ERM-Northeast

501 New Karner Road
Suite 7
Albany, NY 12205
(518) 452-4291
(518) 452-4295 (Fax)

RECEIVED
MAR 10 1997
Dept. of Environmental Conservation
Region 7 Kirkwood Sub. Office

6 March 1997

Mr. Perry Walter
Hadco Corporation
1200 Taylor Road
Owego, New York 13827

ERM

RE: Submittal of the Proposed Performance Monitoring Program for the Ground Water Recovery System at the Robintech/Compudyne, Inc. Site in Owego, New York

Dear Mr. Walter:

Enclosed are three copies of the proposed Performance Monitoring Program for the Robintech/Compudyne, Inc. Site ground water recovery system. This Program is intended to be incorporated into the recovery system O&M Manual as Appendix A. Three copies are also being sent to the New York State Department of Environmental Conservation (NYSDEC) pursuant to your request. If you have any questions, or need any additional copies, please do not hesitate to telephone me.

Sincerely,

William J. Miller, III
Project Director

enclosures

cc. Mr. Tom Suozzo, P.E., NYSDEC (3 copies)
Mr. Brian Morrissey, P. E., ERM-Northeast, Inc. (1 copy)

Focused Feasibility Study

Robintech/Compudyne, Inc. Site
Owego, New York

Prepared For:

Hadco Corporation
1200 Taylor Road
Owego, New York

December 1993

BLASLAND & BOUCK ENGINEERS, P.C.
BLASLAND, BOUCK & LEE
ENGINEERS & SCIENTISTS

6723 Towpath Road
Syracuse, New York 13214
(315) 446-9120

Table of Contents

5.0 Detailed Evaluation of Remedial Alternatives

Tables

Tables (Cont'd)

Figures

Appendices

Executive Summary

This Focused Feasibility Study (FFS) has been prepared to evaluate potential remedial alternatives to address the chemicals of concern identified in the soils and ground water at the Robintech/Compudyne, Inc. (Robintech) site located in Owego, New York. This FFS Report has been prepared in accordance with the Consent Order (Case No. A701518809) entered into between Hadco Corporation (Hadco) and the New York State Department of Environmental Conservation (NYSDEC) effective February 8, 1989; and with the United States Environmental Protection Agency (USEPA) guidance document "Guidelines for Conducting Remedial Investigations and Feasibility Studies Under the Comprehensive Environmental Response Compensation and Liability Act (CERCLA)"; the NYSDEC "Technical and Administrative Guidance Memorandum (TAGM) for the Selection of Remedial Actions at Inactive Hazardous Waste Sites"; and applicable provisions of the National Oil and Hazardous Substances Pollution Contingency Plan (NCP) contained in 40 CFR 300.

This FFS identifies and preliminarily screens remedial alternatives to address soils and ground water. Each identified alternative is described technically and preliminarily screened with respect to effectiveness and implementability. Alternatives that were retained after the preliminary screening process were described in detail and then evaluated on the basis of their ability to meet each of the seven criteria presented in the NCP. Based on this evaluation, a cost-effective remedial alternative for the Robintech site was recommended.

Applicable or Relevant and Appropriate Requirements (ARARs)

Applicable or Relevant and Appropriate Requirements (ARARs) were identified for each soil and ground-water alternative in accordance with the guidelines, criteria, and considerations set forth in the NYSDEC "Technical and Administrative Guidance Memorandum: Guidelines for Remedial Investigations/Feasibility Studies," dated March 31, 1989 and in accordance with the NCP.

The primary ARARs identified for the Robintech site included: the Resource Conservation and Recovery Act (RCRA) regulated levels for toxic characteristic leaching procedure (TCLP) constituents, as outlined in 40 CFR 261; and the NYSDEC Class GA ground-water quality standards delineated in 6NYCRR Part 703.

Remedial Action Objectives (RAOs)

Remedial action objectives (RAOs) for the Robintech site were developed based on the findings of the risk assessment (RA) and/or ARARs. The RA concluded that the environmental media that may affect human health are the subsurface soils in the vicinity of the former chemical storage area and the ground water beneath the site. In addition, chemical concentrations in excess of their respective NYSDEC Class GA ground-water standards were detected in ground-water samples collected from monitoring wells in the vicinity of the Robintech site.

To achieve protection of human health and the environment, RAOs were developed for the soil beneath the former chemical storage area and the ground water for the Robintech site. The following four RAOs were identified for the soil beneath the former chemical storage area:

- Limit potential inhalation of dust from soils by on-site workers during excavation activities;
- Minimize the migration of chemicals of concern that could result in further degradation of ground-water quality;
- Meet NYSDEC soil cleanup objectives for organic constituents for protection of ground-water quality; and
- Remediate inorganic constituents in the soil to "background concentrations."

For the ground water, three RAOs were identified. These RAOs included:

- Reduction of potential human health risks associated with ingestion of ground water containing constituent concentrations that exceed NYSDEC Class GA ground-water standards;
- Attain NYSDEC Class GA ground-water standards at the downgradient site boundary in both the overburden and bedrock for constituents attributable to the Robintech site; and
- Minimize horizontal and vertical migration of the ground-water plume located beneath the Robintech site.

These objectives were used as a basis for developing and screening remedial alternatives.

Identification and Preliminary Screening of Remedial Alternatives

Remedial alternatives were developed for source area soils and ground water at the site. Nine soil remedial alternatives were identified and preliminarily screened. Of the nine soil remedial alternatives, four were eliminated because they would not satisfy the preliminary screening criteria of effectiveness and/or implementability. The five soil remedial alternatives retained for further evaluation were as follows:

- No-Action;
- Limited Action;
- Vapor Extraction;
- Stabilization/Solidification; and
- Off-Site Disposal at a Permitted Landfill.

Six ground-water remedial alternatives for the site were identified and preliminarily screened. Of these six alternatives, three were eliminated because they would not adequately satisfy the preliminary screening criteria of effectiveness and/or implementability. The three ground-water alternatives retained for further evaluation included:

- No-Action
- Limited Action; and
- Ground-Water Withdrawal and Treatment.

Detailed Evaluation of Remedial Alternatives

Based on the results of the preliminary screening, remedial alternatives for these two media were retained for detailed evaluation to form the following comprehensive remedial alternatives for the Robintech site:

- Alternative 1: No-Action;

- Alternative 2: Ground-Water Withdrawal and Treatment;

- Alternative 3: Soil Vapor Extraction, and Ground-Water Withdrawal and Treatment; and

- Alternative 4: Off-Site Disposal of Soil at a Permitted Facility, and Ground-Water Withdrawal and Treatment.

These remedial alternatives retained after the preliminary screening process were described in detail to provide the information necessary for implementing the alternative, and then evaluated against the following seven NCP evaluation criteria:

- Short-Term Effectiveness;
- Long-Term Effectiveness;
- Reduction of Toxicity, Mobility, or Volume;
- Implementability;
- Compliance with ARARs;
- Overall Protection of Human Health and the Environment; and
- Cost.

All of the alternatives (except No-Action) would meed the RAOs for the Robintech site, except for complete restoration of the bedrock due to current technical limitations for remediation of the possible dense non-aqueous phase liquids (DNAPLs) in the fractured bedrock. However, all the alternatives (except No-Action) involve pumping of the overburden which would be expected to reduce downward plume migration into the bedrock. Additionally, there are no known receptors of the bedrock ground water. Therefore, even if complete restoration of the bedrock is not achieved, Alternatives 2, 3, and 4 would be protective of human health.

In accordance with NCP and NYSDEC guidance, the estimated duration used in this FFS is limited to 30 years. This implementation period would not be expected to decrease appreciably below the estimated 30 years, even if the source area soils were treated using a Soil Vapor Extraction (SVE) system (Alternative 3) or if they were excavated (Alternative 4), because the entire saturated overburden beneath the site would continue to act as a source. Thus, implementation of the alternatives which provide for reduction in volatile organic compound (VOC) mass within the unsaturated zone of the overburden would not be expected to reduce the duration of the ground-water component of these alternatives to less than 30 years. This timeframe may be reduced should future development of remedial techniques provide a method of effectively addressing both soil and ground water impacted by DNAPL and residual chemicals within the saturated zone. Thus, it is recommended that a review of available ground-water remedial techniques be conducted every five years to determine if a remedial technique may be implemented at the Robintech site to cost-effectively reduce the overall duration for the selected remedial alternative.

All of the remedial alternatives (except No-Action) would be designed and implemented to meet ARARs. However, complete restoration of the bedrock was determined to be technically impracticable using currently available remedial techniques due to the potential presence of DNAPLs, in conjunction with the complex nature of fractured bedrock beneath the site. Thus, it is also recommended that a review of available remediation techniques be conducted every five years to determine if a remedial technique could be implemented at the Robintech site to achieve ARARs.

Recommendation

Based on the comparative analysis, Alternative 2: Ground-Water Withdrawal and Treatment is the most cost-effective alternative capable of satisfying the seven evaluation criteria and meeting the RAOs for the site. Therefore, Alternative 2 is the recommended remedial alternative for treatment of the chemicals of concern at the Robintech site.

1.0 - Introduction

This FFS has been prepared, at the request of the Hadco Corporation (Hadco), to evaluate potential remedial alternatives to address the chemicals of concern identified in soil and ground water at the Robintech/Compudyne, Inc. (Robintech) site located at 1200 Taylor Road in Owego, New York. This FFS was performed in accordance with the Consent Order (Case No. A701518809) entered into between Hadco and the New York State Department of Environmental Conservation (NYSDEC) effective February 8, 1989. The elements of the FS were detailed in the Remedial Investigation/Feasibility Study (RI/FS) Work Plan prepared by Groundwater Technology, Inc., dated April 5, 1990, and modified by the RI/FS Work Plan Addendum dated July 26, 1991, prepared by Blasland & Bouck Engineers, P.C. (Blasland & Bouck). Blasland & Bouck also implemented supplemental RI activities to address data gaps based on the results of the initial RI activities. The RI Report and Supplemental RI Report were submitted to the NYSDEC in December 1992 and November 1993, respectively.

This FFS is based on the information provided in the aforementioned reports and is prepared in accordance with the following:

- The United States Environmental Protection Agency's (USEPA's) document entitled, "Guidelines for Conducting Remedial Investigations and Feasibility Studies Under the Comprehensive Environmental Response Compensation and Liability Act (CERCLA)";
- Applicable provisions of the National Oil and Hazardous Substances Pollution Contingency Plan (NCP) regulations contained in 40 CFR Part 300; and
- The NYSDEC's "Technical and Administrative Guidance Memorandum for the Selection of Remedial Actions at Inactive Hazardous Waste Sites."

1.1 Purpose and Organization of Report

The purpose of this FFS is to identify and evaluate remedial alternatives that are applicable to specific site conditions, protective of human health and the environment, and consistent with CERCLA regulations. The overall focus of the FFS is to recommend an appropriate remedial alternative that satisfies remediation objectives cost-effectively.

This FFS Report has been organized into six sections: Section 1.0 - Introduction, provides background information for the site and summarizes the results of the RI; Section 2.0 - Development of Applicable or

Relevant and Appropriate Requirements (ARARs), identifies the ARARs that will govern the development and selection of remedial alternatives; Section 3.0 - Remedial Action Objectives, summarizes the risk assessment (RA) and identifies remedial action objectives (RAOs) for the Robintech site; Section 4.0 - Identification and Preliminary Screening of Remedial Alternatives, presents the identification and preliminary screening of alternatives that have the potential to meet the RAOs; Section 5.0 - Detailed Evaluation of Remedial Alternatives, presents a detailed description and screening of the alternatives retained by the preliminary screening process; and Section 6.0 - Comparative Analysis of Remedial Alternatives, presents the recommended remedial alternative for the Robintech site.

1.2 Site Background

This section provides background information on the Robintech site, including a description of the site, its history, and the findings of previous investigations.

1.2.1 Site Description

Portions of the Hadco facility, located at 1200 Taylor Road in the Town of Owego, New York (Figure 1), are listed as a Class 2 Inactive Hazardous Waste Storage Site by the NYSDEC (Site No. 754007) as the Robintech/Compudyne, Inc. site. The facility, as a whole, occupies a property of approximately 17.3 acres, which is bordered to the south by a municipal sewage treatment plant. The land to the west of the site is undeveloped, while the land to the north and east has been developed for industrial use. The facility located immediately east (the Broadway Building) of the Robintech site is leased by IBM. In addition, IBM owns and operates a large facility further to the east of the Robintech property. A complex of buildings, referred to as the Victory Plaza, is located northeast of the Robintech site. Previous investigations performed at the Victory Plaza and at the large IBM facility have shown the presence of dissolved organic constituents in the ground water underlying these sites. In addition, testing at the adjacent Broadway Building facility has identified the presence of trichloroethene (TCE) in the former septic system. Given their location hydraulically upgradient of the Robintech site, these facilities are potential off-site contributors to the dissolved constituents observed underlying the Robintech site. The location of the Robintech site in relation to these surrounding facilities is illustrated on the site vicinity map, presented as Figure 2.

1.2.2 Site History

A discussion of the site history of the Robintech site, included in the RI/FS Work Plan, detailed the past ownership and activities at the site. In summary, the original property was subdivided from the Taylor family farm in 1956 and sold to Mr. George Warneke. Mr. Warneke sold the property within six months to the Owego Development Co., which soon developed this and surrounding properties for industrial use. The property was then leased to Mutual Design, which operated the first manufacturing operation at the facility through 1970. Robintech, Incorporated (Robintech), now known as Compudyne, Inc. (a subsidiary of Compudyne Corporation), owned and operated this facility from 1970 through 1979, and expanded the facility in 1975 and again in 1977. The Robintech facility and the original 3.6-acre parcel of land it occupied were purchased by Hadco in 1979. Discharges of the identified constituents occurred during Robintech's operations.

Hadco increased the size of the site to its current size of 17.3 acres through the purchase of two adjacent parcels of land in 1981 (4.5 acres) and in 1984 (9.2 acres). Since acquiring the site, Hadco has expanded the facility five times, including two expansions in 1983, an addition in 1984, another in 1985, and another in 1990/1991. A sixth expansion of the facility is currently under construction. A separate building was also constructed south of the main facility to house an on-site biological wastewater treatment system.

1.2.3 Previous Investigations

The previous investigations implemented at the site have included: a Preliminary Site Evaluation; a Phase I Hydrogeologic Investigation; a Phase II Hydrogeologic Investigation; a Supplementary Hydrogeologic Investigation; and the performance of an initial RI task associated with the establishment of a site-specific Project Compound List (PCL).

The PCL developed for the Robintech site identifies the types of chemical compounds within soil and ground water at the site, and specifies the analytical procedures required to quantify their concentrations (Groundwater Technology, Inc., 1991). The PCL for this site includes analyses for volatile organic compounds (VOCs) by NYSDEC Method ASP 89-1; and priority pollutant metals plus seven site-specific inorganic compounds (i.e., aluminum, cobalt, iron, magnesium, manganese, sodium, and vanadium) by NYSDEC Method ASP CLP-M.

As part of previous investigations, a network of sixteen monitoring wells (MW-1 through MW-15, and MW-17) was installed at the locations indicated on Figure 3. The ground-water analytical results from these investigations have shown dissolved volatile organic constituents in the ground water underlying the Robintech site.

1.3 Remedial Investigation Summary

The scope of the initial RI activities involved installation and testing of 16 additional monitoring wells, including four shallow overburden wells (MW-19, MW-25, MW-31, and MW-33); eight deep overburden wells (MW-18, MW-23, MW-24, MW-26, MW-27, MW-29, MW-30, and MW-32); and four bedrock wells (MW-20, MW-21, MW-22, and MW-28). The initial RI activities also included 18 soil borings to evaluate the nature and extent of contamination within the suspected source areas; collection of nine surface soil samples in the vicinity of selected monitoring wells; surface water and sediment sampling of Barnes Creek; the performance of a vapor extraction pilot test near the former chemical storage area; the installation and pump testing of the recovery well PW-3; and the performance of an RA. The results of the initial RI activities are detailed in the "Remedial Investigation Report, Hadco Corporation, Owego, New York," dated December 1992.

The supplemental RI activities performed at this site involved: drilling eight additional soil borings to complete the characterization of the source area; installation of an additional vapor extraction well; performance of a Phase II vapor extraction pilot test; collection and analysis of sediment samples from the wetland area downgradient of the site; and resampling of selected monitoring wells. The results of these additional investigation activities are detailed in the "Supplemental Remedial Investigation Report," dated November 1993.

This section summarizes the following information obtained during the RI:

- Physical site characteristics;
- Chemicals of Concern in Environmental Media; and
- Interim Remedial Measures (IRMs).

1.3.1 Physical Site Characteristics

This section, which presents a summary of the physical characteristics of the site based on the results of the RI and previous investigations, is subdivided according to topographic setting and surface water drainage, site geology, and site hydrogeology. Each of these aspects of the physical site characterization is summarized below and discussed in detail in Section 3.0 of the RI Report.

Topographic Setting and Surface Water Drainage

The Robintech site is located on the northern side of the Susquehanna River Valley, which is oriented generally east-west in the site vicinity. The site consists of 17.3 acres of primarily open land in a mixed commercial/industrial land use area. Just to the north of the site, the valley walls slope steeply, and the land surface continues to slope to the south across the site. However, the slope is noticeably less steep across the southern portion of the site. The topography in the facility vicinity is shown on Figure 1.

The Robintech site is located in the northern slope drainage area of the Susquehanna River (see Figure 1). The Susquehanna River is within approximately one mile of the site and drains an area of approximately 4,200 square miles in the reach near Owego [United States Geological Survey (USGS) 1992]. The NYSDEC best usage classification for the Susquehanna River within a two-mile radius of the site is Class B (NYSDEC 1992). The best usages of Class B waters are primary and secondary contact recreation and fishing; the water quality is suitable for fish propagation and survival (reference 6NYCRR Part 701). The Susquehanna River supports fishing and provides other recreational opportunities in the Owego area.

Barnes Creek, the closest surface water to the site, is within 100 yards of the eastern site boundary (see Figure 1). This creek is subject to much seasonal variation in stream flow regime, and discharge reflects precipitation events in the reach near the site. The NYSDEC best usage classification for Barnes Creek in the reach adjacent to the site is Class C (NYSDEC 1992). The best usage of Class C waters is fishing, and the water quality is suitable for primary and secondary contact recreation, although other factors may limit their use for these purposes (reference 6NYCRR Part 701).

A more detailed discussion of surface water resources in the vicinity of the site was presented in the Fish and Wildlife Impact Analysis, presented in Section 5.2 of the RI Report.

Site Geology

The geologic conditions in the immediate site vicinity have been characterized based on the observations of materials encountered during the drilling of monitoring wells at this site during RI activities, as well as through the evaluation of the geologic logs generated during the previous investigations.

The materials encountered in the overburden vary considerably across the site. The near-surface materials encountered across the majority of this site consist of glacial outwash deposits composed of sand and gravel, with varying degrees of silt.

Underlying these glacial outwash deposits is a very compact basil till unit composed predominantly of silt, sand, and gravel. This glacial till was encountered above the bedrock at a majority of the drilling locations. Due to the relatively low permeability of the till materials, the upper surface of this till unit could act as a surface upon which DNAPLs may be perched.

The bedrock unit encountered immediately below the overburden deposits beneath this site consists of interbedded layers of siltstone and fine sandstone. The average depth to bedrock ranges from approximately 60 feet below ground surface (bgs) near the facility to over 90 feet bgs near the southern property boundary.

Site Hydrogeology

The ground-water bearing units of concern to this investigation include the saturated overburden materials, as well as the upper zone of the bedrock. The glacial outwash deposits, which predominantly form the water-bearing materials in the overburden beneath this site, range in thickness from approximately 35 feet beneath the facility to over 80 feet under the southern property boundary.

Both ground-water bearing units beneath the Robintech site (i.e., the saturated overburden materials and the upper zone of the bedrock) are classified as GA by the NYSDEC, indicating that the best potential use of these ground waters is as a source of drinking water (reference 6NYCRR Part 701). Ground-water downgradient from the site (principally from the saturated materials in the shallow overburden) is used for domestic purposes.

To evaluate ground-water movement beneath this site, several rounds of water level measurements were recorded as part of the RI. These data indicate that ground water in the overburden generally flows from northeast to southwest beneath the site in both the shallow and deep zones of this formation. However, a greater westerly component of flow appears to exist in the shallow zone as compared to the deep zone. The direction of the ground-water flow within the bedrock also appears to be generally toward the southwest (i.e., toward the Susquehanna River).

At monitoring well cluster locations, the ground-water elevations in the shallow versus in the deep overburden wells, as well as the ground-water elevations in the overburden versus in the bedrock wells, were compared to determine the vertical hydraulic gradients across the site. These measurements indicate minor vertical gradients that vary in direction beneath the site, suggesting that horizontal gradients are the principal hydraulic gradients influencing ground-water flow beneath the Robintech site.

In-situ hydraulic conductivity tests (slug tests) were performed on eight of the monitoring wells (i.e., MW-18, MW-20, MW-21, and MW-23 through MW-27) to further characterize the various water-bearing materials (see Figure 3 for monitoring well locations). The hydraulic conductivity values calculated for the deep overburden materials ranged from 2.3E-04 centimeters per second (cm/sec) to 1.7E-02 cm/sec. The hydraulic conductivity of the bedrock unit monitored by MW-20 was estimated to be 8.3E-04 cm/sec, based on the slug test performed in this well. These results suggest that the glacially deposited outwash deposits predominantly forming the saturated materials in the overburden are moderately to highly conductive. The bedrock also appears to be moderately conductive, based on these slug test results.

To further evaluate the hydraulic characteristics of the overburden unit underlying the site, a pump test was performed on the new 4-inch diameter recovery well (PW-3) installed during the RI (see Figure 3 for the location of PW-3). Based on a review of the pump test data, the transmissivity of the deep overburden materials in which PW-3 is screened was estimated to range from 1200 to 1900 gallons per day per square foot (gal/day/sq. ft). The overall hydraulic conductivity of the overburden was estimated to range between 9.9 E-04 cm/sec and 1.6 E-03 cm/sec. The storativity of the deep overburden materials was estimated to range between 3.8 E-03 and 4.3 E-05. A detailed discussion of the PW-3 capture zone simulation modeling performed as part of the RI is presented in Appendix A.

1.3.2 Project Compound List (PCL) Chemicals in Environmental Media

The following summarizes the PCL chemicals detected in the soil, ground water, and surface water and sediment at the Robintech site. More detailed information regarding the characterization of the environmental media at the Robintech site was presented in Section 4.0 of the RI Report.

Subsurface Soil

The results of the RI indicate that a primary source of PCL chemicals at the Robintech site is present in the soil beneath the former chemical storage area, which is now the clean room. Previously, this area was reportedly a dirt-floored building that was located beyond the original facility. During subsequent facility expansions conducted in 1975 by Robintech, the portion of the facility in which the clean room is currently located was constructed over the former chemical storage area.

A total of 24 soil borings were installed in or near the former chemical storage area to characterize the physical and chemical nature of the subsurface soil. The boring locations are presented on Figure 4. These soil borings were generally installed to the top of the water table and were continuously sampled for the entire boring depth. The total depth of the soil borings in this area ranged from 6 feet to 9 feet bgs.

The subsurface soils in the former chemical storage area are composed of sand and gravel, with varying degrees of silt. The results of the grain-size distribution analyses performed on the subsurface soil samples collected as part of the RI, are summarized in Table 1-1. Additionally, the near subsurface soil in this area (from ground surface to a depth of approximately 5 to 10 feet bgs) is native fill material, most likely from construction activities associated with the 1975 facility expansion.

To facilitate characterization of the extent of the PCL chemicals in the subsurface soil beneath the former chemical storage area, organic vapor measurements were obtained (using an OVA or PID) as soil samples were recovered from the borings. The results of the organic vapor measurements were presented in the soil boring logs contained in Appendix A of the RI Report. In general, higher concentrations of organic vapors [up to 5,527 parts per million (ppm)] were detected below the 4-foot depth interval. Above this depth interval, organic vapor concentrations were generally less than 100 ppm. Based on the organic vapor measurements, one soil sample was selected for laboratory analysis from each of the borings. The concentrations of organic and inorganic constituents detected in the subsurface soil samples collected to evaluate the former chemical storage area are presented in Tables 1-2 through 1-5.

The subsurface soil analytical results indicate that the source of VOCs is generally centered around soil boring VE-2. Elevated concentrations of several VOCs, primarily TCE (TCE), 1,1,1-trichloroethane (TCA), methylene chloride, 1,1-dichloroethene (1,1-DCE), tetrachloroethene (PCE), toluene, and total xylenes, were detected in the soil samples collected from these borings.

Consistent with the organic vapor measurements collected during the installation of the soil borings, elevated concentrations of organic contaminants were generally detected below the 4-foot depth interval. For example, the soil samples collected from the 2- to 4-foot depth interval and from the 4- to 6-foot depth interval from VE-2 contained 0.013 ppm and 5,300 ppm TCE, respectively. It is likely that the relatively unimpacted near subsurface soils (from ground surface to approximately 4 feet below ground surface) are attributable to construction activities (e.g., compaction, grading, excavation, etc.) associated with facility expansion activities.

The concentrations of most inorganic constituents detected in the subsurface soil samples from the former chemical storage area were within the common range for central New York State. However, the range of concentrations of both chromium (18.8 ppm to 3,490 ppm) and copper (18.8 ppm to 2,680 ppm) was above the common range of New York State background concentrations (see Section 4.2 of the RI Report).

Ground Water

The analytical results of the ground-water samples collected from the monitoring wells located on and adjacent to the Robintech site (Figure 3) indicate the presence of organic and inorganic constituents at concentrations exceeding NYSDEC Class GA ground-water standards. The concentrations of organic and inorganic constituents detected in the ground-water samples collected as part of the RI are presented in Tables 1-6 through 1-11.

The organic constituents detected in the ground-water samples include a number of a halogenated VOCs, principally TCE, TCA, and DCE, and several aromatic hydrocarbons, including toluene, ethylbenzene, and xylenes. The principal source of VOCs for the ground water beneath the Robintech facility appears to be located near the former chemical storage area. Ground-water samples collected from the shallow overburden monitoring well located immediately downgradient of the former chemical storage area (MW-19) consistently contained the highest concentrations of TCE (up to 630 ppm). The concentrations of TCE detected in the ground-water samples collected from MW-19 were nearly 50% of the solubility of TCE in water, suggesting the possible presence of dense non-aqueous phase liquids (DNAPLs) in the vicinity of the former chemical storage area.

The extent of VOCs detected in the ground water extends horizontally the length of the site and vertically into the bedrock formation underlying the site. However, the high VOC concentrations detected near the former chemical storage area appear to attenuate downgradient of the site (i.e., much lower concentrations of VOCs were detected in the ground-water samples from monitoring wells located downgradient of the site).

Several inorganic constituents (including beryllium, chromium, copper, lead, and zinc) were detected in ground-water samples at concentrations which exceed their respective NYSDEC Class GA ground-water standards and are not indicative of upgradient ground-water conditions. The detection of chromium and copper in the soils from the former chemical storage area (at concentrations above the expected common range for central New York State) may indicate that the soils in this area are a contributing source of these inorganic constituents in ground water. The source(s) of the other inorganic constituents of potential concern in the ground water (i.e., beryllium, lead, and zinc) has not been identified. However, all ground-water samples submitted for inorganic analysis as part of the RI were unfiltered.

In an unfiltered sample, the turbidity in the ground-water sample prevents accurate quantification of the analyte concentration. The analyte sorbs to the suspended particles in the ground-water sample, and will be measured and reported as the detected concentration reported in ground water (i.e., the analyte concentration reported in unfiltered ground-water samples may be more reflective of concentrations for the particulate matter present in the ground water and therefore is not representative of actual ground-water quality). Thus, strict application of ground-water standards to unfiltered samples may not be appropriate.

Surface Water and Sediments

The RI included the collection of surface water and sediment samples from four locations along Barnes Creek for the purpose of evaluating the potential impacts to surface water quality from the Robintech site. Figure 3 presents these sample locations. The RI also included the collection of two sediment samples from the wetlands downgradient of the site to evaluate the potential for the site to have impacted these wetlands. The locations of the two wetlands sediment samples are presented on Figure 5.

The results of the analyses performed on the surface water and sediment samples are presented in Tables 1-12 and 1-17. The results of the analyses performed on the surface water and sediment samples indicate that the Robintech site is not adversely impacting Barnes Creek. The concentrations of inorganics detected in the samples collected adjacent to and downstream of the Robintech site are generally consistent with the concentrations detected in the samples collected upstream. With respect to the organic compounds, TCE was detected below the contract required detection limit (but above the instrument detection limit) in the upstream surface water sample, indicating a source of TCE upstream of the Robintech site, and only trace concentrations (i.e., less than the method detection limit) of several volatile constituents were detected in the sediment samples.

The results of VOC analyses performed on the wetlands sediment samples show no indication of the presence of VOCs in the sediment. The results of the inorganic analyses show concentrations of chromium ranging from 683 to 790 mg/kg, copper ranging from 8.3 to 162 mg/kg, and zinc ranging from 48 to 102 mg/kg. The detected concentrations of both chromium and copper were elevated in comparison to the range of concentrations found in background soil. The source of these inorganics has yet to be identified. Potential sources located in the vicinity of these wetlands include the Town of Owego POTW property, the Broadway Building located to the northeast, as well as the Robintech site located north of the POTW property. Because the source of these inorganics has yet to be identified, the wetlands sediment is not addressed by this FFS.

1.3.3 Interim Remedial Measures (IRMs)

An Interim Remedial Measure (IRM) was implemented at the site (October 1993) to begin remediating VOCs in the ground water downgradient of the source area. The IRM, which consists of ground-water extraction and treatment, as described below, will be operated until a final ground-water remedial alternative is implemented.

The interim ground-water extraction and treatment system consists of the following:

- Extraction of ground water from monitoring well PW-3 at a flow rate between 10 to 12 gallons per minute (gpm). The location of PW-3 and the expected ground-water capture zone are shown on Figure 6;

- On-site treatment of the extracted ground water using a low profile, shallow tray air stripper; and

- Discharge of the treated effluent to the Town of Owego's Publicly Owned Treatment Works (POTW).

The treated effluent must meet the following pretreatment limits established by the POTW:

Parameter	Pretreatment Limit (ppm)
Total VOCs	2.13
Copper	5.0
Lead	0.5
Nickel	2.0
Tin	2.5

In addition, the treated ground water is monitored for pH, suspended solids, and oil and grease, in accordance with Hadco's existing POTW discharge permit.

Because the concentrations of inorganics in the influent will not exceed the pre-treatment standards, inorganics are not treated prior to discharge. The on-site ground-water treatment system was designed to ensure compliance with the Town of Owego's pre-treatment limit for total VOCs of 2.13 ppm.

2.0 - Development of ARARs

2.1 General

This FFS was conducted in accordance with the guidelines, criteria, and considerations set forth in the NYSDEC Technical and Administrative Guidance Memorandum (TAGM) Number 4025 entitled "Guidelines for Remedial Investigations/Feasibility Studies" dated March 31, 1989 (which references the use of USEPA guidance when conducting state work) and the National Contingency Plan (NCP). Consistent with the USEPA's framework is the requirement that remedial actions must comply with ARARs. This section describes the ARARs that have been identified for the Robintech site.

2.1.1 Definition of ARARs

"Applicable requirements" are those cleanup standards, standards of control, and other substantive environmental protection requirements, criteria, or limitations promulgated under federal or state law that specifically address a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance.

"Relevant and appropriate" requirements are those cleanup standards, standards of control, and other substantive environmental protection requirements, criteria, or limitations promulgated under federal or state law that, while not "applicable" to a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstances at a site, address problems or situations sufficiently similar to those encountered at the site that their use is well suited to the particular site or actions at the site.

The USEPA has also identified certain guidance as "to-be-considered" (TBC) material. TBCs are non-promulgated advisories or guidance issued by federal or state government that are not legally binding and thus do not have the status of potential ARARs.

2.1.2 Types of ARARs

The NYSDEC has provided guidance on the overall application of the ARARs concept in the RI/FS process. More specific guidance on compliance with ARARs has also been provided by the NYSDEC. ARARs are to be progressively identified and applied on a site-specific basis as the RI/FS proceeds. The potential ARARs considered for the potential remedial actions identified in this FFS were categorized into the following NYSDEC-recommended classifications:

Chemical-Specific ARARs - These ARARs are usually health- or risk-based numerical values or methodologies which, when applied to site-specific conditions, result in the establishment of numerical values for each chemical of interest. These values establish the acceptable amount or concentration of a chemical that may be found in, or discharged to, the ambient environment;

Action-Specific ARARs - These ARARs are usually technology- or activity-based requirements or limitations on actions taken with respect to hazardous waste management and site cleanup; and

Location-Specific ARARs - These ARARs are restrictions placed on the concentration of hazardous substances or the conduct of activities solely because they occur in specific locations.

2.2 ARARs and TBCs

The identification of federal and state ARARs and TBCs for the evaluation of remedial alternatives at the Robintech site was a progressive, multi-step process, which included the RA. The ARARs and TBCs that have been identified for the Robintech site are presented below.

2.2.1 Chemical-Specific ARARs

Soil

A chemical-specific ARAR that may apply to the site pertains to the Resource Conservation and Recovery Act (RCRA) regulated levels for toxic characteristics leaching procedure (TCLP) constituents, as outlined in 40 CFR 261. The RCRA TCLP constituent levels are a set of numerical criteria at which a solid waste is considered a hazardous waste by the characteristic of toxicity.

In conjunction with the Phase I RI, TCLP testing was performed on three subsurface soil samples collected in the former chemical storage area. The TCLP extract was analyzed for the VOCs delineated in 40 CFR 261.24, Table 1. Table 2-1 (of this report) presents the VOC TCLP extract concentrations at or above which a solid waste is considered a hazardous waste because of toxicity. Of these three samples, concentrations above the regulatory levels were detected in the TCLP extract from samples CRB-14 (collected from the 6- to 8-foot-depth interval) and VE-2 (collected from the 4- to 6-foot depth interval). Concentrations of TCE were detected at 2,500 ppb and 43,000 ppb in samples CRB-14 and VE-2, respectively (the regulatory level for TCE is 500 ppb). Additionally, the concentration of PCE detected in the TCLP extract from sample VE-2 (880 ppb) was slightly above the regulatory level (700 ppb). The TCLP results for the three subsurface soil samples are presented in Table 2-2. The TCLP testing results indicate that some of the soil beneath the former chemical storage area will exhibit the hazardous characteristic of toxicity for several VOCs and will therefore be a hazardous waste subject to RCRA regulations.

Ground Water

Ground water beneath and in the vicinity of the Robintech site (both the ground water within the overburden and within the bedrock) is classified as Class GA (indicating the best possible usage is as a potable water supply), and as such, NYSDEC Class GA ground-water quality standards are applicable requirements. Table 2-3 presents the Class GA ground-water quality standards for the PCL chemicals detected in the ground-water samples collected as part of the RI.

