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Golder Associates

# FINAL
# REMEDIAL INVESTIGATION/ FEASIBILITY STUDY WORK PLAN
# LIGHTMAN DRUM COMPANY SUPERFUND SITE
# WINSLOW TOWNSHIP, NEW JERSEY

7/02

Prepared for:

Lightman Yard PRP Group

Prepared by:

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July 2002

Project No.: 013-6054

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July 23, 2002

Project No.: 013-6054

New Jersey Remediation Branch
Emergency and Remedial Response Division
U.S. Environmental Protection Agency, Region II
290 Broadway, 19th Floor
New York, NY 10007-1866

Attn: Mr. Joseph Gowers, Project Manager

RE: LIGHTMAN DRUM COMPANY SUPERFUND SITE, WINSLOW TOWNSHIP, NJ
FINAL REMEDIAL INVESTIGATION/FEASIBILITY STUDY WORK PLAN

Gentlemen:

On behalf of the Lightman Yard PRP Group, Golder Associates Inc. (Golder Associates) is pleased to submit five copies of the Final Remedial Investigation/Feasibility Study Work Plan (RIWP) for the Lightman Drum Company Superfund Site. Three copies have been provided to NJDEP under separate cover.

This RIWP was prepared in accordance with Section VII, Paragraph 33 of the Administrative Order on Consent (AOC) for the Site (USEPA INDEX No. CERCLA-02-2000-2034). The Final RIWP includes the Sampling and Analysis Plan and Quality Assurance Project Plan (SAP); and, the Health and Safety Plan (HASP).

This Final RIWP is submitted pursuant to your approval letter dated July 3, 2002 and incorporates the response to comments and proposed changes to the previous version provided on May 29, 2002. The minor comment contained in your July 3 letter has also been addressed. The Work Plan incorporates a schedule that, as agreed, is initiated on July 24, 2002. We will be in touch with you shortly to confirm the exact date for the start of fieldwork.

Please do not hesitate to call if any questions arise from your review of this document.

Very truly yours,

GOLDER ASSOCIATES INC.

P. Stephen Finn, C.Eng.
Project Coordinator

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cc: James DeNoble, NJDEP
Lightman Yard PRP Group Technical Committee Members

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# 1.0 INTRODUCTION

## 1.1 Regulatory Background

This Remedial Investigation/Feasibility Study (RI/FS) Work Plan (RIWP) has been prepared by Golder Associates Inc. (Golder) on behalf of the Lightman Yard PRP Group (Group). The RIWP is submitted pursuant to Section VII, Paragraph 33 of the Administrative Order on Consent (AOC) executed by the United States Environmental Protection Agency (USEPA) in November 2000 (USEPA Index No. CERCLA-02-2000-2034). This RIWP provides the framework for the activities to be conducted as part of the RI/FS for the Lightman Drum Company Superfund Site (Site) as required by the AOC.

The Lightman Drum Company property covers approximately 15 acres and is located in Winslow Township, Camden County, New Jersey (Figure 1). Jerome Lightman, the owner of the property, operates a drum brokerage business under the name of Lightman Drum Company, Inc. (LDC) and/or United Cooperage. As stated in the AOC, LDC operated an industrial waste hauling and drum reclamation business at the Site beginning in the spring of 1974. Various inspections of the property were conducted by the New Jersey Department of Environmental Protection (NJDEP) from 1974 through 1984. In 1978, the NJDEP issued a one-year Temporary Operating Authorization that allowed the storage of various wastes on the property including chemical powders, pesticides, waste oil, oil sludges, paint, pigment, thinner, ink residues, ketones, alcohols, and mixed solvents. The permit was not renewed.

In 1987, NJDEP collected soil samples from the property that revealed the presence of various organic and inorganic compounds. In 1988, NJDEP issued an Administrative Order (the New Jersey Order) requiring LDC to conduct an RI/FS at the Site. International Exploration, Inc. (INTEX) performed investigation work in two phases in 1989 and 1990. The investigation included installation of groundwater monitoring wells and collection of soil and groundwater samples on the property. Constituents detected in groundwater on the property included chlorinated and aromatic VOCs, and Semi-volatile Organic Compounds (SVOCs) in excess of federal drinking water standards (maximum contaminant levels; MCLs). Constituents detected in soils on the property included VOCs (primarily chlorinated and BTEX compounds), SVOCs, pesticides, and inorganics.

At the request of NJDEP, USEPA performed a Hazard Ranking System (HRS) Evaluation of the Site in May 1999. The purpose of the HRS Evaluation was to determine if the releases at the Site warranted placement of the Site on the National Priorities List (NPL) set forth in 40 CFR Part 300, Appendix B. The HRS Evaluation Site Score was 42.03, based solely on the Groundwater Pathway, and exceeded the 28.50 cut-off for potential listing on the NPL. USEPA placed the Site on the NPL by publication in the Federal Register on October 22, 1999.

### 1.2 Project Objectives

The objectives of this RI/FS, as required by the AOC, are as follows:

- Determine the nature and extent of contamination and any impact to the public health, welfare, or the environment caused by the release or potential release of hazardous substances, pollutants, or contaminants at or from the Site by conducting an RI; and,
- Determine and evaluate alternatives for remedial action, if any, to prevent, mitigate, or otherwise respond to or remedy any release or potential release of hazardous substances, pollutants, or contaminants at or from the Site by conducting a FS.

In order to accomplish these objectives, this RIWP has been prepared to describe the approach which will be used to assess the nature and extent of contamination and evaluate remedial alternatives. The overall approach and key elements of this RIWP were discussed with the USEPA and NJDEP during a meeting on February 14, 2001. The conclusions from this meeting have been incorporated into this RIWP.

### 1.3 RI/FS Work Plan Organization

In general, this RIWP includes the following key elements:

- A summary of previous investigations conducted by others (Section 2.2);
- Objectives, proposed scope of work and methodologies for additional investigations (Sections 2.3 and 3.0);
- Description of activities to be conducted as part of the FS (Section 4.0);
- Organization for implementing the RI/FS (Section 5.1);
- Schedule of RI/FS activities and associated deliverables (Section 5.2); and,
- Supporting work plans including a Sampling and Analysis Plan (SAP), which includes the Quality Assurance Project Plan (QAPP), and a Health and Safety Plan (HASP) are provided as Appendices.

## 2.0 SCOPING OF RI/FS

### 2.1 General

The Lightman property covers approximately 15 acres and is bordered to the east by Route 73, to the west by the Pennsylvania Reading Railroad Line, to the south by farmland and to the north by farmland and wooded areas. The area in the vicinity of the property is semi-rural and is generally used for agricultural purposes with few residences and small businesses located along Route 73, including directly north and south of the property. According to the AOC, approximately 8,000 people live within a 3-mile radius of the Site. For the purposes of this RI/FS, the Site includes any area in the vicinity of the property to which hazardous substances have migrated or threatened to migrate and all areas in close proximity to the contamination necessary for the implementation of the response actions required by the AOC.

The property is narrow in width (approximately 300 feet wide) with the main access from Route 73. The majority of property is wooded as shown on Figure 2. There is very little topographic relief across the property with a maximum elevation range of 15 feet (INTEX, 1989). Topography generally slopes to the south-southwest with some relief apparent to the north of the property. A wetland area is located along the western fringe of the property adjacent to the railroad tracks. A retention area is located near the property entrance, which receives surface water flow from the west via a short culvert that runs beneath a parking area.

The property is currently used as a drum brokerage business. These operations are generally located in the eastern area where the majority of the property is used for storage of empty drums. Drums are stored in truck trailers and in open areas. A small office is located near the Site entrance. A large concrete slab is located adjacent to the office, which served as the foundation for a former storage warehouse. The warehouse was destroyed by fire in 1985 (INTEX, 1989). A water supply well is located near the office and is used for non-potable purposes. A small septic system, which was installed in 1975 to serve the office bathroom, is located adjacent to and west of the concrete slab.

An abandoned house is located adjacent to Route 73. A water well is reportedly located in the basement of the house.

## 2.2 Evaluation of Existing Data

### 2.2.1 History of Site Investigations

Pursuant to the New Jersey Order, an investigation was conducted in two phases by INTEX (Phase I and Phase II) in 1989 and in 1990 on behalf of LDC. The investigation results were presented in reports, included as Appendix E, dated September 1989 (INTEX, 1989) and October 1990 (INTEX, 1990). These investigations focused on delineating the extent of contamination in soil and groundwater. Approximately 80 soil samples were collected and twelve monitoring wells installed including shallow and deep well clusters at locations MW-2 and MW-8. The investigations were concentrated in known waste storage areas as shown on Figure 2 as briefly described below. In addition, a geophysical investigation was conducted, consisting of an electromagnetic terrain conductivity survey, following the Phase I investigation to assist in locating additional monitoring wells downgradient to MW-2 and MW-3 during the Phase II investigation. The results from the geophysical investigation were inconclusive in the operational area of the site as a result of surficial interferences (i.e., metal drums and trailers). A small anomaly was identified in the area of the unlined waste storage pit and monitoring well MW-7 was subsequently installed. As a result, direct investigation information, which is more reliable, obtained prior to and subsequent to the geophysical investigation was used to guide the scope of this RIWP.

*Underground Diesel Fuel Tanks*

Two fiberglass underground storage tanks of 750 and 1,500 gallon capacity were installed in 1976 along the southern property boundary (INTEX, 1989). The tanks were reportedly used for storing diesel fuel until the early 1980s and were removed in 1990. Soil samples were taken from the excavation as part of the Phase II investigation (INTEX, 1990) and indicated low levels of petroleum hydrocarbons and, in one sample, trichloroethene was measured at a concentration of 1950 ppb. Copies of the NJDEP Standard Reporting forms regarding the tank removals, and other available documentation, is provided as Appendix D. The INTEX (1990) Report is included in its entirety as Appendix E.

*Unlined Waste Disposal Pit*

A former waste disposal pit is located in a wooded area in the west-central area of the Site. The small pit was accessed by a truck from the main operations area and was located within a shallow depression. It was reported that the pit was used for the disposal of a single tank trailer containing paint waste and possibly oil. Lightman Drum Company reportedly removed waste and soil in the area in 1974 or 1975.

### *Underground Waste Storage Tanks*

Two 5,000 gallon underground storage tanks were formerly located in the north-central area of the Site. The tanks were reported to store waste paint pigments, ink sludges and thinners, and were reportedly in use under a Temporary Operating Authority between November 2, 1978 and April 30, 1979 (INTEX, 1989). As noted in the AOC, NJDEP observed the removal of the tanks in 1984. Appendix D includes copies of the manifest and the NJDEP Generator Annual Report (1984) showing the disposition of the tank contents.

### *Warehouse*

Drums were stored in a warehouse located in the eastern part of the Site prior to 1985. In September 1985, a fire destroyed the warehouse. The concrete foundation slab from the warehouse is still present.

### *Drum Storage Areas*

Drum storage areas throughout the active portion of the property were also investigated. The areas investigated included the main storage areas located along the southern property boundary west of the former diesel tanks and along the northern tree line east of the former solvent tanks. There have been no reported removal activities in these areas.

Historical aerial photos of the Site have been obtained and reviewed from the following dates:

1940
1954
1970
1974
1975
1979
1984
1986
1987
1989

These photographs confirm the following aspects of the Site history:

1. Prior to 1974, the currently active portion of the Site was used for agricultural purposes;
2. With the exception of the unlined waste disposal pit and associated access tracks, the wooded portion of the property to the west and along the northern boundary has remained unchanged at least since 1940; and,
3. The current operational area has been remained essentially the same since 1974.

### 2.2.2 Site Geologic and Hydrogeologic Conditions

The Site is located in the Coastal Plain physiographic province, which consists of a series of unconsolidated Cretaceous and Quaternary sand and clay deposits. These sediments form a southeasterly dipping wedge which thickens eastward toward the Atlantic Ocean. The Site hydrogeologic model is characterized by the presence of a relatively uniform unconfined aquifer, known as the Cohansey Sand (Zapecza, 1989), consisting of yellowish brown coarse to fine grained sand. The Cohansey Sand is underlain at depth by the Kirkwood Formation which consists of clay, silt, and light grey to yellow very fine to medium grained sand. The base of the Cohansey-Kirkwood aquifer is defined by the top of a clay bed lying at the base of the Kirkwood Formation. Depending upon the thickness of the basal clay of the Kirkwood Formation, the sand aquifer may be on the order of 130 feet thick in the vicinity of the Site. Investigations by INTEX to a maximum depth of 52 feet confirm that the Site geology is consistent with the regional interpretation. Subsurface investigations by INTEX encountered predominantly brown (usually near the surface) to tan, orange-brown or white, very coarse to fine sands with occasional gravel and rare silt or clay layers. The thin clay layers observed by INTEX were not considered confining layers due to their limited thickness and non-continuous nature.

Groundwater in the vicinity of the Site generally flows in a southerly direction, oblique to the long axis of the property. Previous investigations indicate that groundwater is generally encountered at approximately 10 feet below ground surface (bgs) at elevations of approximately 123 to 126 feet above mean sea level (ft MSL), as shown in Table 1. As is typical with Coastal Plain aquifers, the horizontal hydraulic gradient is relatively flat. The mean horizontal hydraulic gradient calculated during the Phase I RI was $9.1\times10^{-4}$, and during the Phase II RI was $1.65\times10^{-5}$. Hydraulic testing of monitoring wells (falling head tests) completed during the Phase I RI indicated a mean hydraulic conductivity of $2\times10^{-2}$ centimeters per second (cm/sec). The results obtained fall within a relatively narrow range, as shown in Table 2, confirming the uniform nature of the aquifer.

### 2.2.3 Soil Chemistry

During the Phase I and Phase II remedial investigations, INTEX collected a number of shallow (0 to 2 feet) and deep soil samples typically ranging from 2 to 17 feet in depth at the locations shown in Figure 4. During the Phase I RI, INTEX collected soil samples from each of the 6 borings in which monitoring wells were subsequently installed (MW-1 through MW-6) and a number of other samples from suspected contaminated areas. In 1990, a Phase II RI was conducted in which INTEX collected additional shallow and deep soil samples to delineate the nature and extent of soil contamination in areas where elevated VOC and SVOC contamination had been detected in the previous investigation. INTEX also installed six additional monitoring wells at the Site and collected soil samples from each of these borings (MW-2B, MW-7, MW-8A, MW-8B, MW-9, and MW-10). Soil data tables from the INTEX Reports are provided in Appendix E and summarized on Figures C-1 and C-2 for shallow and deep sampling points, respectively.

The soil chemistry data has been compared to USEPA Generic Soil Screening Levels (SSLs; USEPA 1996) for Migration to Groundwater (Dilution Attenuation Factor of 1) and for Ingestion as well as the New Jersey Soil Cleanup Criteria. Organic contamination exceeding screening levels for migration to groundwater was found at depth in the area of the Former Waste Solvent USTs, the Former Diesel USTs, and the southwest corner of the Former Southwest Drum Storage Area. The primary contaminants of concern include chlorinated VOCs, benzene, ethylbenzene, toluene and xylene (BTEX). Chlorinated VOCs, were also detected in deep soil samples at concentrations exceeding the screening levels for ingestion. Pesticides and SVOCs were sporadically detected in shallow soil samples. PCBs were not detected.

Various inorganic compounds (i.e., arsenic, lead, beryllium) were detected in shallow soils and at depth throughout the Site that exceed screening criteria. However, the majority of the inorganics detected are well below the NJDEP Residential Direct Contact Soil Cleanup Criteria (RDCSCC). As an example, arsenic was consistently detected throughout the Site (including samples extremely remote from site operations) at concentrations ranging from approximately 1 ppm to 12 ppm. However, the RDCSCC is 20 ppm based on natural background for soils in New Jersey. It should also be noted that few metals were detected in groundwater above MCLs as described in Section 2.2.4.

As such, the Phase I and Phase II data suggests that there are three primary areas where site-related contamination may be expected. These areas are the Former Waste Solvent USTs, the Former Southwest Drum Storage Area, and the Former Diesel USTs (Figure 2). Additionally, the areas around the Former Unlined Waste Storage Pit, Phase I soil locations SS-8 and SS-11 and the areas around Phase II soil locations S-2D and S-1B (see Figure 4 and C-1 and C-2) show impacts of organic constituents.

### 2.2.4 Groundwater Chemistry

Groundwater samples were collected during the Phase I and II remedial investigations (INTEX 1989, INTEX 1990). Groundwater samples collected during the Phase I investigation were analyzed for priority pollutant VOCs, SVOCs, total iron, manganese, and total solids. During the Phase II RI a comprehensive round of samples was collected and analyzed for Priority Pollutant VOCs, SVOCs, pesticides, and metals. In July 2000, USEPA collected samples from all Site wells (except for MW-4 and MW-5) and various residential wells along Route 73 (USEPA 2000a). These samples were analyzed for TCL VOCs, BNAs, pesticides, PCBs, and TAL metals.

These data were compared to the New Jersey Class IIA Groundwater Quality Standards (NJ GWQS, NJDEP 1993) for screening purposes. Exceedances of the Class IIA Standards based on the most recent data for each well are shown on Figure 3. Primarily, chlorinated VOCs and BTEX exceeded the GWQS especially in the areas of the Former Waste Solvent USTs (MW-2 well cluster), and the Former Southwest Drum Storage Area (MW-8 well cluster). VOCs also exceeded the GWQS in the areas of the former diesel USTs (MW-5) and the Unlined Storage Pit (MW-3 and MW-7), however, at significantly lower concentrations. Concentrations of VOCs significantly declined at depth as shown in the deep monitoring wells MW-8B and MW-2B which are screened at about 40 feet bgs. INTEX (1990) indicated slight upward gradients in the MW-2A/2B and MW-8A/8B well pairs, which may be mitigating the downward migration of contaminants. There were no organic concentrations detected above the GWQS in monitoring wells MW-4, MW-6, and MW-1. Pesticides and PCBs have not been detected in the groundwater at the Site. Exceedances of metals (aluminum, cadmium, and manganese) reported for Site groundwater in nearly all wells. These metals were found at lower concentrations that do not exceed GWQS in MW-1 and MW-6. MW-4 and MW-5 were not sampled in 2000. These metals were also detected in residential well samples collected in 2000 at concentrations below the GWQS.

## 2.3 Definition of Data Gaps and Data Quality Objectives

### 2.3.1 General

Data Quality Objectives (DQOs) for the Site have been established in accordance with USEPA guidance (USEPA 2000b), and are presented in Table 3. The DQO process is described in the SAP (Appendix A) and quantitative goals are included in the quality assurance section of the

SAP. The purpose of the RI is to define nature and extent of contamination and to gather data that can be used in a Baseline Risk Assessment (BRA). The BRA will consist of a Baseline Human Health Risk Assessment and the Ecologic Risk Assessment. To that end, the data collected during the Phase I and Phase II investigations by INTEX were used to identify areas of concern and areas where additional data may be necessary to accomplish these goals. Figure 4 shows the proposed locations for the RI investigations. The rationale and purpose for these locations is further discussed in Section 3.0.

As a BRA is required for this Site, it is important that a full suite of contaminants be assessed and that high quality data be obtained. To that end, the RI samples will be analyzed for the Target Compound List (TCL) VOCs, SVOCs, Pesticides, and PCBs, as well as, the Target Analyte List (TAL) metals and cyanide. The compound and analyte lists are those contained in the Contract Laboratory Program (CLP) Statements of Work (SOW) OLM04.2 and ILM04.1. Samples will also be evaluated for two additional potential Site-related compounds (1,2-diphenylhydrazine and benzidine). The Sampling and Analysis Plan (SAP), Appendix A to this RIWP, contains more specifics about all of these analytes including analytical methods, holding times, and target reporting levels.

### 2.3.2 Soil Quality Characterization

As previously described, soil samples collected from the Site show elevated concentrations of chlorinated VOCs and BTEX in the four areas of concern. In addition, SVOCs, metals, and sporadic detections of pesticides have been reported. Shallow soil appears to be less impacted by VOCs than deeper soil (i.e., greater than 2 feet below ground surface).

Data gaps for Site soils have been identified as follows:

1. Areas within the active operational area that have not been fully delineated. This includes mostly areas in the eastern part of the operational area and the septic system where there has been limited soil sampling and no sampling from below the concrete slab.

2. The extent of soil contamination particularly along the northern, southern, and western boundaries of the operational area have not been fully defined.

3. The data quality of some of the Phase I and Phase II soil samples cannot be substantiated. Therefore, additional samples will be collected in previously defined source areas to verify the nature of contamination.

4. Limited soil samples have been collected outside the active operational area to assess background conditions and for use as part of the risk assessment.

5. The Phase I and Phase II soil samples were not analyzed for the full TCL/TAL list of analytes. During Phase II, soil samples were only analyzed for parameters that were deemed of concern from the Phase I RI (i.e., VOCs and SVOCs were generally analyzed, while pesticides, PCBs, and metals were only analyzed if further delineation of an area was necessary)

The RI scope of work described in Section 3.0 will address these data gaps.

### 2.3.3 Groundwater Quality Characterization

Groundwater samples collected to date show elevated concentrations of chlorinated VOCs and BTEX in the four areas of concern shown on Figure 3. The groundwater contamination is most prevalent in shallow wells. In addition, off-property migration of VOCs will be investigated based upon the measured concentrations and groundwater flow direction.

Data gaps for groundwater have been identified as follows:

1. There is no groundwater elevation and quality data north of the Former Waste Solvent UST area to verify groundwater flow direction and provide upgradient water quality data;

2. There is no groundwater data downgradient to the south of the property to define the extent of groundwater contamination;

3. A residential well (unused) and a well used for non-potable purposes on the property have not been sampled;

4. The most current round of groundwater sampling did not include all Site wells.

The RI scope of work described in Section 3.0 will address these data gaps.

### 2.3.4 Ecological and Cultural Resource Evaluation

The USEPA has assessed, in consultation with the U.S. Fish and Wildlife Service, the potential presence of Federal or State threatened or endangered species or their habitat in the vicinity of the Site pursuant to Section 7 of the Endangered Species Act. Swamp Pink (*Helonias bullata*) was identified as a federally listed threatened plant species that may be located on or adjacent to the Site. Therefore, a survey of the appropriate wetland areas for the presence of Swamp Pink is required.

The extent of the 100-year and 500-year floodplains at the Site will be assessed based on the Federal Emergency Management Agency (FEMA) Flood Insurance Rate Map (FIRM) and in consultation with FEMA. The extent of the floodplains will be incorporated on a map in the RI report.

A delineation of the wetland area along the western fringe of the property will be undertaken. The wetland delineation will use the three-parameter Army Corps of Engineers methodology in accordance with the 1987 USACE Manual. Available state and federal wetland maps will be obtained.

In addition, a visual site inspection will be undertaken to identify the different types of terrestrial habitat that occur on the property utilizing the Checklist for Ecological Assessment/Sampling (ERAGS, 1997). The characterization will include identification of the predominant plant species present, documentation of any indications of use by wildlife, a determination of whether the community is composed of native or non-native plant species, and documentation of any readily observable indications of environmental stress. The data that are collected will be used to assess the extent and condition of the habitat and its potential to support specific species of wildlife.

A Stage IA Cultural Resource Survey will be conducted consisting of a literature search, site reconnaissance, and sensitivity study to determine the potential presence of archaeological sites in the project area. The need for a Stage IB will be evaluated following completion of the State IA Cultural Resources Survey.

## 3.0 REMEDIAL INVESTIGATION

### 3.1 General Description

The purpose of the RI is to collect baseline data defining the nature and extent of constituents in soil and groundwater, and factors influencing their extent and rate of migration. A Risk Assessment will then be completed to characterize and assess risks from identified routes of exposure. The data quality objectives defined above will be evaluated and refined as necessary throughout the RI to ensure that all data necessary for determining environmental and health effects, and evaluating remedial alternatives will be collected.

A topographic base map was completed in the spring 2001 for the Lightman property and a minimum 200-foot perimeter beyond the property. To the south (downgradient), mapping extended approximately 800 feet. The base map, included as Figure 2A, was compiled at a 1"=50' scale with a one-foot contour interval. Horizontal control is tied to the New Jersey State Plane Coordinates and vertical datum is NGVD 1929.

A monitoring well integrity survey and full synoptic round of groundwater levels will be obtained prior to drilling activities. Damaged wells that are identified will be repaired or replaced as part of the RI. The water levels will verify existing conditions and groundwater flow directions to assist in locating Geoprobe transects.

Details of field and analytical procedures are included in the SAP and QAPP provided as Appendix A. Field work will be conducted in accordance with the Health and Safety Plan included as Appendix B.

### 3.2 Investigation

#### 3.2.1 Hydrogeologic Investigation

The hydrogeologic investigation will be carried out in a phased approach, using field screening techniques to determine well locations so as to define the extent of contamination in a timely manner, consistent with the overall project schedule requirements. As part of this scoping phase, aquifer parameters were established from the previous work conducted by INTEX as described in Section 2.2.2. Based on this data, a one-dimensional analytical solute transport model was used to estimate the possible downgradient concentrations of TCE[1] in groundwater in order to locate initial screening investigation points downgradient as described in the following sections.

### 3.2.1.1 Analytical Modeling

The analytical model selected for this evaluation is presented in "Quantitative Hydrogeology" by de Marsily (1986). The solution of the one-dimensional advection-dispersion equation for groundwater flow and solute transport is utilized for contaminant transport predictions including constituent retardation and exponential contaminant decay. The solution accounts for natural degradation of the constituents (a first order reaction rate for the sum of natural chemical and biological processes). The parameter used to estimate the rate of degradation is the half-life time (i.e., the amount of time it takes for the concentration of a compound to decrease by one-half due to degradation processes). The solution appropriately accounts for both constituents released into the groundwater (mass increase) and constituents treated through natural degradation processes (mass decrease). The governing equation and parameter values used for the one-dimensional simulations are presented in Table 4.

Based on the slug tests completed by INTEX, a mean hydraulic conductivity value was calculated (Table 2) to be $2.10\text{x}10^{-2}$ cm/sec. An average horizontal hydraulic gradient value of $9.09\text{x}10^{-4}$ was established from the measured groundwater elevations, and porosity of 28% was assumed based on regional knowledge. A simulation time of 27 years was used, this being the length of time from 1974 (the earliest possible release date) to the present. However, sensitivity analyses indicated that the plume approaches steady-state conditions within ten years. Retardation was calculated using published values of $K_{oc}$ and an assumed solid density of 2.5 grams per cubic centimeter. The dispersivity was calculated using the equation developed by Al-Suwaiyan (1996), and a half-life of 321 days was chosen based on published literature. The source concentration was assumed to be 2,500 ug/l based on the groundwater sampling results.

The modeling results shown in Table 4 suggest that detectable concentrations of TCE might be expected up to at least 500 feet downgradient of the property line.

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[1] TCE was selected as a representative contaminant in this screening assessment as it is present in high concentrations at the property line and it is more recalcitrant than the BTEX compounds.

#### 3.2.1.2 Geoprobe Transects

A Geoprobe direct push rig will be used to advance a series of groundwater screening transects downgradient of the potential source areas identified in Section 2.2 and, at the request of the Agencies, downgradient of the western portion of the property. Direct push methods and sampling techniques will be conducted in accordance with "Alternate Ground Water Sampling Techniques Guide" (NJDEP, 1994). Based on the modeling described above, three initial proximal transects will be installed at the approximate locations shown on Figure 4 and a fourth transect (transect 4A) will be located downgradient of the western portion of the property, at the request of the Agencies. These locations will be verified prior to initiating the Geoprobe investigation based on the re-survey of the existing monitoring wells and collection of a synoptic round of water levels. A temporary piezometer will be installed at each of the initial three Geoprobe transects (transects 1A, 2A and 3A) to provide hydraulic head data to assist in selecting permanent monitoring well locations.

The initial borings at transects 1A, 2A, and 3A will be extended to the first confining layer based on the geologic data obtained from the installation of MW-11 (see section 3.2.1.3). The subsequent borings will be extended to about 50 feet below ground surface (bgs) or deeper if necessary to determine the vertical extent of contamination. Groundwater sample will be collected at approximately every 10 feet down to 50 feet and on 20 foot intervals at greater depths. At each sampling depth, a minimum of three volumes will be purged from the center of the drilling rods using a peristaltic pump. After purging, a peristaltic pump will be used to collect a groundwater sample that will be analyzed for Target Compound List (TCL) VOCs in the field mobile laboratory using the SW846 method with a gas chromatograph equipped with a mass spectrometer detector (GC/MS). Using this approach, groundwater quality will be characterized, at a screening level, both horizontally and vertically. At the request of the USEPA, 10% of the samples analyzed in the mobile laboratory will be sent to a fixed laboratory for VOC analysis by CLP OLM04.2 methods. The confirmatory samples will be collected in locations where contamination is present and will be compared to the mobile laboratory data using relative percent difference, in the same manner as field duplicates (see Appendix A).

Following the initial transects, the mobile laboratory data will be reviewed and will be used to "calibrate" the analytical model developed above. In addition to groundwater samples collected from the borings, samples will be collected from monitoring wells MW-2A and MW-8A and analyzed in the mobile laboratory to verify the source term concentration and provide an additional calibration point on the predicted concentration curve. Based on the new data and the results of the model calibration, the location of additional distal transects will be selected. As with the proximal transects, groundwater samples will be collected from each boring every 10 feet to a depth of 50 feet or deeper based on the results of the initial transects and analyzed in the mobile laboratory. Groundwater samples will be collected at 20 foot intervals for depths greater than 50 feet. The analytical, geologic, and hydrogeologic data collected during the Geoprobe investigation will be reviewed in conjunction with EPA and NJDEP in order to select monitoring well locations that will provide definitive downgradient groundwater quality data.

#### 3.2.1.3 Monitoring Well Installation

Using the results of the Geoprobe/GC/MS investigation, the main axis and extent of the groundwater VOC plume will have been identified both horizontally and vertically. A Technical Memorandum will be submitted to EPA and NJDEP for approval following the Geoprobe investigation detailing the proposed monitoring well locations. Following EPA concurrence, two monitoring wells will be placed along the central axis of the plume, one approximately mid-way from the Site to the downgradient edge of the plume, and the second well at the downgradient extent of the plume. Two monitoring wells will also be installed at the eastern and western edges of the plume. In addition, in order to verify groundwater flow direction and to provide upgradient groundwater quality data, a monitoring well (MW-11) is proposed for installation at the northern edge of the property, upgradient from existing monitoring wells MW-2A and MW-2B. A boring will be initially advanced prior to installation of MW-11 to verify geologic conditions to the first confining layer as requested by the Agencies. The boring will be grouted back to the depth required to install MW-11. Alternatively, the boring may be grouted to ground surface and MW-11 installed at an adjacent location.

The monitoring wells will be installed using hollow stem auger drilling techniques, and will be constructed using 2-inch diameter stainless steel screen and riser. It is expected that a 10-foot screen will be installed at each location. The screened intervals will be selected in consultation with EPA based on the results of the Geoprobe/GC/MS analysis. Upon completion, the wells will be developed in accordance with the QAP (Appendix A).

#### 3.2.1.4 Slug Testing

Upon completion of sampling activities, all the existing and newly installed monitoring wells will be slug tested. Rising head slug tests will be performed using electronic transducers and dataloggers to record the change in head. The data will be analyzed using the Hvorlsev method, or other appropriate methods such as van der Kamp depending on the aquifer response.

### 3.2.2 Environmental Sampling

Soil samples will be collected at the approximate locations shown on Figure 4. Forty (40) locations are included at which both shallow and deep soil samples will be collected and analyzed for TCL/TAL parameters. At the request of USEPA, samples will also be evaluated for the presence of 1,2-diphenylhydrazine and benzidine. These compounds are no longer a part of the TCL list and are not included in the calibration standards; so that a separate evaluation is necessary. The laboratory will be evaluating all semi-volatile organic compound (SVOC) sample chromatograms for tentatively identified compounds (TICs). If either of these two compounds is identified in the TICs, new aliquots of those samples will be extracted and analyzed using SW846 Method 8270 in Selective Ion Monitoring (SIM) mode. SIM is a technique used by laboratories to look for a few compounds rather than a broad spectrum of compounds. The advantage of this technique is that lower reporting levels are achievable. Further discussion regarding analysis of these compounds is provided in the SAP. These samples are intended to further define nature and extent of contamination to verify existing data and address the data gaps discussed in Section 2.3.2. Sampling of the retention area at the eastern end of the Site that receives Site runoff is included. Shallow samples will also be collected from nine additional locations in the wooded areas. These samples will be analyzed for TCL/TAL parameters and will be used in evaluation of site wide risks. Surface soil data from open areas (i.e., not beneath buildings or paved areas) will be compared to the appropriate ecological screening values in the RI Report from Efroymson et. al (1997).

Shallow samples will be collected from a depth of 0 feet to 2 feet with the VOCs sample collected from the bottom of the depth interval. A deep sample will be collected from each location at a depth greater than 2 feet but above the water table. The actual sample will correspond to the most contaminated zone based on visual observation and field screening using an organic vapor analyzer. If there are no indications of contamination, the samples will be collected from the 5 to 6-foot interval. Samples will be collected using a GeoProbe or auger. The shallow soil reference samples collected for risk assessment purposes will be taken from a depth of 0 feet to 1 foot, with the VOC sample collected from the bottom of the depth interval. Field procedures for collection of soil samples are included in the SAP (Appendix A).

As requested by USEPA, surface water and sediment samples will be taken at three locations: in the wetland area, at the western end of the Site, and at locations in Pump Branch Creek approximately 1,600 feet and 2,000 feet south of the Site. Samples will also be taken from a location upgradient of the Site. Approximate locations are shown on Figure 4A. Sediment samples will be collected from a depth of zero to 6-inches and 18 to 24-inches below ground surface at each sampling point. The samples will be analyzed for TCL and TAL compounds. Surface water samples will also be analyzed for Total Suspended Solids and hardness. Sediment samples will also be analyzed for Total Organic Carbon and grain size distribution.

The AOC includes reference to potential sampling of building interiors. The only building on the site that was ever used for storage or operational purposes was a warehouse. All that remains of this building is the concrete slab and soil sampling beneath this slab is included (see Figure 4). These samples will be taken in areas of visual surface staining, if present, on the concrete pad.

Once well installation is complete, a synoptic round of groundwater levels and samples will be collected from the existing 12 monitoring wells, the newly installed RI wells, and the two on-property supply wells. These samples will be analyzed for the TCL/TAL analytes and select additional parameters to evaluate natural attenuation processes (see Table 3). Additionally, the samples will be evaluated for the presence of 1,2-diphenylhydrazine and benzidine, as previously discussed.

All of the wells and the RI soil sample locations will be surveyed by a NJ-licensed surveyor in order to accurately locate areas of concern.

