Feasibility Study Report

for

Naval Weapons Industrial Reserve Plant

Bethpage, New York

VOLUME I

DEPARTMENT OF THE NAVY
UNITED STATES OF AMERICA

Northern Division

Naval Facilities Engineering Command

Contract Number N62472-90-D-1298

Contract Task Order 0089

MARCH 1994

Halliburton NUS
CORPORATION

FEASIBILITY STUDY REPORT
FOR
NAVAL WEAPONS INDUSTRIAL RESERVE PLANT
BETHPAGE, NEW YORK

COMPREHENSIVE LONG-TERM ENVIRONMENTAL ACTION NAVY (CLEAN) CONTRACT

Submitted to:
Northern Division
Environmental Branch Code 1823
Naval Facilities Engineering Command
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Lester, Pennsylvania 19113-2090

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CONTRACT NUMBER N62472-90-D-1298
CONTRACT TASK ORDER 0089

MARCH 1994

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TABLE OF CONTENTS

PAGE

TABLE OF CONTENTS (Cont'd)

TABLE OF CONTENTS (Cont'd)

TABLE OF CONTENTS (Cont'd)

PAGE

APPENDICES

TABLE OF CONTENTS

PAGE

TABLES

TABLE OF CONTENTS

PAGE

FIGURES

EXECUTIVE SUMMARY

Introduction

The work to be performed under Contract N62472-90-D-1298, Contract Task Order (CTO) 0089, is to conduct a Phase 2 Remedial Investigation (RI) and a Feasibility Study (FS) at the Naval Weapons Industrial Reserve Plant (NWIRP), Bethpage, New York. This report presents the findings of the FS.

Purpose

The overall objective of the FS is to develop, evaluate, and select potential remedial alternatives that can be implemented and that will protect human health and the environment from risks associated with environmental contamination at the NWIRP Bethpage. A Phase 1 RI was completed in May 1992 (HNUS, 1992) and a Phase 2 RI report was completed in October 1993. The results of these RIs indicate the presence of soils contaminated with metals, PCBs, solvents, and other organics, and groundwater contaminated with solvents and metals.

The FS consists of four tasks.

- Develop remedial action objectives and goals. These objectives and goals are based on minimizing/preventing risks to human health and the environment, and complying with Applicable or Relevant and Appropriate Requirements (ARARs).
- Identify and screen technologies. Potential remedial action technologies are identified and screened based on effectiveness, implementability, and cost.
- Develop remedial action alternatives. Technologies are assembled into alternatives to provide cleanup strategies (General Response Actions) for contaminated soils and groundwater at the site. Alternatives are developed which provide a range of protection to human health and the environment.
- Detailed analysis of alternatives. Alternatives are evaluated based on short-term effectiveness, long-term effectiveness, implementability, cost, reduction of toxicity, mobility, or volume, compliance with ARARs, and overall protection of human health and the environment.

Remedial Action Objectives

Remedial action objectives developed for soil and groundwater at the NWIRP are as follows.

- Prevent human exposure (accidental ingestion, dermal contact, dust inhalation) to contaminated soils at Sites 1, 2, and 3 in concentrations greater than the remedial action goals.

- Prevent leaching of contaminants at resultant groundwater concentrations in excess of groundwater remediation goals.

- Comply with contaminant-specific, location-specific, and action-specific ARARs and guidance.

- Prevent human exposure (through ingestion, inhalation, dermal contact) to groundwater having contaminants in concentrations greater than the remedial action goals.

- As implementable, restore contaminated groundwater to the remedial action goals.

If groundwater goals cannot be achieved or the aquifer restored, then at a minimum the following remedial objectives will be met.

- Reduce human exposure (ingestion, inhalation, dermal contact) to groundwater having contaminants in concentrations greater than remedial action levels.

- Prevent further offsite migration of contaminants.

Remedial action goals (numeric criteria) were developed in accordance with these goals.

Volume of Contaminated Media

Approximate contaminated soil volumes associated with these goals are as follows.

- PCBs greater than 50 ppm: 300 cubic yards
- PCBs between 10 ppm and 50 ppm: 3,700 cubic yards
- Metals greater than hazardous waste criteria: 600 cubic yards
- Volatile Organic Compounds (VOCs) greater than action levels: 240,000 cubic yards
- VOCs greater than modified action levels: 87,000 cubic yards
- Other organics and metals greater than action levels: 60,000 cubic yards

Based on the groundwater remedial action goals, there is a calculated 2.4 billion gallons of groundwater with solvent concentrations greater than 100 ug/l and 36 billion gallons of groundwater with solvent concentrations greater than MCLs (5 ug/l).

The volume estimates are based on data collected during the RI and are used primarily to develop remedial action alternatives and associated cost estimates. Various assumptions were made in preparing these estimates. These assumption need to be verified with additional testing. Since the extent and type of additional testing is dependent on the final remedial strategy, this testing is normally conducted after the selection of the remedial strategy and during design.

Technology Screening

Technology screening of the universe of options was conducted for both soil and groundwater media. Based on the results of the technology screening, a list of potentially viable technologies was retained. These technologies serve as the basis for remedial alternatives.

Alternative Development

The technologies were assembled into eighteen alternatives which address soil contamination and ten alternatives which address groundwater contamination. These soil and groundwater alternatives provide variable levels of protection to human health and the environment, as well as compliance with ARARs and TBCs.

In addition to the no action alternative, soil remedial alternatives include both containment options (onsite capping and offsite landfilling) and treatment options (offsite incineration, chemical fixation, insitu vapor extraction, soil washing, and onsite low temperature thermal stripping). The alternatives include provisions for future use of the site (residential versus industrial), short term versus longer term compliance with VOC-ARARs, and addressing PCBs at ARAR levels versus TBC levels.

For groundwater, alternatives considered include no action, long term monitoring, protection of the public water supply (well head treatment), and groundwater pump and treat options (air stripping, activated carbon, and enhanced oxidation). The alternatives include the provision for treatment of all contaminated groundwater (VOCs greater than 5 ug/l) and a more limited system which addresses major threats and includes onsite/near site treatment of contaminated groundwater (VOCs greater than 100 ug/l).

1.0 INTRODUCTION

1.1 PURPOSE OF REPORT

The work to be performed under Contract N62472-90-D-1298, Contract Task Order (CTO) 0089, is to conduct a Phase 2 Remedial Investigation (RI) and a Feasibility Study at the Naval Weapons Industrial Reserve Plant (NWIRP), Bethpage, New York. This report presents the findings of the Feasibility Study. A Phase 1 RI was completed in May 1992 and a Phase 2 RI was completed in October 1993.

This work is part of the Navy's Installation Restoration (IR) Program, which is designed to identify contamination of Navy and Marine Corps lands/facilities resulting from past operations and to institute corrective measures, as needed. There are typically four distinct stages. Stage 1 is the Preliminary Assessment (formerly known as the Initial Assessment Study). Stage 2 is a Site Investigation, which augments the information collected in the Preliminary Assessment. Stage 3 is the Remedial Investigation/Feasibility Study (RI/FS), which characterizes the contamination at a facility and develops options for remediation of the site. Stage 4 is the Remedial Action, which results in the control or cleanup of contamination at sites. This report was prepared under Stage 3 (RI/FS).

1.2 SCOPE AND OBJECTIVES

The overall objective of the FS is to develop, evaluate, and select potential remedial alternatives that can be implemented and that will protect human health and the environment from risks associated with environmental contamination at the NWIRP Bethpage. A Phase 1 RI was completed in May 1992 (HNUS, 1992) and a Phase 2 RI report was completed in October 1993 (HNUS, 1993). The results of these RIs indicate the presence of soils contaminated with metals, PCBs, and solvents and groundwater contaminated with solvents and metals. A summary of the results from both phases is presented in Sections 1.5 through 1.7. The data used in this FS is based on the NWIRP Bethpage RI data, plus information from the Hooker/RUCO RI (Occidental, 1992) and Grumman RI activities.

1.3 ACTIVITY BACKGROUND INFORMATION

1.3.1 Activity Location and Description

The NWIRP is situated on 108 acres in Nassau County in the Hamlet of Bethpage, Town of Oyster Bay, New York (see Figure 1-1). The NWIRP lies entirely within the Grumman Aerospace complex, which covers approximately 605 acres (see Figure 1-2). The NWIRP is bordered on the north, west, and south by Grumman facilities, and on the east by a residential neighborhood.

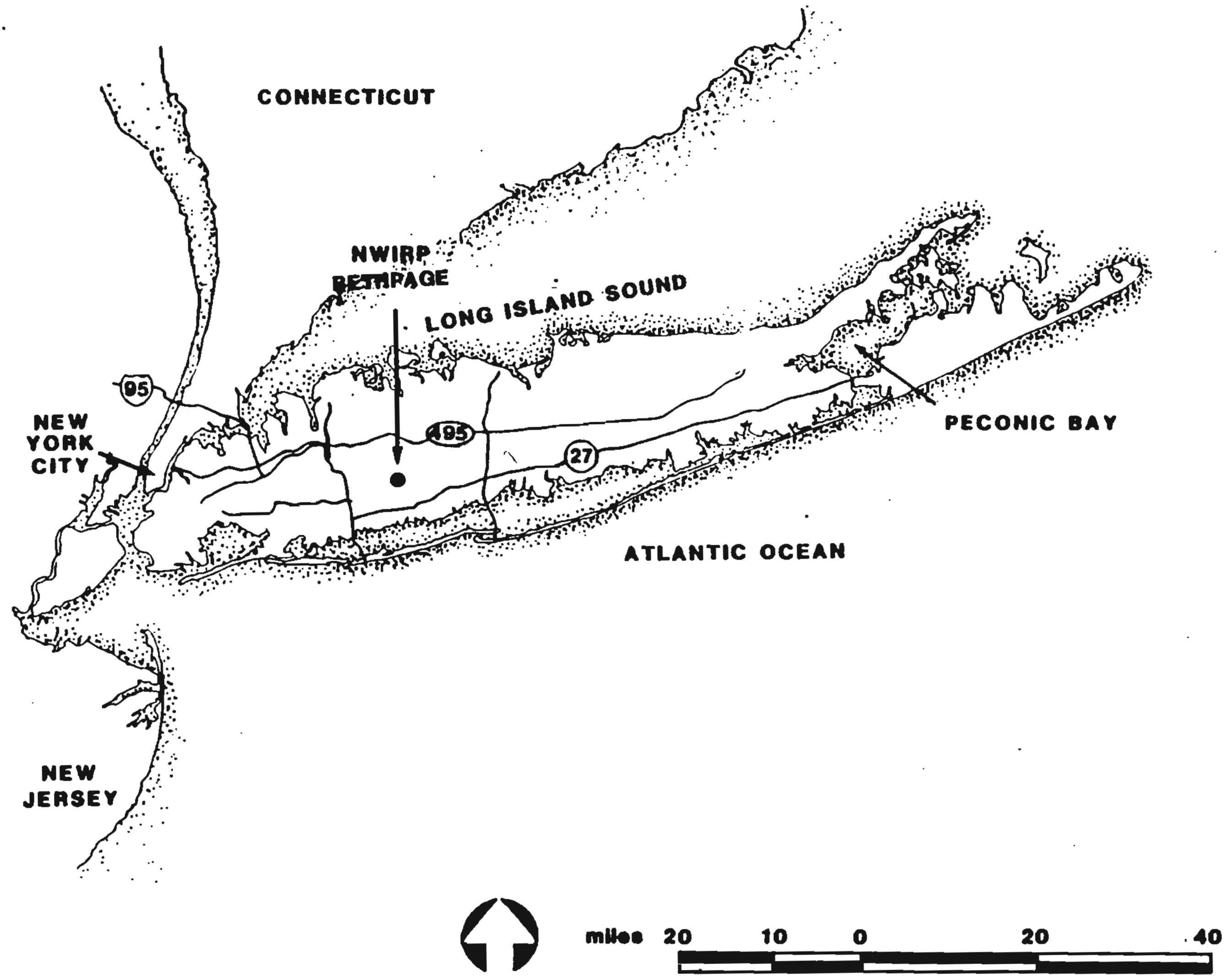

Figure 1–1

General Location Map, NWIRP Bethpage, New York

Naval Weapons Industrial
Reserve Plant
Bethpage
Long Island, New York

ACAD: 3281\BASE.DWG 5/24/93 MJJ

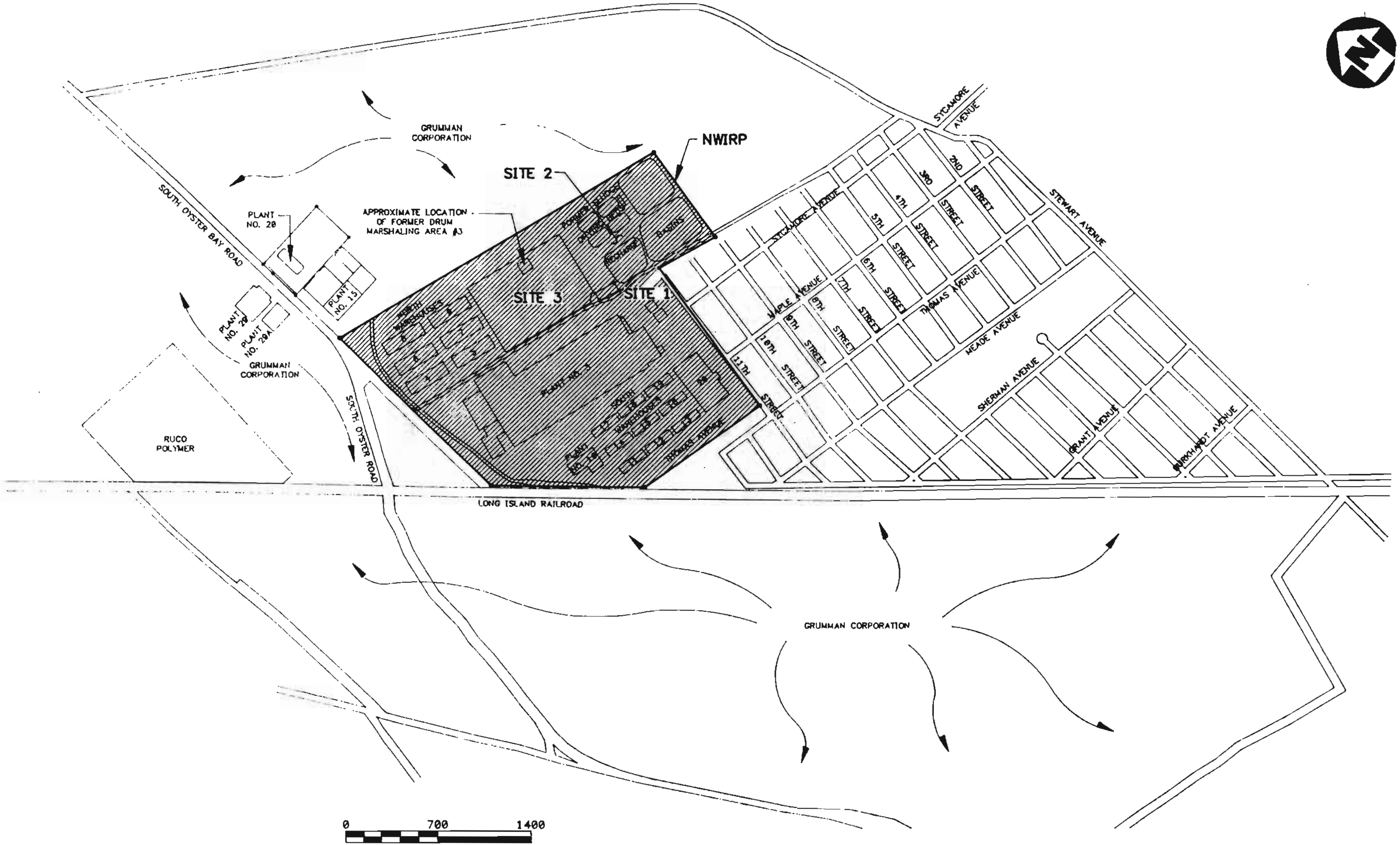

FIGURE 1-2

SITE LAYOUT MAP
PHASE 2 – REMEDIAL INVESTIGATION/FEASIBILITY STUDY
NWIRP, BETHPAGE, NEW YORK

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The climate at NWIRP is described as a fairly humid, modified continental climate. The nearby Atlantic Ocean and Long Island Sound tend to reduce the temperature range commonly encountered further inland. The highest monthly mean temperature occurs in July (74.9 degrees); the lowest occurs in January (31.4 degrees). The mean annual precipitation is 45 inches, and the mean annual evapotranspiration is about 22 inches (RGH, 1986).

1.3.2 Activity History

The histories of the NWIRP and Grumman Aerospace facilities are discussed in detail in the Initial Assessment Study of the NWIRP (RGH, 1986) and the RI/FS Work Plan for the Grumman facility prepared by Geraghty and Miller (G&M, 1990). The following synopsis is from those discussions.

The NWIRP was established in 1933. Since its inception, the plant's primary mission has been the research prototyping, testing, design engineering, fabrication, and primary assembly of military aircraft.

The facilities at NWIRP (see Figures 1-2 and 1-3) include four plants (Nos. 3, 5, and 20, used for assembly and prototype testing; and No. 10, a group of quality control laboratories), two warehouse complexes (north and south), a salvage storage area, water recharge basins, the Industrial Wastewater Treatment Plant (to process chemical effluent from the activity's manufacturing operations), and several smaller support buildings.

An Initial Assessment Study (IAS) of NWIRP Bethpage, New York, and NWIRP Calverton, New York, conducted in 1986 (RGH, 1986) indicated that three areas at the NWIRP Bethpage may pose a threat to human health or the environment. These three sites are Site 1 - Former Drum Marshaling Area (identified as Site 7 in the IAS), Site 2 - Recharge Basin Area (identified as Site 8 in the IAS), and Site 3 -Salvage Storage Area (identified as Site 9 in the IAS). These sites were renumbered to avoid confusion with the site designations at the Calverton NWIRP. Figure 1-3 presents the location and general layout of the three sites at Bethpage.

Based on the historic data presented in the IAS, there is the potential for volatile organic, semivolatile organic, and inorganic contamination at each of the three sites.

In May 1992, a RI (Phase 1) was completed at the site. In October 1992, a Phase 2 RI was initiated to further define the nature and extent of PCB-contaminated soils and to define the extent of solvent-contaminated groundwater. The Phase 2 field activities were completed in June 1993 and a Phase 2 RI report was completed in October 1993. The results of both phases of the RI are summarized in Sections 1.5 through 1.7.

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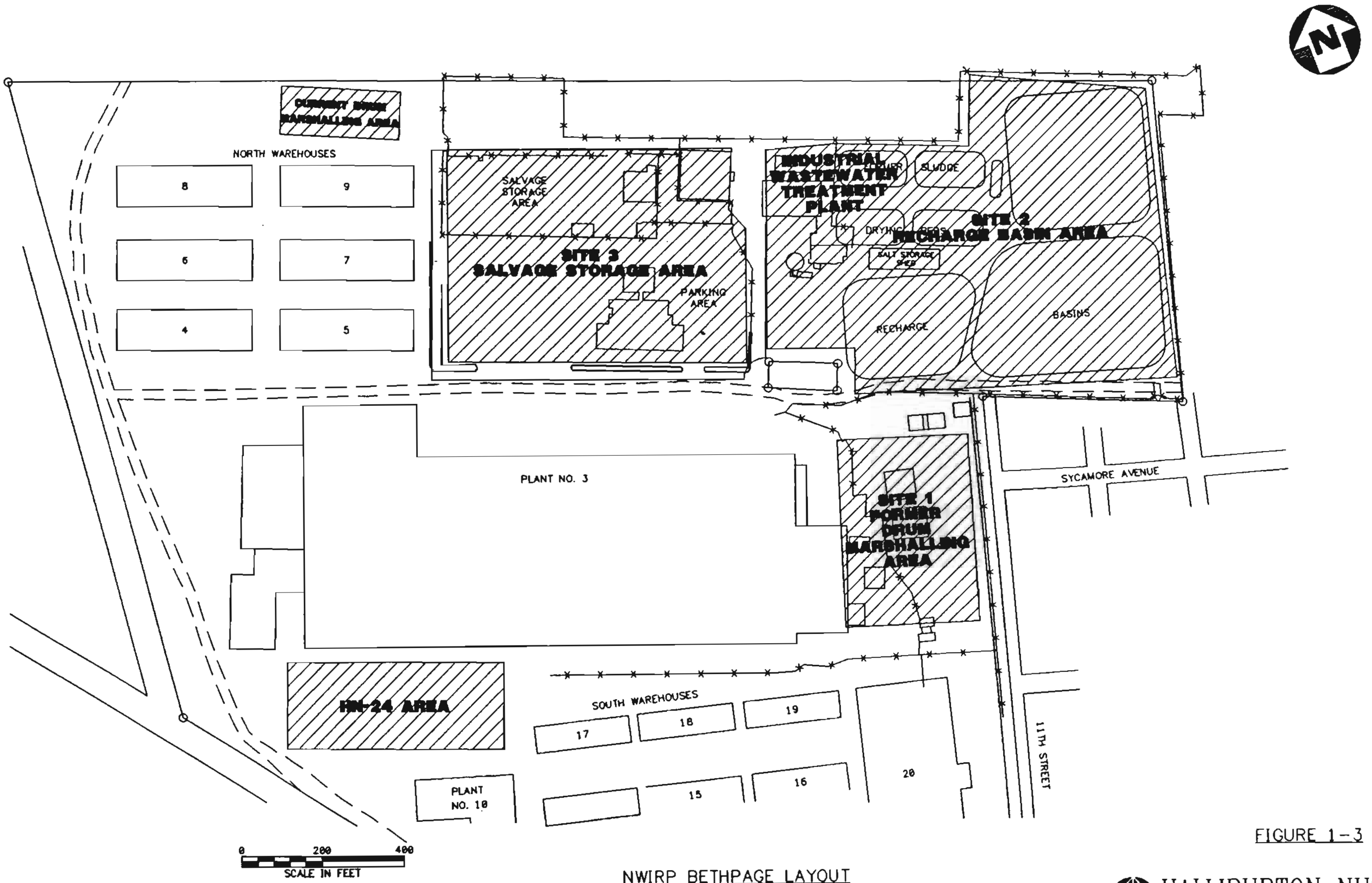

FIGURE 1-3

NWIRP BETHPAGE LAYOUT
PHASE 2 REMEDIAL INVESTIGATION/FEASIBILITY STUDY
NWIRP, BETHPAGE, NEW YORK

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1.4 PHYSICAL CHARACTERISTICS OF STUDY AREA

1.4.1 Surface Features

The NWIRP Bethpage is located on Long Island, New York. It is located on a relatively flat, featureless, glacial outwash plain. The site and nearby vicinity are highly urbanized. Because of this, most of the natural physical features have been reshaped or destroyed. The topography of the activity is relatively flat with a gentle slope toward the south. Elevations range from greater than 140 feet (above mean sea level, MSL) in the north to less than 110 feet (above MSL) at the southwest corner (RGH, 1986).

The NWIRP is about 108 acres in size. The dominant features at the activity are Plant No. 3, (the manufacturing plant) and three groundwater recharge basins located at Site 2. The recharge basins are each approximately 1.5 to 2.5 acres in area and about 30 feet deep. Other notable features at the site are a wastewater treatment plant at Site 2, an office building at Site 3, and a drum marshaling area at Site 3.

1.4.2 Geology

The Upper Glacial Formation (commonly referred to as glacial deposits) forms the surface deposits across the entire NWIRP. The glacial deposits beneath the site consist of coarse sands and gravels. These deposits are generally about 30 to 45 feet thick; local variations in thickness are common due to the irregular and undulating contact of the glacial deposits with the underlying Magothy Formation. The contact between the two formations was defined in the field as the horizon where gravel becomes very rare to absent, and variegated finer sands, silts, and clays predominate. The generally coarse nature of both formations near their contact, however, may make this differentiation either difficult or rather subjective (HNUS, 1992).

The results of the Phase 2 RI drilling program indicate that the general characteristics of the Upper Glacial Formation to the east and southeast of the NWIRP are similar to that found onsite. The glacial deposits penetrated during the temporary monitoring well program consisted chiefly of sands and gravels. The thickness of the glacial deposits was generally about 35 feet, although this can only be considered an approximation because the lithology was determined through an examination of the drill cuttings and no split-spoon samples were taken.

The results of the drilling program at location HN-24 and surrounding well locations (HNUS, 1992) appear to confirm the regional observation that there are no singular, areally extensive clay units beneath the NWIRP. The installation of multiple wells at Sites 1 and 3, at location HN-24, and in the offsite residential neighborhood further indicates that there does not appear to be any clay units of significant local extent. Clay units encountered at any particular location do not persist along strike or in either direction of dip. The stratigraphic section at and below subsurface depths of about 100 feet may be considered "clay-prone" because the number of individual clay units significantly increases below this depth, but none of these clays are laterally persistent.

1.4.3 Hydrogeology

The Upper Glacial Formation and the Magothy Formation comprise the aquifer of concern at the NWIRP. Regionally, these formations are generally considered to form a common, interconnected aquifer as the coarse nature of each unit near their contact and the lack of any regionally confining clay unit allows for the unrestricted flow of groundwater between the formations.

Although the water table beneath the NWIRP occurs below the glacial deposits, they are hydrogeologically important because their high permeability allows for the rapid recharge of precipitation to the underlying Magothy Formation. In addition, the large quantities of groundwater withdrawn daily from the Magothy passes back through part of the glacial deposits via the recharge basins to the Magothy Formation.

The Magothy aquifer is the major source of public water in Nassau County. The most productive water-bearing zones are the discontinuous lenses of sand and gravel that occur within the generally siltier matrix. The major water-bearing zone is the basal gravel.

The Magothy aquifer is commonly regarded to function overall as an unconfined aquifer at shallow depths and a confined aquifer at deeper depths. The drilling program on the NWIRP has revealed that clay zones beneath the facility are common but laterally discontinuous. No confining clay units of facility-wide extent were encountered. This agrees with observations noted in the literature (S-F, 1992).

The degree of confinement within the Magothy aquifer is reported to generally increase with depth due to the cumulative effect of the silts and clays (Isbister, 1966; McClymonds and Franke, 1972). The lack of a singular, continuous confining unit beneath the NWIRP and the dependence of confinement on the occurrence of multiple fine-grained units should make the relationship of confinement to depth laterally inconsistent due to the extreme lithologic heterogeneity of the formation. The response of the Magothy aquifer to production well pumping suggests that groundwater occurs under at least semi-confined conditions in deeper portions of the aquifer.

The groundwater flow dynamics beneath the NWIRP and Grumman are complex. A total of 16 deep production wells (7 on the NWIRP and 9 on Grumman property) are located on the facility. Throughout the year, these wells are pumped in various combinations. Depending on facility demand, any particular well may be turned on and off at frequent intervals, or may be turned on or off for extended periods. In addition, at least one well (Well No. 16), has a variable speed motor, which can vary the well yield depending on demand. The resultant cones of depression formed by the possible well-usage combinations make local variations in the overall groundwater pattern difficult to predict.

Recharge basins have the potential to greatly affect local water elevations and hence, local groundwater flow patterns. Recharge basins within the immediate study area that may influence the local groundwater regime include the NWIRP recharge basins, the Grumman recharge basins (located south of the Long Island Railroad tracks), several recharge basins (including the Hooker/Ruco complex), and two municipal stormwater recharge basins located west of the NWIRP on South Oyster Bay Road and southeast of the NWIRP in the residential neighborhood, at the corner of Burkhardt Avenue and Third Street.

The dominant direction of shallow groundwater flow beneath the NWIRP appears to be dominantly to the southwest and, to a lesser extent, to the south. Radial flow from the Site 2 recharge basin mounding may also introduce a component of southeastward flow from the recharge basins toward the residential neighborhood. The other recharge basins also appear to affect the local groundwater pattern. Groundwater mounding is evident to the west of the NWIRP and is apparently an effect of either (or both of) the Hooker/Ruco basins or the municipal basin. Alternatively, local geological formations may cause this mounding. Similarly, groundwater mounds have formed beneath the Grumman recharge basins and have apparently influenced the local groundwater flow.

Regionally, the horizontal component of groundwater flow is more dominant than the vertical component (B-M, 1992). Vertical gradients, and therefore vertical flow, would be expected to increase near discharge points such as pumping wells. Because of the high transmissivity of the Magothy aquifer and the depth of the nearby production wells it is unlikely that any particular well can pump at sufficient rates to substantially affect the shallower zones. For example, in this investigation's pumping test no. 2 (see Appendix E of the Phase 2 RI), the pumping of PW-11 at nearly 1,000 gpm for 72 hours produced little or no measurable drawdown in the nearby observation wells or other production wells. It may be possible, however, that the heavy pumpage of multiple deep wells in close proximity (which occurs with both the facility and public supply wells) could significantly affect the entire water column.

A groundwater model of the immediate area was constructed as part of this investigation. It was concluded that the computer modeling study was the most efficient way to delineate the local flow regime and determine the influence of the heavy pumpage of the facility wells (with subsequent groundwater recharge at the basins) and the offsite public supply wells. As discussed, the groundwater flow patterns beneath the NWIRP are believed to be extremely complex due to the multiple well pumpage and recharge patterns.

1.4.4 Groundwater Use

Groundwater is the sole source for potable water supply and industrial use. Bethpage Water District (BWD) is the nearest down-gradient supplier of potable water, with four wells approximately 3200 feet to the east and five wells approximately 7500 feet to the south. In 1991, these nine wells were used to supply an average of 3.6 million gallons per day (MGD) of drinking water.

Grumman operates a total of 14 production wells on both Grumman property and the NWIRP Bethpage. In 1992, these wells provided an average of 6.1 MGD. The majority of this water is used for non-contact cooling and then is discharged into recharge basins. The balance of the water is used for contact processing and sanitary uses, and then is discharged to the local POTW. Three recharge basins are located on the NWIRP and are used to infiltrate an estimated 66% of the extracted water. The balance of the recharge basins are located on Grumman property to the south.

1.5 SITE 1: FORMER DRUM MARSHALING AREA

1.5.1 Site Description

Hazardous waste management practices for Grumman facilities on Long Island included marshaling of drummed wastes on the Navy property at NWIRP Bethpage. Such storage first took place on a cinder-covered surface over the cesspool field east of Plant No. 3. From the early 1950s through about 1978, drums containing liquid cadmium waste were stored here. In 1978, the collection and marshaling point was moved a few yards south of the original unpaved site, to an area on a 100- by 100-foot concrete pad. This pad had no cover, nor did it have berms for containment of spills. In 1982, drummed waste storage was transferred to the present Drum Marshaling facility, located in the Salvage Storage Area (Site 3); a cover was added in 1983.

Reportedly, all drums of waste marshaled at the Former Drum Marshaling Areas were taken off-activity by a private contractor for treatment or disposal. There are no reports of leaks or spills of drum contents.

Materials stored at the Former Drum Marshaling Areas included waste halogenated and nonhalogenated solvents. Cadmium and cyanide were also stored in this area from the early 1950s through 1974. Reportedly, 200 to 300 drums were stored at each area at any one time.

Site 1 occupies an area of approximately 4 acres. It is surrounded on three sides by a fence and on the fourth side by Plant No. 3. The site is also bisected by a fence running north-south. To the west of this fence, the surface consists of asphalt and concrete. Bulk chemical storage tanks are also present. To the east of this bisecting fence, the surface is earth, gravel, or grass. The northeastern part of the site is slightly elevated (4 feet), well vegetated, and well maintained. The southeastern part of the site is gravel and earth and is used for the storage of containers, equipment, and debris. The majority of the investigation at Site 1 occurred in the southeastern portion of the site. A vegetated wind row (pine) and fence are present along the eastern edge of the site to reduce community visibility.

1.5.2 Nature and Extent of Contamination

Soil

The soils at Site 1 were found to contain elevated concentrations of chlorinated solvents (such as PCE: 4.8 mg/kg), PCBs (0.147%, and metals (arsenic: 0.338%). In addition, PAHs, and other semivolatile organics and metals were found at concentrations greater than background levels. Solvents were found at both in subsurface and surface soils throughout Site 1, The higher concentrations were found in the subsurface soils near the former drum marshaling pad. The other contaminants were found in most of the surface soils at Site 1, indicating widespread surface soil contamination. Contamination of these other organics was only found at depth (3 to 5 feet bgs) in limited locations. The highest concentrations of volatile organics, PCBs, and arsenic at the NWIRP were found at Site 1.

Groundwater

The groundwater at Site 1 was found to contain elevated concentrations of chlorinated solvents (such as TCE: 1.1 mg/l, PCE: 3.6 mg/l, and TCA: 10 mg/l). The highest concentrations of solvents appear to be associated with the former drum marshaling pad area, indicating this area as a likely source. However, other potential sources in this area include the former cesspool area and eastern edges of Plant No. 3. Contaminated groundwater from Site 1 extends south and west to approximately the Long Island Railroad, at which point it is at a depth of approximately 200 feet bgs. Computer modeling indicates that this contaminated groundwater may continue further south and deeper and eventually be intercepted by Grumman production wells.

Several inorganics (in unfiltered samples) were found at concentrations greater than drinking water criteria, including cadmium (392 ug/l), chromium (169 ug/l), and lead (134 ug/l). The chromium and cadmium results are from a monitoring well considered upgradient of Site 1, although based on the location of the well and the activities at the site, these results could potentially result from Site 1 activities. For filtered samples, inorganics were also detected at concentrations greater than drinking water criteria, including cadmium (91 ug/l) and chromium (56.7 ug/l).

1.5.3 Contaminant Fate and Transport

Potential migration routes of contaminants include direct contact to site workers, fugitive dust and volatile emissions to onsite workers and offsite residents, migration into the groundwater and transport offsite with the groundwater. The relative significance of each migration route is dependent on physical and chemical properties of individual compounds.

Each of the chemicals identified at Site 1 is relatively stable in the environment. Biologically, chlorinated solvents such as PCE and TCE will break down to dichloroethenes and vinyl chloride and TCA will break down to dichloroethanes and chloroethane. The presence of some of these decomposition products in the groundwater is an indication of biological degradation. Because of their relatively high vapor pressure, these organics will volatilize to the air. In the atmosphere, the chlorinated solvents compounds are subject to photochemical degradation forming hydrochloric acid, carbon dioxide, and water. This degradation route is also associated with the formation of ground level ozone formation. Because of their relatively high solubility in water, solvents are readily transported from contaminated soils by infiltration into the groundwater. This groundwater then flows offsite.

PCBs, metals, and semivolatile organics are not very mobile in the environment compared to the volatile organics. These other compounds are normally adsorbed onto soil particles and are only found at depth when mechanically placed there or are carried there by another more mobile fluid. As a result, investigations are typically limited to the near surface areas. Primary migration pathways for these chemicals are direct contact with the materials and fugitive dust emissions.

Computer modeling conducted during the Phase 2 RI indicates that volatile organics from Site 1 are flowing southward in an arc from the southeast to the southwest. The contaminated groundwater is also sinking, primarily because of the influence of Grumman production wells to the southeast. Under current Grumman operating conditions, all contaminated groundwater from Site 1 would be captured by Grumman production wells to the south. Only under the conditions in which Grumman production wells are not operating at current levels would the contaminants from Site 1 extend beyond the southern boundary of Grumman. Because the production wells discharge to recharge basins, primary source areas, such as Site 1, can also create secondary source areas, such as Site 2 - Recharge Basin Area.

1.5.4 Baseline Risk Assessment

To assess the risks to human health from the site contaminants, exposure scenarios were developed. For contaminated soil, the scenarios include direct contact with contaminants in surface soils through dermal contact, ingestion, and inhalation (current soil exposure); potential direct contact with subsurface soils following excavation of such soils (future soil exposure); and indirect exposure through soil contaminants leaching to groundwater, and the contaminated groundwater being consumed (future groundwater exposure). The receptors include onsite adult workers and offsite adult and child residents. The receptors for direct contact were employees only. For the contaminated groundwater, the scenarios include residential and employee consumption of the contaminated groundwater (current groundwater exposure).

In general an acceptable range for excess carcinogenic risk (as defined by the EPA's National Contingency Plan [NCP]) ranges from 10^{-4} (1 in 10,000) to 10^{-6} (1 in 1 million). Remedial alternatives should be designed to attain a 10^{-6} risk level although factors related to exposure, uncertainty, and technical limitations may justify a deviation. For noncarcinogenic risks, a hazard index (HI) in excess of unity (1.0) reflects a potential health risk associated with exposure to a chemical mixture.

Hazard Indices calculated for current and future soil exposure scenarios are all below 1.0; adverse noncarcinogenic health effects for these pathways are not indicated. Total excess cancer risks for current soil exposure range from 8E-6 to 2E-4, with the highest risk occurring for the adult employee dermal exposure scenario. Aroclor 1248 in Site 1 was the major factor in these potential dermal cancer risks. Because of the elevated PCB concentration at one location, steps were taken to isolate these soils from potential receptors. With this area isolated, revised total excess cancer risks for current soil exposure range from 4E-7 to 1E-5, with the highest risk occurring for the adult employee, dermal exposure scenario. Estimated total excess cancer risks for future soil exposure scenarios ranged from 9E-11 to 9E-6, with the highest risks occurring for the adult resident dust inhalation scenario at Site 1. Arsenic at Site 1 was primarily responsible for these projected cancer risks.

For potential exposure to current groundwater concentrations, Hazard Indices exceeded 1.0 for all three potential receptors (employee, adult resident, child resident). Individual Hazard Quotients for several chemicals exceeded 1.0, including both metals and VOCs. Estimated total excess cancer risks ranged from 8E-4 to 3E-3, with TCE risks comprising a large portion of the total risk.

For potential exposure to future groundwater concentrations, Hazard Indices exceeded 1.0 for the resident ingestion/dermal pathways. This was due primarily to PCE, for which the Hazard Quotient exceeded 1.0.

Estimated total excess cancer risks ranged from 6E-6 to 6E-4, with TCE, PCE, and Aroclor 1248 posing the greatest risks.

Based on current risk assessment modeling, it has been determined that groundwater concentrations of VOCs and inorganics are the most significant sources of noncarcinogenic and carcinogenic risk at the Bethpage site. In addition, many groundwater constituents exceeded Federal and state drinking water standards. PCBs in surface and subsurface soil at the NWIRP Bethpage may pose the greatest cancer risk, especially because of their high Cancer Slope Factor (CSF).

1.5.5 Conclusions

Based on volatile organic isoconcentration contour maps, Site 1 is a likely source of on-site and near-site (Grumman) groundwater contamination. Contaminated groundwater from Site 1 extends south and west to approximately the Long Island Railroad, at which point it is at a depth of approximately 200 feet bgs. Computer modeling indicates that this contaminated groundwater may continue further south and deeper and eventually be intercepted by Grumman production wells.

The soils at Site 1 contain sufficient residual volatile organic contamination to confirm the source of groundwater contamination as being near or at the former drum marshaling areas. Based on observed groundwater contamination patterns, there are potentially other source areas at the NWIRP.

The contaminants in the soils at the NWIRP (under the current or in future scenarios) do not represent a significant, direct, non-carcinogenic risk to onsite workers or offsite residents (hazard index is less than 1.0). Likewise, incremental carcinogenic risks are not indicated for offsite residents under the current soil scenario (excess cancer risk less than 1×10^{-6}). However, carcinogenic risks to onsite workers (under the current and future soil scenarios) and offsite residents (under future soil scenarios) exceed an excess cancer risk of 1×10^{-6}. The risks do not, however, exceed an excess cancer risk of 1×10^{-4}.

The groundwater at the NWIRP Bethpage, if used as a potable water source, would be expected to result in significant carcinogenic risks (excess cancer risk greater than 1×10^{-4}) and noncarcinogenic risks (hazard index greater 1.0) to residents and employees under the current and future groundwater scenarios. The one exception to this is that the hazard index to employees under the future groundwater exposure would be about 0.5.

1.6 SITE 2: RECHARGE BASIN AREA

1.6.1 Site Description

Surface water drainage on Long Island is, for the most part, locally controlled, with numerous recharge basins used to channel this resource back to the groundwater. These basins also receive storm water runoff. Several such recharge basins are located at NWIRP Bethpage.

Prior to 1984, some Plant No. 3 production-line rinse waters were discharged to the recharge basins. The Environmental/Energy Survey of the activity, published in 1976, states that 1.85 million gallons per week were discharged to the recharge basins. These waters were directly exposed to chemicals used in industrial processes (involving the rinsing of manufactured parts). Reportedly, these discharges of dilute rinse waters did not contain chromates, based on the Initial Assessment Study (IAS).

Since about 1977, the discharge rate has been 14 million gallons per week of noncontact cooling water. All contact wastewater discharge currently goes to the Industrial Wastewater Treatment Plant.

Also, adjacent to the recharge basins are the former sludge drying beds. Sludge from the Plant No. 2 Industrial Waste Treatment Facility (south Grumman Complex) was dewatered in the drying beds before offsite disposal. Site 2 occupies an area of approximately 16 acres, including the recharge basins and former sludge drying beds.

On at least one occasion, sampling performed by the Nassau County Department of Health detected levels of hexavalent chromium in excess of allowable limits. Grumman was notified of this noncompliance and asked to perform remedial actions necessary to eliminate the problem. Reportedly, Grumman complied with the request.

1.6.2 Nature and Extent of Contamination

Soil

Chemicals detected at significant concentrations at Site 2 include TCE (32 ug/kg), chromium (419 mg/kg), and PCBs (36.6 mg/kg). In addition, PAHs and other metals were found at the site. The concentration of all these contaminants are relatively low when compared to those observed at Site 1. In particular, the relatively low concentration of chlorinated solvents found in the soils at Site 2, indicates that the soils at Site 2 may not be a significant source of solvent-contaminated groundwater from the NWIRP.

No evidence of the former sludge drying beds were encountered during the investigation. This area is currently used for the staging of sediment from the recharge basins. However, it should be noted that the soil samples with the highest chromium and PCB results where encountered in the area of the former sludge drying beds.

PCBs were found in both surface and near surface (3 to 5 feet bgs) soils throughout the site. The surface soils contaminated with PCBs are predominant along the earthen roadways at the site. The subsurface PCB soil contamination is located at two distinct areas, one in the southeast corner and the other in the northwest corner. Limited PCBs were also found in the recharge basin sediment. However, since Grumman routinely removes this basin sediment, it will not be considered in this report.

Groundwater

The groundwater at Site 2 was found to contain chlorinated solvents at concentrations that exceed drinking water criteria, including TCE (11 ug/l), toluene, (10 ug/l), and PCE (6 ug/l). These groundwater concentrations are similar to, or less than, the water measured entering the basins, indicating that recharge basin waters may potentially account for most of the groundwater contamination measured at Site 2.

Chromium (at 169 ug/l), cadmium, (392 ug/l), and cyanide (2.69 mg/l) were found in unfiltered samples from a downgradient well at this site. However, this downgradient well is located on Site 1 and may be influenced by activities at Site 1. Additionally, the operation of the recharge basins creates a significant groundwater mound at Site 2, resulting in all monitoring wells in this area being considered downgradient. Inorganics at similar concentrations were not found in other downgradient monitoring wells.

1.6.3 Contaminant Fate and Transport

Potential migration routes of contaminants include direct contact to site workers, fugitive dust and volatile emissions to onsite workers and offsite residents, migration into the groundwater and transport offsite with the groundwater. The relative significance of each migration route is dependent on physical and chemical properties of individual compounds.

Each of the chemicals identified at Site 2 is relatively stable in the environment. Biologically, chlorinated solvents such as PCE and TCE will break down to dichloroethenes and vinyl chloride and TCA will break down to dichloroethanes and chloroethane. The presence of some of these decomposition products in the groundwater is an indication of biological degradation. Because of their relatively high vapor pressure, these organics will volatilize to the air. In the atmosphere, the chlorinated solvents compounds are subject to photochemical degradation forming hydrochloric acid, carbon dioxide, and water. This degradation route is also associated with the formation of ground level ozone formation. Because of their relatively high solubility in water, solvents are readily transported from contaminated soils by infiltration into the groundwater. This groundwater then flows offsite.

PCBs, metals, and semivolatile organics are not very mobile in the environment compared to the volatile organics. These other compounds are normally adsorbed onto soil particles and are only found at depth when mechanically placed there or are carried there by a another more mobile fluid. As a result, investigations are typically limited to the near surface areas. Primary migration pathways for these chemicals are direct contact with the materials and fugitive dust emissions.

Using the current production well pumping operation, computer modeling conducted during the Phase 2 RI was used to estimate groundwater (and soluble contaminant) flow paths. This modeling indicates that water from the recharge basins water flows south (regional groundwater flow direction) and up to 2000 feet west, 1500 feet north, and 5000 feet east of the recharge basins. Contaminants in this water may account for the some of the contamination found in NWIRP-upgradient monitoring wells. However, contaminants in this water would not be expected to account for solvent contamination found in the Grumman- or Hooker/RUCO-upgradient monitoring wells. The water then turns, or continues, south toward Grumman production wells, the Bethpage Water District (BWD) potable water supply wells, and the ocean. An estimated 30% to 75% would be captured by Grumman production wells. A few percent of this water may be captured by BWD wells to the east (Adams Avenue) and south (Wells 4-1 and 4-2) with the balance of the water continuing on south toward the ocean.

1.6.4 Baseline Risk Assessment

To assess the risks to human health from the site contaminants, exposure scenarios were developed. For contaminated soil, the scenarios include direct contact with contaminants in surface soils through dermal contact, ingestion, and inhalation (current soil exposure); potential direct contact with subsurface soils following excavation of such soils (future soil exposure); and indirect exposure through soil contaminants leaching to groundwater, and the contaminated groundwater being consumed (future groundwater exposure). The receptors include onsite adult workers and offsite adult and child residents. For the contaminated groundwater, the scenarios include residential and employee consumption of the contaminated groundwater (current groundwater exposure).

Hazard Indices calculated for current and future soil exposure scenarios are all below 1.0; adverse noncarcinogenic health effects for these pathways are not indicated. Total excess cancer risks for current soil exposure scenario range from 2E-7 to 6E-6, with the highest risk occurring for the adult employee dermal exposure scenario. Aroclor 1248 in Site 2 was the major factor in these potential dermal cancer risks. Estimated total excess cancer risks for future soil exposure scenarios ranged from 5E-8 to 3E-6, with the highest risks occurring for the employee dermal absorption at Site 2. Aroclor 1248 at Site 2 was primarily responsible for these projected cancer risks.

For potential exposure to current groundwater concentrations scenario, Hazard Indices exceeded 1.0 for all three potential receptors (employee, adult resident, child resident). Individual Hazard Quotients for several chemicals exceeded 1.0, including both metals and VOCs. Estimated total excess cancer risks ranged from 8E-4 to 3E-3, with TCE risks comprising a large portion of the total risk.

For potential exposure to future groundwater concentrations scenario, Hazard Indices exceeded 1.0 for the resident ingestion/dermal pathways. This was due primarily to PCE, for which the Hazard Quotient exceeded 1.0. Estimated total excess cancer risks ranged from 6E-6 to 6E-4, with TCE, PCE, and Aroclor 1248 posing the greatest risks.

1.6.5 Conclusions

Based on volatile organic isoconcentration contour maps and soil data, Site 2 is not a likely source of the significant onsite volatile organic groundwater contamination. However, based on computer modeling, offsite monitoring well data, and the consideration that the recharge basin water contains solvents, the recharge basins probably act as a secondary source of groundwater contamination. This secondary source forms a second groundwater plume to the east and south of the NWIRP, which is much lower in concentration than that associated with Site 1, but covers a significantly greater area, depth, and volume of groundwater.

The contaminants in the soils at the NWIRP (under the current or in future scenarios) do not represent a significant, direct, non-carcinogenic risk to onsite workers or offsite residents (hazard index is less than 1.0). Likewise, incremental carcinogenic risks are not indicated for offsite residences under the current soil scenario (excess cancer risk less than 1×10^{-6}). However, carcinogenic risks to onsite workers (under the current and future soil scenarios) and offsite residents (under future soil scenarios) exceed an excess cancer risk of 1×10^{-6}. The risks do not, however, exceed an excess cancer risk of 1×10^{-4}.

1.7 SITE 3: SALVAGE STORAGE AREA

1.7.1 Site Description

The NWIRP Bethpage Salvage Storage Area is located north of the Plant No. 3. Fixtures, tools, and metallic wastes were stored here from the early 1950s through 1969, prior to recycling. Site 3 occupies an area of approximately 9 acres.

Stored materials included aluminum and titanium scraps and shavings. While in storage, cutting oils dripped from some of this metal. In 1985, IAS team members observed oil-stained ground at the site. However, soil tests performed by Grumman in 1984 revealed that oil stains were superficial; oil residues were not detected below the top several inches of soil material in the Salvage Storage Area at the locations tested.

About 1960, the Salvage Storage Area was reduced in size to accommodate parking. About 1970, it was reduced again for the same reason. Consequently, storage facility locations at this site have been periodically moved to accommodate changes in storage area size.

In addition to salvage storage, a 100- by 100-foot area within the boundary of the Salvage Storage Area was used for the marshaling of drummed waste. This area was covered with coal ash cinders. Drum marshaling continued here from the early 1950s to 1969. Wastes marshaled throughout the area included waste oils as well as waste halogenated and nonhalogenated solvents. The exact location of this former drum marshaling area is uncertain, however, it is suspected to be near the current drum marshaling area.

Potential contaminants of concern at Site 3 (from both drum marshaling and salvage storage) include cutting oils, aluminum, titanium, and halogenated and nonhalogenated solvents.

1.7.2 Nature and Extent of Contamination

Soil

Chemicals detected at significant concentrations at Site 3 include PCE (55 ug/kg), chromium (637 mg/kg), and copper (400 mg/kg). In addition, PAHs, PCBs, and other metals were found at the site. The concentration of all these contaminants are relatively low when compared to those observed at Site 1. In particular, the relatively low concentration of chlorinated solvents found in the soils at Site 3, indicates that the soils at Site 3 may not be a significant source of solvent-contaminated groundwater from the NWIRP. However, groundwater data to be discussed indicates that a historic source may have existed.

Groundwater

The groundwater at Site 3 was found to contain chlorinated solvents at concentrations that exceed drinking water criteria, including TCE (120 ug/l), PCE (75 ug/l), and DCE (100 ug/l). These concentrations were found in a downgradient monitoring well for Site 3 and are significantly lower than concentrations found in upgradient monitoring wells. This data indicates that a potential source of solvent contamination may have existed at Site 3. However, a comparison of groundwater concentrations found at Site 3 with those found at Site 1 indicates that the source at Site 1 would be far more significant than a source at Site 3.

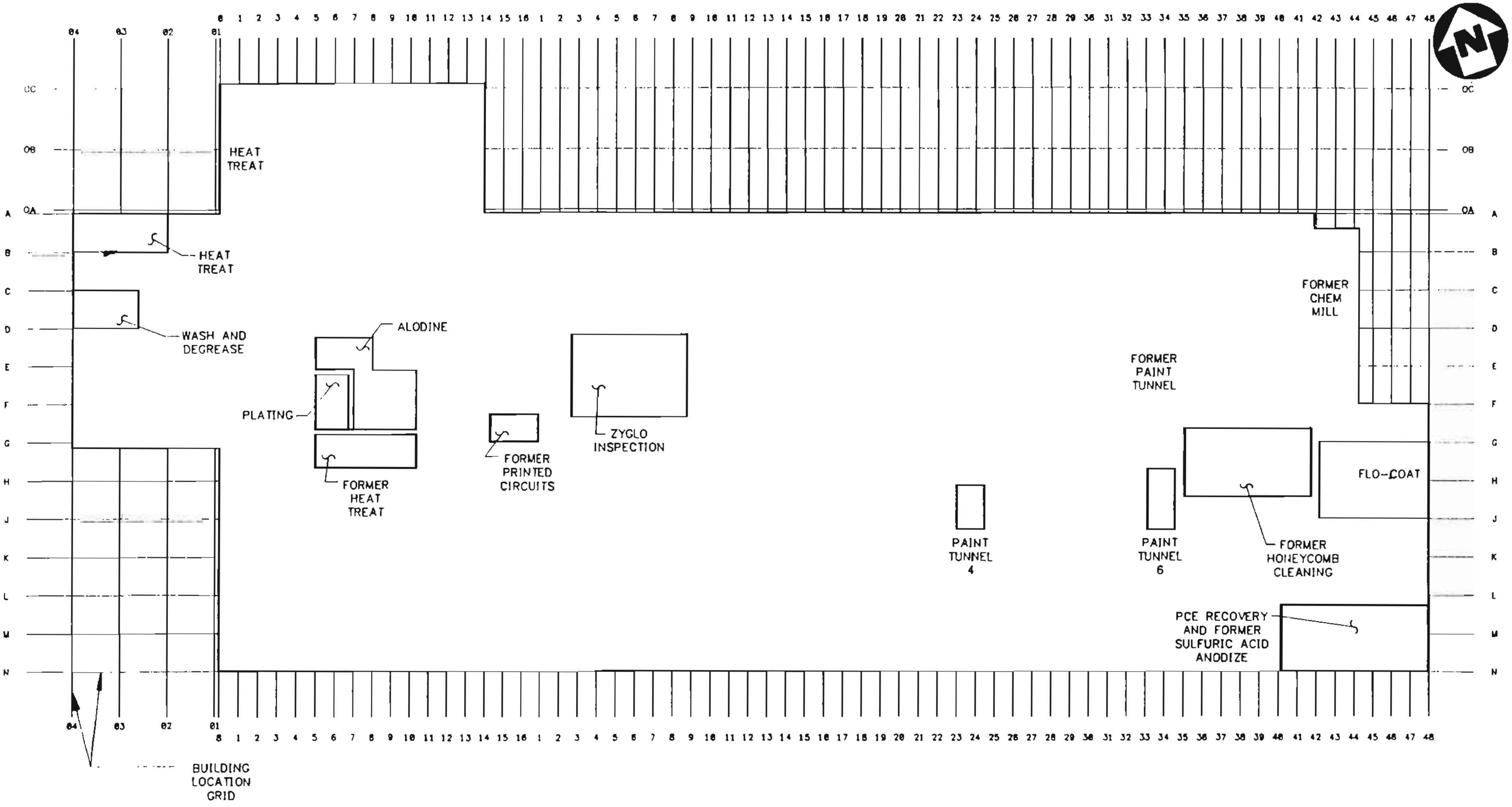
Vanadium (at 359 ug/l) was found in an unfiltered sample from a downgradient well at this site.

1.7.3 Contaminant Fate and Transport

Potential migration routes of contaminants include direct contact to site workers, fugitive dust and volatile emissions to onsite workers and offsite residents, migration into the groundwater and transport offsite with the groundwater. The relative significance of each migration route is dependent on physical and chemical properties of individual compounds.

Each of the chemicals identified at Site 3 is relatively stable in the environment. Biologically, chlorinated solvents such as PCE and TCE will break down to dichloroethenes and vinyl chloride and TCA will break down to dichloroethanes and chloroethane. The presence of some of these decomposition products in the groundwater is an indication of biological degradation. Because of their relatively high vapor pressure, these organics will volatilize to the air. In the atmosphere, the chlorinated solvents compounds are subject to photochemical degradation forming hydrochloric acid, carbon dioxide, and water. This degradation route is also associated with the formation of ground level ozone formation. Because of their relatively high solubility in water, solvents are readily transported from contaminated soils by infiltration into the groundwater. This groundwater then flows offsite.

PCBs, metals, and semivolatile organics are not very mobile in the environment compared to the volatile organics. These other compounds are normally adsorbed onto soil particles and are only found at depth



APPROXIMATE SCALE
0 100 200
SCALE IN FEET

FIGURE 1-4

HALLIBURTON NUS
Environmental Corporation

PLANT No. 3 LAYOUT
PHASE 2 REMEDIAL INVESTIGATION/FEASIBILITY STUDY
NWIRP, BETHPAGE, NY

when mechanically placed there or are carried there by a another more mobile fluid. As a result, investigations are typically limited to the near surface areas. Primary migration pathways for these chemicals are direct contact with the materials and fugitive dust emissions.

Computer modeling conducted during the Phase 2 RI was used to estimate groundwater (and soluble contaminant) flow paths. Site 3 was not specifically addressed during the modeling. However based on Site 1 and Site 2 - Recharge Basin area particle tracks, it is likely that the Site 3 groundwater will mix with recharge basin water, flow in a southerly direction, and be captured by Grumman production wells.

1.7.4 Baseline Risk Assessment

To assess the risks to human health from the site contaminants, exposure scenarios were developed. For contaminated soil, the scenarios include direct contact with contaminants in surface soils through dermal contact, ingestion, and inhalation (current soil exposure); potential direct contact with subsurface soils following excavation of such soils (future soil exposure); and indirect exposure through soil contaminants leaching to groundwater, and the contaminated groundwater being consumed (future groundwater exposure). The receptors include onsite adult workers and offsite adult and child residents. For the contaminated groundwater, the scenarios include residential and employee consumption of the contaminated groundwater (current groundwater exposure).

Hazard Indices calculated for current and future soil exposure scenario are all below 1.0; adverse noncarcinogenic health effects for these pathways are not indicated. Total excess cancer risks for current soil exposure range from 6E-8 to 2E-6, with the highest risk occurring for the adult employee dermal exposure scenario. Benzo[a]pyrene in Site 3 was the major factor in these potential dermal cancer risks.

For potential exposure to current groundwater concentrations scenario, Hazard Indices exceeded 1.0 for all three potential receptors (employee, adult resident, child resident). Individual Hazard Quotients for several chemicals exceeded 1.0, including both metals and VOCs. Estimated total excess cancer risks ranged from 8E-4 to 3E-3, with TCE risks comprising a large portion of the total risk.

For potential exposure to future groundwater concentrations scenario, Hazard Indices exceeded 1.0 for the resident ingestion/dermal pathways. This was due primarily to PCE, for which the Hazard Quotient exceeded 1.0. Estimated total excess cancer risks ranged from 6E-6 to 6E-4, with TCE, PCE, and Aroclor 1248 posing the greatest risks.

1.7.5 Conclusions

Based on volatile organic isoconcentration contour maps, Site 3 is a likely source of onsite groundwater contamination. It is anticipated that the work associated with Site 1-related groundwater will define the extent of this contamination.

Only low concentrations of volatile organics were detected in the soils at Site 3. Therefore, the source area of the volatile organic plume either is no longer present or was not found during the RI.

The contaminants in the soils at the NWIRP (under the current or in future scenarios) do not represent a significant, direct, non-carcinogenic risk to onsite workers or offsite residents (hazard index is less than 1.0). Likewise, incremental carcinogenic risks are not indicated for offsite residences under the current soil scenario (excess cancer risk less than 1×10^{-6}). However, carcinogenic risks to onsite workers (under the current and future soil scenarios) and offsite residents (under future soil scenarios) exceed an excess cancer risk of 1×10^{-6}. The risks do not, however, exceed an excess cancer risk of 1×10^{-4}.

1.8 HN-24 AREA

1.8.1 Site Description

The HN-24 area is being considered separately from the three sites identified in the IAS, because of the high concentration of TCE that was found at depth and because of the absence of other Sites 1, 2-, or 3-related solvents.

HN-24 Area is located near the south west corner of Plant No. 3, (see Figure 1-3). There are no reports of waste disposal and/or storage activities in this area. However, a portion of this area was used in the past for the bulk storage of coal for an adjacent power plant. There is no current evidence of the location of the former coal pile. Based on areal photographs and interviews with plant workers, the former coal pile is believed to have been located immediately north and west of Plant No. 10. Currently, the area consists of a grass covered field as well as parking lots for Plant No. 3 and Plant No. 10.

During the Phase 1 RI activities, trichloroethene (TCE) at a concentration of 58 mg/l was found in groundwater at a depth of approximately 140 to 160 below grade surface (bgs) (HN-24I). This contamination appears to be associated with a 10-foot thick clay layer at a depth of approximately 135-145 feet bgs. Based on the TCE concentration measured, this contamination is potentially DNAPL (dense non-aqueous phase liquid) in nature. Also supporting the potential DNAPL concept is the lack of significant TCE contamination in the shallower groundwater at this location. Several potential sources of this contamination were investigated. These sources include Site 1, Plant No. 3, and offsite areas hydraulically upgradient of the NWIRP (north and west).

1.8.2 Conclusions

TCE is a significant groundwater contaminant in this area and is associated with a dense clay layer at a depth of approximately 135-145 feet bgs. However, direct sampling and analysis of this clay did not find similar levels of contamination. The primary source of the TCE contamination is not likely to be Site 1, the former coal pile area, Plant No. 10, or the Hooker/RUCO Superfund Site. Potential sources include Plant No. 3 and the drum marshaling area near the north warehouses.

Solvent contamination was found in the NWIRP and Grumman production wells. Contamination of the NWIRP wells has been likely caused by a combination of Site 1 sources, recharge basin water, and the Hooker/RUCO Superfund Site.

1.9 PLANT NO. 3

1.9.1 Site Description

Plant No. 3 was constructed in the 1940's for the production of aircraft parts. Current and/or former operations conducted in Plant No. 3 include plating, anodizing, heat treatment, solvent cleaning, chemical milling, painting, and paint stripping operations, (see Figure 1-4). Chemicals and wastes associated with Sites 1, 2, and 3 are likely to have been used and/or generated in Plant No. 3. Specific chemicals used in Plant No. 3 include acids, caustics, solvents, and heavy metals. Currently, raw acid and solvent (PCE) tanks are located on the east end of Plant No. 3. These tanks are located in secondary containment units.

TCE is also used in the plant. Raw and waste TCE is transported to and from current units in 55-gallon drums. Historically, two bulk tanks were located outside and adjacent to Plant No. 3. One was located at the northeast corner of Plant No. 3 and another tank was located along the north central wall of Plant No. 3.

Based on the Phase 1 RI, there is no direct evidence of any contaminant sources within Plant No. 3. However, soil gas testing conducted at Site 1 indicated that the extent of soil gas contamination in the west end of Site 1 (east end of Plant No. 3) is undefined. Additionally, Plant No. 3 is hydraulically upgradient of monitoring well HN-24, which was found to be the most contaminated groundwater at the site.

1.9.2 Conclusions

A two stage soil gas program was conducted to determine if there are sources of solvent contamination in Plant No. 3. Additionally, this data was used to supplement the first phase RI soil gas survey and determine the need for remediation of soils under and near Plant No. 3. The first stage of the Phase 2 soil gas program was semi-quantitative using an OVA to provide real-time readings of the concentration of total organic compounds in the soil gas at each sampling location. This soil gas survey was designed to be a relatively non-intrusive, preliminary field screening technique. The second stage soil gas program was quantitative with a GC used to determine chemical-specific soil gas concentrations.

The findings from the Stage 1 soil gas program are as follows.

- The only potential source area of HN-24I contamination from within Plant No. 3 identified during this study is the Former Honeycomb Cleaning Area. The testing in this area did not penetrate a reported sump and as a result it is uncertain if contamination exists underneath the sump.

- Final conclusions cannot be developed for the Heat Treat Area, because testing was not conducted. However, soil gas results from an area within 50 feet and hydraulically downgradient of the Heat Treat Area sump were 0.5 ppm and less. This data indicates that the Heat Treat Area sump may not be a potential source of HN-24I contamination.

The findings from the Stage 2 soil gas program are as follows.

- The honeycomb cleaning area is a probable source area of volatile organic contamination. The high levels of contamination detected outside of the former sump area apparently indicate that not all of the volatile organic compounds used during this process were captured or contained by the sump. However, because the honeycomb cleaning area is located downgradient of Site 1, it is possible that some of the soil gas contamination is caused by the flow of contaminated groundwater from Site 1 to beneath Plant No. 3.

- The Flo-Coat area may be a source of PCE contamination. However, because this area is located immediately adjacent to Site 1, it is also possible that some of the soil gas contamination is caused by the flow of contaminated groundwater from Site 1 to beneath Plant No. 3.

- The soil gas results indicate that the former TCE storage tanks were not significant sources of volatile organic contamination.

1.10 NORTHERN WAREHOUSES: DRUM MARSHALING AREA

1.10.1 Site Description

Grumman operates a drum marshaling area north of the northern NWIRP warehouses, (see Figure 1-3). Because raw materials instead of waste materials are handled here and that there have been no reports of leaks or spills of hazardous materials, this area has not been identified for investigation in the past. The primary reason for investigating this area is because of the TCE contamination found at HN-24I and the consideration that this area is hydraulically upgradient of HN-24.

1.10.2 Conclusions

The northern warehouses is potentially only a minor source of volatile organic contamination. Groundwater conditions immediately upgradient of this area are not known (Grumman is conducting an investigation in this area). Therefore, it is possible that some of the contamination detected at this area is caused by the flow of contaminated groundwater beneath the area.

1.11 OFFSITE: RESIDENTIAL NEIGHBORHOOD

1.11.1 Site Description

A residential neighborhood is located to the east and south of the NWIRP. There are no known residential groundwater wells in the immediate vicinity of NWIRP. Bethpage Water District (BWD) operates potable water supply wells 3200 feet east of the NWIRP (Plant #1 - Adams Avenue Plant -Wells 7-A, 8-A, and 9 and Well BGD) and a line of water supply wells approximately 7500 feet south of the NWIRP (Plant #s 4, 5, and 6), (see Figure 1-5).

Recent analytical data from these wells is summarized in Table 1-1. Based on this data, the water in several of wells to the south and one of the wells to the east has been measured to contain detectable levels of solvents (greater than 0.5 ug/l). Of these wells, the water in only one well currently exceeds drinking water criteria for solvents. Well #6-1, which is directly south of the NWIRP and Grumman Corporation, contained a maximum TCE concentration of 240 ug/l. Because of this contamination, the water in this well is treated to remove the contamination prior to use. Analytical data on the treated water from this well indicates that the treatment is effective. Analytical data on the other BWD wells indicate limited to no solvent contamination. Well #4-1, which is the second most affected well, was measured to contain a maximum TCE concentration of 2.6 ug/l, (drinking water criteria is less than 5 ug/l).

For the BWD wells to the east, only Well #9 was found to contain detectable levels of solvent, with 1,1 DCA found at a maximum concentration of 5.0 ug/l, (New York State drinking water criteria is less than 5 ug/l). The water in this well also contained similar levels of other solvents. In addition, this well contained significant concentrations of nitrate, with a maximum concentration of 19 mg/l, (drinking water criteria is less than 10 mg/l). Nitrate is a common contaminant associated with fertilizers used for farming. Currently, because of the presence of solvents, this well is not be used. Prior to the finding of an elevated 1,1 DCA concentration, this well was used on a limited basis, with blending being conducted to maintain the nitrate at a concentration below the regulatory criteria.

Of note is the fact that Well #9 is relatively shallow for potable water supply wells in the area, with a screened depth of 225 to 275 feet below grade surface (bgs). Solvents were not found in the two deeper wells in this area, (Wells #7-A and #8-A), with screened depths of approximately 600 to 700 feet bgs.

1.11.2 Conclusions

Based on the offsite monitoring well program, as well as computer modeling results, the shallow groundwater contamination associated with Site 1 is limited to areas within approximately 100 feet east of Site 1, but continues on south to near the Long Island Railroad. Additional shallow groundwater contamination from the recharge basins likely exists at several locations. Intermediate-depth groundwater contamination in the residential neighborhood extends east toward Steward Avenue and south to the Long Island Railroad. A portion of this contamination may be directly attributable to Site 1. However, the majority of the contaminated area is likely associated with recharge basin water.

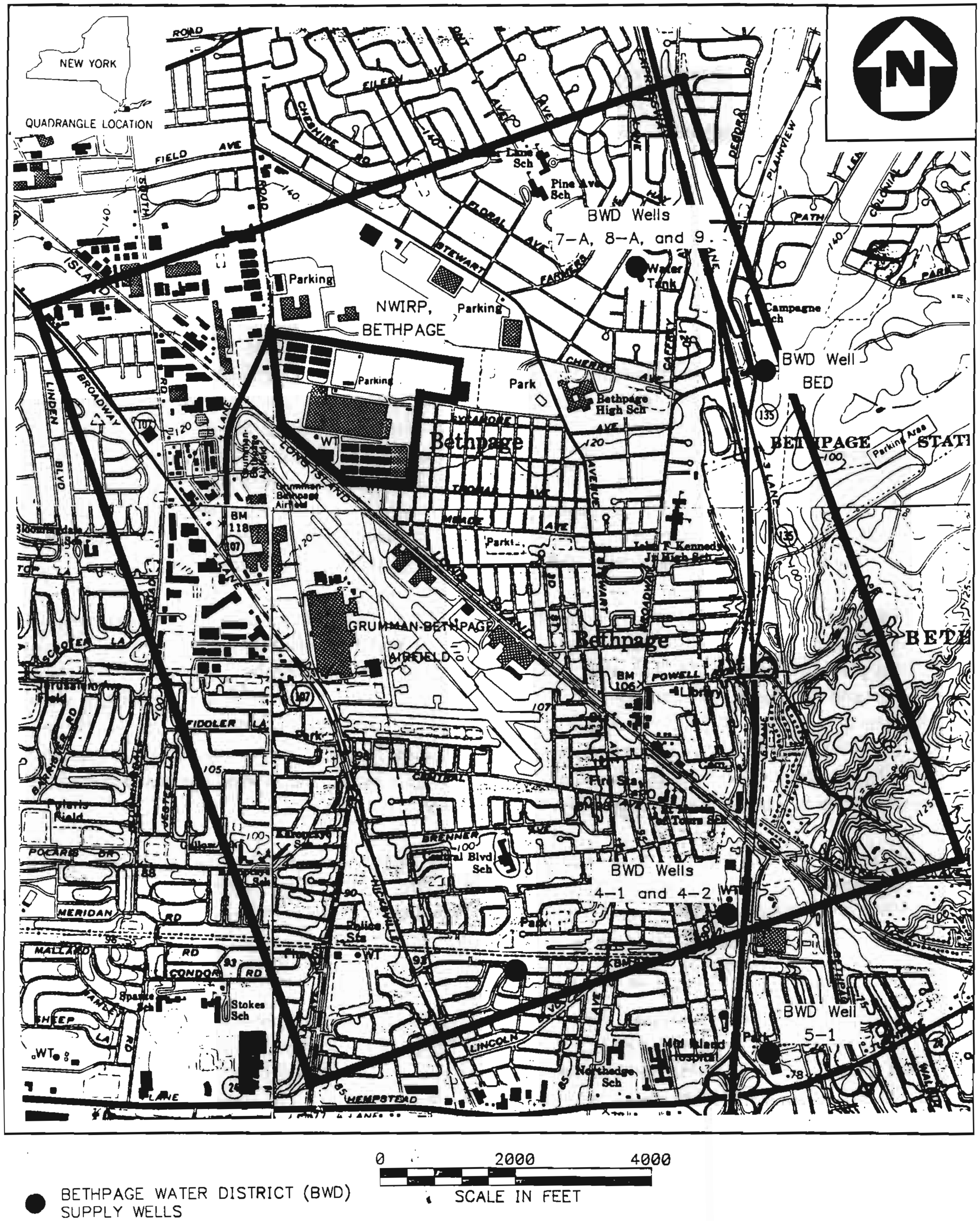


FIGURE 1-5

LOCATION OF PUBLIC WATER SUPPLY WELLS
PHASE 2 REMEDIAL INVESTIGATION/
FEASIBILITY STUDY/NWIRP
BETHPAGE, NEW YORK

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ACAD: 1953\LOCMAP.DWG 05/27/93 MB

TABLE 1-1

SUMMARY OF BETHPAGE WATER DISTRICT WATER QUALITY DATA, 1990 TO 1992[a] PHASE 2 REMEDIAL INVESTIGATION/FEASIBILITY STUDY NWIRP, BETHPAGE, NY

Well	Location	Screen Depth (feet)	Sample Date	Maximum Concentration (ug/l)			
				TCE	PCE	TCA	NO_3
4-1 (10)	Plant #4-Sophia St	540-603	1992	1.2	ND	ND	2.8
			1991	ND	ND	ND	1.3
			1990	2.6	ND	ND	2.7
4-2 (11)	Plant #4-Sophia St	556-606	1992	0.5	ND	ND	2.3
			1991	ND	ND	ND	2.7
			1990	ND	ND	ND	0.8
5-1	Plant #5-Broadway	675-735	1992	ND	ND	ND	ND
			1991	ND	ND	ND	0.4
			1990	ND	0.6	ND	0.2
6-1[b,c]	Plant #6-Park La.	321-381	1992	240	9.9	3.3	ND
			1991	200	ND	5.3	5.0
6-2	Plant #6-Park La.	710-770	1992	ND	ND	ND	5.0
			1991	ND	ND	ND	0.6
			1990	ND	ND	ND	1.5
BGD-1	Plant BGD-Plainview Rd.	542-602	1992	ND	ND	ND	0.7
			1991	ND	ND	ND	0.5
			1990	ND	ND	ND	0.3
7-A	Plant #1-Adams Ave.	590-656	1992	ND	ND	ND	ND
			1991	ND	ND	ND	3.0
			1990	ND	ND	ND	ND
8-A	Plant #1-Adams Ave.	617-677	1992	ND	ND	ND	2.3
			1991	ND	ND	ND	1.2
			1990	ND	ND	ND	1.0
9	Plant #1-Adams Ave.	225-275	1992[d]	ND/ND	1.3/1.8	2.1/2.9	-/19.2[e]
			1991	1.2	ND	2.0	19
			1990	ND	ND	1.4	6.2

TABLE 1-1 (continued)
SUMMARY OF BETHPAGE WATER DISTRICT
WATER QUALITY DATA, 1990 TO 1992[a]
PHASE 2 REMEDIAL INVESTIGATION/FEASIBILITY STUDY
NWIRP, BETHPAGE, NY
PAGE 2

ND Not detected. Detection limits were 0.5 ug/l for volatile organics and 0.1 mg/l for nitrates.

[a] Source: BWD 1993. Drinking water criteria are 5 ug/l for volatile organics and 10 mg/l for nitrates. Data presented is the maximum result reported for that year from regular sampling events.

[b] Groundwater receives treatment prior to distribution. Distributed water meets drinking water criteria. Additional organics beyond that listed are also present.

[c] No data available for Well 6-1 in 1990.

[d] Samples dates are January 1992 and December 1992, respectively. 1,1 DCA was also detected in Well No. 9 at concentrations of 3.7 ug/l and 5.0 ug/l, respectively.

[e] Nitrate data for January 1992 was not available.

2.0 IDENTIFICATION AND SCREENING OF TECHNOLOGIES

2.1 INTRODUCTION

The purpose of this section is to identify applicable or relevant and appropriate requirements (ARARs), develop remedial action objectives, and identify and screen the most appropriate technologies for remediation of the contaminated soils and groundwater. The technologies which pass this screening will be combined into remedial action alternatives in Section 3.0.

This section describes a three-step process for identifying and screening potential technologies. First, remedial action objectives are developed for the soils and groundwater. The remedial action objectives are based on contaminant characterization, risk assessment, and compliance with risk-based and ARAR-based action levels. Second, technology screening criteria are developed. The criteria are based on the remedial action objectives, site-specific parameters, and contaminant characteristics. General response actions, which address the site problems and meet cleanup goals and objectives are also identified at this time. Third, potential technologies associated with the general response actions are identified and evaluated.

In this section, the following components of the Feasibility Study (FS) are presented.

- Establish remedial action objectives (Section 2.2).

- Identify general response actions to meet remedial objectives, including no action (Section 2.3).

- Identify remedial technologies and process options under each general response action with emphasis on permanent solutions (Section 2.4).

- Screen remedial technologies and process options based on effectiveness and implementability considerations (Section 2.4).

2.2 REMEDIAL ACTION OBJECTIVES

Site specific remedial action objectives specify chemicals of concern, media of interest, exposure pathways, and cleanup goals or acceptable contaminant concentrations. Remedial action objectives may be developed to permit consideration of a range of treatment and containment alternatives.

When Applicable or Relevant and Appropriate Requirements (ARARs) or other federal and state guidelines are considered protective, they are used as the acceptable exposure levels. Where an ARAR is not protective (i.e., where it allows risk levels greater than a Hazard Index of 1 for non-carcinogens or greater than a cancer risk of 1 x 10^{-4} for carcinogens) or where an ARAR does not exist, acceptable exposure levels are identified through the risk assessment process.