An additional chemical-specific ARAR that may apply to the ground water is the RCRA-regulated concentrations for TCLP contaminants. As discussed in the chemical-specific ARAR section for soils, the RCRA TCLP concentrations are the concentrations at which a solid waste exhibits the characteristic of toxicity and is considered to be a hazardous waste (reference 40 CFR Part 261.24). Where the waste contains less than 0.5 percent filterable solids (e.g., ground water), the waste itself, after filtering, is considered to be the TCLP extract. Thus, if the ground water contains any of the constituents listed in Table 1 of 40 CFR Part 261.24 at concentrations greater than or equal to the respective value provided in that table, the ground water itself would be a hazardous waste (Table 2-1 of this report presents the VOC TCLP extract concentrations at or above which a solid waste is considered a hazardous waste because of toxicity).

Surface Water and Sediments

Barnes Creek, the closest surface water to the site, is classified as Class C. Therefore, NYSDEC Class C surface water quality standards are applicable requirements (these standards are delineated in 6NYCRR Part 703). Maximum detected concentrations of site-related chemicals in surface water samples collected from Barnes Creek do not exceed any available NYSDEC Class C surface water quality standards.

No chemical-specific ARARs were identified for sediments.

2.2.2 Location-Specific ARARs

Examples of location-specific ARARs include floodplain and wetland regulations, and regulations promulgated under the Endangered Species Act, National Historic Preservation Act (NHPA), and other federal acts. Location-specific ARARs would also include local building permit conditions for facilities constructed on site.

Based on a review of the "Federal Emergency Management Agency Flood Insurance Rate Map," Panel 15 of 30 of Community-Panel Number 3608390015, revised April 23, 1982, the site is not located within a 100-year floodplain. In addition, the NYSDEC freshwater wetlands map, Tioga County (map 17 of 18, Appalachian Quadrangle), indicates that the site is not located in a wetland. The "Identification of Significant Natural Resources" section of the Fish and Wildlife Impact Analysis (FWIA) did not identify any endangered species at the site. As a result, state and federal floodplain regulations and regulations promulgated pursuant to the Endangered Species Act are not considered ARARs for the site.

Based on a review of the NYSDEC's "New York State Archeological Site Locations" map (revised March 1992), the Robintech site may lie in an archaeologically or historically significant area. Thus, the NHPA is a potential location-specific ARAR for the Robintech site.

2.2.3 Action-Specific ARARs

The action-specific ARARs for this site are summarized on Table 2-4. The action-specific ARARs have been divided into the following two categories:

- Action-specific ARARs potentially common to all remedial alternatives; and
- Action-specific ARARs specific to remedial alternatives.

The first category includes general health and safety requirements, and general requirements regarding RCRA hazardous waste facilities (including transportation and disposal facilities). The second category includes the ARARs that apply to individual remedial alternatives for the site soils and ground water.

2.2.4 Other Federal and State Criteria, Advisories, and Guidance

The NYSDEC Technical and Administrative Guidance Memorandum (TAGM) Number 4046 - "Determination of Soil Cleanup Objectives and Cleanup Levels" is a NYSDEC Guidance document that presents NYSDEC's recommended soil cleanup levels for organic and inorganic compounds. The NYSDEC soil cleanup objectives for organic compounds are based on protection of ground water, calculated using a soil-water partitioning model. The NYSDEC soil cleanup objectives for inorganics are based on site background and naturally occurring inorganic concentrations. TAGM No. 4046 is a TBC for the soils at the Robintech site.

The NYSDEC's "Cleanup Criteria for Aquatic Sediments" (December 1989) is a guidance document that presents sediment criteria to be used as cleanup goals, not standards. Therefore, these criteria are TBCs for the sediment at the Robintech site. Maximum detected concentrations of site-related chemicals in the sediment samples collected from Barnes Creek do not exceed any of the NYSDEC's cleanup criteria for aquatic sediments. Because the source of the inorganics detected in the wetlands sediment samples has yet to be identified, the wetlands sediment is not addressed by this FFS.

3.0 - Remedial Action Objectives

This section briefly summarizes the Human Health Risk Assessment, develops the RAOs to be used to screen the alternatives, and develops the general response actions for each medium of concern that will satisfy the RAOs for the Robintech site.

3.1 Human Health Risk Assessment Summary

The potential risks to human health (carcinogenic and non-carcinogenic) under baseline conditions at the Robintech site were qualitatively evaluated in the RA prepared in conjunction with the RI/FS. (The human health RA is presented in Section 5.1 of the RI Report.) As part of the RA, ground water, soil, and surface water/sediment data were evaluated to identify chemicals of interest. Through this evaluation, chemical concentrations from select ground-water and subsurface soil samples were chosen to develop reasonable maximum exposure (RME) concentrations for use in quantitative risk calculations.

Exposure concentrations were then used to estimate risk for each exposure pathway. The significant exposure pathways identified for the Robintech site are presented in Table 3-1.

To facilitate the evaluation (quantification) of potential risk to human health, the USEPA has developed the following approaches for carcinogenic and non-carcinogenic risks:

- Carcinogenic Risk is expressed as a probability of developing cancer as a result of lifetime exposure. The USEPA's acceptable target range for carcinogenic risks associated with Superfund sites is one in ten thousand (10^{-4}) to one in one million (10^{-6}) (USEPA, 1991). Total site risk in excess of 10^{-4} typically serves as a trigger for remediation (OSWER Directive 9355.0-30, April 22, 1992).

- Non-Carcinogenic Risk is assessed using a Hazard Index (HI) approach. In this assessment, exposures are evaluated using chronic reference doses, and simultaneous sub-threshold chronic exposures to multiple chemicals are assumed to be additive. Calculation of a HI in excess of unity indicates the potential for adverse human health effects; if the HI is less than one, no adverse effects would be expected.

A summary of the carcinogenic risks and hazard indices calculated for each significant chemical and pathway of exposure for the Robintech site is presented in Table 3-2.

For hypothetical ingestion of ground water by residents (using exposure concentrations based on the concentrations of chemicals detected in downgradient monitoring wells), the estimated carcinogenic risk is 3.7E-04, and the risk is due primarily to the presence of 1,1-DCE (RME concentration of 0.04 ppm). The original RA also identified a 3E-04 risk associated with beryllium. However, since completion of the human health RA for the Robintech site, the USEPA has determined that there is no specific basis for classifying beryllium as an oral carcinogen. Therefore, the estimated cancer risks due to the presence of beryllium for the hypothetical exposure scenario of ground-water ingestion by residents should be ignored. The hazard index for hypothetical ingestion of ground water by off-site residents is 7, primarily due to the presence of arsenic and manganese, with significant contributions also from TCE; 1,1-DCE; cadmium; copper; and nickel.

Carcinogenic risks for hypothetical on-site excavation workers under future use conditions are all below the USEPA's target range for acceptable risks at Superfund sites. The hazard index for inhalation exposure of this receptor group is greater than one, due solely to the presence of chromium.

3.2 Remedial Action Objectives

Remedial action objectives (RAOs) are medium-specific goals for protecting human health and the environment. These objectives are established under the broad guidelines of meeting the findings of the RA and/or ARARs.

The RA performed as part of the Robintech site RI indicates that the primary environmental media that may affect human health are the subsurface soils in the vicinity of the former chemical storage area and the ground water beneath the site. In addition, chemical concentrations in excess of their respective NYSDEC Class GA ground-water standards were detected in ground-water samples collected from monitoring wells on and in the vicinity of the site. No chemical-specific ARARs were identified for soils. With respect to the concentrations of constituents in the surface water and sediment samples collected from Barnes Creek, there were no exceedences of ARARs, and no adverse effects to human health or the environment were identified. Thus, surface water and sediment in the reach of Barnes Creek adjacent to the Robintech site were not media of concern for this FFS.

To achieve protection of human health and the environment, the RAOs for soil beneath the former chemical storage area and ground water presented in Table 3-3 have been established for the Robintech site. These objectives will be used as a basis for developing and screening remedial alternatives.

3.3 General Response Actions

General response actions are actions that may be taken to satisfy the RAOs established for the Robintech site. Like remedial actions, general response actions are medium-specific. This section develops general response actions for soil and ground water and initially determine areas/volumes of media to which general response actions may be applied. (This initial determination may be refined after site alternatives have been developed for the site).

The following table presents a summary of general response actions identified for soil and ground water. The "no-action" response was included as a general response action for both soil and ground water to serve as a basis for comparison with other potential response actions. Additionally, the development of the no-action alternative is required under the NCP.

Media of Concern	General Response Action
Soil	No-action, institutional actions, excavation, off-site disposal, on-site treatment, and in-situ treatment.
Ground Water	No-action, institutional actions, containment, in-situ treatment, ground-water withdrawal, on-site treatment, and off-site treatment.

Based on the results of the RI, the primary source of the chemicals of concern at the Robintech site is located beneath the former chemical storage area. The actual dimensions of this area are unknown; however, based on historical site information and RI analytical data, the approximate areal extent of source area soils is represented by the estimated former chemical storage area dimensions shown on Figure 4. The concentrations of dissolved VOCs observed in the deep overburden monitoring well MW-23, located in the immediate vicinity of the source area, suggest the presence of residual DNAPL within the saturated overburden materials underlying the source area. However, it is not practical nor is it appropriate to address over 50 feet of saturated soil by applying the general response actions developed for soil. Rather, the soil within the saturated zone beneath the Robintech site is more appropriately addressed through application of general response actions for ground water. Thus, the vertical extent of source area soil is assumed to extend to the ground-water table interface, approximately 10 feet below ground surface (accounting for seasonal variations). The total estimated in-place volume of source area soils is approximately 1,000 cubic yards.

4.1 General

This section of the FFS presents the methodology used to identify potential remedial alternatives for each general response action developed to address the source area soils (within the unsaturated or vadose zone of the overburden) and the presence of constituents in excess of NYSDEC Class GA ground-water standards in the ground water. Each identified remedial alternative is described technically and evaluated against the preliminary screening criteria. This approach is used to determine whether a particular alternative is applicable for remediation of either the soil or ground water at the site. Based on the preliminary screening, potential alternatives will be eliminated or retained for further evaluation in the detailed analysis of the remedial alternatives.

4.2 Identification of Soil and Ground-Water Remedial Alternatives

The identification of remedial alternatives involved a review of available literature, including the following NYSDEC and USEPA documents:

- "NYSDEC Technical and Administrative Guidance Memorandum (TAGM) for the Selection of Remedial Actions at Inactive Hazardous Waste Sites";
- "Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA";
- "Technology Screening Guide for Treatment of CERCLA Soils and Sludges";
- "EPA Superfund Innovative Technology Evaluation (SITE) Program Literature";
- "Technology Briefs - Data Requirements for Selecting Remedial Action Technology"; and
- "Handbook for Evaluating Remedial Action Technology Plans."

These documents, along with remedial technology vendor information, were reviewed to identify alternatives that are potentially applicable for remediating soil and ground water at the site. Consistent with the NCP (40 CFR 300.430), the following range of alternatives was developed:

- The no-action alternative;

- Alternatives that remove or destroy the chemicals of concern to the maximum extent possible, thereby eliminating or minimizing the need for long-term management;

- Alternatives that treat the chemicals of concern but vary in the degree of treatment employed and long-term management needed; and

- Alternatives that involve little or no treatment but provide protection of human health and the environment by preventing or minimizing exposure to chemicals of concern through the use of containment options and/or institutional controls.

Based on a review of available literature and the characteristics of the site, the following list of potential remedial alternatives for soil and ground water has been developed:

SOIL REMEDIAL ALTERNATIVES

- No-Action Alternative

- Limited Action Alternative

- On-Site Treatment Alternatives

    - In-Situ Vitrification
    - In-Situ Bioremediation
    - Soil Washing
    - Vapor Extraction
    - Stabilization/Solidification

- Off-Site Alternatives

    - Off-Site Disposal at a RCRA-Permitted Landfill

GROUND-WATER REMEDIAL ALTERNATIVES

- No-Action Alternative
- Limited Action Alternative
- Containment Alternative
  - Low-Permeability Cap and Cutoff Wall System
- On-Site Treatment Alternatives
  - In-Situ Bioremediation
  - In-Situ Permeable Treatment Beds
- Off-Site Treatment Alternatives
  - Ground-Water Withdrawal and Treatment. (This alternative would include on-site treatment to meet POTW pre-treatment requirements.)

4.3 Preliminary Screening of Soil Remedial Alternatives

4.3.1 General

This subsection presents the preliminary screening of the potential remedial alternatives for source area soils at the site. Each alternative was screened based on its anticipated effectiveness and implementability. The effectiveness of a remedial alternative refers to the degree to which the alternative may reduce the toxicity, mobility, or volume of the chemical constituents and provide adequate protection of human health and the environment (i.e., meet the RAOs defined in Section 3.2). The implementability of the remedial alternative refers to the probability that the remedial alternative will be constructed and reliably operated.

A brief description of each potential soil remedial alternative, the anticipated effectiveness and implementability of each alternative, and the reasons for either excluding the alternative or retaining it for further evaluation are presented below.

4.3.2 No-Action

Technical Description

The no-action alternative would not utilize any remedial techniques for the treatment of the source area soils, but may include some type of environmental monitoring to document site conditions. The site would be allowed to remain in its current condition.

Effectiveness

The no-action alternative would not reduce the toxicity, mobility, or volume of the chemical constituents present in the soils at the site, and would not meet the RAOs for soils.

Implementability

The no-action alternative could be implemented at the site.

Screening Conclusion

The NCP requires that the no-action alternative be considered during the FS process. Therefore, the no-action alternative will be retained for further evaluation during the detailed analysis of alternatives. In addition, the no-action alternative will serve as a baseline for comparing the effectiveness of other soil remedial alternatives.

4.3.3 Limited Action

Technical Description

Under the limited action alternative, institutional actions such as deed restrictions (to limit the future uses of the site) would be implemented to minimize potential human exposure to source area soils. In addition, a periodic ground-water monitoring program would be implemented to document site conditions. No other remedial activities associated with the soils would be implemented under the limited action alternative.

Effectiveness

The limited action alternative would not reduce the mobility, toxicity, or volume of the chemical constituents in the source area soils at the site. However, this alternative would limit potential future human contact with the source area soils, thus limiting the future risks posed by this site.

Implementability

The limited action alternative includes the use of institutional actions and could be implemented at the site.

Screening Conclusion

This alternative would not reduce the toxicity, mobility, or volume of the chemicals of concern present in the source area soils; however, the use of institutional actions (e.g., deed restrictions) may be beneficial if implemented in conjunction with another remedial alternative. Therefore, this alternative will be retained for further evaluation during the detailed analysis of alternatives.

4.3.4 On-Site Treatment Alternatives

4.3.4.1 In-Situ Vitrification

Technical Description

This alternative consists of vitrification of soils in place using an induced electrical current (producing temperatures from 1600° to 2000°C) to melt the soils and bind them into a glass-like solid matrix. The vitrified end-product is resistant to leaching. During the in-situ vitrification process, electrodes are inserted into the soil at spacings determined by pilot studies. An electrical current is passed between the electrodes, and the heat generated by the current causes the surrounding soils to melt and bind into a solid mass. During the heating process, organic constituents present in the soils are destroyed by the heat or are driven off and collected by a shroud placed over the soils. The collected organic constituents are treated or destroyed, and the inorganic constituents present in the soils become contained within the solid mass of treated soils. The treated soils are then covered with topsoil or other materials.

Effectiveness

A treatability test would be required to determine the effectiveness of in-situ vitrification for treatment of soils at the Robintech site. This treatability study would determine if the technology is applicable to the specific soil characteristics and chemical properties at the site.

Implementability

This alternative has been successfully implemented in bench-scale testing and has been implemented with limited success in pilot-scale testing. However, the process has not been successfully implemented on a full-scale commercial basis. Additionally, the following site-specific characteristics must be carefully considered in determining the implementability of in-situ vitrification:

- Buildings in the vicinity of the former chemical storage area would have to be removed, because the soil beneath the structures would be undermined during the processing, as a result of expected soil subsidence due to loss of soil void volume (approximately 20 to 40 percent); and

- Dewatering of the process area may also be required. In-situ vitrification can be used to treat fully-saturated soil; however, the water in the soil must be evaporated before the soil can begin to melt, resulting in significantly increased costs.

Screening Conclusion

This alternative has not been implemented on a full-scale commercial basis. In addition, the buildings in the vicinity of the former chemical storage would have to be removed. Therefore, this alternative will not be retained for further evaluation.

4.3.4.2 Biological Treatment

Technical Description

Biological treatment of soils is accomplished by the stimulation of indigenous or cultured microorganisms, which transform the chemical constituents into innocuous byproducts. A variety of biological treatment techniques are available for the treatment of soils. These techniques can be generally categorized as treatment in a solid-phase, treatment in liquid/solids phase, or in-situ treatment. Each technique is described below.

Solid-Phase Bioremediation

Solid-phase bioremediation involves treating soils in an abovegrade system, using conventional soil management practices to enhance the microbial degradation of organic constituents. Site soils are excavated and placed on a treatment bed consisting of a high-density liner, leachate collection piping, and a sand layer. Nutrients and water are then applied to the soils. The collected leachate is treated and then reapplied to the soil. Once the cleanup levels are met, the treated soils may be placed back into the excavated areas.

Liquid/Solid-Phase Bioremediation

This technique involves treating excavated soils in a treatment vessel or tank. The excavated soils are screened to remove particles larger than ¼ inch in diameter and then mixed with nutrientamended water to produce a slurry of 10 to 30 percent solids. To increase dissolved oxygen levels, the slurry is continuously aerated. The slurry is continuously mixed to keep the solids in suspension and to ensure that microorganisms make contact with the chemical constituents. Once biodegradation is complete, the treated slurry is settled, and residual water is recycled back into the bioreactor or is treated and disposed of off-site. The treated, settled solids are then placed back into the excavated areas.

In-Situ Bioremediation

In-situ bioremediation involves the treatment of soils without excavation. This is accomplished by injecting nutrients and oxygen into the soils through a series of injection points. The addition of nutrients enhances the activity of the naturally occurring microorganisms, subsequently increasing the natural biodegradation process. Leachate generated from the injection of amended water is recovered through a series of extraction wells and recycled back into soils or treated and disposed. This method requires the following:

- The site hydrogeologic characteristics permit the movement of nutrients and oxygen-amended water;
- The indigenous microflora are capable of metabolizing the constituents present; and
- The chemical constituents are available to the microbial community.

Effectiveness

Bioremediation has, with few exceptions, been applied to chlorinated aliphatic compounds only on a pilot or developmental scale. Treatability testing would be required to determine the remedial effectiveness of this technology for the organic constituents in the source area soils at the Robintech site. However, this treatment technology is ineffective for inorganic constituents.

Implementability

These bioremediation alternatives have demonstrated to have limited success at remediating chlorinated organic constituents in soils under anaerobic (low oxygen) conditions in pilot-scale studies. However, bioremediation of chlorinated organics has not been implemented on a full-scale commercial basis.

Screening Conclusion

Bioremediation has not been well demonstrated for remediation of chlorinated aliphatic compounds, the principal classification of chemicals of concern detected at the Robintech site. Additionally, bioremediation is an ineffective treatment technique for the inorganic constituents of concern in the source area soils. Therefore, biological treatment will not be retained for further evaluation.

4.3.4.3 Soil Washing

Technical Description

Soil washing involves the use of a liquid medium to wash chemicals of concern from the soils. The soil washing technology is based on the principle that chemicals of concern adhere mostly to fines present in the soil matrix (i.e., fine sands, silts, and clays).

Excavated soils are screened to remove particles larger than ¼ inch in diameter. The particles larger than ¼ inch in diameter are manually washed with water and surfactants. Water and surfactants (determined by a treatability or pilot study) are added to the screened soils to form a slurry. The slurry is screened with a mesh, and further treatment of the particles that do not pass the mesh usually is not required. The screened slurry is then placed into a froth flotation unit where hydrophobic compounds (compounds not soluble in water) are drawn off the liquid surface and disposed of off site at a permitted RCRA disposal facility. The remaining soil mass settles to the bottom of the unit and is drawn off and placed into a counter-current soil scrubbing unit. The soil scrubbing unit produces a washed soil mass (free from fines) and a process water containing soil fines, onto which the remaining chemicals of concern are attached. The process water containing the fines is placed into a flocculation unit where the fines containing chemicals of concern settle out. The process water is then recycled back into the system, and these fines are either treated by another method or disposed of off site at a permitted facility.

Effectiveness

This alternative may reduce the mobility and volume of the chemical constituents present in the source area soils by removing highly impacted fines (i.e., fine sands, clays, and silts). The removed fines would contain higher concentrations of chemicals of concern than the original feed soil and would therefore require further treatment and/or disposal at a RCRA-permitted TSDF.

The fines fraction for the soils in the source area at the Robintech site, which can not be effectively treated using soil washing, represents approximately 40 to 55 percent of the total soil volume (based on the sieve analysis results presented in Table 1-1). Thus, waste volumes similar to the original volume of soil being treated would be produced.

Implementability

This alternative is technically feasible and could be implemented on the source area soils. Excavation of the source area soils would be required.

Screening Conclusion

This alternative may reduce the mobility and volume of chemicals of concern present in the source area soils. However, soil washing has limited effectiveness on fine-grained sands, silts, and clays. The source area soils at the Robintech site contain approximately 50 percent fine-grain materials, thereby limiting the effectiveness of soil washing. Treatment of the source area soils using this technology would result in significant waste volumes relative to the original volume of soil treated, and excavation of source area soils would be required. This alternative will not be retained for further evaluation.

4.3.4.4 Low-Temperature Thermal Desorption (LTTD)

Technical Description

Low-temperature thermal desorption (LTTD) is a process by which soils containing VOCs with boiling point temperatures less than 800°F are heated, and the VOCs are desorbed from the soils and volatilized into an induced air flow. The soils are excavated and screened to remove objects larger than 2 inches in diameter. Materials larger than 2 inches are crushed and added to the screened materials or treated by another method. The soils are then fed through a pug mill, or rotary drum system, equipped with heat transfer surfaces. The soils are heated to temperatures ranging from 200°F to 800°F. Air or nitrogen gas is passed over the soils to collect the volatilized organic constituents. The carrier gas is then treated by either condensation and carbon filtration or by thermal destruction in a combustion afterburner. The treated soils are then backfilled on-site or disposed of at an off-site landfill.

Effectiveness

This alternative would reduce the toxicity and volume of VOCs present in the source area soils; however, LTTD is an ineffective treatment technique for the inorganic constituents.

Implementability

This alternative is technically feasible and has been commercially demonstrated for remediation of VOCs in soils. However, this technology is generally not considered implementable for remediating soil volumes less than 1,000 cubic yards due to the fixed costs of equipment mobilization.

Screening Conclusion

This alternative would reduce the toxicity and volume of the organic constituents present in the source area soils, but would not treat the inorganic constituents. Additionally, this alternative is not considered implementable for on-site remediation of soil volumes less than 1,000 cubic yards. This remediation alternative will not be considered for further evaluation.

4.3.4.5 Vapor Extraction

Technical Description

This alternative involves the use of an induced vacuum to strip VOCs from unexcavated soils. The process components consist of vacuum pumps, vacuum intake vapor extraction wells, and an organic vapor treatment system.

Vapor extraction wells are installed into the soil areas at spacings determined by mathematical models or by pilot study testing. A series of piping connects the vapor extraction wells to the vacuum pumps. In operation, a vacuum is applied to the vapor extraction wells, causing a pressure gradient in the surrounding soils. Because of the vacuum-induced pressure gradient, VOCs are "stripped" from the soils and diffused through soil pores to the production wells. The process continuously draws volatile organic gases from the soils and draws fresh air from the surface down into the soils. Fresh air inlet wells are often installed to aid in the diffusion of fresh air into the soils. Steam or air may be forced into these wells to expedite the process. The volatile organic gases from the production wells are treated by an activated carbon filter or destroyed by an afterburner.

Effectiveness

Vapor extraction is effective at removing VOCs from unsaturated soils that possess adequate pore space for air movement. This technology is not effective at removing inorganic constituents.

Implementability

This alternative is available on a commercial basis. Vapor extraction can be implemented to remediate source area soils at the site.

Screening Conclusion

This alternative is effective for remediating the VOCs in the source area soils and it can be implemented at the site; therefore, this alternative will be retained for further evaluation.

4.3.4.6 Stabilization/Solidification

Technical Description

Stabilization, which includes solidification and chemical fixation, is a process by which stabilization agents are mixed with soils/sludges to alter the physical and/or chemical state of the constituents in the soil. The end product is a solidified mass that is less toxic and not as leachable as the original soil. Stabilization agents used in this process include cement-based, pozzolanic-based, asphalt-based, and/or organic-polymer-based agents. The stabilization agent to be used would be determined by a treatability study. The stabilization process causes a chemical or physical reduction of the mobility of the inorganic constituents (metals) and organic constituents present in the soil.

Stabilization can be accomplished by in-situ or ex-situ techniques. For ex-situ stabilization, soils would be excavated and fed through a pug-mill type treatment system where stabilization agents would be mixed with the soils. Treated materials would be placed in a secure area to cure (solidify). The stabilized materials would then be placed back into the excavated area or disposed of in a permitted landfill, depending upon the results of analytical testing and regulatory requirements. In-situ stabilization is accomplished by using of mixing blades and augers to blend the soils with stabilization agents in place. Stabilization agents are usually added into the soils through the auger shafts.

Effectiveness

In-situ and ex-situ stabilization/solidification alternatives have proven effective in reducing the mobility and toxicity of inorganic constituents and select organic constituents in soils. However, the long-term effectiveness of this technology is not known, especially if portions of the solidified mass are in the saturated zone, as would be the case for in-situ treatment at the Robintech site. Treatability testing would be required.

Implementability

This alternative is technically feasible and could be implemented at the site. Additionally, several off-site TSDFs offer stabilization/solidification services.

Screening Conclusion

Complete and uniform mixing of the stabilization/solidification agent with in-place soils is often difficult, and the long-term reliability of this technology, especially when portions of the stabilized mass are in the saturated zone, is unknown. Therefore, in-situ stabilization/solidification will not be retained for further evaluation. However, because this alternative may be effective in reducing the toxicity and mobility of the chemical constituents present in the source area soils, ex-situ stabilization/solidification will be retained for further analysis.

4.3.5 Off-Site Alternatives

4.3.5.1 Off-Site Disposal at a Permitted Landfill

Technical Description

This alternative involves excavating soil, within the unsaturated zone beneath the former chemical storage area, using conventional construction equipment and transporting the soils by truck to a permitted hazardous waste facility capable of accepting the soil. The resulting excavations at the site are then backfilled with clean soils and/or fill material.

Effectiveness

This alternative relies on well-established technologies for removal and disposal of contaminated source area soils, and the RAOs for the soil would be met. This alternative would be effective in reducing the toxicity, volume, and mobility of the chemical constituents at the site because it would remove the impacted soils from the site. However, it would not reduce the chemical constituent volume or toxicity in the excavated soils.

Implementability

This alternative has proven effectiveness and could be implemented at the site. However, this alternative would significantly disrupt operations in the clean room area of the facility.

Screening Conclusion

This alternative is effective and could be implemented at the site; therefore, this alternative will be retained for further evaluation.

4.4 Preliminary Screening of Ground-Water Remedial Alternatives

4.4.1 General

This subsection presents the results of the preliminary screening of the potential remedial alternatives for ground water beneath and in the vicinity of the Robintech site. The alternatives identified in Section 4.2 for ground water are preliminarily screened in this section on the basis of effectiveness and implementability (the same criteria used in the preliminary screening of soil remedial alternatives in Section 4.3). The objective of this screening is to select alternatives that will undergo a more thorough, extensive evaluation in Section 5.0 - Detailed Evaluation of Remedial Alternatives.

A brief description of each potential ground-water remedial alternative, the anticipated effectiveness and implementability of each alternative, and the reasons for either excluding the alternative or retaining it for further evaluation are presented below.

4.4.2 No-Action

Technical Description

The no-action alternative would not use any remedial techniques to treat or contain the ground water. The site would be allowed to remain in its current condition. Monitoring of select ground-water wells could be implemented to document site conditions.

Effectiveness

The no-action alternative would not reduce the toxicity, mobility, or volume of the chemical constituents present in the ground water. Additionally, this alternative would not be effective in meeting the RAOs established for the ground water (i.e., prevent exposure to the ground-water plume and attainment of NYSDEC Class GA ground-water standards).

Implementability

The no-action alternative could be implemented at the site.

Screening Conclusion

The NCP requires that the no-action alternative be considered during the FS process. Therefore, the no-action alternative will be retained for further evaluation during the detailed analysis of alternatives. In addition, the no-action alternative will serve as a baseline for comparing the effectiveness of other ground-water remedial alternatives.

4.4.3 Limited Action

Technical Description

Under the limited action alternative, institutional actions, such as deed restrictions (to limit future uses of the ground water beneath the site), would be implemented to minimize potential human exposure to the constituents in the ground water. In addition, the site would be monitored by a periodic ground-water monitoring program to determine if site conditions change and present additional potential concerns. No other remedial activities associated with the ground water would be implemented under the limited action alternative.

Effectiveness

The limited action alternative would not reduce the mobility, toxicity, or volume of the chemical constituents in the ground water at the site. However, this alternative would limit potential future human contact with the ground water at the site, thus limiting the future risks posed by this site.

Implementability

The limited action alternative includes the use of institutional actions and could be implemented at the site.

Screening Conclusion

This alternative will not reduce the toxicity, mobility, or volume of the chemicals of concern present in the ground water; however, future monitoring and the use of the institutional control (e.g., deed restrictions) may be beneficial if implemented in conjunction with another remedial alternative. Therefore, this alternative will be retained for further evaluation during the detailed analysis of alternatives.

4.4.4 Containment Alternative

4.4.4.1 Low-Permeability Cap and Cutoff Wall System

Technical Description

This alternative typically involves constructing a low-permeability cap to minimize infiltration of precipitation, combined with a slurry cutoff wall in the overburden to minimize off-site ground-water plume migration. However, the source area at this site is already capped by buildings and asphalt pavement, therefore, the cap would cover the undeveloped area encompassing the on-site ground-water plume. The cutoff wall would be installed downgradient of the source area.

Construction of the cap would require subgrade preparation to promote drainage, and the placement of low-permeable materials, such as clay or asphalt pavement. The cutoff wall would be constructed by excavating vertical trenches and filling the trenches with a soil-bentonite slurry. The cutoff wall would be keyed into a low-permeability unit underlying the site (i.e., the till unit or bedrock). A ground-water collection system would also be installed to remove ground water from within the low-permeability cap and cutoff wall system and maintain a hydraulic gradient into the containment area. Water collected in the ground-water collection system would require treatment and/or disposal.

Effectiveness

This alternative will not satisfy the RAOs for the ground water within the contained area (i.e., NYSDEC Class GA ground-water standards listed in 6NYCRR Section 703); nor would it reduce the toxicity or volume of the chemical constituents in ground water. Containment will, however, minimize/prevent the lateral migration of ground water beyond the cutoff wall.

The effectiveness of keying the cutoff wall into the till unit or the bedrock to reduce vertical ground-water plume migration from the overburden into the bedrock is limited. The till unit beneath the site is discontinuous, and chemicals of concern have migrated through this unit and into the underlying bedrock.

__Implementability__

This alternative relies on common construction materials and techniques. The alternative is technically feasible and could be implemented at the Robintech site.

__Screening Conclusion__

This alternative would not satisfy the RAOs established for the ground water (i.e., NYSDEC Class GA ground-water standards would not be achieved within the contained area). Therefore, this alternative will not be retained for further evaluation.

4.4.5 On-Site Treatment Alternatives

4.4.5.1 In-Situ Bioremediation

__Technical Description__

In-situ bioremediation involves the enhancement of naturally-occurring microorganisms found in the ground water by the addition of nutrients and oxygen to increase the metabolic activity of the microorganisms. Under increased metabolic activity, the microbial populations break down organic compounds present in the water into carbon dioxide and water. In-situ bioremediation can also be accelerated by introducing microbial populations into the ground water that are specifically adapted to biodegrade the chemicals of interest.

__Effectiveness__

This alternative has not been well demonstrated for remediating chlorinated VOCs in ground water and is ineffective for remediating inorganic constituents. Additionally, the complex nature of the hydrogeology and plume migration pathways would severely limit the effectiveness of any in-situ ground-water treatment alternative.

Implementability

In-situ bioremediation of chlorinated VOCs in ground water has not been implemented on a full-scale commercial basis.

Screening Conclusion

In-situ bioremediation has not been proven effective for remediating chlorinated VOCs, and is ineffective for remediating inorganic constituents. In addition, bioremediation of chlorinated VOCs has not been implemented on a full-scale commercial basis. Therefore, this alternative will not be retained for further evaluation.

4.4.5.2 In-Situ Permeable Treatment Beds

Technical Description

In-situ permeable treatment beds are constructed by excavating a trench along the downgradient perimeter of the site. The trench is filled with permeable treatment material (e.g., sand, activated carbon) to allow the ground-water plume to flow through the beds, thereby physically removing or chemically altering the constituents of concern.

Effectiveness

This alternative would not be effective for remediation of the ground water within the bedrock and would be very limited in its effectiveness of the saturated overburden due to the thickness of the saturated zone (permeable treatment beds are typically more appropriate for sites with shallow water tables). Additionally, numerous potential problems exist in using a permeable treatment bed, including saturation of the bed material, plugging of the bed, and the relatively short life of the treatment material.

Implementability

This alternative has not been well demonstrated for ground-water treatment at hazardous waste sites. Implementation of a permeable treatment bed at the Robintech site would require a treatment bed of considerable depth, since the overburden thickness near the downgradient site boundary is greater than 75 feet. To install and maintain a treatment bed to this depth would be difficult.

Screening Conclusion

In-situ permeable treatment beds would not be effective for remediation of ground water within the bedrock and it would be extremely limited in its effectiveness for the overburden due to the saturated thickness; therefore, this alternative will not be retained for further evaluation.

4.4.6 Off-Site Treatment Alternatives

4.4.6.1 Ground-Water Withdrawal and Treatment

Technical Description

This alternative would consist of withdrawing ground water using extraction wells, pre-treating the extracted ground water and discharging to an off-site POTW. Extraction wells would serve the dual purpose of actively restoring and containing of the ground water beneath the Robintech site. Withdrawn ground water would be treated using the existing ground-water IRM and discharged to the Town of Owego sanitary sewer system for final treatment at the POTW. All treated water discharged to the POTW would meet the POTW's pre-treatment requirements.

Effectiveness

Although the actual site-specific hydrogeologic behavior of the organic and inorganic chemicals of concern cannot be perfectly predicted, this alternative would be expected to achieve the following:

- Prevent further degradation of off-site overburden ground water, thereby facilitating natural ground-water restoration;
- Provide remediation (reduction of toxicity and volume) of the constituents detected in the ground water downgradient of the source area; and
- Provide significant mass reduction of the chemicals of concern in both the overburden and bedrock.

Implementability

This alternative could be easily implemented at the site because it would primarily consist of continuing the existing IRM.

Screening Conclusion

This alternative would provide remediation for the chemicals of concern in the ground water and would limit off-site migration of the ground-water plume. Also, this alternative could be easily implemented because it would principally consist of continuing the existing IRM. Therefore, this alternative will be retained for further evaluation.

