Fumex Sanitation Site

New Hyde Park, Nassau County, New York

1·30·041

Final Feasibility Study Report

DEPARTMENT OF ENVIRONMENTAL CONSERVATION
NEW YORK STATE

NYSDEC Site #1-30-041
Work Assignment #D002925-22

Prepared For:

New York State
Department Of Environmental Conservation
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Executive Summary

Camp Dresser & McKee (CDM) has been retained by the New York State Department of Environmental Conservation (NYSDEC) to prepare a Feasibility Study (FS) Report for the Fumex Sanitation, Inc. site (the "Site") under the New York State Superfund Standby Contract (Work Assignment #D002925-22). This FS Report discusses the basis and procedures used in identifying remedial alternatives that address contamination at the Fumex site. The purpose of the FS is to select a feasible, cost-effective remedial alternative that protects public health and the environment from the potential risks posed by contamination at the Site.

Several presumptive remedial actions are potentially applicable in the remediation of the Site. Presumptive remedies are preferred technologies for common categories of sites, based on historical patterns of remedy selection and EPA/NYSDEC scientific and engineering evaluation of performance data on technology application. Presumptive remedies for soil and groundwater contamination for this FS include surface and subsurface soil removal via excavation, groundwater treatment and monitoring, and capping to prevent infiltration. The use of presumptive remedies speeds up cleanup actions by using the program's past experiences to streamline site investigations.

Site History

The Site is located at 131 Herricks Road in New Hyde Park, Nassau County, New York (see Figure 1-1), encompasses approximately one third acre of land, and includes a one-story masonry and metal frame building with no basement (see Figure 1-2). The surrounding area consists of industrialized, commercial, and residential properties.

The Site lies on a relatively flat and gentle topography. Of the three water-producing aquifers within this region, only water pumped from the Upper Glacial and the deep Magothy aquifers are used. The Jamaica Water Supply Co. extracts a minimal amount of water from the Upper Glacial aquifer along the Nassau/Queens border (approximately 5-10 miles from Site) for industrial usage. The deep Magothy aquifer is used as the primary source of public drinking water in Nassau County. Deep public supply wells screened at 300 to 400 feet below the water table in this aquifer are within a few miles of the Site. Groundwater at the Site generally flows in the southwest direction. Figure 1-1 shows the locations of public supply and Nassau County monitoring/observation wells. The depth to the water table in the Upper Glacial formation is approximately 40 to 50 feet, depending on the season.

There are no surface water bodies within the Site. Several intermittent ponds are located within 0.5 miles of the Site, and are used as recharge basins. Hempstead Lake, located approximately 4 miles southeast of the Site in Hempstead Lake State Park, and Valley Stream, located approximately 5 miles southwest of the Site, are the nearest surface water bodies. On-site runoff is directed towards the on-site dry well. Off-site runoff is directed to a local stormwater collection system that discharges to a stormwater recharge basin located near the Site.

Fumex Sanitation, Inc. operated a commercial termite extermination facility at the Site since 1952. In August 1981, a drum containing less than 30 gallons of chlordane (a common insecticide) rinse water spilled onto the asphalt parking lot behind the Fumex building. The spill entered two stormwater catch basins on the adjacent road (Bedford Ave.) and a dry well in the Site's parking lot. Fumex Sanitation, Inc. also reportedly sprayed its then unpaved parking lot with 1-2% chlordane (typical chlordane level for commercial/residential usage) for insect control from 1952 to 1978. As a result, there is soil and groundwater contaminated with chlordane beneath the Site.

In 1986, the NYSDEC Region 1 office entered into an Order-on-Consent with Fumex Sanitation, Inc. to determine the extent of chlordane in the soil and groundwater at the site and/or evaluate remedial alternatives. In 1989, the Site was included in the Registry on Inactive Hazardous Waste Disposal Sites in New York State.

Contaminants and Pathway of Concern

Soils

Soil contamination by pesticides is present within the Fumex site in excess of NYSDEC soil cleanup guidelines as defined in TAGM HWR-94-4046, dated January 24, 1998. The most significant soil contamination has been identified in soil located within the on-site dry well and within shallow surface soils located immediately below the asphalt pavement to approximately two feet below grade throughout the Fumex site parking lot. The six most frequently detected pesticides included alpha-chlordane, gamma-chlordane, Heptachlor, Dieldrin, 4-4'-DDT, 4-4'-DDE.

The Phase I RI data indicated that shallow soil, from the bottom of the dry well to approximately three feet deep, were contaminated with a number of pesticides at concentrations well in excess of NYSDEC cleanup standards, including: delta-BHC, Heptachlor, Aldrin, alpha-chlordane, and gamma chlordane. Though pesticide concentrations generally decrease within soil samples collected at greater depths below the dry well, there is no consistent trend in decreasing concentrations with increasing soil depth. Pesticides were generally found to exceed NYSDEC soil cleanup standards in soil up to 15 feet below the dry well. Soil from 20 to 25 feet had detectable concentrations of pesticides but no one compound exceeded the soil cleanup guidelines. The sample collected from a depth of 45 to 50 feet below the dry well exhibited delta-BHC, Heptachlor, alpha-chlordane, and gamma-chlordane, all in excess of the NYSDEC soil cleanup standard.

The Phase II RI data indicates relatively high pesticide concentrations (560 to 160,000 ug/kg) within shallow soil samples collected approximately one to two feet below the asphalt pavement of the Fumex site. Concentrations rapidly decrease with increasing depth, with several significant exceptions noted at MW-6. Based on the five Phase II RI sample points, shallow soil throughout the Fumex site parking lot exceed NYSDEC cleanup guidelines for up to nine different pesticide compounds, including Heptachlor, Aldrin, Dieldrin, 4-4'-DDE, Endrin, 4-4'-DDT, alpha-chlordane, gamma-chlordane, Endosulfan II.

Pesticides exceeding NYSDEC cleanup guidelines are also present in deeper soils at several locations including: SB-11 (10 to 27 feet), SB-13 (50-55 feet), SB-14 (10-12 feet) and most significantly at MW-6 (5 to 17 feet). Additionally, most sample locations exhibit an increase in pesticide contamination at or below the water table with soil cleanup guidelines being exceeded for selected pesticides at : SB-11 (45-47 ft), SB-12 45-47 ft), SB-14 (55-57 ft) and at MW-6 (45-47 ft.).

Analysis of soil samples collected from MW-6 for TCL Volatile Organic Compounds and TCL semi-volatile organic compounds indicated only trace detections of 2-butanone (3 ug/kg) and tetrachloroethene (3 ug/kg). The soil sample collected immediately below the asphalt pavement indicated trace levels of several semi-volatile compounds. All volatile and semi-volatile compounds were well below respective NYSDEC cleanup guidelines. Metals analysis indicates all 23 TAL metals to be well below respective NYSDEC soil cleanup guidelines.

The widespread nature of soil contamination identified within the Fumex site would not be indicative of a one-time release of contaminants, such as a spill. The data does suggest that surface soil contamination was the result of numerous releases of various pesticides within the parking lot, possibly occurring over a number of years prior to the area being paved. The presence of pesticides within dry well sediments may have occurred through direct discharge of rinse waters containing the pesticides or possibly runoff from the unpaved parking lot.

The variability of pesticide concentrations within site soil is likely a function of the relatively high soil/water partitioning coefficient of the pesticides and the non-uniform distribution of organic carbon in the glacial sands making up the site soil. TOC analysis of soil samples collected from MW-6 indicate TOC concentrations to be greatest in surface soils and then generally decrease with increasing depth, though TOC increases at 45-47 feet below grade. Due to a high soil/water partitioning coefficient, the pesticides will be relatively immobile in the soil environment and will tend to accumulate in areas of relatively higher TOC.

Groundwater

The Phase II RI groundwater data indicates groundwater contamination by numerous pesticides is present at the Fumex site within the upper zone of the Upper Glacial aquifer. However, offsite migration of this contamination does not appear to have occurred.

Nineteen (19) out of the twenty-one (21) listed TCL pesticides were detected in one or more samples collected from shallow onsite monitoring wells MW-1 through MW-5 during the four sample rounds (two Phase I and two Phase II RI sample rounds). The ten most frequently detected pesticides within shallow groundwater in descending order include gamma-chlordane, alpha-chlordane, 4-4' DDE, Heptachlor Epoxide, Dieldrin, gamma-BHC (Lindane), Heptachlor, 4-4'-DDT, Aldrin, and Endrin.

Out of the 10 most frequently detected pesticides, MW-1 exhibited the highest recorded concentrations for six pesticide compounds, including alpha and gamma-chlordane, with MW-2 accounting for two and MW-3 and MW-5 each accounting for one. Monitoring well MW-1, MW-2 and MW-5 are located west to southwest (downgradient) of the dry well. Though MW-3 is located east of the dry well (upgradient) it is only 14 feet from the dry well manhole cover.

Virtually all positive detections of pesticides collected from onsite shallow well samples exceed the respective NYSDEC Class GA groundwater standard. In the case of the most commonly detected pesticides, such as Heptachlor Epoxide, gamma-chlordane and alpha-chlordane, concentrations exceed the GA standards of 0.04 to 0.05 ug/l by one to three orders of magnitude within onsite shallow groundwater.

Fate and Transport of Pesticides

Currently, the major contaminant transport mechanism at the site is the dispersion of pesticides absorbed to site soils through the infiltration of water either through cracks and porous areas within the asphalt pavement or direct discharge through the onsite dry well. Though in most cases, shallow soil contamination is greater than within the onsite dry well, the dry well is actually serving as the primary transport mechanism for pesticide contamination given onsite precipitation drains through the dry well and into contaminated soil, whereas, the shallow soil is relatively isolated from infiltrating water by the parking lot asphalt pavement. Based on estimated soil/water partitioning coefficients for the majority of pesticides detected in site soils, the pesticides are considered to be immobile or having low mobility within a soil/water environment. Therefore, though dispersion of pesticide contamination is occurring through the infiltration of water, it is occurring at a relatively slow rate.

Based on estimated contaminant velocities within the Upper Glacial aquifer and a highly conservative transport period of 46 years, the six most commonly detected pesticides within site soils would have traveled no further than 146 feet downgradient of the site. In the case of chlordane, the travel distance over this period would be no more than nine feet from the site.

Remedial Action Objectives and Presumptive/Applicable Technologies

RAOs are comprised of medium-specific goals for protecting human health and the environment and focus on the contaminants of concern, exposure routes and receptors, and an acceptable contaminant level or range of levels for each exposure route. A qualitative risk assessment and identification of NYS Standards, Criteria, and Guidelines determine acceptable contaminant routes.

The RAOs established for the Fumex Site include:

1. Treat or remove the principal threat posed by the Site to groundwater and potential impacts to downgradient users.

2. Isolate or remove the contaminated material in order to provide protection to human health from direct contact or ingestion of hazardous constituents in wastes or surface soil at the Site.

3. Prevent infiltration of water through the surface soil and subsequent percolation into the subsurface soil and groundwater.

Based on the data obtained from the Phase I and II RI activities and in accordance with the focused FS approach, a limited number of media specific remedial remedies are identified. The remedies are listed below according to the RAOs addressed by that remedy.

The first RAO for the Site can be addressed by the removal of surface and subsurface soils where contaminants of concern are prevalent according to RI data. Removal can be accomplished by excavation of soils to specified depths. By removing the source of pesticide contamination, groundwater contamination and human interaction would be minimized. Soils accumulated during the excavation activities would be disposed of in a RCRA approved off-site disposal facility.

Associated with excavation are the abandonment and eventual removal of the on-site dry well. Since the dry well serves as a point source of subsurface and groundwater contamination, its abandonment and removal would minimize the risk associated with contamination.

Another treatment technology that meets the first RAO would be the installation and implementation of a groundwater pump and treat system. The system would consist of one extraction well, two liquid activated carbon treatment vessels, and associated piping and fittings. Spent carbon would be treated off-site and replenished by the manufacturer. Treated effluent would be discharged to a local reinforced concrete pipe (RCP) storm drain.

The second and third RAOs can be accomplished by providing an additional impermeable membrane to prevent infiltration of surface water through the surface and subsurface soil and into the groundwater. This would minimize groundwater contamination as runoff water is collected in a catch basin and subsequently diverted through a drain pipe and into a local storm drain. The cap would isolate the contaminated media from public exposure and thus reducing the potential for ingestion and direct contact. The surface runoff drain installed at the Site would direct runoff water into an adjacent storm drain. The impermeable membrane along with an asphalt cap would be placed following excavation of affected surface and subsurface soils.

Evaluation of Alternatives

The four alternatives for remediation developed through the screening process are:

Alternative 1: No Further Action, Institutional Controls, and Groundwater Monitoring;

Alternative 2: Dry Well Abandonment and Associated Surface Runoff Basin and Drain Installation, Repair of the Existing Asphalt Surface, and Groundwater and Site Monitoring;

Alternative 3: Institutional Controls, Excavation of All Surface Soil, Dry Well Abandonment and Associated Surface Runoff Basin and Drain Installation, Impermeable Cap, and Groundwater Monitoring;

Alternative 4: Excavation of All Surface Soil, Excavation of the Dry Well Trench, Dry Well Abandonment and Associated Surface Runoff Basin and Drain Installation, Impermeable Cap, and Groundwater Monitoring.

Alternative 1

The No Action Alternative, which includes institutional controls, does not treat or reduce the site contaminants, but does reduce the potential for human exposure to the contaminants. Long-term groundwater monitoring would track any migration of the contaminants in the future. The institutional controls do not actively reduce the volume or toxicity of the contaminants found at the site, but only prevent exposure to contaminants. On the other hand, natural attenuation, dispersion and dilution will decrease the contaminant concentration in the groundwater over time.

Institutional controls are not labor intensive or difficult to implement. They are technically feasible to implement and delays are not expected. Minimum coordination is expected for agency approvals. Groundwater monitoring can be readily performed on a quarterly basis using the existing Nassau County groundwater monitoring or public supply wells.

Alternative 2

Alternative 2 consists of the abandonment and removal of the on-site dry well, installation of a catch basin in place of the dry well, installation of a RCP drain from the basin to a local storm drain, repair of the parking lot asphalt surface, and implementation of a groundwater monitoring program.

Since no treatment technologies are involved, Alternative 2 does not significantly reduce the volume or toxicity of the contaminants at the Site. Human health and environmental exposures are minimized by the partial removal of the source of contamination via dry well abandonment. The repair of the parking lot asphalt surface to patch all cracks and fissures reduces groundwater impact from infiltration of surface runoff. The new catch basin and associated drain pipe would divert runoff water into a local storm drain. Natural processes, such as attenuation, dispersion, and biodegradation, will dilute the concentration of the contaminants. Groundwater monitoring would be implemented to evaluate the potential off-site migration of contaminants and observe changes in Site conditions, including inspection of the asphalt surface.

Remedial actions in Alternative 2 could be readily implemented with available materials and workers. Light construction equipment would be necessary to remove the dry well, place the new catch basin, create piping trenches, and provide backfill and compaction. Specialized equipment would be necessary to pave the parking lot surface with new asphalt. Multiple vendors are available to bid on the project and to provide the materials and equipment. Limited agency contact is anticipated. Groundwater monitoring is standard and easy to implement.

Alternative 3

Alternative 3 includes provision for institutional controls, excavation of the top 18 inches of soil layer over the entire parking lot area, disposal of the excavated material to an off-site RCRA-approved facility, backfill of excavated area with clean soil, abandonment and removal of the on-site dry well, installation of a catch basin in place of the dry well, installation of a RCP drain from the basin to a local storm drain, installation of an impermeable membrane/asphalt cap, and implementation of a groundwater monitoring program.

Subsurface soil would be left undisturbed. This alternative would minimize human and environmental exposure to Site contaminants by removing the sources of contamination via excavation and dry well abandonment. With the main sources removed and with the installation of an impermeable membrane/asphalt cap, the potential impact to groundwater would be minimized as infiltration is eliminated. The new catch basin would collect surface runoff and the associated RCP line would divert the clean runoff to an existing storm drain located just outside of the Site. The groundwater monitoring program would be implemented to track potential future migration of contaminants and to evaluate changes in groundwater condition over time.

Surface soil excavation and dry well removal are relatively simple to implement. An on-site staging area would be necessary to place excavated soil prior to transport, treatment, and disposal. The impermeable cap and the surface runoff basin and drain installation and construction would need additional coordination and set-up effort since both field activities require readily available equipment, materials, and labor. Limited agency coordination for all field work is anticipated. Numerous vendors are available to bid on the project and to provide materials and equipment. Groundwater monitoring is standard and simple to implement.

Alternative 4

Alternative 4 combines the excavation of the top 18 inches of soil layer over the entire parking lot area, excavation of a 20 feet by 60 feet trench within the location of soil boring SB-11, the dry well, and monitoring well MW-6, disposal of the excavated material to an off-site RCRA-approved facility, backfill of excavated area with clean soil, abandonment and removal of the on-site dry well, installation of a catch basin in place of the dry well, installation of a drain pipe from the basin to a local storm drain, installation of an impermeable membrane/asphalt cap, and implementation of a groundwater monitoring program.

Alternative 4 combines several identified feasible remedial options to bring an enhanced level of exposure prevention and Site remediation. It is anticipated that greater costs would be associated with this significantly larger remediation effort. This alternative minimizes human and environmental exposure by removing the main sources of contamination via surface and subsurface soil excavation and dry well abandonment. Excavation of subsurface soil, in areas with elevated pesticide levels, offers additional reduction in potential public exposure during Site development. The placement of an impermeable membrane/asphalt cap and the installation of a surface runoff catch basin prevent infiltration. As a result, the potential adverse impact to groundwater quality would be minimized.

Alternative 4 requires increased coordination of field activities. Not only do the impermeable cap and catch basin constructions require full inspection, but also the deeper, subsurface excavation would require additional supervision. An on-site staging area would be required to place removed soils prior to transport and disposal. Alternative 4 would require more agency interaction for the duration of field activities. Numerous vendors are available to bid on the project and to provide materials and equipment. Groundwater monitoring is standard and simple implement.

Recommendation of Alternative

Seven criteria (as discussed in The Technical and Administrative Guidance Memorandum) were used to perform a detailed analysis of the four alternatives. These were: compliance with Applicable or Relevant and Appropriate Requirements (ARARs); protection of human health and the environment; short term effectiveness; long term effectiveness and permanence; reduction of toxicity, mobility, or volume; implementability; and cost. The alternatives varied widely in the cost to construct and operate. Alternative 1 was the least expensive technology, with a present worth cost of approximately $70,000. Alternative 4, which is the only alternative that involves the removal of surface and subsurface soils, was the most expensive of the four technologies. The present worth cost for this alternative is approximately $1.8 million. The present worth cost for Alternative 2 was approximately $200,000. The present worth cost for Alternative 3 was roughly $675,000.

Alternative 1 was not selected because it does not sufficiently address the protection of human health and the environment. Alternative 2 provides a greater protection of human health and the environment by partially removing the source of contamination, but it remains inadequate in offering protection during future Site development or usage. Alternative 2 therefore is not selected. Alternatives 3 and 4 provide a significant reduction in human health and environmental risks as they include the removal of the major sources of contamination. In addition, these two alternatives greatly reduce contaminant toxicity and the potential of contaminant mobility. Alternative 4 involves an additional technology to reduce exposure risks, although at a significantly greater cost. This additional benefit is relatively small when compared to the overall cost and benefit of Alternative 3. As a result, Alternative 3 is recommended over Alternative 4. Alternative 3 is the recommended alternative remedial action at the Fumex Sanitation, Inc. site.

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1.1 Introduction

Camp Dresser & McKee (CDM) has been retained by the New York State Department of Environmental Conservation (NYSDEC) to prepare a Feasibility Study (FS) Report for the Fumex Sanitation, Inc. site (the "Site") under the New York State Superfund Standby Contract (Work Assignment #D002925-22). This FS Report discusses the basis and procedures used in identifying remedial alternatives that address contamination at the Fumex site. The purpose of the FS is to select a feasible, cost-effective remedial alternative that protects public health and the environment from the potential risks posed by contamination at the Site.

Several presumptive remedial actions are potentially applicable in the remediation of the Site. Presumptive remedies are preferred technologies for common categories of sites, based on historical patterns of remedy selection and EPA/NYSDEC scientific and engineering evaluation of performance data on technology application. Presumptive remedies for soil and groundwater contamination for this FS include surface and subsurface soil removal via excavation, groundwater treatment and monitoring, and capping to prevent infiltration.

A feasible remedy is one that is suitable to site conditions, capable of being successfully carried out with available technology, and that considers, at a minimum, implementability and cost effectiveness. The use of presumptive remedy guidance can, in this case, provide an immediate focus to the discussion and selection of alternatives. It can help to speed the process by limiting the number of effective alternatives to those technologies that have been selected in the past at similar sites or for similar contaminants. By evaluating technologies that have been consistently selected at similar sites, a presumption can be developed that a particular remedy or set of remedies is appropriate for this specific type of site.

Using this presumptive remedy approach, a limited number of media specific technologies, including any identified presumptive remedies, are identified. Specific technologies may not be applicable to the treatment of contamination in the concentration and form found at the site, or may be impractical due to site constraints and can be eliminated from further consideration. The remaining technologies can then be assembled into a limited number of site-wide remedial alternatives that are subsequently subjected to a detailed, comparative evaluation.

Section 1 of this report begins with a description and background of the Site and details the nature and extent of the contamination, including potential exposure pathways. The Remedial Action Objectives (RAOs) of this FS are discussed in Section 2. A summary of the technologies investigated for remediation of the shallow subsurface (surface) soil, subsurface soil, and groundwater media at the Site are presented in Section 3, followed by a detailed discussion of the development of the four alternatives in Section 4. Section 5 details a comparative analysis of the four alternatives that were evaluated. Section 6 presents a recommended alternative based on the information contained in the previous sections.

1.2 Site Description and Background

The Site is located at 131 Herricks Road in New Hyde Park, Nassau County, New York (see Figure 1-1) and encompasses approximately one third acre of land. It includes a one-story masonry and metal frame building with no basement (see Figure 1-2). Bounded on the north and east by Bedford Avenue and Herricks Road, respectively, the area surrounding the Site consists of industrialized/commercial properties as well as residential properties south and west of the Site.

The Site lies on a relatively flat and gentle topography with a slight increase in elevation to the east and west as a result of drainage improvements on-site and within nearby roadways. Of the three water-producing aquifers within this region, only water pumped from the Upper Glacial and the deep Magothy aquifers are used. The Jamaica Water Supply Co. extracts a minimal amount of water from the Upper Glacial aquifer along the Nassau/Queens border (approximately 5-10 miles from Site) for industrial usage. The deep Magothy aquifer is used as the primary source of public drinking water in Nassau County. Deep public supply wells screened at 300 to 400 feet below the water table in this aquifer are within a few miles of the Site. Groundwater at the Site generally flows in the southwest direction. Figure 1-3 shows the locations of public supply and Nassau County monitoring/observation wells. The depth to the water table in the Upper Glacial formation is approximately 40 to 50 feet, depending on the season.

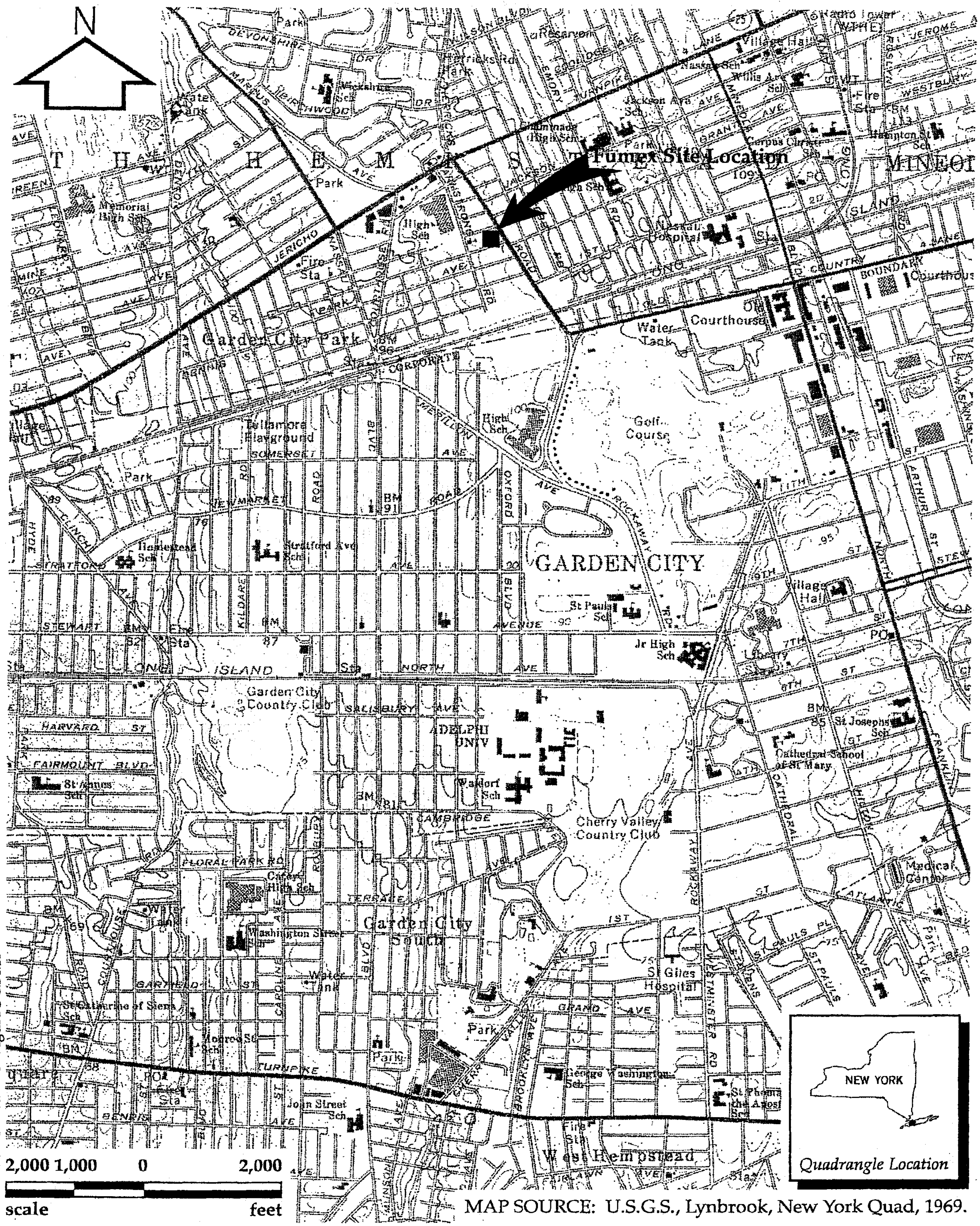
There are no surface water bodies within the Site. Several intermittent ponds are located within 0.5 miles of the Site, and are used as recharge basins. Hempstead Lake, located approximately 4 miles southeast of the Site in Hempstead Lake State Park, and Valley Stream, located approximately 5 miles southwest of the Site, are the nearest surface water bodies. On-site runoff is directed towards the on-site dry well. Off-site runoff is directed to a local stormwater collection system that discharges to a stormwater recharge basin located near the Site (Lawler, Matusky & Skelly, 1989).

Fumex Sanitation, Inc. operated a commercial termite extermination facility at the Site from 1952 to 1992. In August 1981, a drum containing less than 30 gallons of chlordane (a common insecticide) rinse water spilled onto the asphalt parking lot behind the Fumex building. The spill entered two stormwater catch basins on the adjacent road (Bedford Ave.) and a dry well in the Site's parking lot. Fumex Sanitation, Inc. also reportedly sprayed its then unpaved parking lot with 1-2% chlordane (typical chlordane level for commercial/residential usage) for insect control from 1952 to 1978. As a result, there is soil and groundwater contaminated with chlordane beneath the Site.

In 1986, the NYSDEC Region 1 office entered into an Order-on-Consent with Fumex Sanitation, Inc. to determine the extent of chlordane in the soil and groundwater at the site and/or evaluate remedial alternatives. In 1989, the Site was included in the Registry on Inactive Hazardous Waste Disposal Sites in New York State.

