Phase II Excerpts

TABLE OF CONTENTS

Some portions of the Phase II were omitted to expedite review.

LIST OF FIGURES

LIST OF TABLES

LIST OF APPENDICES

I. INTRODUCTION AND BACKGROUND

LSPCO is pleased to provide this Phase II Comprehensive Site Assessment Report (Phase II) as required under the Massachusetts Contingency Plan (MCP) for a release of petroleum product to soil, groundwater, and surface water at The Acme (ACME) facility and land where the facility is located is hereafter referred to as the "Property." The portion of land where the release is present is hereafter referred to as the "Disposal Site."

A site plan and the boundary of the Disposal Site are shown in Figure 2.

The Massachusetts Department of Environmental Protection (MADEP) advised ACME of a release of petroleum product to the Brook Underground culvert, an underground culvert, on October 1, 1998 based on findings reported by The local Department of Public Health (DPH) & Code Enforcement. DHP observed light non-aqueous phase liquid (LNAPL) petroleum seeping into the underground culvert through a 4-inch diameter weep hole in the culvert's wall. Weep holes are evenly spaces along the culvert's wall. The underground culvert is located in an easement, which passes through the east end of the ACME property (See Figure 2). It is a twin box underground culvert with each box about 12-feet wide and 7-feet high. Surface water from Big Lake flows south through the underground culvert to Two Small Pond. Two Small Pond is located about 500-feet down stream to the south. The underground culvert also receives storm water run off throughout this portion of the Town via catch basins that discharge directly to the underground culvert and via tributary storm water drain lines. The release resulted in a petroleum sheen on water in the culvert. LNAPL did not accumulate on water in the underground culvert. The release to the underground culvert was temporarily abated by the DPH at the time of their inspection.

LSPCO determined that a 2-hour reporting condition [310 CMR 40.0311(8)] was present at the Disposal Site where petroleum product had released, or could potentially release to a storm drain. A Condition of Substantial Release Migration [310 CMR 40.0413(2)(a)] was also met. The MCP requires Immediate Response Actions (IRA) in both cases.

Release conditions were verbally reported by LSPCO to MADEP on March 19, 1999. Assessment-only IRA activities were verbally approved at the time of reporting. The following documents were submitted to MADEP since release reporting:

- Release Notification Form, April 5, 1999;
- IRA Plan, May 18, 1999;
- IRA 120-Day Status Report, August 20, 1999;
- IRA First 6-Month Status Report, January 20, 2000;
- Revised MADEP transmittal forms, February 11, 2000;
- Phase I Report & Tier II Classification, March 2000;
- IRA Second 6-Month Status Report, July 21, 2000;
- Modified IRA Plan, November 3, 2000;
- IRA Third 6-Mondth Status Report, January 25, 2001;
- IRA Fourth 6-Month Status Report, July 19, 2002; and
- IRA Fifth 6-Month Status Report, January 23, 2002.

IRA activities are summarized in Section III of this report. A Phase I and Tier Classification was submitted to MADEP, which based on a numerical ranking score of 242 points, classified the Disposal Site as Tier II under the MCP.

This Phase II Report summarizes activities completed at the Disposal Site since submittal of the Phase I Report and Tier II

Classification, the nature and extent of the release, results of a Method 1 Risk Characterization, and response actions conducted to-date.

II. GENERAL DISPOSAL SITE INFORMATION

A. Location and Setting

ACME is located in an area of mixed land use. Commercial and industrial companies are located along West Street. Residential homes and apartment buildings are located east of ACME along South Street. Human and environmental receptors were identified by LSPCO based on field observations and a computer database search conducted by Map Technology Corporation on March 2, 2000. The database search report was submitted to MADEP in the Phase I Report. This information is used to characterize migration and exposure pathways, and to select appropriate MCP Method 1 soil and water quality standards. Findings, as first reported in Phase I, are summarized below:

Receptor	Distance From Site	Source
Location of institutions (hospital, Nursing home, school, etc.) from site:	>500 ft	Topo./Visual
Closest resident to site:	300 ft southeast	Visual
Closest private water supply well:	>500 ft	DataMap
Closest Natural Resource Areas:		DataMap
Outstanding water resource:	>500 ft	
Surface water:	On-site (underground culvert to Salisbury Pd)	
Wetland:	>500 ft	
Potential drinking water source:	None	
Non-Potential drinking water source:	Medium yield aquifer on-site	
Areas of Critical Environmental Concern:	>500 feet	
Sole Source Aquifers:	None	
Protected Open Space:	Institute Park 475 ft south.	
Fish habitat-supports down stream hab.:	on-site	
Habitats of Species of Concern:	>500 ft	
Threatened or Endangered Species Hab.:	>500 ft	

Water in the underground culvert is considered surface water located on-site because the underground culvert discharges directly to Two Small Pond. Two Small Pond is a Class B surface water body designated by DEP as suitable for fish habitat and ~~other aquatic life, wildlife, primary and secondary contact~~ recreation, and as a public water supply source with treatment.

The DPH reports that contact-recreation, fishing and boating are not allowed at the pond and is indicated to the public by posted signs. The pond does reportedly support fish. Therefore, in accordance with 1997 DEP guidance on completing the numerical ranking in Phase I, a fish habitat is considered to be "on-site" because water in the underground culvert supports fish habitat in the pond.

B. Site Description and Layout

The ACME facility occupies two parcels of land - one on each side of South Street. See Figure 2. This section of the report addresses that portion of the Property where the petroleum product release is located, which is north of South Street. One two-story brick building is located on this parcel. The petroleum product release is located at the rear of the facility. Two USTs are located here and include a 3,000-gallon UST and an 8,000-gallon UST. The USTs were used to store No. 2 fuel oil and were closed in-place in 1991 because they are both located beneath the building's floor slab. The Brook underground culvert passes beneath ACME's Property and is located about 45-feet east of the USTs.

The portion of the facility were the USTs are located is used for shot blasting (i.e. de-burring) metal products. Shot blast equipment is located over the USTs. Prior to shot blasting, heat-treating furnaces were located in this portion of the building. The USTs supplied No. 2 oil to furnaces in the facility until 1991 through a system of overhead pipes. The furnaces were later converted to burn natural gas and the tanks were no longer needed. Figure 2 shows current uses at this portion of the facility.

Land located behind the facility including that over the underground culvert is asphalt paved and used for shipping and receiving, and storage. A cyclone dust collector is located adjacent to the building, which collects dust from shot blasting. This material is collected in drums and shipped off-site for disposal.

Natural gas is used to heat the facility and run the furnaces. Water and sewer is provided by the City. Storm water at the rear of the property flows to two catch basins which discharge directly to the Brook underground culvert. The underground culvert discharges to Two Small Pond located about 500-feet to the south.

Land use around the site includes:

- A Commercial Company to the north;
- South Street to the south. Another ACME building is located beyond South Street;
- A Mass Electric substation to the east. Residential homes are located to the southeast and apartment buildings are located beyond the substation; and
- West Street to the west. The The City Transit Authority's maintenance facility is located beyond West Street.

C. Disposal Site History

According to ACME the Property was first developed in the mid 1930's by a couple of similar industries preceeding ACME's purchase of the

property in 1966. All of these companies conducted metal heat-treating. The building, beneath which the two USTs are located, was built in the early 1950's. The 3,000 gallon and 8,000 gallon USTs were over 20 years old when closed in-place in 1991. Because the USTs were located beneath the building, in-place closure was approved. According to ACME, the Property was first developed in the mid 1930's

The USTs were closed in-place in August 1991, in accordance with 527 CMR 9.00. According to ACME, the USTs were emptied of product, cleaned, and filled with concrete slurry.

LSPCO reviewed ACME's use and handling of petroleum product in the east end of the facility as it may relate to the release being investigated. These metal-treating companies utilized quench oil to cool metal parts after heat-treating. Quench oil is stored in a 1,800 gallon above ground storage tank as shown on Figure 3. This quench oil is also stored in above ground tanks located inside the facility. Spent quench oil is collected and stored in a 1,000 gallon above ground storage tank located in a storage building, along with 55-gallon drums of oily solids. This material is transported and disposed off-site. Two furnace oil coolers, which include two approximately 200-gallon above ground oil circulation tanks are located in an attached shed to the facility. There are no other fuel oil USTs or aboveground tanks currently or formerly located at the site. The next closest underground oil storage to the release is a 2,500-gallon UST for quench oil storage. This tank is located about 120-feet west of the fuel oil USTs and was closed in-place in February 1991 according to ACME's records.

An on-line database search conducted by LSPCO on March 2, 2000 for the Disposal Site's Phase I Report and Tier Classification did not reveal reported petroleum releases at ACME other than the release that is the subject of this report. ACME reported that there have been no significant releases at the facility. ACME reported the following permits held for the facility:

- Air Emissions: Limited Plans Approval;
- Small Quantity Generator of hazardous waste:

- Storm Water Discharge (General Multi-Sector);

According to ACME, there have not been notices of non-compliance or violations issued in the last five years, and there have been no records of non-compliance relative to Waste Site Clean Up at the Property.

The MADEP Bureau of Waste Site Clean Up conducted an audit of Immediate Response Actions conducted at the Disposal Site. The audit included a site inspection. No violations were found except for the absence of an operation and maintenance logbook at the Disposal Site for the bioremediation system.

III. IMMEDIATE RESPONSE ACTION

A. Background and Summary

The initial IRA Plan summarized findings from the assessment which identified a small volume of light non-aqueous phase petroleum liquid (LNAPL) located adjacent to the exterior wall of the underground culvert. The petroleum product was believed to have been released from a 3,000-gallon underground storage tank located about 45-feet up gradient of the underground culvert. According to City construction drawings for the underground culvert, a 12-inch thick bed of screened gravel is located beneath the culvert and 18-inches of screened gravel was back-filled along the culvert's wall. A cross-section of the culvert's design obtained from DPH is included in Appendix A.

The IRA plan proposed 1) removal of LNAPL located next to the underground culvert's wall. Collection would occur from inside the underground culvert at the weep hole where LNAPL was observed and 2) groundwater and petroleum product layer monitoring. The plan was presumptively approved by MADEP in 21-days in accordance with the MCP. Because work was to be conducted inside the underground culvert and could affect Two Small Pond, a determination of applicability under wetland regulations was sought from the Town Conservation Commission. In September 1999, the Commission determined that the regulations did not apply, but required notice of field activities to their department and to the DPH.

