038201	01/30/95	
2	W-25-3	A5038203	01/30/95	

Comments: _____

BLASLAND & BOUCK ENGINEER
Wet Chemistry Analysis

10942

Client Sample No.

METHOD BLANK

Lab Name: Recra Environmental, Inc. Contract: _____

Lab Code: RECNY Case No.: _____ SAS No.: _____ SDG No.: _____

Matrix (soil/water): WATER Lab Sample ID: A5B0067401

% Solids: 0.0 Date Samp/Recv: _____ _____

Parameter Name	Units of Measure	Result	C	Q	M	Method Number	Analyzed Date
Chemical Oxygen Demand	MG/L	5.0	U			410.1	01/30/95

Comments:

BLASLAND & BOUCK ENGINEER
METHOD 8240 - TCL VOLATILE ORGANICS
VOLATILE INTERNAL STANDARD AREA AND RT SUMMARY

Lab Name: Recra Environmental Contract: _____ Labsampid: A5B0058104

Lab Code: RECNY Case No.: _____ SAS No.: _____ SDG No.: _____

Lab File ID (Standard): K6137.MSQ Date Analyzed: 01/23/95

Instrument ID: I50K___ Time Analyzed: 08:48

GC Column(1): DB-624___ ID: 0.530 (mm) Heated Purge: (Y/N) N

		IS1 (BCM) AREA	#	RT	#	IS2 (DFB) AREA	#	RT	#	IS3 (CBZ) AREA	#	RT	#
	12 HOUR STD	38183		11.28		141080		13.37		139463		18.15	
	UPPER LIMIT	76366		11.78		282160		13.87		278926		18.65	
	LOWER LIMIT	19092		10.78		70540		12.87		69732		17.65	
	CLIENT SAMPLE												
1	MATRIX SPIKE BLANK	42424		11.28		157705		13.37		143706		18.15	
2	VBLK50	45798		11.27		162232		13.33		149301		18.12	
3	W-25-1	61157		11.28		218184		13.37		191403		18.17	
4	W-25-2	54411		11.28		190069		13.35		179967		18.15	
5	W-25-3	52977		11.28		182690		13.35		177539		18.13	

	AREA UNIT QC LIMITS	RT QC LIMITS
IS1 (BCM) = Bromochloromethane	(50-200)	-0.50 / +0.50 min
IS2 (DFB) = 1,4-Difluorobenzene	(50-200)	-0.50 / +0.50 min
IS3 (CBZ) = Chlorobenzene-D5	(50-200)	-0.50 / +0.50 min

\# Column to be used to flag recovery values
* Values outside of contract required QC limits

BLASLAND & BOUCK ENGINEER
METHOD 8240 - TCL VOLATILE ORGANICS
VOLATILE INTERNAL STANDARD AREA AND RT SUMMARY

Lab Name: Recra Environmental Contract: _____ Labsampid: A5B0058108

Lab Code: RECNY Case No.: _____ SAS No.: _____ SDG No.: _____

Lab File ID (Standard): K6184.MSQ Date Analyzed: 01/25/95

Instrument ID: I50K Time Analyzed: 08:07

GC Column(1): DB-624 ID: 0.530 (mm) Heated Purge: (Y/N) N

		IS1 (BCM) AREA	#	RT	#	IS2 (DFB) AREA	#	RT	#	IS3 (CBZ) AREA	#	RT	#
	12 HOUR STD	32335		11.30		119024		13.37		111800		18.17	
	UPPER LIMIT	64670		11.80		238048		13.87		223600		18.67	
	LOWER LIMIT	16168		10.80		59512		12.87		55900		17.67	
	CLIENT SAMPLE												
1	MATRIX SPIKE BLANK	31487		11.28		116218		13.37		103634		18.15	
2	VBLK52	30225		11.28		103541		13.37		99012		18.15	
3	W-25-1DL	31091		11.28		109965		13.37		101212		18.17	

	AREA UNIT QC LIMITS	RT QC LIMITS
IS1 (BCM) = Bromochloromethane	(50-200)	-0.50 / +0.50 min
IS2 (DFB) = 1,4-Difluorobenzene	(50-200)	-0.50 / +0.50 min
IS3 (CBZ) = Chlorobenzene-D5	(50-200)	-0.50 / +0.50 min

\# Column to be used to flag recovery values
* Values outside of contract required QC limits

Appendix C

Appendix C

BLASLAND, BOUCK & LEE, INC.
engineers & scientists

Risk-Based Criteria Calculations

Appendix C - Risk Based Criteria Calculations

C.1 Introduction

This appendix presents site-specific risk-based criteria for soils/fill and ground water.

Soils/Fill

Site-specific risk-based criteria were calculated using methodology described by USEPA (1991) and the reference toxicity factors presented in the Baseline RA (BB&L, January 1995). These values assume that a 70-kg adult worker is exposed via ingestion and inhalation 250 days per year for 25 years (USEPA, 1991). Cancer-based values are derived for constituents which are classified as known (Group A), probable (Group B), or possible (Group C) human carcinogens, and have oral slope factors. Cancer-based criteria are based on a one-in-one million (1×10^{-6}) risk. Noncancer-based criteria are based on the reference dose for the constituent of interest. Calculations of site-specific criteria are presented in Table C-1. For constituents with both cancer- and noncancer-based values, the lesser of the two values is the risk-based criterion.

Ground Water

Site-specific risk-based criteria were calculated using methodology described by USEPA (1991) and the reference toxicity factors presented in the Baseline RA (BB&L, January 1995). These values assume that a 70 kg adult ingests 2 liters of water per day, 350 days per year, for 30 years for the hypothetical off-site residential ground-water user and assumes a 70-kg adult ingests one liter of water, 250 days/year for 25 years for the hypothetical future industrial worker. Cancer-based values are derived for constituents which are classified as known (Group A), probable (Group B), or possible (Group C) human carcinogens, and have oral slope factors. Cancer-based criteria are based on a one-in-one-million (1×10^{-06}) risk. Non-cancer-based criteria are based on the RfD for the constituent of interest. Calculations of site-specific risk-based criteria are presented in Table C-2. For constituents with both cancer- and non-cancer-based values, the lesser of the two values is the risk-based criterion.

TABLE C-1

RISK-BASED CRITERIA FOR SOIL BASED ON COMMERCIAL/INDUSTRIAL USE
ROSEN SITE
CORTLAND, NEW YORK

Chemical	RfD (1) (mg/kg-day)	SF (2) 1/(mg/kg-day)	RfC (3) (mg/m3)	URF (4) 1/(ug/m u3)	Oral Values (10)		Inhalation Values (11)		PRG (9) (mg/kg)
					PRGnc (5) (mg/kg)	PRGc (6) (mg/kg)	PRGnc (7) (mg/kg)	PRGc (8) (mg/kg)	
Arsenic	3E-04	1.75	-	4.3E-03	6.13E+02	3.27E+00	-	646	**3.27**
Chromium (Assumed hexavalent)	5E-03	-	-	1.2E-02	1.02E+04	-	-	231	**231**
Manganese	1E-01	-	5E-05	-	2.04E+05	-	4.96E+04	-	**49567**

Notes:

(1) RfD = Reference Dose obtained from USEPA IRIS/HEAST sources
(2) SF = Carcinogenic Slope Factor obtained from USEPA IRIS/HEAST sources
(3) RfC = Reference Concentration obtained from USEPA IRIS/HEAST sources
(4) URF = Carcinogenic Unit Risk Factor obtained from USEPA IRIS/HEAST sources
(5) PRGnc = value based on noncarcinogenic effects = RfD x 70 x 365/(50 x 1E-06 x 250)
(6) PRGc = value based on 1E-06 cancer risk = Risk x 70 x 70 x 365/(SF x 50 x 1E-06 x 250 x 25)
(7) PRGnc = value based on noncarcinogenic effects = RfC x 365 x 6.79E+08/(250)
(8) PRGc = value based on carcinogenic effects = 1E-06 x 70 x 365 x 6.79E+08/(URF x 25 x 250 x 1000)
(9) PRG = lowest of all oral and inhalation PRGs
(10) Assumes ingestion of 50 mg soil per day, 250 days/year, 25 years per USEPA (1991).
(11) Assumes inhalation exposure 250 days/year, 25 years per USEPA (1991). Assumes particulate emission factor of 6.79E+08 per USEPA (1993)

TABLE C-2

RISK-BASED CRITERIA FOR POTABLE GROUND WATER USE
ROSEN SITE
CORTLAND, NEW YORK

Chemical	RfD (1) (mg/kg-day	SF (2) 1/(mg/kg-day)	Industrial Use (6) PRGnc (3) (mg/l)	PRGc (4) (mg/l)	PRG (5) (mg/l)	Residential Use (7) PRGnc (8) (mg/l)	PRG (5) (mg/l)
1,1-DCA	0.1		1.02E+01	-	**1.02E+01**	3.65	**3.65**
1,2-DCE	0.01		1.02E+00	-	**1.02E+00**	NC	NC
Chloroform	0.01	0.0061	1.02E+00	4.69E-02	**4.69E-02**	NC	NC
Chloromethane		0.013	-	2.20E-02	**2.20E-02**	NC	NC
Ethyl Benzene	0.1		1.02E+01	-	**1.02E+01**	NC	NC
Toluene	0.2		2.04E+01	-	**2.04E+01**	NC	NC
Xylenes	2		2.04E+02	-	**2.04E+02**	NC	NC

Notes:

(1) RfD = Reference Dose obtained from USEPA IRIS/HEAST sources
(2) SF = Carcinogenic Slope Factor obtained from USEPA IRIS/HEAST sources
(3) PRGnc = value based on noncarcinogenic effects = RfD x 70 x 365/(1 x 250)
(4) PRGc = value based on 1E-06 cancer risk = Risk x 70 x 70 x 365/(SF x 1 x 250 x 25)
(5) PRG = lowest concentration: PRGnc vs PRGc
(6) Assumes 70 kg adult ingests 1 liter of water per day, 250 days per year for 25 years per USEPA (1991)
(7) Assumes 70 kg adult ingests 2 liters of water per day, 350 days/year for 30 years per USEPA (1991)
(8) PRGnc = value based on noncarcinogenic effects = RfD x 70 x 365/(2 x 350)
NC = Not Calculated

Appendix D

Appendix D

BLASLAND, BOUCK & LEE, INC.
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Ground-Water Discharge Options

Appendix D - Ground-Water Discharge Options

D.1 Introduction

Six ground-water discharge options were evaluated for Alternatives 4 and 5.

The purpose of this appendix is to evaluate various ground-water discharge options for the Site to be used in conjunction with the two alternatives that include the recovery of ground water (Section 4 - Alternatives 4 and 5) as part of the remediation of upper outwash aquifer ground water. Consistent with the requirements identified in USEPA guidance (USEPA 1988), this appendix evaluates six discharge options based on their relative effectiveness, implementability, and cost. In addition to the requirements identified by USEPA, the city of Cortland also had significant input into these discharge options as discussed during meetings on March 3 and March 8, 1995 between the CPRP Group and the city and a subsequent meeting on May 2, 1995. The six discharge options, as identified by the USEPA and the city of Cortland, are:

Option 1 - Ground-water discharge via sanitary sewer lateral to the city of Cortland WWTP;

- **Suboption 1A** - Discharge to sanitary sewer (without treatment) along Pendleton Street.
- **Suboption 1B** - Discharge to sanitary sewer (without treatment) along Port Watson Street.

Option 2 - Ground-water discharge via dedicated forcemain to the city of Cortland WWTP;

Option 3 - On-site ground-water treatment followed by discharge to an industrial facility (confidential industry) via dedicated forcemain;

Option 4 - On-site ground-water treatment followed by discharge to Perplexity Creek;

Option 5 - On-Site ground-water treatment followed by discharge to the Tioughnioga River via dedicated pipeline; and

Option 6 - On-site ground-water treatment followed by discharge via ground-water reinjection.

These six discharge options were developed based on USEPA's facsimile (Granger to Gensky, in December 1994), as well as input from the city of Cortland during a review of these options at the above referenced meetings. Specifically, the city requested that Option 3 and Option 5 be added to the list of options developed by the USEPA.

Each of the discharge options will be evaluated for discharge flow rates of 100 gpm (Alternative 4) and 1,200-1,500 gpm (Alternative 5).

As stated previously, these discharge options will be evaluated relative to effectiveness, implementability, and cost. As discussed in Section 3.4.1 of this FS report, effectiveness considers three aspects:

1. The potential effectiveness of the option to handle the estimated areas or volumes of media and meet the remediation goals identified in the RAOs;

2. The potential impact of human health and the environment during the construction and implementation phase; and

3. How proven and reliable the process is with respect to the constituents and conditions at the Site.

Implementability considers both the technical and administrative feasibilities of implementing a technology process. Cost considerations include relative capital and operation and maintenance (O&M) costs, rather than detailed estimates.

D.2 Option 1- Ground-Water Discharge via Sanitary Sewer Lateral to City of Cortland WWTP

Suboption 1A consists of the discharge of ground water to the existing sanitary sewer location on Pendleton Street.

Suboption 1B consists of the discharge of ground water through a 2,000 ft. forcemain to the existing sanitary sewer location along Port Watson Street.

D.2.1 General

This discharge option consists of the direct discharge (without treatment) of recovered ground water to the existing sanitary sewer laterals located in the vicinity of the Site (see Figure D-1). For this option, it was assumed that ground water would be recovered and directly discharged via forcemain at one of two discharge locations. Suboption 1A would discharge recovered ground water using an approximately 200-foot forcemain with a discharge to the sanitary sewer manhole located along Pendleton Street (manhole N2). Suboption 1B would discharge recovered ground water through an approximately 2,000-foot forcemain into an 18-inch diameter sanitary sewer lateral located along Port Watson Street (see Figure D-2). Under both of these sub-options, ground water would be combined with other municipal wastes within the sanitary sewer lateral for treatment at the city's WWTP.

D.2.2 Discharge Evaluation

Effectiveness:

Treatment of Site ground water can be accomplished by the city's WWTP.

The discharge of recovered ground water from the Site to the existing WWTP via the existing sanitary sewer laterals offers an effective approach for the treatment of Site ground water. The city's WWTP is undergoing a major rehabilitation effort, and with the soon-to-be installed activated sludge treatment process, offers a proven treatment technology for the constituents of interest associated with the Site ground water. Potential adverse impact to human health and the environment during the construction and implementation phase would be minimal. Furthermore, the installation of this type of system has been proven at many remedial sites.