As discussed in further detail in this section, NWIRP remedial action objectives and cleanup goals will be based on ARARs for groundwater. For soils, EPA CERCLA guidance is the basis for PCB remedial action objectives and cleanup goals. Risk assessment is utilized for other NWIRP site soil organics and inorganics, where ARARs are unavailable. Both current and future risk scenarios are considered when establishing risk-based cleanup goals.

2.2.1 Media of Concern

This FS addresses onsite contaminated soils and onsite and offsite NWIRP Bethpage-associated groundwater. Contaminated soils and groundwater associated with the Hooker/RUCO Superfund Site and Grumman Corporation are being addressed by other parties. Also, water and sediments associated with the recharge basins are not included in this FS because of negligible risk and the consideration that they are being addressed under an existing SPDES permit.

Potential soil contaminants of concern are identified in Table 2-1 (risk-based), Table 2-2 (background-based), and Table 2-3 (ARAR-based). Table 2-4 presents a summary of primary soil contaminants of concern. The primary contaminants identified are trichloroethene, tetrachloroethene, PCBs, and arsenic. Moreover, low levels of 1,1,1-trichloroethane, pesticides, phenols, phthalates, PAHs, manganese, and beryllium are present. Barium, chromium, nickel, silver, vanadium, and cyanide are cited only because they exceed background concentrations.

For groundwater, Table 2-5 (risk-based) and Table 2-6 (ARAR-based) identify potential contaminants of concern and Table 2-7 presents a summary. The primary contaminants include volatile organics (trichloroethene, trichloroethane, and tetrachloroethene) and toxic metals. The list includes only one primary semi-volatile organic of concern; bis(2-ethylhexyl phthalate).

2.2.2 Applicable or Relevant and Appropriate Requirements (ARARs)

Tables 2-8 and 2-9 present a summary of Federal and New York State ARARs for the NWIRP sites, respectively. These ARARs will be refined and revised as necessary as the RI/FS proceeds. In developing and selecting remedial action alternatives, the degree of public health or environmental protection afforded by each remedy must be considered. Actions that attain or exceed ARARs are given primary consideration.

TABLE 2-1

PRIMARY POTENTIAL SOIL CONTAMINANTS OF CONCERN - RISK BASED
NWIRP, BETHPAGE, NEW YORK

Site Number (Media)	Contaminant of Concern	Non-Carcinogenic Risk (a)	Carcinogenic Risk (b)		RI Results		
		Contaminant HI [Mixture HI]	Risk	Scenario	Maximum Conc. [Location]	Rep. Conc.	CRQL/ CRDL
Site 1 (Soil)	PCBs	0	2.0×10^{-4} 7.8×10^{-6} 2.7×10^{-6}	Current Risk Adult Employee - Dermal Adult Employee-Ingestion Offsite Resident-Inhalation	1,470,000 ug/kg[SS103]	486,000 μg/kg	8 μg/kg
	Arsenic	< 1.0	9.18×10^{-6}	Current Risk Adult Resident Dust Inhalation	55.8J μg/kg [SS106]	33.1 μg/kg	2 μg/kg
Site 2 (Soil)	PCBs	0	$5.4 \times 1.0\text{-}^{-6}$	Current Risk Adult Employee-Dermal	36,600 ug/kg [SB206]	12,900 μg/kg	80 μg/kg
Site 3 (Soil)	None	---	---	—	—	---	---
Sites 1, 2, and 3 (Soil organics leaching to groundwater)	Tetrachloroethene	1.3 [1.4] 3 [3.2] <1.0 <1.0	2.8×10^{-4} $<1 \times 10^{-6}$ 8.4×10^{-5} 2.57×10^{-6}	Future Risk Adult Resident-Ingestion Child Resident-Ingestion Adult Employee-Ingestion Adult Resident-Inhalation	4,800J μg/kg [SB119] 360 μg/l [HN28s]	475.4 μg/l(c)	5 μg/l
	Trichloroethene	0	2.31×10^{-6} 7.5×10^{-6} 3.34×10^{-6}	Future Risk Adult Employee-Ingestion Adult Resident-Ingestion Adult Resident-Inhalation	300J μg/kg [SB119] 58,000 μg/l [HN24I]	60.1 μg/l(c)	5 μg/l
	Benzo[a]anthracene	<1.0	5.9×10^{-6} 2×10^{-6}	Future Risk Adult Employee-Ingestion Adult Resident-Ingestion	740 μg/kg [SB217] ND	0.1 μg/l(c)	10 μg/l
	PCBs	0	(d)	Future Risk Adult Employee-Ingestion Adult Resident-Ingestion	1,470,000 [SS103]	(d)	---

TABLE 2-1 (Continued)
PRIMARY POTENTIAL SOIL CONTAMINANTS OF CONCERN - RISK BASED
PAGE 2

(a) Non-carcinogenic risks evaluated by Hazard Index (HI) in excess of unity (1.0) for a chemical mixture.

(b) Carcinogenic risk evaluated by NCP acceptable range of 10^{-4} (1 in 10,000) to 10^{-6} (1 in 1 million).

(c) Calculated groundwater concentration based on precipitation infiltration and contaminant migration to groundwater. See Appendix A for calculations.

(d) Risks were not recalculated in the Phase 2 RI'.

CRQL/CRDL = Contract Required Quantitation Limit/Contract Required Detection Limit.

ND = Not detected.

NOTE: Only contaminants presenting the primary risk are presented. Low levels of 1,1,1-TCA, Chlordane, chrysene, benzo(b)fluoranthene, benzo(k)fluoranthene, indeno(1,2,3-cd)pyrene, 4-methylphenol, heptachlor epoxide, dieldrin, naphthalene, bis (2-chloroethyl)ether and dimethylphthalate present a risk in terms of future leaching of contaminants from soil to groundwater.

Low levels of benzo(a)pyrene, dibenzo(a,h)anthracene and beryllium exceed New York State soil action level guidelines.

Manganese presents a risk for offsite resident for inhalation of fugitive dust or oral exposure.

TABLE 2-2

POTENTIAL SOIL INORGANIC CONTAMINANTS OF CONCERN - BACKGROUND BASED NWIRP, BETHPAGE, NEW YORK [μg/kg]

Inorganic Cont. of Concern	Background Conc. at 95% confidence limit	CRDL	IDL	Site 1		Site 2			Site 3	
				Surface Soil Max. Conc. [Location]	Subsurface Soil Max. Conc. [Location]	Surface Soil Max. Conc. [Location]	Subsurface Soil Max. Conc. [Location]	Sediment Conc. Max. [Location]	Surface Soil Max. Conc. [Location]	Subsurface Soil Conc. [Location]
Arsenic	3.6	2	0.48/0.72/0.78	55.8J [SS106]	3,380 [SB119]	10.45 [SS210]	10.7 [SB229]	---	56.8 [SS322]	4.6J [SB328]
Barium	35.1	40	0.48/0.78/1.7/2.6	59J [SS106]	30.73 [SB112]	51.6J [SS215]	---	---	107J [SS328]	---
Beryllium	<0.98	1	0.2/0.76	---	---	---	---	---	1.5 [SS322]	---
Cadmium	<1.2	5	0.94	---	4.5 [SB103]	---	---	---	---	---
Chromium	12.7	2	1.6/1.9/2.1	61.1 [SS103]	---	419J [SS216]	---	27.5 [SD200]	637J [SS328]	---
Cyanide	<2.6	2	2.0/3.1	5.4 [SS106]	13.3 [SB119]	3.1 [SS216]	---	---	4.2 [SS323]	---
Nickel	<6.2	8	1.6/4.8/6.2	19.2J [SS106]	---	10.7J [SS225]	---	---	---	---
Silver	<0.31	2	0.18/0.24/0.6	6.3 [ ]	---	6.3 [SS325]	2.65 [SB206]	0.96 [SD100]	---	---
Vanadium	17.9	10	2.9/3.7	39.3J [SS103]	---	87.7J [SS215]	---	---	---	---

J = Estimated
IDL = Instrument Detection Limit
CRDL = Contract Required Detection Limit
--- = Concentration less the background

NOTE: Only inorganics are presented since naturally occurring, organics, such as solvents, should be at non detect levels for background.

TABLE 2-3

POTENTIAL SOIL CONTAMINANTS OF CONCERN - ARAR/TBC BASED NWIRP, BETHPAGE, NEW YORK [mg/kg]

Contaminant of Concern	CRQL	TSCA Criteria	Regulatory (a) Guidance	Site 1		Site 2			Site 3	
				Surface Soil Max. Conc. [Location]	Subsurface Soil Max. Conc. [Location]	Surface Soil Max. Conc. [Location]	Subsurface Soil Max. Conc. [Location]	Sediment Conc. Max. [Location]	Surface Soil Max. Conc. [Location]	Subsurface Soil Conc. [Location]
PCB-1242	0.080	50	10 Industrial 1 Residential	25 [SS101]	ND	ND	ND	ND	ND	ND
PCB-1248	0.080	50	10 Industrial 1 Residential	1,300 [SS103]	1J [SB121]	6.2 [SS216]	33 [SB206]	2.6 [SD201]	0.830J [SS327]	ND
PCB-1254	0.080	50	10 Industrial 1 Residential	170 [SS103]	0.210J [SB121]	1.0J [SS216]	3.6J [SB206]	ND	0.530 [SS328]	ND

CRQL = Contract Required Quantitation Limit
ND = Not Detected
TIC = Tentatively Identified Compound

(a) Reference: "Guidance on Remedial Actions for Superfund Sites with PCB Contamination". OSWER Directive No. 9355.4-01. August 1990.

NOTES: (1) Additionally, low levels of benzo(a)pyrene, dibenzo(a,h)anthracene, and beryllium exceed New York State soil action level guidelines and several other chemicals (TCE, PCE, TCA, pesticides, phenols, and PAHs present a potential risk for leaching to groundwater at unacceptable concentrations.

(2) At one Site 1 location, arsenic is expected to exceed the TCLP hazardous waste criteria of 5 mg/l arsenic.

TABLE 2-4

SUMMARY OF SOIL CONTAMINANTS OF CONCERN (a) NWIRP, BETHPAGE, NEW YORK

Site Number		Contaminant of Concern	Risk-Based Concern (b)		ARAR-Based Concern(c)	Background Based Concern(d)	
			Surface Soils	Subsurface Soil		Surface Soils	Subsurface Soils/Sediment
Site 1 Soils		Trichloroethene		X		X	X
		Tetrachloroethene		X		X	X
		PCBs	X	X	X	X	X
		Arsenic	X		X	X	X
		Chromium				X	
		Nickel				X	
		Silver				X	
		Vanadium				X	
		Cyanide				X	X
Site 2	Soils	PCBs	X	X		X	X
		Silver				X	
		Chromium				X	
		Vanadium				X	
		Arsenic				X	X
	Sediment	Chromium					X
Site 3		Arsenic				X	
		Barium				X	
		Chromium				X	

(a) Listed contaminant have concentrations exceeding the less stringent of twice the CRDL/CRQL or twice the background concentration.
(b) Developed from Table 2-1
(c) Developed from Table 2-3
(d) Developed from Table 2-2

NOTE: Only contaminants presenting the primary risk are presented, as well as inorganic constituents that exceed background concentrations. For organic contamination, low levels of 1,1,1-TCA, Chlordane, chrysene, benzo(b)fluoranthene, benzo(k)fluoranthene, indeno(1,2,3-cd)pyrene, 4-methylphenol, heptachlor epoxide, dieldrin, naphthalene, bis (2-chloroethyl)ether and dimethylphthalate present a risk in terms of future leaching of contaminants from soil to groundwater.

Low levels of benzo(a)pyrene, dibenzo(a,h)anthracene and beryllium exceed New York State soil action level guidelines.

Manganese presents a risk for offsite resident for inhalation of fugitive dust or oral exposure.

TABLE 2-5

OVERALL CURRENT POTENTIAL GROUNDWATER CONTAMINANTS OF CONCERN - RISK BASED NWIRP, BETHPAGE, NEW YORK ($\mu g/l$)

Contaminant of Concern	Non-Carcinogenic Risk[a]		Carcinogenic Risk[b]		RI Results	
	Contaminant HI [Mixture HI]	Scenario	Risk	Scenario	Rep. Conc.	CRQL (Organics) CRDL (Inorganics)
Volatile Organics						
Tetrachloroethene	5.0 [28]	Child Resident-Ing/Dermal	4.8×10^{-4}	Adult Resident-Ingestion	788	5
Trichloroethene	0	—	1.6×10^{-3}	Adult Resident-Ingestion	12,285	5
1,1-Dichloroethene	0.39 [28]	Child Resident-Ing/Dermal	3.9×10^{-4}	Adult Resident-Ingestion	54.7	5
Carbon Tetrachloride	0.34 [28]	Child Resident-Ing/Dermal	5.6×10^{-6}	Adult Resident-Ingestion	3.7	5
1,1,1-Trichloroethane	1.6 [28]	Child Resident-Ing/Dermal	0	---	2,113	5
1,1-Dichloroethane	0.12 [28]	Child Resident-Ing/Dermal	0	—	188	5
1,2-Dichloroethene (trans)	2.5 [28]	Child Resident-Ing/Dermal	0	---	772	5
Semi-Volatile Organics						
Bis(2-ethylhexyl)phthalate	0.07 [28]	Child Resident-Ing/Dermal	3.5×10^{-6}	Adult Resident-Ingestion	21.5	10
Benzo[b]fluoranthene	0	---	3.8×10^{-5}	Adult Resident-Ingestion	2	10
Inorganics[c]						
Arsenic	0.75 [28]	Child Resident-Ing/Dermal	2.4×10^{-4}	Adult Resident-Ingestion	11.7	10
Beryllium	0.017 [28]	Child Resident-Ing/Dermal	6.6×10^{-5}	Adult Resident-Ingestion	1.3	5
Cadmium	11 [28]	Child Resident-Ing/Dermal	0	---	82.9	5
Hexavalent Chromium	0.26 [28]	Child Resident-Ing/Dermal	0	—	21.1	10
Lead	1.6 [28]	Child Resident-Ing/Dermal	0	---	36.9	3
Manganese	0.26 [28]	Child Resident-Ing/Dermal	0	---	402	15
Nickel	0.65 [28]	Child Resident-Ing/Dermal	0	---	20.2	40
Thallium	0.91 [28]	Child Resident-Ing/Dermal	0	---	1.0	10
Vanadium	1.4 [28]	Child Resident-Ing/Dermal	0	---	159	50
Cyanide	1.8 [28]	Child Resident-Ing/Dermal	0	---	578	5

TABLE 2-5
OVERALL CURRENT POTENTIAL GROUNDWATER CONTAMINANTS OF CONCERN - RISK BASED
NWIRP, BETHPAGE, NEW YORK (ug/L)
PAGE 2

(a) Non-carcinogenic risks evaluated by Hazard Index (HI) in excess of unity (1.0) for a chemical mixture.
(b) Carcinogenic risk evaluated by NCP acceptable range of 10^{-4} (in 10,000) to 10^{-6} (1 in 1 million).
(c) Total

— No risk exceedence

CRDL = Contract Required Detection Limit
CRQL = Contract Required Quantitation Limit

TABLE 2-6

OVERALL CURRENT POTENTIAL GROUNDWATER CONTAMINANTS OF CONCERN - ARAR/TBC BASED (µg/l)
NWIRP, BETHPAGE, NEW YORK

Compound	RI Results				Federal Standards MCLs/MCLGs	New York State Standards		New York Guidance
	CRQL/ CRDL	Number Positive Detections/Samples Analyzed	Location of Maximum Conc.(a)	Maximum Positive Concentration		MCLs(b)(c)	GW Quality Standards(d)	Contained In Policy (g)
Volatile Organics								
Trichloroethene	5	14/15	HN24I	58000	5 (FMCL)	5	5	5
Toluene	5	6/15	HN29S	39	1000 (FMCL)	5	5	5
1,1-Dichloroethane	5	3/15	HN29S	880	—	5	5	5
1,2-Dichloroethene	5	3/15	HN29S	3600	70 cis (FMCLG) 100 trans	5	5	5 (cis) 5 (trans)
1,1,1-Trichloroethane	5	12/15	HN29S	10000	200 (FMCLG)	5	5	5
Tetrachloroethene	5	12/15	HN28S	360	5 (FMCL)	5	5	5
1,1-Dichloroethene	5	4/15	HN29S	250	7 (FMCLG)	5	5	5
Carbon Tetrachloride	5	1/15	HN24I	8	5 (FMCL)	5	5	5
Ethylbenzene	5	1/15	HN29S	3J	700 (FMCLG)	5	5	5
Xylenes	5	1/15	HN29S	19	10,000 (FMCLG)	5	5	5 ortho, 5 meta, 5 para
Semi-Volatile Organics								
bis(2-ethylhexyl)phthalate	10	2/15	HN26I	73	4 (PMCL)	50	50	50
Di-n-octyl phthalate	10	2/15	HN28I	17	---	50	---	50
2-Methylphenol	10	1/15	HN29S	2J	---	50	1	1
4-Methylphenol	10	1/15	HN29S	2J	---	50		
2,4-Dimethylphenol	10	1/15	HN29S	7J	---	50		
Naphthalene	10	1/15	HN29S	3J	---	50	---	10
Acenaphthylene	10	1/15	HN29S	1J	---	50	---	20

TABLE 2-6 (continued)
OVERALL CURRENT POTENTIAL GROUNDWATER CONTAMINANTS OF CONCERN-ARAR/TBC BASED (ug/l)
PAGE 2

Compound	RI Results				Federal Standards MCLs/MCLGs	New York State Standards		New York Guidance
	CRQL/ CRDL	Number Positive Detections/Samples Analyzed	Location of Maximum Conc.(a)	Maximum Positive Concentration		MCLs(b)(c)	GW Quality Standards(d)	Contained In Policy (g)
Fluoranthene	10	1/15	USGS	2J	—	50	---	50
Pyrene	10	1/15	USGS	2J	---	50	---	50
Benzo(b)fluoranthene	10	1/15	USGS	2J	0.2 (PMCL)	50	---	0.002
PCBs								
PCB-1248	---	0	—	---	0.5 (FMCL)	50	0.1	0.1
Inorganics (Total)								
Aluminum	200	14/15	HN27S	ND-33800	50-200 (FSMCL)	---	—	---
Arsenic	10	7/15	HN24I, HN28S	ND-16.4	50 (Review)	50	25	50
Barium	200	15/15	HN27S	9.7-211	2,000 (FMCLG)	1,000	1,000	2,000
Beryllium	5	2/15	HN27S	ND-2.9	1 (PMCL)	—	---	3
Cadmium	5	3/13	HN27S	ND-392	5 (FMCLG)	10	10	20
Calcium	5000	15/15	---	38602-27400	---	—	---	---
Chromium	10	7/11	HN27S	ND-169	100 (FMCLG)	50	50	100
Hexavalent chromium	10	3/15	HN25	ND-174J	---	—	50	---
Cobalt	25	5/15	HN29S	ND-12.8	---	---	---	---
Copper	100	13/15	HN27S	ND-823J	1,300 (FMCLG)	1,000 (SMCL)	200	1,000
Iron	3	15/15	HN25S	114-155000	300 (FSMCL)	300 (SMCL)(e)	300(e)	300(e)
Lead	5000	12/15	USGS	ND-124	15 (Action Level)	50	25	15
Magnesium	15	15/15	HN25S	277-7950	---	---	---	35,000
Manganese	0.2	15/15	USGS	7.65-1440J	200 (LMCLG)	300 (SMCL)(e)	300(e)	300(e)

TABLE 2-6 (continued)
OVERALL CURRENT POTENTIAL GROUNDWATER CONTAMINANTS OF CONCERN-ARAR/TBC BASED (ug/l)
PAGE 3

	RI Results					New York State Standards		New York Guidance
Compound	CRQL/ CRDL	Number Positive Detections/Samples Analyzed	Location of Maximum Conc.(a)	Maximum Positive Concentration	Federal Standards MCLs/MCLGs	MCLs(b)(c)	GW Quality Standards(d)	Contained In Policy (g)
Mercury	40	2/15	HN27S	ND-0.2	2 (FMCLG)	2	2	2
Nickel	5000	6/15	USGS	ND-62.9	100 (PMCLG)	---	---	700
Potassium	5	15/15	HN24I	1395-351000	---	---	—	—
Selenium	5000	1/15	HN29S	ND-2.3	—	10	10	10
Sodium	10	15/15	HN29S	12100-222000	---	(f)	20,000	20,000
Thallium	50	1/15	HN24I	ND-3.1J	0.5 (PMCLG)	---	---	4
Vanadium	20	11/15	HN29S	ND-419	—	---	---	250
Zinc	10	8/14	USGS	ND-217	5,000 (FSMCL)	5,000 (SMCL)	300	300
Cyanide	---	4/15	HN27S	ND-2690	200 (PMCLG)	---	100	100
TDS	---	---	---	---	---	500 mg/l (FSMCL)	500 mg/l	---
Inorganics (Dissolved)								
Aluminum	200	4/15	HN29S	ND-293	50-200 (FSMCL)	---	---	---
Arsenic	10	7/15	HN29S	ND-43.2	50 (Review)	50	25	25
Barium	200	9/15	HN25S	ND-89.1J	2000 (FMCLG)	1,000	1000	1,000
Cadmium	5	3/15	HN27S	ND-91J	5 (FMCLG)	10	10	5
Calcium	5000	15/15	HN25S	2730-31100J	---	---	—	---
Chromium	10	3/15	HN28I	ND-56.7	100 (FMCLG)	50	50	50 total 50 hexavalent 35,000 trivalent
Copper	25	7/15	HN25I	ND-4.3	1,300 (FMCLG)	1000 (SMCL)	200	200

TABLE 2-6 (continued)
OVERALL CURRENT POTENTIAL GROUNDWATER CONTAMINANTS OF CONCERN-ARAR/TBC BASED (ug/l)
PAGE 4

Compound	RI Results				Federal Standards MCLs/MCLGs	New York State Standards		New York Guidance
	CRQL/ CRDL	Number Positive Detections/Samples Analyzed	Location of Maximum Conc.(a)	Maximum Positive Concentration		MCLs(b)(c)	GW Quality Standards(d)	Contained In Policy (g)
Iron	100	10/15	USGS	ND-568	---	300 (SMCL)(e)	300(e)	300(e)
Lead	3	1/15	HN24I	ND-6	15 (Action Level)	50	25	15
Magnesium	5000	14/15	HN25S	ND-8330	---	---	—	35,000
Manganese	15	13/15	USGS	ND-572J	200 (LMCLG)	300 (SMCL)(e)	300(e)	300(e)
Potassium	5000	15/15	HN24I	1100-35300	---	---	---	—
Selenium	5	1/15	HN29S	ND-3.1	---	10	10	10
Sodium	5000	15/15	HN29S	12100-230000	---	(f)	20,000	20,000
Thallium	10	4/15	HN24S	ND-17.1J	0.5 (PMCLG)	---	---	4
Vanadium	50	3/15	HN29S	ND-34.3	---	—	---	250
Zinc	20	10/14	USGS	ND-178	---	5,000 (SMCL)	300	300

-		Not detected
CRDL	=	Contract Required Detection Limit
CRQL	=	Contract Required Quantitation Limit
IDL	=	Instrument Detection Limit
MCL	=	Maximum Contaminant Level
L	=	Listed
P	=	Proposed
F	=	Final

TABLE 2-6 (continued)
OVERALL CURRENT POTENTIAL GROUNDWATER CONTAMINANTS OF CONCERN-ARAR/TBC BASED (ug/l)
PAGE 5

S = Secondary

MCLG = Maximum Contaminant Level Goal

(a) Excludes pumping wells PW10, PW11, PW13, and PW15.

(b) Total Principal Organic Contaminants [POCs] (i.e., includes listed volatile organics and Unspecified Organic Contaminants [UOCs]) not to exceed 100 μg/l total.

(c) Reference: New York Public Supply Regulations, Part 5-1, 7/17/92.

(d) Reference: New York Water Classifications and Quality Standards, Title 6, Chapter V, Part 703.

(e) Combined concentration of iron and manganese shall not exceed 500 μg/l. Iron and manganese not to exceed 300 μg/l each.

(f) Water >20 mg/l sodium should not be used for drinking by people with severely restricted sodium diets. Water >270 mg/l sodium should not be used for drinking by people with moderately restricted sodium diets.

(g) Reference: New York Technical Manual, "Contained In" Criteria for Environmental Media.

TABLE 2-7

SUMMARY OF POTENTIAL GROUNDWATER CONTAMINANTS OF CONCERN$^{(a)}$
NWIRP, BETHPAGE, NEW YORK

<table>
<tr><th rowspan="3">Contaminant of Concern</th><th rowspan="3">Risk-Based Concern</th><th colspan="6">ARAR-Based Concern</th></tr>
<tr><th colspan="2" rowspan="2">Federal MCL/MCLG</th><th colspan="4">New York State</th></tr>
<tr><th colspan="2">MCL</th><th colspan="2">Groundwater Quality Standard</th></tr>
<tr><td colspan="8">Volatile Organics</td></tr>
<tr><td>Trichloroethene</td><td>X</td><td colspan="2">X</td><td colspan="2">X</td><td colspan="2">X</td></tr>
<tr><td>Toluene</td><td></td><td colspan="2"></td><td colspan="2">X</td><td colspan="2">X</td></tr>
<tr><td>1,1-Dichloroethane</td><td>X</td><td colspan="2"></td><td colspan="2">X</td><td colspan="2">X</td></tr>
<tr><td>1,2-Dichloroethene</td><td>X</td><td colspan="2">X</td><td colspan="2">X</td><td colspan="2">X</td></tr>
<tr><td>1,1,1-Trichloroethane</td><td>X</td><td colspan="2">X</td><td colspan="2">X</td><td colspan="2">X</td></tr>
<tr><td>Tetrachloroethene</td><td>X</td><td colspan="2">X</td><td colspan="2">X</td><td colspan="2">X</td></tr>
<tr><td>1,1-Dichloroethene</td><td>X</td><td colspan="2"></td><td colspan="2">X</td><td colspan="2">X</td></tr>
<tr><td>Carbon Tetrachloride</td><td>X</td><td colspan="2">X</td><td colspan="2">X</td><td colspan="2">X</td></tr>
<tr><td>Xylenes</td><td></td><td colspan="2"></td><td colspan="2">X</td><td colspan="2">X</td></tr>
<tr><td colspan="8">Semi-Volatile Organics</td></tr>
<tr><td>Bis(2-ethylhexyl phthalate)</td><td>X</td><td colspan="2">X</td><td colspan="2">X</td><td colspan="2">X</td></tr>
<tr><td>Inorganics</td><td>Total</td><td>Total</td><td>Dissolved</td><td>Total</td><td>Dissolved</td><td>Total</td><td>Dissolved</td></tr>
<tr><td>Arsenic</td><td>X</td><td></td><td></td><td></td><td></td><td>X</td><td>X</td></tr>
<tr><td>Cadmium</td><td>X</td><td>X</td><td>X</td><td>X</td><td>X</td><td>X</td><td>X</td></tr>
<tr><td>Chromium</td><td>X</td><td>X</td><td></td><td>X</td><td>X</td><td>X</td><td>X</td></tr>
<tr><td>Hexavalent Chromium</td><td>X</td><td>X</td><td></td><td>X</td><td>X</td><td>X</td><td>X</td></tr>
<tr><td>Copper</td><td></td><td></td><td></td><td></td><td></td><td>X</td><td></td></tr>
<tr><td>Iron</td><td></td><td>X</td><td>X</td><td>X</td><td>X</td><td>X</td><td>X</td></tr>
<tr><td>Lead</td><td>X</td><td>X</td><td></td><td>X</td><td></td><td>X</td><td></td></tr>
<tr><td>Manganese</td><td>X</td><td>X</td><td>X</td><td>X</td><td>X</td><td>X</td><td>X</td></tr>
<tr><td>Nickel</td><td>X</td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>Vanadium</td><td>X</td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>Cyanide</td><td>X</td><td>X</td><td>X</td><td></td><td></td><td>X</td><td>X</td></tr>
<tr><td>Sodium</td><td></td><td></td><td></td><td></td><td></td><td>X</td><td>X</td></tr>
</table>

(a) Listed contaminants exceed the CRDL/CRQL.

TABLE 2-8

FEDERAL APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS
NWIRP, BETHPAGE, NEW YORK

ARAR Citation	Rationale for Use at NWIRP Site	Type of Requirement
CONTAMINANT-SPECIFIC		
Safe Drinking Water Act (42USC 300) - Maximum Contaminant Levels (MCLs) 40CFR 141.11-141.16 - Maximum Contaminant Level Goals (MCLGs) 40CFR 141.50-141.51	Applicable in developing remediation goals for the contaminated groundwater plume in accordance with SARA Section 121(d)(2)(A)(iii)	Applicable
Reference Doses (RfDs), EPA Office of Research and Development	To be considered (TBC) requirement in the public health assessment.	To Be Considered (TBC)
Carcinogenic Potency Factors, EPA Environmental Criteria and Assessment Office; EPA Carcinogen Assessment Group	To be considered (TBC) requirement in the public health assessment.	To Be Considered (TBC)
Health Advisories, EPA Office of Drinking Water	To be considered (TBC) requirement in the public health assessment.	To Be Considered (TBC)
Clean Water Act (33 USC 1251-1376), Federal Ambient Water Quality Criteria (AWQCS)(40 CFR 131)	AWQC may be considered for actions that involve groundwater treatment and/or discharges to surface water	To Be Considered (TBC)
Clean Air Act (42 USC 7401) National Ambient Air Quality Standards (NAAQS) (40 CFR Part 50)	NWIRP site alternatives may result in emission of unacceptable levels of airborne particulates to the atmosphere. The primary (and secondary standard) for particulate matter, expressed as PM-10) is 150 [24-hour, annual arithmetic mean] and 50 [1-year, annual arithmetic mean]	Applicable

TABLE 2-8 (continued)
FEDERAL APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS
NWIRP, BETHPAGE, NEW YORK
PAGE 2

ARAR Citation	Rationale for Use at NWIRP Site	Type of Requirement
CONTAMINANT-SPECIFIC (cont.)		
Air Emissions for Non-Attainment Areas (OSWER Directive 9355.0-28)	Although not classified as a major source, remedial alternatives (e.g., air stripping) may result in air emissions to the atmosphere. The NWIRP site is in a NAAQS non-attainment area for ozone.	Relevant and Appropriate
Clean Air Act (42 USC 7401) National Emissions Standards for Hazardous Air Pollutants (NESHAPs)(40CFR Part 61)	Standards are possibly, but not likely, to be relevant and appropriate since these standards were developed for specific, significant sources.	Potentially Relevant and Appropriate
Guidance on Remedial Actions for Superfund Sites with PCB Contamination (OSWER Directive No. 9355.4-01, August 1990)	The NWIRP site currently qualifies as an industrial area; the more stringent residential area guidance should also be evaluated in the FS as a potential future use scenario. Maximum site PCB soil concentrations exceed both industrial and residential recommended remediation goals for soils. If an industrial scenario is selected as the basis for remediation, PCB contamination will continue to be evaluated at each five year review. PCBs have not been detected in the groundwater.	To Be Considered (TBC)
EPA Polychlorinated Biphenyls Spill Policy (40 CFR Part 761; April 2, 1987)	The NWIRP site is currently in a restricted area, located within a fenced area with controlled access. Comparison of site concentrations with performance standards for new spills is warranted although the concentration of the original spill(s) is unknown.	To Be Considered (TBC)

TABLE 2-8 (continued)
FEDERAL APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS
NWIRP, BETHPAGE, NEW YORK
PAGE 3

ARAR Citation	Rationale for Use at NWIRP Site	Type of Requirement
ACTION-SPECIFIC		
General Pretreatment Regulations for Existing and New Sources of Pollutants (40 CFR Part 403)	Effluent from a groundwater treatment system for the NWIRP site may be discharged to a local Publicly Owned Treatment Works (POTW).	Potentially Applicable
Underground Injection Control Program (40 CFR Parts 144, 147)	Effluent from treatment of NWIRP groundwater may be reinjected (Class IV well) into the same formation from which it was withdrawn.	Potentially Applicable
Toxic Substances Control Act (40 CFR Part 761.6-761.79 Subpart D Storage and Disposal)	The concentration and source of the original spill(s) is unknown. Although soils concentration of PCBs are generally quite low, some soils technologies (e.g., solvent extraction, low temperature thermal stripping) may concentrate PCBs to 50 ppm or more.	Potentially Relevant and Appropriate
OSHA Requirements (29 CFR Parts 1910, 1926, and 1904)*	Required for site workers during construction and operation of remedial activities.	Must be met during remediation*
DOT Rules for Hazardous Materials Transport (40 CFR Parts 107, 171-179)*	Remedial actions may include offsite treatment and disposal of soils or treatment residuals (e.g., offsite regeneration of activated carbon, offsite soils disposal), as well as samples analysis	Must be met during remediation*

* These requirements are not true ARARs since not environmental requirements and cannot obtain ARAR waiver; however, these requirements must be met during remedial action.

TABLE 2-8 (continued)
FEDERAL APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS
NWIRP, BETHPAGE, NEW YORK
PAGE 4

ARAR Citation	Rationale for Use at NWIRP Site	Type of Requirement
ACTION-SPECIFIC (cont.)		
Resource Conservation and Recovery Act of 1976 (Amended 1984)		
• Identification and Listing of Hazardous Waste (40 CFR Part 261)	• The primary contaminants result from solvent use and plating operations. Contamination occurred prior to the effective date of RCRA (1980). Some aspects related to listed hazardous wastes may be relevant and appropriate, although site groundwater contaminant concentrations are less than that of RCRA-listed waste. Also, the site groundwater and/or soils could be considered hazardous by RCRA characteristic (TCLP leachate exceedance).	Relevant and Appropriate
• Land Disposal Restrictions (LDRs) (40 CFR Part 268)	• Some treatment technologies will result in concentrated residuals which may be considered hazardous waste subject to land disposal restrictions.	Potentially Relevant and Appropriate or Potentially Applicable
• Treatment, Storage, and Disposal of Hazardous Waste (40 CFR Parts 262-265, and 266)	• During site restoration, waste generation, transport, and/or treatment, storage, and disposal activities may occur. Not an ARAR for reinjection of treated groundwater.	Potentially Relevant and Appropriate or Potentially Applicable

TABLE 2-8 (continued)
FEDERAL APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS
NWIRP, BETHPAGE, NEW YORK
PAGE 5

ARAR Citation	Rationale for Use at NWIRP Site	Type of Requirement
ACTION-SPECIFIC (cont.)		
Resource Conservation and Recovery Act of 1976 (cont.)		
• Corrective Action for Solid Waste Management Units at Hazardous Waste Management Facilities, Proposed Rule (40 CFR Parts 264, 265, 270 and 271)	• Some of the guidance may be useful in establishing remediation strategy.	To Be Considered (TBC)
• Corrective Action Management Units and Temporary Units, Final Rule (40 CFR Parts 260, 264, 265, 268, 270, and 271)	• Allows broad areas of soil contamination from Sites 1,2, and 3 to be considered a single waste management unit for remedial purposes. The implications are that remediation wastes can be moved between sites or treated and replaced on site without triggering LDRs.	Potentially Applicable
Control of Air Emissions from Superfund Air Strippers at Superfund Groundwater Sites (OSWER Directive 9355.0-28)	Site restoration at the NWIRP site may include air stripping of groundwater. The NWIRP site is in a NAAQS non-attainment area for ozone.	To Be Considered (TBC)
LOCATION-SPECIFIC		
Groundwater Protection Strategy (EPA, 1984)	Groundwater beneath and downgradient of the NWIRP site is likely designated as Class 2.	To Be Considered (TBC)

TABLE 2-9

PRELIMINARY STATE APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS
NWIRP, BETHPAGE, NEW YORK

ARAR Citation	Rationale for Use at NWIRP Site	Type of Requirement
CONTAMINANT-SPECIFIC		
New York Water Classifications and Quality Standards (New York Codes, Rules, and Regulations, Title 6-Environmental Conservation, Chapter V-Resource Management Services, Part 609 and Chapter X-Division of Water Resources, Parts 700-704 [BNA 11/22/91]	Standards impact selection of groundwater plume remediation goals, as well as treatment goals for reinjection of treated effluent to the aquifer. According to Part 701, NWIRP site groundwater is classified as GA; a source of potable water supply. Part 702 allows more stringent groundwater effluent standards or limitations to be established where necessary to prevent pollution and protect the best usages of groundwaters. Part 703 includes groundwater quality standards for Class GA groundwater. Table 2-6 provides available standards for site compounds. Additionally for GA groundwater, pH shall be between 6.5 and 8.5 and TDS shall not exceed 500 mg/l.	Applicable
New York Public Water Supply Regulations (Codes, Rules and Regulations of the State of New York, Title 10-Health, Chapter I-State Sanitary Code, Part 5 Drinking Water Supplies, Subpart 5-1-Public Water Supplies) [BNA 7/17/92]	Drinking water standards impact selection of groundwater plume remediation goals, as well as treatment goals for reinjection of treated effluent to the aquifer.	Applicable

TABLE 2-9 (continued)
PRELIMINARY STATE APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS
NWIRP, BETHPAGE, NEW YORK
PAGE 2

ARAR Citation	Rationale for Use at NWIRP Site	Type of Requirement
CONTAMINANT-SPECIFIC (cont.)		
New York Ambient Air Quality Standards (Official Codes, Rules and Regulations of the State of New York, Title 6, Chapter III, Air Resources, Subchapter B, Part 256-Air Quality Classifications and Part 257 Air Quality Standards) [BNA 4/14/89]	The NWIRP site area is classified as Level ??- ??. Particulate and non-methane hydrocarbon standards will be applicable to the site.	Applicable
ACTION-SPECIFIC		
New York Environmental Conservation Law (New York Consolidated Laws Service; Article 17-Water Pollution Control, Article 37-Substances Hazardous or Acutely Hazardous to Public Health, Safety or the Environment, Article 71-Enforcement, and Article 72-Environmental Regulatory Program Fees [BNA 11/8/91]	Discharges to state groundwater are prohibited unless in compliance with all standards, criteria, limitation, rules and regulations.	Potentially Applicable
New York Water Classifications and Quality Standards (New York Codes, Rules, and Regulations, Title 6-Environmental Conservation, Chapter V-Resource Management Services, Part 609 and Chapter X-Division of Water Resources, Parts 700-704 [BNA 11/22/91]	Part 703- Surface Water and Groundwater Quality Standards and Groundwater Effluent Standards; Treated NWIRP groundwater will likely be reinjected to groundwater so will need to comply with Groundwater Effluent Standards (see Table 2-11 The NWIRP site is in Nassau County, so will additionally have to comply with a maximum concentration of 1,000 mg/l total dissolved solids (TDS) and 10 mg/l total nitrogen (as N)	Applicable

TABLE 2-9 (continued)
PRELIMINARY STATE APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS
NWIRP, BETHPAGE, NEW YORK
PAGE 3

ARAR Citation	Rationale for Use at NWIRP Site	Type of Requirement
ACTION-SPECIFIC (cont.)		
New York Regulations on State Pollutant Discharge Elimination System (New York Compilation of Rules and Regulations, Title 6-Environmental Conservation, Chapter X-Division of Water Resources, Parts 750 through 758) [BNA 10/16/87]	Permits will be required for discharges to surface waters.	Potentially Applicable
New York Solid and Hazardous Waste Management Laws (New York Consolidated Laws Service: Environmental Conservation Law, Article 27-Collection, Treatment and Disposal of Refuse and Other Solid Waste; Article 71-Enforcement, and Article 72-Environmental Regulatory Program Fees) [BNA 9/25/92]	Remedial activities may result in hazardous or nonhazardous solid waste. Sec.27-0704- Land burial and disposal in the Counties of Nassau and Suffolk; special provisions. No new landfills (or expansions to existing landfills) are allowed in a deep flow recharge area. In areas outside deep flow recharge areas numerous requirements are specified including the prohibition of hazardous waste; also, the landfill can only accept material which is the product of resource recovery, incineration or composting.	Potentially Applicable
New York Technical Manual "Contained-In" Criteria for Environmental Media	May aid in establishing soil and groundwater cleanup goals.	To Be Considered (TBC)

TABLE 2-9 (continued)
PRELIMINARY STATE APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS
NWIRP, BETHPAGE, NEW YORK
PAGE 4

ARAR Citation	Rationale for Use at NWIRP Site	Type of Requirement
ACTION-SPECIFIC (cont.)		
New York Rules for Siting Industrial Hazardous Waste Facilities (New York Compilation of Rules and Regulations, Title 6, Chapter 361) [BNA 4/7/89]	Although unlikely that a landfill would be constructed for soils or treatment residuals disposal, based on restrictions imposed by New York State solid waste and hazardous waste management laws, this ARAR will be retained.	Potentially Applicable
New York Waste Transport Permit Regulations (New York Compilation of Rules and Regulations, Title 6-Department of Environmental Conservation, Chapter 364) [BNA 12/20/91]	Offsite transport of contaminated soils or treatment residuals will require compliance with these regulations.	Applicable
New York General Hazardous Waste Management System Regulations (Codes, Rules and Regulations of the State of New York, Title 6, Chapter IV-Quality Services, Subchapter B, Solid Wastes, Part 370) [BNA 8/14/92]	Residuals from treatment could be considered as hazardous waste subject to these regulations.	Potentially Applicable

TABLE 2-9 (continued)
PRELIMINARY STATE APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS
NWIRP, BETHPAGE, NEW YORK
PAGE 5

ARAR Citation	Rationale for Use at NWIRP Site	Type of Requirement
ACTION-SPECIFIC (cont.)		
New York Rules on Hazardous Waste Program Fees (New York Codes, Rules and Regulations, Title 6-Conservation, Chapter IV-Quality, Part 483 and 484) [10/11/91]	No hazardous waste program fees are payable related to cleanup, remediation, or corrective action activities. However, waste transporter program fees will be required for offsite disposal of wastes or treatment residuals.	Potentially Applicable
New York Identification and Listing of Hazardous Wastes Regulations (New York Compilation of Rules and Regulations, Title 6, Chapter 371) [9/25/92]	Treatment residuals could be hazardous waste by characteristic.	Potentially Applicable.
New York Hazardous Waste Manifest System Regulations (Codes, Rules and Regulations of the State of New York, Title 6, Chapter IV-Quality Services, Subchapter B-Solid Wastes, Part 372) [7/17/92]	Manifests will be required for offsite disposal/treatment of treatment residuals.	Potentially Applicable
New York Air Pollution Control Regulations: Parts 200-254 (Codes, Rules and Regulations of the State of New York, Title 6, Chapter III-Air Resources, Subchapter A)	Remedial activities (e.g., air stripping, excavation, vacuum extraction) may adversely impact air quality.	Potentially Relevant and Appropriate

TABLE 2-9 (continued)
PRELIMINARY STATE APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS
NWIRP, BETHPAGE, NEW YORK
PAGE 6

ARAR Citation	Rationale for Use at NWIRP Site	Type of Requirement
ACTION-SPECIFIC (cont.)		
New York Hazardous Waste Treatment, Storage and Disposal Facility Permitting Requirements (New York Compilation of Rules and Regulations, Title 6, Chapter 373-1) [8/14/92]	NWIRP site remediation activities, must meet both administrative and the substantive technical permitting requirements.	Relevant and Appropriate
New York Final Status Standards for Owners and Operators of Hazardous Waste Treatment, Storage and Disposal Facilities (Codes, Rules and Regulations of the State of New York, Title 6-Department of Environmental Conservation, Chapter IV-Quality Services, Subchapter B, Subpart 373-2) [9/11/92]	Treatment and/or storage activities may take place on site.	Relevant and Appropriate
New York Interim Status Standards for Owners and Operators of Hazardous Waste Facilities (Codes, Rules and Regulations of the State of New York, Title 6-Department of Environmental Conservation, Chapter IV-Quality Services, Subchapter B, Subpart 373-3) [9/25/92]	Treatment and/or storage activities may take place on site.	Relevant and Appropriate

TABLE 2-9 (continued)
PRELIMINARY STATE APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS
NWIRP, BETHPAGE, NEW YORK
PAGE 7

ARAR Citation	Rationale for Use at NWIRP Site	Type of Requirement
ACTION-SPECIFIC (cont.)		
New York Standards for Managing Specific Hazardous Wastes and Hazardous Waste Management Facilities (Codes, Rules and Regulations of the State of New York, Title 6, Chapter IV-Quality Services, Subchapter B-Solid Wastes, Part 374) [7/31/92]	Although unlikely, NWIRP site remedial alternatives may include recovery.	Potentially Relevant and Appropriate
New York Rules for Inactive Hazardous Waste Disposal Sites (Codes, Rules and Regulation of the State of New York, Title 6-Department of Environmental Conservation, Chapter IV-Quality Services, Subchapter B, Part 375) [10/9/92]	State review and concurrence with the selected remediation scheme will be required. 375-1.10 Remedy Selection; Federal "standards and criteria" and "guidance" are considered to the extent that they are more stringent than those of the state. The hierarchy of preferred remedial technologies is as follows: • Destruction • Separation/treatment • Solidification/chemical fixation • Control and isolation	Applicable

TABLE 2-9 (continued)
PRELIMINARY STATE APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS
NWIRP, BETHPAGE, NEW YORK
PAGE 8

ARAR Citation	Rationale for Use at NWIRP Site	Type of Requirement
ACTION-SPECIFIC (cont.)		
New York Land Disposal Restrictions Regulations (Codes, Rules and Regulations of the State of New York, Title 6-Department of Environmental Conservation Chapter IV-Quality Services, Subchapter B, Subpart 376) [9/25/92]	Contaminated soil and/or treatment residuals will be subject to land disposal restrictions if hazardous by characteristic	Potentially Applicable
New York Environmental conservation Law (New York Consolidated Laws Service: Environmental Conservation Law, Article 1-General Provisions, Article 3-Department of Environmental Conservation, Article 5-State Environmental Board, Article 7-Council of Environmental Advisers, Article 8-Environmental Quality Review, Article 19-Air Pollution Control, Article 38-Chlorofluorocarbon Compounds, Article 70-Uniform Procedures, Article 71-Enforcement and Article 72-Environmental Regulatory Program Fees [9/11/92]	Remedial activities must be in compliance with state law.	Applicable
LOCATION-SPECIFIC		
No location-specific ARARs have been identified for the NWIRP site	----	----

The definition of ARARs is as follows:

- Any standard, requirement, criterion, or limitation under federal environmental law.
- Any promulgated standard, requirement, criterion, or limitation under a state environmental or facility-siting law that is more stringent than the associated Federal standard, requirement, criterion, or limitation.

One of the primary concerns during the development of remedial action alternatives for hazardous waste sites under CERCLA or "Superfund" is the degree of human health and environmental protection afforded by a given remedy. Section 121 of CERCLA requires that primary consideration be given to remedial alternatives that attain or exceed ARARs. The purpose of this requirement is to make CERCLA response actions consistent with other pertinent Federal and state environmental requirements.

Definitions of the two types of ARARs, as well as other "to be considered" (TBC) criteria, are given below:

- Applicable Requirements means those cleanup standards, standards of control, and other substantive environmental protection requirements, criteria, or limitations promulgated under Federal or state law that directly and fully address a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance at a CERCLA site.
- Relevant and Appropriate Requirements means those cleanup standards, standards of control, and other substantive environmental protection requirements, criteria, or limitations promulgated under Federal or state law, while not "applicable" address problems or situations sufficiently similar (relevant) to those encountered at the CERCLA site, that their use is well suited (appropriate) to the particular site.
- "To Be Considered" (TBC) Criteria are non-promulgated, non-enforceable guidelines or criteria that may be useful for developing remedial action, or necessary for determining what is protective to human health and/or the environment. Examples of TBC criteria include EPA Drinking Water Health Advisories, Carcinogenic Potency Factors, and Reference Doses.

Section 121(d)(4) of CERCLA allows the selection of a remedial alternative that will not attain all ARARs if any of six conditions for a waiver of ARARs exist. These conditions are as follows: (1) the remedial action is an interim measure whereby the final remedy will attain the ARAR upon completion; (2) compliance will result in greater risk to human health and the environment than other options; (3) compliance is technically impracticable; (4) an alternative remedial action will attain the equivalent of the ARAR; (5) for state requirements, the state has not consistently applied the requirement in similar circumstances; or (6) compliance with the ARAR will not provide a balance between protecting public health, welfare, and the environment at the facility with the availability of Fund money for response at other facilities (fund balancing).

ARARS fall into three categories, based on the manner in which they are applied. The characterization of these categories is not perfect, as many requirements are combinations of the three types of ARARs. These categories are as follows:

- Contaminant Specific: Health-/risk-based numerical values or methodologies that establish concentration or discharge limits for particular contaminants. Examples of contaminant-specific ARARs include MCLs and Clean Water Act (CWA) water quality criteria. Contaminant-specific ARARs govern the extent of site cleanup.

- Location Specific: Restrictions based on the concentration of hazardous substances or the conduct of activities in specific locations. These may restrict or preclude certain remedial actions or may apply only to certain portions of site. Examples of location-specific ARARs include RCRA location requirements and floodplain management requirements. Location-specific ARARs pertain to special site features.

- Action Specific: Technology- or activity-based controls or restrictions on activities related to management of hazardous substances. Action-specific ARARs pertain to implementing a given remedy.

2.2.2.1 Contaminant-Specific ARARs and TBCs

This section presents a summary of Federal and state contaminant-specific ARARs and TBC criteria. All ARARs and TBC criteria provide some medium-specific guidance on "acceptable" or "permissible" concentrations of contaminants.

The Safe Drinking Water Act (SDWA) promulgated National Primary Drinking Water Standard MCLs (40 CFR Part 141). Maximum Contaminant Levels (MCLs) are enforceable standards for contaminants in public drinking water supply systems. They consider not only health factors but also the economic and technical feasibility of removing a contaminant from a water supply system. Secondary MCLs (40 CFR Part 143) are not enforceable but are intended as guidelines for contaminants that may adversely affect the aesthetic quality of drinking water, such as taste, odor, color, and appearance, and may deter public acceptance of drinking water provided by public water systems.

The SDWA also established Maximum Contaminant Level Goals (MCLGs) for several organic and inorganic compounds in drinking water. The National Contingency Plan (NCP) (40 CFR Part 300.430(e)(2)(i) states that MCLGs, if set at levels above zero, shall be attained by remedial actions for groundwaters or surface waters that are current or potential sources of drinking water, where the MCLGs are relevant and appropriate under the circumstances of the release. If an MCLG is found not to be relevant and appropriate, the corresponding MCL shall be achieved where relevant and appropriate to the circumstances of the release. For MCLGs that are set at zero, the MCL promulgated for that contaminant under the SDWA shall be attained by the remedial actions. In cases involving multiple contaminants or pathways where attainment of chemical-specific ARARs will result in a cumulative cancer risk in excess of 10^{-4}, criteria in paragraph (e)(2)(i)(A) of Section 300.430 (i.e., risk-based criteria) may be considered when determining the cleanup level to be attained.

Table 2-6 (and Table 2-10) provides Federal SDWA requirements that may be applicable to remedial actions involving groundwater.

EPA Health Advisories are nonenforceable guidelines (TBCs) developed by the EPA Office of Drinking Water for chemicals that may be intermittently encountered in public water supply systems. Health advisories are available for short-term, longer-term, and lifetime exposures for a 10-kg child and/or a 70-kg adult. Health advisories may be pertinent for remedial actions involving groundwater, especially for contaminants that are not regulated under the SDWA.

The Clean Water Act (CWA) sets EPA Ambient Water Quality Criteria (AWQCs) that are non-enforceable guidelines developed for pollutants in surface waters pursuant to Section 304(a)(l) of the Clean Water Act. Although AWQCs are not legally enforceable, they have been used by many states to develop enforceable water quality standards; they should be considered as potential ARARs, as specified by CERCLA. AWQCs are available for the protection of human health from exposure to contaminants in drinking water as well as from ingestion of aquatic biota and for the protection of freshwater and saltwater aquatic life. AWQCs may be considered for actions that involve groundwater treatment and/or discharge to nearby surface waters.

Table 2-10 provides Federal AWQC requirements that may be applicable to remedial actions involving groundwater.

Reference Dose (RfD), as defined in the EPA Integrated Risk Information System (IRIS), is an estimate (with uncertainty spanning perhaps an order of magnitude) of a daily exposure to the human population (including sensitive subgroups) that is likely to be without an appreciable risk of deleterious effects during a lifetime. RfDs are developed for chronic and/or subchronic human exposure to hazardous chemicals and are based on the assumption that thresholds exist for certain toxic effects. The RfD is usually expressed as an acceptable dose (mg) per unit body weight (kg) per unit time (day). The RfD is derived by dividing the no-observed-adverse effect level (NOAEL) or the lowest-observed-adverse

TABLE 2-10

STANDARDS, GUIDELINES, AND DOSE-RESPONSE PARAMETERS FOR CHEMICALS OF CONCERN NWIRP, BETHPAGE, NY

Compound	CSF[1] (mg/kg/day)$^{-1}$		Chronic RFD[1] (mg/kg/day)		MCL/NPDWR (ug/L) MCLG (2)(3)(4)(5)(6)(7)(8)	DWHA (ug/L)	AWQC (ug/L)[9]			NYS[10] MCL (ug/L)
	Inhalation	Oral	Inhalation	Oral			Aquatic Life	Drinking Water & Fish	Fish Only	
Trichloroethene	1.7E-2 B2	1.1E-2 B2			5 G:0	-	21900(L)	2.7	80.7	5
Tetrachloroethene	1.8E-3 B2	5.1E-2 B2		1E-2	5 G:0	1-day child - 2000 10-day child - 2000 Longer term child - 1000 Longer term adult - 5000	840(L)	0.8	8.85	5
Chloroform	8.1E-2 B2	6.1E-3 B2		1E-2	100	1-day child - 4000 10-day child - 4000 Longer term child-100 Longer term adult-500	1240(L)	0.19	15.7	100 (total THM)
Toluene			6E-1	2E-1	1000 G:1000	1-day child - 20000 10-day child - 2000 Longer term child-2000 Longer term adult - 7000 Lifetime adult - 1000	17500(fa) (L)	14300	424000	5
4-Methylphenol	C	C		5E-2	-					50
bis(2-chloroethyl)ether	1.1 B2	1.1 B2			-					5
DDT	3.4E-1 B2	3.4E-1 B2		5E-4	-		0.001	0.000024	0.000024	50
Chlordane	1.3 B2	1.3 B2		6E-5	2 G:0	1-day child - 60 10-day child - 60	0.0043	0.00046	0.00048	50
Aroclor 1248	B2	7.7 B2			0.5 (PCBs) G:0		0.014 (PCBs)	0.000079 (PCBs)	0.000079 (PCBs)	50
Aroclor 1254	B2	7.7 B2			0.5 (PCBs) G:0		0.014 (PCBs)	0.000079 (PCBs)	0.000079 (PCBs)	50
bis(2-ethylhexyl)phthalate	B2	1.4E-2 B2		2E-2	4(P) G:0		3(L) (phthal) 360(P)	15000	5000	50
Butyl benzyl phthalate		C		2E-1	100 (P)		3(L) (phthal)			50
Di-n-butyl phthalate				1E-1	-		3(L) (phthal)	35000	154000	50

TABLE 2-10 (Continued)
STANDARDS, GUIDELINES, AND DOSE-RESPONSE PARAMETERS FOR INDICATOR CHEMICALS
PAGE 2

Compound	CSF[1] (mg/kg/day)$^{-1}$		Chronic RFD[1] (mg/kg/day)		MCL/NPDWR MCLG(ug/L) (1)(2)(3)(4)(5) (6)(7)(8)	DWHA (ug/L)	AWQC (ug/L)			NYS MCL (ug/L)
	Inhalation	Oral	Inhalation	Oral			Aquatic Life	Drinking Water & Fish	Fish Only	
Dimethyl phthalate				1E0	-	-	3(L) (phthal)	313000	2900000	50
Naphthalene				4E-3	-	1-day child - 500 10-day child - 500 Longer term child - 400 Longer term adult - 1000 Lifetime adult - 20	620(L)			50
Acenaphthene				6E-2	-		520(L)			50
Anthracene				3E-1	-		300(ma) (L)(PAHs)	0.0028 (PAHs)	0.0311 (PAHs)	50
Fluoranthene				4E-2	-		3980(fa)(L)	42	54	50
Pyrene				3E-2	-		300(ma) (L)(PAHs)	0.0028(PAHs)	0.0311 (PAHs)	50
Benzo[a]anthracene	8.845E-1 B2	1.6675 B2			0.1(P) G:0		300(ma) (L)(PAHs)	0.0028(PAHs)	0.0311 (PAHs)	50
Chrysene	2.684E-2 B2	5.06E-2 B2			0.2(P) G:0		300(ma) (L)(PAHs)	0.0028(PAHs)	0.0311 (PAHs)	50
Benzo[b]fluoranthene	8.54E-1 B2	1.61 B2			0.2(P) G:0		300(ma) (L)(PAHs)	0.0028(PAHs)	0.0311 (PAHs)	50
Benzo[k]fluoranthene	4.026E-1 B2	7.59E-1 B2			0.2(P) G:0		300(ma) (L)(PAHs)	0.0028(PAHs)	0.0311 (PAHs)	50
Benzo[a]pyrene	6.1 B2	1.15E1 B2			0.2(P) G:0		300(ma) (L)(PAHs)	0.0028(PAHs)	0.0311 (PAHs)	50
Indeno[1,2,3,-c,d]pyrene	1.4152 B2	2.668 B2			0.4(P)		3(ma) (L)(PAHs)	0.0028(PAHs)	0.0311 (PAHs)	50

TABLE 2-10 (Continued)
STANDARDS, GUIDELINES, AND DOSE-RESPONSE PARAMETERS FOR INDICATOR CHEMICALS
PAGE 3

Compound	CSF$^{(1)}$ (mg/kg/day)$^{-1}$		Chronic RFD$^{(1)}$ (mg/kg/day)		MCL/NPDWR MCLG (ug/L) (2)(3)(4)(5)(6)(7)(8)	DWHA (ug/L)	AWQC (ug/L)			NYS MCL (ug/L)
	Inhalation	Oral	Inhalation	Oral			Aquatic Life	Drinking Water & Fish	Fish Only	
Dibenzo[a,h]anthracene	6.771 B2	1.2765E1 B2			0.3(P) G:0		300(ma) (L)(PAHs)	0.0028(PAHs)	0.0311 (PAHs)	50
Benzo[g,h,i]perylene					-		300(ma) (L)(PAHs)	0.0028(PAHs)	0.0311 (PAHs)	50
Fluorene				4E-2	-		300(ma) (L)(PAHs)	0.0028(PAHs)	0.0311 (PAHs)	50
trans 1,2-Dichloroethene				2E-2	100 G:100 70(cis) G:70(cis)	1-day child - 20000 10-day child - 2000 Longer term child-2000 Longer term adult - 6000 Lifetime adult - 100	11600 (L)(fa)	0.033	1.85	5
1,1,1-Trichloroethane			3E-1	9E-2	200 G:200	1-day child - 100000 10-day child - 40000 Longer term child - 40000 Longer term adult - 100000 Lifetime adult - 200	31200(ma) (L)	18400	1030000	5
Carbon disulfide			3E-3	1E-1	-					50
Arsenic	5E1 A	A		1E-3	50(N) G:0		V - 48(L) III-190	0.0022	0.0175	50
Antimony				4E-4	10/5(P) G:3	1-day child - 15 10-day child - 15 Longer term adult - 15 Lifetime adult - 3	1600(L) 30(P)	146	45000	-
Barium			1E-4	5E-2	1000(N) 2000(F) G:2000	Lifetime adult - 2000	1000			1000
Beryllium	8.4 B2	4.3 B2		5E-3	1(P) G:0	1-day child - 30000 10-day child 30000 Longer term child - 4000 Longer term adult - 20000	5.3(L)	0.0068	0.117	-
Cadmium	6.1 B1			5E-4	10(N);5(F) G:5	1-day child - 40 10-day child - 40 Longer term child - 5 Longer term adult - 20 Lifetime adult - 5	1.1 (+)	10	-	10

TABLE 2-10 (Continued)
STANDARDS, GUIDELINES, AND DOSE-RESPONSE PARAMETERS FOR INDICATOR CHEMICALS
PAGE 4

Compound	CSF (mg/kg/day)$^{-1}$		Chronic RFD (mg/kg/day)		MCL/NPDWR MCLG (ug/L)	DWHA (ug/L)	AWQC (ug/L)			NYS MCL (ug/L)
	Inhalation	Oral	Inhalation	Oral			Aquatic Life	Drinking Water & Fish	Fish Only	
Chromium	VI-4.1E1 A		III-6E-7 VI-6E-7	III-1E0 VI-5E-3	50(N);100(F) G:100	1-day child - 1000 10-day child - 1000 Longer term child - 200 Longer term adult - 800 Lifetime adult - 100	VI-11 III-210(+)	VI-50 III-170000	III-3433000	50
Copper				4E-2	1300(A) G:1300		12(+)			1000(S)
Lead	B2	B2	4.3E-4	1.4E-3	50(N);15(A) G:0		3.2(+)	50		50
Manganese			1E-4	1E-1	50(S)			50	100	300(S)
Mercury			9E-5	3E-4	2 G:2	Longer term adult - 2 Lifetime adult - 2	0.012	0.144	0.146	2
Nickel	8.4E-1 A			2E-2	100(P) G:100	1-day child - 1000 10-day child - 1000 Longer term child -100 Longer term adult - 600 Lifetime adult - 100	160(+)	13.4	100	-
Silver				3E-3	50(N)	1-day child - 200 10-day child - 200 Longer term child - 200 Longer term adult - 200 Lifetime adult - 100	0.12	50		50
Vanadium				7E-3	-	1-day child - 80 10-day child - 80 Longer term child - 30 Longer term adult - 110 Lifetime adult - 20				-
Zinc				2E-1	5000(s)	1-day child - 4000 10-day child - 4000 Longer term child - 2000 Longer term adult - 9000 Lifetime adult - 2000	110(+)			5000(S)
Cyanide				2E-2	200(P) G:200	1-day child - 200 10-day child - 200 Longer term child - 200 Longer term adult - 800 Lifetime adult - 200	5.2	200		-

TABLE 2-10
STANDARDS, GUIDELINES, AND DOS-RESPONSE PARAMETERS FOR INDICATOR CHEMICALS
PAGE 5

Compound	CSF (mg/kg/day)$^{-1}$		Chronic RFD (mg/kg/day)		MCL/NPDWR MCLG (ug/L)	DWHA (ug/L)	AWQC (ug/L)			NYS MCL (ug/L)
	Inhalation	Oral	Inhalation	Oral			Aquatic Life	Drinking Water & Fish	Fish Only	
1,1-Dichloroethane			1E-1	1E-1	-					5
1,1-Dichloroethene	1.2 C	6E-1 C		9E-3	7 G:7	1-day child - 2000 10-day child - 1000 Longer term child - 1000 Longer term adult - 4000 Lifetime adult - 7	11600(fa) (L)	0.033	1.85	5
Carbon Tetrachloride	1.3E-1 B2	1.3E-1 B2		7E-4	5 G:0	1-day child - 4000 10-day child - 200 Longer term child - 70 Longer term adult - 300	35200(fa) (L)	0.4	6.94	5
Ethylbenzene			3E-1	1E-1	700 G:700	1-day child - 40000 10-day child - 3000 Longer term child - 1000 Longer term adult - 3000 Lifetime adult - 700	32000 (fa) (L)	1400	3260	5
Xylenes			9E-2	2	10000 G:700	1-day child - 40000 10-day child - 40000 Longer term child - 40000 Longer term adult - 100000 Lifetime adult - 10000				5
Di-n-octyl phthalate				2E-2	-		3(L) (phthal)			50
Phenanthrene				2.9E-2			300(ma)(L) (PAHs)	0.002.8 (PAHs)	0.0311	50
2-Methylphenol				5E-2	-					50
2,4-Dimethylphenol				2E-2	-		2120(fa) (L)			50
Selenium					50(F);10(N) G:50		5			10
Thallium				7E-5	2/1(P) G:0.5	1-day child - 7 10-day child - 7 Longer term child - 7 Longer term adult - 20 Lifetime adult - 0.4	40(L)	13	48	-

TABLE 2-10 (Continued)
STANDARDS, GUIDELINES, AND DOS-RESPONSE PARAMETERS FOR INDICATOR CHEMICALS
PAGE 6

CSF = Cancer slope factor
RFD = Risk reference dose
G = MCLG = MCL Goal
MCL = Maximum contaminant level
N = NPDWR = National Primary Drinking Water Regulation
P = Proposed
DWHA = Drinking Water Health Advisory
S = Secondary MCL
AWQC = Ambient Water Quality Criterion (Chronic freshwater unless otherwise indicated)
NYS = New York State
L = Lowest observed effects level
fa = Freshwater acute
PCBs = Based on polychlorinated biphenyls
Phthal = Based on total phthalates
THM = Trihalomethanes
A = Cancer weight of evidence A (human carcinogen)
B1 = Cancer weight of evidence B1 (probable human carcinogen)
B2 = Cancer weight of evidence B2 (probable human carcinogen)
C = Cancer weight of evidence C (possible human carcinogen)
PAHs = Polycyclic aromatic hydrocarbons
Ms = Marine acute
F = Final
+ = Hardness - dependent
A = Action Level

(1) USEPA, January 1991
(2) USEPA, January 30, 1991
(3) USEPA, April 1991
(4) USEPA, July 1990
(5) USEPA, July 25, 1990
(6) USEPA, July 1, 1991
(7) USEPA, June 7, 1991
(8) USEPA, July 18, 1991
(9) USEPA, 1987
(10) New York State Sanitary Code, July 3, 1991

effect level (LOAEL) by an uncertainty factor (UF) times a modifying factor (MF). The use of uncertainty factors and modifying factors is discussed in the EPA, Office of Research and Development (ORD) Health Effects Assessment Summary Tables, Fourth Quarter FY1989 [October 1989-ORD(RD-689)] (USEPA, 1989). Table 2-10 provides RfDs that may be considered in establishing remediation goals.

Cancer Slope Factors (CSFs) are used for estimating the lifetime probability (assumed 70-year lifespan) of human receptors contracting cancer as a result of exposure to known or suspected carcinogens. These factors are generally reported in units of kg-day/mg and are derived through an assumed low dosage linear relationship and an extrapolation from high to low dose responses determined from human or animal studies. Cancer risk and CSFs are most commonly estimated through the use of a linearized multistage mathematical extrapolation model applied to animal bioassay results. The value used in reporting the slope factor is the upper 95 percent confidence limit. Table 2-10 provides CSFs that may be considered in establishing remediation goals.

The Clean Air Act (CAA) (42 USC 7401) consists of three programs or requirements that may be ARARs: National Ambient Air Quality Standards (NAAQS) (40 CFR Part 50), National Emissions Standards for Hazardous Air Pollutants (NESHAPs) (40 CFR Part 61), and NSPS (40 CFR Part 60).

NESHAPs are emission standards for source types (i.e., industrial categories) that emit hazardous air pollutants, and include significant sources of beryllium, vinyl chloride, benzene, asbestos, wet dust particulates, and other hazardous substances.

EPA requires the attainment and maintenance of primary and secondary NAAQS to protect public health and public welfare, respectively. NAAQS are available for six criteria pollutants (carbon monoxide, lead, nitrogen oxides, ozone, sulfur dioxide and airborne particulates). These standards are not source specific but rather are national limitations on ambient air quality. The sources of the contaminant and the routes of exposure were considered. However, the standards do not consider costs for achievement or feasibility. States are responsible for assuring compliance with the NAAQS. Requirements in an EPA-approved State Implementation Plan (SIP) for the implementation, maintenance, and enforcement of NAAQS are potential ARARs.

NSPS are established for new sources of air emissions to ensure that the new stationary sources minimize emissions. These standards are for categories of stationary sources that cause or contribute to air pollution that may endanger public health or welfare. Standards are based upon the best demonstrated technology (BDT). NSPS are generally not applicable to CERCLA remedial actions but may be relevant and appropriate if the pollutant(s) emitted (e.g., from an air stripping tower) and the technology employed during the cleanup action are sufficiently similar to the pollutant and source category regulated by an NSPS and are well suited to the circumstances at the site. Also, OSWER Directive 9355.0-28 Air Emissions for Non-Attainment Areas requires new major stationary sources of air emissions to determine whether the source is in a NAAQS attainment or non-attainment area.

OSWER Directive 9355.0-28 is a TBC that guides the control of air emissions from air strippers at Superfund groundwater remediation sites. For sites located in areas that are not attaining the NAAQS for ozone, add-on emission controls are required for an air stripper with an actual emission rate in excess of 3 pounds per hour or 15 pounds per day, or a potential (i.e., calculated) rate of 10 tons per year of total volatile organic compounds.

EPA Polychlorinated Biphenyls Spill Policy (40 CFR Part 761) applies to recent spills of materials exceeding 50 ppm PCBs within 24 hours of occurrence. Effective May 1987, requires cleanup of PCB spills to different levels depending on spill location, the potential for exposure to residual PCBs remaining after cleanup, the concentration of PCBs initially spilled and the nature and size of the population potentially at risk of exposure. The policy addresses reporting, cleanup, performance standards, post-cleanup sampling, and record keeping. Generally the cleanup performance standard is 25 ppm for restricted areas and 10 ppm (with a minimum 10 inch depth to be excavated) for nonrestricted access areas. For old spills, requirements are to be established at the discretion of the EPA, usually through the regional offices. This is also true for special cases (i.e. spills directly into surface water, sewers, drinking water, grazing lands, and vegetable gardens).

OSWER Directive No. 9355.4-01 provides guidance on remedial actions for Superfund sites with PCB contamination. For contaminated soils, provides preliminary PCB remediation goals of 1 ppm for residential areas and 10 to 25 ppm for industrial areas. Treatment is recommended when PCBs exceed principal threat concentrations of 100 ppm for residential areas and 500 ppm for industrial areas; between these levels and the cleanup goals, the guidance suggests that various containment or exposure reduction strategies will be sufficient. The concentrations given are based on actual soil concentrations, unlike TSCA regulations which are based on the concentration of the original spill.

For contaminated groundwater, the guidance recommends remediation goals of 0.5 ug/l (i.e., the Federal MCL). Generally, PCB soil cleanup levels should provide sufficient protection unless groundwater is shallow, oily compounds are present, or the unsaturated zone has a very low TOC level.

New York Water Classifications and Quality Standards (New York Codes, Rules, and Regulations, Title 6-Environmental Conservation) regulates reclassification of water based on use and value, including protection and propagation of fish, shellfish and wildlife, recreation in and on the water, public water supplies, and agricultural, industrial and other purposes including navigation. Additionally, regulates the discharge of sewage, industrial waste or other wastes so as not to cause impairment of the best usages of the receiving water as specified by the water classifications at the location of discharge that may be affected by such discharge. Both quantitative standards as well as narrative water quality standards (turbidity, solids, oil, etc.) are provided. (See Action Specific ARARs for Groundwater Effluent Standards which would be applicable for alternatives including reinjection to the aquifer).

Groundwater quality standards (Class GA) for NWIRP site compounds are provided in Table 2-10. Also for GA groundwater, pH shall be between 6.5 and 8.5 and TDS shall not exceed 500 mg/l.

New York Public Water Supply Regulations (Codes, Rules and Regulations of the State of New York, Title 10-Health) provides requirements for state public water supplies. Refer to Table 2-6 for standards applying to NWIRP site compounds.

New York Ambient Air Quality Standards (Official Codes, Rules and Regulations of the State of New York, Title 6-Environmental Conservation) provides four general classifications of social and economic development and resulting pollution potential upon which standards are based and establishes air quality standards to provide protection from adverse health effects of air contamination and protect and conserve natural resources and the environment. Regulates sulfur dioxide, particulates, carbon monoxide, photochemical oxidants, non-methane hydrocarbons, nitrogen dioxide, fluorides, beryllium, and hydrogen sulfide.

2.2.2.2 Location-Specific ARARs and TBCs

Other than EPA's Groundwater Protection Strategy, no location-specific ARARs or TBCs apply to the NWIRP site. As stated in the Phase 1 Remedial Investigation Report (HNUS, 1992) no natural aquatic habitats, no Federal or state endangered species, and no critical habitats are reported to exist on site. Moreover, no impacted floodplains or wetlands have been identified.

EPA's Groundwater Protection Strategy (EPA, 1984) policy is to protect groundwater for its highest present or potential beneficial use. This policy (TBC) will be incorporated into future regulatory amendments. The strategy designates three categories of groundwater:

- Class I - Special Groundwaters: Waters that are highly vulnerable to contamination and are either irreplaceable or ecologically vital sources of drinking water.

- Class II - Current and Potential Sources of Drinking Water and Waters Having Other Beneficial Uses: Waters that are currently used or that are potentially available.

- Class III - Groundwater Not a Potential Source of Drinking Water and of Limited Beneficial Use. Class III groundwater units are further subdivided into two subclasses.

    - Subclass IIIA includes groundwater units that are highly to intermediately interconnected to adjacent groundwater units of a higher class and/or surface waters. They may, as a result, be contributing to the degradation of the adjacent waters. They may be managed at a similar level as Class II groundwaters, depending upon the potential for producing adverse effects on the quality of adjacent waters.

    - Subclass IIIB is restricted to groundwater characterized by a low degree of interconnection to adjacent surface waters or other groundwater units of a higher class within the Classification Review Area. These groundwaters are naturally isolated from sources of drinking waters in such a way that there is little potential for producing adverse effects on quality. They have low resource values outside of mining or waste disposal.

2.2.2.3 Action-Specific ARARs and TBCs

ARARs associated with discharge to surface water are not included in this section since no surface water bodies exist near the site.

RCRA Subtitle C regulates the treatment, storage, and disposal of hazardous waste from its generation until its ultimate disposal. In general, RCRA Subtitle C requirements for the treatment, storage, or disposal of hazardous waste will be applicable if

- The waste is a listed or characteristic waste under RCRA.
- The waste was treated, stored, or disposed (as defined in 40 CFR 260.10) after the effective date of the RCRA requirements under consideration.
- The activity at the CERCLA site constitutes current treatment, storage, or disposal as defined by RCRA.

RCRA Subtitle C requirements may be relevant and appropriate when the waste is sufficiently similar to a hazardous waste and/or the onsite remedial action constitutes treatment, storage, or disposal, and the particular RCRA requirement is well suited to the circumstances of the contaminant release and site. RCRA Subtitle C requirements may also be relevant and appropriate when the remedial action constitutes generation of a hazardous waste. Section 121(e) of CERCLA makes no reference to "Federally ordered" Superfund cleanups, so compliance with both substantive and administrative permitting requirements of RCRA Subtitle C is required for remedial activities. All RCRA Subtitle C requirements must also be met and/or when the hazardous waste moves off site.

The following requirements included in the RCRA Subtitle C regulations may pertain to the NWIRP sites:

- Hazardous waste generator requirements (40 CFR Part 262).
- Transportation requirements (40 CFR Part 263).
- Standards for owners and operators of hazardous waste TSD facilities (40 CFR Part 264).
- Interim status standards for owners and operators of hazardous waste TSD facilities (40 CFR Part 265).
- Land Disposal Restrictions (40 CFR Part 268)

A generator that treats, stores, or disposes of hazardous waste on site must comply with RCRA Standards Applicable to Generators of Hazardous Waste (40 CFR Part 262). These standards include manifest requirements, pre-transport requirements (i.e., packaging, labeling, placarding), record keeping, and reporting hazardous waste.

Standards Applicable to Transporters of Hazardous Waste (40 CFR Part 263) are applicable to offsite transportation of hazardous waste. These regulations include requirements for compliance with the manifest and record keeping systems and requirements for immediate action and cleanup of hazardous waste discharges (spills) during transportation.

Standards for Owners and Operators of Hazardous Waste TSD Facilities (40 CFR Part 264) are applicable to remedial actions and to offsite facilities receiving hazardous waste from the site for treatment and/or disposal and have a RCRA Part B permit. Onsite facilities must also have a RCRA Part B permit if the site is not a Federally ordered CERCLA cleanup. Standards for TSDFs include requirements for preparedness and prevention, releases from solid waste management units (i.e., corrective action requirements), closure and post-closure care, use and management of containers, and design and operating standards for tank systems, surface impoundments, waste piles, landfills, and incinerators.