1.3 Contaminants of Concern

Environmental samples were collected and analyzed following the Order-On-Consent and during the Remedial Investigation (RI) activities to determine the nature and extent of contamination at the Site. Two on-site monitoring wells (MW-1 and MW-2) were installed and sampled in 1984. Three



MAP SOURCE: U.S.G.S., Lynbrook, New York Quad, 1969.

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Figure 1-1
Location Map
Feasibility Study, Fumex Site - New Hyde Park, New York

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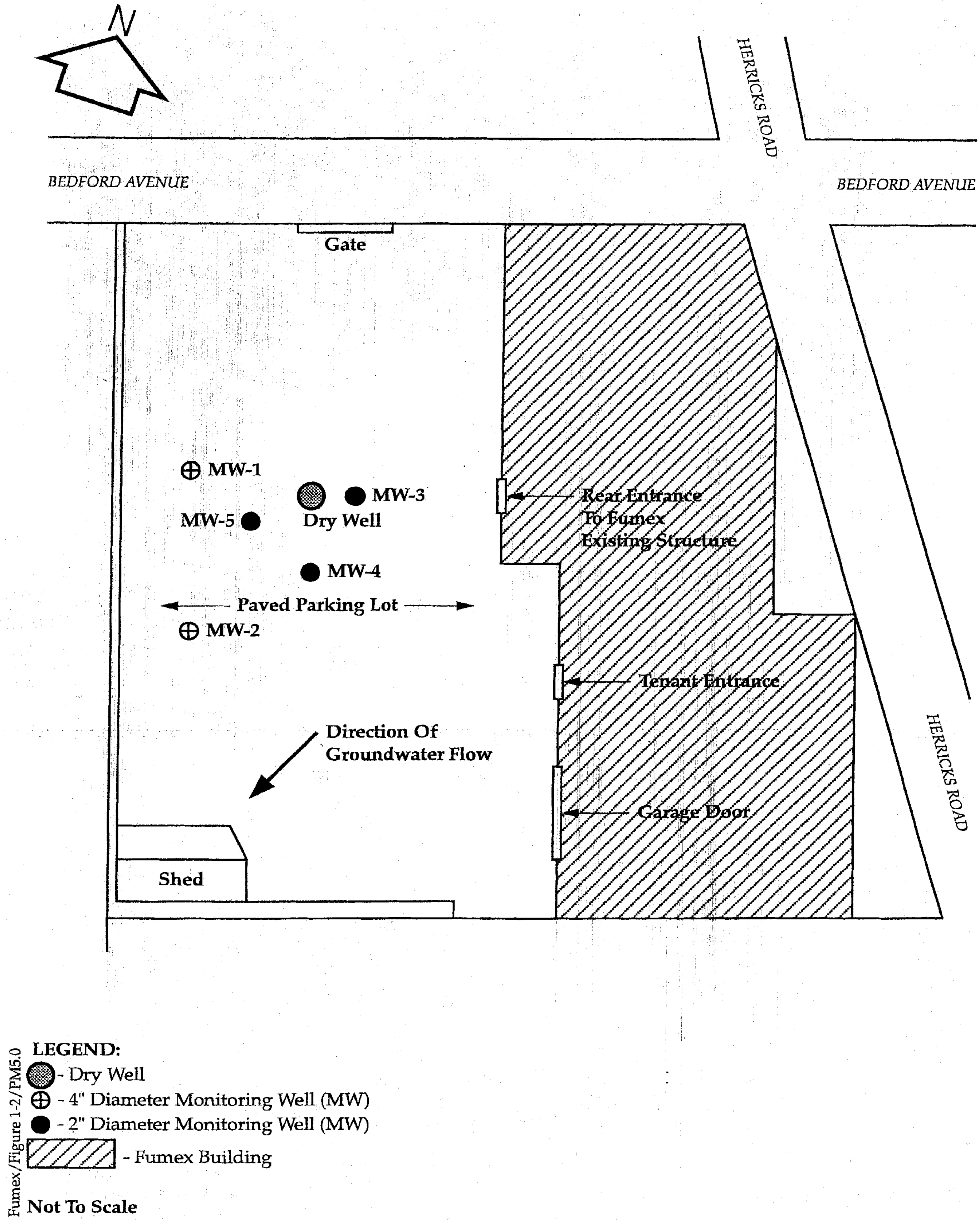

Figure 1-2
Site Map
Feasibility Study, Fumex Site - New Hyde Park, New York

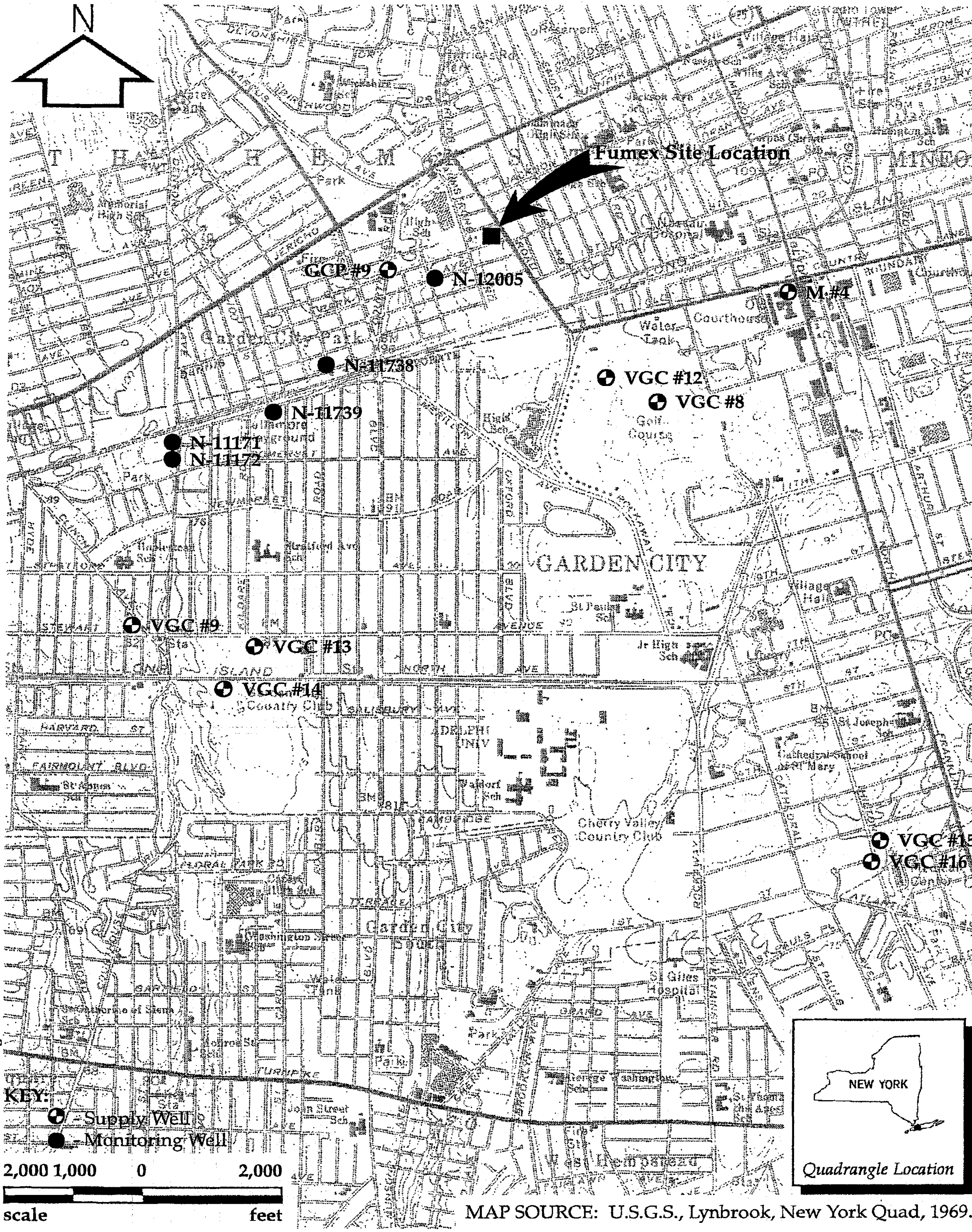

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Figure 1-3
Public Supply Wells And Nassau County Monitoring Wells
Feasibility Study, Fumex Site - New Hyde Park, New York

CDM Camp Dresser & McKee

additional on-site monitoring wells (MW-3, -4, and -5) were installed and sampled twice in 1986. A total of 11 groundwater samples were collected from the five on-site wells. A total of 19 soil samples was collected during the installation of the monitoring wells. An additional investigation performed in 1989 concluded that no airborne pesticides were present.

Phase I RI activities included several rounds of field sampling. A round of sampling in March 1996 included the collection of four sediment samples at varying depths from the on-site dry well and five groundwater samples collected from MW-1 to MW-5. In August 1996, a second round of sampling consisted of five groundwater samples collected from MW-1 to MW-5. In November 1996, a groundwater sample was taken from an off-site monitoring well downgradient of the groundwater flow.

In 1998, Phase II RI activities included surface soil sampling, five on-site soil borings (SB-10 to SB-14), the installation of one additional on-site (MW-6) and six off-site (MW-7D, -7S, -8D, -8S, -9D, and -9S) monitoring wells, and two rounds of groundwater sampling. Figure 1-4 shows the locations of the off-site groundwater monitoring wells. Six surficial soil samples (from immediately below the asphalt pavement to approximately two feet below grade) were collected. Seven subsurface soil samples (greater than two feet depth) per boring were collected during the five borings and the on-site monitoring well installation activities. A total of 50 soil samples were collected.

Groundwater monitoring well installation included one on-site deep well and three off-site well clusters, as mentioned above. Each cluster consisted of one shallow (50-foot depth) and one deep (125-foot depth) well. One well cluster is located north and upgradient of the Site and the other two are placed south and downgradient of the Site. Groundwater sampling events took place in early June 1998 and in late September 1998. Groundwater samples were collected from 17 monitoring wells, including the seven newly installed wells, the existing five on-site wells, and five off-site Nassau County observation wells.

Sample analytical results for all media are presented in detail in the RI reports and are not reproduced for this FS report. All samples were analyzed for TCL Pesticides. Soil samples taken from the additional on-site monitoring well installation (MW-6) were also analyzed for TAL Metals, Volatile and Semi-Volatile Organic Compounds, and Total Organic Carbon. Only contaminants that have been identified as cause of concern for the environment, or health and human safety are summarized in this section. Based upon the detected compounds in each medium, a screening process was used to determine the contaminants of concern. All constituents detected above the relevant New York State Standards, Criteria, and Guidelines (NYS SCGs) in soil and groundwater samples were designated as contaminants of concern (COC). All compounds below the NYS SCGs were screened out. The COCs are listed in Table 1-1 (surface soil), Table 1-2 (subsurface soil), Table 1-3 (dry well sediment), and Table 1-4 (groundwater).

Table 1-1 shows that shallow subsurface or surface soil contains pesticide concentrations that exceed their respective NYS SCGs. This list of pesticides represents the contaminants of concern for surface soil. In general, all minimum pesticide concentrations exceed the NYS SCGs except for 4,4'-DDE and 4,4'-DDT. Alpha- and gamma-chlordane have the highest detected pesticide concentrations on-site: approximately three orders of magnitude higher than their corresponding NYS SCG. The consistent occurrences of pesticides exceeding NYS SCGs indicate surface soil throughout the Site is most likely

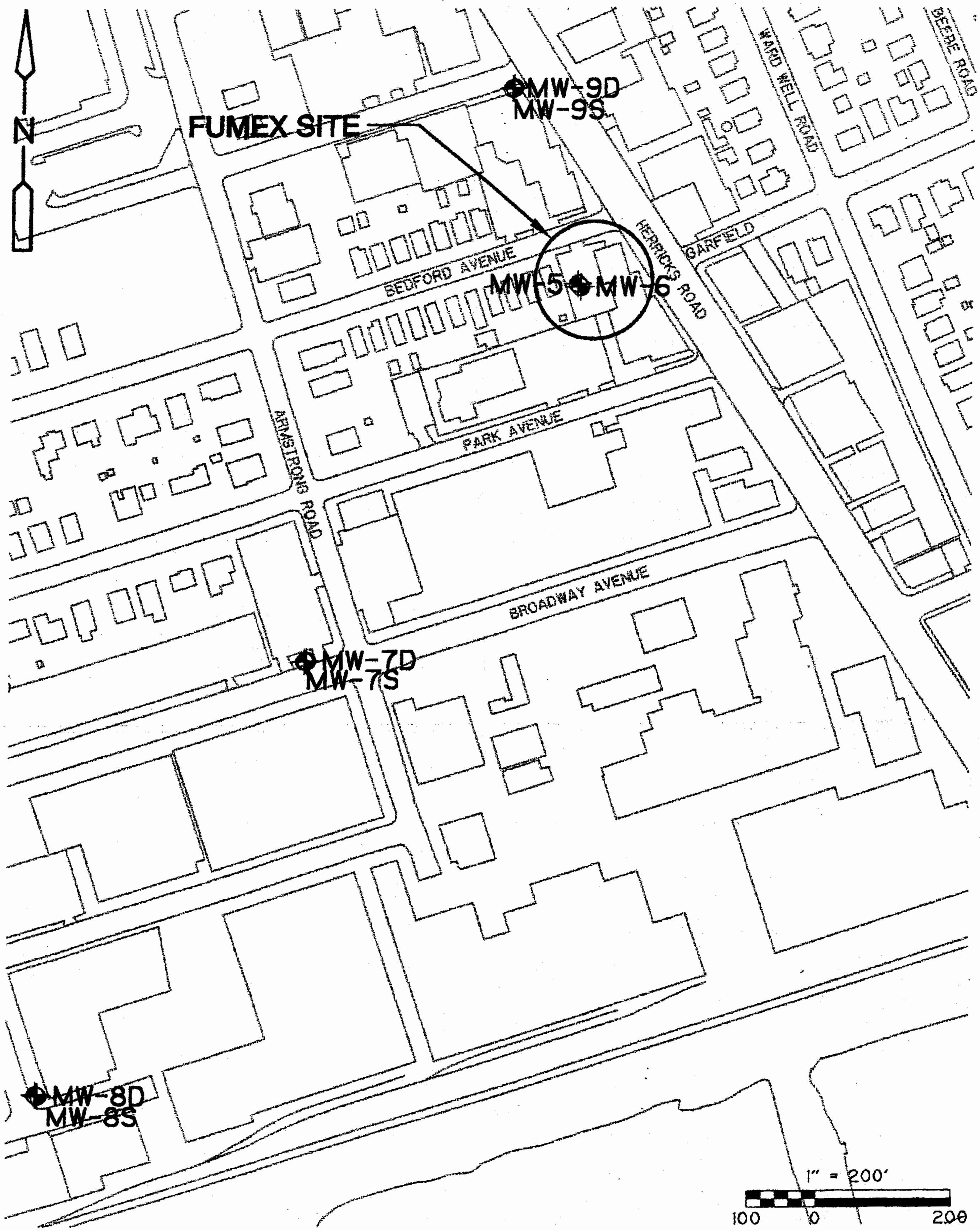

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Figure 1-4
Off-Site Monitoring Wells Locations
Feasibility Study, Fumex Site - New Hyde Park, New York

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Table 1-1
Contaminants of Concern - Surface Soil
Fumex Sanitation, Inc. Feasibility Study
New Hyde Park, New York

All results are reported in ug/kg or as parts per billion (ppb)

Parameter	NYS SCG (1) (2)	Range of Detected Concentrations Minimum - Maximum	Location of Maximum Concentration	Number of Detections	Total Number of Samples	% Detections
Pesticides						
Heptachlor	100	640 - 36,000	SB-12	39	50	78
Aldrin	41	320 - 1,500	SB-12	9	50	18
Endosulfan I	900	930	SB-12	6	50	12
Heptachlor Epoxide	20	8,200	SB-13	6	50	12
Dieldrin	44	720 - 17,000	SB-13	32	50	64
4,4'-DDE	2,100	96 - 14,000	SB-11	22	50	44
Endrin	100	1,600 - 2,200	SB-11	7	50	14
Endosulfan II	900	990 - 2,600	SB-12	6	50	12
4,4'-DDT	2,100	320 - 28,000	SB-11	26	50	52
alpha - chlordane	540	2,500 - 120,000	SB-11, SB-12	48	50	96
gamma - chlordane	540	3000 - 160,000	SB-12	47	50	94

Notes:

QA/QC______

(1) NYSDEC TAGM, HWR-94-4046, January 24, 1994
(2) NYSDEC criteria specified in this table is based on soil organic content of 1%
Surface soil is defined as the top 18 inches of soil beneath the asphalt pavement.

contaminated. No volatile organic compounds (VOCs) and semi-volatile organic compounds (SVOCs) were detected above the soil cleanup standards.

Table 1-2 indicates that subsurface soil at the Site is contaminated with pesticides at levels above the NYS SCGs. Pesticides with elevated concentrations include Heptachlor, Aldrin, Heptachlor epoxide, Dieldrin, Endrin, 4,4'-DDT, alpha- and gamma-chlordane. VOCs, SVOCs, and metals detected in subsurface soils are below their respective NYS SCGs. Although Table 1-2 shows that maximum pesticide levels occur at the monitoring well MW-6 area, Phase I and II RI reports indicate that high concentrations of alpha- and gamma-chlordane, Dieldrin, Heptachlor, and 4,4'-DDT are also present in subsurface soil in the vicinity of soil borings SB-11 and SB-14.

Table 1-3 lists the analytical results for the on-site dry well sediment samples collected at various depths. As discussed in the Phase I and II RI reports, the highest concentrations of pesticides occur in the shallow sediments of the dry well (1-3 feet). Pesticide levels in the soil beneath the dry well generally decrease with depth. However, higher pesticide concentrations were detected below the water table at a depth of approximately 57-ft below the parking lot. Pesticides are present at levels exceeding their respective NYS SCGs in all samples taken except at a depth of 20-22 feet below the bottom of the dry well.

Table 1-4 presents the contaminants of concern detected in groundwater samples collected from on-site monitoring wells. All minimum pesticide levels exceed the NYS SCGs except for Heptachlor, Endosulfan I (no standard), 4,4'-DDE, Endosulfan II (no standard), and gamma-chlordane.

1.4 Nature and Extent of Contamination

This section presents a brief summary of the nature and extent of contamination. A more detailed description is provided in the Phase I and II RI reports.

1.4.1 Surface Soil

Phase II RI data indicate widespread and relatively high pesticide concentrations within shallow soil samples collected approximately one to two feet below the asphalt pavement of the Site. As presented in the Phase II RI Report, concentrations rapidly decrease with increasing depth, with several exceptions noted at MW-6. Pesticide concentrations within the shallow soil samples collected from the parking lot area are generally greater than the pesticide concentrations observed within the dry well sediments.

The widespread nature of the contamination is not indicative of a one-time release of contaminants. More likely, it is a result of numerous and continuous pesticide releases over a number of years prior to the paving of the parking lot area. Sources of contamination may be attributed to the routine cleaning of pesticide-laden equipment, storage containers, or regular pesticide application to the unpaved parking lot between 1952 and 1978 as reported by the property owners. However, chlordane was the only pesticide reportedly applied to this area, whereas numerous pesticides were detected within site soils.

Table 1-2
Contaminants of Concern - Subsurface Soil
Fumex Sanitation, Inc. Feasibility Study
New Hyde Park, New York

All results are reported in ug/kg or as parts per billion (ppb)

Parameter	NYS SCG (1) (2)	Range of Detected Concentrations Minimum - Maximum	Location of Maximum Concentration	Number of Detections	Total Number of Samples	% Detections
Pesticides						
Heptachlor	100	0.9 - 17,000	MW-6, 10-12 ft	39	50	78
Aldrin	41	1 - 970	MW-6, 10-12 ft	9	50	18
Heptachlor Epoxide	20	5 - 1,700	MW-6, 10-12 ft	6	50	12
Dieldrin	44	1.7 - 17,000	MW-6, 10-12 ft	32	50	64
Endrin	100	2.4 - 780	MW-6, 10-12 ft	7	50	14
4,4'-DDT	2,100	2.5 - 4,100	MW-6, 10-12 ft	26	50	52
alpha - chlordane	540	2.6 - 41,000	MW-6, 10-12 ft	48	50	96
gamma - chlordane	540	3 - 48,000	MW-6, 10-12 ft	47	50	94

Notes:

QA/QC______

(1) NYSDEC TAGM, HWR-94-4046, January 24, 1994
(2) NYSDEC criteria specified in this table is based on soil organic content of 1%
Subsurface soil is defined as the soil layer with depths greater than 18 inches below the asphalt pavement.

Table 1-3

Contaminants of Concern - Dry Well Sediment

Fumex Sanitation, Inc. Feasibility Study

New Hyde Park, New York

All results are reported in ug/kg or as parts per billion (ppb)

Parameters	NYS SCG (1) (2)	Depth Below the Bottom of the Dry Well (feet)			
		1-3	10-12	20-22	45-47
Pesticides					
delta-BHC	300	**5,400**	**2,800**	40	**670**
Heptachlor	100	**1,700**	**6,400**	47	**320**
Aldrin	41	**1,100**	**830**	ND<38	ND<240
alpha-chlordane	540	**26,000**	**16,000**	530	**2,600**
gamma-chlordane	540	**30,000**	**14,000**	510	**2,800**

Notes:

QA/QC______

(1) NYSDEC TAGM, HWR-94-4046, January 24, 1994

(2) NYSDEC criteria specified in this table is based on soil organic content of 1%

ND<38 = Not Detected at or above the Contract Required Quantitation Limit (CRQL)

Table 1-4
Contaminants of Concern - Groundwater
Fumex Sanitation, Inc. Feasibility Study
New Hyde Park, New York

All results are reported in ug/L or as parts per billion (ppb)

Parameter	NYSDEC (1)	Range of Detected Concentrations Minimum - Maximum	Location of Maximum Concentration	Event and Sampling Date of Maximum Concentration
Pesticides				
beta-BHC	0.04	0.12	MW-1	Phase II, Round 1, 6/2/98
delta-BHC	0.04	0.14 - 2.2	MW-2	Phase I, Round 1, 3/20/96
gamma-BHC(Lindane)	0.05	0.08 - 0.87	MW-3	Phase I, Round 2, 8/27/96
Heptachlor	0.04	0.03 - 0.5	MW-5	Phase I, Round 1, 3/20/96
Aldrin	ND	0.04 - 0.33	MW-1	Phase II, Round 1, 6/2/98
Endosulfan I	NS	0.09 - 0.93	MW-2	Phase I, Round 1, 3/20/96
Heptachlor Epoxide	0.03	0.11 - 0.61	MW-2	Phase I, Round 1, 3/20/96 and Phase I, Round 2, 8/27/96
Dieldrin	0.00	0.2 - 4.3	MW-2	Phase I, Round 2, 8/27/96
4,4'-DDE	0.20	0.06 - 0.83	MW-1	Phase II, Round 1, 6/2/98
Endrin	ND	0.09 - 2.9	MW-2	Phase I, Round 1, 3/20/96
Endosulfan II	NS	0.06 - 1.4	MW-1	Phase II, Round 1, 6/2/98
4,4'-DDT	0.20	0.08 - 1.3	MW-1	Phase II, Round 1, 6/2/98
alpha - chlordane	0.05	0.45 - 18	MW-1	Phase II, Round 1, 6/2/98
gamma - chlordane	0.05	0.03 - 16	MW-1	Phase II, Round 1, 6/2/98

Notes:
(1) NYSDEC Standard for Class GA Water
NS = No Standard
ND = Non detect

QA/QC______

Based on the five Phase II RI sample points (SB-10 to SB-14), shallow soil throughout the Fumex site parking lot exceed NYSDEC cleanup guidelines for nine different pesticide compounds, including:

- Heptachlor
- Aldrin
- Dieldrin
- 4-4' DDE
- Endrin
- 4-4'-DDT
- alpha-chlordane
- gamma-chlordane
- Endosulfan II

Figures 1-5 to 1-7 show the surface and subsurface soils pesticide contamination in multiples of the TAGM 4046 cleanup standards.