The direct discharge option is not implementable for higher flow rates (i.e., 1,200-1,500 gpm) due to:

1. ***Limited WWTP capacity;***
2. ***Limited sanitary sewer capacity; and***
3. ***SPDES violations at the WWTP.***

With a limited WWTP capacity, the addition of 1.7-2.2 mgd (based on 1,200-1,500 gpm recovery tank) to the city's WWTP may inhibit future industrial/residential growth.

Implementability:

For a discharge of 100 gpm, this option is implementable. A discharge into a manhole along Pendleton Street (manhole N2) would provide a minimal flow contribution to the overall sanitary sewer system for this low flow rate.

While the existing WWTP offers an effective method of treatment for the constituents of interest at the Site for the lower flow rates (i.e.,100 gpm), this option has limited implementability for the 1,200-1,500 flow rate for the following three reasons:

1. Limited wastewater treatment plant capacity - At the March 3, 1995 meeting with the city of Cortland, the city expressed concern regarding the discharge of 1,200-1,500 gpm flow rates since the addition of 1.7-2.2 mgd to the city's WWTP would use the remaining design capacity of the plant. The city stated that the addition of Site ground water would be the largest discharge within the entire sanitary system, and that the city is concerned that using this "reserved" design capacity of the treatment plant may inhibit future industrial/residential growth within the city. The city was also concerned that having recently financed a significant WWTP upgrade, the city would be forced to further expand the treatment facility in the near future.

According to the city, both the 12- and 18- inch diameter sanitary sewer laterals are frequently at their hydraulic capacity. The addition of Site ground water at rates of 1,200-1,500 gpm will further aggravate this situation.

2. Limited sanitary sewer lateral hydraulic capacity - Suboption 1A discharges to the existing 12-inch diameter sanitary sewer lateral located along Pendleton Avenue. While at this time the city does not maintain flow information associated with this 12-inch diameter sewer lateral, the discharge of an additional 1,200-1,500 gpm to this lateral could exceed the hydraulic carrying capacity of this pipeline causing a surcharge condition upstream of the ground-water input. Because of this lack of hydraulic carrying capacity within the 12-inch diameter lateral, Suboption 1B evaluated bypassing this lateral and proceeding to the existing 18-inch diameter sewer lateral that runs along Port Watson Street. This would require the installation of an approximately 2,000-foot forcemain along Pendleton Street to make this connection to the 18-inch diameter sewer lateral. However, according to the city, this 18-inch diameter sewer lateral frequently causes a surcharge condition upstream of this location. The city has determined that this 18-inch diameter sewer lateral services approximately one-quarter of the entire city, and as a result, is grossly undersized. While the city has considered replacing this existing lateral with a larger diameter pipeline, the city has not undertaken this project since this line is located beneath a heavily travelled city roadway, and is approximately 15 feet below the roadway surface. The replacement of this pipeline would not only greatly disturb the businesses located along the street, but also would require significant capital expenditure.

Violations of the percent solids removal requirement may occur at higher flow rates.

3. Potential State Pollutant Discharge Elimination System (SPDES) violations at the WWTP - The city is experiencing difficulty in complying with the percent solids removal requirement of their SPDES permit. The reason for this difficulty is that the influent to the WWTP contains very low levels of solids. While the new plant upgrades will hopefully alleviate this problem to some extent, adding significant volumes of Site ground water (i.e., 1,200-1,500 gpm), which is almost free of solids, would further dilute the solids entering the plant and aggravate the city's difficulty in achieving their percent solids removal requirement.

Finally, the city has expressed concerns regarding workers' safety and the toxic impact of Site ground water to the plant's biomass and the surrounding community. While it could be disputed that the extremely low levels of Site constituents would have little impact, if any, on the WWTP, the city has requested a treatability study be performed before the city would consent to accepting ground water from the Site (applicable to all flow rates).

Suboption 1A has the lowest capital costs of all discharge options.

Suboption 1B has significant capital costs at both flow rates.

Cost:

Capital costs for the installation of Suboption 1A would be the lowest of all the discharge options considered within the FS, since construction activities would only require the installation of a relatively short (200-foot) forcemain.

However, Suboption 1B would have significant capital costs due to the complexity of installing a longer forcemain (2,000 feet) through an urban setting. O&M costs would be similar for both options.

Suboption 1A would be one of the lowest cost discharge options, and Suboption 1B would be one of the highest cost discharge options.

These suboptions were eliminated from further consideration for the 1,200-1,500 gpm discharge rate; however, both would be effective, implementable, and have a relatively low cost for the lower discharge rate.

Summary:

While the treatment of Site ground water via the city's WWTP is an effective method of treating Site ground water at the lower flow rate (ie. 100 gpm), the city has expressed concern regarding this discharge option for higher discharge rates. Furthermore, the limitations associated with the hydraulic carrying capacity of the 12-inch and 18-inch existing sanitary sewer laterals eliminate both Suboptions 1A and 1B from further consideration for the 1,200-1,500 gpm discharge rate; however, the existing sewer laterals would have sufficient capacity for the 100 gpm discharge.

D.3 Option 2 - Ground-Water Discharge Via Dedicated Forcemain to the City of Cortland WWTP

A dedicated forcemain 7,000-foot would be constructed from the Site to the WWTP.

D.3.1 General

This discharge option consists of the direct discharge of recovered ground water through a new dedicated forcemain (approximately 7,000 feet) to the city's WWTP for treatment (see Figure D-3). Similar to the previously discussed discharge options in Section D.2, ground water would be recovered from a series of wells located on the Site and discharged to the city's WWTP. For this option, however, the recovery of ground water would be transported to the city's WWTP through a newly constructed forcemain, eliminating the need to tie into any existing sanitary sewer lateral. Furthermore, this forcemain route would avoid using the existing right-of-ways associated with previously discussed Pendleton and Port Watson Street routes, and instead travel east from the Site along Perplexity Creek and then north to the WWTP.

While this forcemain route is approximately 1,000 feet longer than the Pendleton and Port Watson Street routes, avoiding the urban settings of these proposed routes significantly improves the viability of this option.

D.3.2 Discharge Evaluation

Effectiveness:

The city is requiring a separate influent, treatment process, and discharge of Site ground water for the discharge of 1,200-1,500 gpm. This limits this option's effectiveness.

While the installation of a forcemain to the WWTP is an effective means of transporting ground water from the Site, the city is requiring a separate influent, treatment process and discharge of the Site ground water for acceptance of the 1,200-1,500 gpm flow rate, but not the 100 gpm flow rate. By preventing the commingling of the Site ground water with the existing sanitary waste, the effectiveness of this option is greatly diminished for the

1,200-1,500 gpm discharge. Specifically, the effectiveness of this option is limited for the 1,200-1,500 gpm flow rate for the following reasons:

1. While the city has offered the CPRP Group the use of city property for the construction of a treatment facility, the Site has all the necessary area to construct an on-site treatment facility. As a result, the value of the city's offer to use city property appears to be limited.

2. The city has offered the use of two existing carbon towers, which are currently abandoned within the main treatment facility, for use in the treatment of Site ground water at the 1,200-1,500 gpm flow rate. These existing carbon towers are in excess of 20 years old and would require significant rehabilitation to be utilized. Furthermore, in all likelihood, other treatment processes would be required at the Site that may be more efficient and less expensive to operate than carbon treatment (e,g., air stripping) for such significant flow rates. As a result, the use of the existing carbon towers does not justify the location of a treatment facility on city property.

3. The construction of a 1,200-1,500 gpm treatment facility on city property would be extremely difficult. The existing WWTP is built on a parcel that is bounded by a residential neighborhood and the Tioughnioga River. As a result, a significant portion of this site is covered with existing wastewater treatment unit processes.

While this option would have minimal adverse impact to human health or the environment during construction and implementation, the above considerations limit this option's effectiveness for the 1,200-1,500 gpm flow rate. For the 100 gpm flow rate, this process option would achieve effectiveness similar to Option 1.

Implementability:

Construction of a 7,000-foot forcemain is implementable, but is a significant construction effort.

Assuming the effectiveness issues previously identified for this option can be resolved, the installation of an approximately 7,000-foot forcemain from the Site to the city's WWTP is implementable. While the construction efforts would be a significant undertaking since a pipeline would have to cross Pendleton Avenue, proceed beneath a railroad track, and then proceed along Perplexity Creek towards the Tioughnioga River, the installation of a forcemain along this route would be achievable assuming that the various permits and temporary/permanent property easements could be obtained (applicable to both the 1,200-1,500 gpm and 100 gpm discharge flow rates).

Costs:

Significant capital costs would be associated with this discharge option.

The costs associated with this option would include the installation and maintenance of a new forcemain system, approximately 7,000 feet in length, and the O&M of a treatment facility (applicable to the 1,200-1,500 gpm discharge only). While this cost would be less than the forcemain efforts proposed for Option 1B, the construction of a forcemain from the Site to the city's WWTP would require significant construction efforts and capital expenditure. As a result, this option would have significant capital costs in comparison to the other discharge options.

Summary:

This option was eliminated from future consideration for both discharge flow rates.

The only possible justification for consideration of this option would be if O&M costs for the treatment facility were offset by the capital costs associated with the installation of the 7,000-foot forcemain, or if the discharge costs were similar to those in Option 1. Therefore, with limited justification for this option, it will be eliminated from further consideration.

D.4 Option 3 - On-Site Ground-Water Treatment Followed by Discharge to a Local Industrial Facility (Confidential Industry) via Dedicated Forcemain

This discharge option consists of discharging treated ground water through a new dedicated forcemain to an existing industrial facility.

D.4.1 General

This discharge option consists of the discharge of recovered and treated ground water through a new dedicated forcemain to an existing industrial facility located in the vicinity of the Site (see Figure D-4). Similar to the direct discharge option discussed in Sections D.2 and D.3, ground water would be recovered, treated on Site by air stripping to remove the VOCs and by other treatment means (e.g., precipitation and flocculation) to remove metals (if necessary), and then discharged through a forcemain to the local industrial facility. The industry would then use this treated ground water as non-potable process water before ultimately discharging this water to the facility's existing sanitary sewer.

D.4.2 Discharge Evaluation

Effectiveness:

This option would be an effective means of discharging Site ground water for the higher flow rate (ie. 1,200-1,500 gpm) scenario. Due to insufficient flows, the process option is not effective for the lower flow rate (ie. 100 gpm).

The discharge of treated ground water to a local industry via a new dedicated forcemain (approximately 4,000 feet) would be an effective means of discharging Site ground water at 1,200-1,500 gpm, as well as supply a low-cost source of process water to an industry within the city of Cortland. The discharge of 100 gpm would not be effective since the local industry will potentially require a significantly larger volume of process water. Based on discussions with the city of Cortland, it appears that a local industrial facility may expand its existing manufacturing operation, which would necessitate an additional 1.4 mgd of process water. This option offers the following advantages for the higher flow rate discharge scenario:

1. A local industry would receive process water at a substantial cost reduction in comparison to having to use potable water supplied by the city.

2. The city would benefit since it would receive 1.4 million gallons of process water as wastewater, and therefore, justify using the residual capacity within the city's WWTP for the benefit of the Cortland community.

3. The pipeline route would avoid the urban routes identified with the previous options.

Potential adverse impact to human health and the environment will be minimal due to the nature of the construction activities.

Implementability:

This option offers a "win-win" situation for the city, CPRP Group, and the local industry for the 1,200-1,500 gpm flow rate.

This alternative is implementable and offers a "win-win" situation for the city, the CPRP group, and the local industry for the 1,200-1,500 gpm flow rate. However, the major obstacle with this alternative is the proposed expansion of the industrial facility. At this time, this industry has not committed to expanding in Cortland, New

York and is evaluating two other locations for possible plant expansion. Since this option is highly contingent on this plant's future expansion within the city of Cortland, the implementability of this option is unknown.

Cost:

While this option contains high costs in comparison to the other options, several items could defray costs for the 1,200-1,500 gpm rate.

While the capital costs are high due to on-site treatment and the construction of a forcemain (4,000 feet), the local industry would not have to purchase potable water for process use (for 1,200-1,500 gpm flow rate). The city would receive payment from the industry when the process water is discharged to the sanitary sewer and water purchased could defray the costs of operating the on-site treatment system. O&M costs would be primarily associated with the recovery wells and treatment facility.

Summary:

This option was eliminated from future consideration for the 100 gpm and 1,200-1,500 gpm flow rates.

In summary, this discharge option, while possessing the ability to provide a "win-win" situation for the city, the CPRP Group, and a local Cortland industry, has uncertainties since future expansion of the industry cannot be guaranteed (for the 1,200-1,500 gpm flow rate). In addition, this discharge option is not effective at the 100 gpm flow rate. As a result, this option will not be considered for further evaluation. However, should the industry make its decision regarding expansion in the future, this alternative should be closely re-evaluated (1,200-1,500 gpm flow rate only).

D.5 Option 4 - On-Site Ground-Water Treatment Followed by Discharge to Perplexity Creek

On-site treatment of ground water would provide for the removal of VOCs and possibly metals. The discharge from the treatment system would be to Perplexity Creek.

D.5.1 General

This discharge option consists of the on-site treatment of recovered ground water prior to discharge to Perplexity Creek (see Figure D-5). As with the other discharge options, ground water would be recovered and discharged to an on-site treatment facility before discharge to Perplexity Creek. The on-site treatment system would provide for the removal of VOCs and metals (if necessary) from the ground water. Although the most recent round of sampling (collected during March 1995) indicated that the inorganic compounds (primarily metals) are in the particulate and not in the aqueous (dissolved) form, the necessity of metals removal/treatment processes cannot be conclusively eliminated, and therefore, may be required. Following treatment, ground water would be discharged to Perplexity Creek in the vicinity of Pendleton Avenue.

D.5.2 Discharge Evaluation

Effectiveness:This type of technology is effective in removing Site constituents of interest.

The treatment system may require shutdown for extended periods during flooding events.

The on-site treatment of recovered ground water and the discharge to Perplexity Creek would be an effective means of treating Site ground water. This type of technology has been widely used on a number of remedial projects throughout the United States and is widely accepted by regulatory agencies. However, the goal of the city of

Cortland is to redevelop the Rosen property as a regional transportation terminal, and therefore, the placement of any permanent on-site structures would have to be carefully integrated into future development considerations.

In addition to the above issues, the city was concerned that during flooding events, Perplexity Creek overflows its banks and impacts the residential areas downstream of the Site. During these events, the addition of recovered Site ground water under either the 100 gpm or 1,200-1,500 gpm flow scenarios to a creek already at flood stage would further aggravate the flooding situation. As discussed in correspondence (Attachment D-1, Department of Public Works Letter), the city stated that the cause of this flooding is actually a bottleneck downstream of the Site where Perplexity Creek is contained within a 42-inch diameter culvert before ultimately discharging into the Tioughnioga River. This existing 42-inch diameter culvert does not have sufficient hydraulic capacity during certain flood events, and as a result, causes flooding upstream of the bottleneck. The proposed solution would be to temporarily discontinue ground water recovery at the Site during these flooding occurrences. However, the frequency at which flooding events occur has been estimated by the city of Cortland to be approximately four months per year; therefore, the frequency of the treatment system shutdown would be approximately four months per year. As a result, at a minimum, the treatment system would not effectively treat ground water for a period of four months each year.