RCRA Land Disposal Restrictions (LDR) Requirements (40 CFR Part 268) restrict certain wastes from being placed or disposed on the land unless they meet specific Best Demonstrated Available Technology (BDAT) treatment standards (expressed as concentrations, total or in the TCLP extract, or as specified technologies). Removal and treatment of a RCRA hazardous waste or movement of the waste outside of the Corrective Action Management Unit (CAMU), thereby constituting "placement," will trigger the LDR requirements.

Placement of hazardous waste into underground injection wells constitutes "land disposal" under the LDRs. Furthermore, RCRA Section 3020(a) bans hazardous waste disposal by underground injection into or above an underground source of drinking water. RCRA Section 3020(b), however, exempts from the ban all reinjections of treated contaminated groundwater into such formations undertaken as part of a CERCLA Section 104 or 106 response action, or a RCRA corrective action, if the following conditions are met:

- The contaminated groundwater is treated to substantially reduce hazardous constituents prior to such injection.

- The response action or corrective action is sufficient to protect human health and the environment upon completion.

RCRA Corrective Action for Solid Waste Management Units at Hazardous Waste Management Facilities; Proposed Rule (40 CFR Parts 264, 265, 270, and 271) July 27, 1990 proposes a Superfund-like program for cleaning up hazardous waste treatment, storage, and disposal facilities regulated under RCRA. The proposed rule provides greater flexibility than Superfund, particularly in the use of interim remedies and in setting action levels based on use. Additionally, facility investigation and other analyses will be streamlined to focus on plausible concerns and likely remedies, and to expedite cleanup decisions. Proposed cleanup goals for groundwater consist of MCLs (or limits within a protective range when MCLs are not available) where potentially drinkable groundwater is present. Otherwise, alternative levels protective of the environment could be established. For soils, cleanup levels would be established consistent with plausible future use.

RCRA Corrective Action Management Units and Temporary Units, Final Rule (40 CFR Parts 260, 264, 265, 268, 270, and 271) is a final rule addressing two new units that will be used for remedial purposes under RCRA corrective action authorities; corrective action management units (CAMUs) and temporary units (TUs). These specific provisions were proposed as part of a more comprehensive corrective action rule making on July 27, 1990. The final regulations became effective on April 19, 1993.

Control of Air Emissions from Superfund Air Strippers at Superfund Groundwater Sites (OSWER Directive 9355.0-28) provides guidance criteria as to whether air emission controls are necessary for air strippers. For ozone non-attainment areas, a maximum 3 lb/hr or 15 lb/day or 10 ton/yr of VOC emissions is allowable; air pollution controls are recommended for any emissions in excess of these quantities.

General Pretreatment Regulations for Existing and New Sources of Pollutants (40 CFR Part 403) was promulgated under the Clean Water Act and includes provisions for effluent discharge to Publicly Owned Treatment Works (POTW). Discharge of pollutants that pass through or interfere with the POTW, contaminate sludge, or endanger health/safety of POTW workers is prohibited. These regulations should be used in conjunction with local POTW pretreatment program requirements.

Underground Injection Control Program (40 CFR Parts 144,147) regulations were promulgated under the Safe Drinking Water act to ensure that operation of an underground injection will not endanger drinking water sources by violating MCLs or by adversely affecting health. Typically, two types of wells apply to CERCLA sites:

-Class I well;	injection of wastes (or treated groundwater) beneath the lowermost formation containing an underground drinking water source
-Class IV well;	injection of wastes (or treated groundwater) into or above an underground drinking water source. Note that injection of untreated groundwater into a Class IV well is banned.

Toxic Substances Control Act (40 CFR Part 761.60-761.79 Subpart D Storage and Disposal) specifies treatment, storage, and disposal requirements for PCBs based on PCB concentration of the original material. Specifically, remediation for non-liquids (soil, rags, debris) exceeding 50 ppm is addressed in 40 CFR Section 761.6 Remediation for these non-liquids consists of incineration (in accordance with 761.70), chemical waste landfill (in accordance with 761.75), or an alternative treatment method attaining the same performance as incineration (typically 2 ppm measured in the treated residual).

New York Environmental Conservation Law (New York Consolidated Laws Service; Article 17-Water Pollution Control, Article 37-Substances Hazardous or Acutely Hazardous to Public Health, Safety or the Environment, Article 71-Enforcement, and Article 72-Environmental Regulatory Program Fees) provides policy to require use of all known available and reasonable methods to prevent and control the pollution of state waters consistent with public health and use, propagation and protection of fish and wildlife, and the industrial development of the state.

New York Water Classifications and Quality Standards (New York Codes, Rules, and Regulations, Title 6-Environmental Conservation) Parts 700-704- Regulates the discharge of sewage, industrial waste or other wastes so as not to cause impairment of the best usages of the receiving water as specified by the water classifications at the location of discharge that may be affected by such discharge. Part 703-Surface Water and Groundwater Quality Standards and Groundwater Effluent Standards; Treated NWIRP site groundwater will likely be reinjected to groundwater so will need to comply with Groundwater Effluent Standards (see Table 2-10). The NWIRP site is in Nassau County, so will additionally have to comply with a maximum concentration of 1,000 mg/l total dissolved solids (TDS) and 10 mg/l total nitrogen (as N).

New York Regulations on State Pollutant Discharge Elimination System (New York Compilation of Rules and Regulations, Title 6-Environmental Conservation) prescribe procedures and substantive rules concerning discharges to state waters.

New York Solid and Hazardous Waste Management Laws (New York Consolidated Laws Service: Environmental Conservation Law, Article 27-Collection, Treatment and Disposal of Refuse and Other Solid Waste; Article 71-Enforcement, and Article 72-Environmental Regulatory Program Fees) addresses waste management policy and planning; waste transport permits; marketing of recyclable materials; state aid; solid waste management and resource recovery facilities; industrial hazardous waste management; siting of hazardous waste facilities; inactive hazardous waste disposal sites; storage, treatment, disposal and transportation of regulated medical waste, lead-acid battery recycling; enforcement, and program fees.

New York Rules for Siting Industrial Hazardous Waste Facilities (New York Compilation of Rules and Regulations, Title 6-Environmental Conservation) regulates the siting of new industrial hazardous waste facilities located wholly or partially within the state.

New York Waste Transport Permit Regulations (New York Compilation of Rules and Regulations, Title 6-Environmental Conservation) governs the collection, transport, and delivery of regulated waste, originating or terminating at a location within the state.

New York General Hazardous Waste Management System Regulations (Codes, Rules and Regulations of the State of New York, Title 6, Environmental Conservation) provides general definitions and sets forth state procedures for making information available to the public, confidentiality, petitioning equivalent testing methods, and petitioning for exclusion of a waste from a particular facility.

New York Rules on Hazardous Waste Program Fees (New York Codes, Rules and Regulations, Title 6-Environmental Conservation) addresses generator fees; treatment, storage, or disposal facility fees; and waste transporter fees.

New York Identification and Listing of Hazardous Wastes Regulations (New York Compilation of Rules and Regulations, Title 6-Environmental Conservation) establishes procedures for identifying solid wastes subject to regulation as hazardous wastes.

New York Hazardous Waste Manifest System Regulations (Codes, Rules and Regulations of the State of New York, Title 6- Environmental Conservation) establishes standards for generators; transporters; and treatment, storage or disposal facilities associated with the use of the manifest system and its record keeping requirements.

New York Hazardous Waste Treatment, Storage and Disposal Facility Permitting Requirements (New York Compilation of Rules and Regulations, Title 6-Environmental Conservation) regulates hazardous waste management facilities located within the state.

New York Final Status Standards for Owners and Operators of Hazardous Waste Treatment, Storage and Disposal Facilities (Codes, Rules and Regulations of the State of New York, Title 6-Environmental Conservation) establishes minimum state standards which define the acceptable management of hazardous waste.

New York Interim Status Standards for Owners and Operators of Hazardous Waste Facilities (Codes, Rules and Regulations of the State of New York, Title 6-Environmental Conservation establishes minimum state standards which define the acceptable management of hazardous waste during the period of interim status and until certification of closure.

New York Standards for Managing Specific Hazardous Wastes and Hazardous Waste Management Facilities (Codes, Rules and Regulations of the State of New York, Title 6-Environmental Conservation) contains requirements for generators and transporters of hazardous waste and for owners and operators of facilities managing hazardous wastes. Specifically addresses recyclable materials, hazardous waste or used oil burned for energy recovery, and reclaimed lead-acid batteries.

New York Rules for Inactive Hazardous Waste Disposal Sites (Codes, Rules and Regulation of the State of New York, Title 6-Environmental Conservation) applies to the development and implementation of programs to address inactive hazardous waste disposal sites. The goal for a specific site is to restore it to pre-disposal conditions, to the extent feasible and authorized by law. At a minimum, the remedy selected shall eliminate or mitigate significant threats to the public health and the environment. State review and concurrence with the selected remediation scheme will be required.

New York Land Disposal Restrictions Regulations (Codes, Rules and Regulations of the State of New York, Title 6-Environmental Conservation) identifies hazardous wastes that are restricted from land disposal and defines limited circumstances under which an otherwise prohibited waste may be land disposed.

New York Environmental Conservation Law (New York Consolidated Laws Service: Environmental Conservation Law, Article 1-General Provisions, Article 3-Department of Environmental Conservation, Article 5-State Environmental Board, Article 7-Council of Environmental Advisers, Article 8-Environmental Quality Review, Article 19-Air Pollution Control, Article 38-Chlorofluorocarbon Compounds, Article 70-Uniform Procedures, Article 71-Enforcement and Article 72-Environmental Regulatory Program Fees) concerns the conservation, improvement and protection of state natural resources and environment and controls water, land and air pollution.

New York Air Pollution Control Regulations (Codes, Rules and Regulations of the State of New York, Title 6-Environmental Conservation) regulates emissions from specific sources. Part 212 General Process Emission Sources provides general requirements. For the most stringent rated contaminants (Rating A) emission rate potential greater than 1 lb/hr requires 99% or more removal or best available control technology; emission rate potential less than 1 lb/hr degree of air cleaning required shall be specified by the state. Part 231 regulates new source review for air contamination source projects in non-attainment areas. To be applicable, annual emissions form the source must exceed the de minimus emission limits. For volatile organics the de minimus emission limit is 40 tons per year.

New York Technical Manual "Contained-In" Criteria for Environmental Media is a recently available guidance document requiring soil, sediment, and groundwater contaminated by listed hazardous waste to be managed as hazardous waste unless or until the media is at or below the given action level concentrations. Refer to Tables 2-3 and 2-6 for an identification of site contaminants of concern based on this guidance criteria.

Two other requirements are listed below which must be met during remedial action but which are not true ARARs. These are not environmental requirements and are not subject to potential ARARs waivers.

DOT Rules for Hazardous Materials Transport (49 CFR Parts 107 and 171-179) regulate the transport of hazardous materials, including packaging, shipping equipment, and placarding. These rules are considered applicable to wastes shipped off site for laboratory analysis, treatment, or disposal.

OSHA Requirements (29 CFR Parts 1910, 1926, and 1904 regulates occupational safety and healthy requirements applicable to workers engaged in onsite field activities.

2.2.3 Remedial Action Objectives

Remedial action objectives are being developed for both groundwater and soil. Continued long term exposure to the contaminated groundwater through ingestion and inhalation present the greatest potential public health risks at the site. To protect the public from these current and future health risks, as well as to protect the environment, the following remedial action objectives were developed:

(1) Prevent human exposure (through ingestion, inhalation, dermal contact) to groundwater having contaminants in concentrations greater than the remedial action goals.

(2) As implementable, restore contaminated groundwater to the remedial action goals.

(3) Comply with contaminant-specific, location-specific, and action-specific ARARs and guidance.

The remedial action goals are provided in Section 2.2.4.

If groundwater remediation goals cannot be achieved or the aquifer cannot be restored, then at a minimum the following remedial objectives will be met:

(1) Reduce human exposure (ingestion, inhalation, dermal contact) to groundwater having contaminants in concentrations greater than the remedial action levels.

(2) Prevent further offsite migration of contaminants.

For soils, dermal contact with PCBs in surface and subsurface soil and dust inhalation of arsenic in surface soil are of concern. Additionally future leaching of trichloroethene, tetrachloroethane, and PCBs to groundwater presents an ingestion and inhalation risk. To protect employees and residents from these future health risks, as well as to protect the environment, the following remedial action objectives were developed:

(1) Prevent human exposure (dermal contact, dust inhalation) to contaminated soils in concentrations greater than the remedial action goals.

(2) Prevent leaching of contaminants at resultant groundwater concentrations in excess of groundwater remediation goals.

(3) Comply with chemical-specific, location-specific, and action-specific ARARs and guidance.

The remedial action goals are provided in Section 2.2.4.

2.2.4 Remedial Action Goals

2.2.4.1 Soil

The remedial action goals for soils are presented in Table 2-11. Calculations are presented in Appendix A. There are no New York State standards or Federal standards for soil remediation, although recently available "contained in" guidance is available for consideration. EPA guidance is available for PCB remediation at CERCLA sites. Generally, 10 mg/kg is an acceptable level for industrial sites. However, a future residential use scenario, with a corresponding 1 mg/kg PCB level is also considered. Of note, the risk assessment indicates a future potential for leaching of several contaminants to groundwater at unacceptable concentrations. Remedial action goals for other contaminants are primarily risk based and include trichloroethene, tetrachloroethene, and arsenic.

2.2.4.2 Groundwater

Remedial action goals for groundwater are provided in Table 2-12. Basically, the most stringent promulgated standard has been utilized, including Federal MCLs/MCLGs, New York State MCLs, and New York State Groundwater Quality Standards, for the contaminants of concern. Proposed Federal standards or New York State guidance was only to be considered if no other criteria was available; if proposed standards are less than the detection limit, the detection limit was selected for the remedial action goal.

Compounds with only a secondary MCL/MCLG (e.g., aluminum, iron, TDS, and sodium) are not of concern in establishing groundwater remediation goals but will be considered in establishing treatment levels associated with water quality of effluent from a treatment plant.

2.3 GENERAL RESPONSE ACTIONS

2.3.1 Soil

2.3.1.1 Volume Estimation

Table 2-13 summarizes contaminated soil volumes greater than action levels. For all three sites, contaminated soil volumes for the current industrial scenario and future residential scenario total 242,300 cubic yards and 236,300 cubic yards, respectively. Figures 2-1 through 2-6 present the extent of contamination. Appendix B presents the soil volume and areal extent calculations. Note that the volumes/quantities presented are preliminary and may be modified based on additional testing that would be conducted during the Remedial Design/Remedial Action stage. In addition, soils in areas outside the NWIRP property may need additional action.

TABLE 2-11

REMEDIAL ACTION LEVELS FOR CONTAMINATED SOILS
NWIRP, BETHPAGE, NEW YORK

CHEMICAL OF CONCERN	MAXIMUM SITE SOIL CONC (MG/KG)	RISK BASED REMEDIATION GOAL (MG/KG)(r)	ARAR BASED REMEDIATION GOAL (MG/KG)	TBC BASED REMEDIATION GOAL (MG/KG)	SOIL PRGs (MG/KG)
SITE 1					
ORGANICS - VOLATILES					
Trichloroethene	0.20	NR	**0.0093(c)**	NR	0.010(s)
Tetrachloroethene	4.80	NR	**0.0268(c)**	NR	0.027(s)
1,1,1-Trichloroethane	0.072	NR	**0.00112(c,h)**	NR	0.010(s)
PESTICIDES					
Chlordane	0.240	0.491(b)-49.1(b)	4.12(c)	**0.206(d)**	0.206
POLYCHLORINATED BIPHENYLS					
Total Aroclors	1,470	**0.753(a,k)-75.3(a)** **0.083(b,k)-8.3(b)**	**50(j)**	**1-25(e)**	1 to 10(e)
POLYNUCLEAR AROMATICS					
Benzo(a)anthracene	0.550	NA	147.5(c)	**0.0059(d,h)**	0.330(s)
Chrysene	0.580	NA	147.5(c)	**0.0059(d,h)**	0.330(s)
Benzo(b)fluoranthene	0.680	NA	405.0(c)	**0.0162(d,h)**	0.330(s)
Benzo(k)fluoranthene	0.620	NA	405.0(c)	**0.0162(d,h)**	0.330(s)
Benzo(a)pyrene	0.620	0.0875(b,h)-8.75(b)	16.22(f)	**0.0610(g,h)**	0.330(s)
Indeno(1,2,3-cd)pyrene	0.430	NA	1,180(c)	**0.0472(d,h)**	0.330(s)
Dibenzo(a,h)anthracene	0.150(h)	NA	2,436(c)	**0.014(g,h)**	0.330(s)
INORGANICS					
Arsenic	3,380	**5.38(a,k)-538(a)**	(i)	**80(g)**	5.4
Manganese	167	**142(a,p)**	NA	20,000(g)	142

TABLE 2-11 (Continued)
REMEDIAL ACTION LEVELS FOR CONTAMINATED SOILS
NWIRP, BETHPAGE, NEW YORK
PAGE 2

CHEMICAL OF CONCERN	MAXIMUM SITE SOIL CONC (MG/KG)	RISK BASED REMEDIATION GOAL (MG/KG)(r)	ARAR BASED REMEDIATION GOAL (MG/KG)	TBC BASED REMEDIATION GOAL (MG/KG)	SOIL PRGS (MG/KG)
SITE 2					
ORGANICS - VOLATILES					
Trichloroethene	0.032	NR	**0.01174**(c)	NR	0.012
PHENOLS					
4-Methylphenol(p-cresol)	0.0750(h)	NR	**0.0226**(c,h,l)	0.452(d)	0.330(s)
PESTICIDES					
Heptachlor Epoxide	0.0120	0.072(b)-7.02(b)	**0.00082**(c)(h)(m)	**0.000082**(d,h)	0.0017(s)
Dieldrin	0.0079	0.0399(b)-3.99(b)	1.580(c)	**0.000316**(d,h)	0.0033(s)
POLYCHLORINATED BIPHENYLS					
Total Aroclors	36.6	**0.753**(a,k)**-75.3**(a) **0.083**(k)**-8.3**(b)	50(i)	**1-25**(e)	1 to 10(e)
POLYNUCLEAR AROMATICS					
Benzo(a)anthracene	1.20	NA	186.0(c)	**0.00744**(d,h)	0.330(s)
Chrysene	1.10	NA	186.0(c)	**0.00744**(d,h)	0.330(s)
Benzo(b)fluoranthene	0.980	NA	512.5(c)	**0.0205**(d,h)	0.330(s)
Benzo(k)fluoranthene	1.20	NA	512.5(c)	**0.0205**(d,h)	0.330(s)
Benzo(a)pyrene	1.20	**0.0875**(b,h,k)**-8.75**(b)	20.47(f)	**0.061**(g,h)	0.330(s)
Indeno(1,2,3-cd)pyrene	0.690	NA	1,490(c)	**0.0596**(d,h)	0.330(s)
Dibenzo(a,h)anthracene	0.310(h)	NA	3,071(c)	**0.014**(g,h)	0.330(s)
Naphthalene	0.210(h)	NR	0.875(c)	**0.175**(d,h)	0.330(s)
INORGANICS					
Arsenic	13.4	**5.38**(a,k)**-538**(a)	500(i)	80(g)	5.4
Beryllium	0.880(h)	**0.663**(b,k)**-66.3**(b)	NA	**0.160**(g,h)	1.0(s)

TABLE 2-11 (Continued)
REMEDIAL ACTION LEVELS FOR CONTAMINATED SOILS
NWIRP, BETHPAGE, NEW YORK
PAGE 3

CHEMICAL OF CONCERN	MAXIMUM SITE SOIL CONC (MG/KG)	RISK BASED REMEDIATION GOAL (MG/KG)$^{(r)}$	ARAR BASED REMEDIATION GOAL (MG/KG)	TBC BASED REMEDIATION GOAL (MG/KG)	SOIL PRGS (MG/KG)
SITE 3					
ORGANICS - VOLATILES					
Tetrachloroethene	0.0550	NR	**0.0288**	NR	0.029
ETHERS					
Bis(2-chloroethyl)ether	0.360	**0.024$^{(a,h,k)}$-2.4$^{(a)}$**	0.011$^{(c,h,n)}$	**0.00022$^{(d,h)}$**	0.330$^{(s)}$
PESTICIDES					
Heptachlor	0.0170	NR	0.0759$^{(c)}$	**0.00759$^{(d)}$**	0.008
Dieldrin	0.0050	0.0399$^{(b)}$-3.99$^{(b)}$	1.345$^{(c)}$	**0.000269$^{(d,h)}$**	0.0033$^{(h)}$
POLYNUCLEAR AROMATICS					
Benzo(a)anthracene	0 .880	NA	158.3$^{(c)}$	**0.00633$^{(d,h)}$**	0.330$^{(s)}$
Chrysene	1.06	NA	158.3$^{(c)}$	**0.00633$^{(d,h)}$**	0.330$^{(s)}$
Benzo(b)fluoranthene	1.20	NA	435.0$^{(c)}$	**0.0174$^{(d,h)}$**	0.330$^{(s)}$
Benzo(k)fluoranthene	1.40	NA	435.0$^{(c)}$	**0.0174$^{(d,h)}$**	0.330$^{(s)}$
Benzo(a)pyrene	1.30	**0.0875$^{(b,h,k)}$-8.75$^{(b)}$**	17.40$^{(f)}$	**0.0610$^{(g,h)}$**	0.330$^{(s)}$
Indeno(1,2,3-cd)pyrene	0.920	NA	1,265$^{(c)}$	**0.0506$^{(d,h)}$**	0.330$^{(s)}$
Dimethylphthalate	0.190$^{(h)}$	782,143$^{(b)}$	0.0138$^{(c)(h)(o)}$	NR	0.330$^{(s)}$
INORGANICS					
Arsenic	56.8	**5.38$^{(a,k)}$-538$^{(a)}$**	500$^{(i)}$	80$^{(g)}$	5.4
Beryllium	1.50	**0.663$^{(b,h,k)}$-66.3$^{(b)}$**	NA	**0.160$^{(g,h)}$**	1.0$^{(s)}$
Manganese	267	**142$^{(a,q)}$**	NA	20,000$^{(g)}$	142

TABLE 2-11 (Continued)
REMEDIAL ACTION LEVELS FOR CONTAMINATED SOILS
NWIRP, BETHPAGE, NEW YORK
PAGE 4

(a) Current industrial land use scenario.

(b) Future residential land use scenario.

(c) Groundwater protection based on New York State Public Supply Regulations. (Title 10 - Part 5-1).

(d) Groundwater protection based on New York State Technical Assistance Guidance Memorandum (TAGM) 3028, "Contained in" Criteria, November 30, 1992 and "Determination of Soil Cleanup Objectives and Cleanup Level", TAGM 4046, dated November 16, 1992.

(e) 1 mg/kg residential use, 10 mg/kg industrial use based on Federal and New York State guidance.

(f) Groundwater protection based on Federal SDWA, 40 CFR-141.

(g) Soil action level based on New York State TAGMs.

(h) Less than CRQL (organics) or CRDL (inorganics).

(i) Potential for TCLP leachate to exceed hazardous waste criteria. Only one location at Site 1 exhibited elevated levels of arsenic. TCLP testing was conducted on a composite containing this sample. The TCLP concentration was 0.855 mg/l. RCRA criteria is 5 mg/l.

(j) TSCA criteria (40 CFR 761).

(k) Chemical of concern maximum concentration exceeds 10^{-6} risk; however, cumulative risk for all remaining chemicals are not expected to exceed 10^{-4} following ARAR-based remediation.

(l) Eliminate from further ARAR-based groundwater protection consideration. 4-methylphenol not detected in Site 2 subsurface soil or groundwater and only detected in 1 of 13 surface soil samples analyzed. The one detection is below the CRQL of 0.330 mg/kg.

(m) Eliminate from further ARAR-based groundwater consideration. Heptachlor epoxide not detected in Site 2 surface or subsurface soils or groundwater. Only detected in basin sediments (1 of 2 samples) which are periodically removed by Grumman.

(n) Bis(2-chloroethyl)ether not detected in Site 3 subsurface soils or groundwater and only detected in 1 of 9 surface soil samples at a concentration slightly above the CRQL of 0.330 mg/kg.

(o) Eliminate from further ARAR-based groundwater protection consideration. Dimethyl phthalate not detected in Site 3 subsurface soils or groundwater and only detected in 1 of 9 surface soil samples at a concentration less than the CRQL of 0.330 mg/kg.

(p) Manganese was not detected in Site 1 surface soils. Manganese was detected in 9 of 9 subsurface soils analyzed, at a representative concentration of 126 mg/kg which is less than the risk-based remediation goal. Primary non-carcinogenic risk is associated with dust inhalation.

(q) Manganese was not detected in Site 3 surface soils. Manganese was detected in 6 of 6 subsurface soils analyzed, at a representative concentration of 195 mg/kg which exceeds the risk based remediation goal. Primary non-carcinogenic risk is associated with dust inhalation.

(r) Where data is presented as a range, chemical of concern is carcinogenic and range represents 10^{-6} to 10^{-4} risk.

(s) When the minimum of the risk-based, ARAR-based, and TBC-based goal is less than the CRQLs/CRDLs, the CRQLs and CRDLs will be used.

NA - Not applicable

NR - Not reported since less stringent than ARAR-based criteria highlighted goals indicate an exceedance of maximum site soil concentration.

TABLE 2-12

GROUNDWATER REMEDIAL ACTION GOALS
NWIRP, BETHPAGE, NEW YORK [ug/l]

CHEMICAL	REMEDIAL ACTION GOAL	BASIS
VOLATILE ORGANICS		
Carbon Tetrachloride	5	Federal FMCL/NYS MCL
1,1-Dichloroethane	5	NYS MCL
1,1-Dichloroethene	5	NYS MCL
1,2-Dichloroethene	5	NYS MCL
Ethylbenzene	5	NYS MCL
Tetrachloroethene	5	Federal FMCL/NYS MCL
Toluene	5	NYS MCL
1,1,1-Trichloroethane	5	NYS MCL
Trichloroethene	5	Federal FMCL/NYS MCL
Xylenes	5	NYS MCL
SEMI-VOLATILES		
Bis(2-ethylhexyl phthalate	50	NYS MCL
PCBs		
PCB*	0.1	NYS GWQS
TOXIC METALS		
Arsenic	25	NYS GWQS
Cadmium	5	Federal FMCLG
Chromium	50	NYS MCL
Hexavalent Chromium	50	NYS GWQS
Copper	200	NYS GWQS
Lead	15	NYS and Federal Action Level
Manganese	200	Federal LMCLG
Vanadium	250	NYS Action Level
Cyanide	100	NYS GWQS

TABLE 2-12 (Continued)
GROUNDWATER REMEDIAL ACTION GOALS
NWIRP, BETHPAGE, NEW YORK [ug/l]
PAGE 2

NYS	New York State
MCL	Maximum Contaminant Level L- Listed F- Final
MCLG	Maximum Contaminant Level Goal
GWQS	Groundwater Quality Standard

NOTE: Refer to Table 2-6 for a listing of all contaminated-specific groundwater ARARs.

* Not present to date in groundwater.

TABLE 2-13

CONTAMINATED SOIL VOLUMES (a)
NWIRP, BETHPAGE, NEW YORK

Constituents of Concern	Site 1		Site 2		Site 3		Total	
	Current Industrial (CY)	Future Residential (CY)	Current Industrial (CY)	Future Residential (CY)	Current Industrial (CY)	Future Residential (CY)	Current Industrial (CY)	Future Residential (CY)
PCBs > 50 ppm	300	300	0	0	0	0	300	300
PCBs between 10 ppm and 50 ppm	1,100	1,100	2,600	2,600	0	0	3,700	3,700
Metals > Hazardous Waste Criteria(b)	600	600	0	0	0	0	600	600
VOCs > Action Levels (excludes PCBs > 10 ppm) (excludes metals > hazardous waste criteria)								
- VOCs and other metals/organics	9,400	7,900	1,300	1,300	0	0	10,700	9,200
- VOCs only	106,000(c)	107,500(c)	1,800	1,800	121,400	121,400	229,200	230,700
Total VOCs (d)	115,400	115,400	3,100	3,100	121,400	121,400	239,900	239,900
Other organics and metals > action levels								
- VOCs and other metals/organics	9,400	7,900	1,300	1,300	0	0	10,700	9,200
- Other metals/organics only	2,300	400	30,600	32,400	19,000	13,100	51,900	45,900
Total other metals/organics	11,700	8,300	31,900	33,700	19,000	13,100	62,600	55,100
Total Soil Volumes (e)	119,700	117,800	36,300	38,100	140,400	134,500	296,400	290,400

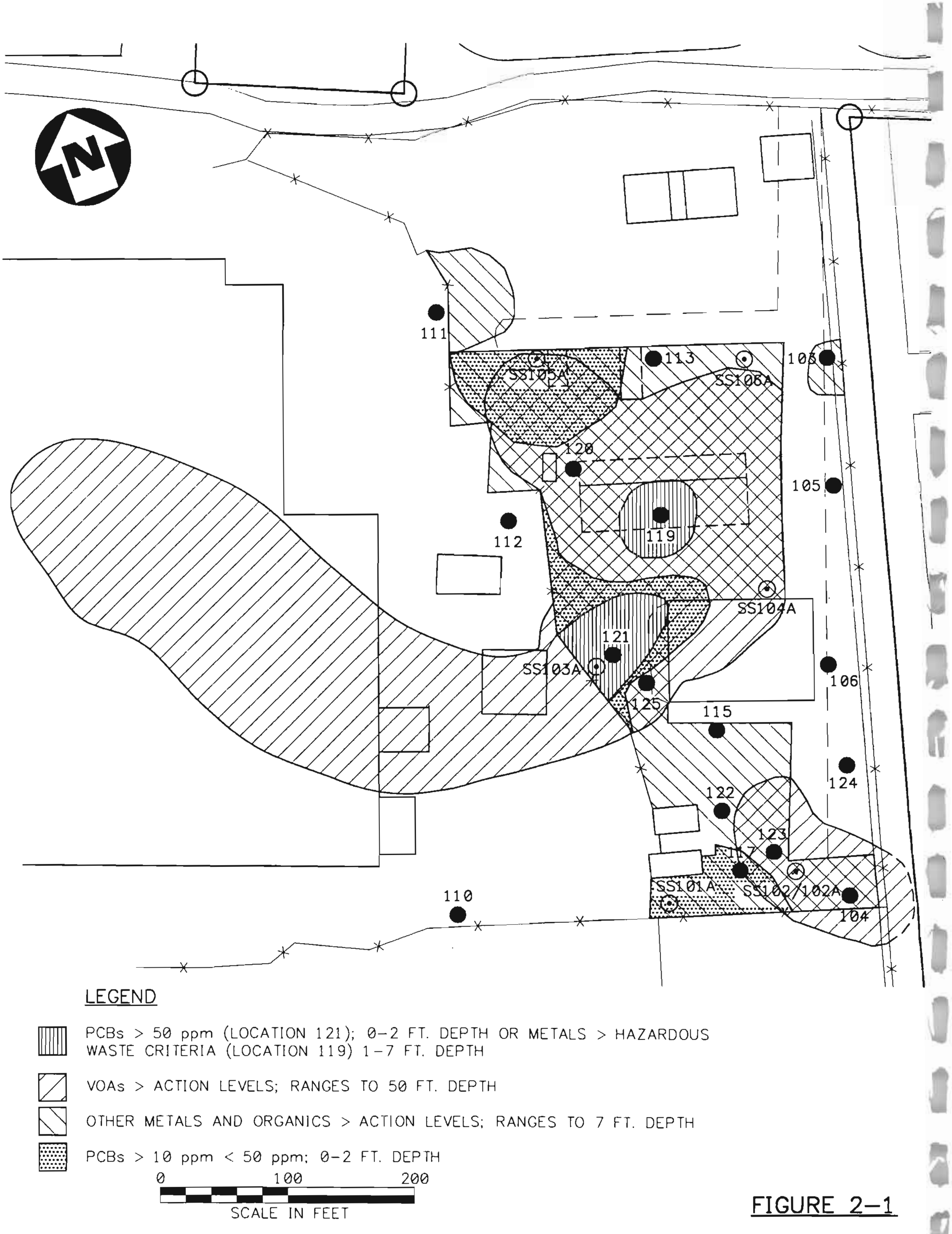
(a) Note that the volumes presented are preliminary and may be modified based on additional testing that would be conducted during the Remedial Design/Remedial Action stage.

(b) Hazardous waste criteria: as defined by the USEPA under 40 CFR 261.24.

(c) Includes 47,100 cubic yards of PCE (tetrachloroethene) contaminated soil originating from the Plant No. 3 area.

(d) The majority of VOC-contaminated soils only exceed the VOC-action levels by a factor of one to three. The volume of VOC-contaminated soils which exceed three times this baseline action level total approximately 87,000 cubic yards, all of which are located at, or adjacent to, Site 1.

(e) Total Soil Volume = PCBs> 50 ppm + PCBs between 10 ppm and 50 ppm + metals>hazardous waste criteria + VOCs only + other metals/organics only + VOCs and other metals/organics



LEGEND

▥ PCBs > 50 ppm (LOCATION 121); 0-2 FT. DEPTH OR METALS > HAZARDOUS WASTE CRITERIA (LOCATION 119) 1-7 FT. DEPTH

▨ VOAs > ACTION LEVELS; RANGES TO 50 FT. DEPTH

▧ OTHER METALS AND ORGANICS > ACTION LEVELS; RANGES TO 7 FT. DEPTH

░ PCBs > 10 ppm < 50 ppm; 0-2 FT. DEPTH

FIGURE 2-1

SITE 1 - CURRENT INDUSTRIAL
USE SCENARIO
NWIRP, BETHPAGE, NEW YORK

HALLIBURTON NUS
Environmental Corporation

ACAD: 1953\SITE1.DWG 7/20/93 MB PLOT2

LEGEND

▥ PCBs > 50 ppm (LOCATION 121); 0-2 FT. DEPTH OR METALS > HAZARDOUS WASTE CRITERIA (LOCATION 119) 1-7 FT. DEPTH

▨ VOAs > ACTION LEVELS; RANGES TO 50 FT. DEPTH

▧ OTHER METALS AND ORGANICS > ACTION LEVELS; RANGES TO 7 FT. DEPTH

░ PCBs > 10 ppm < 50 ppm; 0-2 FT. DEPTH

0 100 200
SCALE IN FEET

FIGURE 2-2

SITE 1 - FUTURE RESIDENTIAL USE SCENARIO NWIRP, BETHPAGE, NEW YORK

HALLIBURTON NUS
Environmental Corporation

ACAD: 1953\SITE1.DWG 7/21/93 MB (PLOT1)

ACAD: 1953/SITE2.DWG 7/21/93 MB (PLOT1)

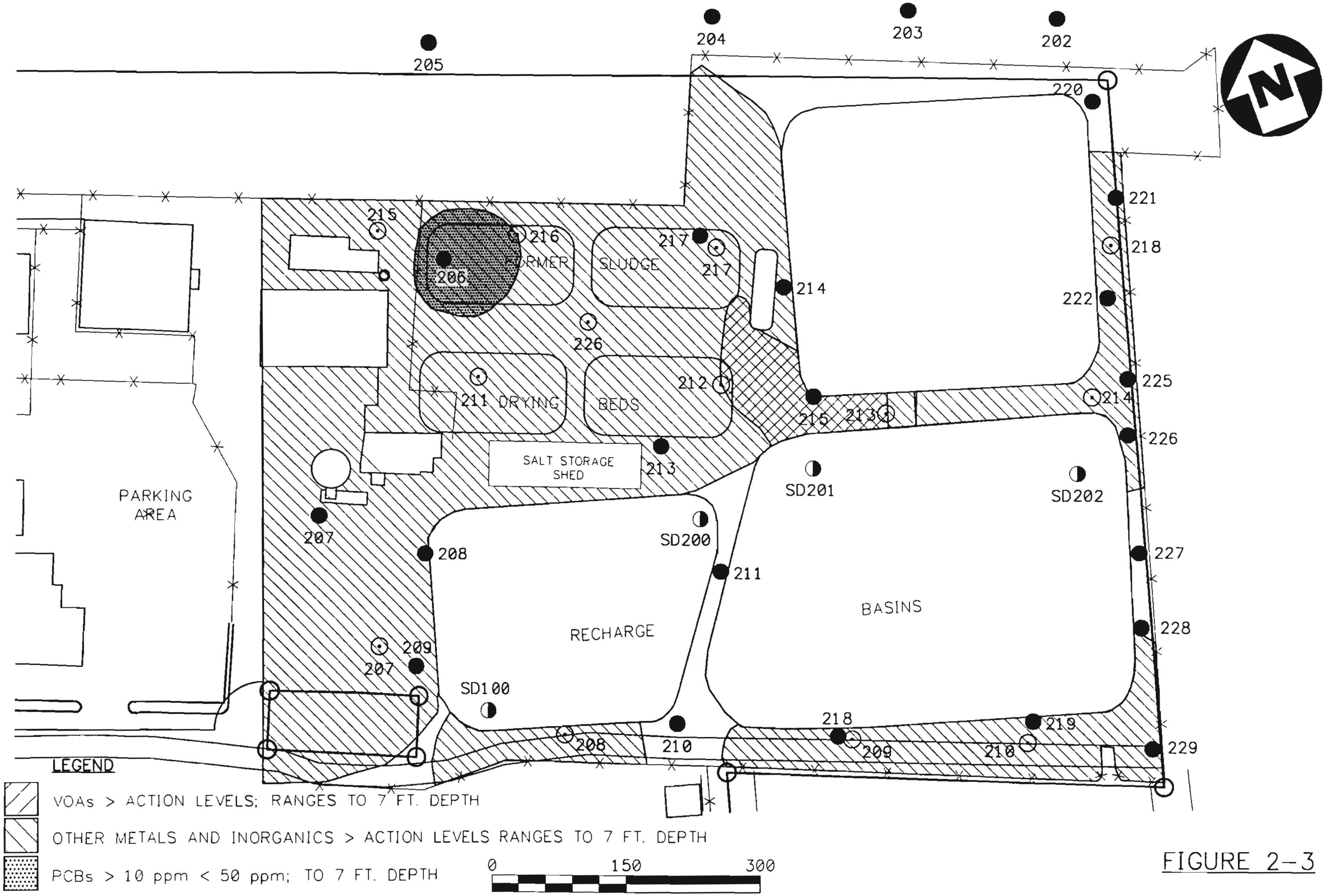


FIGURE 2-3

SITE 2 - CURRENT INDUSTRIAL USE SCENARIO
NWIRP, BETHPAGE, NEW YORK

HALLIBURTON NUS
Environmental Corporation

ACAD: 1953/SITE2.DWG 7/21/93 MB (PLOT2)

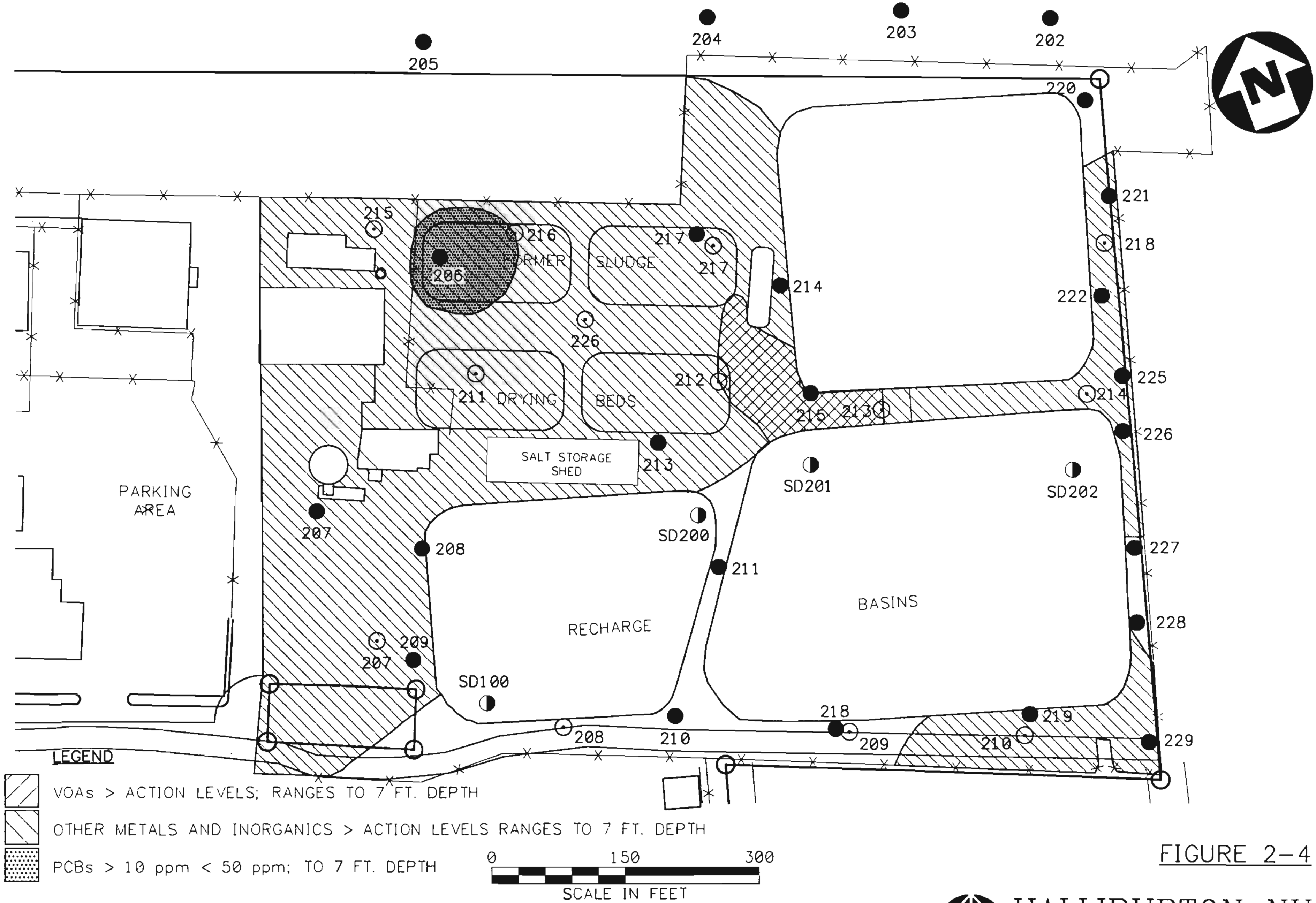
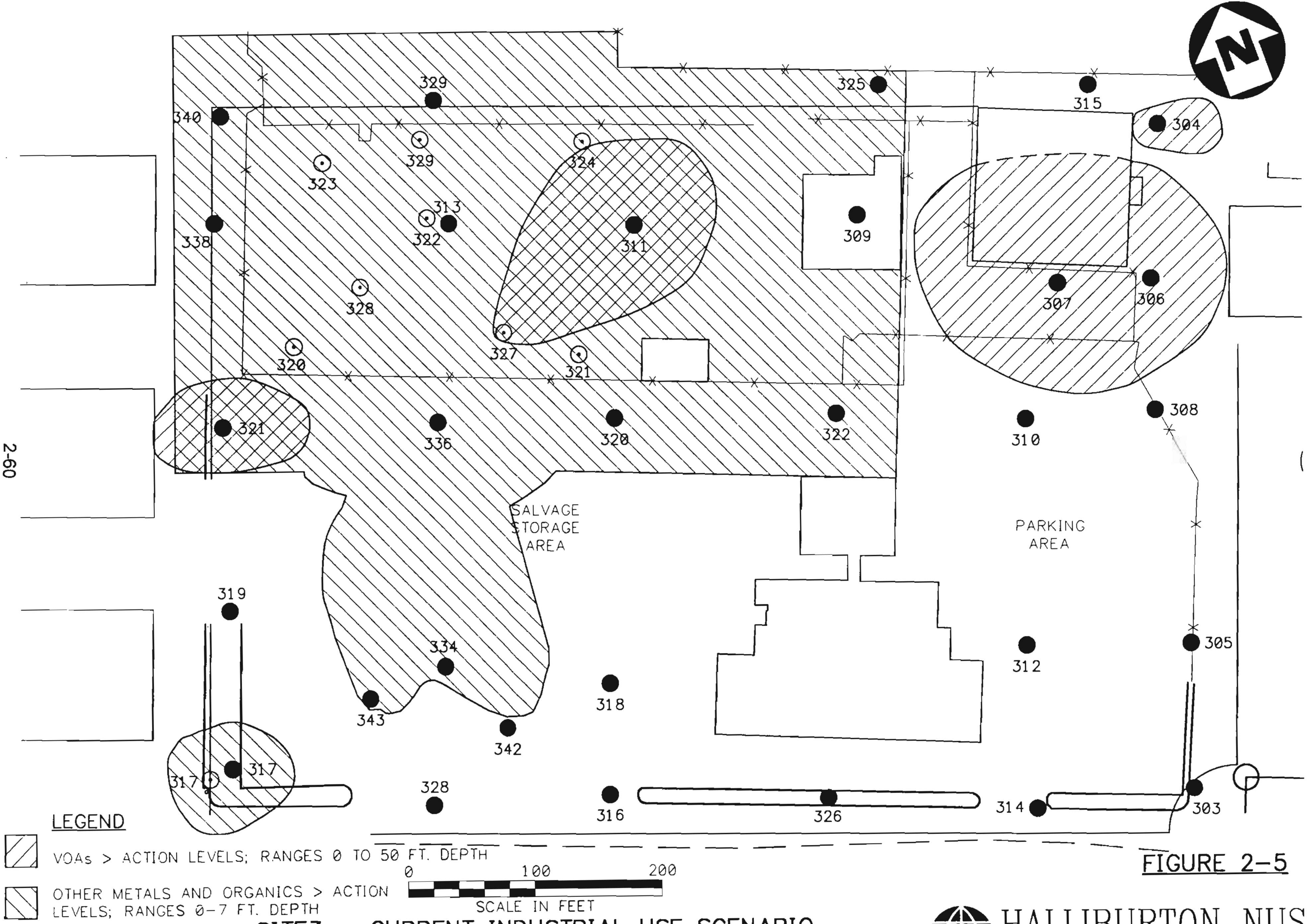


FIGURE 2-4

SITE 2 – FUTURE RESIDENTIAL USE SCENARIO
NWIRP, BETHPAGE, NEW YORK

HALLIBURTON NUS
Environmental Corporation



LEGEND

▨ VOAs > ACTION LEVELS; RANGES 0 TO 50 FT. DEPTH

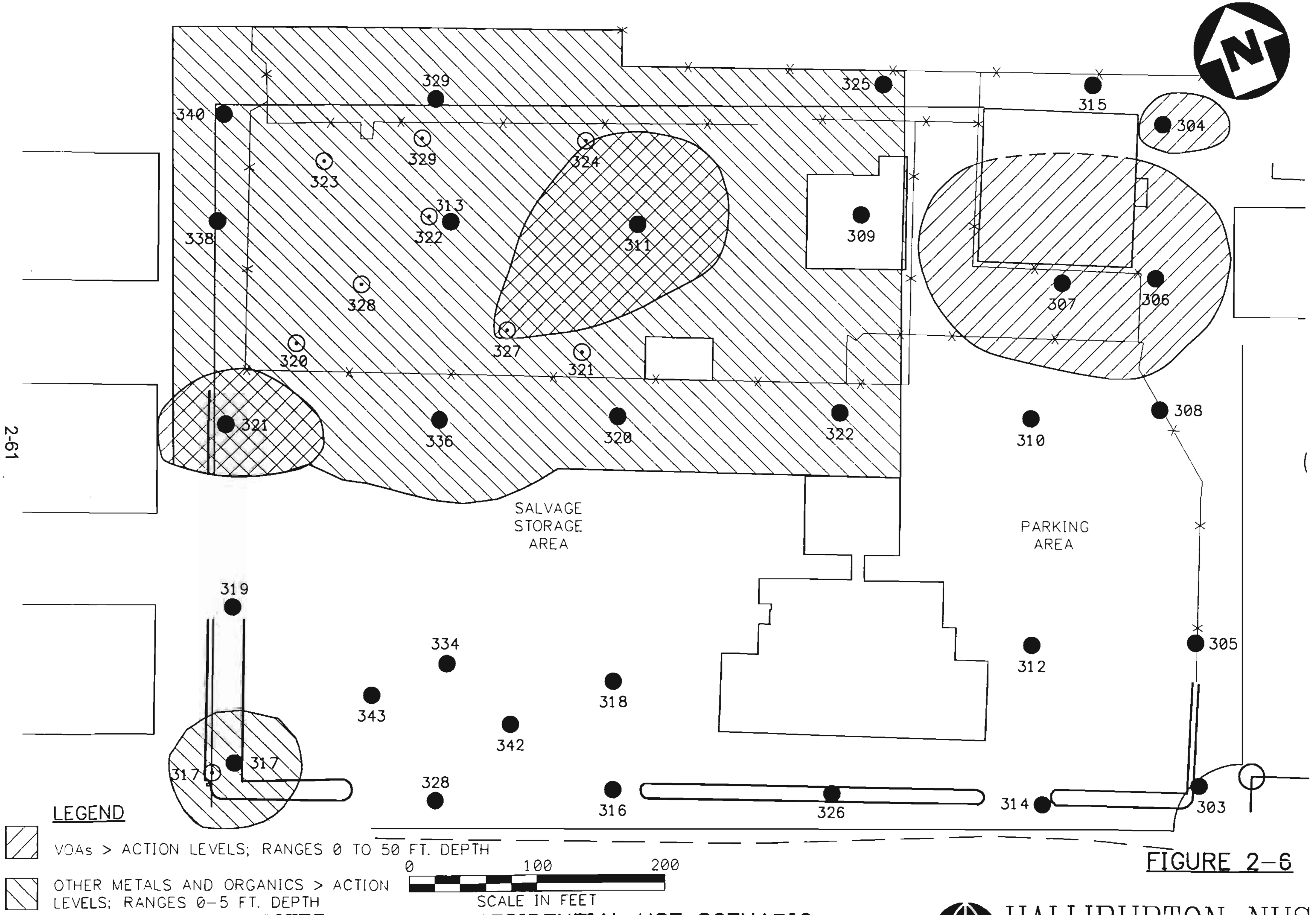
▨ OTHER METALS AND ORGANICS > ACTION LEVELS; RANGES 0-7 FT. DEPTH

FIGURE 2-5

SITE3 - CURRENT INDUSTRIAL USE SCENARIO
NWIRP, BETHPAGE, NEW YORK

HALLIBURTON NUS
Environmental Corporation

ACAD: 1953/SITE3.DWG 7/21/93 MB (PLOT2)



LEGEND

▨ VOAs > ACTION LEVELS; RANGES 0 TO 50 FT. DEPTH

▨ OTHER METALS AND ORGANICS > ACTION LEVELS; RANGES 0-5 FT. DEPTH

SITE3 - FUTURE RESIDENTIAL USE SCENARIO
NWIRP, BETHPAGE, NEW YORK

FIGURE 2-6

HALLIBURTON NUS
Environmental Corporation

2.3.1.2 General Response Actions

Using the general response actions developed for the NWIRP Bethpage, future sections will identify the types of technologies (e.g., thermal treatment) and process options (e.g., incineration, low temperature thermal stripping) associated with these technologies. These will be screened for technical implementability, and a representative process option will be selected for applicable and implementable technologies. The selected process options will then be assembled into remedial alternatives for soils at each site. Listed below are the seven general response actions that were identified for the NWIRP soils.

- No Action
- Institutional Controls
- Removal/Disposal
- Removal/Treatment/Disposal
- Containment
- In-Situ Treatment

2.3.2 Groundwater

2.3.2.1 Volumes for Treatment

Table 2-14 presents the volumes of contaminated groundwater. Refer to Appendix C for groundwater volume calculations. Figure 2-7 illustrates the calculated areal extent of the plume (as well as indicating proposed extraction well locations based on groundwater modeling). The onsite/near site groundwater area shown is based on actual monitoring well data while the offsite area shown is based primarily on computer modeling results with only limited monitoring well data. Appendix D presents groundwater computer modeling results. As shown in the Table 2-14, the bulk of contamination (85.9 percent) is contained in only a small percentage (6.1 percent) of the total groundwater volume. Note that the volumes/quantities presented are preliminary and may be modified based on additional testing that would be conducted during the Remedial Design/Remedial Action stage.

The basis for the estimates are summarized as follows.

- The areas presented are based on an overlap of the three-dimensional particle tracking results from the limiting cases developed during the computer model, as modified/ confirmed by groundwater testing.

- In the absence of, or modified by, other site-specific data, the concentration of a chemical in the groundwater at any point between two measured data points, (horizontally and vertically), is exponentially proportional to the distance.

TABLE 2-14

CONTAMINATED GROUNDWATER VOLUMES
NWIRP, BETHPAGE, NEW YORK

Layer (a)	Scenario	Onsite/Near Site Contamination >100 ug/l			Balance of Contamination (>5 and <100 ug/l)		
	Solvent Concentration	Volume GW (gal)	Soluble Solvents (lbs)	Total Solvents (lbs)	Volume GW (gal)	Soluble Solvents (lbs)	Total Solvents (lbs)
1	> 1000 ug/l	41,839,043	2,380	7,488			
	> 100 ug/l	260,640,600	507	1,338			
	< 100 ug/l				636,847,200	124	327
2	>10000 ug/l	70,686,000	15,454	37,309			
	> 1000 ug/l	56,406,800	3,275	8,879			
	> 100 ug/l	702,147,600	1,364	4,605			
	< 100 ug/l				3,696,092,400	969	2,889
3	> 100 ug/l	583,440,000	3,041	6,581			2,100
	< 100 ug/l				4,259,112,000	725	
4	> 100 ug/l (VC)	102,663,000	492	781			
	> 100 ug/l	334,917,000	575	1,423			
	< 100 ug/l				8,314,020,000	1,427	3,532
5	> 100 ug/l	207,704,640	99	172			
	< 100 ug/l				19,264,605,360	919	2,421
Total Individual System		2,361,000,000	27,200	68,576	36,171,000,000	4,200	11,300
Percentage of Total System		6.1%	86.6%	85.9%	93.9%	13.4%	14.1%

(a) For groundwater modeling purposes, the aquifer was divided into five layers, as follows:

Layer 1 - Thickness 50 feet (shallow depth)
Layer 2 - Thickness 100 feet (intermediate depth)
Layer 3 - Thickness 100 feet (deep depth)
Layer 4 - Thickness 150 feet (production well depth)
Layer 5 - Thickness 223 feet (production well depth)

(b) Note that the volumes/quantities presented are preliminary and may be modified based on additional testing that would be conducted during the Remedial Design/Remedial Action stage.

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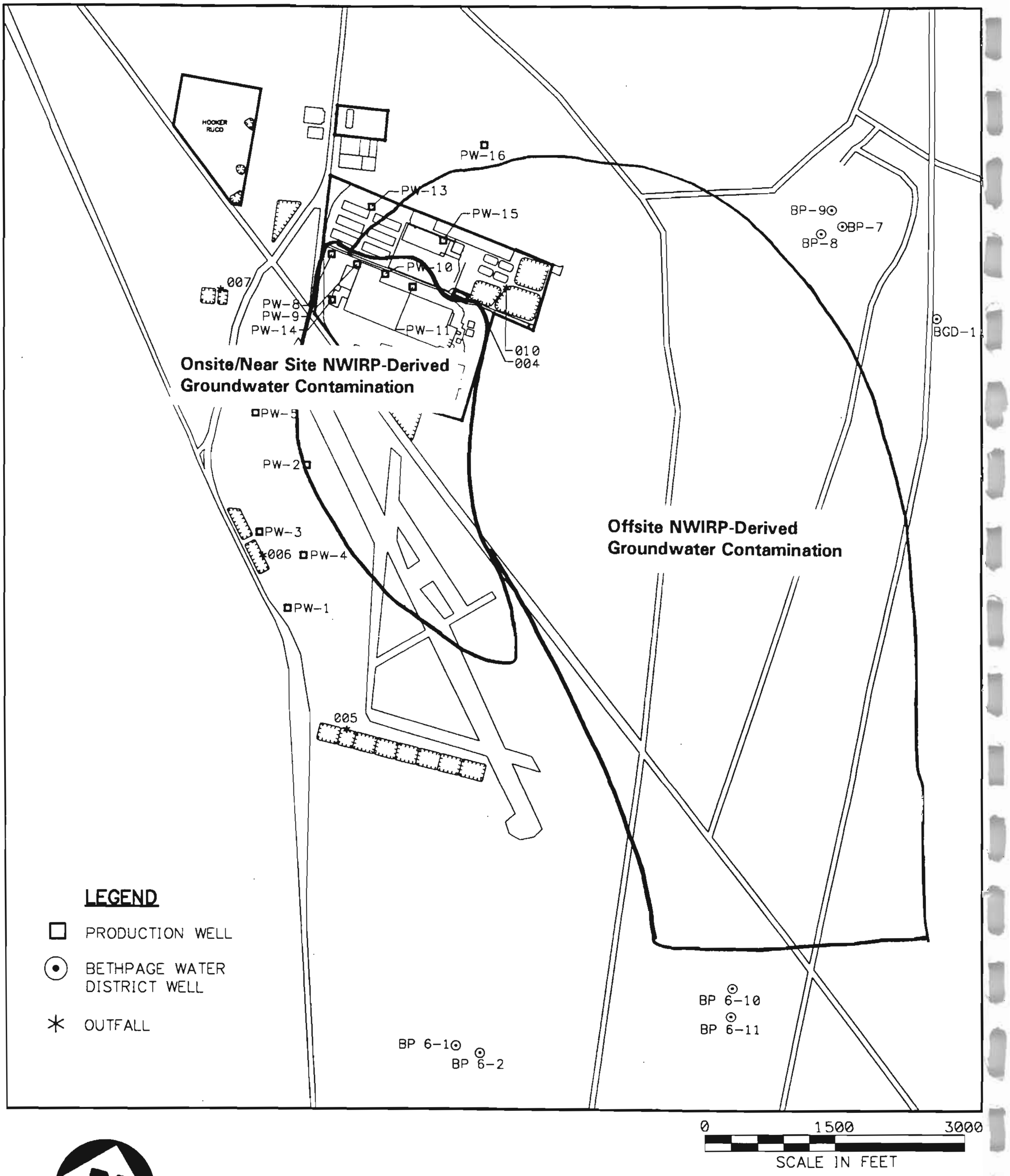

ESTIMATED AREAL EXTENT OF ONSITE/NEAR SITE AND OFFSITE NWIRP-DERIVED GROUNDWATER CONTAMINATION FEASIBILITY STUDY, NWIRP BETHPAGE, NEW YORK

FIGURE 2-7

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2.3.2.2 General Response Actions

Using the general response actions developed for the NWIRP Bethpage, future sections will identify the types of technologies (e.g., physical treatments) and process options (e.g., activated carbon adsorption, ambient-temperature air stripping, high-temperature steam stripping) associated with these technologies. These will be screened for technical implementability, and a representative process option will be selected for applicable and implementable technologies. The selected process options will then be assembled into remedial alternatives for overall groundwater. Listed below are the seven general response actions that were identified for the NWIRP onsite and near site groundwater.

- No Action
- Institutional Controls
- Containment
- Removal (Extraction)/Discharge
- Removal (Extraction)/Treatment/Discharge
- In-situ Treatment

2.4 IDENTIFICATION AND SCREENING OF TECHNOLOGIES AND PROCESS OPTIONS

2.4.1 Initial Identification and Screening of Technologies and Process Options

In this section, potential remedial technologies and process options are identified and screened according to their overall applicability (technical implementability) to the media (soils or groundwater), primary contaminants (volatile organics, metals, PCBs, other organics), and conditions present at the NWIRP facility (high yield aquifer and sandy soils). The purpose of this screening effort is to investigate all available technologies and process options and to eliminate those obviously not applicable for the site, based on the established remedial action objectives and general response actions of Sections 2.2 and 2.3, respectively.

Initial screening of soils technologies is presented in Table 2-15. Technologies which were eliminated from further consideration include those technologies applicable only to sediments/saturated soils (erosion control for stream channels, dredging, dewatering, sedimentation) or miscellaneous media (drum removal). Additionally eliminated were technologies not appropriate to the types of contaminants (biological treatment, detonation) or levels of site contamination (thermoplastic encapsulation, microencapsulation, clay pelletizing/sintering). Also eliminated were technologies not applicable to site conditions (fencing, enhanced removal for fractured bedrock, vertical barriers, crushing/grinding, screening, and neutralization).

Initial screening of groundwater technologies is presented in Table 2-16. Technologies which were eliminated from further consideration include those technologies applicable only to surface water (erosion control for stream channels). Several technologies were eliminated because typically used for higher concentration wastewater streams (extraction, evaporation, distillation, electrodialysis, electrolytic recovery,

TABLE 2-15

SOIL SCREENING OF TECHNOLOGIES/PROCESS OPTIONS (GENERAL APPLICABILITY)
NWIRP, BETHPAGE, NEW YORK

General Response Action	Technology	Process Options	Description	General Screening
No Action	No Action	No Action	No activities conducted at site to address contamination.	*(1)
Institutional Controls	Institutional Controls	Fencing	Barrier used to restrict site access.	x(2)
		Deed Restrictions	Administrative action used to restrict future site activities.	*
Containment	Capping	Capping	Use of impermeable or semipermeable materials to reduce the vertical migration of contaminants to groundwater.	*
	Vertical Barriers	Slurry Walls	Clay wall used to restrict horizontal migration of contaminants to groundwater.	x(3)
		Jet Grouting	Use of pressure-injected cement to restrict horizontal migration of contaminants to groundwater.	x(3)
	Erosion Control	Riprap Concrete	Use of large cobbles or concrete to control erosion of stream channels.	x(3)
Removal	Bulk Excavation	Bulk Excavation	Mechanical removal of solid materials using common construction equipment such as bulldozers and highlifts.	*
	Discrete Removal	Drum Removal	Mechanical removal of drums using common construction equipment such as a grappling arm.	x(4)
	Dredging	Clam Shell	Use of a mechanical clam shell to remove sediments or saturated soils.	x(5)
	Enhanced Removal	Enhanced Removal	Blasting or hydrofracturing of bedrock to promote access to groundwater in bedrock fractures.	x(6)

TABLE 2-15 (continued)
SOIL SCREENING OF TECHNOLOGIES/PROCESS OPTIONS (GENERAL APPLICABILITY)
NWIRP, BETHPAGE, NEW YORK
PAGE 2

General Response Action	Technology	Process Options	Description	General Screening
Disposal	Landfill	Hazardous/ Nonhazardous	Permanent disposal facility for solid waste, with variable degrees of capping and liners.	*
	Recycling/Salvage	Recycling/Salvage	Recycling of wastes or waste components instead of disposal.	x(7)
	Consolidation	Consolidation	Relocation of untreated soils and sediments on site.	*
	Beneficial Re-use	Fill Material	On site re-use of soils in which the contaminants have been removed.	*
Treatment	Fixation	Fixation	Immobilization of contaminants by mixing with cement lime, fly ash, kiln dust, iron, etc.	*
		Thermoplastic Microencapsulation	Enclosure of wastes by mixing with thermoplastics, polymers, or asphalt.	x(8)
		Microencapsulation	Enclosures of wastes by containers, inert coatings, or jackets.	x(8)
		Clay Pelletizing/ Sintering	Enclosure of wastes by mixing with clay, followed by sintering.	x(9)
	Physical	Extraction	Separation of contaminants from a medium by contact with an immiscible liquid with a higher affinity for the contaminants of concern.	*
		Dewatering	Mechanical removal of free water from wastes using equipment such as a filter press or a vacuum filter.	x(5)
		Sedimentation	Gravity settling of suspended solids from water in a vessel.	x(5)
		Detonation	Detoxification of explosive waste by setting off a charge.	x(10)

TABLE 2-15 (continued)
SOIL SCREENING OF TECHNOLOGIES/PROCESS OPTIONS (GENERAL APPLICABILITY)
NWIRP, BETHPAGE, NEW YORK
PAGE 3

General Response Action	Technology	Process Options	Description	General Screening
Treatment (continued)	Thermal	Incineration	Volatilization and oxidation of organics via conveyance through high temperature.	*
		Pyrolysis	Volatilization of organics at high temperatures in the absence of oxygen.	*
		Low Temperature Thermal Stripping	Use of moderate temperatures (150-800 degrees F) to volatilize organics.	*
		Vitrification (ex-situ)	Melting of materials to glassify metals and volatilize/pyrolyze organics.	*
	Biological	Aerobic	Suspended growth or fixed film process employing aeration and biomass recycle to decompose organic components.	x(11)
		Aerobic/Anaerobic	Suspended growth facultative process in pond or basin employing long detention times and aerobic / anaerobic biomass to decompose organic contaminants.	x(11)
		Anaerobic	Suspended growth or fixed film process employing anaerobic biomass to decompose organic contaminants.	x(11)
	Solids Processing	Crushing/Grinding	Use of crushing or grinding to reduce the size of an object.	x(12)
		Magnetic Separation	Separation of tramp metal.	x(13)
		Screening	Separation of a material into fractions of the same size by passing through screens or mesh.	x(12)

TABLE 2-15 (continued)
SOIL SCREENING OF TECHNOLOGIES/PROCESS OPTIONS (GENERAL APPLICABILITY)
NWIRP, BETHPAGE, NEW YORK
PAGE 4

General Response Action	Technology	Process Options	Description	General Screening
Treatment (continued)	Chemical	Oxidation	Use of strong oxidizers such as ozone, peroxide, chlorine, or permanganate to chemically oxidize materials. Oxidation may also be accomplished through the use of high temperatures, pressures, and air.	*
		Neutralization	Use of acids or bases to counteract excessive pHs.	x(14)
		Dechlorination	Use of chemicals to remove chlorine from chlorinated compounds.	*
In-Situ Treatment	Thermal	Vitrification	Melting of solids using electrically generated heat to glassify metals and pyrolyze/combust organics in unexcavated materials.	*
		Radio Frequency Heating	Use of radio waves to heat and volatilize contaminants in unexcavated wastes.	*
	Chemical/Physical	Soil Washing	Flushing of contaminants using an injection / extraction well system and above-ground treatment system.	*
	Physical	Vapor Extraction	Extraction of air containing volatile organic components from unexcavated soils via an induced vacuum created by an injection / extraction well system.	*
		Fixation	Pressure injection of cement / pozzolanic materials to form an impermeable solid.	*
	Biological	Sub-surface Reclamation	Enhancement of in-place biodegradation by addition of nutrients and control of environment.	x(11)

* Potentially applicable
x Not applicable

TABLE 2-15 (continued)
SOIL SCREENING OF TECHNOLOGIES/PROCESS OPTIONS (GENERAL APPLICABILITY)
NWIRP, BETHPAGE, NEW YORK
PAGE 5

(1) No action retained for baseline comparison purposes.

(2) Fencing is already in place at the site and would not prevent migration of/access to contaminants.

(3) Aquifer is too deep to implement an effective vertical barrier or permeable trench. Unrestricted groundwater flow exists to a depth of several hundred feet.

(4) No drummed wastes are a part of the contaminated soil/sediment medium.

(5) Sediments are not being addressed in this FS since recharge basin sediment is periodically removed by Grumman. Additionally, soils excavation is not planned for saturated soils.

(6) Aquifer is sufficiently permeable so as not to require enhanced removal.

(7) Insufficient quantities of VOCs expected to be generated for recycling purposes.

(8) These technologies are typically utilized for high hazard/high concentration wastes.

(9) Typically used for volatile metals remediation, which is not the primary site problem.

(10) Wastes are not explosive.

(11) Primary contaminants (chlorinated aliphatics and toxic metals) are not readily amenable to biodegradation. For the anaerobic biodegradation process, vinyl chloride, which is more toxic than the parent compound, is the apparent end product.

(12) No oversized objects are present in the unconfined sand and sediments above bedrock.

(13) The soils/sediments contain no recyclable materials.

(14) pH adjustment is not required.

TABLE 2-16

GROUNDWATER SCREENING OF TECHNOLOGIES/PROCESS OPTIONS (GENERAL APPLICABILITY) NWIRP BETHPAGE, NEW YORK

General Response Action	Technology	Process Options	Description	General Screening
No Action	No Action	No Action	No activities conducted at site to address contamination.	*(1)
Institutional Controls	Institutional Controls	Fencing	Barrier used to restrict site access.	x(2)
		Deed Restrictions	Administrative action used to restrict future site activities.	*
		Monitoring	Sampling and analysis of media to assess contaminant migration.	*
		Alternative Water Supply	Replacement of contaminated groundwater source with alternative water supply for end user.	x(3)
Containment	Capping	Capping	Use of impermeable or semipermeable materials to reduce the vertical migration of contaminants to groundwater.	*
	Vertical Barriers	Slurry Walls	Clay wall used to restrict horizontal migration of contaminants to groundwater.	x(4)
		Jet Grouting	Use of pressure-injected cement to restrict horizontal migration of contaminants to groundwater.	x(4)
	Erosion Control	Riprap Concrete	Use of large cobbles or concrete to control erosion of stream channels.	x(5)
Removal	Extraction	Extraction Wells	Discrete pumping wells used to remove contaminated water.	*
		Collection Trench	A permeable trench used to intercept and collect groundwater.	x(4)
	Enhanced Removal	Enhanced Removal	Blasting or hydrofracturing of bedrock to promote access to groundwater in bedrock fractures.	x(6)
Disposal	Beneficial Re-use	Process Water / Potable Water	On site re-use of groundwaters in which the contaminants have been removed.	*

TABLE 2-16 (continued)
GROUNDWATER SCREENING OF TECHNOLOGIES/PROCESS OPTIONS (GENERAL APPLICABILITY)
NWIRP, BETHPAGE, NEW YORK
PAGE 2

General Response Action	Technology	Process Options	Description	General Screening
Disposal (continued)	Surface Discharge	Direct Discharge (NPDES)	Discharge of collected / treated water to a local surface water.	x(7)
		Indirect Discharge (POTW)	Discharge of collected / treated water to a publicly owned treatment works.	*
		Offsite Treatment Facility	Treatment and disposal of hazardous or nonhazardous materials at permitted offsite facilities.	x(8)
	Subsurface Discharge	Reinjection	Use of reinjection, spray irrigation, or infiltration to discharge collected / treated groundwater to underground.	*
Treatment	Physical	Extraction	Separation of contaminants from a solution by contact with an immiscible liquid with a higher affinity for the contaminants of concern.	x(9)
		Dewatering	Mechanical removal of free water from wastes using equipment such as a filter press or a vacuum filter.	*
		Sedimentation	Gravity settling of suspended solids from water in a vessel.	*
		Detonation	Detoxification of explosive waste by setting off a charge.	x(10)
		Equalization	Dampening of flow and/or contaminant concentration variation in a large vessel to promote constant discharge rate and water quality.	*
		Filtration	Separation of materials from water via entrapment in a bed or membrane separation.	*
		Flotation	Separation of oils and suspended solids less dense than water by flotation methods.	x(11)

TABLE 2-16 (continued)
GROUNDWATER SCREENING OF TECHNOLOGIES/PROCESS OPTIONS (GENERAL APPLICABILITY)
NWIRP, BETHPAGE, NEW YORK
PAGE 3

General Response Action	Technology	Process Options	Description	General Screening
Treatment (continued)	Physical (continued)	Reverse Osmosis	Use of high pressure and membranes to separate dissolved materials, including organics and inorganics from water.	*
		Volatilization	Contact of contaminated water with air to remove volatile compounds. Air stripping or steam stripping methods are typically employed.	*
		Adsorption	Adsorption of contaminants onto activated carbon, resins, or activated alumina.	*
		Evaporation	Change from the liquid to the gaseous state at a temperature below the boiling point.	x(9)
		Distillation	Vaporization of a liquid followed by condensation of the vapors by cooling.	x(9)
		Electrodialysis	Recovery of anions or cations using special membranes under the influence of an electrical current.	x(9)
	Biological	Aerobic	Suspended growth or fixed film process employing aeration and biomass recycle to decompose organic components.	x(12)
		Aerobic/Anaerobic	Suspended growth facultative process in pond or basin employing long detention times and aerobic / anaerobic biomass to decompose organic contaminants.	x(12)
		Anaerobic	Suspended growth or fixed film process employing anaerobic biomass to decompose organic contaminants.	x(12)
	Chemical	Ion Exchange	Process in which ions, held by electrostatic forces, to charged functional groups on the ion exchange resin surface, are exchanged for ions of similar charge in a water stream.	*

TABLE 2-16 (continued)
GROUNDWATER SCREENING OF TECHNOLOGIES/PROCESS OPTIONS (GENERAL APPLICABILITY)
NWIRP, BETHPAGE, NEW YORK
PAGE 4

General Response Action	Technology	Process Options	Description	General Screening
Treatment (continued)	Chemical (continued)	Electrolytic Recovery	Passage of an electric current through a solution with resultant ion recovery on positive and negative electrodes.	x(9)
		Enhanced Oxidation	Use of strong oxidizers such as ultraviolet light, ozone, peroxide, chlorine, or permanganate to chemically oxidize materials. Typically hydrogen peroxide (and/or ozone) with UV light is utilized for groundwater remediation. Oxidation may also be accomplished through the use of high temperatures, pressures, and air.	*
		Reduction	Use of strong reducers such as sulfur dioxide, sulfite, or ferrous iron to chemically reduce the oxidation state of materials.	*
		Neutralization	Use of acids or bases to counteract excessive pHs or to adjust pH to optimum for a given technology.	*
		Dechlorination	Use of chemicals to remove chlorine from chlorinated compounds.	x(9)
		Flocculation / Coagulation	Use of chemicals to neutralize surface charges and promote attraction of colloidal particles to facilitate settling.	*
		Precipitation	Use of reagents to convert soluble materials into insoluble materials.	*
In-Situ Treatment	Chemical/Physical	Soil Flushing	Flushing of contaminants using an injection / extraction well system and above-ground treatment system.	*
	Biological	Subsurface Reclamation	Enhancement of in-place biodegradation by addition of nutrients and control of environment.	x(12)

* Potentially applicable

x Not applicable

TABLE 2-16 (continued)
GROUNDWATER SCREENING OF TECHNOLOGIES/PROCESS OPTIONS (GENERAL APPLICABILITY)
NWIRP, BETHPAGE, NEW YORK
PAGE 5

(1) No action retained for baseline comparison purposes.

(2) Fencing is already in place at the site and would not prevent migration of/access to groundwater contaminants.

(3) Deleted based on large volume users and lack of another potable water source.
(4) Aquifer is too deep to implement an effective vertical barrier or permeable trench. Unrestricted groundwater flow exists to a depth of several hundred feet.

(5) Sediments are not being addressed in this FS since recharge basin sediment is periodically removed by Grumman.

(6) Aquifer is sufficiently permeable so as not to require enhanced removal.

(7) There are no local surface waters for discharge purposes.

(8) Volume of contaminated groundwater is too large to effectively transport and treat off site.

(9) These technologies are typically utilized for high concentration wastewater streams and are rarely utilized for groundwater remediation.

(10) Wastes are not explosive.

(11) No floating products are located in the groundwater.

(12) Primary contaminants (chlorinated aliphatics and toxic metals) are not readily amenable to biodegradation. For the anaerobic biodegradation process, vinyl chloride, which is more toxic than the parent compounds, is the apparent end product.

dechlorination) or because not applicable to site contaminants (detonation, flotation, biological treatment). Also eliminated were those technologies not applicable to site conditions primarily due to large extent of the contaminated plume or the aquifer type/depth (fencing, enhanced removal, vertical barriers, collection trenches). Surface discharge was eliminated since no streams or rivers exist nearby the facility. Discharge of untreated groundwater to an offsite treatment facility is not an option due to the large volumes anticipated.

2.4.2 Summary of Initial Technology Screening

The retained technologies and process options based on general applicability are listed on Tables 2-17 for soils and Table 2-18 for groundwater. This list is organized in terms of media and serves as a starting point for the upcoming screening (refer to Sections 2.4.4 and 2.4.5) which is based on effectiveness, implementability, and cost.

2.4.3 Evaluation Criteria

The evaluation of technologies utilizes three criteria; effectiveness, implementability, and relative cost. The Interim Final RI/FS Guidance Document suggests that this evaluation focus on the effectiveness criterion, with less emphasis directed at the implementability and relative cost criteria.

Brief definitions of effectiveness, implementability, and relative cost, as they apply to the screening process, follow.

Effectiveness - This criterion focuses on the potential effectiveness of process options in handling the estimated volume of media and meeting the remediation goals; the potential impacts to human health and the environment during construction and implementation; and how proven and reliable the process is with respect to the contaminants and conditions at the site.