4.5 Preliminary Screening Results

Alternatives developed for the source area soils and ground water were briefly described and preliminarily evaluated with respect to effectiveness and implementability in the preceding sections. The conclusions of this evaluation, as well as the rationale for selecting or eliminating the remedial alternatives, are presented herein.

Source Area Soils

In Section 4.3, nine remedial alternatives for the source area soils were identified and preliminarily screened. Of these nine alternatives, four can be eliminated because of questionable effectiveness or because they were unreasonably difficult to implement. Five distinct, viable source area soil treatment alternatives will be retained for further evaluation as follows:

- No-Action
- Limited Action
- Vapor Extraction
- Stabilization/Solidification
- Off-Site Disposal at a Permitted Landfill

The four source area soil alternatives that have been eliminated from further consideration are in-situ vitrification, biological treatment, soil washing, and LTTD. The reasons for elimination are summarized below:

- In-situ vitrification would be unreasonably difficult to implement, because buildings in the vicinity of the source area would have to be removed due to the expected soil subsidence.

- Biological treatment was eliminated from further consideration, because this technology has not been well demonstrated for remediation of chlorinated aliphatic compounds, the principal type of chemical of concern detected at the Robintech site.

- Soil washing was eliminated based on the questionable effectiveness of soil washing in treating the fine-grained soils in the source area.

- LTTD was determined to be difficult to implement due to the relatively small volume of in-place source area soils requiring treatment. Additionally, the fine-grain nature of the soils may result in poor processing performance due to caking and increased dust loading.

Ground Water

In Section 4.4., three of the six alternatives identified for ground water were eliminated from further consideration. These three ground-water alternatives (i.e., low-permeability cap and cutoff wall system, in-situ bioremediation, and in-situ permeable beds), were eliminated because they would not be effective remedial techniques at the Robintech site. The reasons for elimination are summarized as follows:

- Low-permeability cap and cutoff wall system would not satisfy the RAOs established for the site, and effective physical containment of the ground water beneath the site would be difficult due to hydrogeologic conditions and migration pathways for the chemicals of concern.

- In-situ bioremediation has not been well demonstrated as an effective remedial technique for chlorinated VOCs and is ineffective for remediating inorganic constituents.

- In-situ permeable treatment beds would not be effective for remediation of the ground water within the bedrock and would be extremely limited in its effectiveness for the overburden due to the saturated thickness.

The following three ground-water alternatives were retained for detailed analysis:

- No-Action;
- Limited Action; and
- Ground-Water Withdrawal and Treatment.

Combining The Remedial Alternatives

The interaction between the source area soils and the ground water is clear (i.e., the soil beneath the former chemical storage area is a source of contamination for the ground water), and thus, the remedial actions for these two media must be integrated. The retained alternatives listed above for soil and ground water have therefore been combined into the following comprehensive remedial alternatives for the Robintech site:

- Alternative 1: No-Action;
- Alternative 2: Ground-Water Withdrawal and Treatment;
- Alternative 3: Soil Vapor Extraction, and Ground-Water Withdrawal and Treatment; and
- Alternative 4: Off-Site Disposal of Soil at a Permitted Facility, and Ground-Water Withdrawal and Treatment.

5.0 - Detailed Evaluation of Remedial Alternatives

5.1 General

In this section, the relevant information for the selection of a remedial alternative is presented. The alternatives retained after the preliminary screening process for the combined source area soils and ground water are described in detail, providing the information necessary for implementing the alternative and for performing any ancillary activities required. The alternatives are then analyzed with respect to the seven NCP criteria specified by NYSDEC in its TAGM Number 4030 entitled, "Selection of Remedial Actions at Inactive Hazardous Waste Site." These criteria encompass statutory requirements and include other gauges of the overall feasibility and acceptability of remedial alternatives. Criteria by which the alternatives will be assessed include the following:

- Short-term effectiveness;
- Long-term effectiveness;
- Reduction of toxicity, mobility, or volume;
- Implementability;
- Compliance with ARARs;
- Overall protection of human health and the environment; and
- Cost.

Section 5.2 presents descriptions of the evaluation criteria used in the detailed analysis of remedial alternatives.

5.2 Description of Evaluation Criteria

5.2.1 Short-Term Effectiveness

The short-term effectiveness of the remedial alternative is evaluated relative to its effect on human health and the environment during implementation of the alternative. The evaluation of the alternative, with respect to short-term effectiveness, must consider the following:

- Short-term risks that might be posed to the community during implementation of the alternative;

- Potential impacts on workers during the remedial actions and effectiveness of protective measures; and

- Potential environmental impacts of the remedial action and effectiveness of mitigative measures to be used during implementation.

5.2.2 Long-Term Effectiveness

The long-term effectiveness of the remedial alternative is evaluated relative to the risks that may remain following completion of the remedial alternative. The following factors will be assessed in the evaluation of the alternative's long-term effectiveness.

- Environmental impacts from untreated waste or treatment residuals remaining at the completion of the remedial alternative;

- The adequacy and reliability of controls (if any) that will be used to manage treatment residuals or remaining untreated waste; and

- Ability to meet RAOs.

5.2.3 Reduction of Toxicity, Mobility, or Volume

This evaluation criterion addresses the degree to which remedial actions will permanently and significantly reduce the toxicity, mobility, or volume of the constituents and/or the contaminated media. The evaluation focuses on the following factors:

- The treatment process and the amount of materials to be treated;

- The degree of expected reduction in toxicity, mobility, or volume, and the degree to which the treatment will be irreversible; and

- The nature and quantity of treatment residuals that will remain after treatment.

5.2.4 Implementability

This evaluation criterion addresses the technical and administrative feasibility of implementing the remedial alternative, including the availability of various services and materials required for implementation. The following factors are considered during the implementability evaluation:

the remedial alternatives. A 20 percent contingency factor is included to cover unforeseen costs incurred during construction. Present worth costs were calculated for alternatives expected to last more than two years. In accordance with USEPA guidance, a 5 percent discount rate (before taxes and after inflation) was used to determine the present worth factor.

5.3 Detailed Evaluation of Remedial Alternatives

This section presents a detailed evaluation of the remedial alternatives retained after the preliminary screening process for the combined source area soils and ground water at the site. (As stated in Section 4.5, the remedial actions for source area soils and ground water were integrated due to the interaction between these two media.) Each alternative is evaluated based on the criteria described in Section 5.2.

5.3.1 Alternative 1: No-Action Alternative

Technical Description

The no-action alternative serves as a baseline for comparison of the overall effectiveness of each remedial alternative. The no-action alternative would not use any remedial technologies for the treatment of soil or ground water. The site would remain in its current condition, and no effort would be made to change the current site conditions. However, a ground-water monitoring program would be implemented. To effectively monitor the ground water beneath and in the vicinity of the site, select existing wells would be sampled on a semi-annual basis and analyzed for target compound list VOCs, chromium, copper, lead, and zinc.

Short-Term Effectiveness

Since no remedial action would be implemented for the soil or ground water, there would be no short-term environmental impacts or risks posed to the community.

Long-Term Effectiveness

Risks identified in the RA resulting from constituents in the ground water and source area soils would not be mitigated. The no-action alternative would allow further migration of ground-water plumes, thereby increasing the possibility of potential exposure.

Reduction of Toxicity, Mobility, or Volume

Under the no-action alternative, treatment of the ground water and soils would not occur. Therefore, the toxicity, mobility, and volume of the chemicals of concern present in the ground water and soils would not be reduced.

Implementability

Implementation of a ground-water monitoring program to adequately track plume migration would be relatively straightforward and simple.

Compliance with ARARs

Chemical-Specific ARARs

The chemical-specific ARARs identified for this alternative are presented in the NYSDEC TAGM entitled, "Ambient Water Quality Standards and Guidance Values." These ARARs are cleanup objectives for the chemical constituents of concern in the ground water beneath the Robintech site. Because the ground-water within the overburden and bedrock is classified as Class GA, Class GA ground-water standards would be applicable. The no-action alternative would not meet the requirements of this ARAR. Existing exceedences of Class GA ground-water standards would continue, and plume sizes could increase.

Location-Specific ARARs

Based on the "New York State Archeological Site Locations" map, which was revised March 1992, the Robintech site may lie in an archaeologically-sensitive area due to its close proximity to the Susquehanna River. Thus, the National Historic Preservation Act (NHPA) is a potential location-specific ARAR for the site. A requirement of the NHPA is that remedial actions must take into account the effects of remedial activities on any historic properties included on, or eligible for inclusion on, the National Register of Historic Places (NRHP). Additional information from the NYSDEC Field Services Bureau is required (i.e., NYSDEC needs to review the site location to determine if an archaeological site extends into the Robintech site). However, remedial actions conducted as part of this alternative would not be expected to negatively impact cultural resources (if any) present at the site, because implementation of a ground-water monitoring program is the only component of this alternative.

Action-Specific ARARs

This criterion is not applicable, since no remedial actions would be taken.

Overall Protection of Human Health and the Environment

The no-action alternative is ineffective and does nothing to meet the RAOs for the Robintech site. This alternative would not contain, treat, or destroy the chemicals of concern present at the site; therefore, the long-term human health and environmental risks for the site would be the same as those identified in the baseline RA. Potential public health exposure pathways would remain unchanged. Because no remediation actions would be taken, the no-action alternative could allow for continued plume migration within the overburden and bedrock formations.

Cost

This alternative does not require implementation of any remedial technologies or the use of any institutional controls. However, under the no-action alternative, a program for monitoring of the ground water would be implemented. The estimated annual O&M cost for this alternative is $15,000.00. This cost includes conducting semi-annual ground-water sampling at 10 existing monitoring wells and analyzing the samples for VOCs, chromium, copper, lead, and zinc. Due to the implementation period of this alternative (greater than 30 years), the costs associated with this alternative were subjected to a present worth analysis for a 30-year period of time. The estimated present worth cost for this alternative is $230,000.00.

5.3.2 Alternative 2: Ground-Water Withdrawal and Treatment

Technical Description

This alternative would consist of withdrawing ground water using extraction wells, pre-treating the ground water on-site and then discharging the ground water to the sanitary sewer for off-site treatment at the Town of Owego POTW. Under this alternative, existing on-site well PW-3 and a downgradient well located near the southern property boundary would be pumped to serve the dual purpose of active ground-water plume restoration and containment (see Figure 3 for well locations).

Well PW-3 was selected because the simulated capture zone, developed in conjunction with the RI, suggests that pumping from this well may hydraulically control shallow, intermediate, and deep overburden ground water. Based on modeling results the capture zone within the deep overburden ground water was estimated to extend approximately 600 feet crossgradient and approximately 100 feet downgradient. The ground water beneath the source area is located within the simulated capture zone. Figure 6 presents the plan view of the simulated PW-3 ground-water capture zone in the deep overburden. In addition, well PW-3 is currently being used as part of the IRM for the remediation of VOCs in the ground water. As part of the IRM, ground-water elevation data is being analyzed to determine the actual ground-water capture zone created by pumping PW-3 at an average rate of 11 gpm. Although it is expected that pumping PW-3 would hydraulically control overburden ground water near the source, it would not hydraulically control dissolved constituents in the overburden that extend beyond the downgradient capture zone of PW-3, nor would it contain the migration of dissolved chemical constituents in the bedrock.

The overburden plume extends to the downgradient (southern) site property boundary, approximately 680 feet from the downgradient capture zone of PW-3. Because this portion of the overburden ground-water plume extends beyond the PW-3 capture zone, plume migration would not be hydraulically controlled by pumping PW-3. Rather, ground-water plume migration may continue as dictated by the rate of ground-water flow within the overburden, the chemical properties of the plume (e.g., solubility, density, organic carbon partition coefficient, etc.), and the ability of the formation to attenuate specific chemical compounds.

The rate of overburden ground-water flow is controlled by the effective porosity and hydraulic conductivity of the saturated overburden materials, and by hydraulic gradients. The ground-water velocity can be estimated using the following equation:

$$V = \frac{Ki}{n_e}$$

Where:

V = ground-water velocity (feet/day)
K = hydraulic conductivity (feet/day)
i = hydraulic gradient
n_e = effective porosity

Using this equation and hydrogeologic characteristic data obtained during the RI, the ground-water velocity within the overburden is estimated at 0.4 feet/day ($i = 0.029$, $n_e = 0.28$, and $K = 4.1$ feet/day). Based on this estimated overburden ground-water velocity, ground water currently located immediately beyond the PW-3 downgradient capture zone would be estimated to take more than 4.5 years to reach the site boundary. However, dissolved chemicals of concern within the overburden would be expected to move much more slowly than the ground water due, in part, to hydrogeologic properties of the formation and chemical properties of the plume, which influence sorption/desorption processes. These processes tend to retard the rate of plume migration, thereby increasing the length of time required for the overburden ground-water plume to traverse the length of the site. Additionally, if only PW-3 is pumped, RAOs established for the site would not be met for the following reasons:

- The overburden ground water beneath the site would act as a source for further degradation of off-site overburden ground water for years to come; and

- The potential for off-site exposure to the chemicals of concern within the overburden ground water would increase.

Thus, to achieve the RAOs established for the protection of human health and the environment (see Table 3-3), this alternative would also consist of extracting ground water from a deep overburden well with a capture zone that extends to (or near) the southern property boundary. The purpose of extracting ground water from a well in this area would be to hydraulically contain the on-site overburden ground-water, thereby reducing off-site migration of chemicals of concern within the overburden ground water.

Existing well MW-29 is a 4-inch-diameter, deep overburden well located near the southern site boundary. This well could potentially be used as the downgradient pumping well if the source of the 11.8 pH value measured in this well during the June 1993 ground-water sampling event can be determined. (A subsequent pH value was measured by Hadco in November 1993 and confirmed the previous pH measurement obtained at MW-29). The source of this pH value should be investigated during remedial design/remedial action activities to determine the effects (if any) on implementation of remedial activities.

A pump test on the downgradient well used for ground-water extraction would be required prior to implementation of this alternative. The purpose of the pump test would be to provide the necessary information for simulating the capture zone created by pumping this well. For the purposes of this FFS, it has been assumed that one deep overburden well would be installed, and that this well would effectively prevent further degradation of off-site ground water, which will in turn facilitate ground-water restoration.

With respect to the bedrock formation, the potential presence of DNAPLs, in conjunction with the complex nature of the fractured bedrock beneath the site, greatly reduces the effectiveness of any ground-water extraction system for this unit. DNAPL flow in fractured rock is also difficult to trace and there are no proven technologies to reduce the total mass of subsurface DNAPL to concentrations low enough to effect full restorations of the ground water (USEPA 1992).

The primary concern with respect to pumping the bedrock is the downward hydraulic gradients that would be induced beneath the site, resulting in reduced capillary pressures at bedrock fracture entrances. Any reduction in capillary pressure may induce DNAPLs to enter previously uninvaded fractures and facilitate migration within the bedrock. Pumping the bedrock to achieve either remediation or plume containment is technically impracticable and could facilitate migration. However, pumping of the overburden would be expected to create an upward hydraulic gradient that would minimize the downward rate of plume migration. Additionally, there are no known downgradient receptors of the ground water within the bedrock. Therefore, ground-water recovery from the bedrock would not be included under this remedial alternative.

The pumping rate from the downgradient overburden monitoring well would initially be estimated using a pump test and subsequent ground-water modeling results. However, for this FFS, the following pumping rates have been assumed: PW-3, 11 gpm; and downgradient well, 10 gpm. During the design, construction, or operation of the ground-water withdrawal system, the pumping rates may be altered to ensure goals are being met in the most efficient manner possible. For example, switching from continuous pumping to pulse pumping may minimize the volume of ground water withdrawn while maximizing the mass of constituents removed.

Withdrawn ground water would be pumped to the existing IRM treatment system, treated using a low-profile air stripper, and subsequently discharged to the Town of Owego POTW. The existing IRM treatment process, a single low-profile air stripper, removes VOCs from the ground water to levels that comply with the existing POTW discharge permit (less than 2.13 ppm) and are less than the concentrations would be considered a characteristic hazardous waste because of toxicity (reference 40 CFR Part 261). After being pre-treated by the low-profile air stripper, the ground water would be discharged to the sanitary sewer for further treatment at the Town of Owego POTW.

The existing treatment system components are capable of meeting the POTW discharge limits for flow rates in excess of the assumed combined flow rate for this alternative of 21 gpm. The actual design capacity would be dependent upon the chemical constituents in the extracted ground water and their concentrations.

The duration of this alternative can not be accurately predicted, but it is expected to take a long time due to the migration of the chemicals of concern into the less permeable zones of the formation and other factors, such as desorption. Additionally, the concentrations of halogenated aliphatic compounds detected in several of the ground-water samples collected as part of the RI indicate the possible presence of DNAPLs. If present, DNAPL chemicals in the subsurface soils are difficult to withdraw and would continue to act as a source for years to come. For cost estimating purposes, a treatment duration of 30 years was assumed. The present worth of remedial actions further into the future would not significantly affect the total present worth. (This is consistent with NCP and NYSDEC guidance). Because the ground water would remain impacted for a long period of time, long-term monitoring would be required, and institutional actions, such as deed restrictions and regulatory restrictions on the construction and use of private water wells, would be implemented.

Short-Term Effectiveness

Potential short-term risks to public health and the environment are associated with the ground-water treatment system. An analysis of potential air quality impacts from the air stripper would be required and, if necessary, an air pollution control system would be installed to ensure compliance with air emission standards. These standards include prevention of significant deterioration (PSD) air emission provisions contained in 40 CFR 51 and all relevant requirements under the Clean Air Act (40 CFR 1-99). Additionally, all New York State regulations concerning air emissions would be applicable, such as New York Air Permits and Certificates (6NYCRR Part 201) and New York Regulations for General Process Emission Sources (6NYCRR Part 212). (Table 2-4 presents the potential ARARs identified for the Robintech site.)

Long-Term Effectiveness

This alternative would be effective in the long-term by virtue of the fact that it may be maintained as a long-term operation. The overburden ground-water withdrawal and treatment system would operate for as long as chemicals of concern in the overburden (both organic and inorganics) continue to desorb into the ground water at concentrations resulting in exceedences of NYSDEC Class GA ground-water standards.

This alternative would be expected to minimize/mitigate further degradation of off-site ground water, thereby facilitating restoration of ground water beyond the site boundary. This alternative would also provide mass reduction of the chemicals of concern.

Because the on-site ground water would remain impacted for a period of time, long-term monitoring would be required and institutional actions may be implemented. For the protection of on-site workers, health and safety measures consistent with Occupational Safety and Health Administration (OSHA) regulations must be followed during any excavation/construction activities conducted in the vicinity of the former chemical storage area.

Reduction of Toxicity, Mobility, or Volume

Ground-water withdrawal and treatment (using an on-site air stripper) would effectively reduce the volume of the chemicals of concern present in the ground water beneath the Robintech site. If the air emissions from the air stripper are treated, the VOCs would most likely be destroyed (e.g., if carbon adsorption is used, the VOCs would be destroyed during regeneration or incineration of the spent carbon). This alternative would not, however, treat the chemicals of concern present in the source area soils. This alternative, in effect, hydraulically contains the chemicals of concern in the source area soils.

Implementability

This alternative is readily implementable. The existing IRM would be capable of treating the withdrawn ground water to meet the POTW's pre-treatment requirements at the assumed approximate total flow rate of 21 gpm. However, Hadco's current POTW discharge permit would need to be modified to allow for the increased flow rates.

The overall effectiveness of this alternative could be easily monitored using existing wells, and additional wells could readily be installed, if necessary. Prior to implementation, pump tests and subsequent modeling on the downgradient pumping well would be required.

Compliance with ARARs

Chemical-Specific ARARs

The chemical-specific ARARs identified for this alternative consist solely of the Class GA ground-water quality standards. Within the site boundary, ground-water chemicals of concern (within the overburden) would be hydraulically contained and reduced through the withdrawal and treatment of ground water. Because the source area soils would remain, isolated locations of higher concentrations would exist in the ground water near the source area. Over time, the concentrations of the chemicals of concern in the source area would decrease to the point where they no longer impacted ground-water quality due to constant desorption. At this point, the source of the chemicals of concern for ground water would be eliminated and the ground water would naturally attenuate and achieve ARARs. However, the desorption process for the chemicals of concern would likely take a long time due to the properties of the chemicals, the heterogeneous hydrogeologic conditions at the Robintech site, and the effects of tailing. Although withdrawal of ground water from the overburden would reduce the mass of chemicals of concern entering the bedrock, and in turn facilitate natural attenuation of the bedrock, complete restoration of the bedrock is technically impractical at this time. Thus, exceedences of ground-water standards would likely persist within the bedrock. The overburden ground-water downgradient of the site, would be expected to naturally attenuate and achieve ARARs.

Location-Specific ARARs

The NHPA is a potential location-specific ARAR for this site, pending NYSDEC's decision regarding the applicability of this ARAR for the Robintech site. However, remedial actions conducted as part of this alternative would not be expected to negatively impact cultural resources (if any) present at the site due to the limited amount of subsurface work (e.g., the possible installation of additional wells) and the presence of existing buildings.

Action-Specific ARARs

The action-specific ARARs for this alternative consist of attaining the pre-treatment requirements specified in the POTW's discharge permit and compliance with air emission standards for the air stripper. ARARs applicable to air emissions would include the PSD air emission provisions contained in 40 CFR 51 and all relevant requirements under the Clean Air Act (40 CFR 1-99). Additionally, New York State regulations concerning air emissions would be applicable (i.e., New York Regulations for General Process Emission Sources, 6NYCRR Part 212, and New York Air Permits and Certificates, 6NYCRR Part 201). To comply with the above-mentioned ARARs, the ground-water treatment system would be designed and operated so that the PSD limits would not be exceeded and the system would comply with all state and federal air emission requirements.

Overall Protection of Human Health and the Environment

The subsurface soil in the vicinity of the former chemical storage area at the Robintech site poses a risk to human health solely under the hypothetical exposure pathway of on-site workers inhaling soil dust particulates. This risk would be minimized/mitigated by requiring appropriate health and safety measures during potential construction/excavation activities in the vicinity of the former chemical storage area.

This alternative provides hydraulic containment of the on-site overburden ground-water, as well as some mass reduction of the chemicals of concern within the bedrock, thereby mitigating further degradation of off-site overburden ground water. Because the ground water would remain impacted for a period of time, long-term monitoring and institutional controls would be implemented to ensure protectiveness.

Cost

The capital costs associated with this alternative include installation of the ground-water withdrawal system, tapping into the existing IRM pre-treatment system, and performing site restoration activities. O&M costs associated with this alternative include equipment O&M, a POTW discharge fee, implementation of a ground-water monitoring program, and sampling and analyzing the pre-treated ground water prior to discharge into the sanitary sewer to demonstrate compliance with the POTW discharge permit. Due to the implementation period associated with this alternative (greater than 30 years), the O&M costs associated with this alternative were subjected to a present worth analysis for a 30-year period of time. The estimated present worth cost of this alternative is approximately $1.4 million. Table 5-1 presents a detailed breakdown of the cost and a list of assumptions for this alternative.

5.3.3 Alternative 3: Soil Vapor Extraction, and Ground-Water Withdrawal and Treatment

Technical Description

This alternative consists of withdrawing, treating, and disposing of ground water at the Town of Owego POTW; and implementing soil vapor extraction (SVE) technology in the unsaturated zone of the source area soils. Because the detailed analysis presented in the previous section (5.3.2) addressed the ground-water component of this alternative, the overall focus of this evaluation is the implementation of SVE to treat source area soils and the identification of any effects SVE may produce on the ground water.

SVE has been proven effective at removing VOCs from unsaturated soils. This technology has been successfully applied for VOC removal at numerous sites over a wide range of geologic and hydrogeologic conditions. All of the volatile priority pollutants have been successfully extracted with the SVE process, and applications have ranged from small gas stations to large Superfund sites.

The process consists of inducing a negative pressure gradient within the soil matrix through vapor extraction wells. As the induced vacuum propagates through the subsurface soils, VOCs at the soil/ground-water interface vaporize, and VOC vapors migrate toward the vacuum extraction well, where they are drawn to the surface and treated. Typically, extracted vapors are treated by vapor-phase granular-activated carbon (GAC) prior to being discharged through an exhaust stack. Typical equipment used for implementation of SVE includes horizontal or vertical extraction wells, a vacuum unit, a liquid/vapor separator, a vapor treatment system, and system controls and instrumentation.

In order for SVE to be an effective remedial technology, the system design must take into consideration a number of parameters, including soil permeability, porosity, moisture content, stratigraphy, depth to ground water, and chemical properties of the VOCs. The soil must have a sufficient air-filled porosity to allow the SVE system to strip the VOCs from the soil matrix. Water deters this stripping action and, therefore, the effectiveness of SVE, because the presence of water, reduces the air-filled porosity.

The vertical extent of the source area soils is assumed to extend to the soil/ground-water table interface, approximately 10 feet bgs (accounting for seasonal variations). Due to the presence of water at this interface, VOCs could not be effectively removed using the SVE process. Therefore, the ground-water elevation would need to be lowered to achieve sufficient air-filled porosity to allow effective operation of the SVE system. This would be accomplished by using a ground-water extraction well, or by implementing a dual vapor extraction (DVE) approach.

DVE simultaneously extracts ground water and organic vapors from the SVE wells. This technique would lower the water table, thereby increasing the effective unsaturated zone of soil in which the vacuum extraction process could vaporize VOCs. Simultaneous extraction of ground water and vapors under vacuum enhances the recovery of ground-water chemicals of concern and reduces the timeframe for total cleanup.

Air and/or ground water extracted from an extraction well would require proper handling and may require treatment prior to discharge, since vacuum extraction is a mass transfer process and would not destroy the halogenated and aromatic organics detected at the Robintech site. The VOC-laden air stream would most likely be treated using vapor-phase activated carbon units. These units would require periodic replacement and/or regeneration. A likely disposal option for the spent carbon would be off-site regeneration, so that the organic compounds adsorbed on the carbon could either be recycled or destroyed. Any ground water extracted in conjunction with the SVE system would be treated and/or disposed of at the Town of Owego POTW.

For this site, two possible vacuum extraction scenarios could be implemented to remove VOCs. The first would consist of installing DVE wells below the existing clean room. The function of the DVE wells would be to draw down the water table approximately 2 feet, extract and treat VOC vapors from the unsaturated soils, and extract and treat VOCs from the unsaturated soil/ground-water interface. In general, the DVE system in the soils below the clean room would target the VOCs in the 6- to 10-foot depth interval of the overburden, which act as a source of VOCs for the ground-water. As previously stated, due to the possible presence of DNAPLs and concentrations of VOCs in the saturated soils, the unsaturated soils below the clean room are not the only source of VOCs for the ground-water. However, based on vapor extraction studies conducted by Blasland & Bouck during the RI, SVE appears to be an effective means for extracting VOC constituent mass from below the clean room.

Implementation of DVE below the clean room could be achieved by installing horizontal wells below the clean room, or by installing vertical wells either inside or around the perimeter of the clean room. Installation of the horizontal DVE system would require further evaluation of underground utilities, structures, or other potential obstructions that may exist in the area of the horizontal well installation. If horizontal wells are installed, they would require excavation of soils outside the clean room to a depth below the existing foundation system to allow horizontal augering of the wells. Although vertical SVE well installations would not require excavation activities, they may disrupt process activities inside the clean room.

The most appropriate type of extraction well and their locations would be determined during the remedial design. For cost estimating purposes, the installation of a horizontal DVE system beneath the clean room has been assumed.

The second vacuum extraction scenario consists of applying the SVE system at select ground-water withdrawal well location(s). Similar to the first scenario, this application would use the DVE approach: a vacuum extraction well, outfitted with a ground-water recovery system, would be used to simultaneously extract soil vapors and ground water from the same well. As a result, the vacuum extraction process takes advantage of the downward cone of depressions (created by the extraction of ground water) to extract the residual VOCs in the soil as the water table is lowered. Generally, the DVE process would enhance overall ground-water plume withdrawal by removing residual VOCs while accelerating the ground-water recovery process. The potential application of DVE under this scenario would require pilot testing and further evaluation. As a result, this scenario has not been included in the cost estimate presented at the end of this evaluation.

For both of the DVE application scenarios, termination of the DVE system would occur when the cleanup goals have been met or when the DVE system has attained optimum organic mass removal. Optimum organic mass removal for the DVE system would be attained if the DVE system could not practically further reduce VOC concentrations. Additional methods that may be employed to further increase the optimum removal of VOCs using DVE may include air sparging, steam injection, or pulse pumping.

Short-Term Effectiveness

Potential short-term risks to public health and the environment are associated with excavation activities (if necessary) that may be associated with implementation of the SVE system. Excavation activities may result in fugitive dust emissions or releases of VOCs. To mitigate these risks, dust control measures, such as water sprays and foam suppressants, would be used, as necessary. In addition, air monitoring at the site boundary would be performed to ensure air emissions are below regulatory limits.

Potential short-term risks may also be posed by air emissions from the SVE and ground-water treatment systems. If necessary, air pollution control systems would be installed to limit air emissions to within the acceptable regulatory criteria. Also, stack and site perimeter air monitoring would be performed to ensure that air emissions are within regulatory limits.

Risks to on-site workers may occur due to exposure during excavation activities. To mitigate these risks, a NYSDEC-approved Work Plan and site-specific Health and Safety Plan (HASP) would be prepared to identify appropriate health and safety measures. Furthermore, workers may be required to wear appropriate personal protective equipment (PPE) as specified in the site-specific HASP.

Although the duration of Alternative 3 cannot be accurately predicted, it is expected that this alternative would be implemented for a period of time greater than 30 years due to the implementation period associated with the ground-water remedial alternative due to the following:

- The saturated overburden beneath the site would continue to act as a source even if the unsaturated source area soils were excavated;

- The presence of chemicals of concern in the less permeable zones of the formation which were difficult to remove;

- The potential presence of DNAPLs; and

- The hydrogeologic properties of the formation and the physical/chemical properties of the chemicals of concern which influence sorption/desorption processes.

Thus, even though this alternative provides for reduction of VOC mass within the unsaturated zone, it would not be expected to reduce the duration of the ground-water component of this alternative to less than 30 years. (The maximum duration recommended by NYSDEC.)

Long-Term Effectiveness

SVE and ground-water withdrawal have been proven effective for remediating VOCs in the unsaturated soils and organic and inorganic compounds present in the saturated soils, respectively. Inorganic constituents present in the unsaturated soils would not be remediated by implementing this alternative. However, as presented in the previous sections, the ground-water withdrawal system, in effect, hydraulically contains the chemicals of concern within the source area soils. Future off-site migration of the ground-water chemicals of concern within the overburden would be controlled by the ground-water extraction system.

This alternative would require implementing a site-specific HASP to limit future risks to on-site workers (e.g., during excavation activities). In addition, a ground-water monitoring program at the site boundaries would be implemented to evaluate the effectiveness of the ground-water hydraulic controls.

The SVE portion of this alternative could be capable of meeting the cleanup objectives for the unsaturated soils. If the cleanup criteria are met, the unsaturated soil below the clean room would no longer be a source of VOCs for the ground water. However, it may not be practical or technically feasible to reduce soil VOC concentrations to meet cleanup objectives using SVE in the saturated soils. Furthermore, the presence of residual chemicals of concern in the saturated overburden materials would be expected to act as a continued source of dissolved chemicals to the ground water.

In addition to not remediating the saturated portion of the overburden, SVE may not effectively remediate residual DNAPLs present in the soil (if any). Therefore, the overall effectiveness of implementing SVE to achieve RAOs established for the Robintech site (i.e., eliminating or reducing migration of organic chemicals of concern that would result in further degradation of ground-water quality) would be limited.

The volume of soil that could be addressed by SVE is relatively small compared to the volume of saturated overburden materials beneath the site that contain residual chemicals of concern (the average depth of saturated overburden material beneath the site is approximately 65 feet). The presence of residual chemicals in the saturated overburden materials and residual DNAPLs (if any) would continue to act as a source of dissolved chemicals to the ground water for years to come. Thus, even if soil clean-up criteria are achieved in the unsaturated source area soils, the residual chemicals of concern within the saturated overburden materials would continue to result in further degradation of ground-water quality.

Reduction of Toxicity, Mobility, or Volume

Ground-water withdrawal and soil vapor extraction would reduce the toxicity, mobility, and volume of the VOCs in the unsaturated soils and the organic and inorganic constituents present in the ground water. If the air emissions from the air stripper and the SVE system are treated, the VOCs would most likely be destroyed (e.g., if carbon adsorption is used, the VOCs would be destroyed during regeneration or incineration of the spent carbon).

Implementability

SVE has been successfully used at numerous sites to remove VOCs from unsaturated soils and also to enhance the performance of ground-water withdrawal alternatives. Based on the SVE pilot tests performed by Blasland & Bouck, SVE appears to be an implementable alternative for removing organic vapors from the unsaturated soils located beneath the clean room. As stated in the RI (Section 3.5), for a full-scale vapor extraction system to be capable of remediating the unsaturated soil below the clean room within a reasonable timeframe, much higher organic constituent removal rate would need to be achieved. Ground-water withdrawal and disposal could be effectively implemented at this site to remove chemicals of concern from ground water and to provide hydraulic control of plume migration.

Implementation of this alternative would require updating Hadco's current POTW discharge permit to allow for the increased flow rates. Also, air monitoring of exhaust stacks for the SVE and withdrawn ground-water treatment systems would be conducted to ensure compliance with air emission regulations. These regulations include the PSD air emission provisions contained in 40 CFR 51 and all relevant requirements under the Clean Air Act (40 CFR 1-99). Additionally, New York State Regulations concerning air emissions would also be applicable (e.g., New York Regulations for General Process Emission Sources listed in 6NYCRR Part 212). Compliance with the POTW discharge permit would be verified by sampling and analyzing treated ground water prior to discharge to the POTW.

SVE and ground-water extraction systems are commercially available. Installation and start-up of this alternative could be conducted within a reasonable period of time.

Compliance with ARARs

Chemical-Specific ARARs

The chemical-specific ARARs for this alternative consist solely of NYSDEC Class GA ground-water quality standards. Therefore, the chemical-specific ARAR evaluation presented in Section 5.3.2 for the ground-water remedial alternative (Alternative 2) is also applicable to this alternative.

Location-Specific ARARs

The location-specific ARAR evaluation presented in Section 5.3.2 (Alternative 2) is also applicable to this alternative.

Action-Specific ARARs

Action-specific ARARs for this alternative apply to potential excavation activities, monitoring requirements, OSHA health and safety requirements, and operation of the SVE and ground-water treatment systems.

Workers and worker activities that would occur during the implementation of this alternative must comply with the OSHA requirements for training, safety equipment and procedures, monitoring, recordkeeping, and reporting. In addition, the RCRA requirements for preparedness and prevention, contingency plans, and emergency procedures would be relevant and appropriate for this alternative. Compliance with these ARARs would be achieved by following a NYSDEC-approved Work Plan and a site-specific HASP.