Potential adverse impact to human health and the environment would be minimal since construction and operation of these types of facilities are commonly performed. However, the impact to human health and the environment of a shutdown of the treatment system during flooding is currently unknown.

Implementability:

This option is not implementable due to the flooding of Perplexity Creek.

The construction and operation of on-site treatment system that consists of proven technologies for the removal of organics and possibly inorganics would be technically implementable, although significantly more complex than the direct discharge options and may impact future Site development (applicable to both the 100 gpm and 1,200-1,500 gpm discharge rates). Furthermore, the discharge of Site ground water to a surface water (Perplexity Creek) of the state of New York would need to meet the intent of a SPDES permit. Although technically implementable, this option would likely not be administratively implementable to the city of Cortland since additional discharge to Perplexity Creek would further aggravate the current flooding situation (See Attachment D-1). Likewise, this option would not be administratively implementable to the NYSDEC or the USEPA due to the extended periods the treatment system would require shutdown in order to alleviate additional discharge during flooding.

Cost:

Capital costs would be the same order of magnitude as for other options which require forcemain installation or ground-water treatment.

The costs associated with this option would be more costly than those alternatives identified in Sections D.2 through D.4. The capital costs associated with the construction of an on-site treatment system would be of the same order of magnitude as those alternatives which required installation of a forcemain. However, in addition to these capital costs, this option would require long-term O&M costs which would be incurred for the life of the facility. This full-time O&M cost would include labor, machinery repairs, utilities, chemical addition, effluent sampling, and permitting.

This option was eliminated from further consideration for both the 100 gpm and 1,200-1,500 gpm discharge flow rates as a result of the flooding of Perplexity Creek.

Summary:

The installation of an on-site treatment system for VOCs and metals (if necessary) followed by discharge to Perplexity Creek may be an effective means of treating Site ground water during operation. However, this option

would not be implementable due to the additional flow to Perplexity Creek during flooding and the extended periods of treatment system shutdown which would be required as a result of flooding. As a result, this option was not retained for further analysis.

D.6 Option 5 - On-Site Ground-Water Treatment Followed by Discharge to Tioughnioga River via Dedicated Pipeline

On-Site treatment of ground water would provide for the removal of VOCs and possibly metals. The discharge would require the construction of a dedicated pipeline from the Site to the Tioughnioga River (1,200-1,500 gpm flow rate).

This type of technology is effective in removing Site constituents of interest.

This option is implementable for the treatment system components, but is questionable due to the complex discharge option that includes installation of a pipeline over a fairly significant distance.

D.6.1 General

This discharge option consists of the on-site treatment of recovered ground water prior to discharge to the Tioughnioga River though a new dedicated pipeline (see Figure D-6). Similar to Option 4, ground water would be recovered and discharged to an on-site treatment facility (evaluated for 1,200-1,500 gpm discharge rate only) for the removal of VOCs and metals (if necessary). Following treatment, ground water would be discharged to the Tioughnioga River via a newly constructed pipeline east of the Site, parallel to Perplexity Creek. This evaluation was not performed for the 100 gpm flow rate scenario since undertaking such a major construction effort for such a minimal flow does not seem appropriate.

D.6.2 Discharge Evaluation

Effectiveness:

The on-site treatment of recovered ground water followed by discharge to Tioughnioga River would be an effective means of treating Site ground water. As discussed in Option 4, the goal of the city of Cortland is to redevelop the Rosen property as a regional transportation terminal; therefore, the placement of any permanent on-site structures would have to be carefully integrated into future development considerations.

However, unlike Option 4, the operation of the treatment system would not require shutdown as a result of flooding of Perplexity Creek. This situation is alleviated through the installation of a dedicated pipeline.

Implementability:

Similar to Option 4, the construction and operation of an on-site treatment system that consists of proven technologies would be technically implementable. However, the installation of a dedicated pipeline to the Tioughnioga River may be technically questionable. Significant construction efforts would be required for the installation of the approximately 4,700-foot pipeline. The installation of the pipeline would require placement along Perplexity Creek to the Tioughnioga River, including the crossing of Pendleton Avenue, a set of railroad tracks, and various underground utilities (known and unknown) between the Site and the Tioughnioga River. Furthermore, the discharge of Site ground water to a surface water (Tioughnioga River) would need to meet the intent of a SPDES permit. At this time, the SPDES permit requirements for the treatment facility discharges are unknown.

Cost:

The capital costs associated with this option would be the highest due to the combined installation of a treatment system and dedicated pipeline.

The costs associated with this option would be higher than the other options evaluated due to the construction of an on-site treatment system and installation of a dedicated pipeline from the treatment system to Tioughnioga River. In addition to these capital costs, this option would require significant long-term O&M costs that would be incurred for the life of the facility. The full-time O&M cost would include treatment system O&M as described in Option 4 in addition to the routine maintenance of the forcemain itself.

Summary:

This option was retained and is a component of Alternative 5.

The installation of an on-site treatment system for VOCs and metals coupled with a dedicated pipeline discharge to Tioughnioga River satisfies the effectiveness and implementability criteria more appropriately than Options 1 through 4 and 6, even though it would have the highest cost relative to the other discharge options (applicable to 1,200-1,500 gpm flow rate), and the pipeline installation is more technically complex. As a result, this discharge option was retained and is incorporated as a component of Alternative 5.

D.7 Option 6 - On-Site Ground-Water Treatment Followed by Discharge via Ground-Water Reinjection

Ground water would be treated for VOC removal and possible metals removal and reinjected back into the aquifer at high flow rates.

D.7.1 General

This discharge option consists of the direct discharge of recovered ground water back into the aquifer upgradient of the proposed extraction well(s) (see Figure D-7). Ground water would be extracted, treated at an on-site treatment facility for VOCs and metals (if necessary), and reinjected into a series of wells along the southern perimeter of the Site. This discharge option is only evaluated for the higher flow rate scenario (i.e., 1,200-1,500 gpm), since reinjection of the ground water would likely be required to be "contained" by the hydraulic cone of influence of the Site's ground- water recovery system (not possible for the single-well 100 gpm flow rate pumping scenario).

D.7.2 Discharge Evaluation

Effectiveness:

The geologic conditions inhibit the quantity of ground water which can be injected. The effectiveness of ground-water reinjection is limited.

The reinjection of recovered ground water has limited effectiveness due to the geologic conditions beneath the Site. These geologic conditions may inhibit the quantity of ground water which can be physically reinjected into the aquifer. Specifically, the ground water at this Site is in relatively close proximity to existing grade, and in some areas is within 3 or 4 feet of ground surface. Reinjection into these areas would be difficult since attempting to discharge treated water would cause ground-water mounding which could saturate surface soils/fill surrounding the reinjection wells. Furthermore, the hardness (naturally occurring minerals within the aquifer) associated with the ground water will precipitate and clog reinjection wells without constant maintenance.

With respect to human health and the environment, minimal impact would be anticipated due to construction or implementation activities.

Implementability:

This option has significant technical difficulties.

The reinjection of ground water on-site, while implementable from a construction perspective, has significant technical difficulties as discussed in the effectiveness section. In addition, similar to Option 4, ground-water reinjection would need to meet the intent of a SPDES permit. This reinjection permit would likely have the same or more stringent discharge limitations than a surface water discharge permit. Considering the difficulties associated with reinjection and the possibility of comparable discharge limitations to a surface water, this option was not considered implementable.

Cost:

Costs for this option are difficult to predict since Site conditions are not conducive to this option.

Costs are difficult to project since the discharge option has a low probability of success. In the event that the geologic conditions are capable of supporting reinjection, the costs associated with this option would in all likelihood be less than the options that require substantial pipeline construction, with the exception of Suboption 1A.

Summary:

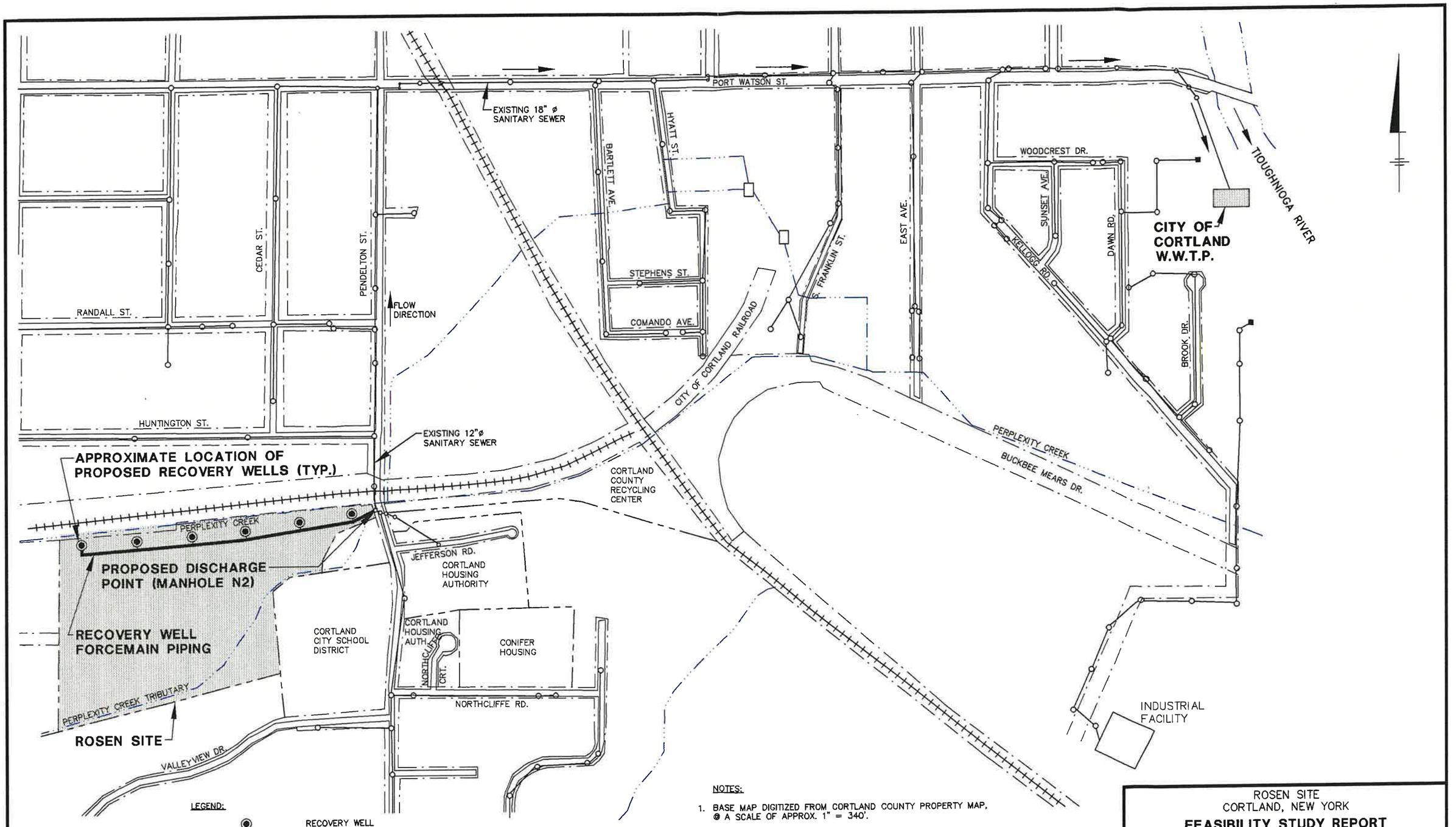
This option was eliminated from further consideration.

As a result of the limited effectiveness of ground water reinjection, this option was not retained for further analysis.

D.8 Conclusions

Option 1 was selected for Alternative 4 and Option 5 was selected for Alternative 5.

Based on the evaluation of the six discharge options, Option 1 - Ground-Water Discharge via Sanitary Sewer Lateral to the City of Cortland WWTP will be retained for the Detailed Analysis of Remedial Alternatives (Section 4), specific to Alternative 4; Option 5 - On-Site Ground Water Treatment followed by Discharge to Tioughnioga River via dedicated pipeline will be retained for the Detailed Analysis of Alternatives (Section 4), specific to Alternative 5.



NOTES:

1. BASE MAP DIGITIZED FROM CORTLAND COUNTY PROPERTY MAP, @ A SCALE OF APPROX. 1" = 340'.
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3. NOT ALL PROPERTY LINES ARE SHOWN.
4. CONCEPTUAL DRAWING - FOR PURPOSES OF FEASIBILITY STUDY DOCUMENT ONLY. FINAL LOCATIONS OF ITEMS ASSOCIATED WITH REMEDIAL ACTIONS (e.g. STRUCTURES, WELLS, PIPING) TO BE DETERMINED DURING REMEDIAL DESIGN.