### 3.2.3 Sample Analysis/Data Validation

Groundwater and soil samples will be analyzed in a fixed laboratory for TCL/TAL analytes in accordance with the USEPA CLP SOWs OLM04.2 and ILM04.1 and evaluated for 1,2-diphenylhydrzine and benzidine, as discussed in Section A.3.2.2. In addition, groundwater samples will be analyzed for the following parameters necessary to evaluate natural attenuation processes. Light Hydrocarbons (methane, ethane, and ethene; MEE), chloride, total alkalinity, sulfate, sulfide, nitrate, nitrite, total phosphate, total organic carbon (TOC) and dissolved organic carbon (DOC). pH, specific conductance, oxidation reduction potential (Eh), temperature, dissolved oxygen, and ferrous iron ($Fe^{+2}$) will be measured in the field. The TCL VOC analysis will be performed using a modified OLM04.2 (i.e., 25 ml purge) in order to achieve reporting limits that are at or below NJDEP GWQS. The procedure is consistent with SW846 8260. The anticipated laboratory turnaround time is 28 calendar days. The confirmatory groundwater samples collected as part of the Geoprobe investigation will be analyzed for VOCs as described above.

CompuChem, a Division of Liberty Analytical Corporation, of Cary NC (CompuChem) will be used for all laboratory analyses except MEE parameters. CompuChem is a laboratory that has been involved in the CLP program for many years. The laboratory analyzes Performance Evaluation Samples (PESs) on a routine basis for various certification programs and in order to maintain their status in the CLP. The SAP (Appendix A of this RIWP) includes information regarding sampling procedures, analytical procedures, and quality assurance (QA) procedures for the program and the laboratory. Microseeps of Pittsburgh, Pennsylvania will perform analysis for the MEE parameters. Microseeps has satisfactorily provided these analytical services on several previous Region II Superfund Sites for Golder Associates.

Analytical data will be validated in accordance with the USEPA Region II Standard Operating Procedures. The SAP provides further details regarding data validation procedures. These validated data will be used in the risk assessment to determine COPCs and EPCs. Validated data will be presented to USEPA in the Site Characterization Summary Report and the RI Report.

### 3.3 Site Characterization Report

In accordance with the schedule outlined in the AOC, a Site Characterization Report will be submitted 45 days following completion of data validation activities. The Site Characterization Report will include a review of the investigative activities that were undertaken, and will present the data from each sampling activity, Stage IA Cultural Resource Survey, delineation of the 100-year and 500-year floodplains, and wetlands delineation. In addition, a well search will be conducted in accordance with N.J.A.C. 7:26E-4.4(h)v and the results will be presented in the Site Characterization Report.

## 3.4 Baseline Human Health Risk Assessment

Following collection of environmental data, a Baseline Human Health Risk Assessment (BRA) will be completed to identify and characterize actual and potential risks that the Site may pose to human health. The Human Health Risk Assessment will be performed in accordance with the appropriate Risk Assessment Guidance for Superfund (RAGS) including:

- RAGS, Volume I, Human Health Evaluation Manual (Part A), EPA/540/1-89/002, December 1989;
- RAGS, Volume I, Human Health Evaluation Manual (Part B), EPA/540/R-92/003, December 1991;
- Supplemental Guidance to RAGS: Calculating the Concentration Term (OSWER Directive 9285.7-081), May 1992;
- RAGS, Volume I, Human Health Evaluation Manual (Part D), OERR No. 9285.7-01D, January 1998;
- The Superfund Evaluation Manual EPA/540/1-88/001, April 1988 (or most recent revision);
- Dermal Exposure Assessment: Principles and Applications. EPA/600/8-91/011B, January 1992;
- The Exposure Factors Handbook (EPA/600/8-89/043, March 1997;
- Guidance for Data Usability in Risk Assessment (EPA/540/G-90/008, October 1990 (or most recent revision); and,
- RAGS, Volume 1, Supplemental Guidance: Standard Default Exposure Factors, OSWER Directive 9285.6-03, March 1991.

The Human Health Risk Assessment will be performed and submitted in a phased approach to allow the Agency early review of the assumptions and data to be used in calculating risks for this Site. The following paragraphs explain the various risk assessment deliverables.

> Memorandum on Exposure Scenarios and Assumptions: A memorandum describing the exposure scenarios and assumptions which will be considered for current and future use of the Site will be prepared and submitted to the Agency within 60 days of approval of this RIWP. The memorandum will include the preliminary conceptual site model (CSM) and a summary of the exposure routes of concern for the Site. In addition, the memorandum will include a summary of the exposure variables that are planned for use in risk calculations. RAGS Part D Tables 1 and 4 will be included with this memorandum. Upon approval by the Agency, these scenarios and assumptions will be carried forward in the risk assessment.
>
> A List of Hazardous Substances Present and Proposed Contaminants of Concern: Within the Site Characterization Summary Report (SCSR) a list of Contaminants of Potential Concern (COPCs) for each media, as appropriate, will be provided to the Agency for review. In addition, media specific exposure point concentrations (EPCs) will be calculated and included in the SCSR. These data will be provided in RAGS Part D format Tables 2 and 3. Upon approval by the Agency, these COPCs and EPCs will be carried forward in the risk assessment.

Toxicological and Epidemiological Studies Memorandum: Within 60 days of submission of the SCSR, a memorandum describing the toxicological values for COPCs will be submitted to the Agency for review. These values include Cancer Slope Factors, Reference Doses, Reference Concentrations, Weight of Evidence, and adjusted dermal toxicological factors, as appropriate. These data will be derived from the Integrated Risk Information System (IRIS), the Health Effects Assessment Summary Tables (HEAST) and, if necessary, the National Center for Environmental Assessment (NCEA). These data will be provided in RAGS Part D format Tables 5 and 6. Upon approval by the Agency, these toxicological factors will be carried forward in the risk assessment.

Baseline Human Health Risk Assessment: Within 60 days of USEPA approval of the preceding deliverables including the Toxicological memorandum, the associated text and tables containing the risk calculations and assessment will be submitted to the Agency for review. The risk calculations will be provided in RAGS Part D format Tables 7 through 10. The text will contain the appropriate information describing the risk and non-carcinogenic hazard calculations and summarizing the risk and hazards for each medium of concern and for the entire Site, as well as a discussion of the associated uncertainties.

## 3.5 Ecological Risk Assessment

A Screening Level Ecological Risk Assessment (SLERA) will be completed in accordance with EPA's *Ecological Risk Assessment Guidance for Superfund* (ERAGS, 1997). The assessment will comprise Steps 1 and 2 of the ERAGS process and will include the following components:

*Step 1*

- Site environmental setting (summarized using the ERAGS checklist, see section 2.3.4) and known contaminants;
- Potential contaminant fate and transport mechanisms;
- Mechanisms of ecotoxity and likely categories of receptors;
- Potential complete exposure pathways;
- Selection of assessment endpoints and measurement endpoints based on screening ecotoxicity values equivalent to chronic no adverse effect levels (NOAELs) where possible.

*Step 2*

- For complete exposure pathways, identifying conservatively high contaminant concentrations for each environmental medium;
- Assessment of conservative exposure parameters;
- Calculation of screening level Hazard Quotients and, where relevant, screening level Hazard Indices;
- Uncertainty assessment

The SLERA will utilize the following EPA guidance, as appropriate:

- Ecological Risk Assessment Guidance for Superfund: Process for Designing and Conducting Ecological Risk Assessments, EPA 540-R-97-006, June 1997;

- Ecological Assessments of hazardous Waste Sites: A Field and Laboratory Reference Document, EPA/600/3-89/013, USEPA, ORD, 1989;
- Terrestrial Ecological Risk Assessment Methods Handbook, USEPA, 1993;
- Considering Wetlands at CERCLA Sites, EPA 540/R-94/019, USEPA OSWER, 1994;
- Role of the Ecological Risk Assessment in the Baseline Risk Assessment, OSWER Directive9285.7-17;
- Guidelines for Ecological Risk Assessment, EPA/630/R-95/002F, April 1998; and,
- Wildlife Exposure Factors Handbook, EPA 1993.

The SLERA will be submitted together with the Baseline Human Health Risk Assessment. Based upon the SLERA a decision will be made either to continue with a Baseline Ecological Risk Assessment or that further ecological evaluation is not warranted. Collectively, the Baseline Human Health Risk Assessment and the SLERA or Baseline Ecological Risk Assessment constitute the Baseline Risk Assessment (BRA) for the Site. Upon USEPA approval of the BRA, it shall be included in the RI Report.

### 3.6 Remedial Investigation Reports

On completion of the field investigations, sampling, laboratory testing, analysis, and data validation, the geological and hydrogeologic conceptual models for the Site will be refined to characterize the Site. Results of the validated data obtained during the RI will be compared to historical data to develop a spatial and temporal understanding of the nature extent and fate of contamination. The RI Report will summarize the Site Characterization Report and will contain all the information from the evaluation of existing data and provide full details and results of the field investigation. The report will also identify additional data gaps, if any. The RI Report will also incorporate the BRA for the Site. The final Remedial Investigation Report will be prepared following receipt of EPA comments on the draft RI Report.

# 4.0 FEASIBILITY STUDY

## 4.1 General

The FS will be performed in accordance with the guidelines in the Interim Final Guidance for Conducting Remedial Investigation and Feasibility Studies Under CERCLA, October 1988, OSWER Directive #9355.3-01. The FS will include the development of alternatives that are appropriate for assessment under CERCLA, SARA and the National Contingency Plan (NCP) and appropriate guidance. Consistent with the AOC, the FS will be performed and submitted in a phased approach as described in the following sections.

## 4.2 Candidate Technologies Memorandum

A Candidate Technologies Memorandum will be submitted in conjunction with the Site Characterization Summary Report (i.e., 45 days after validation of data). Based on existing information for the Site (see Section 2) and additional Site characterization studies to be carried out in the RI, the Candidate Technologies Memorandum will identify and screen an array of potential remedial technologies, including institutional controls (e.g., CEA, deed notice). Requirements for site-specific treatability studies shall be considered for each technology. The final list of technologies will be carried forward in the feasibility study for further evaluation and screening during development and screening of remedial alternatives.

## 4.3 Treatability Studies

A Treatability Testing Work Plan (TTWP) together with the required schedule extension, may be completed and submitted to EPA for review and approval, if the most promising candidate technology requires such a study.

## 4.4 Remedial Action Objectives and Remedial Alternatives

Remedial Action Objectives (RAO's) will be established based on the results of the Risk Assessment, the potential future use for the Site, and an analysis if applicable or relevant and appropriate requirements (ARARs). The development of remedial action alternatives will be based on the list of candidate remedial technologies outlined in the Candidate Technologies Memorandum and the RAOs. Based on the results of the RI, technologies will be refined and prescreened for suitability as part of alternatives. The various technologies will then be assembled into combinations of site-wide remedial alternatives.

Once identified, the potential remedial action alternatives will be screened in accordance with EPA's guidance (based on overall protection, implementability and cost) to determine which alternatives are most feasible. After the initial screening, a final short list of remedial action alternatives will be compiled for detailed evaluation. A "No Action" alternative will be included to comply with the requirements of the NCP.

A presentation will be made to the Agencies following development of the RAOs and screening of remedial action alternatives.

### 4.5 Detailed Analysis of Alternatives

A detailed analysis will be performed for each of the remedial action alternatives resulting from the initial screening process. The analysis of each remedial alternative will be based on an evaluation of nine criteria established in the NCP. Two criteria (state acceptance and community acceptance) will not be evaluated because they will be evaluated during the public comment period following EPA's development of the Proposed Remedial Action Plan (PRAP). The remaining seven NCP criteria are as follows:

- Overall Protection of Human Health and the Environment

  Under this criterion, an alternative is assessed to determine whether it can adequately protect human health and the environment, in both the short-term and long-term, from unacceptable risks posed by hazardous substances, pollutants or contaminants present at the site, by eliminating, reducing or controlling exposures. This criterion is an overall assessment of protection based on a composite of factors assessed under other evaluation criteria, especially short-term and long-term effectiveness and permanence.

- Compliance with ARARs

  This criterion evaluates whether and how the alternative attains applicable or relevant and appropriate requirements under federal environmental laws and state environmental or facility siting laws, or provides grounds for invoking the legal waiver of such requirements.

- Short-Term Effectiveness

  This criterion evaluates the impacts of the alternative during implementation with respect to human health and the environment. The short-term impacts of an alternative are assessed considering: short-term risks that might be posed to the community during implementation of an alternative; potential impacts on workers during remedial action and the effectiveness and reliability of protective measures; potential environmental impacts of the remedial action and the effectiveness and reliability of mitigative measures during implementation. The effects of each alternative on wetland areas and the 100-year and 500-year floodplains and potential mitigation measures will be considered.

- Reduction of Toxicity, Mobility, and Volume Through Treatment

  Under this criterion, the degree to which an alternative employs recycling or treatment that reduces toxicity, mobility, or volume is assessed, including how treatment is used to address the principal threats posed at the site. Factors that are considered include: the treatment or recycling processes the alternatives employ and the materials they will treat; the amount of hazardous substances, pollutants or contaminants that will be destroyed, treated, or recycled; the degree of expected reduction in toxicity, mobility or volume of the waste due to treatment or recycling and the specification of which reduction(s) are occurring; the degree to which the treatment is irreversible; the type and quantity of residuals that will remain following treatment considering the persistence, toxicity, mobility, and propensity to bio-accumulate of such hazardous substances and their constituents; and the degree to which treatment reduces the inherent hazards posed by principal threats at the site.

- Long-Term Effectiveness and Permanence

  ~~Under this criterion, an alternative is assessed for the long-term effectiveness~~ and permanence it affords, along with the degree of uncertainty that the alternative will prove successful. Factors that are considered, as appropriate, include: the magnitude of residual risk remaining from untreated waste or treatment residuals remaining at the conclusion of the remedial activities; and the adequacy and reliability of controls such as containment systems and institutional controls that are necessary to manage treatment residuals and untreated waste.

- Implementability

  This criterion addresses the technical and administrative feasibility of implementing the alternative as well as the availability of various services and materials required.

- Cost

  Cost items evaluated include capital and operation and maintenance expenditures to implement the alternative, presented as a present worth analysis for cost-effectiveness comparison purposes.

## 4.6 Feasibility Study Report

A Draft Feasibility Study Report will be prepared following completion of the detailed evaluation of each remedial action alternative. The report will summarize the entire FS screening process and provide the detailed evaluation information for each alternative to facilitate EPA's selection of the remedy. For each alternative that will affect wetlands or the 100 year floodplain, a Statement of Finding (Statement) will be included. The Statement will be no longer than three pages and will include the following information:

- The reasons why the proposed action must be located in or affect the floodplains or wetlands;
- A description of significant facts considered in making the decision to locate in or affect the floodplain or wetlands including alternative sites and actions;
- A statement indicating whether the proposed action conforms to applicable State or local floodplain/wetland protection standards;
- A description of the steps taken to design or modify the proposed act to minimize potential harm to or within the floodplain or wetlands; and
- A statement indicating how the proposed action affects the natural or beneficial values of the floodplain or wetlands.

If Monitored Natural Attenuation is included in the retained alternatives it will be evaluated consistent with N.J.A.C. 7:26E-63(d).

A draft FS report will be submitted to EPA for review. The Final Feasibility Report will be prepared following receipt of EPA comments on the draft.

## 5.0 PROJECT ORGANIZATION AND SCHEDULE

### 5.1 Project Organization

Figure 5 presents the RI/FS Organizational Chart. The USEPA Remedial Project Manager, Joseph Gowers, will coordinate with the NJDEP Case Manager, and serve as the primary contact with the Group's Project Coordinator, Steve Finn of Golder Associates. The Project Coordinator will provide overall management of activities related to the RI/FS and coordinate between the Agencies and the Group. Mr. Finn will be assisted by Robert Illes within Golder Associates.

Golder Associates will utilize various specialty subcontractors during the RI stage for surveying, drilling and analytical laboratory services. The analytical laboratory will be CompuChem of Cary, North Carolina. Microseeps of Pittsburgh, Pennsylvania will also provide analytical laboratory services for the light hydrocarbons. $S_2C_2$ of Warren, New Jersey will conduct geoprobe and field GC/MS analyses. Well drilling and surveying subcontractors will be determined prior to initiating the RI. Both subcontractors will be licensed in the State of New Jersey and details will be provided to USEPA in advance of the field program.

### 5.2 Project Schedule

The proposed schedule is presented on Figure 6. The schedule begins with Agency approval of this RIWP and ends with the submittal of the Final Feasibility Study Report. A 19-month schedule is identified for implementation of the RI/FS following Agency approval of this RIWP. The schedule for deliverables reflects the requirements of the AOC and an additional Technical Memorandum regarding proposed monitoring well locations requested by EPA.

The schedule allows for a nominal four week Agency review period for each deliverable (2 weeks for the monitoring well Technical Memorandum) followed by a 3 week response period (4 weeks for the BRA) in accordance with the AOC. A two week period for Agency approval following the responses is provided. The present schedule does not include conducting any treatability studies and will be extended if such studies are necessary, or if additional Agency review or approval time is required at any stage.

A 4-month period has been allocated to complete the field work described herein. The completion of fieldwork is contingent on securing off-property access agreements. Access has been obtained for the two properties to the south and the Group is pursuing access for the sampling of Pump Branch Creek.

Many of the deliverables are contingent on the substantial completion and approval of previous documents. As such, the schedule will be reviewed and periodically updated. Progress on each deliverable will be described in Monthly Progress Reports to the Agencies, as required by the AOC.

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USEPA 2000b Guidance for the Data Quality Objectives Process (EPA QA/G-4), EPA/600/R-96/0555, August 2000

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Zapecza, Otto S. "Hydrogeologic Framework of the New Jersey Coastal Plan, Regional Aquifer-System Analysis"; U.S. Geologic Survey Professional Paper 1404-B; 1989

# TABLE 1
# WATER TABLE ELEVATIONS
# LIGHTMAN DRUM RI/FS WORKPLAN

| WELL I.D. | SCREENED INTERVAL (ft BGS) | M.P. ELEV [ft MSL] | DEPTH TO WATER [ft TOC] | | | | WATER TABLE ELEVATION [ft MSL] | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | Apr-89 | May-89 | 6/13/1990 | 6/19/1990 | Apr-89 | May-89 | 6/13/1990 | 6/19/1990 |
| MW-1 | 14-24 | 139.70 | 16.70 | 16.48 | 13.18 | 13.29 | 123.00 | 123.22 | 126.52 | 126.41 |
| MW-2A | 11-21 | 139.09 | 15.80 | 16.05 | 13.39 | 13.42 | 123.29 | 123.04 | 125.70 | 125.67 |
| MW-2B | 30-40 | 138.00 | NI | NI | 12.31 | 12.27 | NI | NI | 125.69 | 125.73 |
| MW-3 | 9-19 | 134.94 | 12.28 | 12.12 | 9.99 | 10.10 | 122.66 | 122.82 | 124.95 | 124.84 |
| MW-4 | 28-48 | 128.51 | 6.10 | 6.03 | 4.00 | 4.01 | 122.41 | 122.48 | 124.51 | 124.50 |
| MW-5 | 13-23 | 140.14 | 17.32 | 17.10 | 14.46 | 14.35 | 122.82 | 123.04 | 125.68 | 125.79 |
| MW-6 | 14-24 | 139.74 | 16.65 | 16.44 | 13.56 | 13.40 | 123.09 | 123.30 | 126.18 | 126.34 |
| MW-7 | 3-16 | 133.59 | NI | NI | 9.61 | 9.62 | NI | NI | 123.98 | 123.97 |
| MW-8A | 9-19 | 138.76 | NI | NI | 13.31 | 13.39 | NI | NI | 125.45 | 125.37 |
| MW-8B | 28-40 | 138.65 | NI | NI | 13.32 | 13.25 | NI | NI | 125.33 | 125.40 |
| MW-9 | 9-19 | 138.20 | NI | NI | 12.69 | 12.88 | NI | NI | 125.51 | 125.32 |
| MW-10 | 9-19 | 139.11 | NI | NI | 13.50 | 13.61 | NI | NI | 125.61 | 125.50 |

Notes: ft MSL Feet above Mean Sea Level

# TABLE 2
# SUMMARY OF HYDRAULIC CONDUCTIVITIES
# LIGHTMAN DRUM RI/FS WORKPLAN

| WELL I.D. | HYDRAULIC CONDUCTIVITY [ft/sec] | HYDRAULIC CONDUCTIVITY [cm/sec] |
|---|---|---|
| MW-1 | 4.97E-04 | 1.51E-02 |
| MW-2A | 2.33E-04 | 7.10E-03 |
| MW-2B | 5.65E-04 | 1.72E-02 |
| MW-3 | 6.85E-04 | 2.09E-02 |
| MW-4 | 1.53E-03 | 4.66E-02 |
| MW-5 | 5.60E-04 | 1.71E-02 |
| MW-6 | 6.40E-04 | 1.95E-02 |
| MW-7 | 8.85E-04 | 2.70E-02 |
| MW-8A | 1.03E-03 | 3.14E-02 |
| MW-8B | 8.37E-04 | 2.55E-02 |
| MW-9 | 3.67E-04 | 1.12E-02 |
| MW-10 | 1.62E-03 | 4.94E-02 |
| Geometric Mean | 6.87E-04 | 2.10E-02 |

| | |
|---|---|
| Reference | Data taken from Phase I and Phase II Remedial Investigation Reports prepared by INTEX (1989, 1990) |

## TABLE 3
## PROPOSED REMEDIAL INVESTIGATION AND DATA QUALITY OBJECTIVES
## LIGHTMAN DRUM RI/FS WORK PLAN

| Remedial Investigation Activity | Matrix | Number of Samples | Parameters of Interest | Frequency of Monitoring | Purpose/Objective of Activity |
|---|---|---|---|---|---|
| Plume Definition | Groundwater | 50 (see note 8) | VOCs | Once | Use field screening techniques to collect groundwater and identify areas of VOC contamination. These data will be used in identifying locations for placement of downgradient permanent monitoring wells. |
| Contamination Delineation | Surface Water | 4 | TCL/TAL, TSS, Hardness | Once | Collect definitive data to define nature and extent of contamination and for use in preparing the Baseline and Ecological Risk Assessments. |
| Contamination Delineation | Sediment | 8 | TCL/TAL, TOC, Grain Size | Once | Collect definitive data to define nature and extent of contamination and for use in preparing the Baseline and Ecological Risk Assessments. |
| Contamination Delineation | Soil | 89 (see note 7) | TCL/TAL, TOC | Once | Collect definitive data to define nature and extent of contamination and for use in preparing the Baseline and Ecological Risk Assessments. |
| Contamination Delineation | Groundwater | 12 exiting on-property wells 1 new on-property well | TCL/TAL, Natural Attenuation parameters, and field parameters | Once | Collect definitive data to define nature and extent of contamination, evaluate potential for Natural Attenuation processes, and for use in preparing the Baseline Risk Assessment. |
| | | 2 water supply wells | TCL/TAL, Natural Attenuation parameters, and field parameters | Once | |
| | | 3 or 4 new off-property wells | TCL/TAL, Natural Attenuation parameters, and field parameters | Once | |
| Hydrogeologic Testing | Groundwater | 12 Existing wells and all new wells | Hydraulic Conductivity | Once | Collect definitive data to characterize aquifer hydraulic parameters |
| Surveying | NA | All soil locations and well locations | Elevation, northings and eastings | Once | Verify existing well elevations and provide accurate location and elevation data for new borings and wells |

**Notes:**

1. The Target Compound List (TCL) VOC, SVOC, Pesticide and PCB lists are defined in CLP Statements of Work OLM04.2. The Target Analyte List (TAL) parameters are listed in CLP Statement of Work ILM04.1.
2. The methodologies that will be used for analysis are listed in SAP Tables A-3 and A-5.
3. Natural Attenuation parameters include: Total Alkalinity, Chloride, Sulfate, Sulfide, Nitrate, Nitrite, Total Phosphate Light Hydrocarbons (methane, ethane, ethene), Total Organic Carbon (TOC) and Dissolved Organic Carbon (DOC).
4. Quality control samples will be collected per matrix at the following frequency : 1 field duplicate per twenty primary samples; 1 MS/MSD pair per twenty primary + field duplicate samples; 1 rinsate blank per day per type of decontamination event where non-dedicated equipment is used. 1 trip blank per day when aqueous VOC samples are collected.
5. Field Parameters for groundwater monitoring include: pH, Temperature, Specific Conductivity, Turbidity, Dissolved Oxygen, Oxidation-Reduction Potential, and Ferrous Iron. Field parameters for soil screening include: VOC vapors and visual characteristics.
6. For VOC data generated by on-Site field screening via GC/MS, field duplicate samples will be collected at a 10% frequency. MS/MSDs, rinsate and trip blanks will not be collected for these screening samples.
7. During soil delineation, samples for grain size determination will be collected from 10% of the borings (approximately 4 samples to be collected).
8. Number of samples is approximate. Actual number of samples will be based on number of Geoprobe locations and depth to water encountered at each location.
9. Samples for TCL/TAL analysis will be evaluated for the presence of 1,2-diphenylhydrazine and benzidine. If quantitative analysis is required, samples will be analyzed using SW846 8270 SIM.

## TABLE 4

## PREDICTED TCE CONCENTRATIONS DOWNGRADIENT OF THE SITE LIGHTMAN DRUM RIFS WORKPLAN

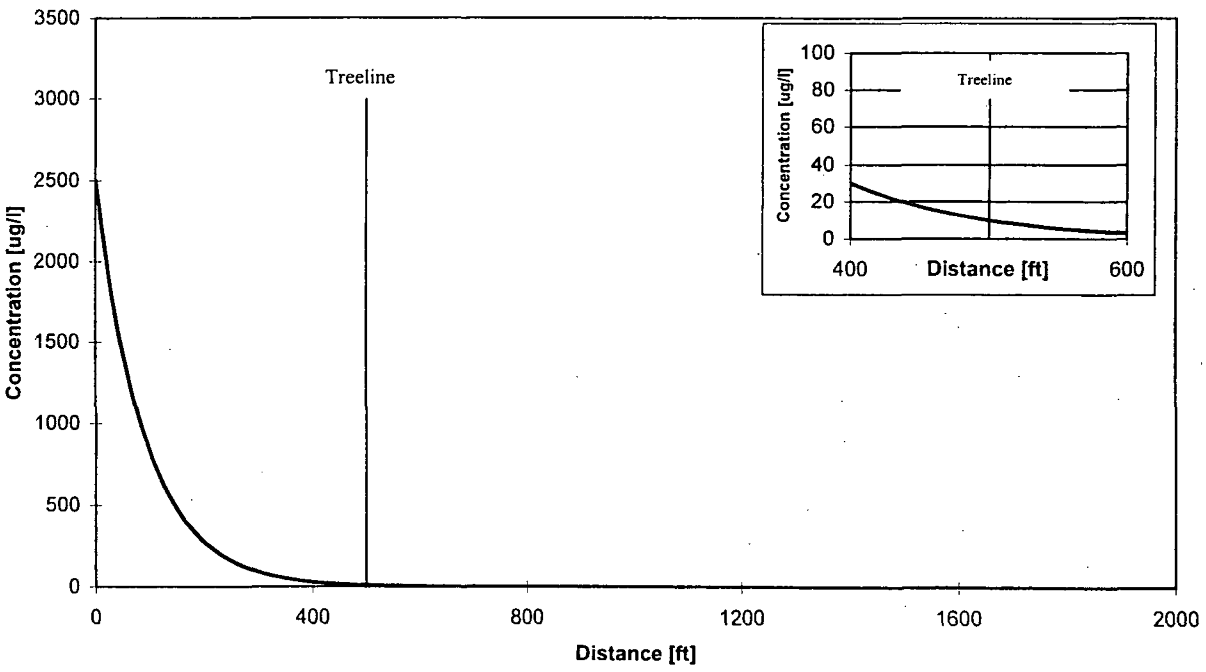
**Steady State One-Dimensional Advection/Dispersion Model with Reaction Terms (Degradation)**

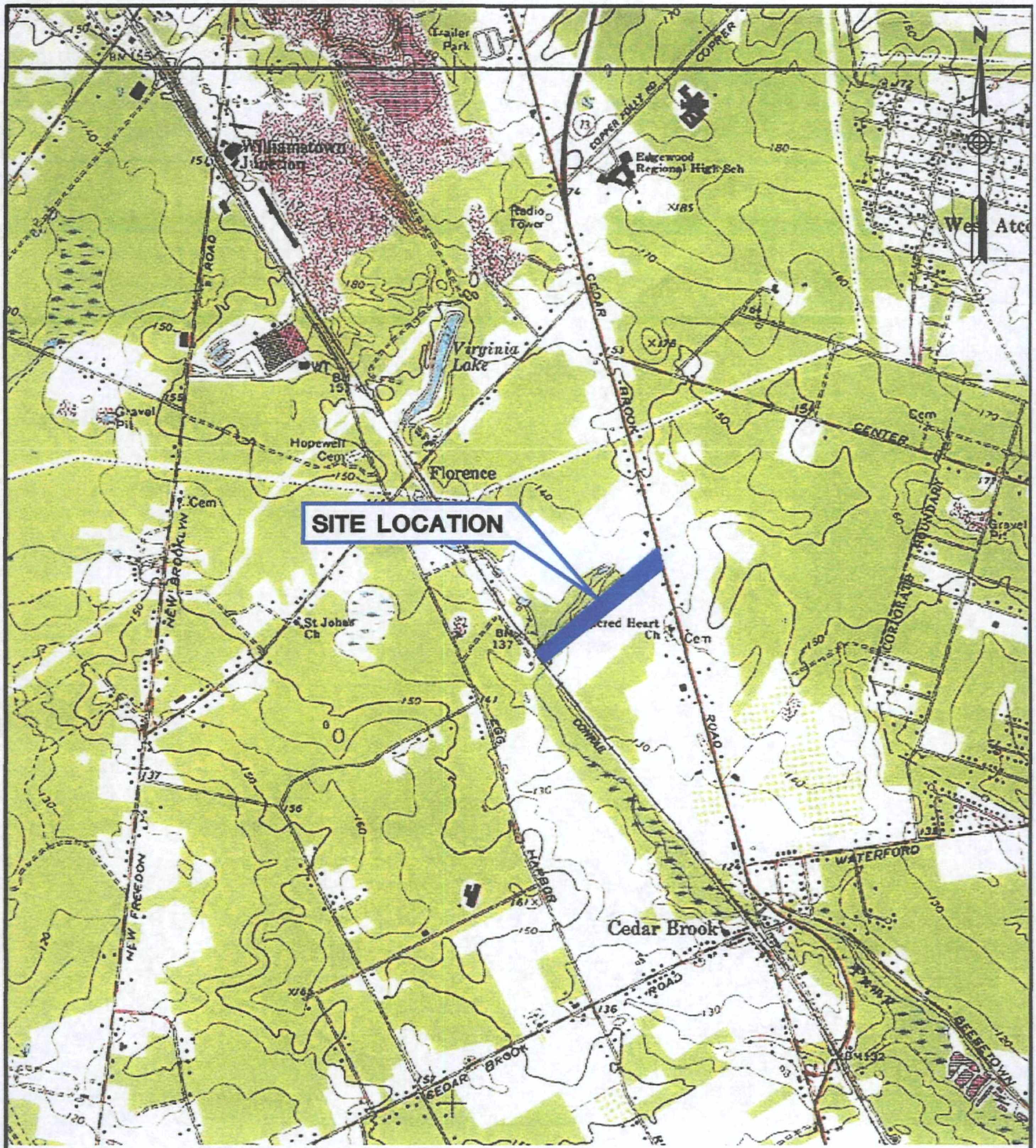
$$C(x,t)=\frac{C_o}{2}\exp\left(\frac{Ux}{2D}\right)\left\{\exp(-Bx)\,erfc\left[\frac{x-t\sqrt{(U/\omega R)^2+4\lambda D/\omega R}}{2\sqrt{Dt/\omega R}}\right]+\exp(Bx)\,erfc\left[\frac{x+t\sqrt{(U/\omega R)^2+4\lambda D/\omega R}}{2\sqrt{Dt/\omega R}}\right]\right\}$$

where: $B=\sqrt{(U/2D)^2+(\lambda\omega R/D)}$ (Ref. deMarsily, *Quantitative Hydrogeology*, 1986)

**Model Input Parameters**

| | | | | |
|---|---|---|---|---|
| Darcy Velocity | U = K i | 0.055 | [ft/day] | |
| Hydraulic Conductivity | K | 2.10e-2 | [cm/s] | |
| Dispersivity | ♋ | 42.4 | [ft] | (Al-Suwaiyan, 1996) |
| Total Porosity | n | 0.28 | [Dimensionless] | |
| Initial Concentration | $C_0$ | 2500 | [mg/l] | |
| Retardation Factor | $R = 1 + K_d\,\rho_b/n$ | 1.46 | [Dimensionless] | |
| Bulk Density | $\rho_b$ | 1.8 | [g/cm$^3$] | |
| Distribution Coefficient | $K_d$ | 0.07238 | [cm$^3$/g], [ml/g] | |
| Decay Coefficient | $\lambda = (\ln 2) / t_{1/2}$ | 0.79 | [year$^{-1}$] | |
| Half-Life Time | $t_{1/2}$ | 321 | [days] | |
| | $t_{1/2}$ | 0.9 | [years] | |
| Simulation Time | | 27 | [years] | |



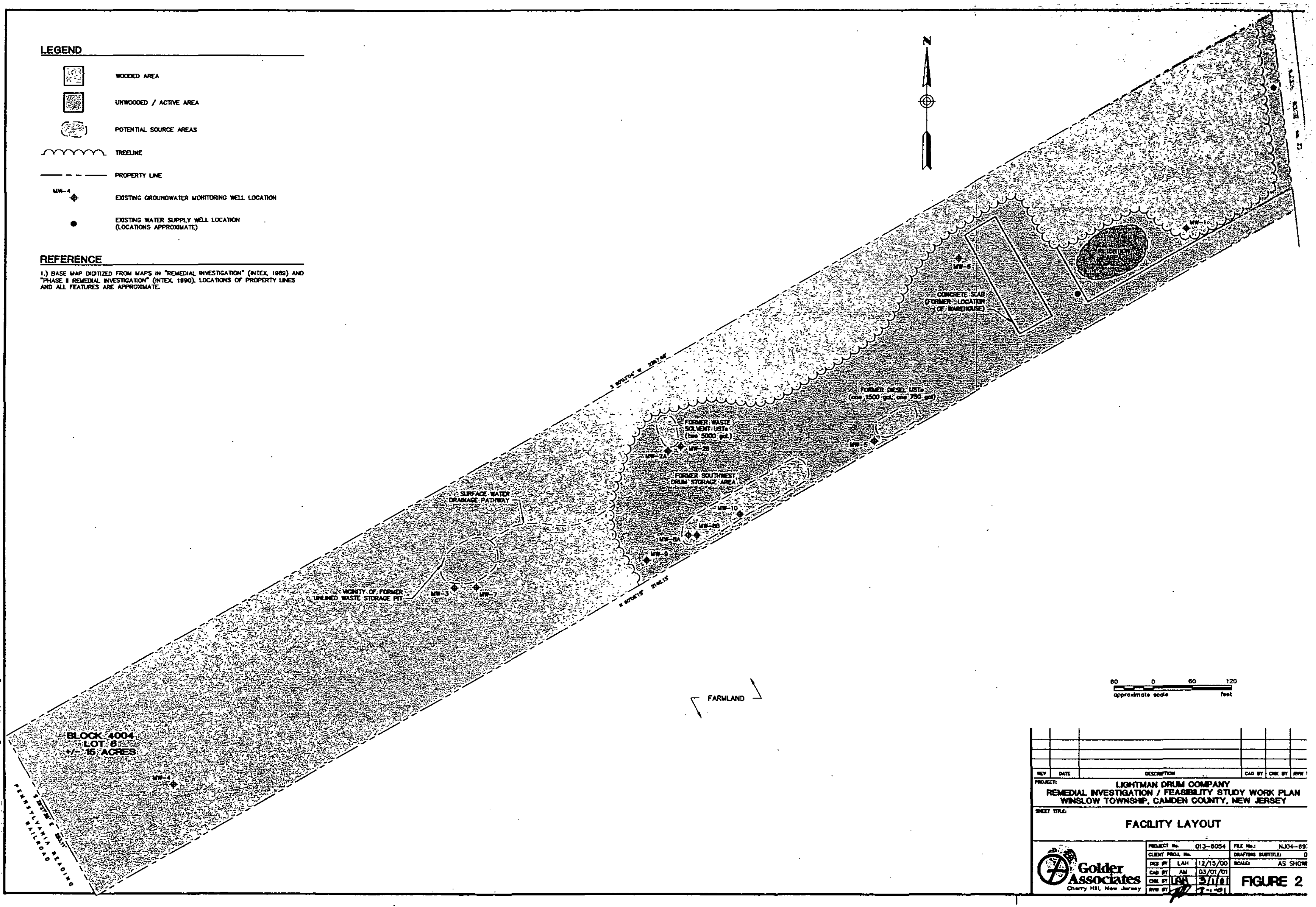


## REFERENCE

1.) MAP TAKEN FROM U.S.G.S. 7.5 MINUTE QUADRANGLE OF WILLIAMSTOWN, NEW JERSEY, DATED 1981.