Based on the IRM system for this site, the withdrawn ground water will need to be pre-treated prior to being discharged to the POTW in accordance with a POTW-issued discharge permit. To show that the effluent ground-water constituent concentrations comply with the discharge permit, pre-treated ground water would be sampled and analyzed.

Implementation of this alternative would result in the generation of air emissions. ARARs applicable to air emissions would include the PSD air emission provisions contained in 40 CFR 51 and all relevant requirements under the Clean Air Act (40 CFR 1-99). Additionally, New York State regulations concerning air emissions would be applicable, such as New York Regulations for General Process Emission Sources (6NYCRR Part 212) and New York Air Permits and Certificates (6NYCRR Part 201). (Table 2-4 presents the potential ARARs identified for the Robintech site.) To comply with the above-mentioned ARARs, the SVE and ground-water treatment system would be designed and operated so that the PSD limits would not be exceeded, and the systems would comply with all state and federal air emission requirements.

Residual wastes, such as soil cuttings and filter bags, would be transported off-site to a USEPA-permitted RCRA hazardous waste landfill. The RCRA and United States Department of Transportation (NYSDOT) requirements for packaging and transporting of hazardous waste would be applicable. Compliance with these ARARs would be achieved by using a licensed hazardous waste hauler and disposing of the wastes in a permitted hazardous waste landfill.

Overall Protection of Human Health and the Environment

This alternative would meet the RAOs by removing constituents present in the ground water and soils, and by providing hydraulic control of migration of constituents present in the ground water. During implementation of this alternative, human health and the environment would be protected by complying with the applicable ARARs.

In-situ vacuum extraction would remove VOC mass from the unsaturated zone beneath the clean room, but would not address the inorganic constituents of concern in the soil. Therefore, appropriate health and safety measures would be required during potential excavation/construction activities in the vicinity of the clean room to prevent exposure. Additionally, because the concentrations of chemicals of concern in the ground water would remain above NYSDEC Class GA ground-water standards for a period of time, long-term monitoring and institutional controls would be required.

Cost

The capital costs associated with this alternative include designing the SVE system, installing the SVE wells and ancillary equipment, and installing the ground-water extraction system. O&M costs associated with this alternative include equipment O&M, sampling and analysis of the SVE and ground-water pre-treatment, and residuals disposal. Due to the implementation period associated with the ground-water component of this alternative (greater than 30 years), the O&M costs associated with this alternative were subjected to a present worth analysis for a 30-year period of time. The estimated cost for this alternative is $2.1 million. Table 5-2 presents a detailed breakdown of the cost and a list of assumptions for this alternative.

5.3.4 Alternative 4: Off-Site Disposal of Soil at a Permitted Facility, and Ground-Water Withdrawal and Treatment

Technical Description

This alternative would consist of withdrawing, treating, and properly disposing of ground water at the Town of Owego's POTW (as outlined in the previous alternatives) and excavating soils located below the clean room to a depth of 10 feet bgs. Because the detailed analysis presented in Section 5.3.2 addressed the ground-water component of this alternative, the overall focus of this evaluation is the implementation of soil excavation to remove source area soils and the identification of any effects soil excavation may produce on the ground water.

Excavation of soils below the clean room has been identified because this area served as the former chemical storage area, as presented in the RI. Organic and inorganic constituents present in the unsaturated soils and soil/ground-water interface currently act as a source of the chemicals of concern detected in the underlying ground water. Excavating the soils beneath the clean room to a depth of 10 feet would accomplish removal of the unsaturated soils which, based on the RI data, were found to contain relatively high concentrations of VOCs. However, removal of the soils to this depth would not remove all of the chemicals impacting the ground water, because saturated soils (at depths greater than 10 feet bgs) would continue to impact ground-water quality.

For this alternative, the equipment and furnishings located inside the existing clean room would be temporarily staged in a designated location at the facility. Equipment access into the clean room could be accomplished by removing a portion of the exterior masonry block wall. The concrete slab inside the clean room would be demolished and placed inside a roll-off for off-site disposal with excavated soils. Because the concrete volume represents less than 10 percent of the excavated soil volume, disposal of the concrete debris using other methods would not be practical. The subsurface soils would then be excavated, placed in a designated staging area, sampled and analyzed to determine if it could be placed back into the excavation or if it would need to be placed into roll-offs, and transported to a RCRA-permitted TSDF. Due to the VOC concentrations detected in soil samples collected beneath the clean room, disposal in a RCRA-permitted landfill would most likely not be permitted due to the RCRA Land Disposal Restrictions (LDRs).

The RCRA LDRs set treatment standards that must be met prior to land disposal of the soil in a RCRA-permitted facility. For organic chemicals such as those detected in the source area soils at the Robintech site, the treatment standards are expressed as actual chemical concentrations within the waste material, and not chemical concentrations in toxicity characteristic leaching procedure (TCLP) extract.

Because the organic concentrations in the source area soil will most likely exceed RCRA land disposal treatment standards, a reduction in their concentration would be necessary prior to land disposal in a RCRA-permitted TSDF. Thus, it has been conservatively assumed that the excavated soil will be incinerated at a RCRA-permitted TSDF prior to land disposal.

Excavated soils with constituent concentrations that meet NYSDEC levels for protection of ground water would be placed back into the excavation and compacted; soils that exceed the NYSDEC levels would be transported to an off-site RCRA-permitted incinerator. During excavation activities, sheeting and bracing would be installed, as necessary, to ensure the stability of the excavation sidewalls. Also, dewatering activities would be conducted to facilitate the excavation of soils to 10 feet. Ground water collected during dewatering activities would be pre-treated prior to being discharged to the POTW. Once excavating activities are complete, the exterior wall would be repaired and the excavation would be backfilled and compacted with imported fill material. A reinforced concrete slab would then be reinstalled, and the equipment and furnishings returned to the room.

This alternative would also include the withdrawal and pre-treatment of ground water prior to being discharged to a POTW, as described in Section 5.3.2.

Short-Term Effectiveness

Potential short-term risks to public health and the environment would be associated with the pre-treatment of the ground water and the excavation and handling of the source area soils. Potential risks to public health and the environment may result from inhalation of volatilized organic compounds or fugitive dust during excavation activities. To mitigate potential risks to human health and the environment posed by the volatilization of organic constituents or dust, water sprays and foam suppressants would be used during remedial action activities. In addition, air monitoring would be conducted to ensure that emissions are within regulatory limits.

Potential risks to workers may occur due to volatilization of organic compounds during excavation activities, inhalation of dust, and potential dermal contact with the source area materials. To mitigate these risks, a NYSDEC-approved Work Plan and a site-specific HASP would be prepared and followed. Potential risks to public health and the environment may result due to an accident during transportation of the excavated soils to the incineration facility. To reduce these risks, a traffic control plan, including routing trucks to avoid populated areas (to the extent possible), would be developed and followed.

Potential risks to human health and the environment may also result due to emissions from the ground-water pre-treatment system. However, these risks would be mitigated by periodically sampling and analyzing the exhaust air emissions from the ground-water pre-treatment system.

In accordance with NYSDEC and NCP guidance, the estimated duration of this alternative is limited to 30 years. Although this alternative provides reduction in VOC mass within the unsaturated materials, it would not be expected to reduce the duration of the ground-water component of this alternative to less than 30 years due to the previously described limitations in addressing dissolved chemicals and DNAPLs (if any) present in saturated materials (e.g., sorption/desorption process and heterogeneity of the saturated materials) as discussed previously with regard to the practical use of the SVE remedial alternative.

Long-Term Effectiveness

Under this alternative, removal and off-site treatment of the unsaturated soils below the clean room would reduce the contributions of chemicals of concern from these soils into the ground water. However, excavation and removal of the saturated soil impacted by the chemicals of concern would not be practical or technically feasible. Therefore, the presence of residual chemicals of concern or DNAPLs (if any) in the saturated overburden materials would act as a continued source of dissolved chemicals to the ground water. Therefore, the overall effectiveness of soil removal and treatment to achieve the RAOs established for ground water (i.e., eliminating or reducing migration of organic chemicals of concern that would result in further degradation of ground-water quality) would be limited and would not be expected to reduce the remediation time period for the site ground water to less than 30 years.

This alternative would require implementing a site-specific HASP to limit future risks to on-site workers (e.g., during excavation activities). In addition, a ground-water monitoring program at the site boundaries would be implemented to evaluate the effectiveness of the ground-water extraction wells to provide hydraulic control of constituent migration.

Reduction of Toxicity, Mobility, or Volume

Removal and off-site treatment of the unsaturated soils below the clean room would reduce the toxicity, mobility, and volume of organic and inorganic constituents present in the unsaturated soils. Ground-water withdrawal and off-site treatment at a POTW would reduce the toxicity, mobility, and volume of constituents present in the ground water.

Implementability

Excavation and transportation of soils are commonly employed construction activities and are technically feasible. The RCRA incinerator would effectively destroy the organic constituents present in the source area materials, but would be ineffective for remediation of the inorganic constituents. However, most RCRA incineration facilities have the ability to stabilize/solidify the treatment residuals (if necessary) prior to disposal.

Ground-water withdrawal and off-site treatment at a POTW could be effectively implemented at this site to remove chemicals of concern from ground water and provide hydraulic control to mitigate off-site constituent migration. Implementation of this alternative would require updating Hadco's current POTW discharge permit to allow for the increased flow rates. Compliance with the POTW discharge permit would be verified by sampling and analyzing pre-treated ground water prior to being discharged to the POTW. Also, air monitoring of the exhaust stack of the ground-water pre-treatment system would be conducted to demonstrate compliance with regulatory emission levels. (Table 2-4 presents the ARARs identified for the Robintech site.)

Contractors and hazardous waste transporters are available for implementing this alternative. Coordination and advanced scheduling is required to ensure the RCRA incineration facility will have adequate capacity to treat the soils.

Compliance with ARARs

Chemical-Specific ARARs

This alternative is expected to meet the site RAOs for constituents present in the source area soils and ground water at the site.

The concentrations of the total halogenated organic compounds present in the areas of the soils located below the clean room would most likely exceed RCRA land disposal treatment standards and therefore will need to be incinerated at a RCRA incineration facility prior to land disposal. The RCRA incinerator would effectively destroy the organic constituents present in the soil, but may not effectively remove inorganic constituents. Therefore, the incinerated soils will be required to meet the RCRA-regulated levels for TCLP constituents contained in 40 CFR 261 prior to land disposal. If the inorganic concentrations do not comply with this ARAR, the incinerated soils will have to be stabilized/solidified prior to disposal.

The chemical-specific ARARs for the ground-water component of this remedial alternative consists solely of the NYSDEC Class GA ground-water quality standards. Therefore, the chemical-specific ARAR evaluation presented in Section 5.3.2 is applicable to this alternative.

Location-Specific ARARs

Based on the "New York State Archeological Site Locations" map, which was revised March 1992, this site may lie in an archaeologically-sensitive area. However, this alternative consists of installation of a ground-water withdrawal system and excavating below an existing structure; therefore, this alternative is not anticipated to be significantly disruptive to this area. To comply with this ARAR, the site location would be submitted to the NYSDEC Field Services Bureau for review prior to implementation of this alternative.

Action-Specific ARARs

Action-specific ARARs for this alternative apply to the excavation of soils, monitoring requirements, and transportation, treatment and disposal requirements.

Workers and worker activities that would occur during the implementation of this alternative must comply with the OSHA requirements for training, safety equipment and procedures, monitoring, recordkeeping, and reporting. In addition, the RCRA requirements for preparedness and prevention, contingency plans, and emergency procedures would be relevant and appropriate for this alternative. Compliance with these ARARs would be achieved by following a NYSDEC-approved Work Plan and site-specific HASP.

Based on Hadco's current POTW discharge permit, the withdrawn ground water will need to be pre-treated prior to being discharged to the POTW. To demonstrate that the effluent ground-water constituent concentrations comply with the POTW-issued discharge permit, the pre-treated ground water would be sampled and analyzed.

Implementation of this alternative would result in the generation of air emissions. ARARs applicable to air emissions would include the PSD air emission provisions contained in 40 CFR 51 and all relevant requirements under the Clean Air Act (40 CFR 1-99). Additionally, all New York State regulations concerning air emissions would be applicable, such as New York Regulations for General Process Emission Sources (6NYCRR Part 212). (See Table 2-4 for additional potential ARARs identified for the Robintech site.) To comply with the above-mentioned ARARs, the ground-water pre-treatment system would be designed and operated so that the PSD limits would not be exceeded, and the system would comply with all state and federal air emission requirements.

The action-specific ARARs associated with the incineration and disposal of treated soils at a RCRA facility would include the RCRA standards for "Owners/Operators of Permitted Hazardous Waste Facilities" contained in 40 CFR 264, the air emission standards contained in 40 CFR 60, and the PSD provisions in the Clean Air Act. The permitted RCRA incineration and disposal facility must comply with these action-specific ARARs.

The RCRA and NYSDOT requirements for the packaging and transportation of hazardous waste would be applicable to this alternative. Compliance with these ARARs would be achieved by utilizing a licensed hazardous waste hauler and disposing of the wastes at a RCRA-permitted incineration and disposal facility.

Overall Protection of Human Health and the Environment

This alternative would meet the RAOs by removing chemicals of concern present in the ground water and soils and providing hydraulic control of migration of constituents present in the ground water. During implementation of this alternative, human health and the environment would be protected by complying with the applicable ARARs.

Excavation would remove the organic and inorganic constituents of concern from the unsaturated zone beneath the former chemical storage. However, the ground water would contain concentrations of chemicals of concern in excess of NYSDEC Class GA standards for a period of time, requiring implementation of long-term ground-water monitoring and institutional controls.

Cost

The capital costs associated with this alternative include soil excavation, transportation and incineration, backfilling, installation of the ground-water extraction system, and site restoration. O&M costs associated with this alternative include the ground-water pre-treatment system operation, equipment O&M, sampling and analysis of pre-treated ground water, and sampling and analysis of air emissions from the ground-water pre-treatment system. Due to the anticipated implementation period associated with the ground-water component of this alternative (greater than 30 years), the O&M costs associated with this alternative were subjected to a present worth analysis for a 30-year period of time. The estimated cost for this alternative is $2.8 million. Table 5-3 presents a detailed breakdown of the cost and a list of assumptions for this alternative.

6.0 - Comparative Analysis of Remedial Alternatives

This section presents a comparative analysis of each remedial alternative using the seven NCP evaluation criteria identified in Section 5.0. This comparative analysis identifies the advantages and disadvantages of each alternative relative to one another to highlight the differences. The results of this comparative analysis will be used as the basis for recommending a remedial alternative for addressing the chemicals of concern at the site.

Short-Term Effectiveness

All of the remedial alternatives, except for the no-action alternative, involve soil excavation activities. However, Alternative 3 involves more soil excavation activities than Alternative 2 due to implementation of the SVE system. Alternative 4 involves significantly more soil excavation activities than either Alternative 3 or Alternative 2, because, under Alternative 4, the source area soils would be excavated. Soil alternatives that involve soil excavation activities present a higher potential for short-term risks to on-site workers during implementation. A greater number of mitigative measures would need to be implemented to control potential short-term environmental impacts to ambient air quality associated with off-site dust migration and volatilization of the chemicals of concern during soil excavation.

Potential short-term risks, if any, to public health from inhalation of organic vapors associated with the ground-water treatment system and SVE system would need to be evaluated during the remedial design. An analysis of the potential air quality impacts, including compliance with identified ARARs, would be required and, if necessary, an air pollution control system would be installed for the protection of human health and compliance with air emission standards.

Although the duration of the treatment alternatives (Alternatives 2, 3, and 4) cannot be accurately predicted, it is expected that these alternatives would be implemented for a long time (i.e., greater than 30 years) due to the implementation period associated with the ground-water component of the alternatives. This implementation period would not be expected to decrease appreciably, even if the source area soils were treated using an SVE system or if they were excavated, because the saturated overburden beneath the site would continue to act as a source. Thus, implementation of the alternatives which provide for reduction of VOC mass within the unsaturated zone of the overburden (Alternatives 3 and 4) would not be expected to reduce the duration of the ground-water component of these alternatives to less than 30 years.

In accordance with NCP and NYSDEC guidance, the estimated duration of all alternatives (except No-Action) used in this FFS is limited to 30 years. This time frame could be reduced depending on future development of remedial techniques to address ground water impacted by DNAPL and residual chemicals. Thus, it is recommended that a review of available ground-water remediation techniques be conducted every five years to determine if a remedial technique could be implemented at the Robintech site to cost-effectively reduce the overall duration for the selected alternative.

Long-Term Effectiveness

The no-action alternative would not meet RAOs for the Robintech site. Risks identified in the RA, resulting from the chemicals of concern present in the ground water and source area soils, would not be eliminated or reduced under the no-action alternative. The no-action alternative also allows continued leaching of chemicals of concern to site ground water. The remaining remedial alternatives would meet the RAOs for the site, except for complete restoration of the bedrock due to current technical limitations for remediation of possible DNAPLs in the fractured bedrock. However, all alternatives (except Alternative 1 - No-Action) involve pumping of the overburden ground water, which would be expected to reduce downward plume migration into the bedrock. Additionally, there are no known receptors of the bedrock ground water. Thus, even if complete restoration of the bedrock is not achieved, Alternatives 2, 3, and 4 would be protective of human health.

Reduction of Toxicity, Mobility, or Volume

The no-action alternative would not reduce the toxicity, mobility, or volume of the chemicals of concern in site soils. Alternatives 2, 3, and 4 would reduce the toxicity, mobility, and volume of the chemicals of concern in ground water; and Alternatives 3 and 4 would also reduce the toxicity, mobility, and volume of chemicals in the source area soils.

Implementability

All of the remedial alternatives are technically feasible and can be implemented at the site. All alternatives (except no-action) would require performing pump tests on the downgradient pumping well to estimate ground-water capture zones. Treatability testing of the SVE system would be required prior to implementation of Alternative 3.

Compliance with ARARs

All of the remedial alternatives (except no-action) would be designed and implemented to meet ARARs. However, complete restoration of the bedrock is technically impracticable using currently available remedial techniques. The development of remedial techniques to address ground water impacted by DNAPLs is rapidly progressing. It is recommended that a review of available ground-water remediation techniques be conducted every five years to determine if a remedial technique can be implemented at the Robintech site to achieve ARARs and to cost-effectively reduce the overall time frame for implementation.

Overall Protection of Human Health and the Environment

All of the alternatives (except no-action) are protective of human health. All of the remedial alternatives, except the no-action alternative, will hydraulically control the chemicals of concern in the overburden ground water to meet the RAOs.

Cost

A summary of the present worth cost for each alternative is presented below (detailed cost estimates are provided in Tables 5-1 through 5-3).

Alternative	Estimated Present Worth Cost
Alternative 1: No Action	$ 230,000
Alternative 2: Ground-Water Withdrawal and Off-Site Treatment at a POTW	$ 1,400,000
Alternative 3: Soil Vapor Extraction, and Ground-Water Withdrawal and Treatment	$ 2,100,000
Alternative 4: Soil Excavation, and Ground-Water Withdrawal and Treatment	$ 2,800,000

Recommendation

Based on the foregoing comparative analysis, Alternative 2: Ground-Water Withdrawal and Treatment, is the most cost-effective alternative that can meet the RAOs. The estimated present worth cost of this alternative, assuming a 5 percent discount rate for 30 years, is approximately $1,400,000.

Respectively Submitted Edward R. Lynch

Edward R. Lynch, P.E.
Executive Vice President

Tyler E Gass

Tyler E. Gass, C.P.G.
Executive Vice President

Prepared By
David J. Ulm
William T. McCune
M. Cathy Geraci
Terry W. Young

References

1. Blasland & Bouck Engineers, P.C., 1991. Hadco Corporation Work Plan Addendum.
2. Blasland & Bouck Engineers, P.C., 1992. Remedial Investigation Report.
3. Blasland & Bouck Engineers, P.C., 1993. Supplemental Remedial Investigation Report.
4. Ground Water Technology, Inc., 1990. Work Plan for RI/FS, Hadco Corporation, Owego, N.Y.
5. Ground Water Technology, Inc., 1991. Correspondence to Amitava Chakraborti, New York State Department of Environmental Conservation, Division of Hazardous Waste Remediation, from Nicholas Pressly, Ground Water Technology, Inc.
6. NYSDEC, 1989. Technical and Administrative Memorandum Number 4024: "Guidelines for Remedial Investigations/Feasibility Studies."
7. NYSDEC, 1989. "Clean-Up Criteria for Aquatic Sediments."
8. NYSDEC, 1990. Revised Technical and Administrative Memorandum: "Selection of Remedial Actions at Inactive Hazardous Waste Sites."
9. NYSDEC, 1992. New York State Department of Environmental Conservation, Division of Water, (Personal Communication: Jim Beach, re: Surface Water Classifications), Albany, New York, November 19, 1992.
10. USGS, 1992. U.S. Geological Survey, Water Resources Division, (Personal Communication with Richard Mulks, re: Susquehanna Drainage Basin), Ithaca, New York, November 20, 1992.
11. USEPA, 1988. Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA, Interim Final, EPA/540/F-89/004, OSWER Directive 9355.3-01 (Washington, D.C.: U.S. Government Printing Office, 1988).
12. USEPA, 1988. Technology Screening Guide for Treatment of CERCLA Soils and Sludges, EPA/540/2-88/004, Washington, D.C.
13. USEPA, 1989. Terra Vac In Situ Vacuum Extraction System - Applications Analysis Report, EPA/540/A5-89/003, Washington, D.C.
14. USEPA, 1991. OSWER Directive 9355.0-30 (April 22, 1991), Washington, D.C.
15. USEPA, 1992. Dense Non-Aqueous Phase Liquids - A Work Shop Summary, Dallas, Texas, April 16-18, 1991, EPA/600/R-92/30, Washington, D.C.

Tables

TABLE 1-1

SUMMARY OF SUBSURFACE SOIL SAMPLING RESULTS FOR SIEVE ANALYSIS

ROBINTECH/COMPUDYNE SITE
OWEGO, NEW YORK

Sample I.D. (Sample Depth)	Sieve Size - Percent Passing Sieve											
	1"	3/4"	1/2"	3/8"	1/4"	#4	#10	#30	#40	#60	#100	#200
CRB-1A (5 to 6 ft.)	100	85.2	67.0	59.5	48.5	44.2	32.3	20.6	19.1	17.5	16.6	15.5
CRB-5 (8 to 9 ft.)	100	80.6	64.5	57.5	50.0	45.3	34.0	23.3	21.4	19.1	17.8	16.4
CRB-9 (5 to 6 ft.)	100	97.8	81.8	71.2	52.3	44.9	30.9	20.4	18.4	15.7	14.0	12.2
CRB-11 (5 to 6 ft.)	100	87.4	84.0	70.8	58.2	52.4	37.7	24.2	22.4	20.2	18.7	16.5
MW-23 S-8 (14 to 16 ft.)	--	100	92.7	92.7	89.3	87.8	80.5	60.1	50.8	31.8	23.4	18.9
MW-23 S-6 (10 to 12 ft.)	--	100	91.0	87.2	80.9	76.3	61.1	45.3	41.5	32.2	24.9	19.2

Notes:

The sieve analysis was performed in accordance with ASTM D422.
Soil samples were prewashed according to ASTM D1140.

TABLE 1-2

SUMMARY OF SOURCE AREA SOIL BORING ANALYTICAL RESULTS – VOLATILE ORGANIC COMPOUNDS, JUNE 1992

ROBINTECH/COMPUDYNE SITE
OWEGO, NEW YORK

SAMPLE ID (SAMPLE DEPTH)	CRB-1 (7 to 8 ft.)	CRB-2 (7 to 8 ft.)	CRB-3 (7 to 8 ft.)	CRB-4 (5 to 6 ft.)	CRB-5 (6 to 7 ft.)	CRB-6 (7 to 8 ft.)	CRB-7 (3 to 4 ft.)	CRB-8 (8 to 9 ft.)	CRB-9 (6 to 7ft.)	CRB-10 (6 to 7ft.)	CRB-11 (6 to 7ft.)	CRB-12 (7 to 8ft.)
Compound												
Acetone	--	--	54	18	--	--	--	18	--	6 J	14	13
Benzene	--	--	--	--	--	--	--	--	--	--	--	--
Bromomethane	--	--	--	--	--	--	--	--	--	--	--	--
Bromodichloromethane	--	--	--	--	--	--	--	--	--	--	--	--
Bromoform	--	--	--	--	--	--	--	--	--	--	--	--
2-Butanone	--	--	11	13	--	--	--	--	--	--	--	--
Carbon Disulfide	--	--	--	--	--	--	--	--	--	--	--	--
Carbon Tetrachloride	--	--	--	--	--	--	--	--	--	--	--	--
Chlorobenzene	--	--	--	--	--	--	--	--	--	--	--	--
Chloroethane	--	--	--	--	--	--	--	--	--	--	--	--
Chloroform	--	--	--	--	--	--	--	--	--	--	--	--
Chloromethane	--	--	--	--	--	--	--	--	--	--	--	--
Dibromochloromethane	--	--	--	--	--	--	--	--	--	--	--	--
1,1-Dichloroethane	--	--	--	--	--	--	--	2 J	--	--	--	--
1,2-Dichloroethane	--	--	--	--	--	--	--	--	--	--	--	--
1,1-Dichloroethene	43,000 J	--	--	--	45,000 J	--	--	--	--	--	--	--
1,2-Dichloroethene (total)	--	49 BJ	4 J	--	--	--	--	31	--	--	--	2 J
1,2-Dichloropropane	--	--	--	--	--	--	--	--	--	--	--	--
cis-1,3-Dichloropropene	--	--	--	--	--	--	--	--	--	--	--	--
trans-1,3-Dichloropropene	--	--	--	--	--	--	--	--	--	--	--	--
Ethylbenzene	--	--	--	--	--	--	--	--	--	--	--	--
2-Hexanone	--	--	--	9	--	--	--	--	--	--	--	--
Methylene Chloride	21,000 BJ	100 BJ	2 BJ	2 BJ	22,000 BJ	740 BJ	2 BJ	2 BJ	83 BJ	2 BJ	2 BJ	2 BJ
4-Methyl-2-Pentanone	--	--	--	8	--	--	--	--	--	--	--	--
Styrene	--	--	--	--	--	--	--	--	--	--	--	--
1,1,2,2-Tetrachloroethane	--	--	--	1	--	--	--	--	--	--	--	--
Tetrachloroethene	110,000 J	190 J	--	--	31,000 J	--	--	--	810 J	--	--	--
Toluene	200,000 J	610 BJ	1 J	--	150,000 J	3,400 J	--	--	680 J	--	--	--
1,1,1-Trichloroethane	190,000 J	99 J	--	--	210,000 J	5,000 J	--	--	800 J	--	--	--
1,1,2-Trichloroethane	--	--	--	--	--	--	--	--	--	--	--	--
Trichloroethene	17,000,000 D	8,300	99	52	15,000,000 D	170,000	66	3 J	26,000 D	41	39	83
Vinyl Chloride	--	--	--	--	--	--	--	5 J	--	--	--	--
Xylene (total)	10,000 J	--	--	--	--	--	--	--	--	--	--	--
Total VOCs	17,574,000	9,348	171	103	15,458,000	179,140	68	61	28,373	49	55	100

Notes:

All concentrations reported in ug/kg, dry weight (ppb).
B = Compound determined to be present in the blanks as well as in the sample.
J = Estimated value; concentration less than the quantitation limit but greater than zero.
D = Coumpounds identified at a secondary dilution factor.
-- = Not detected.
Total VOCs is the sum of the concentrations for the volatile organic compounds listed.

TABLE 1–3

SUMMARY OF SOURCE AREA SOIL BORING ANALYTICAL RESULTS – VOLATILE ORGANIC COMPOUNDS, DECEMBER 1992

ROBINTECH/COMPUDYNE SITE
OWEGO, NEW YORK

SAMPLE ID	CRB–13	CRB–14	CRB–14	CRB–15	CRB–16	CRB–17	CRB–17	CRB–18	CRB–19	CRB–20*	VE–2	VE–2
(SAMPLE DEPTH)	(6 to 8 ft.)	(2 to 4 ft.)	(6 to 8 ft.)	(4 to 6 ft.)	(6 to 8 ft.)	(2 to 4 ft.)	(4 to 6 ft.)	(4 to 6 ft.)	(4 to 6 ft.)	(4 to 6 ft.)	(2 to 4ft.)	(4 to 6 ft.)
Compound												
Acetone	––	––	––	––	––	––	––	––	––	––	––	––
Benzene	––	––	––	––	––	––	––	––	––	––	––	––
Bromomethane	––	––	––	––	––	––	––	––	––	––	––	––
Bromodichloromethane	––	––	––	––	––	––	––	––	––	––	––	––
Bromoform	––	––	––	––	––	––	––	––	––	––	––	––
2–Butanone	––	––	––	––	––	––	––	––	––	––	––	––
Carbon Disulfide	––	––	––	––	––	––	––	––	––	––	––	––
Carbon Tetrachloride	––	––	––	––	––	––	––	––	––	––	––	––
Chlorobenzene	––	––	––	––	––	––	––	––	––	––	––	––
Chloroethane	––	––	––	––	––	––	––	––	––	––	––	––
Chloroform	––	––	––	––	––	––	––	––	––	––	––	––
Chloromethane	––	––	––	––	––	––	––	––	––	––	––	––
Dibromochloromethane	––	––	––	––	––	––	––	––	––	––	––	––
1,1–Dichloroethane	––	––	––	––	––	––	––	––	––	––	––	––
1,2–Dichloroethane	––	––	––	––	––	––	––	––	––	––	––	––
1,1–Dichloroethene	––	––	––	––	––	––	––	––	––	––	––	––
1,2–Dichloroethene (total)	––	––	––	––	––	––	––	––	––	––	––	––
1,2–Dichloropropane	––	––	––	––	––	––	––	––	––	––	––	––
cis–1,3–Dichloropropene	––	––	––	––	––	––	––	––	––	––	––	––
trans–1,3–Dichloropropene	––	––	––	––	––	––	––	––	––	––	––	––
Ethylbenzene	––	––	850 J	––	––	––	––	––	––	––	––	––
2–Hexanone	––	––	470 J	––	––	––	––	––	––	––	––	––
Methylene Chloride	––	1 J	––	––	––	1 J	––	––	––	––	––	––
4–Methyl–2–Pentanone	––	––	610	––	––	––	––	––	––	––	––	––
Styrene	––	––	––	––	––	––	––	––	––	––	––	––
1,1,2,2–Tetrachloroethane	––	––	110 J	––	––	––	––	––	––	––	––	––
Tetrachloroethene	170 J	1 J	23,000	280 J	27	––	7 J	3 J	0.9 J	610 J	––	110,000 J
Toluene	100 J	2 J	7,600	100 J	––	––	3 J	1 J	––	79 J	––	46,000 J
1,1,1–Trichloroethane	––	1 J	2,800	––	25	––	5 J	2 J	––	––	––	170,000
1,1,2–Trichloroethane	––	––	360 J	––	2 J	––	––	––	––	––	––	––
Trichloroethene	2,500	170	360,000 D	5,400	3,300 D	9 J	200 D	210	6 J	9,900	13	5,300,000 D
Vinyl Chloride	––	––	––	––	––	––	––	––	––	––	––	––
Xylene (total)	110 J	––	5,000	––	––	––	––	––	––	––	––	13,000 J
Total VOCs	2,880	175	400,800	5,780	3,354	10	215	216	7	10,589	13	5,639,000

Notes:

All concentrations reported in ug/kg, dry weight (ppb).
B = Compound determined to be present in the blanks as well as in the sample.
J = Estimated value; concentration less than the quantitation limit but greater than zero.
D = Coumpounds identified at a secondary dilution factor.
–– = Not detected.
Total VOCs is the sum of the concentrations for the volatile organic compounds listed.
*CRB–20 is a duplicate of CRB–15 (4 to 6 feet).

TABLE 1–4

SUMMARY OF SOURCE AREA SOIL BORING ANALYTICAL RESULTS – INORGANICS, JUNE 1992

ROBINTECH/COMPUDYNE SITE
OWEGO, NEW YORK

SAMPLE ID (SAMPLE DEPTH)	CRB–1 (7 to 8 ft.)	CRB–2 (7 to 8 ft.)	CRB–3 (7 to 8 ft.)	CRB–4 (5 to 6 ft.)	CRB–5 (6 to 7 ft.)	CRB–6 (7 to 8 ft.)	CRB–7 (3 to 4 ft.)	CRB–8 (8 to 9 ft.)	CRB–9 (6 to 7ft.)	CRB–10 (6 to 7ft.)	CRB–11 (6 to 7ft.)	CRB–12 (7 to 8ft.)
Analyte												
Beryllium	1.1 U	1.1 U	1.1 U	1.0 U	1.2 U	1.1 U	1.1 U	1.1 U	1.1 U	1.1 U	1.1 U	1.1 U
Chromium	485	220	1,560	51.3	886	169	46.7	810	2,130	712	980	432
Copper	290	257	410	172	374	490	775	2,680	415	170	1,450	141
Lead	255	50.7	97.9	120	2,050	68.7	184	81.8	49.4	256	34.7	41.3
Zinc	20.6	73.5	56.7	61.2	41.4	70.2	21.5	71.3	61.6	21.7	58.4	78.3

Notes:

All concentrations reported in mg/kg, dry weight (ppm).
U = Compound was analyzed for but not detected at the detection limit indicated.

TABLE 1–5

SUMMARY OF SOURCE AREA SOIL BORING ANALYTICAL RESULTS – INORGANICS, DECEMBER 1992

ROBINTECH/COMPUDYNE SITE
OWEGO, NEW YORK

ANALYTE	SAMPLE I.D.											
	CRB–13 (6 to 8 ft)	CRB–14 (2 to 4 ft)	CRB–14 (6 to 8 ft)	CRB–15 (4 to 6 ft)	CRB–16 (6 to 8 ft)	CRB–17 (2 to 4 ft)	CRB–17 (4 to 6 ft)	CRB–18 (4 to 6 ft)	CRB–19 (4 to 6 ft)	CRB–20* (4 to 6 ft)	VE–2 (2 to 4 ft)	VE–2 (4 to 6 ft)
Beryllium	1.0 U	1.1 U	1.1 U	1.1 U	1.1 U	1.1 U	1.1 U	1.2 U	1.1 U	1.1 U	1.1 U	1.2 U
Chromium	419	595	1810	1220	2700	18.8	1590	1800	866	1270	2670	3490
Copper	238	220	438	385	268	18.8	143	830	117	543	2460	524
Lead	230	489	477	688	498	3.7	155	1570	108	667	268	625
Zinc (total)	81.8	35.1	32.3	27.5	37.5	73.3	37.0	12.7	18.0	15.6	56.6	16.2

Notes:

All concentrations reported in mg/kg (ppm).
B – Compound determined to be present in the blanks as well as in the sample.
U – Compound was analyzed for but not detected.
* Duplicate sample of CRB–15 (4 to 6 feet).