Implementability - The implementability evaluation encompasses both technical and institutional feasibility of implementing a process. Technical implementability was used in Section 2.4.1 as an initial screen of technology types and process options, to eliminate those that are clearly ineffective or unworkable at a site. Therefore, this subsequent, more detailed evaluation of process options places greater emphasis on the institutional aspects of implementability, such as the ability to obtain permits, availability of treatment, storage, and disposal services, and availability of necessary equipment and resources.

Cost - Cost plays a limited role in this screening. The cost analysis is based on engineering judgment, and each process is evaluated as to whether costs are high, low, or medium relative to the other options in the same technology type. If there is only one process option, costs are compared to other candidate technologies.

One representative process option is selected, if possible, for each technology type, to simplify the subsequent development and evaluation of alternatives without limiting flexibility during remedial design.

TABLE 2-17

TECHNOLOGIES AND PROCESS OPTIONS PASSING PRELIMINARY SCREENING
GENERAL SITE SOILS
NWIRP, BETHPAGE, NEW YORK

GENERAL RESPONSE ACTION COMPONENTS	TECHNOLOGY	PROCESS OPTION
No Action	No Action	o No Action
Institutional Controls	Institutional Controls	o Deed Restrictions
Containment	Capping	o Capping
Removal	Bulk Excavation	o Bulk Excavation
Disposal	Landfill	o Hazardous / Non-Hazardous
	Consolidation	o Consolidation
	Beneficial Re-use	o Fill Material
Treatment	Physical	o Fixation o Extraction
	Thermal	o Incineration o Pyrolysis o Low Temperature Thermal Stripping o Vitrification (ex-situ)
	Chemical	o Oxidation o Dechlorination
In-Situ Treatment	Physical	o Fixation o Vapor Extraction
	Thermal	o Vitrification o Radio Frequency Heating
	Chemical/Physical	o Soil Washing

TABLE 2-18

TECHNOLOGIES AND PROCESS OPTIONS PASSING PRELIMINARY SCREENING
GENERAL SITE GROUNDWATER
NWIRP BETHPAGE, NEW YORK

GENERAL RESPONSE ACTION COMPONENTS	TECHNOLOGY	PROCESS OPTION
No Action	No Action	o No Action
Institutional Controls	Institutional Controls	o Deed Restrictions o Monitoring
Containment	Capping	o Capping
Removal	Extraction	o Extraction Wells
Disposal	Surface Discharge	o Indirect Discharge (POTW)
	Subsurface Discharge	o Reinjection
	Beneficial Re-use	o Process Water/Potable Water
Treatment	Physical	o Dewatering o Sedimentation o Equalization o Filtration o Reverse Osmosis o Volatilization o Adsorption
	Chemical	o Ion Exchange o Enhanced Oxidation o Reduction o Neutralization o Flocculation/Coagulation o Precipitation
In-Situ Treatment	Chemical / Physical	o Soil Flushing

2.4.4 Identification and Screening of Technologies and Process Options-Soil

During the screening process, the technologies and process options presented are broken down into seven components of the General Response (Remedial) Actions as follows:

- No Action
- Institutional Controls
- Removal
- Containment
- In-Situ Treatment
- Treatment
- Disposal

After screening, those components of the General Response Actions which are still remaining are then recombined to form Alternatives. Detailed analysis of Alternatives is conducted in Section 4.0.

2.4.4.1 No Action

The no action scenario is considered to provide a baseline level to which other remedial technologies and alternatives can be compared. Under this scenario, no removal or treatment of the contaminants in the soils would occur.

Effectiveness. The no-action option would not achieve any of the remediation objectives. Excess Carcinogenic Risks (ECR) to onsite workers and future residents would remain at levels greater than 10^{-6}. It would not provide long term protection for uncontaminated groundwater since the contaminants in the soils would continue to migrate into the groundwater. Because contaminated soils would remain on site, 5-year site reviews would be conducted to evaluate the contamination of the site. Other effectiveness criteria are not applicable for the no action scenario.

Implementability. There are no implementability considerations associated with the no-action scenario.

Cost. Because no action would be taken at the site, capital and O&M costs would be negligible.

Conclusion. Retain no action as a baseline as required by CERCLA.

2.4.4.2 Institutional Controls

Deed Restrictions

Deed restrictions are institutional controls that are placed on property deeds. These restrictions may limit future activities, such as placement of new wells or certain types of construction.

Effectiveness. Deed restrictions could be applied to the contaminated soils, since only administrative action would be required. No additional risks to human health and the environment would directly result from the imposition of deed restrictions. Deed restrictions could ensure that future uses in all areas of the contaminated soils would be restricted. However, these restrictions have not proven to be very reliable, are difficult to enforce, and would not address the restoration and migration components of the remedial objectives.

Implementability. Deed restrictions could be implemented by local authorities. Availability of TSD facilities, and the need for permits are not applicable to deed restrictions.

Cost. Because no action would be taken at the site, capital and O&M costs would be negligible.

Conclusion. Although this is not feasible as a stand alone technology at NWIRP Bethpage, this option may be used in conjunction with other technologies to restrict future use of the soils. If future uses of the facility include residential development, deed restrictions in the form of limitations on future well development and/or construction may be required.

2.4.4.3 Removal

Bulk Excavation

Bulk excavation involves the large scale removal of soil. Traditional excavation equipment such as backhoes, bulldozers, and highlifts are typically used. The excavated material could be loaded onto trucks and hauled off site to an approved treatment or disposal facility, or could be treated and/or relocated on site. Removal of contaminated soil beneath buildings would require demolition and removal of the buildings. Backfilling would require the use of clean fill from another area and/or the use of decontaminated soils to restore the site to its original state.

Effectiveness. Removal of the contaminated soil would be effective in handling the volume of media at the site. Excavation of contaminated soils would require the control of volatile organics and fugitive dust during construction to protect the community. Inadequate collection and treatment of fugitive emissions could result in adverse health and safety concerns for the residential area to the east of the site. This technology, combined with subsequent treatment and/or disposal, would be a permanent solution and attain the goals outlined in the remedial objectives. The quantities of material involved and the types of soils at the site are readily excavated.

Implementability. Excavation is readily implementable for shallow soils which are easily accessible. Where VOCs are present up to 50-foot depths at the site, excavation is possible but difficult and sheet piling will be required. Removal of contaminated soil from beneath the buildings will also be somewhat difficult to implement. Removal of contaminated soil around the buildings can be implemented but would involve some difficulties including interferences with underground utilities and the structural integrity of the buildings. Excavation would most likely be accomplished in a staged approach to minimize these adverse conditions. Excavation would be less of a problem in the future residential use scenario in which case the buildings could be razed. Contractors for this type of excavation are readily available, although shoring of building foundations and sheet piling activities would require some specialty in this area. The need for permits or TSD facilities should not be required for excavation.

Cost. The costs range from medium for soils around building structures to high for soils beneath the buildings and soils at depth.

Conclusion. Removal of contaminated soils via excavation is retained for further evaluation in conjunction with other process options, even though difficult to implement under buildings and at depth.

2.4.4.4 Containment

Capping

Capping involves the installation of a semi-permeable or impermeable barrier over the contaminated soils to restrict access and/or reduce infiltration of precipitation into the soils. Impermeable barriers should be considered where soil contamination threatens groundwater or surface water. Consolidation and/or regrading of isolated quantities of contaminated soils prior to capping may be required. Cap materials can either be natural or synthetic. Frequently used impermeable materials include low-permeability clays such as bentonite; cement; asphalt; and synthetic membranes such as high-density polyethylene (HDPE), polyvinyl chloride (PVC), and Hypalon. These materials can be covered with soil to protect them against weathering and erosion.

In addition to conventional capping techniques, developed to prevent direct contact and to minimize leaching of contaminants to groundwater, a simpler cover will be considered to address site contaminants that only present a direct contact risk. For the current industrial use scenario, the cover material could consist of approximately six inches of gravel while for the future residential use scenario, a 1-foot layer of soil with vegetation would be more appropriate.

Effectiveness. The amount of contaminated area at NWIRP Bethpage lends itself to capping technology. Impermeable capping is a reliable technology which would be effective in limiting the infiltration of water and subsequently the leaching of soil bound contaminants to groundwater. Capping would reduce risk to human health by providing a barrier between contaminated soils and potential receptors, thus significantly limiting fugitive dust emissions and dermal contact with contaminated soils. Capping does not address existing contamination, offering no decrease in contaminant levels. During remedial activities, fugitive dust emissions would have to be controlled to minimize effects on human health and the environment.

A gravel cover (industrial use) or vegetated soil cover (residential) will be effective in reducing the potential for direct contact, but will have limited effectiveness in preventing leaching of soil contaminants to groundwater.

Implementability. The construction of an impermeable cap is moderately implementable at NWIRP Bethpage. A variety of proven construction methods can be used, including soils, clay soils, man-made membranes/fabrics, asphalt, and combinations of the above. Some earthwork may be required to achieve proper slopes for surface water runoff control. Interferences with existing structures is a concern since conventional caps are approximately four feet in depth. The remedial action activities involving capping are relatively common and can be conducted by many contractors. No permits or other administrative requirements would be necessary. Because no offsite activities would be occurring, the need for TSD facilities is not a concern. However, deed restrictions are required in conjunction with capping in order to limit the future usage of the capped areas. A gravel cover (industrial use) or vegetated soil cover (residential) are each readily implementable.

Cost. The capital costs for conventional cap construction is expected to be moderate. Costs for a gravel or soil cover are low. O&M costs are low for both a conventional cap and a simple cover.

Conclusion. Although capping would not meet all of the remedial objectives, it would significantly reduce the migration of contaminants to the groundwater, as well as prevent direct contact risks, thereby meeting future groundwater objectives and minimizing risk to human health. As a result, clay capping will be retained as a process option where leaching to groundwater is a concern, and gravel/soil cover will be retained where the only risks are through direct contact.

2.4.4.5 In-Situ Treatment

The following in-situ treatment technologies and process options for contaminated site soils are evaluated in this section.

- Physical/Fixation
- Physical/Vapor Extraction
- Chemical-Physical/Soil Flushing
- Thermal/Vitrification
- Thermal/Radio Frequency Heating

Fixation

Chemical fixation refers to those techniques that reduce the hazard potential of a soil by converting the contaminants into less soluble, mobile, or toxic forms. The physical nature and handling characteristics of the material are not necessarily changed by fixation. Lime, iron, and/or cement are common chemicals used to stabilize metals present in soils.

Effectiveness. Fixation is a viable option for the contaminated soils and should be effective in immobilizing the arsenic and other metals exceeding hazardous waste criteria at the NWIRP Bethpage Site. It is generally not an effective process for controlling organic contaminant migration or mixtures of metals and organics. Iron-based methods using ferric sulfate have shown to be effective in immobilizing arsenic and are potentially applicable. Cement/lime based fixation on the other hand has shown to be effective in the immobilization of other metals. Specific test results on arsenic-contaminated soils from a Superfund Site in Pennsylvania are summarized as follows (NUS, 1990).

Test	Reagent	Reagent to Soil Ratio	TCLP Result (Arsenic - mg/l)
0	none	none	13.9
1	cement	1	0.36
2	cement	0.1	2.6
3	ferric sulfate/ lime	0.05	0.08
4	ferric sulfate/ line	0.1	0.14

These test results indicate that arsenic can be effectively immobilized in a soil matrix. However, in-situ fixation has not been demonstrated over the long term. In addition, the volume of site contaminated soil exceeding hazardous waste criteria is very low compared to the amounts typically considered for in-situ treatment processes. There are concerns about both the adequacy of in-situ methods in achieving a good soil/fixative mixture and the long term stability of the waste in a non-protected area outside of a landfill. Implementation should not cause any adverse effects on human health and the environment.

Implementability. Fixation is implementable. Since treatment is conducted onsite, potential constraints, such as the need for permits, establishing a TSD facility, and extensive monitoring of that facility could be significant issues. The equipment and resources necessary to fixate the soils onsite are available with several vendors capable of performing this work.

Cost. The relative capital and O&M costs are low for iron based methods and moderate for cement based methods.

Conclusion. In-situ fixation of the contaminated soils will be eliminated from consideration due to the effectiveness issues, concerning small volumes of site soils exceeding hazardous waste criteria for metals, and long term stability.

Vapor Extraction

In-situ vapor extraction is a well demonstrated technology for the removal of VOCs from the unsaturated region or vadose zone of soils. Vapor extraction uses an induced vacuum to pull air through the soil. This vacuum volatilizes and transports organic contaminants to a collection system. The air stream removes VOCs in the soil and, upon withdrawal, is treated with a technique appropriate for the specific contaminant. The recovery rate increases as the vapor pressure of the VOC increases. Treatment technologies may include carbon adsorption, combustion, or catalytic destruction. Vapor extraction technology can potentially treat soils beneath structures and around utility lines, and to soil depths beyond the practical limits of excavation. Although primarily applicable to soils above the groundwater, in-situ vacuum extraction can also be used to treat the fringe area where the groundwater table fluctuates. When operating in the fringe area and contacting groundwater, the system essentially sparges contaminants from the fringe groundwater.

Vapor extraction may also include air sparging. Air sparging is the injection of air into the groundwater. The injected air strips contaminants from the groundwater and carries them upward into the vadose zone soils. The maximum practical depth of air injection is normally limited by the discharge pressure of commercially available blowers (typically 10 to 12 psi), although higher pressure compressors can also be used.

Effectiveness. In-situ vapor extraction should be reliable and capable of effectively treating the majority of VOC contamination located at the NWIRP Bethpage site to remedial objective levels. This treatment technology is particularly well suited to the permeable soils and can easily handle the volumes required at this facility. Offgas treatment would be required to protect human health and the environment during operation. Due to interactions between contaminants in the groundwater and soils, removal of some contaminants from the groundwater would occur. Concurrent groundwater remediation is necessary to prevent groundwater contaminants from migrating back into the soils near the groundwater table fringe area. Vapor extraction would not address inorganic, semi-volatile organic, or pesticide/PCB contamination.

Implementability. This technology could be implemented for the soils surrounding and beneath the buildings at the NWIRP Bethpage complex. There are currently only a few vendors available for this technology, however the equipment necessary is readily available. Air Quality Permits will be required for the vacuum extraction while the disposal or regeneration of activated carbon used for air stream treatment will require a hazardous waste generator permit and the availability of a TSD facility. New York State Ambient Air Quality Standards should be attained when using this technology.

Cost. Capital and O&M costs are low to moderate.

Conclusion. Vapor extraction is a viable technology and should be retained for further consideration in treating VOCs. Inorganic, semi-volatile organic, and pesticide/PCB contamination is not addressed by this process option.

Soil Washing

Soil washing is an in-situ process which uses a closed loop recirculation system of injection and extraction wells to remove contaminants from the saturated and unsaturated soils. Under soil washing, water, with or without other additives, is sprayed onto or injected into the soils. Additives are used to increase the mobility of the contaminants. For organics removal, surfactants or alkalis are commonly used. For inorganics removal, acids, alkalis, oxidizers, reducing agents, and/or complexing agents are commonly used. Collection of the washing fluids is an important step. At the collection point, treatment systems such as air stripping or carbon adsorption are then utilized to separate the contaminants from the extracted water. The treated water is recirculated through the system by reinjection into the contaminated soil.

Effectiveness. In-situ soil washing should be effective in treating the various types of organic and inorganic contaminants at the site to remedial objective levels. However, several factors can limit its effectiveness. Of primary concern, it will be difficult to treat organics and inorganics simultaneously. Some other effectiveness concerns are the ability to contact all the soils, the ability to mobilize the contaminants, the ability to capture the mobilized contaminants, the ability to separate the contaminants from the lixiviant, and the ability to monitor compliance. For this site, the homogeneity of the soils makes the contaminated areas accessible. In-situ soil washing should be able to handle the volume of contaminated soils at the site. Groundwater level control may be required to treat saturated soils. Additionally, the burdened lixiviant would likely contain significant concentrations of contaminants in highly mobile forms; and thereby potentially result in significant risk to human health and the environment, if it is not completely captured.

Implementability. Since treatment is conducted onsite, potential constraints such as the need for permits for a TSD facility and extensive monitoring of that facility could be significant issues. Also, because contamination is extensive, this in-situ process would be difficult to control. In addition, the disposal or regeneration of activated carbon, used to separate contaminants from the extracted water, may require a hazardous waste generator permit and the availability of an outside TSD facility. The availability of equipment and resources to conduct this work are somewhat limited.

Cost. The capital and O&M costs are moderate.

Conclusion. Due to several effectiveness and implementability concerns, including potential risk to human health, in-situ soil washing will be eliminated from further consideration as a process option.

Vitrification

In-situ vitrification is an in-place technology that immobilizes soil contaminants by converting the contaminated organic and inorganic waste to a chemically inert, stable, glass product. In-situ vitrification is conducted by applying energy through electrodes inserted around the area to be melted. (The electrodes are placed by drilling or other appropriate methods.) Graphite is placed on top of the waste material to connect the electrodes and to act as a "starter" in melting the soil. The molten zone grows downward as the energy is applied, encompassing the contaminated material and producing a vitreous mass. Organics are either pyrolyzed in the subsurface or volatilized and treated by an off-gas system. Inorganics are either volatilized and captured in an off-gas system or trapped in the molten material. When the power is turned off, the molten material cools. The final product is a glass-like material resembling natural obsidian.

Typically, an 18-foot by 18-foot grid is used. The depth of in-situ vitrification is site-specific. Optimum operating depths for vitrification are about 12 to 20 feet. The volume of the final mass is about 10 to 30 percent less than the original soil volume, due to elimination of the voids in the soil. Soil is then placed on the area to restore the site to its original contours. The hood and electrodes are then moved to the next grid to repeat the process. The temperatures employed in the process (normally 3,000°F) equal or exceed those used in incinerators. Gravel drainage systems may be provided to promote groundwater flow around the impermeable treated mass.

Effectiveness. The vitrification process would be capable of handling only a portion of contaminated soils near the surface. Using this process, inorganic contaminants would be immobilized while organic contaminants would be destroyed to below remedial objective levels. Human health and environmental concerns include potential risks resulting from volatilization of arsenic, TCE, PCE, and 1,1,1 TCA. Except for the problem in addressing contaminated soils at depth, vitrification should be reliable with respect to the site contaminants and conditions.

Implementability. In-situ vitrification could be implemented for the soils surrounding the buildings, but not for the soils underneath the buildings. Implementation for either area would be very difficult due to the use of high temperatures near occupied structures, interferences with underground utilities, and potential health and safety risks associated with air emissions from the volatilized contaminants. Since treatment is conducted on site, New York State ambient air quality standards would have to be met and an associated permit obtained. Availability of offsite TSD facilities would not be applicable. The equipment and resources necessary to vitrify the soils on site are available, and several vendors are capable of performing this work. However, the capacity of these vendors' units is typically low.

Cost. The relative capital and O&M costs are high.

Conclusion. Onsite vitrification has questionable effectiveness at depths greater than twenty feet, is not implementable, and costs are prohibitive. Therefore, in-situ vitrification is not retained for further consideration.

Radio Frequency Heating

The radio frequency process involves the placement of electrodes along the ground surface. The soil medium adsorbs the electromagnetic energy produced by these electrodes. As the energy is adsorbed, it is converted to heat as a result of dipole rotation and molecular vibration. The organics in the soils are then destroyed or mobilized by vaporization, thermal decomposition, or distillation. A containment and recovery barrier is placed above the heated area to collect the emitted gases and vapors, which require treatment prior to release to the atmosphere. Operating temperatures range from 190 to 280 degrees Fahrenheit.

This method is especially suited for soils contaminated with volatiles or easily decomposed organic compounds. Contaminants with high boiling points and low vapor pressures, such as high molecular weight PAHs and PCBs, may need a reagent to react with the contaminant before it will work. Contamination in the soil can be treated to depths of approximately 20 feet. Once collected, air emissions from this process will require separation of gases and liquids that have condensed from vapors. The gases can be sent through an activated carbon treatment unit, while the liquids can be sent off site for incineration.

Effectiveness. In-situ radio frequency extraction is a relatively new process which is capable of treating shallow sub-soils to levels that would meet the remediation goals identified in the remedial objectives for VOCs. However, if the depth of contamination is greater than 20 feet, this process may not completely detoxify the contaminants, thereby allowing them to migrate. In addition, soils beneath buildings could not be treated by this technology. Radio frequency extraction should be applicable to the VOC contaminants and volumes at NWIRP Bethpage. However, inability to collect volatilized vapors may adversely affect the protection of human health and the environment. Radio frequency heating would not address inorganic, semi-volatile organic, or pesticide/PCB contamination.

Implementability. This technology could be implemented for the soils surrounding the buildings, but not for the soils underneath the buildings. Implementation for either area would be very difficult due to the use of high temperatures near occupied structures, interferences with underground utilities, and potential health and safety risks associated with air emissions from the volatilized contaminants. This treatment technique does not require excavating, staging, or storing of the waste material; however, because treatment is conducted on site and vapors may be emitted, a New York State Ambient Air Quality Permit would have to be obtained and emissions standards would have to be met. In addition, the disposal or regeneration of activated carbon used for vapor stream treatment may require a hazardous waste generator permit and the availability of an offsite TSD facility. There are currently only a few vendors capable of performing this work.

Cost. The capital costs are high and O&M costs are moderate.

Conclusion. In-situ radio frequency heating of the contaminated soil has questionable effectiveness at depths greater than twenty feet and is not implementable. Therefore radio frequency heating will not be retained for further consideration.

2.4.4.6 Treatment

The following treatment technologies and process options for contaminated site soils are evaluated in this section.

- Physical/Fixation
- Physical/Extraction
- Thermal/Incineration
- Thermal/Pyrolysis
- Thermal/Low Temperature Thermal Stripping
- Thermal/Vitrification

- Chemical/Oxidation
- Chemical/Dechlorination

Fixation

Chemical fixation refers to those techniques that reduce the hazard potential of a soil by converting the contaminants into less soluble, mobile, or toxic forms. The physical nature and handling characteristics of the material are not necessarily changed by fixation. Lime, iron and/or cement are common chemicals used to stabilize metals present in soils.

Effectiveness. Fixation is a viable option for only a small portion of the contaminated soils and should be effective in immobilizing the arsenic and other metals exceeding hazardous waste criteria at the NWIRP Bethpage Site. It is generally not effective in the immobilization of VOCs, semi-volatile organics, or pesticides/PCBs. Iron-based methods using ferric sulfate have been found to be effective at immobilizing arsenic, while cement and lime based methods have been effective at immobilizing other metals, (refer to Section 2.4.4.5 for fixation results). Ex-situ fixation should be capable of handling the volume of contaminated soils at NWIRP Bethpage. Implementation should not cause any adverse effects on human health and the environment.

Implementability. Fixation is implementable. If treatment is conducted onsite, potential constraints, such as the need for permits and permitted facility (TSD) availability, would be significant concerns. Offsite treatment, is more readily implementable. If the treatment is conducted offsite, there are very few existing fixation facilities currently operating that would be able to treat this waste. In addition, transportation and treatment permits would be required. The equipment and resources necessary to fixate the soils onsite are readily available with several vendors capable of performing this work.

Cost. The relative capital and O&M costs are low for iron-based methods and medium for cement-based methods. Based on the low volumes of targeted site contaminated soils, costs for offsite treatment will be much lower than for onsite treatment.

Conclusion. Ex-situ iron-based fixation of the contaminated soils should be effective and implementable, and should be more cost effective than cement-based fixation. As a result it is selected as the representative fixation process option. Both onsite and offsite treatment options have been retained for further consideration.

Physical Extraction (Soil Washing)

Contaminants adsorbed on soil or sediment can be desorbed by solvent extraction or soil washing processes through the application of hydraulic forces and physicochemical reactions. The passage of a liquid through the excavated soil can scrub and/or dissolve the soluble contaminants and entrain these dissolved contaminants in the liquid. The liquid may be composed of water, water with surfactants, carbon dioxide, triethylamine and other organic solvents, water/chelating agents, and acids or bases, depending on the contaminants that need to be removed. Water-based extraction, which may be applicable for metals removal, is often referred to as soil washing. Non-water-based extraction, which may be applicable to organic contaminant removal, is referred to as solvent extraction.

Extraction or soil washing, is an external process in which excavated soils are fed into a contactor or washing unit. Typical contactors include countercurrent extraction equipment, a pug mill, or a truck loaded cement mixer. After contact, solvent with contaminants is removed from soil by methods such as centrifugation or filtration. Contaminants are then removed from the solvent via the appropriate treatment systems.

Effectiveness. The volume and grain size of the contaminated soils at NWIRP Bethpage is within the range in which extraction or soil washing is viable. With proper controls, minimal risks to human health and the environment would be expected to result from this process. Volatilization during excavation is the primary concern. Extraction should be effective in achieving the remediation goals for metals, PCBs, PAHs, VOCs, and other organics by varying the extraction liquid and thus removing the contaminants of concern from the soils. A successful extraction scheme would effectively reduce the volume of contaminated media. Concentrated residual streams will require further treatment prior to disposal.

Implementability. This technology first requires excavation of targeted soils. Excavation is readily implementable for accessible soils, but excavation will be more difficult for areas beneath buildings. Additionally, excavation of VOC-contaminated soils will be difficult; depths to 50 feet will require shoring/sheet piling. If treatment is conducted onsite, potential constraints, such as the need for permits for a TSD facility and monitoring of that facility are concerns. If the treatment is conducted offsite, transportation and treatment permits would be required. There are few, if any, offsite TSD facilities which would be able to accept and treat the large volume of site contaminated soils. This shortage effectively limits consideration of extraction technologies to onsite processes. The equipment and resources necessary to extract the soils onsite are available, and several vendors are capable of performing this work.

Cost. The relative capital and O&M costs are moderate.

Conclusion. This technology can be used in conjunction with other disposal process options such as landfilling and beneficial reuse as fill material, and will be retained for further consideration.

Incineration

Incineration is a thermal oxidation process that converts organic solids, liquids, and gases to inorganic substances at high temperatures in the presence of oxygen. The technology uses controlled flame combustion in an enclosed reactor to decompose organics. Carbon and hydrogen waste components are converted to carbon dioxide (CO_2) and water, respectively. Chlorine, if present, is mostly converted to hydrochloric acid (HCl). Other combustion products are also formed in smaller quantities and may include carbon monoxide, nitrogen oxides, and free chlorine and fluorine. Metals are not treated in incineration and may, in some situations, become more toxic due to a concentration effect. Incineration produces a solid stream from the incombustible portion of the original material, which is removed as bottom and fly ash, detoxified soil, and possibly other solid treatment residuals. If a wet scrubber air pollution control system is used, a liquid waste stream could also be generated. Depending on the original waste stream, process residuals/effluents may require further treatment and/or disposal. The rotary kiln incinerator is the most common and versatile type of incinerator which is capable of burning a broad range of hazardous gases, liquids, solids, and slurries. Other types of incinerators include the plasma arc pyrolysis, low temperature, and infrared incinerators.

Effectiveness. Incineration is a highly proven technology that is capable of handling the volume of organic contaminated soils and various treatment residues at NWIRP Bethpage. Incineration does not affect inorganic contamination. It is a common and relatively reliable means of treating organic wastes in general, and is the required technology for removal of PCBs from soils at concentrations greater than 500 ppm. Incineration should allow for the treated soils to be disposed of as non-hazardous material either onsite or offsite, and should also be capable of achieving the remediation goals as identified in the remedial objectives for organics. Air emissions from the incinerator must be monitored closely in order to protect human health and the environment.

Implementability. Onsite and offsite incineration are both implementable. The equipment and resources necessary to incinerate soils are available and several vendors are capable of performing this work. Whether treatment is conducted onsite or offsite, New York State Ambient Air Quality Standards would have to be met, and a RCRA incineration permit from the EPA or New York State would be necessary. If incineration is conducted onsite, these permits would be expected to be difficult to obtain due to the proximity of the community to this site and because PCBs are a site contaminant. RCRA permit regulations require a trial burn for onsite activities to demonstrate destruction and removal efficiency. The incineration permit regulates emissions of hydrogen chloride, nitric and sulfuric oxides, and particulates. It also requires monitoring for carbon monoxide. If incineration is conducted offsite, a transportation permit would have to be obtained.

Excavation is readily implementable for accessible soils, but excavation will be more difficult for areas beneath buildings. Additionally, excavation of VOC-contaminated soils will be difficult; depths to 50 feet will require shoring/sheet piling.

Costs. The relative capital and O&M costs are high for incineration.

Conclusion. Offsite incineration is a relatively effective and implementable option for destroying the high PCB concentrations present in the contaminated soils. Thus, offsite incineration is retained for further consideration. Due to the relatively small volumes of soils involving high PCB contamination, it is not practical to install an onsite incineration system. Onsite incineration for the majority of the contaminated soils (i.e., VOCs) may also not be implementable due to the proximity of the community.

Pyrolysis

Pyrolysis is a thermal process that differs from incineration in that combustion is performed under starved air conditions. Available air provides less than the stoichiometric oxygen requirements for complete combustion. The products of pyrolysis are generally combustible gases that can be used as fuel. Processes of this type include plasma arc pyrolysis, high-temperature fluid wall reactors, and low-temperature pyrolysis.

Effectiveness. The pyrolysis process could most likely handle the volume of contaminated soils, and should be capable of achieving the organic-related remediation goals. Pyrolysis does not affect inorganic contamination. Pyrolysis should allow for the treated soils to be disposed of as non-hazardous material either onsite or offsite, and should also be capable of achieving the remediation

goals as identified in the remedial objectives for organics. Air emissions from the pyrolytic furnace must be monitored closely in order to protect human health and the environment.

Implementability. Onsite and offsite pyrolysis are both implementable. Whether treatment is conducted on site or off site, New York State Ambient Air Quality Standards would have to be met, and a RCRA incineration permit from the EPA or New York State would be necessary. If pyrolysis is conducted onsite, these permits would be expected to be difficult to obtain due to the proximity of the community to this site. RCRA permit regulations require a trial burn for onsite activities to demonstrate destruction and removal efficiency. The pyrolysis permit regulates emissions of hydrogen chloride, nitric and sulfuric oxides, and particulates. It also requires monitoring for carbon monoxide. If pyrolysis is conducted offsite, a transportation permit would have to be obtained.

Excavation is readily implementable for accessible soils, but excavation will be more difficult for areas beneath buildings. Additionally, excavation of VOC-contaminated soils will be difficult; depths to 50 feet will require shoring/sheet piling.

Cost. The relative capital and O&M costs for pyrolysis are very high.

Conclusion. Onsite pyrolysis for the majority of the contaminated soils may not be implementable due to the proximity of the community. The cost for offsite pyrolysis is higher than for incineration. Therefore, pyrolysis will be eliminated from further consideration as a process option.

Low Temperature Thermal Stripping

Low-temperature thermal stripping is a thermal process that uses direct or indirect heating to thermally desorb or volatilize organic contaminants present in soils/sediments. The temperatures used are contaminant and matrix-specific, with a range of approximately 150°F to 800°F. Typically, contaminated soils are processed through an externally fired pug mill or rotary drum system equipped with heat transfer surfaces that are heated by circulating hot oil. An induced air flow conveys the desorbed organics through a secondary treatment system, such as a carbon adsorption unit, combustion afterburner, or a condenser unit. The air stream is then discharged through a stack. Low-temperature thermal stripping processes are generally more applicable to the removal of volatile organic compounds. Low-temperature thermal stripping is a well-demonstrated technology for industrial sludge and product drying applications, but its use for remediation of soils is less demonstrated.

Effectiveness. Low-Temperature Thermal Stripping (LTTS) should be capable of accommodating the volumes of contaminated soils at NWIRP Bethpage. LTTS may be expected to achieve some of the remediation goals and should be effective for the VOC contaminants. Inorganic and some organic contamination would not be addressed by using this technology. The effectiveness of LTTS is dependent primarily on the boiling point of the contaminant. For volatile organics such as PCE, TCE, and 1,1,1 TCA, with relatively low boiling points, nearly complete removal from the soils would be expected. A study conducted on a CERCLA surrogate soil indicated up to 99.9 percent removal of PCE at 550°F. The semivolatile organics present in some of the contaminated soils have much higher boiling points. Under the same study, greater than 97.3 percent of anthracene (BP=532°F) was removed.

Initial success has been shown for some less volatile organics such as PCB and PAHs. Full-scale/pilot-scale testing at one Superfund Site in Massachusetts obtained the following data.

Parameter	Initial Conc. (mg/kg)	Treated Conc. (mg/kg)
PCBs	227	< 2
PCE	118	< 0.25
TCE	28	< 0.25
Chrysene	15	0.42
Benzo(a)anthracene	20	0.51

The upper temperature range for LTTS approaches the lower temperature range for incineration, and some LTTS systems are permitted as incinerators.

Implementability. There are few, if any, known offsite TSD facilities which would be able to accept these soils; thus, consideration of LTTS is effectively limited to onsite processes. The equipment and resources necessary to treat the soils onsite are available, with several vendors capable of performing this work. Onsite Low Temperature Thermal Stripping is readily implementable. If an incineration permit is required, New York State Ambient Air Quality Standards would have to be met, and a RCRA incineration permit from the EPA or New York State would be necessary. RCRA permit regulations require a trial burn for onsite activities to demonstrate destruction and removal efficiency. The incineration permit regulates emissions of hydrogen chloride, nitric and sulfuric oxides, and particulates. It also requires monitoring for carbon monoxide.

Excavation is readily implementable for accessible soils, but excavation will be more difficult for areas beneath buildings. Additionally, excavation of VOC-contaminated soils will be difficult; depths to 50 feet will require shoring/sheet piling.

Cost. The relative capital and O&M costs for low temperature thermal stripping are moderate.

Conclusion. Low temperature thermal stripping will be retained for further consideration as a process option.

Vitrification

Ex-situ vitrification is a process in which solids, such as soils, are melted inside a refractory vessel to form a pool of molten glass. Heat is supplied by electrodes submerged in the glass. The solids are pyrolyzed in the molten glass. The resulting gases are oxidized in the turbulent zone above the glass. Solid (inorganic) residues are trapped in the glass during the subsequent cooling step. The glass matrix is then landfilled.

Effectiveness. The vitrification process should be capable of handling the volume of contaminated soils and should be capable of achieving the remediation goals. Using this process, inorganic contaminants would be immobilized while organic contaminants would be destroyed to below remedial objective levels. Human health and environmental concerns are similar to those for incineration, with potential risks resulting from volatilization of arsenic, TCE, PCE, and 1,1,1 TCA. Vitrification should be reliable with respect to the site contaminants and conditions.

Implementability. Ex-situ vitrification could be implemented for the soils surrounding the buildings, but not for the soils underneath the buildings. Implementation for either area would be very difficult due to the use of high temperatures near occupied structures, interferences with underground utilities, and potential health and safety risks associated with air emissions from the volatilized contaminants. There are few, if any, offsite vitrification facilities which would be able to treat these soils. Thus, treatment is effectively limited to onsite processes. Since treatment is conducted onsite, New York State ambient air quality standards would have to be met and an associated permit obtained. The equipment and resources necessary to vitrify the soils on site are available, and several vendors are capable of performing this work. However, the capacity of these vendors' units is typically low.

Excavation is readily implementable for accessible soils, but excavation will be more difficult for areas beneath buildings. Additionally, excavation of VOC-contaminated soils will be difficult; depths to 50 feet will require shoring/sheet piling.

Cost. The relative capital and O&M costs are high.

Conclusion. Onsite vitrification is effective, but not implementable, and costs are nearly equivalent to those for incineration. Since the throughput of available ex-situ vitrification units is relatively low, it will be eliminated from further consideration at this time.

Oxidation

Oxidation is a chemical process whereby organics are reacted to form carbon dioxide, water, and/or other reaction intermediates or compounds; or inorganics are reacted to form a higher oxidation state. Oxidation can result in higher or lower mobility, and higher or lower toxicity, of the various compounds present. One type of oxidation available is wet-air oxidation.

Effectiveness. The wet-air oxidation process should be capable of handling the volume of contaminated soils. During treatment, minimal adverse impacts to human health and the environment would be expected. The wet-air oxidation process would not be expected to be reliable for destroying the organic contaminants in the soils. The major concern is that the concentrations of organics in the soils are much lower than typically considered feasible for this oxidation process. The iron and arsenic in the soils may also interfere with the oxidation process.

Implementability. Onsite oxidation is implementable. If treatment is conducted onsite, potential constraints, such as the need for permits and permitted facility (TSD) would be significant concerns. If the treatment is conducted offsite, transportation and treatment permits would be required, however, there are few if any known offsite TSD facilities that would be able to accept and treat this material. This shortage effectively limits consideration of oxidation to onsite processes. The equipment and resources necessary to oxidize the soils onsite are available. A limited number of vendors are capable of performing this work.

Excavation is readily implementable for accessible soils, but excavation will be more difficult for areas beneath buildings. Additionally, excavation of VOC-contaminated soils will be difficult; depths to 50 feet will require shoring/sheet piling.

Cost. The relative capital and O&M costs for oxidation are moderate.

Conclusion. Even though oxidation should be implementable, the low organic concentrations in this material severely limit the effectiveness of wet-air oxidation. As a result, wet-air oxidation is eliminated from further consideration.

Dechlorination

Potassium polyethylene glycolate (KPEG) dechlorination is an innovative chemical process used to dehalogenate chlorinated organics in contaminated soils. The process will convert PCBs, dioxins, and chlorobenzenes in soils into lower toxicity, water soluble materials. The KPEG solution reacts with the chlorinated organic and displaces a chlorine molecule. This technology has been demonstrated to reduce PCBs in soils to levels of 1 to 2 ppm. The process involves mixing equal portions of contaminated soil and KPEG reactants in a heated reactor. The slurry is then heated and mixed while the reaction occurs. Reaction time can range from 30 minutes to 5 hours depending on the type and concentration of contaminants and the level of treatment desired. The excess reagent is then decanted and the soil is washed with water to remove excess reagent and the products of the reaction. The decontaminated soils are then removed from the reactor, while the decanted reagent and washes can be recycled to treat additional soils.

Effectiveness. The dechlorination process should be capable of handling the volumes of soils at NWIRP Bethpage since a 1.5 ton per hour continuous system is already in operation. It will meet some of the remediation goals for pesticides and PCBs as outlined in the remedial objectives. Although KPEG reduces the toxicity of the waste, it increases the volume of waste that must further be treated as wastewater.

Wastewaters created as a residual to the KPEG process are commonly treated by chemical oxidation, biodegradation, carbon adsorption, or incineration. Minimal risks to human health and the environment would be expected to result from dechlorination.

Implementability. Onsite dechlorination is readily implementable for those soils which can be excavated, i.e., those not located beneath building structures. If treatment is conducted onsite, potential constraints, such as the need for permits and permitted facility (TSD) are significant concerns. If the treatment is conducted offsite, transportation and treatment permits would be required, however, there are few, if any, offsite TSD facilities which would be able to accept and treat the soils. This shortage effectively limits consideration of extraction technologies to onsite processes. The equipment and resources necessary to extract the soils on site are available, and a few vendors are capable of performing this work.

Excavation is readily implementable for accessible soils, but excavation will be more difficult for areas beneath buildings. Additionally, excavation of VOC-contaminated soils will be difficult; depths to 50 feet will require shoring/sheet piling.

Cost. The relative capital and O&M costs for dechlorination are high.

Conclusion. Based upon the fact that treatment levels are comparable to incineration, but additional wastewater treatment streams are generated and must be treated further themselves, this technology will be eliminated from further consideration.

2.4.4.7 Disposal

Landfills

The contaminated soils and sediments may ultimately be disposed at an offsite landfill. Three general types of landfills considered are hazardous waste landfills, intermediate waste landfills, and nonhazardous waste landfills. The main differences between these landfills are the administrative requirements and the degree of leachate control provided. These three types of landfills are described as follows:

- **Hazardous Waste Landfill**

  Hazardous waste landfills are regulated by the landfill and post-closure requirements of RCRA (40 CFR 264, Subparts G and N), the Toxic Substances Control Act, and state and local laws. Among the requirements are foundations, double liner systems, leak detection systems, leachate collection and treatment systems, capping, post-closure inspections and maintenance of the landfill (30-year period), and post-closure groundwater monitoring (30-year period). The liner system, consisting of two layers of synthetic membranes, clay, or other acceptable material which meets permeability and strength requirements, inhibits the migration of leachate from the waste into the groundwater and surrounding soil. The cap system, similar in construction to the liner system, minimizes precipitation percolation, promotes surface water runoff, and controls volatilization of the waste. Volatilization is usually controlled by placing a gas interception system over and/or throughout the waste material to collect the gas and treat it, if necessary. The leachate collection system consists of permeable layers of sand and/or gravel or drainage nets above the liner layers. The collected leachate may be stored in a tank and periodically treated, by either an onsite treatment system or an offsite, permitted facility.

- **Intermediate Landfill**

  Intermediate landfills include some residual waste landfills and construction/demolition waste landfills. Design and operating practices are typically similar to hazardous waste landfills; however, the permitting requirements are not nearly as stringent. These landfills may be used for wastes which are not classified as hazardous but may still significantly contaminate groundwater. Among the design and operating requirements are foundations; liner systems; leak detection systems; leachate collection and treatment systems; capping; post-closure inspection and maintenance of the landfill; and post-closure groundwater monitoring.

  Construction/demolition landfills are one variation of intermediate landfills. A construction/demolition waste landfill is a landfill that normally accepts solid waste resulting from the construction or demolition of buildings and other structures; including, but not limited to wood, plaster, metals, asphaltic substances, bricks, block, and unsegregated concrete. These wastes may be generated during remediation of the soil/sediments, if building or roadway demolition is required. The design and operating requirements may include foundations; liner systems; leak detection systems; leachate collection and treatment systems; capping; post-closure inspection and maintenance of the landfill; and post-closure groundwater monitoring.

- **Nonhazardous Landfill**

  Nonhazardous landfills may be designed similarly to intermediate landfills. However, as used in this report, they represent landfills which can accept wastes that should have no significant impact on groundwater. These landfills typically isolate the wastes from the environment by capping, fencing, and deed restrictions.

Effectiveness. Since a significant portion of the soils are contaminated with inorganics, a landfill may be required for ultimate disposal. The options available include a secure hazardous waste landfill, an intermediate landfill, a construction/demolition waste landfill, and a nonhazardous landfill. The selection of one landfill over another depends on the relative toxicity of the soils/sediments and the risks associated with their disposal. The contaminated soils contain low to moderate levels of arsenic and low levels of organics and other metals. A hazardous waste landfill may be appropriate for disposal of the most contaminated (untreated) soils, an intermediate landfill may be appropriate for disposal of the moderately contaminated and partially treated soils, and a nonhazardous landfill may be appropriate for slightly contaminated soils or those which have been treated. Construction/debris landfills would be appropriate for clean demolition waste.

The landfill(s) can be located onsite or offsite. Either location should be capable of handling the volumes of contaminated soils and sediments. Landfilling alone would achieve some of the remediation goals. Minimal or no treatment may be required for landfilling most of the contaminated soils. The level of organics in the soils is not expected to be high enough to cause liner degradation or mobility concerns. Risks to human health and the environment associated with implementing landfilling are minor. Onsite disposal presents somewhat less short-term risks than offsite disposal, because the soils would not have to be trucked long distances. On the other hand, because of considerations such as the vulnerability of groundwater beneath the site an onsite setting is not optimal for a landfill.

Onsite landfill space is limited, but available. Offsite landfills are available to accept the contaminated soils; however, the large volumes and varieties of contaminated soils at the site would likely require the use of more than one type of landfill.

Implementability. Offsite landfills are implementable, but onsite landfills are not. For an offsite landfill, a permit would be required to accept the various types of wastes from NWIRP, Bethpage. Treatment of the wastes in compliance with RCRA LDRs prior to landfilling would be required for some of the soils. Offsite TSD facilities are available to receive this waste, although the rather high volume, potentially upwards of 60,000 CY, may limit the number of facilities willing to accept the material. Equipment and resources needed to transport the soils off site are readily available.

For an onsite landfill, permits would be required. Additionally, applicable or relevant and appropriate promulgated New York landfill siting regulations or proposed regulations (TBCs) may prohibit the landfilling of wastes on site.

Cost. For both offsite and onsite landfills, the relative capital costs are low to moderate. Offsite disposal in hazardous waste landfills is more expensive than disposal in intermediate landfills. Disposal in nonhazardous and construction/demolition landfills is the least expensive process option.

Conclusion. Offsite landfilling in hazardous, intermediate, nonhazardous and construction/demolition waste landfills is somewhat effective and implementable for the contaminated soils. As a result, landfilling is retained for further consideration. Onsite landfilling is not implementable and is therefore eliminated from further consideration.

Consolidation

Consolidation is an option in which untreated soils would be relocated in the same area of contamination from which they were excavated.

Effectiveness. Consolidation of the soils would be considered if the risks associated with them are addressed by other actions (e.g., capping). The consolidation would occur within the same area of contamination and would likely take place in or near the original excavation location. Since the materials would no longer be toxic or the exposure pathways are addressed by other actions, there would be minimal health concerns associated with the consolidated soils. Consolidation would readily handle the volume of soils at this site.

Implementability. No permits are required for consolidation, and items such as availability of TSD facilities are not applicable. The consolidation would be conducted using readily available construction equipment.

Cost. The relative capital costs for consolidation are minimal compared to landfilling.

Conclusion. Consolidation of untreated soils would be effective and implementable, provided the risks associated with the materials are addressed by concurrent actions. As a result, consolidation will be retained for further consideration and, based on cost, will be selected over landfilling, where applicable.

Beneficial Reuse

Beneficial reuse is an option in which treated soils would be used as fill material as necessary anywhere on the NWIRP Bethpage site.

Effectiveness. Beneficial reuse as fill material would be a viable option for areas where soils have been treated onsite to remove contaminants in accordance with remediation goals. Since the materials are no longer a concern there would be minimal health concerns associated with the soils. Beneficial reuse would readily handle the volume of soils at this site.

Implementability. No permits are required for beneficial reuse and items such as availability of TSD facilities and permits are not applicable. The beneficial reuse as fill would be conducted using readily available construction equipment.

Cost. The relative capital and O&M costs for beneficial reuse are minimal compared to landfilling.

Conclusion. Beneficial reuse of treated soils would be effective and implementable. As a result, this process option will be retained for further consideration and, based on cost, will be selected over landfilling, where applicable.

2.4.4.8 Selection of Representative Technologies and Process Options - Soils

A summary of the technology and process option screening for the contaminated soils is presented in Table 2-19. In this table, the evaluations under effectiveness, and implementability are rated as "low", "medium", or "high" indicating an unfavorable, intermediate, or favorable rating, respectively. Evaluations under cost are rated as "low", "medium", or "high" in the conventional sense of the description. Several

TABLE 2-19

COMPARATIVE SUMMARY OF TECHNOLOGY SCREENING FOR GENERAL SITE SOILS NWIRP, BETHPAGE, NEW YORK

Remedial Action	Technology	Process Option	Effectiveness	Implementability	Cost	Retain/ Eliminate
No Action	No Action	No Action	Handles Volume NA Reliability NA Protectiveness Low Meets Goals Low	TSD Availability NA Equipment/Resources High Acquire Permits NA	Capital Low O & M Low	Retain
Institutional Controls	Institutional Controls	Deed Restrictions	Handles Volume High Reliability Low Protectiveness Medium Meets Goals Low	TSD Availability NA Equipment/Resources High Acquire Permits NA	Capital Low O & M Low	Retain
Containment	Capping	Capping	Handles Volume High Reliability Medium Protectiveness Medium Meets Goals Medium	TSD Availability NA Equipment/Resources High Acquire Permits NA	Capital Medium O & M Low	Retain
Removal	Bulk Excavation	Bulk Excavation	Handles Volume High Reliability High Protectiveness Medium Meets Goals Medium	TSD Availability NA Equipment/Resources Medium Acquire Permits NA	Capital Medium O & M Medium	Retain
Disposal	Landfill	Hazardous / Non-Hazardous	Handles Volume High Reliability Medium Protectiveness Medium Meets Goals Medium	TSD Availability Medium Equipment/Resources High Acquire Permits Medium	Capital Medium O & M Low	Retain
	Consolidation	Consolidation	Handles Volume High Reliability Medium Protectiveness Medium Meets Goals Medium	TSD Availability NA Equipment/Resources High Acquire Permits NA	Capital Low O & M Low	Retain
	Beneficial Re-use	Fill Material	Handles Volume High Reliability Medium Protectiveness High Meets Goals High	TSD Availability NA Equipment/Resources High Acquire Permits NA	Capital Low O & M Low	Retain

TABLE 2-19 (continued)
COMPARATIVE SUMMARY OF TECHNOLOGY SCREENING FOR GENERAL SITE SOILS
NWIRP, BETHPAGE, NEW YORK
PAGE 2

Remedial Action	Technology	Process Option	Effectiveness	Implementability	Cost	Retain/ Eliminate
Exsitu Treatment	Physical	Fixation	Handles Volume High Reliability Medium Protectiveness High Meets Goals Medium	TSD Availability Low Equipment/Resources High Acquire Permits Medium	Capital Medium O & M Medium	Retain
		Extraction	Handles Volume Medium Reliability Medium Protectiveness Medium Meets Goals High	TSD Availability Low Equipment/Resources Medium Acquire Permits Medium	Capital Medium O & M Medium	Retain
	Thermal	Incineration	Handles Volume High Reliability Medium Protectiveness Medium Meets Goals Medium	TSD Availability Medium Equipment/Resources Medium Acquire Permits Low	Capital High O & M High	Retain
		Pyrolysis	Handles Volume High Reliability Medium Protectiveness Medium Meets Goals Medium	TSD Availability Medium Equipment/Resources Medium Acquire Permits Low	Capital High O & M High	Eliminate
		Low Temperature Thermal Stripping	Handles Volume Medium Reliability Medium Protectiveness Low Meets Goals Medium	TSD Availability Medium Equipment/Resources Medium Acquire Permits Medium	Capital Medium O & M Medium	Retain
		Vitrification	Handles Volume Low Reliability Medium Protectiveness Low Meets Goals High	TSD Availability Low Equipment/Resources Medium Acquire Permits Low	Capital High O & M High	Eliminate
	Chemical	Oxidation	Handles Volume Medium Reliability Low Protectiveness Medium Meets Goals Low	TSD Availability Low Equipment/Resources Medium Acquire Permits Medium	Capital Medium O & M Medium	Eliminate

TABLE 2-19 (continued)
COMPARATIVE SUMMARY OF TECHNOLOGY SCREENING FOR GENERAL SITE SOILS
NWIRP, BETHPAGE, NEW YORK
PAGE 3

Remedial Action	Technology	Process Option	Effectiveness	Implementability	Cost	Retain/ Eliminate
		Dechlorination	Handles Volume Medium Reliability Medium Protectiveness Medium Meets Goals Medium	TSD Availability Low Equipment/Resources Medium Acquire Permits Medium	Capital High O & M High	Eliminate
In-Situ Treatment	Physical	Fixation	Handles Volume Low Reliability Low Protectiveness Medium Meets Goals Medium	TSD Availability NA Equipment/Resources High Acquire Permits Medium	Capital Medium O & M Medium	Eliminate
		Vapor Extraction	Handles Volume High Reliability High Protectiveness Medium Meets Goals Medium	TSD Availability NA Equipment/Resources Medium Acquire Permits Medium	Capital Medium O & M Medium	Retain
	Chemical/ Physical	Soil Washing	Handles Volume High Reliability Low Protectiveness Low Meets Goals Medium	TSD Availability NA Equipment/Resources Low Acquire Permits Medium	Capital Medium O & M Medium	Eliminate
	Thermal	Vitrification	Handles Volume Medium Reliability Medium Protectiveness Low Meets Goals High	TSD Availability NA Equipment/Resources Medium Acquire Permits Low	Capital High O & M High	Eliminate
		Radio Frequency Heating	Handles Volume Medium Reliability Medium Protectiveness Low Meets Goals Low	TSD Availability NA Equipment/Resources Low Acquire Permits Medium	Capital High O & M Medium	Eliminate

items are identified as "NA" meaning not applicable. In general, "NA" is used for the implementability criteria of permits and offsite TSD availability. Technologies and process options are retained or eliminated from further consideration in the "Retain/Eliminate" column of this table.

The technologies and process options for soils remediation to be further considered in this report are as follows:

- No Action

- Institutional Controls
  - Deed Restrictions

- Containment
  - Capping

- Removal
  - Bulk Excavation

- Physical Treatment
  - In-Situ Vapor Extraction
  - Fixation
  - Extraction (Soil Washing)

- Thermal Treatment
  - Incineration
  - Low Temperature Thermal Stripping

- Disposal
  - Landfill
  - Consolidation
  - Beneficial Reuse / Fill Material

2.4.5 Identification and Screening of Technologies and Process Options - Groundwater

2.4.5.1 No Action

The no action scenario is considered to provide a baseline level to which other remedial technologies and alternatives can be compared. Under this scenario, no removal or treatment of the contaminants in the groundwater would occur.

Effectiveness. The no-action scenario would not achieve any of the remediation objectives. Excess Carcinogenic Risks (ECR) to onsite workers and future residents would remain at levels greater than 10^{-6}. Additionally, the plume will continue to enlarge and thereby contaminate currently unaffected areas.

The no-action option would provide no additional reduction in the toxicity, mobility, or volume of contaminants in the groundwater other than that offered by the natural environment. Over time, the degree of contamination in the groundwater may decrease through natural attenuation and dilution provided that the sources of contamination are eliminated. Long-term periodic groundwater monitoring would be required to assess the ability of the aquifer to naturally lower contaminant levels through flushing. Because contaminated groundwater would remain on site, 5-year site reviews would be conducted to evaluate the contamination of the site.

Implementability. There are no implementability considerations associated with the no-action scenario.

Cost. Because no action would be taken at the site, capital and O&M costs would be very low.

Conclusion. Retain no action as a baseline as required by CERCLA.

2.4.5.2 Institutional Controls

Deed Restrictions

Deed restrictions are institutional controls that are placed on property deeds. These restrictions may limit future activities, such as placement of new wells or construction.

Effectiveness. Deed restrictions could be applied to the plume of contaminated groundwater, since only administrative action would be required. Deed restrictions could ensure that no new wells would be installed in the contaminated plume, thereby reducing the potential risk to human health associated with ingestion/inhalation of contaminated groundwater. However, these restrictions have not proven to be very effective, are difficult to enforce, and would not address the restoration and migration components of the remedial objectives. Moreover, deed restrictions for existing contaminated production wells and potable wells is not viable since these wells are essential and no alternative sources are practical.

Implementability. This technology could be implemented by local authorities. Availability of TSD facilities, equipment and personnel, and the need for permits are not applicable to deed restrictions.

Cost. Because no action would be taken at the site, capital and O&M costs would be very low.

Conclusion. Although this is not feasible as a stand alone technology at NWIRP Bethpage, based on the large extent of contamination and present contamination of essential wells, this option may be used in conjunction with other technologies to restrict future use of the groundwater. In particular, deed restrictions may be necessary for alternatives which incorporate natural attenuation of a portion of the plume. In any case, the continuing offsite migration of contaminated groundwater necessitates deed restrictions during what is expected to be a lengthy remediation period.

Monitoring

Sampling and analysis of groundwaters throughout the area of potential groundwater contamination could be used to evaluate migration of contaminants and the potential for contamination of onsite drinking water supply and nearby residential, municipal and commercial wells. Monitoring can also be used to monitor the progress of groundwater remediation.

Effectiveness. Groundwater monitoring would not reduce the toxicity, mobility, or volume of contaminants in the groundwater. Also, monitoring would not provide any additional protection of the environment since the plume would continue to spread into uncontaminated or lesser contaminated areas. By serving as a warning mechanism, periodic groundwater monitoring would enable households to discontinue use of groundwater if a threat of contamination arose in the area. Monitoring will also be helpful in measuring and evaluating the effectiveness of groundwater remediation.

Implementability. A groundwater monitoring program could be readily implemented at NWIRP Bethpage. Local and state permits would be required for monitoring well installation.

Cost. For monitoring only, capital and O&M costs would be relatively low.

Conclusion. Groundwater monitoring would be partially effective. Contaminant migration could be observed, but not controlled. Monitoring would be implementable. As a result, it will be retained in combination with other process options.

2.4.5.3 Removal

Extraction Wells

The extraction option uses a pumping well system, composed of a series of wells completed in overburden deposits, which can be used to capture contaminated groundwater for treatment. The wells used in the capture system are designed and located to provide optimum efficiency in capturing contaminated groundwater while minimizing the collection of uncontaminated groundwater.

Effectiveness. The effectiveness of an extraction well system depends largely on the extent of contamination and the geology and hydrogeology. Since pumping tests and known site geology/hydrogeology confirm a high yield aquifer in portions of the aquifer beneath NWIRP Bethpage, and since contamination extends to depths of several hundred feet, extraction wells should effectively control the migration of contaminants and remove the contaminated groundwater for subsequent treatment and/or disposal. The use of wells to extract groundwater should attain the remediation goals identified in the remedial objectives. The technology is reliable and minimal effects on human health and the environment would be expected during implementation.

Implementability. Groundwater extraction through a pumping well system can be readily implemented at NWIRP Bethpage. The technology uses readily available equipment and techniques and has proven to be effective in similar situations. Implementation of this technology would require long term operation and maintenance. Maintenance may require periodic replacement of mechanical components and well flushing to remove fine grained material that may clog the wells. Local and state permits will be required for installation of the extraction wells.

Cost. Both Capital and O&M costs are relatively low.

Conclusion. The extraction well system should be effective and implementable and is retained for further evaluation.

2.4.5.4 Containment

Capping

Capping involves the installation of a semi-permeable or impermeable barrier over the contaminated soils to restrict access and/or reduce infiltration of precipitation into the soils. Impermeable barriers should be considered where soil contamination threatens groundwater or surface water. Consolidation and/or regrading of isolated quantities of contaminated soils prior to capping may be required. Cap materials can either be natural or synthetic. Frequently used impermeable materials include low-permeability clays, such as bentonite; cement; asphalt; and synthetic membranes such as high-density polyethylene (HDPE) and polyvinyl chloride (PVC) and Hypalon. These materials can be covered with soil to protect them against weathering and erosion.

Effectiveness. The areal extent of contamination at NWIRP Bethpage lends itself to capping technology. Capping is effective in controlling contaminant migration by limiting the infiltration of water and subsequently the leaching of soil-bound contaminants to groundwater. It does not address reductions in toxicity, mobility or volume of contamination. During remedial activities, fugitive emissions would have to be controlled to minimize effects on human health and the environment. Because the areas to be capped are located in a currently used industrial area, synthetic membrane caps are not favored as they are subject to structural damage. A clay cap is selected as the representative process option since a lower permeability can be achieved with a clay cap than with concrete or asphalt.

Implementability. The construction of an impermeable cap is somewhat implementable at NWIRP Bethpage. A variety of proven construction methods can be used, including clay soils, man-made membranes/fabrics, asphalt, and combinations of the above. Some earthwork may be required to achieve proper slopes for surface water runoff control. Because the top of the complete cap would be approximately four feet above the current ground elevation, interferences with existing structures may present a problem. The remedial action activities involving capping are relatively common and can be conducted by many contractors. A TSD permit will likely be required prior to implementing this technology, since hazardous wastes (by characteristic) are involved. Because no offsite activities would be occurring, the need for TSD facilities is not a concern. However, deed restrictions may be desirable in conjunction with capping in order to limit the future usage of the capped areas.

Cost. The capital and O&M costs for cap construction is expected to be low.

Conclusion. Although capping would not meet all of the Remedial Objectives, especially those involving contaminant levels in surface and sub-surface soils, it would significantly reduce the continued migration of contaminants to the groundwater thereby meeting future groundwater objectives. Capping will be retained, with clay capping selected as the representative process option.

2.4.5.5 In-Situ Treatment

In-Situ Soil Flushing

Soil flushing is an in-situ process applied to unexcavated soils using a groundwater extraction/reinjection system. In-situ soil flushing consists of injecting a solvent or surfactant solution (or water) to enhance contaminant solubility, which results in increased recovery of contaminants in the leachate or groundwater. The system includes extraction wells drilled in the contaminated soils zone, reinjection wells upgradient of the contaminated area, and a wastewater treatment system. This technology is often used for the removal of volatile organics from permeable soils.

Soil flushing includes extraction and treatment systems for contaminated groundwater. Following treatment the groundwater is reinjected upgradient of the extraction wells and leaches through the contaminated soils. The leachate is then collected, treated, and reinjected back into the system, creating a closed loop system. Non-toxic or biodegradable surfactants or chelating agents may be added to the groundwater prior to reinjection. The contaminated groundwater is then treated using various common wastewater techniques depending on the contaminant(s) being removed.

Effectiveness. In-situ soil flushing has the greatest potential success for those soils contaminated with only a few specific chemicals, preferably all of the same classification (e.g., volatile organics, metals). Several factors can limit the effectiveness of soil extraction/soil washing. Some of these are the ability to contact all the soils, the ability to mobilize the contaminants, the ability to capture the mobilized contaminants, the ability to separate the contaminants from the lixiviant, and the ability to monitor compliance.

For this site, the homogeneity and sandy nature of the soils favors in-situ soil washing/extraction. Unfortunately, site contaminants include several classes of compounds which would be difficult to extract/wash in a one-step process. Additionally, site contaminants include carcinogenic PAHs and

PCBs, which are presently only a surface soil concern; it is preferable not to spread these contaminants through the subsurface soils and to the aquifer.

The burdened lixiviant would likely contain significant concentrations of contaminants in highly mobile forms; and thereby potentially result in significant risk to human health and the environment, if it is not completely captured. As with any in-situ process, monitoring for compliance with the remedial action goals is very difficult.

Implementability. Because such an extensive area is affected and because of the added complexity of existing pumping/discharge at the recharge basin areas, an in-situ process would be difficult to control. Because hazardous wastes (by characteristic) are involved, there is a need for a TSD permit. The availability of equipment and resources to conduct this work are somewhat limited.

Cost. The relative capital cost is moderate and the O&M costs are moderate.

Conclusion. Due to several effectiveness and implementability concerns, in-situ soil flushing will be eliminated from further consideration as a process option.

2.4.5.6 Treatment

In this section, treatment technologies for the removal of the contaminants will be discussed. Discussion of treatment technologies that may be required for water conditioning before or after primary treatment, such as filtration or sedimentation for the removal of suspended solids, will also be included as part of the discussions.

Volatilization

Volatilization or air stripping technology is well suited for the removal of VOCs from contaminated groundwater. This aeration process encourages the transfer of VOCs found in site groundwater from the aqueous phase to the gas phase as defined by Henry's Law. In general, air stripping is used for VOCs with a Henry's Law constant greater than or equal to 3.0 atm-L/mole(Camp, Dresser and McKee Incorporated, 1985). Removal efficiencies of VOCs typically exceed 99% depending on the operating parameters as well as the physical properties of the organic contaminant(s).

The countercurrent packed tower is the most commonly used air stripping configuration. Water is distributed over the top of the unit while air is forced upward through the bottom. Loosely fitted packing material serves to increase the air/water interface area to provide maximum mass transfer. Key factors that influence process performance include air to water ratio, type of packing material, operating temperature, surface hydraulic loading, and contact time.

Steam stripping uses steam to strip volatile organic compounds from wastewater. This technology is very similar to air stripping, except that steam is used as a carrier gas and provides heat to enhance removal.

Steam stripping is generally considered for product recovery and/or for removal of organic compounds that are only slightly more volatile than water.

Effectiveness. Air stripping is a well proven and reliable technology that would be effective for removing the primary VOCs from groundwater at NWIRP Bethpage. Removal efficiencies greater than 99% can theoretically be achieved for the contaminants present at the site. Since air stripping only removes the contaminants from the water and concentrates them in the off-gas, the off-gas may have to be treated by other means such as granular activated carbon adsorption, catalytic oxidation, or thermal destruction. The need and type of offgas treatment depends on the specific contaminants and their concentration. It is likely that offgas treatment will be required for the treatment of onsite groundwater but will not likely be required for air stripping treatment operations for offsite groundwater or potable water. Each of the noted offgas treatment technologies should be effective for contaminants in site groundwater, except for vinyl chloride. Granular activated carbon is selected as the representative process option based on cost considerations. Where vinyl chloride is present, thermal treatment is the representative process option since vinyl chloride is a high toxicity compound which adsorbs extremely poorly on activated carbon.

For the site contaminants, steam stripping does not provide any advantage in effectiveness beyond that of steam stripping.

Implementability. Air stripping would be readily implementable at the site. (For steam stripping condensed organics must be properly disposed of). There are a significant number of vendors that provide air stripping technology. In order to meet New York State Ambient Air Quality Standards, control of off-gas emissions may be required, as well as an air permit. Construction permits and a TSD permit will also likely be required.

A maintenance problem associated with air stripping is the channeling of flow resulting from clogging in the packing material. Common causes of clogging include high oils, suspended solids, and iron concentrations, and slightly soluble salts such as calcium carbonate. None of these nuisance constituents are expected to present a problem for NWIRP Bethpage groundwater.

Cost. The capital costs are low and O&M costs range from low to moderate depending on influent contaminant concentrations, the degree of removal required, and the type of offgas treatment required.

Conclusion. Air stripping, via a countercurrent packed tower, is an effective and reliable technology for VOC removal at the Site and is retained as a representative process option for further consideration. Activated carbon is retained as the representative process option for offgas treatment, unless vinyl chloride is present, in which case thermal destruction is selected as the representative process option. Metals contamination must be addressed by other technologies.

Carbon Adsorption

Activated carbon adsorption is a frequently applied technology for the removal of organic compounds from contaminated water. Activated carbon will adsorb many organic compounds to some extent but is most effective for the less polar and less soluble compounds. Removal efficiency exceeding 99% is possible depending on the type of organic solute and system operating parameters such as retention time and carbon replacement frequency. The fundamental principle behind activated carbon treatment involves the physical attraction of organic solute molecules to exchange sites on the internal pore surface areas of the specially treated (activated) carbon grains. As water is filtered through the adsorbent, the organic molecules eventually occupy all of the surface sites on the carbon grains. The exhausted carbon must then be either regenerated or disposed of according to Federal (RCRA) or New York State regulations.

Typical activated carbon adsorption treatment systems include gravity flow or pressure flow columns in series and/or parallel configuration with backwashing capability. Granular activated carbon (GAC) is generally used in these systems. Common flow rates range from 0.5 to 5.0 gpm/ft^2. Factors such as pH and temperature of the influent, empty bed contact time (EBCT), surface area/volume ratio of the activated carbon, and solubility of the organic compound will affect the carbon adsorption process.

Effectiveness. Carbon adsorption is a well proven, reliable technology that would be effective for removing most of the primary VOCs from the groundwater at NWIRP Bethpage. Generally, the most effective application of carbon adsorption would be for dilute concentrations of organics to result in a relatively low carbon consumption. Additionally, other organics could be removed concurrently, although no other organics are currently present in the groundwater at levels above detection limits. Removal efficiencies exceeding 99% could potentially be achieved for most of the site organic contaminants. Vinyl chloride is an exception since it adsorbs very poorly on activated carbon. Spent carbon containing the concentrated organic contaminants would have to be regenerated or disposed of in a hazardous waste landfill.

Implementability. Carbon adsorption would be readily implementable at NWIRP Bethpage. There are a sufficient number of vendors that provide carbon adsorption units. General construction permits and a TSD permit will likely be required for the implementation of carbon adsorption technologies.

Pretreatment may be required if the influent has a suspended solids concentration greater than 50 mg/L, oil and grease concentrations greater than 10 mg/L, or calcium or magnesium concentrations greater than 500 mg/L to prevent clogging and high pressure drops (Berkowitz et al., 1978; and EPA, 1986b). At NWIRP Bethpage, a filtration pretreatment step may be included as a safeguard, where applicable, to protect any activated carbon unit installed downstream of a precipitation process to ensure maximum carbon life.

Implementation factors include planning for disposal or regeneration of the spent carbon. Thermal, steam, and solvent treatments are the most common types of regeneration technologies, which are typically conducted off site. Special handling of the periodically generated backwash liquids must also be taken into account.

Cost. Capital costs are low while O&M costs range from low to high, depending on the carbon usage rate, which is a function of influent contaminant concentration.

Conclusion. Carbon adsorption is a viable technology for treating site organics, except vinyl chloride, and is retained for further consideration. Other technologies and process options are required to address the inorganic contaminants.

Filtration

Filtration is a process using a porous medium to remove suspended solids from a liquid. It is valuable in wastewater treatment as a pre-treatment to remove suspended solids before other treatment processes and/or for the final cleaning or polishing of treated effluent. It is effective in removing organic and inorganic contaminants (particularly metals) that are bound to suspended solids in groundwater, often reducing the need for further treatment of these contaminants.

Liquid filtration may be accomplished by numerous methods including screens, fibrous fabrics (paper or cloth), ultrafiltration, or beds of granular material. Flow through a filter can be encouraged by pressure on the inlet side or by drawing a vacuum on the filter outlet.

Effectiveness. This technology is widely used for the removal of suspended materials. Filtering systems can be staged to progressively remove smaller materials; many system variations have been designed to reduce clogging and provide easy maintenance.

Filtration is especially useful in reducing contaminant levels of particulate metals and organic compounds that are bound to suspended solid materials. These compounds may not easily be removed by other treatment methods such as aeration or carbon filtration, making filtration a common pre-treatment step for these technologies. It should be noted, however, that conventional filtration is not effective in removing dissolved contaminants but is readily applicable to suspended solids.

For groundwater treatment at NWIRP Bethpage, the primary use of a filtration system will be as a safeguard, where applicable, to protect any activated carbon unit installed downstream of a precipitation process to ensure maximum carbon life. Additionally, filtration will remove particulate metals. Suspended solids in site groundwater are not a concern.

Implementability. Filtration systems are commercially available from a wide variety of manufacturers and can be readily ordered to almost any specification. No permits, other than general construction permits will likely be required for the implementation of filtration technologies.

Filter media will occasionally have to be replaced or regenerated, potentially resulting in the generation of sludges requiring specialized disposal because of contaminant content.

Cost. Capital costs for filtration are low, as are O&M costs. Although not anticipated at the Bethpage site, O&M costs may elevate slightly if frequent turbidity in the pumped groundwater requires additional filter maintenance.

Conclusion. Filtration will be retained as a process option for groundwater treatment, as a safeguard for activated carbon when followed by a precipitation process and when needed for particulate metals removal.

Reverse Osmosis

Reverse osmosis uses a semi-permeable barrier that will pass only certain components of a solution. The membrane is permeable to water but impermeable to most dissolved substances, both organic and inorganic. The driving force is an applied pressure gradient to overcome the osmotic pressure of the contaminated solution. Relatively clean water is produced on the down-flow side of the membrane, whereas the larger, rejected organic and inorganic compounds remain on the up-flow side as a concentrated reject stream (for further treatment or disposal).

Reverse osmosis systems are operationally sensitive. Therefore, close monitoring of the temperature, pressure, and pH of the contaminated solution is necessary. In addition, the chemical and physical structure of the membrane must be closely monitored because the contaminants in the solution may react with it and reduce its integrity.

Effectiveness. Reverse osmosis may be used to concentrate dilute solutions of many inorganic and organic solutes. Reverse osmosis reduces excess dissolved solids, reduces or removes many organics and metals, and produces almost turbidity-free water. Concerning NWIRP groundwater, the primary contaminants are chlorinated organics which may degrade the reverse osmosis unit membranes. Turbidity is not a site concern. Additionally, the reject stream would consist of a fairly large steam with combined organics and metals requiring additional treatment.

Implementability. Although equipment and resources are specialized, the reverse osmosis process is commercially available. General construction permits and a TSD permit will likely be required for the implementation of reverse osmosis technologies. Reverse osmosis membranes, in general, are subject to deterioration and may require frequent replacement. Pretreatment may be required to optimize pH.

Cost. Capital and O&M costs are high.

Conclusion. Reverse osmosis is eliminated from further consideration due to effectiveness concerns and the availability of other more conventional, effective and economical technologies (i.e., precipitation) for metals removal.

Equalization

Equalization, in the form of a holding tank at the treatment plant inlet, allows for dampening of flow fluctuations and reduction of variations in chemical composition of the influent. This technology promotes a constant discharge rate and near-constant water quality, to prevent flow surges or upset conditions that could affect downstream processes. It does not however directly remediate contaminants.

Effectiveness. Although equalization does not directly remediate contaminants, it is a necessary part of any treatment scheme at the site. The groundwater extraction system will consist of numerous wells, each of a different chemical composition. Flow and chemical equalization will be required for proper operation of downstream equipment. Equalization will be able to dampen flow and contaminant surges. Equalization is not necessary for treatment at only one point source location; for example, an individual treatment system at a potable well.

Implementability. Equalization is readily implementable. Likely, general construction permits and a TSD permit will be required.

Cost. Equalization capital costs and O&M costs are low.

Conclusion. Equalization is effective and implementable, and will be retained for use in each treatment alternative.

Dewatering

Dewatering is the mechanical removal of free water from wastes and can be used for the treatment of residues generated by various groundwater treatment technologies. Dewatering produces a relatively dry, concentrated sludge cake. Typical equipment includes the belt filter press, plate and frame press, and vacuum filter.

Effectiveness. Dewatering of groundwater treatment residuals (sludge) will be required to improve sludge handling characteristics and lower disposal costs. Of the available options (i.e., plate and frame filter press, belt filter press, and vacuum filter), the plate and frame filter press produces the driest cake. This may be the most advantageous option to minimize sludge volumes.

Implementability. Dewatering is feasible. Equipment and resources are readily available. Likely, general construction permits and a TSD permit will be required.

Cost. Capital and O&M costs for dewatering are moderate.

Conclusion. Dewatering for processing residuals is retained. The plate and frame filter press will be used as the representative option.

Sedimentation

Sedimentation is a process that removes the suspended solids from a liquid by producing quiescent hydraulic conditions. This allows the forces of gravity to settle out the unstable solids from suspension. This technology may be used in conjunction with precipitation. Two slightly different sedimentation options are used including clarification (to typically produce a 2 to 8 percent sludge) and thickening (to typically further concentrate clarification sludges to 8 to 15 percent).

Effectiveness. Sedimentation by itself will not reduce groundwater contaminant concentrations to the required action levels. However, if precipitation is selected for inorganic removal, a clarifier/thickener can be used to collect the precipitated solids.

Implementability. Clarification/thickening is readily implementable as part of a treatment scheme. Likely, general construction permits and a TSD permit will be required.

Cost. Capital and O&M costs for clarification are low.

Conclusion. Sedimentation is retained for use in conjunction with precipitation.

Ion Exchange

Ion exchange resins are insoluble solids containing fixed cations or anions capable of reversible exchange with mobile ions of the same charge in solutions with which they are brought into contact. The ion exchange resins will eventually be exhausted and must be regenerated. The regeneration waste contains a high concentration of contaminants and must be further treated and/or disposed of.

Effectiveness. Ion exchange is effective for the removal of soluble metals and anions such as halides, sulfates, and nitrates. Because of resin capacity and regeneration restrictions, ion exchange is most applicable for treating dilute waste streams. At NWIRP Bethpage, ion exchange would effectively remove metals to very low concentrations. The regenerant stream produced would require additional treatment prior to disposal. Although ion exchange is typically used for metals recovery, the concentrations and types of metals present in the site groundwater do not warrant recovery.

Implementability. Ion exchange would be implementable. There are many vendors that provide ion exchange units. Influent suspended solids must be very low, otherwise the resin bed could be fouled or plugged. Some organics, especially aromatics, can be irreversibly adsorbed by the resin, resulting in decreased capacity. Sophisticated controls are required to detect breakthrough of contaminants when the capacity of the resin is close to being exceeded. General construction permits and a TSD permit will likely be required for the implementation of ion exchange technologies.

Cost. Capital costs are moderate and O&M costs range from moderate to high, depending on the frequency of regeneration required, which is a function of influent contaminant concentrations.

Conclusion. Ion exchange is eliminated from further consideration since due to effectiveness concerns and the availability of other more conventional, effective and economical technologies (i.e., precipitation) for metals removal.

Enhanced Oxidation

Enhanced oxidation processes use a controlled combination of either ozone or hydrogen peroxide and ultraviolet light to induce photochemical oxidation of organic compounds. Ozone has been used extensively in Europe for purification, disinfection, and odor control of drinking water. Ozone alone has the ability to break down some organics but has generally proven to be an ineffective oxidant of halogenated organics under conditions normally used for drinking water treatment or for disinfecting wastewaters (i.e., 1 to 10 mg/L concentration levels and 5- to 10-minute contact times) (Brenton et al., 1986; and Arienti et al., 1986).