Oil recovery was conducted using a vacuum truck. About 150-gallons of oily water was collected via the weep hole in September 1999. After observation of activities by the DPH their department believed that petroleum product recovery inside the underground culvert posed an unacceptable risk to surface water quality and required future remedial activities to occur outside the underground culvert. No further petroleum product recovery was conducted since the initial effort.

A Modified IRA Plan was submitted to MADEP in November 2000. The Modified IRA Plan proposed construction and operation of an in-situ bioremediation system. The system's layout is shown in Figure 3. The bioremediation system includes a groundwater recovery trench, recovery well, nutrient treatment shed, and a groundwater recharge trench. Its hydraulic flow schematic is shown in Figure 4. Construction, operation, and maintenance of the bioremediation system was performed by the Subcontractor (the Sub) as a subcontractor to LSPCO. The system was constructed in April and May 2001. Continuous operation of the system began on May 23, 2001. Weekly to bi-weekly operation and maintenance of the system has been conducted by the Sub to manually remove LNAPL from oil/water separator drums, maintain nutrient and microbe levels, and check and maintain system hydraulic equipment as necessary.

Environmental monitoring under the IRA includes quarterly groundwater monitoring for depth to water, LNAPL thickness, dissolved petroleum product by MADEP Extractable Petroleum Hydrocarbon (EPH) and Volatile Petroleum Hydrocarbon analyses, and nutrient analysis that includes nitrogen-ammonia, nitrogen-nitrate, and total phosphorus. Water in the underground culvert is monitored quarterly for nutrients and visually inspected for a petroleum sheen on the water's surface. ACME continues to operate the bioremediation system.

MADEP audited the IRA, which included an inspection of the Disposal Site, on February 14, 2002. Only one violation was identified by MADEP where the nutrient treatment shed should have a monitoring logbook for operation and maintenance of the bioremediation system. MADEP's Notice of Audit Finding is included in Appendix B.

B. Performance of the Bioremediation System

During the IRA Status Report period from July 5, 2001 to January 2, 2002, the bioremediation system had removed 23-gallons of LNAPL. LNAPL was recovered from oil/water separator drums located in the treatment shed. About an 80/20 mixture of LNAPL and biomass is decanted weekly from the drums and stored in DOT-approved 55-gallon drum and labeled as hazardous waste. The drum is a designated RCRA satellite accumulation container and is pumped along with other waste oil streams for bulk transport from the facility 48-gallons of LNAPL had been removed since system startup on May 23, 2001. The drum was emptied once since system startup with disposal of the waste oil reflected in a November 5, 2001 bulk shipment from the facility.

168,258 gallons of contaminated groundwater has been treated since system startup.

The rate of LNAPL removed from the subsurface and rate of groundwater circulated through the treatment system has diminished significantly between IRA status reporting periods. The average volume of LNAPL recovered between July 2001 and January 2002 was 3.8-gallons per month compared to about 11-gallons per month when the system operated from late May 2001 (startup) to July 2001. Average groundwater circulation was almost 62,000-gallons per month from late May 2001 (startup) to July 2001, and only 7,288-gallons per month from July 2001 to January 2002. The reduction in groundwater circulation reflects drought conditions, which has affected New England. Groundwater levels at the site have dropped between 2 and 4-feet compared to levels measured in May 2001 when the system was installed.

Diminished LNAPL recovery is believed to have occurred from successfully reducing the overall volume of petroleum product in the subsurface and from also the increased difficulty in recovering petroleum product due to the lower groundwater table.

The next 6-month IRA Status Report will be submitted to MADEP by July 19, 2002.

IV. FIELD INVESTIGATIONS

Phase II investigations included groundwater monitoring and surface water monitoring. These activities were conducted under the IRA and performed quarterly in accordance with the IRA Plans. Drilling, soil sampling and analysis, and well installation to determine the nature and extent of the release were conducted in Phase I. No soil sampling or well installation was performed in Phase II.

A. Review of Phase I Investigations

Subsurface investigations in Phase I were conducted in two phases. The first phase was conducted under the Immediate Response Action (IRA) Plan with the objective of identifying the source of petroleum product to the underground culvert. Five groundwater monitoring wells (MW-1 through MW-5) were installed and sampled, petroleum product from the underground culvert was fingerprinted, and groundwater direction was determined. This information was evaluated in conjunction with petroleum product use/storage at ACME and adjacent properties.

The second phase of investigation was conducted to fulfill MCP Phase I data requirements necessary to support Tier Classification. Soil samples and sub-slab soil gas were analyzed immediately adjacent to the 3,000-gallon UST to determine the nature and extent of contamination including the extent of LNAPL identified immediately down gradient of the tank at well MW-4. Aspects of the investigation are discussed below.

OIL FINGERPRINTING

Subsurface investigations began on December 1998 with fingerprint analysis of the oil reported by the Department of Public Health and Code Enforcement (DPH). On December 8, 1998, LSPCO ~~collected a sample of LNAPL from the weep hole to the~~ underground culvert. Analysis for volatile petroleum hydrocarbons (VPH) and extractable petroleum hydrocarbons (EPH) with target compounds by DEP methods, and a hydrocarbon scan by gas chromatograph EPA Method 8100M was conducted. The sample was identified as No. 2 fuel oil. No target compounds were detected.

DRILLING AND SOIL SAMPLING

Five soil borings (MW-1 through MW-5) were advanced on March 31, 1999. Locations are shown in Figure 2. Sampling locations were selected to evaluate the nature and extent of petroleum product along the underground culvert wall (MW-2 and MW-5) and whether ACME's two USTs, now closed in-place, where the source of the release (i.e, MW-1 and MW-4). Well MW-3 was installed along the underground culvert wall at ACME's property line to determine if the source of contamination was possibly from a No. 2 fuel oil UST identified at adjacent property occupied by the adjacent commercial Company. The UST at that Company is located about 100-feet from the property line to the northwest.

Drilling was conducted using 4 ¼ inch inside diameter hollow stem augers. All borings were advanced to 17-feet below the ground surface. Soil samples were collected during drilling using a two-foot long split spoon sampler. Samples were collected continuously at wells MW-1 and MW-4 from 0 to 10 feet below the ground. One additional sample was collected at these locations from 15 to 17 feet. Samples were collected at five foot intervals at remaining boring locations. Groundwater was encountered at about 8 feet below the ground surface.

Samples were screened in the field for total volatile organic compounds (VOCs) in headspace in accordance with MADEP guidelines. Screening results are listed in Table 1. Five soil samples were selected for laboratory analysis based on field screening results and visual observation. Samples were analyzed by an independent state certified laboratory for VPH and EPH with no target compounds in accordance with MADEP methods. Soil for

VPH testing was preserved with methanol in the field. Soil samples were geologically classified and logged. Boring logs are included in Appendix C.

All down-hole drilling equipment (i.e. augers, drilling rods, and tools) were steam cleaned prior to drilling the first boring and between subsequent borings. The split spoon sampler was decontaminated between sample collection with an Alconox detergent wash followed by methanol and distilled water rinses.

Soil cuttings from wells MW-1, -2, and -4 were contained in a 55-gallon drum, labeled "Investigation Derived Waste", and stored on-site, Subsequent laboratory results determined that this material could be re-used on-site.

On February 11, 2000, three soil borings (GP-1, GP-2, and GP-3 were advanced adjacent to the 3,000-gallon UST. Drilling was conducted inside the facility using Geoprobe drilling equipment. Sampling locations are shown in Figure 2. Borings GP-1 and GP-3 were advanced to refusal at six feet below the top of the concrete slab. Boring GP-2 was advanced to refusal at four feet below the top of the concrete slab. Coring was not conducted, however chips of concrete and concrete powder was observed on Geoprobe sampling equipment indicating that a subsurface concrete obstruction was present beneath the USTs. ACME could not confirm whether the concrete obstruction was a slab installed for the purpose of supporting the USTs. No groundwater was encountered.

Soil sampling was conducted continuously using four foot long precleaned plastic disposable acetate liners. The liners were cut open along its length to evaluate the sample. Soil was screened in three foot intervals for total VOCs in headspace following MADEP guidance. Results are listed in Table 1. Two samples from each boring, six samples total, were selected for laboratory analysis based on screening results. Samples were tested for VPH and EPH without target compounds.

Decontamination of drilling and soil sampling equipment was conducted using an Alconox wash followed by a methanol and then distilled water rinse.

Samples were geologically classified and logged. Geology consists of medium dense to loose sand and gravel with varying amounts of silt and fines. Traces of brick were encountered at MW-1. Bedrock was not encountered. Boring logs are included in Appendix C.

GROUNDWATER MONITORING WELLS

Groundwater monitoring wells were installed in borings MW-1 through MW-5. All wells were designed to monitor the top ten feet of groundwater. Wells were not installed in the Geoprobe borings because groundwater was not encountered at these locations. GP borings were backfilled with bentonite clay chips and the floor sealed with concrete.

All wells were constructed of two inch inside diameter polyvinyl chloride (PVC) well screen and solid riser. The well screen was machined with 0.010-inch slots to allow groundwater flow through the well. The screen extended about three feet above the water table and seven feet below the water table to ensure accurate monitoring of LNAPL, if encountered. The annular space between the borehole and well screen was backfilled with silica sand to prevent clogging and to enhance well production. A protective steel casing, flush with the ground surface was placed over the well and set in concrete. Monitoring well construction logs are in Appendix D.

The wells were developed by surging and over-pumping. Development continued until the well water became reasonably clear of sediment. Development water was contained in a single 55-gallon drums, labeled "Investigation Derived Waste", and transported off-site by a licensed waste hauler.

GROUNDWATER SAMPLING

Groundwater sampling from all wells was conducted on April 12, 1999. Water quality at MW-2 was monitored as an early detection point for petroleum that could migrate through the gravel back-fill along the underground culvert. Well MW-2 was sampled on April 12, July 29, November 1, 1999, and February 16, 2000. Weep holes in the culvert's wall located down stream of the Disposal Site were also visually inspected for petroleum. The thickness of oil product at well MW-4 was monitored along with well MW-2. Water quality at MW-4 was measured again on February 16, 2000.

The presence of LNAPL on groundwater was measured prior to sampling using an electronic oil/water interface probe. A 0.01 to 0.12-foot thick petroleum product layer was present at MW-4, which is located immediately down gradient of the 3,000-gallon UST. No petroleum product was present in remaining wells. It was anticipated that a LNAPL would be detected at MW-5, because the well was located adjacent to the underground culvert's weep hole where petroleum product had entered the culvert. No LNAPL was detected however. It is believed that MW-5 was installed outside the gravel back-fill in which LNAPL is located and therefore this well may not be detecting LNAPL that was entering the underground culvert. Table 3 lists LNAPL monitoring results.