1.4.2 Subsurface Soil

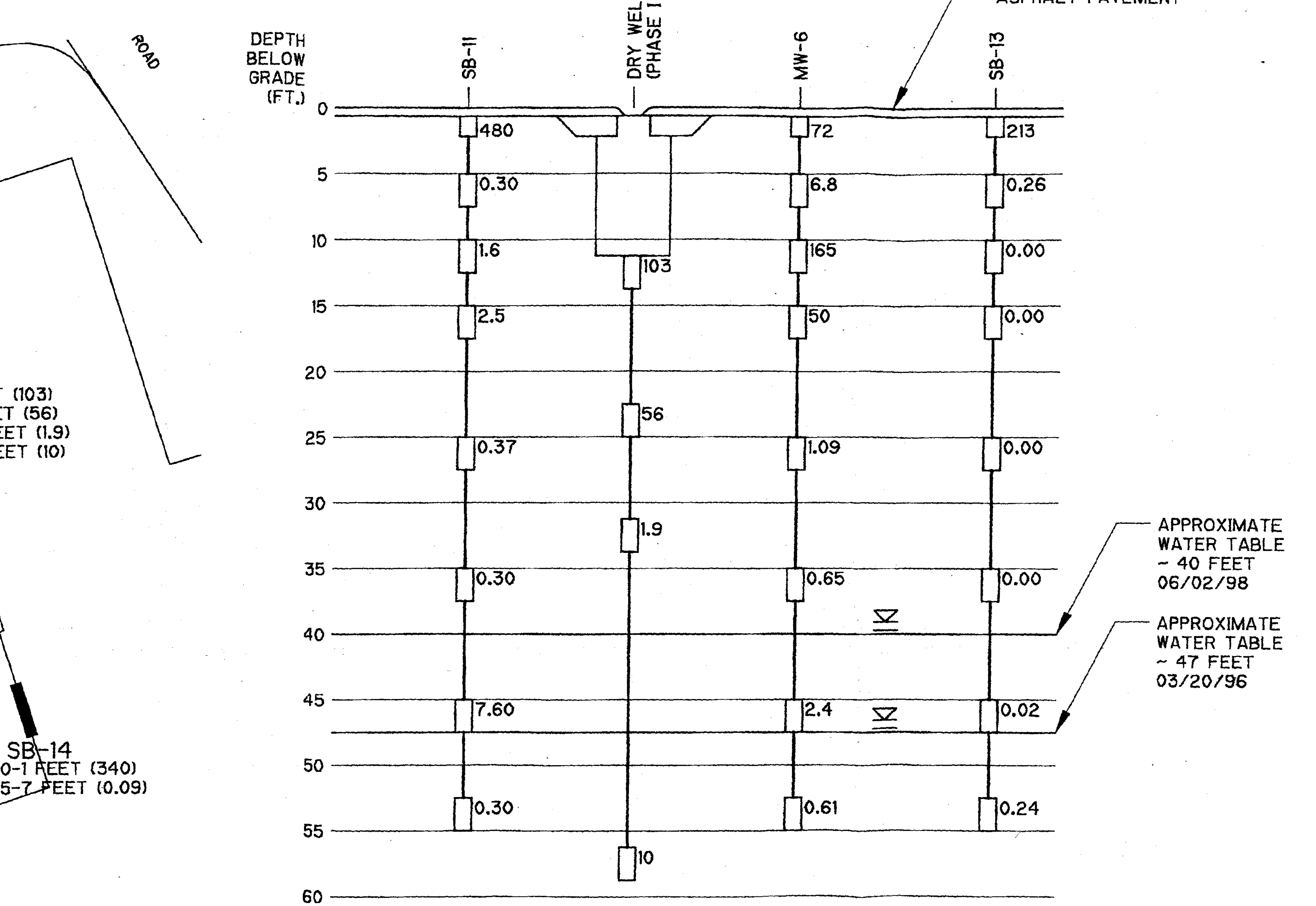
Pesticide levels exceeding NYSDEC cleanup standards are also present in deeper soils at several locations, including:

- Dieldrin and alpha- and gamma- chlordane in SB-11 (10 to 27 feet)
- Dieldrin and Heptachlor in SB-14 (10 to 12 feet)
- Dieldrin, Heptachlor, Heptachlor epoxide, 4,4'-DDT, alpha- and gamma-chlordane at MW-6 (5 to 17 feet)

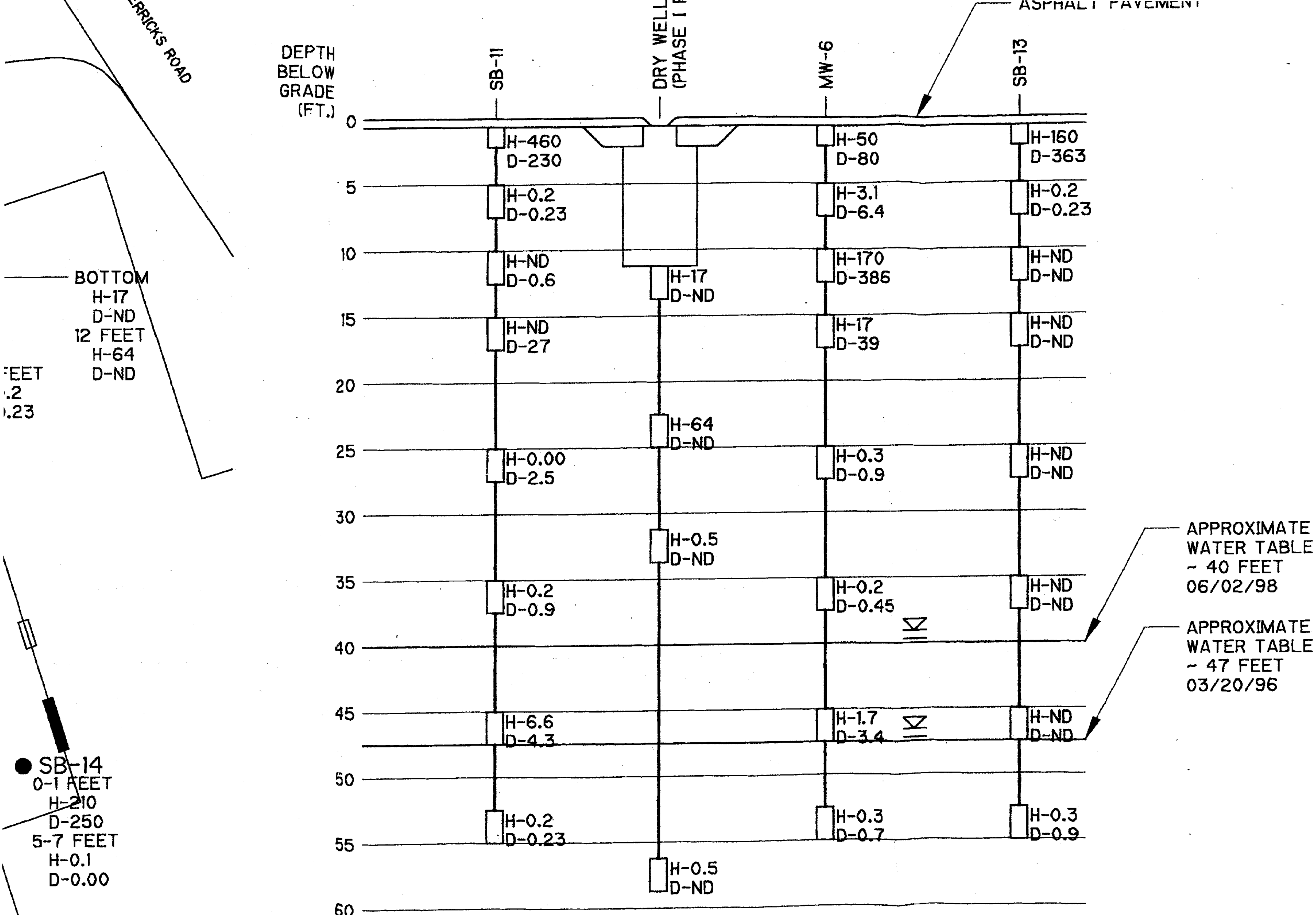
In addition, pesticide concentrations appear to increase to levels above the NYS SCGs at or below the water table in SB-11 (45-47 feet), SB-12 (45-47 feet), SB-14 (55-57 feet) and at MW-6 (45-47 feet). The reason for the apparent increase in the pesticide concentrations at and below the water table is not clear. However, total organic carbon (TOC) analysis of samples collected from MW-6 does show an increase in TOC at 45-47 feet compared to TOC from samples collected from depths ranging from 10 to 37 feet below grade. It is likely that the higher TOC results in a greater sorbtive capacity within soils at or immediately below the water table with corresponding increases in pesticide concentrations.

Six pesticide compounds detected at levels exceeding the NYS SCGs in subsurface soil above the water table include:

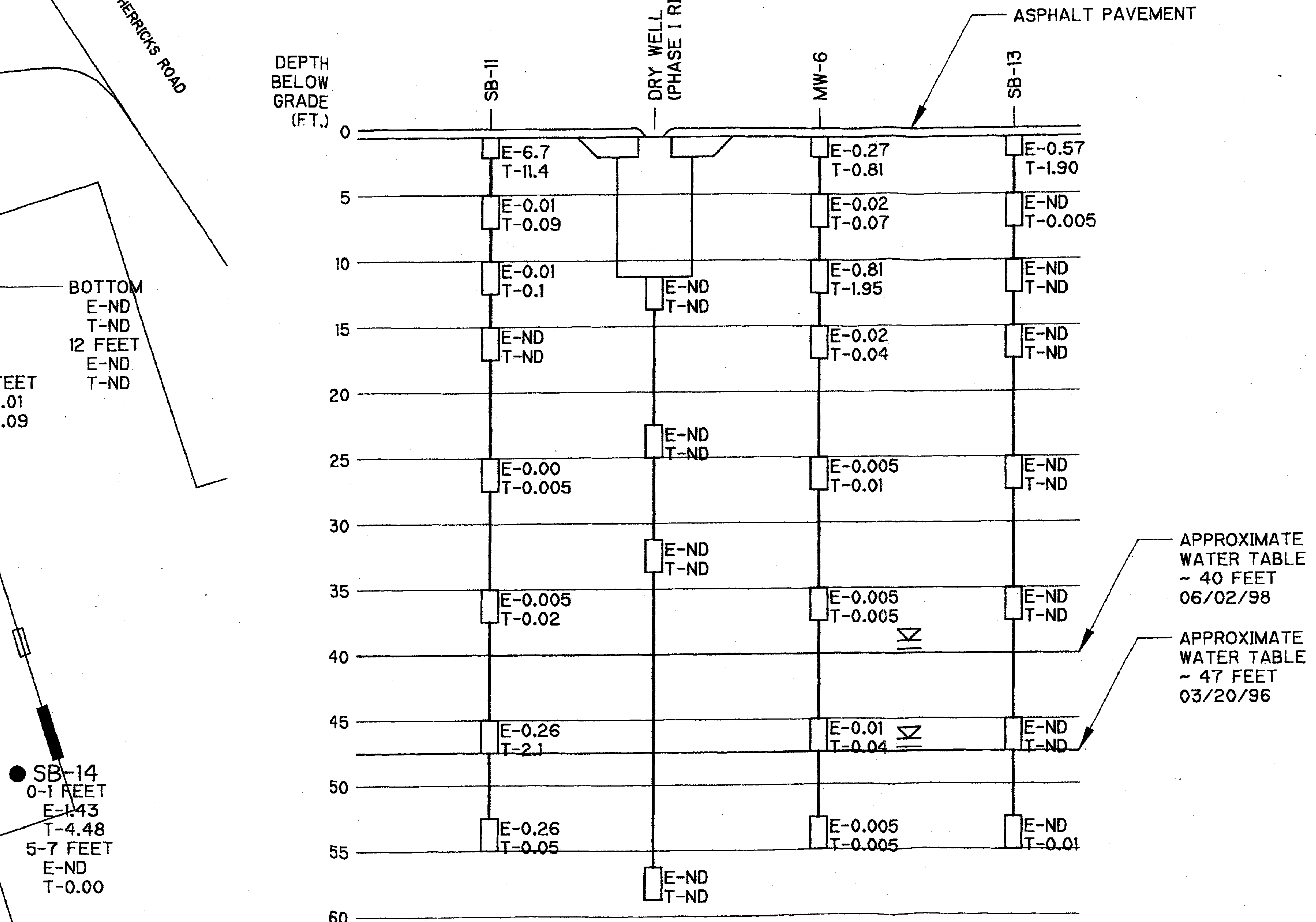
- Heptachlor
- Heptachlor epoxide
- Dieldrin
- 4,4'-DDT
- alpha-chlordane
- gamma-chlordane



NOTE:
NYSDEC SOIL CLEANUP STANDARDS:
ALPHA-CHLORDANE = 0.54 PPM
GAMMA-CHLORDANE = 0.54 PPM



NOTE:
H = HEPTACHLOR
D = DIELDRIN
VALUES SHOWN ARE IN PPM
NYSDEC CLEANUP STANDARDS:
HEPTACHLOR = 0.100 PPM
DIELDRIN = 0.044 PPM



NOTE:
E = 4-4'-DDE
T = 4-4'-DDT
VALUES SHOWN ARE IN PPM
NYSDEC CLEANUP STANDARDS:
4-4'-DDE = 2.1 PPM
4-4'-DDT = 2.1 PPM

Pesticide constituents are also present within the subsurface dry well sediments. The presence of pesticides within dry well sediments may have occurred through direct discharge of rinse water containing the pesticides or runoff from the unpaved parking lot. The presence of relatively high concentrations of pesticides within subsurface soils (5 to 17 feet below grade) collected from MW-6, located approximately 18 feet southwest of the dry well, may be attributed to pesticide contaminated rinse water or stormwater runoff infiltrating soils surrounding the dry well. As discussed in the Phase II RI Report, the majority of the pesticides detected on-site have relatively high soil water partitioning coefficients (K_ds) and tend to strongly adsorb onto organic carbon present in soil. Therefore, as water containing pesticides in solution infiltrate through the unsaturated soil surrounding the dry well, the pesticides would tend to adsorb onto soils relatively close to the dry well.

Split spoon samples were collected at depths of 1-3 feet, 10-12 feet, 20-22 feet, and 45-47 feet below the bottom of the dry well located in the Site parking lot. The pesticide constituents detected in the samples include:

- delta-BHC (Lindane)
- Heptachlor
- Aldrin
- Heptachlor epoxide
- Endrin
- alpha-chlordane
- gamma-chlordane

Delta-BHC, Heptachlor, Aldrin, and gamma-chlordane were frequently detected in soil samples collected at various depths within the dry well at concentrations exceeding the NYSDEC soil cleanup criteria. With the exception of Heptachlor, the highest estimated concentrations of delta-BHC, Aldrin, and gamma-chlordane were detected in the first 1 to 3 feet of soil collected from the bottom of the dry well. The highest concentration of Heptachlor was detected from samples collected at 10 to 12 feet below the bottom of the dry well. While similar pesticides were detected at 20 to 22 feet in the dry well, none exceeded the NYSDEC soil cleanup criteria. In addition, both Heptachlor Epoxide, and Endrin were detected in this sample at concentrations below the NYSDEC cleanup criteria. Alpha chlordane concentrations were also two orders of magnitude higher in the samples collected at the 1 to 3 feet and 10 to 12-feet depths than in the 20 to 22 feet interval.

These results indicate that the highest concentrations of pesticides are typically present in the sediment of the dry well to a depth of at least 12 feet. Similar pesticide compounds are present at elevated concentrations in the deeper soil samples collected at 45 to 45 feet below the bottom of the dry well.

Figures 1-5 to 1-7 show the surface and subsurface soils pesticide contamination in multiples of the TAGM 4046 cleanup standards.

1.4.3 Groundwater

On-site shallow monitoring wells MW-1 through MW-5 were sampled four times and deep well MW-6 was sampled once during the Phase I and II RI activities. All on-site monitoring wells exhibited positive detections of at least one targeted pesticide compound. MW-1, MW-2, and MW-5 groundwater samples yielded as many as 8 to 13 different pesticides. Out of the 21 TCL Pesticides, 17 were detected in one or more samples during the four sample rounds for all on-site shallow wells MW-1 to MW-5. The most frequently detected pesticides in shallow groundwater are:

- alpha-chlordane
- gamma-chlordane
- Dieldrin
- gamma-BHC (Lindane)
- Heptachlor Epoxide
- 4,4'-DDT

Alpha-chlordane was the only pesticide detected in the groundwater sample taken from the deep well MW-6. Consistent with on-site surface and subsurface soil quality, the most commonly detected pesticides in on-site groundwater were alpha- and gamma-chlordane. During all sample rounds, the highest chlordane concentrations were observed in groundwater samples collected from MW-1, MW-2, and to a lesser degree MW-5. These wells are located downgradient of the dry well based on a southwest groundwater flow direction. Increase in pesticide concentrations in on-site groundwater during the most recent sampling activities may be attributed to the fluctuations of the groundwater table as a result of heavy precipitation. Groundwater table fluctuations exposing contaminated soils to horizontal groundwater flow may still contribute to the on-site groundwater contamination.

Nearly all positive detections of pesticides collected from on-site groundwater samples exceed the corresponding NYSDEC Class GA groundwater standard.

As mentioned in Section 1.3, six off-site wells were installed and sampled to assess upgradient groundwater quality and the potential downgradient migration of pesticides from the Site. Additionally, five Nassau County observation wells located downgradient of the Site were also sampled to assess or define any potential off-site migration. Figure 1-3 shows the locations of the Phase II RI off-site wells and the Nassau County observation wells.

Of the 11 off-site wells sampled during the Phase II RI, one positive detection was observed over the two sample rounds. Dieldrin was detected at an estimated concentration of 0.03 ug/L within the shallow upgradient monitoring well MW-9S in the first sampling round, but was not detected in the second sampling round. The three Nassau County observation wells screened within the Upper Glacial aquifer, N-11738, N-11739 and N-12005 where found to be free of all TCL Pesticides. As discussed in the Phase I RI report, sampling conducted by the Nassau County Department of Public Works in November 1996 of N-12005 indicated the presence of chlordane at 1.0 ug/l and Heptachlor Epoxide at 0.2 ug/l. Although Nassau County Department of Public Works identified the presence of chlordane and Heptachlor Epoxide, Phase II RI sample results showed the well to be free of all pesticides. Given that the RI laboratory data undergo strict QA/QC under the NYSDEC ASP program and are further qualified through third party data validation, the RI data are considered more reliable than the Nassau County data. All off-site deep monitoring wells screened within the upper zone of the Magothy aquifer, including Nassau County observation wells N-11171 and N-11172, were found to be free of TCL Pesticides in both sample rounds.

1.5 Fate and Transport

The primary sources of contamination at the Fumex site are chemical constituents present in the surface and subsurface soil, and in the dry well sediment. The focus of this FS is the fate and transport of the identified contaminants in various media. Potential migration pathways are:

- leaching of contaminants from soils to underlying groundwater
- potential migration of chemical contaminants in groundwater

The Phase I and II RI reports present analytical data and evaluate the extent of contamination in the various media.

1.5.1 Groundwater

As discussed in the Phase II RI Report, the major contaminant transport mechanism at the Site is the dispersion of pesticides adsorbed to organic carbon in Site soils through the infiltration of water. Infiltration most likely occurs either through cracks and porous areas within the asphalt pavement or direct discharge through the on-site dry well. In theory, as the infiltrating water comes in contact with the contaminated soil, a small fraction of the pesticides adsorbed onto Site soils will desorb, or partition, into the water. The infiltrating water will continue moving vertically under the force of gravity transporting the pesticides a short distance before being readsorbed to Site soils. This process will continue dispersing pesticides within soils from areas of high concentration to areas of low concentration. Upon reaching the water table, the pesticides will be further dispersed through the natural movement of groundwater. Based on the understanding that shallow groundwater at the site flows predominantly in a horizontal direction, dispersion within the Upper Glacial aquifer will be predominantly horizontal in the direction of groundwater flow.

Based on a review of technical literature, geochemical and biochemical degradation of selected pesticides is known to occur within a soil and groundwater environment, however, the factors effecting the rate of degradation for most pesticide compounds is not well understood. As mentioned in the Phase II RI Report, the presence of several compounds known to be breakdown products of pesticides, or daughter products, within site soil and groundwater indicates that natural degradation of the pesticide contamination is occurring on-site. In general, pesticides have relatively low Henry's Law Constants; therefore, volatilization is not considered a significant transport mechanism.

Table 1-5 summarizes the organic carbon partition coefficient (K_{oc}) for each TCL pesticide. K_{oc} reflects the propensity of an organic compound to sorb to the organic matter found in soil and therefore, governs the degree of dissolution and mobility for the compound in the groundwater. Chemicals that sorb onto organic materials in an aquifer (i.e. organic carbon) are retarded in their movement in groundwater. Therefore, the greater the organic carbon partition coefficient, the greater the reduction in the mobility of the compound. The normal range of K_{oc} values extends from $1x10^{-7}$ to $1x10^{7}$ with higher values indicating greater sorption potential.

The distribution of contaminants between water and the adjoining soil matrix is often described by the soil-water distribution coefficient (K_d). The K_d has been calculated by normalizing the K_{oc} against the organic carbon content (f_{oc}) of the soil or aquifer material, as follows (Lyman, 1983).

$$K_d = K_{oc} * f_{oc}$$

where,

K_d = soil water partition coefficient
K_{oc} = carbon solution distribution
f_{oc} = fraction of organic carbon

Using a Total Organic Carbon (TOC) for the site of 0.14 percent (0.0014), which is the average of all TOC values of soil samples collected from MW-6, the K_d for each TCL pesticide has been calculated and summarized in Table 1-5.

Olsen and Davis (1990) categorize contaminants with K_ds ranging from 2-10 as having low mobility and with K_ds over 10 as being immobile within a soil/water environment. Based on the K_d values for each pesticide, all would be considered as having low mobility or immobile with the exception of Aldrin with a K_d of only 0.6. The six most frequently detected pesticides within site soils, including Heptachlor, Dieldrin, 4-4'-DDE, 4-4'-DDT, alpha-chlordane and gamma-chlordane have K_ds well in excess of 10, and, therefore, would be considered highly immobile.

The soil/water partition of coefficient is a constant relating the thermodynamic activities of the two phases:

$$K_d = a_s / a_w$$

where a_s is the activity of the chemical in the soil (or solid matrix) and a_w is the activity of the chemical in the water (aqueous phase) (Mackay and Shui, 1981).

Because the activities are equal to the activity coefficients multiplied by the chemical concentrations and the activity coefficients approach unity for environmental concentrations, the K_d is usually defined as the ratio of concentrations in the solid and water phase.

$$K_d = C_s/C_w$$ = Mass of solute on the solid phase per unit mass of solid phase/ Concentration of solute in solution

C_s is usually expressed in terms of mg/kg (ppm in the solid) and C_w is expressed in terms of mg/L (or ppm in the water, if the density equals one). Therefore, the units on K_d are L/kg or mL/g. (Freese and Cherry, 1979).

Table 1-5

Soil-Water Partition Coefficients, Retardation Factors, and Estimated Contaminant Velocities

Fumex Sanitation, Inc. Feasibility Study

New Hyde Park, New York

Compound	Organic Carbon Partition Coefficient (K_{oc})	Soil-Water Partition Coefficient (K_d)	Calculated Retardation Factor (R_d)	Estimated Contaminant Velocity (feet/day)
alpha-BHC	1,901	3	27	0.0835
beta-BHC	3,548	5	46	0.0489
delta-BHC	1,902	3	27	0.0834
gamma-BHC(Lindane)	3,311	5	43	0.0520
Heptachlor	21,878	31	258	0.0087
Aldrin	407	1	10	0.2319
Heptachlor Epoxide	20,893	29	246	0.0091
Endosulfan I	2,042	3	29	0.0787
Dieldrin	35,481	50	415	0.0054
4,4'-DDE	1,000,000	1,400	11,555	0.0002
Endrin	8,318	12	101	0.0223
Endosulfan II	2,344	3	32	0.0702
4,4'-DDD	43,651	61	509	0.0044
Endosulfan Sulfate	2,344	3	32	0.0702
4,4'-DDT	1,659,587	2,323	19,173	0.0001
Methoxychlor	89,125	125	1,034	0.0022
Endrin Ketone	NDF	NA	NA	NA
Endrin Aldehyde	26,915	38	316	0.0071
alpha-chlordane	371,535	520	4,296	0.0005
gamma-chlordane	1,000,000	1,400	11,555	0.0002
Toxaphene	1,513	2	22	0.1001

Source: Montgomery, J.H., Welkon, L.M., Groundwater Chemicals Desk Reference, Lewis Publishers Inc. Chelsea, Michigan 1990.

Notes:

NDF = No data found

NA = Not applicable

Using K_d as a ratio of mass of pesticide in the solid phase (solid matrix) versus the mass in solution, it can be shown that the fraction of pesticide mass in infiltrating water compared to the soil matrix mass is very small and, as a result, the dispersion of pesticide contamination by the infiltrating water is a relatively slow process. For alpha-chlordane, the fraction would be 1 ppm dissolved in water to 520 ppm, adsorbed to soil, for gamma-chlordane, it would be 1 ppm in water for 1,400 ppm adsorbed to soil.

Using K_d in conjunction with other aquifer properties, the retardation of a compound relative to the velocity of groundwater can be estimated by the following equation (Freeze and Cherry, 1979):

$$R_d = V/VC = \frac{1 + B * K_d}{n}$$

where

R_d = Retardation factor
Vc = Velocity of retarded contaminant
V = Average Darcian velocity of groundwater (2.25 ft/day)
B = Bulk density of aquifer material (1.65 gm/cm^3)
K_d = Calculated soil-water partition coefficient
n = porosity (20%)

Using the estimated K_d for each pesticide and a bulk density of 1.65 gm/cm^3 as a reasonable estimate for glacial sands, the retardation factor (R_d) is calculated and summarized in Table 1-5. Using the estimated groundwater velocity of 2.25 ft/day for the Upper Glacial aquifer and the K_d for each pesticide, the estimated contaminant velocity for each pesticide is estimated and summarized in Table 1-5. As with the estimated groundwater velocity, the contaminant velocities are only a crude approximation of the actual migration rates of contaminants within the groundwater environment. The contaminant velocity assumes homogeneous aquifer properties and only accounts for adsorption. It does not account for contaminant dispersion or degradation through geochemical and biochemical reactions. Degradation would tend to further limit advective transport of contaminants, the estimated retardation rates are likely to be conservatively low.

Based on a highly conservative assumption that pesticides entered the Upper Glacial aquifer in 1952, the year when Fumex started operations at the site, the pesticides would have had 46 years to travel within the aquifer. Based on the contaminant velocities and the 46-year period, the six most commonly detected pesticides within site soils would have traveled the following distances downgradient of the site:

- alpha-chlordane 8.2 feet
- gamma-chlordane 3.3 feet
- Heptachlor 142 feet
- Dieldrin 88 feet
- 4,4'-DDT 1.7 feet
- 4,4-DDE 3.3 feet

Even pesticides with relatively higher mobilities, such as gamma-BHC (Lindane), which was one of the six most frequently detected pesticides within groundwater, would have traveled only 851 feet over this 46 year period. Aldrin, listed as the most mobile pesticide, would have traveled 3,800 feet over this period. However, soil and groundwater data suggest that Aldrin is only sporadically detected in on-site soil and groundwater and is likely degrading to Dieldrin, which has a significantly greater retardation factor.

Degradation would tend to decrease the mobilities of the contaminants. Half-life properties of chemicals are typically used to determine the amount of time necessary for a certain compound to degrade 50 percent. For instance, chlordane (alpha- and gamma-), the most commonly detected pesticides in on-site soil and groundwater, has a reported mean half -life of 3.3 years in soil. Using this half-life value and the log-based degradation equation, the degradation of chlordane can be estimated. It is estimated that chlordane (detected in groundwater from the on-site monitoring well MW-1) would take 28.5 years to degrade from its highest detected level of 20 ug/L, to its current NYSDEC Class A groundwater standard of 0.05 ug/L. With an estimated chlordane velocity of 0.0005 feet per day (as shown in Table 1-5), alpha-chlordane would travel approximately 5 feet in 28.5 years.

The on-site and off-site groundwater data support the estimated contaminant velocities. Only on-site monitoring wells screened immediately within the contaminant source area consistently indicate the presence of pesticides within groundwater. All off-site monitoring wells, including the nearest well MW-7S, located approximately 700 feet southwest of the Site, were found to be free of any detectable levels of pesticides during both Phase II RI sample rounds.

Additional off-site, dowgradient monitoring wells installed to depths of 55 feet did not reveal detectable levels of pesticides in soil and groundwater. Monitoring wellsMW-10 and MW-11 were installed 10 feet and 100 feet, respectively, from the south corner of the site boundary in October 1999.

Sampling of MW-6, which is screened within the upper zone of the Magothy aquifer, approximately 120 feet below grade at the Site, does indicate detectable levels of gamma chlordane at this location: 0.03 ug/l in Round 1 and 0.057 in Round 2 of the Phase II RI. Static head measurements within onsite wells do suggest a subtle downward vertical gradient at the Fumex site. As a result, there exists a potential for downward migration of pesticides within the Upper Glacial aquifer.

The Site is located in an area of Nassau County where gradients exist to cause vertical downward movement of water from the Upper Glacial to the Magothy aquifer. This raises the slight possibility that contamination could eventually migrate to public supply wells screened in the Magothy aquifer and located downgradient of the Site. The Magothy aquifer, however, usually has a higher organic content than the Upper Glacial aquifer, and therefore has higher adsorptive capabilities for contaminants with high partition coefficient values. The organic content of the Magothy aquifer would impede further migration of contaminants, thus minimizing even further the risk of deep public supply wells contamination.

1.6 Applicable or Relevant and Appropriate Requirements and New York State Standards, Criteria, and Guidelines (ARARs/SCGs)

The NYSDEC Technical Assistance Guidance Manual (TAGM), A Selection of Remedial Action Alternatives at Inactive Hazardous Waste Sites, requires consideration of Applicable or Relevant and Appropriate Requirements (ARARs). SCGs and ARARs for the Fumex site are categorized as chemical-specific, action-specific or location-specific. Because New York State does not have ARARs in its statute, and to avoid misrepresentation of New York State's requirements, ARARs are replaced with NYS SCGs. NYS SCGs also include more stringent federal requirements.

Applicable requirements pertain to cleanup standards, standards of control, and other substantive environmental protection requirements, criteria, or limitations promulgated under Federal or state law specifically addressing a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstances at a site. In particular, USEPA Drinking Water Standard Maximum Contaminant Levels, NYSDEC Class GA groundwater standards, and NYSDOH Drinking Water Standard Maximum Contaminant Levels are identified as applicable requirements.

Relevant and appropriate NYS SCGs pertain to cleanup standards, standards of control, and other substantive environmental protection requirements, criteria, or limitations promulgated under New York State law that, while not "applicable", address problems or situations sufficiently similar to those encountered at a site.

SCGs must be determined on a site by site basis, and are identified with increasing certainty as the RI/FS study for the site progresses. For this identification process, it is useful to group SCGs into the following three general categories:

Chemical-Specific

These requirements are usually health or risk-based numbers limiting the concentration or amount of a chemical that may be discharged into the environment. They are independent of the location of the discharge, but may be related to the intended use of the environmental medium.

Action-Specific

These requirements will be triggered by the remedial actions selected for the site. They are based on the implementation and limitations of particular technologies or actions.

Location-Specific

These restrictions are generally placed upon chemical concentration releases or activities solely because they are in a particular location.