Ultraviolet (UV) radiation is electromagnetic energy whose wavelengths fall between those of visible light and X-ray radiation on the electromagnetic spectrum. UV energy is capable of breaking down or rearranging a molecular structure, depending on the dissociation energies of the chemical bonds within the structure (EPA, 1987). The combination of ultraviolet radiation with ozone or hydrogen peroxide treatment results in the oxidation of organic contaminants at a rate many times faster than that obtained from applying UV light alone (McShea et al., 1987).

A typical continuous-flow hydrogen peroxide/ozone/UV system consists of an oxygen or air source, an ozone generator or hydrogen peroxide feed system, a UV/oxidation reactor, and an ozone decomposer. Flow patterns and configurations are designed to maximize exposure of the wastewater to the UV radiation, which is supplied by an arrangement of UV lamps. Typical reactor designs range from mechanically agitated reactors to spray, packed, and tray-type towers. If ozone is utilized, reactor gases are passed through a catalytic ozone decomposer, which converts remaining ozone to oxygen and destroys any volatiles.

Effectiveness. Hydrogen peroxide/ozone/UV technology has effectively oxidized halogenated organics, benzene derivatives, and various aliphatics (McShea et al., 1987). PCE and TCE have been reduced from levels of 20 ppm to less than 5 ppb (McShea et al., 1987). Effectiveness varies greatly depending on the contaminant of concern. For the NWIRP site groundwater, the alkenes (TCE, PCE) would be readily removed while the alkanes (TCA) are more difficult. Enhanced oxidation is particularly effective on vinyl chloride, a compound difficult to address when considering only conventional technologies.

This process is considered an innovative technology; only a few commercial systems have been installed and tested. Bench- and pilot-scale treatability studies would therefore need to be conducted to determine the actual effectiveness and cost of applying this process to the contaminants in the groundwater at NWIRP Bethpage.

Implementability. Hydrogen peroxide/ozone/UV technology should be implementable. Only a few vendors, however, currently offer this technology. General construction permits and a TSD permit will likely be required for the implementation of reverse osmosis technologies.

Recent improvements have been made by hydrogen peroxide/UV vendors to minimize energy usage and reduce UV lamp fouling problems. With this treatment, no toxics are emitted to the atmosphere or adsorbed onto media that require further treatment or disposal. Hydrogen peroxide is a strong oxidizing agent; therefore, diking and other engineering controls are required to minimize potential risks associated with peroxide releases.

Cost. Capital and O&M costs are moderate to high. Operating costs vary significantly depending on flow rate, and contaminant type and concentration. Enhanced oxidation requires high energy usage, which can result in prohibitive costs.

Conclusion. Enhanced oxidation will be retained for further consideration because this innovative technology warrants additional evaluation, particularly with respect to costing. Moreover, it warrants additional evaluation where vinyl chloride is a concern. Hydrogen peroxide/UV is selected as the representative process option.

Coagulation-Flocculation/Precipitation

Coagulation-flocculation/precipitation are closely related liquid treatment processes that involve the addition of chemical reagents that bind to dissolved inorganics to form insoluble salts, encouraging the creation of particles that are too large to remain in suspension and resulting in the precipitation or settling of suspended material. The technology is useful as a pretreatment step for removing contaminants such as dissolved metals. Commonly, dissolved metals are removed through the formation of hydroxides by lime or caustic soda addition; formation of sulfides through use of sodium hydrosulfide, ferrous sulfide, or hydrogen sulfide has; or formation of a metal-iron compound by ferric chloride or ferric sulfate addition. Metal hydroxides have a tendency to redissolve outside an optimum pH range; however, they are much easier to handle, safer, and less expensive to generate than sulfides. Sulfide precipitation, however, generally allows for significantly lower treated effluent concentration. Coprecipitation techniques are also capable of attaining low effluent concentrations.

Proprietary processes, such as Sulfex^R and Unipure^R employ ferrous iron compounds which can simultaneously result in reduction and precipitation at neutral pH conditions.

Effectiveness. Coagulation-flocculation/precipitation is useful for the removal of dissolved materials from groundwater. It is not effective in the removal of dissolved organic contaminants such as VOCs. As stated, the technology is especially useful as a pretreatment step for removing dissolved metals. Use of ferrous iron is selected as the representative process option to reduce site hexavalent chromium to the trivalent form, without pH adjustment, then concurrently precipitate the trivalent chromium.

Precipitation units are capable of handling the projected influent flow rates. Sludge produced may require further treatment prior to disposal, based on results of waste characterization testing to determine whether the material is considered hazardous.

Implementability. This technology is widely used in groundwater treatment and is readily available commercially, although proprietary processes are only available through a few vendors. Key process parameters include reagent dosages, pH adjustment requirements, and sludge handling capabilities. As with filtration, excessive suspended solids in the raw water may require added maintenance and can result in the generation of sludges requiring specialized disposal because of contaminant content. General construction permits and a TSD permit will likely be required for the implementation of precipitation technologies. However, sludge produced must be properly disposed of in a permitted facility.

Cost. The capital costs are expected to be moderate, as are O&M costs due to chemical addition and sludge handling/disposal requirements.

Conclusion. Coagulation-flocculation/precipitation will be retained as a process option for removal of dissolved metals from site groundwater. Proprietary methods will be emphasized, due to effectiveness concerns. Other technologies will be required to address site organics.

Reduction

Reduction consists of the use of strong reducing agents, such as sulfur dioxide, sulfite, or ferrous iron, to chemically lower the oxidation state of inorganic contaminants present in wastewaters. A few proprietary one-step processes are conducted at neutral pH using ferrous iron compounds to eliminate the conventional pH reduction step associated with reduction.

Effectiveness. One of the NWIRP Bethpage contaminants of concern includes hexavalent chromium. Reduction of hexavalent chromium to the trivalent form is a well proven process. However, most data available concerns process wastewaters at much higher influent concentrations than anticipated for NWIRP Bethpage groundwater. Typically, for hexavalent chromium reduction, the waste stream is first lowered to a pH between 2 and 3 using sulfuric acid; then, a reducing agent is added. Alternatively, the use of ferrous compounds are simultaneously effective for precipitation.

Implementability. Reduction would be readily implementable for the NWIRP Bethpage groundwater. Only a few vendors are available for proprietary processes which simultaneously precipitate the metals. General construction permits and a TSD permit will likely be required for implementation of this option.

Cost. Reduction costs would be relatively low for capital costs and low to moderate for O&M costs. Sulfur dioxide, ferrous sulfate, or ferrous chloride are primarily used as reducing agents because they are relatively inexpensive and effective.

Conclusion. Retain reduction technology for use in combination with technologies which require the presence of chromium to be in the trivalent form for effective treatment.

Neutralization

Neutralization is a treatment process for altering the pH or acidity/alkalinity of a solution. This is generally accomplished by adding acidic compounds to balance alkaline solutions or vice-versa.

Effectiveness. Neutralization is an easily accomplished means of balancing or changing the pH of a solution. The process is best performed in a well-mixed system. A thorough analysis of the wastewater to be treated is advisable to avoid the creation of compounds more toxic than the original compounds and to ensure that incompatible compounds are not introduced into the system. The technology is particularly useful as a pretreatment step for pH adjustment before other treatment steps that require altered pH levels for optimum efficiency. Neutralization is also frequently used as a finishing step prior to discharge to meet specified water quality criteria.

Implementability. Neutralization technology is easily implemented; it is widely used and commercially available. Limited construction is necessary to include neutralization equipment as a step in a treatment system. General construction permits and a TSD permit will likely be required for the implementation of neutralization technologies.

Cost. The capital and O&M costs for neutralization are expected to be low.

Conclusion. Neutralization will be retained as a process option for groundwater treatment where required by a given technology. Otherwise, the influent contaminated groundwater pH is within the acceptable range.

2.4.5.7 Disposal Technologies

Extracted groundwater must eventually be disposed when brought to the surface. The available disposal options include discharge to the local POTW, reinjection to the aquifer, or reuse as potable or process water.

Discharge to Local POTW

This discharge option considers discharge of treated and/or untreated groundwater to the local POTW. Influent flow rate and contaminant concentration are the potential limiting factors for this disposal option.

Effectiveness. Indirect discharge of untreated groundwater to the local POTW would not be effective since municipal facilities are rarely equipped to handle chlorinated organics. Indirect discharge of treated groundwater could potentially considered as a polishing step. However, it is highly unlikely that the POTW would have adequate excess capacity to address the large flow rates anticipated for groundwater remediation. Even if excess capacity were available, the large volume of essentially clean effluent from the groundwater treatment system would significantly alter POTW operations.

Implementability. Indirect discharge to a local POTW is unlikely to be implementable due to the large flow rate anticipated for remediation. A thorough evaluation of impacts to the POTW would be required before proceeding with this option. Discharge flow rate, contaminant types and concentrations would have to comply with the POTW permit conditions.

Cost. Capital costs and O&M costs for discharge to the POTW are expected to be high, considering that an upgrade of the POTW would likely be required.

Conclusion. POTW discharge is eliminated from further consideration due to numerous effectiveness and implementability concerns.

Reinjection

Subsurface discharge includes the use of injection wells to reinject treated groundwater into an aquifer. Underground injection wells can be coupled with extraction wells to create a closed system in which pumping and injection rates balance one another.

Effectiveness. Subsurface discharge is an effective means of disposing of the volumes of water generated by the groundwater pumping/treatment system. Injection wells offer the advantage of decreasing groundwater remediation time by increasing the groundwater flow rate through the aquifer.

Implementability. Installation of a well system for underground injection is implementable; however, achieving a closed system may be difficult, considering the large extent of contamination and the complexity of pumping/recharge basins within the area of concern. Reinjected water that is not captured by the extraction wells could potentially force contaminated groundwater into lesser contaminated areas. Periodic groundwater monitoring would help to assess whether or not this condition is occurring. Subsurface discharge would require that groundwater be treated to either action or background levels prior to reinjection.

Underground injection of water may require a state permit, depending on whether it occurs on site or off site. The permit would set limitations on contaminant concentrations, and possibly flow rates, of disposed water.

Cost. The capital and O&M costs for reinjection are moderate.

Conclusion. Because the costs for reinjection are high compared to use of the recharge basins and because implementation of this option is questionable due to complex aquifer use patterns and large extent of contamination, reinjection is eliminated from further consideration.

Process Water/Potable Water Reuse

This discharge option considers use of the existing NWIRP and Grumman recharge basins to allow gravity drainage of treated groundwater into the aquifer. Additionally, this discharge option considers use of treated effluent for potable water purposes.

Effectiveness. Beneficial reuse of treated groundwater should be effective if treated to the necessary standards. Preferably, continued use as process water should be the option of choice for the more highly contaminated onsite groundwater. Minimally contaminated existing potable water supply wells and offsite wells could be used for potable water following adequate treatment.

Implementability. Beneficial reuse would be readily implementable considering that the recharge basins are existing and have the proper drainage characteristics. Reinjected water that is not captured by the extraction wells could potentially force contaminated groundwater into lesser contaminated areas. Periodic groundwater monitoring would help to assess whether or not this condition is occurring. This discharge option would require that groundwater be treated to either action or background levels prior to reinjection.

The recharge basins have existing SPDES permits. Discharge to the recharge basins must comply with the existing permit conditions. Likely, a permit modification will be required.

Cost. The capital and O&M costs for reinjection are low.

Conclusion. Because the costs for reinjection are high compared to use of the recharge basins and because implementation of this option is questionable due to complex aquifer use patterns and large extent of contamination, reinjection is eliminated from further consideration.

2.4.5.8 Summary of Final Screening of Technologies and Process Options- Groundwater

The evaluations of technologies and process options, based on effectiveness, implementability, and cost, are summarized in Table 2-20. In this table, the technologies are organized according to the general response actions developed in Section 2.3. Technologies and process options are retained or eliminated for further consideration in the last column of this table.

The technologies and process options to be further considered in this report are as follows:

- No Action
- Institutional Controls
  - Groundwater Monitoring
  - Deed Restrictions
- Clay Capping
- Extraction wells
- Discharge as beneficial reuse of process/potable water

TABLE 2-20

COMPARATIVE SUMMARY OF TECHNOLOGY SCREENING FOR GENERAL SITE GROUNDWATERS
NWIRP, BETHPAGE, NEW YORK

Remedial Action	Technology	Process Option	Effectiveness	Implementability	Cost	Retain/ Eliminate
No Action	No Action	No Action	Handles Volume NA Reliability Low Protectiveness Low Meets Goals Low	TSD Availability NA Equipment/Resources NA Acquire Permits NA	Capital Low O & M Low	Retain
Institutional Controls	Institutional Controls	Deed Restrictions	Handles Volume Low Reliability Low Protectiveness Medium Meets Goals Low	TSD Availability NA Equipment/Resources Medium Acquire Permits NA	Capital Low O & M Low	Retain for limited use
		Monitoring	Handles Volume High Reliability High Protectiveness Medium Meets Goals Low	TSD Availability NA Equipment/Resources High Acquire Permits High	Capital Low O & M Low	Retain for limited use
Containment	Capping	Clay Capping	Handles Volume High Reliability Medium Protectiveness Medium Meets Goals Medium	TSD Availability NA Equipment/Resources High Acquire Permits Medium	Capital Low O & M Low	Retain
Removal	Extraction	Extraction Wells	Handles Volume High Reliability High Protectiveness High Meets Goals Medium	TSD Availability NA Equipment/Resources High Acquire Permits High	Capital Low O & M Low	Retain
Disposal	Surface Discharge	Indirect Discharge(POTW)	Handles Volume Low Reliability Medium Protectiveness High Meets Goals High	TSD Availability High Equipment/Resources Low Acquire Permits Low	Capital High O & M High	Eliminate
	Subsurface Discharge	Reinjection	Handles Volume High Reliability Medium Protectiveness Medium Meets Goals Medium	TSD Availability NA Equipment/Resources High Acquire Permits High	Capital Medium O & M Medium	Eliminate

TABLE 2-20 (continued)
COMPARATIVE SUMMARY OF TECHNOLOGY SCREENING FOR SITE GROUNDWATERS
NWIRP, BETHPAGE, NEW YORK
PAGE 2

Remedial Action	Technology	Process Option	Effectiveness	Implementability	Cost	Retain/ Eliminate
	Beneficial Re-use	Process Water / Potable Water	Handles Volume High Reliability High Protectiveness Medium Meets Goals High	TSD Availability NA Equipment/Resources High Acquire Permits High	Capital Low O & M Low	Retain
Treatment	Physical	Dewatering	Handles Volume High Reliability High Protectiveness Medium Meets Goals Medium	TSD Availability NA Equipment/Resources High Acquire Permits High	Capital Medium O & M Medium	Retain
	Physical	Sedimentation	Handles Volume High Reliability High Protectiveness Medium Meets Goals Medium	TSD Availability NA Equipment/Resources High Acquire Permits High	Capital Low O & M Low	Retain
		Volatilization	Handles Volume High Reliability High Protectiveness High Meets Goals High	TSD Availability NA Equipment/Resources High Acquire Permits Medium	Capital Low O & M Low/Med	Retain
		Equalization	Handles Volume High Reliability High Protectiveness Medium Meets Goals Medium	TSD Availability NA Equipment/Resources High Acquire Permits High	Capital Low O & M Low	Retain
		Filtration	Handles Volume High Reliability High Protectiveness Medium Meets Goals Medium	TSD Availability NA Equipment/Resources High Acquire Permits High	Capital Low O & M Low/Med	Retain
		Reverse Osmosis	Handles Volume High Reliability Medium Protectiveness Medium Meets Goals Medium	TSD Availability NA Equipment/Resources Medium Acquire Permits Medium	Capital High O & M High	Eliminate

TABLE 2-20 (continued)
COMPARATIVE SUMMARY OF TECHNOLOGY SCREENING FOR SITE GROUNDWATERS
NWIRP, BETHPAGE, NEW YORK
PAGE 3

Remedial Action	Technology	Process Option	Effectiveness	Implementability	Cost	Retain/ Eliminate
		Adsorption	Handles Volume High Reliability High Protectiveness High Meets Goals High	TSD Availability High Equipment/Resources High Acquire Permits High	Capital Low O & M Low/High	Retain
	Chemical	Enhanced Oxidation	Handles Volume Medium Reliability Medium Protectiveness High Meets Goals High	TSD Availability NA Equipment/Resources Medium Acquire Permits High	Capital Med/Hi O & M Med/Hi	Retain
		Ion Exchange	Handles Volume High Reliability High Protectiveness Medium Meets Goals Medium	TSD Availability NA Equipment/Resources High Acquire Permits High	Capital Medium O & M Med/Hi	Eliminate
		Reduction	Handles Volume High Reliability High Protectiveness Medium Meets Goals Medium	TSD Availability NA Equipment/Resources Medium Acquire Permits High	Capital Low O & M Low/Med	Retain for limited use
	Chemical	Neutralization	Handles Volume High Reliability High Protectiveness Medium Meets Goals Medium	TSD Availability NA Equipment/Resources High Acquire Permits High	Capital Low O & M Low	Retain
		Flocculation / Coagulation	Handles Volume High Reliability High Protectiveness Medium Meets Goals Medium	TSD Availability NA Equipment/Resources Medium Acquire Permits High	Capital Medium O & M Medium	Retain
		Precipitation	Handles Volume High Reliability High Protectiveness High Meets Goals Medium	TSD Availability NA Equipment/Resources Medium Acquire Permits High	Capital Medium O & M Medium	Retain

TABLE 2-20 (continued)
COMPARATIVE SUMMARY OF TECHNOLOGY SCREENING FOR SITE GROUNDWATERS
NWIRP, BETHPAGE, NEW YORK
PAGE 4

Remedial Action	Technology	Process Option	Effectiveness	Implementability	Cost	Retain/ Eliminate
In-Situ Treatment	Chemical / Physical	Soil Flushing	Handles Volume Medium Reliability Low Protectiveness Medium Meets Goals Medium	TSD Availability NA Equipment/Resources Medium Acquire Permits Low/Med	Capital Medium O & M Medium	Eliminate

- Treatment Technologies
  - Equalization
  - Neutralization
  - Volatilization (Air stripping)
  - Adsorption (Granular activated carbon)
  - Enhanced oxidation (UV/hydrogen peroxide)
  - Filtration (pressure sand filters)
  - Coagulation/flocculation/precipitation w/reduction (ferrous iron)
  - Sedimentation (clarification and sludge thickening)
  - Sludge dewatering (plate and frame filter press)

3.0 DEVELOPMENT AND DESCRIPTION OF REMEDIAL ACTION ALTERNATIVES

3.1 RATIONALE FOR DEVELOPMENT OF ALTERNATIVES

3.1.1 Introduction

In this section, remedial alternatives are developed to address the remedial response objectives for the contaminated soils and groundwater at the Bethpage NWIRP. The alternatives range from no-action alternatives to alternatives which completely achieve the remediation goals using treatment. The no-action alternatives for soils and groundwater provide a baseline for comparison purposes. Components of the remaining alternatives consist of the various technologies and process options retained from the screening procedures (Section 2.4) and are assembled into alternatives in accordance with the General Response Actions (Section 2.3).

The National Contingency Plan (NCP; 40 CFR 300.430) encourages development of alternatives that favor treatment technologies to address principal threats and favor engineering controls to address relatively low long-term threats. Additionally, the NCP suggests development of a range of treatment alternatives, one or more engineering control alternatives (e.g., containment), one or more innovative treatment alternatives, and the baseline no-action alternative. The alternatives presented in this FS were developed in accordance with the NCP.

3.1.2 Soil

As discussed in Section 2.3.1, the General Response Actions potentially applicable to soils are:

- No Action
- Institutional Controls
- Containment
- Removal/Disposal
- Removal/Treatment/Disposal
- In-situ Treatment

The technology and process option screening (Section 2.4) did not eliminate any of the above listed General Response Actions from further consideration. Institutional controls (i.e., deed restrictions, monitoring) are eliminated from consideration as an independent alternative; however, institutional controls are retained in support of other alternatives where contaminated soil remains on site. Examples include onsite containment alternatives or alternatives which do not remove or treat all of the contaminated soil.

The retained technologies/process options have been combined into alternatives discussed in detail in Section 3.3. Support soil volume calculations and soil alternatives costing are provided in Appendix B and Appendix E, respectively.

3.1.3 Groundwater

As discussed in Section 2.3.2, the General Response Actions potentially applicable to groundwater are:

- No Action
- Institutional Controls
- Containment
- Extraction/Discharge
- Extraction/Treatment/Discharge
- In-situ Treatment

The technology and process option screening (Section 2.4) eliminated three of the General Response Actions from further consideration. Removal (extraction)/discharge was eliminated because no existing onsite or offsite treatment facility is capable of handling the large volumes of contaminated groundwater. In-situ treatment was eliminated because of the deep vertical extent of contamination. Moreover, in-situ treatment is ineffective for the site toxic metals. Containment was eliminated as a response action due to the large horizontal and vertical extent of groundwater contamination.

Institutional controls (i.e., deed restrictions and monitoring) are eliminated from consideration as an independent alternative; however, institutional controls are retained in support of other alternatives while groundwater remediation is in progress and where contaminated groundwater remains in place. Although excluded from a given alternative descriptive title, institutional controls are included in each alternative except for the no action alternative.

The retained technologies/process options have been combined into alternatives discussed in detail in Section 3.4. Support groundwater volume and treatment system calculations are provided in Appendix C. Appendix D provides groundwater modeling results. Appendix E presents groundwater alternatives costing.

3.2 EVALUATION CRITERIA

The groundwater and soil remedial alternatives are evaluated against three broad criteria: effectiveness, implementability, and cost. This evaluation typically reduces the number of alternatives that will undergo a more thorough and extensive analysis; alternatives are evaluated more generally in this phase than during the subsequent detailed analysis of Section 4.0. Due to the limited number of alternatives developed for the NWIRP site, all alternatives will be carried through to detailed analysis. All alternatives developed are feasible based on an initial evaluation of effectiveness, implementability, and cost.

A key aspect of the screening evaluation is the effectiveness of an alternative in protecting human health and the environment. In addition to determining the effectiveness of the alternatives in meeting the remedial action objectives, each alternative is evaluated for its effectiveness in achieving reductions in toxicity, mobility, and volume. The short- and long-term effectiveness are also evaluated, with the short-term effectiveness referring to the active remediation (construction) period and the long-term effectiveness referring to the post-remediation period.

Implementability is a measure of both the technical and administrative feasibility of constructing, operating, and maintaining a remedial alternative. It provides a means of evaluating the ability of an alternative to be adapted to site-specific conditions.

Cost evaluations allow a relative comparison between similar alternatives. The cost evaluation is based on a variety of cost-estimating data such as vendor quotations, cost curves, generic unit costs, conventional cost-estimating guides, commercial remedial costs, and previous similar remediation costs as modified by site-specific information.

3.3 IDENTIFICATION AND SCREENING OF SOIL ALTERNATIVES

The remedial alternatives developed for soil are described below:

3.3.1 Alternative S1 - No Action

This alternative is a no-action alternative, and is developed and retained for baseline comparison purposes with the other alternatives, as required by the NCP. The only activity that would occur under the no-action alternative is periodic reviews, typically every 5 years. Additional description of this alternative is provided in Section 4.2.1.

3.3.2 Alternative S2A - Clay Capping (Current Industrial Use)

Alternative S2A (refer to Figure 3-1) was developed as a containment response action. At each of the three sites, contaminated soils with metals and organics concentrations greater than the current industrial use scenario action levels would be capped. Primary contaminants contained include chlorinated volatile organics (TCE, PCE, and TCA), arsenic, PCBs, and various other metals and organics. Although contaminated soils would remain in place, exposure pathways are reduced. An impermeable clay cap system is featured. From bottom to top layers, the clay cap system consists of 6 inches of gravel (vapor barrier), 1 foot of compacted clay, and 6 inches of gravel covered by 2 feet of clean soil. Soil conditioning, fertilization, and revegetation would be employed as necessary, based on end use and erosion considerations.

Deed restrictions would also be required to restrict future use of the affected areas. Additional description of this alternative is provided in Section 4.2.2.

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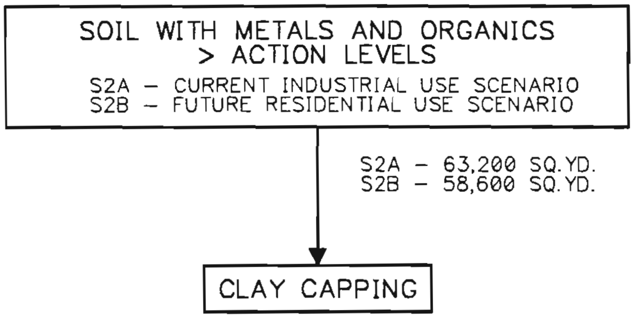

NOTE:

1. SOIL ACTION LEVELS ARE PRESENTED IN TABLE 2–12. UNLESS OTHERWISE NOTED, THE SOIL ACTION LEVEL IS THE MINIMUM OF THE RISK–BASED, ARAR–BASED, AND TBC–BASED GOALS.

2. AREAS AND VOLUMES PRESENTED ARE PRELIMINARY AND MAY BE REVISED DURING THE REMEDIAL DESIGN AND REMEDIAL ACTION STAGES.

SOILS ALTERNATIVES S2A AND S2B
CLAY CAPPING
NWIRP, BETHPAGE, NEW YORK

FIGURE 3–1

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Alternative S2A results in the capping of approximately 63,200 square yards (Site 1- 7,800 square yards; Site 2- 31,200 square yards; Site 3- 24,200 square yards), see Figure 3-2. This acreage excludes the Site 1 VOC-contaminated soils underlying Plant No. 3 and the concrete area adjacent to Plant No. 3, which already serves as an effective cap. Note that the volumes presented are preliminary and may be modified based on additional testing that would be conducted during the Remedial Design/Remedial Action stage.

3.3.3 Alternative S2B - Clay Capping (Future Residential Use)

Alternative S2B is essentially the same as Alternative S2A, except that associated total soil volume is less for the future residential use scenario of Alternative S2B than the current industrial use scenario of Alternative S2A. The decrease in volume is attributed to the assumption that fugitive dust sources are insignificant in a residential area. This assumption is based on the consideration that residential area soils are effectively covered by asphalt (roads) and vegetation (lawns).

Alternative S2B (refer to Figure 3-1) was developed as a containment response action. At each of the three sites, contaminated soils with metals and organics concentrations greater than the future residential use scenario action levels would be capped. Primary contaminants contained include chlorinated volatile organics (TCE, PCE, and TCA), arsenic, PCBs, and various other metals and organics. Although contaminated soils would remain in place, exposure pathways are reduced. An impermeable clay cap system is featured. From bottom to top layers, the clay cap system consists of 6 inches of gravel (vapor barrier), 1 foot of compacted clay, and 6 inches of gravel covered by 2 feet of clean soil. Soil conditioning, fertilization, and revegetation would be employed as necessary, based on end use and erosion considerations.

Deed restrictions would also be required to restrict future use of the affected areas. Additional description of this alternative is provided in Section 4.2.2.

Alternative S2B results in the capping of approximately 58,600 square yards (Site 1- 7,300 square yards; Site 2- 29,400 square yards; Site 3- 21,900 square yards), see Figure 3-2. This acreage excludes the Site 1 VOC-contaminated soils underlying Plant No. 3 and the concrete area adjacent to Plant No. 3, which already serves as an effective cap. Note that the volumes presented are preliminary and may be modified based on additional testing that would be conducted during the Remedial Design/Remedial Action stage.

3.3.4 Alternative S3 - Fixation of Metals, Incineration of PCBs> 50 ppm, and In-Situ Vapor Extraction of VOCs

Alternative S3 combines removal/treatment/disposal and in-situ treatment response actions. This alternative addresses soil "hot spots" (i.e., metals at concentrations greater than hazardous waste criteria, as defined by the USEPA under 40 CFR 261.24, and PCB concentrations greater than 50 ppm) using conventional techniques. Additionally, the primary site contaminants, VOCs, are addressed using in-situ vapor extraction and air sparging; this technology was featured due to anticipated technical effectiveness

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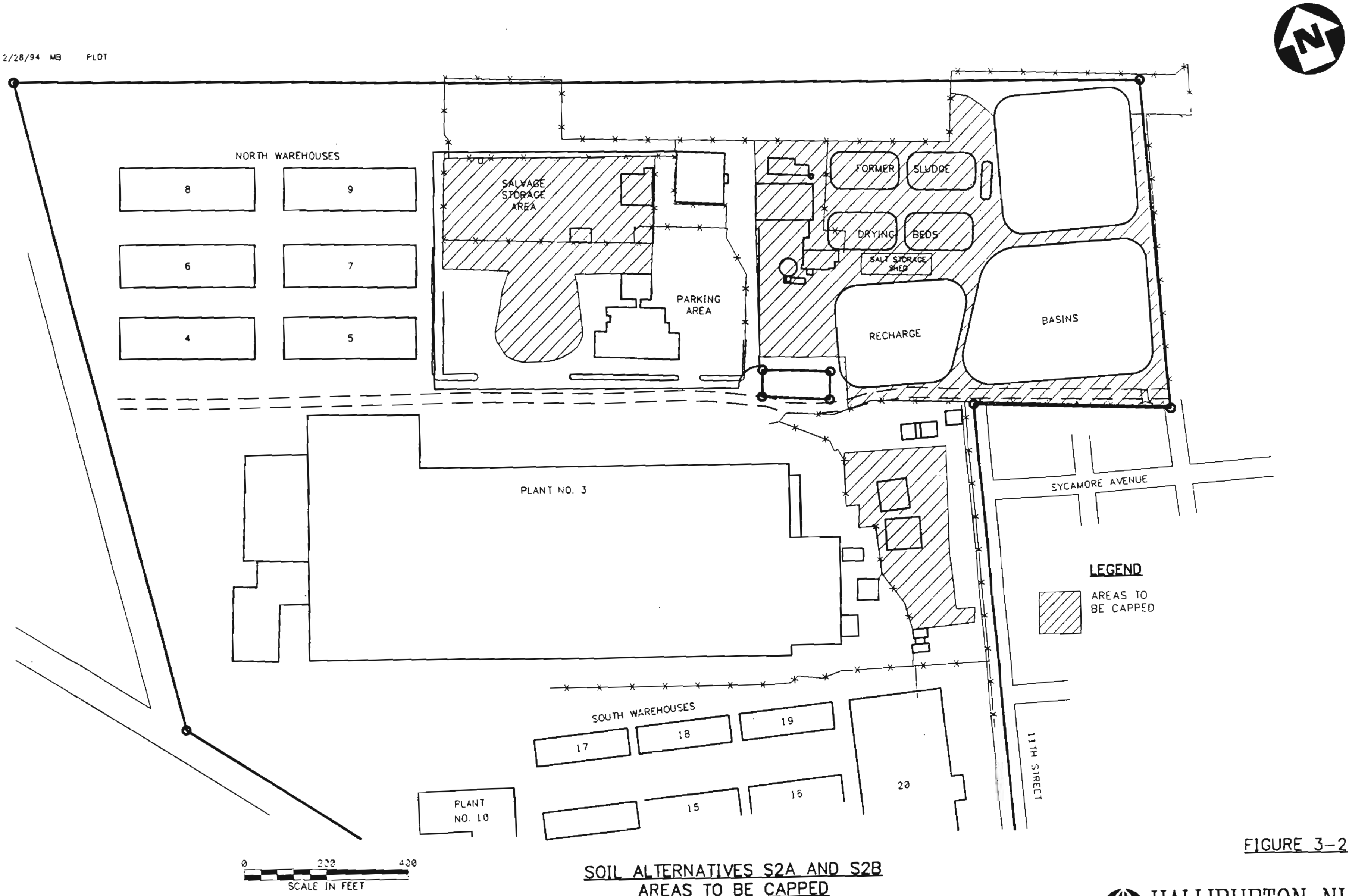

FIGURE 3-2

SOIL ALTERNATIVES S2A AND S2B
AREAS TO BE CAPPED
PHASE 2 REMEDIAL INVESTIGATION/FEASIBILITY STUDY
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and cost effectiveness, considering the large extent of contamination and the presence of highly permeable sandy soils at the sites. For areas with other metal- and organic-contaminated soils at concentrations greater than action levels, a 6-inch gravel cover or a 6-inch vegetated soil cover would be employed for industrial (S3A) or residential (S3B) use scenarios, respectively, (see Figure 3-2 for areas that would be capped). Additional description of this alternative is provided in Section 4.2.3.

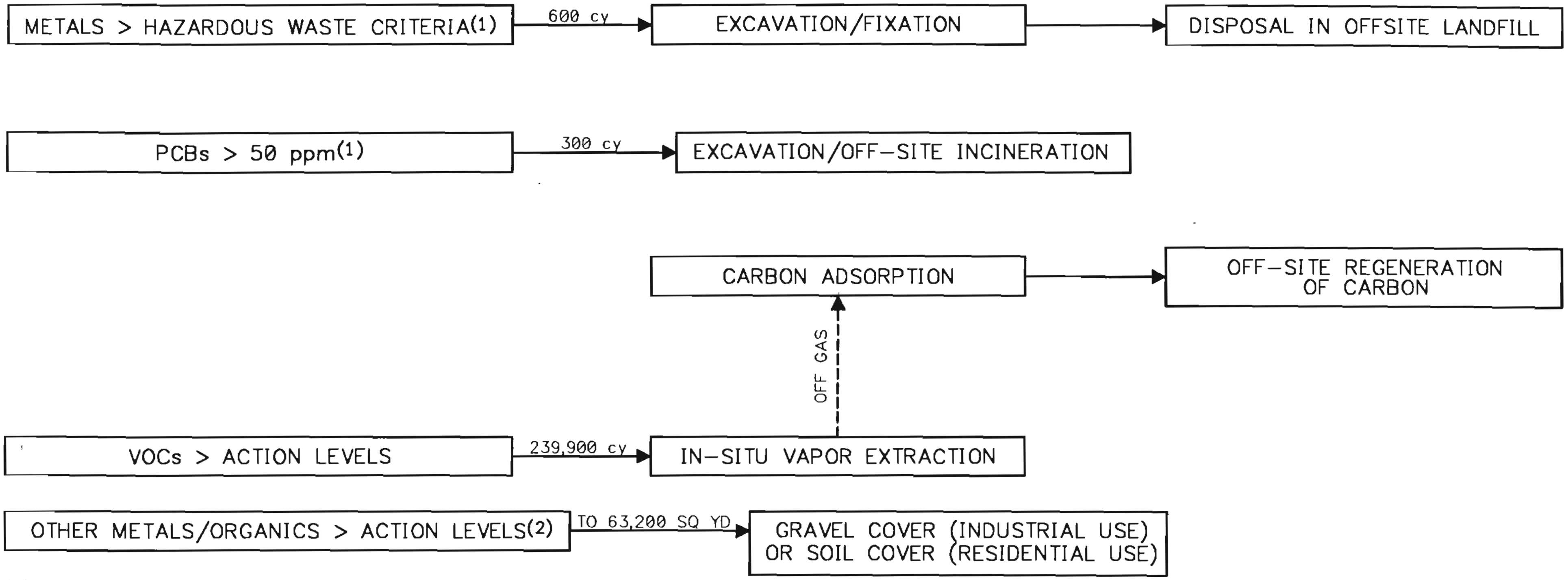
Alternative S3 (refer to Figure 3-3) includes bulk excavation of all soils with metal concentrations greater than the hazardous waste criteria, which occurs only at Site 1 and only for arsenic. The hazardous waste criteria for arsenic in the TCLP leachate is 5 mg/l. This contaminated soil would be fixated either on site or off site, using a suitable binder such as ferrous sulfate and/or lime to reduce the mobility of the metals. Preliminary screening of the material may also be required to protect the treatment equipment by separating out oversized material. The fixated soil would then be disposed of in an offsite landfill. A nonhazardous waste landfill should suffice since the resultant fixated soil should no longer be hazardous by characteristic.

In accordance with TSCA regulations, soils containing PCBs in concentrations greater than 50 ppm, which occurs only at Site 1, would be excavated and transported to an approved offsite incineration facility. The PCBs of concern at the site include Aroclors 1248 and 1254. During offsite incineration, the PCBs would volatilize in the offsite incinerator's primary chamber and be oxidized to harmless substances such as carbon dioxide and water in the secondary chamber.

Soils contaminated with VOCs at concentrations greater than action levels would be processed via in-situ vapor extraction and air sparging. Primary site volatile organics to be addressed include PCE, TCE, and 1,1,1-TCA. In-situ vapor extraction is a demonstrated technology for the removal of VOCs from the unsaturated region or vadose zone of soils. Following excavation of soils with hazardous levels of metals and PCB "hot spots", the periphery of the contaminated region would be identified and injection/extraction wells placed accordingly. Site 1 VOC-contaminated soils underlying Plant No. 3 would be accessed by drilling injection/extraction wells through the plant floor. Vapor extraction utilizes an induced vacuum to pull air through the soil. The vacuum transports volatile organic contaminants out of the soil to a vapor collection system. Upon withdrawal, the contaminated air stream is treated with a technique appropriate for the specific compounds. Treatment technologies for the effluent air steam may consist of carbon adsorption, combustion, or catalytic destruction. Carbon adsorption has been selected as the representative process option, based on anticipated air stream contaminant concentrations. Spent carbon would be regenerated either offsite or onsite.

For areas to be capped, a permeable material would be used, as feasible. This cap would minimize restrictions on future use of the site, as well as promote precipitation infiltration and natural attenuation of residual contaminants. Deed restrictions would be required to restrict both current industrial use and future residential use of the site since other metal- and organics-contaminated soil remains in place.

Soil volumes include 600 cubic yards of arsenic-contaminated soil exceeding the hazardous waste criteria (Site 1 only) to be excavated, fixated and landfilled; 300 cubic yards of PCB-contaminated soil with



(1) TO BE CONDUCTED PRIOR TO VOCs TREATMENT
(2) TO BE CONDUCTED FOLLOWING VOCs TREATMENT

NOTE:

1. SOIL ACTION LEVELS ARE PRESENTED IN TABLE 2-12. UNLESS OTHERWISE NOTED, THE SOIL ACTION LEVEL IS THE MINIMUM OF THE RISK-BASED, ARAR-BASED, AND TBC-BASED GOALS.
2. AREAS AND VOLUMES PRESENTED ARE PRELIMINARY AND MAY BE REVISED DURING THE REMEDIAL DESIGN AND REMEDIAL ACTION STAGES.

SOILS ALTERNATIVES S3A AND S3B
FIXATION OF METALS, LANDFILLING OF PCBS > 50 ppm
IN-SITU VAPOR EXTRACTION OF VOCS
AND COVER OF OTHER METALS/ORGANICS > ACTION LEVELS
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FIGURE 3-3

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concentrations greater than 50 ppm (Site 1 only) to be incinerated offsite; and 239,900 cubic yards of VOC-contaminated soil (Site 1- 115,400 cubic yards; Site 2- 3,100 cubic yards; Site 3- 121,400 cubic yards) to undergo in-situ vapor extraction. The Site 1 soil volume includes the VOC-contaminated soils underlying Plant No. 3 and the concrete area adjacent to Plant No. 3. Note that the volumes presented are preliminary and may be modified based on additional testing that would be conducted during the Remedial Design/Remedial Action stage.

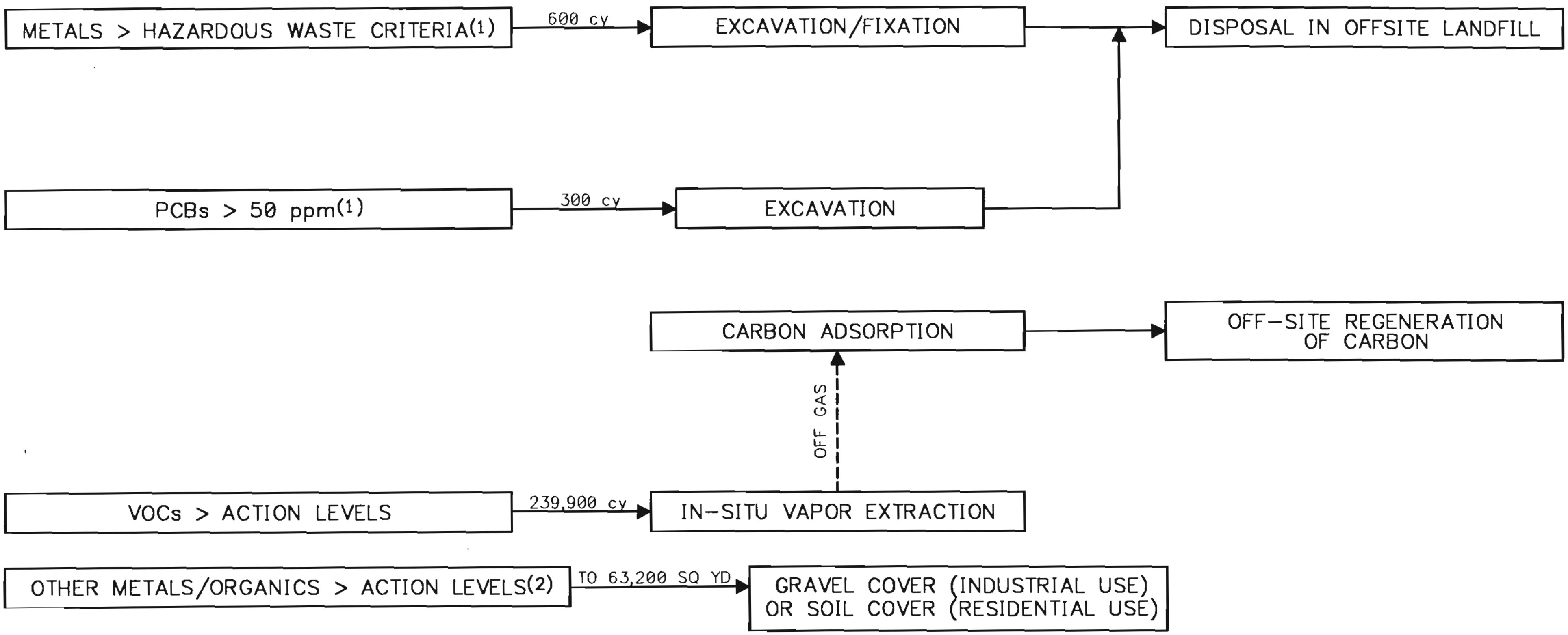
3.3.5 Alternative S4 - Fixation of Metals, Landfilling of PCBs> 50 ppm, and In-Situ Vapor Extraction of VOCs

This alternative is same as Alternative 3, except that soils with PCB concentrations greater than 50 ppm would be landfilled offsite instead of incinerated. Alternative S4 combines removal/treatment/disposal and in-situ treatment response actions. This alternative addresses soil "hot spots" (i.e., metals at concentrations greater than hazardous waste criteria, as defined by the USEPA under 40 CFR 261.24, and PCB concentrations greater than 50 ppm) using conventional techniques. Additionally, the primary contaminants, VOCs, are addressed using in-situ vapor extraction and air sparging; this technology was featured due to anticipated technical effectiveness and cost effectiveness, considering the large extent of contamination and the presence of highly permeable sandy soils at the sites. For areas with other metal- and organic-contaminated soils at concentrations greater than action levels, a 6-inch gravel cover or a 6-inch vegetated soil cover would be employed for industrial (S4A) or residential (S4B) use scenarios, respectively, (see Figure 3-2 for areas that would be capped). Additional description of this alternative is provided in Section 4.2.4.

Alternative S4 (refer to Figure 3-4) includes bulk excavation of all soils with metal concentrations greater than the hazardous waste criteria, which occurs only at Site 1 and only for arsenic. The hazardous waste criteria for arsenic in the TCLP leachate is 5 mg/l. This contaminated soil would be fixated either on site or off site, using a suitable binder such as ferrous sulfate and/or lime to reduce the mobility of the metals. Preliminary screening of the material may also be required to protect the treatment equipment by separating out oversized material. The fixated soil would then be disposed of in an offsite landfill. A nonhazardous waste landfill should suffice since the resultant fixated soil should no longer be hazardous by characteristic.

In accordance with TSCA regulations, soils containing PCBs in concentrations greater than 50 ppm, which occurs only at Site 1, would be excavated and transported to an approved offsite landfill. The PCBs of concern at the site include Aroclors 1248 and 1254.

Soils contaminated with VOCs at concentrations greater than action levels would be processed via in-situ vapor extraction and air sparging. Primary site volatile organics to be addressed include PCE, TCE, and 1,1,1-TCA. In-situ vapor extraction is a demonstrated technology for the removal of VOCs from the unsaturated region or vadose zone of soils. Following excavation of the soils with metals at hazardous waste concentrations and PCB "hot spots", the periphery of the contaminated region would be identified and injection/extraction wells placed accordingly. Site 1 VOC-contaminated soils underlying Plant No. 3



(1) TO BE CONDUCTED PRIOR TO VOCs TREATMENT
(2) TO BE CONDUCTED FOLLOWING VOCs TREATMENT

NOTE:

1. SOIL ACTION LEVELS ARE PRESENTED IN TABLE 2-12. UNLESS OTHERWISE NOTED, THE SOIL ACTION LEVEL IS THE MINIMUM OF THE RISK-BASED, ARAR-BASED, AND TBC-BASED GOALS.
2. AREAS AND VOLUMES PRESENTED ARE PRELIMINARY AND MAY BE REVISED DURING THE REMEDIAL DESIGN AND REMEDIAL ACTION STAGES.

SOILS ALTERNATIVES S4A AND S4B
FIXATION OF METALS, LANDFILLING OF PCBS > 50 ppm
IN-SITU VAPOR EXTRACTION OF VOCS
AND COVER OF OTHER METALS/ORGANICS > ACTION LEVELS
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FIGURE 3-4

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would be accessed by drilling injection/extraction wells through the plant floor. Vapor extraction utilizes an induced vacuum to pull air through the soil. The vacuum transports volatile organic contaminants out of the soil to a vapor collection system. Upon withdrawal, the contaminated air stream is treated with a technique appropriate for the specific compounds. Treatment technologies for the effluent air steam may consist of carbon adsorption, combustion, or catalytic destruction. Carbon adsorption has been selected as the representative process option, based on anticipated air stream contaminant concentrations. Spent carbon would be regenerated either offsite or onsite.

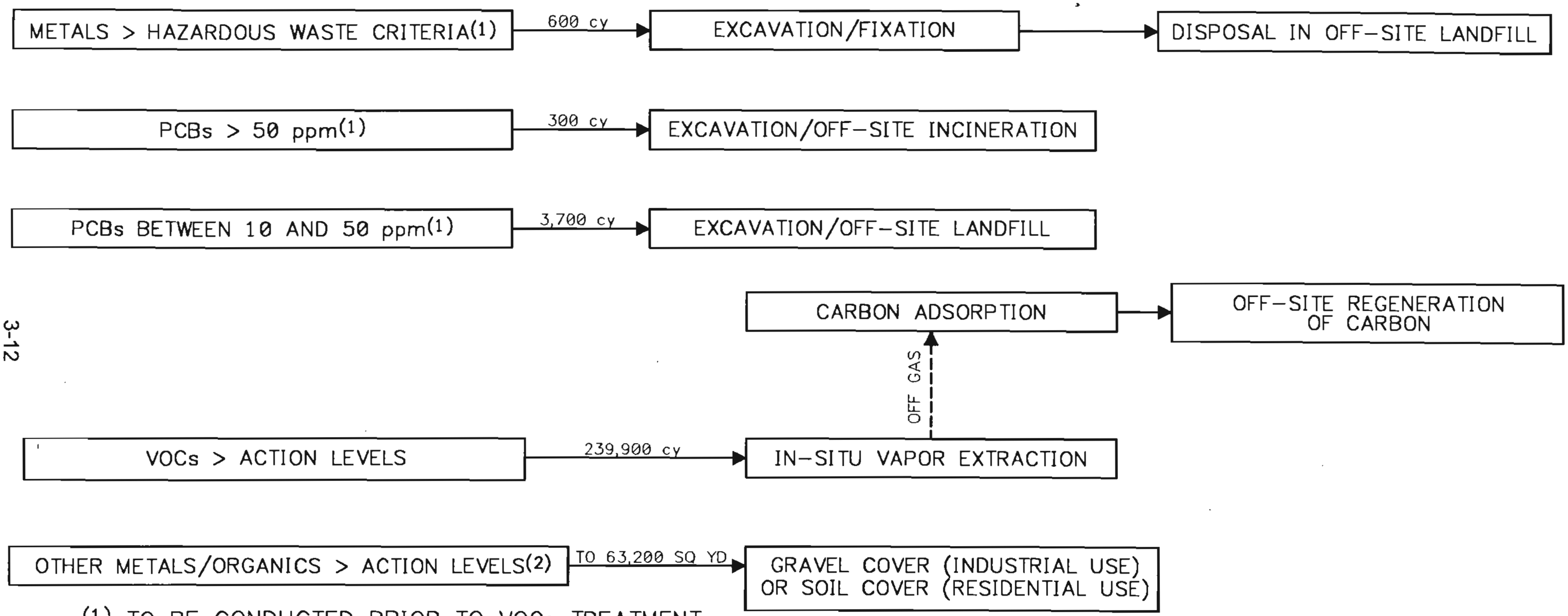
For areas to be capped, a permeable material would be used, as feasible. This cap would minimize restrictions on future use of the site, as well as promote precipitation infiltration and natural attenuation of residual contaminants. Deed restrictions would be required to restrict both current industrial use and future residential use of the site since other metal- and organics-contaminated soil remains in place.

Soil volumes include 600 cubic yards of arsenic-contaminated soil exceeding the hazardous waste criteria (Site 1 only) to be excavated, fixated and landfilled; 300 cubic yards of PCB-contaminated soil with concentrations greater than 50 ppm (Site 1 only) to be landfilled off site; and 239,900 cubic yards of VOC-contaminated soil (Site 1- 115,400 cubic yards; Site 2- 3,100 cubic yards; Site 3- 121,400 cubic yards) to undergo in-situ vapor extraction. The Site 1 soil volume includes the VOC-contaminated soils underlying Plant No. 3 and the concrete area adjacent to Plant No. 3. Note that the volumes presented are preliminary and may be modified based on additional testing that would be conducted during the Remedial Design/Remedial Action stage.

3.3.6 Alternative S5 - Fixation of Metals, Incineration of PCBs> 50 ppm, Landfill of PCBs between 10 ppm and 50 ppm, and In-Situ Vapor Extraction of VOCs

Alternative S5 consists of the same components/soil volumes as Alternative S3, except that Alternative S5 provides for offsite landfilling of soils with PCB concentrations of 10 ppm to 50 ppm. Under Alternative S3, these soils would be covered with a permeable cap along with the other soils contaminated with metals and organics greater than the action levels. Alternative S5 combines removal/ treatment/disposal, removal/disposal and in-situ treatment response actions. This alternative addresses soil "hot spots" (i.e., metals at concentrations greater than hazardous waste criteria and PCB concentrations greater than 10 ppm) using conventional techniques. Additionally, the primary contaminants, VOCs, are all addressed using in-situ vapor extraction and air sparging. This technology was selected based on anticipated technical effectiveness and cost effectiveness criteria, especially when considering the large extent of contamination and the presence of highly permeable sandy soils at the sites. For areas with other metal- and organic-contaminated soils at concentrations greater than the action levels, a 6-inch gravel cover or a 6-inch vegetated soil cover would be employed for industrial (S5A) or residential (S5B) use scenarios, respectively, (see Figure 3-2 for areas that would be capped). Additional description of this alternative is provided in Section 4.2.5.

Alternative S5 (refer to Figure 3-5) includes bulk excavation of all soils with metal concentrations greater than the hazardous waste criteria, which occurs only at Site 1 and only for arsenic. The hazardous waste



(1) TO BE CONDUCTED PRIOR TO VOCs TREATMENT
(2) TO BE CONDUCTED FOLLOWING VOCs TREATMENT

NOTE:

1. SOIL ACTION LEVELS ARE PRESENTED IN TABLE 2-12. UNLESS OTHERWISE NOTED, THE SOIL ACTION LEVEL IS THE MINIMUM OF THE RISK-BASED, ARAR-BASED, AND TBC-BASED GOALS.
2. AREAS AND VOLUMES PRESENTED ARE PRELIMINARY AND MAY BE REVISED DURING THE REMEDIAL DESIGN AND REMEDIAL ACTION STAGES.

SOILS ALTERNATIVES S5A AND S5B
FIXATION OF METALS, INCINERATION OF PCBS > 50 ppm
OFF-SITE LANDFILL PCBs BETWEEN 10 ppm AND 50 ppm
IN-SITU VAPOR EXTRACTION OF VOCS
AND COVER OF OTHER METALS/ORGANICS > ACTION LEVELS
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FIGURE 3-5

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criteria for arsenic in the TCLP leachate is 5 mg/l. This contaminated soil would be fixated either on site or off site, using a suitable binder such as ferrous sulfate and/or lime to reduce the mobility of the metals. Preliminary screening of the material may also be required to protect the treatment equipment by separating out oversized material. The fixated soil would then be disposed of in an offsite landfill. A nonhazardous waste landfill should suffice since the resultant fixated soil should no longer be hazardous by characteristic.

In accordance with TSCA regulations, soils containing PCBs in concentrations greater than 50 ppm, which occurs only at Site 1, would be excavated and transported to an approved offsite incineration facility. The PCBs of concern at the site include Aroclors 1248 and 1254. During offsite incineration, the PCBs would volatilize in the offsite incinerator's primary chamber and be oxidized to harmless substances such as carbon dioxide and water in the secondary chamber.

This alternative includes offsite disposal for soils containing PCBs in concentrations between 10 ppm and 50 ppm. Offsite disposal is an acceptable method based on TSCA regulatory criteria and is more economical than incineration. Soils of concern would be excavated and transported offsite to an approved hazardous waste landfill.

Soils contaminated with VOCs at concentrations greater than action levels would be processed via in-situ vapor extraction and air sparging. Primary site volatile organics to be addressed include PCE, TCE, and 1,1,1-TCA. In-situ vapor extraction is a demonstrated technology for the removal of VOCs from the unsaturated region or vadose zone of soils. Following excavation of soils with metals at a hazardous level and PCB "hot spots", the periphery of the contaminated region would be identified and injection/extraction wells placed accordingly. Site 1 VOC-contaminated soils underlying Plant No. 3 would be accessed by drilling injection/extraction wells through the plant floor. Vapor extraction utilizes an induced vacuum to pull air through the soil. The vacuum transports volatile organic contaminants out of the soil to a vapor collection system. Upon withdrawal, the contaminated air stream is treated with a technique appropriate for the specific compounds. Treatment technologies for the effluent air steam may consist of carbon adsorption, combustion, or catalytic destruction. Carbon adsorption has been selected as the representative process option, based on anticipated air stream contaminant concentrations. Spent carbon would be regenerated either offsite or onsite.

For areas to be capped, a permeable material would be used, as feasible. This cap would minimize restrictions on future use of the site, as well as promote precipitation infiltration and natural attenuation of residual contaminants. Deed restrictions would be required to restrict both current industrial use and future residential use of the site since other metal- and organics-contaminated soil remains in place.

Soil volumes include 600 cubic yards of arsenic-contaminated soil exceeding the hazardous waste criteria (Site 1 only) to be excavated, fixated and landfilled; 300 cubic yards of PCB-contaminated soil with concentrations greater than 50 ppm (Site 1 only) to be incinerated off site; 3,700 cubic yards of PCB-contaminated soil with concentrations between 10 ppm and 50 ppm (Site 1- 1,100 cubic yards; Site 2- 2,600 cubic yards) to be disposed of off site; and 239,900 cubic yards of VOC-contaminated soil (Site 1- 115,400 cubic yards; Site 2- 3,100 cubic yards; Site 3- 121,400 cubic yards) to undergo in-situ vapor extraction. The Site 1 soil volume includes VOC-contaminated soils underlying Plant No. 3 and the adjacent Plant No. 3 concrete area. Note that the volumes presented are preliminary and may be modified based on additional testing that would be conducted during the Remedial Design/Remedial Action stage.

3.3.7 Alternative S6 - Fixation of Metals, Incineration of PCBs> 50 ppm, Landfill of PCBs between 10 ppm and 50 ppm, and Limited In-Situ Vapor Extraction of VOCs

Alternative S6 is similar to Alternative S5, except Alternative S6 addresses a more limited volume of VOC-contaminated soils. Alternative S6 combines removal/treatment/disposal, removal/disposal and in-situ treatment response actions. This alternative addresses soil "hot spots" (i.e., metals at concentrations greater than hazardous waste criteria, as defined by the USEPA under 40 CFR 261.24, and PCB concentrations greater than 10 ppm) using conventional techniques. Additionally, a majority of the primary contaminants, VOCs, are addressed using in-situ vapor extraction and air sparging. This technology was selected based on anticipated technical effectiveness and cost effectiveness criteria, especially when considering the large extent of contamination and the presence of highly permeable sandy soils at the sites. For areas with other metal- and organic-contaminated soils at concentrations greater than action levels, a 6-inch gravel cover or a 6-inch vegetated soil cover would be employed for industrial (S6A) or residential (S6B) use scenarios, respectively, (see Figure 3-2 for areas that would be capped). Additional description of this alternative is provided in Section 4.2.6.

Alternative S6 (refer to Figure 3-6) includes bulk excavation of all soils with metal concentrations greater than the hazardous waste criteria, which occurs only at Site 1 and only for arsenic. The hazardous waste criteria for arsenic in the TCLP leachate is 5 mg/l. This contaminated soil would be fixated either on site or off site, using a suitable binder such as ferrous sulfate and/or lime to reduce the mobility of the metals. Preliminary screening of the material may also be required to protect the treatment equipment by separating out oversized material. The fixated soil would then be disposed of in an offsite landfill. A nonhazardous waste landfill should suffice since the resultant fixated soil should no longer be hazardous by characteristic.

In accordance with TSCA regulations, soils containing PCBs in concentrations greater than 50 ppm, which occurs only at Site 1, would be excavated and transported to an approved offsite incineration facility. The PCBs of concern at the site include Aroclors 1248 and 1254. During offsite incineration, the PCBs would volatilize in the offsite incinerator's primary chamber and be oxidized to harmless substances such as carbon dioxide and water in the secondary chamber.

This alternative includes offsite disposal for soils containing PCBs in concentrations between 10 ppm and 50 ppm. Offsite disposal is an acceptable method based on TSCA regulatory criteria and is more economical than incineration. Soils of concern would be excavated and transported offsite to an approved hazardous waste landfill.

Soils contaminated with VOCs at concentrations greater than modified action levels would be processed *via in-situ* vapor extraction and air sparging. The modified action levels for VOCs are equal to three times

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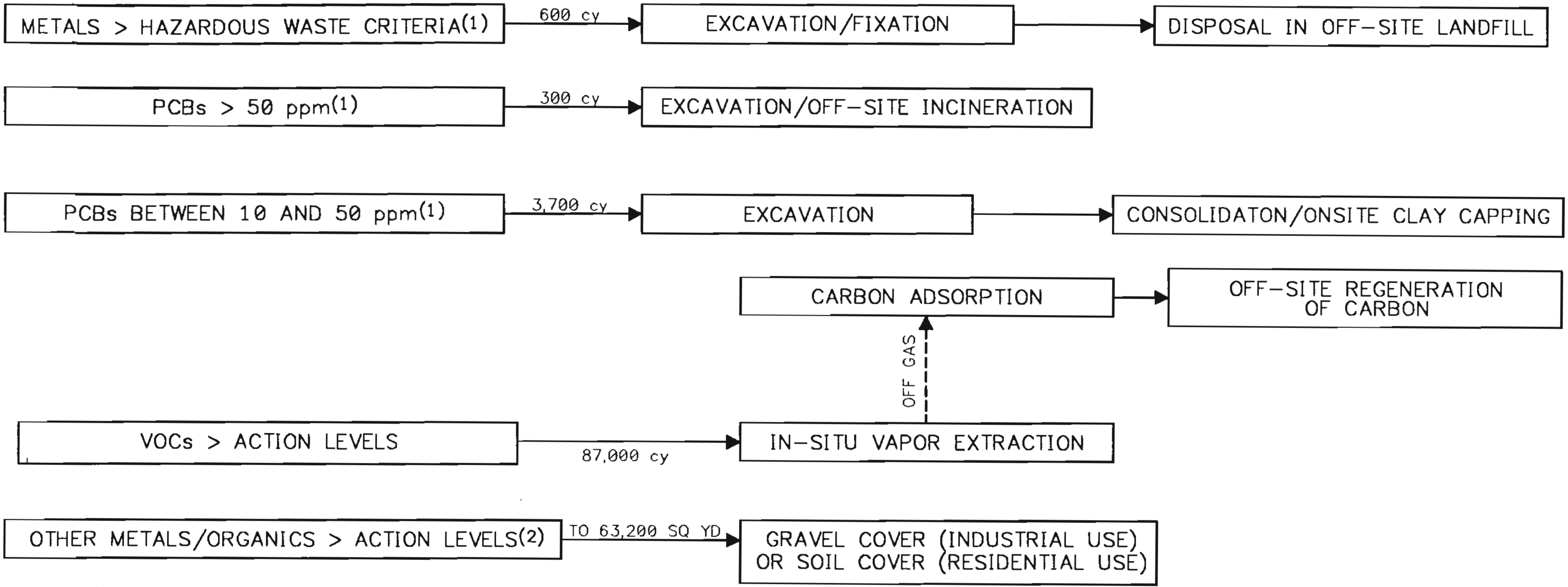

(1) TO BE CONDUCTED PRIOR TO VOCs TREATMENT
(2) TO BE CONDUCTED FOLLOWING VOCs TREATMENT

NOTE:

1. SOIL ACTION LEVELS ARE PRESENTED IN TABLE 2-12. UNLESS OTHERWISE NOTED, THE SOIL ACTION LEVEL IS THE MINIMUM OF THE RISK-BASED, ARAR-BASED, AND TBC-BASED GOALS.
2. AREAS AND VOLUMES PRESENTED ARE PRELIMINARY AND MAY BE REVISED DURING THE REMEDIAL DESIGN AND REMEDIAL ACTION STAGES.

SOILS ALTERNATIVES S6A AND S6B
FIXATION OF METALS, INCINERATION OF PCBS > 50 ppm
OFF-SITE LANDFILL PCBs BETWEEN 10 ppm AND 50 ppm
LIMITED IN-SITU VAPOR EXTRACTION OF VOCS
AND COVER OF OTHER METALS/ORGANICS > ACTION LEVELS
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FIGURE 3-6

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the VOC-action levels considered under other alternatives. The modified VOC action level was developed because a large percentage of the soil (65%) was found to contain VOCs at concentrations only slightly greater than the baseline action levels. The VOC-contaminated soils to be addressed under this alternative represent approximately 34% of the total volume of VOC-contaminated soils, but address a calculated 94% of the quantity of VOCs in the site soils. Also, at these relatively low residual VOC concentrations, other factors such as natural volatilization and infiltration flushing become significant removal mechanisms. Primary site volatile organics to be addressed include PCE, TCE, and 1,1,1-TCA. In-situ vapor extraction is a demonstrated technology for the removal of VOCs from the unsaturated region or vadose zone of soils. The vapor extraction would also be used to treat the soils in the upper few feet of the saturated zone. Following excavation of soils with metals at a concentration greater than the hazardous level and PCB "hot spots", the periphery of the contaminated region would be identified and injection/extraction wells placed accordingly. Site 1 VOC-contaminated soils underlying Plant No. 3 would be accessed by drilling injection/extraction wells through the plant floor. Vapor extraction utilizes an induced vacuum to pull air through the soil. The vacuum transports volatile organic contaminants out of the soil to a vapor collection system. Upon withdrawal, the contaminated air stream is treated with a technique appropriate for the specific compounds. Treatment technologies for the effluent air steam may consist of carbon adsorption, combustion, or catalytic destruction. Carbon adsorption has been selected as the representative process option, based on anticipated air stream contaminant concentrations. Spent carbon would be regenerated either offsite or onsite.

For areas to be capped, a permeable material would be used, as feasible. This cap would minimize restrictions on future use of the site, as well as promote precipitation infiltration and natural attenuation of residual contaminants. It is assumed that the residual contaminated infiltration would be addressed by groundwater remediation. Deed restrictions would be required to restrict both current industrial use and future residential use of the site since other metal- and organics-contaminated soil remains in place.

Soil volumes include 600 cubic yards of arsenic-contaminated soil exceeding the hazardous waste criteria (Site 1 only) to be excavated, fixated and landfilled; 300 cubic yards of PCB-contaminated soil with concentrations greater than 50 ppm (Site 1 only) to be incinerated off site; 3,700 cubic yards of PCB-contaminated soil with concentrations between 10 ppm and 50 ppm (Site 1 - 1,100 cubic yards; Site 2 - 2,600 cubic yards) to be disposed of off site; and 87,000 cubic yards of VOC-contaminated soil (Site 1 and underneath Plant No. 3) to undergo in-situ vapor extraction. Note that the volumes presented are preliminary and may be modified based on additional testing that would be conducted during the Remedial Design/Remedial Action stage.

3.3.8 Alternative S7 - Fixation of Metals, Incineration of PCBs> 50 ppm, Onsite Consolidation and clay capping of PCBs between 10 ppm and 50 ppm, and Limited In-Situ Vapor Extraction of VOCs

Alternative S7 is similar to Alternative S6, except that under Alternative S7 the PCB-contaminated soils, with a PCB concentration of 10 ppm to 50 ppm, would be consolidated in one area and a clay cap would be used to limit infiltration in that area. Alternative S7 combines removal/treatment/disposal, removal/disposal and in-situ treatment response actions. This alternative addresses soil "hot spots" (i.e., metals at a concentration greater than hazardous waste criteria, as defined by the USEPA under 40 CFR 261.24, and PCB concentrations greater than 10 ppm) using conventional techniques. Additionally, a majority of the primary contaminants, VOCs, are addressed using in-situ vapor extraction and air sparging. This technology was selected based on anticipated technical effectiveness and cost effectiveness criteria, especially when considering the large extent of contamination and the presence of highly permeable sandy soils at the sites. For areas with other metal- and organic-contaminated soils at concentrations greater than action levels, a 6-inch gravel cover or a 6-inch vegetated soil cover would be employed for industrial (S7A) or residential (S7B) use scenarios, respectively, (see Figure 3-2 for areas that would be capped). Additional description of this alternative is provided in Section 4.2.7.

Alternative S7 (refer to Figure 3-7) includes bulk excavation of all soils with metal concentrations greater than the hazardous waste criteria, which occurs only at Site 1 and only for arsenic. The hazardous waste criteria for arsenic in the TCLP leachate is 5 mg/l. This contaminated soil would be fixated either on site or off site, using a suitable binder such as ferrous sulfate and/or lime to reduce the mobility of the metals. Preliminary screening of the material may also be required to protect the treatment equipment by separating out oversized material. The fixated soil would then be disposed of in an offsite landfill. A nonhazardous waste landfill should suffice since the resultant fixated soil should no longer be hazardous by characteristic.

In accordance with TSCA regulations, soils containing PCBs in concentrations greater than 50 ppm, which occurs only at Site 1, would be excavated and transported to an approved offsite incineration facility. The PCBs of concern at the site include Aroclors 1248 and 1254. During offsite incineration, the PCBs would volatilize in the offsite incinerator's primary chamber and be oxidized to harmless substances such as carbon dioxide and water in the secondary chamber.

This alternative includes the onsite consolidation of soils containing PCBs in concentrations between 10 ppm and 50 ppm. An area in the northwest corner of Site 3 has been identified as a potential location for the consolidated material and cap, (see Figure 3-8). However other areas at the NWIRP are also potentially viable. Onsite capping of marginally-contaminated soils, such as these, is an acceptable method and is more economical than offsite landfilling or incineration. From bottom to top layers, the clay cap system consists of 6 inches of gravel (vapor barrier), 1 foot of compacted clay, and 24 inches of gravel.

Soils contaminated with VOCs at concentrations greater than modified action levels would be processed via in-situ vapor extraction and air sparging. The modified action levels for VOCs are equal to three times the VOC-action levels considered under other alternatives. The modified VOC action level was developed because a large percentage of the soil (65%) was found to contain VOCs at concentrations only slightly greater than the baseline action levels. The VOC-contaminated soils to be addressed under this alternative represent approximately 34% of the total volume of VOC-contaminated soils, but address a calculated 94% of the quantity of VOCs in the site soils. Also, at relatively low residual VOC concentrations, other factors such as natural volatilization and infiltration flushing become significant

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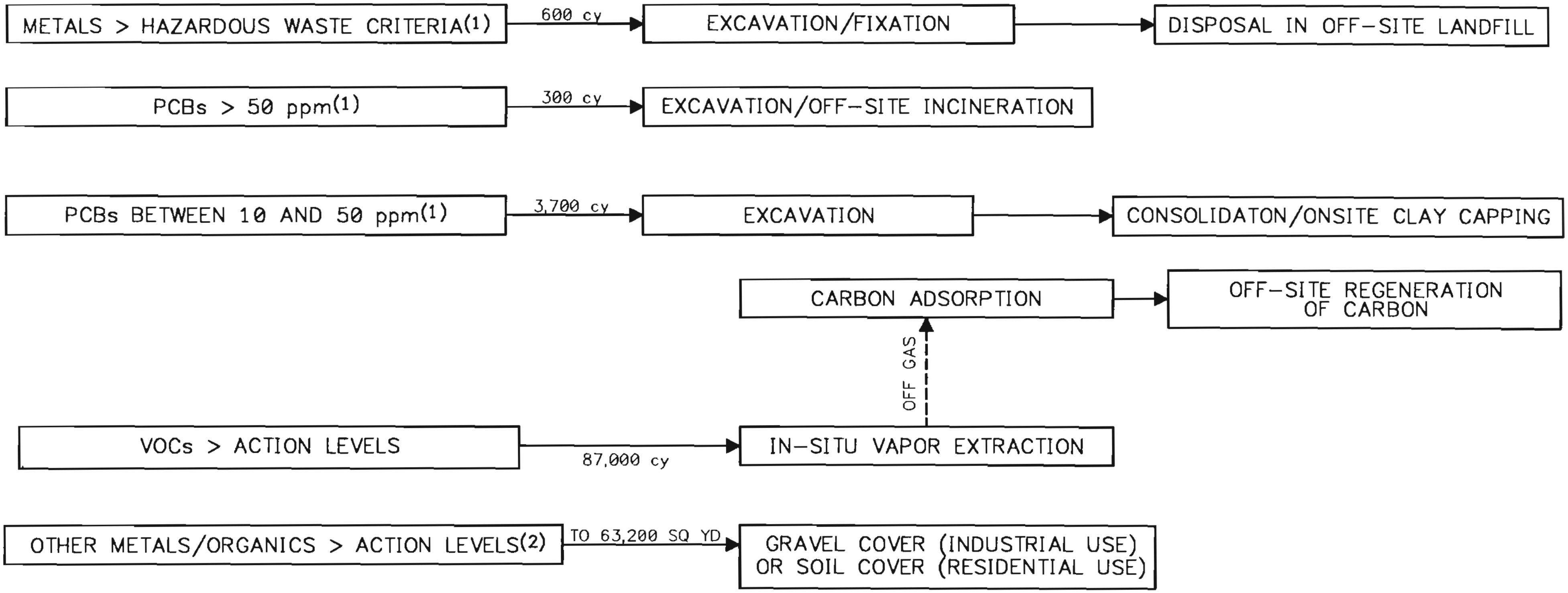

(1) TO BE CONDUCTED PRIOR TO VOCs TREATMENT
(2) TO BE CONDUCTED FOLLOWING VOCs TREATMENT

NOTE:

1. SOIL ACTION LEVELS ARE PRESENTED IN TABLE 2-12. UNLESS OTHERWISE NOTED, THE SOIL ACTION LEVEL IS THE MINIMUM OF THE RISK-BASED, ARAR-BASED, AND TBC-BASED GOALS.

2. AREAS AND VOLUMES PRESENTED ARE PRELIMINARY AND MAY BE REVISED DURING THE REMEDIAL DESIGN AND REMEDIAL ACTION STAGES.

SOILS ALTERNATIVES S7A AND S7B
FIXATION OF METALS, INCINERATION OF PCBS > 50 ppm
ONSITE CONSOLIDATION AND CLAY CAPPING OF
PCBs BETWEEN 10 ppm AND 50 ppm
IN-SITU VAPOR EXTRACTION OF VOCS
AND COVER OF OTHER METALS/ORGANICS > ACTION LEVELS
NWIRP, BETHPAGE, NEW YORK

FIGURE 3-7

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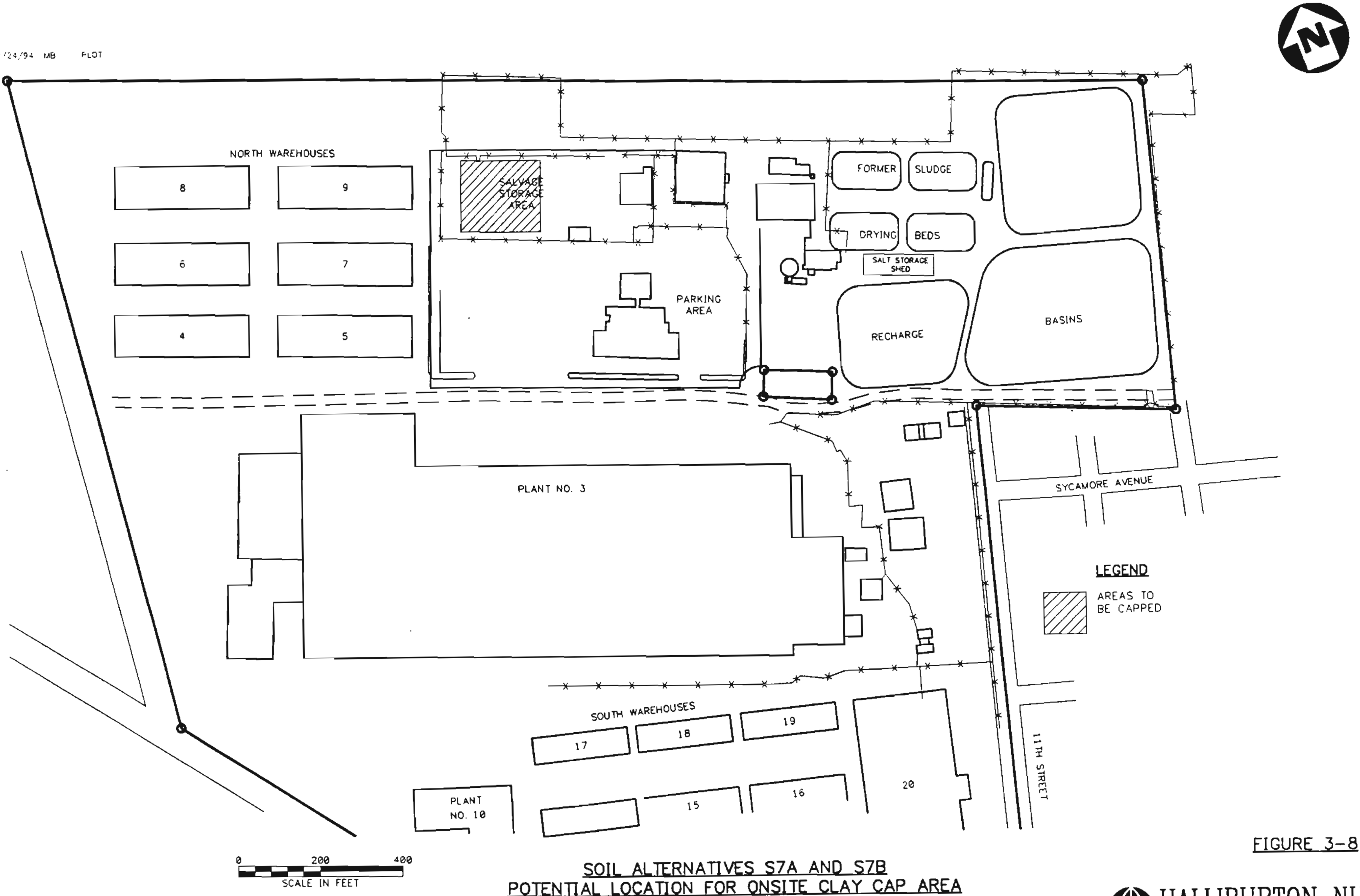

FIGURE 3-8

SOIL ALTERNATIVES S7A AND S7B
POTENTIAL LOCATION FOR ONSITE CLAY CAP AREA
PHASE 2 REMEDIAL INVESTIGATION/FEASIBILITY STUDY
NWIRP, BETHPAGE, NEW YORK

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removal mechanisms. Primary site volatile organics to be addressed include PCE, TCE, and 1,1,1-TCA. In-situ vapor extraction is a demonstrated technology for the removal of VOCs from the unsaturated region or vadose zone of soils. The vapor extraction would also be used to treat the soils in the upper few feet of the saturated zone. Following excavation of soils with metals at a hazardous level and PCB "hot spots", the periphery of the contaminated region would be identified and injection/extraction wells placed accordingly. Site 1 VOC-contaminated soils underlying Plant No. 3 would be accessed by drilling injection/extraction wells through the plant floor. Vapor extraction utilizes an induced vacuum to pull air through the soil. The vacuum transports volatile organic contaminants out of the soil to a vapor collection system. Upon withdrawal, the contaminated air stream is treated with a technique appropriate for the specific compounds. Treatment technologies for the effluent air steam may consist of carbon adsorption, combustion, or catalytic destruction. Carbon adsorption has been selected as the representative process option, based on anticipated air stream contaminant concentrations. Spent carbon would be regenerated either offsite or onsite.