2000 0 2000
scale feet

| | | | | |
|---|---|---|---|---|
| JOB No.: | 013-6054 | SCALE: | AS SHOWN | **SITE LOCATION MAP** |
| CAD BY: | AM | DATE: | 02/15/01 | |
| CHK BY: | LAH | FILE No.: | NJ04-691 | |
| REV BY: | | DR SUBTITLE: | 01 | |
| **Golder Associates** | | | | LIGHTMAN DRUM COMPANY — FIGURE 1 |



## LEGEND

| | |
|---|---|
| ▨ | WOODED AREA |
| ▩ | UNWOODED / ACTIVE AREA |
| ◌ | POTENTIAL SOURCE AREAS |
| ⌒⌒⌒⌒ | TREELINE |
| — – – — | PROPERTY LINE |
| MW-4 ⌖ | EXISTING GROUNDWATER MONITORING WELL LOCATION |
| ● | EXISTING WATER SUPPLY WELL LOCATION<br>(LOCATIONS APPROXIMATE) |

## REFERENCE

1.) BASE MAP DIGITIZED FROM MAPS IN "REMEDIAL INVESTIGATION" (INTEX, 1989) AND "PHASE II REMEDIAL INVESTIGATION" (INTEX, 1990). LOCATIONS OF PROPERTY LINES AND ALL FEATURES ARE APPROXIMATE.

| REV | DATE | DESCRIPTION | CAD BY | CHK BY | RVW |
|---|---|---|---|---|---|
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |

PROJECT:

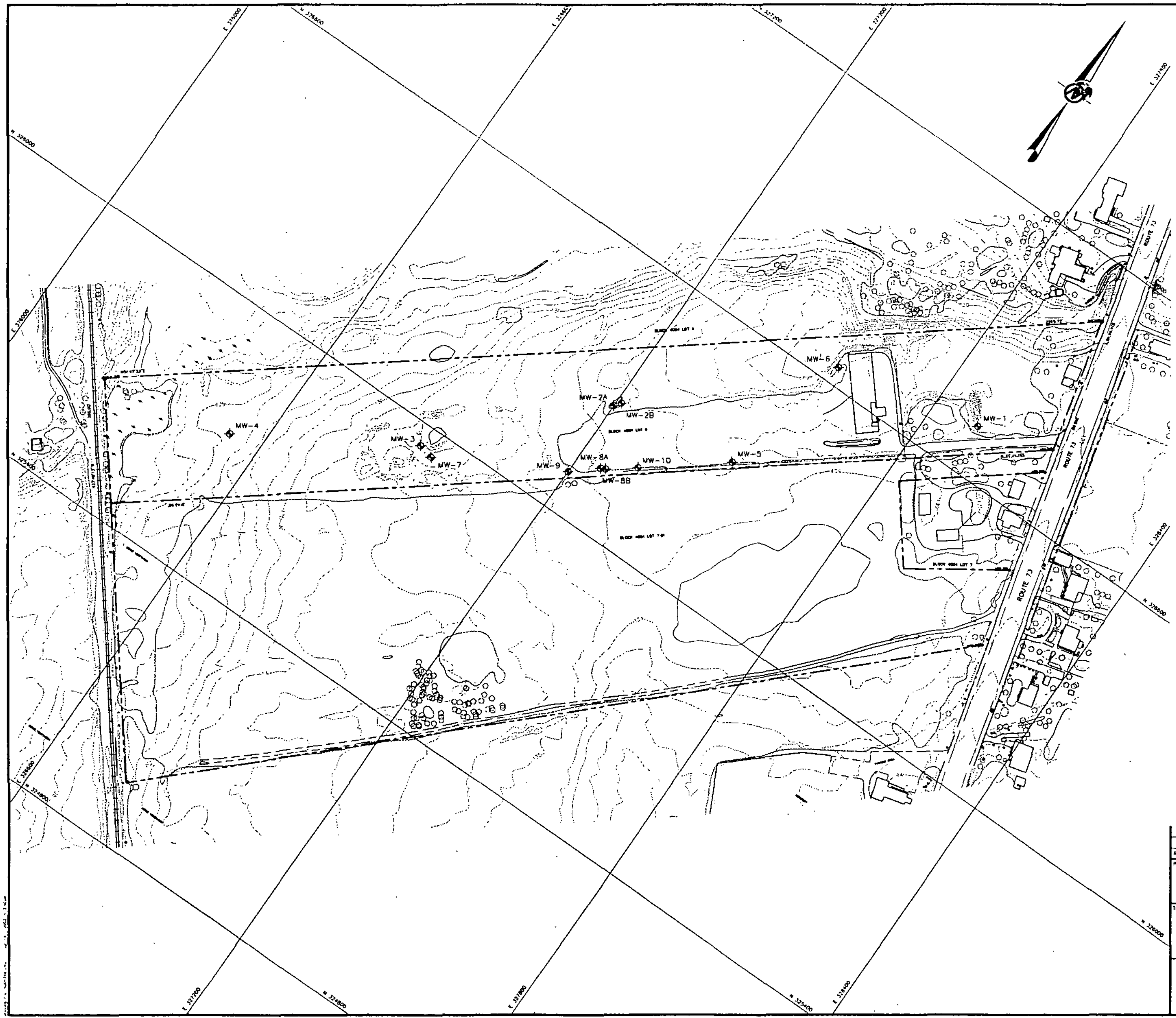
LIGHTMAN DRUM COMPANY
REMEDIAL INVESTIGATION / FEASIBILITY STUDY WORK PLAN
WINSLOW TOWNSHIP, CAMDEN COUNTY, NEW JERSEY

SHEET TITLE:

# FACILITY LAYOUT

Golder Associates
Cherry Hill, New Jersey

| | | | | |
|---|---|---|---|---|
| PROJECT No. | 013-6054 | | FILE No.: | NJ04-69 |
| CLIENT PROJ. No. | | | DRAFTING SUBTITLE: | 0 |
| DES BY | LAH | 12/15/00 | SCALE: | AS SHOW |
| CAD BY | AM | 03/01/01 | | |
| CHK BY | LAH | 3/1/01 | FIGURE 2 | |
| RVW BY | | 3-1-01 | | |



## LEGEND

BOUNDARY LINE
RIGHT OF WAY LINE
MANHOLE
UTILITY POLE
OVERHEAD LIGHT POLE
LIGHT POLE
CATCH BASIN
INLET
FENCE
FIRE HYDRANT
TREE LINE
DECIDUOUS TREE
CONIFEROUS TREE
MONITORING WELL

## NOTES

1.) GENERAL NOTES 1

2.) GENERAL NOTES 2

## REFERENCES

1.) MAP TAPEN FROM FILE 2702-01.DWG, TITLED "PLAN OF SURVEY", PROVIDED BY JAMES M. STEWART, INC.

100 0 100 200
SCALE FEET

| REV | DATE | DES | REVISION DESCRIPTION | CADD | CHK | RVW |
|---|---|---|---|---|---|---|
| | | | | | | |

PROJECT
LIGHTMAN DRUM PRP GROUP
REMEDIAL INVESTIGATION / FEASIBILITY STUDY WORKPLAN
WINSLOW TOWNSHIP, NEW JERSEY

TITLE

# TOPOGRAPHIC BASE MAP

Golder Associates
Philadelphia USA

| | | | | |
|---|---|---|---|---|
| PROJECT No. | | 013-6054 | FILE No. | NJ04-766/ST-01 |
| DESIGN | RJI | 05/16/02 | SCALE AS SHOWN | REV. 0 |
| CADD | AM | 05/17/02 | | |
| CHECK | | | | |
| REVIEW | RC | 7/19/02 | | |

**FIGURE 2A**

## LEGEND

▨ WOODED AREA

▨ UNWOODED / ACTIVE AREA

POTENTIAL SOURCE AREAS

TREELINE

PROPERTY LINE

MW-4 ⌖ EXISTING GROUNDWATER MONITORING WELL LOCATION

● EXISTING WATER SUPPLY WELL LOCATION (LOCATIONS APPROXIMATE)

## NOTES

1.) ALL UNITS PARTS-PER-BILLION (ppb=ug/L)

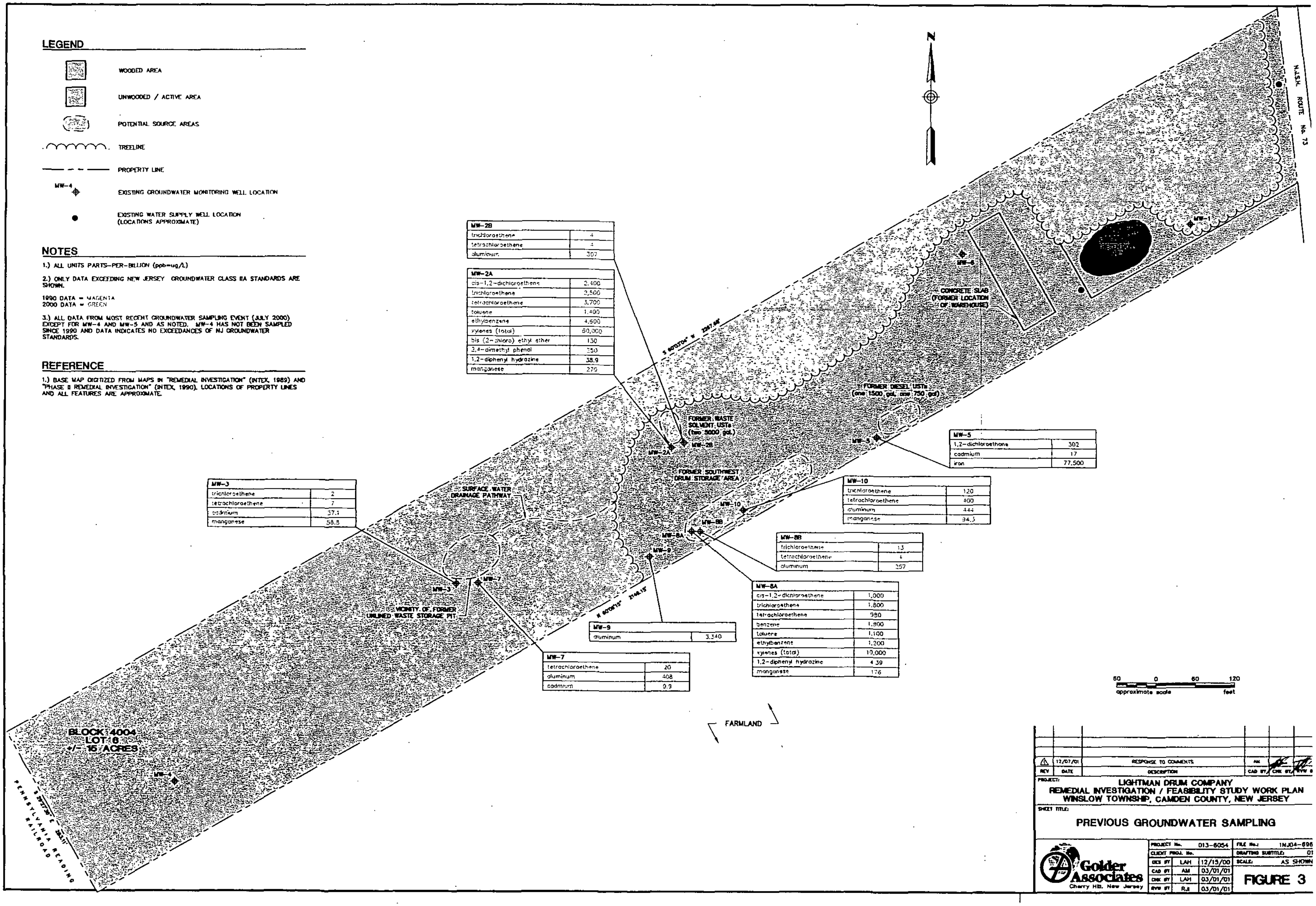
2.) ONLY DATA EXCEEDING NEW JERSEY GROUNDWATER CLASS IIA STANDARDS ARE SHOWN.

1990 DATA = MAGENTA
2000 DATA = GREEN

3.) ALL DATA FROM MOST RECENT GROUNDWATER SAMPLING EVENT (JULY 2000) EXCEPT FOR MW-4 AND MW-5 AND AS NOTED. MW-4 HAS NOT BEEN SAMPLED SINCE 1990 AND DATA INDICATES NO EXCEEDANCES OF NJ GROUNDWATER STANDARDS.

## REFERENCE

1.) BASE MAP DIGITIZED FROM MAPS IN "REMEDIAL INVESTIGATION" (INTEX, 1989) AND "PHASE II REMEDIAL INVESTIGATION" (INTEX, 1990). LOCATIONS OF PROPERTY LINES AND ALL FEATURES ARE APPROXIMATE.



| MW-2B | |
|---|---|
| trichloroethene | 4 |
| tetrachloroethene | 4 |
| aluminum | 307 |

| MW-2A | |
|---|---|
| cis-1,2-dichloroethene | 2,400 |
| trichloroethene | 2,500 |
| tetrachloroethene | 3,700 |
| toluene | 1,400 |
| ethylbenzene | 4,600 |
| xylenes (total) | 60,000 |
| bis (2-chloro) ethyl ether | 130 |
| 2,4-dimethyl phenol | 250 |
| 1,2-diphenyl hydrazine | 38.9 |
| manganese | 279 |

| MW-3 | |
|---|---|
| trichloroethene | 2 |
| tetrachloroethene | 7 |
| cadmium | 37.1 |
| manganese | 58.8 |

| MW-5 | |
|---|---|
| 1,2-dichloroethane | 302 |
| cadmium | 17 |
| iron | 77,500 |

| MW-10 | |
|---|---|
| trichloroethene | 120 |
| tetrachloroethene | 400 |
| aluminum | 444 |
| manganese | 94.3 |

| MW-8B | |
|---|---|
| trichloroethene | 13 |
| tetrachloroethene | 4 |
| aluminum | 257 |

| MW-8A | |
|---|---|
| cis-1,2-dichloroethene | 1,000 |
| trichloroethene | 1,800 |
| tetrachloroethene | 980 |
| benzene | 1,300 |
| toluene | 1,100 |
| ethylbenzene | 1,200 |
| xylenes (total) | 10,000 |
| 1,2-diphenyl hydrazine | 4.39 |
| manganese | 176 |

| MW-9 | |
|---|---|
| aluminum | 3,340 |

| MW-7 | |
|---|---|
| tetrachloroethene | 20 |
| aluminum | 408 |
| cadmium | 9.9 |

| REV | DATE | DESCRIPTION | CAD BY | CHK BY | RVW BY |
|---|---|---|---|---|---|
| △ | 12/07/01 | RESPONSE TO COMMENTS | AM | | |

PROJECT:
**LIGHTMAN DRUM COMPANY**
**REMEDIAL INVESTIGATION / FEASIBILITY STUDY WORK PLAN**
**WINSLOW TOWNSHIP, CAMDEN COUNTY, NEW JERSEY**

SHEET TITLE:
**PREVIOUS GROUNDWATER SAMPLING**

Golder Associates
Cherry Hill, New Jersey

| | | |
|---|---|---|
| PROJECT No. | 013-6054 | |
| CLIENT PROJ. No. | | |
| DES BY | LAH | 12/15/00 |
| CAD BY | AM | 03/01/01 |
| CHK BY | LAH | 03/01/01 |
| RVW BY | RJ | 03/01/01 |

FILE No.: 1NJ04-696
DRAFTING SUBTITLE: 01
SCALE: AS SHOWN

**FIGURE 3**

## LEGEND

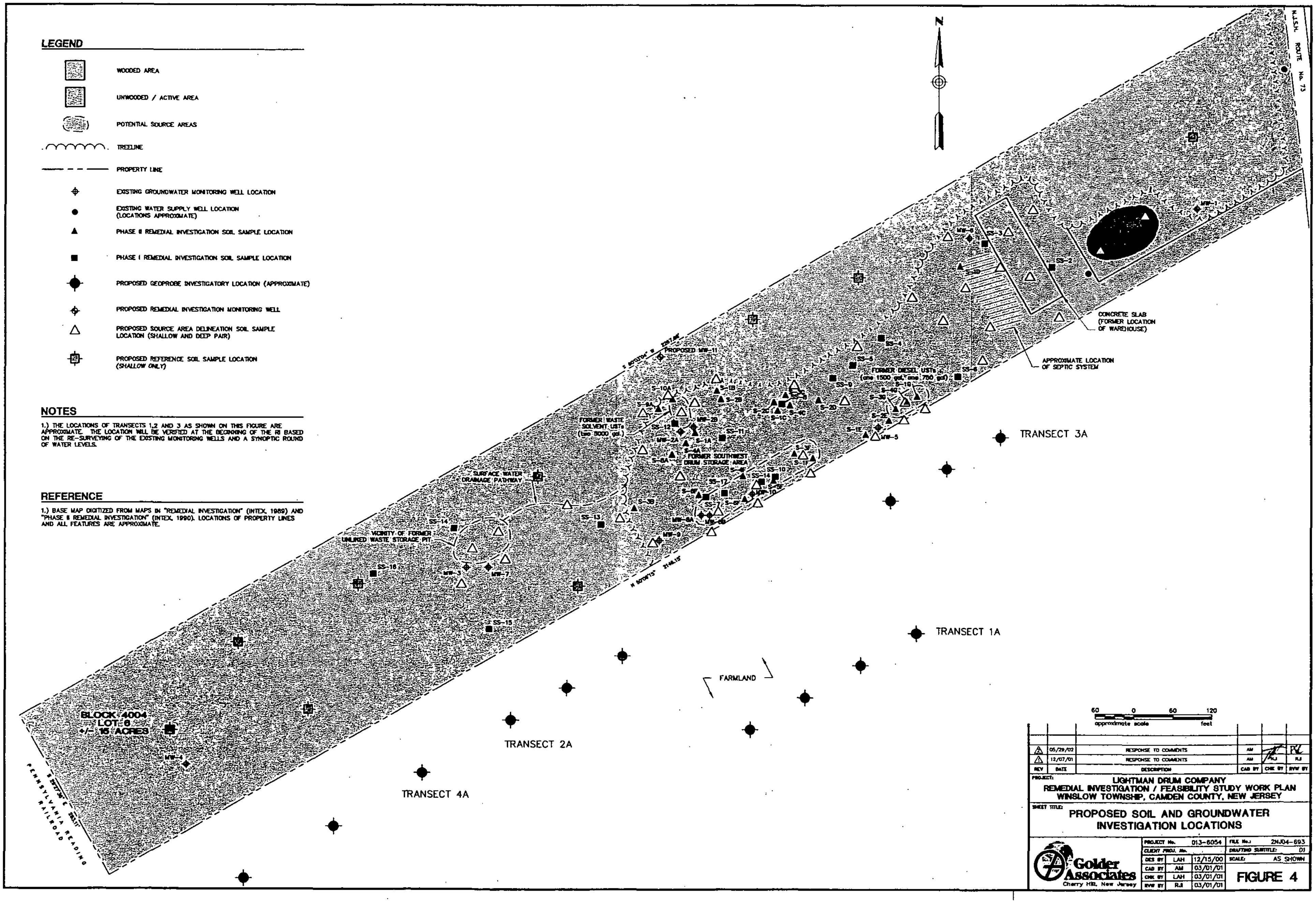
| | |
|---|---|
| ▨ | WOODED AREA |
| ▨ | UNWOODED / ACTIVE AREA |
| ▨ | POTENTIAL SOURCE AREAS |
| ⌒⌒⌒ | TREELINE |
| — — — | PROPERTY LINE |
| ⌖ | EXISTING GROUNDWATER MONITORING WELL LOCATION |
| ● | EXISTING WATER SUPPLY WELL LOCATION (LOCATIONS APPROXIMATE) |
| ▲ | PHASE II REMEDIAL INVESTIGATION SOIL SAMPLE LOCATION |
| ■ | PHASE I REMEDIAL INVESTIGATION SOIL SAMPLE LOCATION |
| ⯁ | PROPOSED GEOPROBE INVESTIGATORY LOCATION (APPROXIMATE) |
| ◈ | PROPOSED REMEDIAL INVESTIGATION MONITORING WELL |
| △ | PROPOSED SOURCE AREA DELINEATION SOIL SAMPLE LOCATION (SHALLOW AND DEEP PAIR) |
| ⊞ | PROPOSED REFERENCE SOIL SAMPLE LOCATION *(SHALLOW ONLY)* |

## NOTES

1.) THE LOCATIONS OF TRANSECTS 1,2 AND 3 AS SHOWN ON THIS FIGURE ARE APPROXIMATE. THE LOCATION WILL BE VERIFIED AT THE BEGINNING OF THE RI BASED ON THE RE-SURVEYING OF THE EXISTING MONITORING WELLS AND A SYNOPTIC ROUND OF WATER LEVELS.

## REFERENCE

1.) BASE MAP DIGITIZED FROM MAPS IN "REMEDIAL INVESTIGATION" (INTEX, 1989) AND "PHASE II REMEDIAL INVESTIGATION" (INTEX, 1990). LOCATIONS OF PROPERTY LINES AND ALL FEATURES ARE APPROXIMATE.



| REV | DATE | DESCRIPTION | CAD BY | CHK BY | RVW BY |
|---|---|---|---|---|---|
| 2 | 05/29/02 | RESPONSE TO COMMENTS | AM | | RL |
| 1 | 12/07/01 | RESPONSE TO COMMENTS | AM | RJ | RJ |

PROJECT:
LIGHTMAN DRUM COMPANY
REMEDIAL INVESTIGATION / FEASIBILITY STUDY WORK PLAN
WINSLOW TOWNSHIP, CAMDEN COUNTY, NEW JERSEY

SHEET TITLE:
### PROPOSED SOIL AND GROUNDWATER INVESTIGATION LOCATIONS

Golder Associates
Cherry Hill, New Jersey

| | | | | |
|---|---|---|---|---|
| PROJECT No. | 013-6054 | | FILE No.: | 2NJ04-693 |
| CLIENT PROJ. No. | | | DRAFTING SUBTITLE: | 01 |
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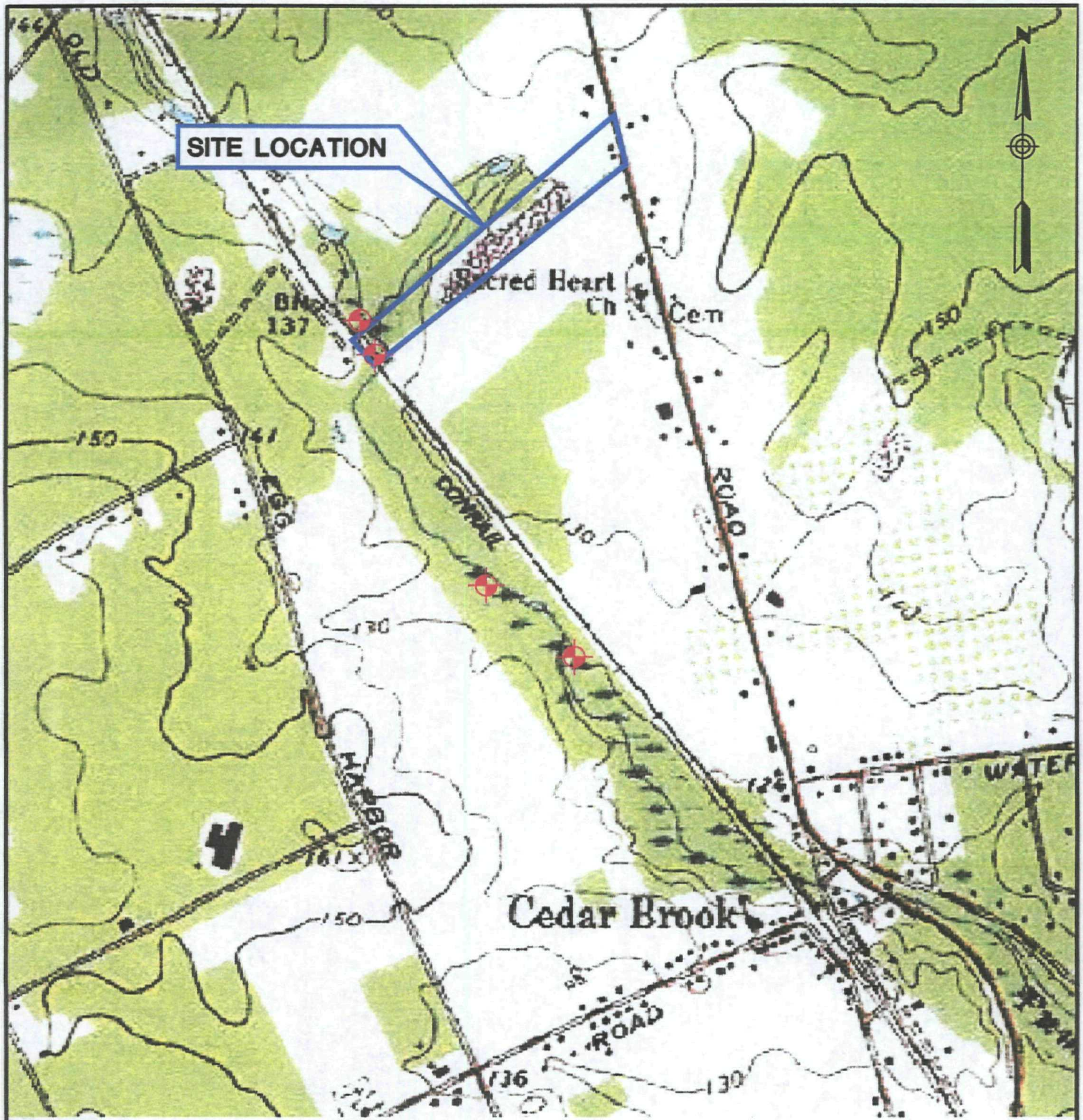
| CAD BY | AM | 03/01/01 | | |
| CHK BY | LAH | 03/01/01 | | |
| RVW BY | RJ | 03/01/01 | | |

FIGURE 4



## LEGEND

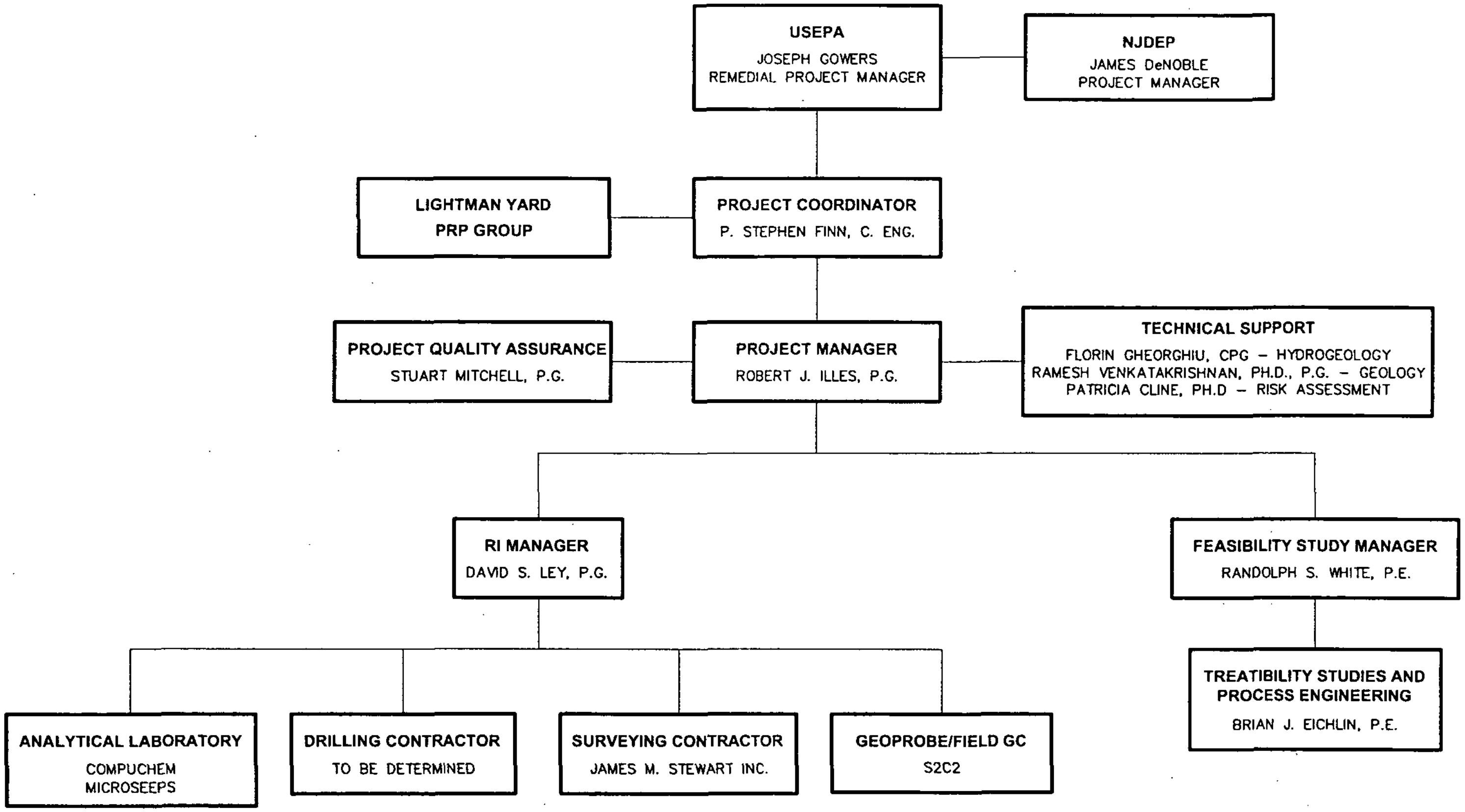
⊕ APPROXIMATE LOCATION OF SURFACE WATER/SEDIMENT SAMPLING LOCATIONS. ACTUAL LOCATIONS WILL BE DETERMINED IN THE FIELD BASED ON SITE CONDITIONS.

## REFERENCE

1.) MAP TAKEN FROM U.S.G.S. 7.5 MINUTE QUADRANGLE OF WILLIAMSTOWN, NEW JERSEY, DATED 1981.