1.6.1 Chemical-Specific

Several federal and state chemical-specific criteria are applicable to the Fumex site. Table 1-6 summarizes the chemical-specific ARARs and SCGs identified during the FS. Criteria considered include regulations pertaining to both solid and liquid media. Of importance to the site are cleanup criteria established by New York State for groundwater and soils.

1.6.2 Action-Specific

All the remedial alternatives to be evaluated for this project have been analyzed for compliance with action-specific SCGs developed for the Fumex site. Table 1-7 summarizes action-specific SCGs that were reviewed, and their applicability to the site. Action-specific SCGs address not only regulations to consider during the actual implementation of the remedial plan, but also include secondary actions such as wetlands mitigation and wildlife preservation which could play an important role during implementation.

1.6.3 Location-Specific

Depending on the location of the site, several SCGs require consideration during remedial alternative evaluation. These SCGs often give criteria that provide protection for any sensitive flood plains, wetlands, and natural preserves with endangered species. Table 1-8 summarizes the SCGs that were considered, and their applicability to this site.

1.6.4 NYS SCGs Appropriate to the Site

Based on the analytical results of the two rounds of the Phase II RI groundwater sampling events conducted in 1998, no contamination has migrated off-site in the Upper Glacial aquifer. However, because of the existence of downstream deep public supply wells further off-site, a monitoring program will be implemented. Groundwater standards and criteria will be used as SCGs when evaluating and monitoring the groundwater during this period.

Soil SCGs will be applied in the case of surface and subsurface soil remediation at the Site. In those areas where pesticides are present, NYS Soil Cleanup Guidelines will be used, as appropriate, to set soil cleanup target levels.

A review of NYSDEC maps and files indicate that there are no sensitive environmental areas, wetlands, flood plains, or natural preserves with endangered species present near the Site. For this reason, no location-specific SCGs will be applied.

Table 1-6
Potentially Applicable Chemical-Specific SCGs
Fumex Sanitation Site Feasibility Study
New Hyde Park, New York

Standard, Requirement Criteria or Limitation	Citation or Reference	Description	Comments
Federal			
<u>*Groundwater*</u>			
National Primary Drinking Water Standards	40 CFR Part 141	Applicable to the use of public water systems; establishes maximum contaminant levels (MCLs), monitoring requirements and treatment techniques.	Potentially applicable to off-site groundwater.
National Secondary Drinking Water Standards	40 CFR Part 143	Applicable to the use of public water systems; controls contaminants in drinking water that primarily effect the aesthetic qualities relating to public acceptance of drinking water.	Potentially applicable to off-site groundwater.
Safe Drinking Water Act	Pub. L 95-523, as amended by Pub. L. 96502, 22 USC 300 et. seq.	Sets limits to the maximum contaminant levels (MCLs) and maximum contaminant level goals (MCLGs).	Potentially applicable to off-site groundwater.
SDWA MCL Goals	40 CFR 141.50 FR 46936	Established drinking water quality goals set at levels of anticipated adverse health effects with an adequate margin of safety.	Potentially applicable to off-site groundwater.
USEPA Office of Drinking Water Health Advisories		Standards issued by the USEPA Office of Drinking Water.	
<u>*Surface Water*</u>			
Clean Water Act (CWA)	33 USC 1251 et.seq.	Applicable for alternatives involving treatment with point source discharges to surface water.	Criteria available for water and fish ingestion, and fish consumption for human health. Not applicable to site remedial alternatives.

Table 1-6
Potentially Applicable Chemical-Specific SCGs
Fumex Sanitation Site Feasibility Study
New Hyde Park, New York

Standard, Requirement Criteria or Limitation	Citation or Reference	Description	Comments
Toxic Pollutant Effluent Standards	40 CFR Part 129	Applicable to the discharge of toxic pollutants into navigable waters.	Not applicable to the site.
General Provisions for Effluent Guidelines and Standards	40 CFR 401	Establishes legal authority and general definitions that apply to all regulations issued concerning specific classes and categories of point sources.	Provides for point source identification. Applicable to remedial action with effluent discharge.
Air			
Clean Air Act	42 USC 7401 Section 112 (as amended 1993)	Establishes upper limits on parameter emissions to atmosphere.	Not applicable to the Site.
National Primary and Secondary Ambient Air Quality Standards	40 CFR 50	Establishes primary and secondary NAAQS under Section 109 of the Clean Air Act.	Primary NAAQS define levels of air quality necessary to protect public health. Secondary NAAQS define levels of air quality necessary to protect the public welfare from any known or anticipated adverse effects of a pollutant. Not applicable to the Site.
National Emissions Standards for Hazardous Air Pollutants	40 CFR 61	Establishes NESHAPs.	Not applicable to the Site.

Table 1-6
Potentially Applicable Chemical-Specific SCGs
Fumex Sanitation Site Feasibility Study
New Hyde Park, New York

Standard, Requirement Criteria or Limitation	Citation or Reference	Description	Comments
RCRA			
Resource Conservation and Recovery Act- Identification and Listing of Hazardous Wastes	40 CFR 264.1	Defines those wastes which are subject to regulations as hazardous wastes under 40 CFR Parts 262-265 and Parts 124, 270,271.	Applies to soil remediation alternatives.
RCRA Maximum Concentration Limits	40 CFR 264	Ground Water protection standards for toxic metals and pesticides.	These provisions are applicable to RCRA regulated units that are subject to permitting.
Other			
USEPA Office of Research and Development Reference Doses		Reference dose issued by USEPA.	To Be Considered.
USEPA Environmental Criteria and Assessment Office- Carcinogenic Potency Factors		As developed by USEPA.	To Be Considered.
New York State			
Soil			
NYSDEC Soil Cleanup Objectives	NYSDEC TAGM, HWR-94-4046, January 24, 1994.	Applicable to the cleanup of contaminated soils. Cleanup goals recommended based on human health criteria, ground water protection, background levels, and laboratory quantification levels.	These objectives provide the maximum values for determining soil cleanup levels.
Air			
NYSDEC Division of Air Guidelines for the Control of Toxic Ambient Air Contaminants	Air Guide 1	Establishes air quality standards.	Not applicable to remedial alternatives for the site.
New York Ambient Air Quality Standards	6 NYCRR 256-257	Establishes air quality standards.	Not applicable to remedial alternatives for the site.

Table 1-6
Potentially Applicable Chemical-Specific SCGs
Fumex Sanitation Site Feasibility Study
New Hyde Park, New York

Standard, Requirement Criteria or Limitation	Citation or Reference	Description	Comments
Surface Water & Ground Water			
NYSDEC Ground Water Quality Regulations	6 NYCRR Part 702	Applicable to existing surface water quality and the discharge of runoff and contaminated groundwater into surface waters.	Several sporadic ponds that may be used as recharge basins are located within 0.5 miles of the Site.
NYSDEC Ground Water Quality Regulations	6 NYCRR Part 703	Applicable to the groundwater quality of both the shallow and deep aquifers; sets forth criteria for the consumption of potable water.	The Upper Glacial and Magothy Aquifers are both classified as Class GA potable groundwater supply.
Ambient Water Quality Standards and Guidance Values	TOGS 1.1.1, October 22, 1993	Establishes groundwater quality standards.	
New York Water Classifications and Quality Standards	6 NYCRR Parts 609, 700-704	Describes classification system for surface water and groundwater. Establishes standards of Quality and Purity.	Establishes required clean-up criteria based on water classification.
NYSDEC Standards Raw Water Quality	10 NYCRR 170.4	Provides water quality standards.	May be applicable to groundwater clean-up levels.
NYSDOH Sanitary Code			
Drinking Water Supplies	10 NYCRR Sub Part 5-1	Applicable for consumption of potable water from public water supplies.	
Hazardous Waste			
New York Identification and Listing of Hazardous Waste Regulations	6 NYCRR part 371	Identifies hazardous wastes.	May be applicable if hazardous wastes are generated, stored or transported during remediation.
NYSDEC Land Disposal Restrictions	6 NYCRR Part 376	Identifies hazardous wastes that are subject to land disposal restrictions.	Applicable as site remediation involves land disposal of contaminated soils.

Table 1-7
Potentially Applicable Action-Specific SCGs
Fumex Sanitation Site Feasibility Study
New Hyde Park, New York

Standard, Requirement Criteria or Limitation	Citation or Reference	Description	Comments
Federal			
Clean Air Act	42 U.S.C. 7401	Applicable if alternatives will impact ambient air quality.	Not applicable to the Site.
National Ambient Air Quality Standards	40 CFR Part 50	Applicable to alternatives that may emit pollutants to the air; establishes standards to protect public health and welfare.	Not applicable to the Site.
Resource Conservation and Recovery Act (RCRA)	42 USC 6901-6987 40 CFR part 264 RCRA Subtitle C	Applicable to the treatment, storage, transportation and disposal of hazardous wastes and wastes listed under 6 NYCRR Part 371.	May be required for contaminated soil disposal options.
	40 CFR Part 264 RCRA Subtitle D	Applicable to management and disposal of non-hazardous wastes.	
	40 CFR Part 265	Interim standards for owners of hazardous waste facilities.	Includes design requirements for capping, treatment, and post closure care.
	40 CFR Part 262 and 263	Applicable to generators and transporters of hazardous waste.	Applicable to off-site disposal or treatment of hazardous material. Soils on-site may be deemed hazardous.
	40 CFR Part 268	Applicable to alternatives involving off-site disposal of hazardous waste; requires treatment to diminish waste toxicity.	May be required for soil disposal options.

Table 1-7
Potentially Applicable Action-Specific SCGs
Fumex Sanitation Site Feasibility Study
New Hyde Park, New York

Standard, Requirement Criteria or Limitation	Citation or Reference	Description	Comments
CERCLA/SARA/NCP	40 CFR Part 300	Applicable to remedial actions at CERCLA and NYS Superfund Sites.	The Fumex Sanitation, Inc. site is a designated NYS Superfund Site.
	40 CFR 270,124	EPA administers hazardous waste permit program for CERCLA/Superfund Sites.	Covers basic permitting, application, monitoring, and reporting, requirements for off-site hazardous waste management facilties.
Clean Water Act	33 USC 1251	Restoration and maintenance of the chemical, physical and biological integrity of the nation's water.	May be applicable if groundwater and surface water are found to be negatively impacted by the site.
Safe Drinking Act Underground Injection	40 CFR Parts 144 and 146	Applicable to waste water treatment alternatives involving underground injections that may endanger drinking water sources.	Not applicable to site remedial alternatives.
Wetlands Permit	40 CFR Part 232	Applicable to remedial actions in and around wetlands.	There are no wetlands in and around the site.
Occupational Safety and Health Act	29 CFR Part 1910 and 300.38	Applicable to workers and the work place during remediation of the site.	Applies to all response activities under the NCP.
Hazardous Materials Transportation Act	49 USC ss 1801-1813, 49 CFR Parts 107, 171	Applicable to transporters of hazardous materials.	May be relevant if action results in sludge, waste or soil being transported off-site.

Table 1-7
Potentially Applicable Action-Specific SCGs
Fumex Sanitation Site Feasibility Study
New Hyde Park, New York

Standard, Requirement Criteria or Limitation	Citation or Reference	Description	Comments
New York State			
NYSDEC TAGM	HWR-90-4030	Guidance for Selection of Remedial Actions at Inactive Hazardous Waste Sites.	Issued May 15, 1990.
Hazardous Waste Management	6 NYCRR Part 373	Standards for owners of hazardous waste facilities.	Includes design requirements for soil capping and treatment options, and post-closure care.
Transportation of Hazardous Materials	6 NYCRR Part 364	Regulates transportation of hazardous materials.	Applicable as site remediation involves off-site disposal of potentially hazardous soils.
Air			
New York State Air Regulations	(6 NYCRR Parts 200 through 207,210,211,212 and 219)		
	6 NYCRR Part 212	General process emission sources.	Not applicable to the Site.
	6 NYCRR Part 201, 202	Permits for construction/operations of air pollution sources.	Not applicable to the site.
	6NYCRR Part 219	Particulate emission limits.	Not applicable to the site.

Table 1-7
Potentially Applicable Action-Specific SCGs
Fumex Sanitation Site Feasibility Study
New Hyde Park, New York

Standard, Requirement Criteria or Limitation	Citation or Reference	Description	Comments
New York State Air Regulations (cont.)	6NYCRR Part 211	Regulates fugitive dust emissions.	Requires control of fugitive dust emissions from excavations and transport. Applicable for soil excavation alternatives.
	6 NYCRR Part 257	Air quality standards.	Requires control for on-site treatment. Not applicable to the site.
NYSDEC Draft Air guidelines-1: Guidelines for Control of Toxic Ambient air Contaminants	New York State Division of Air Resources Guidelines	Provides guidance on permit process review, gives AGCs and SCGs for ambient air based human health criteria.	Not applicable to ambient air near the Site.
Transportation of Hazardous Materials	6 NYCRR Part 364	Regulates transportation of hazardous materials.	Applicable as site remediation involves off-site disposal of potentially hazardous soils.
Local			
Building Codes Sanitary Codes Fire Codes Plans Protecting Sensitive Areas			The feasibility of each remedial alternative will be evaluated in light of applicable local codes.

Table 1-8
Potentially Applicable Location-Specific SCGs
Fumex Sanitation Site Feasibility Study
New Hyde Park, New York

Standard, Requirement Criteria or Limitation	Citation or Reference	Description	Comments
Federal			
Fish and Wildlife Coordination Act	16 USC	Requires consultation when Federal department or agency proposes or authorizes any modification of any stream or other water body and adequate provision for protection of fish and wildlife resources.	Not applicable to site remedial alternatives.
Endangered Species Act	40 CFR 6.302 (g)	Requires Federal agencies to ensure that actions they authorize, fund or carry out are most likely to jeapordize the continued existence of endangered/threatened species or adversely modify the critical habitats of such species.	No endangered species are present in the study area.
Executive Order On Floodplain Management	Execuitive Order No. 11988 40 CFR 6.302(a) and Appendix A	Requires Federal agencies to evaluate potential effects of actions that may take place in a floodplain to avoid, to the maximum extent possible, the adverse impacts associated with direct and indirect development of a floodplain.	No floodplain is located in the vicinity of the site.
Wetland Executive Order	Executive Order No. 11990	Details requirements for the preservation of wetlands.	No wetlands are located in the vicinity of the site.
Farmlands Protection	7 USC 4201 et. seq.	Protects significant or important agricultural lands from irreversible conversion to uses which result in loss of an environmental or essential food production resource.	No farmlands are located in the vicinity of the site.

Table 1-8
Potentially Applicable Location-Specific SCGs
Fumex Sanitation Site Feasibility Study
New Hyde Park, New York

Standard, Requirement Criteria or Limitation	Citation or Reference	Description	Comments
New York State			
Air			
New York Environmental Conservation Law	New York Consolidated Laws Service: Environmental Conservation Law, Articles 1,3,5,7-8,19,38,70-72	Establishes requirements for the protection of air quality	Not applicable. Remedial activities do not include discharge to air.
New York Air Pollution Control Regulations	6 NYCRR Parts 220-221	Provides provisions for the prevention and control of air contamination and air pollution.	Not applicable. Remedial activities do not include discharge to air.
Fish and Wildlife			
Endangered and Threatened Species of Fish and Wildlife	6 NYCRR Part 182	Designates endangered and threatened species for protection.	No endangered and/or threatened species are present in the vicinity of the site.
New York Wetlands Laws	NYCRR Articles 24, 25	Establishes requirements for the protection of freshwater and tidal wetlands.	No wetlands are present in the vicinity of the site.
Environmental Conservation Law	New York Environmental Law: Articles 17, 37, 71, 72	Establishes requirements for the protection of New York State waters.	Applicable to remedial activities which include discharge to groundwater or surface water.
Use and Protection of Waters	6 NYCRR Part 608	Establishes standards for use and protection of waters	Applicable to remedial activities which affect waters.

Section 2
Remedial Action Objectives

2.1 Introduction

Remedial Action Objectives (RAOs) are developed to protect human health and the environment, which includes terrestrial and aquatic biota, sensitive or critical habitats, and endangered species. The potential environmental and human health threats reviewed below are based on data from the RI.

2.2 Medium-Specific Objectives

RAOs are comprised of medium-specific goals for protecting human health and the environment and focus on the contaminants of concern, exposure routes and receptors, and an acceptable contaminant level or range of levels for each exposure route. A qualitative risk assessment and identification of NYS Standards, Criteria, and Guidelines determine acceptable contaminant routes.

The RAOs established for the Fumex Site include:

1. Treat or remove the principal threat posed by the Site to groundwater and potential impacts to downgradient users.

2. Isolate or remove the contaminated material in order to provide protection to human health from direct contact or ingestion of hazardous constituents in wastes or surface soil at the Site.

3. Prevent infiltration of water through the surface soil and subsequent percolation into the subsurface soil and groundwater.

2.3 Potential Exposure Pathways

A potential contaminant exposure pathway is the consumption of groundwater from public supply wells located downgradient from the Site. Downgradient public supply wells VGC#9, VGC#13, and VGC#14 are located 7,600 feet, 6,300 feet, and 7,400 feet away, respectively, from the Site in a south-southwest direction. The closest public supply well is situated 1,300 feet west from the Site and is used only in emergency situations. Figure 1-3 shows the locations of the public supply wells near the Site. All public supply wells in the vicinity of the Site extract groundwater from the deep Magothy aquifer. The RI concludes that no private wells are in use within 1,000 feet radius of the Site.

A second potential contaminant exposure pathway is direct contact or ingestion of contaminants in surface and subsurface soils during possible future site development.

Lastly, infiltration of water from the surface of the Site into the on-site dry well or through fissures in the paved parking lot may impact groundwater quality as water percolates through contaminated surface and subsurface soils to the water table. Sediment and soil boring samples collected from beneath the dry well and throughout the Site indicate that surface and subsurface soils are affected by the contaminants.

2.4 Remedial Approach

Based on the data obtained from the Phase I and II RI activities and in accordance with the focused FS approach, a limited number of media specific remedial remedies are identified. The remedies are listed below according to the RAOs addressed by that remedy.

The first RAO for the Site can be addressed by the removal of surface and subsurface soils where contaminants of concern are prevalent according to RI data. Removal can be accomplished by excavation of soils to specified depths. By removing the source of pesticide contamination, groundwater contamination and biota and human interaction would be minimized. Soils accumulated during excavation activities would be disposed accordingly to an off-site disposal facility. Removal of soils is typically performed as excavation. Excavation is therefore considered as a treatment technology.

Associated with excavation are the abandonment and eventual removal of the on-site dry well. Since the dry well serves as a point source of subsurface and groundwater contamination, its abandonment and removal would minimize the risk associated with contamination.

Another treatment technology that meets the first RAO would be the installation and implementation of a groundwater pump and treat system. The system would consist of one extraction well, two liquid activated carbon treatment vessels, and associated piping and fittings. Spent carbon would be treated off-site and replenished by the manufacturer. Treated effluent would be discharged to a local reinforced concrete pipe RCP storm drain.

The second and third RAOs can be accomplished by providing an additional impermeable membrane to prevent infiltration of surface water through the surface and subsurface soil and into the groundwater. This would minimize groundwater contamination as runoff water is collected in a catch basin and subsequently diverted through a drain pipe and into a local storm drain. The cap would isolate the contaminated media from public exposure and thus reducing the potential for ingestion and direct contact. The surface runoff drain installed at the Site would direct runoff water into an adjacent storm drain. The impermeable membrane along with an asphalt cap would be placed following excavation of affected surface and subsurface soils.

Section 3
Remediation Alternatives

A limited number of remediation technologies to meet the RAOs are available for the Fumex site based on existing Site conditions discussed in the RI Report. In accordance with the presumptive remedy approach, an extensive discussion of general response action is not presented here. The limited number of technologies for the Fumex site can be focused within the following general categories:

- No Further Action
- Institutional Controls
- Disposal of Removed Contaminated Media
  - Excavation, Off-Site Disposal, and Treatment
- Containment of Contaminant Migration
  - Impermeable Membrane/Asphalt Cap
- Treatment of In Situ Contaminated Media
  - Groundwater Pump and Treat System
- Engineering Controls
  - Dry Well Abandonment and Replacement
  - Installation of a Catch Basin
  - Installation of Piping for Runoff Water

For all of the migration pathways, a No Further Action remediation alternative is considered as a baseline remedial action against which all other remediation approaches are compared. The No Further Action alternative includes a groundwater monitoring plan and the adoption of institutional controls for the Site.

Institutional controls may be physical, such as fences and barriers to limit access to the Site, or legal, such as deed restrictions and zoning changes to impose restrictions on future uses of the Site.

Potential remedial actions identified as part of the presumptive remedy approach for surface and subsurface soils and groundwater are described below. The remedial actions for soils include excavation and capping. Remedial action for groundwater is an on-site groundwater pump and treat system. An impermeable cap to prevent water from percolating through the waste and a redesign of the Site stormwater control structure. The No Further Action alternative applies to both soils and groundwater remediation.

3.1 Surface Soil

Surface or shallow soil samples collected from five locations throughout the Site during the Phase II RI indicate the presence of up to nine different pesticide compounds at concentrations exceeding their corresponding NYS SCGs. Certain pesticide levels found in surface soils are an order of magnitude higher than the NYS SCGs. Pesticide constituents detected include alpha-chlordane, gamma-chlordane, Heptachlor, Aldrin, Dieldrin, Endrin, 4,4'-DDE, and 4,4'-DDT.

The Phase II RI data also reveal widespread pesticide contamination throughout the surface soils. As discussed in Section 1, surface soils are defined as the top 18 inches of soil immediately below the parking lot asphalt pavement. The widespread nature of the contamination is not indicative of a one-time release of contaminants, but most likely of a persistent and site-wide release throughout the years in the then unpaved parking lot.

3.1.1 Excavation of All Surface Soil

Since the detected pesticide concentrations are well above the NYS SCGs within the shallow surface soils, typically 100 times the NYS SCGs, technologies to minimize the threat or hazard to human health were evaluated.

The first technology evaluated was the removal of the Site's surface soil. During the Phase I and II RI activities it was determined from sampling results that the highest concentrations of pesticides were in the surface soil. Excavation of the surface soil is a technology involving the removal of the top 18 inches of soil at the Site, excluding monitoring well and dry well locations. Figure 3-1 details the area to be excavated.

Excavation of the surface soil at the Site would produce approximately 350 cubic yards (cy) of soil. The approximate size of the parking lot is 6,300 ft^2. The asphalt surface, which to a large degree is in a state of disrepair, would be demolished and removed prior to excavation. Following asphalt removal, a bucket-equipped backhoe would excavate the top 18 inches of soil throughout the Site. Excavated soil would be placed in a staging area at the Site to allow for dewatering if required. Although the surface soil is well above level of the groundwater table, the soil may be saturated due to the percolation of water through either of the following scenarios: 1) the fissures and cracks of the asphalt surface and/or 2) the influence of the dry well which enables runoff water to infiltrate into the media.

Once "dry", the excavated material would be loaded into roll-offs, transported to an RCRA-approved disposal facility, and treated. Traffic control would be coordinated to allow efficient soil excavation, transport, and disposal and to avoid unnecessary disturbances to the existing active parking lot usage and facility operations. It is likely that the excavation of the Site's surface soil would preclude normal activities from occurring at the site.

All excavated areas would be backfilled with clean soils and regraded accordingly. It is estimated, for cost purposes, that an additional 390 cy of backfill material would be required to regrade the Site.

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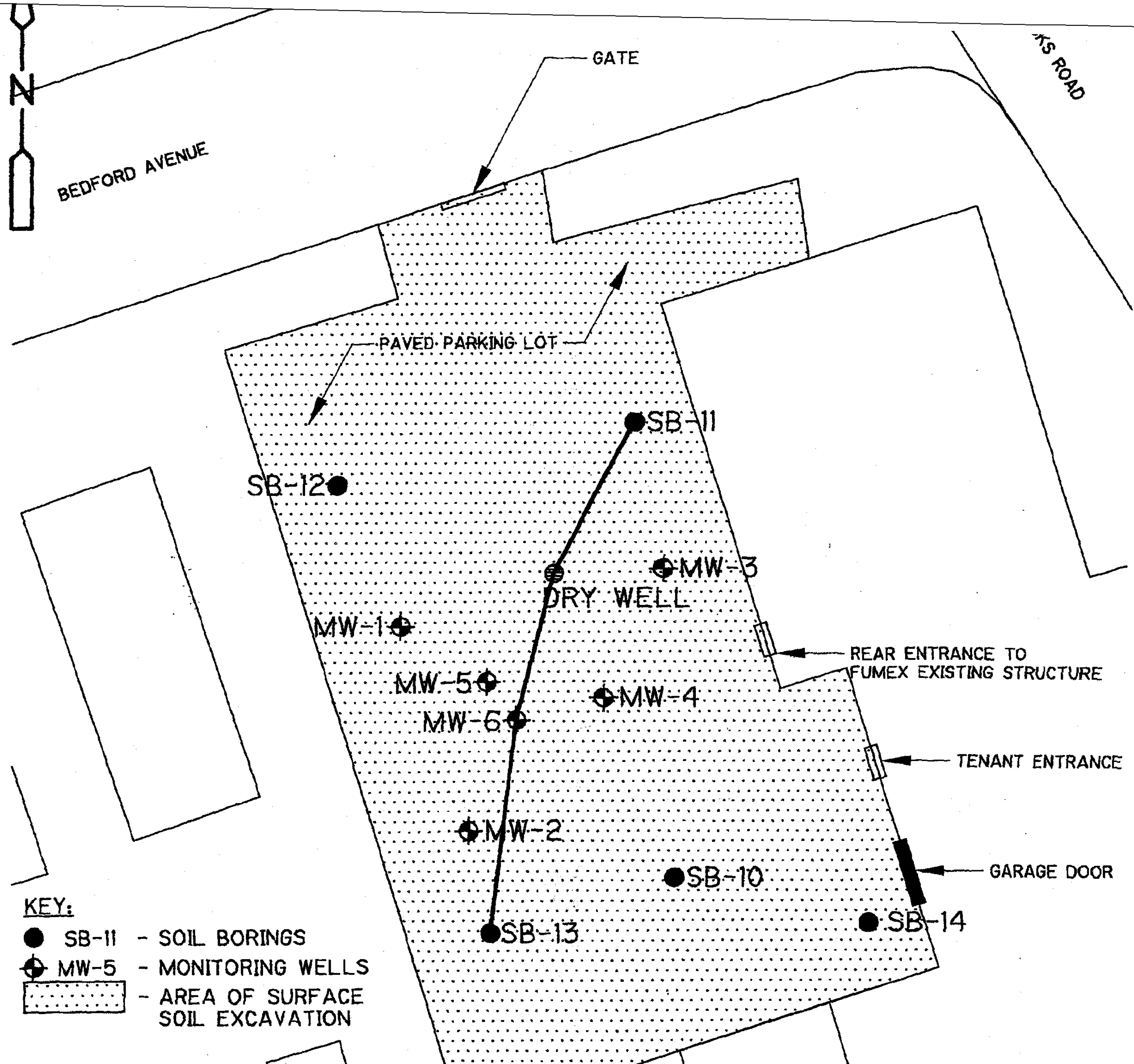
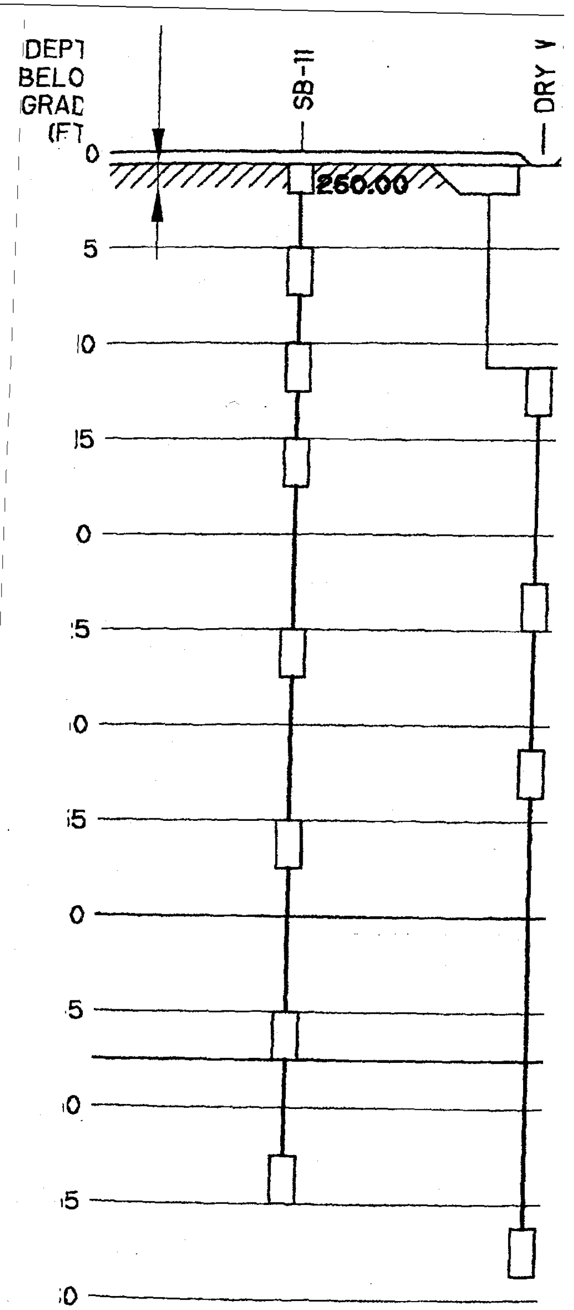


NOTE:
SURFACE SOIL IS DEFINED AS THE TOP 18-INCHES OF SOIL IMMEDIATELY BELOW THE ASPHALT PAVEMENT.