TABLE 1-6

SUMMARY OF GROUND-WATER ANALYTICAL RESULTS – VOLATILE ORGANIC COMPOUNDS, OCTOBER 1991

ROBINTECH/COMPUDYNE SITE
OWEGO, NEW YORK

WELL I.D.	MW-1	MW-2	MW-3	MW-4	MW-5	MW-6	MW-7	MW-8	MW-9	MW-10	MW-11	MW-12	MW-13	MW-14	MW-15
Compound															
Acetone	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Benzene	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Bromomethane	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Bromodichloromethane	--	--	--	--	0.5 J	--	--	--	--	--	--	0.3 J	--	--	--
Bromoform	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
2-Butanone	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Carbon disulfide	6	--	--	--	--	--	--	--	48	--	--	--	--	--	--
Carbon tetrachloride	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Chlorobenzene	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Chloroethane	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Chloroform	--	--	--	--	0.5 J	--	--	--	--	--	0.2 J	0.5 J	--	1 J	--
Chloromethane	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Dibromochloromethane	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
1,1-Dichloroethane	--	7	--	--	--	5	--	5	--	--	14	--	--	11	11
1,2-Dichloroethane	--	--	--	--	--	--	--	--	--	--	0.7 J	--	--	--	--
1,2-Dichloroethene (total)	--	21	--	--	--	68	--	14	--	--	52	--	--	110	11
1,1-Dichloroethene	--	2 J	--	--	--	0.9 J	--	3 J	--	--	5	--	--	37	1 J
1,2-Dichloropropane	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
cis-1,3-Dichloropropene	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
trans-1,3-Dichloropropene	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Ethyl benzene	--	--	--	--	--	0.3 J	--	--	--	--	--	--	--	--	--
2-Hexanone	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Methylene chloride	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
4-Methyl-2-pentanone	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Styrene	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
1,1,2,2-Tetrachloroethane	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Tetrachloroethene	--	--	--	--	--	--	--	--	--	--	--	--	--	1 J	--
Toluene	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
1,1,1-Trichloroethane	--	12	--	--	--	--	--	21	--	--	39	--	2 J	140	5
1,1,2-Trichloroethane	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Trichloroethene	4 J	83	--	50	4 J	27	0.7 J	110	12	0.7 J	260 D	--	6	660 D	120
Vinyl acetate	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Vinyl chloride	--	7 J	--	--	--	39	--	--	--	--	--	--	--	--	--
Xylene (total)	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Total VOCs	10	132	0	50	5	140.2	0.7	153	60	0.7	370.9	0.8	8	960	148

TABLE 1-5
(Cont'd.)

SUMMARY OF GROUND-WATER ANALYTICAL RESULTS – VOLATILE ORGANIC COMPOUNDS, OCTOBER 1991

ROBINTECH/COMPUDYNE SITE
OWEGO, NEW YORK

WELL I.D.	MW-B17	MW-18	MW-19	MW-B20	MW-B21	MW-B22	MW-23	MW-24	MW-25	MW-26	MW-27	MW-B28	PW-1	MW-8A DUP MW-8	MW-19A DUP MW-19
Compound															
Acetone	110	--	320	--	--	--	63	--	--	--	10	110	89	--	350
Benzene	40	--	340	--	--	--	47	--	--	3 J	--	--	0.7 J	--	340
Bromomethane	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Bromodichloromethane	--	--	10 J	--	--	--	--	--	--	--	--	--	--	--	--
Bromoform	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
2-Butanone	57	--	--	--	--	--	--	--	--	--	--	--	300 D	--	--
Carbon disulfide	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Carbon tetrachloride	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Chlorobenzene	--	--	--	--	--	--	1 J	--	--	--	--	--	--	--	--
Chloroethane	52	--	--	--	--	--	4 J	--	--	--	--	--	17	--	--
Chloroform	10	0.7 J	79 J	--	--	--	16	--	2 J	1 J	0.3 J	--	--	--	82 J
Chloromethane	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Dibromochloromethane	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
1,1-Dichloroethane	8700 D	86	120	9	--	1 J	1400 D	11	7 J	200 D	21	21	47	6	120
1,2-Dichloroethane	57	3	100	--	--	--	14	--	--	7	--	--	--	--	110
1,2-Dichloroethene (total)	470 DJ	48	340	3 J	--	7	1400 D	110	74	200 D	110	38	77	18	380
1,1-Dichloroethene	170 DJ	75	23000 DJ	5	--	2 J	1100 D	10	10	180	25	16	--	4 J	21000 DJ
1,2-Dichloropropane	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
cis-1,3-Dichloropropene	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
trans-1,3-Dichloropropene	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Ethyl benzene	190 DJ	--	770	--	--	--	59	--	--	--	--	--	22	--	730
2-Hexanone	--	--	--	--	--	--	66	--	--	--	--	--	--	--	--
Methylene chloride	18	--	4700 DJ	--	--	--	250 DJ	--	--	1 J	0.8 J	--	1 J	--	5100 DJ
4-Methyl-2-pentanone	230 E	--	320	--	--	--	59	--	--	--	--	--	--	--	350
Styrene	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
1,1,2,2-Tetrachloroethane	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Tetrachloroethene	23	--	2100	--	--	--	170 DJ	--	0.3 J	2 J	2 J	--	--	--	2300
Toluene	3800 D	--	24000 DJ	--	--	--	1100 D	--	--	--	4 J	--	170	--	22000 DJ
1,1,1-Trichloroethane	11000 D	420 D	190000 D	110	--	11	9300 D	210	52	1300 D	83	180	2 J	26	180000 D
1,1,2-Trichloroethane	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Trichloroethene	18000 BD	720 D	630000 BD	19	--	23	57000 BD	320 B	350 D	2100 D	890 BD	360	3 J	160	600000 BD
Vinyl acetate	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Vinyl chloride	29	--	--	--	--	--	7 J	38	--	27	38	2 J	11	--	--
Xylene (total)	1200 D	--	2900	--	--	--	340	--	--	--	--	--	62	--	2800
Total VOCs	44,156	1,352.7	879,099	146	0	44	72,396	699	495.3	4,021	1,184.1	727	801.7	214	835,662

Notes:

Units in ug/L.
All concentrations reported in ug/L (ppb).
B = Compound determined to be present in the blanks as well as in the sample.
D = Compounds identified 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.
U = Compound was analyzed for but not detected.
Dates = October 21, 1991 – October 24, 1991.
-- = Not detected.
Total VOCs is the sum of the concentration for the organic compounds listed.

TABLE 147 4

SUMMARY OF GROUND-WATER ANALYTICAL RESULTS – VOLATILE ORGANIC COMPOUNDS, AUGUST/SEPTEMBER 1992

ROBINTECH/COMPUDYNE SITE
OWEGO, NEW YORK

	WELL NUMBER																
	MW-14	MW-17	MW-18	MW-19	MW-20	MW-22	MW-23	MW-24	MW-25	MW-26	MW-27	MW-29	MW-30	MW-31	MW-32	MW-33	PW-3
Compound																	
Acetone	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Benzene	--	--	--	--	--	--	--	--	--	7 J	--	--	--	--	--	9 J	8 J
Bromomethane	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Bromodichloromethane	--	--	--	--	--	--	--	--	0.6 J	--	--	--	--	--	--	--	--
Bromoform	--	--	--	--	--	--	--	--	0.3 J	--	--	--	--	--	--	--	--
2-Butanone	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Carbon Disulfide	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Carbon Tetrachloride	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Chlorobenzene	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.3 BJ	--
Chloroethane	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Chloroform	--	--	0.5 J	--	--	--	--	--	2 J	4 J	--	--	--	--	0.1 J	--	3 J
Chloromethane	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Dibromochloromethane	--	--	--	--	--	--	--	--	0.7 J	--	--	--	--	--	--	--	--
1,1-Dichloroethane	--	2000	81	--	24	29 J	190 J	4 J	3 J	410 DJ	--	18 J	--	--	2 J	1 J	570 DJ
1,2-Dichloroethane	--	--	3 J	--	--	--	--	--	0.2 J	13	--	--	--	--	--	--	13
1,1-Dichloroethene	--	440 J	62	16000 J	22	64	1500 J	4 J	8 J	640 D	--	49 J	--	--	4 J	--	310 DJ
1,2-Dichloroethene (total)	59 J	3600	41 J	--	11	130	1500 J	15	34	710 D	53 J	92 J	--	--	4 J	3 J	360 DJ
1,2-Dichloropropane	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
cis-1,3-Dichloropropene	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
trans-1,3-Dichloropropene	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Ethylbenzene	--	270 J	--	520 J	--	--	--	--	--	--	--	--	--	--	--	0.3 J	12
2-Hexanone	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Methylene Chloride	--	--	5 BJ	8100 BJ	--	3 BJ	270 BJ	--	1 BJ	4 J	--	7 BJ	0.5 BJ	0.6 BJ	--	--	5 J
4-Methyl-2-Pentanone	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Styrene	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
1,1,2,2-Tetrachloroethane	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Tetrachloroethene	--	--	--	2200 J	--	--	48 J	0.9 J	0.7 J	12	--	5 J	--	--	--	0.6 J	10
Toluene	8 J	5600	--	20000 J	--	--	400 J	2 J	--	--	--	10 J	--	--	--	1 J	92
1,1,1-Trichloroethane	110	54000 D	480	120000	230 D	230	8000	110	48	5200 D	34 J	220	4 J	--	24	2 J	6700 D
1,1,2-Trichloroethane	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Trichloroethene	1100 B	51000 BD	720	470000	89	800	29000	240 BD	330 D	9100 D	1700 B	1000	4 J	1 J	2 J	31	7900 BD
Vinyl Chloride	--	--	--	--	--	--	--	--	--	56	--	--	--	--	--	--	28
Xylene (total)	--	1100	--	2400 J	--	--	100 J	0.9 J	--	--	--	7 J	--	--	0.5 J	16	48
Total VOCs	1277	118010	1392.5	639220	376	1256	41008	376.8	428.5	16156	1787	1408	8.5	1.6	36.6	64.2	16059

Notes:

All concentrations reported in ug/L (ppb).
B = Compound determined to be present in the blanks as well as in the sample.
D = Compounds identified at a secondary dilution factor.
J = Indicates an estimated value.
-- = Not detected.
Total VOCs is the sum of the concentrations for the volatile organic compounds listed.

TABLE ~~1-8~~ 4

SUMMARY OF GROUND-WATER ANALYTICAL RESULTS – VOLATILE ORGANIC COMPOUNDS, JUNE 1993

ROBINTECH/COMPUDYNE SITE
OWEGO, NEW YORK

	WELL NUMBER																
	MW-2	MW-6	MW-11	MW-15	MW-17	MW-19	MW-23	MW-24	MW-25	MW-26	MW-27	MW-29	MW-30	MW-31	MW-32	MW-33	PW-3
Compound																	
Acetone	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Benzene	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	19	--
Bromomethane	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Bromodichloromethane	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Bromoform	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
2-Butanone	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Carbon Disulfide	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Carbon Tetrachloride	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Chlorobenzene	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Chloroethane	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Chloroform	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Chloromethane	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Dibromochloromethane	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
1,1-Dichloroethane	7	25 D	14 D	11	5700 D	--	--	26 DJ	8 DJ	210 DJ	--	14	--	--	--	4 J	480 D
1,2-Dichloroethane	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
1,1-Dichloroethene	3 J	15 DJ	13 D	2 J	--	14000 DJ	3600 D	--	7 DJ	220 DJ	--	25	--	--	2 J	--	210 DJ
1,2-Dichloroethene (total)	22	260 D	51 D	12	1600 DJ	--	1800 DJ	46 DJ	63 D	410 D	94 DJ	69	--	--	4 J	7	360 D
1,2-Dichloropropane	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
cis-1,3-Dichloropropene	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
trans-1,3-Dichloropropene	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Ethylbenzene	--	--	--	--	1200 DJ	--	--	--	--	--	--	--	--	--	--	1 J	--
2-Hexanone	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Methylene Chloride	--	--	--	--	--	3900 DJ	--	--	--	--	--	--	--	--	--	--	--
4-Methyl-2-Pentanone	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Styrene	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
1,1,2,2-Tetrachloroethane	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Tetrachloroethene	--	--	--	0.5 J	--	2200 DJ	--	--	--	--	--	--	--	--	--	0.8 J	--
Toluene	--	--	--	--	6400 D	20000 D	2600 D	--	--	--	--	--	--	--	--	0.6 J	--
1,1,1-Trichloroethane	12	18 DJ	84 D	6	31000 D	140000 D	38000 D	1200 D	43 D	2500 D	39 DJ	100	--	--	22	5	5800 D
1,1,2-Trichloroethane	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Trichloroethene	120	620 D	350 D	120	37000 D	500000 D	72000 D	1100 D	320 D	4600 D	3200 D	370	--	--	--	52	6400 D
Vinyl Chloride	8 J	94 D	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Xylene (total)	--	--	--	--	910 DJ	--	--	--	--	--	--	--	--	--	0.9 J	20	--
Total VOCs	172	1032	512	151.5	83810	680100	118000	2372	441	7940	3333	578	0	0	28.9	109.4	13250

Notes:

All concentrations reported in ug/L (ppb).
B = Compound determined to be present in the blanks as well as in the sample.
J = Estimated value; concentration less than the quantitation limit but greater than zero.
D = Coumpounds identified at a secondary dilution factor.
-- = Not detected.
Total VOCs is the sum of the concentrations for the volatile organic compounds listed.

TABLE 1–9

SUMMARY OF GROUND–WATER ANALYTICAL RESULTS – INORGANICS, OCTOBER 1991

ROBINTECH/COMPUDYNE SITE
OWEGO, NEW YORK

ANALYTE	SAMPLE I.D.									
	MW–1	MW–2	MW–3	MW–4	MW–5	MW–6	MW–7	MW–8	MW–9	MW–10
Aluminum	0.176 B	5.64	4.02	0.05	5.36	5.6	1.43	26.6	15.1	31.4
Antimony	0.01 U	0.01 U	0.005 U	0.005 U	0.01 U	0.01 U	0.005 U	0.005 U	0.005 U	0.01 U
Arsenic	0.005 U	0.009 B	0.005 U	0.005 U	0.005 U	0.041	0.019	0.02	0.006 B	0.019
Beryllium	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.0053	0.005 U	0.005 U	0.005 U	0.005 U
Cadmium	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U
Chromium	0.01 U	0.124	3.47	0.076	0.567	0.803	18.1	0.446	0.017	0.0507
Cobalt	0.02 U	0.02 U	0.02 U	0.02 U	0.02 U	0.0289 B	0.0211 B	0.0268 B	0.021 B	0.0353 B
Copper	0.01 U	0.101	0.0639	0.029	0.0273	0.738	0.0952	0.179	0.0759	0.0844
Iron	4.36	29.4	89.2	0.304	15.7	69.1	51.9	55.6	27.7	61
Lead	0.003	0.023	0.029	0.003	0.0171	0.18	0.01	0.0468	0.029	0.0985
Magnesium	8.28	18.3	11.7	18.9	5.38	17.8	6.24	17.8	14.6	44.5
Manganese	1.16	5.32	0.442	0.005 U	0.657	5.69	0.204	1.07	3.42	18.5
Mercury	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0013	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U
Nickel	0.0368 B	0.086	0.0491	0.02 U	0.177	0.156	0.868	0.155	0.0905	0.343
Selenium	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.05 U	0.005 U	0.05 U	0.05 U	0.05 U
Silver	0.027	0.01 U	0.006 U	0.006 U	0.01 U	0.0144	0.006 U	0.006 U	0.006 U	0.026
Sodium	28.3	31.6	30.4	89.5	73.7	43.8	33.4	36.2	39.9	99.4
Thallium	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U
Vanadium	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U	0.0419 B	0.0401 B	0.0321 B	0.03 U	0.03 U
Zinc (total)	0.0167 B	0.0474	0.0395	0.0184 B	0.0578	0.225	0.0819	0.178	0.221	0.266

Notes:

All concentrations reported in mg/l (ppm).
B – Compound determined to be present in the blanks as well as in the sample.
U – Compound was analyzed for but not detected.

TABLE 1-9
(Cont'd.) 6

SUMMARY OF GROUND-WATER ANALYTICAL RESULTS - INORGANICS, OCTOBER 1991

ROBINTECH/COMPUDYNE SITE
OWEGO, NEW YORK

ANALYTE	SAMPLE I.D.									
	MW-11	MW-12	MW-13	MW-14	MW-15	MW-17	MW-18	MW-19	MW-20	MW-21
Aluminum	315	2.45	63.3	104	9.24	0.568	18.9	92.3	74.7	7.55
Antimony	0.005 U	0.01 U	0.005 U	0.01 U	0.01 U	0.01 U	0.005 U	0.01 U	0.005 U	0.005 U
Arsenic	0.066	0.005 U	0.019	0.019	0.007 B	0.012	0.009 B	0.052	0.016	0.005 U
Beryllium	0.011	0.005 U	0.005 U	0.006	0.005 U	0.005 U	0.005 U	0.0098	0.0065	0.005 U
Cadmium	0.005 U	0.005 U	0.005 U	0.005	0.006	0.005 U	0.005 U	0.012	0.005 U	0.005 U
Chromium	5.86	0.01 U	0.04	0.345	0.063	0.01 U	0.078	17.6	0.587	0.011
Cobalt	0.322	0.02 U	0.0395 B	0.103	0.0233 B	0.02 U	0.0229 B	0.129	0.0803	0.02 U
Copper	1.44	0.01 U	0.664	0.3	0.0717	0.118	0.0441	22.5	0.292	0.0814
Iron	710	4.45	68	202	17.4	36.1	35.1	128	173	15.2
Lead	0.33	0.004	0.051	0.18	0.023	0.011	0.0509	0.113	0.126	0.017
Magnesium	714	8.67	19	47.2	42	9	21.9	53.5	46.1	31.2
Manganese	19.7	0.561	15.4	9.68	1.65	2.62	0.383	12.2	2.34	1.4
Mercury	0.0015	0.0002 U	0.0002 U	0.00042	0.0002 U	0.0002 U	0.0002 U	0.0014	0.0002 U	0.0002 U
Nickel	1.006	0.0355 B	0.343	0.315	0.0254 B	0.0327 B	0.0338 B	1.07	0.195	0.0392 B
Selenium	0.005 U	0.005 U	0.05 U	0.05 U	0.005 U	0.005 U	0.05 U	0.05 U	0.05 U	0.05 U
Silver	0.011	0.01 U	0.0063 B	0.0116	0.012	0.01 U	0.006 U	0.0162	0.006 U	0.0061 B
Sodium	31.7	29.7	28	128	37.1	35.3	19	83	16.5	22.5
Thallium	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U
Vanadium	0.425	0.03 U	0.0398 B	0.118	0.03 U	0.03 U	0.03 U	0.0777	0.0833	0.03 U
Zinc (total)	1.628	0.0445	2.01	0.602	0.125	0.0631	0.107	0.873	0.525	0.097

Notes:

All concentrations reported in mg/l (ppm).
B – Compound determined to be present in the blanks as well as in the sample.
U – Compound was analyzed for but not detected.

TABLE 1–9
(Cont'd.)

SUMMARY OF GROUND–WATER ANALYTICAL RESULTS – INORGANICS, OCTOBER 1991

ROBINTECH/COMPUDYNE SITE
OWEGO, NEW YORK

ANALYTE	SAMPLE I.D.									
	MW–22	MW–23	MW–24	MW–25	MW–26	MW–27	MW–28	PW–1	MW–8A DUP MW–8	MW–19A DUP MW–19
Aluminum	1.18	1.76	0.194 B	7.88	1.02	0.762	179	8.34	13.1	56.7
Antimony	0.005 U	0.01 U	0.01 U	0.005 U	0.005 U	0.01 U	0.005 U	0.01 U	0.005 U	0.01 U
Arsenic	0.007 B	0.05 U	0.005 U	0.005 U	0.005 U	0.005 U	0.048	0.026	0.006 B	0.016
Beryllium	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.0083
Cadmium	0.005 U	0.006	0.005 U	0.005 U	0.005 U	0.009	0.05 U	0.005 U	0.005 U	0.005 U
Chromium	0.01 U	0.029	0.01 U	0.522	0.06	0.098	0.644	0.26	0.028	8.56
Cobalt	0.02 U	0.0224 B	0.02 U	0.02 U	0.02 U	0.02 U	0.176	0.02 U	0.02 U	0.108
Copper	0.066	0.0517	0.0182 B	0.417	0.0405	0.0251	2.39	0.334	0.0493	19.8
Iron	26.5	1.43	0.207	10.5	2.66	1.43	1860	57.1	22.9	32.3
Lead	0.01	0.009	0.003	0.013	0.008	0.011	0.35	0.016	0.016	0.025
Magnesium	11.1	50.3	10.3	13.8	17.7	13.6	94.1	33.6	19.3	41.2
Manganese	1.16	2.11	0.788	2.66	0.888	1.28	12.3	35.4	0.253	11
Mercury	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.00034
Nickel	0.0207 B	0.0751	0.02 U	0.121	0.0207 B	0.02 U	0.644	0.542	0.0392 B	1.02
Selenium	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.05 U	0.05 U
Silver	0.006 U	0.01 U	0.01 U	0.006 U	0.006 U	0.01 U	0.0093 B	0.0165	0.006 U	0.01 U
Sodium	29	203	39.2	49.5	53.5	45.3	443	70.2	19.3	81.4
Thallium	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U
Vanadium	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U	0.3 U	0.03 U	0.03 U	0.03 U
Zinc (total)	0.185	0.0397	0.01 U	0.0625	0.0557	0.0528	1.48	0.045	0.0889	0.764

Notes:

All concentrations reported in mg/l (ppm).
B – Compound determined to be present in the blanks as well as in the sample.
U – Compound was analyzed for but not detected.

TABLE 1-10

SUMMARY OF GROUND-WATER ANALYTICAL RESULTS - INORGANICS, AUGUST/SEPTEMBER 1992

ROBINTECH/COMPUDYNE SITE
OWEGO, NEW YORK

	WELL NUMBER								
	MW-14	MW-17	MW-18	MW-19	MW-20	MW-22	MW-23	MW-24	MW-25
Analyte									
Arsenic	0.0338	0.015	0.006 B	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U
Beryllium	0.005	0.005 U	0.005 U	0.007	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U
Cadmium	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U
Chromium	0.294	0.013	0.010 U	6.72	0.010 U	0.010 U	0.022	0.028	0.170
Copper	0.303	0.010 U	0.162	18.4	0.142	0.100	0.034	0.010 U	0.199
Lead	0.158	0.005	0.017	0.011	0.004	0.003 U	0.004	0.004	0.004
Manganese	5.72	3.1	0.103	10.2	0.212	0.058	2.04	0.149	0.229
Mercury	0.00023	0.00020 U	0.00020 U	0.00068	0.00020 U	0.00020 U	0.00020 U	0.00020 U	0.00020 U
Nickel	0.218	0.039 B	0.030 U	0.956	0.030 U	0.030 B	0.314	0.030 U	0.061
Silver	0.024	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U
Zinc	0.683	0.010 U	0.223	0.767	0.098	0.097	0.032	0.010 U	0.020

	WELL NUMBER							
	MW-26	MW-27	MW-29	MW-30	MW-31	MW-32	MW-33	PW-3
Analyte								
Arsenic	0.005 B	0.005 U	0.013	0.005 U	0.020	0.005 U	0.014	0.005 U
Beryllium	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U
Cadmium	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U
Chromium	0.033	0.108	0.054	0.048	0.032	0.014	0.309	0.01 U
Copper	0.035	0.015 B	0.106	0.065	0.142	0.022 B	0.264	0.01 U
Lead	0.021	0.006	0.056	0.012	0.060	0.011	0.069	0.004
Manganese	2.16	1.41	2.05	1.28	1.91	0.125	6.88	0.583
Mercury	0.00020 U	0.00020 U	0.00020 U	0.00020 U	0.00020 U	0.00020 U	0.00020 U	0.00020 U
Nickel	0.031 B	0.030 U	0.088	0.074	0.080	0.030 U	0.124	0.030 U
Silver	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U
Zinc	0.058	0.015 B	0.198	0.093	0.216	0.038	0.220	0.021

Notes:

All concentrations reported in mg/L (ppm).
U = Compound was analyzed for but not detected at the detection limit indicated.
B = Analyte found in the associated blank as well as the sample.

TABLE 1–11

SUMMARY OF GROUND–WATER ANALYTICAL RESULTS – INORGANICS, JUNE 1993

ROBINTECH/COMPUDYNE SITE
OWEGO, NEW YORK

WELL NUMBER:	MW–2	MW–6	MW–11	MW–15	MW–17	MW–19	MW–23	MW–24	MW–25
ANALYTE									
Chromium	0.013	2.7	1	0.53	0.010 U	6.7	0.087	0.030	0.20
Copper	0.011	6.8	0.58	0.12	0.011	14.1	0.097	0.016	0.077
Zinc	0.075	0.65	0.53	0.50	0.14	0.52	0.10	0.056	0.034

WELL NUMBER:	MW–26	MW–27	MW–29	MW–30	MW–31	MW–32	MW–33	PW–3
ANALYTE								
Chromium	0.019	0.38	0.022	0.010 U	0.041	0.010 U	0.20	0.049
Copper	0.023	0.12	0.011	0.018	0.067	0.018	0.11	0.10
Zinc	0.073	0.20	0.020 U	0.079	0.59	0.093	0.15	0.36

Notes:

All concentrations reported in mg/L.
U – Compound was analyzed for but not detected at the detection limit indicated.

TABLE 1-12

SUMMARY OF SURFACE WATER ANALYTICAL RESULTS – VOLATILE ORGANIC COMPOUNDS

ROBINTECH/COMPUDYNE SITE
OWEGO, NEW YORk

SAMPLE I.D.	SW-1	SW-2	SW-3	SW-4	SW-5 DUP SW-3
COMPOUND					
Acetone	--	--	--	--	--
Benzene	--	--	--	--	--
Bromomethane	--	--	--	--	--
Bromodichloromethane	--	--	--	--	--
Bromoform	--	--	--	--	--
2-Butane	--	--	--	--	--
Carbon disulfide	--	--	--	--	--
Carbon tetrachloride	--	--	--	--	--
Chlorobenzene	--	--	--	--	--
Chloroethane	--	--	--	--	--
Chloroform	--	--	--	--	--
Chloromethane	--	--	--	--	--
Dibromochloromethane	--	--	--	--	--
1,1-Dichloroethane	--	--	--	--	--
1,2-Dichloroethane	--	--	--	--	--
1,2-Dichloroethane (total)	--	--	--	--	--
1,1-Dichloroethene	--	--	--	--	--
1,2-Dichloropropane	--	--	--	--	--
cis-1,3-Dichloropropene	--	--	--	--	--
trans-1,3-Dichloropropene	--	--	--	--	--
Ethyl benzene	--	--	--	--	--
2-Hexanone	--	--	--	--	--
Methylene chloride	--	--	--	--	--
4-Methyl-2-pentanone	--	--	--	--	--
Styrene	--	--	--	--	--
1,1,2,2-Tetrachloroethane	--	--	--	--	--
Tetrachloroethene	--	--	--	--	--
Toluene	--	--	--	--	--
1,1,1-Trichloroethane	--	--	--	--	--
1,1,2-Trichloroethane	--	--	--	--	--
Trichloroethene	3 J	2 J	--	--	--
Vinyl acetate	--	--	--	--	--
Vinyl chloride	--	--	--	--	--
Xylene (total)	--	--	--	--	--

Notes:

All concentrations reported in ug/l (ppb).
J = Estimated value; concentration less than the sample quantitation limit but greater than zero.
-- = Not detected.

TABLE 1-13

SUMMARY OF SURFACE WATER ANALYTICAL RESULTS – INORGANICS

ROBINTECH/COMPUDYNE SITE
OWEGO, NEW YORK

	SAMPLE I.D.				
ANALYTE	SW-1	SW-2	SW-3	SW-4	SW-5
Aluminum	60 U	60 U	60 U	87.9 B	60 U
Antimony	10 U	10 U	10 U	10 U	10 U
Arsenic	5 U	5 U	5 U	5 U	5 U
Beryllium	5 U	5 U	5 U	5 U	5 U
Cobalt	20 U	20 U	20 U	20 U	20 U
Cadmium	5 U	5 U	5 U	5 U	5 U
Chromium	10 U	10 U	10 U	10 U	10 U
Copper	10 U	10 U	10 U	10 U	10 U
Iron	67.3 B	61.9 B	51.4 B	82.9 B	47.8 B
Lead	3 U	3 U	3 U	3	3 U
Magnesium	5990	6040	8260	8820	8240
Manganese	27.4	14.4 B	14.8 B	41	5.8 B
Mercury	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
Nickel	20 U	21 B	20 U	20 U	20 U
Selenium	5 U	5 U	5 U	5 U	5 U
Silver	10 U	10 U	10 U	10 U	10 U
Sodium	9310	14000	20400	27300	21200
Thallium	5 U	5 U	5 U	5 U	5 U
Vanadium	30 U	30 U	30 U	30 U	30 U
Zinc (total)	10 U	10 U	10 U	10 U	10 U

Notes:

All concentrations reported in ug/l (ppb).
B – Compound determined to be present in the blanks as well as in the sample.
U – Compound was analyzed for but not detected.

TABLE 1–14

SUMMARY OF STREAM SEDIMENT ANALYTICAL RESULTS – VOLATILE ORGANIC COMPOUNDS

ROBINTECH/COMPUDYNE SITE
OWEGO, NEW YORK

SAMPLE I.D.	SED–1	SED–2	SED–3	SED–4	SED–5 DUP SED3
Compound					
Acetone	11 BJ	12 BJ	––	––	6 BJ
Benzene	––	––	1 J	––	––
Bromomethane	––	––	––	––	––
Bromodichloromethane	––	––	––	––	––
Bromoform	––	––	––	––	––
2–Butane	––	––	––	––	––
Carbon disulfide	––	––	––	––	––
Carbon tetrachloride	––	––	––	––	––
Chlorobenzene	––	––	––	––	––
Chloroethane	––	––	––	––	––
Chloroform	––	––	––	––	––
Chloromethane	––	––	––	––	––
Dibromochloromethane	––	––	––	––	––
1,1–Dichloroethane	––	––	––	––	––
1,2–Dichloroethane	––	––	––	––	––
1,2–Dichloroethane (total)	––	––	––	––	––
1,1–Dichloroethene	––	––	––	––	––
1,2–Dichloropropane	––	––	––	––	––
cis–1,3–Dichloropropene	––	––	––	––	––
trans–1,3–Dichloropropene	––	––	––	––	––
Ethyl benzene	––	––	––	––	––
2–Hexanone	––	––	––	––	––
Methylene chloride	––	––	0.8 J	––	––
4–Methyl–2–pentanone	––	––	––	––	––
Styrene	––	––	––	––	––
1,1,2,2–Tetrachloroethane	––	––	––	––	––
Tetrachloroethene	––	––	––	––	––
Toluene	––	––	––	––	––
1,1,1–Trichloroethane	––	––	––	––	––
1,1,2–Trichloroethane	––	––	––	––	––
Trichloroethene	––	––	––	––	2 J
Vinyl acetate	––	––	––	––	––
Vinyl chloride	––	––	––	––	––
Xylene (total)	––	––	––	––	––

Notes:

All concentrations reported in ug/kg, dry weight (ppb).
B = Compound determined to be present in the blanks as well as in the sample.
J = Estimated value; concentration less than the sample quantitation limit but greater than zero.
–– = Not detected.

TABLE 1–15

SUMMARY OF WETLANDS SEDIMENT ANALYTICAL RESULTS
VOLATILE ORGANIC COMPOUNDS

ROBINTECH/COMPUDYNE SITE
OWEGO, NEW YORK

SAMPLE ID (SAMPLE DEPTH)	SS–1–93 0–6"	SS–2–93 0–6"
Compound		
Acetone	--	--
Benzene	--	--
Bromomethane	--	--
Bromodichloromethane	--	--
Bromoform	--	--
2–Butanone	--	--
Carbon Disulfide	--	--
Carbon Tetrachloride	--	--
Chlorobenzene	--	--
Chloroethane	--	--
Chloroform	--	--
Chloromethane	--	--
Dibromochloromethane	--	--
1,1–Dichloroethane	--	--
1,2–Dichloroethane	--	--
1,1–Dichloroethene	--	--
1,2–Dichloroethene (total)	--	--
1,2–Dichloropropane	--	--
cis–1,3–Dichloropropene	--	--
trans–1,3–Dichloropropene	--	--
Ethylbenzene	--	--
2–Hexanone	--	--
Methylene Chloride	--	--
4–Methyl–2–Pentanone	--	--
Styrene	--	--
1,1,2,2–Tetrachloroethane	--	--
Tetrachloroethene	--	--
Toluene	--	--
1,1,1–Trichloroethane	--	--
1,1,2–Trichloroethane	--	--
Trichloroethene	--	--
Vinyl Chloride	--	--
Xylene (total)	--	--
Total VOCs	--	--

Note:

All concentrations reported in ug/kg, dry weight (ppb).

TABLE 1–16

SUMMARY OF STREAM SEDIMENT ANALYTICAL RESULTS – INORGANICS

ROBINTECH/COMPUDYNE SITE
OWEGO, NEW YORK

	SAMPLE I.D.				
ANALYTE	SED–1	SED–2	SED–3	SED–4	SED–5
Aluminum	12900	15200	10600	15100	10700
Antimony	2.3 U	2.5 U	23.5 U	2.4 U	2.3 U
Arsenic	10	20.8	12.6	17.4	11.8
Beryllium	1.1 U	1.3 U	1.2 U	1.2 U	1.1 U
Cobalt	12.2	14.6	9.6	16.6	8.9 B
Cadmium	1.1 U	1.3 U	1.2	1.2 U	1.1 U
Chromium	17.7	19	14.6	22.5	15.2
Copper	30.3	27.3	18.6	59.4	28.7
Iron	33800	37500	25700	36200	25400
Lead	10.2	27.5	15.7	41.4	12.9
Magnesium	4310	5000	3620	5180	3510
Manganese	704	1000	472	1430	331
Mercury	0.1 U	0.11 U	0.11 U	0.11 U	0.1 U
Nickel	37.6	46.3	29.4	49.3	25.7
Selenium	1.2 U	1.3 U	1.2 U	1.2 U	1.1 U
Silver	15.4	12.8	2.9	2.4	2.3 U
Sodium	246 B	274 B	231 B	259 B	235 B
Thallium	1.2 U	1.3 U	1.2 U	1.2 U	1.1 U
Vanadium	12.4	15.9	10.1 B	16.1	10 B
Zinc (total)	78.8	89.2	60.7	104	62.7

Notes:

All concentrations reported in mg/kg, dry weight (ppm).
B = Compound determined to be present in the blanks as well as in the sample.
U = Compound was analyzed for but not detected.