1000 0 1000
scale feet

| | | | | |
|---|---|---|---|---|
| JOB No.: | 013-6054 | SCALE: | AS SHOWN | **SURFACE WATER/SEDIMENT SAMPLING LOCATIONS** |
| CAD BY: | AM | DATE: | 05/17/02 | |
| CHK BY: | | FILE No.: | NJ04-767 | |
| REV BY: | | DR SUBTITLE: | 01 | |
| **Golder Associates** | | | | LIGHTMAN DRUM COMPANY — FIGURE **4A** |



| | | | |
|---|---|---|---|
| JOB No.: | 013-6054 | SCALE: | AS SHOWN |
| CAD BY: | AM | DATE: | 07/19/02 |
| CHK BY: | | FILE No.: | 2NJ04-689 |
| REV BY: | | DR SUBTITLE: | 01 |

**RI/FS ORGANIZATIONAL CHART**

**Golder Associates**

LIGHTMAN DRUM COMPANY

FIGURE **5**

| ID | Task Name |
|---|---|
| 1 | **RI/FS Work Plan Agency Approval** |
| 2 | |
| 3 | **Site Characterization** |
| 4 | Field Work |
| 5 | Memorandum - Monitoring Well Locations |
| 6 | Agency Review |
| 7 | Data Validation |
| 8 | Submit Data |
| 9 | Summary Report |
| 10 | Submit Summary Report |
| 11 | Presentation |
| 12 | Agency Review |
| 13 | Response to Comments |
| 14 | |
| 15 | **Candidate Technologies Memo** |
| 16 | Memorandum |
| 17 | Agency Review |
| 18 | Response to Comments |
| 19 | |
| 20 | **Treatability Studies** |
| 21 | |
| 22 | **Baseline Risk Assessment** |
| 23 | Memorandum: Exposure Scenarios & Assumptions |
| 24 | Agency Review |
| 25 | Response to Comments |
| 26 | List of Haz. Substances Present and Proposed COCs |
| 27 | Agency Review |
| 28 | Response to Comments |
| 29 | Agency Approval |
| 30 | Toxicological and Epidemiological Studies Memorandum |
| 31 | Agency Review |
| 32 | Response to Comments |
| 33 | Agency Approval |
| 34 | Baseline Human Health and Ecological RA |
| 35 | Agency Review |
| 36 | Response to Comments |
| 37 | Agency Approval |
| 38 | |
| 39 | **Presentation - Draft RI RAOs, RA Screening** |
| 40 | |
| 41 | **RI Report** |
| 42 | Draft Report |
| 43 | Agency Review |
| 44 | Response to Comments/Final Report |
| 45 | |
| 46 | **FS Report** |
| 47 | Draft FS Report |
| 48 | Presentation |
| 49 | Agency Review |
| 50 | Response to Comments/Final Report |

| | | | |
|---|---|---|---|
| JOB No.: | 013-6054 | SCALE: | AS SHOWN |
| CAD BY: | AM | DATE: | 11/27/01 |
| CHK BY: | | FILE No.: | 1NJ04-701 |
| REV BY: | | DR SUBTITLE: | 01 |

**PROJECT SCHEDULE**

**Golder Associates**

LIGHTMAN DRUM COMPANY

FIGURE 6

# APPENDIX A

# SAMPLING AND ANALYSIS PLAN

# APPENDIX A

# SAMPLING AND ANALYSIS PLAN
# FOR THE
# REMEDIAL INVESTIGATION WORK PLAN
# LIGHTMAN DRUM COMPANY SITE
# WINSLOW TOWNSHIP, NEW JERSEY

July 2002

Revision #1

| | Signature | Date |
|---|---|---|
| RI Consultant Project Manager | | |
| RI Consultant Project QA Manager | | |
| USEPA Remedial Project Manager | | |
| NJDEP Project Manager | | |
| USEPA Quality Assurance Manager | | |

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## LIST OF FIGURES

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| 3 Copies | New Jersey Department of Environmental Protection |
| 9 Copies | Lightman Yard Technical Committee |
| 2 Copies | Golder Associates Inc. |

## A.1.0 PROJECT MANAGEMENT

### A.1.1 Project Background

This Sampling and Analysis Plan (SAP), which includes a Field Sampling Plan (FSP) and a Quality Assurance Project Plan (QAPP), has been prepared by Golder Associates Inc. (Golder Associates) on behalf of the Lightman Yard PRP Group (Group). The RIWP addresses remedial investigation activities for groundwater and soil required under the Administrative Order on Consent (AOC), USEPA Index No. CERCLA-02-2000-2034, executed by the U.S. Environmental Protection Agency (USEPA) in November, 2000. The SAP was prepared as part of the Remedial Investigation Work Plan (RIWP) for the Lightman Drum Company Superfund Site (Site). This SAP supports the RIWP by providing information regarding field, sampling, analytical and quality assurance/quality control (QA/QC) procedures for remedial investigation field activities.

This SAP was prepared in accordance with the AOC for the Site and the USEPA guidance documents specified below:

1. Guidance for Conducting Remedial Investigations and Feasibility Studies under CERCLA (EPA/540/G-89/004), dated October, 1988;
2. EPA NEIC Policies and Procedures Manual (EPA 330/9-78-001-R) dated May 1978, revised May 1986;
3. A Compendium of Superfund Field Operations Methods (OSWER Directive 9355-0-14), December 1987;
4. Guidance for the Data Quality Objective Process, EPA QA/G-4(EPA/600/R-96/055), dated August 2000
5. EPA Requirements for Quality Assurance Project Plans for Environmental Data Operations (EPA QA/R-5), Interim Final, dated November 1999.
6. EPA Requirements for Quality Assurance Project Plans (EPA QA/R-5), March 2001;
7. Interim Final Guidance for Conducting Remedial Investigations and Feasibility Studies under CERCLA (OSWER Directive 9355.3-01) and,
8. Region II CERCLA Quality Assurance Manual, Revision 1, EPA Region 2 (October 1989).

The format of this SAP follows that of guidance Document No. 6, which specifies four groups of elements containing a total of twenty-five essential elements to be included in a SAP. The four groups are Project Management, Measurement/Data Acquisition, Assessment/Oversight, and Data Validation/Usability. The first three elements of the Project Management Group (Title Page including provision for approval signatures, the Table of Contents, and the Distribution List) are included in the front of this document. The remaining four Project Management elements are discussed in this section. The remaining three groups of elements are presented in Sections A.2 through A.4, respectively.

This SAP describes general QA/QC procedures that will be used during all aspects of sample collection and handling in the field and in the laboratory. Laboratory QA procedures regarding personnel, management structure, analytical equipment, and data management are contained in the laboratory's Quality Assurance Plan (QAP). A copy of the laboratory QAP will be provided to USEPA , under separate cover. Any substantive revisions to this SAP will be submitted to USEPA Region II for approval prior to implementation.

Many of the quality assurance procedures to be used for this project are described in the following documents:

1. Contract Laboratory Program Statement of Work for Organics Analysis, OLM04.2;
2. Contract Laboratory Program Statement of Work for Inorganics Analysis, ILM04.1;
3. Test Methods for Evaluating Solid Waste - Physical/Chemical Methods, SW-846, Third Edition, November 1986; Update III, December 1996;
4. Methods for Chemical Analysis of Water and Wastes (EPA-600/4-79-020), USEPA, 1979, revised 1983;
5. Standard Methods for the Examination of Water and Wastewater, 18th Edition, 1992, APHA-AWWA-WPCF;
6. EPA Region II Contract Lab Program Organics Data Review and Preliminary Review, Standard Operating Procedures #HW-6, Revision 11;
7. Evaluation of Metals Data for the Contract Laboratory Program, Standard Operating Procedure #HW-2, Revision 11; and,
8. Annual Book of ASTM Standards, Volume 4.08, April 1999.

The text of this document, which presents each of the four elements of the SAP, refers to the above listed documents, as appropriate. This approach is in accordance with USEPA guidance documents, which require that referencing of other documents be clearly defined in order to facilitate location of required information.

The signatures on the cover sheet of this SAP demonstrate the review, approval, acceptance and responsibility for the QA/QC procedures specified herein by the project team. A list of key project personnel determined thus far identified for this project is presented in Table A-1 of this SAP.

### A.1.2 Project Organization

The project team organization is shown on Figure A-1. Contact information for the project team members are provided in Table A-1. Notably the listed project team members have primary responsibility for the project, although other individuals within their respective organizations will be involved.

The lead regulatory Agency for the Site is USEPA Region II. Ms. Michelle Granger is USEPA's Remedial Project Manager (RPM). USEPA's technical oversight contractor is CDM Federal. The New Jersey Department of Environmental Protection (NJDEP) will also provide regulatory oversight on this project.

The USEPA RPM will coordinate with Mr. James DeNoble, the NJDEP Project Manager, and serve as the primary contact with the Group's Project Coordinator, Steve Finn of Golder Associates. The Project Coordinator will provide overall management of activities related to the RI/FS and coordinate between the Agencies and the Group. Golder Associates has also been approved by USEPA as the RI Consultant for the remedial investigation. Mr. Finn will be assisted by Robert Illes, Project Manager, within Golder Associates. Overall Quality Assurance/Quality Control (QA/QC) of the project, sampling, operations, and data management may be provided by the Golder Associates' QA Manager, Stuart Mitchell, or his designee.

CompuChem, a division of Liberty Analytical, of Cary, North Carolina (CompuChem), will provide analytical services for sampled media. CompuChem is a participant in the USEPA Contract Laboratory program (CLP). Microseeps, Inc. of Pittsburgh, Pennsylvania (Microseeps) will provide analytical services for select parameters (i.e., light hydrocarbons). $S_2C_2$, Inc. of Warren, New Jersey will provide Geoprobe® services including mobile lab services. Surveying services will be provided by James M. Stewart, Inc., a New Jersey licensed surveyor. Drilling services will be provided by a New Jersey licensed driller. USEPA will be notified of the selected driller prior to initiating fieldwork. If at any time during this project, the identity or role of any of these key organizations or personnel changes, the USEPA would be notified.

### A.1.3 Project Description

The Lightman Drum Company property covers approximately 15 acres and is located in Winslow Township, Camden County, New Jersey (Figure 1). Jerome Lightman, the owner of the property, operates a drum brokerage business under the name of Lightman Drum Company, Inc. (LDC) and/or United Cooperage. As stated in the AOC, LDC operated an industrial waste hauling and drum reclamation business at the Site beginning in the spring of 1974. Various inspections of the property were conducted by the New Jersey Department of Environmental Protection (NJDEP) from 1974 through 1984. In 1978, the NJDEP issued a one-year Temporary Operating Authorization that allowed the storage of various wastes on the property including chemical powders, pesticides, waste oil, oil sludges, paint, pigment, thinner, ink residues, ketones, alcohols, and mixed solvents. The permit was not renewed.

In 1987, NJDEP collected soil samples from the property that revealed the presence of various organic and inorganic compounds. In 1988, NJDEP issued an Administrative Order (the New Jersey Order) requiring LDC to conduct an RI/FS at the Site. International Exploration, Inc. (INTEX) performed investigation work in two phases in 1989 and 1990. The investigation included installation of groundwater monitoring wells and collection of soil and groundwater samples on the property. Constituents detected in groundwater included chlorinated and aromatic VOCs, and Semi-volatile Organic Compounds (SVOCs) in excess of federal drinking water standards (maximum contaminant levels; MCLs). Constituents detected in soils on the property included VOCs (primary chlorinated and BTEX compounds), SVOCs, pesticides, and inorganics.

At the request of NJDEP, USEPA performed a Hazard Ranking System (HRS) Evaluation of the Site in May 1999. The purpose of the HRS Evaluation was to determine if the releases at the Site warranted placement of the Site on the National Priorities List (NPL) set forth in 40 CFR Part 300, Appendix B. The HRS Evaluation Site Score was 42.03, based solely on the Groundwater

Pathway, and exceeded the 28.50 cut-off for potential listing on the NPL. USEPA placed the Site on the NPL by publication in the Federal Register on October 22, 1999. An AOC was signed in November 2000 requiring the Group to perform a RI/FS at the Site and prepare the RIWP.

The purpose of this SAP is to describe the sampling and analysis activities, which will be conducted to gather information needed to address the data gaps identified in the RIWP. Sampling programs to be performed under this SAP are summarized in Table A-2. Figure 6 of the RIWP provides a schedule of remedial investigation activities. The objectives of the RI/FS, as required by the AOC, are as follows:

- Determine the nature and extent of contamination and any threat to the public health, welfare, or the environment caused by the release or threatened release of hazardous substances, pollutants, or contaminants at or from the Site by conducting an RI; and,
- Determine and evaluate alternatives for remedial action, if any, to prevent, mitigate, or otherwise respond to or remedy any release or threatened release of hazardous substances, pollutants, or contaminants at or from the Site by conducting a FS.

### A.1.4 Quality Assurance Objectives for Measurement

The USEPA Data Quality Objectives (DQO) Guidance document specifies that the sampling program be designed in order to meet the requirements of the investigation and achieve the DQOs. Part of this process is to determine what data is being collected and how it will be used in assessing Site conditions. For the purposes of this project, two types of data will be produced. Definitive data will be collected from samples that are submitted to an approved laboratory for analysis. Screening data will be produced using field measurement instruments and field analysis of VOCs in order to refine the drilling program.

As part of the evaluation component of the QA program, results are compared with certain data quality indicators. These data quality indicators are part of the overall DQOs for the project. DQOs for field and laboratory analysis are provided in Table A-2. Tables A-3 through A-6 provide details regarding the planned chemical analyses and the quality criteria used to assess the data.

QA program objectives for the analytical laboratory are in the laboratory's QAP. In general, data quality indicators include precision, accuracy, representativeness, completeness, and comparability (PARCC). Each indicator may be defined as follows:

1. Precision is the agreement or reproducibility among individual measurements of the same property, usually made under the same conditions;
2. Accuracy is the degree of agreement of a measurement with the true or accepted value;
3. Representativeness is the degree to which a measurement accurately and precisely represents a characteristic of a population, parameter, or variations at a sampling point, a process condition, or an environmental condition;
4. Completeness is a measure of the amount of valid data obtained from a measurement system compared with the amount that was expected to be obtained under correct normal conditions; and,
5. Comparability is an expression of the confidence with which one data set can be compared with another data set in regard to the same property.

QA objectives vary according to the specific objectives of each analysis. The *accuracy, precision* and *representativeness* of data will be functions of the sample origin, analytical procedures and the specific sample matrices. QC practices used to evaluate these data quality indicators include use of accepted analytical procedures, adherence to hold time, and analysis of QC samples such as blanks, replicates, spikes, calibration standards and reference standards. Tables A-3 through A-6 summarize the PARCC criteria for groundwater and soil samples.

For each parameter analyzed, quantitative QA objectives for precision, accuracy and sensitivity (detection limits) were established in accordance with the specific analytical method employed, published historical data, laboratory method validation studies, and laboratory experience with similar samples. A list of the Reporting Limits for the TCL/TAL analytes is provided as Table A-7. It should be noted that these reporting limits are the minimum reporting limits appropriate for undiluted relatively uncontaminated samples. However, the reporting limits may be elevated due to contaminant concentrations in excess of the method calibration range, the sample matrix, and percent moisture adjustment for soil samples.

*Representativeness* is a non-quantitative (qualitative) characteristic which primarily addresses proper design of a sampling program in terms of number and location of samples and sample collection techniques. The rationale for the number and location of samples for this project is discussed in the RIWP and the sampling procedures are described in Section A.2 of this SAP. The representativeness of the analytical data is also a function of the procedures used to process the samples. Standard USEPA or USEPA-accepted analytical procedures will be followed.

*Completeness* is a quantitative characteristic which is defined as the fraction of valid data obtained from a measurement system (sampling and analysis) compared to that which was planned. Completeness can be less than 100 percent due to low sample recovery, sample damage, or disqualification of results which are outside of control limits due to laboratory error or matrix-specific interference. Completeness is documented by including sufficient information in the laboratory reports to allow the data user to assess the quality of the results. For this project, an attempt will be made to attain 85 percent completeness or better (field and laboratory) where chemical analysis is required. The completeness goal for laboratory measurements will be 90 percent.

*Comparability* is a qualitative characteristic which allows for comparison of analytical results with those obtained by other laboratories. This may be accomplished through the use of standard accepted methodologies, traceability of standards to National Bureau of Standards (NBS) or USEPA sources, use of appropriate levels of quality control, reporting results in consistent, standard units of measure and participation in inter-laboratory studies designed to evaluate laboratory performance.

Samples collected during the project will be analyzed for the parameters outlined in Tables A-2, A-3, A-5, and A-7. The DQOs, as summarized by the PARCC criteria in Tables A-3 through A-6, may not always be achievable. The USEPA Region II data validation guidelines provide direction for the determination of data usability. Qualified data can often provide useful information, although the degree of certainty associated with the results may not be as planned. Professional judgment will be used to determine data usability with respect to project goals.

### A.1.5 Training Requirements/Certifications

Samples will be collected by personnel trained in the use of the sampling equipment. Training will include use of proper sampling protocols as well as Health and Safety procedures. Laboratory personnel will have been trained in the analysis of samples and the review of analytical data. Personnel performing the remedial investigation activities will be required to present documentation of OSHA 40-hour HAZWOPER training and annual updates prior to actively performing intrusive work activities at the Site.

### A.1.6 Documentation and Records

All field records will be compiled and retained in the RI Consultant's project files. Field parameter data collected during the remedial investigation will be included in the RI report. Analytical data packages will contain all information necessary for data validation, if data validation should be required. At a minimum, the following information is needed as appropriate to the analytical methodology:

- Case narrative;
- Chain of Custody (COC) records;
- QC summaries;
- Analytical data report;
- Calibration information;
- Chromatograms;
- Quantitation reports;
- Spectra;
- Analytical sequence logs; and,
- Sample preparation logs.

The laboratory will keep sample evidence files containing the following items:

- COC records;
- Sample log-in information (if applicable);
- Copies of laboratory records and notebook pages;
- Copies of laboratory bench data sheets;
- Instrument raw data, both hardcopy and electronic;
- Chromatograms;
- Pertinent correspondence memoranda; and,
- Final report file.

The RI Consultant will retain relevant and appropriate project information in project files. The information contained in these files includes, but is not limited to, the following items:

- COC records;
- Field notes and information;
- Correspondence and telephone memoranda;
- Meeting notes;

- Laboratory information;
- Data validation information;
- Reference information;
- Audit information; and,
- Copies of reports.

These files will be retained for a minimum of ten years following commencement of construction of the Remedial Action as specified in Paragraph 74 of Section XV of the AOC. If the laboratory cannot retain its records for the 10-year period, all laboratory records will be provided to the RI Consultant or the Group for retention.

## A.2.0 MEASUREMENT/DATA ACQUISITION

### A.2.1 Remedial Investigation Activities

This section presents a description of the Remedial Investigation activities as described in Section 3.0 of the RIWP. Specific sections of the RIWP are referenced below to avoid potential conflicts with the RIWP text:

- The hydrogeologic investigation is described in Section 3.2.1 of the RIWP main text.
- The groundwater field screening investigation is described in Section 3.2.1.2 of the RIWP main text.
- The surface and subsurface soil, sediment, and surface water is described in Section 3.2.2 of the RIWP main text.
- The groundwater investigation is described in Section 3.2.2 of the RIWP main text.

### A.2.2 Water Level Measurements

Prior to the initiation of drilling activities, a full synoptic round of water levels will be collected to establish a groundwater flow direction. Based on these measurements, the transect location proposed in the Scope of Work may be modified slightly to ensure that they are situated downgradient from their intended areas of investigation. A second synoptic round of water levels will be collected following the installation of the proposed wells. A well integrity survey of existing monitoring wells will also be conducted in conjunction with the initial round of water levels. The well integrity survey will include:

- Visual inspection of the exterior of the well to assess the condition of the external casing, lock and surface seal;
- Visual inspection of the internal casing for damage (i.e., free of kinks and bends) and that it is secure (i.e., not loose);
- Visual inspection of the annulous between outer and inner casing for excess water accumulation, animals, and debris; and,
- Sound bottom of well to check for kinks or bends in the casing or excessive accumulation of sediment.

### A.2.3 Geoprobe Investigation

A Geoprobe rig will be used to advance borings at the locations shown on Figure 4 of the RIWP. The initial borings at transects 1A, 2A, and 3A will be extended to the first confining layer based on the geologic data obtained from the installation of the upgradient monitoring well MW-11 (see Section 3.2.1.3 of the RIWP). Subsequent borings will be advanced to a depth of approximately 50 feet or deeper if necessary to determine the vertical extent of contamination. A temporary piezometer will be installed at each of the initial Geoprobe transects to provide hydraulic head data to assist in selecting permanent monitoring well locations. Groundwater samples will be collected every 10 feet from the water (approximately 10 to 15 feet below ground surface) down to 50 feet and on 20 foot intervals at greater depths. Groundwater samples will be collected in the following manner:

- At the correct depth interval, the water in the drilling rods will be purged using a peristaltic pump;
- A volume equivalent to three times the standing water column will be purged each time;
- Following purging, a sample will be collected using the peristaltic pump; and,
- The sample will be analyzed in the field mobile laboratory using a gas chromatograph/mass spectrometer (GC/MS) for VOCs using USEPA SW846 method 8260.

The QA procedures for the mobile lab will be carried out in accordance with the procedures set forth in the 1988 USEPA Region II memorandum entitled "Use of a Mobile Lab GC – Review Requirements". QA/QC samples (i.e., method blanks, duplicates, and spikes) will be conducted at a frequency of once per twenty primary samples.

### A.2.4 Groundwater Monitoring Well Installation

Following the completion of the Geoprobe investigation, and with EPA concurrence, the location of downgradient monitoring wells will be selected. A Technical Memorandum will be submitted to USEPA following the geoprobe investigation detailing the proposed monitoring well locations. In addition to the four downgradient locations, a monitoring well will be installed at an upgradient location north of monitoring well MW-2A. At each location, a hollow stem auger-drilling rig will be used to advance the borehole to the required depth. Six (6) inch diameter boreholes will be drilled for the purpose of installing 2-inch groundwater monitoring wells.

### A.2.4.1 Well Construction

*Well Screen and Casing Placement*

The well casings should be secured to the well screen by flush-jointed threads and placed into the borehole. Before the well screen and casings are placed on the bottom of the borehole, at least 6 inches of filter material should be placed at the bottom of the borehole to serve as a firm footing. The string of well screen and casings should then be placed into the borehole and plumbed.

No lubricating oils or grease should be used on casing threads. Teflon tape can be used to wrap the threads to insure a tight fit and minimize leakage. No glue of any type should be used to secure casing joints. Teflon "O" rings can also be used to insure a tight fit and minimize leakage; however, "O" rings made of other materials are not acceptable.

*Filter Pack Placement*

When placing the filter pack into the borehole, a minimum of 6 inches of the filter pack material should be placed under the bottom of the well screen to provide a firm footing and an unrestricted flow under the screened area. A #1 silica sand will be used and should extend a minimum of 3 feet above the top of the well screen. An additional 2 feet of #00 silica sand should be placed on top of the #1 sand prior to grouting. The filter pack should be placed by carefully pouring the sand in the annulus between the well and borehole wall.

*Grouting the Annular Space*

The annular space between the casing and the borehole wall should be filled with a cement/bentonite grout. The grout should be placed into the borehole, by the tremie method, from the top of the bentonite seal to within 2 feet of the ground surface or below the frostline, whichever is greater. The tremie tube should have a side discharge port to minimize damage to the filter pack during grout placement. The grout should be allowed to cure for a minimum of 12 hours before the concrete surface pad is installed.

Cement grouts should be mixed using 6.5 to 7 gallons of water per 94-lb bag of Type 1 Portland cement. The addition of bentonite (5 to 10 percent) to the cement grout is generally used to delay the "setting" time and may not be needed in all applications. Any other types of cement and/or grout proposed should be evaluated on a case by case basis by a senior field geologist.

### *Above Ground Riser Pipe and Outer Protective Casing*

The well casing, when installed and grouted, should extend above the ground surface a minimum of 2.5 feet. A vent hole should be drilled into the top of the well casing cap to permit pressure equalization, if applicable. An outer protective casing should be installed into the borehole after the annular grout has cured for at least 24 hours. The outer protective casing should be of steel construction with a locking cap. Generally, outer protective casings used over 2-inch well casings are 4 inches square (or round) by 5 feet long and fitted with a locking lid. All protective casings should have sufficient clearance around the inner well casings, so that the outer protective casings will not come into contact with the inner well casings after installation. The protective casings should have a minimum of two weep holes for drainage. These weep holes should be a minimum 1/4-inch in diameter and drilled into the protective casings just above the top of the concrete surface pads to prevent water from standing inside of the protective casings. Protective casings made of aluminum or other soft metals are normally not acceptable because they are not strong enough to resist tampering. A protective casing is installed by pouring concrete into the borehole on top of the grout. The protective casing is then pushed into the wet concrete and borehole a minimum of 2 feet. Extra concrete may be needed to fill the inside of the protective casing so that the level of the concrete inside of the protective casing is at or above the level of the surface pad. The protective casing should extend approximately 3 feet above the ground surface or to a height so that the cap of the inner well casing is exposed and accessible when the protective casing is opened.

### *Concrete Surface Pad*

A concrete surface pad should be installed around each well at the same time as the outer protective casing is being installed. The surface pad should be formed around the well casing. Concrete should be placed into the formed pad and into the borehole (on top of the grout) in one operation making a contiguous unit. The protective casing is then installed into the concrete as described above. The finished pad should be sloped so that drainage will flow away from the protective casing and off of the pad. In addition, a minimum of 3 inches of the finished pad should be below grade or ground elevation to prevent washing and undermining by soil erosion. All locks on the outer protective casings should be keyed alike.

### A.2.4.2 Well Construction Materials

Well construction materials are chosen based on the goals and objectives of the proposed program and the geologic conditions at the site(s). In this section, the different types of available materials will be discussed.

#### *Well Screen and Casing Materials*

It is anticipated that all well screens and casing materials utilized will be constructed of Type 304, Schedule 10 Stainless Steel. The inside diameter (ID) for well screens and casings used for the site wells will be 2 inches. Screen lengths are estimated to be 10 feet for each new monitoring well. Well screen openings will be 0.010 inches.

#### *Filter Pack Materials*

The filter pack materials should consist of clean, rounded to well-rounded, hard, #1 and #00, silica sands. Filter pack materials should not be acceptable unless accompanied by proper analyses documentation.

### A.2.4.3 Well Development

The newly completed well should not be developed for at least 24 hours after the surface pad and outer protective casing are installed. This will allow sufficient time for the well materials to cure before development procedures are initiated. The main purpose of developing new wells is to remove the residual materials remaining in the wells after installation has been completed, and to attempt to re-establish the natural hydraulic flow conditions of the formations which may have been disturbed by well construction, around the immediate vicinity of each well. New wells will be developed until the column of water in the well is relatively turbid-free, and the pH, temperature, and specific conductivity have stabilized.

The following development procedures may be used to develop the wells:

1. Pumping;
2. Compressed air (with the appropriate organic filter system);
3. Bailing;
4. Surging;
5. Backwashing ("rawhiding"); and
6. Jetting.

The newly installed wells will not be sampled until at least 2 weeks after the completion of well development to allow for the formation to restabilize to pre-well construction conditions. The selected development method(s) will be approved by a field geologist/hydrogeologist before any well development activities are initiated.

### A.2.5 Aquifer Performance Testing

To further refine the Site hydrogeologic model, slug testing will be performed in all newly installed monitoring wells, in addition to the existing Site monitoring wells. Monitoring well slug testing procedures are described below.

### A.2.5.1 Slug-Test Procedures

Each rising head slug test will be conducted in accordance with ASTM D4044-96. The field procedures are described briefly below:

1. The static water level will be measured using a water level probe;
2. An In-Situ TROLL™ transducer/datalogger will be lowered into the well and a data collection test will be set up to record water level fluctuations. The minimum data collection interval will be 3 seconds, and the data will be collected using a logarithmic collection interval;
3. A slug of known volume will be lowered in to the well, and the water level allowed to return to static conditions;
4. The test will be initiated by rapidly removing the slug and monitoring the recovery of the water level;
5. The test will be continued until the water level has returned to within at least 70% of the static level, or in the case of tight formations, for a period of 30 minutes; and,
6. Once a clear understanding of aquifer response is obtained, then the applicable data analysis method will be selected. The data will be then analyzed as described in the RIWP.

### A.2.6 Sampling Method Requirements/Procedures

The ultimate accuracy of any data generation begins with a sampling and measurement procedure that is well conceived and carefully implemented. The details of the sampling protocols are provided in this section, which presents the procedures with which samples will be acquired or measurements made during the execution of the project.

In general, the sampling procedures discussed below address the following items as they have been determined thus far:

- A description of the planned sampling locations for collection of soil and groundwater samples;
- A description of the sampling devices and procedures to be used;
- A description of containers, procedures, reagents, etc., used for sample collection, preservation, transport and storage;
- A description of sample preservation methods;
- A discussion of the time considerations for shipping samples promptly to the laboratory;
- Examples of the custody procedures and forms (Figure A-2);
- A description of the forms, notebooks, and procedures to be used to record sample history, sampling conditions, and analyses to be performed; and,
- A discussion of field QC checks such as field blanks, trip blanks, and field duplicates.

The following general procedures shall be considered during field work and sampling:

- To prevent cross-contamination in the field, new gloves will be worn by the sampling team members each time a new soil sample is collected or a different well is sampled.
- The laboratory will provide certified clean glassware for sample collection that conforms to all guidelines specified in *Specification and Guidance for Obtaining Contaminant-Free Sample Containers*, EPA 540/R-93/051 and OSWER Directive 9240.0-05A (EPA, 1992b).
- Sampling information will be recorded in field notebooks and/or on sample collection information sheets, as appropriate.

### A.2.6.1 Groundwater

This section discusses the sample collection procedures to be employed and the equipment needed for collecting representative groundwater samples.

#### A.2.6.1.1 Monitoring Well Sampling

Prior to sampling, all monitoring wells will be inspected for signs of damage, tampering, and access. Sampling of all newly installed and developed wells will occur after a stabilization period of a minimum of two weeks. All groundwater samples will be analyzed for TCL/TAL and Natural Attenuation Parameters as indicated in Tables A-2, A-3, and A-8. Additionally, the data will be evaluated for the presence of 1,2-diphenylhydrazine and benzidine. If determined to be present, those samples will be quantitatively analyzed for these two compounds. Information about sample handling, preservation and hold times is included in Table A-8.

### *Groundwater Sampling - Low Flow Purging and Sampling Using Submersible Pump*

### *Equipment*

Groundwater sampling equipment will be constructed of inert materials such as stainless steel or Teflon. Proper equipment decontamination procedures will be followed to minimize the potential for cross-contamination. The following equipment may be required:

- Grundfos Redi-Flow II submersible pump (or equivalent);
- Teflon-lined polyethylene tubing (recommended for low flow purge and sampling technique);
- Latex and/or nitrile gloves;
- Generator;
- 55-gallon drums (to containerize water);
- Field Meter(s) capable of in-line measurements for pH, specific conductance, dissolved oxygen (DO), temperature, turbidity, and oxidation-reduction potential (ORP or Eh);
- Groundwater Sample Field Information Form/COC form;
- Sample bottles and preservatives;
- Cooler with ice;
- Water level meter; and,
- Sample location map.

### *Procedure*[1]

Prior to purging the monitoring well, a water level meter will be used to measure the depth from top of the well casing to the top of water surface to the nearest 0.01 feet. The water level meter will be cleaned prior to each measurement in accordance with the equipment decontamination procedures included in Section A.2.9. The depth to the bottom of the existing wells will be measured to confirm the construction details. In order to minimize potential cross-contamination and disturbance to sediments, which may have accumulated in the bottom of the well, well depth measurements will only be taken after the groundwater samples have been collected.

The monitoring wells will be purged and sampled with a stainless steel Grundfos Redi-Flo 2 submersible pump (or equivalent). The decontamination procedure for the submersible pump is described in Section A.2.9. The low flow purge and sampling procedures are described below.

- The submersible pump, with dedicated Teflon lined polyethylene tubing, will be carefully lowered into the well to the midpoint of the well screen or open interval. In instances where the screened or open interval is not completely saturated, the pump will be lowered to the midpoint of the saturated interval where possible. Care will be taken to collect representative samples by placing the pump adjacent to a water-bearing zone.

- Each well will be purged at a rate of between approximately 200 and 1000 milliliters per minute. The water level in the well will be monitored during pumping, and ideally the pumping rate should equal the well recharge rate with little or no water level drawdown in the well. Best efforts should be made in order to minimize well drawdown by adjusting the flow when necessary and frequently monitoring the water level during purging. There will be at least 1 foot of water over the pump intake so there is no risk of the pump suction being broken, or entrainment of air in the sample. Record the pumping rate adjustments and depth(s) to water in the logbook.

- During purging, monitor the field parameters (temperature, pH, turbidity, specific conductance, oxidation-reduction potential (ORP), and dissolved oxygen (DO)) with a Horiba U-20 instrument (or equivalent) approximately every 5 minutes until the parameters have stabilized. Stabilization is considered achieved if pH is within +/- 0.1, conductivity is within 3%, temperature is within ±0.5 degrees, ORP is within 10 mV, turbidity is within 10% (or is less than 50 NTU), and DO is within 10% (or within 0.1 mg/l when the DO is less than 1 mg/l), over three consecutive readings. Readings will be taken in a clean container, rinsed with distilled water prior to each use, and the monitoring instrument allowed to stabilize before collection of the next sample. The Horiba instrument takes the readings consecutively and therefore the process to record all the measurements may take longer than 5 minutes. If so, measurements will be taken as often as practicable. Measurements will be taken with a flow-through cell so that they are recorded prior to the sample being exposed to the atmosphere. All measurements will be recorded in field notebooks.

- The pump flow rate will be reduced to approximately 100 milliliters per minute during collection of samples for VOCs and appropriate gas-sensitive parameters and as high as approximately 500 milliliters per minute for other parameters depending on the well yield and turbidity of the sample. Once the field parameters have stabilized, record the final measurements and collect the samples directly from the end of the tubing. Samples for VOC and appropriate gas sensitive parameters must be collected first. The bottles will be preserved according to the specifications in the Section A.2.11.2. All sample bottles will be filled by allowing the pump discharge to flow gently down the inside of the bottle with minimal turbulence. Cap each bottle as it is filled. For VOCs and appropriate gas-sensitive parameters, steps will be taken to eliminate headspace in the 40-milliliter (ml) vial. Such

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[1] The procedures to be used for sampling monitoring wells are based upon the USEPA Region II document entitled "Groundwater Sampling Procedure Low Stress Purging and Sampling" dated March 16, 1998.

steps may include adding several drops of the sample to the cap before screwing on and inverting the vial once it has been filled to check for air bubbles.

- Immediately after sample collection, sample bottles will be placed on ice and maintained at approximately 4° Celsius (C). Further information on sample handling is included in Section A.2.11.

- The following information will be recorded in the Groundwater Sample Field Information Form (Figure A-3) for each monitoring well sampled:

  - Before Purging:
    - Date, time, and weather conditions;
    - Well ID;
    - PID readings taken from the well immediately after the cap is removed; and,
    - Depth to water.

  - Purging:
    - Start and end time for purging;
    - Purge method;
    - Purge rate;
    - Depth to water; and,
    - pH, ORP, temperature, specific conductance, turbidity and dissolved oxygen (every 5 minutes).

  - Sampling:
    - Start and end time for sampling;
    - Sampling method; and,
    - Pertinent observations regarding sample characteristics (turbidity, color, etc.).

- Quality-Control samples will be used to monitor sampling and laboratory performance and will include duplicates, spikes, and blanks. Quality control and quality assurance (QA/QC) procedures are described in Section 2.13.

### A.2.6.1.2 Residential Well Sampling

This section discusses the sample collection procedures to be employed and the equipment needed for collecting groundwater samples from the Office well and on-Site residential well. Since the on-Site residence is unoccupied, sampling techniques described in Section A.2.6.1.1 may be utilized if the existing well is not operable (i.e., a pump or electrical connection is not present).

***Equipment***

The following equipment may be required for residential well purging and ground water sampling:

- Garden hose;
- latex and/or nitrile gloves;
- pH/Conductivity/Temperature/Turbidity meter;
- Groundwater Sample Field Information Form/COC form;
- Sample bottles and preservatives; and
- Cooler with ice.