1" = 20'



NOTE:
VALUES SHOWN ARE CHLORDANE (
NYSDEC CLEANUP STANDARDS:
ALPHA-CHLORDANE = 0.54 PPM
GAMMA-CHLORDANE = 0.54 PPM

Total cost to remove the surface soil and to place the backfill material is presented in Section 4. Cost back-up information is presented in Appendix A.

3.1.2 Excavation of Discrete Surface Soil Areas

This technology, similar in scope to the previous description, consists of excavating surface soils from four discrete, 20-foot diameter circles around soil borings SB-11 to SB-14 (see Figure 3-2). The selection of these four areas is based on pesticide concentrations within the surface soil exceeding the TAGM soil cleanup standards by a factor of 100. As discussed in Section 3.1.1, only the top 18 inches of soil would be excavated at these discrete circles.

The Total Chlordane concentration in the surface soil at the SB-11 location was 260 mg/kg. The NYS SCG for alpha and gamma chlordane is 0.54 mg/kg. This soil boring location had the second highest concentration of chlordane sampled at the site.

Directly west (about 40 feet) of SB-11 is the location of SB-12. The most elevated concentrations of Total Chlordane, from the surface soil, were obtained from this location. The Total Chlordane concentration obtained from SB-12 was 280 mg/kg. This concentration is almost 520 times the individual NYS SCG for gamma chlordane. SB-12 is located upgradient of all monitoring wells at the site.

Approximately 60-ft south of SB-12 is the location of SB-13. The surface soil concentration of Total Chlordane obtained at this location was approximately 115 mg/kg or about 210 times the NYS SCG for gamma chlordane.

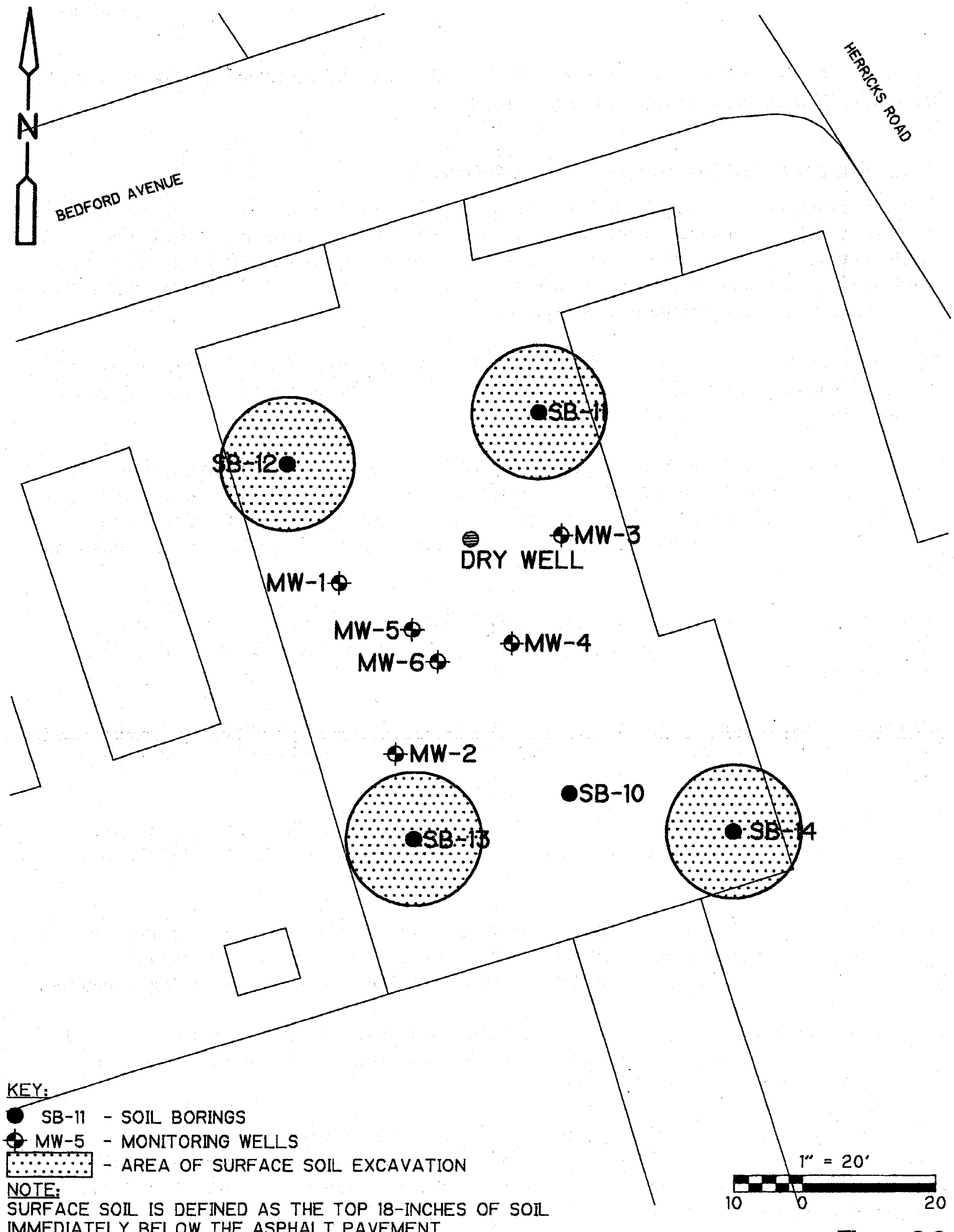
In the southeast corner of the parking lot, SB-14 was augered. Sampling results indicate that the Total Chlordane concentration within the surface soil at this location, was about 184 mg/kg or 340 times the NYS SCG for gamma chlordane.

Within these four soil borings, the most elevated concentrations of chlordane were found. In addition, these soil borings also had elevated concentrations of heptachlor, dieldrin, 4-4'-DDE and 4-4'-DDT.

The asphalt surface within the designated areas will be removed prior to excavation. Following asphalt removal, the top 18 inches of soil within these four, discrete areas will be excavated. Excavated soil would be placed in a small staging area at the Site to allow for dewatering, if required.

The excavated material would be loaded into roll-offs, transported to an RCRA-approved disposal facility, and treated. Excavation of the surface soil within these discrete locations may preclude normal activities from occurring at the site.

Approximately 70 cy of soil would be excavated and disposed of off-site. All excavated areas would be backfilled with clean soils and regraded accordingly. An additional 80 cy of backfill material would be required to regrade the Site. Total cost to remove the surface soil and to place the backfill material is presented in Appendix A.



S:\0897\21547\FS\ Site2 01/12/99 17:44:39 10:14:32 KALNYCP

Figure 3-2
Excavation Of Discrete Surface Soil Areas
Feasibility Study, Fumex Site - New Hyde Park, New York

CDM Camp Dresser & McKee

3.1.3 Impermeable Membrane/Asphalt Cap

Another remedial technology evaluated was the placement of an impermeable geomembrane/ geotextile layer underneath an asphalt cap. Installation of the cap would require approximately 12-18 inches of soil to be removed from the existing site.

The geomembrane would prevent water from infiltrating into the unsaturated Upper Glacial material and subsequently into the groundwater table. Although, as stated in the RI, the lateral and vertical movement of the pesticides is limited due to the high organic carbon partition (K_{oc}) coefficients they possess, chemical migration is still possible.

The cap would consist of a Polyvinyl Chloride (PVC) membrane material, a geotextile cushioning layer, and an asphalt surface. Figure 3-3 presents a cross-section of an impermeable membrane with an asphalt cap. The PVC layer is initially rolled on top of the backfilled soil followed by the geotextile material. Prior to the placement of the asphalt cap, normal fill and then a layer of gravel would be placed. The impermeable membrane/asphalt cap would greatly minimize infiltration through the soil and into groundwater, thus diverting any surface runoff to an alternate surface runoff drain.

Similar to the first technology, the installation of a geomembrane/geotextile barrier would require the excavation of approximately 350 cy of soil. The approximate size of the parking lot is 6,300 ft^2. The existing asphalt surface would be removed prior to excavation. Following asphalt removal, a backhoe would excavate the top 18 inches of soil throughout the Site. Excavated soil would be placed in a staging area at the Site to allow for dewatering.

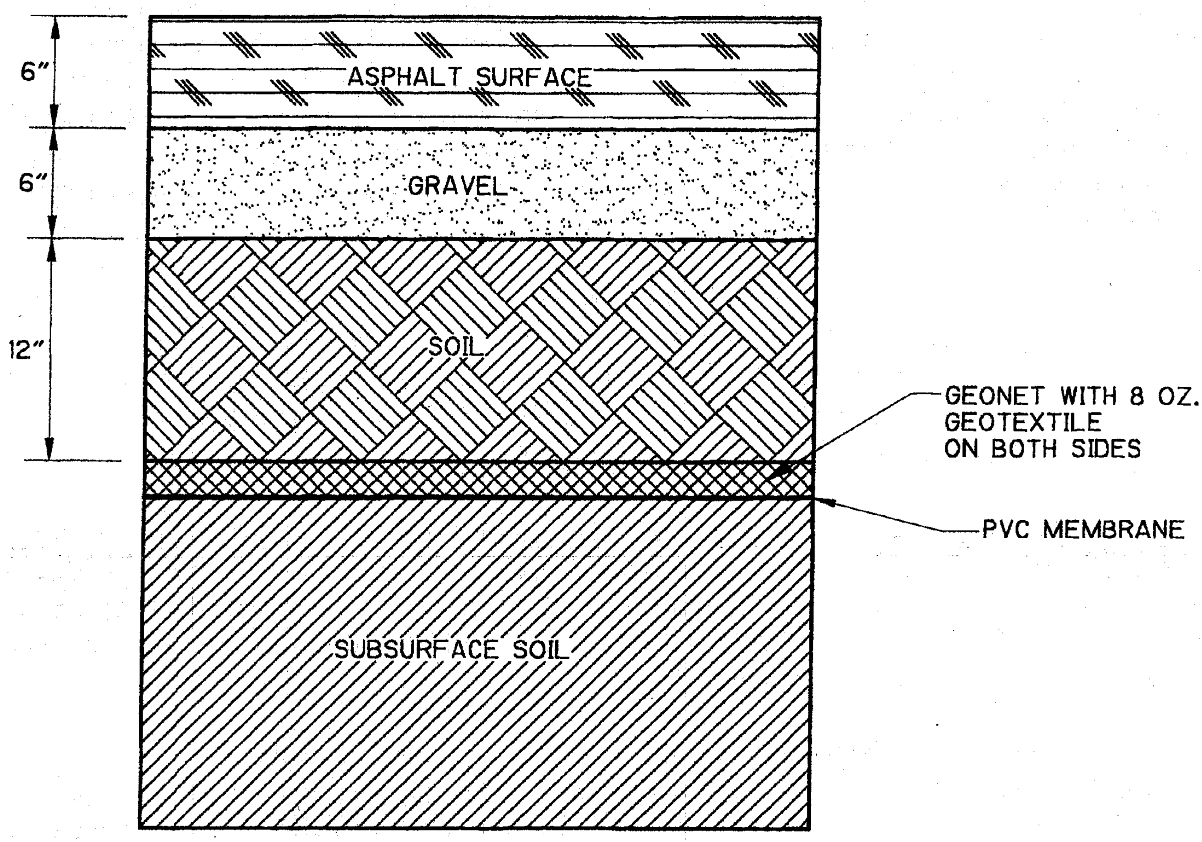
Once "dry", the excavated material would be loaded into roll-offs, transported to an RCRA-approved disposal facility, and treated. Traffic control would be coordinated to allow efficient soil excavation, transport, and disposal and to avoid unnecessary disturbances to the existing active parking lot usage and facility operations. It is likely that the excavation of the Site's surface soil would preclude normal activities from occurring at the Site.

All excavated areas would be backfilled with approximately 12 inches of clean fill and regraded accordingly. On top of the fill 6 to 12 inches of gravel would be placed to form a base for the asphalt pavement. It is estimated for cost purposes that 230 cy of backfill and 120 cy of gravel material would be required to regrade the Site. Total cost to remove the surface soil and to place the geomembrane/geotextile layers is presented in Section 4. Cost breakdown information is presented in Appendix A.

3.1.4 Repair of Existing Pavement

Another remedial technology evaluated was the repair of the existing parking lot. Similar to the placement of the impermeable geomembrane/geotextile layer, this technology's purpose is to minimize the volume of water that infiltrates through the Upper Glacial unsaturated zone.

Repairs to the parking lot would prevent water from infiltrating into the unsaturated Upper Glacial material and subsequently into the groundwater table. Although, as stated in the RI, the lateral and



NOTE: DIMENSIONS AND MATERIAL SPECIFICATIONS ARE PROJECT SPECIFIC

Figure 3-3
Impermeable Membrane/Asphalt Cap Detail
Feasibility Study, Fumex Site - New Hyde Park, New York

vertical movement of the pesticides is limited due to the high organic carbon partition (K_{oc}) coefficients they possess, chemical migration is still possible.

Unlike the geomembrane technology, the existing asphalt surface would not be removed. Repairs to the parking lot would be performed on an as needed basis. Any excavation that may be performed would be conducted similar to the guidelines for all other technologies. Excavated material would be disposed of within available drums or possibly into roll-offs. The excavated material would be transported to an RCRA-approved disposal facility. Traffic control would be coordinated to allow efficient soil excavation, transport, and disposal and to avoid unnecessary disturbances to the existing active parking lot usage and facility operations. It is likely that this technology would allow normal activities to proceed without interruption.
Total cost to repair the existing parking lot is presented in Section 4. Cost back-up information is presented in Appendix A.

3.1.5 Dry Well Abandonment and Surface Runoff Basin and Drain Installation

Previous sampling performed by CDM during the Phase I RI revealed pesticide contamination present within the sediments of the on-site dry well in excess of NYSDEC cleanup standards. The most prevalent pesticide compounds detected within the dry well sediments include Heptachlor, delta-BHC, Aldrin, and alpha- and gamma-chlordane. The data suggest that the highest pesticide concentrations are present within sediments collected from directly at the bottom of the dry well to three feet below the dry well. Pesticide concentrations tend to decrease with increasing depth directly below the dry well.

In addition to the high pesticide concentrations within the dry well sediment, the existing dry well is the Site's primary source for water infiltrating into the Upper Glacial aquifer. The current dry well has elevated pesticide concentrations in addition to being a primary source for contaminant migration. Dry well abandonment is a technology that would eliminate these two source problems. This technology involves the complete abandonment and removal of the dry well. In order to maintain the drainage pattern of the existing parking lot a surface runoff catch basin would be installed within the excavated dry well location.

The source of contamination within the dry well would be removed upon excavation and removal of the existing dry well. The sediment within the dry well would be removed to a depth that would allow for the installation of a new manhole or catch basin.

To collect surface runoff at the Site, a concrete catch basin 10-foot deep and 4-foot wide would be installed in the former excavated dry well area. Connected to the basin would be a 6" reinforced concrete pipe (RCP) drain to divert water from the basin to an existing 24-inch RCP storm drain located on Herricks Road (see Figure 3-4). Approximately 180 feet of RCP material would be required. The surface runoff drain would be designed with the proper pipe slope to provide effective runoff of water collected from the Site in addition to efficient distribution to the existing RCP line.

During installation of the new catch basin, soil would be removed, staged and then placed in a roll-off for future disposal and treatment at a RCRA-approved disposal facility. Traffic control would be coordinated to allow efficient soil excavation, transport, and disposal and to minimize disturbances

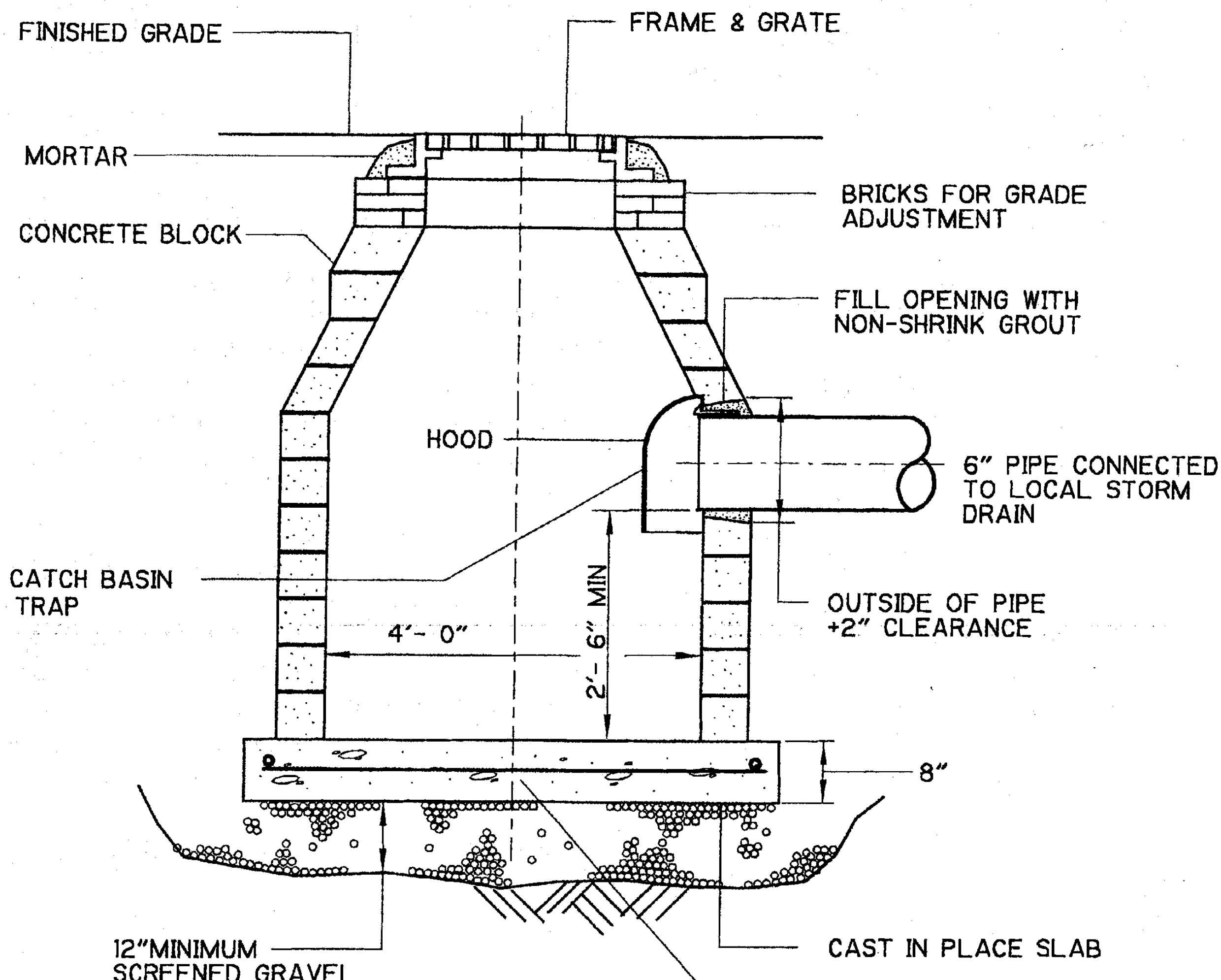


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Figure 3-4
Concrete Block Catch Basin Detail
Feasibility Study, Fumex Site - New Hyde Park, New York

to the active parking lot, facility operations and neighborhood roads. It is probable that the dry well removal and catch basin installation at the Site would preclude normal activities from occurring at the site.

All excavated areas would be backfilled with a minimum of 12 inches of screened gravel prior to installation of the catch basin. The catch basin would be constructed on top of the screened gravel bedding. Total cost to remove the existing dry well and replace it with a catch basin is presented in Section 4. Cost back-up information is shown in Appendix A.

3.2 Subsurface Soil

Subsurface soil is defined as several areas with pesticide concentrations above the NYS SCGs in subsurface soil. This includes the vicinities of soil boring SB-11, the on-site dry well, and monitoring well MW-6. Since subsurface soils to be excavated are above the groundwater table, it is assumed that dewatering efforts are unnecessary. However, there may be some moisture surrounding the dry well area due to precipitation and surface runoff drainage. Cracks and fissures throughout the parking lot area will also contribute to minimal soil saturation.

3.2.1 Site Excavation and Disposal

A presumptive remedial technology for subsurface soil is the excavation of all soils that exceed the soil cleanup standards. Based on Phase I and II RI data, contaminated soil extends to a depth of approximately 40 feet. This technology evaluates the viability of excavating the Site to a depth of 40 feet throughout the parking lot area.

Sampling results indicate that pesticide contamination is present throughout the depth of the unsaturated portion of the Upper Glacial aquifer. Off-site sampling, however, indicates that vertical and horizontal migration of pesticide contamination has not occurred. Based on an evaluation of partition coefficients, off-site migration is not expected to pose a significant threat. Removal of all contaminated material (i.e. excavation to 40 feet) would eliminate the potential for mobility but as previously demonstrated, that potential is already low.

Excavation of soil at depths greater than 15 feet becomes a safety hazard. Trench shoring therefore would be necessary. Shoring walls would be installed down to 40 feet below ground surface (bgs). Excavation activities would be performed by an excavator with a large bucket and long hydraulic arm to reach at least 40 feet bgs. Alternatively, the excavation could be performed in 10-foot lifts but physical Site constraints would likely reduce the feasibility of this option.

All removed soil would be stockpiled in a staging area, to dry before being be placed in roll-offs, for future transport and off-site disposal and treatment at a RCRA-approved disposal facility. An off-site staging area would be necessary due to the volume of soil being collected in relation to the Site's acreage. In addition, a traffic control plan would have to be developed to coordinate soil excavation, disposal activities and existing traffic flow within the Site area.

An estimated volume of 9,700 cy of soil would be removed and disposed off-site to a RCRA-approved facility. In addition, approximately 10,700 cy of backfill material would be required to regrade the Site.

Additional costs would be incurred from the implementation of the shoring walls and extra health and safety coordination. The total cost of this technology far exceeds any other technology. The cost to implement this technology would be approximately $8 million, or $7 million more than any other technology. Cost back-up information for this technology is included in Appendix A.

3.2.2 Dry Well Trench Excavation

In this technology, a rectangular section approximately 20 feet wide and 60 feet long, located in the center of Site (see Figure 3-5), would be excavated. The rectangular area, which begins at soil boring SB-11 and extends southeasterly to monitoring well MW-6, extends out from the dry well. Sampling results from the RI indicate that pesticide levels significantly exceed the soil cleanup standards (TAGM 4046 criteria) at the surface and to a depth of 25 feet.

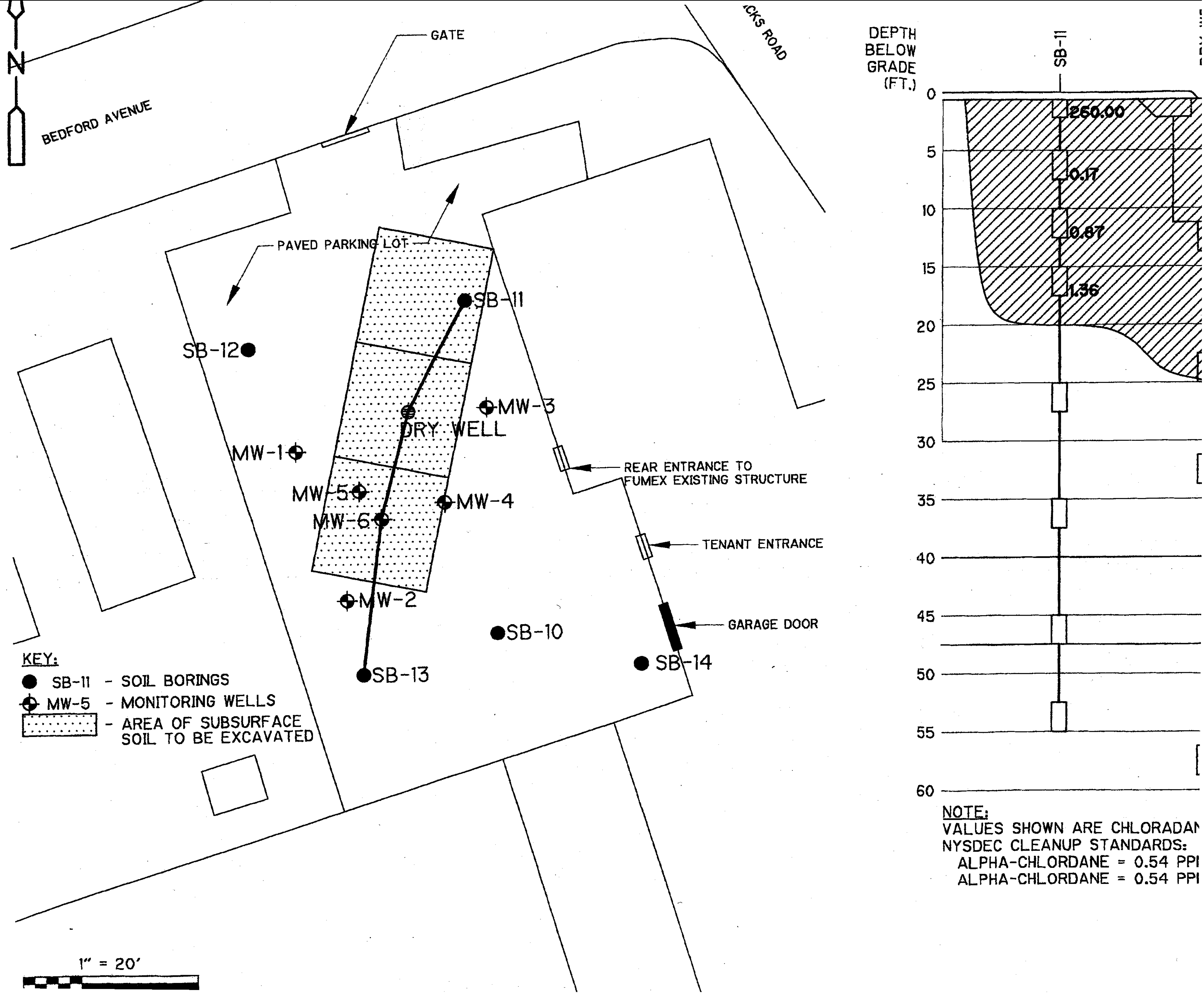
Pesticide constituents present within the rectangular section include Heptachlor, alpha- and gamma-chlordane, and to a lesser extent 4,4'-DDT. Subsurface soils beneath SB-11, the dry well, and MW-6 would be excavated to a depth of 20 feet, 25 feet, and 15 feet bgs, respectively based on the corresponding depth of contamination. Removal of the contaminated material (i.e. excavation to 15-25ft) from this trench would further reduce the potential for mobility from this area but, due to high partition coefficients, that potential is already low.