Wells were purged after LNAPL monitoring to remove stagnant well water and enhance well production. Groundwater was screened in the field for pH, temperature, conductivity, oxidation/reduction potential, and dissolved oxygen. Screening results were used to ensure adequate purging. A minimum of three well volumes were purged or until measurements from the last two well volumes were within ten percent. Results are listed in field notes included in Appendix E of this report.

All samples were submitted to an independent state certified laboratory and tested for VPH and EPH without target compounds. Laboratory reports are included in Appendix F.

GROUNDWATER FLOW

Groundwater flow direction at the site was measured on April 12, 1999 before the bioremediation system was installed. Top of PVC casing elevations were measured by a Massachusetts Registered Land Surveyor using an arbitrary on-site datum. The depth to groundwater was about 9-feet below the ground surface. Groundwater elevations are listed in Table 2. As shown in Figure 5, groundwater flows from west to east toward the underground culvert. Groundwater is expected to discharge to the culvert through its weep holes and/or flow along the culvert in the down stream direction (i.e. south). Groundwater on the other side of the culvert is expected to flow toward the culvert as well. The underground culvert is located at the bottom of a steep hill located to the east. Although groundwater elevations east of the underground were not measured by LSPCO , the hill's strong topographic feature alone indicates that groundwater beyond the underground culvert would flow west toward the culvert. Therefore, the underground culvert is believed to be a convergent groundwater discharge point.

Figure 6 illustrates groundwater flow measured on October 11, 2001 with the bioremediation system operating. Groundwater elevations measured on October 11, 2001 are listed in Table 3.

The rate of groundwater flow was calculated using Darcy's Law:

$$V = (K*i)/n$$

Where: V = Groundwater flow velocity, feet/year

K = Aquifer hydraulic conductivity, feet/year

i = Hydraulic gradient, feet/feet

n = Aquifer porosity, unitless

The pre-remedial groundwater flow measured at the Disposal Site on April 12, 1999 had a hydraulic gradient (i) of 0.0091 feet/feet. Hydraulic conductivity (K) and porosity (n) were not measured at the Disposal Site, but estimated from literature sources. Freeze & Cherry (1979) report the hydraulic conductivity for silty sand aquifers to range from 10^{-4} to 10^{-2} feet/minute, or 52.6 to 5,256 feet/year. Freeze & Cherry report a porosity range for this material at 25 to 50 percent. Using this data in Darcy's equation, groundwater flow velocity at the Disposal Site is estimated at 3.5 to 191 feet/year. The rate of petroleum migration through the aquifer will be less than the rate of groundwater flow because of partitioning between groundwater and aquifer soil.

SUB-SLAB SOIL GAS

Sub-slab soil gas was evaluated to determine the likelihood for petroleum vapor migration to indoor air at ACME . Groundwater contamination at MW-4 and soil contamination at GP-2 and GP-3 exceeded standards protective of contaminant migration to indoor air. A Level 1 Soil Gas Screening was conducted in accordance with DEP guidance on Implementing VPH/EPH (1997). Sub-slab soil gas was sampled adjacent to GP-2 using a dedicated boring. The soil gas probe was advanced about two inches below the bottom of the floor slab, which is about six inches thick. The probe was briefly purged using a personal air-sampling pump before analysis of soil gas directly from the probe. Soil gas was measured for total VOCs using a Thermo 580B PID meter calibrated to benzene. Four parts per million of total VOCs was measured. This value is below DEP's 40-ppm threshold; therefore, there is a low probability of adverse impact to indoor air. Following DEP guidance no further assessment was required.

B. Phase II Investigations

Field investigations performed since submittal of the Phase I Report and considered to be Phase II investigations included environmental monitoring conducted in accordance with the IRA Plans. Activities included:

- LNAPL monitoring on February 16, 22, 29, 2000;
- Groundwater monitoring which included LNAPL measurement and groundwater sampling and analysis for VPH and EPH without target compounds was conducted on May 8, May 21, and August 21, 2000; January 22 and May 7, and July 23 and October 11, 2001. and
- Water monitoring in the underground culvert was conducted on May 8, 2000 (visual inspection only); and May 7, July 23 and October 11, 2001 (visual inspection and nutrient analysis).

Monitoring performed on May 7, 2001 is considered a baseline assessment of subsurface conditions before startup of the bioremediation system on May 23, 2001.

Field notes are included in Appendix E. Phase II laboratory reports are included in Appendix F.

V. LABORATORY RESULTS

Results from Phase I and II are discussed in this section. Oil fingerprint results are listed in Table 4. LNAPL thickness results are listed in Table 5. Soil laboratory results are listed in Table 6. Results are listed with MCP Method 1 soil quality standards for unrestricted land use (i.e. S-1) and with standards that reflect exposure limited by pavement and the building (i.e. S-3), which apply to the Disposal Site. Groundwater results are listed in Table 7. Results here are listed with MCP groundwater quality standards protective of vapor migration to indoor air (i.e. GW-2) and standards protective of groundwater migration to surface water (i.e. GW-3). The GW-2 standard only applies to groundwater located within thirty feet of occupied structures. The GW-2 standard does not apply to groundwater located more than 30-feet from occupied structures. Therefore, groundwater quality at wells MW-1 and MW-4 are subject to GW-2 standards and water quality at wells MW-2, MW-3, and MW-5 are not.

VI. NATURE AND EXTENT OF CONTAMINATION

The nature and extent of petroleum contamination at the Disposal Site is discussed below. Figures 7 and 8 illustrate a conceptual model of the petroleum release from the 3,000-gallon UST and the impact to down gradient environmental media and receptors.

A. Source Area

The 3,000-gallon UST was determined to be the source of the release based on the following conditions:

- LNAPL is present at well MW-4 located about 5-feet directly down gradient of the 3,000-gallon UST. Measurable LNAPL has not been present at well MW-1 which is located about 5-feet directly down gradient of the 8,000-gallon UST.
- Dissolved petroleum concentrations in groundwater located immediately down gradient of the USTs were 22 times lower at the 8,000-gallon UST (MW-1) compared to concentrations at the 3,000-gallon UST (MW-4) when tested before startup of the bioremediation system in 1999. The concentrations at MW-1 were below groundwater quality standards. LNAPL at MW-4 was purged prior to sampling groundwater for dissolved petroleum analysis.
- Petroleum measured on soil collected from the capillary zone (8-10 feet below the ground surface) revealed concentrations about 15 times lower immediately down gradient of the 8,000-gallon UST (MW-1, 8-10′)compared to capillary soil located immediately down gradient of the 3,000-gallon UST (MW-4, 8-10′).
- Geoprobe soil sample collected at borings GP-2 and GP-3 which were located within 3-feet of the 3,000-gallon UST revealed elevated petroleum concentrations in soil to concentrations that exceeded MCP Upper Concentration Limits (UCLs). Boring GP-1, which was located between the USTs, had petroleum concentrations in soil below Method 1 S-1 soil standards.

The nature and extent of contaminated soil and groundwater located beneath the 3,000-gallon UST was determined by field investigation. Drilling refusal by what is believed to be a concrete slab was encountered from 4-6 feet below the top of the floor slab. Drilling through this subsurface obstruction would require a rotary drill rig inside the operating facility. Drilling at the UST inside the facility was not feasible using such equipment because it was not physically accessible and drilling activities would substantially disrupt manufacturing operations.

Because petroleum concentrations in soil decrease with depth at borings GP-2 and GP-3, the release appears to have occurred from overfilling the UST and/or leaking pipes connecting to the top of the UST. The release appears to have migrated down to the subsurface concrete obstruction immediately beneath the UST, traveled over the obstruction and continued to migrate downward to groundwater below. Petroleum product that reached the groundwater table migrated eastward via groundwater flow and discharged to the underground culvert located approximately 45-feet to the east. Severest petroleum concentrations in soil are believed to be present in soil located above the subsurface concrete obstruction. Contaminated soil and groundwater may be present beneath the UST but LNAPL is not believed to be located beneath the tank, because the subsurface concrete obstruction is believed to have diverted the majority of the release to the east end of the UST toward well MW-4. Because planned response actions at the Disposal Site to achieve a Condition of No Significant Risk include bioremediation of the petroleum plume located down gradient of the UST and implementation of an Activity and Use Limitation for contaminated soil located around the UST, LSPCO concluded that collecting data to validate subsurface conditions beneath the 3,000-gallon UST was not critical to the response action outcome.

B. Down Gradient Plume

A plume of petroleum product contamination is present at the Disposal Site and extents from the 3,000-gallon UST to the Brook underground culvert. The plume consists of LNAPL as measured at well MW-4 and along the underground culvert's wall, dissolved petroleum in groundwater, and contaminated soil in the capillary zone. The petroleum plume has not migrated beyond the underground culvert because 1) the underground culvert had been a discharge point for groundwater flowing from the Disposal Site. and 2) The underground culvert is located at the bottom of a steep hill located to the east where groundwater beneath this area flows west also discharging to the underground culvert.

LSPCO was concerned that the petroleum plume would migrate along the west side of the underground culvert's wall in the down gradient direction and therefore installed well MW-2 to monitor groundwater quality for this purpose. Dissolved petroleum concentrations have decreased at this well indicating that migration of the plume in this direction has not occurred. LSPCO also visually inspected weep holes located in the underground culvert's wall about 25-feet down stream (south) of the Disposal Site on June 11, 2001 and did not identify petroleum migrating into the culvert at these locations.

Down gradient contaminant plume conditions reported to MADEP in the last IRA Status Report dated January 23, 2002 are summarized here. The bioremediation system had been operating about 8-months at the time the status report was submitted to MADEP. Except for well MW-5, dissolved concentrations of petroleum spiked since the system began operating on May 23, 2001. Concentrations showed a significant increase when sampled on July 23, 2001 and then showed a significant decrease when sampled on October 11, 2001. Concentrations at MW-5 did not spike, but have gradually increased since the system began operation. The concentration spike was expected and reflects mobilization of petroleum in groundwater and on soil from enhanced groundwater movement and microbial action caused by the treatment system. Mobilization of petroleum in the subsurface is also evident at well MW-1, which is located cross-gradient of the 3,000-gallon UST. The subsequent decrease of petroleum reflects the consumption of petroleum by the oil-eating microbes. Further evidence of effective treatment is the increase in nutrient levels (See Table 3) in groundwater introduced by the system and a spike in petroleum concentrations measured in groundwater influent to the treatment system. The petroleum spike in the influent occurred in the monitoring round after the spike occurred in groundwater, and reflects the lag in travel time for liberated petroleum to reach the recovery trench.