***Sampling Methodology***

Before sampling, residential wells will be purged a minimum of 10 minutes. This can be done directly at an indoor tap or by connecting a garden hose to an outside tap. Throughout the purging process field parameters will be monitored and recorded. The sampling tap should be located near the pressure tank and holding tank and before any treatment processes to ensure an untreated and representative sample. Any garden hose shall be removed from the spigot prior to sample collection. Sample bottles can be filled directly from the tap and should be immediately placed in a cooler with wet ice or frozen blue ice packs and completed COC form. The samples must be maintained at approximately 4° C after collection.

### A.2.6.2 Surface Water and Sediment Sampling

Surface water and sediment samples will be collected to determine if site contaminants have impacted these media. Sediment and surface water samples will be co-located and will be collected as follows:

- One location upstream of the Site;
- One location in the wetland area at the western end of the Site;
- One location 1,600 feet south of the Site in Pump Branch Creek; and,
- One location 2,000 feet south of the Site in Pump Branch Creek.

Surface water samples will be collected from each of these locations, if present. These samples will be analyzed for TCL/TAL, Total Suspended Solids and Hardness as indicated in Tables A-2, A-3, and A-8. Additionally, the data will be evaluated for the presence of 1,2-diphenylhydrazine and benzidine. If determined to be present, those samples will be quantitatively analyzed for these two compounds.

Two sediment samples will be collected from each location. The first sample will be collected from a depth of 6 inches below surface and the second from 18 to 24 inches below surface. Each sediment sample will be analyzed for TCL/TAL analytes as shown on Table A-7. Additionally, the data will be evaluated for the presence of 1,2-diphenylhydrazine and benzidine. If determined to be present, those samples will be quantitatively analyzed for these two compounds. In addition, all of the samples will be analyzed for Total Organic Carbon (TOC) using USEPA SW846 method 9060. and Grain Size using ASTM D-422.

### A.2.6.2.1 Surface Water

The surface water sampling techniques and equipment presented below are designed to minimize effects on the chemical and physical integrity of the sample. The guidance provided in this section is designed to allow collection of surface water representative samples.

#### *Surface Water Sampling Equipment*

The physical location of the person collecting a surface water sample may dictate the equipment to be used. During surface water sample collection, all attempts will be made to collect the sample by direct dipping of the sample container into the stream. In order to collect the sample in this manner, wading may be necessary. Wading, however, may cause the re-suspension of bottom deposits and bias the sample results. Wading is acceptable only if Pump Branch Creek has a noticeable current (i.e., is not impounded), and the samples are collected while facing upstream. The following equipment may be required for collection of surface water samples:

- 100 ml glass beaker or other sample transfer vessel;
- Waders;
- Latex and/or nitrile gloves;
- Flow meter;
- Field Meter(s) capable of measuring pH, specific conductance, dissolved oxygen, temperature, turbidity, and oxidation-reduction potential;
- Sample Collection form/COC form;
- Sample bottles and preservatives; and,
- Cooler with ice.

#### *Sampling Procedure*

A sample may be collected directly into the sample container when the surface water source is accessible by wading or other means. The sampler should face upstream and collect the sample without disturbing the sediment. The sampler should be careful not to displace the preservative from a pre-preserved sample container such as the 40-ml VOC vial. For pre-preserved sample bottles like the VOC vial, it may be helpful to have a sample transfer bottle or a stainless steel scoop or beaker to prevent loss of preservative and to ensure zero head space. All sample transfer vessels will be will be decontaminated as described in Section A.2.9 prior to sample collection.

Immediately after sample collection, sample bottles must be placed in a cooler with wet ice or frozen blue ice packs and completed COC form. The samples must be maintained at approximately 4°C after collection. Further information on sample handling is included in Section A.2.11. Prior to or immediately subsequent to sample collection, field measurements for flow, pH, specific conductance, dissolved oxygen, turbidity, ORP, and temperature should be recorded on the Sample Collection form.

### A.2.6.2.2 Sediment

Sediment sampling techniques and equipment presented below are designed to maintain the chemical and physical integrity of the sample.

***Equipment***

The following equipment may be required for collection of sediment samples:

- 5 gallon buckets;
- Stainless steel hand auger or other coring device;
- Stainless steel scoop and/or trowel;
- Stainless steel bowl;
- Waders;
- Latex and/or nitrile gloves;
- Sample Collection form/COC form;
- Sample bottles and preservatives; and,
- Cooler with ice.

***Sampling Procedure***

Sediment samples will be collected after collection of surface water samples. The physical location of the sampling point and nature of the substrate may dictate the type of sampling equipment that will be used. Sediment sample collection may be performed by excavating a sample using stainless steel hand auger or similar soil coring device or a stainless steel scoop. At locations with shallow water, a PVC bucket with the bottom removed may be used to temporarily isolate the sediment sample extraction area from the flowing surface water to minimize the loss of fines. Prior to conducting field activities, all sampling equipment will be decontaminated as described in Section A.2.9. For each sample, multiple sediment cores may be needed due to sample volume requirements of the laboratory. If so, then the sediment cores will all be collected from the same location and homogenized after collection of the VOC aliquot. The sediment cores will be homogenized by quartering and mixing in a stainless steel bowl with a stainless steel scoop prior to transfer to sample jars. The sample glassware will be filled completely. Any sediment that remains after the jars have been filled will be returned to the location where the sample was collected. Homogenization procedures are described in more detail in Section A.2.7.2.2. Immediately after sample collection, sample bottles must be placed in a cooler with wet ice or frozen blue ice packs and completed COC form. The samples must be maintained at approximately 4° C after collection. Further information on sample handling is included in Section A.2.11.

### A.2.7 Soil Sampling

Soil sampling may be accomplished in a number of ways. It is our intention to use a truck-mounted GeoProbe® rig using collection of soil samples. However, if access is a problem soil samples may be collected using a stainless steel hand-auger. This methodology will not be described in detail. A hand auger rather than a GeoProbe® rod is used to advance a boring to specified depths and soil is collected from the auger at required depths. Other QA requirements for sampling would be the same as for the GeoProbe® method described below.

### A.2.7.1 Soil Borings and Soil Sampling

Soil borings will be advanced at selected locations using a truck-mounted GeoProbe® rig. A 48-inch long, 2-inch diameter carbon steel split spoon will be advanced such that a continuous record of soil conditions can be obtained. All borings will be advanced to the groundwater surface. The soil samples will be classified using the Unified Soil Classification System (USCS) and a representative sample will be retained from each different soil horizon.

A core of soil from the desired depth, wrapped in a plastic sheath from GeoProbe®, will be removed from the ground and split open using a decontaminated, stainless steel knife. All recovered soil cores will be field screened using a PID by slightly scoring the surface of soil core with a stainless steel knife and immediately running the PID probe along the scored section of the core. Shallow soil samples will be collected for laboratory analysis from the top 2 feet of soil (non-VOCs from 0 inch to 6 inch interval and VOCs from 6-inch to 24-inch interval) while deep samples will be collected below 2 feet to the water table from the 6-inch interval(s) exhibiting the highest reading on the PID and based on visual indicators of contamination (i.e., staining). If there are no indications of contamination, the samples will be collected from the 5 feet to 6 feet interval. Field screening shall be performed at a location shielded from the wind. Each soil sample will be collected from the designated interval using standard surface soil sampling techniques (e.g., EnCore® sampler, as described in Section A.2.7.2.1. Each soil sample will be analyzed for TCL/TAL analytes as shown on Table A-7. Additionally, the data will be evaluated for the presence of 1,2-diphenylhydrazine and benzidine. If determined to be present, those samples will be quantitatively analyzed for these two compounds. In addition, all of the samples will be analyzed for Total Organic Carbon (TOC) using USEPA SW846 method 9060. Ten percent (10%) of the sample boring locations will be analyzed for Grain Size using ASTM D-422 (approximately 4 samples). Table A-9 provides information regarding sample collection requirements and holding times.

There are 9 borings from which only shallow samples will be collected for risk assessment purposes. These samples will be collected from a 0-1 foot depth and will be analyzed for TCL/TAL analytes and TOC and evaluated for 1,2-diphenylhydrazine and benzidine as described above.

### A.2.7.2 Soil Sampling Procedures

#### A.2.7.2.1 EnCore® Sampling Methodology for VOCs

This section describes the equipment and procedures that will be used to collect soil samples for TCL-VOC analysis. This method is based upon EPA SW846 Method 5035. The samples will be analyzed for VOCs via CLP SOW OLM04.2 as specified in the AOC.

***Equipment***

- PID;
- Latex and/or nitrile gloves;
- Field Notebook;
- COC form;
- Stainless steel knife;
- EnCore® samplers and T-handle;
- Paper toweling;
- Temperature blank; and
- Cooler with ice.

***Sampling Methodology***

Remove an individual EnCore® sampler from the wrapper and attach to the T-handle. Take care to make sure that the sampler body has been securely fastened to the hollow portion of the T-handle. A "click" can be heard when the sampler has been properly placed. Remove the cap if it is attached to the body. At the desired interval of the soil sample core (either split-spoon or GeoProbe® sleeve) selected (previously identified through field screening), quickly push the sampler into a portion of freshly exposed soil. Make sure that the sampler is full, but is not overfilled so as to prevent the cap from fitting properly. Use paper toweling to wipe off any excess soil that may have accumulated on the sides of the sampler. Put the cap over the sampler and twist to fasten cap to the body of the sampler. Fill out label and place on wrapper. Re-insert the sampler into the wrapper and seal. Immediately insert into cooler with ice. Four 5-gram EnCore® samplers will be collected for each sample location. Additional EnCore® samplers will be used for collection of QC samples. All samplers will be kept at 4° C. A laboratory-supplied temperature blank will be included in each cooler so that the laboratory can perform a temperature check upon receipt. If VOCs are the only parameters of interest and assuming that there is enough material, additional soil will be collected in a small jar and submitted to the laboratory for the determination of percent solids. If this is necessary, a minimum of 10 grams of soil will be placed into a jar and shipped along with the EnCore® samplers to the laboratory.

The unpreserved EnCore® samples will be shipped cool (4°C) and must reach the laboratory preferably within 24 hours but no later than 48 hours of sample collection. Without additional preservations (such as sodium bisulfate or methanol) the samples obtained with the EnCore® sampler have holding times of 48 hours from sample collection. The laboratory will preserve the samples upon receipt with sodium bisulfate and methanol. The resulting maximum holding time for the preserved sample is 14 days. The laboratory will utilize the sodium bisulfate preserved samples in order to achieve low level reporting limits. One EnCore® for each sample may be preserved with methanol in case a dilution analysis is warranted due to potential elevated concentration of target analytes. Since certain types of soil may effervesce with the use of sodium bisulfate the soil will be checked prior to being placed in sodium bisulfate. Should effervescence occur, the soil will be placed in lab-deionized water and an attempt made to analyze the sample within 48 hours of sample collection.

#### A.2.7.2.2 Soil Sampling for Parameters Other Than VOCs

The following sections describe the equipment and procedures that will be used to collect soil samples that will be analyzed for parameters other than TCL-VOCs.

***Equipment***

- PID;
- latex and/or nitrile gloves;
- COC form;
- Field notebook
- Stainless steel knife;
- Stainless steel mixing bowls and spoons;
- Appropriate sample bottles;
- Temperature blank; and
- Cooler with ice.

For samples being analyzed for TCL SVOCs, Pesticides, and PCBs, TAL metals and cyanide, and TOC, a core of soil from the desired depth, wrapped in a plastic sheath from GeoProbe®, will be removed from the ground and split open using a decontaminated, stainless steel knife. Soil will be collected for non-VOC parameters using a decontaminated stainless steel spoon and will be placed into a decontaminated stainless steel mixing bowl and homogenized. Care will be taken to ensure that the soil samples are collected from areas that have not been in contact with the plastic sheath.

Homogenization of the soil will be performed in the stainless steel mixing bowl. Large rocks, twigs, roots, and leaves will be removed. The soil will be homogenized with a decontaminated stainless steel spoon according to the procedure below:

- The sample will be scraped from the sides, bottom, and any corners of the bowl and rolled into the middle of the mass using the stainless steel spoon.
- The mass of the sample will be mixed thoroughly. The sample will then be divided into four quarters, which will be moved to separate parts of the bowl. Each quarter will be individually mixed. Then the four quarters will be recombined and the entire sample mass mixed again.
- Sample jars for non-VOC parameters will be filled following homogenization.

Required amounts of sample are listed in Table A-9. The appropriate amount of soil for each parameter will be placed into sampling jars. The jars will then be labeled and put into a cooler with ice. All samples will be stored and shipped at 4° C. A laboratory-supplied temperature blank will be included in each cooler so that the laboratory can perform a temperature check upon receipt.

For samples being analyzed for grain-size, a sufficient volume of samples will be placed in a large labeled zip-lock bag and sent to Golder Associates' soils laboratory in Cherry Hill, New Jersey. No refrigeration or other special handling/preservation procedures are required.

### A.2.8 Field Measurement Procedures

The following sections describe procedures to be followed for collection of field measurements.

#### A.2.8.1 Water Level Measurements

Groundwater level measurements will be collected prior to purging the well and during the low flow purge process to monitor well drawdown.

*Equipment*

The following equipment and materials are required to perform this procedure:

- Electronic water level meter;
- Distilled or de-ionized water;
- Groundwater Sample Groundwater Sample Field Information Form; and,
- Field notebook.

*Water Level Measurement Procedure*

The well identification number, measuring device type and serial number, date and time will be recorded prior to each day water level measurement are obtained. The water level meter will be decontaminated in accordance with the procedures described in Section A.2.9 prior to each use. The water level meter will be turned on and the battery checked prior to each water level measurement. The wire will be lowered into the monitoring well and stopped at the depth where the meter indicates a completed circuit. Depth to water measurements will be made relative to an established surveyed reference point on the well casing and recorded to the nearest 0.01 foot.

*Total Well Depth Measurement Procedures*

The bell sounder, weighted tape, or electronic water level indicators can be used to determine the total well depth. This is accomplished by lowering the tape or cable until the weighted end is felt resting on the bottom of the well. Because of tape buoyancy and weight effects encountered in deep wells with long water columns, it may be difficult to determine when the tape end is touching the bottom of the well. Care must be taken in these situations to ensure accurate measurements. Total well depth measurements will be made relative to an established reference point on the well casing and recorded to the nearest 0.1 foot. In all instances, the instrument used to measure well depth should be decontaminated prior to and after use in accordance with the procedures outlined in Section A.2.9.

### A.2.8.2 Field Parameter Measurements

This procedure should be used to obtain representative groundwater field parameters measurements of temperature, specific conductance, pH, ORP, turbidity, and DO.

***Equipment***

The following equipment and materials are required to perform this procedure:

- An in-line, flow through sampling chamber;
- Calibration Standards;
- An instrument capable of measuring temperature, specific conductance, pH, ORP, turbidity, and DO;
- Groundwater Sample Groundwater Sample Field Information Form; and,
- Field notebook.

***Procedure***

All field measurements should be made where they are shielded from the wind and direct sunlight (if possible), away from electrical systems, motors, pumps, wires, etc. which might induce stray electrical currents in the instrument or its probe, and with the probe and calibration standards temperature equilibrated with the water to be tested. Samples for field measurements should never be filtered or preserved.

After the meter has been calibrated according to manufacturer specifications and Section A.2.15, sample measurements can be taken. Place the container to be used as the sampling chamber in line before purging of the well begins. For groundwater samples collected using low flow purge technique, insert the instrument/probe into a flow-through cell. Position the instrument/probe so that it will measure the influent sample to the chamber. Record field parameter measurements, date, time, volume of water removed, and flow rate at uniform increments of approximately 5 minutes.

- Temperature should be recorded to the nearest 0.1 degrees Celsius;

- Specific conductance units are measured in micromhos per centimeter (μmohs/cm) or microsiemens (μS/cm) corrected for 25°C. Results should be reported to the nearest ten (10) units for readings below 1,000 μmohs/cm @ 25°C and to the nearest one hundred (100) units for reading above 1,000 μmohs/cm @ 25°C;

- pH measurements will be recorded to the nearest 0.1 standard pH units (SU);

- Turbidity measurements will be recorded to the nearest whole number nephelometric turbidity units (NTUs);

- DO measurements will be recorded to the nearest 0.1 milligrams per liter (mg/l); and

- ORP measurements will be recorded to the nearest 0.1 millivolts (mV).

### A.2.9 Decontamination

Decontamination procedures in this section are intended for use by field personnel for cleaning sampling, drilling and other equipment in the field. Deviations from these procedures should be documented in the field records and investigative reports. Specifications for standard decontamination materials follow. These materials will be used, as appropriate, for non-dedicated equipment used during sample collection (e.g., stainless steel bowls, spoon, knife).

- Soap shall be a phosphate-free laboratory detergent such as Liquinox® or Alconox.® Use of other detergent must be documented in the field logbooks and investigative reports.

- Solvent shall be pesticide-grade isopropanol. Use of a solvent other than pesticide-grade isopropanol for equipment cleaning purposes must be justified and documented in field logbooks and investigation reports.

- Tap water may be used from any municipal water treatment system. Use of an untreated potable water supply is not an acceptable substitute for tap water.

- Deionized water is tap water that has been run through a standard deionizing resin column. It is commercially available.

- Distilled water is tap water that has been distilled. It is commercially available.

- Analyte free water is tap water that has been treated with activated carbon and a standard deionizing resin column. At a minimum, the finished water should contain no constituents above the laboratory reporting limits that are being analyzed for as part of the remedial investigation.

- Other solvents may be substituted for a particular purpose if required. For example, removal of concentrated waste materials may require the use of either pesticide-grade hexane or petroleum ether. After the waste material is removed, the equipment must be subjected to the standard cleaning procedure. Because these solvents are not miscible with water, the equipment must be completely dry prior to use.

Solvents, laboratory detergent, and rinse waters used to clean equipment shall not be reused during field decontamination and shall be stored in DOT-approved 55-gallon drums. These materials will be treated as investigation derived waste (IDW). See Section A.2.9.3 for proper handling and disposal of these materials.

### A.2.9.1 Drilling Equipment

The procedures in this section are to be used for all non-dedicated drilling equipment. All decontamination procedures in this section will be performed on a decontamination pad, constructed to the specifications in this section.

#### *Decontamination Pad Specifications*

Decontamination pads constructed for field cleaning of sampling and drilling equipment should meet the following minimum specifications:

- The pad should be constructed in an area known or believed to be free of surface contamination.
- Ideally, the pad should be located very close to a potable water source.
- The pad should not leak excessively.
- If possible, the pad should be constructed on a level, paved surface and should facilitate the removal of wastewater. This may be accomplished by either constructing the pad with one corner lower than the rest, or by creating a sump or pit in one corner or along one side. Any sump or pit should also be lined.
- Water should be removed from the decontamination pad as needed.
- A temporary pad should be lined with a water impermeable material. This material should be either easily replaced (disposable) or repairable.

At the completion of site activities, the decontamination pad should be deactivated. The pit or sump should be backfilled with the appropriate material designated by the site project field leader. No solvent rinsates will be placed on the pad. Solvent rinsates should be collected in separate containers for proper disposal.

*Decontamination Procedures*

1. Clean with tap water and soap using a brush to remove obvious particulate matter and surface films;
2. Rinse thoroughly and power wash with tap water; and,
3. Rinse non-dedicated equipment that might contact samples with distilled water. If distilled water is not available, equipment should be allowed to completely dry.

### A.2.9.2 Sampling Equipment

The procedures in this section are to be used for all non-dedicated sampling equipment used to collect groundwater or for collection/homogenization of soil samples.

1. Clean with tap water and soap using a brush to remove obvious particulate matter and surface films;
2. Rinse thoroughly with tap water;
3. If sampling for inorganic constituents rinse equipment with a 10% nitric acid solution (nitric acid is not to be run through the Grundfos pump);
4. Rinse thoroughly with deionized or distilled water;
5. Rinse thoroughly with solvent (pesticide-grade isopropanol) unless made of PVC or plastic. These items are not to be solvent rinsed;
6. Rinse thoroughly with analyte free water. If analyte free water is not available, equipment should be allowed to completely dry;
7. Equipment should be wrapped in aluminum foil until needed for sampling. If possible please allow equipment to air dry before wrapping in aluminum.

#### A.2.9.2.1 Groundwater Sampling Equipment (Non-Dedicated Submersible Pump)

Non-dedicated groundwater sampling equipment used for the low flow purging and sampling technique (such as the submersible pump) will be decontaminated prior to sampling each well. The submersible pump will not be removed from the well between purging and sampling operations. The pump and tubing (including support cable and electrical wires that are in contact with the sample) will be decontaminated by the procedure described below. It should be noted that the outside of the pump will be decontaminated consistent with the procedure in Section A.2.9. In addition, decontamination fluids will be pumped from buckets through the pump as follows:

1. Flush the pump with tap water to remove any sediment that may be trapped in the pump;
2. Flush the pump with a weak, non-phosphate detergent solution (approximately 5 gallons);
3. Flush the pump with tap water to remove all the detergent solution. Generous amounts of tap water (at least 3 pump volumes) should be used to ensure that detergent and any sediment that may be trapped in the pump does not remain in the pump;
4. Flush the pump with deionized or distilled water;
5. Flush the pump with isopropyl alcohol. Use sparingly to minimize presence of this decontamination fluid in the samples; and,
6. Flush the pump with analyte free water. Generous amounts of water (at least three pump volumes) should be used to remove as much of the isopropyl alcohol as practical.

#### A.2.9.2.2 pH, ORP, Temperature, Specific Conductance, Dissolved Oxygen, Turbidity, Depth to Water Probes, and Total Well Depth Recorders

All pH, ORP, temperature, specific conductance, DO, turbidity, and depth to water probes will be rinsed thoroughly with distilled or deionized water prior to each use.

### A.2.9.3 Investigation Derived Waste

IDW generated during remedial investigation field activities include: soil, decontamination water and solvent, purge water, well development water, and PPE. Each type of IDW will be handled as described below:

***Soil:***

- All excess soil generated from sampling and drilling activities will be retained in 55-gallon drums and labeled as “Drill Cuttings” or placed in an appropriately sized, lined, roll-off container. Once a drum has been filled, it will be sealed, dated, and numbered, and recorded in the Field notebook.

*Water:*

- All decontamination, purge, and well development water will be retained in 55-gallon drums and labeled or placed in an appropriately sized container. Once a drum has been filled, it will be sealed, dated, and numbered, and recorded in the Field notebook.

*PPE:*

- All PPE generated during the remedial investigation will be retained in containers and labeled "PPE". Once a drum has been filled, it will be sealed, dated and numbered, and recorded in the Field notebook.

The drums will be staged on-Site. At the end of the field activities, IDW will be disposed of in accordance with all applicable state and federal regulations.

### A.2.10 Field Documentation

In order to ensure that all pertinent information and data collected during the performance evaluation are documented completely and correctly, the following procedures and protocols described in the following sections will be implemented.

#### A.2.10.1 Field Notebooks

All information pertinent to the field investigation will be recorded in bound and numbered field notebooks. All field notes must be legible. Any errors should be crossed out with a single line and initialed. Each team member will be assigned an individual notebook. Field records should at a minimum contain the following information:

- Date;
- Project or site name;
- Time of each data entry;
- Description of work being performed that day;
- Names and affiliations of personnel at location;
- Weather conditions on site;
- Location and type of activity;
- Visual observations;
- Pertinent field data (and any other measurements);
- Serial numbers, if any, on seals, and transportation cases, and equipment;
- Name of field custodian; and,
- Photographs taken, including date, time, direction faced, description of subject or activity, sequential number of the photo and film roll number will be recorded in the field notebook.

Specific sample information will be compiled into the field notebook and/or COC. All field notebooks will be standard engineering hardbound books. All field notebooks will be photocopied so that copies of field notes can be kept in appropriate project files.

### A.2.10.2 Field Meters

Calibration of field meters should be documented including:

- Analysts' name;
- Date and time of calibration;
- Date and time and results of calibration checks;
- Instrument type, model number, and serial number ( if present); and,
- Manufacturer, concentration, and lot number of calibration standards which are used.

### A.2.10.3 Photo-Documentation

When photographs are taken, field personnel will record time, date, site location, general direction faced, sequential number of photograph and roll number, and brief description of the subject in a field notebook. This information will be transcribed onto the back of the photographs after they have been developed.

### A.2.10.4 Correspondence/Communications

Correspondence received or sent from the field will be dated and labeled with a project filing identification number. Telephone conversations will be documented and filed.

### A.2.10.5 Changes in Procedures

Approval from the USEPA Remedial Project Manager will be obtained as needed prior to implementation for major changes in sampling procedures as outlined in this SAP. Minor procedural changes will be made by Golder Associates' personnel, and if present, with the concurrence of the on-site USEPA representative. Changes will be documented in the field notebooks.

## A.2.11 Sample Handling and Custody Requirements

### A.2.11.1 Sample Handling

The methods and references for collecting samples are previously provided in this section. The laboratory supplies appropriately prepared sample containers, reagents, preservation procedures and analytical holding times will be in accordance with the published analytical methods and USEPA Region II guidelines.

### A.2.11.2 Sample Preservation

The specific requirements for sample container preparation, sample preservation, and holding times, and any special sample handling requirements are listed in Tables A-8 and A-9. Sample containers will be kept closed until the time each set of sample containers are to be filled. After filling, the containers will be securely closed, residue wiped from the sides of the containers, and immediately placed in a cooler. Samples will be kept chilled and will generally be shipped on the day of sample collection to the laboratory if an overnight courier is being used. The following procedure should be followed to preserve environmental samples for laboratory analysis such that the integrity of the sample is maintained prior to analysis to the extent possible.

#### A.2.11.2.1 Equipment

The following equipment and materials are required for sample preservation:

- Frozen blue packs or wet ice;
- Zip locked bags;
- Temperature blank;
- Spare sample bottles;
- Several eye droppers (if bottles are not pre-preserved);
- pH test strip paper; and,
- Appropriate preservatives (i.e., HCl, $HNO_3$, NaOH, etc.).

#### A.2.11.2.2 Procedure

Sample preservation requirements are given for aqueous and soil samples in Tables A-8 and A-9. For aqueous samples, be certain that the proper chemical preservative is added to each jar. In general, the only preservation procedure required for soil samples is cooling to 4°C immediately after collection. This temperature should be maintained for both aqueous and soil samples during storage and shipment to the laboratory. Samples collected for TCL VOC analysis using EnCore$^{(TM)}$ samplers will be preserved by the laboratory upon receipt in accordance with SW846 5035.

### *VOC Sample Preservation*

- An extra aqueous VOC sample vial should be filled at each sample location to be used as a pH check. The preservation procedure for aqueous VOC samples is given below, *if vials are not already pre-preserved*:

  - ◊ The extra sample vial will be used to determine the number of drops of HCl required to attain a pH less than 2;
  - ◊ Initially, six drops of HCl should be added;
  - ◊ The vial cap should be replaced and the vial inverted several times to mix the sample;
  - ◊ The cap should be removed and a pH indicator strip dipped into the vial;
  - ◊ The color of the strip should be compared to the color chart provided with the strips;
  - ◊ Repeat the above procedure until a pH less than 2 has been attained. HCl should be ~~added one drop at a time;~~
  - ◊ Discard the test vial, and carefully add the same number of drops of acid to the other sample vials;
  - ◊ Fill the vial with sample and place the cap such that no headspace is present in the vial;
  - ◊ If the sample effervesces upon addition of the acid, the sample should be submitted to the laboratory without the addition of HCl, but it should be cooled to 4°C. The lack of preservative, and the consequent 7 day technical holding time, should be specified in the comments section of the COC;
  - ◊ If the behavior of the samples at specific locations is known, then pre-preserved VOC vials may be used for sample collection; and
  - ◊ If the pH of the samples is >2 for samples collected in pre-preserved VOC vials, the consequent 7 day technical holding time should be specified in the comments section of the COC along with a note about inadequate preservation.

### *Non-VOC Sampling Preservation*

- Non-VOC aqueous samples should also be checked to assess the required amount of chemical preservation to attain the pH specified in Table A-8.

- Separate sample bottles are not required to check pH because non-VOC sample bottles are permitted to contain headspace. The preservation procedure is given below *if bottles are not already pre-preserved.*

  - ◊ Initially, four drops of preservative should be added;
  - ◊ The cap should be replace and the bottle inverted several times to mix the sample;
  - ◊ A few milliliters of sample should be poured into a separate container (e.g., an unused sample jar cap) and the pH checked using indicator paper;
  - ◊ Additional preservative should be added two drops at a time and the above procedure repeated until the specified pH is attained; and,

◊ After some of the initial samples have been preserved, the sampler can increase the initial number of drops added if necessary based upon the approximate amount of sample required for other locations.

### A.2.11.3 Sample Identification

All samples shall be adequately marked for identification from the time of collection and packaging through shipping and storage. Marking shall be on a sample label attached to the sample container. Sample identification shall include, as a minimum:

- Project name and/or code;
- Sample identification number;
- Analysis requested;
- Chemical preservatives added to the sample container;
- Sample date and time; and,
- Initials of the individual performing the sampling (samples for chemical analysis).

Each sample will be assigned a unique sample identification number to be recorded on the sample label. Each sample identification number will be recorded in the field notebook a Groundwater Sample Groundwater Sample Field Information Form and, as applicable, on chain-of-custody documentation. Designations for sample identification numbers for this project are described below.

***Equipment***

- Water proof marking pen;
- Sample jar labels;
- Transparent tape; and,
- Site base map with designated sampling locations.

***Procedure***

Sample labels should be marked with the sample ID, the analytes to be tested, the initials of the sampler, and the date of sample collection. The labels should be affixed to the sample jars (or EnCore® resealable bags) and if necessary secured with tape. The corresponding sample ID should be marked on the Site base map for correlation during report preparation.

During sample collection, a system for assignment of sample identification (ID) numbers will be used for new sampling points to distinguish between different media and different quality control samples. Samples from soil borings will have a suffix indicating the bottom depth interval from which the sample was collected.

For primary samples, the two characters will indicate the matrix of the sample as follows:

| | |
|---|---|
| SB | Subsurface Soil sample from a soil boring or well boring; |
| SS | Surficial Soil sample from a soil boring or well boring; |
| GW | Groundwater; |
| SW | Surface Water; and, |
| SD | Sediment. |

For groundwater, the monitoring well ID will be used for the next portion of the ID (e.g., GWMW-10). The office supply well will be identified as GWOFFICE and the on-property residential well will be identified as GWRES. Groundwater samples will include a suffix that indicates the month and year of sample collection (e.g., 0802 for August 2002). Consequently, a unique sample ID for a groundwater sample during the RI would be GWMW-10-0802 or GWOFFICE-0802.

For soil, sediment and surface water samples, the third and fourth characters will be a sequential number starting at 01 and continuing until sampling is complete.

For soil and sediment samples, the fifth and sixth characters will indicate the bottom of the sample interval from which the sample was collected. In the case of the surficial soil samples, this will be 24 (to indicate the bottom of the 18-inch to 24-inch interval). In the case of the upper sediment samples, this will be 06 (to indicate the 0-inch to 6-inch interval).

For QC samples, the first digit indicates the type of QC sample, if applicable, as follows:

| | |
|---|---|
| T | trip blank; |
| R | rinsate blank; and |
| D | field duplicate. |

The second character will indicate the matrix as follows:

| | |
|---|---|
| W | Monitoring well or surface water |
| S | Soil or sediment |

The third and fourth character will be a sequential number starting at 01. Rinsate blanks will be identified as sequential numbers such as RS01 (soil borings) or RW01 (groundwater samples). Trip blanks will only be collected for aqueous samples with IDs such as TW01.

Samples that are chosen for field duplicate analysis will have the same ID as the primary sample except that the prefix D will be used. Samples that are chosen for MS/MSD will be collected with triple volume, but the ID will remain the same as the primary sample. The sampler will note on the COC that triple volume was collected for QA/QC purposes.

### A.2.11.4 Sample Custody

Samples are physical evidence collected from a facility or the environment. Sample data generated during this project may be used as evidence in USEPA enforcement proceedings. In support of potential litigation, COC procedures have been established to ensure sample traceability from the time of collection through completion of analysis.

The National Enforcement Investigations Center (NEIC) of USEPA considers a sample to be in custody under the following conditions:

1. It is in your possession; or
2. It is in your view after being in your possession; or
3. It was in your possession and you locked it up; or
4. It is in a designated secure area.

#### A.2.11.4.1 Field Sample Custody

All environmental samples will be handled under strict COC procedures beginning in the field. Figure A-2 is an example COC. The following procedure should be used to maintain COC of environmental samples.

***Equipment***

The following equipment and materials are needed to perform COC procedures:

- Chain-of-custody forms;
- Chain-of-custody seals; and,
- A secure (locked) vehicle or building.

***Procedures***

COC is usually initiated in the field by the sampling team. When COC is initiated at the laboratory, the laboratory personnel responsible for shipping sampling containers will have initialed and signed the COC form and sealed the shipping container with a COC seal. It is preferable for the custody seal to be signed and dated by the laboratory and to have a unique serial number that is recorded on the COC by the lab. In such cases, field staff should check this information to assess the potential for tampering with sample containers prior to receipt in the field. The field staff should acknowledge receipt and container integrity by signing the COC form, and noting any discrepancies.

Samples and sample containers must be kept under proper COC during field sampling. If custody of the samples (and sample bottles) is exchanged during field sampling, such transfer must be documented on the COC form. The departing field staff should sign indicating the custody has been relinquished, and the arriving field staff should sign indicating responsibility for the custody of the samples. Each sample bottle label should include:

- Project (site) name;
- Sample point identification number;
- Chemical preservative added to the bottle;
- Sample collection date and time, sampler's initials; and
- Analytical method to be performed.

The COC form and Field notebook should include:

- Sample identification number and matrix;
- Project or site name or number;
- Sampler's name or initials;
- Sample collection date and time (military time);
- Designation as a grab or composite sample;
- Requested analysis;
- Any special comments (i.e. 7 day hold time for unpreserved VOCs); and,
- Any preservatives added to the sample.

When shipping samples to the laboratory, all sample bottles and requested analyses should be noted on the COC form. Where multiple analytical methods are available for a particular analysis, the specific method number should be listed on the COC form. For example, soil samples for TCL

VOC analysis could be performed by USEPA 8260, or CLP. The specific method should be referenced.

One member of the sampling team should sign the COC form relinquishing custody to the laboratory. If using an overnight courier service, record the tracking number on the COC. The COC form should be sealed inside the shipping container with the samples. The paperwork should be sealed inside a plastic bag to prevent damage from water condensation. The courier does not need to sign the COC form if it is sealed within the shipping container using custody seals. If the samples are hand delivered to the laboratory by field staff, the COC form should be signed at the laboratory when the samples are delivered and the shipping container does not need to be sealed as long as it is kept under proper COC until delivered to the laboratory. If possible, COC seals should be signed and dated, and the serial numbers listed on the COC form. At least two seals should be used on each shipping container.