For areas to be capped (except for the area designated for a clay cap), a permeable material would be used, as feasible. This cap would minimize restrictions on future use of the site, as well as promote precipitation infiltration and natural attenuation of residual contaminants. It is assumed that the residual contaminated infiltrations would be addressed by groundwater remediation. Deed restrictions would be required to restrict both current industrial use and future residential use of the site since other metal- and organics-contaminated soil remains in place.

Soil volumes include 600 cubic yards of arsenic-contaminated soil exceeding the hazardous waste criteria (Site 1 only) to be excavated, fixated and landfilled; 300 cubic yards of PCB-contaminated soil with concentrations greater than 50 ppm (Site 1 only) to be incinerated off site; 3,700 cubic yards of PCB-contaminated soil with concentrations between 10 ppm and 50 ppm (Site 1 - 1,100 cubic yards; Site 2 - 2,600 cubic yards) to be consolidated and capped onsite; and 87,000 cubic yards of VOC-contaminated soil (Site 1 and underneath Plant No. 3) to undergo in-situ vapor extraction. Note that the volumes presented are preliminary and may be modified based on additional testing that would be conducted during the Remedial Design/Remedial Action stage.

3.3.9 Alternative S8A - Fixation of Metals, Incineration of PCBs> 50 ppm, In-Situ Vapor Extraction of VOCs, and Offsite Landfill of Other Metals/Organics (Current Industrial Use Scenario)

Alternative S8A was developed to address all site contamination via conventional treatment. This alternative combines removal/treatment/disposal and in-situ treatment response actions. This alternative is essentially the same as Alternative S3, with the addition of excavation/offsite landfill for soils contaminated with other metals and organics at concentrations greater than the industrial use scenario. These soils with other metal- and organic-contamination represent low level contamination and can likely be safely disposed of in a nonhazardous landfill. Additional description of this alternative is provided in Section 4.2.8.

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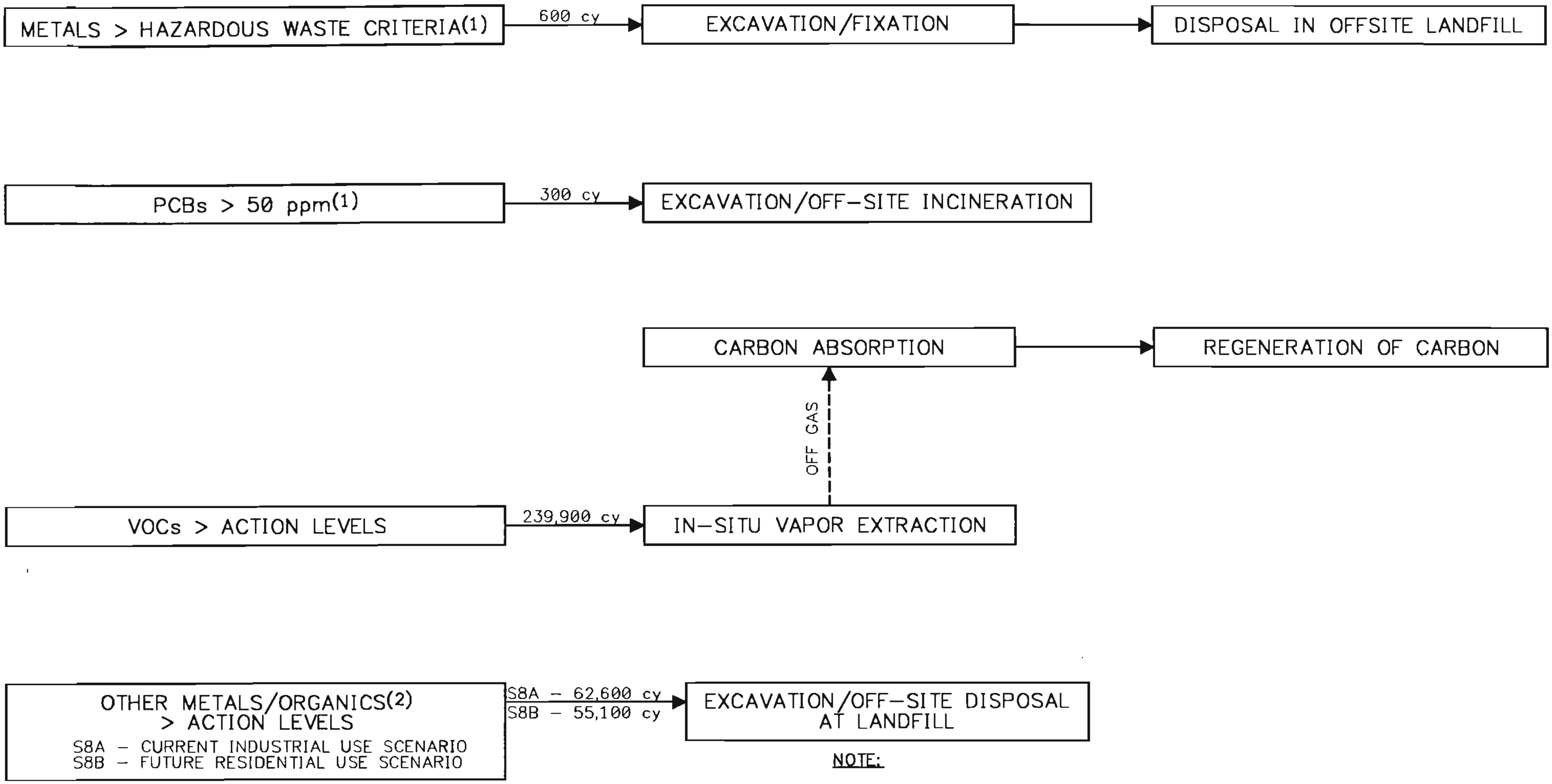

(1) TO BE CONDUCTED PRIOR TO VOCs TREATMENT
(2) TO BE CONDUCTED FOLLOWING VOCs TREATMENT

NOTE:

1. SOIL ACTION LEVELS ARE PRESENTED IN TABLE 2-12. UNLESS OTHERWISE NOTED, THE SOIL ACTION LEVEL IS THE MINIMUM OF THE RISK-BASED, ARAR-BASED, AND TBC-BASED GOALS.
2. AREAS AND VOLUMES PRESENTED ARE PRELIMINARY AND MAY BE REVISED DURING THE REMEDIAL DESIGN AND REMEDIAL ACTION STAGES.

SOILS ALTERNATIVES S8A AND S8B
FIXATION OF METALS, INCINERATION OF PCBS > 50 PPM,
IN-SITU VAPOR EXTRACTION VOCS AND
OFF-SITE LANDFILL OF OTHER METALS/ORGANICS > ACTION LEVELS
NWIRP, BETHPAGE, NEW YORK

FIGURE 3-9

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Alternative S8A (refer to Figure 3-9) includes bulk excavation of all soils with metals concentrations greater than the hazardous waste criteria, which occurs only at Site 1 and only for arsenic. The hazardous waste criteria for arsenic in the TCLP leachate is 5 mg/l. This contaminated soil would be fixated either on site or off site, using a suitable binder such as ferrous sulfate and/or lime to reduce the mobility of the metals. Preliminary screening of the material may also be required to protect the treatment equipment by separating out oversized material. The fixated soil would then be disposed of in an offsite landfill. A nonhazardous waste landfill should suffice since the resultant fixated soil should no longer be hazardous by characteristic.

In accordance with TSCA regulations, soils containing PCBs in concentrations greater than 50 ppm, which occurs only at Site 1, would be excavated and transported to an approved offsite incineration facility. The PCBs of concern at the site include Aroclors 1248 and 1254. During offsite incineration, the PCBs would volatilize in the offsite incinerator's primary chamber and be oxidized to harmless substances such as carbon dioxide and water in the secondary chamber.

Soils contaminated with VOCs at concentrations greater than action levels would be processed via in-situ vapor extraction and air sparging. Primary site volatile organics to be addressed include PCE, TCE, and 1,1,1-TCA. In-situ vapor extraction is a demonstrated technology for the removal of VOCs from the unsaturated region or vadose zone of soils. Following excavation of soils with metals at a hazardous level and PCB "hot spots", the periphery of the contaminated region would be identified and injection/extraction wells placed accordingly. Site 1 VOC-contaminated soils underlying Plant No. 3 would be accessed by drilling injection/extraction wells through the plant floor. Vapor extraction utilizes an induced vacuum to pull air through the soil. The vacuum transports volatile organic contaminants out of the soil to a vapor collection system. Upon withdrawal, the contaminated air stream is treated with a technique appropriate for the specific compounds. Treatment technologies for the effluent air steam may consist of carbon adsorption, combustion, or catalytic destruction. Carbon adsorption has been selected as the representative process option, based on anticipated concentrations. Spent carbon would be regenerated either offsite or onsite.

Soils with other metal and organic concentrations greater than the current industrial use action levels would be disposed in an offsite landfill only after the in-situ vapor extraction is complete so that the soils slated for offsite disposal are first freed of VOCs. Bulk excavation of contaminated soils would be completed followed by disposal in an offsite landfill. To minimize costs, the offsite disposal of other metal- and organic-contaminated soils includes two different types of landfills. Site 1- and Site 2-associated soil, which contains low-level PCB contamination (up to 50 ppm), would be sent to a nonhazardous waste landfill. Site 3-associated soil could potentially be used as cover material for a municipal or private landfill.

Deed restrictions would not be required to restrict industrial use of the site since no contaminated soil exceeding current industrial use action levels remains in place. Likewise, no deed restrictions are required for future residential use, which employs less stringent action levels.

Soil volumes include 600 cubic yards of arsenic-contaminated soil exceeding the hazardous waste criteria (Site 1 only) to be excavated, fixated and landfilled; 300 cubic yards of PCB-contaminated soil with concentrations greater than 50 ppm (Site 1 only) to be incinerated off site; and 239,900 cubic yards of VOC-contaminated soil (Site 1- 115,400 cubic yards; Site 2- 3,100 cubic yards; Site 3- 121,400 cubic yards) to undergo in-situ vapor extraction; and 62,600 cubic yards of other metals/organics contaminated soil (Site 1- 11,700 cubic yards; Site 2- 31,900 cubic yards; Site 3- 19,000 cubic yards) to be disposed of off site. The Site 1 soil volume includes VOC-contaminated soils underlying Plant No. 3 and the concrete area adjacent to Plant No. 3. Note that the volumes presented are preliminary and may be modified based on additional testing that would be conducted during the Remedial Design/Remedial Action stage.

3.3.10 Alternative S8B - Fixation of Metals, Incineration of PCBs > 50 ppm, In-Situ Vapor Extraction of VOCs, and Offsite Landfill of Other Metals/Organics (Future Residential Use Scenario)

Alternative S8B is essentially the same as Alternative S8A, except that associated total soil volume is less for the future residential use scenario of Alternative S8B than the current industrial use scenario of Alternative S8A. The decrease is attributed to a decrease in risks for other soils contaminated with other metals and organics. Additional description of this alternative is provided in Section 4.2.8.

Alternative S8B (refer to Figure 3-10) includes bulk excavation of all soils with metal concentrations greater than the hazardous waste criteria, which occurs only at Site 1 and only for arsenic. The hazardous waste criteria for arsenic in the TCLP leachate is 5 mg/l. This contaminated soil would be fixated either on site or off site, using a suitable binder such as ferrous sulfate and/or lime to reduce the mobility of the metals. Preliminary screening of the material may also be required to protect the treatment equipment by separating out oversized material. The fixated soil would then be disposed of in an offsite landfill. A nonhazardous waste landfill should suffice since the resultant fixated soil should no longer be hazardous by characteristic.

In accordance with TSCA regulations, soils containing PCBs in concentrations greater than 50 ppm, which occurs only at Site 1, would be excavated and transported to an approved offsite incineration facility. The PCBs of concern at the site include Aroclors 1248 and 1254. During offsite incineration, the PCBs would volatilize in the offsite incinerator's primary chamber and be oxidized to harmless substances such as carbon dioxide and water in the secondary chamber.

Soils contaminated with VOCs at concentrations greater than action levels would be processed via in-situ vapor extraction and air sparging. Primary site volatile organics to be addressed include PCE, TCE, and 1,1,1-TCA. In-situ vapor extraction is a demonstrated technology for the removal of VOCs from the unsaturated region or vadose zone of soils. Following excavation of the hazardous metals and PCB "hot spots", the periphery of the contaminated region would be identified and injection/extraction wells placed accordingly. Site 1 VOC-contaminated soils underlying Plant No. 3 would be accessed by drilling injection/extraction wells through the plant floor. Vapor extraction utilizes an induced vacuum to pull

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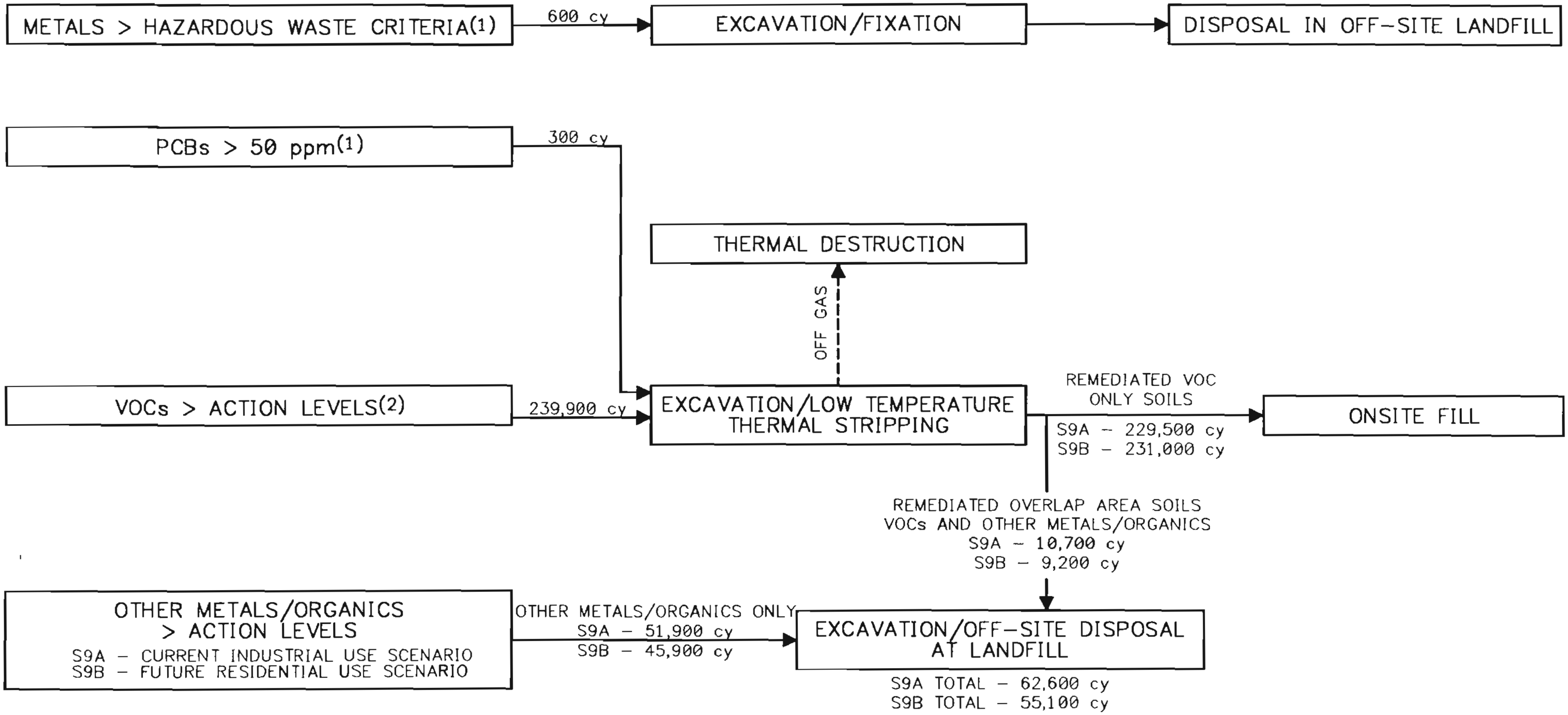

(1) TO BE CONDUCTED PRIOR TO VOCs TREATMENT

(2) OVERLAP AREAS (VOCs PLUS METALS AND OTHER ORGANICS ABOVE ACTION LEVELS) TO BE REMEDIATED FIRST, THEN VOCs ONLY SOIL

NOTE:

1. SOIL ACTION LEVELS ARE PRESENTED IN TABLE 2-12. UNLESS OTHERWISE NOTED, THE SOIL ACTION LEVEL IS THE MINIMUM OF THE RISK-BASED, ARAR-BASED, AND TBC-BASED GOALS.
2. AREAS AND VOLUMES PRESENTED ARE PRELIMINARY AND MAY BE REVISED DURING THE REMEDIAL DESIGN AND REMEDIAL ACTION STAGES.

SOILS ALTERNATIVES S9A AND S9B
FIXATION OF METALS, ONSITE LOW TEMPERATURE
THERMAL STRIPPING OF VOCS AND PCBs > 50 ppm AND
OFF-SITE LANDFILL OF OTHER METALS/ORGANICS > ACTIONS LEVELS
NWIRP, BETHPAGE, NEW YORK

FIGURE 3-10

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air through the soil. The vacuum transports volatile organic contaminants out of the soil to a vapor collection system. Upon withdrawal, the contaminated air stream is treated with a technique appropriate for the specific compounds. Treatment technologies for the effluent air steam may consist of carbon adsorption, combustion, or catalytic destruction. Carbon adsorption has been selected as the representative process option, based on anticipated concentrations. Spent carbon would be regenerated either offsite or onsite.

Soils with other metal and organic concentrations greater than the future residential use action levels would be disposed in an offsite landfill only after the in-situ vapor extraction is complete so that the soils slated for offsite disposal are first freed of VOCs. Bulk excavation of contaminated soils would be completed followed by disposal in an offsite landfill. To minimize costs, the offsite disposal of other metals/organics-contaminated soil includes two different types of landfills. Site 1- and Site 2-associated soil, which contains low level PCB contamination up to 50 ppm, would be sent to a nonhazardous waste landfill. Site 3-associated soil could potentially be used as cover material for a municipal or private landfill.

To minimize costs, the offsite disposal of other metals/organics-contaminated soil includes two different types of landfills. Site 1- and Site 2- associated soil, which contains low level PCB contamination up to 50 ppm, would be sent to a nonhazardous waste landfill. Site 3-associated soil could potentially be used as cover material for a municipal or private landfill.Deed restrictions would not be required to restrict future residential use of the site since no contaminated soil remains in place. However, deed restrictions for industrial use are applicable for remaining soils which exceed the current industrial use action levels.

Soil volumes include 600 cubic yards of arsenic-contaminated soil exceeding the hazardous waste criteria (Site 1 only) to be excavated, fixated and landfilled; 300 cubic yards of PCB-contaminated soil (Site 1 only) to be incinerated off site; 239,900 cubic yards of VOC-contaminated soil (Site 1- 115,400 cubic yards; Site 2- 3,100 cubic yards; Site 3- 121,400 cubic yards) to undergo in-situ vapor extraction; and 55,100 cubic yards of other metals/organics contaminated soil (Site 1- 8,300 cubic yards; Site 2- 33,700 cubic yards; Site 3- 13,100 cubic yards). Note that the volumes presented are preliminary and may be modified based on additional testing that would be conducted during the Remedial Design/Remedial Action stage.

The Site 1 soil volume includes VOC-contaminated soils underlying Plant No. 3 and the concrete area adjacent to Plant No. 3.

3.3.11 Alternative S9A - Fixation of Metals, Onsite Low Temperature Stripping of VOCs and PCBs >50 ppm, and Offsite Landfill of Other Metals/Organics (Current Industrial Use Scenario)

Alternative S9A was also developed to address all site contamination using a combination of removal/treatment/disposal and removal/disposal response actions. Metals present in soil "hot spots" are addressed using conventional techniques and soils with other metals and organics greater than the industrial use scenario are safely disposed of in a nonhazardous waste landfill. However, VOC- and PCB- (at a concentration greater than 50 ppm) contaminated soils are addressed via low temperature thermal stripping. Soils contaminated with other metals and organics at concentrations greater than the industrial use scenario would be excavated and disposed of in an offsite landfill. These soils with other metal- and organic-contamination represent low level contamination and can likely be safely disposed of in a nonhazardous landfill. Additional description is provided in Section 4.2.9.

Alternative S9A (refer to Figure 3-10) includes bulk excavation of all soils with metals concentrations greater than the hazardous waste criteria, which occurs only at Site 1 and only for arsenic. The hazardous waste criteria for arsenic in the TCLP leachate is 5 mg/l. This contaminated soil would be fixated either on site or off site, using a suitable binder such as ferrous sulfate and/or lime to reduce the mobility of the metals. Preliminary screening of the material may also be required to protect the treatment equipment by separating out oversized material. The fixated soil would then be disposed of in an offsite landfill. A nonhazardous waste landfill should suffice since the resultant fixated soil should no longer be hazardous by characteristic.

Soils contaminated with VOCs at a concentration greater than action levels and PCB concentrations greater than 50 ppm would be processed via low temperature thermal stripping. Primary contaminants to be addressed include PCE, TCE, and 1,1,1-TCA for the majority of the soils and PCBs for a limited volume of the soils. Following removal of the soils with metals at a hazardous level "hot spots", soils contaminated with concentrations of VOCs greater than the action levels and soils with PCBs concentrations greater than 50 ppm would be excavated and processed through low temperature thermal stripping. The Site 1 Plant No. 3 floor and concrete area adjacent to Plant No. 3 would be removed to allow access to underlying VOC-contaminated soils. For all soil containing VOC contamination only, the resultant processed soils would then be reused as onsite fill. However, for soils that contain both VOCs and other metals and organics above the action levels, the processed soils would further require offsite landfill disposal. Initially the soil may require screening to separate out oversized material. The soil would then be tilled and passed through a thermal desorption unit. Treatment of the offgas from the process would be via onsite thermal destruction; or condensation, recirculation, and offsite treatment/disposal of condensates.

Soils with other metal and organic concentrations greater than the current industrial use action levels would be disposed in an offsite landfill, only after the low temperature thermal stripping is complete so that the soils slated for offsite disposal are first freed of VOCs. To minimize costs, the offsite disposal of other metals/organics-contaminated soil includes two different types of landfills. Site 1- and Site 2-associated soils, which contain low-level PCB contamination up to 50 ppm, would be sent to a nonhazardous waste landfill. Site 3-associated soil could potentially be used as cover material for a municipal or private landfill.

Deed restrictions would not be required to restrict industrial use of the site since no contaminated soil exceeding current industrial use action levels remains in place. Likewise, no deed restrictions are required for future residential use, which employs less stringent action levels.

Soil volumes include 600 cubic yards of arsenic-contaminated soil exceeding the hazardous waste criteria (Site 1 only) to be excavated, fixated and landfilled; and 234,200 cubic yards of VOC-contaminated or PCB (greater than 50 ppm) soil (Site 1- 115,700 cubic yards; Site 2- 3,100 cubic yards; Site 3- 121,400 cubic yards) to undergo low temperature thermal stripping; and 62,600 cubic yards of other metals/organics contaminated soil (Site 1- 11,700 cubic yards; Site 2- 31,900 cubic yards; Site 3- 19,000 cubic yards) to ultimately be disposed. The Site 1 soil volume includes VOC-contaminated soils underlying Plant No. 3 and the concrete area adjacent to Plant No. 3. Note that the volumes presented are preliminary and may be modified based on additional testing that would be conducted during the Remedial Design/Remedial Action stage.

3.3.12 Alternative S9B - Fixation of Metals, Onsite Low Temperature Stripping of VOCs and PCBs >50 ppm, and Offsite Landfill of Other Metals/Organics (Future Residential Use Scenario)

Alternative S9B is essentially the same as Alternative S9A, except that associated total soil volume is less for the future residential use scenario of Alternative S9B than the current industrial use scenario of Alternative S9A. The decrease is attributed to a decrease in risks for soils contaminated with other metals and organics. Additional description is provided in Section 4.2.9.

Alternative S9B (refer to Figure 3-10) includes bulk excavation of all soils with metal concentrations greater than the hazardous waste criteria, as defined by the USEPA under 40 CFR 261.24, which occurs only at Site 1 and only for arsenic. The hazardous waste criteria for arsenic in the TCLP leachate is 5 mg/l. This contaminated soil would be fixated either on site or off site, using a suitable binder such as ferrous sulfate and/or lime to reduce the mobility of the metals. Preliminary screening of the material may also be required to protect the treatment equipment by separating out oversized material. The fixated soil would then be disposed of in an offsite landfill. A nonhazardous waste landfill should suffice since the resultant fixated soil should no longer be hazardous by characteristic.

Soils contaminated with VOCs at concentrations greater than action levels and PCB concentrations greater than 50 ppm would be processed via low temperature thermal stripping. Primary contaminants to be addressed include PCE, TCE, and 1,1,1-TCA for the majority of the soils and PCBs for a limited volume of the soils. Following removal of the soils with metals at a hazardous level "hot spots", soils contaminated with concentrations of VOCs greater than the action levels and soils with PCB concentrations greater than 50 ppm would be excavated and processed through low temperature thermal stripping. The Site 1 Plant No. 3 floor and concrete area adjacent to Plant No. 3 would be removed to allow access to underlying VOC-contaminated soils. For all soil containing VOC contamination only, the resultant processed soils would then be reused as onsite fill. However, for soils that contain both VOCs and other metals/organics, the processed soils would further require offsite landfill disposal. Initially the soil may require screening to separate out oversized material. The soil would then be tilled and passed through a thermal desorption unit. Treatment of the offgas from the process would be via onsite thermal destruction; or condensation, recirculation, and offsite treatment/disposal of condensates.

Soils with other metal and organic concentrations greater than the current industrial use action levels would be disposed in an offsite landfill, only after the low temperature thermal stripping is complete so that the soils slated for offsite disposal are first freed of VOCs. To minimize costs, the offsite disposal of other metals/organics-contaminated soil includes two different types of landfills. Site 1- and Site 2-associated soil, which contains low level PCB contamination up to 50 ppm, would be sent to a nonhazardous waste landfill. Site 3-associated soil could potentially be used as cover material for a municipal or private landfill.

Deed restrictions would not be required to restrict future residential use of the site since no contaminated soil remains in place. However, deed restrictions for industrial use are applicable for remaining soils which exceed the current industrial use action levels.

Soil volumes include 600 cubic yards of arsenic-contaminated soil exceeding the hazardous waste criteria (Site 1 only) to be excavated, fixated and landfilled; 300 cubic yards of PCB-contaminated soil (Site 1 only) to be incinerated off site; and 239,900 cubic yards of VOC-contaminated soil (Site 1- 115,400 cubic yards; Site 2- 3,100 cubic yards; Site 3- 121,400 cubic yards) to undergo low temperature thermal stripping; and 55,100 cubic yards of other metals/organics contaminated soil (Site 1- 8,300 cubic yards; Site 2- 33,700 cubic yards; Site 3- 13,100 cubic yards) to be disposed of off site. The Site 1 soil volume includes the excavation of VOC-contaminated soils underlying Plant No. 3 and the concrete area adjacent to Plant No. 3. Note that the volumes presented are preliminary and may be modified based on additional testing that would be conducted during the Remedial Design/Remedial Action stage.

3.3.13 Alternative S10A - Soil Washing/Onsite Fill of Metals and Organics (Current Industrial Use Scenario) with Offsite Landfill of Metal Treatment Residuals, and Incineration of Organic Treatment Residuals

Alternative S10A addresses all site contamination through one technology; soil washing. This alternative represents a removal/treatment/disposal response action. Although technical effectiveness may be diminished by attempting to address all contaminants simultaneously, cost effectiveness should be favorable. Additional description of this alternative is provided in Section 4.2.10.

For Alternative S10A (refer to Figure 3-11), contaminated soils would be excavated and processed with a soil washing technique to remove the contaminants from the soil matrix. The Site 1 Plant No. 3 floor and concrete area adjacent to Plant No. 3 would be removed to allow access to underlying VOC-contaminated soils. Following soil washing, the processed soils would then be placed as onsite fill. The organic treatment residuals would subsequently be incinerated offsite. The metals treatment residuals would be disposed of at an offsite landfill. The metals residuals may require fixation prior to disposal.

Soil washing extracts/leaches contaminants from the soil. This process is accomplished by passing a leaching solution through the soils using an injection/recirculation process. Usually pretreatment of the

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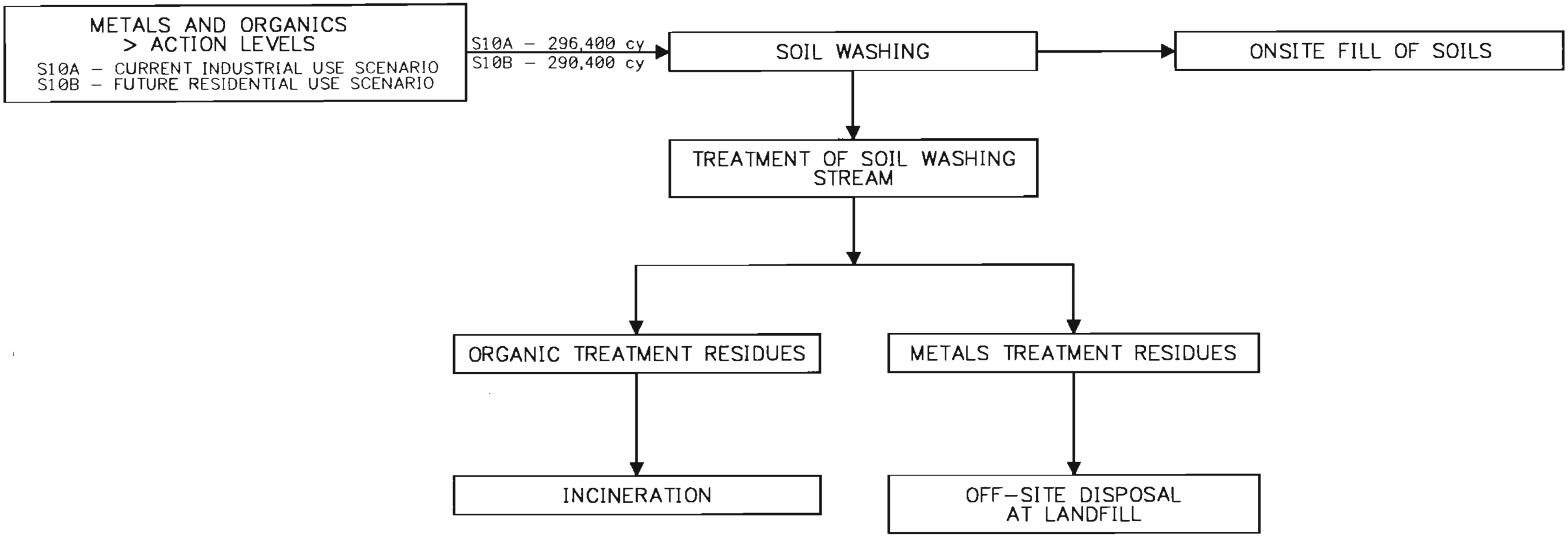

NOTE:

1. SOIL ACTION LEVELS ARE PRESENTED IN TABLE 2–12. UNLESS OTHERWISE NOTED, THE SOIL ACTION LEVEL IS THE MINIMUM OF THE RISK–BASED, ARAR–BASED, AND TBC–BASED GOALS.
2. AREAS AND VOLUMES PRESENTED ARE PRELIMINARY AND MAY BE REVISED DURING THE REMEDIAL DESIGN AND REMEDIAL ACTION STAGES.

FIGURE 3–11

SOILS ALTERNATIVES S10A AND S10B
SOIL WASHING / ONSITE FILL, RESIDUALS TREATMENT
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soil feed is required such as screening and conditioning. Separate leaching processes are usually required for soils contaminated with both inorganics and organics due to the specific nature of the leaching solutions. Deed restrictions would not be required to restrict industrial use of the site since no contaminated soil exceeding current industrial use action levels remains in place. Likewise, no deed restrictions are required for future residential use, which employs less stringent action levels.

Soil volumes total 296,400 cubic yards of contaminated soil (Site 1- 119,700 cubic yards; Site 2- 36,300 cubic yards; Site 3- 140,400 cubic yards) to undergo soil washing. This soil volume includes the Site 1 VOC-contaminated soils underlying Plant No. 3 and the concrete area adjacent to Plant No. 3. Note that the volumes presented are preliminary and may be modified based on additional testing that would be conducted during the Remedial Design/Remedial Action stage.

3.3.14 Alternative S10B - Soil Washing/Onsite Fill of Metals and Organics (Future Residential Use Scenario) with Offsite Landfill of Metal Treatment Residues, and Incineration of Organic Treatment Residues

Alternative S10B is essentially the same as Alternative S10A, except that associated total soil volume is less for the future residential use scenario of Alternative S10B than the current industrial use scenario of Alternative S10A. The decrease is attributed to a decrease in risks for other metals and organics. Additional description of this alternative is provided in Section 4.2.10.

For Alternative S10B (refer to Figure 3-11), contaminated soils would be excavated and processed with a soil washing technique to remove the contaminants from the soil matrix. The Site 1 Plant No. 3 floor and concrete area adjacent to Plant No. 3 would be removed to allow access to underlying VOC-contaminated soils. Following soil washing, the processed soils would then be placed as onsite fill. The organic treatment residuals would subsequently be incinerated offsite. The processed soils would then be placed as onsite fill. The organic treatment residuals would subsequently be incinerated offsite. The metals treatment residuals would be disposed of at an offsite landfill. The metal residuals may require fixation prior to disposal.

Soil washing extracts/leaches contaminants from the soil. This process is accomplished by passing a leaching solution through the soils using an injection/recirculation process. Usually pretreatment of the soil feed is required such as screening and conditioning. Separate leaching processes are usually required for soils contaminated with both inorganics and organics due to the specific nature of the leaching solutions.

Deed restrictions would not be required to restrict future residential use of the site since no contaminated soil remains in place. However, deed restrictions for industrial use are applicable for remaining soils which exceed the current industrial use action levels.

Soil volumes total 290,400 cubic yards of contaminated soil (Site 1- 117,800 cubic yards; Site 2- 38,100 cubic yards; Site 3- 134,500 cubic yards) to undergo soil washing. This soil volume includes the Site 1 VOC-contaminated soils underlying Plant No. 3 and the concrete area adjacent to Plant No. 3. Note that the volumes presented are preliminary and may be modified based on additional testing that would be conducted during the Remedial Design/Remedial Action stage.

3.4 IDENTIFICATION AND SCREENING OF GROUNDWATER ALTERNATIVES

3.4.1 Alternative GW1 - No Action

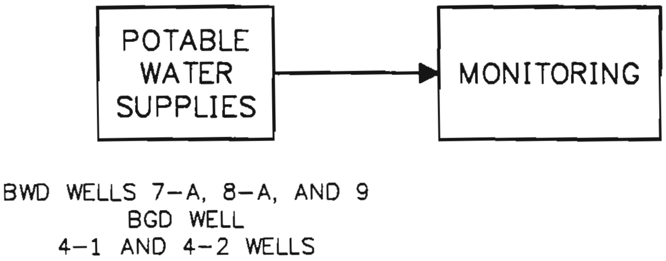
This alternative is a no action alternative, and is developed and retained for baseline comparison purposes with the other alternatives, as required by the NCP. The only activity that would occur under the no-action alternative is periodic reviews, typically every 5 years. The no action scenario does not include the extraction and treatment system currently envisioned by the Navy for production wells PW-8, PW-9, PW-10, PW-11, PW-13, PW-14, PW-15 and PW-16. Additional description of this alternative is provided in Section 4.3.1.

3.4.2 Alternative GW2 - Monitoring of Existing Potable Water Supplies

Alternative GW2 (refer to Figure 3-12) features an institutional controls general response action, consisting of the installation of three groups of monitoring wells upgradient of the current potable wells. The three groups of potable wells are BWD wells 7A, 8A, and 9; the BGD well; and wells 4-1 and 4-2. Two up-gradient wells are included for each of the three groups, for a total of six monitoring wells. Quarterly monitoring for site volatile organic compounds ensures that the potable well users do not receive any contaminants from the migrating groundwater plume. This alternative, further described in Section 4.3.2, requires minimal effort to protect current users. During the detailed evaluation process, the preferred alternative for potable water supplies may vary for each of the three groups of potable wells; combinations of Alternatives GW2, GW3A, and GW3B may be utilized.

3.4.3 Alternative GW3A - Air Stripping of Existing Potable Water Supplies

Alternative GW3A (refer to Figure 3-13), an extraction/treatment/discharge general response action, consists of air stripping treatment systems for the current potable wells of concern. The three groups of potable wells are BWD wells 7A, 8A, and 9; the BGD well; and wells 4-1 and 4-2. Each group of wells would have an independent air stripping system. Each treatment system would pump contaminated groundwater through a countercurrent packed tower to remove the VOCs. The treated groundwater would then be distributed to the users. As an option under this alternative, treatment of the BWD Plant No. 5 water and well replacement (any cluster) may be considered. Specifically for well replacement, an impacted well may be replaced with a new well in an uncontaminated area and/or depth. No offgas treatment is anticipated as the contaminant concentrations are sufficiently low



GROUNDWATER ALTERNATIVE GW2
MONITORING OF EXISTING POTABLE WATER SUPPLIES
NWIRP, BETHPAGE, NEW YORK

FIGURE 3-12

HALLIBURTON NUS
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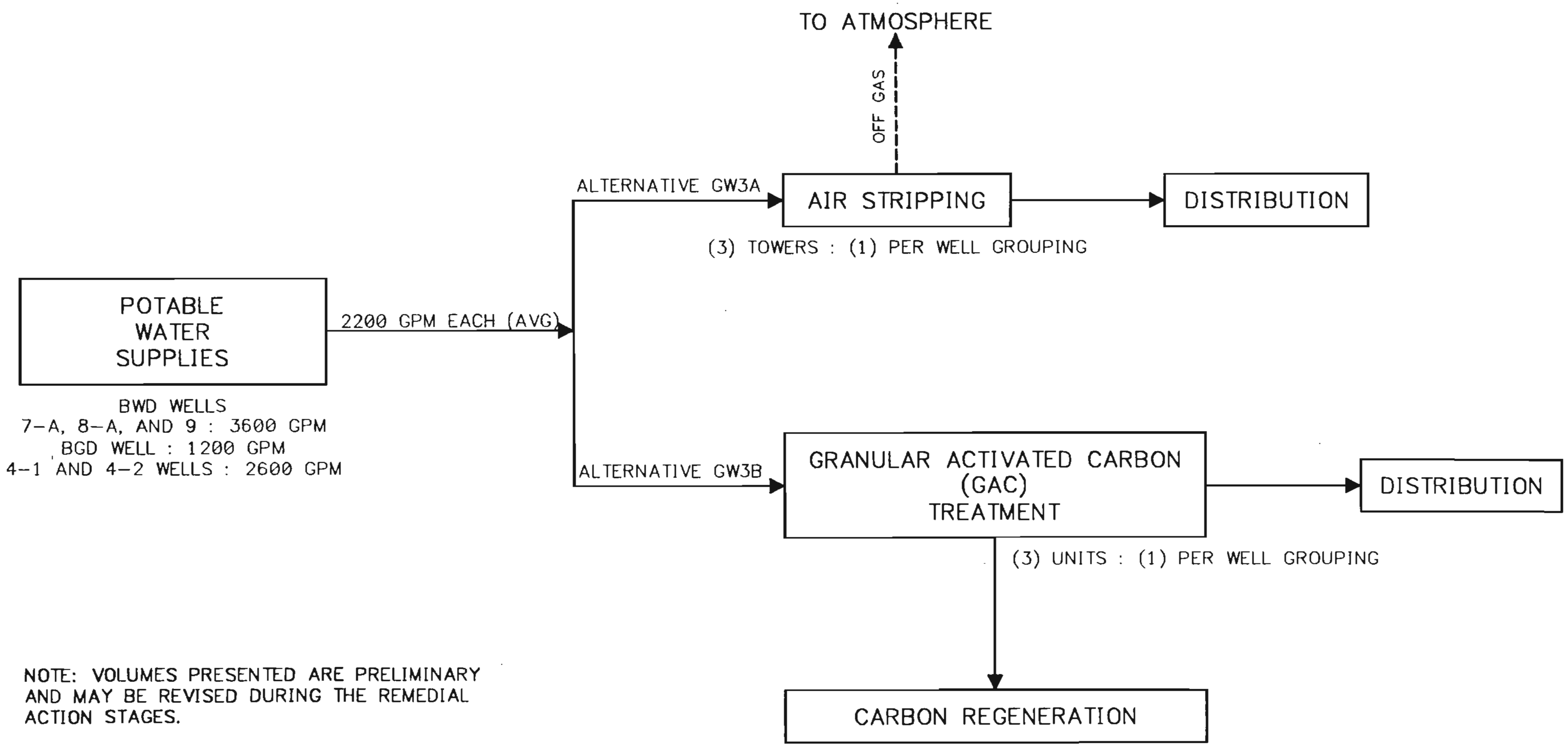

NOTE: VOLUMES PRESENTED ARE PRELIMINARY AND MAY BE REVISED DURING THE REMEDIAL ACTION STAGES.

GROUNDWATER ALTERNATIVES GW3A AND GW3B
AIR STRIPPING OR GAC TREATMENT OF
EXISTING POTABLE WATER SUPPLIES
NWIRP, BETHPAGE, NEW YORK

FIGURE 3-13

HALLIBURTON NUS
Environmental Corporation

enough not to warrant treatment. Additional description of this alternative is provided in Section 4.3.3. During the detailed evaluation process, the preferred alternative for potable water supplies may vary for each of the three groups of potable wells; combinations of Alternatives GW2, GW3A, and GW3B may be utilized.

3.4.4 Alternative GW3B - GAC Treatment of Existing Potable Water Supplies

Alternative GW3B (refer to Figure 3-13), an extraction/treatment/discharge general response action, consists of granular activated carbon (GAC) treatment systems for the current potable wells of concern. The three groups of potable wells are BWD wells 7A, 8A, and 9; the BGD well; and wells 4-1 and 4-2. Each group of wells would have an independent granular activated carbon (GAC) system. Each treatment system would pump contaminated groundwater through the GAC to remove the VOCs via adsorption. The treated groundwater would then be distributed to the users. As an option under this alternative, treatment of the BWD Plant No. 5 water and well replacement (any cluster) may be considered. Specifically for well replacement, an impacted well may be replaced with a new well in an uncontaminated area and/or depth. Spent activated carbon would be sent off site for regeneration. Additional description of this alternative is provided in Section 4.3.4. During the detailed evaluation process, the preferred alternative for potable water supplies may vary for each of the three groups of potable wells; combinations of Alternatives GW2, GW3A, and GW3B may be utilized.

3.4.5 Alternative GW4A - Extraction (Onsite/Near Site Groundwater > 100 ug/l VOCs), Precipitation/Filtration (Inorganics), Air Stripping (VOCs), and Reuse

Alternative GW4A was developed to address the most highly contaminated portion of the plume using conventional air stripping treatment for VOC removal and precipitation/filtration for toxic metals removal. Contaminated groundwater with VOC concentrations greater than 100 ug/l would be captured by a new groundwater extraction system and the operation of select existing onsite production wells. Additional description of this extraction/treatment/discharge general response action alternative is provided in Section 4.3.5.

For Alternative GW4A (refer to Figure 3-14), seven new onsite/near site extraction wells (EW-1 to EW-7) would be installed to treat contamination greater than 100 ug/l VOCs. Extraction wells EW-1 to EW-5 would extract 300 gpm each and extraction wells EW-6 and EW-7 would extract 200 gpm each, from depths ranging to 300 ft, for a total of 1900 gpm. The extracted groundwater would then be combined into an equalization tank to dampen flow and contaminant surges. Following equalization, ferrous sulfate would be added to reduce hexavalent chromium to trivalent chromium and precipitate the metals constituents, including trivalent chromium. The precipitate would then be thickened and dewatered and the result sludge cake shipped offsite for disposal. The processed groundwater would continue to a packed tower air stripper for VOC removal. The air stripper offgas emissions would be subjected to vapor phase activated carbon adsorption. Spent carbon from vapor phase adsorption

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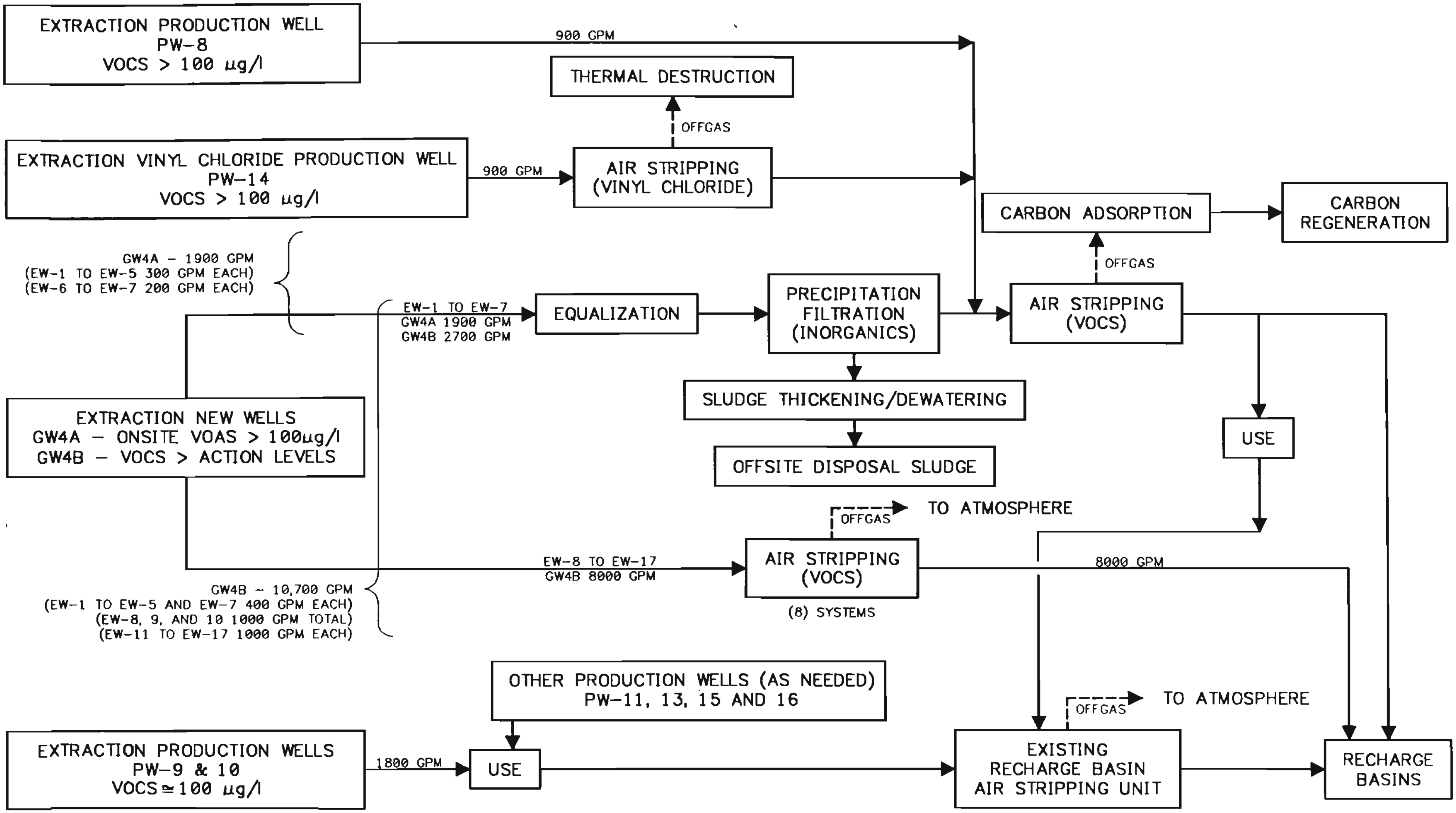

NOTE: VOLUMES PRESENTED ARE PRELIMINARY AND MAY BE REVISED DURING THE REMEDIAL ACTION STAGES.

**GROUNDWATER ALTERNATIVES GW4A AND GW4B
EXTRACTION, PRECIPITATION/FILTRATION,
AIR STRIPPING AND REUSE
NWIRP, BETHPAGE, NEW YORK**

FIGURE 3-14

HALLIBURTON NUS
Environmental Corporation

would be regenerated either offsite or onsite. After air stripping, the treated effluent would be either discharged to the NWIRP recharge basins or used in the plant.

This alternative includes the use and treatment of the most contaminated production wells at the NWIRP (VOCs greater than 100 ug/l). An aeration basin treatment system is being introduced by Grumman to allow the use of most of their production wells (PW-9, PW-10, PW-11, PW-13, PW-15, and PW-16). These production wells contain VOCs in the range of 5 to 100 ug/l. The wells are being used to supply water at approximately 1800 gpm (winter) to 4900 gpm (summer). The pending Grumman treatment system, as illustrated in Figure 3-14, will utilize the existing NWIRP recharge basins and a new aeration basin. The aeration basin offgas emissions will exit to the atmosphere since the offgas contaminant concentrations are sufficiently low enough not to warrant offgas treatment. The treated effluent water will be discharged to the NWIRP recharge basins. Under this alternative, two of these production wells (PW-9 and PW-10) with VOCs of approximately 100 ug/l, would be used preferentially.

Production wells PW-8 and PW-14 are on the NWIRP Bethpage, but are not operated because of relatively high VOC concentrations (approximately 1,000 ug/l). However, based on the VOC concentrations in these wells, they are also targeted for preferential use under this alternative. Because the new aeration basin is only intended as a polishing unit, supplemental treatment of PW-8 and PW-14 waters would be required prior to use or discharge of this water. In addition, PW-14 contains very significant levels of vinyl chloride (1400 ug/l). Vinyl chloride (also a VOC) requires special pretreatment.

Vinyl chloride is amenable to air stripping; however the system requires thermal destruction of the offgas emissions since vapor-phase activated carbon is ineffective for vinyl chloride removal. A packed tower air stripping unit would be installed specifically for PW-14 and designed to remove only the vinyl chloride. The pretreated water from PW-14, as well as water from PW-8, would be sent to the new onsite/near site groundwater treatment unit to remove the VOCs. The treated water would then be either used at the plant or discharged to the NWIRP recharge basins.

Once the treatment system is functional, the more contaminated (VOCs greater than 100 ug/l) production wells, PW-8, PW-9, PW-10, and PW-14 should be preferentially used to ensure site cleanup. During the heavy summer demand of approximately 4900 gpm, pumping from the additional production wells PW-11, 13, 15, and 16 could be added to satisfy the demand. Also, treated water from the onsite/near site treatment system could be used to supply part of the demand.

3.4.6 Alternative GW4B - Extraction (All Contaminated Groundwater), Precipitation/Filtration (Inorganics), Air Stripping (VOCs), and Reuse

Alternative GW4B addresses both onsite/near site and offsite contamination. The onsite/near site system is essentially that of Alternative GW4A, although the GW4B onsite/near site flow rate is higher to include VOC contamination < 100 ug/l at depth. The offsite extraction system also features conventional air stripping for VOC treatment; no metals removal is necessary for offsite contamination.

Additional description of this extraction/treatment/discharge response action alternative is provided in Section 4.3.6.

For Alternative GW4B (refer to Figure 3-14), seven new onsite/near site extraction wells, EW-1 to EW-7, and ten new offsite extraction wells, EW-8 to EW-17, would be installed to treat all of the contaminated groundwater. The onsite/near site extraction wells EW-1 to EW-5 and EW-7 would each extract 400 gpm and extraction well EW-6 would extract 300 gpm, from depths ranging to 450 feet, for a total of 2700 gpm.

The onsite/near site extracted groundwater would be combined into an equalization tank to dampen flow and contaminant surges. The equalization tank would receive a total of 2700 gpm of contaminated groundwater. Following equalization, ferrous sulfate would be added to reduce the hexavalent chromium to trivalent chromium and precipitate the metals constituents, including trivalent chromium. The precipitate would then be thickened and dewatered and the resultant sludge disposed of offsite. The processed groundwater would be pumped to an air stripping countercurrent packed tower for VOC removal. The air stripper offgas emissions would be subjected to vapor phase activated carbon adsorption. Spent carbon would be regenerated either offsite or onsite. After air stripping, the treated effluent from the onsite/near site wells EW-1 to EW-7 would be either discharged to the NWIRP recharge basins or used in the plant.

Wells EW-8 to EW-17 are the offsite extraction wells. The following is a summary of extraction rates from wells EW-8 to EW-17:

EW-8 - 300 gpm
EW-9 - 280 gpm
EW-10 - 350 gpm
EW-11 - 1060 gpm
EW-12 - 990 gpm
EW-13 - 990 gpm
EW-14 - 860 gpm
EW-15 - 890 gpm
EW-16 - 1160 gpm
EW-17 - 1160 gpm

All of the offsite extraction wells will draw from a depths ranging to 450 feet at a combined total flow of 8040 gpm.

Air stripping using a countercurrent packed tower will be conducted at each well sites. For convenience, a total of 8 systems would be installed each with a capacity of approximately 1000 gpm. Extraction wells EW-8, EW-9, and EW-10 would flow into one combined system while each of the remaining wells EW-11 to EW-17 would have their own individual systems. After air stripping, the treated effluent from wells EW-8 to EW-10 would discharge to the NWIRP recharge basins, treated effluent from EW-11 to EW-15 would be sent to the East recharge basins, and treated effluent from EW-16 and EW-17 would proceed to the South Grumman recharge basins.

This alternative includes the use and treatment of the most contaminated production wells at the NWIRP (VOCs greater than 100 ug/l). An aeration basin treatment system is being introduced by

Grumman to allow the use of most of their production wells (PW-9, PW-10, PW-11, PW-13, PW-15, and PW-16). These production wells contain VOCs in the range of 5 to 100 ug/l. The wells are being used to supply water at approximately 1800 gpm (winter) to 4900 gpm (summer). The pending Grumman treatment system, as illustrated in Figure 3-14, will utilize the existing NWIRP recharge basins and a new aeration basin. The aeration basin offgas emissions will exit to the atmosphere since the offgas contaminant concentrations are sufficiently low enough not to warrant offgas treatment. The treated effluent water will be discharged to the NWIRP recharge basins. Under this alternative, two of these production wells (PW-9 and PW-10) with VOCs of approximately 100 ug/l, would be used preferentially.

Production wells PW-8 and PW-14 are on the NWIRP Bethpage, but are not operated because of relatively high VOC concentrations (approximately 1,000 ug/l). However, based on the VOC concentrations in these wells, they are also targeted for preferential use under this alternative. Because the new aeration basin is only intended as a polishing unit, supplemental treatment of PW-8 and PW-14 waters would be required prior to use or discharge of this water. In addition, PW-14 contains very significant levels of vinyl chloride (1400 ug/l). Vinyl chloride (also a VOC) requires special pretreatment.

Vinyl chloride is amenable to air stripping; however the system requires thermal destruction of the offgas emissions since vapor-phase activated carbon is ineffective for vinyl chloride removal. A packed tower air stripping unit would be installed specifically for PW-14 and designed to remove only the vinyl chloride. The pretreated water from PW-14, as well as water from PW-8, would be sent to the new onsite/near site groundwater treatment unit to remove the VOCs. The treated water would then be either used at the plant or discharged to the NWIRP recharge basins.

Once the treatment system is functional, the more contaminated (VOCs greater than 100 ug/l) production wells, PW-8, PW-9, PW-10, and PW-14 should be preferentially used to ensure site cleanup. During the heavy summer demand of approximately 4900 gpm, pumping from the additional production wells PW-11, 13, 15, and 16 could be added to satisfy the demand. Also, treated water from the onsite/near site treatment system could be used to supply part of the demand.

3.4.7 Alternative GW5A - Extraction (Onsite/Near Site Groundwater > 100 ug/l), Precipitation/ Filtration (Inorganics), GAC (VOCs), and Reuse

Alternative GW5A is essentially that of GW4A; however, GW5A features conventional granular activated carbon (GAC) rather than air stripping for VOC removal, as well as enhanced oxidation for production well PW-14 containing vinyl chloride. Note that GAC is ineffective for vinyl chloride adsorption and therefore was not included as a component of this alternative. Additional description of this extraction/treatment/discharge general response action alternative is provided in Section 4.3.7.

For Alternative GW5A (refer to Figure 3-15), seven new onsite/near site extraction wells (EW-1 to EW-7) would be installed to treat contamination greater than 100 ug/l VOCs.

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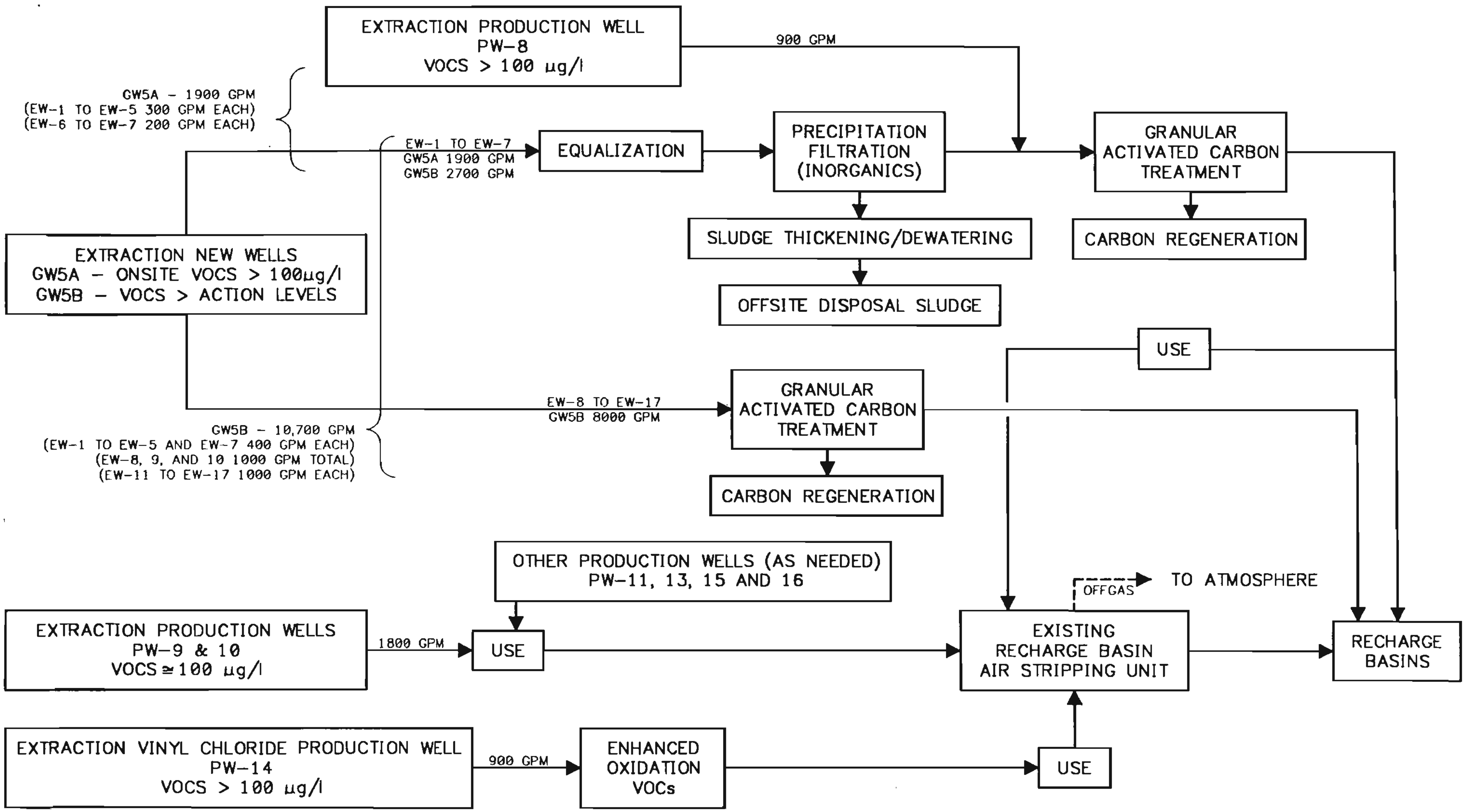

NOTE: VOLUMES PRESENTED ARE PRELIMINARY
AND MAY BE REVISED DURING THE REMEDIAL
ACTION STAGES.

GROUNDWATER ALTERNATIVES GW5A AND GW5B
EXTRACTION, PRECIPITATION/FILTRATION,
GAC, AND REUSE
NWIRP, BETHPAGE, NEW YORK

FIGURE 3-15

HALLIBURTON NUS
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Extraction wells EW-1 to EW-5 would extract 300 gpm each and extraction wells EW-6 and EW-7 would extract 200 gpm each, from depths ranging to 300 feet, for a total of 1900 gpm. The extracted groundwater would then be combined into an equalization tank to dampen flow and contaminant surges. Following equalization, ferrous sulfate would be added to reduce the chromium from hexavalent to trivalent and precipitate the metals constituents, including trivalent chromium. The precipitate would then be thickened and dewatered and the resultant sludge cake disposed of offsite.

The processed water would continue to a granular activated carbon (GAC) treatment unit for VOC removal. Spent liquid phase carbon would be regenerated offsite. After the GAC unit, the treated effluent would be either discharged to the NWIRP recharge basins or used in the plant.

This alternative includes the use and treatment of the most contaminated production wells at the NWIRP (VOCs greater than 100 ug/l). An aeration basin treatment system is being introduced by Grumman to allow the use of most of their production wells (PW-9, PW-10, PW-11, PW-13, PW-15, and PW-16). These production wells contain VOCs in the range of 5 to 100 ug/l. The wells are being used to supply water at approximately 1800 gpm (winter) to 4900 gpm (summer). The pending Grumman treatment system, as illustrated in Figure 3-15, will utilize the existing NWIRP recharge basins and a new aeration basin. The aeration basin offgas emissions will exit to the atmosphere since the offgas contaminant concentrations are sufficiently low enough not to warrant offgas treatment. The treated effluent water will be discharged to the NWIRP recharge basins. Under this alternative, two of these production wells (PW-9 and PW-10) with VOCs of approximately 100 ug/l, would be used preferentially.

Production wells PW-8 and PW-14 are on the NWIRP Bethpage, but are not operated because of relatively high VOC concentrations (approximately 1,000 ug/l). However, based on the VOC concentrations in these wells, they are also targeted for preferential use under this alternative. Because the new aeration basin is only intended as a polishing unit, supplemental treatment of PW-8 and PW-14 waters would be required prior to use or discharge of this water. In addition, PW-14 contains very significant levels of vinyl chloride (1400 ug/l). Vinyl chloride (also a VOC) requires special pretreatment.

Alternative GW5A features an enhanced oxidation unit (UV/hydrogen peroxide) installed specifically for PW-14 and designed to remove the vinyl chloride, since activated carbon is ineffective for vinyl chloride. Treatment of the water vinyl chloride would be expected to effectively treat the water for the other organics as well. As a result, this water can be either used at the plant or discharged to the recharge basins.

The water from PW-8 would be sent to the new onsite/near site groundwater treatment unit to remove the VOCs. The treated water would then be either used at the plant or discharged to the NWIRP recharge basins.

Once the treatment system is functional, the more contaminated (VOCs greater than 100 ug/l) production wells, PW-8, PW-9, PW-10, and PW-14 should be preferentially used to ensure site cleanup.

During the heavy summer demand of approximately 4900 gpm, pumping from the additional production wells PW-11, 13, 15, and 16 could be added to satisfy the demand. Also, treated water from the onsite/near site treatment system could be used to supply part of the demand.

3.4.8 Alternative GW5B - Extraction (All Contaminated Groundwater), Precipitation/Filtration (Inorganics), GAC (VOCs), and Reuse

Alternative GW5B addresses both onsite/near site and offsite contamination. The onsite system is essentially that of Alternative GW5A although the GW5B onsite flow rate is higher to include VOC contamination < 100 ug/l at depth. The offsite remediation also features conventional GAC for VOC treatment; no metals removal is necessary for offsite contamination. Additional description of this extraction/treatment/discharge general response action alternative is provided in Section 4.3.8.

For Alternative GW5B (refer to Figure 3-15), seven new onsite/near site extraction wells, EW-1 to EW-7, and ten new offsite extraction wells, EW-8 to EW-17, would be installed to treat all of the contaminated groundwater.

The onsite/near site extraction wells EW-1 to EW-5 and EW-7 would each extract 400 gpm and extraction well EW-6 would extract 300 gpm, from depths ranging to 450 feet, for a total of 2700 gpm. The extracted groundwater would be combined into an equalization tank to dampen flow and contaminant surges. The equalization tank would be receiving a total of 2700 gpm of potentially contaminated groundwater. Following equalization, ferrous sulfate would be added to reduce the chromium from hexavalent to trivalent and precipitate the metals constituents, including trivalent chromium. The precipitate would then be thickened and dewatered and the resultant sludge cake disposed of offsite. The processed groundwater would be pumped to a granular activated carbon (GAC) treatment unit for VOC removal. Spent carbon would be regenerated offsite. After the GAC treatment, the treated effluent from the wells EW-1 to EW-7 would be either discharged into the NWIRP recharge basins or used in the plant.

Wells EW-8 to EW-17 are the offsite extraction wells. The following is a summary of extraction rates from wells EW-8 to EW-17:

EW-8 - 300 gpm
EW-9 - 280 gpm
EW-10 - 350 gpm
EW-11 - 1060 gpm
EW-12 - 990 gpm
EW-13 - 990 gpm
EW-14 - 860 gpm
EW-15 - 890 gpm
EW-16 - 1160 gpm
EW-17 - 1160 gpm

All of the extraction wells will draw from depths ranging to 450 feet at a combined total flow of 8,040 gpm.

A GAC treatment unit would be installed at each well site for VOC removal. For convenience, a total of 8 systems would be installed each with a capacity of approximately 1000 gpm. Extraction wells EW-8, EW-9, and EW-10 would flow into one combined system while each of the remaining wells EW-11 to EW-17 would have their own individual systems. After the carbon adsorption, the treated effluent from the wells EW-8 to EW-10 would discharge into the NWIRP recharge basins, treated effluent from EW-11 to EW-15 would be sent to the east recharge basins, and treated effluent from EW-16 and EW-17 would proceed to the south Grumman recharge basins.

This alternative includes the use and treatment of the most contaminated production wells at the NWIRP (VOCs greater than 100 ug/l). An aeration basin treatment system is being introduced by Grumman to allow the use of most of their production wells (PW-9, PW-10, PW-11, PW-13, PW-15, and PW-16). These production wells contain VOCs in the range of 5 to 100 ug/l. The wells are being used to supply water at approximately 1800 gpm (winter) to 4900 gpm (summer). The pending Grumman treatment system, as illustrated in Figure 3-15, will utilize the existing NWIRP recharge basins and a new aeration basin. The aeration basin offgas emissions will exit to the atmosphere since the offgas contaminant concentrations are sufficiently low enough not to warrant offgas treatment. The treated effluent water will be discharged to the NWIRP recharge basins. Under this alternative, two of these production wells (PW-9 and PW-10) with VOCs of approximately 100 ug/l, would be used preferentially.

Production wells PW-8 and PW-14 are on the NWIRP Bethpage, but are not operated because of relatively high VOC concentrations (approximately 1,000 ug/l). However, based on the VOC concentrations in these wells, they are also targeted for preferential use under this alternative. Because the new aeration basin is only intended as a polishing unit, supplemental treatment of PW-8 and PW-14 waters would be required prior to use or discharge of this water. In addition, PW-14 contains very significant levels of vinyl chloride (1400 ug/l). Vinyl chloride (also a VOC) requires special pretreatment.

Alternative GW5B features an enhanced oxidation unit (UV/hydrogen peroxide) installed specifically for PW-14 and designed to remove the vinyl chloride, since activated carbon is ineffective for vinyl chloride. Treatment of the water vinyl chloride would be expected to effectively treat the water for the other organics as well. As a result, this water can be either used at the plant or discharged to the recharge basins.

The water from PW-8 would be sent to the new onsite/near site groundwater treatment unit to remove the VOCs. The treated water would then be either used at the plant or discharged to the NWIRP recharge basins.

Once the treatment system is functional, the more contaminated (VOCs greater than 100 ug/l) production wells, PW-8, PW-9, PW-10, and PW-14 should be preferentially used to ensure site cleanup. During the heavy summer demand of approximately 4900 gpm, pumping from the additional production wells PW-11, 13, 15, and 16 could be added to satisfy the demand. Also, treated water from the onsite/near site treatment system could be used to supply part of the demand.

3.4.9 Alternative GW6A - Extraction (Onsite/Near Site Groundwater), Precipitation/Filtration (Inorganics), Enhanced Oxidation (VOCs), and Reuse

Alternative GW6A is essentially that of GW5A; however, GW6A features the innovative enhanced oxidation for VOC removal, as well as enhanced oxidation for production well PW-14 containing vinyl chloride. Additional description of this extraction/treatment/discharge general response action alternative is provided in Section 4.3.9.

For Alternative GW6A (refer to Figure 3-16) seven new onsite/near site extraction wells would be installed to treat contamination greater than 100 ug/l VOCs. Extraction wells EW-1 to EW-5 would extract 300 gpm each and extraction wells EW-6 and EW-7 would extract 200 gpm each, from depths ranging to 300 feet for a total of 1900 gpm. The extracted groundwater would then be combined into an equalization tank to dampen flow and contaminant surges. Following equalization, ferrous sulfate would be added to reduce the hexavalent chromium to trivalent chromium and precipitate the metal constituents, including trivalent chromium. The precipitate would then be thickened and dewatered and the resultant sludge cake disposed of offsite. The processed groundwater would continue to an enhanced oxidation unit (UV/hydrogen peroxide) to remove the VOCs. No residuals would be generated. After enhanced oxidation, the treated effluent would be either discharged to the NWIRP recharge basins or used in the plant.

This alternative includes the use and treatment of the most contaminated production wells at the NWIRP (VOCs greater than 100 ug/l). An aeration basin treatment system is being introduced by Grumman to allow the use of most of their production wells (PW-9, PW-10, PW-11, PW-13, PW-15, and PW-16). These production wells contain VOCs in the range of 5 to 100 ug/l. The wells are being used to supply water at approximately 1800 gpm (winter) to 4900 gpm (summer). The pending Grumman treatment system, as illustrated in Figure 3-16, will utilize the existing NWIRP recharge basins and a new aeration basin. The aeration basin offgas emissions will exit to the atmosphere since the offgas contaminant concentrations are sufficiently low enough not to warrant offgas treatment. The treated effluent water will be discharged to the NWIRP recharge basins. Under this alternative, two of these production wells (PW-9 and PW-10) with VOCs of approximately 100 ug/l, would be used preferentially.

Production wells PW-8 and PW-14 are on the NWIRP Bethpage, but are not operated because of relatively high VOC concentrations (approximately 1,000 ug/l). However, based on the VOC concentrations in these wells, they are also targeted for preferential use under this alternative. Because the new aeration basin is only intended as a polishing unit, supplemental treatment of PW-8 and PW-14 waters would be required prior to use or discharge of this water. In addition, PW-14 contains very significant levels of vinyl chloride (1400 ug/l). Vinyl chloride (also a VOC) requires special pretreatment.

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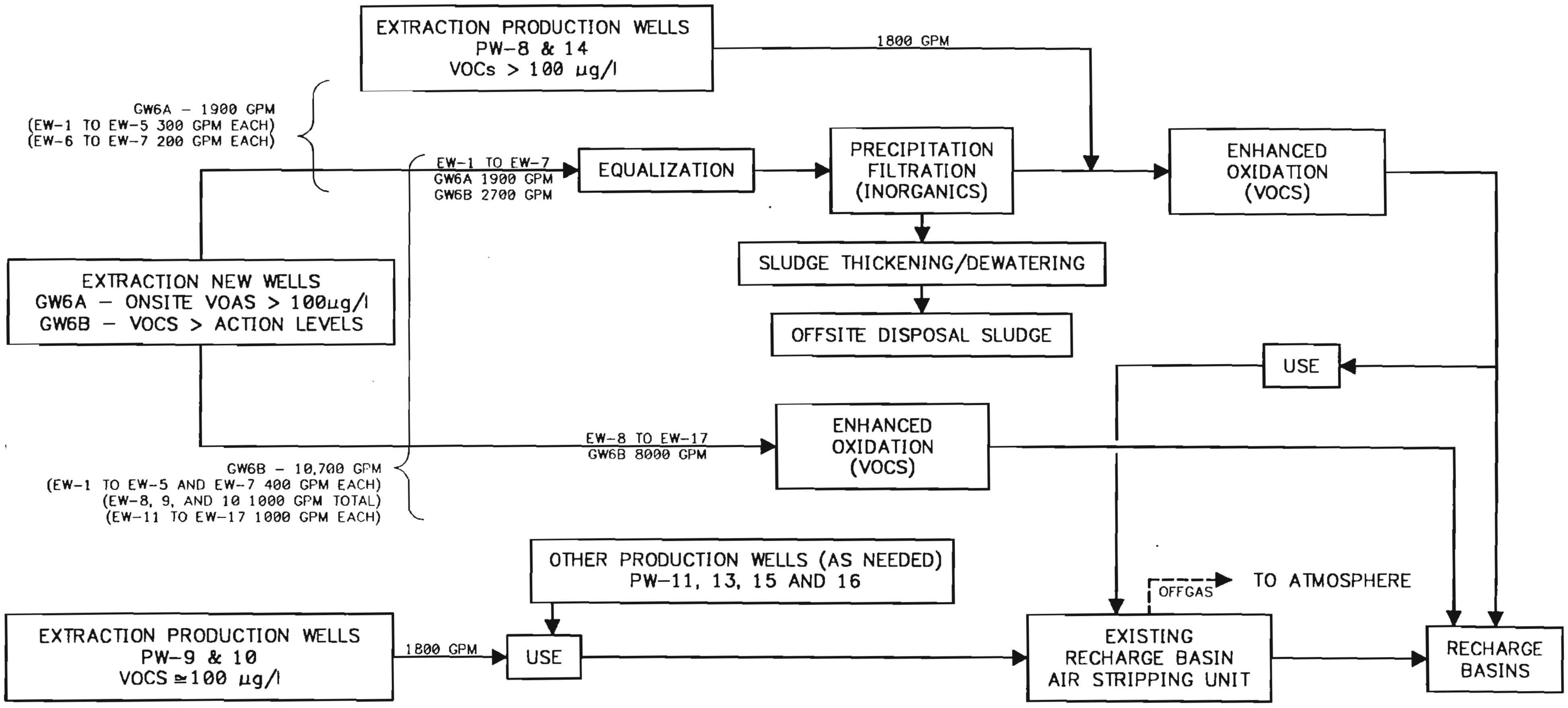

NOTE: VOLUMES PRESENTED ARE PRELIMINARY AND MAY BE REVISED DURING THE REMEDIAL ACTION STAGES.