TABLE 1-17

SUMMARY OF WETLANDS SEDIMENT ANALYTICAL RESULTS INORGANICS

ROBINTECH/COMPUDYNE SITE
OWEGO, NEW YORK

SAMPLE ID (SAMPLE DEPTH)	SS-1-93 0"-6"	SS-2-93 0"-6"
Analyte		
Chromium	683	790
Copper	162	8.3
Zinc	102	48.3
TOC	1,430	786

Notes:

Concentrations reported in mg/kg dry weight.
TOC = Total Organic Carbon (ug/g)

TABLE 2-1

MAXIMUM CONCENTRATION OF VOLATILE ORGANIC CONTAMINANTS FOR THE TOXICITY CHARACTERISTIC LEACHING PROCEDURE (TCLP)

ROBINTECH/COMPUDYNE SITE
OWEGO, NEW YORK

USEPA HAZARDOUS WASTE NO.	CONTAMINANT	REGULATORY LEVEL (mg/l)
D018	Benzene	0.5
D035	2-Butanone	200.0
D019	Carbon Tetrachloride	0.5
D021	Chlorobenzene	100.0
D022	Chloroform	6.0
D028	1,2-Dichloroethane	0.5
D029	1,1-Dichloroethene	0.7
D039	Tetrachloroethene	0.7
D040	Trichloroethene	0.5
D043	Vinyl Chloride	0.2

TABLE 2-2

SUMMARY OF TOXICITY CHARACTERISTIC LEACHING PROCEDURE (TCLP) ANALYTICAL RESULTS

ROBINTECH/COMPUDYNE SITE
OWEGO, NEW YORK

SAMPLE ID (SAMPLE DEPTH)	CRB-14 (6 TO 8 FEET)	CRB-17 (4 TO 6 FEET)	VE-2 (4 TO 6 FEET)	REGULATORY LEVEL
Benzene	--	--	8 J	500
2-Butanone	--	--	--	200,000
Carbon Tetrachloride	--	--	--	500
Chlorobenzene	--	--	4 J	100,000
Chloroform	--	--	--	6,000
1,2-Dichloroethane	--	--	--	500
1,1-Dichloroethene	--	--	--	700
Tetrachloroethene	120	4 J	880	700
Trichloroethene	2,500 D	270	43,000 D	500
Vinyl Chloride	--	--	--	200

Notes:

All concentrations reported in ug/l (ppb).
J = estimated value; concentration less than the quantitation limit but greater than zero.
D = compounds identified at a secondary dilution factor.
-- = not detected.

TABLE 2–3

NEW YORK STATE CLASS GA GROUND–WATER STANDARDS

ROBINTECH/COMPUDYNE SITE
OWEGO, NEW YORK

Compound	CAS NO.*	Class GA Ground Water
Volatile Organics		
Acetone	67–64–1	––
Benzene	71–43–2	0.7
Bromomethane	74–83–9	––
Bromodichloromethane	75–27–4	50(G)
Bromoform	75–25–2	50(G)
2–Butanone	78–93–3	––
Carbon disulfide	75–15–0	––
Carbon tetrachloride	56–23–5	5
Chlorobenzene	108–90–7	5
Chloroethane	75–00–3	––
Chloroform	67–66–3	7
Chloromethane	74–87–3	––
Dibromochloromethane	124–48–1	50(G)
1,1–Dichloroethane	75–34–3	5
1,2–Dichloroethane	107–06–2	5
1,2–Dichloroethene (total)	540–59–0	––
1,1–Dichloroethene (DCE)	75–35–4	5
1,2–Dichloropropane	78–87–5	5
cis–1,3–Dichloropropene	10061–01–5	––
trans–1,3–Dichloropropene	10061–02–6	––
Ethylbenzene	100–41–4	5
2–Hexanone	591–78–6	50(G)
Methylene chloride	75–09–2	5
4–Methyl–2–pentanone	108–10–1	––
Styrene	100–42–5	5
1,1,2,2–Tetrachloroethane	79–34–5	5
Tetrachloroethene (PCE)	127–18–4	5
Toluene	108–88–3	5
1,1,1–Trichloroethane (TCA)	71–55–6	5
1,1,2–Trichloroethane	79–00–5	5
Trichloroethene (TCE)	79–01–6	5
Vinyl chloride	75–1–4	2
Xylene (total)	1330–20–7	5

TABLE 2–3
(Cont'd.)
NEW YORK STATE CLASS GA GROUND–WATER STANDARDS

ROBINTECH/COMPUDYNE SITE
OWEGO, NEW YORK

Compound	CAS NO.*	Class GA Ground Water
Inorganics		
Aluminum	N/A	––
Antimony	N/A	3(G)
Arsenic	N/A	25
Beryllium	N/A	3(G)
Cadmium	N/A	10
Chromium	N/A	50
Cobalt	N/A	––
Copper	N/A	200
Iron	N/A	300(++)
Lead	N/A	25
Magnesium	N/A	35,000(G)
Manganese	N/A	300(++)
Mercury	N/A	2
Nickel	N/A	––
Selenium	N/A	10
Silver	N/A	50
Sodium	N/A	20,000
Thallium	N/A	4(G)
Vanadium	N/A	––
Zinc (total)	N/A	300

Notes:

These standards and guidance values are from the November 15, 1991 Division of Water Technical and Operational Guidance Series (1.1.1).
Classes of ground water are based on the definitions found in Title 6 Part 701, New York Code of Rules and Regulations.
All concentrations in units of micrograms per liter (ug/L; ppb).
–– = No standard or guidance value listed.
* = Chemical Abstracts Reference Number.
(++) = The value listed applies to the sum of iron and manganese concentrations.
(G) = Guidance Value.

TABLE 2-4

POTENTIAL ACTION-SPECIFIC ARARS
ROBINTECH/COMPUDYNE SITE
OWEGO, NEW YORK

ARARs	STATUS	SUMMARY OF REQUIREMENTS	ACTIONS TO BE TAKEN TO SATISFY REQUIREMENTS
1. ARARs POTENTIALLY COMMON TO ALL ALTERNATIVES			
OSHA-General Industry Standards (29 CFR 1910)	Applicable	These regulations specify the 8-hour time-weighted average concentration for worker exposure to various organic compounds. Training requirements for workers at hazardous waste operations are specified in 29 CFR 1910.120.	Proper respiratory equipment will be worn if it is not possible to maintain the work atmosphere below these concentrations.
OSHA-Safety and Health Standards (29 CFR 1926)	Applicable	These regulations specify the type of safety equipment and procedures to be followed during site remediation.	All appropriate safety equipment will be on site and appropriate procedures will be followed during all remedial activities.
OSHA-Recordkeeping, Reporting, and Related Regulations (29 CFR 1904)	Applicable	These regulations outline recordkeeping and reporting requirements for an employer under OSHA.	These regulations apply to the company(s) contracted to install, operate, and maintain the remedial actions at the site.
RCRA-Standards for Owners/Operators of Permitted Hazardous Waste Facilities (40 CFR 264.10-264.18)	Relevant & Appropriate	General facility requirements outlining general waste analysis, security measures, inspections, and training requirements.	Facilities will be designed, constructed, and operated in accordance with this requirement. All workers will be properly trained.
RCRA-Preparedness and Prevention (40 CFR 264.30-264.31)	Relevant & Appropriate	These regulations outline requirements for safety equipment and spill control.	Safety and communication equipment will be installed at the site. Local authorities will be familiarized with the site.
RCRA-Contingency Plan and Emergency Procedures (40 CFR 264.50-264.56)	Relevant & Appropriate	Provides requirements for outlining emergency procedures to be used following explosions, fires, etc.	Plans will be developed and implemented during remedial design/remedial action process. Copies of the plan will be kept on site.
New York Hazardous Waste Management System - General (6 NYCRR Part 370)	Relevant & Appropriate	Provides definitions of terms and general instructions for the Part 370 series of hazardous waste management.	This regulation will be followed concerning hazardous waste management.

TABLE 2-4
(Continued)

POTENTIAL ACTION-SPECIFIC ARARS

ROBINTECH/COMPUDYNE SITE
OWEGO, NEW YORK

ARARs	STATUS	SUMMARY OF REQUIREMENTS	ACTIONS TO BE TAKEN TO SATISFY REQUIREMENTS
Identification and Listing of Hazardous Wastes (6 NYCRR Part 371)	Applicable	Establishes procedures for identifying solid wastes that are subject to regulation as hazardous wastes.	Soils and ground water excavated/removed from the site that exhibit the hazardous characteristic of toxicity will be handled in accordance with RCRA and New York State Hazardous Waste regulations.
RCRA-General Standards (40 CFR 264.111)	Relevant & Appropriate	General performance standards requiring minimization of need for further maintenance and control; minimization or elimination of post-closure escape of hazardous waste, hazardous constituents, leachate, contaminated runoff, or hazardous waste decomposition products. Also requires decontamination or disposal of equipment, structures, and soils.	Proper design considerations will be implemented to minimize the need for future maintenance. Decontamination facility will be included.
RCRA-Closure and Post-Closure (40 CFR 264.110 - 264.120)	Relevant & Appropriate	These regulations detail specific requirements for closure and post-closure of hazardous waste facilities.	The remedial action implemented at the site will be designed and operated to meet the RCRA closure requirements.
NYSDEC Final Status Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities (6 NYCRR Part 373)	Applicable	These regulations outline the requirements for owners and operators of hazardous waste TSDFs.	Site activities and off-site facilities receiving materials from this site will be required to follow these regulations as appropriate.
Hazardous Waste Manifest System and Related Standards for Generators, Transporters, and Facilities (6 NYCRR Part 372)	Applicable	Provides guidelines relating to the use of the manifest system and its recordkeeping requirements. It applies to all generators, transporters, and facilities in New York State.	This regulation will be applicable to any company contracted to do treatment work at the site or transport hazardous material from the site.
Standards Applicable to Transporters of Applicable Hazardous Waste-RCRA Section 3003, (40 CFR 262 and 263, 40 CFR 170 to 179)	Applicable	Establishes the responsibility of off-site transporters of hazardous waste in the handling, transportation and management of the waste. Requires manifesting, recordkeeping, and immediate action in the event of a discharge.	These requirements will be applicable to any company contracted to transport hazardous material from the site.

TABLE 2-4
(Continued)

POTENTIAL ACTION-SPECIFIC ARARS

ROBINTECH/COMPUDYNE SITE
OWEGO, NEW YORK

ARARs	STATUS	SUMMARY OF REQUIREMENTS	ACTIONS TO BE TAKEN TO SATISFY REQUIREMENTS
DOT Rules for Transportation of Hazardous Materials (49 CFR Parts 107, 171.1-172.558)	Applicable	Outlines procedures for the packaging, labeling, manifesting, and transporting of hazardous materials.	Any company contracted to transport hazardous material from the site will be required to follow these regulations.
New York Regulations for Transportation of Hazardous Waste (6 NYCRR 372.3 a-d)	Applicable	These regulations outline procedures for the packaging, labeling, manifesting, and transporting of hazardous waste.	These requirements will be applicable to any company contracted to transport hazardous material from the site.
CAA-NAAQS for Particulate Matter Less Than 10 microns in diameter (40 CFR Part 60, Appendix J)	Relevant & Appropriate	This regulation specifies the maximum annual arithmetic mean and 24-hour allowable dust levels	Operations will be performed in such manner to minimize the production of particulate matter.
2. Potential ARARs Specific to Remedial Alternatives			
ARARS POTENTIALLY APPLICABLE TO LAND DISPOSAL			
RCRA Land Disposal Restrictions (40 CFR 268, Subpart D)	Applicable	Since November 8, 1988, movement of excavated materials to new locations and placement in or on land triggers the land disposal restrictions.	Any soils containing regulated materials will be properly disposed of or treated as required by the regulations.
EPA-Administered Permit Program: The Hazardous Waste Permit Program RCRA Section 3005, (40 CFR 270.124)	Applicable	Covers the basic permitting, application, monitoring, and reporting requirements for off-site hazardous waste management facilities.	Any off-site facility accepting hazardous waste from the site must be properly permitted. Implementation of the alternative will include consideration of these requirements.
RCRA Land Disposal Restrictions (40 CFR 268, Subpart A)	Applicable	Covers general information for land disposal restrictions. Requires testing of treatment residuals before disposal.	All treatment residuals must be tested before land disposal.
New York Regulations for Hazardous Waste Management Facilities (6 NYCRR 373-1.1-373-1.8)	Applicable	Provides requirements and procedures for obtaining a permit to operate hazardous waste TSDF. Also lists contents and conditions of permits.	Any off-site facility accepting hazardous waste from the site must be properly permitted.

TABLE 2-4
(Continued)

POTENTIAL ACTION-SPECIFIC ARARS

ROBINTECH/COMPUDYNE SITE
OWEGO, NEW YORK

ARARs	STATUS	SUMMARY OF REQUIREMENTS	ACTIONS TO BE TAKEN TO SATISFY REQUIREMENTS
Corrective Action Management Units (CAMU) (40 CFR 264, Subpart S)	Relevant and Appropriate	Defines an area within a facility in which remediation wastes may be moved, treated and disposed of without meeting the Land Disposal Restrictions or minimum technology requirements. Requires that on-site remedial actions be protective of human health and the environment.	The movement of hazardous waste for treatment and redisposition of hazardous wastes into the CAMU will be accomplished in a manner that is protective of human health and the environment as required by the CAMU Regulation.
NYSDEC-Land Disposal Restrictions (6NYCRR Part 376)	Applicable	The movement of excavated materials or process residuals that are hazardous wastes to a new location and placement in or on land in New York State triggers land disposal restrictions.	Any soils or process residuals containing regulated materials/hazardous waste will be properly disposed of or treated, as required by the regulations, prior to land disposal.
ARARS POTENTIALLY APPLICABLE TO CAPPING			
Closure and Post-Closure Care for Surface Impoundments, Waste Piles, Landfills, and Land Treatment Units (40 CFR 264)	Applicable	These regulations identify closure and site monitoring requirements for closed hazardous waste facilities.	A closure plan will be prepared and implemented to meet these requirements as appropriate.
New York State Pollution Discharge Elimination System (6NYCRR Parts 750-758)	Applicable	These regulations identify requirements for discharging treated water. It establishes allowable chemical constituent levels that can be discharged.	Facilities will be designed, constructed, and operated in accordance with this requirement.
ARARS POTENTIALLY APPLICABLE TO ON-SITE SOIL AND GROUND-WATER TREATMENT			
New York Air Quality Classification System (6 NYCRR Part 256)	Relevant & Appropriate	Outlines the air quality classification system and gives classifications for different land uses and population densities.	Air quality classification system should be referenced during the soil treatment process design.
National Emission Standards for Hazardous Air Pollutants [NESHAP (40 CFR 61)]	Applicable	Provides emission standards for hazardous air pollutants.	Proper designs on air emissions controls will be implemented to meet these regulations.

TABLE 2-4
(Continued)

POTENTIAL ACTION-SPECIFIC ARARS

ROBINTECH/COMPUDYNE SITE
OWEGO, NEW YORK

ARARs	STATUS	SUMMARY OF REQUIREMENTS	ACTIONS TO BE TAKEN TO SATISFY REQUIREMENTS
Clean Air Act - National Ambient Air Quality Standards [CAA-NAAQS (40 CFR 1-99)]	Applicable	Applies to major stationary sources such as treatment units that have the potential to emit significant amounts of pollutants such as NO_X, SO_2, CO, lead, mercury, and particulates (more than 250 tons/year). Prevention of significant deterioration provisions may apply to an on-site treatment facility.	The treatment system will be designed to meet these emission limits. If required, PSD procedures will be incorporated into the remedial design/remedial action process.
Interim RCRA/CERCLA Guidance on Non-Contiguous Sites and On-Site Management of Waste and Treated Residue (USEPA Policy Statement, March 27, 1986)	To be Considered	If a treatment or storage unit is to be constructed for on-site remedial action, there should be a clear intent to dismantle, remove, or close the unit after the remedial action is completed.	Only properly permitted facilities will be considered for disposal of hazardous materials.
CAA-NAAQS for Particulate Matter Less than 10 Microns in Diameter (40 CFR Part 60, Appendix J)	Relevant & Appropriate	This regulation specifies maximum annual arithmetic mean and maximum 24-hour dust levels.	Equipment will be designed to meet these requirements.
New York Air Permits and Certificates (6 NYCRR Part 201)	Applicable	Gives instructions and regulations for obtaining a permit to operate an incinerator. Also gives instructions of what to do in case of malfunction.	Permit must be obtained before thermal treatment or incineration may begin.
New York Regulations for General Process Emission Sources (6 NYCRR Part 212)	Applicable	Outlines the procedure of environmental rating. The Commissioner determines a rating of emissions based on sampling.	The Commissioner will issue an environmental rating for emissions based on this regulation.
Protection of Significant Deterioration of Air Quality [PSD (40 CFR 51.2)]	Applicable	New major stationary sources may be subject to PSD review [i.e., require best available control technology (BACT), lowest achievable emission limit (LAEL), and/or emission off-sets].	If necessary, PSD procedures will be included in the remedial design/remedial action process. The procedures could be expanded to BACT and LAEL evaluations.

TABLE 2-4
(Continued)

POTENTIAL ACTION-SPECIFIC ARARS

ROBINTECH/COMPUDYNE SITE
OWEGO, NEW YORK

ARARs	STATUS	SUMMARY OF REQUIREMENTS	ACTIONS TO BE TAKEN TO SATISFY REQUIREMENTS
New York State Air Resources Regulations - General Provisions (6 NYCRR Part 200)	Relevant & Appropriate	Provides definitions and general provisions of New York State Air Resources regulations. Also lists references used in developing these laws.	This regulation may serve as a reference during the sludge/soil thermal treatment process design.
New York General Prohibitions (6 NYCRR Part 211)	Relevant & Appropriate	This regulation lists restricted pollution activities.	No restricted activities will occur at the Robintech site.
New York Air Quality Standards (6 NYCRR Part 257)	Applicable	Provides air quality standards for different chemicals (including those found at the site), particles, and processes.	The emissions from the treatment processes will meet the air quality standards.
Discharge to a Publicly Owned Treatment Works (40 CFR 403)	Applicable	Discharge must comply with the local POTW pre-treatment program.	A ground-water pre-treatment program would be implemented to ensure attainment of discharge requirements established by the POTW. Additionally, compliance with appropriate/required reporting and monitoring requirements would also be necessary.
RCRA Permits by Rule (40 CFR 270.60)	Applicable	RCRA permit by rule requirements must be complied with for discharges of RCRA hazardous wastes to POTW.	Ground water that is a characteristic hazardous waste must be discharged to a POTW that is in compliance with RCRA requirements.
New York State Pollution Discharge Elimination System (SPDES) (6NYCRR Parts 750-758)	Applicable	These regulations detail the specific permit requirements for the discharge of pollutants to the waters of New York State.	Any water discharge to the waters of New York State would be treated and discharged in accordance with a NYSDEC SPDES Permit.

TABLE 3–1

IDENTIFICATION OF SIGNIFICANT EXPOSURE PATHWAYS

ROBINTECH/COMPUDYNE SITE
OWEGO, NEW YORK

	Ground Water			Soils				Stream Bottom Sediments				Surface Water		
	IG	D	IHo	IG	D	IHo	IHp	IG	D	IHo	IHp	IG	D	IHo
Baseline Receptor Populations														
Off–Site Human Resident	H	L	L	A	A	A	A	L	L	A	A	L	L	L
Future Use Receptor Populations														
On–Site Human Excavation Worker	L	L	L	M	M	L	M	A	A	A	A	A	A	A

Key to Exposure Levels:

– denotes a potentially significant exposure pathway which will be evaluated in the risk assessment

H – probability of exposure is high
M – probability of exposure is moderate
L – probability of exposure is low
A – probability of exposure is absent

Key to Exposure Pathways:

IG – Ingestion
D – Dermal Contact
IHo–Inhalation exposure to organic vapors
IHp–Inhalation exposure to airborne particulates

TABLE 3–2

PATHWAY–SPECIFIC RISK CHARACTERIZATION SUMMARY

ROBINTECH/COMPUDYNE SITE
OWEGO, NEW YORK

Receptor	Medium	Route	Summation of Chemical–Specific Carcinogenic Risks	Summation of Chemical–Specific Hazard Indices
Off–Site Residents	Ground Water	Ingestion of Well Water	3.7E–04	7.0E+00
On–Site Excavation Workers	Soils	Incidental Ingestion & Dermal Contact	8E–10	3E–02
On–Site Excavation Workers	Soils	Inhalation of of Dust from Soils	2E–14	4E+00

TABLE 3-3

REMEDIAL ACTION OBJECTIVES

ROBINTECH/COMPUDYNE SITE
OWEGO, NEW YORK

Media of Concern	Remedial Action Objective
Soil Beneath the Former Chemical Storage Area	Prevent inhalation of dust from soils for hypothetical on-site excavation workers.
	Prevent/minimize migration of chemicals of concern that would result in further degradation of ground-water quality (i.e., halogenated VOCs, aromatic hydrocarbons, copper, chromium, lead, and zinc).
	For organic soil constituents (i.e., halogenated VOCs and aromatic hydrocarbons), the cleanup objectives are those concentrations presented in NYSDEC's TAGM #4046 - Determination of Soil Cleanup Objectives and Cleanup Levels for the protection of ground-water quality (a copy of this TAGM is provided in Appendix B).
	For inorganic soil constituents, including copper, chromium, lead, and zinc, background concentrations will be used as cleanup objectives. Specifically, the following average concentrations detected in the soil samples collected in the vicinity of upgradient monitoring well MW-3 will be used: Chromium 15 ppm Copper 26 ppm Lead 33 ppm Zinc 88 ppm
Ground Water	Reduce potential risks to human health associated with ingestion of ground water containing constituent concentrations in excess of NYSDEC Class GA ground-water standards. (Private water supply wells, located south of the site, are principally within the shallow overburden.)
	Attain NYSDEC Class GA ground-water standards at the site boundary in both the overburden and bedrock for constituents attributable to the Robintech site, including halogenated VOCs, aromatic hydrocarbons, chromium, copper, lead, and zinc.
	Minimize ground-water plume migration (both horizontally and vertically).

Note: ppm = parts per million.

TABLE 5-1

FOCUSED FEASIBILITY STUDY COST ESTIMATE

ALTERNATIVE 2: GROUND-WATER WITHDRAWAL AND TREATMENT

ROBINTECH/COMPUDYNE SITE
OWEGO, NEW YORK

Item #	Description	Estimated Quantity	Unit	Unit Price Mat. & Lab.	Estimated Amount
1	Mobilization/Demobilization	--	LS	--	$ 10,000.00
2	Install a 4-inch diameter well	1	Each	5,000.00	5,000.00
3	Excavation	500	CY	12.00	6,000.00
4	Place and Compact Select Fill	100	CY	15.00	1,500.00
5	Place and Compact Excavated Soil	500	CY	10.00	5,000.00
6	Provide and Install Pre-Case Concrete Manhole	1	Each	6,000.00	6,000.00
7	Provide and Install Submersible Well Pump	1	Each	2,000.00	2,000.00
8	Provide and Install Piping	600	LF	15.00	9,000.00
9	Tap into Existing IRM System	--	LS	--	5,000.00
10	Provide and Install Electric and Instrumentation	--	LS	--	20,000.00
11	Site Restoration	--	LS	--	2,000.00
12	Bituminous Pavement	--	LS	--	2,000.00
				Subtotal	$ 73,500.00
				Administrative and Engineering (30%)	22,050.00
				Contingency (20%)	14,700.00
				Subtotal	$110,250.00
	PRE-TREATMENT SYSTEM O&M				
13	Effluent Sampling	12	Month	1,020.00	12,240.00
14	Equipment Maintenance	--	LS	--	2,000.00
15	Energy Consumption	--	LS	--	5,000.00
16	Ground-Water Monitoring	--	LS	--	15,000.00
17	POTW Discharge Fee	11,000,000	Gallon	0.003	33,000.00
				Subtotal	$ 67,240.00
				Contingency (20%)	13,448.00
				Estimated Annual O&M	$ 80,688.00
				Present Worth Factor (30 Years; 5%)	15.37
				Total Present Worth of O&M	$1,240,174.00
				Total	**$1,350,424.00**
				Rounded Total	**$1,400,000.00**

Notes:

LS = Lump Sum
LF = Lineal Feet
CY = Cubic Yard

TABLE 5-1

FOCUSED FEASIBILITY STUDY COST ESTIMATE

ALTERNATIVE 2: GROUND-WATER WITHDRAWAL AND TREATMENT

ROBINTECH/COMPUDYNE SITE
OWEGO, NEW YORK

ASSUMPTIONS:

1. Mobilization/demobilization cost estimate includes mobilization and demobilization of all labor, equipment, and materials necessary to construct the ground-water withdrawal system and connect it to the existing IRM system. Cost estimate also includes development of a HASP and performing monitoring (i.e., air monitoring) during construction.

2. Well installation cost estimate includes all equipment, labor, and materials necessary to install a 4-inch diameter well constructed with PVC screen and riser pipe. The estimate assumes that the well will be installed into the deep overburden.

3. Excavation cost estimate includes all equipment, labor, and material necessary to excavate the soil for pipe installation, to install the piping from a downgradient pumping well to the existing IRM, and to install a manhole at the well. Cost based on no special soil disposal; and no permanent or temporary sheeting being required.

4. Place and compact select fill cost estimate includes all equipment, labor, and material necessary to import, place, and compact select fill material below manholes and piping at a minimum depth of one foot.

5. Place and compact excavated soil cost estimate included all equipment and labor necessary to backfill and compact excavated soils around manholes and piping. Estimate assumes special handling and/or disposal of soil will not be necessary.

6. Provide and install pre-cast concrete manhole cost estimate includes all equipment, labor, and materials necessary to provide and install a 4-foot-square by 5-foot-deep pre-case concrete manhole at the downgradient pumping well.

7. Provide and install submersible well pump cost estimate includes all equipment, labor, and materials necessary to provide and install a submersible well pump at the downgradient pumping well.

8. Provide and install piping cost estimate includes all equipment, labor, and materials necessary to provide and install approximately 600 lineal feet of piping from the downgradient pumping well to the existing IRM. The piping will consist of a 1-inch-diameter HDPE pipe with a 3-inch-diameter CPVC secondary containment pipe.

9. Tap into existing IRM system cost estimate includes all equipment, labor, and materials necessary to tap into the existing system and make minor modifications to the existing IRM to pre-treat the ground water prior to discharging to the POTW.

10. Provide and install electric and instrumentation cost estimate includes all equipment, labor, and materials necessary to provide and install electrical service and instrumentation for the ground-water extraction system. The electrical service and instrumentation will include, but not necessarily be limited to, the following:

    - One level float in the manhole;
    - Two 3/4-inch conduits and wires from the manhole to the existing biological treatment building;
    - One starter and one contact for the submersible well pump;
    - Intrinsic barriers for the manhole;
    - One low water-level float switch for the well; and
    - One cabinet/alarm pane for the manhole.

11. Site restoration cost estimate includes all equipment, labor, and materials to grade all excavated areas and hydroseed in grassy areas.

12. Bituminous pavement cost estimate includes all equipment, labor, and materials necessary to install a bituminous binder and wearing coarse over areas of excavation in paved areas.

TABLE 5-1

FOCUSED FEASIBILITY STUDY COST ESTIMATE

ALTERNATIVE 2: GROUND-WATER WITHDRAWAL AND TREATMENT

ROBINTECH/COMPUDYNE SITE
OWEGO, NEW YORK

13. Pre-treatment system sampling and analysis cost estimate includes collection of influent and effluent water samples from the pre-treatment system once per month to demonstrate compliance with the POTW discharge permit. Analysis of each of the water samples would consist of VOCs (Method 8240), copper, nickel, lead, tin, pH, suspended solids, and oil and grease with a 24-hour turnaround time for analytical results.

14. Equipment maintenance cost estimate includes costs associated with making repairs and performing routine maintenance to the ground-water collection and pre-treatment system.

15. Energy consumption cost estimate includes power necessary to operate the ground-water collection and pre-treatment system.

16. Ground-water monitoring cost estimate includes performing semi-annual sampling at 10 existing well locations and analyzing the extracted ground water for four inorganic constituents (chromium, copper, lead, and zinc), and VOCs using USEPA SW-846 Method 8240.

17. POTW discharge fee based on the cost per thousand gallons (th gal) to discharge to the town of Owego POTW under Hadco's current discharge permit.

18. Existing IRM system (e.g., shallow tray stripper) and POTW will be able to accommodate the increased flow rate associated with implementing this remedial alternative.

19. Cost estimate does not include any costs associated with implementation of institutional actions.

20. Cost estimate based on 1993 dollars.

21. Cost estimate based on Blasland & Bouck's past experience and vendor estimates.

TABLE 5-2

FOCUSED FEASIBILITY STUDY COST ESTIMATE

ALTERNATIVE 3: SOIL VAPOR EXTRACTION, GROUND-WATER WITHDRAWAL AND TREATMENT

ROBINTECH/COMPUDYNE SITE
OWEGO, NEW YORK

Item #	Description	Estimated Quantity	Unit	Unit Price Mat. & Lab.	Estimated Amount
1	Mobilization/Demobilization	--	LS	--	$ 10,000.00
2	Soil Vapor Extraction System Design	--	LS	--	5,000.00
3	Soil Vapor Extraction System Installation	--	LS	--	50,000.00
4	Soil Vapor Extraction System Start-Up	--	LS	--	20,000.00
5	Disposal of Miscellaneous Wastes	20	Ton	1,200.00	24,000.00
6	Site Restoration	--	LS	--	5,000.00
7	Ground-Water Withdrawal and Discharge to POTW	--	LS	--	73,500.00
8	Soil Vapor Extraction System Operation	--	LS	--	480,000.00
				Subtotal	$ 667,500.00
				Administrative and Engineering (10%)	66,750.00
				Contingency (20%)	133,500.00
				Subtotal	$ 867,750.00
	GROUND-WATER WITHDRAWAL O&M				
9	Ground-Water Withdrawal O&M	--	LS	--	1,240,174.00
				Present Worth of O&M for Ground-Water Withdrawal	$1,240,174.00
				Total	**$2,107,924.00**
				Rounded Total	**$2,100,000.00**

Note: LS = Lump Sum

TABLE 5-2

FOCUSED FEASIBILITY STUDY COST ESTIMATE

ALTERNATIVE 3: SOIL VAPOR EXTRACTION, GROUND-WATER WITHDRAWAL AND TREATMENT

ROBINTECH/COMPUDYNE SITE
OWEGO, NEW YORK

ASSUMPTIONS:

1. Mobilization/demobilization cost estimate includes mobilization and demobilization of all labor, equipment, and materials necessary to construct the soil vapor extraction system.

2. Soil vapor extraction system design cost estimate based on vendor estimate.

3. Soil vapor extraction system installation cost estimate includes all equipment, labor, and materials necessary to install three horizontal soil vapor extraction wells beneath the clean room, blowers, electrical and instrumentation, and soil vapor treatment system with exhaust stack. Estimate assumes that soil vapor extraction will be conducted below the clean room only.

4. Soil vapor extraction system start-up cost estimate includes all equipment, labor, and materials necessary to start up the system and make optimization adjustments.

5. Miscellaneous disposal cost estimate includes all equipment, labor, and materials necessary to transport items (i.e., soil cuttings, excavated soil, etc.) to a RCRA-permitted incinerator. Estimate assumes disposal of waste from one 20-ton roll-off.

6. Site restoration cost estimate includes all equipment, labor, and materials necessary to backfill and compact excavations, repair bituminous pavement, and perform other miscellaneous restoration activities.

7. Ground-water withdrawal and discharge to POTW cost estimate based on previously developed estimate. Refer to Table 5-1 for the detailed breakdown of estimate and a listing of the associated assumptions.

8. Soil vapor extraction system O&M cost estimate based on O&M of soil vapor extraction system, including replacement of vapor-phase GAC (used to treat extracted vapors) and O&M of the vapor extraction system assumed over a two-year operation period.

9. Cost estimate does not include implementation of institutional actions at the site.

10. Cost estimate based on 1993 dollars.

11. Cost estimate based on Blasland & Bouck's past experience and vendor experience.

TABLE 5-3

FOCUSED FEASIBILITY STUDY COST ESTIMATE

ALTERNATIVE 4: OFF-SITE DISPOSAL OF SOIL AT A PERMITTED FACILITY, AND GROUND-WATER WITHDRAWAL AND TREATMENT

ROBINTECH/COMPUDYNE SITE
OWEGO, NEW YORK

Item #	Description	Estimated Quantity	Unit	Unit Price Mat. & Lab.	Estimated Amount
1	Mobilization/Demobilization	--	LS	--	$ 10,000.00
2	Provide Access Through Existing Exterior Wall	--	LS	--	2,000.00
3	Remove and Stage Existing Room Furnishings	--	LS	--	1,400.00
4	Install Protective Polyethylene	6,000	SF	0.50	3,000.00
5	Demolish and Remove Existing Floor Slab	50	CY	50.00	2,500.00
6	Provide and Install Shoring and Bracing	3,000	SF	15.00	45,000.00
7	Dewatering Activities	--	LS	--	2,000.00
8	Excavate Subbase and Place into Roll-Offs or Stage	1,000	CY	20.00	20,000.00
9	Dismantle Polyethylene and Place into Roll-Off	--	LS	--	3,000.00
10	Transportation of Soil to Incineration Facility	36	Roll-Off	3,000.00	108,000.00
11	Incineration of Soil and Debris	720	Ton	1,200.00	864,000.00
12	Place and Compact Select Fill	1,000	CY	20.00	20,000.00
13	Place New Concrete Floor Slab	50	CY	600.00	30,000.00
14	Repair Exterior Wall	--	LS	--	2,000.00
15	Install Carpeting	300	SY	35.00	10,500.00
16	Reinstall Room Furnishings	--	LS	--	1,400.00
17	Site Restoration	--	LS	--	2,000.00
18	Ground-Water Withdrawal and Discharge to POTW	--	LS	--	73,500.00
19	Soil Verification Sampling	--	LS	10,000.00	10,000.00
				Subtotal Administrative and Engineering (5%) Contingency (20%) Subtotal	$1,210,300.00 60,515.00 242,060.00 $1,512,875.00
	GROUND-WATER WITHDRAWAL O&M				
20	Ground-Water Withdrawal O&M	--	LS	--	$1,240,174.00
				Total **Rounded Total**	**$2,753,049.00** **$2,800,000.00**

Notes:

LS = Lump Sum
SF = Square Feet
CY = Cubic Yards
SY = Square Yards

TABLE 5-3

FOCUSED FEASIBILITY STUDY COST ESTIMATE

ALTERNATIVE 4: OFF-SITE DISPOSAL OF SOIL AT A PERMITTED FACILITY, AND GROUND-WATER WITHDRAWAL AND TREATMENT

ROBINTECH/COMPUDYNE SITE
OWEGO, NEW YORK

ASSUMPTIONS:

1. Mobilization/demobilization cost estimate includes mobilization and demobilization of all labor, equipment, and materials necessary to excavate, transport, incinerate and backfill the soils located beneath the existing clean room. Cost estimate also includes development of a HASP and performing monitoring (i.e., air monitoring) during construction.

2. Provide access through existing exterior wall cost estimate includes all equipment and labor necessary to cut an access hole in the exterior masonry wall of the clean room and dispose of the resulting debris.

3. Remove and stage existing room furnishings cost estimate includes all equipment, labor, and materials necessary to store, stage, and protect from damage existing equipment, furnishings, fixtures, and partitions from the existing clean room in an area designated by Hadco at the Owego facility.