ROSEN SITE
CORTLAND, NEW YORK

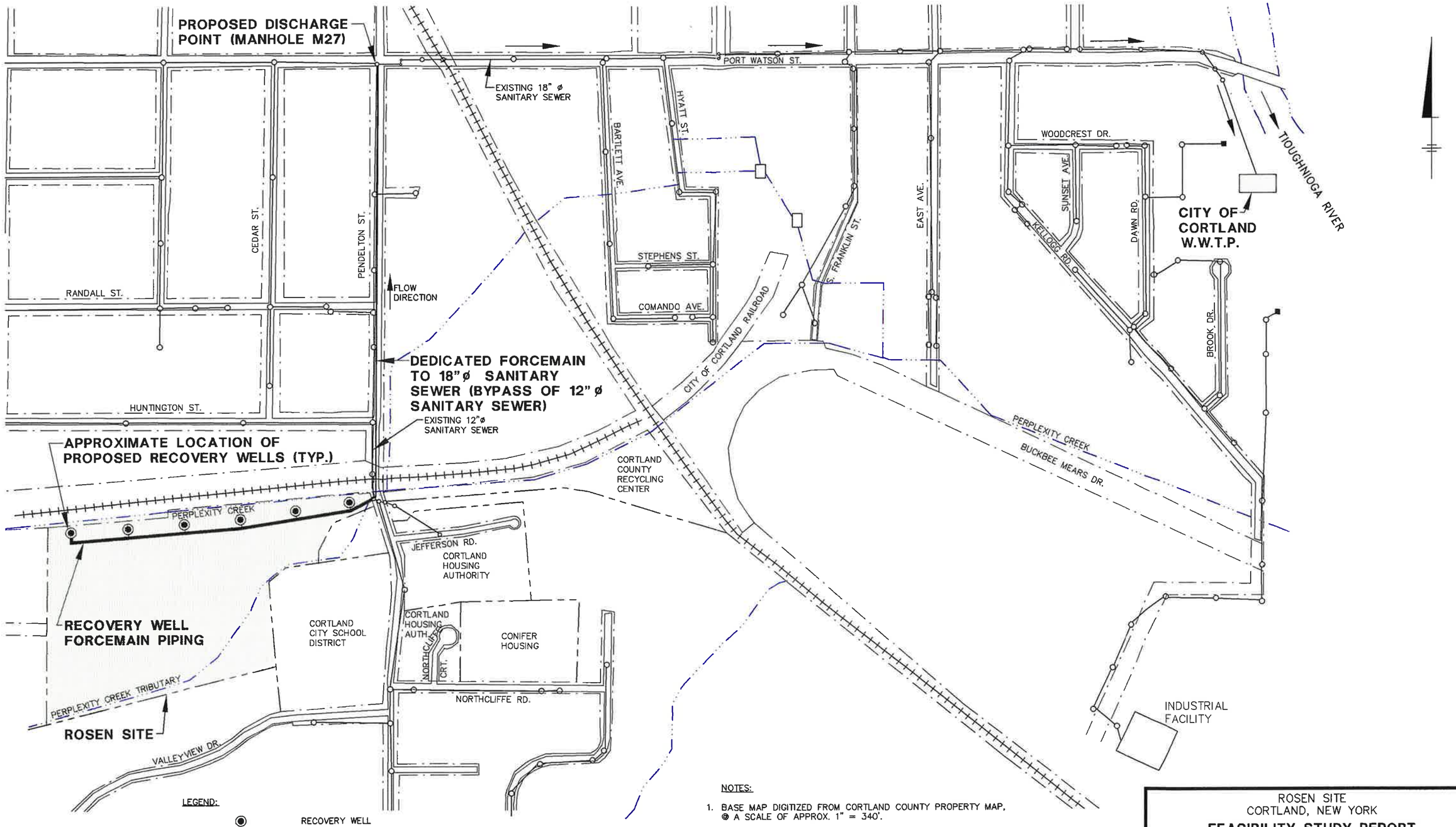
FEASIBILITY STUDY REPORT

OPTION 1A - DISCHARGE TO SANITARY SEWER (WITHOUT TREATMENT) ALONG PENDELTON STREET

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

FIGURE D-1

49402SM1.PCP
4/28/97 SYR-54-PGL AK DMW
49401070/49401G05.DWG



NOTES:

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ROSEN SITE
CORTLAND, NEW YORK

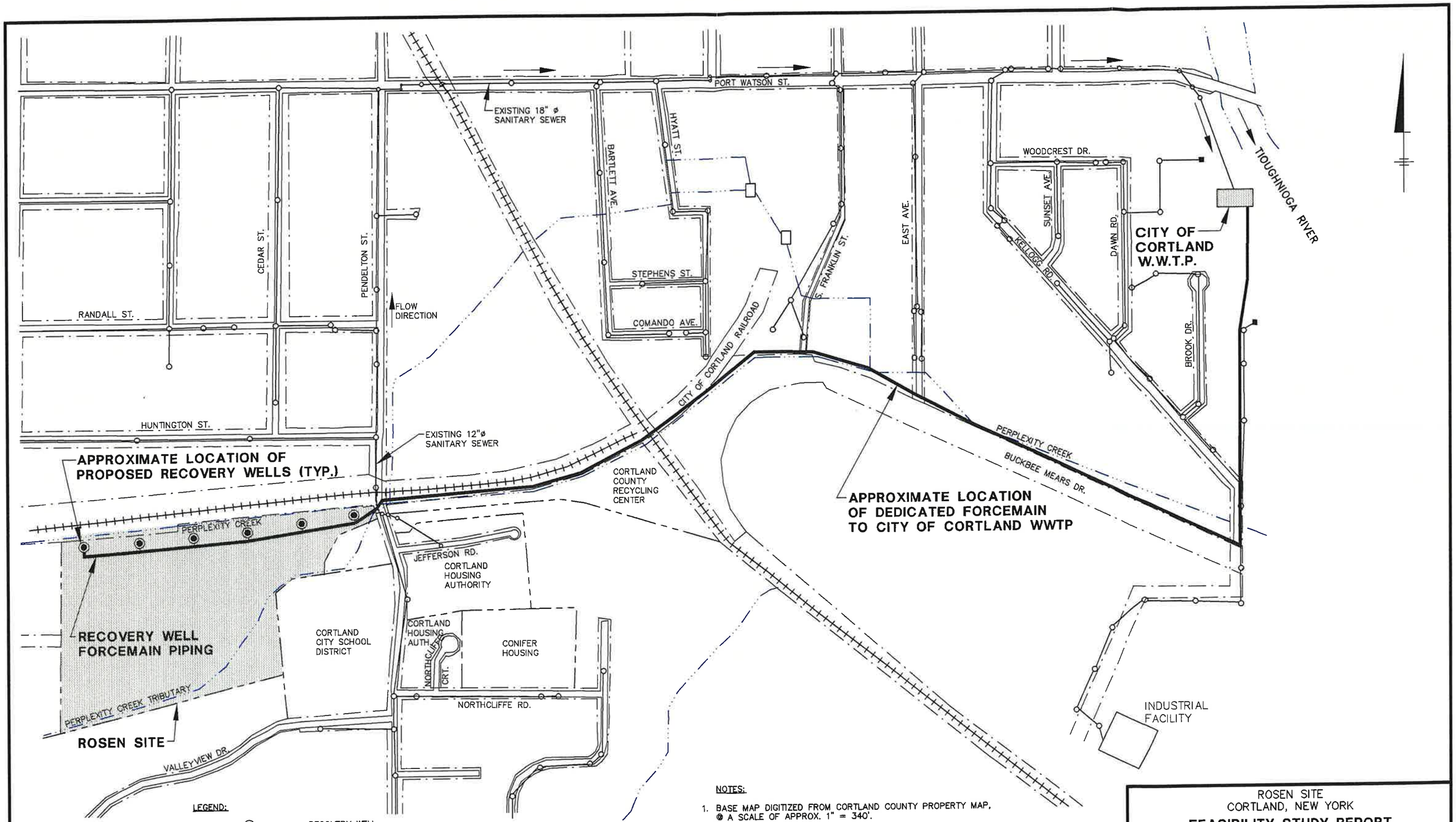
FEASIBILITY STUDY REPORT

OPTION 1B - DISCHARGE TO SANITARY SEWER (WITHOUT TREATMENT) ALONG PORT WATSON STREET

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

FIGURE **D-2**

FSR.PCP
4/28/97 SYR-54-PGL AK DMW
49401070/49401G06.DWG



NOTES:

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ROSEN SITE
CORTLAND, NEW YORK

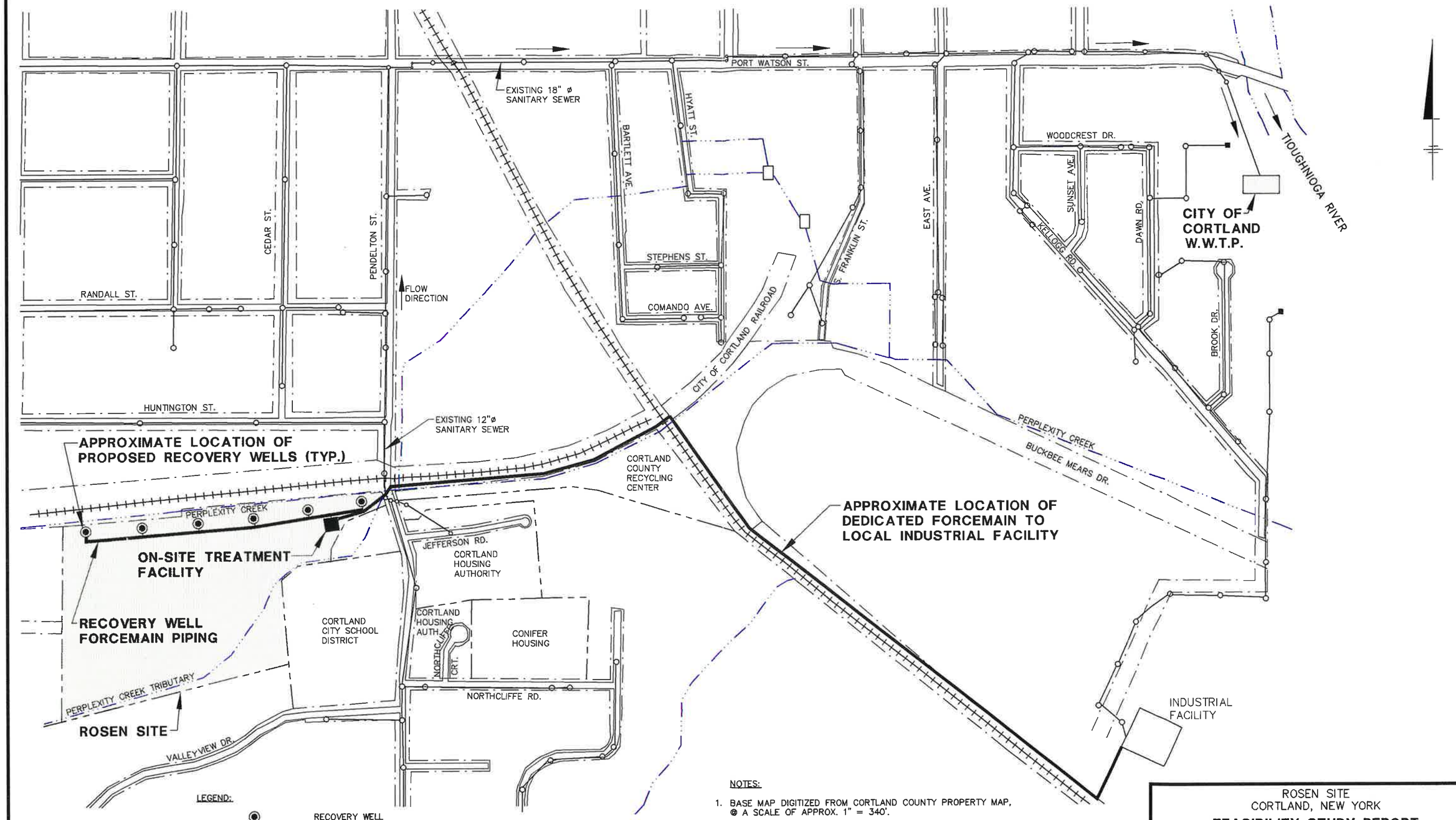
FEASIBILITY STUDY REPORT

OPTION 2 - DISCHARGE VIA DEDICATED PIPELINE TO CITY OF CORTLAND WWTP

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

FIGURE D-3

FSR.PGP
4/28/97 SYR-54-PGL AK DMW
49401070/49401G07.DWG



NOTES:

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ROSEN SITE
CORTLAND, NEW YORK

FEASIBILITY STUDY REPORT

OPTION 3 - ON-SITE TREATMENT FOLLOWED BY DISCHARGE TO AN INDUSTRIAL FACILITY VIA DEDICATED PIPELINE

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

FIGURE **D-4**

FSR.PCP
4/28/97 SYR-54-PGL AK DMW
49401070/49401G08.DWG

PORT WATSON ST.

EXISTING 18" ø SANITARY SEWER

BARTLETT AVE.

HYATT ST.

WOODCREST DR.

SUNSET AVE.

KELLOGG RD.

DAWN RD.

TIOUGHNIOGA RIVER

CITY OF CORTLAND W.W.T.P.

CEDAR ST.

PENDELTON ST.

STEPHENS ST.

S. FRANKLIN ST.

EAST AVE.

BROOK DR.

RANDALL ST.

FLOW DIRECTION

COMANDO AVE.

CITY OF CORTLAND RAILROAD

EXISTING 12"ø SANITARY SEWER

HUNTINGTON ST.

PROPOSED DISCHARGE LOCATION TO PERPLEXITY CREEK

PERPLEXITY CREEK

BUCKBEE MEARS DR.

APPROXIMATE LOCATION OF PROPOSED RECOVERY WELLS (TYP.)

CORTLAND COUNTY RECYCLING CENTER

PERPLEXITY CREEK

ON-SITE TREATMENT FACILITY

JEFFERSON RD.

CORTLAND HOUSING AUTHORITY

RECOVERY WELL FORCEMAIN PIPING

CORTLAND CITY SCHOOL DISTRICT

CORTLAND HOUSING AUTH.

NORTHCLIFFE CRT.

CONIFER HOUSING

NORTHCLIFFE RD.

INDUSTRIAL FACILITY

PERPLEXITY CREEK TRIBUTARY

ROSEN SITE

VALLEYVIEW DR.