Excavation to depths greater than 15 feet would require trench shoring to eliminate safety hazards. Shoring walls would be installed down to 25 feet depth during excavation. Soil excavation would be performed by an excavator with a large bucket and long hydraulic arm to reach at least 25 feet bgs. Excavated soil would be stockpiled in a staging area and subsequently placed in roll-offs prior to disposal and treatment.

Approximately 900 cy of soil would be excavated and disposed. All removed soils would be disposed at a RCRA-approved facility and treated. All excavated areas would be backfilled with clean soils and regraded accordingly. An additional 990 cy of soil would be required for backfill. Total cost to excavate the dry well trench is presented in Section 4. Cost back-up information is shown in Appendix A.

3.2.3 Impermeable Membrane/Asphalt Cap

As discussed earlier in Section 3.1.3, the impermeable membrane/asphalt cap is a technology that would prevent migration of contaminants by eliminating the percolation of water through the subsurface or unsaturated zone. The cap would minimize infiltration and thereby reduce the transport of pesticides in the subsurface soil to groundwater. Cap installation methods and materials are discussed in Section 3.1.3.



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3.3 Groundwater

The Phase I and Phase II RI groundwater sampling activities reveal that on-site groundwater is affected by pesticides. However, a comparison of all sampling rounds does not indicate any clear trends in contaminant concentrations over the 18-month sampling period. With the exception of alpha- and gamma-chlordane, the pesticide detected within on-site groundwater are at or below the contract required quantitation limit (CRQL) at most locations. As a result, positive detections are sporadic in nature from one sample round to the next, making it difficult to identify any clear trend.

Of the 11 off-site wells sampled during the Phase II RI, one positive detection was observed over the two sample rounds. Dieldrin was detected at 0.03 ug/L. However, as previously mentioned, the detection was in MW-9S, a shallow upgradient monitoring well, and is not related to the Site contamination. The nearest public supply water well located 7,600 feet downgradient of the Site extracts water from the deeper Magothy aquifer. The Magothy aquifer, which generally has a higher organic content than the shallower Upper Glacial aquifer, would produce a further reduction of pesticide migration or mobility. As discussed in Section 1.5, the K_ds of the most commonly detected pesticides in Site soils are relatively high, thus indicating high adsorptive capacity and immobility. As a result, the pesticide constituents tend to bind to the soil matrix. All off-site monitoring wells screened within the upper zone of the Magothy aquifer, including Nassau County observation wells N-11171 and N-11172, were found to be free of pesticides in both Phase II RI sample rounds. Due to the depth and location of the downgradient public supply wells and the tendency of the pesticides to bind to the soil, it is anticipated that the migration of pesticides from the Site will not move vertically through the Magothy aquifer and impact downgradient public supply wells. It is typical on Long Island that velocities controlling vertical migration are an order of magnitude slower than horizontal velocities.

3.3.1 Groundwater Monitoring

Groundwater monitoring is a technology performed to augment the existing Site database obtained from the site investigation and to observe the changes in site conditions over time. Continued monitoring of groundwater at and in the vicinity of the Site will allow approximation of the restoration rates occurring from natural attenuation (included in the No Action alternative) and observation of potential off-site migration of contaminants. Monitoring would entail annual groundwater sampling for ten years from Site remediation completion at the six on-site and six off-site wells installed by CDM. A total of 14 samples comprised of 12 samples from the 12 monitoring wells, 1 duplicate sample, and 1 field blank sample would be collected per sampling activity. Groundwater would be analyzed for TCL pesticides only. The monitoring program should be reviewed and revised after five years depending on findings.

3.3.2 Groundwater Pump and Treat System

Groundwater pump and treat technology consists of the collection of affected groundwater, treatment of affected groundwater via physical, chemical, and biological methods, and discharge of treated groundwater. Figure 3-6 shows a conceptual diagram of a groundwater pump and treat system.

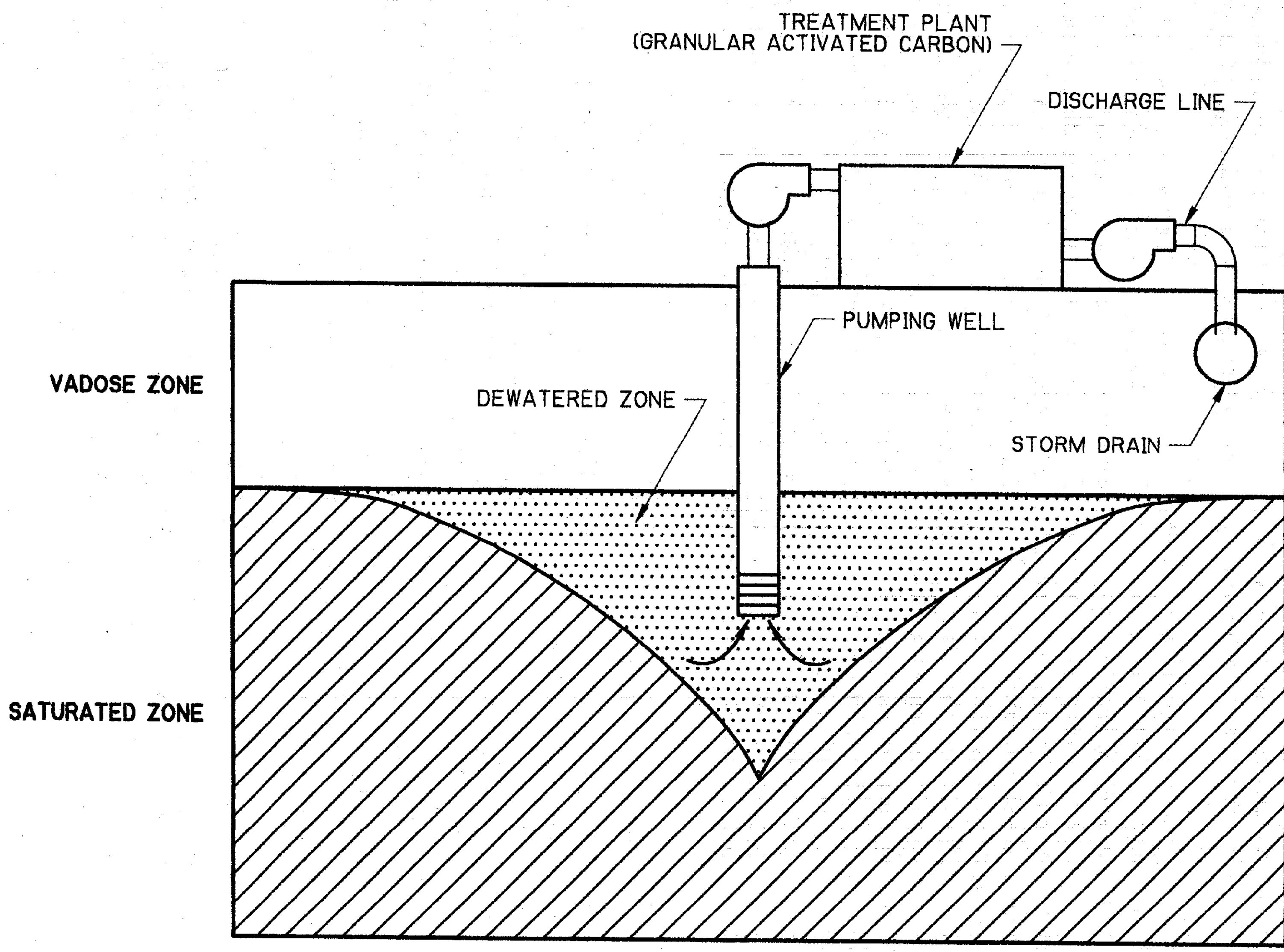

Figure 3-6
Ground Water Pump And Treat
Feasibility Study, Fumex Site - New Hyde Park, New York

In this technology, groundwater collection involves placing extraction wells near known areas of high pesticide contamination identified in the RI. The extraction wells would recover pesticide-laden groundwater that has migrated off-site and the local affected groundwater. Existing private and monitoring wells near or at the Site may be used for extraction wells. Based on the Site geology and hydrogeology, one extraction well is most likely sufficient in collecting water at pumping rates between 100 to 200 gallons per minute. Preliminary pumping tests would need to be conducted to determine the optimum pumping rates. The extraction or pumping well would be connected to an on-site treatment system via a piping manifold constructed of standard PVC piping, valves, and fittings.

Several physical, chemical, and biological treatment technologies are available to treat groundwater contaminated with organic constituents. These technologies include air stripping, steam stripping, biological reactor, chemical oxidation, and granular activated carbon adsorption (GAC). All the technologies mentioned above involve groundwater extraction and injection by pumping. Factors to consider in selecting the best available technology include contaminant properties, energy usage, implementation, feasibility, and total capital and operation and maintenance cost.

Properties of common pesticide compounds detected in soil and groundwater at the Site are listed in Table 3-1. The most common pesticide constituents found in local groundwater have relatively low vapor pressure. For this reason, air and steam stripping technologies are eliminated since the pesticide compounds are not readily volatilized. Biological treatment method is also eliminated since the total pesticide levels may not be sufficient to sustain a biological culture to degrade the contaminants. Finally, chemical oxidation technology is not selected because of its potential high material and energy usage costs.

A conventional groundwater treatment technology that is effective in treating water with organic constituents is granular activated carbon. The large surface area of the carbon particles provides adsorption sites for the pesticide compounds to bind as the groundwater passes through. Carbon vessels are sized according to pumping rates and are packaged in skids with intermediate piping, valves, and fittings between the vessels. The vessels are generally utilized in a parallel mode to reduce frequency of carbon changeouts. Spent carbon would be returned to the manufacturer where acquired organic constituents are incinerated during the carbon regeneration process.

Treated effluent from the treatment system would be directed via PVC piping into the nearest local storm drain for eventual recharge to the groundwater in a recharge basin.

3.4 Initial Screening of Potentially Feasible Technologies

The technologies described in the remediation of surface and subsurface soils and groundwater are listed in Table 3-2. This table lists each technology and its corresponding effectiveness in meeting the RAOs for surface and subsurface soil and groundwater.

The excavation and off-site disposal and treatment technologies would effectively remediate the surface and subsurface soils at the Site. The technologies effectively remove the contaminated media from the Site and reduce the toxicity of the material. The technologies transfer the contaminated waste from the Site to a RCRA-approved facility for treatment and disposal.

Table 3-1
Properties of Pesticide Compounds
Fumex Sanitation, Inc. Feasibility Study
New Hyde Park, New York

Chemical Name	Water Solubility @ 25° C (mg/L)	Vapor Pressure @ 25° C (mm Hg)	K_{oc} (mL/g)
Chlordane	5.60E-01	1.00E-05	1.40E+05
4,4'-DDE	4.00E-02	6.50E-06	4.40E+06
4,4'-DDT	5.50E-03	1.90E-07	2.43E+05
Dieldrin	1.95E-01	1.78E-07	1.70E+03
Endosulfan	5.30E-01	1.00E-05	NA
Heptachlor	1.80E-01	3.00E-04	1.20E+04

Source: "Hazardous Waste Management" by LaGrega, Buckingham, and Evans, 1994.

Table 3-2

Initial Screening of Potentially Applicable Technologies Soil and Groundwater Contamination

Fumex Sanitation, Inc.

New Hyde Park, New York

Technology	Effectiveness	Implementability	Cost	Screening
<u>No Further Action</u> No Further Action involves institutional controls and site-access restrictions and a groundwater monitoring program.	The No Further Action technology limits access to the site. This technology does not contain, remove or treat the on-site contamination.	The No Further Action technology is simple to implement. The action would typically require restrictions in future Site development or usage and/or installation of a fence to restrict public access.	The cost to implement the No Further Action Technology would be minimal.	Evaluate Further
<u>Excavation of All Surface Soil and Off-Site Disposal</u> Excavation of surface soil (top 18 inches of soil beneath the asphalt pavement) throughout the entire parking lot area and off-site disposal of contaminated material.	The excavation of surface soil throughout the entire parking lot area is an effective technology that will remove the most highly contaminated soil and therefore minimize migration to groundwater. This technology does not treat the contaminated material but instead transports and disposes it in a proper facility.	This technology can be easily implemented. It would involve the excavation of surface soils and would require a staging area for the excavated material. All excavated material would be transported and disposed in a RCRA approved disposal facility. This technology would interrupt the normal day to day activities at the Site. The entire parking lot would be removed thus preventing traffic from entering into the facility.	The cost to implement this technology is relatively expensive. Approximately 350 cubic yards (cy) of affected media would be removed.	Evaluate Further Selected because of its effectiveness and moderate cost.
<u>Excavation of Discrete Surface Soil Areas and Off-Site Disposal</u> Excavation of surface soil in 20-foot diameter circles centered around soil borings SB-11 to SB-14 and off-site disposal of contaminated material are performed.	The excavation of discrete surface soil areas is ineffective in removing the source of contamination since most of the contaminated surface soil will remain untouched. The potential migration via infiltration from surface soil to groundwater remains. This technology does not treat the contaminated material but instead transports and disposes it to an appropriate facility.	This technology is relatively simple to implement and would require an excavation and a staging area for the excavated material. The excavated material would be transported and disposed of at an appropriate facility.	The cost to implement this technology is relatively inexpensive. Approximately 70 cy of affected media would be removed from the discrete areas of concern.	Not selected since this technology removes only a portion of the highly contaminated soil and is ineffective in removing the source of contamination from the Site.
<u>Impermeable Membrane/Asphalt Cap Installation</u> An impermeable membrane/asphalt cap consisting of a PVC membrane material, a geotextile layer, and an asphalt cap will be installed on top of the backfill.	The cap is effective in eliminating percolation of runoff water through the affected soil media and into the groundwater. Not only will the cap prevent further migration of contaminants to the groundwater, but it will also provide a barrier against subsurface soil exposure.	The PVC and geotextile layers are readily placed on top of the backfill material. Another layer of clean soil is then put above the geotextile material, followed by an asphalt surface. Both operations are easily accomplished. This technology will interrupt the normal day to day activities at the Site. The entire parking lot will be removed thus preventing traffic from entering into the facility.	The overall cost to implement the impermeable membrane/asphalt cap is moderate. Inherent to this technology is that surface excavation of the site would be required.	Evaluate Further Selected for its effectiveness in providing protection to groundwater and subsurface soil and its moderate implementation cost.

Table 3-2

Initial Screening of Potentially Applicable Technologies Soil and Groundwater Contamination

Fumex Sanitation, Inc.

New Hyde Park, New York

Technology	Effectiveness	Implementability	Cost	Screening
Repair of Existing Pavement Repairing the existing parking lot to prevent the infiltration of runoff water through the fissures and cracks of the existing asphalt "cap".	Repair of the parking lot is effective in minimizing the infiltration of runoff water through affected soil media and possibly into the groundwater. The repairs will minimize the migration of contaminants and provide a barrier against direct exposure to contaminated surface soils.	Repair of the existing parking lot is a safe and simple technology. This technology can be performed quickly and efficiently. This technology would minimize interruptions to normal activities at the Site.	The overall cost to implement the asphalt cap is inexpensive.	Evaluate Further Selected because of its effectiveness and ease of implementation.
Dry Well Abandonment and Surface Runoff Basin and Drain Installation The on-site dry well will be abandoned and removed. In its place, a new catch basin will be installed. In addition, an associated drain pipe will be installed to divert water from the basin to an existing storm drain located just outside of the Site.	This technology is effective in removing the major source of water from infiltrating into the Upper Glacial aquifer. The threat of water coming into contact with the contaminated surface and subsurface soil is removed. Potential for groundwater contamination is also reduced.	The new catch basin will be placed in the former dry well location with proper structural supports. A trench with proper pipe supports will be created and the transmission pipe will be installed and connected from the basin to the existing local storm drain located just outside of the Site. This is a standard civil engineering solution.	The overall cost to remove the dry well, install the catch basin and the drain pipe, and provide trenching and backfill are relatively inexpensive.	Evaluate Further Selected for its effectiveness in providing protection to groundwater, surface and subsurface soil and its comparatively low implementation cost.
Excavation of All Soils and Off-Site Disposal Excavation of surface and subsurface soil throughout the entire parking lot area down to 40 feet depth and subsequent off-site disposal of contaminated material.	The excavation of surface and subsurface soil throughout the entire parking lot area is effective in removing the source of contamination. With the source removed, the potential of groundwater contamination via infiltration is eliminated. This technology does not treat the contaminated material but instead transports and disposes of it in a proper facility.	This technology is difficult to implement and would require extensive excavation and shoring efforts. An off-site staging area would be required. All excavated material would be disposed of off-site. This technology will interrupt the normal day to day activities at the Site. The entire parking lot will be removed thus preventing traffic from entering into the facility.	The cost to implement this technology is the most expensive in comparison with all other technologies. Approximately 9,700 cy of soil would be removed.	Not selected due to its high cost and difficult implementation. In addition, this technology does not provide additional protection to human health, the environment, and groundwater. When compared to other less costly and more implementable technologies, its high cost and difficult implementation outweigh its benefits.
Excavation of the Dry Well Trench and Off-Site Disposal Excavation of surface and subsurface soil in a 20 feet by 60 feet rectangular area within the vicinities of soil boring SB-11, the dry well, and monitoring well MW-6 and subsequent off-site disposal of affected material will be performed. Depths of excavation beneath SB-11, the dry well, and MW-6 vary.	The excavation of the dry well trench to varying depths is an effective technology that will remove the majority of contamination in the subsurface soil. The potential of groundwater contamination via infiltration is reduced. This technology does not treat the contaminated material but instead transports and disposes of it in a proper facility.	This technology is moderately simple to implement and would require excavation, shoring, and a staging area for the removed material. All excavated soil will be disposed off-site in a proper facility.	The cost to implement this technology is moderately expensive in comparison with surface soil excavation and off-site disposal technologies.	Evaluate Further Selected because of its effectiveness in providing protection to human health, the environment, and groundwater. Although the cost is moderately expensive this technology could be readily implemented.

Table 3-2

Initial Screening of Potentially Applicable Technologies Soil and Groundwater Contamination

Fumex Sanitation, Inc.

New Hyde Park, New York

Technology	Effectiveness	Implementability	Cost	Screening
Groundwater Pump and Treat Pump and Treat involves the extraction of groundwater with a pump from an on-site monitoring well, the treatment of the groundwater as it passes through granular activated carbon vessels, and the discharge of the treated effluent to a local storm drain.	Pump and treat system with granular activated carbon is effective in stripping organic constituents from groundwater. However, its applicability is limited at the Site since the pesticides have a strong tendency to bind to the soil matrix in the saturated zone. It is therefore highly inefficient and pumps would result in a long term operation.	This technology involves installing pipes that connect the extraction well to the treatment system and to the discharge line. The granular activated carbon treatment unit is readily available in a skid-mounted trailer with internal pipes and pumps.	The overall capital cost to install the pump and treat system is moderate to expensive. The costs increase further due to its high operation and maintenance costs and long duration.	Not selected due to its limited effectiveness and high O&M cost. This option does not provide additional protection to human health and the environment commensurate with the high cost.

Excavation of the surface soil throughout the entire parking lot area is an effective technology that reduces the threat to human health, public exposure, and the environment. This remedial option offers the removal of the source of contamination. The excavation and off-site disposal of the highly affected surface soil decrease the risk to public exposure during potential Site development, and prevent the possible migration of contaminants from the soil matrix to groundwater via infiltration. The threat to further groundwater contamination, albeit small, is therefore reduced as the source for contamination is eliminated. The cost of excavation and off-site disposal and treatment of roughly 350 cy of affected soil is estimated to be less than $500,000.

The technology of surface soil excavation at discrete contaminated areas provides only limited protection to human health and the environment. The discrete circle locations may not effectively remediate most of the affected surface soil. Areas outside of the discrete locations would remain untouched. Approximately 70 cy of contaminated material would be removed from the four discrete circles. Inferring from the sample results collected during Phase I and II RI field activities, it is probable that surface soil outside of the area excavated is similarly contaminated with pesticides. Therefore, the remaining surface soil could still pose a threat to public health and the environment through ingestion. The estimated cost for this technology is less than $110,000. The cost for this technology is the least expensive of all the excavation technologies proposed. However, the effectiveness of this technology cannot be determined. It is feasible that within the surface soil remaining, sources of pesticide contamination exist that exceed any of the four areas targeted for removal. Due to the uncertain nature of the effectiveness of this technology it would not be evaluated further.

The dry well trench excavation is an effective technology of subsurface material removal that meets the RAOs. Based on the Phase I and II RI data, and as discussed in Section 3.2.2, the rectangular area proposed for excavation in this technology encompasses the soil boring, SB-11, the dry well, and monitoring well MW-6. These areas have known elevated pesticide levels in the subsurface soil. This technology involves the removal of the source of contamination in surface and subsurface soils and thus reduces the threat to human health and the environment. The source removal, as already discussed earlier, also decreases the migration of pesticides via infiltration into groundwater. Therefore, this technology eliminates the threat of further groundwater contamination. Shoring would be required during soil removal activities. The cost to remove, dispose off-site, and treat nearly 900 cy of soil is estimated to be approximately $1,150,000.

The complete Site excavation technology provides an effective remedial action by removing all contaminated surface and subsurface soils. As a result, the risks associated with this contamination; public exposure, threat to human health and the environment, and further groundwater contamination, are further limited. However, excavation to depth of 40 feet bgs would require extensive shoring efforts, traffic coordination, and Site preparation. The cost to excavate about 9,700 cy of soil and dispose off-site and treat, implement shoring, and develop a traffic control plan and staging area is estimated to be several million dollars. Although this technology is effective, it does not substantially decrease the risks associated with human health and environment deterioration and groundwater contamination. When compared to the other, less extensive excavation technologies, this is clearly the most expensive. The added benefit is minimal due to the limited migration potential of the pesticides. Due to the complexity of performing this technology at this Site and the prohibitive costs associated with it, this technology would not be further evaluated.

Dry well abandonment (surface runoff basin and drain installation) serves as an effective remedial technology that minimizes the potential for groundwater contamination by removing the primary source of contamination (the dry well). Not only groundwater contamination could be prevented, but surface and subsurface soil contamination could also be minimized. The dry well historically has been a source of surface and subsurface soil and groundwater contamination resulting from runoff water infiltrating and percolating through the well. Therefore, abandoning the dry well, installing a new catch basin, and connecting a RCP line from the new basin to an existing local storm drain would terminate future runoff percolation through the dry well, into the soil, and finally into groundwater. This reduces the threat to human health and the environment as well as groundwater contamination. This technology is not only less costly than the excavation and off-site disposal and treatment options, but is also easy to implement. As a result, this remedial option is considered as a standard technology.

Capping the parking lot area by means of an impermeable membrane/asphalt cap or by repairing the asphalt would isolate the contaminated material, prevent infiltration through the surface soil and subsequent percolation into the groundwater. The cap would consist of a PVC layer, a geotextile cushioning layer, and an asphalt surface. The PVC layer is placed directly above the backfill materials followed by the geotextile layer, another thin soil layer (18 inches of sand/gravel), and an asphalt surface. These technologies provide an effective barrier against the potential migration of pesticides from the soil into the groundwater and against public exposure. The threat to human health and the environment is minimized. In addition, the impermeable membrane/asphalt cap and asphalt repairs are relatively inexpensive to implement.

Groundwater monitoring is included as a standard technology. Monitoring includes groundwater sampling from six on-site and six off-site wells installed by CDM. Sampling would be on an annual basis for ten years. The program should be reviewed after five years of implementation. Groundwater samples would be analyzed for TCL Pesticides. Monitoring provides an observation of changes in Site conditions over time.

The groundwater pump and treat technology is suitable for treatment of groundwater contaminated with organic constituents. The "pump" aspect of this technology involves using existing monitoring wells to extract groundwater at pumping rates between 100 to 200 gpm. These rates may be changed following additional pump tests to determine an optimum rate. The extracted water is routed to the "treatment" system where granular activated carbon contained in vessels is the preferred method. The large surface area of the carbon particles provides binding sites for adsorption of organic constituents as the groundwater flows through the carbon vessels. The manufacturer would replenish the spent carbon once it reaches breakthrough or saturation. The treated effluent would be directed to a local storm drain located just outside of the Site. It is assumed that all piping materials, valves, and fittings are made of PVC.

Although the groundwater pump and treat technology is effective in removing many types of organic constituents, its application would be far less effective for the Fumex site. As discussed in Section 1, the pesticide constituents detected at Site soils have high partitioning coefficients and thus are readily bounded to the soil matrix. Extracting water through the soil medium would not capture enough pesticides to make this a suitable treatment option. Pesticides prefer adsorption to soil over dissolution in water. Any pump and treat system would require hundreds of complete flushings of the Site in order to remove a substantial mass of contaminants. This is impractical, and would result in extremely long treatment duration at very low efficiencies. Fate and transport analyses presented in the RI Report conclude that pesticide mobility in the soil/water environment is low. Although dispersion is occurring through the infiltration of water, it is occurring at a relatively slow rate. Based on estimated contaminant velocities within the Upper Glacial aquifer and a highly conservative transport period of 46 years, the six most commonly detected pesticides within site soils would have traveled no further than 146 feet downgradient of the Site. In the case of chlordane, the travel distance over this period would be no more than nine feet from the Site. It is not expected that contaminants will migrate off-site.

The cost to implement the groundwater pump and treat system would be less than a million dollars. However, the operation and maintenance of the system, including carbon changeouts, would require additional labor and expenses. Annual maintenance cost may vary between $15,000 to $20,000 and treatment duration would be lengthy. The cost of this technology outweighs its benefits. Therefore, based on the current extent of groundwater contamination, the nature of contaminants, and the maintenance cost, groundwater treatment is not recommended at this time. In addition, due to the depth and distance of the nearest public supply well, the potential health risks posed by the groundwater pathway from this Site are minimal. Groundwater pump and treat would not be further evaluated as a remedial technology.

Summarizing the effectiveness of each technology shows that excavation and off-site disposal of affected soils is potentially effective for remediation of surface and subsurface soils. However, excavation and off-site disposal and treatment of discrete surface soil areas is not considered effective since most of the contaminated soils are left untouched. Dry well abandonment and associated installation of a new catch basin and drain are effective in reducing the potential for groundwater contamination and removing the sources of contamination in the surface and subsurface soils. Likewise, installation of an impermeable membrane/asphalt cap would provide a barrier against further migration of contaminants via infiltration of rain through the soil medium to groundwater. Groundwater pump and treat system is ineffective when applied due to the nature of contaminants.

The technologies were further evaluated with particular attention to cost and ease of implementation. Although effective in removing the sources of contamination, excavation of the entire Site to 40 feet bgs and subsequent off-site disposal and treatment technology is the most expensive and difficult to implement. Its additional environmental benefits are minimal. This technology is thus not suitable for the Site as a remedial option. Excavation of surface soil throughout the entire Site and the dry well trench excavation are less costly and relatively easy to moderate to implement. Likewise, the dry well abandonment , associated catch basin and drain installation and the impermeable membrane/asphalt cap installation could be implemented with lower expenses and less labor. Groundwater monitoring is considered as a standard technology and would be included. The minimal effectiveness and high operation and maintenance cost of the groundwater pump and treat system deem this technology as inapplicable for the Site.

Using the guidelines described above, the following technologies would potentially be the most effective at the Fumex site:

- surface soil removal of the entire parking lot area
- dry well trench excavation
- dry well abandonment and associated new catch basin and drain installation
- impermeable membrane/asphalt cap installation
- repair of the existing parking lot
- groundwater monitoring

3.5 Development of Candidate Remedial Alternatives

Based on the review of the technologically feasible options for the Fumex site presented in this section, and the elimination of those technologies that are not feasible, practical, or cost-effective, four remedial alternatives have been developed for a more detailed evaluation.