#### A.2.11.4.2 Laboratory Custody

Once samples are transported to the analytical laboratory, custodial responsibility is transferred to the Laboratory Sample Manager to assure that the procedures presented in the laboratory's QAP and the appropriate analytical method are followed. The laboratory QAP will contain a detailed description of the laboratory chain-of-custody procedures, including receipt of samples, designation of a sample custodian, custody within the laboratory and laboratory storage, and disposal procedures. The laboratory chosen for this project will be furnished a copy of this SAP, which has been prepared in accordance with USEPA guidelines and specifications

### A.2.11.5 Sample Packaging and Shipment

The following procedure is to be used to enhance successful shipping of samples to the laboratory.

***Equipment***

The following equipment and materials are required to perform this procedure:

- Overnight courier airbills and courier phone number (if applicable);
- Fiber reinforced strapping tape or duct tape;
- Cushion material such as bubble wrap or vermiculite;
- Address labels; and,
- Laboratory address and phone number.

***Procedure***

Samples should be packed into a shipping container (usually a cooler) in a manner that will minimize potential breakage of sample bottles. This might include use of laboratory-supplied bubble wrap designed to fit the particular bottle, polystyrene chips, or vermiculite. If wet ice is used for preservation, make sure that it is securely placed in zip locked bags and cannot leak. If the bottles sit in standing water, the sample integrity may be compromised. The sample containers must contain enough frozen blue ice packs or wet ice to maintain a temperature of 4°C during transport to the laboratory. A temperature blank should be placed in each cooler being returned to the laboratory. Samples must be shipped to the laboratory within 24 hours of collection.

### A.2.12 Analytical Method Requirements

Most samples collected during this project will be analyzed by analytical methods from the following documents:

1. Contract Laboratory Program Statement of Work for Organics Analysis, OLM04.2;
2. Contract Laboratory Program Statement of Work for Inorganics Analysis, ILM04.1;
3. Test Methods for Evaluating Solid Waste - Physical/Chemical Methods, SW-846, Third Edition, November 1986; Update III, December 1996;
4. Methods for Chemical Analysis of Water and Wastes (EPA-600/4-79-020), USEPA, 1979, revised 1983;
5. Standard Methods for the Examination of Water and Wastewater, 18th Edition, 1992, APHA-AWWA-WPCF;
6. EPA Region II Contract Lab Program Organics Data Review and Preliminary Review, Standard Operating Procedures #HW-6, Revision 11;
7. Evaluation of Metals Data for the Contract Laboratory Program, Standard Operating Procedure #HW-2, Revision 11;
8. Annual Book of ASTM Standards, Volume 4.08, April 1999.

Method references for the analyses to be performed for this project are summarized in Tables A-3 and A-5. These chosen methods are deemed suitable for achieving the project DQOs. Information regarding the laboratory's equipment and capability in performing the analytical methodologies are contained in the laboratory QAP.

Historically, 1,2-diphenylhydrazine was detected in one or two groundwater samples collected from the Site. This compound is no longer one of the CLP target compounds and an alternate method for evaluating its presence in the samples from this project is needed. Additionally, USEPA has requested that the samples be evaluated for the presence of benzidine as this compound can be associated with 1,2-diphenylhydrazine and dye chemical waste materials. Like 1,2-diphenylhydrazine, benzidine is no longer one of the CLP target compounds.

The following analytical approach will be used for these compounds. Samples from this Site will be analyzed for SVOCs using CLP methods. The Tentatively Identified Compounds (TICs) will be reviewed for the presence of these two compounds. If either of these compounds is identified in the TIC search, the extracts will be analyzed using SW846 8270 run in the Selective Ion Monitoring (SIM) mode. The use of SIM will allow for better identification and sensitivity for quantitation. The laboratory will use calibration standards that include only the two compounds of interest and the associated surrogate and internal standards. In this manner, degradation of the standards should be minimized.

Precision, Accuracy, and Sensitivity (reporting levels) for these two compounds will be determined by performing a Method Detection Limit (MDL) Study and associated QC sample analysis. The laboratory will perform this study prior to any sample collection activities and the results will be provided to the USEPA. Consequently, Tables A-3 through A-7 cannot be completed for these two compounds at this time.

### A.2.13 Quality Control Requirements

This section describes the various QA/QC samples that will be collected in the field and analyzed in the laboratory and the frequency at which they will be performed. QA/QC samples which will be collected will consist of field blanks, field duplicates, and matrix spike/matrix spike duplicates (MS/MSD). These QA/QC samples are described briefly in the following sections.

### A.2.13.1 Trip Blanks

Trip blanks will be collected for VOC analysis at a frequency of one per day of sampling for aqueous VOCs. The trip blanks must be placed in each cooler containing VOCs. In order to avoid collection and analysis of an excessive number of QC samples, the sampling team should endeavor to pack all VOC vials in one cooler. Trip blanks are prepared in the field using laboratory supplied demonstrated analyte free water. The trip blank vials travel to the Site with the sample bottles. The trip blank vials are prepared each morning by the field crew and carried along while sampling, then submitted to the laboratory for analysis with the aqueous samples.

### A.2.13.2 Field Rinsate Blanks

Field rinsate blanks will be collected for all required analyses at a frequency of one per day per type of decontamination event where non-dedicated equipment is used. Field rinsate blanks are prepared in the field using lab supplied demonstrated analyte free water. The water is poured over and through each type of sampling equipment and submitted to the laboratory for analysis of target analytes.

### A.2.13.3 Field Duplicates

Field duplicates will be collected for all required analyses at a frequency of one per 20 primary samples per matrix. Field duplicates are collected by sampling the same location twice, but the field duplicate is assigned a unique sample identification number (see Section A.2.11.3).

### A.2.13.4 MS/MSD

MS/MSD samples will be collected for all required analyses at a frequency of one per 20 primary samples per matrix. Additional sample volume is collected from a location and submitted to the laboratory for analysis. The laboratory will use the additional volume to prepare spiked samples to assess accuracy and precision.

### A.2.13.5 Internal QC Samples

Internal QC checks have been developed to help ensure accuracy and precision during field sampling and measurement as well as laboratory analysis. Field checks will be performed regularly. Laboratory QC checks will be performed in accordance with the specific analytical methods.

Field measurements will be made in duplicate at a frequency of one in twenty measurements taken. These duplicate measurements should agree ±20 percent. If the duplicate measurements do not meet this criterion, the instrument will be recalibrated and the measurements will be retaken. All field measurements will be recorded in the field notebooks and later entered into summary tables.

The laboratory will have an established quality control check program utilizing procedural (method) blanks, laboratory control spikes, matrix spikes, and duplicates. Details of the internal QC checks utilized by the laboratory will be found in the laboratory QAP and the published analytical methods. Laboratory QC samples will be analyzed at a frequency of one per twenty analytical samples or at a frequency dictated by the methods. These QC samples will be used to determine if results may have been affected by field activities or procedures used in sample transportation or if matrix interferences are an issue. Assessment of laboratory QC will take into account the PARCC criteria specified for this project as shown in Tables A-3 through A-6. The individual methods and Section A.4 of this SAP discuss procedures to be used to calculate QC data.

Split samples may be accepted by a USEPA contractor during the project. These samples will be collected separately and analyzed by a laboratory other than the laboratory identified for this project at a later time. Comparison of the split sample results will demonstrate how well the results reported by two different laboratories are replicated. The comparison will be expressed in terms of precision using the relative percent difference calculations shown in Section A.4.

### A.2.14 Instrument/Equipment Testing, Inspection, and Maintenance Requirements

Preventive maintenance of equipment is essential if project resources are to be utilized in a cost-effective manner. Preventive maintenance will ensure accuracy of measurement systems, minimize downtime, and provide inventory control of critical spare parts, back up systems, and other necessary equipment. The field sampling team will maintain an inventory of replacement parts for field instruments, and will routinely perform preventive maintenance or repair. Spare parts that often require replacement will be kept on hand at the Site during field activities. The preventive maintenance approach for equipment used in field for sampling, monitoring, and testing includes checking batteries and electrodes, checking condition of meters, checking sample bottles for cleanliness and breakage, and ensuring that a reasonable supply of bottles, batteries, probes, calibration solution, and supplies are on-hand to avoid unnecessary delays in the field.

Preventive maintenance of laboratory equipment and hardware will be described in specific sections of the laboratory QAP. More than one instrument is generally available for each type of analysis in case the initial instrument malfunctions or does not meet the required measurement criteria. Laboratory personnel or qualified manufacturer representatives will perform preventive maintenance and repair. The laboratory will retain logbooks documenting preventative maintenance and repair for each instrument.

### A.2.15 Instrument Calibration and Frequency

### A.2.15.1 Field Calibration

The calibration and maintenance of field equipment will be the responsibility of the field sampling team. Field instruments, such as meters for measuring field parameters, will be standardized/calibrated in accordance with the manufacturers' recommendations against NBS traceable standards, where appropriate. During sampling, calibration checks will occur at a minimum of three times a day (beginning of each day and at least every four hours of operation with the final check at the end of the work shift). Duplicate field measurements will be performed at a frequency of once per twenty samples. Tables A-3 and A-5 provide precision criteria for field precision measurements. Appropriate calibration records will be maintained in project field notebooks or Groundwater Sample Field Information Forms. The field team leader is responsible for ensuring that calibrations are properly performed at the appropriate frequency.

### A.2.15.1.1 Photovac Microtip Photoionization Detector

A Photovac Microtip (or equivalent) will be used for screening soil samples collected during the soil boring program. The Photovac Microtip is a microprocessor controlled PID. The instrument normally operates with a 10.6 electron Volt (eV) lamp, however 8.4, 9.5, 10.2 and 11.7 eV lamps are available as options. The detector is capable of measuring concentrations down to about 1 ppm sensitivity for certain compounds. The results of the previous investigations indicate that the surface and subsurface soils contain various concentrations of TCL VOCs. These volatiles are a mixture of single and double-bonded compounds that have ionization potentials (IP) that range from 9.24 to 11.37. Since there were many aromatics and double-bonded chlorinated VOCs previously detected at the Site, a 10.6 eV lamp will be used on the PID as gross screen for VOCs since, most of the VOCs on this project have good responses to the 10.6 eV lamp. The PID cannot be used to identify unknown substances, it can only quantify/estimate VOC vapors. Winds and high humidity will affect measurement readings. Foggy or high humidity conditions can cause condensation on the lamp, thus affecting measurements.

*Operational Information*

Turn the instrument on by pressing the back of the power switch. The pump will start and the message "Warming up now, please wait" will be displayed. Within three minutes the following information will appear on the display:

| **Instrument Status**<br>**Ready** | **Current Detected**<br>**Concentration**<br>**2000 ppm** |
|---|---|
| 008<br>Event Number | 10:15 Feb 15<br>Time Date |

The Microtip then operates automatically. The user reads the concentration directly from the display. The display updates itself each half second. The minimum, maximum, and average concentrations measured in each 15-second period are automatically recorded in memory. The memory holds the last 12 hours of data. The concentration data can be retrieved from memory on the instrument's display or sent to a printer or computer in either tabular or a graphical format. Data are recorded by date, time, and by a user-entered event number. Data are played back by the user specifying a start and a stop event number.

The instrument must be calibrated against a dynamic standard in order to display concentrations in units equivalent to ppm. Clean outdoor air is suitable as Zero Gas. Isobutylene should be used as the calibration gas. The keypad is used to set up and calibrate the Microtip. Following is a description of the calibration procedure:

1. Press SETUP and check all display information. Select a Cal Memory (usually #1) with the arrow keys and press ENTER. Press EXIT to leave the Setup;

2. Press BATT and record battery voltage;

3. Press ALARM and set the alarm level to 5.0 and then press enter;

4. Press CAL and expose the instrument to Zero Gas. Press ENTER and the zero point is set;

5. The instrument then asks for the Span Gas concentration. Enter the known concentration from the span gas cylinder and press ENTER;
6. Assemble a calibration manifold;
7. Connect the span gas fitting to the sample inlet;
8. Press ENTER and the sensitivity is set; and,
9. When the display reverts to normal, the instrument is calibrated and ready for use.

#### A.2.15.1.2 pH/ ORP/Temperature/Conductivity/Turbidity/Dissolved Oxygen Meter

Calibration is performed in accordance with the manufacturer's specifications. Calibration is performed at the beginning of each day and checked at least every four hours during sampling. The following information is documented in the field notebook:

- Date and time;
- Meter identification (make, model, serial number);
- Calibration results including source and lot number of standards; and,
- Sampler's initials.

### A.2.15.2 Laboratory Calibration

Instrumentation calibration procedures are established in manufacturer's specifications and in the analytical methodologies. Trained personnel, using the approved written procedures, will perform instrument calibration. Calibration procedures and frequency will be described in the laboratory's QAP and in the specific analytical methodologies. These instruments include GC/MS, ICPs, analytical balances, syringes, thermometers, etc.

All sample results should be within the calibration range of the instrument. Samples which do not contain concentrations of target analytes that exceed the instrument calibration range should be analyzed undiluted to achieve the lowest possible reporting limits. However, samples containing elevated levels of target analytes cannot be analyzed undiluted because the calibration range of the method would be exceeded. Such samples will require analysis at dilutions which would result in elevated reporting limits.

The major chemical analytical equipment used for this project will be described in the laboratory QAP and the individual analytical methods. A laboratory QAP will provide information regarding types of equipment used by the laboratory facility. Calibration procedures will follow published analytical methodologies. The laboratory QAP will reference the specific methodologies or laboratory standard operating procedures (SOPs) for calibration procedures. The laboratory will document sources for calibration material; for example, USEPA repository, NBS, Supelco© or equivalent. The laboratory QAP will describe traceability of all stock solutions and working standards back to the neat materials. The laboratory QAP will also describe the procedures used to document equipment repair and maintenance.

### A.2.16 Inspection/Acceptance Requirements for Supplies and Consumables

All sampling equipment will be inspected prior to use to ensure proper operation and create a safe ~~working environment. The laboratory chosen for this~~ project will have preventative maintenance and health and safety programs to ensure proper execution of project work.

### A.2.17 Data Acquisition Measurements (non-direct measurements)

Non-direct means of data acquisition refers to the use of non-measurement sources such as computer databases, spreadsheets, programs and literature files. To ensure confidence in the data generated from these sources, computer programs used for this project will be within the public domain and, as such, accepted by the industry. Historical data generated from samples collected and analyzed with approved USEPA methodologies will be used to scope the elements of the RIWP. Only data that have been evaluated and/or validated or accepted into the project record by USEPA will be used to determine the nature and extent of contamination. Validated data will be accepted on their merit. Professional judgement must be used, however, as necessary and appropriate to disregard any of the data generated from previous sampling events.

Any literature references used to scope the RI must have been through the peer review process and/or have been published in periodicals commonly known to the environmental industry. References that have not been substantiated in this way will be deemed unreliable and will not be used.

### A.2.18 Data Management

Data collection during this project will be retained in both hardcopy and electronic format. Data collected in the field will be transcribed from field forms or notebooks and tabulated, as appropriate, using a spreadsheet or database program. Data entry will be checked to ensure no transcription errors occurred. Tabulated data will be provided in the remedial investigation reports.

Analytical data packages from the laboratory will contain the information listed in Section A.1 6. Electronic files containing the analytical results will be provided by the laboratory and down loaded into the project database. Any qualifiers resulting from data validation will also be entered into the database. Database entries will be checked for correctness and completeness. The RI report will contain the tabulated analytical results.

## A.3.0 ASSESSMENT/OVERSIGHT

### A.3.1 Assessments and Response Actions

Performance of activities or procedures will be the responsibility of the personnel performing such activities and procedures. For field measurements, the field team leader will be responsible for performance while the analyst and sample custodian will be responsible for performance within the laboratory. The performance of activities or procedures must comply with those specified in this SAP. The responsible personnel must be prepared to justify that the specified procedure or reference method was implemented properly. Deviations of a technical procedure or reference method must be noted within the appropriate logbook and, for laboratory analyses, in the Case Narrative of the analytical report.

Performance will be monitored in the field through the use of QC checks as previously discussed in Section A.2.15. Performance will be monitored in the laboratory through the use of QC checks discussed in the laboratory QAP and the PARCC criteria presented in Table A-3 through A-6.

As described in the guidance documents, assessment includes surveillance, peer review, management systems review, readiness review, technical systems audit, performance evaluation, data quality audit, and data quality assessment. For performance monitoring, the following assessment activities are planned:

- Surveillance;
- Peer review;
- Technical systems audit; and,
- Data quality assessment

#### A.3.1.1 Surveillance

During the course of sample collection, it is anticipated that the Agencies will provide oversight services for specific activities. This oversight will be geared to ensuring that sampling procedures and activities discussed in the SAP are properly executed. It has been assumed that the Agencies will provide feedback to the sampling team, the RI Consultant, and the Group regarding any issues arising from oversight.

In accordance with the Administrative Order on Consent, Index No. CERCLA-02-2000-2034, the PRP Group will notify USEPA at least twenty-one (21) days prior to performance of RI/FS-related fieldwork. In addition, NJDEP will be notified at least fourteen (14) days prior to performance of fieldwork. These notifications will be made via letter or electronic mail to the USEPA and NJDEP Project Managers.

### A.3.1.2 Peer Review

Throughout the project, the RI Consultant will maintain a system of peer review by which data generated can be checked and verified. Data that is transcribed and tabulated will be checked for accuracy and completeness.

### A.3.1.3 Audits

The QA/QC audit is an independent systematic on-site review of facilities, equipment, training procedures, record keeping, data validation, data management, and reporting aspects of the field and laboratory QA/QC program. Audits may be performed on field operations and sampling procedures, laboratory analyses and documentation.

#### A.3.1.3.1 Field/Sampling Audit

The RI Consultant field team leader will be responsible for ensuring that the applicable quality assurance procedures described in this SAP are followed. An on-Site Agency representative may audit field activities, with respect to the technical requirements, procedures, and protocols established in the SAP. Activities that may be audited are described below.

- Field sampling activities;
- Documentation of activities (logbooks, etc.);
- Equipment decontamination;
- Use of proper sampling equipment;
- Proper sample identification;
- Sample preservation;
- Sample packaging;
- Sample shipment; and,
- Chain-of-custody.

### A.3.1.3.2 Laboratory Audits

The laboratory is expected to have a QA program whereby the QA department will routinely conduct internal audits. The laboratory QAP will discuss internal laboratory audits. If an external audit is deemed necessary by the Agencies, then the Agencies will consult with the Respondents and the RI Consultant regarding an appropriate approach.

### A.3.1.4 Data Quality Assessment

Analytical data will be assessed through a series of evaluation procedures. The details regarding data evaluation and validation are discussed in Section A.4.

### A.3.1.5 Corrective Actions

If through the data assessment process problems are identified, corrective actions will be initiated. All identified QA problems and corrective actions will be documented to provide a complete record of QA activities and help identify needed long-term corrective actions. The need for corrective action is based upon predetermined limits of acceptability for all aspects of data collection and measurement, such as PARCC criteria (Tables A-3 through A-6), historical data, laboratory control spike sample results, and experience using the analytical procedures. Following standard QA/QC procedures will help detect erroneous data. The need for corrective action may be determined by the samplers, analysts, supervisors, quality assurance personnel, laboratory managers or Project Managers.

The detection of system and performance problems and the corrective actions procedures used in the field during monitoring and sample collection will be documented in the field notebooks or Sample Collection Forms with copies placed in the RI Consultant's project files. Any problems that cannot be resolved by the sampler or Field Sampling Team Leader will be brought to the attention of the RI Consultant's Project Manager. The RI Consultant's Project Manager and USEPA Project Manager (if necessary) will determine the corrective action to be taken, if any.

The laboratory QAP will describe the Corrective Action procedures and documentation used by the laboratory. Any problems which cannot be resolved by the analysts, laboratory managers or laboratory quality assurance officers will be brought to the attention of the RI Consultant's Project

Manager and Project Quality Assurance Manager. The RI Consultant's Project Manager and USEPA Project Manager (if necessary) will determine the corrective action to be taken, if any.

The laboratory personnel will assess laboratory QC samples and re-analyze stored samples that do not meet QC criteria prior to expiration of hold times. Corrective actions may include re-analysis, or resampling and analysis. Laboratory personnel will use corrective action reporting forms to document identification and resolution of significant defects. These report forms will be kept on file in the laboratory QA files.

If a system or performance audit identifies a situation requiring corrective action, the corrective action will be initiated upon approval of the responsible supervisor. Documentation of corrective actions will be made in a report to the RI Consultant's Project Manager. Corrective actions will be reported as appropriate to the Project QA Manager, and, if necessary, the USEPA QA Manager and Region II Remedial Project Manager.

### A.3.2 Reports to Management

Timely Quality Assurance reports are necessary to the successful completion of this project. Quality assurance deficiencies in the field must be reported to the field team leader and the RI Consultant QA and project managers. Quality assurance deficiencies in the laboratory must be reported in a timely manner to laboratory and project management personnel. The laboratory's policies and procedures for reporting quality assurance activities to management are included in their QAP and/or SOPs. Corrective actions for field and laboratory activities will be reported to the RI Consultant's QA and Project Manager, and, if necessary, the USEPA QA Manager and Region II Project Manager.

In accordance with the AOC, monthly progress reports will be provided to USEPA and NJDEP which will include summary of actions taken to achieve compliance with the AOC. Any changes which need to be made to the Plan will be noted in the progress report. Prior to initiation and implementation, these changes will be discussed with the USEPA Remedial Project Manager.

## A.4.0 DATA VALIDATION AND USABILITY

### A.4.1 Data Review, Validation, and Verification Requirements

Accurate data reduction, validation and reporting methods will support decision analysis. Data reduction techniques for both field and laboratory activities are described in this section. In addition, the laboratory chosen for this project will have further data reduction, validation and reporting procedures which will be described in the laboratory QAP or SOPs.

In general, data reduction of field measurements will not be necessary because all readings will be recorded in field notebooks or Groundwater Sample Field Information Forms directly from the field instruments. Field measurements will be tabulated using spreadsheet or data base software. Field measurements are anticipated to be recorded as follows:

- VOC vapors are to be recorded to the nearest 0.1 ppmv;
- Ferrous iron to the nearest 0.1 ppm;
- DO is to be recorded to the nearest 0.1 ppm;
- pH is to be recorded to the nearest 0.1 std pH units;
- Turbidity is to be recorded to the nearest 1 NTU;
- ORP is to be recorded to the nearest 0.1 mV;
- Specific conductance is to be recorded to the nearest 10 microsiemens/centimeter (or µmhos/cm) for results less than 1000 µS/cm or 100 µS/cm for results greater than 1000 µS/cm; and
- Temperature is to be recorded to the nearest 0.1°C;

The laboratory will perform data reduction in accordance with the individual analytical methodologies used for this project. The laboratory QAP or SOPs will have more detailed information regarding the laboratory data reduction procedures.

The laboratory will attempt to achieve the target reporting limits and units for each parameter of interest as provided in the analytical methods and as summarized on Table A-7. The equations and procedures used to calculate concentrations are specified in the individual methodologies (refer to

Tables A-8 and A-9 for method numbers and references). Given the conditions under which samples will be collected and analyzed, the laboratory may not always be able to achieve the target reporting limits. For example, due to insufficient sample volume or elevated concentrations of target compounds, the samples may be diluted prior to analysis, thereby elevating the reporting limits. The laboratory will provide a narrative in the data package to explain the reasons for elevated reporting limits.

Assessment of accuracy, precision and completeness of both field and laboratory measurements is based upon the acceptable results from QC samples. Where appropriate these may include blanks, duplicate samples, laboratory control spiked samples or matrix spike/matrix spike duplicate samples.

Method and field/rinsate are not expected to contain any target analytes with concentrations greater than the reported detection limit with the possible exception of common laboratory contaminants (i.e., methylene chloride, acetone, 2-butanone, and phthalate esters).

Field and laboratory duplicate results are assessed based upon relative percent difference (RPD) between values, using the following equation:

$$RPD = \frac{(D1 - D2)}{(D1 + D2)/2} \times 100\%$$

where, D1 = Primary sample result; and,
D2 = Duplicate sample result.

Laboratory control spiked samples are assessed based upon the percent recovery (%R) of spiked analytes. The percent recovery is calculated using the following equation:

$$\%R = \frac{X}{TV} \times 100\%$$

where, X = observed value of measurement; and,
TV = "true" value of spiked analyte.

Matrix spike/matrix spike duplicate (MS/MSD) data are assessed based upon the percent recovery of spiked analytes using the following equation:

$$\%R = \frac{(SSR - SR)}{SA} \times 100\%$$

where, SSR = Spiked sample result for analyte x;
SR = Sample result for analyte x; and,
SA = Spike added of analyte x.

The relative percent difference between the MS/MSD results is calculated using the RPD equation presented above.

Data completeness is assessed based upon the amount of valid data obtained from a particular measurement system (sampling and analysis). It may be quantitatively expressed using the following equation:

$$\text{Completeness} = \frac{N1}{N2} \times 100\%$$

where, N1 = number of valid measurements obtained; and,
N2 = number of valid measurements expected.

The laboratory will assess all quality control data with regard to precision and accuracy. Corrective actions are initiated as necessary.

### A.4.2 Data Validation and Verification Methods

#### A.4.2.1 Data Validation

Data validation techniques include screening, accepting, rejecting or qualifying data on the basis of specific quality control criteria for holding times, calibration, blank results, spike results, surrogates, and field duplicates. Data validation is a process whereby erroneous data may be identified prior to entering the project record. Validation of field measurements will be performed by field personnel in consultation with technical supervisors. Field personnel will validate the field data through review of calibration and duplicate data readings. The data will be reviewed to determine if there are any anomalous readings. Anomalies will be resolved immediately by means such as re-calibration or re-acquisition of the measurement.

For all analytical samples associated with this project, the laboratory will produce CLP data packages that will contain all information needed for formal validation of the data. Data validation will be performed in accordance with the USEPA Region II Standard Operating Procedures (SOPs) HW-6, Revision 11 (TCL Organics data) and HW-2, Revision 11(TAL Inorganics data). These procedures are specific with regard to evaluation of holding time, surrogate and spike recoveries, precision of duplicate measurements, calibration and instrument performance, blank contamination, compound identification, and compound quantification. Data will be qualified as necessary in accordance with the SOPs and any qualification will be explained in a data validation narrative.

Non-TCL/TAL data will be evaluated based upon holding times, blank results, and QC results assessing accuracy and precision. All analytical data packages will be reviewed for completeness and QC summaries will be evaluated and compared to precision and accuracy criteria in Tables A-3 and A-5. All data review required for this project will be performed under the direction of the data validation specialist and Quality Assurance Manager identified in Table A-1. If necessary, data will be qualified using the logic specified in the validation guidelines.

Qualified results will be reported for all validated samples on the analytical reporting forms provided in the data packages or as data summary tables accompanying the laboratory deliverable package. Qualified results, data packages and analytical results will be stored in the RI Consultant's project files and will also be entered into the RI Consultant's project database.

The PARCC criteria and criteria specified in applicable guidelines may not always be achievable. The data validation guidelines provide directions for the determination of data usability. Qualified data can often provide useful information, although the degree of certainty associated with the result may not be as planned. Professional judgment, in conjunction with USEPA guidance documents, will be used to determine data usability.

### A.4.2.2 Data Reporting

Field measurements recorded during field activities will be tabulated using standard spreadsheet or database software. The resulting summary tables will be reviewed and verified and data will be provided in the remedial investigation reports.

Laboratory data will be reported by the laboratory in a validatable package. Data summary tables containing the reviewed data will be prepared and these tables will be provided in the RI reports.

### A.4.3 Reconciliation With User Requirements

Throughout the performance monitoring program, the RI Consultant will determine if project DQOs are being met and assess whether the data being collected is sufficient and appropriate. Periodic evaluations of the monitoring program will be made to determine if a change in frequency or analytical parameters is appropriate. Individuals making measurements throughout the process will also make assessments of whether the DQOs are being met.

Individuals making field measurements will determine whether or not field quality control criteria were met. The field QA/QC will be overseen by the field team leader. Corrective actions will be initiated in the field as necessary. This corrective action may include recalibration of instruments, obtaining a replacement instrument, or use of a different type of instrument.

The analysts in the laboratory will determine if analytical QC criteria are achieved. Corrective action in the form of re-analysis or re-calibration may be warranted. Laboratory analytical data and field data will be assessed by a data validation specialist under the direction of the person identified in Table A-1 to determine usability with regard to the DQOs. As mentioned, USEPA Region II guidelines, individual methodologies and SOPs and the PARCC criteria presented in Tables A-3 through A-6 will be used to evaluate all data deliverables.

As noted in the data validation guidelines, data may not always meet precision and accuracy requirements but may still be considered usable. The data will be assessed with regard to the project DQOs, and professional judgment used in conjunction with guidance documents will determine data usability.

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## TABLE A-1
## PROJECT PERSONNEL
## LIGHTMAN DRUM RI/FS WORK PLAN
## SAMPLING AND ANALYSIS PLAN

| | |
|---|---|
| USEPA Remedial Project Manager: | Joseph Gowers<br>USEPA Region II<br>290 Broadway<br>19th Floor<br>NY, NY 10007-1866<br>Telephone: (212) 637-4975<br>Facsimile: (212) 637-4429 |
| USEPA Technical Oversight Contractor: | Kristen Edelmann<br>CDM Federal Programs Corporation<br>125 Maiden Lane, 5th Floor<br>New, York, NY 10038<br>Telephone: (212) 785-6114 |
| NJDEP Project Manager: | James DeNoble<br>NJ Department of Environmental Protection<br>Site Remediation Program<br>401 East State Street, 5th Floor<br>P.O. Box 028<br>Trenton, NJ 08625<br>Telephone: (609) 777-4101<br>Facsimile: (609) 633-1439 |
| Project Coordinator: | P. Stephen Finn, C.Eng.<br>Golder Associates Inc<br>1951 Old Cuthbert Road, Suite 301<br>Cherry Hill, NJ 08034<br>Telephone: (856) 616-8166<br>Facsimile: (856) 616-1874 |
| RI Consultant Project Manager: | Robert J. Illes, P.G.<br>Golder Associates Inc<br>1951 Old Cuthbert Road, Suite 301<br>Cherry Hill, NJ 08034<br>Telephone: (856) 616-8166<br>Facsimile: (856) 616-1874 |
| RI Manager and Site HSC: | David Ley, P.G.<br>Golder Associates Inc<br>1951 Old Cuthbert Road, Suite 301<br>Cherry Hill, NJ 08034<br>Telephone: (856) 616-8166<br>Facsimile: (856) 616-1874 |
| RI Quality Assurance Manager: | Stuart Mitchell, P.G.<br>Golder Associates Inc<br>1951 Old Cuthbert Road, Suite 301<br>Cherry Hill, NJ 08034<br>Telephone: (856) 616-8166<br>Facsimile: (856) 616-1874 |

### TABLE A-1
### PROJECT PERSONNEL
### LIGHTMAN DRUM RI/FS WORK PLAN
### SAMPLING AND ANALYSIS PLAN

| | |
|---|---|
| RI Laboratory Coordinator and Data Validator: | Douglas Dugan<br>Golder Associates Inc<br>1951 Old Cuthbert Road, Suite 301<br>Cherry Hill, NJ 08034<br>Telephone: (856) 616-8166<br>Facsimile: (856) 616-1874 |
| CompuChem Project Manager:<br>Alternate Laboratory Project Manager: | Rodney Raimonde<br>Marlene Swift<br>CompuChem<br>501 Madison Ave<br>Cary, NC 27513<br>Telephone: (919) 379-4013<br>Facsimile: (919) 379-4040 |
| CompuChem Quality Assurance Director: | Robert Meierer<br>CompuChem<br>501 Madison Ave<br>Cary, NC 27513<br>Telephone: (919) 379-4004<br>Facsimile: (919) 379-4050 |
| Microseeps, Inc. Project Manager<br>Alternate Laboratory Project Manager | Rebecca Hans<br>Frank Phillips<br>Microseeps, Inc.<br>University of Pittsburgh Applied Research Center<br>220 William Pitt Way<br>Pittsburgh, PA 15238<br>Telephone: (800) 659-2887<br>Facsimile: (412) 826-3433 |
| Drilling Services | To Be Determined |
| Geoprobe/Field GC Services: | Todd Morgan<br>S2C2, Inc.<br>150 Mount Bethel Road<br>Building One<br>Warren, NJ 07059<br>Telephone: (908) 542-1999<br>Facsimile: (908) 542-9288 |
| Surveyor: | James M. Stewart, Inc.<br>9622 Evans Street<br>Philadelphia, PA 19115<br>Telephone: (215) 969-1577<br>Facsimile: (215) 969-0338 |

# TABLE A-2
# PROPOSED REMEDIAL INVESTIGATION AND DATA QUALITY OBJECTIVES
# LIGHTMAN DRUM RI/FS WORK PLAN

| Remedial Investigation Activity | Matrix | Number of Samples | Parameters of Interest | Frequency of Monitoring | Purpose/Objective of Activity |
|---|---|---|---|---|---|
| Plume Definition | Groundwater | 50 (see note 8) | VOCs | Once | Use field screening techniques to collect groundwater and identify areas of VOC contamination. These data will be used in identifying locations for placement of downgradient permanent monitoring wells. |
| Contamination Delineation | Surface Water | 4 | TCL/TAL, TSS, Hardness | Once | Collect definitive data to define nature and extent of contamination and for use in preparing the Baseline and Ecological Risk Assessments. |
| Contamination Delineation | Sediment | 8 | TCL/TAL, TOC, Grain Size | Once | Collect definitive data to define nature and extent of contamination and for use in preparing the Baseline and Ecological Risk Assessments. |
| Contamination Delineation | Soil | 89 (see note 7) | TCL/TAL, TOC | Once | Collect definitive data to define nature and extent of contamination and for use in preparing the Baseline and Ecological Risk Assessments. |
| Contamination Delineation | Groundwater | 12 exiting on-property wells 1 new on-property well | TCL/TAL, Natural Attenuation parameters, and field parameters | Once | Collect definitive data to define nature and extent of contamination, evaluate potential for Natural Attenuation processes, and for use in preparing the Baseline Risk Assessment. |
| | | 2 water supply wells | TCL/TAL, Natural Attenuation parameters, and field parameters | Once | |
| | | 3 or 4 new off-property wells | TCL/TAL, Natural Attenuation parameters, and field parameters | Once | |
| Hydrogeologic Testing | Groundwater | 12 Existing wells and all new wells | Hydraulic Conductivity | Once | Collect definitive data to characterize aquifer hydraulic parameters |
| Surveying | NA | All soil locations and well locations | Elevation, northings and eastings | Once | Verify existing well elevations and provide accurate location and elevation data for new borings and wells |

<u>Notes:</u>

1. The Target Compound List (TCL) VOC, SVOC, Pesticide and PCB lists are defined in CLP Statements of Work OLM04.2. The Target Analyte List (TAL) parameters are listed in CLP Statement of Work ILM04.1.
2. The methodologies that will be used for analysis are listed in SAP Tables A-3 and A-5.
3. Natural Attenuation parameters include: Total Alkalinity, Chloride, Sulfate, Sulfide, Nitrate, Nitrite, Total Phosphate Light Hydrocarbons (methane, ethane, ethene), Total Organic Carbon (TOC) and Dissolved Organic Carbon (DOC).
4. Quality control samples will be collected per matrix at the following frequency : 1 field duplicate per twenty primary samples; 1 MS/MSD pair per twenty primary + field duplicate samples; 1 rinsate blank per day per type of decontamination event where non-dedicated equipment is used. 1 trip blank per day when aqueous VOC samples are collected.
5. Field Parameters for groundwater monitoring include: pH, Temperature, Specific Conductivity, Turbidity, Dissolved Oxygen, Oxidation-Reduction Potential, and Ferrous Iron. Field parameters for soil screening include: VOC vapors and visual characteristics.
6. For VOC data generated by on-Site field screening via GC/MS, field duplicate samples will be collected at a 10% frequency. MS/MSDs, rinsate and trip blanks will not be collected for these screening samples.
7. During soil delineation, samples for grain size determination will be collected from 10% of the borings (approximately 4 samples to be collected).
8. Number of samples is approximate. Actual number of samples will be based on number of Geoprobe locations and depth to water encountered at each location.
9. Samples for TCL/TAL analysis will be evaluated for the presence of 1,2-diphenylhydrazine and benzidine. If quantitative analysis is required, samples will be analyzed using SW846 8270 SIM.