LEGEND:

- RECOVERY WELL
- SANITARY SEWER W/ MANHOLES
- PROPERTY LINE
- RIGHT-OF-WAY
- WATER – STREAMS & RIVER

1" = 400'

400' 0 400' 800'

NOTES:

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ROSEN SITE
CORTLAND, NEW YORK

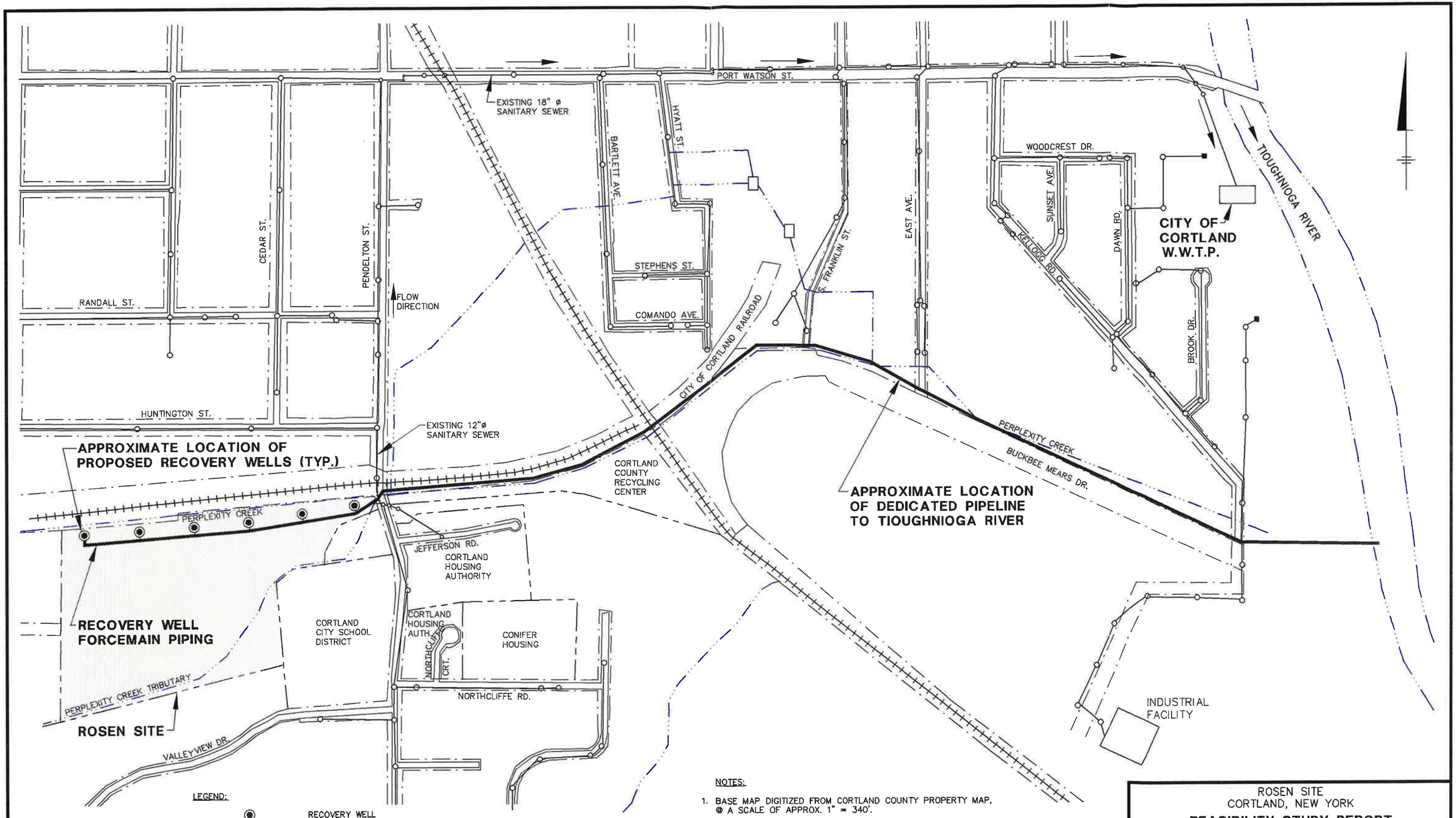
FEASIBILITY STUDY REPORT

OPTION 4 - ON-SITE TREATMENT FOLLOWED BY DISCHARGE TO PERPLEXITY CREEK

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

FIGURE **D-5**

FSR.PCP
4/28/97 SYR-54-PGL AK DMW
49401070/49401G09.DWG



NOTES:

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ROSEN SITE
CORTLAND, NEW YORK

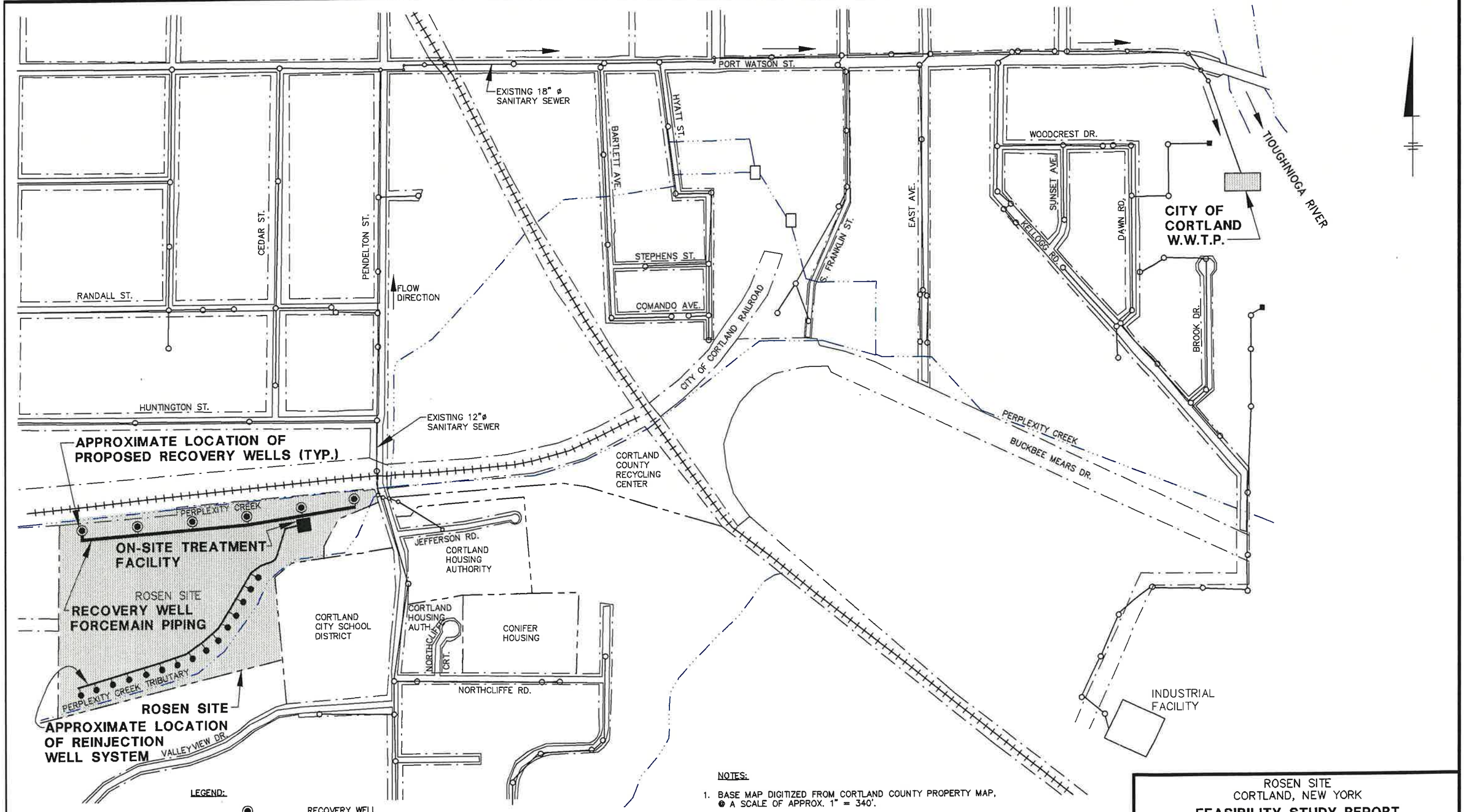
FEASIBILITY STUDY REPORT

OPTION 5 - ONSITE GROUND-WATER TREATMENT FOLLOWED BY DISCHARGE TO TIOUGHNIOGA RIVER VIA DEDICATED PIPELINE

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

FIGURE D-6

FSR.PCP
4/28/97 SYR-54-PGL AK DMW
49401070/49401G10.DWG



NOTES:

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ROSEN SITE
CORTLAND, NEW YORK

FEASIBILITY STUDY REPORT

OPTION 6 - ON-SITE TREATMENT FOLLOWED BY DISCHARGE VIA REINJECTION

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FIGURE D-7

FSR.PCP
4/28/97 SYR-54-PGL AK DMW
49401070/49401G11.DWG

Attachment D-1

BLASLAND, BOUCK & LEE, INC.
engineers & scientists

Department of Public Works Letter

DEPARTMENT OF PUBLIC WORKS

South Franklin
Cortland, New York 13045
607-756-6221

ROBERT J. SPADA
Superintendent

ANGELO A. TRIVISONNO
Deputy Superintendent

May 24, 1995

Mr. David Hale
Blasland, Bouck & Lee, Inc.
6723 Towpath Road
Syracuse, NY 13214

Dear David:

This letter is to confirm our earlier conversations regarding the use of Perplexity Creek for the discharge of pumped ground water from the Rosen Site on South Pendleton Street in the City of Cortland. As I mentioned before, it is not uncommon to see Perplexity Creek, in the area of the Rosen Site, flowing to its maximum capacity for the months of March through May in the spring and from the end of September through the end of October in the fall. Several times throughout the year the creek overflows its banks and floods the railroad tracks bordering the Rosen property, South Pendleton Street and Huntington Street, including the Rosen Site property.

As you know, the creek is piped with a 42" diameter concrete reinforced pipe from South Pendleton Street to East Avenue, a distance of 2,400 feet. Along the length of the piped section, there are several manholes wherever the pipe changes direction. During high water conditions these manholes surcharge to the point that water seeps out from the lids and saturates the ground around them. The pipe also travels under two city streets, through the County Recycling Center, behind the Department of Public Works garage, under a section of New York Susquehanna and Western main line railroad tracks that run through the city and outfalls into an open ditch in a residential area before leaving the city and entering the Tioughnioga River near Kellogg Road in Cortlandville.

Therefore, it is my opinion that using this creek as the discharge for pumped ground water from the Rosen Site would not be practical and would very likely cause more flooding problems for the City of Cortland and the property owners along its path. If you have any other questions regarding this situation, please do not hesitate to contact me.

Sincerely,

Robert J. Spada

Robert J. Spada
Superintendent of Public Works

RJS/wv

Appendix E

Appendix E

BLASLAND, BOUCK & LEE, INC.
engineers & scientists

Quickflow ™ Ground-Water Flow Modeling

Appendix - Quick Flow™ Ground-Water Flow Modeling

E.1 Introduction

QuickFlow™ modeling simulated steady flow to estimate the pumping well configuration needed for hydraulic containment.

Model input parameters were assigned based on data from the ATP and RI to simulate typical hydraulic conditions.

Hydraulic containment at the northern property boundary was achieved under steady-state conditions using six wells pumping a total rate of approximately 1,125 gpm (assuming a 0.01 ft/ft hydraulic gradient).

Assuming a 0.018 ft/ft hydraulic gradient, the total pumping rate increased to approximately 1,500 gpm.

This appendix presents a summary of the two-dimensional (2-D) analytical ground-water flow modeling conducted using QuickFlow™ (Rumbaugh III, September 1991). QuickFlow™ was used to estimate the pumping rate and well configuration necessary to attain hydraulic containment at the northern property boundary of the Site under typical ground-water flow and steady-state conditions.

This modeling effort used data from the Remedial Investigation (RI) (Blasland, Bouck & Lee, May 1994) and the ATP conducted in January 1995 by BB&L at the Site. Implementation and results of the ATP are presented in Appendix A.

Determination of Input Parameters:

Based on Site data obtained during the ATP and the RI, the following model input parameters were assigned:

- Horizontal hydraulic conductivity (K_h) of 220 feet per day (ft/day), which is the geometric mean of the K_h values calculated for the upper outwash in the ATP;
- Saturated thickness (b) of 40 feet for the upper outwash aquifer, as observed at the northern property boundary;
- Hydraulic gradient (i) of 0.01 ft/ft, the geometric mean of the observed typical horizontal hydraulic gradient for the upper outwash at the Site (BB&L, May 1994, Table 56);
- Storage coefficient (S) of 0.1, which is not used in the steady state simulation; and
- Porosity (n) of 0.30, based on discussion with Todd Miller of the United States Geological Survey (USGS).

Model Implementation:

Several simulations were run to evaluate the effects of changing pumping well placement and pumping rates, and hydraulic coefficients. Model calibration consisted of comparing the hydraulic gradients generated from model simulations to those observed at the Site under typical-flow conditions. Two of the model simulations are presented here. Figure E-1 provides the first model simulation, which shows the initial water table conditions with a hydraulic gradient of 0.01 ft/ft. This steady-state simulation showed that hydraulic containment along the northern property boundary was achieved under the following conditions:

- Six vertical wells along the northern property boundary, numbered from west to east as Well 1 through Well 6; and
- Total pumping rate of approximately 1,125 gpm (i.e., Wells 1 through 4 pumping at 175 gpm, Well 5 pumping at 200 gpm, and Well 6 pumping at 225 gpm).

As shown on Figure E-2, the second model simulation shows that the flow lines originating from the Site are captured by the pumping wells, thus indicating hydraulic containment.

Assuming a hydraulic gradient (i) of 0.018 ft/ft (the upper end of the range presented in the technical memorandum in Appendix A), hydraulic containment along the northern property boundary was achieved under steady-state conditions using six wells pumping a total rate of approximately 1,500 gpm.

References

Blasland, Bouck & Lee, Inc., 1994, *Remedial Investigation Report, Rosen Site, Cortland, New York,* October 1992, revised May 1994.

Miller, Todd, Personal Communication to Mr. Michael Gefell, Blasland, Bouck & Lee, Inc., regarding ground-water modeling input parameters, 1994.

Runbaugh, James, O., Quickflow™ Analytical 2D Ground-Water Flow Model, Version 1.0, Geraghty & Miller, Inc., Reston, Virginia, September 1991.