Alternative 1 -No Further Action, Institutional Controls, and Groundwater Monitoring

The No Further Action alternative is typically included in an FS to provide a baseline for comparison to other remedial actions. This alternative usually involves future monitoring at the Site and institutional controls. The No Further Action alternative would include:

- land use controls to minimize site development and limit exposure to affected soil,

- access restrictions with physical barriers and proper written warnings to prohibit public entry to the Site and to warn the public of hazards associated with the Site,

- well permit regulations to restrict potential public exposure during the installation or abandonment of wells, and

- Periodic monitoring of existing on-site groundwater monitoring wells and off-site public supply wells.

Monitoring of the wells would be used to augment the existing site database from the RI and to evaluate changes in site conditions over time. The monitoring program would be based upon an annual sampling schedule for the next ten years with a review after the initial five years.

Alternative 2 - Dry Well Abandonment and Associated Surface Runoff Basin and Drain Installation, Repair of the Existing Asphalt Surface, and Groundwater Monitoring

Alternative 2 consists of:

- abandonment and removal of the on-site dry well
- installation of a catch basin in place of the dry well
- installation of a RCP drain from the basin to a local storm drain

- repair of the parking lot asphalt surface, and
- implementation of a groundwater and Site monitoring program.

This alternative does not involve the excavation of surface or subsurface soils. Human and environmental exposures are minimized by the partial removal of the source of contamination via the dry well abandonment. The repair of the parking lot asphalt surface to patch all cracks and fissures reduces groundwater impact from infiltration of surface runoff. The new catch basin and associated RCP would divert runoff water into a local storm drain. Groundwater and Site monitoring would be implemented to evaluate the potential off-site migration of contaminants and observe changes in Site conditions, including inspection of the asphalt surface.

Alternative 3 – Institutional Controls, Excavation of All Surface Soil, Dry Well Abandonment and Associated Surface Runoff Basin and Drain Installation, Impermeable Cap, and Groundwater Monitoring

Alternative 3 includes the following technologies:

- provision for institutional controls
- excavation of the top 18 inches of soil layer over the entire parking lot area
- disposal and treatment of the excavated material to an off-site RCRA-approved facility
- backfill of excavated area with clean soil
- abandonment and removal of the on-site dry well
- installation of a catch basin in place of the dry well
- installation of a RCP drain from the basin to a local storm drain
- installation of an impermeable membrane/asphalt cap, and
- implementation of a groundwater monitoring program.

Subsurface soil would be left undisturbed. This alternative would minimize human and environmental exposure to Site contaminants by removing the sources of contamination via excavation and dry well abandonment. With the main sources removed and with the installation of an impermeable membrane/asphalt cap, the potential impact to groundwater would be minimized as infiltration is eliminated. The new catch basin would collect surface runoff and the associated RCP line would divert the runoff to an existing storm drain located just outside of the Site. The monitoring program would be implemented to track potential future off-site migration of contaminants and to evaluate changes in groundwater condition over time.

Alternative 4 -Excavation of All Surface Soil, Excavation of the Dry Well Trench, Dry Well Abandonment and Associated Surface Runoff Basin and Drain Installation, Impermeable Cap, and Groundwater Monitoring

Alternative 4 combines the following remedial options:

- excavation of the top 18 inches of soil layer over the entire parking lot area,
- excavation of a 20 feet by 60 feet trench within the vicinities of SB-11, the dry well, and MW-6 to depths discussed earlier,
- disposal and treatment of the excavated material to an off-site RCRA-approved facility,

- backfill of excavated area with clean soil,
- abandonment and removal of the on-site dry well,
- installation of a catch basin in place of the dry well,
- installation of a RCP drain from the basin to a local storm drain,
- installation of an impermeable membrane/asphalt cap, and
- implementation of a groundwater monitoring program.

Alternative 4 combines several identified feasible remedial options to bring an enhanced level of exposure prevention and Site remediation. It is anticipated that greater costs would be associated with this greater remediation effort. This alternative minimizes human and environmental exposure by removing the main sources of contamination via surface and subsurface soil excavation and dry well abandonment. Excavation of subsurface soil in areas with elevated pesticide levels offers additional reduction in potential public exposure during Site development. As the placement of an impermeable membrane/asphalt cap and the installation of a surface runoff catch basin and associated RCP line prevent infiltration, the potential adverse impact to groundwater quality would be minimized.

Section 4
Detailed Analysis of Alternatives

4.1 Criteria

The four alternatives for remediation developed through the screening process presented in Section 3 are:

- Alternative 1: No Further Action, Institutional Controls, and Groundwater Monitoring;
- Alternative 2: Dry Well Abandonment and Associated Surface Runoff Basin and Drain Installation, Repair of the Existing Asphalt Surface, and Groundwater and Site Monitoring;
- Alternative 3: Institutional Controls, Excavation of All Surface Soil, Dry Well Abandonment and Associated Surface Runoff Basin and Drain Installation, Impermeable Cap, and Groundwater Monitoring;
- Alternative 4: Excavation of All Surface Soil, Excavation of the Dry Well Trench, Dry Well Abandonment and Associated Surface Runoff Basin and Drain Installation, Impermeable Cap, and Groundwater Monitoring.

The purpose of this section is to evaluate these alternatives based on the seven evaluation criteria identified in the TAGM to address technical and policy considerations.

4.1.1 Compliance With Applicable or Relevant and Appropriate Requirements, and Standards Criteria and Guidelines (ARARS/SCGs)

Alternatives are evaluated to determine whether they comply with all applicable or relevant and appropriate requirements, or if a waiver is required, how it is justified. The alternatives are evaluated against three categories of SCGs, chemical-, action-, and location-specific. The SCGs are listed in Tables 1-6 through 1-8.

4.1.2 Protection of Human Health and the Environment

Alternatives are evaluated to determine whether they can adequately protect human health and the environment following remedial action. The analysis indicates how much risk at the site is eliminated, reduced, or controlled, and considers exposure levels established during the development of the remediation goals.

4.1.3 Short-Term Effectiveness

The short-term impacts of each alternative are evaluated according to: (1) the risks that may result during construction; (2) the time until remedial response objectives are achieved; (3) the potential impacts on workers during remedial action, the effectiveness and reliability of protective measures available to workers; and (4) the potential environmental impacts of the remedial action and the effectiveness of mitigative measures during construction.

4.1.4 Long-Term Effectiveness and Permanence

Alternatives are also assessed for the long-term effectiveness and permanence they provide, along with the degree of certainty that the alternative will be successful. This evaluation concerns the time period during the operation of the remedial action and after the operation of the remedial action. Other long-term effectiveness and permanence factors include the magnitude of residual risk from untreated waste or treatment residuals remaining at the conclusion of the remedial activities. The adequacy and reliability of controls such as containment systems and institutional controls that are necessary to manage treatment residuals and/or untreated waste will also be evaluated. This criterion should include assessment of the potential need to replace components of the alternative and associated risks.

4.1.5 Reduction of Toxicity, Mobility, or Volume

The degree to which alternatives employ recycling or treatment that reduces toxicity, mobility, or volume shall be assessed, including how treatment is used to address the principal threats posed by the site. Factors that shall be considered include: (1) the amount of hazardous contaminants that will be destroyed, treated, or recycled; (2) the degree to which treatment reduces the inherent hazards posed by principal threats at the site; (3) the degree to which the treatment is irreversible; and (4) the type and quantity of residuals that will remain following treatment.

4.1.6 Implementability

The ease or difficulty of implementing the alternatives shall be assessed by considering the technical and administrative feasibility of a technology and the availability of services and materials. The technical feasibility includes: (1) difficulties and unknowns associated with the construction and operation of a technology; (2) the reliability of the technology; (3) the ease of undertaking additional remedial actions; and (4) the ability to monitor the effectiveness of the remedy. The administration factors include coordination with other offices and agencies. The assessment of availability of services and materials includes: (1) the availability of adequate off-site treatment, storage capacity, and disposal capacity and services; (2) the availability of necessary equipment, specialists and skilled operators, and provisions to ensure any necessary additional resources; and (3) the availability of services and materials with competitive bidding.

4.1.7 Cost

The types of costs that are evaluated include capital costs, including both direct and indirect costs; annual operation and maintenance costs; future capital costs, and cost of future land use as described below:

- <u>Capital Costs</u> - Capital costs consist of direct (construction) and indirect (non-construction and overhead) costs.
  - Equipment Costs - Equipment necessary and available for the remedial action.
  - Land and Site-Development Costs - Purchase of land and site preparation of existing property.

- Building and Services Costs - Buildings, utilities, and purchased services.
- Disposal Costs - Transporting and disposing of waste material.
- Engineering Expenses - Administration, design, construction supervision, drafting, and treatability testing.
- Legal Fees and License or Permit Costs
- Start Up and Shakedown Costs
- Contingency Allowances - To cover unforeseen circumstances.

- Operation and Maintenance Costs - Annual post-construction costs necessary to ensure the continued effectiveness of a remedial action. The following annual cost components should be considered:

  - Operating Labor Costs - Wages, salaries, training, overhead, and fringe benefits associated with post-construction operation
  - Maintenance Material and Labor Costs
  - Auxiliary Materials and Energy - Chemicals, electricity, water, and sewer, etc.
  - Disposal of Residues - To treat or dispose of residuals such as sludges from treatment processes or spent activated carbon.
  - Purchased Services - Sampling costs, laboratory fees, and professional fees that can be predicted.
  - Administrative Costs
  - Insurance, Taxes, and Licensing Costs
  - Replacement Costs
  - Costs of Periodic Site Reviews - Reviews to be conducted every five years if a remedial action leaves any hazardous substances, pollutants, or contaminants at the site.

- Future Capital Costs - Costs for future remedial actions should be evaluated when there is the potential for a major component of the remedial alternative to break down or need replacement.

- Cost of Future Land Use - Potential future land use of the site is normally considered with regards to future zoning or residential development that may be restricted if hazardous waste is left at the site or if groundwater use is impacted. However, for this study it was not considered because each alternative will have similar impacts on surrounding land use. Once the site is remediated so that it no longer presents a significant threat to human health or the environment, the future use and property value of surrounding properties will be enhanced.

A present worth analysis is performed to bring all future costs to the current year for easy comparison. The total present worth cost of the alternative includes the direct and indirect capital costs and the present worth of the annual and periodic costs over the design life of the alternative at an annual rate of six percent. A cost sensitivity analysis may evaluate any uncertainties concerning specific assumptions made for individual costs, if necessary. At this stage of the Feasibility Study, costs are expected to be within -30 to +50 percent.

4.2 Remediation Alternatives

4.2.1 Alternative 1 - No Further Action, Institutional Control, and Groundwater Monitoring

The evaluation of Alternative 1 includes the implementation of institutional controls, groundwater monitoring and the impact of no further action.

4.2.1.1 Compliance with ARARs/SCGs

Three types of ARARs/SCGs evaluated in this Feasibility Study are chemical-specific, action-specific, and location-specific.

The chemical-specific ARARs/SCGs address whether the Site's impacts to the soil and groundwater exceed the Federal, State, or Local standards. For example, in order to comply with the chemical-specific ARARs/SCGs, soil condition should observe the NYSDEC TAGM, HWR-94-4046 regulations as well as other applicable standards listed in Table 1-6. In Alternative 1, no active remediation is applied and only institutional controls are considered. Institutional controls comprise of physical or zoning restrictions within the Site boundary. Although these controls minimize public access to the Site, they do not result in compliance with the chemical-specific ARARs/SCGs for soil and groundwater at the Site.

The action-specific ARARs/SCGs addresses the potential adverse impacts to the surrounding area as a result of remedial action performed as part of the alternative. Table 1-7 lists all the action-specific ARARs/SCGs that this alternative must comply. Because institutional controls do not involve heavy construction and removal and/or transportation of contaminated media or residual generated from the Site, this alternative is in compliance with applicable action-specific ARARs/SCGs.

The location-specific ARARs/SCGs apply to remedial actions that may affect natural preserves with endangered-species, wetlands, and sensitive flood plains. These ARARs/SCGs also include regulations governed by local regulatory agencies for special air emissions caused by the proposed remedial actions. Because institutional controls do not affect any wetlands and sensitive flood plains nor emit any air emissions, this alternative is in compliance with location-specific ARARs/SCGs.

4.2.1.2 Protection of Human Health and the Environment

Institutional controls consist of warning signs and fencing around the Site property boundary. These physical controls protect human health by restricting public access.

Institutional controls alone do not address protection of the environment. Institutional controls strictly place physical or zoning restrictions on land or water use, but do not actively remediate the Site. Although naturally occurring processes will take place to eventually reduce the distribution and concentration of the contamination, contaminant release in soil and to groundwater will continue to occur. Therefore, the residual risk remaining at the Site is classified as moderate.

4.2.1.3 Short-Term Effectiveness

Institutional controls in Alternative 1 do not pose short-term risks to the community because the controls constitute mostly administrative changes to zoning or well permitting. No heavy construction (only the installation of property fencing) is associated with institutional controls. Installation of fencing around the property will take approximately one week. The second part of this alternative, groundwater monitoring, does not pose any short-term risks.

4.2.1.4 Long-Term Effectiveness and Permanence

Alternative 1 does not treat or reduce the contaminants and therefore cannot be considered effective over the long term. Institutional controls only minimally reduce the potential for human exposure to the contaminants.
Long term groundwater monitoring will track any migration of contaminants in the future.

4.2.1.5 Reduction of Toxicity, Mobility or Volume

Institutional controls do not actively reduce the volume or toxicity of the contaminants at the Site, but only limit exposure to contaminants. However, natural attenuation, dispersion and dilution will decrease the contaminant concentration over time.

4.2.1.6 Implementability

As previously discussed, institutional controls are neither labor intensive nor difficult to implement. The controls are technically feasible to implement and delays are not expected. Minimum coordination is expected for agency approvals. Multiple vendors are available to provide competitive bidding. Groundwater monitoring can be readily performed on an annual basis using the existing groundwater and private wells.

4.2.1.7 Cost

The estimated costs for Alternative 1 include:

- Capital Cost — $14,800
- Operations and Maintenance Cost — $7,900 per year (for 10 years)
- Future Capital Cost — $0
- Present Worth — $70,000

Cost breakdown is presented in Appendix A. Capital cost includes the materials needed to construct the fencing and to place warning signs around the Site. The operations and maintenance costs include maintaining the fencing at the Site, and costs to perform annual sampling of 12 monitoring wells.

Present worth costs of this alternative includes the direct and indirect capital costs and the present worth of the annual and periodic costs over the design life of the alternative at an annual rate of six percent.

4.2.2 Alternative 2 - Dry Well Abandonment and Associated Surface Runoff Basin and Drain Installation, Repair of the Existing Asphalt Surface, and Groundwater and Site Monitoring

The evaluation of Alternative 2 includes dry well abandonment and associated surface runoff basin and drain, repair or repaving of the parking lot asphalt surface, and groundwater and Site monitoring.

4.2.2.1 Compliance with ARARs/SCGs

Alternative 2 does not address the chemical-specific ARARs/SCGs for soil. Although the dry well source for surface and subsurface soil contamination is removed, the existing affected soils remain in the surface and subsurface. Soil concentrations will not be in compliance with applicable chemical ARARs/SCGs. This alternative partially complies with the chemical-specific ARARs/SCGs for groundwater since the potential for further groundwater contamination is reduced, but not eliminated, as the dry well is abandoned and the parking lot asphalt surface is repaved. Percolation of runoff water through affected soil and into groundwater is significantly decreased. Direct discharge of runoff water is eliminated. As a result, Alternative 2 may potentially comply with the chemical-specific ARARs/SCGs for groundwater in the future if: all cracks and fissures in the parking lot asphalt surface are repaired, the asphalt surface is frequently maintained, and the catch basin and drain are periodically checked for leaks and deposit build-up.

This alternative meets the action-specific ARARs/SCGs since minimal construction and dust generation activities are anticipated. All other relevant standards, such as OSHA regulations for construction and remediation activities, worker safety, and hazardous materials transportation, will be observed during field activities.

Alternative 2 is in compliance with location-specific ARARs/SCGs since this alternative will not affect any immediate wetlands or sensitive flood plains in the area.

4.2.2.2 Protection of Human Health and the Environment

Alternative 2 partially protects human health and the environment. The dry well removal and the asphalt surface repaving provide limited protection to the public and the environment by minimizing future soil and groundwater contamination through runoff infiltration. The remaining affected soils at the surface and subsurface layers will not allow unrestricted future use or development of the Site. The potential public exposure to contaminants during future Site development will remain high.

Groundwater monitoring will serve to identify the future risks to human health and the environment via the groundwater pathway, but future exposure could potentially result because the affected soils will still be present at the Site, and runoff water infiltration through the soil media will still occur at minimal rate. Site monitoring will provide evaluation of the asphalt surface condition over time.

The residual risk at the Site is classified as moderate.

4.2.2.3 Short-Term Effectiveness

Minimal amounts of dust may be generated during the dry well removal and pipe trenching activities. Suppression measures, such as water or chemical dust suppressants, will be applied when necessary. In addition, workers may be subjected to short-term contaminant exposure during dry well removal and trenching as surface and subsurface soils are exposed during excavation. Although the contaminants are not airborne or volatile, workers will be required to wear the corresponding minimum level of personal protective equipment.

It is anticipated that remedial measures of this alternative could be implemented within several months. At least six months will be needed to design, permit, trench, install, connect the surface runoff drain and to backfill the trench accordingly. An additional two weeks is required to repave the parking lot area and for clean-up activities.

4.2.2.4 Long-Term Effectiveness and Permanence

Alternative 2 does not reduce the volume or concentration of the contaminants. In addition, this alternative does not entirely eliminate the potential for future groundwater contamination via infiltration since the affected surface and subsurface soils are left untouched. However, the dry well removal and asphalt surface repaving will minimize runoff water infiltration through the affected soil and into the groundwater. The catch basin and the associated drain installation will direct runoff water into a storm drain and therefore will not allow direct discharge into the underlying aquifer. The long-term risk is thus considered to be moderate.

4.2.2.5 Reduction of Toxicity, Mobility, or Volume

Since no treatment technologies are included, this alternative does not significantly reduce the volume and toxicity found at the Site. Mobility of contaminants entering the groundwater system via infiltration will be reduced as cracks and fissures in the asphalt surface are repaired. Natural processes, such as attenuation, dispersion, and biodegradation will dilute the level of contaminants over time, resulting in a further reduction of volume and toxicity.

4.2.2.6 Implementability

Remedial actions in Alternative 2 could be readily implemented with available materials and workers. Light construction equipment will be necessary to remove the dry well, place the new basin, create piping trenches, and provide backfill and compaction. Specialized equipment will be necessary to pave the parking lot surface with new asphalt. Multiple vendors are available to bid on the project and to provide the materials and equipment. Limited agency contact is anticipated. Groundwater monitoring is standard and therefore easy to implement.

4.2.2.7 Cost

The estimated costs presented below include dry well abandonment and removal, surface runoff basin and drain installation, asphalt surface repaving, and groundwater monitoring.

- Capital Cost — $137,000
- Operations and Maintenance Cost — $10,000 per year (for 10 years)
- Future Capital Cost — $0

- Present Worth $200,000

Costs breakdown is provided in Appendix A.

4.2.3 Alternative 3 - Institutional Controls, Excavation of All Surface Soil, Dry Well Abandonment and Associated Surface Runoff Basin and Drain Installation, Impermeable Cap, and Groundwater Monitoring

The evaluation of Alternative 3 includes provision for institutional controls, excavation of the top 18 inches of soil layer immediately below the asphalt pavement, removal of existing dry well and associated installation of runoff basin and drain, placement of impermeable cap, and provision for groundwater monitoring.

4.2.3.1 Compliance with ARARs/SCGs

Alternative 3 partially addresses the chemical-specific ARARs/SCGs for soil. Removal of the surface soil throughout the parking lot area will minimize public exposure and contact. After removal and subsequent backfill, soil concentrations in the surface soil will be in compliance with the chemical-specific ARARs/SCGs. Although excavation of the surface soil significantly reduces the impact of contamination at the surface, it does not completely eliminate the potential of the deeper, subsurface soil (soil below a depth of 18 inches) exposure during future Site development. The remaining affected subsurface soils may pose a hazard during future land use of the Site and will remain above the applicable ARARs/SCGs. Institutional controls provided under this alternative include physical or zoning restrictions within the Site boundary. These controls will minimize public access to the Site, but they will not result in compliance of the chemical-specific ARARs/SCGs for soil. However, this alternative is in compliance with the chemical-specific ARARs/SCGs for groundwater. The placement of the impermeable membrane/asphalt cap should prevent infiltration of runoff through the soil and into the groundwater. Additionally, the dry well removal and replacement with the catch basin and drain will divert runoff into a local storm drain and prevent runoff from percolating through the aquifer. This alternative will further improve compliance with the chemical-specific ARARs/SCGs for groundwater.

Alternative 3 in part meets the action-specific ARARs/SCGs. There is limited potential for fugitive dust emissions that may exceed relevant ARARs/SCGs during excavation and transportation activities of surface soil, the construction of the impermeable cap, the abandonment of the dry well, and the installation of the basin and drain. All other relevant standards, such as OSHA regulations for construction and remediation activities, worker safety, and hazardous materials transportation, will be observed during all activities.

Alternative 3 is in compliance with location-specific ARARs/SCGs since this alternative will not affect any immediate wetlands or sensitive flood plains in the area.

4.2.3.2 Protection of Human Health and the Environment

Alternative 3 provides protection of human health and the environment by including institutional controls and the removal of the sources of groundwater and soil contamination. Institutional controls provided by warning signs and fencing around the Site boundary will result in the protection of human health by restricting public access. Removal of the surface soil will decrease the potential of public exposure or contact during future Site development and lessen further damage to the environment. In addition, the potential for further groundwater contamination via infiltration will also be minimized. The addition of the impermeable cap will eliminate the amount of runoff infiltrating the soil. Likewise, the dry well removal and its replacement with a catch basin and a discharge pipe connected to a storm basin will disallow further discharge into the underlying aquifer. This alternative therefore provides protection to human health and the environment by eliminating potential pathways of contact and exposure.

As already discussed, groundwater monitoring will be used to observe changes in conditions over time and to identify future risks to human health and the environment via the groundwater pathway.

The residual risk at the Site is considered low.

4.2.3.3 Short-Term Effectiveness

Institutional controls do not pose short-term risks because the controls constitute mostly administrative changes to zoning or well permitting. However, dust may be generated during the excavation of surface soil, dry well removal, catch basin installation, and trenching for RCP installation. Suppression measures described in Alternative 2 will be used as necessary. The activities described above may also subject workers to short-term exposure of contaminants. A monitoring program will be implemented to identify action levels.

It is anticipated that remedial measures of this alternative could be implemented within six to nine months. This includes excavate and remove the dry well, design, permit and install the catch basin, and design and install the impermeable cap and the surface runoff drain.

4.2.3.4 Long-Term Effectiveness and Permanence

Institutional controls only minimally reduce the potential for human exposure to the contaminants and are thus ineffective over the long term. The removal of the highly affected surface soil and the dry well diminishes the risks associated with human health and environment deterioration. As previously discussed, these sources of soil and groundwater contamination, mainly through infiltration of runoff, will be removed in order to provide protection to public exposure and contact. In addition, the installation of the impermeable cap will prevent subsurface contaminant exposure and continued runoff infiltration into the groundwater. The catch basin and the associated RCP drain will offer additional protection against infiltration by diverting runoff water into a local storm drain. The long-term risk at the Site is therefore considered low.

4.2.3.5 Reduction of Toxicity, Mobility, or Volume

In a RCRA-approved soil disposal facility, contaminated soils will be treated (chemically and/or thermally) to reduce the soil contaminant concentrations to levels acceptable for landfill application. Treated soils will then be placed in a landfill and capped. Alternative 3 therefore reduces the toxicity or volume of contaminants. The placement of the impermeable cap decreases the potential contaminant migration into the groundwater by virtually eliminating infiltration. The cap will result in a reduction of contaminants entering the groundwater system. Natural processes, such as attenuation, dispersion, and biodegradation will dilute the level of contaminants over time, resulting in a further reduction of volume and toxicity.

4.2.3.6 Implementability

The implementation of the remedial actions in Alternative 3 will require coordination to minimize disturbance to neighboring residential areas. Institutional controls are neither labor intensive nor difficult to implement. In addition, soil excavation and dry well removal are relatively simple to implement. An on-site staging area will be necessary to place excavated soil prior to transport and disposal. The impermeable cap and the surface runoff basin and drain installation and construction will need additional coordination and set-up effort since both field activities require readily available equipment, materials, and labor. Minimal agency coordination for all field work is anticipated. Numerous vendors are available to bid on the project and to provide materials and equipment. Groundwater monitoring is standard and therefore easy to implement.

4.2.3.7 Cost

The estimated costs presented below include installation of fencing and warning signs, Site surface excavation, dry well abandonment, basin and drain installation, impermeable cap placement, and groundwater monitoring.

- Capital Cost — $608,000
- Operations and Maintenance Cost — $10,700 per year (for 10 years)
- Future Capital Cost — $0
- Present Worth — $675,000

Costs breakdown is included in Appendix A.

4.2.4 Alternative 4 - Excavation of All Surface Soil and, Excavation of the Dry Well Trench, Dry Well Abandonment and Surface Runoff Basin and Drain Installation, Impermeable Cap, and Groundwater Monitoring

The evaluation of Alternative 4 includes the following activities: Site surface excavation, dry well removal and installation of a catch basin and drain installation, impermeable membrane/asphalt cap installation, groundwater monitoring and a trench, subsurface excavation in the area encompassing SB-11, the existing dry well, and MW-6.

4.2.4.1 Compliance with ARARs/SCGs

Alternative 4 partially addresses the chemical-specific ARARs/SCGs for soil. Excavation of the highly affected surface soils throughout the entire parking lot area and the subsurface soils in the vicinities of SB-11, the dry well, and MW-6 will result in soil concentrations within compliance of the chemical-specific ARARs/SCGs for these areas. The remaining affected subsurface soils may pose a potential hazard during future land use of the Site and will remain above the applicable ARARs/SCGs. These activities will also lessen the potential for public exposure during future Site development or use and minimize the risks of further groundwater contamination. As previously discussed, the dry well removal, the runoff basin and drain installation, and the impermeable cap placement will improve compliance with the chemical-specific ARARs/SCGs for soil and groundwater. This alternative will further improve compliance with the chemical-specific ARARs/SCGs for groundwater.

Action-specific ARARs/SCGs are only partially met. During the more intensive dry well trench excavation, fugitive dust emissions may potentially exceed relevant ARARs/SCGs. All other relevant standards, such as OSHA regulations for construction and remediation activities and hazardous materials transport standards, will be observed during all activities.

Because this alternative will not affect any wetlands and sensitive flood plains nor emit any air emissions, it is in compliance with location-specific ARARs/SCGs.

4.2.4.2 Protection of Human Health and the Environment

Alternative 4 provides adequate protection of human health and to the environment. The excavation of surface soils, the removal of the dry well, the installation of the surface runoff basin and drain, and the placement of the impermeable cap will significantly eliminate the potential of public exposure during Site development. These activities will also diminish the risks to human health and the environment by minimizing groundwater contamination. The dry well trench excavation further reduces the risks mentioned above since additional contaminated soils are removed from the subsurface.

4.2.4.3 Short-Term Effectiveness

During field activities dust may be generated at the Site. More dusts may be emitted during the dry well trench excavation. Suppression measures will thus be used to decrease dust generation. This alternative also may subject workers to more short-term contaminant exposure, in particular during the subsurface excavation. Although unlikely, workers may therefore be required to upgrade their personal protective equipment as necessary.