4. Install protective polyethylene cost estimate includes all equipment, labor, and materials necessary to install polyethylene along the walls and ceiling of the clean room to limit the potential spread of contamination and to delineate the staging areas.

5. Demolish and remove existing floor slab cost estimate includes all equipment, labor, and materials necessary to saw-cut around the perimeter of the existing 6-inch-thick clean room concrete slab, break up the slab, and place the resulting debris in a 20-ton-capacity roll-off.

6. Provide and install shoring and bracing cost estimate includes all equipment, labor, and materials necessary to install temporary sheeting and bracing around the perimeter of the clean room and to a depth of 10 feet to stabilize the excavation walls.

7. Dewatering activities cost estimate includes all equipment, labor, and materials necessary to dewater and treat ground water from the lower 2 feet of the excavation below the clean room during excavation activities.

8. Excavate subbase and place into roll-offs cost estimate includes all labor and equipment necessary to excavate the soil subbase located beneath the clean room and place into roll-offs. Soil volume based on excavating area below clean room (30-foot by 90-foot) to a depth of 10 feet below grade and placing 600 cubic yards of contaminated soils into roll-offs and 400 cubic yards (40% of the soil volume) in a designated staging area. Assumed a soil density of 1.3 tons/yd^3.

9. Dismantle polyethylene and place into roll-off cost estimate includes all equipment and labor necessary to remove the polyethylene from the clean room walls and ceiling and place into a roll-off.

10. Transportation of soil to incineration facility cost estimate includes all equipment, labor, and materials necessary to characterize and transport the excavated soil and debris to the RCRA-permitted incineration facility.

11. Incineration of soil and debris cost estimate includes incinerating and properly disposing of the soils and debris at a RCRA-permitted incineration facility.

TABLE 5-3

FOCUSED FEASIBILITY STUDY COST ESTIMATE

ALTERNATIVE 4: OFF-SITE DISPOSAL OF SOIL AT A PERMITTED FACILITY, AND GROUND-WATER WITHDRAWAL AND TREATMENT

ROBINTECH/COMPUDYNE SITE
OWEGO, NEW YORK

12. Place and compact select fill cost estimate includes equipment, labor, and materials necessary to place and compact 1,000 cubic yards of material (600 cubic yards of imported select fill and 400 cubic yards of staged soils).

13. Place new concrete floor slab cost estimate includes all equipment, labor, and materials to provide and place concrete, formwork, and reinforcing steel for a new 6-inch-thick concrete slab inside the clean room.

14. Repair exterior wall cost estimate includes all equipment, labor, and materials necessary to patch the access hole cut in the existing exterior masonry wall of the clean room with masonry block materials and brick to match the existing architecture.

15. Install carpeting cost estimate includes all equipment, labor, and materials for the installation of an industrial-strength carpet on the floor of the clean room.

16. Reinstall room furnishing cost estimate includes all equipment and labor necessary to return all staged existing room furnishings from item 4 above to their original location in the room.

17. Site restoration cost estimate includes all equipment, labor, and materials necessary to restore the site to pre-construction condition (i.e., placing bituminous pavement).

18. Ground-water withdrawal and discharge to POTW cost estimate based on previous cost estimate. Refer to cost estimate presented in Table 5-1 for detailed breakdown of costs and list of assumptions.

19. Soil verification sampling cost includes performing necessary soil sampling during excavation activities to determine appropriate options for excavated soil (e.g., incineration, backfill). Assumed that soil samples would be analyzed for VOCs and 4 inorganic constituents (chromium, copper, lead, and zinc).

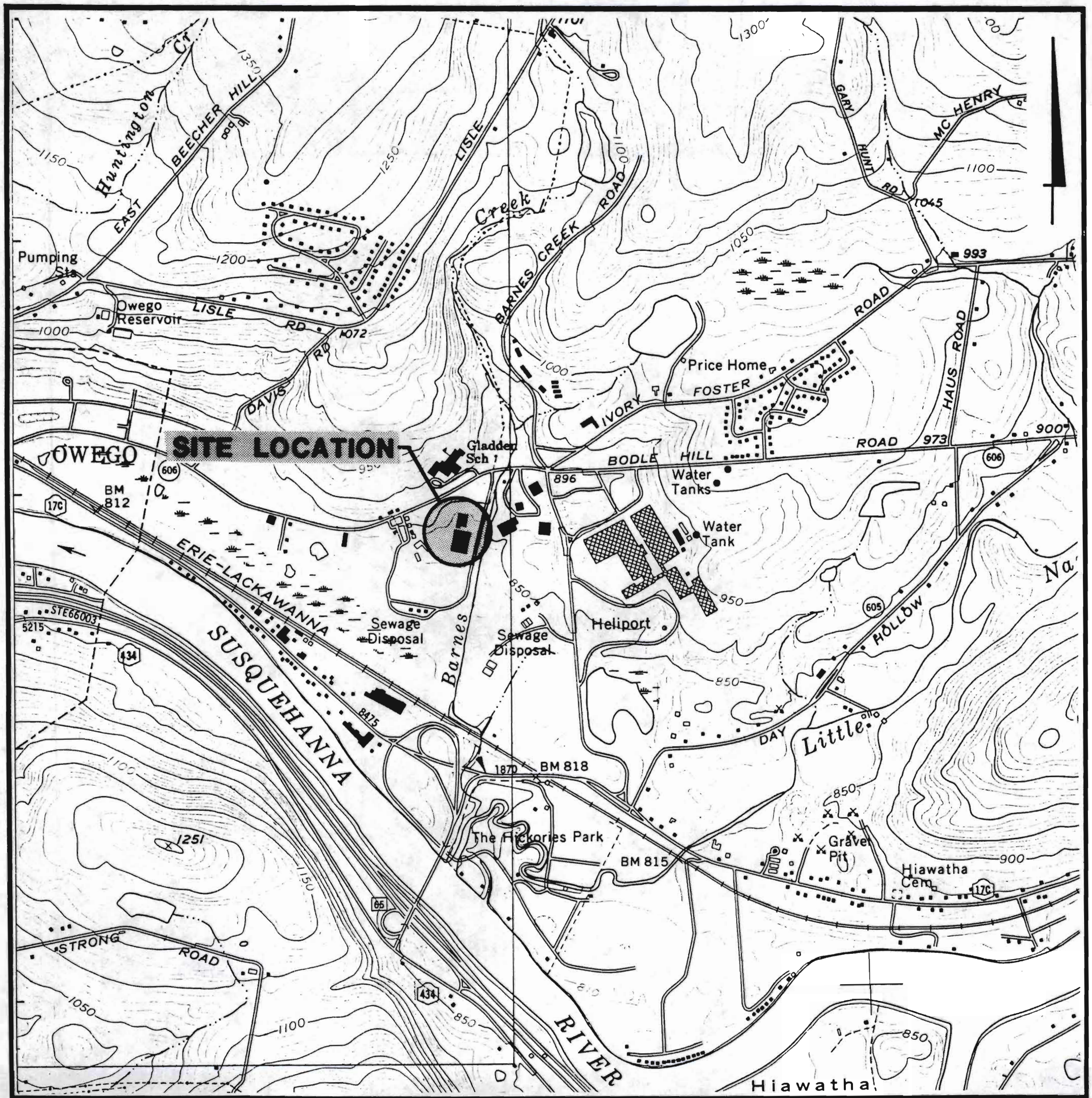
20. Ground-water withdrawal O&M cost estimate based on previous cost estimate. Refer to cost estimate presented in Table 5-1 for a detailed breakdown of costs and a list of assumptions.

21. Cost estimate does not include implementation of institutional actions at the site.

22. Cost estimate based on 1993 dollars.

23. Cost estimate based on Blasland & Bouck's past experience and vendor information.

FIGURE 1



ROBINTECH/COMPUDYNE, INC. SITE
OWEGO, NEW YORK

CONTOUR INTERVAL = 10 FEET

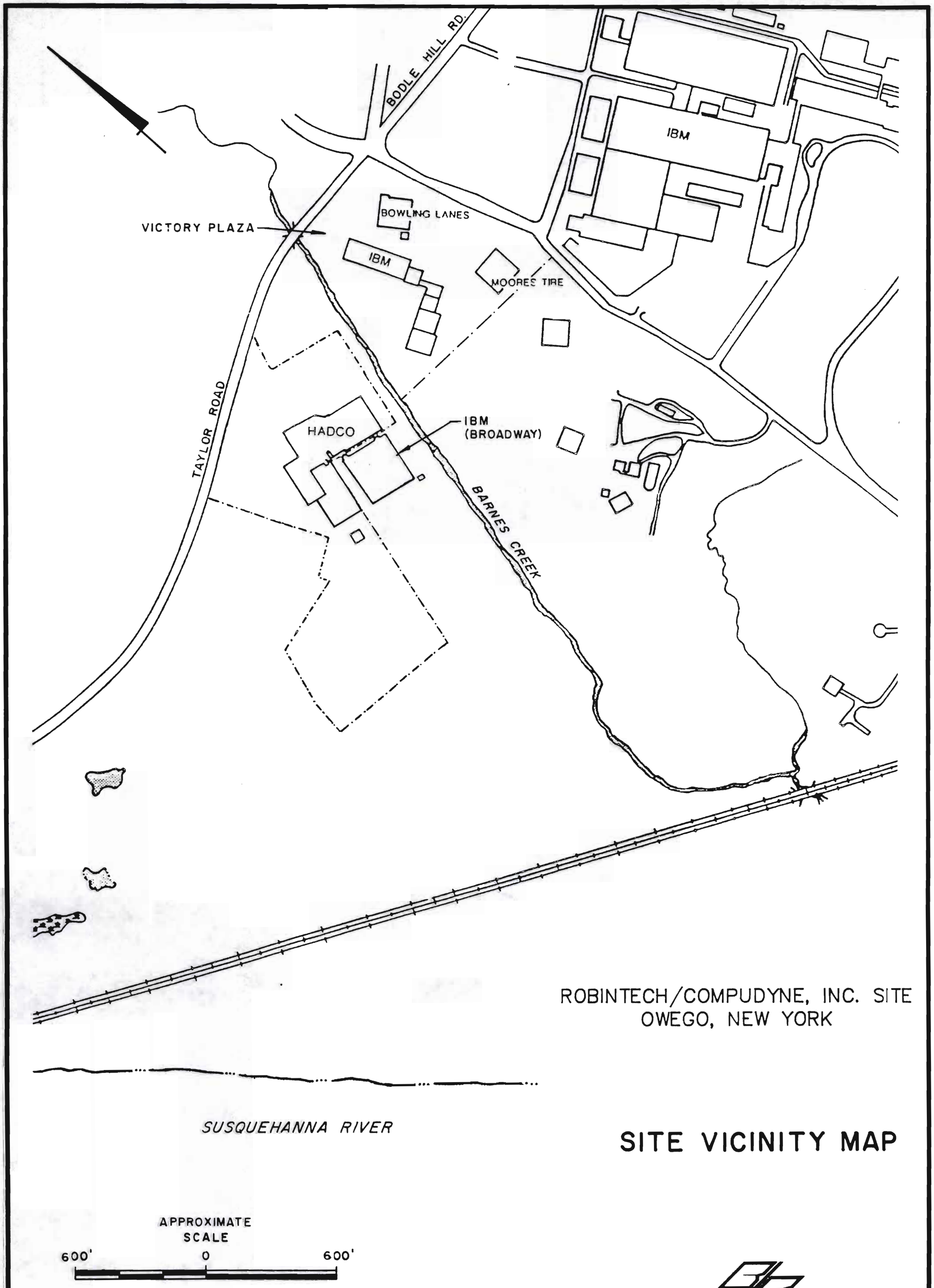
SITE LOCATION MAP

SCALE:
2000' 0 2000'

SOURCE: USGS 7 1/2 MINUTE TOPOGRAPHIC QUADRANGLE:
APALACHIN, NEW YORK, 1973

BLASLAND & BOUCK ENGINEERS, P.C.
ENGINEERS & GEOSCIENTISTS

FIGURE 2



ROBINTECH/COMPUDYNE, INC. SITE
OWEGO, NEW YORK

SITE VICINITY MAP

BLASLAND & BOUCK ENGINEERS, P.C.
ENGINEERS & GEOSCIENTISTS

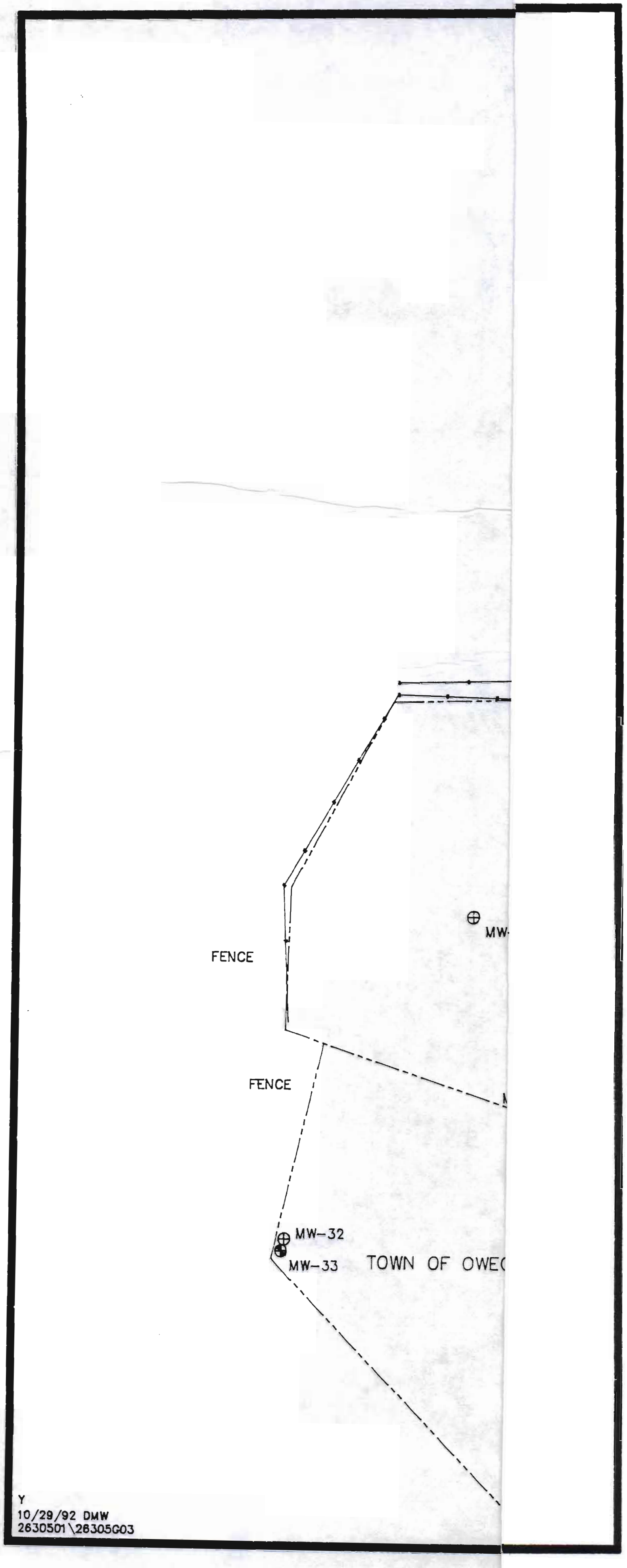


FIGURE ~~3~~ 2

LEGEND

═	INTERMITTENT STREAM WITH TOP OF STREAM BANKS SHOWN
◕	SHALLOW OVERBURDEN MONITORING WELL
⊕	DEEP OVERBURDEN MONITORING WELL
◎	BEDROCK MONITORING WELL
●	SURFACE WATER SAMPLE
△	VAPOR EXTRACTION WELL

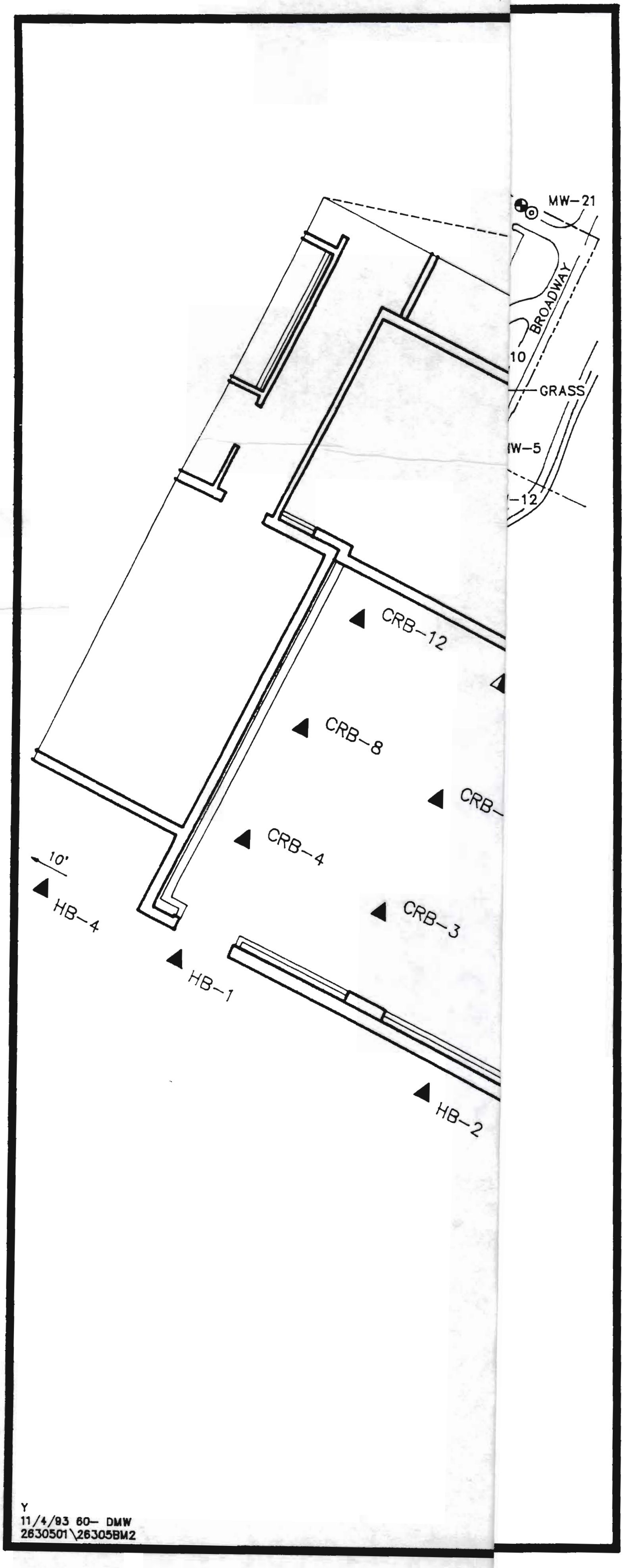
ROBINTECH/COMPUDYNE, INC. SITE
OWEGO, NEW YORK

MONITORING WELL LOCATION MAP

SCALE
200' 0 200'

BLASLAND & BOUCK ENGINEERS, P.C.
ENGINEERS & GEOSCIENTISTS

FIGURE 4



LEGEND

- ◉ SHALLOW OVERBURDEN MONITORING WELL
- ⊕ DEEP OVERBURDEN MONITORING WELL
- ⊚ BEDROCK MONITORING WELL
- ● SURFACE WATER SAMPLE
- ▲ VAPOR PROBE LOCATION
- ▲ SOIL BORING
- △ VAPOR EXTRACTION WELL

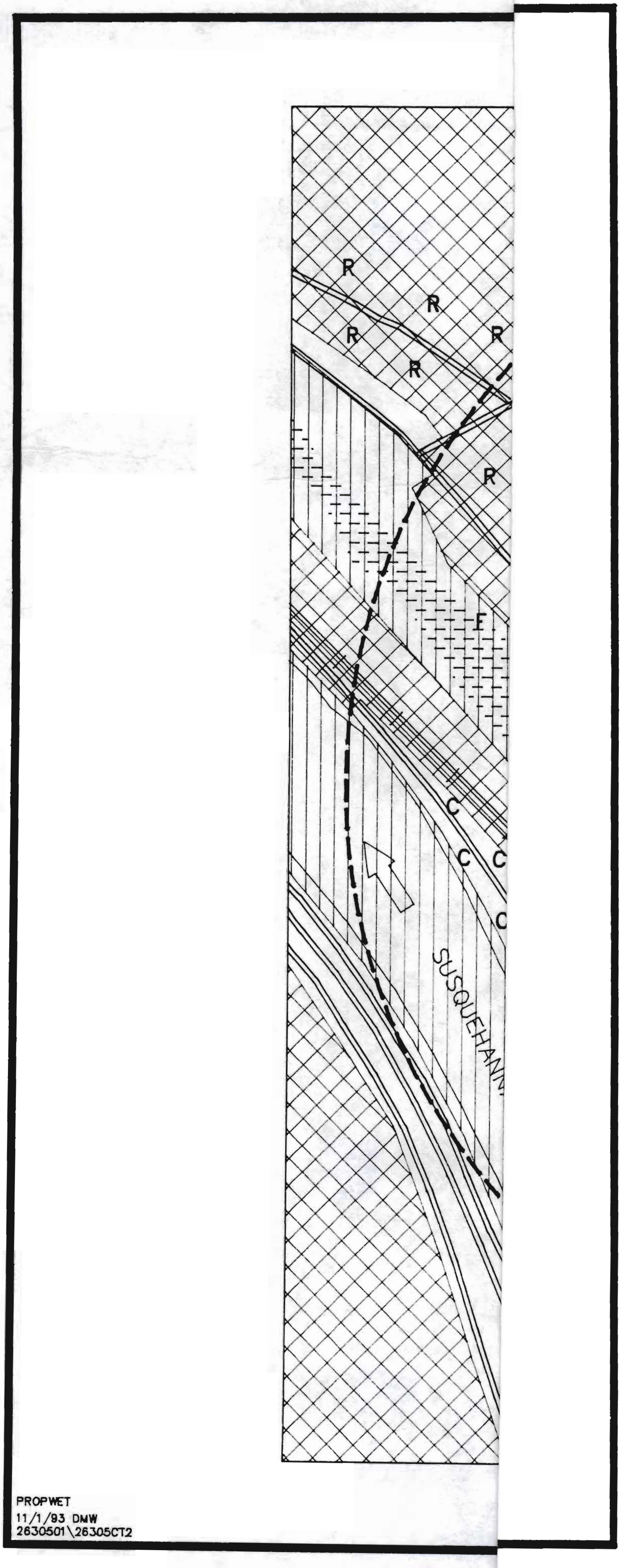
ROBINTECH/COMPUDYNE, INC. SITE
OWEGO, NEW YORK

FORMER CHEMICAL STORAGE AREA LOCATION MAP

SCALE
10' 0 10'

BLASLAND & BOUCK ENGINEERS, P.C.
ENGINEERS & GEOSCIENTISTS

FIGURE 5



PROPWET
11/1/93 DMW
2630501\26305CT2

LEGEND

- - - -	WETLANDS
—··—	SITE BOUNDARY
	HABITAT VALUES:
☐	NO VALUE
▨	LOW VALUE
▥	MODERATE VALUE
F	FOREST
R	RESIDENTIAL
C	COMMERCIAL
I	INDUSTRIAL
A	AGRICULTURAL
◐	WETLAND SAMPLING LOCATION

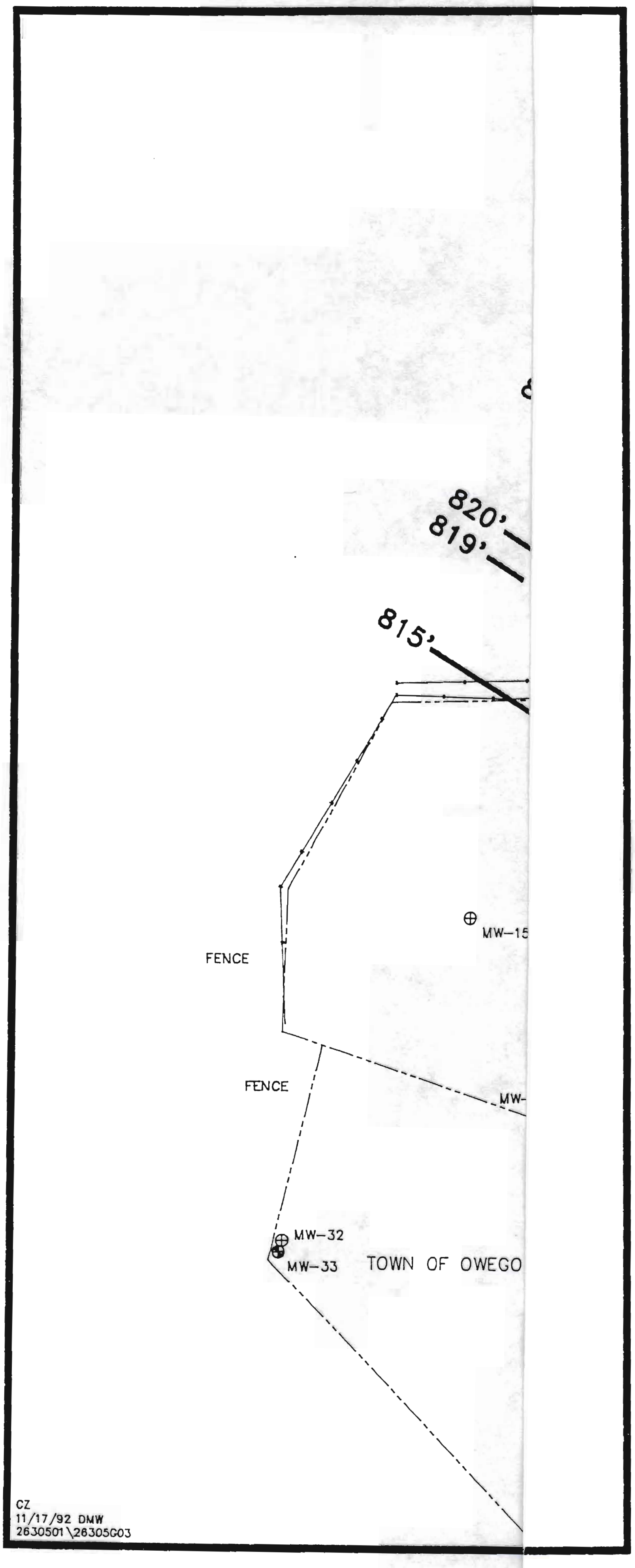
SOURCE: NYSDOT 7.5 MIN PLANIMETRIC QUADRANGLE
APALACHIN, N.Y., 1973.

ROBINTECH/COMPUDYNE, INC. SITE
OWEGO, NEW YORK

WETLAND SAMPLNG LOCATION MAP

SCALE
800' 0 800'

BLASLAND & BOUCK ENGINEERS, P.C.
ENGINEERS & GEOSCIENTISTS



4

FIGURE 6

LEGEND

═══	INTERMITTENT STREAM WITH TOP OF STREAM BANKS SHOWN
◒	SHALLOW OVERBURDEN MONITORING WELL
⊕	DEEP OVERBURDEN MONITORING WELL
⊚	BEDROCK MONITORING WELL
•	SURFACE WATER SAMPLE
△	VAPOR EXTRACTION WELL
820'——— 819'— —	SIMULATED POTENTIOMETRIC CONTOUR LINE
--------	SIMULATED CAPTURE ZONE LIMIT
←———	SIMULATED FLOW LINE

ROBINTECH/COMPUDYNE, INC. SITE
OWEGO, NEW YORK

PLAN VIEW OF SIMULATED PW-3 CAPTURE ZONE IN DEEP OVERBURDEN

SCALE
200' 0 200'

BLASLAND & BOUCK ENGINEERS, P.C.
ENGINEERS & GEOSCIENTISTS

Appendix A

PW-3 Capture Zone Simulation

APPENDIX A

Introduction

This Appendix describes a numerical modeling effort performed to help delineate the ground-water capture zone that may be achieved during long-term pumping from recovery well PW-3. The key objectives of ground-water flow modeling were to: (1) evaluate whether pumping from PW-3 may hydraulically control and remove shallow overburden ground water from the vicinity of PW-3, which is screened in the deep overburden; (2) illustrate in plan view and cross section the capture zone of ground water that may be achieved by pumping from PW-3; and (3) assess the downgradient limit of the three-dimensional capture zone.

Conceptual Model of Overburden Ground-Water Flow

The geologic data generated during monitoring well installation at the site demonstrate that the overburden is geologically heterogeneous, including zones of sand; sand and gravel; silt, sand, and gravel; clay; and till. No laterally-continuous, low-permeability, confining unit has been identified, however, within the unconsolidated overburden deposits. The numerical model described in this section, therefore, treats the overburden as a single, complex hydrogeologic unit.

Hydrogeologic data from monitoring well boreholes indicate that the overburden is grossly stratified parallel to the top-of-rock surface. In bulk, these stratified deposits may be expected to be more permeable in the horizontal than the vertical direction. The numerical model accommodates this anistropy by allowing input of greater horizontal than vertical hydraulic conductivity for the overburden as a whole.

Model Selection

The model selected for PW-3 capture zone simulation was "MODFLOW," the USGS Modular Three-Dimensional Finite-Difference Ground-Water Flow Model (McDonald and Harbaugh, 1988). Using a three-dimensional array of rectilinear finite flow units, or cells, MODFLOW offered the flexibility to represent the complex hydrogeologic flow regime, including a variable horizontal to vertical conductivity ratio and three-dimensional flow.

Three-Dimensional Model Grid Setup

The MODFLOW model was designed to simulate the entire overburden formation as a single hydrogeologic unit. The model grid developed to simulate the hydraulic response to pumping from PW-3 consisted of 4 layers, 19 rows, and 33 columns. The grid orientation is shown schematically in Figure A-1. To facilitate the modeling process, the model grid was designed to utilize the symmetry of the flow system during pumping. Column #1 (of 17 columns) crossed through the location of PW-3, and was oriented parallel to the south-southwestward hydraulic gradient across the site. The entire modeled zone was thus simulated using a model grid covering one half of the symmetrical flow system.

The cell representing PW-3 was in the middle of Column #1 in the bottom model layer (Layer #4). The model grid extended to a distance of approximately 2,000 feet, where the potentiometric responses to pumping from PW-3 were assumed to be negligible. Cells along Rows #1 and #33, and Column #17, therefore, were assigned constant head values compatible with the pre-existing south-southwestward hydraulic gradient of 0.03 feet per foot, parallel to the columns in the model grid. Head values at all other cells in the grid were variable.

As shown in Figure A-2, four model layers were used to evaluate the simulated response to pumping from PW-3 in three dimensions. The layer thicknesses from top (Layer #1) to bottom (Layer #4) were 12 feet, 12 feet, 15 feet, and 18 feet, respectively, corresponding to the 57-foot thick overburden zone penetrated by PW-3.

Model Calibration

Prior to simulating the affects of long-term pumping from PW-3, the model was calibrated against the actual potentiometric responses observed at observation wells MW-25 and MW-26 during the pumping test of PW-3, performed on August 18, 1992. After 10 hours of pumping from PW-3 on August 18, 1992, potentiometric drawdowns of 0.18 feet and 2.89 feet were observed at shallow overburden well MW-25 and deep overburden well MW-26, respectively. The objective of the calibration, therefore, was to identify parameters that, when used in the MODFLOW model, yielded computed drawdowns that match these observed drawdowns. The iterative calibration process entailed:

- running the MODFLOW model with PW-3 pumping at 11 gpm for 10 hours, as during the pumping test;
- determining the simulated drawdowns at MW-25 and MW-26;
- comparing the simulated drawdowns to the observed drawdowns of 0.18 feet and 2.89 feet at MW-26;
- adjusting the model parameters; and
- re-running the model.

Based on the pumping test results and hydrogeologic data obtained during monitoring well installation at the site, the following hydrogeologic parameters were initially used in the calibration effort:

- horizontal and vertical hydraulic conductivity (K) = 1.8 x 10^{-3} cm/sec;
- ratio of horizontal to vertical K (Kh/Kv) = 1;
- Layer #1 storativity = 0.2, Layers #2-4 storativity - 0.001;
- hydraulic gradient = 0.03 ft/ft south-southwestward;
- PW-3 pumping rate - 11 gpm; and
- pumping time = 10 hours.

After 19 iterations of the calibration process, the simulated drawdown values of 0.18 feet and 2.69 feet were computed, providing a reasonable match with the 0.18 feet and 2.89 feet of drawdown observed at MW-25 and MW-26 after 10 hours of pumping PW-3 at 11 gpm. The parameters that were modified to provide this calibration "match" are:

- horizontal hydraulic conductivity (Kh) = 9.1 x 10^{-4} cm/sec, vertical hydraulic conductivity (Kz) = 1.8 x 10^{-4} cm/sec;
- ratio of horizontal to vertical K (Kh/Kv) = 5; and
- Layer #1 storativity - 0.05, Layers #2-4 storativity = 0.001.

The calibrated vertical hydraulic conductivity is controlled within the model by assigned values of vertical "conductance" between the model layers. Storativity values calculated from short-term pumping periods typically are low, but the effective storativity increases during pumping (Nwankwor, 1984). This affect results from delayed drainage of stored water at the top of the saturated zone. The calibrated value of 0.05 is appropriate for the relatively short 10-hour pumping test modeled during the calibration procedure. During long-term pumping, however, the effective storativity value for the top of the overburden flow system would be expected to approach the specific yield of the unconfined aquifer material, approximately 0.1 to 0.3. The calibrated Layer #1 storativity value of 0.05 was thus replaced with an estimated value of 0.2 for use in long-term capture-zone modeling. Increasing the storativity slightly reduces the computed drawdown in Layer #1 and is conservative with respect to capture zone simulation.