Virtually no dissolved petroleum was present at well MW-2. This well was monitored to determine if petroleum was migrating off-site along the underground culvert wall. Results continue to show that no significant petroleum has migrated along this pathway prior to operation of the remediation system. Overall, the treatment system is operating as designed.

VII. POTENTIAL MIGRATION PATHWAYS

A. Air

Migration pathways for petroleum vapors from the Disposal Site to enter outdoor ambient or indoor air are possible. Petroleum contaminated groundwater and LNAPL is present adjacent to the ACME facility less than 10-feet below the ground surface. Additionally, contaminated soil is located immediately beneath the facility's floor slab at the 3,000-gallon UST. LSPCO determined from a MADEP VPH/EPH Level 1 Soil Gas Screening investigation that migration of petroleum vapors to indoor air would not likely result in a Condition of Significant Risk.

A pathway exists for petroleum and petroleum vapors to migrate in to the underground culvert, a confined space, and potentially impact air quality. Discharge of petroleum product in to the underground culvert through a weep hole was identified by the DPH in 1998 when the release was first discovered. The weep hole was plugged by DPH at that time. LSPCO plugged remaining weep holes in that portion of the underground culvert traversing the Disposal Site on June 11, 2001. Therefore, migration of petroleum product and vapor into the underground culvert has been temporarily abated. Contamination to air has not been identified in the underground culvert based on the following; 1) plugging the weep holes to prevent petroleum from entering the underground culvert, 2) the absence of a petroleum sheen on water in the underground culvert, 3) the absence petroleum odors in the underground culvert, and 4) Lower Explosive Limit (LEL) concentrations in underground culvert air below instrument detection limits when measured as part of confined space entry.

Based on the information above, there is no evidence of contamination to air from the release.

B. Soil

Petroleum contaminated soil has been identified at the Disposal Site. Contaminated soil is present above the groundwater table adjacent to the 3,000-gallon UST from which the release occurred. Soil samples could not be collected below the UST because of drilling refusal from a subsurface concrete obstruction beneath the UST. LSPCO assumed that contaminated soil is present beneath the tank. Soil around the 3,000-gallon UST is located beneath a 6-inch thick concrete floor slab to the facility. Contaminated soil is present down gradient of the 3,000-gallon UST in the capillary fringe where migration of petroleum via groundwater flow has contaminated the aquifer. Down gradient soil is located 8-10 feet below the ground surface, which is covered with asphalt in good condition.

C. Groundwater

Petroleum contaminated groundwater is present at the Disposal Site in dissolved concentrations and as LNAPL. Contaminated groundwater is located beneath the UST, which is beneath the ACME facility, and located beneath asphalt pavement down gradient of the UST. Except for the underground culvert, no exposure pathways to groundwater are present. There are no reported private water supply wells within 500-feet of the property and the site is not located within or near a public water supply protection area. Groundwater migrates toward the underground culvert and could enter the underground culvert through weep holes.

D. Surface Water

Although the culvert is located underground, water in the culvert is considered surface water because it conveys surface water from Big Lake to Two Small Pond. The underground culvert also receives storm water runoff from catch basins. The presence of petroleum sheen on the water was reported by the DPH in 1998, and LSPCO had confirmed the accumulation of LNAPL in the weep hole plugged by DPH at that time. Plugging the underground culvert weep hole by DPH in 1998 and plugging remaining weep holes located in the Disposal Site by LSPCO in June 2001 have temporarily abated this migration pathway.

IX. ENVIRONMENTAL RISK CHARACTERIZATION

Water in the underground culvert discharges to Two Small Pond located about 500-feet down stream south of the Disposal Site. Because the underground culvert is a concrete structure there was no sediment present to form a natural ecological habitat. Sediment sampling in the underground culvert is not possible. The closest ecological system for potential evaluation relative to this Disposal Site is Two Small Pond, which is located about 500-feet south of the Disposal Site. Environmental risk characterization was not considered necessary or appropriate in this investigation for the following reasons:

- The 500-foot distance between the Disposal Site and Two Small Pond make it difficult to determine adverse impacts attributable to the Disposal Site. The underground culvert receives storm water run off from a large area of land in the town that includes run off from industrial developments.
- Petroleum releases from the Disposal Site to the underground culvert resulted in periodic petroleum sheens on the water. LNAPL did not accumulate in the underground culvert and LNAPL did not migrate to Two Small Pond.
- The DPH reports that contact-recreation, fishing and boating are not allowed at Two Small Pond and is indicated to the public by posted signs. Therefore, the quality of the ecological system at Two Small Pond is for aesthetic purposes primarily.

X. PHASE II CONLUSIONS

Based on the information presented above, the following conclusions are made:

- Contamination at the Disposal Site has been characterized as No. 2 fuel oil, which originated from the 3,000-gallon UST located beneath the eastern end of the facility.

- The petroleum release resulted in contamination to soil located around the 3,000-gallon UST, and contamination to groundwater and soil in the capillary zone down gradient of the UST extending from the UST to the Brook underground culvert.

- LNAPL is present immediately down gradient of the 3,000-gallon UST at well MW-4 and along the west wall to underground culvert. LNAPL had discharged to surface water in the underground culvert. The culvert discharges to Two Small Pond located about 500-feet from the Disposal Site.

A Method 1 risk characterization has determined a Condition of Significant Risk at the Disposal Site where comprehensive response actions are required as follows:

- The discharge of LNAPL to water in the underground culvert would occur in absence of the bioremediation system currently operating at the Disposal Site and in absence of the plugs placed in the weep holes to the culvert.

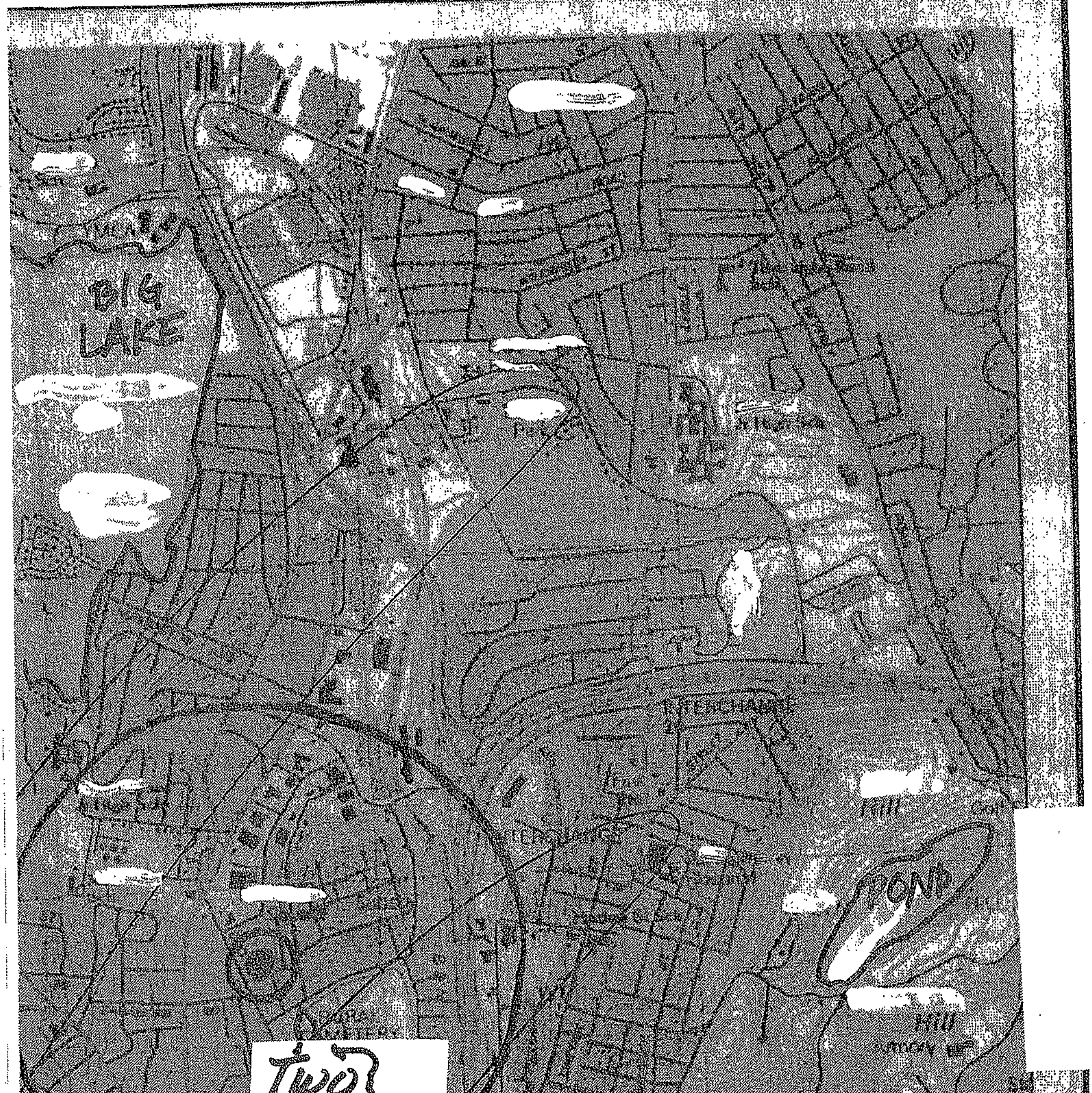
- The presence of LNAPL at well MW-4 would be present at a thickness exceeding the threshold thickness required to implement an IRA in absence of the bioremediation system currently operating at the Disposal Site.

- The EPC of EPH C19-C36 Aliphatics in soil around the 3,000-gallon UST located beneath the facility exceed Method 1 S-3 soil standards. UCLs are not exceeded.