# TABLE A-3
# PARCC DATA FOR AQUEOUS SAMPLES
# LIGHTMAN DRUM RI/FS WORK PLAN
# SAMPLING AND ANALYSIS PLAN

| MEASUREMENT PARAMETER | METHOD REFERENCE | LABORATORY PRECISION | FIELD & LABORATORY PRECISION | ACCURACY | COMPLETENESS (c) |
|---|---|---|---|---|---|
| TCL Volatile Organics | CLP SOW OLM04.2 | see Table A-4 | ±50% | see Table A-4 | 85% |
| TCL Semi-Volatile Organics | CLP SOW OLM04.2 | see Table A-4 | ±50% | see Table A-4 | 85% |
| TCL Pesticides/PCBs | CLP SOW OLM04.2 | see Table A-4 | ±50% | see Table A-4 | 85% |
| TAL Metals | CLP SOW ILM04.1 | see Table A-4 | ±50% | see Table A-4 | 85% |
| TAL Cyanide | CLP SOW ILM04.1 | see Table A-4 | ±50% | see Table A-4 | 85% |
| 1,2-DPH and Benzidine | SW846 8270 (SIM) | To Be Determined | To Be Determined | To Be Determined | 85% |
| Total Suspended Solids | EPA 160.2 | ±20% | ±50% | 75% - 125% | 85% |
| Hardness | Calculation | ±20% | ±50% | 75% - 125% | 85% |
| Dissolved Organic Carbon | EPA 415.1 | ±20% | ±50% | 75%-125% | 85% |
| Total Organic Carbon | EPA 415.1 | ±20% | ±50% | 75%-125% | 85% |
| Chloride | SM 4500CLB | ±20% | ±50% | 75%-125% | 85% |
| Alkalinity | EPA 310.1 | ±20% | ±50% | 75%-125% | 85% |
| Sulfate | EPA 375.4 | ±20% | ±50% | 75%-125% | 85% |
| Sulfide | EPA 376.1 | ±20% | ±50% | 75%-125% | 85% |
| Nitrate | EPA 353.2 | ±20% | ±50% | 75%-125% | 85% |
| Nitrite | EPA 353.2 | ±20% | ±50% | 75%-125% | 85% |
| Total Phosphate | EPA 365.2 | ±20% | ±50% | 75%-125% | 85% |
| Methane (sub-ppb detection level) | SW846 8015M (a) | ±20% | ±50% | 75%-125% | 85% |
| Ethane (sub-ppb detection level) | SW846 8015M (a) | ±20% | ±50% | 75%-125% | 85% |
| Ethene (sub-ppb detection level) | SW846 8015M (a) | ±20% | ±50% | 75%-125% | 85% |
| Ferrous Iron | Field Test Kit | NA | ±20% | NA (b) | 85% |
| Turbidity | Electrode | NA | ±20% | NA (b) | 85% |
| Oxidation-Reduction Potential | Electrode | NA | ±20% | NA (b) | 85% |
| Dissolved Oxygen | Electrode | NA | ±20% | NA (b) | 85% |
| Specific Conductance | Electrode | NA | ±20% | NA (b) | 85% |
| pH | Electrode | NA | ±0.5 std pH units | NA (b) | 85% |
| Temperature | Electrode | NA | ±0.5 deg C | NA (b) | 85% |

**NOTES:**

(a) If Method SW846 8015M is not routinely performed by the laboratory, then an equivalent method will be used.
(b) Accuracy goals that can not be defined as matrix spikes will not be performed.
(c) While the goal for completeness of laboratory measurements is 90%, the goal for total completeness (sampling and analytical) is 85%.
(d) Field meters will be standardized/calibrated daily and checked every four hours at a minimum.

1. NA = Not applicable
2. TCL = CLP Target Compound List, see CLP Statement of Work OLM04.2; TAL = CLP Target Analyte List, see CLP Statement of Work ILM04.1. See Table A-7
3. Precision expressed as either percent relative standard deviation (%RSD) or relative percent difference (%RPD).
4. Accuracy expressed as percent recovery of matrix spike or laboratory control sample.
5. Precision and accuracy for TCL/TAL parameters provided in Table A-4.
6. Representativeness and Comparability are non-quantitative parameters.
7. Accuracy and precision criteria for laboratory measurements will be consistent with the criteria cited in the individual methodologies for the natural attenuation parameters.

## TABLE A-4
## LABORATORY PRECISION AND ACCURACY CRITERIA FOR AQUEOUS TCL/TAL SAMPLES
## LIGHTMAN DRUM RI/FS WORK PLAN
## SAMPLING AND ANALYSIS PLAN

| VOLATILE ORGANICS: | QC LIMITS | |
|---|---|---|
| Target Spike Compound | % Recovery | % RPD |
| 1,1-Dichloroethene | 61%-145% | 0%-14% |
| Trichloroethene | 71%-120% | 0%-14% |
| Benzene | 76%-127% | 0%-11% |
| Toluene | 76%-125% | 0%-13% |
| Chlorobenzene | 75%-130% | 0%-13% |
| | | |
| Surrogate Compound | | |
| Toluene-d8 | 88%-110% | Not Applicable |
| Bromofluorobenzene | 86%-115% | Not Applicable |
| 1,2-Dichloroethane-d4 | 76%-114% | Not Applicable |
| | | |
| SEMI-VOLATILE ORGANICS: | QC LIMITS | |
| Target Spike Compound | % Recovery | % RPD |
| Phenol | 12%-110% | 0%-42% |
| 2-Chlorophenol | 27%-123% | 0%-40% |
| N-Nitroso-di-n-propylamine | 41%-116% | 0%-38% |
| 4-Chloro-3-methylphenol | 23%-97% | 0%-42% |
| Acenaphthene | 46%-118% | 0%-31% |
| 4-Nitrophenol | 10%-80% | 0%-50% |
| 2,4-Dinitrotoluene | 24%-96% | 0%-38% |
| Pentachlorophenol | 9%-103% | 0%-50% |
| Pyrene | 26%-127% | 0%-31% |
| | | |
| Surrogate Compound | | |
| Nitrobenzene-d5 | 35%-114% | Not Applicable |
| 2-Fluorobiphenyl | 43%-116% | Not Applicable |
| Terphenyl-d14 | 33%-141% | Not Applicable |
| Phenol-d5 | 10%-110% | Not Applicable |
| 2-Fluorophenol | 21%-110% | Not Applicable |
| 2,4,6-Tribromophenol | 10%-123% | Not Applicable |
| 2-Chlorophenol-d4 (advisory) | 33%-110% | Not Applicable |
| 1,2-Dichlorobenzene-d4 (advisory) | 16%-110% | Not Applicable |
| | | |
| PESTICIDES: | QC LIMITS | |
| Target Spike Compound | % Recovery | % RPD |
| gamma-BHC | 56%-123% | 0%-15% |
| Heptachlor | 40%-131% | 0%-20% |
| Aldrin | 40%-120% | 0%-22% |
| Dieldrin | 52%-126% | 0%-18% |
| Endrin | 56%-121% | 0%-21% |
| 4,4'-DDT | 38%-127% | 0%-27% |
| | | |
| Surrogate Compound | | |
| Tetrachloro-m-xylene | 30%-150% | Not Applicable |
| Decachlorobiphenyl | 30%-150% | Not Applicable |
| | | |
| POLYCHLORINATED BIPHENYLS: | QC LIMITS | |
| Target Spike Compound | % Recovery | % RPD |
| Aroclor 1254 | 50%-100% | 0%-20% |
| | | |
| Surrogate Compound | | |
| Tetrachloro-m-xylene | 30%-150% | Not Applicable |
| Decachlorobiphenyl | 30%-150% | Not Applicable |
| | | |
| TARGET ANALYTE LIST: | QC LIMITS | |
| Target Spike Compound | % Recovery | % RPD |
| Metals | 75%-125% | ±20% |
| Cyanide | 75%-125% | ±20% |

**NOTES:**

1. VOC, SVOC, and Pesticide accuracy and precision criteria based upon CLP SOW OLM04.2.
2. PCB accuracy and precision criteria based upon CompuChem established limits.
3. TAL accuracy and precison criteria based upon CLP SOW ILM04.1.
4. Precision criteria for metals is ±CRDL (reporting limit) for results less than 5xCRDL.

## TABLE A-5
## PARCC DATA FOR SOIL SAMPLES
## LIGHTMAN DRUM RI/FS WORK PLAN
## SAMPLING AND ANALYSIS PLAN

| MEASUREMENT PARAMETER | METHOD REFERENCE | LABORATORY PRECISION | FIELD & LABORATORY PRECISION | ACCURACY | COMPLETENESS (b) |
|---|---|---|---|---|---|
| TCL Volatile Organics | CLP SOW OLM04.2 | see Table A-6 | ±100% | see Table A-6 | 85% |
| TCL Semi-Volatile Organics | CLP SOW OLM04.2 | see Table A-6 | ±100% | see Table A-6 | 85% |
| TCL Pesticides/PCBs | CLP SOW OLM04.2 | see Table A-6 | ±100% | see Table A-6 | 85% |
| TAL Metals | CLP SOW ILM04.1 | see Table A-6 | ±100% | see Table A-6 | 85% |
| TAL Cyanide | CLP SOW ILM04.1 | see Table A-6 | ±100% | see Table A-6 | 85% |
| 1,2-DPH and Benzidine | SW846 8270 (SIM) | To Be Determined | To Be Determined | To Be Determined | 85% |
| TOC | SW846 9060 | ±50% | ±100% | 75%-125% | 85% |
| Grain Size Analysis | ASTM D422 | NA (a) | NA (a) | NA (a) | 85% |

**NOTES:**

(a) NA - Not applicable. Precision and accuracy goals that can not be defined as matrix spikes and duplicates will not be performed on geotechnical analyses.

(b) While the goal for completeness of laboratory measurements is 90%, the goal for total completeness (sampling and analytical) is 85%.

1. NA = Not applicable
2. TCL = CLP Target Compound List, see CLP Statement of Work OLM04.2; TAL = CLP Target Analyte List, see CLP Statement of Work ILM04.1. See Table A-7
3. Precision expressed as either percent relative standard deviation (%RSD) or relative percent difference (%RPD).
4. Accuracy expressed as percent recovery of matrix spike or laboratory control sample.
5. Precision and accuracy for TCL/TAL parameters provided in Table A-6.
6. Representativeness and Comparability are non-quantitative parameters.
7. 1,2-diphenylhydrazine (1,2-DPH) and benzidine will be analyzed, if determined to be present, by SW846 8270 in SIM mode. Refer to SAP Section A.2.12 for further discussion.

## TABLE A-6
## LABORATORY PRECISION AND ACCURACY CRITERIA FOR SOIL TCL/TAL SAMPLES
## LIGHTMAN DRUM RI/FS WORK PLAN
## SAMPLING AND ANALYSIS PLAN

| VOLATILE ORGANICS: | QC LIMITS | |
|---|---|---|
| **Target Spike Compound** | **% Recovery** | **% RPD** |
| 1,1-Dichloroethene | 52%-172% | 0%-22% |
| Trichloroethene | 62%-137% | 0%-24% |
| Benzene | 66%-142% | 0%-21% |
| Toluene | 59%-139% | 0%-21% |
| Chlorobenzene | 60%-133% | 0%-21% |
| **Surrogate Compound** | | |
| Toluene-d8 | 84%-138% | Not Applicable |
| Bromofluorobenzene | 59%-113% | Not Applicable |
| 1,2-Dichloroethane-d4 | 70%-121% | Not Applicable |
| SEMI-VOLATILE ORGANICS: | QC LIMITS | |
| **Target Spike Compound** | **% Recovery** | **% RPD** |
| Phenol | 26%-90% | 0%-35% |
| 2-Chlorophenol | 25%-102% | 0%-50% |
| N-Nitroso-di-n-propylamine | 41%-126% | 0%-38% |
| 4-Chloro-3-methylphenol | 26%-103% | 0%-33% |
| Acenaphthene | 31%-137% | 0%-19% |
| 4-Nitrophenol | 11%-114% | 0%-50% |
| 2,4-Dinitrotoluene | 28%-89% | 0%-47% |
| Pentachlorophenol | 17%-109% | 0%-47% |
| Pyrene | 35%-142% | 0%-36% |
| **Surrogate Compound** | | |
| Nitrobenzene-d5 | 23%-120% | Not Applicable |
| 2-Fluorobiphenyl | 30%-115% | Not Applicable |
| Terphenyl-d14 | 18%-137% | Not Applicable |
| Phenol-d5 | 24%-113% | Not Applicable |
| 2-Fluorophenol | 25%-121% | Not Applicable |
| 2,4,6-Tribromophenol | 19%-122% | Not Applicable |
| 2-Chlorophenol-d4 (advisory) | 20%-110% | Not Applicable |
| 1,2-Dichlorobenzene-d4 (advisory) | 20%-110% | Not Applicable |
| PESTICIDES: | QC LIMITS | |
| **Target Spike Compound** | **% Recovery** | **% RPD** |
| gamma-BHC | 46%-127% | 0%-50% |
| Heptachlor | 35%-130% | 0%-31% |
| Aldrin | 34%-132% | 0%-43% |
| Dieldrin | 31%-134% | 0%-38% |
| Endrin | 42%-139% | 0%-45% |
| 4,4'-DDT | 23%-134% | 0%-50% |
| **Surrogate Compound** | | |
| Tetrachloro-m-xylene | 30%-150% | Not Applicable |
| Decachlorobiphenyl | 30%-150% | Not Applicable |
| POLYCHLORINATED BIPHENYLS: | QC LIMITS | |
| **Target Spike Compound** | **% Recovery** | **% RPD** |
| Aroclor 1254 | 50%-100% | 0%-20% |
| **Surrogate Compound** | | |
| Tetrachloro-m-xylene | 30%-150% | Not Applicable |
| Decachlorobiphenyl | 30%-150% | Not Applicable |
| TARGET ANALYTE LIST: | QC LIMITS | |
| **Target Spike Compound** | **% Recovery** | **% RPD** |
| Metals | 75%-125% | ±20% |
| Cyanide | 75%-125% | ±20% |

**NOTES:**

1. VOC, SVOC, and Pesticide accuracy and precision criteria based upon CLP SOW OLM04.2.
2. PCB accuracy and precision criteria based upon CompuChem established limits.
3. TAL accuracy and precison criteria based upon CLP SOW ILM04.1.
4. Precision criteria for metals is ±CRDL (reporting limit) for results less than 5xCRDL.

## TABLE A-7
## TARGET COMPOUNDS/ANALYTES OF INTEREST
## LIGHTMAN DRUM RI/FS WORK PLAN
## SAMPLING AND ANALYSIS PLAN

| TARGET PARAMETERS FOR RI | REPORTING LIMITS [ug/l] | REPORTING LIMITS [ug/kg] |
|---|---|---|
| **Volatile Organic Compounds** | | |
| Dichlorodifluoromethane | 0.5 | 10 |
| Chloromethane | 0.5 | 10 |
| Bromomethane | 0.5 | 10 |
| Vinyl chloride | 0.5 | 10 |
| Chloroethane | 0.5 | 10 |
| Trichlorofluoromethane | 0.5 | 10 |
| 1,1,2-Trichloro-1,2,2-trifluoroethane | 0.5 | 10 |
| Methyl acetate | 0.5 | 10 |
| Methylene chloride | 0.5 | 10 |
| Acetone | 10 | 10 |
| Carbon disulfide | 0.5 | 10 |
| *tert*-Butyl methyl ether | 0.5 | 10 |
| 1,1-Dichloroethene | 0.5 | 10 |
| 1,1-Dichloroethane | 0.5 | 10 |
| *cis*-1,2-Dichloroethene | 0.5 | 10 |
| *trans*-1,2-Dichloroethene | 0.5 | 10 |
| Chloroform | 0.5 | 10 |
| 1,2-Dichloroethane | 0.5 | 10 |
| 2-Butanone | 10 | 10 |
| Bromochloromethane | 0.5 | 10 |
| 1,1,1-Trichloroethane | 0.5 | 10 |
| Cyclohexane | 0.5 | 10 |
| Carbon Tetrachloride | 0.5 | 10 |
| Bromodichloromethane | 0.5 | 10 |
| 1,2-Dichloropropane | 0.5 | 10 |
| *cis*-1,3-Dichloropropene | 0.5 | 10 |
| Trichloroethene | 0.5 | 10 |
| Methylcyclohexane | 0.5 | 10 |
| Dibromochloromethane | 0.5 | 10 |
| 1,1,2-Trichloroethane | 0.5 | 10 |
| Benzene | 0.5 | 10 |
| *trans*-1,3-Dichloropropene | 0.5 | 10 |
| Bromoform | 0.5 | 10 |
| 4-Methyl-2-pentanone | 10 | 10 |
| 2-Hexanone | 10 | 10 |
| Tetrachloroethene | 0.5 | 10 |
| Isopropylbenzene | 0.5 | 10 |
| 1,1,2,2-Tetrachloroethane | 0.5 | 10 |
| 1-2-Dibromoethane | 0.5 | 10 |
| Toluene | 0.5 | 10 |
| Chlorobenzene | 0.5 | 10 |
| Ethylbenzene | 0.5 | 10 |
| Styrene | 0.5 | 10 |

## TABLE A-7
## TARGET COMPOUNDS/ANALYTES OF INTEREST
## LIGHTMAN DRUM RI/FS WORK PLAN
## SAMPLING AND ANALYSIS PLAN

| TARGET PARAMETERS FOR RI | REPORTING LIMITS [ug/l] | REPORTING LIMITS [ug/kg] |
|---|---|---|
| Xylenes (total) | 0.5 | 10 |
| 1,3-Dichlorobenzene | 0.5 | 10 |
| 1,4-Dichlorobenzene | 0.5 | 10 |
| 1,2-Dichlorobenzene | 0.5 | 10 |
| 1,2-Dibromo-3-chloropropane | 0.5 | 10 |
| 1,2,4-Trichlorobenzene | 0.5 | 10 |
| **Semi-Volatile Organic Compounds** | | |
| Benzaldehyde | 10 | 330 |
| Phenol | 10 | 330 |
| *bis*-(2-Chloroethyl)ether | 10 | 330 |
| 2-Chlorophenol | 10 | 330 |
| 2-Methylphenol | 10 | 330 |
| 2,2'-oxybis(1-Chloropropane) | 10 | 330 |
| Acetophenone | 10 | 330 |
| 4-Methylphenol | 10 | 330 |
| N-Nitroso-di-n-propylamine | 10 | 330 |
| Hexachloroethane | 10 | 330 |
| Nitrobenzene | 10 | 330 |
| Isophorone | 10 | 330 |
| 2-Nitrophenol | 10 | 330 |
| 2,4-Dimethylphenol | 10 | 330 |
| bis-(2-Chloroethoxy) methane | 10 | 330 |
| 2,4-Dichlorophenol | 10 | 330 |
| Naphthalene | 10 | 330 |
| 4-Chloroaniline | 10 | 330 |
| Hexachlorobutadiene | 10 | 330 |
| Caprolactam | 10 | 330 |
| 4-Chloro-3-methylphenol | 10 | 330 |
| 2-Methylnaphthalene | 10 | 330 |
| Hexachlorocyclopentadiene | 10 | 330 |
| 2,4,6-Trichlorophenol | 10 | 330 |
| 2,4,5-Trichlorophenol | 25 | 830 |
| 1,1'-Biphenyl | 10 | 330 |
| 2-Chloronaphthalene | 10 | 330 |
| 2-Nitroaniline | 25 | 830 |
| Dimethylphthalate | 10 | 330 |
| 2,6-Dinitrotoluene | 10 | 330 |
| Acenaphthylene | 10 | 330 |
| 3-Nitroaniline | 25 | 830 |
| Acenaphthene | 10 | 330 |
| 2,4-Dinitrophenol | 25 | 830 |
| 4-Nitrophenol | 25 | 830 |
| Dibenzofuran | 10 | 330 |
| 2,4-Dinitrotoluene | 10 | 330 |
| Diethylphthalate | 10 | 330 |
| Fluorene | 10 | 330 |
| 4-Chlorophenyl-phenyl ether | 10 | 330 |

# TABLE A-7
# TARGET COMPOUNDS/ANALYTES OF INTEREST
# LIGHTMAN DRUM RI/FS WORK PLAN
# SAMPLING AND ANALYSIS PLAN

| TARGET PARAMETERS FOR RI | REPORTING LIMITS [ug/l] | REPORTING LIMITS [ug/kg] |
|---|---|---|
| 4-Nitroaniline | 25 | 830 |
| 4,6-Dinitro-2-methylphenol | 25 | 830 |
| N-Nitroso-diphenylamine | 10 | 330 |
| 4-Bromophenyl-phenyl ether | 10 | 330 |
| Hexachlorobenzene | 10 | 330 |
| Atrazine | 10 | 330 |
| Pentachlorophenol | 25 | 830 |
| Phenanthrene | 10 | 330 |
| Anthracene | 10 | 330 |
| Carbazole | 10 | 330 |
| Di-n-butyl phthalate | 10 | 330 |
| Fluoranthene | 10 | 330 |
| Pyrene | 10 | 330 |
| Butylbenzyl phthalate | 10 | 330 |
| 3,3'-Dichlorobenzidine | 10 | 330 |
| Benzo(a)anthracene | 10 | 330 |
| Chrysene | 10 | 330 |
| *bis*-(2-Ethylhexyl) phthalate | 10 | 330 |
| Di-n-octylphthalate | 10 | 330 |
| Benzo(b)fluoranthene | 10 | 330 |
| Benzo(k)fluoranthene | 10 | 330 |
| Benzo(a)pyrene | 10 | 330 |
| Indeno(1,2,3-cd)pyrene | 10 | 330 |
| Dibenzo(a,h)anthracene | 10 | 330 |
| Benzo(g,h,I)perylene | 10 | 330 |
| 1,2-Diphenylhydrazine | To Be Determined | To Be Determined |
| Benzidine | To Be Determined | To Be Determined |
| | | |
| **Pesticides/PCBs** | | |
| alpha-BHC | 0.05 | 1.7 |
| beta-BHC | 0.05 | 1.7 |
| delta-BHC | 0.05 | 1.7 |
| gamma-BHC | 0.05 | 1.7 |
| Heptachlor | 0.05 | 1.7 |
| Aldrin | 0.05 | 1.7 |
| Heptachlor epoxide | 0.05 | 1.7 |
| Endosulfan I | 0.05 | 1.7 |
| Dieldrin | 0.1 | 3.3 |
| 4,4'-DDE | 0.1 | 3.3 |
| Endrin | 0.1 | 3.3 |
| Endosulfan II | 0.1 | 3.3 |
| 4,4'-DDD | 0.1 | 3.3 |
| Endosulfan sulfate | 0.1 | 3.3 |
| 4,4'-DDT | 0.1 | 3.3 |
| Methoxychlor | 0.5 | 17 |
| Endrin ketone | 0.1 | 3.3 |
| Endrin aldehyde | 0.1 | 3.3 |

# TABLE A-7
# TARGET COMPOUNDS/ANALYTES OF INTEREST
# LIGHTMAN DRUM RI/FS WORK PLAN
# SAMPLING AND ANALYSIS PLAN

| TARGET PARAMETERS FOR RI | REPORTING LIMITS [ug/l] | REPORTING LIMITS [ug/kg] |
|---|---|---|
| alpha-Chlordane | 0.05 | 1.7 |
| gamma-Chlordane | 0.05 | 1.7 |
| Toxaphene | 5.0 | 17 |
| Aroclor-1016 | 1.0 | 33 |
| Aroclor-1221 | 2.0 | 67 |
| Aroclor-1232 | 1.0 | 33 |
| Aroclor-1242 | 1.0 | 33 |
| Aroclor-1248 | 1.0 | 33 |
| Aroclor-1254 | 1.0 | 33 |
| Aroclor-1260 | 1.0 | 33 |
| | | |

# TABLE A-7
# TARGET COMPOUNDS/ANALYTES OF INTEREST
# LIGHTMAN DRUM RI/FS WORK PLAN
# SAMPLING AND ANALYSIS PLAN

| TARGET PARAMETERS FOR RI | REPORTING LIMITS [ug/l] | REPORTING LIMITS [ug/kg] |
|---|---|---|
| Target Analyte List | [ug/l] | [mg/kg] |
| Aluminum | 200 | 40 |
| Antimony | 60 | 12 |
| Arsenic | 10 | 2 |
| Barium | 200 | 40 |
| Beryllium | 5 | 1 |
| Cadmium | 5 | 1 |
| Calcium | 5000 | 1000 |
| Chromium | 10 | 2 |
| Cobalt | 50 | 10 |
| Copper | 25 | 5 |
| Iron | 5000 | 1000 |
| Lead | 3 | 0.6 |
| Magnesium | 5000 | 1000 |
| Manganese | 15 | 3 |
| Mercury | 0.2 | 0.1 |
| Nickel | 40 | 8 |
| Potassium | 5000 | 1000 |
| Selenium | 5 | 1 |
| Silver | 10 | 2 |
| Sodium | 5000 | 1000 |
| Thallium | 10 | 2 |
| Vanadium | 50 | 10 |
| Zinc | 20 | 4 |
| Cyanide | 10 | 2 |

VOC, SVOC, Pesticide and PCB Lists from CLP SOW OLM04.2
TAL Metals List from CLP SOW ILM04.1

The Reporting Limits shown for the Target Analyte List are the maximum reporting limits that may be used for an undiluted sample. The laboratory will report results to the Instrument Detection Limit (IDL) which are generated every quarter.

Reporting Limits will be modified on an individual sample basis depending upon dilution, percent solids, and sample matrix considerations.

### TABLE A-8
### ANALYTICAL METHODS, SAMPLE CONTAINERS, PRESERVATION AND ANALYTICAL HOLD TIMES FOR AQUEOUS SAMPLES
### LIGHTMAN DRUM RIFS WORK PLAN
### SAMPLING AND ANALYSIS PLAN

| PARAMETER | METHODOLOGY | CONTAINER | MINIMUM SAMPLE | PRESERVATION (1) | HOLD TIME (2) |
|---|---|---|---|---|---|
| TCL Volatile Organics | CLP SOW OLM04.2 (8) | 3-40 ml G | 3 - 40 ml | Cool 4 °C;HCl,pH<2 | 14 days (3) |
| TCL Semi-Volatile Organics | CLP SOW OLM04.2 | 2-1000ml G | 1000ml | Cool 4° C | 7 days (5) |
| TCL Pesticides/PCBs | CLP SOW OLM04.2 | 2-1000ml G | 1000ml | Cool 4° C | 7 days (5) |
| TAL Metals | CLP SOW ILM04.1 | 1-500 ml P | 250 ml | Cool 4° C; $HNO_3$, pH<2 | 180 days (6) |
| TAL Cyanide | CLP SOW ILM04.1 | 1-1000ml P | 500ml | Cool 4° C; NaOH, pH>12 | 14 days |
| 1,2-DPH and Benzidine | SW846 8270 (SIM) | 2-1000ml G | 1000ml | Cool 4° C | 7 days (5) |
| Total Suspended Solids | EPA 160.2 | 1-1000ml P | 1000ml | Cool 4° C | 7 days |
| Hardness | Calculation | from metals analysis | NA | NA | NA |
| Dissolved Organic Carbon | EPA 415.1 | 3-40ml G | 3-40ml | Cool 4° C; $H_2SO_4$, pH<2 | 28 days |
| Total Organic Carbon | EPA 415.1 | 3-40ml G | 3-40ml | Cool 4° C; $H_2SO_4$, pH<2 | 28 days |
| Chloride | SM 4500CLB | 1-1000ml P | 500ml | Cool 4° C | 14 days |
| Alkalinity | EPA 310.1 | 1-500 ml P | 250 ml | Cool 4° C | 28 days |
| Sulfate | EPA 375.4 | 1-500 ml P | 250 ml | Cool 4° C | 7 days |
| Sulfide | EPA 376.1 | 1-500 ml P | 250 ml | Cool 4° C; ZnAc/NaOH, pH>9 | 7 days |
| Nitrate | EPA 353.2 | 1-500 ml P | 250 ml | Cool 4° C | 48 hours |
| Nitrite | EPA 353.2 | 1-1000ml P | 500ml | Cool 4° C | 28 days |
| Total Phosphate | EPA 365.2 | 1-500 ml P | 250 ml | Cool 4° C; $H_2SO_4$, pH<2 | 28 days |
| Methane (sub-ppb detection level) | SW846 8015M (6) | 3-40ml G (7) | 3-40ml | Cool 4° C (7) | 7 days |
| Ethane (sub-ppb detection level) | SW846 8015M (6) | 3-40ml G (7) | 3-40ml | Cool 4° C (7) | 7 days |
| Ethene (sub-ppb detection level) | SW846 8015M (6) | 3-40ml G (7) | 3-40ml | Cool 4° C (7) | 7 days |
| Ferrous Iron | Field Test Kit | NA | NA | None | Field Measurement |
| Turbidity | Electrode | NA | NA | None | Field Measurement (4) |
| Oxidation-Reduction Potential | Electrode | NA | NA | None | Field Measurement (4) |
| Dissolved Oxygen | Electrode | NA | NA | None | Field Measurement (4) |
| Specific Conductance | Electrode | NA | NA | None | Field Measurement (4) |
| pH | Electrode | NA | NA | None | Field Measurement (4) |
| Temperature | Electrode | NA | NA | None | Field Measurement (4) |

**Notes:**

1. Sample preservation is performed by sampler immediately upon sample collection.
2. Hold time based upon day of sample collection not Verified Time of Sample Receipt.
3. If sample cannot be preserved due to foaming, unpreserved sample will be analyzed within 7 days.
4. Field measurements will be collected using a flow-through cell equipped with a field meter and parameter specific electrodes.
5. Hold time is 7 days until start of sample extraction, 40 days following extraction for analysis.
6. Hold Time for metals is 180 days, except for Mercury which is 28 days.
6. If Method SW846 8015M is not routinely performed by the laboratory, then an equivalent method will be used.
7. Vials that have specially designed, teflon lined septa to prevent loss of light hydrocarbons will be used.
8. VOC analysis will be performed using a 25 ml purge to achieve lower reporting limits.

P indicates that a Plastic bottle should be used.
G indicates that a Glass bottle should be used.