GROUNDWATER ALTERNATIVES GW6A AND GW6B
EXTRACTION, PRECIPITATION/FILTRATION,
ENHANCED OXIDATION AND REUSE
NWIRP, BETHPAGE, NEW YORK

FIGURE 3-16

HALLIBURTON NUS
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The water from PW-8 and PW-14 would be sent to the new onsite/near site groundwater treatment unit to remove the VOCs (including vinyl chloride) using enhanced oxidation. The treated water would then be either used at the plant or discharged to the NWIRP recharge basins.

Once the treatment system is functional, the more contaminated (VOCs greater than 100 ug/l) production wells, PW-8, PW-9, PW-10, and PW-14 should be preferentially used to ensure site cleanup. During the heavy summer demand of approximately 4900 gpm, pumping from the additional production wells PW-11, 13, 15, and 16 could be added to satisfy the demand. Also, treated water from the onsite/near site treatment system could be used to supply part of the demand.

3.4.10 Alternative GW6B - Extraction (All Contaminated Groundwater), Precipitation/Filtration (Inorganics), Enhanced Oxidation (VOCs) and Reuse

Alternative GW6B addresses both onsite/near site and offsite contamination. The onsite system is essentially that of Alternative GW6A although the GW6B onsite flow rate is higher to include VOC contamination < 100 ug/l at depth. The offsite extraction system also features enhanced oxidation for VOC treatment; no metals removal is necessary for offsite contamination. Additional description of this extraction/treatment/discharge general response action alternative is provided in Section 4.3.10.

Alternative GW6B (refer to Figure 3-16), seven new onsite/near site extraction wells, EW-1 to EW-7, and ten new offsite extraction wells, EW-8 to EW-17, would be installed to treat all of the contaminated groundwater.

The onsite/near site extraction wells EW-1 to EW-5 and EW-7 would each extract 400 gpm and extraction well EW-6 would extract 300 gpm, from depths ranging to 450 feet, for a total of 2700 gpm. The extracted groundwater would be combined into an equalization tank to dampen flow and contaminant surges. The equalization tank would receive a total of 2700 gpm of potentially contaminated groundwater. Following equalization, ferrous sulfate would be added to reduce the hexavalent chromium to trivalent chromium and precipitate the metals constituents, including trivalent chromium. The precipitate would then be thickened and dewatered and the resultant sludge cake disposed of offsite. The processed water would be pumped to an enhanced oxidation (UV/hydrogen peroxide) treatment unit for VOC removal. No residuals would be generated. After enhanced oxidation, the treated effluent from the onsite/near site wells EW-1 to EW-7 would be either discharged to the NWIRP recharge basins or used in the plant.

Wells EW-8 to EW-17 are the offsite extraction wells. The following is a summary of extraction rates from wells EW-8 to EW-17:

EW-8 - 300 gpm
EW-10 - 350 gpm
EW-12 - 990 gpm
EW-14 - 860 gpm
EW-16 - 1160 gpm
EW-9 - 280 gpm
EW-11 - 1060 gpm
EW-13 - 990 gpm
EW-15 - 890 gpm
EW-17 - 1160 gpm

All of the offsite extraction wells would draw from depths of 450 feet at a combined total flow of 8040 gpm.

An enhanced oxidation treatment unit would be installed at each well site for VOC removal. For convenience, a total of 8 systems would be installed each with a capacity of approximately 1000 gpm. Extraction wells EW-8, EW-9, and EW-10 would flow into one system while each of the remaining wells EW-11 to EW-17 would have their own individual systems. After removal of the VOCs, the treated effluent from the wells EW-8 to EW-10 would discharge into the NWIRP recharge basins, treated effluent from EW-11 to EW-15 would be sent to the east recharge basins, and treated effluent from EW-16 and EW-17 would proceed to the south Grumman recharge basins.

This alternative includes the use and treatment of the most contaminated production wells at the NWIRP (VOCs greater than 100 ug/l). An aeration basin treatment system is being introduced by Grumman to allow the use of most of their production wells (PW-9, PW-10, PW-11, PW-13, PW-15, and PW-16). These production wells contain VOCs in the range of 5 to 100 ug/l. The wells are being used to supply water at approximately 1800 gpm (winter) to 4900 gpm (summer). The pending Grumman treatment system, as illustrated in Figure 3-16, will utilize the existing NWIRP recharge basins and a new aeration basin. The aeration basin offgas emissions will exit to the atmosphere since the offgas contaminant concentrations are sufficiently low enough not to warrant offgas treatment. The treated effluent water will be discharged to the NWIRP recharge basins. Under this alternative, two of these production wells (PW-9 and PW-10) with VOCs of approximately 100 ug/l, would be used preferentially.

Production wells PW-8 and PW-14 are on the NWIRP Bethpage, but are not operated because of relatively high VOC concentrations (approximately 1,000 ug/l). However, based on the VOC concentrations in these wells, they are also targeted for preferential use under this alternative. Because the new aeration basin is only intended as a polishing unit, supplemental treatment of PW-8 and PW-14 waters would be required prior to use or discharge of this water. In addition, PW-14 contains very significant levels of vinyl chloride (1400 ug/l). Vinyl chloride (also a VOC) requires special pretreatment.

The water from PW-8 and PW-14 would be sent to the new onsite/near site groundwater treatment unit to remove the VOCs (including vinyl chloride) using enhanced oxidation. The treated water would then be either used at the plant or discharged to the NWIRP recharge basins.

Once the treatment system is functional, the more contaminated (VOCs greater than 100 ug/l) production wells, PW-8, PW-9, PW-10, and PW-14 should be preferentially used to ensure site cleanup. During the heavy summer demand of approximately 4900 gpm, pumping from the additional production wells PW-11, 13, 15, and 16 could be added to satisfy the demand. Also, treated water from the onsite/near site treatment system could be used to supply part of the demand.

3.5 ALTERNATIVES RETAINED FOR DETAILED ANALYSIS

Typically, in this section of the feasibility study (FS), the list of potential alternatives for each medium (soils and groundwater) is screened, based on effectiveness, implementability, and cost, to reduce the list of alternatives that will be subsequently analyzed in detail. However, because only a limited number of alternatives were developed for each medium, screening in this section is not warranted. Therefore, to streamline the FS and to provide a clearer evaluation of alternatives, this tier of screening has been eliminated, and all alternatives assembled in Alternatives developed in Section 3.2 and 3.3 will be retained for detailed analysis.

4.0 DETAILED ANALYSIS OF ALTERNATIVES

4.1 INTRODUCTION

4.1.1 Introduction

The remedial alternatives developed in Section 3.0 for soils and groundwater are described and analyzed in detail in this section. The detailed analysis of the retained remedial alternatives serves to provide information to facilitate the selection of a specific remedy or combination of remedies. The detailed analysis of alternatives was developed in accordance with Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA (EPA Interim Final, October 1988) and the NCP.

4.1.2 Evaluation Criteria for Detailed Analysis of Remedial Alternatives

In conformance with the NCP, the following nine criteria were used to evaluate each of the retained alternatives during the detailed analysis:

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

Brief discussions on each of these criteria are presented in the following subsections.

Short-Term Effectiveness

The assessment of short-term effectiveness includes consideration of the following factors:

- Potential impacts to, and protection of, the community during remedial actions at the Site.

- Potential impacts to, and protection of, the workers during remedial actions at the Site.

- Time until remedial action objectives are achieved.

Long-Term Effectiveness and Permanence

This criterion reflects CERCLA's emphasis on implementing remedies that will ensure immediate and long-term protection of human health and the environment. In evaluating alternatives for their long-term effectiveness and the degree of permanence they afford, the analysis focuses on the residual risks that may remain at the Site after the completion of remedial action. In general, the analysis should result in an evaluation of the following:

- Degree of threat to human health and the environment posed by the contaminants of concern remaining at the Site.
- Adequacy and reliability of any controls (e.g., engineering and institutional controls) used to manage the contaminants of concern remaining at the Site.
- Potential impacts on human health and the environment should the remedy fail, based on assumptions included in a reasonable maximum exposure assessment.

The evaluation of long-term effectiveness and permanence is designed to take into consideration statutory requirements to assess:

- Uncertainties associated with land disposal.
- Goals, objectives, and requirements of RCRA.
- Persistence, toxicity, mobility, and bioaccumulation capacity of the contaminants of concern.
- Long-term potential for adverse health effects from exposure to the contaminants of concern.
- Potential for future remedial action costs, if the remedy were to fail.
- Potential threat to human health and the environment associated with redisposal or contaminant of the contaminants of concern.

Reduction of Toxicity, Mobility, or Volume

This criterion addresses the statutory preference for remedies that employ treatment as a principal element by assessing the relative performance of different treatment technologies for reducing the toxicity, mobility, or volume of the contaminated-media at the Site. Specifically, the analysis should examine the magnitude, significance, and irreversibility of the estimated reductions.

The degree to which remedial alternatives employ treatment that reduces toxicity mobility, or volume are to be assessed by considering the following factors:

- The treatment processes that the remedies employ, and the media they will treat.
- The approximate amount of hazardous materials that will be destroyed or treated.
- The degree of expected reduction in toxicity, mobility, or volume.
- The degree to which the treatment is irreversible.
- The type and quantity of residuals that will remain following treatment, considering the persistence, toxicity, mobility, and bioaccumulation capacity of the contaminants of concern and impacted media.
- The ability of alternatives to satisfy the statutory preference for treatment as a principal element.

Implementability

The ease or difficulty of implementing a remedial alternative should be assessed by considering the following factors:

- Technical feasibility:
  - Degree of difficulty associated with constructing and operating the alternative.
  - Expected operational reliability of the treatment technologies comprising the alternative.
  - Ease of undertaking additional remedial actions, if necessary.
  - Ability to monitor the effectiveness of the remedy.
- Administrative feasibility:
  - Need to coordinate with and obtain necessary approvals and permits (e.g., NPDES permits)
- Availability of services and materials:
  - Availability of necessary equipment and specialists.

  - Availability of adequate capacity and location of treatment, storage, and disposal services, if required.

  - Availability of treatment technologies comprising the alternative.

  - Availability of services and materials, and the potential for obtaining competitive bids.

Cost

The evaluation of cost includes consideration of construction and operations and maintenance (O&M) costs incurred over the duration of the remedial action. The focus during the detailed analysis is on the net present value of these costs. A discount rate is included which results in a realistic accounting of future costs associated with the remedial alternatives, and an accurate comparison of the total costs, as well as the cost-effectiveness, of treatment and non-treatment remedies.

The types of costs that need to be assessed during the FS include:

- Capital costs.

- Annual operation and maintenance costs.

- Present worth costs.

The typical cost estimate performed during the FS is expected to provide an accuracy of plus 50 percent to minus 30 percent. Also, when necessary, a sensitivity analysis may be performed. A sensitivity analysis assesses the effect that variations in specific assumptions associated with an alternative may have on the estimated cost.

Compliance with ARARs

Compliance with ARARs is a statutory requirement for remedy selection. Alternatives are developed and refined throughout the CERCLA process to ensure that they will either comply with all pertinent ARARs, or that there is sufficient rationale for waiving an ARAR. During the detailed analysis, information on Federal and State action-specific ARARs will be assembled along with previously identified chemical-specific and location-specific ARARs. Alternatives will be refined to ensure compliance with these requirements, or initiate identification of waivers that may be invoked.

Overall Protection of Human Health and the Environment

This evaluation criterion provides a final check to assess whether each alternative provides adequate protection of human health and the environment. The overall assessment of protection draws on the assessments conducted under other evaluation criteria, including long-term effectiveness and permanence, short-term effectiveness, and compliance with ARARs. The evaluation focuses on whether a specific alternative achieves adequate protection.

State Acceptance

New York State input and concurrence with the project and associated documents are ongoing. New York State comments on remedial alternatives will be addressed following their review of a draft version of the RI/FS report.

Community Acceptance

This criterion refers to the community's comments on the remedial alternatives under consideration, where community is broadly defined to include all interested parties. Community concerns will be addressed after the public comment period, which follows the release of the RI/FS report.

4.1.3 Relative Importance of Criteria

During the FS analysis, the nine evaluation criteria will be discussed in order of consideration, with regard to selecting a recommended alternative. The nine evaluation criteria can be categorized into three groups, each with distinct functions in selecting the remedy. The first group consists of threshold criteria that must be satisfied so that an alternative is eligible for selection. Overall protection of human health and the environment and compliance with applicable or relevant and appropriate requirements (or invoking a waiver) are threshold criteria. The second group of evaluation criteria consists of the following primary balancing factors used to weight the trade-offs between alternative hazardous waste management strategies: long-term effectiveness and permanence; reduction of toxicity, mobility, or volume; short-term effectiveness; implementability; and cost. The third group of evaluation criteria are modifying considerations that are formally taken into account after public comment is received on the proposed plan and RI/FS report. State and community acceptance are modifying considerations.

4.1.4 Selection of Remedy

In selecting a remedy, the statutory requirements discussed below must be satisfied. These requirements will be addressed differently, depending on the scope of the action being taken.

- The selected remedy is protective of human health and the environment by eliminating, reducing, or controlling risks posed through each pathway so that human and environmental receptors are no longer threatened. The protectiveness evaluation of an operable unit may be limited to that unit itself; at a minimum, the protectiveness determination should show that conditions at a site are not exacerbated as a result of the action.

- The selected remedy at least attains all ARARs, unless use of a waiver or waivers is justified.

- The selected remedy is cost-effective, in that its overall effectiveness is proportionate to its total costs.

- The selected remedy utilizes permanent solutions, treatment technologies, or resource recovery technologies to the maximum extent practicable.

4.2 DETAILED ANALYSIS OF SOIL ALTERNATIVES

4.2.1 Alternative S1 - No Action

This alternative is a no-action alternative, and is developed and retained for baseline comparison purposes with the other alternatives, as required by the NCP. The only activity that would occur under the no-action alternative is periodic reviews, typically every 5 years.

Short-Term Effectiveness

Since no actions would occur, the no action alternative would not pose any risks to the local community or onsite workers during implementation. None of the remedial action objectives would be achieved.

Long-Term Effectiveness

Since no removal would occur, the current threat to human health and the environment would remain. The contaminants remaining at the site would include solvents (VOCs), semi-volatile organics, metals, and PCBs. The risks associated with these contaminants would remain. These risks include the VOCs continuing to migrate to the groundwater at unacceptable rates and onsite workers would continue to be exposed to the contaminants.

Under the no action alternative, there are no controls used to manage the contaminants at the site. Therefore, the adequacy and reliability of controls are not applicable.

The no action alternative includes the use of interim actions and natural site conditions to minimize risk to human health and the environment. The interim measures include capping of PCB-contaminated surface soils. Natural conditions include asphalt, buildings, and soils also serving as covers/caps. The interim measures and natural conditions, significantly limit current risks to human health by providing a barrier to contact. However, these measures may not remain in place in the future. Soil, including the soil cap over the PCB-contaminated soils and arsenic contaminated soils can erode. Fugitive dust and direct contact pathways would then be established.

VOC contamination of the groundwater would continue. In addition, deterioration of asphalt and concrete will cause increased precipitation infiltration. Increased infiltration contacting VOC-contaminated soils underlying these areas would result in increased groundwater contamination.

Reduction of Toxicity, Mobility, or Volume

The no action alternative would not reduce the toxicity, mobility, or volume of contamination, since no treatment is being used to address the contaminated soils. As a result, no hazardous materials will be specifically treated or destroyed. Contaminated soils would remain.

Natural removal mechanisms for VOCs in soils include volatilization to the air and flushing into the groundwater. Because of the presence of the VOCs deep into the soils (up to 50 feet below grade), volatilization is not expected to result in significant VOC removal. Once the VOCs are in the atmosphere, they are permanently destroyed through photochemical degradation. In the groundwater, the VOCs would flow with the groundwater and eventually be discharged to the ocean or be captured by potable water supply wells to the south.

PCBs and metals, would remain in the soils for extended periods of time. PCBs may degrade slowly over time, however, the types of PCBs present at the site (Aroclor 1254 and 1248) are the most stable. Metals do not degrade with time, but remain with the soil. The PCBs and the majority of the metals present in the site soils are not expected to be water soluble at significant concentrations, especially when depths to groundwater are taken into account. As a result, PCBs and for the most part metals are not expected to be a groundwater concern. A relatively high concentration of arsenic was identified in one soil sample at Site 1. Also, the arsenic was found to leach at a relatively significant concentration (0.8 mg/l), indicating that arsenic from this location could represent a groundwater concern.

PAHs would also remain in the soils for extended periods of time. PAHs are not very mobile and therefore significant groundwater contamination would not be expected. Also, PAHs degrade biologically with time.

Implementability

Since no action is occurring, the no action alternative is readily implementable. The technical feasibility criteria including constructability, operability, and reliability are not applicable. Additional actions could be taken. However, no monitoring is considered under no action.

Permits would not be required under Alternative S1.

The criteria of availability of equipment and resources, treatment technologies, and TSD facilities are not applicable.

Cost

There are no capital costs associated with the no action alternative. The average O&M cost for 5-years reviews is $4,000 per year. Overall a 30 year period, the net present worth cost is $56,000.

Compliance with ARARs

The no action alternative would not comply with ARARs and TBCs. Relevant and appropriate sections of Federal and state RCRA programs and Federal TSCA would not be complied with. In addition, VOCs would continue to migrate to the groundwater leading to continuing noncompliance with Federal and state drinking water/ groundwater criteria.

The no action alternative would not comply with NYSDEC soil and groundwater guidelines and the OSWER directive for PCB contamination.

Overall Protection of Human Health and the Environment

The no action alternative would not be protective of human health and the environment. Contaminants in the soils can affect human health through dermal contact, accidental ingestion, and fugitive dust inhalation. Also, VOCs can continue to migrate into the groundwater.

4.2.2 Alternative S2A and S2B - Clay Capping

Alternative S2A addresses clay capping of contaminated soils with metals and organics concentrations greater than the current industrial use scenario action levels. Alternative S2B addresses clay capping of contaminated soils with metal and organic concentrations greater than the future residential use scenario action levels. The areas to be capped are presented in Figure 3-2. For all practical purposes these two areas are identical. For this discussion, unless there is a difference between the two options, Alternatives S2A and S2B will be referred to collectively as Alternative S2.

Under this alternative, an impermeable clay cap system is featured. From bottom to top layers, the clay cap system consists of 6 inches of gravel (vapor barrier), 1 foot of compacted clay, and 6 inches of gravel covered by 2 feet of clean soil. Soil conditioning, fertilization, and revegetation would be employed as necessary, based on end use and erosion considerations. Deed restrictions would also be required to restrict future use of the affected areas.

Short-Term Effectiveness

Alternative S2 would not pose any risks to the local community or onsite workers during implementation. Onsite workers would be protected from risks through appropriate use of PPE. Risks to offsite residents would be minimized by using dust suppressants to control potential fugitive dust emissions during the capping of soils.

The remedial action objectives would be complied with once the cap is place. Cap placement would require 1 to 3 years to implement from signing of the ROD.

Long-Term Effectiveness

Once the cap has been completed, risks to human health and the environment would be drastically reduced. The cap would effectively limit direct contact with the waste and reduce precipitation infiltration and resulting groundwater contamination. The contaminants remaining at the site would include VOCs (solvents), semi-volatile organics, metals, and PCBs.

The cap would be used to manage the contaminants at the site. Monitoring wells would be used to monitor the long term effectiveness of the cap. However, because of the existing groundwater contamination, this monitoring may not be adequate or reliable.

Capping of the soils is potentially viable in the long term. However, ongoing maintenance/repair of the cap would be required to ensure the long term effectiveness. Also deed restrictions, which are only somewhat effective, would be required to restrict disturbance of the cap.

Reduction of Toxicity, Mobility, or Volume

Alternative S2 would not reduce the toxicity, mobility, or volume of contamination, since no treatment is being used to address the contaminated soils. As a result, no hazardous materials will be specifically treated or destroyed. Contaminated soils would remain.

Natural removal mechanisms for VOCs in soils, which include volatilization to the air and flushing into the groundwater, would be drastically reduced. The capping should significantly limit the migration. However, by limiting migration, contaminants would remain indefinitely.

PCBs and VOCs would remain in the soils for very long periods of time, since they only slowly degrade naturally. PAHs would also remain in the soils for extended periods of time, but PAHs degrade more rapidly. Metals do not degrade at all.

Implementability

Alternative S2 is implementable. The cap can be readily constructed and the monitoring wells sampled on an ongoing basis. Construction of the cap should be reliable since only common construction equipment is required.

Only state and local construction-type permits would be required. These permits should be readily obtainable.

The equipment and resources needed to construct a cap are readily available. The criteria of treatment technologies and TSD facilities are not applicable.

The implementation of this alternative would significantly interfere with the ongoing operations at the Grumman facility or any potential future use of the site.

Cost

The estimated capital costs for Alternatives S2A and S2B are $3,800,000 and $3,500,000, respectively. The estimated O&M costs for cap maintenance and 5-year reviews are $19,000 per year and $18,000 per year. Over a thirty year period, the net present worth costs are $4,065,000 and $3,820,000 for Alternatives S2A and S2B, respectively. Note that costs presented are preliminary and may be modified based on additional testing that would be conducted during the Remedial Design/Remedial Action stage.

Compliance with ARARs

Alternative S2 may comply with ARARs and TBCs, including relevant and appropriate sections of Federal and state RCRA and drinking water/groundwater protection, and Federal TSCA regulations.

Alternative S2 may not comply with NYSDEC soil and groundwater guidelines and the OSWER directive for PCB contamination.

Action-specific ARARs to be followed under Alternative S2 include the OSHA construction standards and RCRA closure regulations.

Overall Protection of Human Health and the Environment

Alternative S2 would be protective of human health and the environment. Contaminants in the soils would be isolated from contact with the public and migration of contaminants would be significantly limited. Alternative S2 would interfere with the ongoing operations at Grumman. Also, the cap would require long term maintenance to remain protective.

4.2.3 Alternative S3 - Fixation of Metals, Incineration of PCBs> 50 ppm, and In-Situ Vapor Extraction of VOCs

Alternative S3 addresses soil "hot spots" (i.e., metal concentrations greater than hazardous waste criteria, as defined by the USEPA under 40 CFR 261.24, and PCB concentrations greater than 50 ppm) using conventional techniques. Additionally, the primary site contaminants, VOCs (solvents), are addressed using in-situ vapor extraction and air sparging. For areas with other metal- and organic-contaminated soils at concentrations greater than the action levels, a 6-inch gravel cover or a 6-inch vegetated soil cover would be employed for industrial (S3A) or residential (S3B) use scenarios, respectively (refer to Figure 3-2 for areas to be capped). For this discussion, unless there is a difference between the options, Alternatives S3A and S3B will be referred to collectively as Alternative S3.

Alternative S3 (refer to Figure 3-3) includes bulk excavation of all soils with metal concentrations greater than the hazardous waste criteria. This contaminated soil would be fixated either on site or off site to reduce the mobility of the metals. The fixated soil would then be disposed of in an offsite landfill.

In accordance with TSCA regulations, soils containing PCBs in concentrations greater than 50 ppm, which occurs only at Site 1, would be excavated and transported to an approved offsite incineration facility.

Soils contaminated with VOCs greater than action levels would be processed via in-situ vapor extraction and air sparging. The air sparging component would also address the upper portion of the groundwater aquifer and soil/groundwater interface.

Deed restrictions would be required to restrict both current industrial use and future residential use of the site since other metal- and organic-contaminated soils remains in place.

Short-Term Effectiveness

Alternative S3 would not pose any significant risks to the local community or onsite workers during implementation. Onsite workers would be protected from risks through appropriate use of PPE, particularly during the excavation of the PCB- and arsenic-hot spots. During excavation, risks to offsite residents would be minimized by using dust suppressants to control potential fugitive dust emissions.

There would be minimal contact by workers with contaminants during the installation of the vapor extraction system. The offgas from the vapor extraction would be treated with activated carbon to capture the volatile organics. The VOCs would then be thermally destroyed during the regeneration process.

The remedial action objectives for arsenic- and PCB-contaminated soils should be achieved within 1 to 3 years after signing of the ROD. The treatment of the VOC-contaminated soils would require a total of 2 to 4 years to complete. Treatment of VOC contamination in soils and in underlying groundwater must be addressed simultaneously, since contaminated groundwater has the potential to recontaminate soils through fluctuating groundwater levels and soil gas migration.

Long-Term Effectiveness

Once the PCB- and arsenic-contaminated soils have been removed and the VOC-contaminated soils treated, risks to human health and the environment would be drastically reduced. Unrestricted use of the site would result in residual risks to human health in the range of 10^{-4} to 10^{-6}. This residual risk results from direct contact (dermal and ingestion) with the contaminants. A cover using either gravel (S3A - industrial use) or soil (S3B - residential use) would be used in conjunction with deed restrictions to minimize contact, and therefore eliminate risks to human health. Future threats to the groundwater would be eliminated by removing the VOC contamination.

The primary contaminants remaining at the site, to be addressed by the cover, would include PAHs, metals (at non hazardous levels), and PCBs (less than 50 ppm).

Monitoring wells would be used to monitor the long term effectiveness of the action. However, because of the existing groundwater contamination, this monitoring may not be adequate or reliable. Also, since vapor extraction is an in-situ process, testing for compliance with the VOC criteria is difficult. Isolated untreated areas may remain undetected.

Treatment of the soils, including thermal destruction of PCBs and VOCs, is permanent. Fixation and landfilling of the arsenic-contaminated soils is also relatively permanent. Insitu vapor extraction of the VOCs should be permanent, with one concern being potential recontamination of soils from contaminated groundwater. Covering of the remaining contaminated soils is potentially viable in the long term. Ongoing maintenance and repair of the cover would be required to ensure the long term effectiveness. Also deed restrictions, which are only somewhat effective, would be required to restrict disturbance of the cap. However, since the majority of the risks to onsite contaminants have been removed, the potential for ineffectiveness of the cover is not as significant of a concern as with Alternative S2 - Clay Capping.

Reduction of Toxicity, Mobility, or Volume

Alternative S3 includes excavation and offsite incineration of an estimated 300 cubic yards of PCB-contaminated soils; excavation, fixation, and landfilling of an estimated 600 cubic yards of arsenic-contaminated soils; and insitu vapor extraction and air sparging of an estimated 239,900 cubic yards of VOC-contaminated soils. Offgas treatment of the vapor extraction unit may use activated carbon. The VOCs would then be thermally destroyed. Note that the volumes presented are preliminary and may be modified based on additional testing that would be conducted during the Remedial Design/Remedial Action stage.

Alternative S3 would permanently reduce the toxicity of PCBs and VOCs through offsite thermal destruction. Destruction efficiencies of 99.99% are commonly achieved. The mobility of the arsenic would be reduced by 50 to 99% through the fixation process. The volume of VOC-contaminated soils (solvent) would be reduced by approximately 239,900 cubic yards. Soils with other contaminants would remain.

PCBs (less than 50 ppm) would remain in the soils for very long periods of time, since they only slowly degrade naturally. PAHs would also remain in the soils for extended periods of time, but PAHs degrade more rapidly. Metals do not degrade at all. These remaining contaminants are not very mobile in the environment and there is approximately 50 feet to the water table. As a result, significant groundwater contamination is not expected from the remaining soil contaminants.

Implementability

Alternative S3 is implementable. The soils designated for exsitu treatment can be readily excavated. The volume of soil to be addressed by insitu vapor extraction system is very extensive and includes areas under buildings. Some interferences to existing operations could be expected, however, no critical problems are expected. The cover can be readily constructed and the monitoring wells sampled on an ongoing basis. Construction of the cover should be reliable since only common construction equipment is required.

In addition to state and local construction-type permits, other permits would also be required. Permits for offsite transportation and disposal of the arsenic- and PCB-contaminated soils would be required. Also, a state air discharge permit would be required for the vapor extraction system. These permits should be readily obtainable. If the arsenic is treated on site, a RCRA TSD permit would be needed. This permit may be more difficult to obtain.

The equipment and resources needed to construct a cover are readily available. Landfill and incinerator capacities are limited. However, because the volumes of soils to be addressed are relatively low (900 cubic yards), there should be adequate TSD facilities available.

The insitu vapor extraction process is relatively new, but has been demonstrated at several sites. There are a limited number of vendors capable of performing the insitu vapor extraction process, however, there is not a critical shortage of vendors. The equipment used to construct and operate this technology are relatively common.

Cost

The estimated capital cost for Alternative S3 is $16,847,000. The estimated O&M cost for cap maintenance and 5-year reviews is $14,000 per year. Over a thirty year period, the net present worth cost is $17,056,000. Note that the costs presented are preliminary and may be modified based on additional testing that would be conducted during the Remedial Design/Remedial Action stage.

Compliance with ARARs

Alternative S3 should comply with ARARs, including relevant and appropriate sections of Federal and state RCRA and drinking water/groundwater protection regulations, and Federal TSCA regulations.

Alternative S3 would not comply with NYSDEC soil and groundwater guidelines and the OSWER directive for PCB contamination.

Action-specific ARARs to be complied with during the implementation of Alternative S3 include OSHA construction standards; Federal and/or state RCRA hazardous waste identification, treatment/storage/disposal, and land disposal restrictions; TSCA PCB requirements; and state Air Pollution Control Regulations.

Overall Protection of Human Health and the Environment

Alternative S3 would be protective of human health and the environment. The most significant contaminants would be removed from the NWIRP and be either thermally destroyed or immobilized and landfilled. Remaining contaminants in the soils would be isolated from contact with the public through the use of a cover. Future risk of ongoing groundwater contamination would be addressed by removing the solvents from the soils. Alternative S3 would interfere to an extent with the ongoing operations at Grumman. Also, the cover would require long term maintenance to remain protective.

4.2.4 Alternative S4 - Fixation of Metals, Landfilling of PCBs> 50 ppm, and In-Situ Vapor Extraction of VOCs

Alternative S4 addresses soil "hot spots" (i.e., metal concentrations greater than hazardous waste criteria, as defined by the USEPA under 40 CFR 261.24, and PCB concentrations greater than 50 ppm) using conventional techniques. Additionally, the primary site contaminants, VOCs (solvents), are addressed using in-situ vapor extraction and air sparging. For areas with other metal- and organic-contaminated soils at concentrations greater than the action levels, a 6-inch gravel cover or a 6-inch vegetated soil cover would be employed for industrial (S4A) or residential use (S4B) scenarios, respectively (refer to Figure 3-2 for areas to be capped). For this discussion, unless there is a difference between the options, Alternatives S4A and S4B will be referred to collectively as Alternative S4.

Alternative S4 (refer to Figure 3-4) includes bulk excavation of all soils with metal concentrations greater than the hazardous waste criteria. This contaminated soil would be fixated either on site or off site to reduce the mobility of the metals. The fixated soil would then be disposed of in an offsite landfill.

In accordance with TSCA regulations, soils containing PCBs in concentrations greater than 50 ppm, which occurs only at Site 1, would be excavated and transported to an approved offsite TSCA landfill.

Soils contaminated with VOCs greater than action levels would be processed via in-situ vapor extraction and air sparging. The air sparging component would also address the upper portion of the groundwater aquifer and soil/groundwater interface.

Deed restrictions would be required to restrict both current industrial use and future residential use of the site since other metal- and organic-contaminated soil remains in place.

Short-Term Effectiveness

Alternative S4 would not pose any significant risks to the local community or onsite workers during implementation. Onsite workers would be protected from risks through appropriate use of PPE, particularly during the excavation of the PCB and arsenic hot spots. During excavation, risks to offsite residents would be minimized by using dust suppressants to control potential fugitive dust emissions.

There would be minimal contact by workers with contaminants during the installation of the vapor extraction system. The offgas from the vapor extraction would be treated with activated carbon to capture the volatile organics. The VOCs would then be thermally destroyed during the regeneration process.

The remedial action objectives for arsenic- and PCB-contaminated soils should be achieved within 1 to 3 years after signing of the ROD. The treatment of the VOC-contaminated soils would require a total of 2 to 4 years to complete. Treatment of VOC contamination in soils and in underlying groundwater must be addressed simultaneously, since contaminated groundwater has the potential to recontaminate soils through fluctuating groundwater levels and soil gas migration.

Long-Term Effectiveness

Once the PCB- and arsenic-contaminated soils have been removed and the VOC-contaminated soils treated, risks to human health and the environment would be drastically reduced. Unrestricted use of the site would result in residual risks to human health in the range of 10^{-4} to 10^{-6}. This residual risk results from direct contact (dermal and ingestion) with the contaminants. A cover using either gravel (S4A - industrial use) or soil (S4B - residential use) would be used in conjunction with deed restrictions to minimize contact, and therefore eliminate risks to human health. Future threats to the groundwater would be eliminated by removing the VOC contamination.

The primary contaminants remaining at the site, to be addressed by the cover, would include PAHs, metals (at non hazardous levels), and PCBs (less than 50 ppm).

Monitoring wells would be used to monitor the long term effectiveness of the action. However, because of the existing groundwater contamination, this monitoring may not be adequate or reliable. Also, since vapor extraction is an in-situ process, testing for compliance with the VOC criteria is difficult. Isolated untreated areas may remain undetected.

Treatment of the soils, including thermal destruction of VOCs, is permanent. Fixation and landfilling of the arsenic-contaminated soils and landfilling of PCB-contaminated soils are also relatively permanent. Insitu vapor extraction of the VOCs should be permanent, with one concern being potential recontamination of soils from contaminated groundwater. Covering of the remaining contaminated soils is potentially viable in the long term. Ongoing maintenance and repair of the cover would be required to ensure the long term effectiveness. Also deed restrictions, which are only somewhat effective, would be required to restrict disturbance of the cap. However, since the majority of the risks to onsite contaminants have been removed, the potential for ineffectiveness of the cover is not as significant of a concern as with Alternative S2 - Clay Capping.

Reduction of Toxicity, Mobility, or Volume

Alternative S4 includes excavation and offsite landfilling of an estimated 300 cubic yards of PCB-contaminated soils; excavation, fixation, and landfilling of an estimated 600 cubic yards of arsenic-contaminated soils; and insitu vapor extraction/air sparging of an estimated 239,900 cubic yards of VOC-contaminated soils. Offgas treatment of the vapor extraction unit may use activated carbon. The VOCs would then be thermally destroyed. Note that the volumes presented are preliminary and may be modified based on additional testing that would be conducted during the Remedial Design/Remedial Action stage.

Alternative S4 would permanently reduce the toxicity of VOCs through offsite thermal destruction. Destruction efficiencies of 99.99% are commonly achieved. The mobility of the arsenic would be reduced by 50 to 99% through the fixation process. The volume of VOC-contaminated soils (VOC) would be reduced by approximately 239,900 cubic yards. Soils with other contaminants would remain.

PCBs (less than 50 ppm) would remain in the soils for very long periods of time, since they only slowly degrade naturally. PAHs would also remain in the soils for extended periods of time, but PAHs degrade more rapidly. Metals do not degrade at all. These remaining contaminants are not very mobile in the environment and there is approximately 50 feet to the water table. As a result, significant groundwater contamination is not expected from the remaining soil contaminants.

Implementability

Alternative S4 is implementable. The soils designated for exsitu treatment can be readily excavated. The volume of soil to be addressed by insitu vapor extraction system is very extensive and includes areas under buildings. Some interferences to existing operations could be expected, however, no critical problems are expected. The cover can be readily constructed and the monitoring wells sampled on an ongoing basis. Construction of the cover should be reliable since only common construction equipment is required.

In addition to state and local construction-type permits, other permits would also be required. Permits for offsite transportation and disposal of the arsenic- and PCB-contaminated soils would be required. Also, a state air discharge permit would be required for the vapor extraction system. These permits should be readily obtainable. If the arsenic is treated on site, a RCRA TSD permit would be needed. This permit may be more difficult to obtain.

The equipment and resources needed to construct a cover are readily available. Landfill and incinerator capacities are limited. However, because the volumes of soils to be addressed are relatively low (900 cubic yards), there should be adequate TSD facilities available.

The insitu vapor extraction process is relatively new, but has been demonstrated at several sites. There are a limited number of vendors capable of performing the insitu vapor extraction process, however, there is not a critical shortage of vendors. The equipment used to construct and operate this technology are relatively common.

Cost

The estimated capital cost for Alternative S4 is $15,900,000. The estimated O&M cost for cap maintenance and 5-year reviews is $14,000 per year. Over a thirty year period, the net present worth cost is $16,109,000. Note that the costs presented are preliminary and may be modified based on additional testing that would be conducted during the Remedial Design/Remedial Action stage.

Compliance with ARARs

Alternative S4 should comply with ARARs, including relevant and appropriate sections of Federal and state RCRA and drinking water/groundwater protection regulations, and Federal TSCA regulations.
Alternative S4 would not comply with NYSDEC soil and groundwater guidelines and the OSWER directive for PCB contamination.

Action-specific ARARs to be complied with during the implementation of Alternative S4 include OSHA construction standards; Federal and/or state RCRA hazardous waste identification, treatment/storage/disposal, and land disposal restrictions; TSCA PCB requirements; and state Air Pollution Control Regulations.

Overall Protection of Human Health and the Environment

Alternative S4 would be protective of human health and the environment. The most significant contaminants would be removed from the NWIRP and be either thermally destroyed or immobilized and/or landfilled. Remaining contaminants in the soils would be isolated from contact with the public through the use of a cover. Future risk of ongoing groundwater contamination would be addressed by removing the VOCs from the soils. Alternative S4 would interfere to an extent with the ongoing operations at Grumman. Also, the cover would require long term maintenance to remain protective.

4.2.5 Alternative S5 - Fixation of Metals, Incineration of PCBs> 50 ppm, Landfill of PCBs between 10 ppm and 50 ppm, and In-Situ Vapor Extraction of VOCs

Alternative S5 addresses soil "hot spots" (i.e., metal concentrations greater than hazardous waste criteria, as defined by the USEPA under 40 CFR 261.24, and PCB concentrations greater than 10 ppm) using conventional techniques. Additionally, the primary site contaminants, VOCs (solvents), are addressed using in-situ vapor extraction and air sparging. For areas with other metal- and organic-contaminated soils at concentrations greater than the action levels, a 6-inch gravel cover or a 6-inch vegetated soil cover would be employed for industrial (S5A) or residential use (S5B) scenarios, respectively (refer to Figure 3-2 for areas to be capped). For this discussion, unless there is a difference between the options, Alternatives S5A and S5B will be referred to collectively as Alternative S5.

Alternative S5 (refer to Figure 3-5) includes bulk excavation of all soils with metal concentrations greater than the hazardous waste criteria. This contaminated soil would be fixated either on site or off site. The fixated soil would then be disposed of in an offsite landfill.

In accordance with TSCA regulations, soils containing PCBs in concentrations greater than 50 ppm would be excavated and transported to an approved offsite incineration facility.

This alternative includes offsite disposal for soils containing PCBs in concentrations between 10 ppm and 50 ppm. Soils of concern would be excavated and transported offsite to an approved hazardous waste landfill. Alternatively, landfills with less stringent manifesting requirements may be considered.

Soils contaminated with VOCs greater than action levels would be processed via in-situ vapor extraction and air sparging. The air sparging component would also address the upper portion of the groundwater aquifer and soil/groundwater interface.

Deed restrictions would be required to restrict both current industrial use and future residential use of the site since other metal- and organic-contaminated soil remains in place.

Short-Term Effectiveness

Alternative S5 would not pose any significant risks to the local community or onsite workers during implementation. Onsite workers would be protected from risks through appropriate use of PPE, particularly during the excavation of the PCB and arsenic hot spots. During excavation, risks to offsite residents would be minimized by using dust suppressants to control potential fugitive dust emissions.

There would be minimal contact by workers with contaminants during the installation of the vapor extraction system. The offgas from the vapor extraction would be treated with activated carbon to capture the volatile organics. The VOCs would then be thermally destroyed during the regeneration process.

The remedial action objectives for arsenic- and PCB-contaminated soils should be achieved within 1 to 3 years after signing of the ROD. The treatment of the VOC-contaminated soils would require a total of 2 to 4 years to complete. Treatment of VOC contamination in soils and in underlying groundwater must be addressed simultaneously, since contaminated groundwater has the potential to recontaminate soils through fluctuating groundwater levels and soil gas migration.

Long-Term Effectiveness

Once the PCB- and arsenic-contaminated soils have been removed and the VOC-contaminated soils treated, risks to human health and the environment would be drastically reduced. Unrestricted use of the site would result in residual risks to human health in the range of 10^{-4} to 10^{-6}. This residual risk results from direct contact (dermal and ingestion) with the contaminants. A cover using either gravel (S5A - industrial use) or soil (S5B - residential use) would be used in conjunction with deed restrictions to minimize contact, and therefore eliminate risks to human health. Future threats to the groundwater would be eliminated by removing the VOC contamination.

The primary contaminants remaining at the site, to be addressed by the cover, would include PAHs, metals (at non hazardous levels), and PCBs (less than 10 ppm).

Monitoring wells would be used to monitor the long term effectiveness of the action. However, because of the existing groundwater contamination, this monitoring may not be adequate or reliable. Also, since vapor extraction is an insitu process, testing for compliance with the VOC criteria is difficult. Isolated untreated areas may remain undetected.

Treatment of the soils, including thermal destruction of PCBs and VOCs, is permanent. Fixation and landfilling of the arsenic-contaminated soils and landfilling of PCB-contaminated soils (10 to 50 ppm) are also relatively permanent. Insitu vapor extraction of the VOCs should be permanent, with one concern being potential recontamination of soils from contaminated groundwater.

Covering of the remaining contaminated soils is potentially viable in the long term. Ongoing maintenance/repair of the cover would be required to ensure the long term effectiveness. Also deed restrictions, which are only somewhat effective, would be required to restrict disturbance of the cover. However, since the majority of the risks to onsite contaminants have been removed, the potential for ineffectiveness of the cover is not as significant of a concern as with Alternative S2 - Clay Capping.

Reduction of Toxicity, Mobility, or Volume

Alternative S5 includes excavation and offsite incineration of an estimated 300 cubic yards of PCB-contaminated soils (greater than 50 ppm); excavation, fixation, and landfilling of an estimated 600 cubic yards of arsenic-contaminated soils; excavation and offsite landfilling of an estimated 3,700 cubic yards of PCB-contaminated soils (10 to 50 ppm); and insitu vapor extraction/air sparing of an estimated 239,900 cubic yards of VOC-contaminated soils. Offgas treatment of the vapor extraction unit may use activated carbon. The VOCs would then be thermally destroyed. Note that the volumes presented are preliminary and may be modified based on additional testing that would be conducted during the Remedial Design/Remedial Action stage.

Alternative S5 would permanently reduce the toxicity of PCBs and VOCs through offsite thermal destruction. Destruction efficiencies of 99.99% are commonly achieved. The mobility of the arsenic would be reduced by 50 to 99% through the fixation process. The volume of VOC-contaminated soils would be reduced by approximately 239,900 cubic yards. Soils with other contaminants would remain.

PCBs (less than 10 ppm) would remain in the soils for very long periods of time, since they only slowly degrade naturally. PAHs would also remain in the soils for extended periods of time, but PAHs degrade more rapidly. Metals do not degrade at all. These remaining contaminants are not very mobile in the environment and there is approximately 50 feet to the water table. As a result, significant groundwater contamination is not expected from the remaining soil contaminants.

Implementability

Alternative S5 is implementable. The soils designated for exsitu treatment can be readily excavated. The volume of soil to be addressed by insitu vapor extraction system is very extensive and includes areas under buildings. Some interferences to existing operations could be expected, however, no critical problems are expected. The cover can be readily constructed and the monitoring wells sampled on an ongoing basis. Construction of the cover should be reliable since only common construction equipment is required.

In addition to state and local construction-type permits, other permits would also be required. Permits for offsite transportation and disposal of the arsenic- and PCB-contaminated soils would be required. Also, a state air discharge permit would be required for the vapor extraction system. These permits should be readily obtainable. If the arsenic is treated on site, a RCRA TSD permit would be needed. This permit may be more difficult to obtain.

The equipment and resources needed to construct a cover are readily available. Landfill and incinerator capacities are limited. However, because the volumes of soils to be addressed are relatively low (4,600 cubic yards), there should be adequate TSD facilities available.

The insitu vapor extraction process is relatively new, but has been demonstrated at several sites. There are a limited number of vendors capable of performing the insitu vapor extraction process, however, there is not a critical shortage of vendors. The equipment used to construct and operate this technology are relatively common.

Cost

The estimated capital cost for Alternative S5 is $19,441,000. The estimated O&M cost for cover maintenance and 5-year reviews is $14,000 per year. Over a thirty year period, the net present worth cost is $19,056,000. Note that the costs presented are preliminary and may be modified based on additional testing that would be conducted during the Remedial Design/Remedial Action stage.

Compliance with ARARs

Alternative S5 should comply with ARARs, including relevant and appropriate sections of Federal and state RCRA and drinking water/groundwater protection regulations, and Federal TSCA regulations, and the OSWER directive for PCB contamination.

Alternative S5 would not comply with NYSDEC soil and groundwater guidelines.

Action-specific ARARs to be complied with during the implementation of Alternative S5 include OSHA construction standards; Federal and/or state RCRA hazardous waste identification, treatment/storage/disposal, and land disposal restrictions; TSCA PCB requirements; and state Air Pollution Control Regulations.

Overall Protection of Human Health and the Environment

Alternative S5 would be protective of human health and the environment. The most significant contaminants would be removed from the NWIRP and be either thermally destroyed or immobilized and landfilled. Remaining contaminants in the soils would be isolated from contact with the public through the use of a cover. Future risk of ongoing groundwater contamination would be addressed by removing the VOCs from the soils. Alternative S5 would interfere to an extent with the ongoing operations at Grumman. Also, the cover would require long term maintenance to remain protective.

4.2.6 Alternative S6 - Fixation of Metals, Incineration of PCBs> 50 ppm, Landfill of PCBs between 10 ppm and 50 ppm, and Limited In-Situ Vapor Extraction of VOCs

Alternative S6 addresses soil "hot spots" (i.e., metal concentrations greater than hazardous waste criteria, as defined by the USEPA under 40 CFR 261.24, and PCB concentrations greater than 10 ppm) using conventional techniques. Additionally, the majority of the primary site contaminants, VOCs (solvents), are addressed using in-situ vapor extraction/air sparging. For areas with other metal- and organic-contaminated soils at concentrations greater than the soil action levels, a 6-inch gravel cover or a 6-inch vegetated soil cover would be employed for industrial (S6A) or residential use (S6B), respectively (refer to Figure 3-2 for areas to be capped). For this discussion, unless there is a difference between the options, Alternatives S6A and S6B will be referred to collectively as Alternative S6.

Alternative S6 (refer to Figure 3-6) includes bulk excavation of all soils with metal concentrations greater than the hazardous waste criteria. This contaminated soil would be fixated either on site or off site. The fixated soil would then be disposed of in an offsite landfill.

In accordance with TSCA regulations, soils containing PCBs in concentrations greater than 50 ppm would be excavated and transported to an approved offsite incineration facility.

This alternative includes offsite disposal for soils containing PCBs in concentrations between 10 ppm and 50 ppm. Soils of concern would be excavated and transported offsite to an approved hazardous waste landfill.

Soils contaminated with VOCs greater than the modified VOC action levels would be processed via in-situ vapor extraction and air sparging. The modified VOC action levels are three times higher than VOC action levels considered under other alternatives. The air sparging component would also address the upper portion of the groundwater aquifer and soil/groundwater interface.

Deed restrictions would be required to restrict both current industrial use and future residential use of the site since other metal- and organic-contaminated soil remains in place.

Short-Term Effectiveness

Alternative S6 would not pose any significant risks to the local community or onsite workers during implementation. Onsite workers would be protected from risks through appropriate use of PPE, particularly during the excavation of the PCB and arsenic hot spots. During excavation, risks to offsite residents would be minimized by using dust suppressants to control potential fugitive dust emissions.

There would be minimal contact by workers with contaminants during the installation of the vapor extraction system. The offgas from the vapor extraction would be treated with activated carbon to capture the volatile organics. The VOCs would then be thermally destroyed during the regeneration process.

The remedial action objectives for arsenic- and PCB-contaminated soils should be achieved within 1 to 3 years after signing of the ROD. The treatment of the VOC-contaminated soils would require a total of 2 to 4 years to complete. Treatment of VOC contamination in soils and in underlying groundwater must be addressed simultaneously, since contaminated groundwater has the potential to recontaminate soils through fluctuating groundwater levels and soil gas migration.

Long-Term Effectiveness

Once the PCB- and arsenic-contaminated soils have been removed and the majority of the VOC-contaminated soils treated, risks to human health and the environment would be drastically reduced. Unrestricted use of the site would result in residual risks to human health in the range of 10^{-4} to 10^{-6}. This residual risk results from direct contact (dermal and ingestion) with the contaminants. A cover using either gravel (S6A - industrial use) or soil (S6B - residential use) would be used in conjunction with deed restrictions to minimize contact, and therefore eliminate risks to human health. Future threats to the groundwater would be drastically reduced by removing the majority of the VOC contamination. Residual VOCs, in excess of the remedial action levels, would continue to leach to the groundwater. The resulting VOC concentrations in the groundwater at the facility would be initially in the range of 1 to 3 times the MCLs. It is estimated that approximately 10 to 30 years would be required to leach the remaining VOC contamination from the soils, (see Appendix B).

The primary contaminants remaining at the site, to be addressed by the cover, would include PAHs, metals (at non hazardous levels), PCBs (less than 10 ppm), and VOCs (less than approximately 3 to 100 ug/kg).

Monitoring wells would be used to monitor the long term effectiveness of the action. However, because of the existing groundwater contamination, this monitoring may not be adequate or reliable. Also, since vapor extraction is an insitu process, testing for compliance with the VOC criteria is difficult. Isolated untreated areas may remain undetected.

Treatment of the soils, including thermal destruction of PCBs and VOCs, is permanent. Fixation and landfilling of the arsenic-contaminated soils and landfilling of PCB-contaminated soils (at concentrations of 10 to 50 ppm) are also relatively permanent. Insitu vapor extraction of the VOCs should be permanent, with one concern being potential recontamination of soils from contaminated groundwater.

Covering of the remaining contaminated soils is potentially viable in the long term. Ongoing maintenance/repair of the cover would be required to ensure the long term effectiveness. Also deed restrictions, which are only somewhat effective, would be required to restrict disturbance of the cap. However, since the majority of the risks to onsite contaminants have been removed, the potential for ineffectiveness of the cover is not as significant of a concern as with Alternative S2 - Clay Capping.

Reduction of Toxicity, Mobility, or Volume

Alternative S6 includes excavation and offsite incineration of an estimated 300 cubic yards of PCB-contaminated soils (with a concentration greater than 50 ppm); excavation, fixation, and landfilling of an estimated 600 cubic yards of arsenic-contaminated soils; excavation and landfilling of an estimated 3,700 cubic yards of PCB-contaminated soils (at a concentration of 10 to 50 ppm); and insitu vapor extraction/air sparging of an estimated 87,000 cubic yards of VOC-contaminated soils. Offgas treatment of the vapor extraction unit would likely use vapor phase activated carbon. Note that the volumes presented are preliminary and may be modified based on additional testing that would be conducted during the Remedial Design/Remedial Action stage.

Alternative S6 would permanently reduce the toxicity of PCBs and VOCs through offsite thermal destruction. Destruction efficiencies of 99.99% are commonly achieved. The mobility of the arsenic would be reduced by 50 to 99% through the fixation process. The volume of VOC-contaminated soils would be reduced by approximately 87,000 cubic yards and approximately 94% of the calculated quantity of VOCs in soils would be removed and destroyed during the thermal regeneration of vapor phase carbon. Soils with other contaminants would remain.

PCBs (at a concentration of less than 10 ppm) would remain in the soils for very long periods of time, since they only slowly degrade naturally. PAHs would also remain in the soils for extended periods of time, but PAHs degrade more rapidly. Metals do not degrade at all.

Residual VOCs would remain in the soil and continue to migrate to the groundwater at concentrations of one to three times above the baseline action levels. Natural volatilization, biodegradation, and infiltration flushing of VOCs would occur, eventually removing the VOCs from the soils. If a groundwater pump and treat system is in place, the VOCs entering the groundwater should be effectively captured and treated. However, the VOC-contaminated soils would continue to result in long term groundwater contamination. An additional long term concern under this alternative is an area where structures are present over VOC-contaminated soils (e.g. Plant No. 3). These structure would inhibit the natural removal of VOCs. If these structures are removed, increased VOC concentrations in groundwater may occur.

Except for the VOCs, the remaining contaminants are not very mobile in the environment and there is approximately 50 feet of soil to the water table. As a result, significant groundwater contamination is not expected from the remaining soil contaminants.

Implementability

Alternative S6 is implementable. The soils designated for exsitu treatment can be readily excavated. The volume of soil to be addressed by insitu vapor extraction system is very extensive and includes areas under buildings. Some interferences to existing operations could be expected, however, no critical problems are expected. The cover can be readily constructed and the monitoring wells sampled on an ongoing basis. Construction of the cover should be reliable since only common construction equipment is required.

In addition to state and local construction-type permits, other permits would be required. Permits for offsite transportation and disposal of the arsenic- and PCB-contaminated soils would be required. Also, a state air discharge permit would be required for the vapor extraction system. These permits should be readily obtainable. If the arsenic is treated on site, a RCRA TSD permit would be needed. This permit may be more difficult to obtain.

The equipment and resources needed to construct a cover are readily available. Landfill and incinerator capacities are limited. However, because the volumes of soils to be addressed are relatively low (4,600 cubic yards), there should be adequate TSD facilities available.

The insitu vapor extraction process is relatively new, but has been demonstrated at several sites. There are a limited number of vendors capable of performing the insitu vapor extraction process, however, there is not a critical shortage of vendors. The equipment used to construct and operate this technology are relatively common.

Cost

The estimated capital cost for Alternative S6 is $10,655,000. The estimated O&M cost for cover maintenance and 5-year reviews is $14,000 per year. Over a thirty year period, the net present worth cost is $10,865,000. Note that the costs presented are preliminary and may be modified based on additional testing that would be conducted during the Remedial Design/Remedial Action stage.

Compliance with ARARs

Alternative S6 should comply with ARARs, including relevant and appropriate sections of Federal and state RCRA regulations, and Federal TSCA regulations, and the OSWER directive for PCB contamination. Alternative S6 may not comply with relevant and appropriate sections of Federal and state drinking water/ groundwater protection regulations at the completion of the soil remedy. However, because of natural attenuation of VOCs and a long term groundwater remediation system, these ARARs should be complied with at the completion of the groundwater remediation system.

Alternative S6 would not comply with NYSDEC soil and groundwater guidelines.

Action-specific ARARs to be complied with during the implementation of Alternative S6 include OSHA construction standards; Federal and/or state RCRA hazardous waste identification, treatment/ storage/ disposal, and land disposal restrictions; TSCA PCB requirements; and state Air Pollution Control Regulations.

Overall Protection of Human Health and the Environment

Alternative S6 would be protective of human health and the environment. The most significant contaminants would be removed from the NWIRP and be either thermally destroyed or immobilized and landfilled. Remaining contaminants in the soils would be isolated from contact with the public through the use of a cover. Future risk of ongoing groundwater contamination would be addressed by removing the majority of VOCs from the soils. Alternative S6 would interfere to an extent with the ongoing operations at Grumman. Also, the cover would require long term maintenance to remain protective.

4.2.7 Alternative S7 - Fixation of Metals, Incineration of PCBs> 50 ppm, Onsite consolidation and Clay Capping of PCBs between 10 ppm and 50 ppm, and Limited In-Situ Vapor Extraction of VOCs

Alternative S7 addresses soil "hot spots" (i.e., metal concentrations greater than hazardous waste criteria, as defined by the USEPA under 40 CFR 261.24, and PCB concentrations greater than 50 ppm) using conventional techniques. Additionally, the majority of the primary site contaminants, VOCs (solvents), are addressed using in-situ vapor extraction/air sparging. Soils, with PCB concentrations between 10 and 50 ppm, would be excavated and consolidated onsite (see Figure 3-8). A clay cap system (as described under Alternative S2) would be used to minimize infiltration. For areas with other metal- and organic-contaminated soils at concentrations greater than the soil action levels, a 6-inch gravel cover or a 6-inch vegetated soil cover would be employed for industrial (S7A) or residential use (S7B), respectively (refer to Figure 3-2 for areas to be capped). For this discussion, unless there is a difference between the options, Alternatives S7A and S7B will be referred to collectively as Alternative S7.

Alternative S7 (refer to Figure 3-7) includes bulk excavation of all soils with metal concentrations greater than the hazardous waste criteria. This contaminated soil would be fixated either on site or off site. The fixated soil would then be disposed of in an offsite landfill.

In accordance with TSCA regulations, soils containing PCBs in concentrations greater than 50 ppm would be excavated and transported to an approved offsite incineration facility.

This alternative includes onsite consolidation and impermeable clay capping for soils containing PCBs in concentrations between 10 ppm and 50 ppm. The clay cap would consist of (from bottom to top layers) of 6 inches of gravel (vapor barrier), 1 foot of compacted clay, and 6 inches of gravel covered by 2 feet of clean soil. Soil conditioning, fertilization, and revegetation would be employed as necessary, based on end use and erosion considerations.

Soils contaminated with VOCs greater than the modified VOC action levels would be processed via in-situ vapor extraction and air sparging. The modified VOC action levels are three times higher than VOC action levels considered under other alternatives. The air sparging component would also address the upper portion of the groundwater aquifer and soil/groundwater interface.

Deed restrictions would be required to restrict both current industrial use and future residential use of the site since other metal- and organic-contaminated soil remains in place.

Short-Term Effectiveness

Alternative S7 would not pose any significant risks to the local community or onsite workers during implementation. Onsite workers would be protected from risks through appropriate use of PPE, particularly during the excavation of the PCB and arsenic hot spots. During excavation, risks to offsite residents would be minimized by using dust suppressants to control potential fugitive dust emissions.

There would be minimal contact by workers with contaminants during the installation of the vapor extraction system. The offgas from the vapor extraction would be treated with activated carbon to capture the volatile organics. The VOCs would then be thermally destroyed during the regeneration process.

The remedial action objectives for arsenic- and PCB-contaminated soils should be achieved within 1 to 3 years after signing of the ROD. The treatment of the VOC-contaminated soils would require a total of 2 to 4 years to complete. Treatment of VOC contamination in soils and in underlying groundwater must be addressed simultaneously, since contaminated groundwater has the potential to recontaminate soils through fluctuating groundwater levels and soil gas migration.

Long-Term Effectiveness

Once the PCB- and arsenic-contaminated soils have been removed and the VOC-contaminated soils treated, risks to human health and the environment would be drastically reduced. Unrestricted use of the site would result in residual risks to human health in the range of 10^{-4} to 10^{-6}. This residual risk results from direct contact (dermal and ingestion) with the contaminants.

A clay cap would be used to minimize direct human contact and precipitation/infiltration with PCB-contaminated soils (at a concentration of 10 to 50 ppm). Since PCBs are not very mobile in the environment and the risks to human health associated with unrestricted direct contact with PCB-contaminated soils at this concentration (10 to 50 ppm), are in the range of 10^{-4} to 10^{-6}, potential concerns with partial failure of the cap in the long term are not significant.

For the other areas, a cover using either gravel (S7A - industrial use) or soil (S7B - residential use) would be used in conjunction with deed restrictions to minimize contact, and therefore eliminate risks to human health. Future threats to the groundwater would be drastically reduced by removing the majority of the VOC contamination. Residual VOCs, in excess of the remedial action levels, would continue to leach to the groundwater. The resulting VOC concentrations in the groundwater at the facility initially would be in the range of 1 to 3 times the MCLs. It is estimated that approximately 10 to 30 years would be required to leach the remaining VOC contamination from the soils, (see Appendix B).

The primary contaminants remaining at the site, to be addressed by the permeable cover, would include PAHs, metals (at non hazardous levels), PCBs (less than 10 ppm), and VOCs (less than approximately 3 to 100 ug/kg).

Monitoring wells would be used to monitor the long term effectiveness of the action. However, because of the existing groundwater contamination, this monitoring may not be adequate or reliable. Also, since vapor extraction is an insitu process, testing for compliance with the VOC criteria is difficult. Isolated untreated areas may remain undetected.

Treatment of the soils, including thermal destruction of PCBs and VOCs, is permanent. Fixation and landfilling of the arsenic-contaminated soils and onsite consolidation/clay capping are also relatively permanent. Insitu vapor extraction of the VOCs should be permanent, with one concern being potential recontamination of soils from contaminated groundwater.

Covering of the remaining contaminated soils is potentially viable in the long term. Ongoing maintenance/repair of both the permeable and impermeable cover would be required to ensure the long term effectiveness. Also deed restrictions, which are only somewhat effective, would be required to restrict disturbance of the cap. However, since the majority of the risks to onsite contaminants have been removed, the potential for ineffectiveness of the cover is not as significant of a concern as with Alternative S2 - Clay Capping.

Reduction of Toxicity, Mobility, or Volume

Alternative S7 includes excavation and offsite incineration of an estimated 300 cubic yards of PCB-contaminated soils (at a concentration greater than 50 ppm); excavation, fixation, and landfilling of an estimated 600 cubic yards of arsenic-contaminated soils; excavation, consolidation, and capping of an estimated 3,700 cubic yards of PCB-contaminated soils (concentrations of 10 to 50 ppm); and insitu vapor extraction/air sparging of an estimated 87,000 cubic yards of VOC-contaminated soils. Offgas treatment of the vapor extraction unit would likely use vapor phase activated carbon. Note that the volumes presented are preliminary and may be modified based on additional testing that would be conducted during the Remedial Design/Remedial Action stage.

Alternative S7 would permanently reduce the toxicity of PCBs and VOCs through offsite thermal destruction. Destruction efficiencies of 99.99% are commonly achieved. The mobility of the arsenic would be reduced by 50 to 99% through the fixation process. The volume of VOC-contaminated soils would be reduced by approximately 87,000 cubic yards and approximately 94% of the calculated quantity of VOCs in soils would be removed and destroyed during the thermal regeneration of vapor phase carbon. Soils with other contaminants would remain.

PCBs, with a concentration less than 10 ppm, would remain in the soils for very long periods of time, since they only slowly degrade naturally. PAHs would also remain in the soils for extended periods of time, but PAHs degrade more rapidly. Metals do not degrade at all.

Residual VOCs would remain in the soil and continue to migrate to the groundwater at concentrations of one to three times above the baseline action levels. Natural volatilization, biodegradation, and infiltration flushing of VOCs would occur, eventually removing the VOCs from the soils. If a groundwater pump and treat system is in place, the VOCs entering the groundwater should be effectively captured and treated.

However, the VOC-contaminated soils would continue to result in long term groundwater contamination. An additional long term concern under this alternative is an area where structures are present over VOC-contaminated soils (e.g. Plant No. 3). These structure would inhibit the natural removal of VOCs. If these structures are removed, increased VOC concentrations in groundwater may occur.

Except for the VOCs, the remaining contaminants are not very mobile in the environment and there is approximately 50 feet of soil to the water table. As a result, significant groundwater contamination is not expected from the remaining soil contaminants.

Implementability

Alternative S7 is implementable. The soils designated for exsitu treatment can be readily excavated. The volume of soil to be addressed by insitu vapor extraction system is very extensive and includes areas under buildings. Some interferences to existing operations could be expected, however, no critical problems are expected. The cover can be readily constructed and the monitoring wells sampled on an ongoing basis. Construction of the cover should be reliable since only common construction equipment is required.

In addition to state and local construction-type permits, other permits would be required. Permits for offsite transportation and disposal of the arsenic- and PCB-contaminated soils would be required. Also, a state air discharge permit would be required for the vapor extraction system. These permits should be readily obtainable. If the arsenic is treated on site, a RCRA TSD permit would be needed. This permit may be more difficult to obtain. In addition, a permit may be required for the onsite consolidation and capping of the PCB-contaminated soils (10 to 50 ppm). If required, the ability to obtain this permit is uncertain.

The equipment and resources needed to construct a cover are readily available. Landfill and incinerator capacities are limited. However, because the volumes of soils to be addressed are relatively low (900 cubic yards), there should be adequate TSD facilities available.

The insitu vapor extraction process is relatively new, but has been demonstrated at several sites. There are a limited number of vendors capable of performing the insitu vapor extraction process, however, there is not a critical shortage of vendors. The equipment used to construct and operate this technology are relatively common.

Cost

The estimated capital cost for Alternative S7 is $8,250,000. The estimated O&M cost for cover maintenance and 5-year reviews is $14,000 per year. Over a thirty year period, the net present worth cost is $8,459,000. Note that the costs presented are preliminary and may be modified based on additional testing that would be conducted during the Remedial Design/Remedial Action stage.

Compliance with ARARs

Alternative S7 should comply with ARARs, including relevant and appropriate sections of Federal and state RCRA regulations, and Federal TSCA regulations, and the OSWER directive for PCB contamination. Alternative S7 may not comply with relevant and appropriate sections of Federal and state drinking water/ groundwater protection regulations at the completion of the soil remedy. However, because of natural attenuation of VOCs and a long term groundwater remediation system, these ARARs should be complied with at the completion of the groundwater remediation system.

Alternative S7 would not comply with NYSDEC soil and groundwater guidelines.

Action-specific ARARs to be complied with during the implementation of Alternative S7 include OSHA construction standards; Federal and/or state RCRA hazardous waste identification, treatment/ storage/ disposal, and land disposal restrictions; TSCA PCB requirements; and state Air Pollution Control Regulations.

Overall Protection of Human Health and the Environment

Alternative S7 would be protective of human health and the environment. The most significant contaminants would be removed from the NWIRP and be either thermally destroyed or immobilized and landfilled. Remaining contaminants in the soils would be isolated from contact with the public through the use of a cap and cover. Future risk of ongoing groundwater contamination would be addressed by removing the majority of VOCs from the soils. Alternative S7, especially the clay capped area, would interfere to an extent with ongoing operations at Grumman. Also, the cover would require long term maintenance to remain protective.

4.2.8 Alternative S8 - Fixation of Metals, Incineration of PCBs> 50 ppm, In-Situ Vapor Extraction of VOCs, and Offsite Landfill of Other Metals/Organics

Alternative S8 (refer to Figure 3-9) includes bulk excavation of all soils with metal concentrations greater than the hazardous waste criteria. This contaminated soil would be fixated either on site or off site. The fixated soil would then be disposed of in an offsite landfill.

In accordance with TSCA regulations, soils containing PCBs in concentrations greater than 50 ppm, which occurs only at Site 1, would be excavated and transported to an approved offsite incineration facility.

Soils contaminated with VOCs (solvents) at concentrations greater than action levels would be processed via in-situ vapor extraction and air sparging. The air sparging component would also address the upper portion of the groundwater aquifer and soil/groundwater interface. Soils with other metals and organics concentrations greater than the current industrial use (Alternative S8A) or future residential use (Alternative S8B) scenario action levels would be disposed in an offsite landfill only after the in-situ vapor extraction is complete so that the soils slated for offsite disposal are first freed of VOCs. Bulk excavation of contaminated soils would be completed followed by disposal in an offsite landfill. For this discussion, unless there is a difference between the options, Alternatives S8A and S8B will be referred to collectively as Alternative S8.

Short-Term Effectiveness

Alternative S8 would not pose any significant risks to the local community or onsite workers during implementation. Onsite workers would be protected from risks through appropriate use of PPE, particularly during the excavation of the PCB and arsenic hot spots. During excavation, risks to offsite residents would be minimized by using dust suppressants to control potential fugitive dust emissions.

There would be minimal contact by workers with contaminants during the installation of the vapor extraction system. The offgas from the vapor extraction would be treated by activated carbon to capture the volatile organics. The VOCs would then be thermally destroyed during the regeneration process.

The remedial action objectives for arsenic- and PCB-contaminated soils could be achieved within 1 to 3 years after signing of the ROD. The treatment of the VOC-contaminated soils would require a total of 2 to 4 years to complete. Treatment of VOC contamination in soils and in underlying groundwater must be addressed simultaneously, since contaminated groundwater has the potential to recontaminate soils through fluctuating groundwater levels and soil gas migration.

Excavation, offsite landfilling for the other organics and metals, and regrading at the site would require a total of 3 to 5 years to complete from the signing of the ROD.

Long-Term Effectiveness

Once all of the contaminated soils have been removed and the VOC-contaminated soils treated, there would be insignificant quantities of contaminants remaining at the site. As a result, there would be no remaining risk to human health and the environment and no need for the associated restrictions on site use.

Treatment of the soils, including thermal destruction of PCBs and VOCs, is permanent. Fixation of the arsenic-contaminated soils and landfilling of the non VOC-contaminated soils is also relatively permanent. Insitu vapor extraction of the VOCs should be permanent, with one concern being potential recontamination of soils from contaminated groundwater.

Since vapor extraction is an insitu process, testing for compliance with the VOC criteria is difficult. Isolated untreated areas may remain undetected.

Reduction of Toxicity, Mobility, or Volume

Alternative S8 includes excavation and offsite incineration of an estimated 300 cubic yards of PCB-contaminated soils (greater than 50 ppm); excavation, fixation, and landfilling of an estimated 600 cubic yards of arsenic-contaminated soils; excavation and landfilling of an estimated 55,000 to 63,000 cubic yards of metal- and organic-contaminated soils (greater than action levels); and insitu vapor extraction/air sparging of an estimated 239,900 cubic yards of VOC-contaminated soils. Offgas treatment of the vapor extraction unit may use activated carbon. The VOCs would then be thermally destroyed. Note that the volumes presented are preliminary and may be modified based on additional testing that would be conducted during the Remedial Design/Remedial Action stage.

Alternative S8 would permanently reduce the toxicity of PCBs and VOCs through offsite thermal destruction. Destruction efficiencies of 99.99% are commonly achieved. The mobility of the arsenic would be reduced by 50 to 99% through the fixation process. The volume of VOC-contaminated soils would be reduced by approximately 239,900 cubic yards. No contaminated residues would remain at the site.

Implementability

Alternative S8 is implementable. The soils designated for exsitu treatment can be readily excavated. The volume of soil to be addressed by insitu vapor extraction system is very extensive and includes areas under buildings. Some interferences to existing operations could be expected, however, no critical problems are expected.

In addition to state and local construction-type permits, other permits would also be required. Permits for offsite transportation and disposal of the arsenic- and PCB-contaminated soils would be required. Also, a state air discharge permit would be required for the vapor extraction system. These permits should be readily obtainable. If the arsenic is treated on site, a RCRA TSD permit would be needed. This permit may be more difficult to obtain.

The equipment and resources needed to excavate the soils are readily available. Landfill and incinerator capacities are limited. Because of a relatively low volume of soil to be addressed by incineration (300 cubic yards), incineration capacities are available. The landfilling of approximately 60,000 cubic yards of marginally contaminated soils from Long Island may be more difficult. There are no active landfills on Long Island. Many county landfills in the general New York City area ban out of county wastes. Landfills in central and northern New York may be able to accept these soils.

The insitu vapor extraction process is relatively new, but has been demonstrated at several sites. There are a limited number of vendors capable of performing the insitu vapor extraction process, however, there is not a critical shortage of vendors. The equipment used to construct and operate this technology are relatively common.

Cost

The estimated capital costs (and net present worth cost) for Alternatives S8A and S8B are $44,490,000 and $41,758,000, respectively. Since all contaminants have been removed from the site, there are no requirements for continued maintenance at the site and therefore there is no associated O&M costs. Note that the costs presented are preliminary and may be modified based on additional testing that would be conducted during the Remedial Design/Remedial Action stage.

Compliance with ARARs

Alternative S8 should comply with ARARs, including relevant and appropriate sections of Federal and state RCRA and drinking water/groundwater protection regulations, Federal TSCA regulations, the OSWER directive for PCB contamination, and NYSDEC soil and groundwater guidelines.

Action-specific ARARs to be complied with during the implementation of Alternative S8 include OSHA construction standards; Federal and/or state RCRA hazardous waste identification, treatment/storage/disposal, and land disposal restrictions; TSCA PCB requirements; state Air Pollution Control Regulations, and NYS solid waste management regulations.

Overall Protection of Human Health and the Environment

Alternative S8 would be protective of human health and the environment. The most significant contaminants would be removed from the NWIRP and be either thermally destroyed or immobilized and landfilled. Remaining contaminants in the soils would also be removed from the site. Future risk of ongoing groundwater contamination would be addressed by removing the VOCs from the soils. Alternative S8 would interfere with the ongoing operations at Grumman.

4.2.9 Alternative S9 - Fixation of Metals, Onsite Low Temperature Stripping of VOCs and PCBs, and Offsite Landfill of Other Metals/Organics

Alternative S9 (refer to Figure 3-10) includes bulk excavation of all soils with metal concentrations greater than the hazardous waste criteria. This contaminated soil would be fixated either on site or off site. The fixated soil would then be disposed of in an offsite landfill.

Soils contaminated with VOCs greater than action levels would be processed via low temperature thermal stripping. Soils with other metals and organics concentrations greater than the current industrial use (Alternative S9A) or future residential use (Alternative S9B) scenario action levels would be disposed in an offsite landfill, only after the low temperature thermal stripping is complete so that the soils slated for offsite disposal are first freed of VOCs and PCBs (concentration greater than 50 ppm). For this discussion, unless there is a difference between the options, Alternatives S9A and S9B will be referred to collectively as Alternative S9.

Short-Term Effectiveness

Alternative S9 should not pose any significant risks to the local community or onsite workers during implementation. Onsite workers would be protected from risks through appropriate use of PPE, particularly during the excavation of the PCB and arsenic hot spots. During excavation, risks to offsite residents would be minimized by using dust suppressants to control potential fugitive dust emissions. The volatile organics and PCBs in the offgas from the low temperature thermal stripping (LTTS) unit would be thermally destroyed onsite or condensed, collected, and thermally destroyed offsite.

The remedial action objectives for arsenic- and PCB-contaminated soils could be achieved within 1 to 3 years after signing of the ROD. The treatment of the VOC-contaminated soils would require a total of 2 to 6 years to complete. Treatment of VOC contamination in soils and in underlying groundwater must be addressed simultaneously, since contaminated groundwater has the potential to recontaminate soils through fluctuating groundwater levels and soil gas migration.

Excavation, offsite landfilling for the other organics and metals, and regrading at the site would require a total of 3 to 5 years to complete from the signing of the ROD.

Long-Term Effectiveness

Once all of the contaminated soils have been removed and the VOC-contaminated soils treated, there would be insignificant quantities of contaminants remaining at the site. As a result, there would be no remaining risk to human health and the environment and no need for the associated restrictions on site use.

Treatment of the soils, including thermal destruction of PCBs and VOCs, is permanent. Fixation of the arsenic and landfilling of the non VOC-contaminated soils is also relatively permanent. LTTS of contaminated soils should be permanent, with one concern being potential recontamination of soils from contaminated groundwater.

Reduction of Toxicity, Mobility, or Volume

Alternative S9 includes excavation and onsite LTTS of an estimated 300 cubic yards of PCB-contaminated soils (greater than 50 ppm); excavation, fixation, and landfilling of an estimated 600 cubic yards of arsenic-contaminated soils; excavation and landfilling of an estimated 55,000 to 63,000 cubic yards of metal- and organic-contaminated soils (greater than action levels); and excavation and LTTS of an estimated 239,900 cubic yards of VOC-contaminated soils. The offgas from the LTTS would be treated to thermally destroy or capture and thermally destroy the VOCs and PCBs. Note that the volumes presented are preliminary and may be modified based on additional testing that would be conducted during the Remedial Design/Remedial Action stage.

Alternative S9 would permanently reduce the toxicity of PCBs and VOCs through thermal destruction. Destruction efficiencies of 99.99% are commonly achieved. The mobility of the arsenic would be reduced by 50 to 99% through the fixation process. The volume of VOC-contaminated soils would be reduced by approximately 239,900 cubic yards. No contaminated residues would remain at the site.

Implementability

Alternative S9 should be implementable. The soils designated for exsitu treatment can be excavated. However, the depth of excavation (50 feet) and presence of several buildings in the areas of excavation would significantly interfere with this process. Significant interferences to existing operations could be expected.

In addition to state and local construction-type permits, other permits would also be required. Permits for offsite transportation and disposal of the arsenic- and PCB-contaminated soils would be required. Also, a state air discharge permit would be required for the LTTS system. These permits should be obtainable. If the arsenic is treated on site, a RCRA TSD permit would be needed. This permit may be more difficult to obtain.