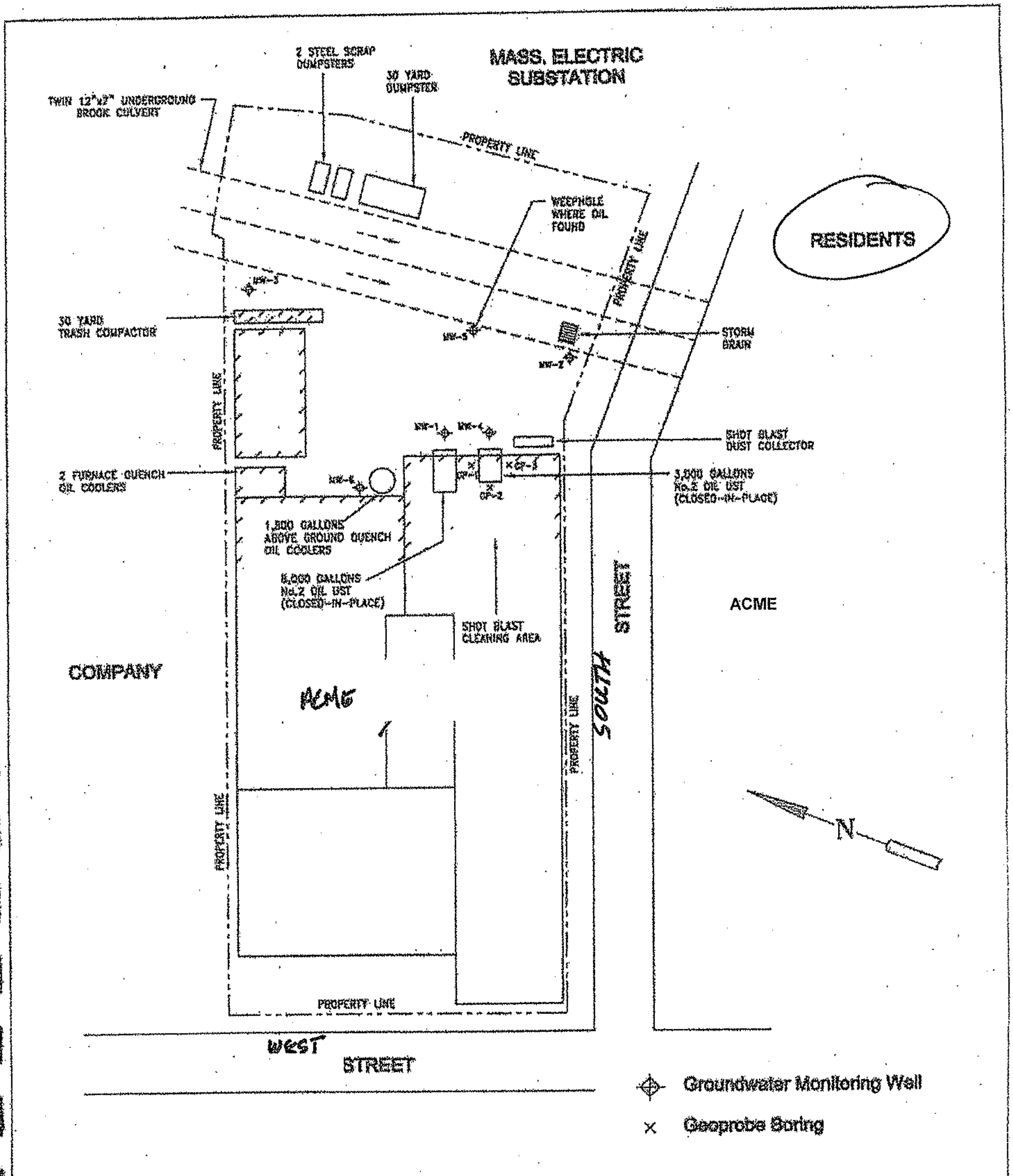
- The EPC of EPH C19-C36 Aliphatics in soil across the entire Disposal Site exceed Method 1 S-3 soil standards. UCLs are not exceeded.

This Phase II Comprehensive Site Assessment has been conducted in accordance with the regulations set forth in 310 CMR 40.0834 through 40.0840 and conforms with the applicable Phase II requirements and conditions specified by MADEP. The information discussed in this report does not affect the Disposal Site's Tier II Classification.

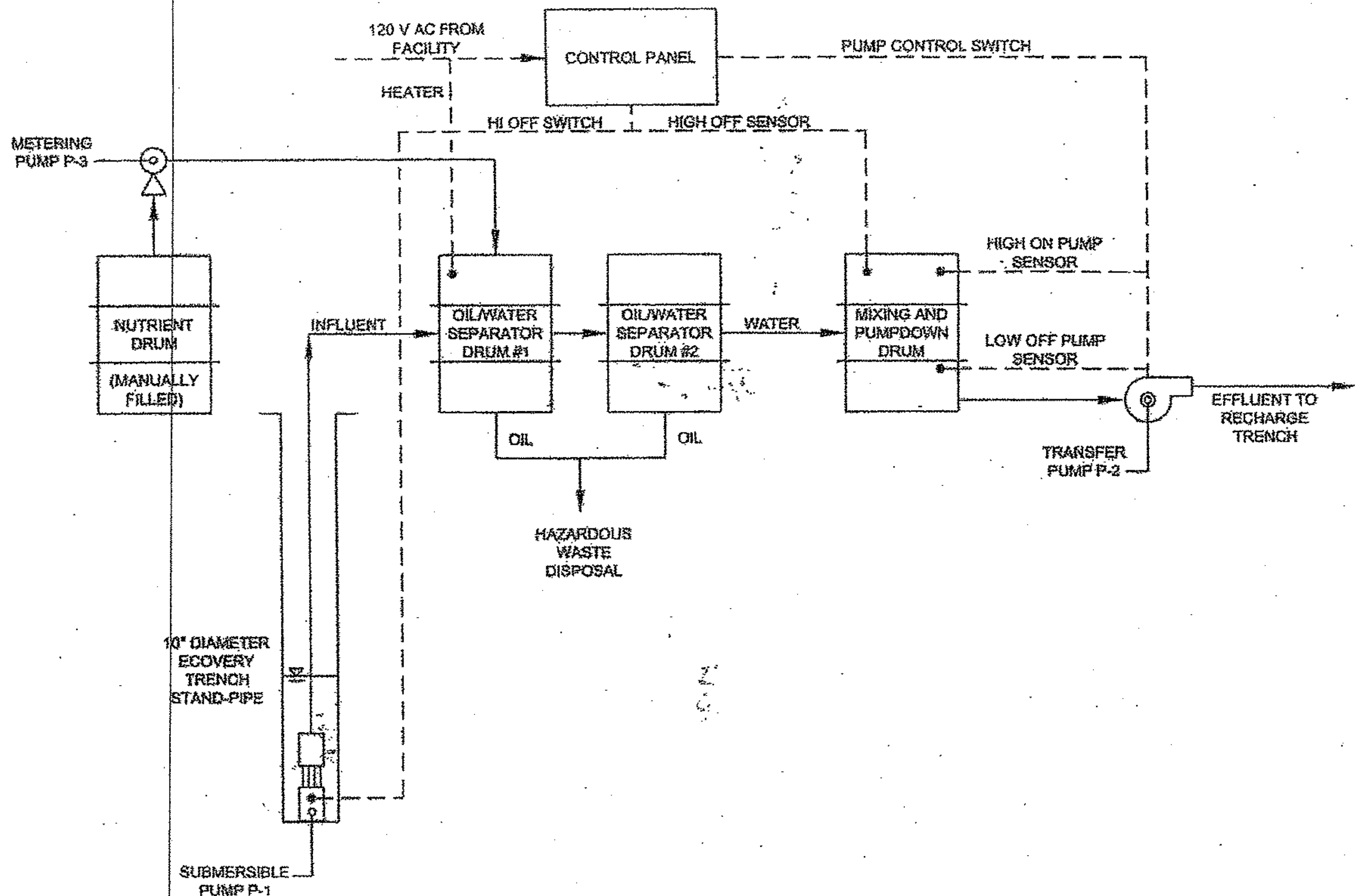
PHASE II
FIGURES



SITE LOCATION MAP FIGURE 1.



APPROVAL		DATE		
DRAWN BY		8/6/01		PROJECT NO.
CHECKED		8/6/01		SCALE: 1"=50'-0"
REVISED		8/6/01	TITLE	CAD NO.
REVISED		1/21/02	SITE PLAN	DRAWING NO. Figure 2
REVISED		10/21/02		REV. 0



APPROVAL		DATE
DRAWN BY		10/26/00
CHECKED		10/26/00
REVISED		07/16/01
REVISED		8/15/03

CLIENT

TITLE: FLOW SCHEMATIC

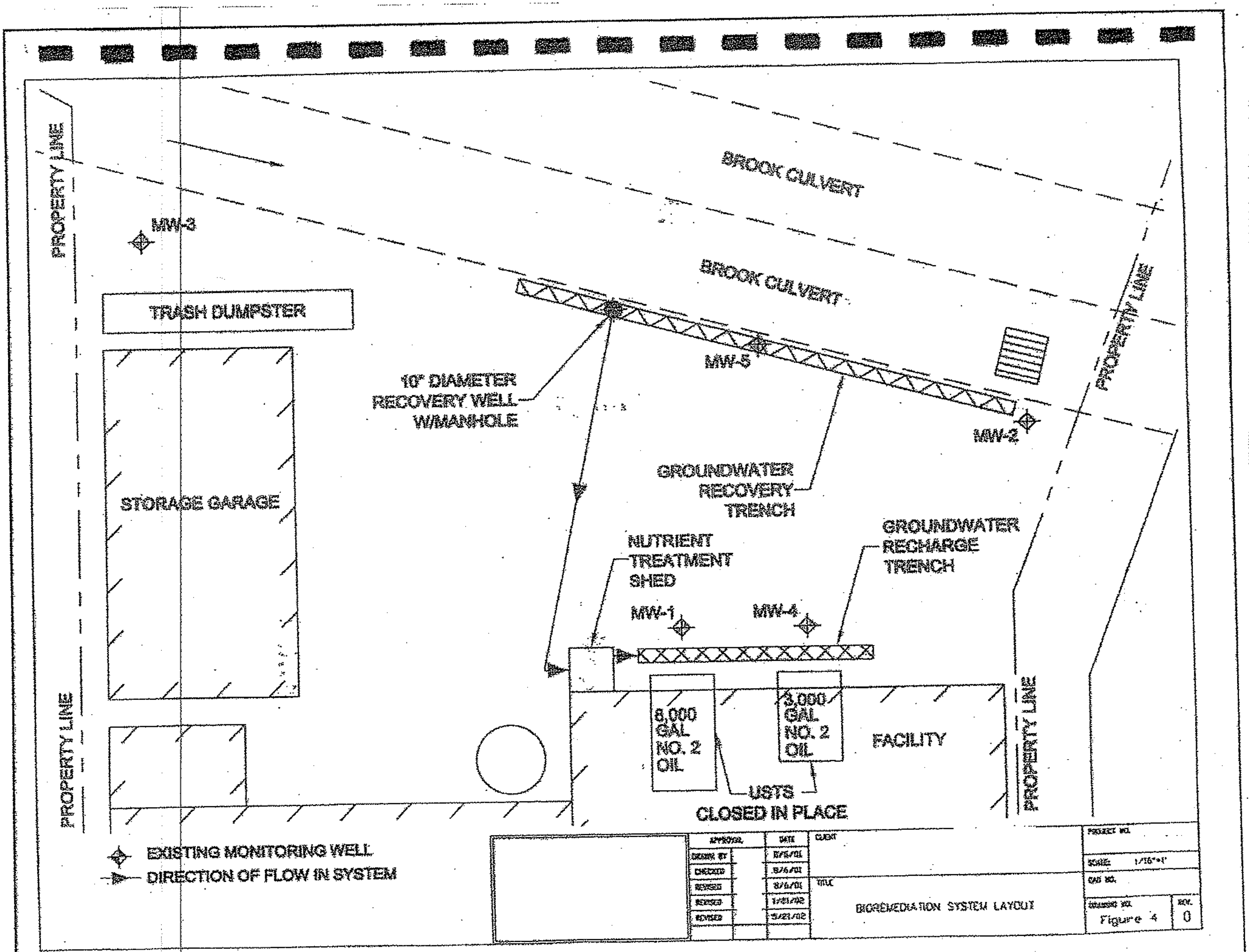
PROJECT NO.