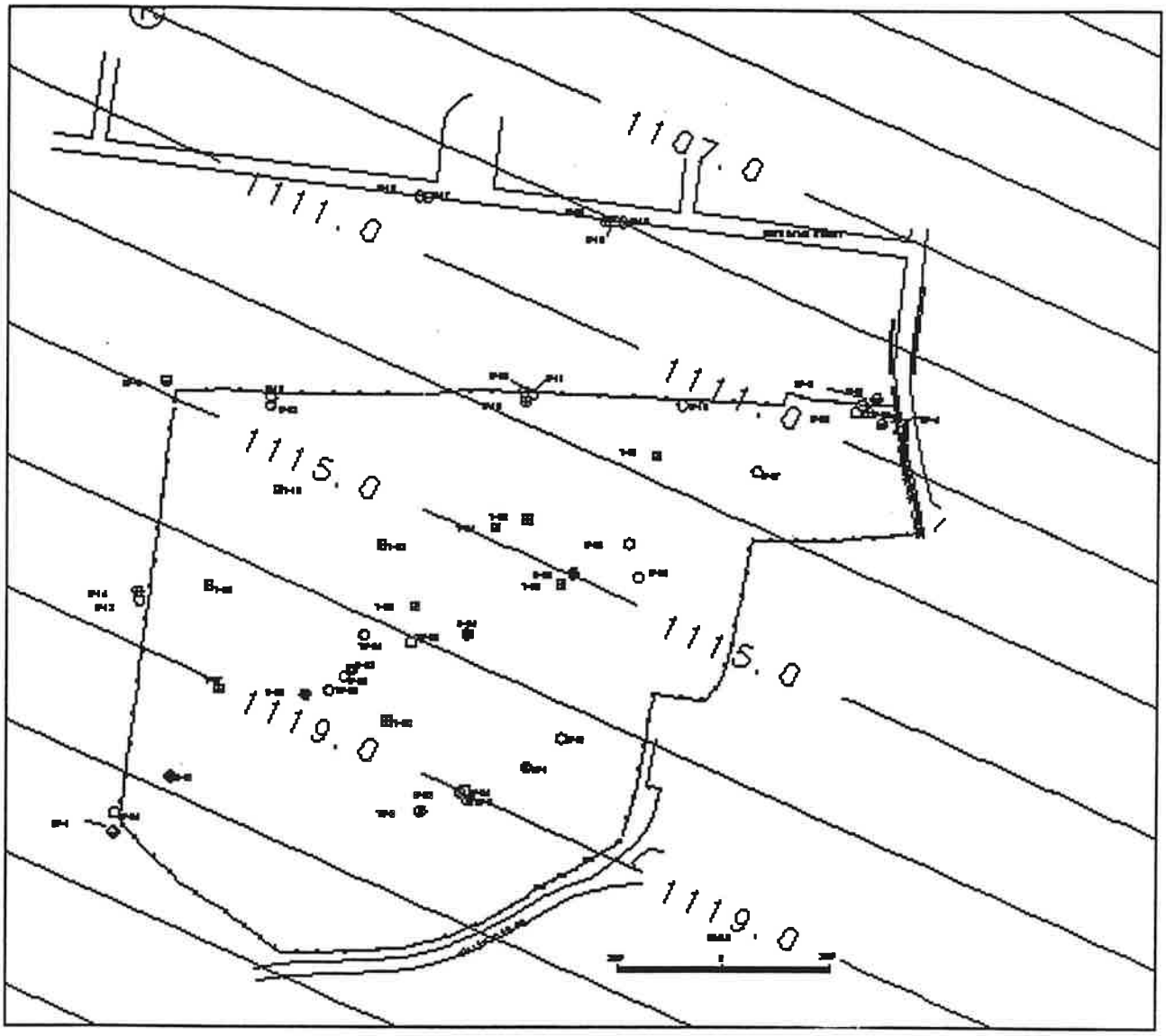


Figure E-1

Rosen Site
Cortland, New York

QuickFlow Model Simulation

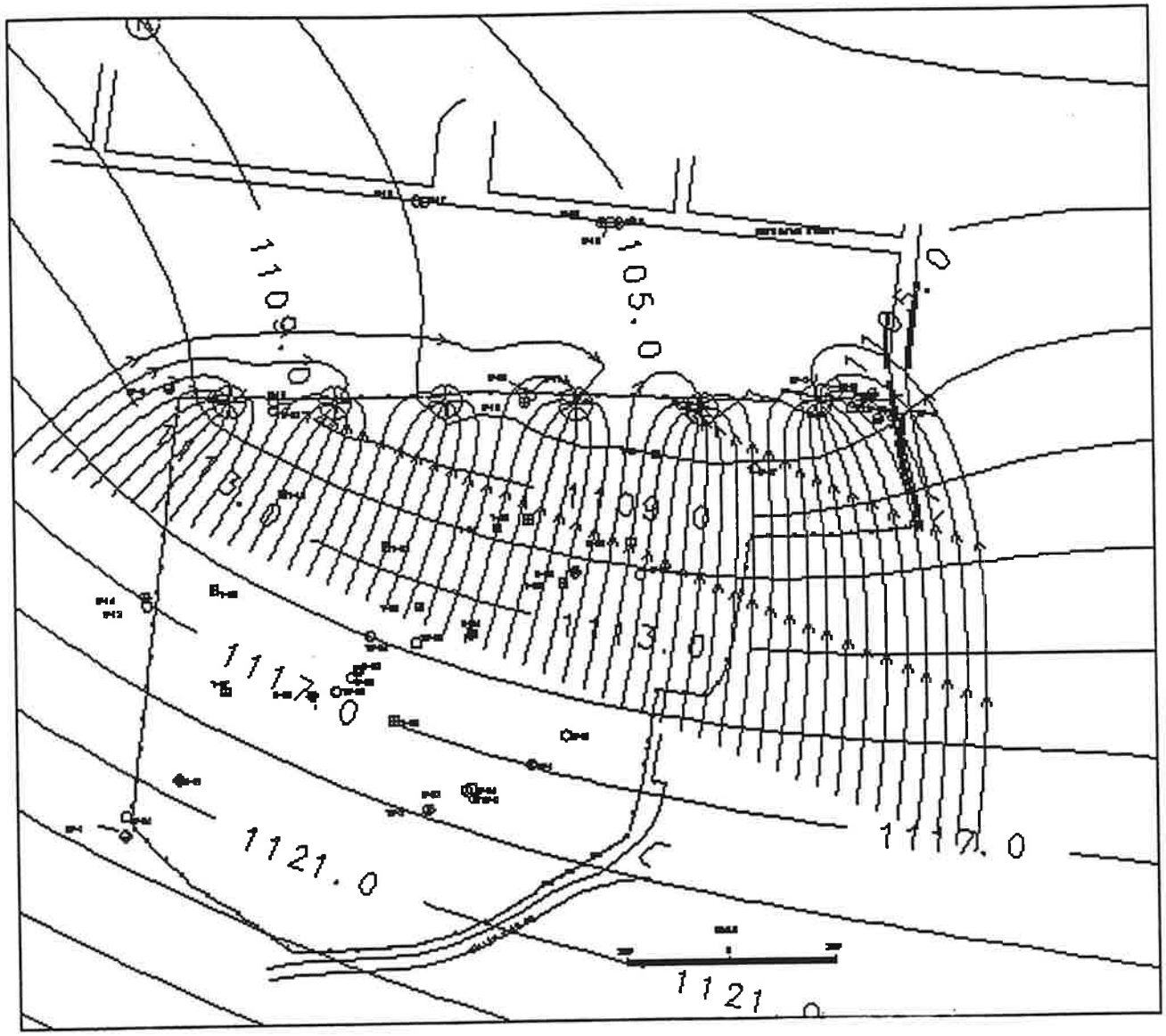


Figure E-2

Rosen Site
Cortland, New York

QuickFlow Model Simulation

Appendix F

Appendix F

BLASLAND, BOUCK & LEE, INC.
engineers & scientists

Cost Estimates

ALTERNATIVE 1

ROSEN SITE
FEASIBILITY STUDY
COST ESTIMATE

Capital (Direct and Indirect)

Item	Quantity	Units	Unit Cost[1]	Item Cost	Comments
1. Monitoring Wells[2]	5	well	2860	$14,300	New 2-inch diameter stainless steel wells to supplement existing wells for the long-term monitoring program.
SUBTOTAL				$14,300	
15% ENGINEERING & SUPPORT[3]				$2,145	
20% CONTINGENCY[4]				$2,860	
			TOTAL:	$19,305	
			ROUNDED TOTAL:	$19,000	

Annual (Operation & Maintenance) Cost

Item	Quantity	Units	Unit Cost[1]	Item Cost	Comments
1. Ground Water Monitoring[5]					
a. Ground Water Sampling[6]	12	manday	520	$6,240	Two field technicians for three days; semi-annually.
b. Analytical[7]	2	event	13,725	27,450	Fifteen samples per event for full parameters (Note 11) and one sample for PCBs.
c. Direct Expenses[8]	1	lump sum	2,000	2,000	
d. Data Evaluation/Reporting	1	lump sum	10,000	10,000	
SUBTOTAL				$45,690	
15% ENGINEERING & SUPPORT[3]				6,854	
20% CONTINGENCY[4]				9,138	
			TOTAL:	$61,682	
			ROUNDED TOTAL:	$60,000	

Thirty-Year Present Worth Cost[9]: $0.94 Million

Notes:

1 Unit Cost shown includes material and labor, unless otherwise noted.
2 Monitoring well cost provided by Empire Soils Investigation, Inc. Cost includes mobilization and demobilization.
3 A 15 percent Engineering & Support cost includes, but is not limited to the following: administration and supervision, design and development, monitoring and testing, and cost estimating. Engineering & Support cost does not include legal fees and permit acquisition. Engineering & Support cost developed and based upon EPA 600/8-87/049 "Remedial Action Costing Procedures Manual" (1987).
4 A 20 percent contingency allowance is included to provide for unforessen circumstances or variabiity in estimated areas, volumes/labor and material costs. Contingency allowance developed based upon EPA 600/8-87/049 "Remedial Action Costing Procedures Manual" (1987).
5 Ground water monitoring will be performed semi-annually for a period of ten years. After ten years, monitoring will be performed annually for an additional five years. After 15 years, monitoring will be performed once every five years up to a total of 30 years of monitoring.
6 Unit Cost assumes labor rate of $65/hour for an eight hour day (Blasland, Bouck & Lee, Inc. senior field technician rate).
7 Laboratory analytical cost includes analysis for TAL/TCL – VOCs, PCBs (well W-07 only), and metals. Additional analytical parameters to facilitate the monitoring of natural attenuation include; dissolved oxygen, oxidation-reduction potential, ferric/ferrous iron, nitrate/nitrite and sulfate/sulfite.
8 Direct expenses consist of sampling equipment and subsistence (meals, lodging, vehicle).
9 Present worth cost is based on a total capital (direct and indirect) expenditure (taken in the first year) and annual (operation and maintenance) costs taken over a 30-year time frame at a discount rate of five percent per EPA Guidance (EPA/540/G-89/004) and 1997 Discount Rates published by the Office of Management and Budget, Executive Office of the President, Washington, D.C. (A.M. Rivlin memorandum, 2/7/95).

ALTERNATIVE 2

ROSEN SITE
FEASIBILITY STUDY
COST ESTIMATE

Capital (Direct and Indirect)

Item	Quantity	Units	Unit Cost[1]	Item Cost	Comments
1. Mobilization/Demobilization	1	lump sum	5%	$81,812	Five percent of cost of items 2 through 9.
2. Site Clearing[2]	4.8	acre	2,850	13,680	Assumes 25 percent of 19.2 acres.
3. Debris Relocation[3]	1	lump sum	117,000	117,000	Assumes on-site relocation of site debris.
4. Silt Fencing[2]	4,100	linear foot	1.00	4,100	Assumes entire site perimeter.
5. PCB "Hot Spot" Excavation and On-Site Relocation	1300	cubic yard	$6.50	8,450	Assumes excavation of soils with PCB concentrations > 25 ppm, at an average depth of 3 feet.[19]
6. TCA "Hot Spot" Excavation and On-Site Relocation					
a. Test Pit T-02 area	1700	cubic yard	$6.50	11,050	Assumes excavation limit halfway to adjacent boring < 1 ppm TCA. Uniform depth of 3 feet.[19]
b. Former cooling pond (well W-06) area	630	cubic yard	$6.50	4,095	Assumes excavation limit to cooling pond and 75 foot square excavation. Uniform depth of 3 feet.[19]
7. Part 360 Cap					Assumes 3 acre cooling pond area.
a. Geotextile[4]	14,520	square yard	1.60	23,232	
b. Gas Venting Layer[5]	5,000	cubic yard	13.50	67,500	12-inch thickness
c. Geomembrane Liner[6]	131,000	square foot	0.60	78,600	40-mil thickness
d. Soil Layer[7]	12,100	cubic yard	14	169,400	30-inch thickness
e. Topsoil Layer[8]	2,500	cubic yard	22	55,000	6-inch thickness
f. Vegetative Cover[2]	3	acre	2,000	6,000	
8. Site Grading[2]	78,410	square yard	0.50	39,205	Assumes 16.2-acre area.
9. Surface Pavement Cover[9]					Assumes 16.2-acre area.
a. Base Course[2]	78,410	square yard	4.70	368,527	12-inch thickness
b. Binder Course[2]	78,410	square yard	5.40	423,414	3-inch thickness
c. Wearing Course[2]	78,410	square yard	3.15	246,992	1.5-inch thickness
SUBTOTAL				$1,718,057	
15% ENGINEERING & SUPPORT[16]				$257,709	
20% CONTINGENCY[17]				$343,611	
			TOTAL:	$2,319,377	
			ROUNDED TOTAL:	$2.32 Million	

(See Notes on Page 2)

ALTERNATIVE 2

ROSEN SITE
FEASIBILITY STUDY
COST ESTIMATE

Annual (Operation & Maintenance) Cost

Item	Quantity	Units	Unit Cost[1]	Item Cost	Comments
1. Ground Water Monitoring[10]					
a. Ground Water Sampling[11]	12	manday	520	$6,240	Two field technicians for three days; semi-annually.
b. Analytical[12]	2	event	13,725	27,450	Fifteen samples per event for full parameters (Note 11) and one sample for PCBs.
c. Direct Expenses[13]	1	lump sum	2,000	2,000	
d. Data Evaluation/Reporting	1	lump sum	10,000	10,000	
2. Cap Maintenance					
a. Mowing[2]	6	event	200	1,200	Assumes six events annually.
b. Repairs[14]	1	lump sum	500	500	
3. Pavement Repairs[15]	1	lump sum	500	500	
SUBTOTAL				$47,890	
15% ENGINEERING & SUPPORT[16]				7,184	
20% CONTINGENCY[17]				9,578	
			TOTAL:	$64,652	
			ROUNDED TOTAL:	$60,000	
Thirty-Year Present Worth Cost[18]:				$3.24 Million	

Notes:

[1] Unit Cost shown includes material and labor, unless otherwise noted.
[2] Unit Cost from Means 1996.
[3] Debris relocation cost from previous Blasland, Bouck & Lee quote for the Site, adjusted for inflation.
[4] Geotextile material cost ($0.45/square yard) provided by Mirafi, Inc.; installation cost ($1.15/square yard) per Means 1996.
[5] Sand material and delivery cost ($12/cubic yard) provided by local sand and gravel distributor; placement cost ($1.50/cubic yard) per Means 1996.
[6] Geomembrane liner material and installation cost ($0.60/square foot) provided by Gundle Lining Systems, Inc.
[7] Soil material and delivery cost ($10/cubic yard) provided by local distributor; placement cost ($4/cubic yard) per Means 1996.
[8] Topsoil material and delivery cost ($18/cubic yard) provided by local distributor; placement cost ($4/cubic yard) per Means 1996.
[9] For cost estimation purposes, a surface pavement cover is assumed.
[10] Ground water monitoring will be performed semi-annually for a period of ten years. After ten years, monitoring will be performed annually for an additional five years. After 15 years, monitoring will be performed once every five years up to a total of 30 years of monitoring.
[11] Unit Cost assumes labor rate of $65/hour for an eight hour day (Blasland, Bouck & Lee, Inc. senior field technician rate).
[12] Laboratory analytical cost includes analysis for TAL/TCL – VOCs, PCBs (well W-07 only), and metals. Additional analytical parameters to facilitate the monitoring of natural attenuation include; dissolved oxygen, oxidation-reduction potential, ferric/ferrous iron, nitrate/nitrite and sulfate/sulfite.
[13] Direct expenses consist of sampling equipment and subsistence (meals, lodging, vehicle).
[14] Repair cost assumes hand placement of five cubic yards of topsoil to repair erosion.
[15] Pavement repair cost assumes hand placement of cold patch material and sealing of repaired areas.
[16] A 15 percent Engineering & Support cost includes, but is not limited to the following: administration and supervision, design and development, monitoring and testing, and cost estimating. Engineering & Support cost does not include legal fees and permit acquisition. Engineering & Support cos developed and based upon EPA 600/8-87/049 "Remedial Action Costing Procedures Manual" (1987).
[17] A 20 percent contingency allowance is included to provide for unforessen circumstances or variability in estimated areas, volumes/labor and material costs. Contingency allowance developed based upon EPA 600/8-87/049 "Remedial Action Costing Procedures Manual" (1987).
[18] Present worth cost is based on a total capital (direct and indirect) expenditure (taken in the first year) and annual (operation and maintenance) costs taken over a 30-year time frame at a discount rate of five percent per EPA Guidance (EPA/540/G-89/004) and 1997 Discount Rates published by the Office of Management and Budget, Executive Office of the President, Washington, D.C. (A.M. Rivlin memorandum, 2/7/95).
[19] Volume estimated from data from Rosen Site RI Report (BB&L, October 1992, revised May 1994).