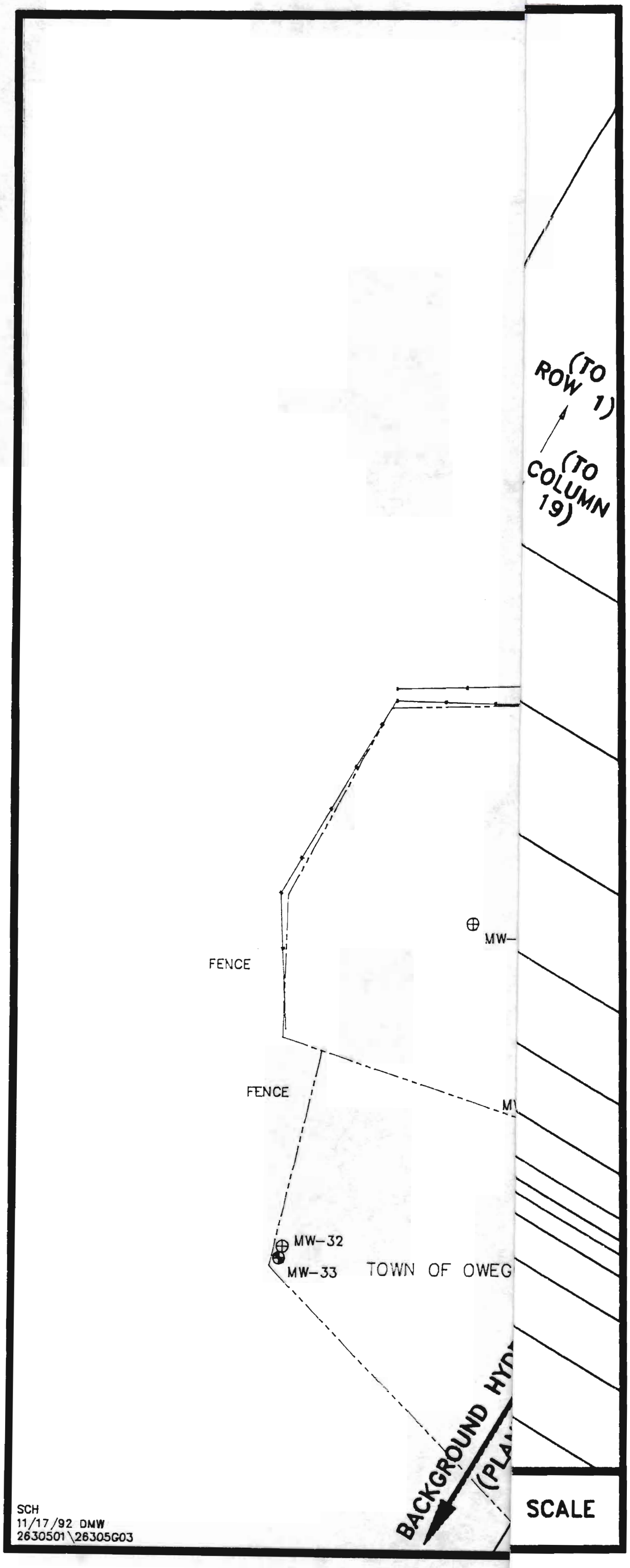
Capture-Zone Simulation

To simulate the capture zone that may be achieved during long-term pumping from PW-3, the calibrated MODFLOW model was run using a pumping rate of 11 gpm at PW-3 and a pumping duration of 60 days. The hydraulic heads computed by the model were used to depict the simulated capture zone of PW-3. The flow system in the vicinity of PW-3 is assumed to be symmetrical. Head values computed for the modeled half of the flow system, therefore, were projected across the plane of symmetry through PW-3 to enable depiction of the entire symmetrical capture zone.

The results of the simulation are depicted on Figures A-2 and A-3. To evaluate the vertical profile of the capture zone through PW-3, head values computed along Column #1 in all four model layers are plotted and contoured on Figure A-2. Simulated flow lines also are drawn, showing the vertical capture zone through PW-3 parallel to the pre-existing hydraulic gradient. The simulated capture zone suggests that pumping 11 gpm from PW-3 for 60 days may hydraulically control shallow, intermediate, and deep overburden ground water. The simulated capture zone is unlimited in the upgradient direction. The predicted capture zone downgradient of PW-3 extends to a distance of approximately 80 to 100 feet for shallow or deep overburden ground water, respectively.

Figure A-3 shows a plan view of the capture zone computed for deep overburden ground water. The computed head values from model Layer #4 are contoured, and the simulated ground-water flow lines are drawn showing the computed capture zone. The capture zone of deep overburden ground water predicted by the model extends approximately 600 feet cross-gradient and approximately 100 feet downgradient of PW-3.

FIGURE A-1



LEGEND

═══	INTERMITTENT STREAM WITH TOP OF STREAM BANKS SHOWN
◑	SHALLOW OVERBURDEN MONITORING WELL
⊕	DEEP OVERBURDEN MONITORING WELL
◎	BEDROCK MONITORING WELL
●	SURFACE WATER SAMPLE
△	VAPOR EXTRACTION WELL

ROBINTECH/COMPUDYNE, INC. SITE
OWEGO, NEW YORK

NUMERICAL MODEL GRID SCHEMATIC ORIENTATION

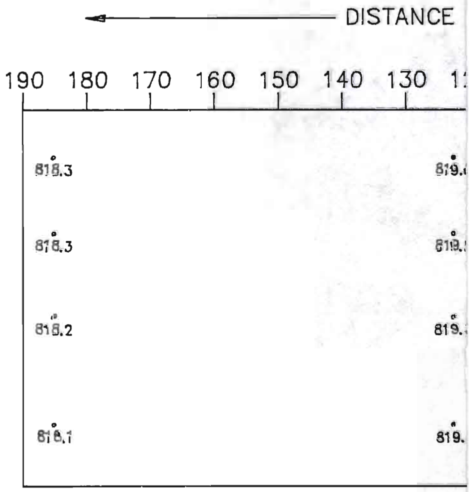
SCALE
200' 0 200'

BLASLAND & BOUCK ENGINEERS, P.C.
ENGINEERS & GEOSCIENTISTS

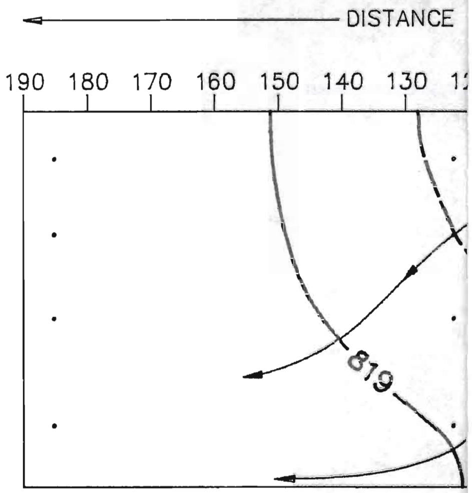
FIGURE A-2

LAYER	THICKNESS	HORI HYD COND (c
LAYER 1	12 FT.	9.1
LAYER 2	12 FT.	9.1
LAYER 3	15 FT.	9.1
LAYER 4	18 FT.	9.1

57 FT.



S



11/11/92 DMW
2630501\26305X02

LEGEND

•	MODEL CELL NODE
819.1	SIMULATED HEAD DURING PUMPING AT PW-3
◄────	SIMULATED GROUND-WATER FLOW LINE
—817— ---815---	SIMULATED POTENTIOMETRIC HEAD CONTOURS

ROBINTECH/COMPUDYNE, INC. SITE
OWEGO, NEW YORK

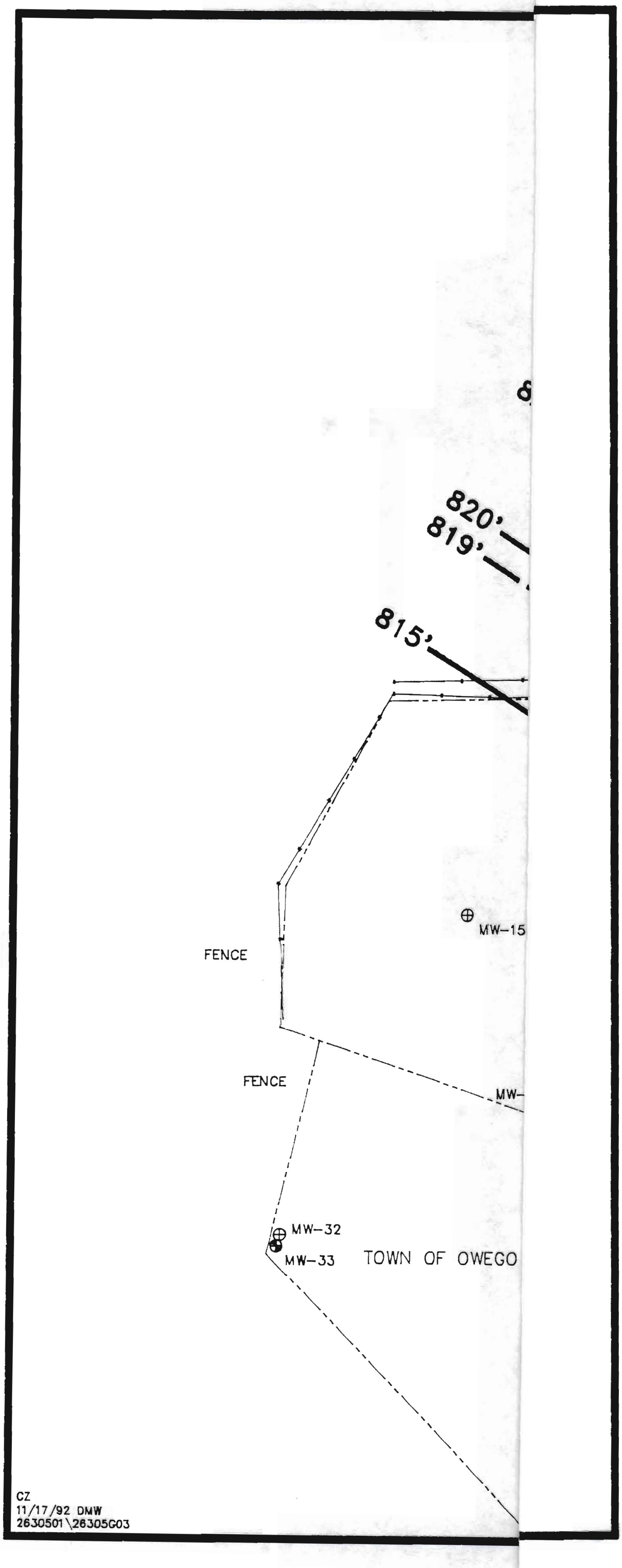
CROSS SECTION OF SIMULATED PW-3 CAPTURE ZONE

HORIZONTAL AND VERTICAL
SCALE

30' 0 30'

BLASLAND & BOUCK ENGINEERS, P.C.
ENGINEERS & GEOSCIENTISTS

FIGURE A-3



LEGEND

═══	INTERMITTENT STREAM WITH TOP OF STREAM BANKS SHOWN
◓	SHALLOW OVERBURDEN MONITORING WELL
⊕	DEEP OVERBURDEN MONITORING WELL
⊙	BEDROCK MONITORING WELL
•	SURFACE WATER SAMPLE
△	VAPOR EXTRACTION WELL
820'—— 819'— —	SIMULATED POTENTIOMETRIC CONTOUR LINE
--------	SIMULATED CAPTURE ZONE LIMIT
←——	SIMULATED FLOW LINE

ROBINTECH/COMPUDYNE, INC. SITE
OWEGO, NEW YORK

PLAN VIEW OF SIMULATED PW-3 CAPTURE ZONE IN DEEP OVERBURDEN

SCALE
200' 0 200'

BLASLAND & BOUCK ENGINEERS, P.C.
ENGINEERS & GEOSCIENTISTS

Appendix B

NYSDEC's "Technical and Administrative Guidance Memorandum Number 4046 - Determination of Soil Cleanup Objectives and Cleanup Levels"

HWR-92-4046
November 16, 199

New York State Department of Environmental Conservation

MEMORANDUM

): Regional Haz. Waste Remediation Engineers, Bureau Dirs. & Section Chiefs
FROM: Michael J. O'Toole, Jr., Director, Div. of Hazardous Waste Remediation
SUBJECT: DIVISION TECHNICAL AND ADMINISTRATIVE GUIDANCE MEMORANDUM: DETERMINATION OF SOIL CLEANUP OBJECTIVES AND CLEANUP LEVELS
DATE: NOV 16 1992

Michael J O'Toole Jr.

The cleanup goal of the Department is to restore inactive hazardous waste sites to predisposal conditions, to the extent feasible and authorized by law. However, it is recognized that restoration to predisposal conditions will not always be feasible.

1. INTRODUCTION:

This TAGM provides a basis and procedure to determine soil cleanup levels at individual Federal Superfund, State Superfund, 1986 EQBA Title 3 and Responsible Party (RP) sites, when the Director of the DHWR determines that cleanup of a site to predisposal conditions is not possible or feasible.

The process starts with development of soil cleanup objectives by the Technology Section for the contaminants identified by the Project Managers. The Technology Section uses the procedure described in this TAGM to develop soil cleanup objectives. Attainment of these generic soil cleanup objectives will, at a minimum, eliminate all significant threats to human health and/or the environment posed by the inactive hazardous waste site. Project Managers should use these cleanup objectives in selecting alternatives in the Feasibility Study (FS). Based on the proposed selected remedial technology (outcome of FS), final site specific soil cleanup levels are established in the Record of Decision (ROD) for these sites.

It should be noted that even after soil cleanup levels are established in the ROD, these levels may prove to be unattainable when remedial construction begins. In that event, alternative remedial actions or institutional controls may be necessary to protect the environment.

2. BASIS FOR SOIL CLEANUP OBJECTIVES:

The following alternative bases are used to determine soil cleanup objectives:

(a) Human health based levels that correspond to excess lifetime cancer risks of one in a million for Class A[1] and B[2] carcinogens, or one in 100,000 for Class C[3] carcinogens. These levels are contained in USEPA's Health Effects Assessment Summary Tables (HEASTs) which are compiled and updated quarterly by the NYSDEC's Division of Hazardous Substances Regulation;

(b) Human health based levels for systemic toxicants, calculated from

APPENDIX A

TABLE 1

Recommended soil cleanup objectives (mg/kg or ppm)

Volatile Organic Contaminants

taminant	Solubility mg/l or ppm S	Partition coefficient Koc	Groundwater Standards/ Criteria Cv ug/l or ppb.	a Allowable Soil conc. ppm. Cs	b ** Soil Cleanup objectives to Protect GW Quality (ppm)	USEPA Health Based (ppm)		CRQL (ppb)	*** Rec.soil Clnup Object. (ppm)
						Carcinogens	Systemic Toxicants		
Benzene	1,750	83	0.7	0.0006	0.06	24	N/A	5	0.06
Xylenes	198	240	5	0.012	1.2	N/A	200,000	—	1.2
Ethylbenzene	152	1,100	5	0.055	5.5	N/A	8,000	5	5.5
Toluene	535	300	5	0.015	1.5	N/A	20,000	5	1.5
Tetrachloroethene	150	277	5	0.014	1.4	14	800	5	1.4
Trichloroethene	1,100	126	5	0.007	0.70	64	N/A	5	0.7
Methylene chloride	16,700	21	5	0.001	0.1	93	5,000	5	0.1
Acetone	1,000,000	2.2	50	0.0011	0.11	N/A	8,000	10	0.2
2-Butanone	268,000	4.5*	50	0.003	0.3	N/A	4,000	10	0.3
4-Methyl-2-Pentanone	19,100	19*	50	0.01	1.0	N/A	N/A	10	1.0
1,1-Dichloroethane	5,500	30	5	0.002	0.2	N/A	N/A	5	0.2
1,2-Dichloroethane	8,520	14	5	0.001	0.1	7.7	N/A	5	0.1
1,1,1-Trichloroethane	1,500	152	5	0.0076	0.76	N/A	7,000	5	0.8
1,1,2,2-Tetrachloroethane	2,900	118	5	0.006	0.6	35	N/A	5	0.6
1,1-Dichloroethene	2,250	65	5	0.004	0.4	12	700	5	0.4
1,2-Dichloroethene(trans)	6,300	59	5	0.003	0.3	N/A	2,000	5	0.3
Chlorobenzene	466	330	5	0.017	1.7	N/A	2,000	5	1.7
Chloroethane	5,740	37*	50	0.019	1.9	N/A	N/A	10	1.9
-Dichlorobenzene	100	1,700	4.7	0.079	7.9	N/A	N/A	330	7.9
1,3-Dichlorobenzene	123	310 *	5	0.0155	1.55	N/A	N/A	330	1.6
1,4-Dichlorobenzene	79	1,700	5	0.085	8.5	N/A	N/A	330	8.5
1,2,4-Trichlorobenzene	30	670 *	5	0.034	3.4	N/A	N/A	330	3.4
Vinyl chloride	2,670	57	2	0.0012	0.12	N/A	N/A	10	0.2
1,2,3-trichloropropane	1,900	68	5	0.0034	0.34	N/A	80	5	0.4
1,3-dichloropropane	2,700	51	5	0.003	0.3	N/A	N/A	5	0.3
Dibromochloromethane	N/A	N/A	50	N/A	N/A	N/A	N/A	5	N/A
Chloroform	8,200	31	7	0.003	0.30	114	800	5	0.3
Carbon Tetrachloride	757	110*	5	0.006	0.6	5.4	60	5	0.6
Benzoic Acid	2,900	54*	50	0.027	2.7	N/A	300,000	5	2.7
Carbon Disulfide	2,940	54*	50	0.027	2.7	N/A	8,000	5	2.7

a. Allowable Soil Concentration Cs = f x Cw x Koc

b. Soil cleanup objective = Cs x Correction Factor (CF)

* Partition coefficient is calculated by using the following equation: log Koc = -0.55 log S + 3.64. Other values are experimental values.

** Correction Factor (CF) of 100 is used as per proposed TAGM

*** As per proposed TAGM, Total VOCs < 10 ppm.

Note: Soil clnup objectives are developed for soil organic carbon content (f) of 1% , and should be adjusted for the actual soil organic carbon content if it is known.

APPENDIX A (cont.)

TABLE 2

Recommended Soil Cleanup Objectives (mg/kg or ppm)

Semi-Volatile Organic Contaminants

Contaminant	Solubility mg/l or ppm S	Partition coefficient Koc	Groundwater Standards/ Criteria Cw ug/l or ppb.	a Allowable Soil conc. ppm. Cs	b ** Soil Cleanup objectives to Protect GW Quality (ppm)	USEPA Health Based (ppm) Carcinogens	USEPA Health Based (ppm) Systemic Toxicants	CRQL (ppb)	Rec.soil Clnup Object. (ppm)
Benzo(b)fluoranthene	0.014	550,000	0.002	0.011	1.1	N/A	N/A	330	1.1
Benzo(k)fluoranthene	0.0043	550,000	0.002	0.011	1.1	N/A	N/A	330	1.1
Phenanthrene	1.0	4,365*	50	2.20	220.0	N/A	N/A	330	50.0***
Fluoranthene	0.206	38,000	50	19	1900.0	N/A	3,000	330	50.0***
Pyrene	0.132	13,295*	50	6.65	665.0	N/A	2,000	330	50.0***
Benzo(a)pyrene	0.0012	5,500,000	0.002(ND)	0.110	11.0	0.0609	N/A	330	0.061 or MDL
Indeno(1,2,3-cd)pyrene	0.0005	1,600,000	0.002	0.032	3.2	N/A	N/A	330	3.2
2-Methylphenol	31,000	15	5	0.001	0.1	N/A	N/A	330	0.100 or MDL
4-Methylphenol	24,000	17	50	0.009	0.9	N/A	4,000	330	0.9
Fluorene	1.7	7,300	50	3.5	350.0	N/A	3,000	330	50.0***
Dibenzofuran	10	1,230*	5	0.062	6.2	N/A	N/A	330	6.2
Acenaphthene	3.42	4,600	20	0.9	90.0	N/A	5,000	330	50.0***
Acenaphthylene	3.93	2,056*	20	0.41	41.0	N/A	N/A	330	41.0
Naphthalene	31.70	1,300	10	0.130	13.0	N/A	300	330	13.0
2-methylnaphthalene	26.00	727*	50	0.364	36.4	N/A	N/A	330	36.4
Anthracene	0.045	14,000	50	7.00	700.0	N/A	20,000	330	50.0***
bis(2-ethylhexyl)phthalate	0.285	8,706*	50	4.35	435.0	50	2,000	330	50.0***
Dimethylphthlate	5,000	40	50	0.020	2.0	N/A	80,000	330	2.0
Diethylphthlate	896.00	142	50	0.071	7.1	N/A	60,000	330	7.1
Butylbenzylphthlate	2.9	2,430	50	1.215	122.0	N/A	20,000	330	50.0***
Di-n-butyl phthalate	400	162*	50	0.081	8.1	N/A	8,000	330	8.1
Di-n-octyl phthlate	3.0	2,346*	50	1.2	120.0	N/A	2,000	330	50.0***
Chrysene	0.0018	200,000	0.002	0.004	0.4	N/A	N/A	330	0.4
Benzo(a)anthracene	0.0057	1,380,000	0.002	0.03	3.0	0.224	N/A	330	0.220 or MDL
Benzo(g,h,i)perylene	0.0007	1,600,000	5	8.0	800	N/A	N/A	330	50.0***
2,4-Dichlorophenol	4,600	380	1	0.004	0.4	N/A	200	330	0.4
2,4,5-Trichlorophenol	1,190	89*	1	0.001	0.1	N/A	8,000	330	0.1

APPENDIX A (cont.)

TABLE 2

Recommended Soil Cleanup Objectives (mg/kg or ppm)

Semi-Volatile Organic Contaminants

Contaminant	Solubility mg/l or ppm S	Partition coefficient Koc	Groundwater Standards/ Criteria Cw mg/l or ppb.	a Allowable Soil conc. ppm. Cs	b ** Soil Cleanup objectives to Protect GW Quality (ppm)	USEPA Health Based (ppm) Carcinogens	USEPA Health Based (ppm) Systemic Toxicants	CRQL (ppb)	Rec.soil Clnup Object. (ppm)
Dibenzo(a,h)anthracene	0.0005	33,000,000	50	1,650	165,000	0.0143	N/A	330	0.014 or MDL
3,3'-Dichlorobenzidine	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Hexachlorobenzene	0.006	3,900	0.35	0.014	1.4	0.41	60	330	0.41
Phenol	82,000	27	1	0.0003	0.03	N/A	50,000	330	0.03 or MDL
Pentachlorophenol	14.00	1,022	1	0.01	1.0	N/A	2,000	1,600	1.0 or MDL
Nitrobenzene	1,900	36	5	0.002	0.2	N/A	40	330	0.200 or MDL
4-Chloro-3-methylphenol	3,850	47	5	0.0024	0.24	N/A	N/A	330	0.240 or MDL
2,4-Dinitrophenol	5,600	38	5	0.002	0.2	N/A	200	1,600	0.200 or MDL
4-Nitrophenol	16,000	21	5	0.001	0.1	N/A	N/A	1,600	0.100 or MDL
2-Nitrophenol	2,100	65	5	0.0033	0.33	N/A	N/A	330	0.330 or MDL
2-Chlorophenol	28,500	15*	50	0.008	0.8	N/A	400	330	0.8
Aniline	35,000	13.8	5	0.001	0.1	123	N/A	330	0.1
2-Nitroaniline	1,260	86	5	0.0043	0.43	N/A	N/A	1,600	0.430 or MDL
3-Nitroaniline	1,100	93	5	0.005	0.5	N/A	N/A	1,600	0.500 or MDL
4-Chloroaniline	----	43 ****	5	0.0022	0.22	200	300	330	0.220 or MDL
2,6 Dinitrotoluene	277.0	198*	5	0.01	1.0	1.03	N/A	330	1.0

a. Allowable Soil Concentration Cs = f x Cw x Koc
b. Soil cleanup objective = Cs x Correction Factor (CF)

MDL is Method Detection Limit
b. Soil cleanup objective = Cs x Correction Factor (CF)
* Partition coefficient is calculated by using the following equation:
log Koc = -0.55 log S + 3.64. Other values are experimental values.
** Correction Factor (CF) of 100 is used as per proposed TAGM
*** As per proposed TAGM, Total VOCs < 10 ppm., Total Semi-VOCs < 500 ppm. and Individual Semi-VOCs < 50 ppm.
**** Koc is derived from the correlation Koc = 0.63 Kow (Determining Soil Response Action Levels..... EPA/540/2-89/057). Kow is obtained from the USEPA computer database 'MAIN'.

Note: Soil clnup objectives are developed for soil organic carbon content (f) of 1%, and should be adjusted for the actual soil organic carbon content if it is known.

APPENDIX A (cont.)

TABLE 3

Recommended soil cleanup objectives (mg/kg or ppm)

Organic Pesticides / Herbicides and PCBs

						USEPA Health Based (ppm)			
Contaminant	Solubility mg/l or ppm S	Partition coefficient Koc	Groundwater Standards/ Criteria Cv ug/l or ppb.	a Allowable Soil conc. ppm. Cs	b ** Soil Cleanup objectives to Protect GW Quality (ppm)	Carcinogens	Systemic Toxicants	CRQL (ppb)	*** Rec.soil Clnup Object. (ppm)
4,4'-DDD	0.16	770,000*	ND(<0.01)	0.077	7.7	2.9	N/A	16	2.9
4,4'-DDE	0.04	440,000*	ND(<0.01)	0.0440	4.4	2.1	N/A	16	2.1
4,4'-DDT	0.005	243,000*	ND(<0.01)	0.025	2.5	2.1	40	16	2.1
Dieldrin	0.195	10,700*	ND(<0.01)	0.0010	0.1	0.044	4	16	0.044
Endrin	0.26	9,157*	ND(<0.01)	0.001	0.1	N/A	20	8	0.10
Aldrin	0.017	96,000	ND(<0.01)	0.005	0.5	0.041	2	8	0.041
Endosulfan I	0.32	8,168*	0.1	0.009	0.9	N/A	N/A	16	0.9
Endosulfan II	0.33	8,031*	0.1	0.009	0.9	N/A	N/A	16	0.9
Endosulfan Sulfate	0.22	10,038*	0.1	0.01	1.0	N/A	N/A	16	1.0
Heptachlor	0.18	12,000	ND(<0.01)	0.0010	0.1	0.16	40	8	0.10
Heptachlor epoxide	0.35	220	ND(<0.01)	0.0002	0.02	0.077	0.8	8	0.02
Chlordane	0.056	21,305*	0.1	0.02	2.0	0.54	50	80	0.54
2,4-D	890	104*	4.4	0.005	0.5	N/A	800	800	0.5
2,4,5-T	238	53	35	0.019	1.9	N/A	200	330	1.9
Silvex	140	2,600	0.26	0.007	0.7	N/A	600	330	0.7
PCBs	0.08	17,510*	0.1	0.1	10.0	1.0	N/A	160	1.0(Surface) 10.0 (Sub-surface)
ychlorinated dibenzo-furans(PCDF)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Dibenzo-P-dioxins(PCDD) 2,3,7,8 TCDD	0.0000193	1709800	0.000035	0.0006	0.06	N/A	N/A	N/A	N/A
alpha - BHC	1.63	3,800	ND(<0.05)	0.002	0.2	0.111	N/A	8	0.11
beta - BHC	0.24	3,800	ND(<0.05)	0.002	0.2	3.89	N/A	8	0.2
delta - BHC	3.14	6,600	ND(<0.05)	0.003	0.3	N/A	N/A	8	0.3
gamma - BHC (Lindane)	7.0	1,080	ND(<0.05)	0.0006	0.06	5.4	20	8	0.06
Parathion	24.0	760	1.5	0.012	1.2	N/A	500	8	1.2
Mitotane	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Methoxychlor	0.040	25,637	35.0	9.0	900	N/A	400	80	10.0***
Endrin keytone	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
gamma - chlordane	0.56	140,000	0.1	0.14	14.0	0.54	5	80	0.54

a. Allowable Soil Concentration Cs = f x Cv x Koc

b. Soil cleanup objective = Cs x Correction Factor (CF)

* Partition coefficient is calculated by using the following equation: log Koc = -0.55 log S + 3.64. Other values are experimental values.

** Correction Factor (CF) of 100 is used as per proposed TAGM

*** As per proposed TAGM, Total Pesticides < 10 ppm.

Note: Soil clnup objectives are developed for soil organic carbon content (f) of 1% (5% for PCBs as per PCB guidance document), and should be adjusted for the actual soil organic Carbon content if it is known.

APPENDIX A

TABLE 4

Recommended Soil Cleanup Objectives (mg/kg or ppm)
for Heavy Metals

Contaminants	USEPA HEALTH BASED (ppm) Carcinogens	Systemic Toxicants	Protect water Quality ppm	Eastern USA Background ppm	CRDL* mg/kg or ppm	Rec.soil Clnup Goal (ppm)
Aluminum	N/A	30[a]	N/A	33,000	0.2	30 or SB
Antimony	N/A	30	N/A	N/A	0.6	30 or SB
Arsenic	N/A	N/A	N/A	3-12**	0.1	7.5 or SB
Barium	N/A	4,000	N/A	15-600	0.2	300 or SB
Beryllium	0.143	400	N/A	0-1.75	0.05	0.14
Cadmium	N/A	N/A	N/A	0.1-1	0.05	1 or SB
Calcium	N/A	3,000[b]	N/A	130 - 35,000**	50.0	SB
Copper	N/A	N/A	N/A	1-50	0.25	25 or SB
Chromium	N/A	400[c]	N/A	1.5-40**	0.1	10 or SB
Cobalt	N/A	N/A	N/A	2.5-60**	0.5	30 or SB
Cyanide	N/A	2,000	N/A	N/A	N/A	N/A
Iron	N/A	N/A	N/A	2,000 - 550,000	1.0	2,000 or SB
Lead	N/A	N/A	N/A	4-61	0.05	30 or SB
Magnesium	N/A	N/A	N/A	100 - 5,000	50.0	SB
Manganese	N/A	N/A	N/A	50 - 5,000	0.15	SB
Mercury	N/A	N/A	N/A	0.001-0.2	0.002 - 0.2	0.1
Nickel	N/A	2,000	N/A	0.5-25	0.4	13 or SB
Potassium	N/A	4,000[e]	N/A	8,500 - 43,000**	50.0	4,000 or SB
Silver	N/A	200	N/A	N/A	0.1	200
Selenium	N/A	N/A	N/A	0.1-3.9	0.05	2 or SB
Sodium	N/A	3,000[f]	N/A	6,000 - 8,000	50.0	3,000 or SB
Thallium	N/A	20[h]	N/A	N/A	0.1	20 or SB
Vanadium	N/A	2,000	N/A	1-300	0.5	150 or SB
Zinc	N/A	20[d]	N/A	9-50	0.2	20 or SB

* CRDL for soil is approx. 10 times the CRDL for water

** New York State backgrond

SB is site backgrond

[a] Aluminum as aluminum phosphide

[b] Calcium as Calcium Cyanide

[c] Chromium as Chromium (VI)

[d] Zinc as Zinc phosphide

[e] Potassium as Potassium Cyanide

[f] Sodium as Sodium Cyanide

[g] Vanadium as Vanadium Pentoxide

[h] Thallium as Thallium Sulfate

TOTAL ORGANIC CARBON (TOC)

USE AND LIMITATIONS

Total organic carbon is a measure of the total amount of nonvolatile, volatile, partially volatile, and particulate organic compounds in a sample. Total organic carbon is independent of the oxidation state of the organic compounds and is not a measure of the organically bound and inorganic elements that can contribute to the biochemical and chemical oxygen demand tests.

Because inorganic carbon (e.g., carbonates, bicarbonates, free CO_2) will interfere with total organic carbon determinations, samples should be treated to remove inorganic carbon before being analyzed.

FIELD PROCEDURES

Collection

Samples can be collected in glass or plastic containers. A minimum sample size of 25 g is recommended. If unrepresentative material is to be removed from the sample, it should be removed in the field under the supervision of the chief scientist and noted on the field log sheet.

Processing

Samples should be stored frozen and can be held for up to 6 mo under that condition. Excessive temperatures should not be used to thaw samples.

LABORATORY PROCEDURES

Analytical Procedures

- Equipment
    - Induction furnace
      e.g., Leco WR-12, Dohrmann DC-50, Coleman CH analyzer, Perkin Elmer 240 elemental analyzer, Carlo-Erba 1106
    - Analytical balance
      0.1 mg accuracy
    - Desiccator
    - Combustion boats
    - 10 percent hydrochloric acid (HCl)
    - Cupric oxide fines (or equivalent material)
    - Benzoic acid or other carbon source as a standard.

- Equipment preparation
  - Clean combustion boats by placing them in the induction furnace at 950° C. After being cleaned, combustion boats should not be touched with bare hands.
  - Cool boats to room temperature in a desiccator.
  - Weigh each boat to the nearest 0.1 mg.

- Sample preparation
  - Allow frozen samples to warm to room temperature.
  - Homogenize each sample mechanically, incorporating any overlying water.
  - Transfer a representative aliquot (5-10 g) to a clean container.

- Analytical procedures
  - Dry samples to constant weight at 70 ± 2° C. The drying temperature is relatively low to minimize loss of volatile organic compounds.
  - Cool dried samples to room temperature in a desiccator.
  - Grind sample using a mortar and pestle to break up aggregates.
  - Transfer a representative aliquot (0.2-0.5 g) to a clean, preweighed combustion boat.
  - Determine sample weight to the nearest 0.1 mg.
  - Add several drops of HCl to the dried sample to remove carbonates. Wait until the effervescing is completed and add more acid. Continue this process until the incremental addition of acid causes no further effervescence. Do not add too much acid at one time as this may cause loss of sample due to frothing. Exposure of small samples (i.e., 1-10 mg) having less than 50 percent carbonate to an HCl atmosphere for 24-48 h has been shown to be an effective means of removing carbonates (Hedges and Stern 1984). If this method is used for sample sizes greater than 10 mg, its effectiveness should be demonstrated by the user.
  - Dry the HCl-treated sample to constant weight at 70 ± 2° C.
  - Cool to room temperature in a desiccator.
  - Add previously ashed cupric oxide fines or equivalent material (e.g., alumina oxide) to the sample in the combustion boat.
  - Combust the sample in an induction furnace at a minimum temperature of 950 ± 10° C.

- Calculations
  - If an ascarite-filled tube is used to capture CO_2, the carbon content of the sample can be calculated as follows:

$$\text{Percent carbon} = \frac{A(0.2729)(100)}{B}$$

Where:

A = the weight (g) of CO_2 determined by weighing the ascarite tube before and after combustion
B = dry weight (g) of the unacidified sample in the combustion boat
0.2729 = the ratio of the molecular weight of carbon to the molecular weight of carbon dioxide

A silica gel trap should be placed before the ascarite tube to catch any moisture driven off during sample combustion. Additional silica gel should be placed at the exit end of the ascarite tube to trap any water that might be formed by reaction of the trapped CO_2 with the NaOH in the ascarite.

If an elemental analyzer is used, the amount of CO_2 will be measured by a thermal conductivity detector. The instrument should be calibrated daily using an empty boat blank as the zero point and at least two standards. Standards should bracket the expected range of carbon concentrations in the samples.

QA/QC Procedures

It is critical that each sample be thoroughly homogenized in the laboratory before a subsample is taken for analysis. Laboratory homogenization should be conducted even if samples were homogenized in the field.

Dried samples should be cooled in a desiccator and held there until they are weighed. If a desiccator is not used, the sediment will accumulate ambient moisture and the sample weight will be overestimated. A color-indicating desiccant is recommended so that spent desiccant can be detected easily. Also, the seal on the desiccator should be checked periodically and, if necessary, the ground glass rims should be greased or the "O" rings should be replaced.

It is recommended that triplicate analyses be conducted on one of every 20 samples, or on one sample per batch if less than 20 samples are analyzed. A method blank should be analyzed at the same frequency as the triplicate analyses. The analytical balance should be inspected daily and calibrated at least once per week. The carbon analyzer should be calibrated daily with freshly prepared standards. A standard reference material should be analyzed at least once for each major survey.

DATA REPORTING REQUIREMENTS

Total organic carbon should be reported as a percentage of the dry weight of the unacidified sample to the nearest 0.1 unit. The laboratory should report the results of all samples (including QA replicates, method blanks, and standard reference measurements) and should note any problems that may have influenced sample quality. The laboratory should also provide a summary of the calibration procedure and results (e.g., range covered, regression equation, coefficient of determination).