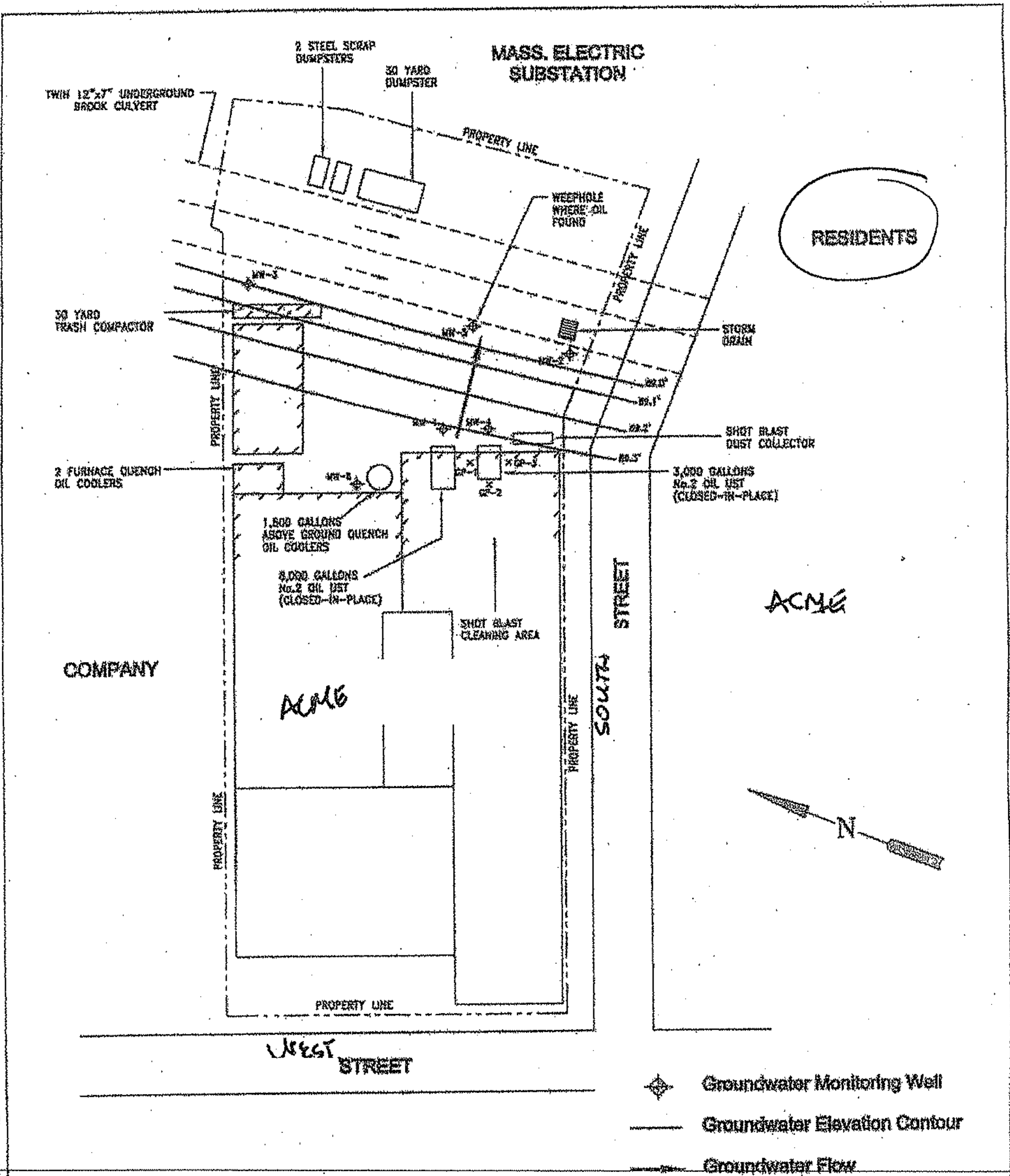
SCALE: NTS

CAD NO.

DRAWING NO. Figure 3

REV. 2


PROPERTY LINE
BROOK CULVERT
BROOK CULVERT
MW-3
TRASH DUMPSTER
STORAGE GARAGE
10" DIAMETER
RECOVERY WELL
W/MANHOLE
MW-5
MW-2
GROUNDWATER
RECOVERY
TRENCH
NUTRIENT
TREATMENT
SHED
GROUNDWATER
RECHARGE
TRENCH
MW-1
MW-4
8,000
GAL
NO. 2
OIL
3,000
GAL
NO. 2
OIL
FACILITY
USTS
CLOSED IN PLACE
EXISTING MONITORING WELL
DIRECTION OF FLOW IN SYSTEM
APPROVAL
DATE
CLIENT
DRAWN BY
CHECKED
REVISED
REVISED
REVISED
TITLE
BIOREMEDIATION SYSTEM LAYOUT
PROJECT NO.
SCALE: 1/16"=1'
CAD NO.
DRAWING NO.
Figure 4
REV.
0



APPROVAL		DATE
DRAWN BY		3/5/01
CHECKED		8/6/01
REVISED		8/5/01
REVISED		1/21/02
REVISED		3/21/02

CLIENT

TITLE

GROUNDWATER FLOW
BEFORE REMEDIATION
4/12/99

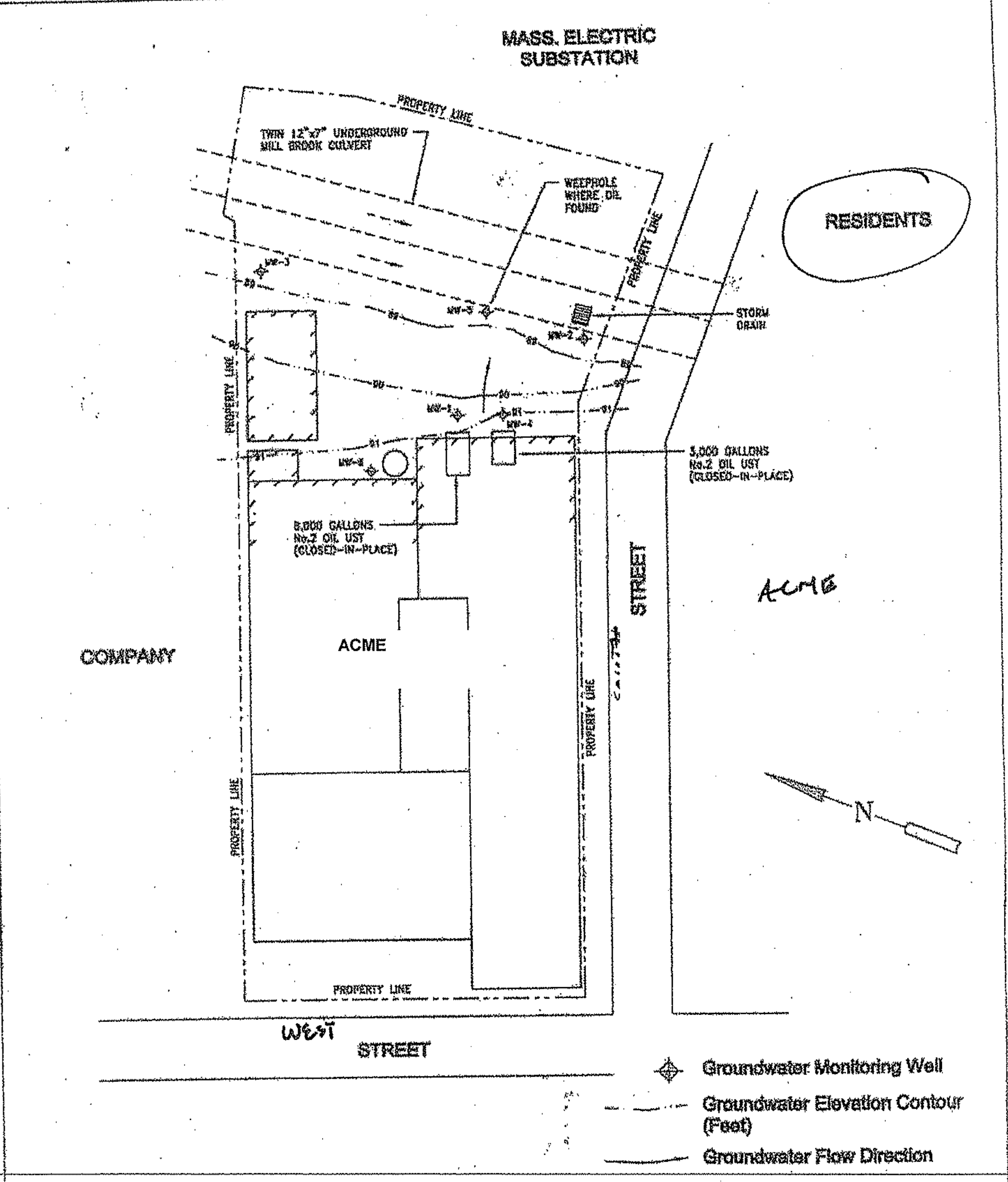
PROJECT NO.