ALTERNATIVE 3

ROSEN SITE
FEASIBILITY STUDY
COST ESTIMATE

Capital (Direct and Indirect)

Item	Quantity	Units	Unit Cost[1]	Item Cost	Comments
1. Mobilization/Demobilization	1	lump sum	5%	$85,992	Five percent of cost of items 2 through 8.
2. Site Clearing[2]	4.8	acre	2,850	13,680	Assumes 25 percent of 19.2 acres.
3. Debris Relocation[3]	1	lump sum	117,000	117,000	Assumes on-site relocation of Site debris.
4. Silt Fencing[2]	4,100	linear foot	1.00	4,100	Assumes entire site perimeter.
5. Part 360 Cap					Assumes 3 acre area.
a. Geotextile[4]	14,520	square yard	1.60	23,232	
b. Gas Venting Layer[5]	5,000	cubic yard	13.50	67,500	12-inch thickness
c. Geomembrane Liner[6]	131,000	square foot	0.60	78,600	40-mil thickness
d. Soil Layer[7]	12,100	cubic yard	14	169,400	30-inch thickness
e. Topsoil Layer[8]	2,500	cubic yard	22	55,000	6-inch thickness
f. Vegetative Cover[2]	3	acre	2,000	6,000	
6. Site Grading[2]	78,410	square yard	0.50	39,205	Assumes 16.2-acre area.
7. Surface Pavement Cover[9]					Assumes 16.2-acre area.
a. Base Course[2]	78,410	square yard	4.70	368,527	12-inch thickness
b. Binder Course[2]	78,410	square yard	5.40	423,414	3-inch thickness
c. Wearing Course[2]	78,410	square yard	3.15	246,992	1.5-inch thickness
8. Biological Treatment System					
a. Treatability Study	1	lump sum	50,000	50,000	
b. Treatment Building[2]	200	square foot	36	7,200	Assumes metal prefabricated building.
c. Treatment System Equipment	1	lump sum	50,000	50,000	
SUBTOTAL				$1,805,842	
15% ENGINEERING & SUPPORT[17]				270,876	
20% CONTINGENCY[18]				361,168	
			TOTAL:	$2,437,887	
			ROUNDED TOTAL:	$2.44 Million	

(See Notes on Page 2)

ALTERNATIVE 3

ROSEN SITE
FEASIBILITY STUDY
COST ESTIMATE

Annual (Operation & Maintenance) Cost

Item	Quantity	Units	Unit Cost[1]	Item Cost	Comments
1. Ground Water Monitoring[10]					
a. Ground Water Sampling[11]	12	manday	520	$6,240	Two field technicians for three days; semi-annually.
b. Analytical[12]	2	event	13,725	27,450	Fifteen samples per event for full parameters (Note 12) and one sample for PCBs.
c. Direct Expenses[13]	1	lump sum	2,000	2,000	
d. Data Evaluation/Reporting	1	lump sum	10,000	10,000	
2. Cap Maintenance					
a. Mowing[2]	6	event	200	1,200	Assumes six events annually.
b. Repairs[14]	1	lump sum	500	500	
3. Pavement Repairs[15]	1	lump sum	500	500	
4. Biological Treatment System					
a. Nutrient Addition[16]	425	pound	1.25	531	
b. Operator	1	lump sum	12,480	12,480	Assumes one part - time operator (8 hours per week) at $30 per hour.
c. Miscellaneous Repairs	1	lump sum	500	500	
SUBTOTAL				$61,401	
15% ENGINEERING & SUPPORT[17]				9,210	
20% CONTINGENCY[18]				12,280	
			TOTAL:	$82,892	
			ROUNDED TOTAL:	$80,000	

Thirty-Year Present Worth Cost[19]: $3.67 Million

Notes:

[1] Unit Cost shown includes material and labor, unless otherwise noted.
[2] Unit cost from Means 1996.
[3] Debris relocation cost from previous Blasland, Bouck & Lee quote for the Site, adjusted for inflation.
[4] Geotextile material cost ($0.45/square yard) provided by Mirafi, Inc.; installation cost ($1.15/square yard) per Means 1996.
[5] Sand material and delivery cost ($12/cubic yard) provided by local sand and gravel distributor; placement cost ($1.50/cubic yard) per Means 1996.
[6] Geomembrane liner material and installation cost ($0.60/square foot) proivded by Gundle Lining Systems, Inc.
[7] Soil material and delivery cost ($10/cubic yard) provided by local distributor; placement cost ($4/cubic yard) per Means 1996.
[8] Topsoil material and delivery cost ($18/cubic yard) provided by local distributor; placement cost ($4/cubic yard) per Means 1996.
[9] For cost estimation purposes, a surface pavement cover is assumed.
[10] Ground water monitoring will be performed semi-annually for a period of 30 years. Cost reflects the collection and analysis of two monitoring events.
[11] Unit Cost assumes labor rate of $65/hour for an eight hour day (Blasland, Bouck & Lee, Inc. senior field technician rate).
[12] Laboratory analytical cost includes analysis for TAL/TCL - VOCs, PCBs (well W-07 only), and metals. Additional analytical parameters to facilitate the monitoring of natural attenuation include dissolved oxygen, oxidation-reduction potential, ferric/ferrous iron, nitrate/nitrite, and sulfate/sulfite.
[13] Direct expenses consist of sampling equipment and subsistence (meals, lodging, vehicle).
[14] Repair cost assumes hand placement of five cubic yards of topsoil to repair erosion.
[15] Pavement repair cost assumes hand placement of cold patch material and sealing of repaired areas.
[16] Unit Cost from Environmental Cost Handling Options and Solutions (ECHOS 1995).
[17] A 15 percent Engineering & Support cost includes, but is not limited to the following: administration and supervision, design and development, monitoring and testing, and cost estimating. Engineering & Support cost does not include legal fees and permit acquisition. Engineering & Support cost developed based upon EPA 600/8-87/049 "Remedial Action Costing Procedures Manual (1987).
[18] A 20 percent contingency allowance is included to provide for unforessen circumstances or variabiity in estimated areas, volumes/labor and material costs. Contingency allowance developed based upon EPA 600/8-87/049 "Remedial Action Costing Procedures Manual" (1987).
[19] Present worth cost is based on a total capital (direct and indirect) expenditure (taken in the first year) and annual (operation and maintenance) costs for Natural Attenuation (Alternative 2) for the first five years of implementation, followed by increased capital and O&M costs for In-Situ Biolgogical treatment for the remainder of the 30-year period. A discount rate of five percent was used per EPA Guidance (EPA/540/G-89/004) and 1997 Discount Rates published by the Office of Management and Budget, Executive Office of the President, Washington, D.C. (A.M. Rivlin memorandum, 2/7/95).

ALTERNATIVE 4

ROSEN SITE
FEASIBILITY STUDY
COST ESTIMATE

Capital (Direct and Indirect)

Item	Quantity	Units	Unit Cost[1]	Item Cost	Comments
1. Mobilization/Demobilization	1	lump sum	5%	$83,617	Five percent of cost of items 2 through 9.
2. Site Clearing[2]	4.8	acre	2,850	13,680	Assumes 25 percent of 19.2 acres.
3. Debris Relocation[3]	1	lump sum	117,000	117,000	Assumes on-site relocation of site debris.
4. Silt Fencing[2]	4,100	linear foot	1.00	4,100	Assumes entire site perimeter.
5. Part 360 Cap					Assumes 3-acre area.
a. Geotextile[4]	14,520	square yard	1.60	23,232	
b. Gas Venting Layer[5]	5,000	cubic yard	13.50	67,500	12-inch thickness
c. Geomembrane Liner[6]	131,000	square foot	0.60	78,600	40-mil thickness
d. Soil Layer[7]	12,100	cubic yard	14	169,400	30-inch thickness
e. Topsoil Layer[8]	2,500	cubic yard	22	55,000	6-inch thickness
f. Vegetative Cover[2]	3	acre	2,000	6,000	
6. Site Grading[2]	78,410	square yard	0.50	39,205	Assumes 16.2-acre area.
7. Surface Pavement Cover[9]					Assumes 16.2-acre area.
a. Base Course[2]	78,410	square yard	4.70	368,527	12-inch thickness
b. Binder Course[2]	78,410	square yard	5.40	423,414	3-inch thickness
c. Wearing Course[2]	78,410	square yard	3.15	246,992	1.5-inch thickness
8. Ground Water Recovery System (100 gpm) (includes wells, pumps, well piping, and electrical controls/ alarms)[10]	1	well	32,100	32,100	6-inch diameter stainless steel well casing assumed depth of 55 feet.
9. Recovery Well Forcemain[11]	1,200	linear foot	23	27,600	Assumes 3-inch diameter HDPE pipe from wells to POTW manhole.
SUBTOTAL				$1,755,967	
15% ENGINEERING & SUPPORT[19]				263,395	
20% CONTINGENCY[20]				351,193	
			TOTAL:	$2,370,555	
			ROUNDED TOTAL:	$2.37 Million	

(See Notes on Page 2)

ROSEN SITE
FEASIBILITY STUDY
COST ESTIMATE

Annual (Operation & Maintenance) Cost

Item	Quantity	Units	Unit Cost[1]	Item Cost	Comments
1. Ground Water Monitoring[12]					
a. Ground Water Sampling[13]	12	manday	520	$6,240	Two field technicians for three days semi-annually.
b. Analytical[14]	2	event	13,725	27,450	Fifteen samples per event for full parameters (Note 13) and one sample for PCBs.
c. Direct Expenses[15]	1	lump sum	2,000	2,000	
d. Data Evaluation/Reporting	1	lump sum	10,000	10,000	
2. Cap Maintenance					
a. Mowing[2]	6	event	200	1,200	Assumes six events annually.
b. Repairs[16]	1	lump sum	500	500	
3. Pavement Repairs[17]	1	lump sum	500	500	
4. Ground Water Recovery System					
a. Operator	1	lump sum	12,480	12,480	Assumes one part-time operator at 8 hours per week at $30 per hour.
b. Miscellaneous Repairs	1	lump sum	1,000	1,000	
c. Utilities	1	lump sum	5,000	5,000	Estimated electrical consumption. (Includes 30 percent additional due to demand charge.)
d. Sewer User Fee[18]	1	lump sum	26,280	26,280	Assumes a discharge flow rate of 100 gallons per minute.
SUBTOTAL				$92,650	
15% ENGINEERING & SUPPORT[19]				13,898	
20% CONTINGENCY[20]				18,530	
			TOTAL:	$125,078	
			ROUNDED TOTAL:	$130,000	

Thirty-Year Present Worth Cost[21]: $4.37 Million

Notes:

1 Unit Cost shown includes material and labor, unless otherwise noted.
2 Unit cost from Means 1996.
3 Debris relocation cost from previous Blasland, Bouck & Lee quote for the Site, adjusted for inflation.
4 Geotextile material cost ($0.45/square yard) provided by Mirafi, Inc.; installation cost ($1.15/square yard) per Means 1996.
5 Sand material and delivery cost ($12/cubic yard) provided by local sand and gravel distributor; placement cost ($1.50/cubic yard) per Means 1996.
6 Geomembrane liner material and installation cost ($0.60/square foot) provided by Gundle Lining Systems, Inc.
7 Soil material and delivery cost ($10/cubic yard) provided by local distributor; placement cost ($4/cubic yard) per Means 1996.
8 Topsoil material and delivery cost ($18/cubic yard) provided by local distributor; placement cost ($4/cubic yard) per Means 1996.
9 For cost estimation purposes, a surface pavement cover is assumed.
10 Ground water recovery system cost ($32,100/well) consists of recovery well installation, recovery pump, 3-inch diameter HDPE well piping, and electric controls (floats, switches, and alarms).
11 Recovery well force main consists of 3-inch diameter HDPE force main piping, and placement (trenching, backfilling, and compaction). Pipe cost provided by local distributor; placement costs per Means 1996.
12 Ground water monitoring will be performed semi-annually for a period of 30 years. Cost reflects the collection and analysis of two monitoring events.
13 Unit Cost assumes labor rate of $65/hour for an eight hour day (Blasland, Bouck & Lee, Inc. senior field technician rate).
14 Laboratory analytical costs include analysis for TAL/TCL – VOCs, PCBs (well W-07 only), and metals. Additional analytical parameters to facilitate the monitoring of natural attenuation include; dissolved oxygen, oxidation-reduction potential, ferric/ferrous iron, and sulfate/sulfite.
15 Direct expenses consist of sampling equipment, and subsistence (meals, lodging, vehicle).
16 Repair cost assumes hand placement of five cubic yards of topsoil to repair erosion.
17 Pavement repair cost assumes hand placement of cold patch material and sealing of repaired areas.
18 Sewer use fee developed based upon a rate of $0.50/1,000 gallons provided by the city of Cortland.
19 A 15 percent Engineering & Support cost includes, but is not limited to to the following: administration and supervision, design and development, monitoring and and cost estimating. Engineering & Support cost does not include legal fees and permit acquisition. Engineering & Support cost developed based upon EPA 600/8-87/049 "Remedial Action Costing Procedure Manual" (1987).
20 A 20 percent contingency allowance is included to provide for unforessen circumstances or variabiity in estimated areas, volumes/labor and material costs. Contingency allowance developed based upon EPA 600/8-87/049 "Remedial Action Costing Procedures Manual" (1987).
21 Present worth cost is based on a total capital (direct and indirect) expenditure (taken in the first year) and annual (operation and maintenance) costs for Natural Attenuation (Alternative 2) for the first five years of implementation, followed by increased capital and O&M costs for ground-water recovery for the remainder of the 30-year period. A discount rate of five percent was used per EPA Guidance (EPA/540/G-89/004) and 1997 Discount Rates published by Office of Management and Budget, Executive Office of the President, Washington, D.C. (A.M. Rivlin memorandum, 2/7/95).