4.2.4.4 Long-Term Effectiveness and Permanence

Alternative 4 provides long-term effectiveness and permanence because sources of soil and groundwater contamination are removed via excavation of surface soils and dry well removal. Advantages of the impermeable cap, the runoff catch basin, and the connection RCP drain are highlighted in Alternative 3. However, this alternative offers additional protection to human health and the environment by including the excavation of affected subsurface soil. The removal of subsurface soil will reduce the risks associated with public exposure during future Site development. As a result, the long-term risk of this alternative is considered low. As indicated in Alternatives 2 and 3, groundwater monitoring provides routine groundwater quality inspection.

4.2.4.5 Reduction of Toxicity, Mobility, and Volume

In a RCRA-approved soil disposal facility, contaminated soils will be treated (chemically and/or thermally) to reduce the soil contaminant concentrations to levels acceptable for landfill application. Treated soils will then be placed in a landfill and capped. Alternative 4 therefore reduces the toxicity or volume of contaminants. The placement of the impermeable cap decreases the potential contaminant migration into the groundwater by virtually eliminating infiltration. The cap will result in a reduction of contaminants entering the groundwater system. Natural processes, such as attenuation, dispersion, and biodegradation will dilute the level of contaminants over time, resulting in a further reduction of volume and toxicity.

4.2.4.6 Implementability

Alternative 4 requires increased coordination. Not only do the impermeable cap and the surface runoff basin construction require full inspection, but also the deeper, subsurface excavation will require additional supervision. An on-site staging area will be needed to place removed soils prior to transport and disposal. Minimal agency interaction for all field work is anticipated. Numerous vendors are available to bid on the project and to provide materials and equipment. Groundwater monitoring is standard and therefore easy to implement.

4.2.4.7 Cost

The following outlines the estimated costs involved in implementing Alternative 4:

- Capital Cost — $1,760,000
- Operations and Maintenance Cost — $10,200 per year (for 10 years)
- Future Capital Cost — $0
- Present Worth — $1,825,000

Cost breakdown is included in Appendix A.

Section 5
Comparative Analysis

The previous section described each of the four alternatives and evaluated them individually against the seven criteria specified in the NYSDEC Technical and Administrative Guidance Memorandum (TAGM). This section compares the four alternatives to each other according to the seven TAGM criteria. This comparison will identify the strengths and weaknesses of each alternative relative to each other.

5.1 Compliance with ARARs/SCGs

The chemical-specific ARARs will be discussed first. The No Further Action alternative does not address the chemical-specific standards because this alternative does not reduce or remediate the constituents of concern in any media.

Alternative 2 does not meet the chemical-specific ARARs/SCGs for soil by leaving affected soil in place without excavation. This alternative however partially complies with chemical-specific ARARs/SCGs for groundwater as the dry well is removed to eliminate direct discharge into the subsurface media and the underlying aquifer, and the asphalt surface is repaved to reduce runoff infiltration through cracks and fissures.

Minimal groundwater contamination may continue to occur, through contact with contaminated subsurface soil, during normal fluctuations within the groundwater table.

Alternative 3 only partially complies with the chemical-specific ARARs/SCGs for soil because this alternative only addresses removal of surface soil and provision for institutional controls. This alternative does not specify the excavation of affected subsurface soil. Alternative 3 would partially comply with the chemical-specific ARARs/SCGs for groundwater by including the impermeable cap placement, the dry well removal, and the catch basin and drain installation.

Alternative 4 would be in partial compliance with the chemical-specific ARARs/SCGs for groundwater. The potential risks for future groundwater contamination would be reduced as infiltration from the Site is minimized. Additionally, the placement of the impermeable cap, designated soil excavation and the dry well removal would further reduce the sources of contamination at the Site. Alternative 4 partially complies with the chemical-specific ARARs/SCGs for soil because contaminated surface and subsurface soil would be excavated and disposed of off-site.

Action-specific standards include OSHA health and safety protocols and CERCLA/SARA regulations for hazardous wastes. These standards would be addressed during the construction, installation, and implementation of each alternative according to site specific conditions. It is assumed that all of the alternatives can meet the SCGs during field activities.

The location specific standards apply to surface water bodies, wetlands, endangered species, and floodplains. These standards are not applicable to the Site since no wetlands, endangered species habitats, or floodplains are located near the landfill.

5.2 Protection of Human Health and the Environment

The No Further Action alternative is ineffective in reducing the exposure to contaminants in all media. The magnitude of the risk to human health and the environment under the No Further Action alternative was determined to be moderate.

The risk to human health and the environment under Alternative 2 is classified as low to moderate. Alternative 2 does provide protection but it is limited protection since the affected soils in the surface and subsurface are not removed. Potential exposure via the soil pathway and subsequently the groundwater pathway is low to moderate.

Alternative 3 is more effective in limiting potential exposure via the soils and groundwater pathway than Alternative 2. The removal of the sources of contamination and the placement of the impermeable cap decrease the threat to human health, the environment, and groundwater. However, the remaining unexcavated subsurface soil may pose future public exposure during site development. The residual risk is considered low.

Alternative 4 results in minimal exposure to contaminants via soils and groundwater. The removal of the sources of contamination would reduce further groundwater quality deterioration and potential public exposure during future site uses or development. The magnitude of risk to human health and the environment is considered low.

5.3 Short-Term Effectiveness

Alternative 1 presents moderate short term risks to the community and the environment associated with all contaminated media. All other alternatives present potential short term risks to the community during the excavation activities, dry well abandonment, and surface runoff basin and drain installation due to the potential for the generation of fugitive dusts and heavy equipment traffic.

In all alternatives, dust and short-term contaminant exposure control measures would be developed to mitigate short-term risks during field activities. All four alternatives could take less than twelve months to complete. The duration of Alternative 4, due to the more extensive excavation activities, is expected to exceed twelve months.

5.4 Long-Term Effectiveness and Permanence

Alternatives 1 and 2 do not provide long term-effectiveness or a permanent remedy since the contaminants of concern are left untreated in all media. The removal of the dry well and the repair and repaving of the parking lot proposed in Alternative 2 would be effective in limiting the potential for groundwater contamination. In addition, natural processes, such as attenuation, dispersion, and biodegradation, will dilute the level of contaminants over time. The long-term risk to human health and the environment is considered moderate for Alternative 1 and low to moderate for Alternative 2.

Alternatives 3 and 4 provide partial long-term effectiveness and permanence since most sources of contamination are removed. Alternatives 3 and 4 also minimize groundwater contamination and public exposure by eliminating runoff infiltration (with the placement of an impermeable cap). Moreover, installation of the catch basin and the RCP drain would collect and divert runoff water to a nearby storm drain. Alternative 4 is slightly more effective in providing long-term remedy because it involves the removal of the affected subsurface area. All alternatives require moderate long-term monitoring. The long-term risk to human health and the environment is considered low for Alternatives 3 and 4.

5.5 Reduction of Toxicity, Mobility, or Volume

Alternative 1 does not reduce the toxicity, mobility, or volume of any contaminated media in the short term. Natural degradation processes will reduce the volume and toxicity of the contaminated media over a long period of time.

Alternative 2 does not reduce the toxicity or volume of contaminants. However, Alternative 2 would provide a reduction in the potential mobility of contaminants into the groundwater with the replacement of the existing parking lot and the removal of the dry well.

Alternatives 3 and 4 provide reduction of the toxicity or volume of contaminants. Contaminated media are treated (chemically and/or thermally) at a RCRA-approved facility. Alternatives 3 and 4 provide reduction in the potential mobility of contaminants into the groundwater with the placement of an impermeable cap over the entire parking lot area, and the placement of the highly contaminated soils in an approved facility.

5.6 Implementability

Alternative 1 is readily feasible because minimal field activities are performed. Excavation as part of remedial actions in Alternative 3 is also feasible. The excavation activities proposed for Alternative 4 would require additional coordination and technical evaluation, due to the limited on-site space availability and the depth of the excavation. Impermeable cap placement, dry well abandonment and removal, and catch basin and drain installation identified in Alternatives 2, 3, and 4 are readily feasible. Long-term groundwater monitoring in all alternatives can be readily implemented.

5.7 Cost

The estimated present worth of the four alternatives are summarized below:

- Alternative 1: $70,000
- Alternative 2: $200,000
- Alternative 3: $675,000
- Alternative 4: $1,825,000

Section 6
Recommendation of Alternative

The previous section described each of the four alternatives and evaluated them individually against the seven criteria specified in the NYSDEC Technical and Administrative Guidance Memorandum (TAGM). In Section 5, the four alternatives were compared with each other using the seven TAGM criteria. This final section uses the information and conclusions from the previous sections in order to recommend the most appropriate alternative for remedial action at the Fumex Sanitation, Inc. site.

6.1 Alternative 1

The No Action alternative, as discussed in Section 3, is included to provide a baseline for comparison to other remedial actions. The No Action alternative includes future monitoring at the Site and some institutional controls. Institutional controls consist of warning signs and fencing around the landfill property. This restricts the public's access to the landfill to protect human health and the environment. Similarly, placing deed restrictions on the use of groundwater on properties downgradient of the Site would also protect human health. The institutional controls alone do not address protection of the environment. Institutional controls place physical or zoning restrictions on land or water use, but do not actively remediate Site contaminants.

There is no active removal or destruction of contaminants in this alternative. The institutional controls only minimize potential exposure to contaminants. On the other hand, natural attenuation, dispersion and dilution will decrease the contaminant concentration in the groundwater over time. Therefore, these actions and processes serve to reduce the concentration of the groundwater contaminant plume in the future.

This alternative also includes long-term groundwater monitoring of existing monitoring wells that would serve as an initial warning for the off-site migration of contaminated groundwater. The present worth of this alternative is approximately $70,000. Alternative 1 is the least desirable of the four alternatives considered because of its inability to meet the majority of RAOs.

6.2 Alternative 2

Alternative 2 includes the abandonment and removal of the existing dry well, installation of a catch basin in the former dry well location, installation of a drain pipe from the catch basin to a local storm drain, repaving the existing parking lot and periodic sampling of existing on-site and off-site groundwater monitoring wells. The affected surface and subsurface soils would be left undisturbed. This alternative provides limited protection of human and environmental exposure to Site contaminants.

The combination of the dry well abandonment and removal, the catch basin installation, and the runoff drain connection from the basin to a storm drain eliminates direct discharge of runoff into the subsurface near the existing dry well location. This reduces the potential mobility of the contaminants from the subsurface soil into the groundwater since runoff water is prevented from percolating, and is instead diverted to a catch basin and subsequently to a storm drain. Repaving the parking lot asphalt surface to repair cracks and fissures would also provide protection by limiting or minimizing infiltration through the parking lot. Periodic maintenance of the asphalt surface is necessary.

Since no treatment technologies are included, Alternative 2 does not reduce the volume or toxicity of the contaminants. Alternative 2 would, to a degree, prevent contaminant migration through the surface and subsurface soils. Infiltration of runoff would occur if the parking lot asphalt surface were not periodically maintained. Natural processes, such as attenuation, dispersion, and biodegradation, will decrease the levels of contaminants found in soil and potentially groundwater.

The capital costs of Alternative 2 are approximately $137,000. The total present worth cost of this alternative is approximately $200,000. This cost includes the O&M costs associated with the groundwater monitoring, periodic asphalt surface inspection and catch basin maintenance.

Alternative 2 represents a reduction in risk when compared to Alternative 1. However, this alternative does not include the removal of the contaminated media and thus presents a potential public and environmental exposure risks. Although preferred over Alternative 1, Alternative 2 is not recommended because Alternatives 3 and 4 offer benefits of contaminant removal and additional reduction in potential risks.

6.3 Alternative 3

Alternative 3 consists of provision for institutional controls, surface soil excavation throughout the entire parking lot area, dry well abandonment and removal, runoff catch basin installation in the former dry well location, drain pipe installation to direct runoff flow from catch basin to the local storm drain, impermeable membrane/asphalt cap placement, and periodic groundwater monitoring of on-site and off-site monitoring wells.

Alternative 3 combines several feasible technologies to bring an enhanced level of human health and environmental protection. Somewhat higher costs would be associated with this greater level of remediation. This alternative minimizes human and environmental exposure through removal of the affected surface soil and the placement of the impermeable cap. The removal of the highly affected surface soil lessens the potential of public contact during unrestricted future Site development or use. Institutional controls, such as fencing and warning signs, will restrict public access. Contaminated soils removed from the Site will be treated (chemically and/or thermally) to levels acceptable for landfill application. The impermeable cap eliminates runoff infiltration through soil and thus, along with the new catch basin and drain, prevents further groundwater contamination and also subsurface soil exposure. Alternative 3 significantly reduces the exposure risks and provides an effective level of remediation.

The cost to implement and maintain this alternative is more than Alternatives 1 and 2, but considerably less than Alternative 4. The present worth cost of Alternative 3 is approximately $675,000. This cost is nearly $500,000 more than Alternative 2.

6.4 Alternative 4

Alternative 4 combines several identified feasible technologies to significantly reduce the risks associated with human and environmental exposure to the contaminants. This alternative includes the technologies indicated in Alternative 3, with the addition of a trench or subsurface soil excavation in the location of soil boring SB-11, the dry well, and monitoring well MW-6. The technologies are surface soil excavation, dry well abandonment and removal, catch basin installation, runoff drain pipe installation, impermeable cap placement, and groundwater monitoring. The added technology of trench excavation provides for further minimization of human and environmental exposure, especially during future Site development or use. Contaminated soils removed from the Site will be treated (chemically and/or thermally) to levels acceptable for landfill application

The cost to implement and maintain this alternative is the highest of the four alternatives evaluated. The present worth cost is estimated to be approximately $1,825,000. This is nearly $1,200,000 more expensive than the estimated present worth cost of Alternative 3.

Alternative 4 is not recommended because it provides a slight advantage for human health and environmental protection at a higher cost and a more complicated implementation activity.

6.5 Recommendation of Alternative

Alternative 3 is recommended for implementation at the Fumex Sanitation, Inc. site. This alternative provides a significant reduction in human health and environmental risks associated with exposure to the contaminants. In addition, Alternative 3 also offers long-term effectiveness in minimizing the potential mobility of contaminants.

Alternative 3 is selected over Alternative 4 because of its lower implementation costs and equally effective remedial approach. Although Alternative 4 provides an additional effective technology in protecting human health and the environment, the added benefit is not significantly higher. The reduction is risk associated with exposure is slightly more than Alternative 3, but Alternative 3 is equally adequate in minimizing the risks. Furthermore, with the deeper subsurface excavation, Alternative 4 is also more difficult to implement and requires additional supervision and coordination to limit disturbances to the neighboring residential areas. For the added benefits, Alternative 4 is nearly half a million dollars more expensive. This analysis concludes that the costs and slight increase in risk reduction far outweigh the benefits. Alternative 3 is therefore selected over Alternative 4.

Section 7
References

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Appendix A

CAPITAL COST - Institutional Controls

Fumex Sanitation Site Feasibility Study

New Hyde Park, New York

Screening of Remedial Action Alternatives

Cost Estimating Worksheet

(+50% to -30% level)

Item	Description	Unit	Unit Cost	Quantity	Cost
1	Chain Link Fence and Gates	lf	$24	300	$7,200
2	Warning Signs	ea	$50	4	$200
3	***TOTAL COST***				***$7,400***

Notes:

lf = length foot
ea = each

CAPITAL COST - Repaving of Asphalt Surface

Fumex Sanitation Site Feasibility Study

New Hyde Park, New York

Screening of Remedial Action Alternatives

Cost Estimating Worksheet

(+50% to -30% level)

Item	Description	Unit	Unit Cost	Quantity	Estimated Cost	Assumptions
	Repaving of Asphalt Surface					Assume asphalt repaving of the entire parking lot area.
1	Pavement Resurfacing	sy	$8	700	$5,600	
2	***Subtotal***				***$5,600***	
	Miscellaneous					
3	Mobilization/Demobilization	ls	$5,000	1	$5,000	
4	Miscellaneous Excavation and Disposal of Waste Materials	ls	$5,000	1	$5,000	
5	***Subtotal***				***$5,000***	
6	**Subtotal Estimated Capital Cost**				**$10,600**	
7	Contingencies (15%)				$1,590	
8	Engineering (10%)				$1,060	
9	Contractor (15%)				$1,590	
10	***TOTAL ESTIMATED CAPITAL COST***				***$15,000***	

Notes:

sy = square yard

ls = lump sum

CAPITAL COST - Catch Basin and Associated Runoff Drain Installation

Fumex Sanitation Site Feasibility Study

New Hyde Park, New York

Screening of Remedial Action Alternatives

Cost Estimating Worksheet

(+50% to -30% level)

Item	Description	Unit	Unit Cost	Quantity	Estimated Cost	Assumptions
	Alternate Drain/Pipeline Installation					Assumes a 4'x4'x10' deep catch basin to collect runoff water. Assumes a 6-inch diameter pipe to direct water from the basin to the local storm drain. Backfill material will include sand and excavated soil material. Trenches will be compacted to 90% relative compaction with a vibratory plate.
1	Material					
2	- Catch Basin	ls	$7,500	1	$7,500	
3	- Piping, valves, and fittings	lf	$50	180	$9,000	
4	Trench Excavation	lf	$15	180	$2,700	
5	Gravel Fill	lf	$15	180	$2,700	
6	Backfill	cy	$25	90	$2,250	
7	Asphalt Repair	ls	$4,000	1	$4,000	
6	Excavation and Removal of Existing Dry Well	ls	$10,000	1	$10,000	
7	Soil Disposal and Testing resulting from Dry Well Removal and Trench Excavation	ls	$15,000	1	$15,000	
8	CDM Excavation Oversight	hr	$75	160	$12,000	
9	Decontamination Costs	day	$400	15	$6,000	
10	***Subtotal***				***$71,150***	
	Miscellaneous					
11	Mobilization/Demobilization	lf	$10,000	1	$10,000	
12	***Subtotal***				***$10,000***	
13	**Subtotal Estimated Capital Cost**				**$81,150**	
14	Contingencies (15%)				$12,173	
15	Engineering (10%)				$8,115	
16	Contractor (15%)				$12,173	
17	***TOTAL ESTIMATED CAPITAL COST***				***$114,000***	

Notes:

lf = length foot
ls = lump sum
cy =cubic yards

CAPITAL COST - Excavation
Fumex Sanitation Site Feasibility Study
New Hyde Park, New York

Screening of Remedial Action Alternatives
Cost Estimating Worksheet
(+50% to -30% level)

Item	Description	Unit	Unit Cost	Quantity	Estimated Cost	Assumptions
	Surface Soil - Discrete Areas					Excavation volume based on four 20-foot diameter circular discrete areas of concern. Assume imported clean soil will be used for backfill and compacted to 90% relative compaction. A fluff factor of 1.10 is used for imported fill. Assume excavated soils hazardous. All hazardous materials will be transported, disposed, and treated at a RCRA-approved facility.
1	Excavation	cy	$30	70	$2,100	
2	Backfill					
3	- Import Soil Haul	cy	$15	80	$1,200	
4	- Fill Spread and Compaction	cy	$5	80	$400	
5	Transport, Dispose, and Treat	cy	$800	70	$56,000	
6	CDM Excavation Oversight	hr	$25	80	$2,000	
7	***Subtotal***				**$61,700**	
	Miscellaneous					
8	Mobilization/Demobilization	ls	$10,000	1	$10,000	
9	***Subtotal***				**$10,000**	
10	**Subtotal Estimated Capital Cost**				***$71,700***	
11	Contingencies (15%)				$10,755	
12	Engineering (10%)				$7,170	
13	Contractor (15%)				$10,755	
14	***TOTAL ESTIMATED CAPITAL COST***				***$101,000***	

Notes:
cy = cubic yards
ls = lump sum

CAPITAL COST - Excavation

Fumex Sanitation Site Feasibility Study

New Hyde Park, New York

Screening of Remedial Action Alternatives
Cost Estimating Worksheet
(+50% to -30% level)

Item	Description	Unit	Unit Cost	Quantity	Estimated Cost	Assumptions
	Surface Soil - All Areas					Excavation volume based on surface soil removal throughout the entire parking lot area. Assume imported clean soil will be used for backfill and compacted to 90% relative compaction. A fluff factor of 1.10 is used for imported fill. Assume excavated soils hazardous. All hazardous materials will be transported, disposed, and treated at a RCRA-approved facility.
1	Excavation	cy	$30	350	$10,500	
2	Backfill					
3	- Import Soil Haul	cy	$15	400	$6,000	
4	- Fill Spread and Compaction	cy	$5	400	$2,000	
5	Transport, Dispose, and Treat	cy	$800	350	$280,000	
6	CDM Excavation Oversight	hr	$75	240	$18,000	
7	Decontamination Costs	day	$400	30	$12,000	
8	***Subtotal***				**$328,500**	
	Miscellaneous					
9	Mobilization/Demobilization	ls	$10,000	1	$10,000	
10	***Subtotal***				**$10,000**	
11	**Subtotal Estimated Capital Cost**				***$338,500***	
12	Contingencies (15%)				$50,775	
13	Engineering (10%)				$33,850	
14	Contractor (15%)				$50,775	
15	***TOTAL ESTIMATED CAPITAL COST***				***$474,000***	

Notes:

Surface soil is defined as the top 18 inches of soil immediately beneath the asphalt surface pavement.
Subsurface soil is defined as the soil layer beneath the surface soil.
cy = cubic yards
ls = lump sum

CAPITAL COST - Impermeable Cap

Fumex Sanitation Site Feasibility Study

New Hyde Park, New York

Screening of Remedial Action Alternatives

Cost Estimating Worksheet

(+50% to -30% level)

Item	Description	Unit	Unit Cost	Quantity	Estimated Cost	Assumptions
	Surface Soil					Excavation volume based on surface soil removal throughout the entire parking lot area. Assume imported clean soil will be used for backfill and compacted to 90% relative compaction. A fluff factor of 1.10 is used for imported fill. Assume excavated soils hazardous. All hazardous materials will be transported, disposed, and treated at a RCRA-approved facility.
1	Excavation	cy	$30	350	$10,500	
2	Backfill					
3	- Import Soil Haul	cy	$15	400	$6,000	
4	- Fill Spread and Compaction	cy	$5	400	$2,000	
5	Transport, Dispose, and Treat	cy	$800	350	$280,000	
6	CDM Excavation Oversight	hr	$75	240	$18,000	
7	Decontamination Costs	day	$400	30	$12,000	
8	***Subtotal***				**$328,500**	
	Impermeable Cap Material and Installation					Assumes a geomembrane cap will be installed throughout the entire parking lot area.
9	Geomembrane (PVC)	sf	$0.7	6,500	$4,225	
10	Geotextile Cushion	sf	$0.5	6,500	$3,250	
11	***Subtotal***				**$7,475**	
	Miscellaneous					Assumes a 6-inch asphalt pavement following site grading.
12	Mobilization/Demobilization	ls	$5,000	1	$5,000	
13	Asphalt Pavement	sy	$8	700	$5,600	
14	***Subtotal***				**$10,600**	
15	**Subtotal Estimated Capital Cost**				***$346,575***	
16	Contingencies (15%)				$51,986	
17	Engineering (10%)				$34,658	
18	Contractor (15%)				$51,986	
18	***TOTAL ESTIMATED CAPITAL COST***				***$486,000***	

Notes:

sf = square foot
sy = square yard
cy = cubic yards
ls = lump sum

CAPITAL COST - Excavation
Fumex Sanitation Site Feasibility Study
New Hyde Park, New York

Screening of Remedial Action Alternatives
Cost Estimating Worksheet
(+50% to -30% level)

Item	Description	Unit	Unit Cost	Quantity	Estimated Cost	Assumptions
	Subsurface Soil and Dry Well Trench Excavation					Excavated volume based on 20 ft by 60 ft rectangular area encompassing SB-11, MW-6, and the dry well. Assume imported clean soil will be used for backfill and compacted to 90% relative compaction. A fluff factor of 1.10 is used for imported fill. Assume excavated soils and sediment beneath the dry well are hazardous. All hazardous materials will be transported, disposed, and treated at a RCRA-approved facility. Assumes sheet piling will be used for shoring.
1	Excavation	cy	$25	900	$22,500	
2	Backfill					
3	- Import Soil Haul	cy	$15	1,050	$15,750	
4	- Fill Spread and Compaction	cy	$5	1,050	$5,250	
5	Transport, Dispose, and Treat	cy	$800	900	$720,000	
6	Shoring	sf	$10	1,200	$12,000	
7	CDM Excavation Oversight	hr	$75	200	$15,000	
8	Decontamination Costs	day	$400	30	$12,000	
9	***Subtotal***				**$802,500**	
	Miscellaneous					
10	Mobilization/Demobilization	ls	$20,000	1	$20,000	
11	***Subtotal***				**$20,000**	
12	**Subtotal Estimated Capital Cost**				***$822,500***	
13	Contingencies (15%)				$123,375	
14	Engineering (10%)				$82,250	
15	Contractor (15%)				$123,375	
16	***TOTAL ESTIMATED CAPITAL COST***				***$1,152,000***	

Notes:
Surface soil is defined as the top 18 inches of soil immediately beneath the asphalt surface pavement.
Subsurface soil is defined as the soil layer beneath the surface soil.
cy = cubic yards
ls = lump sum
sf = square feet

CAPITAL COST - Total Excavation

Fumex Sanitation Site Feasibility Study

New Hyde Park, New York

Screening of Remedial Action Alternatives

Cost Estimating Worksheet

(+50% to -30% level)

Item	Description	Unit	Unit Cost	Quantity	Estimated Cost	Assumptions
	Surface Soil					Assumes imported clean soil will be used for backfill and compacted to 90% relative compaction. A fluff factor of 1.15 is used for imported fill. Assumes excavated soils hazardous. All hazardous materials will be transported, disposed, and treated at a RCRA-approved facility.
1	Excavation	cy	$25	9,700	$242,500	
2	Backfill					
3	- Import Soil Haul	cy	$15	11,150	$167,250	
4	- Fill Spread and Compaction	cy	$5	11,150	$55,750	
5	Transport, Dispose, and Treat	cy	$800	9,700	$7,760,000	
6	CDM Excavation Oversight	hr	$75	400	$30,000	
7	Decontamination Costs	day	$400	40	$16,000	
6	***Subtotal***				**$8,271,500**	
	Miscellaneous					Assumes chain link fence installation surrounding the parking lot area.
13	Mobilization/Demobilization	ls	$10,000	1	$10,000	
14	Chain Link Fence and Gates	lf	$25	300	$7,500	
15	Warning Signs	ea	$50	5	$250	
16	Asphalt Pavement	sy	$8	700	$5,600	
16	***Subtotal***				**$17,750**	
17	**Subtotal Estimated Capital Cost**				***$8,289,250***	
18	Contingencies (15%)				$1,243,388	
19	Engineering (10%)				$828,925	
20	Contractor (15%)				$1,243,388	
21	***TOTAL ESTIMATED CAPITAL COST***				***$11,610,000***	

Notes:
cy = cubic yards
ls = lump sum
lf = length foot
sy = square yard

O&M COST - Institutional Controls

Fumex Sanitation Site Feasibility Study

New Hyde Park, New York

Screening of Remedial Action Alternatives

Cost Estimating Worksheet

(+50% to -30% level)

DIRECT ANNUAL/PERIODIC COSTS:	Unit Cost ($)	Quantity	Cost ($)
Annual Fence Maintenance	$500.00	1	$500
Annual Total			**$500**

O&M COST - Annual Groundwater Monitoring

Fumex Sanitation Site Feasibility Study

New Hyde Park, New York

Screening of Remedial Action Alternatives

Cost Estimating Worksheet

(+50% to -30% level)

Item	Description	Unit	Unit Cost	Quantity	Estimated Cost	Assumptions
	Groundwater Sampling and Reporting					Monitoring program will be conducted annually and reviewed after five years.
1	TCL Pesticides	ea	$110	14	$1,540	
2	Validation	ea	$55	14	$770	
3	Labor	hr	$25	16	$400	
4	Expendables	ls	$1,000	1	$1,000	
5	ODCs	ls	$1,000	1	$1,000	
6	Report	ls	$2,600	1	$2,600	
7	***Annual Subtotal***				***$7,400***	

Notes:

ea = each
hr = hour
ls = lump sum