SCALE: 1"=30'-0"

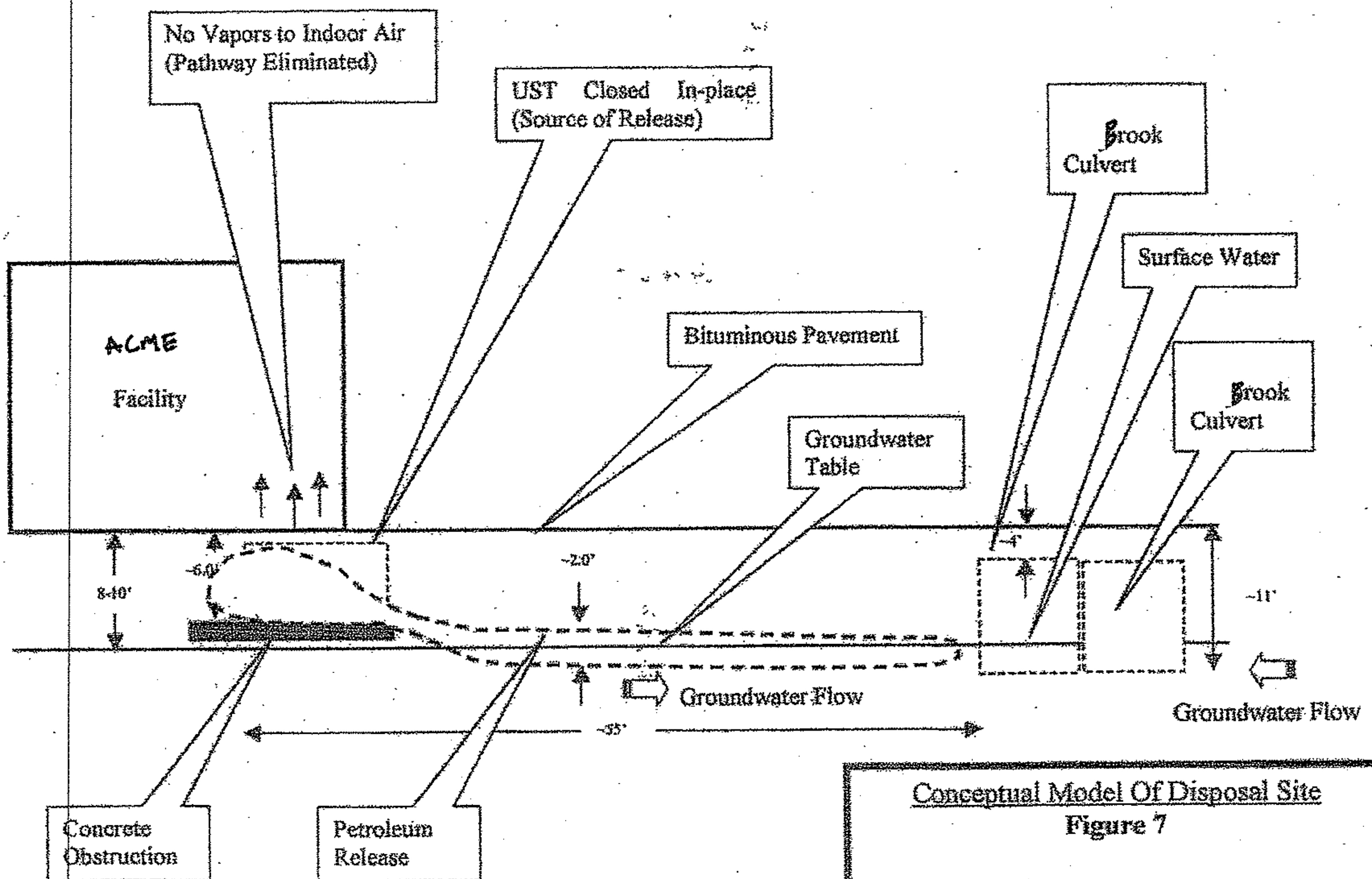
CAD NO.

DRAWING NO. Figure 3

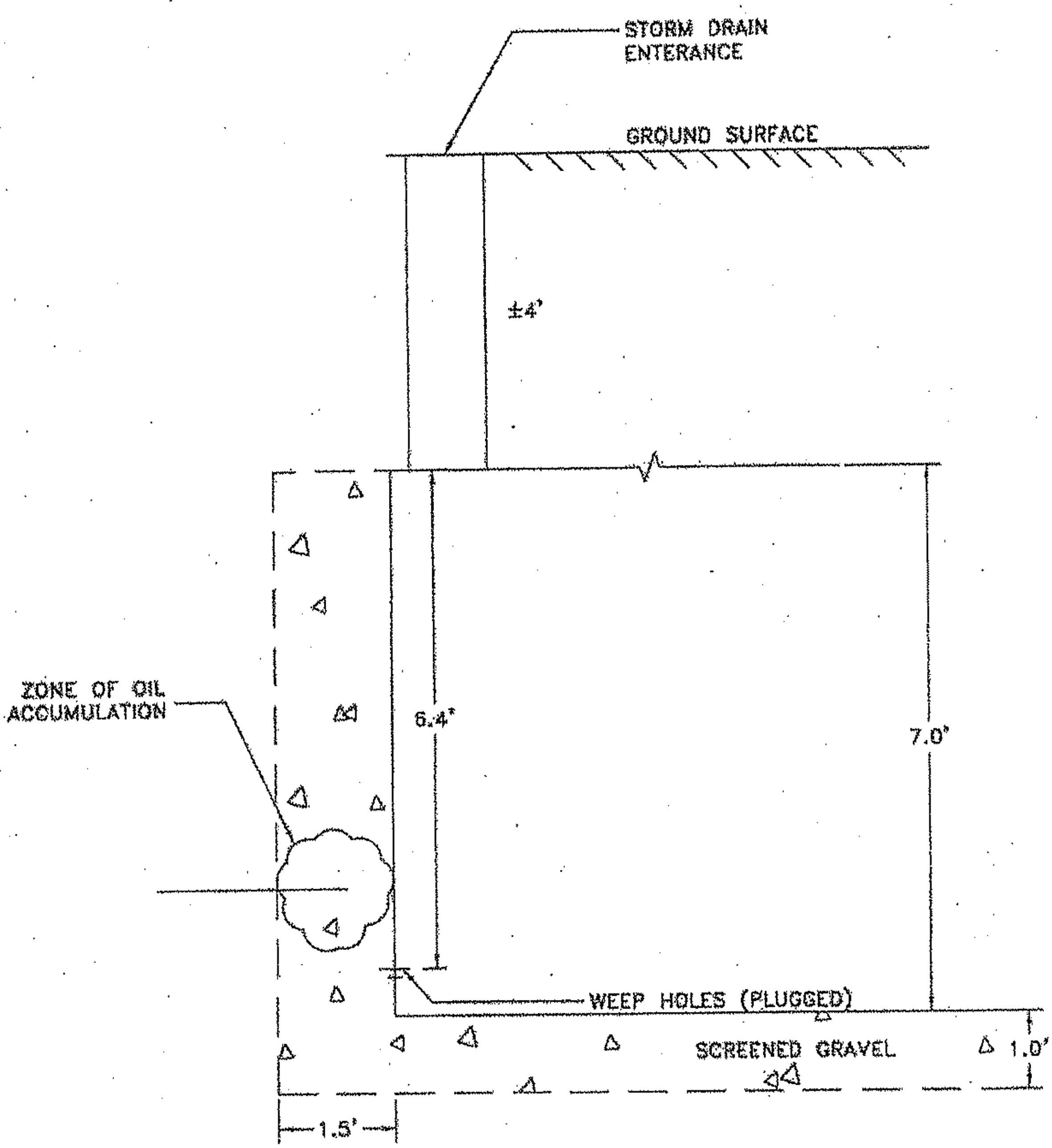
REV. 0



APPROVAL		DATE	CLIENT	PROJECT NO.
DRAWN BY		8/6/01		SCALE 1"=50'-0"
CHECKED		8/6/01		CAD NO.
REVISED		8/6/01	TITLE GROUNDWATER FLOW DURING REMEDIATION OCTOBER 11, 2001	DRAWING NO. Figure 6
REVISED		1/21/02		REV. 0
REVISED		5/21/02		



Conceptual Model Of Disposal Site
Figure 7



NOTES:
1. Plan taken from unnamed design drawing provided by the Department of Public Health

APPROVAL		DATE	CLIENT:	PROJECT NO.	
DRAWN BY		8/6/01		SCALE: 1" = 2'	
CHECKED		8/6/01	TITLE	CAD NO.	
REVISED		8/6/01	CROSS SECTION OF BROOK CULVERT	DRAWING NO.	REV.
REVISED		1/21/02		Figure 8	0
REVISED		5/21/02			

TABLES

TABLE 1 [1,2]
TOTAL VOC SOIL HEADSPACE, PPM

Boring	Sample	Depth, feet	Total VOCs, ppm
MW-1	SS-1	0 to 2	0
	SS-2	2 to 4	0
	SS-3	4 to 6	0
	SS-4	6 to 8	0
	SS-5	8 to 10	2.8
	SS-6	15 to 17	0
MW-2	SS-1	0 to 2	0
	SS-2	5 to 7	0
	SS-3	10 to 12	237
	SS-4	15 to 17	38
MW-3	SS-1	0 to 2	10.4
	SS-2	5 to 7	1.1
	SS-3	10 to 12	0
	SS-4	15 to 17	0
MW-4	SS-1	0 to 2	0
	SS-2	2 to 4	0
	SS-3	4 to 6	0
	SS-4	6 to 8	0
	SS-5	8 to 10	44.2
	SS-6	15 to 17	3
MW-5	SS-1	0 to 2	0.7
	SS-2	5 to 7	18.3
	SS-3	10 to 12	81.2
	SS-4	15 to 17	8.3
GP-1	SS-1	0 to 1	10
	SS-2	3 to 4	16
	SS-3	5.5	18 [3]
GP-2	SS-1	0 to 1	23
	SS-2	3 to 4	12
GP-3	SS-1	0 to 1	4
	SS-2	3 to 4	11
	SS-3	5.5	6.2 [3]

Notes:
1. VOCs were measured using a Hnu or Thermo PID meter calibrated to benzene.
2. VOCs = volatile organic compounds; ppm = parts per million.
3. Value reflects soil gas measurement. No soil sample recovered at this depth.