ALTERNATIVE 5

ROSEN SITE
FEASIBILITY STUDY
COST ESTIMATE

Capital (Direct and Indirect)

Item	Quantity	Units	Unit Cost[1]	Item Cost	Comments
1. Mobilization/Demobilization	1	lump sum	5%	$335,667	Five percent of cost of items 2 through 13.
2. Site Clearing[2]	4.8	acre	2,850	13,680	Assumes 25 percent of 19.2 acres.
3. Debris Relocation[3]	1	lump sum	117,000	117,000	Assumes on-site relocation of site debris.
4. Silt Fencing[2]	4,100	linear foot	1.00	4,100	Assumes entire site perimeter.
5. Part 360 Cap					Assumes 3-acre area.
a. Geotextile[4]	14,520	square yard	1.60	23,232	
b. Gas Venting Layer[5]	5,000	cubic yard	13.50	67,500	12-inch thickness
c. Geomembrane Liner[6]	131,000	square foot	0.60	78,600	40-mil thickness
d. Soil Layer[7]	12,100	cubic yard	14	169,400	3-inch thickness
e. Topsoil Layer[8]	2,500	cubic yard	22	55,000	6-inch thickness
f. Vegetative Cover[2]	3	acre	2,000	6,000	
6. Site Grading[2]	78,410	square yard	0.50	39,205	Assumes 16.2-acre area.
7. Surface Pavement Cover[9]					Assumes 16.2-acre area.
a. Base Course[2]	78,410	square yard	4.70	368,527	12-inch thickness
b. Binder Course[2]	78,410	square yard	5.40	423,414	3-inch thickness
c. Wearing Course[2]	78,410	square yard	3.15	246,992	1.5-inch thickness
8. Ground Water Recovery System (includes wells, pumps, well piping, and electrical controls/ alarms)[10]	6	well	32,100	192,600	6-inch diameter stainless steel well casing assumed depth of 55 feet.
9. Recovery Well Forcemain[11]	1,300	linear foot	27	35,100	Assumes 8-inch diameter HDPE pipe from wells to treatment system.
10. VOC Ground-Water Treatment System					
a. Counter-Current Air Stripper[12]	1	lump sum	300,000	300,000	Assumes treatment for VOCs to meet NYSDEC surface water effluent discharge limitations.
11. Metals Ground-Water Treatment System[12]	1	lump sum	2,137,500	2,137,500	Assumes treatment for metals to meet NYSDEC surface water effluent discharge limitations.
- Influent Holding/Equalization Tank					
- Metals Precipitation					
- Coagulation, Neutralization, and Flocculation					
- Clarifier					
- Sludge Processing					
- Effluent Holding/Equalization Tank					
12. Ground-Water Discharge System (1,200-1,500 gpm)					
a. Piping[13]	1	lump sum	2,000,000	2,000,000	Assumes placement of discharge pipe from treatment system to Tioughnioga River.
b. Headwall Structure[2]	1	lump sum	3,500	3,500	Concrete headwall and rip-rap at discharge into Perplexity Creek.
13. Treatment Building[2]	12,000	square foot	36	432,000	Assumes metal prefabricated building.
14. Treatment System Start-Up[14]	1	lump sum	20%	1,342,670	Twenty percent of cost of items 2 through 13.
SUBTOTAL				$8,391,687	
15% ENGINEERING & SUPPORT[24]				1,258,753	
20% CONTINGENCY[25]				1,678,337	
			TOTAL:	$11,328,777	
			ROUNDED TOTAL:	$11.33 Million	

(See Notes on Page 3)

ALTERNATIVE 5

ROSEN SITE
FEASIBILITY STUDY
COST ESTIMATE

Annual (Operation & Maintenance) Cost

Item	Quantity	Units	Unit Cost[1]	Item Cost	
1. Ground Water Monitoring[15]					
a. Ground Water Sampling[16]	12	manday	520	$6,240	Two field technicians for three days semi-annually.
b. Analytical[17]	2	event	12,000	24,000	Fifteen samples per event for VOCs and metals, and one sample for PCBs.
c. Direct Expenses[18]	1	lump sum	2,000	2,000	
d. Data Evaluation/Reporting	1	lump sum	10,000	10,000	
2. Cap Maintenance					
a. Mowing[2]	6	event	200	1,200	Assumes six events annually.
b. Repairs[19]	1	lump sum	500	500	
3. Pavement Repairs[20]	1	lump sum	500	500	
4. Ground Water Recovery/Treatment System					
a. Operator	1	lump sum	62,400	62,400	Assumes one full-time operator at 40 hours per week at $30 per hour.
b. Miscellaneous Repairs	1	lump sum	30,000	30,000	Approximately 0.5 percent of capital cost.
c. Air Stripper Maintenance	1	lump sum	24,000	24,000	Includes monthly maintenance of air stripper packing.
d. Chemical Addition Supplies[21]	1	lump sum	300,000	300,000	Includes treatment chemicals for precipitation, neutralization, and flocculation.
e. Sludge Disposal[22,23]					
- Non-Hazardous Waste Landfill Disposal	7,800	ton	100	780,000	Estimated annual sludge quantity with assumed weight of 1.2 tons per cubic yard.
- Transportation	434	load	175	75,950	Assumed distance of 50 miles per loaded truck (18-ton limit per truck).
f. Utilities	1	lump sum	100,000	100,000	Estimated electrical consumption. (Includes 30 percent additional due to demand charge.)
g. Analytical[23]	1	lump sum	37,544	37,544	Includes analyses for treatment system influent (quarterly), effluent (monthly), and sludge (monthly).
h. Data Evaluating/Reporting	1	lump sum	5,000	5,000	
SUBTOTAL				$1,459,334	
15% ENGINEERING & SUPPORT[24]				218,900	
20% CONTINGENCY[25]				291,867	
			TOTAL:	$1,970,101	
			ROUNDED TOTAL:	$1.97 Million	

Thirty-Year Present Worth Cost[26]: $41.61 Million

(See Notes on Page 3)

ALTERNATIVE 5

ROSEN SITE
FEASIBILITY STUDY
COST ESTIMATE

Notes:

[1] Unit Cost shown includes material and labor, unless otherwise noted.
[2] Unit cost from Means 1996.
[3] Debris relocation cost from previous Blasland, Bouck & Lee quote for the Site, adjusted for inflation.
[4] Geotextile material cost ($0.45/square yard) provided by Mirafi, Inc.; installation cost ($1.15/square yard) per Means 1996.
[5] Sand material and delivery cost ($12/cubic yard) provided by local sand and gravel distributor; placement cost ($1.50/cubic yard) per Means 1996
[6] Geomembrane liner material and installation cost ($0.60/square foot) provided by Gundle Lining Systems, Inc.
[7] Soil material and delivery cost ($10/cubic yard) provided by local distributor; placement cost ($4/cubic yard) per Means 1996.
[8] Topsoil material and delivery cost ($18/cubic yard) provided by local distributor; placement cost ($4/cubic yard) per Means 1996.
[9] For cost estimation purposes, a surface pavement cover is assumed.
[10] Ground water recovery system cost ($32,100/well) consists of recovery well installation, recovery pump, 3–inch diameter HDPE well piping, and electric controls (floats, switches, and alarms).
[11] Recovery well force main consists of 8–inch diameter HDPE force main piping, and placement (trenching, backfilling, and compaction). Pipe cost provided by local distributor; placement costs per Means 1996.
[12] Ground water treatment costs developed based upon previous Blasland, Bouck & Lee, Inc. experience for similar projects and vendor quotes provided by Duall Division of Met–Pro Corporation and CSK Technical, Inc.
[13] Cost for discharge piping from treatment system to Tioughnioga River based on verbal communication with the city of Cortland.
[14] A 20 percent start–up cost includes, but is not limited to the following: equipment and material testing, operator training, and initial field monitoring. Start–up cost developed based upon EPA 600/8–87/049 "Remedial Action Costing Procedures Manual" (1987).
[15] Ground water monitoring will be performed semi–annually for a period of 30 years. Cost reflects the collection and analysis of two monitoring events.
[16] Unit Cost assumes labor rate of $65/hour for an eight hour day (Blasland, Bouck & Lee, Inc. senior field technician rate).
[17] Laboratory analytical costs include analysis for TAL/TCL – VOCs, PCBs (well W–07 only), and metals.
[18] Direct expenses consist of sampling equipment, and subsistence (meals, lodging, vehicle).
[19] Repair cost assumes hand placement of five cubic yards of topsoil to repair erosion.
[20] Pavement repair cost assumes hand placement of cold patch material and sealing of repaired areas.
[21] Cost developed using ECHOS 1995.
[22] Sludge volume developed by ERM–North Central, Inc.
[23] Influent analytical costs include analysis for VOCs, metals, BOD, COD, and pH; effluent analytical cost includes analysis for VOCs and metals; sludge analytical c includes analysis for TCLP–VOCs, SVOCs, and metals.
[24] A 15 percent Engineering & Support cost includes, but is not limited to the following: administration and supervision, design and development, monitoring and testing, and cost estimating. Engineering & Support cost does not include legal fees and permit acquisition. Engineering & Support cost contingency developed based upon EPA 600/8–87/049 "Remedial Action Costing Procedures Manual (1987).
[25] A 20 percent contingency allowance is included to provide for unforessen circumstances or variabiity in estimated areas, volumes/labor and material costs. Contingency allowance developed based upon EPA 600/8–87/049 "Remedial Action Costing Procedures Manual" (1987).
[26] Present worth cost is based on a total capital (direct and indirect) expenditure (taken in the first year) and annual (operation and maintenance) costs taken over a 30–year time frame at a discount rate of five percent per EPA Guidance (EPA/540/G–89/004) and 1997 Discount Rates published by the Office of Management and Budget, Executive Office of the President, Washington, D.C. (A.M. Rivlin memorandum, 2/7/95).

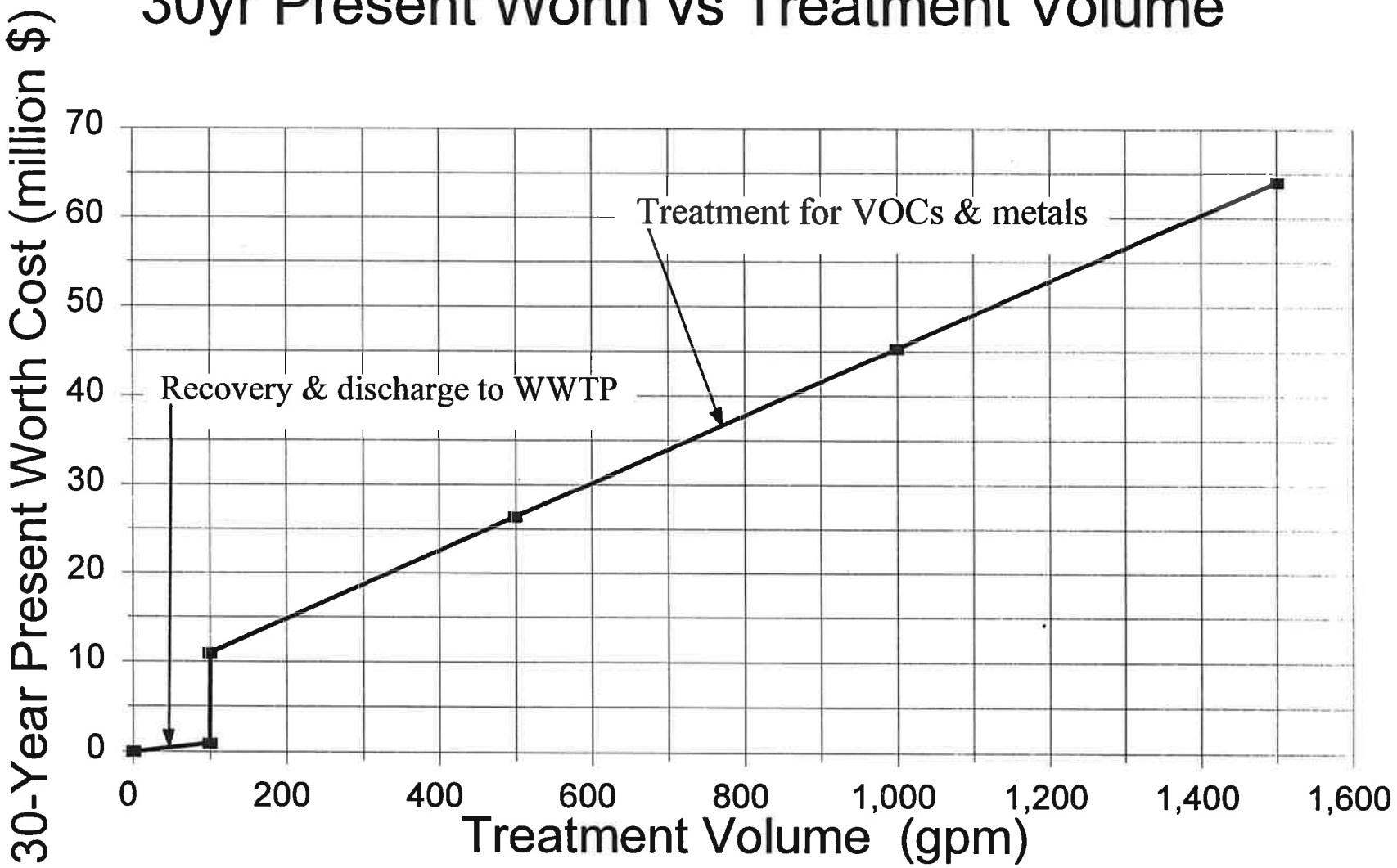
Attachment F-1

BLASLAND, BOUCK & LEE, INC.
engineers & scientists

Ground-Water Treatment Costs Graph

Ground-Water Treatment Costs

30yr Present Worth vs Treatment Volume



Note: Costs reflect the assumptions presented in the Alternative 5 Cost Estimate.

(Only ground-water recovery, treatment, and discharge components are included.)