The equipment and resources needed to excavate the soils are readily available. Landfill and incinerator capacities are limited. The landfilling of approximately 60,000 cubic yards of marginally contaminated soils from Long Island may be more difficult. There are no active landfills on Long Island. Many county landfills in the general New York City area ban out of county wastes. Landfills in central and northern New York may be able to accept these soils.

The LTTS is relatively new, but has been demonstrated at several sites for VOCs. LTTS for treatment of PCBs has been tested at several sites with promising results. There are a limited number of vendors capable of performing this process, however, there is not a critical shortage of vendors. The equipment used to construct and operate this technology are not very common, but are available.

Cost

The estimated capital costs (and net present worth cost) for Alternatives S9A and S9B are $109,376,000 and $105,637,000, respectively. Since all contaminants have been removed from the site, there are no requirements for continued maintenance at the site and therefore there is no associated O&M costs. Note that the costs presented are preliminary and may be modified based on additional testing that would be conducted during the Remedial Design/Remedial Action stage.

Compliance with ARARs

Alternative S9 should comply with ARARs, including relevant and appropriate sections of Federal and state RCRA and drinking water/groundwater protection regulations, Federal TSCA regulations, the OSWER directive for PCB contamination, and NYSDEC soil and groundwater guidelines.

Action-specific ARARs to be complied with during the implementation of Alternative S9 include OSHA construction standards; Federal and/or state RCRA hazardous waste identification, treatment/ storage/disposal, and land disposal restrictions; TSCA PCB requirements; state Air Pollution Control Regulations, and NYS solid waste management regulations.

Overall Protection of Human Health and the Environment

Alternative S9 would be protective of human health and the environment. The most significant contaminants would be removed from the NWIRP and be either thermally destroyed or immobilized and landfilled. Remaining contaminants in the soils would also be removed from the site. Future risk of ongoing groundwater contamination would be addressed by removing the VOCs from the soils. Alternative S9 would significantly interfere with the ongoing operations at Grumman.

4.2.10 Alternative S10 - Soil Washing/Onsite Fill of Metals and Organics with Offsite Landfill of Metal Treatment Residuals, and Incineration of Organic Treatment Residuals

For Alternative S10 (See Figure 3-11), contaminated soils greater than the current industrial use (Alternative S10A) or future residential use (Alternative S10B) would be excavated and processed with a soil washing technique to remove the contaminants from the soil matrix. Following soil washing, the processed soils would then be placed as onsite fill. The organic treatment residuals would subsequently be incinerated offsite. The metals treatment residuals would be disposed of at an offsite landfill. The metals residuals may require fixation prior to disposal. For this discussion, unless there is a difference between the options, Alternatives S10A and S10B will be referred to collectively as Alternative S10.

Short-Term Effectiveness

Alternative S10 would not pose any significant risks to the local community or onsite workers during implementation. Onsite workers would be protected from risks through appropriate use of PPE, particularly during the excavation of the PCB and arsenic hot spots. During excavation, risks to offsite residents would be minimized by using dust suppressants to control potential fugitive dust emissions. The organic residues would be thermally destroyed offsite. The metal residues would be treated as required and landfilled offsite.

The remedial action objectives could be achieved within 3 to 5 years after signing of the ROD. Treatment of VOC contamination in soils and in underlying groundwater must be addressed simultaneously, since contaminated groundwater has the potential to recontaminate soils through variable groundwater levels and soil gas migration.

Long-Term Effectiveness

Once all of the contaminated soils have been treated and the contaminants removed, there would be no remaining risk to human health and the environment and no need for the associated restrictions on site use.

Treatment of the soils including the thermal destruction of organics is permanent. Fixation of the metals (as needed) and landfilling of the residues is also relatively permanent. Soil washing should be relatively permanent, with one concern being potential recontamination of soils from contaminated groundwater.

Reduction of Toxicity, Mobility, or Volume

Alternative S10 includes excavation and onsite soil washing/VOC extraction of approximately 290,400 cubic yards of contaminated soils. The organic and metal residues would be treated offsite.

Alternative S10 would permanently reduce the toxicity of organics through thermal destruction of residues. Destruction efficiencies of 99.99% are commonly achieved. The mobility of the arsenic and other metal residues would be reduced by 50 to 99% through the fixation process. The volume of contaminated soils would be reduced by approximately 290,400 cubic yards. No contaminated soils or residues would remain at the site. Note that the volumes presented are preliminary and may be modified based on additional testing that would be conducted during the Remedial Design/Remedial Action stage.

Implementability

Alternative S10 should be implementable. The soils designated for exsitu treatment can be excavated. However, the depth of excavation (50 feet) and presence of several buildings in the areas of excavation would significantly interfere with this process. Significant interferences to existing operations could be expected.

In addition to state and local construction-type permits, other permits would also be required. Permits for offsite transportation and disposal of the arsenic- and PCB-contaminated soils would be required. These permits should be obtainable. If the arsenic is treated on site, a RCRA TSD permit would be needed. This permit may be more difficult to obtain.

The equipment and resources needed to excavate the soils are readily available. Landfill and incinerator capacities are limited. Because of a relatively low volume of soil to be addressed by incineration and landfilling (less than 500 cubic yards), incineration and landfilling facilities are available.

The soil washing/VOC extraction process is relatively new and has not been demonstrated at large sites for multiple contaminants. Since the site soils are primarily sand, there is a relatively good potential that the system could be effective. There are a limited number of vendors capable of performing the this process, however, there is not a critical shortage of vendors. The equipment used to construct and operate this technology are relatively common.

Cost

The estimated capital costs (and net present work costs) for Alternatives S10A and S10B are $91,597,000 and $89,907,000, respectively. Since all contaminants have been removed from the site, there are no requirements for continued maintenance at the site and therefore there is no associated O&M costs. Note that the costs presented are preliminary and may be modified based on additional testing that would be conducted during the Remedial Design/Remedial Action stage.

Compliance with ARARs

Alternative S10 should comply with ARARs, including relevant and appropriate sections of Federal and state RCRA and drinking water/groundwater protection regulations, Federal TSCA regulations, the OSWER directive for PCB contamination, and NYSDEC soil and groundwater guidelines.

Action-specific ARARs to be complied with during the implementation of Alternative S10 include OSHA construction standards; Federal and/or state RCRA hazardous waste identification, treatment/storage/ disposal, and land disposal restrictions; TSCA PCB requirements; and NYS solid waste management regulations.

Overall Protection of Human Health and the Environment

Alternative S10 would be protective of human health and the environment. All significant contaminants would be removed from the NWIRP and be either thermally destroyed or immobilized and landfilled. Future risk of ongoing groundwater contamination would be addressed by removing the VOCs from the soils. Alternative S10 would significantly interfere with the ongoing operations at Grumman.

4.3 DETAILED ANALYSIS OF GROUNDWATER ALTERNATIVES

4.3.1 Alternative GW1 - No Action

This alternative is a no action alternative, and is developed and retained for baseline comparison purposes with the other alternatives, as required by the NCP. The only activity that would occur under the no-action alternative is periodic reviews, typically every 5 years.

Short-Term Effectiveness

Since no actions would occur, the no action alternative would not pose any risks to the local community or onsite workers during implementation. None of the remedial action objectives would be achieved.

Long-Term Effectiveness

Since no removal would occur, the current threat to human health and the environment would remain. The contaminants remaining in the groundwater at the site are primarily VOCs. Although there are no current risks to human health, the contaminated groundwater would continue to flow to the south and east. Portions of the contaminated groundwater may be captured by potable water supplies to the south and east.

Also, since the no action alternative considers unrestricted use of the site, private drinking water supply wells could be installed and used. Use of the most contaminated onsite groundwater could result in significant risk to the user.

Under the no action alternative, there are no controls specifically used to manage the contaminants at the site. Therefore, the adequacy and reliability of controls would not be known.

Currently the Bethpage Water District (BWD) conducts regular testing of the water supply to ensure protection of the community. If contamination was detected in a well, the use of the well would be significantly limited or completely stopped.

Reduction of Toxicity, Mobility, or Volume

The no action alternative would not reduce the toxicity, mobility, or volume of contamination, since no treatment is being used to address the contaminated groundwater. As a result, no hazardous materials will be specifically treated or destroyed. Contaminated groundwater would continue to migrate offsite.

Currently, a portion of the contaminated groundwater is being captured by Grumman production wells on both the NWIRP and Grumman property. For the wells on the Grumman property, a new VOC treatment system has been installed to protect against future groundwater contamination. Grumman is planning to install a similar treatment system on the Navy property in the near future. These systems treat the groundwater by volatilizing the VOCs. Once the VOCs are in the atmosphere, they are permanently destroyed through photochemical degradation. For contaminated groundwater not captured by these production wells, the VOCs would flow with the groundwater and eventually be discharged to the ocean or be captured by potable water supply wells to the south.

Implementability

Since no action is occurring, the no action alternative is readily implementable. The technical feasibility criteria including constructability, operability, and reliability are not applicable. Additional actions could be taken. No monitoring is specifically considered under no action. However, it is expected that the BWD would continue with its current monitoring of the public water supply.

Permits would not be required under no action.

The criteria of availability of equipment and resources, treatment technologies, and TSD facilities are not applicable.

Cost

There are no capital costs associated with the no action alternative. O&M costs for 5 year reviews are $4,000 per year, and the associated net present worth cost is $56,000.

Compliance with ARARs

The no action alternative would not comply with ARARs and TBCs, including relevant and appropriate sections of Federal and state drinking water/ groundwater criteria.

The no action alternative would not comply with NYSDEC groundwater guidelines.

Overall Protection of Human Health and the Environment

The no action alternative would not be protective of human health and the environment. If the groundwater was used as a potable water supply, contaminants in the groundwater can affect human health through ingestion and inhalation.

Contaminated groundwater would continue to migrate, affecting new areas. Also, the concentration of VOCs in several critical areas (BWD wells) could potentially increase with time.

4.3.2 Alternative GW2 - Monitoring of Existing Potable Water Supplies

Alternative GW2 (refer to Figure 3-12) features an institutional controls general response action, consisting of the installation of three groups of monitoring wells upgradient of the current potable wells. The three groups of potable wells are BWD wells 7, 8, and 9; the BGD well; and wells 4-1 and 4-2. Quarterly monitoring for site volatile organic compounds ensures that the potable well users do not receive any contaminants from the migrating groundwater plume. Note that a treatment system is currently being designed by the BWD for Wells 4-1 and 4-2.

Short-Term Effectiveness

Alternative GW2 would not pose any risks to the local community or onsite workers during implementation. Only monitoring wells would be installed. Workers would be protected from risks through appropriate use of PPE. None of the remedial action objectives would be achieved.

Long-Term Effectiveness

Since no removal would occur, the current threat to human health and the environment would remain. The contaminants in the groundwater remaining at the site are primarily VOCs. Although there are no current risks to human health, the contaminated groundwater would continue to flow to the south and east. Portions of the contaminated groundwater may be captured by potable water supplies to the south and east.

Also, since Alternative GW2 considers unrestricted use of the site, private drinking water supply wells could be installed and used. Use of the most contaminated onsite groundwater could result in significant risk to the user.

Under Alternative GW2, there are no controls specifically used to manage the contaminants at the site. Potential contamination would be monitored by sampling and analyzing groundwater in several new monitoring wells to be installed near the potable supply wells. The sampling of the wells should be relatively adequate and reliable in detecting contaminants. However, since an aquifer cannot be characterized completely, there are some concerns with select flow paths conveying contaminants to the potable water supply wells without being detected by surrounding monitoring wells.

Currently the Bethpage Water District conducts regular testing of the water supply to ensure protection of the community. If contamination was detected in a well, the use of the well would be significantly limited or completely stopped.

Reduction of Toxicity, Mobility, or Volume

Alternative GW2 would not reduce the toxicity, mobility, or volume of contamination, since no treatment is being used to address the contaminated groundwater. As a result, no hazardous materials will be specifically treated or destroyed. Contaminated groundwater would continue to migrate offsite.

Currently, a portion of the contaminated groundwater is being captured by Grumman production wells on both the NWIRP and Grumman property. For the Grumman property, a new VOC treatment system has been installed to protect against future groundwater contamination. Grumman is planning to install a similar treatment system on the Navy property in the near future. These systems treat the groundwater by volatilizing the VOCs. Once the VOCs are in the atmosphere, they are permanently destroyed through photochemical degradation. For contaminated groundwater not captured by these production wells, the VOCs would flow with the groundwater and eventually be discharged to the ocean or be captured by potable water supply wells to the south.

Implementability

Alternative GW2 is readily implementable. The technical feasibility criteria including constructability, operability, and reliability are not applicable. Monitoring of the existing potable water supplies would not adversely affect any future activities.

Monitoring with both the monitoring wells and the testing being conducted by BWD public water supply should be adequate in protecting public health.

Permits associated with offsite drilling of monitoring wells would be required.

Equipment and resources are available to perform this work.

The criteria of treatment technologies, and TSD facilities are not applicable.

Cost

The estimated capital cost for Alternative GW2 is $249,000 and the estimated O&M cost is $27,300 per year. Over a thirty year period, the net present worth cost is $669,000. Note that the costs presented are preliminary and may be modified based on additional testing that would be conducted during the Remedial Design/Remedial Action stage.

Compliance with ARARs

Alternative GW2 would not comply with ARARs and TBCs, including relevant and appropriate sections of Federal and state drinking water/ groundwater criteria.

Alternative GW2 would not comply with NYSDEC groundwater guidelines.

Overall Protection of Human Health and the Environment

Alternative GW2 would be only partially protective of human health and would not be protective of the environment. If the groundwater was used for potable water use, contaminants in the groundwater can affect human health through ingestion and inhalation.

Contaminated groundwater would continue to migrate, affecting new areas and the concentrations in several critical areas (BWD wells) could potentially increase with time.

4.3.3 Alternative GW3A - Air Stripping of Existing Potable Water Supplies

Alternative GW3A (refer to Figure 3-13), consists of air stripping treatment systems for the current potable wells of concern. The three groups of potable wells are BWD wells 7, 8, and 9; the BGD well; and wells 4-1 and 4-2. As an option under this alternative, treatment of Plant No. 5 waters or well replacement (at any cluster) may be considered. Specifically for well replacement, an impacted well may be replaced with a new well in an uncontaminated area and/or depth. Note that a treatment system is currently being designed by the BWD for Wells 4-1 and 4-2.

Short-Term Effectiveness

Alternative GW3A would not pose any risks to the local community or onsite workers during implementation. Workers would be protected from risks through appropriate use of PPE.

The potable water supply system would be protected once the system is installed and operated. Installation and startup of treatment system for the potable water supply would be expected to require 1 to 3 years from signing of the ROD.

The aquifer restoration objective for groundwater would not be achieved. Additionally, contaminated groundwater from NWIRP would be expected to continue to flow toward the potable water supply wells.

Long-Term Effectiveness

Once well head treatment of the potable water supply is in place, the primary potential risk pathway (public consumption of contaminated groundwater) would be addressed.

However, since Alternative GW3A considers unrestricted use of the site, private drinking water supply wells could be installed and used. Use of the most contaminated onsite groundwater could result in significant risk to the user.

Under Alternative GW3A, there are no controls specifically used to manage the contaminants at the site. Potential contamination of the potable water supply would be monitored by sampling and analyzing water in potable supply wells. The sampling of the wells should be relatively adequate and reliable in detecting contaminants. The testing of water before and after treatment should provide adequate protection, since contaminant concentrations would be expected to increase only slowly with time.

Currently the Bethpage Water District conducts regular testing of the water supply to ensure protection of the community. If contamination was detected in a well, the use of the well would be significantly limited or completely stopped.

Reduction of Toxicity, Mobility, or Volume

Alternative GW3A would not reduce the toxicity, mobility, or volume of contamination, since no treatment is being used to address the contaminated groundwater. As a result, no hazardous materials will be specifically treated or destroyed. Contaminated groundwater would continue to migrate offsite.

Currently, a portion of the contaminated groundwater is being captured by Grumman production wells on both the NWIRP and Grumman property. For the Grumman property, a new VOC treatment system has been installed to protect against future groundwater contamination. Grumman is planning to install a similar treatment system on the Navy property in the near future. These systems treat the groundwater by volatilizing the VOCs. Once the VOCs are in the atmosphere, they are permanently destroyed through photochemical degradation. For contaminated groundwater not captured by these production wells, the VOCs would flow with the groundwater and eventually be discharged to the ocean or be captured by potable water supply (BWD) wells to the south.

Also, under this alternative treatment would be placed on the existing potable water supply wells. For Alternative GW3A, air stripping would be used to treat the potable water supply prior to distribution. Air stripping towers remove only volatile organics such as the VOCs.

Implementability

Alternative GW3A is readily implementable. Air stripping towers are easily constructed and are commonly used. They are easy to operate and are reliable. The use of air stripping towers would not interfere with possible future actions.

Monitoring of the potable water supply before and after treatment should be adequate in protecting public health. The testing of the water prior to treatment is conducted to evaluate the potential for VOC concentrations at this location exceeding the design criteria of the treatment system.

Local and construction-type permits would be required. In addition state, county, and local interaction would be needed.

Equipment and resources are available to perform this work.

The criteria of TSD facilities is not applicable.

Cost

The estimated capital cost for Alternative GW3A is $ 1,400,000 and the estimated O&M cost is $169,000 per year. Over a thirty year period, the net present worth cost is $3,980,000. Note that the costs presented are preliminary and may be modified based on additional testing that would be conducted during the Remedial Design/Remedial Action stage.

Compliance with ARARs

Alternative GW3A may comply with ARARs and TBCs, including relevant and appropriate sections of Federal and state drinking water/ groundwater criteria.

Alternative GW3A would not comply with NYSDEC groundwater guidelines.

Overall Protection of Human Health and the Environment

Alternative GW3A would be partially protective of human health by providing well head treatment of the potable water supplies. But this alternative would not be protective of the environment. If the groundwater is used for potable water use in the contaminated area, contaminants in the groundwater can affect human health through ingestion and inhalation.

Contaminated groundwater would continue to migrate, affecting new areas.

4.3.4 Alternative GW3B - GAC Treatment of Existing Potable Water Supplies

Alternative GW3B (refer to Figure 3-13), consists of granular activated carbon (GAC) treatment systems for the current potable wells of concern. The three groups of potable wells are BWD wells 7, 8, and 9; the BGD well; and wells 4-1 and 4-2. As an option under this alternative, treatment of Plant No. 5 waters or well replacement (any cluster) may be considered. Specifically for well replacement, an impacted well may be replaced with a new well in an uncontaminated area and/or depth. Note that a treatment system is currently being designed by the BWD for Well 4-1 and Well 4-2.

Short-Term Effectiveness

Alternative GW3B would not pose any risks to the local community or onsite workers during implementation. Workers would be protected from risks through appropriate use of PPE.

The potable water supply system would be protected once the system is installed and operated. Installation and startup of treatment system for the potable water supply would be expected to require 1 to 3 years from signing of the ROD.

The aquifer restoration objective for groundwater would not be achieved. Additionally, contaminated groundwater from NWIRP would be expected to continue to flow toward the potable water supply wells.

Long-Term Effectiveness

Once well head treatment of the potable water supply is in place, the primary potential risk pathway (public consumption of contaminated groundwater) would be addressed.

However, since Alternative GW3B considers unrestricted use of the site, private drinking water supply wells could be installed and used. Use of the most contaminated onsite groundwater could result in significant risk to the user.

Under Alternative GW3B, there are no controls specifically used to manage the contaminants at the site. Potential contamination of the potable water supply would be monitored by sampling and analyzing water in potable supply wells. The sampling of the wells should be relatively adequate and reliable in detecting contaminants. The testing of water before and after treatment should provide adequate protection, since contaminant concentrations would be expected to increase only slowly with time.

Currently the Bethpage Water District conducts regular testing of the water supply to ensure protection of the community. If contamination was detected in a well, the use of the well would be significantly limited or completely stopped.

Reduction of Toxicity, Mobility, or Volume

Alternative GW3B would not reduce the toxicity, mobility, or volume of contamination, since no treatment is being used to address the contaminated groundwater. As a result, no hazardous materials will be specifically treated or destroyed. Contaminated groundwater would continue to migrate offsite.

Currently, a portion of the contaminated groundwater is being captured by Grumman production wells on both the NWIRP and Grumman property. For the Grumman property, a new VOC treatment system has been installed to protect against future groundwater contamination. Grumman is planning to install a similar treatment system on the Navy property in the near future. These systems treat the groundwater by volatilizing the VOCs. Once the VOCs are in the atmosphere, they are permanently destroyed through photochemical degradation. For contaminated groundwater not captured by these production wells, the VOCs would flow with the groundwater and eventually be discharged to the ocean or be captured by potable water supply (BWD) wells to the south.

Also, under this alternative, treatment would be placed on the existing potable water supply wells. For Alternative GW3B, granular activated carbon would be used to treat the potable water supply prior to distribution. GAC removes most volatile organics such as the VOCs in the groundwater, as well as most other organics. It should be noted that GAC is not effective in removing vinyl chloride from water. Vinyl chloride has been detected only near Hooker/RUCO and areas south and south east toward Grumman production wells. Vinyl chloride has not been detected in the groundwater in the area of the BWD wells addressed under this alternative.

Implementability

Alternative GW3B is readily implementable. GAC units are easily constructed and are commonly used. They are easy to operate and are reliable. The use of GAC units would not interfere with possible future actions.

Monitoring of the potable water supply before and after treatment should be adequate in protecting public health. The testing of the water prior to treatment is conducted to evaluate the potential for VOC concentrations at this location exceeding the design criteria of the treatment system.

Local and construction-type permits would be required. In addition state, county, and local interaction would be needed.

Equipment and resources are available to perform this work.

The spent activated carbon would be regenerated offsite. Facilities are limited but are available to regenerate the carbon offsite.

Cost

The estimated capital cost for Alternative GW3B is $1,600,000 and the estimated O&M cost is $24,300 per year. Over a thirty year period, the net present worth cost is $2,020,000. Note that the costs presented are preliminary and may be modified based on additional testing that would be conducted during the Remedial Design/Remedial Action stage

Compliance with ARARs

Alternative GW3B may comply with ARARs and TBCs, including relevant and appropriate sections of Federal and state drinking water/ groundwater criteria.

Alternative GW3B would not comply with NYSDEC groundwater guidelines.

Overall Protection of Human Health and the Environment

Alternative GW3B would be partially protective of human health by providing well head treatment of the potable water supplies. But this alternative would not be protective of the environment. If the groundwater is used for potable water use in the contaminated area, contaminants in the groundwater can affect human health through ingestion and inhalation.

Contaminated groundwater would continue to migrate, affecting new areas.

4.3.5 Alternative GW4A - Extraction (Onsite/Near Site Groundwater > 100 ug/l VOCs), Precipitation/ Filtration (Inorganics), Air Stripping (VOCs), and Reuse

Alternative GW4A (see Figure 3-14) was developed to address the most highly contaminated portion of the plume using conventional air stripping treatment for VOC removal and precipitation/filtration for toxic metals removal. Contaminated groundwater with VOC concentrations greater than 100 ug/l would be captured by the groundwater extraction system.

Short-Term Effectiveness

Alternative GW4A should not pose any risks to the local community or onsite workers during construction. Workers would be protected from risks through appropriate use of PPE.

During operation of this alternative, vapor phase activated carbon would be used on the onsite/near site well clusters to capture VOCs in the offgas, thereby protecting the community. The activated carbon would then be regenerated offsite.

Under this alternative, the potable water supply system may not be protected completely until the groundwater remediation is near completion. Installation and startup of the groundwater treatment system would be expected to require 1 to 3 years from signing of the ROD. Based on the computer modeling results, it is estimated that 15 to 25 years of operation of the onsite/near site treatment system would be required for the VOC concentrations in groundwater to be consistently less than 100 ug/l (20 times MCLs). Also, cleanup of groundwater to MCLs (5 ug/l) would require more than 30 years of operation. Because of natural attenuation over a 30 year period, only small pockets of groundwater contamination would remain in offsite areas.

The aquifer restoration objective for groundwater could be achieved. However, extended periods of time would be required. The more contaminated groundwater from the NWIRP (greater than 100 ug/l) would be contained and treated. Other less contaminated groundwater from NWIRP would be expected to continue to flow toward the potable water supply wells and areas further south.

Currently the Bethpage Water District conducts regular testing of the water supply to ensure protection of the community. If contamination was detected in a well, the use of the well would be significantly limited or completely stopped.

Long-Term Effectiveness

At the completion of remediation, the majority (greater than 85%) of the contamination would be captured and permanently destroyed. Most of the balance of the contamination would be reduced to a concentration less than MCLs through dispersion and potentially degradation. However, small pockets of contamination would likely remain in relatively stagnant areas of the aquifer, with VOC concentrations in the range of 5 to 50 ug/l.

Because of the residual VOC concentrations and relatively isolated areas of contamination, this contamination may or may not adversely affect the potable water supply wells.

Since Alternative GW4A considers unrestricted use of the site, private drinking water supply wells could be installed and used in these select areas. Based on the residual concentrations expected, groundwater may result in unacceptable risks to the user.

Under Alternative GW4A, air stripping would be used to treat groundwater. Testing of treated air and water streams is fairly reliable. Likewise, potential contamination of the potable water supply would be monitored by sampling and analyzing water in potable supply wells. The sampling of the wells should be somewhat relatively adequate and reliable in detecting contaminants.

Reduction of Toxicity, Mobility, or Volume

Alternative GW4A would reduce the toxicity of VOCs by greater than 99% and volume of contaminated groundwater by greater than 95% through the treatment process of volatilizing the VOCs from groundwater, capturing the VOCs of vapor phase activated carbon, and then permanently destroying the VOCs during the thermal regeneration of the carbon. Also, vinyl chloride would be thermally destroyed onsite. The mobility of the contaminants would not be affected.

Alternative GW4A would involve the extraction of approximately 87 billion gallons of groundwater over 30 years. A calculated 70,000 pounds of VOCs would be removed and destroyed. Note that the volumes/quantities presented are preliminary and may be modified based on additional testing that would be conducted during the Remedial Design/Remedial Action stage.

Currently, a portion of the contaminated groundwater is being captured by Grumman production wells on both the NWIRP and Grumman property. For the Grumman property, a new VOC treatment system has been installed to protect against future groundwater contamination. Grumman is planning to install a similar treatment system on the Navy property in the near future. These systems treat the groundwater by volatilizing the VOCs. Once the VOCs are in the atmosphere, they are permanently destroyed through photochemical degradation. For contaminated groundwater not captured by the production wells and treatment system extraction wells, the VOCs would flow with the groundwater and eventually be discharged to the ocean or be captured by potable water supply (BWD) wells to the south.

Implementability

Alternative GW4A is readily implementable. Air stripping units are easily constructed and are commonly used. They are easy to operate and are reliable. The use of air stripping units would not interfere with possible future actions.

Monitoring of the potable water supply before should be adequate in protecting public health.

Local and construction-type permits would be required. A state air and SPDES permit would be required for the treatment units.

Equipment and resources are available to perform this work.

The spent activated carbon would be regenerated offsite. Facilities are limited but are available to regenerate the carbon offsite. A limited volume of non-hazardous inorganic sludge would be disposed in an offsite landfill. Landfill space is limited, but not critically.

Cost

The estimated capital cost for Alternative GW4A is $9,629,000 and the estimated O&M cost is $1,666,000 per year. Over a thirty year period, the net present worth cost is $35,233,000. Note that the costs presented are preliminary and may be modified based on additional testing that would be conducted during the Remedial Design/Remedial Action stage.

Compliance with ARARs

Alternative GW4A would comply with ARARs and TBCs, including relevant and appropriate sections of Federal and state drinking water/ groundwater criteria.

Alternative GW4A may comply with NYSDEC groundwater guidelines.

The most significant action-specific ARARs and TBCs include the following.

- Underground Injection Control Program (40 CFR Parts 144, 147)
- RCRA (40 CFR Part 260 - 268)
- Control of Air Emissions from Superfund Air Stripper at Superfund Groundwater Sites (OSWER Directive 9355.0-28)
- NY Environmental Conservation Law (Articles 17 and 37)
- NY Water Classification and Quality Standards (Title 6, Parts 609, and 700 to 704)
- NY State Pollutant Discharge Elimination System (SPDES, Title 6, Parts 750 to 758)

The action-specific ARARs would be complied with.

Overall Protection of Human Health and the Environment

Alternative GW4A would minimize future risks to human health and the environment by treating the most contaminated groundwater. Migration of onsite/near site contaminated water would be controlled. Contaminated groundwater beyond the capture zone of the onsite/near site extraction system would continue to migrate to the south.

Full protection of human health would depend on monitoring/control of the public water supplies. BWD currently monitors and controls the use of potable water supply. This monitoring and shutdown (if necessary) of wells should protect the community.

During implementation of this alternative, if the groundwater from the contaminated areas was used as a potable water supply, contaminants in the groundwater would significantly affect human health through ingestion and inhalation. With time as remediation progressed, risks would decrease accordingly.

4.3.6 Alternative GW4B - Extraction (All Contaminated Groundwater), Precipitation/Filtration (Inorganics), Air Stripping (VOCs), and Reuse

Alternative GW4B (see Figure 3-14) addresses both onsite/near site and offsite contamination. The onsite/near site system is essentially that of Alternative GW4A, although the GW4B onsite/near site flow rate is higher to include VOC contamination less than 100 ug/l at depth. The offsite extraction system also features conventional air stripping for VOC treatment; no metals removal is necessary for offsite contamination.

Short-Term Effectiveness

Alternative GW4B should not pose any risks to the local community or onsite workers during construction. Workers would be protected from risks through appropriate use of PPE.

During operation of this alternative, vapor phase activated carbon would be used to on the onsite/near site well clusters to capture VOCs in the offgas, thereby protecting the community. The activated carbon would then be regenerated offsite. Because of the relatively low concentration of VOCs in the offsite extraction wells, offgas treatment would not be required to protect the community.

Under this alternative, the potable water supply system should be protected once extraction wells just north of the BWD wells are started. These wells would act as a barrier to contaminants. Installation and startup of the groundwater treatment system would be expected to require 2 to 5 years from signing of the ROD. Based on the computer modeling results, it is estimated that approximately 30 years plus of operation would be required for the VOC concentrations in groundwater to be consistently less than the MCLs (5 ug/l). At 30 years of operation, only small pockets of groundwater contamination would remain.

The aquifer restoration objective for groundwater could be achieved. However, extended periods of time would be required. All contaminated groundwater from the NWIRP (greater than MCLs) would be contained and treated.

Currently the Bethpage Water District conducts regular testing of the water supply to ensure protection of the community. If contamination was detected in a well, the use of the well would be significantly limited or completely stopped.

Long-Term Effectiveness

At the completion of remediation, the majority (greater than 95%) of the contamination would be captured and permanently destroyed. The balance of the contamination would be reduced to a concentration less than MCLs through dispersion and potentially degradation. However, the potential remains for small pockets of contamination to remain in relatively stagnant areas of the aquifer, with VOC concentrations in the range of 5 to 10 ug/l.

Because of the residual VOC concentrations and relatively isolated areas of contamination, this contamination may or may not adversely affect the potable water supply wells.

Since Alternative GW4B considers unrestricted use of the site, private drinking water supply wells could be installed and used in these select areas. Based on the residual concentrations expected, groundwater should not result in unacceptable risks to the user.

Under Alternative GW4B, air stripping would be used to treat groundwater. Testing of treated air and water streams is fairly reliable. Likewise, potential contamination of the potable water supply would be monitored by sampling and analyzing water in potable supply wells. The sampling of the wells should be somewhat relatively adequate and reliable in detecting contaminants.

Reduction of Toxicity, Mobility, or Volume

Alternative GW4B would reduce the toxicity of VOCs by greater than 99% and volume of contaminated groundwater by greater than 95% through the treatment process of volatilizing the VOCs from groundwater, capturing the VOCs of vapor phase activated carbon, and then permanently destroying the VOCs during the thermal regeneration of the carbon. Also, vinyl chloride would be thermally destroyed onsite. The mobility of the contaminants would not be affected.

Alternative GW4B would involve the extraction of approximately 220 billion gallons of groundwater over 30 years. A calculated 80,000 pounds of VOCs would be removed and destroyed. Note that the volumes/quantities presented are preliminary and may be modified based on additional testing that would be conducted during the Remedial Design/Remedial Action stage.

Currently, a portion of the contaminated groundwater is being captured by Grumman production wells on both the NWIRP and Grumman property. For the Grumman property, a new VOC treatment system has been installed to protect against future groundwater contamination. Grumman is planning to install a similar treatment system on the Navy property in the near future. These systems treat the groundwater by volatilizing the VOCs. Once the VOCs are in the atmosphere, they are permanently destroyed through photochemical degradation. All contaminated groundwater should be captured by the production wells and treatment system extraction wells. No VOCs should flow to the ocean or be captured by potable water supply (BWD) wells to the south.

Implementability

Alternative GW4B is implementable. Air stripping units are easily constructed and are commonly used. They are easy to operate and are reliable. The use of air stripping units would not interfere with possible future actions. One potential implementation problem is locating extraction wells, injection wells, and air stripping towers in a relatively congested residential area.

Monitoring of the potable water supply should be adequate in protecting public health.

Local and construction-type permits would be required. A state air and SPDES permit would be required for the treatment units.

Equipment and resources are available to perform this work.

The spent activated carbon would be regenerated offsite. Facilities are limited but are available to regenerate the carbon offsite. A limited volume of non-hazardous inorganic sludge would be disposed in an offsite landfill. Landfill space is limited, but not critically.

Cost

The estimated capital cost for Alternative GW4B is $17,093,000 and the estimated O&M cost is $3,070,000 per year. Over a thirty year period, the net present worth cost is $64,286,000. Note that the costs presented are preliminary and may be modified based on additional testing that would be conducted during the Remedial Design/Remedial Action stage.

Compliance with ARARs

Alternative GW4B would comply with ARARs and TBCs, including relevant and appropriate sections of Federal and state drinking water/ groundwater criteria, and NYSDEC groundwater guidelines.

The most significant action-specific ARARs and TBCs include the following.

- Underground Injection Control Program (40 CFR Parts 144, 147)
- RCRA (40 CFR Part 260 - 268)
- Control of Air Emissions from Superfund Air Stripper at Superfund Groundwater Sites (OSWER Directive 9355.0-28)
- NY Environmental Conservation Law (Articles 17 and 37)
- NY Water Classification and Quality Standards (Title 6, Parts 609, and 700 to 704)
- NY State Pollutant Discharge Elimination System (SPDES, Title 6, Parts 750 to 758)

The action-specific ARARs would be complied with.

Overall Protection of Human Health and the Environment

Alternative GW4B would minimize future risks to human health and the environment by treating all contaminated groundwater. Migration of contaminated water, including contaminated groundwater north of BWD well would be controlled, thereby limiting the potential contamination of the potable water supply.

Also, BWD currently monitors and controls the use of potable water supply. This monitoring and shutdown (if necessary) of wells should protect the community.

During implementation of this alternative, if the groundwater from the contaminated areas was used as a potable water supply, contaminants in the groundwater would significantly affect human health through ingestion and inhalation. With time as remediation progressed, risks would decrease accordingly.

4.3.7 Alternative GW5A - Extraction (Onsite/Near Site Groundwater > 100 ug/l), Precipitation/ Filtration (Inorganics), GAC (VOCs), and Reuse

Alternative GW5A (see Figure 3-15) is essentially that of GW4A; however, GW5A features conventional granular activated carbon (GAC) rather than air stripping for VOC removal, as well as enhanced oxidation for production well PW-14 containing vinyl chloride.

Short-Term Effectiveness

Alternative GW5A should not pose any risks to the local community or onsite workers during construction. Workers would be protected from risks through appropriate use of PPE.

During operation of this alternative, liquid phase activated carbon would be used to treat groundwater prior to reinjection. The activated carbon would then be regenerated offsite.

Under this alternative, the potable water supply system may not be protected completely until the groundwater remediation is near completion. Installation and startup of the groundwater treatment system would be expected to require 1 to 3 years from signing of the ROD. Based on the computer modeling results, it is estimated that 15 to 25 years of operation of the onsite/near site treatment system would be required for the VOC concentrations in groundwater to be consistently less than 100 ug/l (20 times MCLs). Also, cleanup of groundwater to MCLs (5 ug/l) would require more than 30 years of operation. Because of natural attenuation over a 30 year period, only small pockets of groundwater contamination would remain in offsite areas.

The aquifer restoration objective for groundwater could be achieved. However, extended periods of time would be required. The more contaminated groundwater from the NWIRP (greater than 100 ug/l) would be contained and treated. Other less contaminated groundwater from NWIRP would be expected to continue to flow toward the potable water supply wells and areas further south.

Currently the Bethpage Water District conducts regular testing of the water supply to ensure protection of the community. If contamination was detected in a well, the use of the well would be significantly limited or completely stopped.

Long-Term Effectiveness

At the completion of remediation, the majority (greater than 85%) of the contamination would be captured and permanently destroyed. Most of the balance of the contamination would be reduced to a concentration less than MCLs through dispersion and potentially degradation. However, small pockets of contamination would likely remain in relatively stagnant areas of the aquifer, with VOC concentrations in the range of 5 to 50 ug/l.

Because of the residual VOC concentrations and relatively isolated areas of contamination, this contamination may or may not adversely affect the potable water supply wells.

Since Alternative GW5A considers unrestricted use of the site, private drinking water supply wells could be installed and used in these select areas. Based on the residual concentrations expected, groundwater may result in unacceptable risks to the user.

Under Alternative GW5A, granular activated carbon would be used to treat groundwater. Testing of treated water streams is fairly reliable. Likewise, potential contamination of the potable water supply would be monitored by sampling and analyzing water in potable supply wells. The sampling of the wells should be somewhat relatively adequate and reliable in detecting contaminants.

Reduction of Toxicity, Mobility, or Volume

Alternative GW5A would reduce the toxicity of VOCs by greater than 99% and volume of contaminated groundwater by greater than 95% through the treatment process of adsorbing VOCs from the groundwater and then permanently destroying the VOCs during the thermal regeneration of the carbon. Also, vinyl chloride would be photochemically destroyed onsite. The mobility of the contaminants would not be affected.

Alternative GW5A would involve the extraction of approximately 87 billion gallons of groundwater over 30 years. A calculated 70,000 pounds of VOCs would be removed and destroyed. Note that the volumes/quantities presented are preliminary and may be modified based on additional testing that would be conducted during the Remedial Design/Remedial Action stage.

Currently, a portion of the contaminated groundwater is being captured by Grumman production wells on both the NWIRP and Grumman property. For the Grumman property, a new VOC treatment system has been installed to protect against future groundwater contamination. Grumman is planning to install a similar treatment system on the Navy property in the near future. These systems treat the groundwater by volatilizing the VOCs. Once the VOCs are in the atmosphere, they are permanently destroyed through photochemical degradation. For contaminated groundwater not captured by the production wells and treatment system extraction wells, the VOCs would flow with the groundwater and eventually be discharged to the ocean or be captured by potable water supply (BWD) wells to the south.

Implementability

Alternative GW5A is readily implementable. GAC units are easily constructed and are commonly used. They are easy to operate and are reliable. The use of GAC would not interfere with possible future actions.

Monitoring of the potable water supply before should be adequate in protecting public health.

Local and construction-type permits would be required. A SPDES permit would be required for the treatment units.

Equipment and resources are available to perform this work. The enhanced oxidation process is relatively new with a limited number of vendors capable of performing the work, although not critically.

The spent activated carbon would be regenerated offsite. Facilities are limited but are available to regenerate the carbon offsite. A limited volume of non-hazardous inorganic sludge would be disposed in an offsite landfill. Landfill space is limited, but not critically.

Cost

The estimated capital cost for Alternative GW5A is $10,885,000 and the estimated O&M cost is $2,328,000 per year. Over a thirty year period, the net present worth cost is $46,667,000. Note that the costs presented are preliminary and may be modified based on additional testing that would be conducted during the Remedial Design/Remedial Action stage.

Compliance with ARARs

Alternative GW5A would comply with ARARs and TBCs, including relevant and appropriate sections of Federal and state drinking water/ groundwater criteria. Alternative GW5A may comply with NYSDEC groundwater guidelines.

The most significant action-specific ARARs and TBCs include the following.

- Underground Injection Control Program (40 CFR Parts 144, 147)
- RCRA (40 CFR Part 260 - 268)
- NY Environmental Conservation Law (Articles 17 and 37)
- NY Water Classification and Quality Standards (Title 6, Parts 609, and 700 to 704)
- NY State Pollutant Discharge Elimination System (SPDES, Title 6, Parts 750 to 758)

The action-specific ARARs would be complied with.

Overall Protection of Human Health and the Environment

Alternative GW5A would minimize future risks to human health and the environment by treating the most contaminated groundwater. Migration of onsite/near site contaminated water would be controlled. Contaminated groundwater beyond the capture zone of the onsite/near site extraction system would continue to migrate to the south.

Full protection of human health would depend on monitoring/control of the public water supplies. BWD currently monitors and controls the use of potable water supply. This monitoring and shutdown (if necessary) of wells should protect the community.

During implementation of this alternative, if the groundwater from the contaminated areas was used as a potable water supply, contaminants in the groundwater would significantly affect human health through ingestion and inhalation. With time as remediation progressed, risks would decrease accordingly.

4.3.8 Alternative GW5B - Extraction (All Contaminated Groundwater), Precipitation/Filtration (Inorganics), GAC (VOCs), and Reuse

Alternative GW5B (see Figure 3-15) addresses both onsite/near site and offsite contamination. The onsite system is essentially that of Alternative GW5A although the GW5B onsite flow rate is higher to include VOC contamination less than 100 ug/l at depth. The offsite remediation also features conventional GAC for VOC treatment; no metals removal is necessary for offsite contamination.

Short-Term Effectiveness

Alternative GW5B should not pose any risks to the local community or onsite workers during construction. Workers would be protected from risks through appropriate use of PPE.

During operation of this alternative, liquid phase activated carbon would be used to treat groundwater prior to reinjection. The activated carbon would then be regenerated offsite.

Under this alternative, the potable water supply system should be protected once extraction wells just north of the BWD wells are started. These wells would act as a barrier to contaminants. Installation and startup of the groundwater treatment system would be expected to require 2 to 5 years from signing of the ROD. Based on the computer modeling results, it is estimated that approximately 30 years plus of operation would be required for the VOC concentrations in groundwater to be consistently less than the MCLs (5 ug/l). At 30 years of operation, only small pockets of groundwater contamination would remain.

The aquifer restoration objective for groundwater could be achieved. However, extended periods of time would be required. All contaminated groundwater from the NWIRP (greater than MCLs) would be contained and treated.

Currently the Bethpage Water District conducts regular testing of the water supply to ensure protection of the community. If contamination was detected in a well, the use of the well would be significantly limited or completely stopped.

Long-Term Effectiveness

At the completion of remediation, the majority (greater than 95%) of the contamination would be captured and permanently destroyed. The balance of the contamination would be reduced to a concentration less than MCLs through dispersion and potentially degradation. However, the potential remains for small pockets of contamination to remain in relatively stagnant areas of the aquifer, with VOC concentrations in the range of 5 to 10 ug/l.

Because of the residual VOC concentrations and relatively isolated areas of contamination, this contamination may or may not adversely affect the potable water supply wells.

Since Alternative GW5B considers unrestricted use of the site, private drinking water supply wells could be installed and used in these select areas. Based on the residual concentrations expected, groundwater should not result in unacceptable risks to the user.

Under Alternative GW5B, granular activated carbon would be used to treat groundwater. Testing of water streams is fairly reliable. Likewise, potential contamination of the potable water supply would be monitored by sampling and analyzing water in potable supply wells. The sampling of the wells should be somewhat relatively adequate and reliable in detecting contaminants.

Reduction of Toxicity, Mobility, or Volume

Alternative GW5B would reduce the toxicity of VOCs by greater than 99% and volume of contaminated groundwater by greater than 95% through the treatment process of adsorbing the VOCs from the groundwater and then permanently destroying the VOCs during the thermal regeneration of the carbon. Also, vinyl chloride would be photochemically destroyed onsite. The mobility of the contaminants would not be affected.

Alternative GW5B would involve the extraction of approximately 220 billion gallons of groundwater over 30 years. A calculated 80,000 pounds of VOCs would be removed and destroyed. Note that the volumes/quantities presented are preliminary and may be modified based on additional testing that would be conducted during the Remedial Design/Remedial Action stage.

Currently, a portion of the contaminated groundwater is being captured by Grumman production wells on both the NWIRP and Grumman property. For the Grumman property, a new VOC treatment system has been installed to protect against future groundwater contamination. Grumman is planning to install a similar treatment system on the Navy property in the near future. These systems treat the groundwater by volatilizing the VOCs. Once the VOCs are in the atmosphere, they are permanently destroyed through photochemical degradation. All contaminated groundwater should be captured by the production wells and treatment system extraction wells. No VOCs should flow to the ocean or be captured by potable water supply (BWD) wells to the south.

Implementability

Alternative GW5B is implementable. GAC units are easily constructed and are commonly used. They are easy to operate and are reliable. The use of GAC units would not interfere with possible future actions. One potential implementation problem is locating extraction wells, injection wells, and air stripping towers in a relatively congested residential area.

Monitoring of the potable water supply should be adequate in protecting public health.

Local and construction-type permits would be required. A state air and SPDES permit would be required for the treatment units.

Equipment and resources are available to perform this work. The enhanced oxidation process is relatively new with a limited number of vendors capable of performing the work, although not critically.

The spent activated carbon would be regenerated offsite. Facilities are limited but are available to regenerate the carbon offsite. A limited volume of non-hazardous inorganic sludge would be disposed in an offsite landfill. Landfill space is limited, but not critically.

Cost

The estimated capital cost for Alternative GW5B is $21,321,000 and the estimated O&M cost is $4,781,000 per year. Over a thirty year period, the net present worth cost is $94,819,000. Note that the costs presented are preliminary and may be modified based on additional testing that would be conducted during the Remedial Design/Remedial Action stage.

Compliance with ARARs

Alternative GW5B would comply with ARARs and TBCs, including relevant and appropriate sections of Federal and state drinking water/ groundwater criteria, and NYSDEC groundwater guidelines.

The most significant action-specific ARARs and TBCs include the following.

- Underground Injection Control Program (40 CFR Parts 144, 147)
- RCRA (40 CFR Part 260 - 268)
- NY Environmental Conservation Law (Articles 17 and 37)
- NY Water Classification and Quality Standards (Title 6, Parts 609, and 700 to 704)
- NY State Pollutant Discharge Elimination System (SPDES, Title 6, Parts 750 to 758)

The action-specific ARARs would be complied with.

Overall Protection of Human Health and the Environment

Alternative GW5B would minimize future risks to human health and the environment by treating all contaminated groundwater. Migration of contaminated water, including contaminated groundwater north of BWD well would be controlled, thereby limiting the potential contamination of the potable water supply.

Also, BWD currently monitors and controls the use of potable water supply. This monitoring and shutdown (if necessary) of wells should protect the community.

During implementation of this alternative, if the groundwater from the contaminated areas was used as a potable water supply, contaminants in the groundwater would significantly affect human health through ingestion and inhalation. With time as remediation progressed, risks would decrease accordingly.

4.3.9 Alternative GW6A - Extraction (Onsite/Near Site Groundwater), Precipitation/Filtration (Inorganics), Enhanced Oxidation (VOCs), and Reuse

Alternative GW6A (see Figure 3-16) is essentially that of GW5A; however, GW6A features the innovative enhanced oxidation for VOC removal, as well as enhanced oxidation for production well PW-14 containing vinyl chloride.

Short-Term Effectiveness

Alternative GW6A should not pose any risks to the local community or onsite workers during construction. Workers would be protected from risks through appropriate use of PPE.

During operation of this alternative, enhanced oxidation would be used to treat groundwater prior to reinjection.

Under this alternative, the potable water supply system may not be protected completely until the groundwater remediation is near completion. Installation and startup of the groundwater treatment system would be expected to require 1 to 3 years from signing of the ROD. Based on the computer modeling results, it is estimated that 15 to 25 years of operation of the onsite/near site treatment system would be required for the VOC concentrations in groundwater to be consistently less than 100 ug/l (20 times MCLs). Also, cleanup of groundwater to MCLs (5 ug/l) would require more than 30 years of operation. Because of natural attenuation over a 30 year period, only small pockets of groundwater contamination would remain in offsite areas.

The aquifer restoration objective for groundwater could be achieved. However, extended periods of time would be required. The more contaminated groundwater from the NWIRP (greater than 100 ug/l) would be contained and treated. Other less contaminated groundwater from NWIRP would be expected to continue to flow toward the potable water supply wells and areas further south.

Currently the Bethpage Water District conducts regular testing of the water supply to ensure protection of the community. If contamination was detected in a well, the use of the well would be significantly limited or completely stopped.

Long-Term Effectiveness

At the completion of remediation, the majority (greater than 85%) of the contamination would be captured and permanently destroyed. Most of the balance of the contamination would be reduced to a concentration less than MCLs through dispersion and potentially degradation. However, small pockets of contamination would likely remain in relatively stagnant areas of the aquifer, with VOC concentrations in the range of 5 to 50 ug/l.

Because of the residual VOC concentrations and relatively isolated areas of contamination, this contamination may or may not adversely affect the potable water supply wells.

Since Alternative GW6A considers unrestricted use of the site, private drinking water supply wells could be installed and used in these select areas. Based on the residual concentrations expected, groundwater may result in unacceptable risks to the user.

Under Alternative GW6A, enhanced oxidation would be used to treat groundwater. Testing of treated water streams is fairly reliable. Likewise, potential contamination of the potable water supply would be monitored by sampling and analyzing water in potable supply wells. The sampling of the wells should be somewhat relatively adequate and reliable in detecting contaminants.

Reduction of Toxicity, Mobility, or Volume

Alternative GW6A would reduce the toxicity of VOCs by greater than 99% and volume of contaminated groundwater by greater than 95% through the treatment process of photochemically destroying VOCs in groundwater. The mobility of the contaminants would not be affected.

Alternative GW6A would involve the extraction of approximately 87 billion gallons of groundwater over 30 years. A calculated 70,000 pounds of VOCs would be removed and destroyed. Note that the volumes/quantities presented are preliminary and may be modified based on additional testing that would be conducted during the Remedial Design/Remedial Action stage.

Currently, a portion of the contaminated groundwater is being captured by Grumman production wells on both the NWIRP and Grumman property. For the Grumman property, a new VOC treatment system has been installed to protect against future groundwater contamination. Grumman is planning to install a similar treatment system on the Navy property in the near future. These systems treat the groundwater by volatilizing the VOCs. Once the VOCs are in the atmosphere, they are permanently destroyed through photochemical degradation. For contaminated groundwater not captured by the production wells and treatment system extraction wells, the VOCs would flow with the groundwater and eventually be discharged to the ocean or be captured by potable water supply (BWD) wells to the south.

Implementability

Alternative GW6A is readily implementable. Enhanced oxidation units are available and have been constructed. These are more difficult to operate than other common units such air stripping and GAC. The use of enhanced oxidation would not interfere with possible future actions.
Monitoring of the potable water supply before should be adequate in protecting public health.

Local and construction-type permits would be required. A SPDES and air discharge permit would be required for the treatment units.

Equipment and resources are available to perform this work. The enhanced oxidation process is relatively new with a limited number of vendors capable of performing the work, although not critically.

Offsite TSD facilities are not required for the organic contaminants. A limited volume of non-hazardous inorganic sludge would be disposed in an offsite landfill. Landfill space is limited, but not critically.

Cost

The estimated capital cost for Alternative GW6A is $ 23,718,000 and the estimated O&M cost is $7,609,000 per year. Over a thirty year period, the net present worth cost is $140,698,000. Note that the costs presented are preliminary and may be modified based on additional testing that would be conducted during the Remedial Design/Remedial Action stage.

Compliance with ARARs

Alternative GW6A would comply with ARARs and TBCs, including relevant and appropriate sections of Federal and state drinking water/ groundwater criteria.

Alternative GW6A may comply with NYSDEC groundwater guidelines.

The most significant action-specific ARARs and TBCs include the following.

- Underground Injection Control Program (40 CFR Parts 144, 147)
- RCRA (40 CFR Part 260 - 268)
- NY Environmental Conservation Law (Articles 17 and 37)
- NY Water Classification and Quality Standards (Title 6, Parts 609, and 700 to 704)
- NY State Pollutant Discharge Elimination System (SPDES, Title 6, Parts 750 to 758)

The action-specific ARARs would be complied with.

Overall Protection of Human Health and the Environment

Alternative GW6A would minimize future risks to human health and the environment by treating the most contaminated groundwater. Migration of onsite/near site contaminated water would be controlled. Contaminated groundwater beyond the capture zone of the onsite/near site extraction system would continue to migrate to the south.

Full protection of human health would depend on monitoring/control of the public water supplies. BWD currently monitors and controls the use of potable water supply. This monitoring and shutdown (if necessary) of wells should protect the community.

During implementation of this alternative, if the groundwater from the contaminated areas was used as a potable water supply, contaminants in the groundwater would significantly affect human health through ingestion and inhalation. With time as remediation progressed, risks would decrease accordingly.

4.3.10 Alternative GW6B - Extraction (All Contaminated Groundwater), Precipitation/Filtration (Inorganics), Enhanced Oxidation (VOCs) and Reuse

Alternative GW6B (see Figure 3-16) addresses both onsite/near site and offsite contamination. The onsite system is essentially that of Alternative GW6A although the GW6B onsite flow rate is higher to include VOC contamination less than 100 ug/l at depth. The offsite extraction system also features enhanced oxidation for VOC treatment; no metals removal is necessary for offsite contamination.

Short-Term Effectiveness

Alternative GW6B should not pose any risks to the local community or onsite workers during construction. Workers would be protected from risks through appropriate use of PPE.

During operation of this alternative, enhanced oxidation would be used to treat groundwater prior to reinjection.

Under this alternative, the potable water supply system should be protected once extraction wells just north of the BWD wells are started. These wells would act as a barrier to contaminants. Installation and startup of the groundwater treatment system would be expected to require 2 to 5 years from signing of the ROD. Based on the computer modeling results, it is estimated that approximately 30 years plus of operation would be required for the VOC concentrations in groundwater to be consistently less than the MCLs (5 ug/l). At 30 years of operation, only small pockets of groundwater contamination would remain.

The aquifer restoration objective for groundwater could be achieved. However, extended periods of time would be required. All contaminated groundwater from the NWIRP (greater than MCLs) would be contained and treated.

Currently the Bethpage Water District conducts regular testing of the water supply to ensure protection of the community. If contamination was detected in a well, the use of the well would be significantly limited or completely stopped.

Long-Term Effectiveness

At the completion of remediation, the majority (greater than 95%) of the contamination would be captured and permanently destroyed. The balance of the contamination would be reduced to a concentration less than MCLs through dispersion and potentially degradation. However, the potential remains for small pockets of contamination to remain in relatively stagnant areas of the aquifer, with VOC concentrations in the range of 5 to 10 ug/l.

Because of the residual VOC concentrations and relatively isolated areas of contamination, this contamination may or may not adversely affect the potable water supply wells.

Since Alternative GW6B considers unrestricted use of the site, private drinking water supply wells could be installed and used in these select areas. Based on the residual concentrations expected, groundwater should not result in unacceptable risks to the user.

Under Alternative GW6B, enhanced oxidation would be used to treat groundwater. Testing of water streams is fairly reliable. Likewise, potential contamination of the potable water supply would be monitored by sampling and analyzing water in potable supply wells. The sampling of the wells should be somewhat relatively adequate and reliable in detecting contaminants.

Reduction of Toxicity, Mobility, or Volume

Alternative GW6B would reduce the toxicity of VOCs by greater than 99% and volume of contaminated groundwater by greater than 95% through the treatment process of photochemically destroying VOCs in groundwater. The mobility of the contaminants would not be affected.

Alternative GW6B would involve the extraction of approximately 220 billion gallons of groundwater over 30 years. A calculated 80,000 pounds of VOCs would be removed and destroyed. Note that the volumes/quantities presented are preliminary and may be modified based on additional testing that would be conducted during the Remedial Design/Remedial Action stage.

Currently, a portion of the contaminated groundwater is being captured by Grumman production wells on both the NWIRP and Grumman property. For the Grumman property, a new VOC treatment system has been installed to protect against future groundwater contamination. Grumman is planning to install a similar treatment system on the Navy property in the near future. These systems treat the groundwater by volatilizing the VOCs. Once the VOCs are in the atmosphere, they are permanently destroyed through photochemical degradation. All contaminated groundwater should be captured by the production wells and treatment system extraction wells. No VOCs should flow to the ocean or be captured by potable water supply (BWD) wells to the south.

Implementability

Alternative GW6B is readily implementable. Enhanced oxidation units are available and have been constructed. These are more difficult to operate than other common units such air stripping and GAC. One potential implementation problem is locating extraction wells, injection wells, and enhanced oxidation units in a relatively congested residential area.

Monitoring of the potable water supply should be adequate in protecting public health.

Local and construction-type permits would be required. A state air and SPDES permit would be required for the treatment units.

Equipment and resources are available to perform this work. The enhanced oxidation process is relatively new with a limited number of vendors capable of performing the work, although not critically.

Offsite TSD facilities are not required for the organic contaminants. A limited volume of non-hazardous inorganic sludge would be disposed in an offsite landfill. Landfill space is limited, but not critically.

Cost

The estimated capital cost for Alternative GW6B is $33,003,000 and the estimated O&M cost is $13,020,000 per year. Over a thirty year period, the net present worth cost is $233,170,000. Note that the costs presented are preliminary and may be modified based on additional testing that would be conducted during the Remedial Design/Remedial Action stage.

Compliance with ARARs

Alternative GW6B would comply with ARARs and TBCs, including relevant and appropriate sections of Federal and state drinking water/ groundwater criteria, and NYSDEC groundwater guidelines.

The most significant action-specific ARARs and TBCs include the following.

- Underground Injection Control Program (40 CFR Parts 144, 147)
- RCRA (40 CFR Part 260 - 268)
- NY Environmental Conservation Law (Articles 17 and 37)
- NY Water Classification and Quality Standards (Title 6, Parts 609, and 700 to 704)
- NY State Pollutant Discharge Elimination System (SPDES, Title 6, Parts 750 to 758)

The action-specific ARARs would be complied with.

Overall Protection of Human Health and the Environment

Alternative GW6B would minimize future risks to human health and the environment by treating all contaminated groundwater. Migration of contaminated water, including contaminated groundwater north of BWD well would be controlled, thereby limiting the potential contamination of the potable water supply.

Also, BWD currently monitors and controls the use of potable water supply. This monitoring and shutdown (if necessary) of wells should protect the community.

During implementation of this alternative, if the groundwater from the contaminated areas was used as a potable water supply, contaminants in the groundwater would significantly affect human health through ingestion and inhalation. With time as remediation progressed, risks would decrease accordingly.

4.4 COMPARATIVE ANALYSIS OF SOILS ALTERNATIVES

4.4.1 Short-Term Effectiveness

Adverse impacts to the community are not expected during implementation of any of the alternatives. Excavation activities associated with Alternatives S3 through S10 are expected to generate minimal quantities of fugitive dust and VOCs. Dust generation would be controlled through common practices such as wetting of the soils. VOCs would be monitored and controlled if necessary using a foam-type suppressant.

Alternative S1 does not achieve any of the remedial objectives. Alternative S2 can be completed within 1 to 3 years after signing of the ROD. Alternatives S3, S4, S5, S6, and S7 would require approximately 2 to 4 years to complete. Alternatives S8 through S10 would require 3 to 6 years after signing of the ROD to complete.

4.4.2 Long-Term Effectiveness

Under Alternative S1, metals, VOCs, PCBs, and PAHs would remain at the NWIRP in significant quantities. No action would be taken to protect human health and the environment. Under Alternative S2, the contaminants would remain, however, a clay cap would be used to isolate the contaminants from the public and minimize infiltration of precipitation. Deed restrictions would be used to control future excavations into the area. Alternatives S3 through S10 address removal, treatment, and/or offsite disposal of RCRA characteristic wastes and TSCA regulated wastes. Also, the soils would be treated for removal of volatile organics. Alternatives S3, S4, S5, S8, S9, and S10 target removal of all VOCs greater than the baseline VOC action levels. Alternatives S6 and S7 target removal of approximately 94% of the VOC contamination, with the residual VOC concentrations at only one to three times the action levels.

Under Alternatives S3 through S7, contaminants (metals and other organics) at concentrations greater than the action levels would remain, however these soils would be covered to isolate the contaminants from the public. Under Alternatives S8 through S10, the contaminants (metals and other organics) would be removed from the site. Alternatives S8 and S9 use offsite landfilling to dispose of these contaminants. Alternative S10 includes onsite soil washing to separate the contaminants from the soils. The concentrated contaminant residues would be treated and disposed off site.

Incineration of soils with PCB concentrations greater than 50 ppm (Alternatives S3, S5 through S10) is expected to permanently destroy the PCBs. Fixation and offsite landfilling of hazardous soils (Alternatives S3 through S10) is also expected to be relatively permanent. Treatment of the soils for VOCs under Alternatives S3 through S10 includes capture of the VOCs and thermal destruction. The clay cap for all contaminated areas (Alternative S2) and for a PCB-contaminated soils at concentrations of 10 to 50 ppm (Alternative S7), and the soil/gravel cover (Alternatives S3 through S7) when coupled with deed restrictions are somewhat permanent. However, long term maintenance of the cap or cover is required.

The residual risks to human health are greater than 1 x 10^{-4} under Alternative S1. Under Alternatives S2 though S10, the residual risks are less than 1 x 10^{-6}. Under Alternative S2, if the cap and deed restrictions are not effective, then the residual risks exceed 1 x 10^{-4}. Under Alternatives S3 through S7, if the cap and deed restrictions are not effective then the residual risks are the in the range of 1 x 10^{-4} to 10^{-6}. Under Alternatives S8 through S10, there are no restrictions on future use of the site.

Alternative S1 would not protect the groundwater from future VOC contamination. Alternatives S2 through S5 and S8 through S10 would be protective of groundwater at the completion of soil remediation. Alternatives S6 and S7 minimize future VOC contamination of the groundwater, by treating the most contaminated soils. However, low level VOC groundwater contamination would continue until the residual VOCs are flushed from the soils (10 to 30 years). Alternative S2 relies on the continued effectiveness of the clay cap. Alternatives S3 through S10 remove these contaminants from the site.

4.4.3 Reduction of Toxicity, Mobility, or Volume

There is no reduction in toxicity, mobility or volume under Alternatives S1 and S2, since no treatment is used. Alternatives S3, and S5 through S10 all use thermal treatment to eliminate the toxicity of PCBs (at concentrations greater than 50 ppm) and VOCs; and fixation (also including Alternative S4) to reduce the mobility of arsenic (determined to be hazardous, as defined by the USEPA under 40 CFR 261.24), by 50 to 99%. The volume of contaminated soil is reduced by approximately 87,000 cubic yards under Alternatives S6 and S7; by approximately 240,000 cubic yards under Alternatives S3, S4, S5, S8 and S9; and by approximately 290,000 cubic yards under Alternative S10.

Alternatives S3 through S8 also employ insitu vapor extraction and air sparging to treat VOC-contaminated soils. Alternative S9 uses LTTS to treat these VOC-contaminated soils, as well as to treat PCB-contaminated soils (at a concentration greater than 50 ppm). Alternative S10 uses soil washing to treat the VOC-contaminated soils as well as the other organics and metal contaminants.

4.4.4 Implementability

Each of the alternatives should be implementable. Equipment and resources and TSD facilities are available as applicable. Alternative S1 is the most easily implemented since no actions or permits are required. Alternative S2, and to a less extent Alternative S7, involve a clay cap which would significantly affect the future use of the site. In-situ vapor extraction, LTTS, and soil washing are relatively new processes. Also, there are only limited vendors available to perform the work under Alternatives S3 through S10, however these issues are not expected to be critical. Alternatives S8 and S9 both include the offsite landfilling of significant quantities of contaminated soil (approximately 60,000 cubic yards). Landfills are available, however space is limited. Alternatives S8 and S9 involve excavating soils to a depth of 50 plus feet. This excavation would be difficult.

4.4.5 Cost

The costs associated with each of the soil alternatives is provided in Table 4-1.

4.4.6 Compliance with ARARs

Alternative S1 would not comply with TSCA, RCRA, SDWA ARARs, OSWER directive for PCB contamination, or NYS soil guidelines. Alternatives S2 through S10 should comply with all ARARs and Alternatives S8 through S10 would comply with the OSWER directive for PCB contamination and the NYSDEC soil guidelines. Alternatives S3 and S4 would not comply with NYSDEC soil guidelines or the OSWER directive for PCBs. Alternatives S5 through S7 would comply with only the industrial use scenario under these TBCs.

Action-specific ARARs include Federal and State RCRA programs for excavation and treatment of hazardous waste, TSCA for soils with PCB concentrations greater 50 ppm, and state Air Pollution Control regulations for Alternatives S3 through S7, and S9.

4.4.7 Overall Protection of Human Health and the Environment

Alternative S1 would not be protective of human health and the environment. Alternative S2 would protect human health by preventing contact with the contaminants, and the environment by minimizing groundwater infiltration and resulting groundwater contamination. Alternatives S3 through S10 address the major chemical threats at the site by removing and treating (or offsite landfilling under Alternative S4) soils with PCB concentrations greater 50 ppm and hazardous wastes, and treating soils contaminated with VOCs. Alternatives S3 through S7 provide protection of human health for the balance of the site

TABLE 4-1

SUMMARY OF SOILS ALTERNATIVES COSTS
NWIRP, BETHPAGE, NEW YORK

Alternative No.		Current Industrial Scenario			Future Residential Scenario		
		Capital Cost	O&M Cost/Yr	Present Worth Cost (30-Yr)	Capital Cost	O&M Cost/Yr	Present Worth Cost (30-Yr)
S1 -	No Action (1)	S1- $ 0	$ 4,000	$ 56,000	—	—	-----
S2 -	Clay Capping	S2A - $ 3,779,000	$ 19,000	$ 4,065,000	S2B - $ 3,546,000	$ 18,000	$ 3,817,000
S3 -	Fixation of Metals, Incineration of PCBs >50 ppm, and In-Situ Vapor Extraction of VOCs (1,4,5)	S3 - $ 16,847,000	$ 14,000	$ 17,056,000	—	—	-----
S4 -	Fixation of Metals, Offsite Landfill of PCBs >50 ppm, and In-Situ Vapor Extraction of VOCs (5)	S4 - $ 15,900,000	$ 14,000	$ 19,651,000	—	—	-----
S5 -	Fixation of Metals, Incineration of PCBs> 50 ppm, Offsite Landfill of PCBs between 10 ppm and 50 ppm, and In-Situ Vapor Extraction of VOCs (1,5)	S5 - $ 19,441,000	$ 14,000	$ 19,651,000	-----	—	-----
S6 -	Fixation of Metals, Incineration of PCBs> 50 ppm, Offsite Landfill of PCBs between 10 ppm and 50 ppm, and Limited In-Situ Vapor Extraction of VOCs (1,5)	S6 - $ 10,655,000	$ 14,000	$ 10,865,000	—	—	-----
S7 -	Fixation of Metals, Incineration of PCBs> 50 ppm, Onsite consolidation and clay capping of PCBs between 10 ppm and 50 ppm, and Limited In-Situ Vapor Extraction of VOCs (1,5)	S7 - $ 8,250,000	$ 14,000	$ 8,459,000	-----	—	-----
S8 -	Fixation of Metals, Incineration of PCBs> 50 ppm, In-Situ Vapor Extraction of VOCs, and Offsite Landfill of Other Metals/Organics (2)	S8A - $ 44,490,000	—	-----	S8B - $ 41,758,000	-----	-----
S9 -	Fixation of Metals, Onsite Low Temperature Thermal Stripping of VOCs and PCBs, and Offsite Landfill of Other Metals/Organics (2)	S9A - $109,376,000	-----	—	S9B - $105,637,000	-----	-----
S10 -	Soil Washing/Onsite Fill of Metals and Organics with Offsite Landfill of Metal Treatment Residuals, and Incineration of Organic Treatment Residuals (2)	S10A - $ 91,597,000	—	-----	S10B - $ 89,907,000	-----	-----

(1) Costs for current industrial use scenario and future residential use scenario are identical.
(2) No long-term operating costs are incurred since no residual contamination remains on site; therefore, present worth costs are not applicable.
(3) Note that the costs presented are preliminary and may be modified based on additional testing that would be conducted during the Remedial Design/Remedial Action stage.
(4) The estimated capital and present worth costs for Alternative S3 with only limited In-Situ Vapor Extraction would be $8,061,000 and $8,270,000, respectively.
(5) Alternatives S3 through S7 also include permeable covering and deed restriction components for the remaining soils with chemical concentrations greater than the action levels.

contaminants by providing a barrier. Alternatives S5 and S6 would be slightly more protective than S3 and S4 since lower concentrations of PCBs would remain at the site. Alternative S7 achieves a similar level of protection to Alternatives S5 and S6 by placing PCB-contaminated soils in an onsite clay capped area. Alternatives S8 and S9 would provide this protection by placing the contaminants in an offsite landfill. Under Alternative S10, the contaminants would be separated from the soils. The contaminants would then be treated offsite. Alternatives S6 and S7 would be slightly less protective of the groundwater than Alternatives S2 through S5 and Alternatives S8 through S10, since residual VOCs at concentrations of 1 to 3 times the action levels would remain in soil. Because of natural attenuation, the threat to groundwater would decrease with time.

4.5 COMPARATIVE ANALYSIS OF GROUNDWATER ALTERNATIVES

4.5.1 Short-Term Effectiveness

Adverse impacts to the community would not be expected during implementation of any of the alternatives. Air pollution controls would be used to treat discharges of the more contaminated air streams under Alternatives GW4A and GW4B. All extracted groundwater would be treated to drinking water criteria prior to reinjection into the aquifer (via the recharge basins) under each alternative featuring groundwater treatment (Alternatives GW4 through GW6.

Alternatives GW1 and GW2 do not achieve any of the remedial objectives. Alternatives GW3A, GW3B, GW4A, GW5A, and GW6A can be installed and operating within 1 to 3 years after signing of the ROD. Alternative GW4B, GW5B, and GW6B can be installed and operating within 2 to 5 years after signing of the ROD.

Alternatives GW3A, GW3B, GW4B, GW5B, and GW6B would be protective of the public water supply as soon as the system is operating. Alternatives GW4A, GW5A, and GW6A, would not be protective of the public water supply until groundwater remediation is near completion (approximately 30 years). Offsite areas not addressed under Alternatives GW4A, GW5A, and GW6A would likely cleanup through natural attenuation.

Under each of the alternatives, risks to human health remain if a potable water supply well was installed in the area of contamination. Deed restrictions would be used under each alternative (except GW1) to minimize this risk.

4.5.2 Long-Term Effectiveness

Alternatives GW1, GW2, GW3A, and GW3B would not be effective in the long term. Contamination would continue to migrate south and eventually be captured by potable water supplies or be discharged to the ocean. Alternatives GW3A and GW3B minimize risk to human health by providing well head treatment. Alternatives GW4A, GW5A, and GW6A would be mostly protective in the long term with only relatively small pockets of low level VOC-contaminated groundwater remaining. Alternatives GW4B, GW5B, and GW6B would be more protective in the long term with smaller pockets of lower level VOC-contaminated groundwater remaining.

4.5.3 Reduction of Toxicity, Mobility, or Volume

There would be no reduction in toxicity, mobility or volume under Alternatives GW1, GW2, GW3A, and GW3B, since no treatment of the groundwater would be provided. Alternatives GW4A, GW4B, GW5A, and GW5B all use thermal treatment to eliminate the toxicity of VOCs. Alternatives GW6A and GW6B use photochemical oxidation to destroy VOCs. For each of the alternatives that use groundwater extraction, GW4 through GW6, the volume of contaminated groundwater would be reduced by approximately 95%. Alternatives GW4B, GW5B, and GW6B use treatment to achieve this reduction. Alternative GW4A, GW5A, and GW5A require the use of both treatment and natural attenuation to achieve this reduction.

Alternatives GW3A, GW4A and GW4B use air stripping to treat groundwater. Alternatives GW3B, GW5A, and GW5B use GAC to treat groundwater. Enhanced oxidation is used for Alternatives GW6A and GW6B.

4.5.4 Implementability

Each of the alternatives would be implementable. Alternatives GW1 and GW2 would be very easy to implement since only minimal actions are occurring. Alternatives GW3A, GW3B, GW4A, GW5A, and GW6A should also be relatively easy to implement. Alternatives GW4B, GW5B, and GW6B which include treatment systems in a residential area may be more difficult to implement.

The equipment and resources are readily available for each of the alternatives, except for Alternatives GW6A and GW6B, particularly for the large anticipated flow rates. There are only a limited number of vendors available for Alternatives GW6A and GW6B, although not critically.

Local and construction-type permits would be required for all alternatives except Alternative GW1. Alternatives GW3A and GW3B would require close interaction with the state, county, and local agencies. Alternatives GW4, GW5, and GW6 would require SPDES permits. Alternatives GW4A and GW4B would also require air discharge permits. Each of these permits should be obtainable.

4.5.5 Cost

The costs associated with each of the groundwater alternatives is provided in Table 4-2.

4.5.6 Compliance with ARARs

Alternatives GW1 and GW2 would not comply with groundwater/drinking water ARARs and TBCs. Alternatives GW3A and GW3B may comply with drinking water ARARs, but may not comply with groundwater ARARs and TBCs. Alternatives GW4, GW5, and GW6 would comply with all groundwater/ drinking water ARARs and TBCs.

4.5.7 Overall Protection of Human Health and the Environment

Alternative GW1 would not be protective of human health or the environment. Alternative GW2 provides minimal protection of the public water supply through monitoring. If contamination is detected, an alternative water source or treatment would be required. Alternatives GW3A and GW3B would protect the public water supply by treating the water at the specific well head locations. Alternatives GW2, GW3A, and GW3B would not protect the environment as a stand-alone alternative. GW4A, GW5A, and GW6A would protect human health and the environment by extracting and treating the most contaminated groundwater. In the short term, risks to the public water supply would remain. GW4B, GW5B, and GW6B would further protect human health and the environment by extracting and treating all contaminated groundwater. Short term risks to the public water supply would not be expected.

TABLE 4-2

SUMMARY OF GROUNDWATER ALTERNATIVES COSTS
NWIRP, BETHPAGE, NEW YORK

Alternative No.		Onsite/Near Site Contamination > 100 ug/l			All Contamination > 5 ug/l		
		Capital Cost	O&M Cost/Yr	Present Worth Cost (30-Yr)	Capital Cost	O&M Cost/Yr	Present Worth Cost (30-Yr)
GW1 -	No Action [1]	---	---	---	GW1-$ 0	$ 4,000	$ 56,000
GW2 -	Monitoring of Existing Potable Water Supplies	---	---	---	GW2-$249,000	$ 27,300	$ 669,000
GW3 -	Air Stripping (GW3A) or GAC Treatment (GW3B) of Existing Potable Water Supplies	---	---	—	GW3A-$1,385,000 GW3B-$1,647,000	$ 169,000 $ 24,300	$ 3,984,000 $ 2,020,000
GW4 -	Extraction, Precipitation/Filtration, Air Stripping, and Reuse	GW4A-$7,589,000	$1,452,000	$29,907,000	GW4B-$15,053,000	$2,856,000	$ 58,960,000
	Adder for Air Stripping PW-14 Vinyl Chloride Well	$2,040,000	$ 214,000	$ 5,326,000	$2,040,000	$ 214,000	$ 5,326,000
GW5 -	Extraction, Precipitation/ Filtration, GAC, and Reuse	GW5A-$8,647,000	$1,783,000	$36,049,000	GW5B-$19,083,000	$4,236,000	$ 84,201,000
	Adder for Enhanced Oxidation PW-14 Vinyl Chloride Well	$2,238,000	$ 545,000	$10,618,000	$2,238,000	$ 545,000	$ 10,618,000
GW6 -	Extraction, Precipitation/ Filtration, Enhanced Oxidation, and Reuse	GW6A-$23,718,000	$7,608,000	$ 140,698,000	GW6B-$33,003,000	$13,020,000	$233,170,000

[1] Costs are the same for onsite/near site contamination > 100 ug/l as for all contamination.

[2] Note that the costs presented are preliminary and may be modified based on additional testing that would be conducted during the Remedial Design/Remedial Action stage.

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