TABLE 2 [1,2]
PRE-REMEDIAL GROUNDWATER ELEVATIONS, FEET
April 12, 1999

Well	Top of PVC Elevation	Depth to Groundwater	Groundwater Elevation
MW-1	98.7	9.39	89.31
MW-2	97.46	8.52	88.94
MW-3	98.84	9.8	89.04
MW-4	98.52	9.23	89.29
MW-5	97.81	8.83	88.98

Notes: 1. Top of PVC casing elevations measured by Massachusetts Registered Land Surveyor.
2. Survey based on arbutrary on-site datum.

TABLE 3 [1,2]

GROUNDWATER ELEVATIONS DURING REMEDIATION, FEET

October 11, 2001

Well	Top of PVC Elevation	Depth to Groundwater	Groundwater Elevation
MW-1	98.7	8.33	90.37
MW-2	97.46	8.8	88.66
MW-3	98.84	10.04	88.8
MW-4	98.52	7.47	91.05
MW-5	97.81	8.82	88.99
MW-6	Not Measured	9.28	-

Notes: 1. Top of PVC casing elevations measured by Massachusetts Registered Land Surveyor.
2. Survey based on arbutrary on-site datum.

TABLE 4
OIL FINGERPRINT RESULTS, PPM
12/10/98

FUEL OIL #2/Diesel	90000
VOLATILE PETROLEUM HYDROCARBONS	
C5-C8 ALIPHATICS	ND
C9-C12 ALIPHATICS	12600
C9-C10 AROMATICS	3410
C5-C8 ALIPHATICS, ADJUSTED	ND
C9-C12 ALIPHATICS, ADJUSTED	9220
TARGET COMPOUNDS (ppb)	ND
EXTRACTABLE PETROLEUM HYDROCARBONS	
C9-C18 ALIPHATICS	29400
C19-C36 ALIPHATICS	46100
C11-C22 AROMATICS	16900
TARGET COMPOUNDS (ppb)	ND

Notes: 1. Ppm = parts per million;
'ppb = parts per billion.

TABLE 5
OIL PRODUCT LAYER MONITORING, FEET

Well	Date	Depth to Oil	Depth to Water	Oil Layer Measured Thickness	Oil Layer Average	
MW-1	4/12/99	None	9.39	0		
	7/23/01		5.48	0		
	10/11/01		8.33	0	0	
MW-2	4/12/99	None	8.52	0		
	7/29/99	None	8.62	0		
	9/2/99	None	8.89	0		
	10/4/99	None	5.48	0		
	11/1/99	None	8.58	0		
	2/16/00	None	8.58	0		
	5/8/00	None	8.31	0		
	8/21/00	None	8.56	0		
	1/22/01	None	8.55	0		
	5/7/01	None	8.48	0		
	7/23/01		8.5	0		
	10/11/01		8.8	0	0	
MW-3	4/12/99	None	9.8	0		
	7/23/01		NM			
	10/11/01		10.04	0	0	
MW-4	*4/12/1999	9.11	9.23	0.12		
	*7/29/1999	None	9.44	0		
	9/2/99	9.51	9.52	0.01		
	*10/4/1999	9.05	9.15	0.1		
	11/1/99	9.11	9.21	0.1		
	*2/16/2000	7.85	7.86	0.01		
	2/22/00	None	7.31	0		
	2/29/00	6.65	6.66	0.01		
	*5/8/2000	None	8.41	0		
	*8/21/2000	None	8.99	0		
	*5/7/2001	None	8.93	0		
	*7/23/2001		4.65	0		
	*10/11/2001		4.47	0	0.026	Average from quarterly monitoring results denoted by (*)
MW-5	4/12/99	None	8.83	0		
	7/29/99	None	8.62	0		
	9/2/99	None	9.01	0		
	10/4/99	None	5.76	0		
	11/1/99	None	8.91	0		
	2/16/00	None	8.91	0		
	5/8/00	None	8.66	0		
	8/21/00	None	9.91	0		
	5/7/01	None	8.7	0		
	7/23/01	None	6.65	0		
	10/11/01	None	8.72	0	0	
MW-6	10/11/01		9.28			

MCP 120-day reporting threshold: 0.010 or greater
MCP IRA threshold (72-hour): 0.042
MCP Upper Concentration Limit: 0.042

TABLE 6
SOIL LABORATORY RESULTS, PPM

VOLATILE PETROLEUM HYDROCARBONS

Boring: Depth (ft):	DOWN GRADIENT MW-1 (6-8)	MW-1 (8-10)	MW-2 (10-12)	MW-4 (6-8)	MW-4 (8-10)	AT UST GP-1 (0-1)	GP-1 (3-4)	GP-2 (0-1)	GP-2 (3-4)	GP-3 (0-1)	GP-3 (3-4)	Exposure Point Concentration (All Locations) [3]	Exposure Point Concentration (UST Only) [4]	MCP STANDARDS Method 1 S-1/GW-2, GW-3	Method 1 S-3/GW-2, GW-3	Method 3 UCL
C5-C8 ALIPHATICS	LT 1.36	LT 1.27	11.6	LT 1.2	8.8	3.5	LT 2.5	7.6	8.1	3.8	4.4	7	5.1	100	500	
C9-C12 ALIPHATICS	5.2	1.8	83.4	LT 1.2	112.0	4.7	4.5	14.0	18.0	8.5	7.8	24	9.6	1,000	5,000	
C9-C10 AROMATICS	4.3	LT 1.27	33.6	LT 1.2	54.6	4.3	4.4	12.0	12.0	6.5	5.8	15	7.5	100	500	

EXTRACTABLE PETROLEUM HYDROCARBONS

	MW-1 (6-8)	MW-1 (8-10)	MW-2 (10-12)	MW-4 (6-8)	MW-4 (8-10)	GP-1 (0-1)	GP-1 (3-4)	GP-2 (0-1)	GP-2 (3-4)	GP-3 (0-1)	GP-3 (3-4)	Exposure Point Concentration (All Locations) [3]	Exposure Point Concentration (UST Only) [4]	Method 1 S-1/GW-2, GW-3	Method 1 S-3/GW-2, GW-3	Method 3 UCL
C9-C18 ALIPHATICS	84.4	42.7	1180.0	42.4	1480.0	73.0	180.0	3200.0	430.0	4000.0	3300.0	1,274	1,884	1,000	5,000	20,000
C19-C36 ALIPHATICS	43.7	19.0	563.0	16.4	923.0	870.0	320.0	[illegible]	11000.0	[illegible]	13000.0	7,343	13,198	2,500	5,000	20,000
C11-C22 AROMATICS	105.0	29.9	773.0	238.0	1830.0	310.0	326.0	5700.0	2090.0	4400.0	2600.0	1,866	2,556	800	5,000	10,000

Notes: 1. PPM = parts per million. Unadjusted values listed because target compounds were not tested. Regulatory standards are listed for reference only. A risk characteriza ion has not been conducted.
2. Values in bold exc ed MCP Method 1 S-1 soil standard. Values underlined exceed Method 1 S-3 standards. Shaded values exceed Method 3 UCL.

TABLE 7
GROUNDWATER QUALITY - PETROLEUM, PPB

	MW-1	MW-1	MW-1	MW-1	MW-2	MW-2	MW-2	MW-2	MW-2	MW-2	MW-2	MW-2	MW-2
Date:	4/12/99	5/7/01	7/23/01	10/11/01	4/12/99	7/29/99	11/1/99	2/16/00	5/3/00	8/21/00	1/22/01	5/7/01	7/23/01
Depth To Groundwater, feet	9.39	9.17	8.48	8.33	8.52	8.82	8.56	8.58	8.31	8.56	8.65	6.48	8.5
VOLATILE PETROLEUM HYDROCARBONS													
C5-C8 ALIPHATICS	28.3	LT 40	LT 40	LT 40.0	463	118	148	110	89.7	50.8	50.2	55.6	252
C9-C12 ALIPHATICS	79.3	541	744	178.0	22.7	378	488	74	LT 40	LT 40	LT 40	LT 40	268
C9-C10 AROMATICS	62.1	176	366	LT 40.0	20.8	99.2	143	52	LT 40	LT 40	LT 40	LT 40	167
EXTRACTABLE PETROLEUM HYDROCARBONS													
C9-C18 ALIPHATICS	179	3520	13,300	2730	2800	1400	1980	270	415	1,000	581	LT 100	1,230
C19-C36 ALIPHATICS	ND	2240	7,570	2240	2010	1200	1650	400	481	914	717	LT 100	2,090
C11-C22 AROMATICS	347	2890	5,300	2560	2080	772	1530	340	350	943	612	LT 100	1,700

	MW-2	MW-3	MW-3	MW-4	MW-4	MW-4	MW-4	MW-4	MW-5	MW-6	MW-6	MW-6	MW-6	Method 1 Standards GW-2	Method 1 Standards GW-3
Date:	10/11/01	4/12/99	10/11/01	4/12/99	2/16/00	5/7/01	7/23/01	10/11/01	4/12/99	5/7/01	7/23/01	10/11/01	10/11/01		
Depth To Groundwater, feet	8.8	8.8	10.04	9.23	7.86	8.83	4.65	7.47	8.63	8.7	8.65	9.72	9.28		
VOLATILE PETROLEUM HYDROCARBONS															
C5-C8 ALIPHATICS	94.6	LT 40	LT, 40.0	LT 40	62	LT 40	LT 40	LT, 40.0	LT 40	LT 40	LT 40	LT 40.0	343.0	1000	4000
C9-C12 ALIPHATICS	LT 40.0	LT 40	1120	283	330	132	4,630	LT, 40.0	52.9	96.7	278	156.0	260.0	1000	20000
C9-C10 AROMATICS	LT 40.0	LT 40	442.0	247	220	LT 40	2,670	LT, 40.0	45	61.3	186	74.6	159.0	5000	4000
EXTRACTABLE PETROLEUM HYDROCARBONS															
C9-C18 ALIPHATICS	LT 100	175	14100	3470	4300	565	15,800	1870	2960	114	537	700.0	374.0	1000	20000
C19-C36 ALIPHATICS	LT 100	LT 100	37900	3260	4200	692	12,700	1990	11100	293	1,970	2160	289.0	N/A	20000
C11-C22 AROMATICS	LT 100	260	15900	4530	3317	691	9,640	1150	9130	451	1,310	2020	454.0	50000	30000

Notes:
1. ppb = parts per billion; LT = Less Than. No value indicates not tested.
2. Values in bold equal or exceed MCP Method 1 GW-2 groundwater standard for wells located within 30 feet of an occupied building.
3. Method 1 GW-3 standards were not exceeded.
4. MW-2, MW-3, and MW-5 is located more than 30 feet from an occupied structure and therefore not subject to Method 1 GW-2 standards.