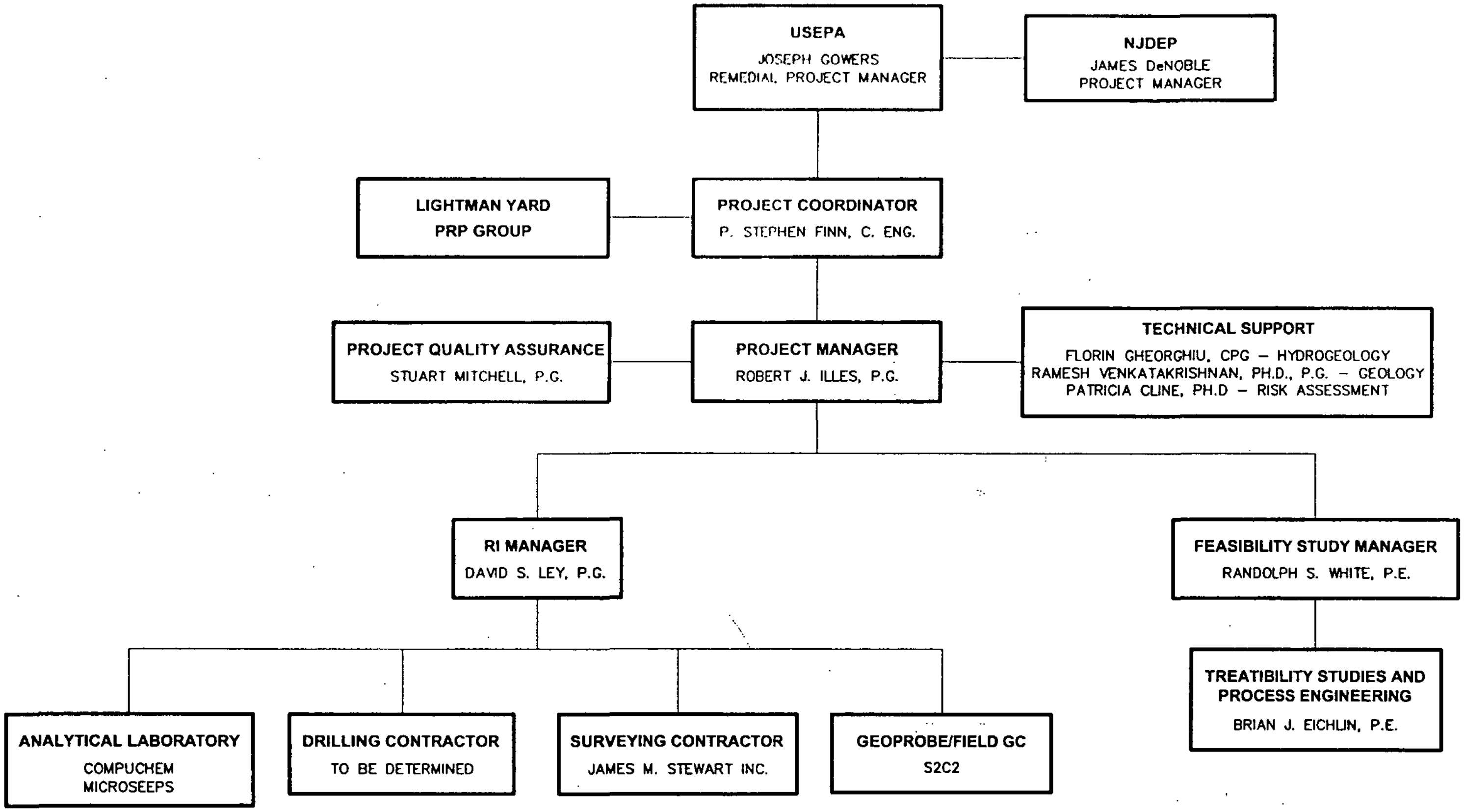
## TABLE A-9
## ANALYTICAL METHODS, SAMPLE CONTAINERS, PRESERVATION AND ANALYTICAL HOLD TIMES FOR SOIL SAMPLES
## LIGHTMAN DRUM RI/FS WORK PLAN
## SAMPLING AND ANALYSIS PLAN

| PARAMETER | METHODOLOGY | CONTAINER | MINIMUM SAMPLE | PRESERVATION (1) | HOLD TIME (2) |
|---|---|---|---|---|---|
| TCL Volatile Organics | CLP SOW OLM04.2 | 4 EnCore samplers | 20 gm | Cool 4 °C | 14 days (3) |
| TCL Semi-Volatile Organics | CLP SOW OLM04.2 | 4 oz G | 30 gm | Cool 4 °C | 7 days (4) |
| TCL Pesticides/PCBs | CLP SOW OLM04.2 | 4 oz G | 30 gm | Cool 4 °C | 7 days (4) |
| TAL Metals | CLP SOW ILM04.0 | 4 oz G | 30 gm | Cool 4 °C | 180 days (5) |
| TAL Cyanide | CLP SOW ILM04.0 | 4 oz G | 30 gm | Cool 4 °C | 14 days |
| 1,2-DPH and Benzidine | SW846 8270 (SIM) | 4 oz G | 30 gm | Cool 4 °C | 7 days (4) |
| Total Organic Carbon | SW846 9060 | 4 oz G | 100 gm | Cool 4 °C | 28 days |
| Grain Size Analysis | ASTM D422 | 16 oz G | 1000 gm | None | None |

Notes:

1. Sample Preservation is performed by sampler immediately upon sample collection except for VOCs which is performed by laboratory upon receipt (see Note 3).
2. Hold time based upon day of sample collection not Verified Time of Sample Receipt.
3. Hold time is 48 hours for preservation using methanol and/or sodium bisulfate and 14 days to analysis.
4. Hold Time for SVOCs, Pesticides/PCBs is 7 days for extraction and 40 days for analysis.
5. Hold Time for metals is 180 days, except for Mercury which is 28 days.

G indicates that a Glass bottle should be used.



|  |  |  |  |
|---|---|---|---|
| JOB No.: | 013-6054 | SCALE: | AS SHOWN |
| CAD BY: | AM | DATE: | 07/23/02 |
| CHK BY: |  | FILE No.: | 2NJ04-702 |
| REV BY: |  | DR SUBTITLE: | 01 |

## RI/FS ORGANIZATIONAL CHART

Golder Associates

LIGHTMAN DRUM COMPANY

FIGURE A-1

## EXAMPLE CHAIN OF CUSTODY RECORD

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| PROJ. NO. | PROJECT NAME | | | | NO. OF CON-TAINERS | CONTAINER TYPE | | | | | | REMARKS |
| SAMPLERS: | | | | | | | | | | | | |
| SAMPLE | DATE | TIME | MATRIX | SAMPLE LOCATION | | | | | | | | |
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|---|---|---|---|---|---|
| RELINQUISHED BY: (Signature) | Date / Time | RECEIVED BY: (Signature) | RELINQUISHED BY: (Signature) | Date / Time | RECEIVED BY: (Signature) |
| RELINQUISHED BY: (Signature) | Date / Time | RECEIVED BY: (Signature) | RELINQUISHED BY: (Signature) | Date / Time | RECEIVED BY: (Signature) |
| RELINQUISHED BY: (Signature) | Date / Time | RECEIVED FOR LABORATORY BY: | Date / Time | REMARKS: | |

Figure A-2

# GROUNDWATER SAMPLE FIELD INFORMATION FORM

Site: **Lightman Drum Company Superfund Site**
Location: **Winslow Township, NJ**
Project Number: **013-6054**

Golder Associates

**MONITORING WELL ID:**
Depth to Water Prior to Purging [ft-btoc]:
Well Casing Diameter [in]:
Start Time (purging):
Purging Device:
Well Depth [ft-btoc]:
Weather Conditions:

Sampling Date/Time:
Sampler (s):
Sampling Device:
Sample Characteristics:
Analytical Parameters:

Ferrous Iron [ppm]:

*FIELD PARAMETERS*

| Time [hh:mm] | Temperature [°C] | pH [std] | Specific Conductance [mS/cm or uS/cm] | Turbidity [ntu] | Dissolved Oxygen [mg/l] | Redox Potential [mV] | Depth To Water [ft-btoc] | Volume Purged [liters] | Approximate Purge Rate [ml/min] |
|---|---|---|---|---|---|---|---|---|---|
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**Comments:**

**Figure A-3**

# APPENDIX B

# HEALTH AND SAFETY PLAN

APPENDIX B

# HEALTH AND SAFETY PLAN
# FOR THE
# REMEDIAL INVESTIGATION/FEASIBILITY STUDY WORK PLAN
# LIGHTMAN DRUM COMPANY SITE
# WINSLOW TOWNSHIP, CAMDEN COUNTY, NEW JERSEY

Prepared for:

Lightman Yard PRP Group

Prepared by:

Golder Associates Inc.
1951 Old Cuthbert Road, Suite 301
Cherry Hill, New Jersey 08034

July 2002

Project No.: 013-6054

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Acronyms and Definitions

SECTION PAGE

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LIST OF ATTACHMENTS

## ACRONYMS AND DEFINITIONS

Terms used in the HASP, are as follows:

ACGIH - American Conference of Governmental Industrial Hygienists

Authorized Personnel - Person, including task-specific personnel, project personnel, oversight personnel, contractors and consultants whose presence is authorized.

Breathing Zone - The worker's breathing zone is an imaginary sphere of 2-foot radius surrounding the head.

Contamination-Reduction Zone - The area designated as required for removal of contaminants from personnel and equipment. This area is adjacent to the Exclusion Zone.

Contaminant of Potential Concern – The constituents that have been identified at the Site that are expected to cause the greatest concern for chemical safety risks.

Contractor/Consultant - Person or firm, retained or hired by the Client and/or their contractors, to carry out and/or supervise portions of the activities conducted at the Site.

CPR – Cardiopulmonary Resuscitation

EPA – Environmental Protection Agency

Exclusion Zone - The area to which all personnel entering must be directly involved in the ongoing work, have designated personal protective equipment (PPE), and meet training and medical monitoring requirements. The Exclusion Zone will be defined as required by an approximate 25-foot radius around the work area, which will be suitably marked.

FS – Feasibility Study

HASP - Health and Safety Plan

HSC – On-Site Health and Safety Coordinator

HSO - Health and Safety Officer

IDLH - Immediate Danger to Life and Health

IDW – Investigation Derived Waste

MSDS - Material Safety Data Sheets, which provide information on the physical, chemical, and hazardous properties of chemical compounds.

NBR – Nitrile butadiene rubber

NIOSH - National Institute of Occupational Safety and Health

OSHA - Occupational Safety and Health Administration

Oversight Personnel - Any person, designated by the state or federal government, who is assigned to carry out oversight work.

PEL - Permissible Exposure Limit

PID – Photoionization Detector

PPE - Personal Protective Equipment

PPM - Parts per million; expressed as ppm(v) for gases and vapors.

REL - Recommended Exposure Limit

RI – Remedial Investigation

RIWP – Remedial Investigation/Feasibility Study Work Plan

SAP - Sampling and Analysis Plan

Site - The Lightman Drum Company Superfund Site in Winslow Township, New Jersey.

Support Zone - The area outside the Exclusion Zone that is considered clean for the purpose of the HASP. It is used for transfer of equipment and materials into the work site (i.e., support) and providing communications between the various zones.

TLV - Threshold Limit Value

USCG – United States Coast Guard

VOCs – Volatile Organic Compounds

## B.1.0 GENERAL INFORMATION AND SCOPE OF WORK

### B.1.1 Project Description

This Health and Safety Plan (HASP) has been prepared in support of the Remedial Investigation/Feasibility Study Work Plan (RIWP) for performance of the Remedial Investigation (RI) and Feasibility Study (FS) on behalf of the Lightman Yard PRP Group. This plan was prepared in accordance with "Guidance for Conducting Remedial Investigations and Feasibility Studies (RI/FS) under CERCLA" and the NIOSH/OSHA/USCG/EPA "Occupational Safety and Health Guidance Manual for Hazardous Waste Site Activities" as well as 29 CFR 1910.120, 29 CFR 1926 and applicable Federal and state regulations and guidelines. The plan will be reviewed as appropriate when field and/or laboratory data becomes available and amended to ensure that the proper level(s) of protection are maintained. This plan covers all field activities including drilling, hydrogeologic testing, and soil and groundwater sampling and applies to all on and off site activities associated with the RIWP.

### B.1.2 General Site Description

The following is a brief description of the Lightman Drum Company (Site). For more detailed information see Section 1.0 of the RIWP. The Site is located at 139 N. Route 73 within Winslow Township in Camden County, New Jersey. A map showing the approximate boundary of the Site is presented on Figure B-1. The site is approximately 15 acres and is located in a semi-rural area. The site is an active facility and is currently operating as a drum reclamation business. Volatile organic compounds (VOCs), semi-volatile organic compounds (SVOCs), and metals have been detected in Site groundwater. VOCs, SVOCs, pesticides, and metals have been detected in Site soils. Golder Associates Inc. (Golder) has been retained to characterize contaminants of potential concern (COPC) in soil and groundwater associated with the site.

### B.1.3 Project Safety Requirements

The level of protection and the procedures specified in this HASP are based on the information currently available and represent the minimum health and safety requirements to be observed by all Site personnel engaged in the RI. Unknown conditions at the Site may exist and known conditions may change. Should any situation arise which is beyond the scope of the personal protection and decontamination procedures specified herein, work activities shall be immediately halted pending discussion between the on-site Health and Safety Coordinator (HSC), the Health and Safety Officer (HSO), and/or Project Manager, and revision of the specified health and safety procedures, as needed. Any revision of the health and safety procedures will be recorded in the Field Procedure Change Authorization Form, shown in Attachment B-1, and will require authorization from the HSO and the Project Manager.

All Site personnel engaged in any of the project activities listed in Section B.1.1 must read this HASP carefully and complete the Site Health and Safety Plan Acknowledgement Form in Attachment B-2. Personnel who have any questions or concerns regarding implementation of this plan are encouraged to request clarification from the HSO or HSC. All personnel must follow the designated health and safety procedures, be alert to the hazards associated with working close to vehicles and equipment, and above all else, use common sense and exercise reasonable caution at all times.

### B.1.3.1 Designated Safety Personnel and Chain of Command

Personnel responsible for implementing this HASP include the following:

| | |
|---|---|
| David S. Ley, P.G. | Golder Associates On-Site Health and Safety Coordinator |
| Stuart D. Mitchell, P.G. | Golder Associates Cherry Hill, New Jersey Office Health and Safety Officer |
| Charles C. Haury, CIH, CSP | Golder Associates Corporate Health and Safety Officer |
| Robert J. Illes, P.G. | Project Manager |
| David S. Ley, P.G. | Remedial Investigation Manager |

Each subcontractor will have a designated HSC. HSCs are responsible for assuring that the designated procedures are implemented in the field. The Golder Associates HSC is responsible for coordinating site safety activities and has the authority to stop work for health and safety reasons.

The HSO has overall responsibility for establishing appropriate health and safety procedures for the project and will have the requisite authority to implement those procedures including, if necessary, the authority to temporarily suspend field activities for health and safety reasons.

The Project Manager also has the authority to take whatever actions may be necessary, based on the advice and direction of the HSC and/or HSO, to provide a safe working environment for all project personnel.

The ultimate responsibility for the health and safety of the individual employee rests with the employee, and his or her colleagues. Each employee is responsible for exercising the utmost care and good judgment in protecting his or her own health and safety and that of fellow employees. Should any employee observe a potentially unsafe condition or situation, it is the responsibility of that employee to immediately bring the observed condition to the attention of the appropriate health and safety personnel as designated above, and to follow-up the verbal notification by completing the "Unsafe Conditions and Practices" report form provided in Attachment B-3.

Should an employee find himself or herself in a potentially hazardous situation, the employee should immediately discontinue the hazardous procedure(s) and either personally affect appropriate preventive or corrective measures, or immediately notify the HSC or Project Manager of the nature of the hazard. In the event of an immediately dangerous or life-threatening situation, any employee <u>always</u> has "stop work" authority.

Unsafe work practices or procedures are never justified by "extenuating circumstances" such as budget or time constraints, equipment breakdown, changing or unexpected conditions, etc. In fact, the opposite is true. Under stressful circumstances all project personnel must be mindful of the potential to consciously or unconsciously compromise health and safety standards, and be especially safety conscious. All Site personnel are required to consider "safety first" at all times.

### B.1.3.2 Medical Surveillance and Training

All personnel engaged in field activities on this project must have baseline physical examinations and be participants in their employer's medical surveillance program. This program meets, at a minimum, the requirements of 29 CFR 1910.120(f). Procedures beyond baseline physical and routine medical surveillance are not planned for the tasks listed in Section B.1.1 of this HASP.

All project personnel, who have potential to contact contaminated soil, water, and/or air, must be trained in hazardous waste site investigation health and safety in accordance with 29 CFR 1910.120(e) including respiratory protection, personal protective clothing, decontamination, hazard recognition and the proper calibration and use of a photoionization detector (PID), and colorimetric detector tubes. Personnel must have appropriate refresher courses as detailed in 29 CFR 1910.120(e).

Personnel who operate specialized equipment (e.g., drill rigs, forklifts) shall be trained by their employer(s) to operate such equipment.

These training requirements apply to all employees unless the employer can demonstrate that the operation does not involve employee exposure, or the reasonable possibility for employee exposure, to safety and health hazards. Some non-intrusive activities (e.g. supply delivery, limited surveying activities) may meet this exemption. In that site conditions are subject to change, the training requirements for non-intrusive activities will be reviewed on a case-by-case basis. The HSC will make the determination on the case by case basis and will consult the HSO as necessary.

### B.1.3.3 First Aid

A first aid kit shall be available in all field vehicles and in the Site trailer, if applicable, during all site activities. This kit shall be of an appropriate size in relation to the number of personnel on site and shall include at a minimum two pairs of latex gloves, CPR barrier and eye wash solution, in addition to first aid supplies (e.g., bandages, first aid cream, antiseptic). See Section B.5.1 of this document for emergency response procedures.

### B.1.3.4 Communications

Mobile phones will be located in all field vehicles. Note that mobile phones operating outside of their original territory may not contact the proper (i.e., local) emergency response authorities. Mobile phone users would be better served by dialing the full appropriate emergency response numbers listed in Table B-1.

Additionally, if field operations require that two or more field teams work at the Site, but beyond visual/aural range, the "Buddy System" will be used. Workers or field teams that are not in the line of sight of each other may be equipped with two-way radios to maintain communication. Workers will also provide each other with assistance in checking the integrity of each other's personnel protective equipment (PPE), and will notify the HSO in case of emergency.

The protective equipment requirements for some tasks may necessitate the use of respiratory protection, which could adversely affect communications. In such instances, the field team will review basic hand signal communications during a safety briefing prior to donning respiratory protection equipment.

### B.1.4 General Hygiene and Conduct Guidelines

The following general personal hygiene and work practice guidelines are intended to prevent injuries and adverse health effects. These guidelines represent the minimum standard procedures for reducing potential risks associated with various aspects of this project and are to be followed by all Site personnel at all times.

- If the HSC deems that a respirator is necessary, any facial hair that would interfere with the proper fit of such equipment will not be worn.
- A multi-purpose dry chemical fire extinguisher, a complete field first aid kit, and a bottle of emergency eye wash solution shall be maintained in every field vehicle.
- Do not handle waste samples or any other potentially contaminated items unless wearing NBR (nitrile butadiene rubber) or neoprene rubber gloves, or equivalent, as a minimum. Employees should treat all unknown soil and water as if it were contaminated. Always make an effort to approach any potentially contaminated feature from upwind.
- Thoroughly wash hands and face before eating or putting anything in your mouth (i.e., avoid hand to mouth contamination).
- Eating, drinking, chewing gum or tobacco and smoking are permitted only in areas designated by the HSC. Under no circumstances will these activities be permitted in the immediate vicinity of any intrusive activities (e.g., drilling).
- Be alert to potentially changing exposure conditions, for example, as evidenced by perceptible odors or oily sheen on water.
- Do not, under any circumstances, enter or ride in or on any backhoe bucket, materials hoist, or any other similar device not specifically designed for carrying human passengers.
- Be alert to the symptoms of fatigue and heat/cold stress and their affects on the normal caution and judgment of personnel.
- Noise may pose a health and safety hazard, particularly during drilling and construction activities. A good rule of thumb is if it is necessary to shout to communicate at a distance of three feet in steady state (continuous) noise, hearing protection should be worn. Likewise, any impact noises from activities (e.g., driving casing on a drilling operation) which is loud enough to cause discomfort, would also indicate the need for hearing protection. Hearing protection is available and is included in the standard field kit along with hard hat and safety glasses.

- Always use an appropriate level of personal protection. Reduced levels of protection can result in preventable exposure; excessive levels of safety equipment can impair efficiency and increase the potential for accidents to occur.

- Be aware of the effect that inclement weather (rain, snow, ice, lightning) has on Site safety. Be prepared to suspend activities as conditions warrant.

- Extreme caution must be used when drilling, or other activities, that occur near overhead utility lines. The National Drilling Federation recommends a minimum distance of 20 feet between the lines and drill rig. Contact the local power company if you have any questions regarding utility line status or voltage. In addition, underground utilities must be positively located and marked prior to intrusive activities.

- All personnel are required to wear orange colored vests when working in the proximity of public rights-of-way and/or parking areas. Additionally, traffic cones and other warning devices may be required if the public rights-of-way are obstructed.

### B.1.5 Site Safety Meetings

The HSC shall conduct a Site safety briefing for all personnel and subcontractors directly involved in implementing the RI field activities on their initial arrival at Site. Personnel will be required to read the Health & Safety Plan and will be required to sign the declaration in Attachment B-2 before conducting any work on-site. The HSC shall indicate where the Material Safety Data Sheets (MSDS) will be located during Site activities so that they are readily available to the Site field investigation team and subcontractors.

The HSC or his/her designee shall conduct and document the date, time, content and attendees of these meetings, which will be held as needed. The topics to be covered are determined by the task activities, and should include:

- Weather and traffic related safety issues.
- Hazards specific to the task(s) and protective equipment.
- Unusual site conditions/areas.
- Safety problems and issues.
- Changes to the materials being used by Site field investigation team or subcontractors (i.e., additional MSDS available).
- Changes in the HASP.

## B.2.0 HAZARD EVALUATION

Potential Site hazards include chemical hazards, physical hazards, and biological hazards. Each of these groups of potential hazards is addressed in Table B-2.

### B.2.1 Potential Chemical Hazards

Results of previous investigations at the Site indicate that there are chemical impacts to the soil and groundwater. Table B-3 lists the Chemicals of Potential Concern (COPC) selected for the Site and associated exposure hazard information. The chemicals selected are chlorinated aliphatic and aromatic hydrocarbon VOCs, SVOCs, and metals based on the magnitude of historic detection, frequency of detection, and potential toxicity. MSDS for these COPCs are provided in Attachment B-5. Table B-4 summarizes the airborne exposure limits for these contaminants. The chemical hazard associated with the reported chemical concentrations in the groundwater and soil is toxicity. Potential hazards include:

(1) Inhalation of organic vapors due to the presence of VOCs in the soil and groundwater;

(2) Inadvertent ingestion of potentially toxic substances via hand to mouth contact or deliberate ingestion of materials inadvertently contaminated with potentially toxic materials; and,

(3) Dermal exposure and possible percutaneous (skin) absorption of certain lipophilic (readily absorbed through the skin) organic chemicals including benzene.

Exposure via the ingestion route can be controlled effectively by the means of good personal hygiene habits, and prohibition of smoking, eating, drinking and chewing in contaminated areas. Similarly, dermal exposure can be controlled by good personal hygiene and appropriate clothing. Inhalation hazards are addressed in Section B.4.3.

### B.2.2 Potential Physical Hazards

#### B.2.2.1 Heat Stress

Working in protective clothing can greatly increase the likelihood of developing heat stress. Heat stress can result in health effects ranging from transient heat fatigue to serious illness or death. The signs and symptoms of heat stress are presented in Section B.2.4. Workers shall monitor themselves and others for signs of heat stress when ambient temperatures exceed 70°F.

### B.2.2.2 Cold Stress

Personnel exposed to cold temperatures (especially during windy conditions) may be subjected to cold stress in the form of frost nip, frostbite or hypothermia. Signs and symptoms of cold stress are described in Section B.2.4. Workers shall monitor themselves and others for signs of cold stress when ambient temperatures are 40°F or less. Extra caution will be exercised when working in windy conditions and/or when clothing becomes wet.

### B.2.2.3 Confined Space Hazards

No confined space work is anticipated. Should such work become necessary, a Confined Space Entry Permit will be completed and an addendum to this HASP will be prepared. Written authorization by the Project Manager will be required prior to conducting any confined space work. The Project Manager will consult with the HSO prior to providing written authorization.

### B.2.2.4 Other Physical Hazards

All Site employees must take note of physical hazards which are identified during site safety briefings. These hazards include, but are not limited to: steep slopes, soft sediments, muck, creeks (trips, falls, and drowning); sharp debris from underbrush (puncture wound); overhead utilities, public traffic, over-exposure to the sun and slippery and/or congested walking surfaces (falls). Orange vests will be worn when working near public rights-of-way. Work areas such as drilling must be delineated using high visibility caution tape.

During drilling activities no more than two lengths of drill rod may extend above the top of the rig derrick at any time.

Field personnel must be alert to the hazards associated with site vehicles, drill rig operation, heavy equipment, and powered hand-held equipment operations. These hazards include noise, crushing injuries, overhead hazards, and pinch points. Personnel must be alert to weather-related hazards (e.g., lightning) or the possibility of increased hazard due to weather (e.g., slipping on mud or ice).

### B.2.3 Potential Biological Hazards

Contact with waste materials can lead to infected cuts. Personnel shall follow the guidelines for general hygiene in Section B.1.4 and follow first aid procedures for disinfection of cuts and abrasions in Section B.5.3.

The Site area may contain ticks, which can transmit Rocky Mountain Spotted Fever and Lyme Disease. During tick season (March to November), Site employees will check for ticks. Light colored clothing should be worn and any openings (shirt and pant cuffs) should be secured to inhibit tick movement from clothing to skin. The use of insect repellents should be considered if its use will not interfere with sampling activities. Personnel must check with their Project Manager before using repellents. Field personnel will acquaint themselves with the symptoms of tick-borne diseases detailed below and will contact a physician as well as the HSO if a disease is suspected.

The Site area may contain poison ivy which can be recognized by an oily sheen on the leaf and/or three leaflets together or similar vegetation. The active substances can be transmitted by direct skin contact and via contact with contaminated clothing. Field personnel should avoid contact with any vegetation that can irritate the skin.

### B.2.4 Signs and Symptoms of Exposure

#### B.2.4.1 Chemical Exposure

The health effects associated with the chemical contaminants at the site are varied. Personnel who experience any of the following symptoms should report the occurrence to the HSC promptly:

- skin, eye, or respiratory system irritations;
- skin rashes/burns;
- headaches/dizziness;
- nausea/gastrointestinal tract problems;
- muscle spasms/tremors;
- chills; and/or
- fatigue.

Note that the above symptoms are not necessarily caused by chemical exposure. Any serious medical problem should be promptly referred to professional medical care. If personnel experience any of the above symptoms, the HSC shall evacuate the area (upwind if possible) if necessary and evaluate affected personnel for signs and symptoms of exposure. Appropriate first aid measures shall be taken. The activity will not resume until the atmospheric conditions are evaluated using monitoring instruments by personnel wearing Level C (or B, if Level C was utilized when the incident occurred) PPE. Atmospheric conditions will be evaluated by monitoring for concentrations of VOCs and dust (as necessary) as described in Section B.3.0.

### B.2.4.2 Physical Exposure

The signs of heat fatigue are as follows:

- Heat rash may result from continuous exposure to heat or humid air.
- Heat cramps caused by heavy sweating with inadequate electrolyte replacement. Signs and symptoms include:
  - ◊ muscle spasms; and
  - ◊ pain in hands, feet, and abdomen.

Heat exhaustion results from increased stress on various body organs, including inadequate blood circulation due to cardiovascular insufficiency or dehydration. Signs and symptoms include:

- pale, cool, moist skin;
- heavy sweating;
- dizziness;
- nausea; and
- fainting.

Heat stroke is the most serious form of heat stress. Temperature regulation fails and the body temperature rises to critical levels. Immediate action must be taken to cool the body before serious injury and death occur. Competent medical help must be obtained. Signs and symptoms are:

- red, hot, usually dry skin;
- lack of or reduced perspiration;
- nausea;
- dizziness and confusion;
- strong, rapid pulse; and
- coma.

Working in protective clothing can greatly increase the likelihood of heat fatigue, heat exhaustion, and heat stroke, the latter being a life threatening condition. When working in ambient temperatures greater than 70°F, employees shall use the 'buddy system' to monitor each other's pulse rate at the start of each rest period. A rest period shall consist of a continuous time period of at least five (5) minutes preferably in a shaded area. The personnel will not be assigned to other work during this rest period. If the pulse rate exceeds 110 beats per minute, the employee shall take his or her oral temperature with a clean disposable calorimetric oral thermometer. If the oral temperature exceeds 99.6°F, the next work period shall be shortened by one third. The pulse rate and oral temperature shall be monitored again at the beginning of the next rest period; and if the oral temperature exceeds 99.6°F, the work period shall again be shortened by one third, etc., until the oral temperature is below 99.6°F.

All employees are to be alert to the possibility and symptoms of heat stress. If heat stress is suspected the employee will leave the work area, rest, cool off, and drink plenty of cool water/Gatorade/Squelcher or equivalent. Sufficient cool potable water and clean disposable cups shall be maintained at all times on-site. If the symptoms do not subside after a reasonable rest period, the employee shall notify the HSC and seek medical assistance.

Signs of cold stress include yellow or white patches of skin on the fingertips, nose and ears. These areas will be numb. The affected parts will be rewarmed gently and the patient will not return to work until additional protection (e.g., gloves, hard hat liner) is obtained. It is essential to prevent frostbite, as the person may become susceptible to future cold-related medical problems. Personnel are encouraged to change into dry socks after the lunch break as perspiration held by the socks prompts cooling of the feet. Should clothing become wet, it is imperative that the person change into dry clothes before resuming work. Wet clothing can lead to hypothermia. Symptoms of hypothermia include uncontrollable shivering, decreased physical and mental capabilities, and lowered body temperature. Persons exhibiting symptoms of cold stress or hypothermia will not return to work without the approval of the HSC.

### B.2.4.3 Biological Exposure

Since the bite of a tick has the potential to cause Rocky Mountain Spotty Fever, personnel should be aware that the symptoms include fever chills, headache, abdominal, muscle pain, and nausea.

A red rash develops at the wrist and ankles two to five days after exposure. Symptoms develop two to fourteen days after exposure.

Also spread by ticks is Lyme Disease. Symptoms include fatigue, stiffness (particularly in the neck). There may be a red circular rash. Fever may be present. Symptoms develop a few days to two years after exposure.

Personnel exhibiting symptoms of Rocky Mountain Spotted Fever or Lyme Disease should consult a medical professional immediately. Personnel bitten by a snake or any other wildlife will immediately clean the wound and proceed to the hospital for medical evaluation.

Skin-sensitizing (poisonous) vegetation produces a bumpy, swollen rash at the point of contact. This rash is easily spread if the oil gets on the fingers. Wash affected area(s) including tools, as soon as possible. Use over-the-counter medications to reduce the irritation. Avoid scratching the rash. Cover the affected area(s) with clean dressings. Severe exposure may necessitate evaluation by a medical professional.

If personnel are in need of immediate first aid, the guidelines outlined in Section B.5.1 for emergency medical procedures will be followed.

### B.2.5 Task Risk Analysis

Table B-5 presents a comparative risk analysis based on anticipated field activities and hazards. All personnel will be aware that specific hazards and the associated potential severity may be influenced by weather, season, and fatigue.

## B.3.0 SITE MONITORING AND ACTION LEVELS

Air monitoring is required during intrusive tasks. The requirements for air monitoring and associated action levels for each site activity are detailed in Table B-6. The monitoring methods involved and their interpretation are discussed in the following sections. Intrusive activities have the potential for exposures to VOCs.

### B.3.1 VOC Monitoring

VOCs that are of most concern from an inhalation standpoint are those that are moderately to highly toxic and have odor thresholds higher than their corresponding TLV. Vinyl chloride falls into this category. Since benzene is the COPC that has the lowest OSHA PEL (TWA 0.1 ppm), and since the ionization potentials for this compound is 9.24 eV, the Photo Ionization Detector (PID) that is used to monitor air quality will be equipped with at least a 10.6 eV lamp to detect for the presence of these compounds.

The designated HSC shall have on-site at all times during intrusive and groundwater sampling activities a PID. Calibration of the instrument must be checked daily prior to each day of use and then at least every four hours during use by introducing a known concentration of isobutylene gas in accordance with the manufacturer's instructions. Background levels must be established well upwind of any excavation, borehole, spoils pile, etc. During drilling/split spoon activity, the HSC shall monitor the borehole, split spoon samples, and employee breathing zone initially at the start of each task, then periodically as indicated by initial results, or whenever there is any indication that concentrations may have changed (odors, visible gases, appearance of drill cuttings, etc.) since the last measurement.

If a constant reading of >1 and ≤ 5 ppm above background level is detected for more than 5 minutes in the breathing zone, a detector tube for benzene shall be used to determine airborne concentrations. If the benzene concentration is less than 1 ppm in the breathing zone, and the total VOC concentration does not exceed 5 ppm for more than five minutes in the breathing zone, the PPE shall be Level "D". If a consistent reading > 5 ppm above background is detected for more than 5 minutes in the breathing zone or any peak > 25 ppm above background level in the breathing zone is detected, the PPE shall be upgraded to Level "C". If at any time the concentration of benzene exceeds 1 ppm in the breathing zone, the level of PPE shall be upgraded to Level "C". Furthermore, PPE should be upgraded to Level "B" if PID readings are consistently greater than 25 ppm, readings show frequent peaks greater than 50 ppm, or the concentration of benzene exceeds 100 ppm[1] in the breathing zone. Engineering or administrative control such as portable fans may be used to reduce exposure to or generation of VOC concentrations and possibly eliminate the need for respiratory protection. The HSO must be advised of conditions that warrant a change in the level of PPE and approve the revised procedures.

Given the rapid "break through" time of some substances, cartridges will be replaced after each day of use or immediately upon an indication of "break through" (perceptible odors inside of the mask), whichever is less. High humidity situations (>80% relative humidity) may require cartridge replacement at a more frequent rate (every 4 hours).

Engineering controls such as positioning activities upwind, covers, or additional ventilation may be used in place of respiratory protection if it is demonstrated through monitoring that the engineering controls are effective in reducing airborne concentrations.

### B.3.2 Nuisance Dust Monitoring

Nuisance dust and metals have the potential for becoming a problem during disruptive or intrusive activities such as drilling. The specific metal concentrations are variable through the site. Activities that generate dust will require engineering controls (e.g., water misting of the air and surrounding soil) before and during the activities. Should engineering controls be ineffective as evidenced by chronic visible airborne dust, Level C respiratory protection will be utilized, real time aerosol monitoring using an MIE PDM-3 miniram or equivalent will be conducted and the airborne metal concentration will be estimated using prior worst case soil concentration data for metals. The MIE PDM-3 miniram will be calibrated according to manufacturer's instructions prior to field use. Calibration will be performed at least weekly, or before and after sampling each day that the instrument is used if high concentrations of dusts are being measured.

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[1] Concentration based on a qualitative respirator fit test and the use of full face respirator.

When collecting measurements using the MIE PDM-3 miniram or equivalent, the readings will be taken over a minimum period of ten minutes in an area or areas representative of worker's breathing zone. The HSC will record the average result for the interval. This strategy accounts of variability in the concentration with time and avoids the situation where a decision to change PPE is made based on one instantaneous measurement.

## B.4.0 ON-SITE CONTROL

### B.4.1 Site Communication System

Personnel will operate using the "buddy system." Each individual shall maintain visual/aural contact with another individual or group at all times. If more than one group is working at a facility and the groups are not within visual/aural communication range, two-way radios may be necessary to maintain communications.

### B.4.2 Site Safety Zone and Access Control

No on-site safety zones are required for non-intrusive activities. During intrusive activities (e.g., drilling), an Exclusion Zone will be established by the on-site HSC, as required. The Exclusion Zone will generally be a 25-foot radius from the boreholes. Monitoring will be periodically conducted at the downwind perimeters to assure that the concentrations are similar to background concentrations. If perimeter concentrations are greater than background concentrations for more than five minutes, the downwind perimeter shall be extended, where practical, or engineering controls will be implemented such that downwind and background concentrations are similar. Exposed materials such as cuttings will be contained or covered and perimeter monitoring will continue until ambient air concentrations upwind and downwind of the Exclusion Zone are equal. The limits of the Exclusion Zone will be marked with high visibility flagging tape or four or more traffic cones or similar devices.

The Exclusion Zone will be accessed through a marked Contamination Reduction Zone (CRZ). The CRZ shall be used for gross decontamination of both personnel and equipment items. It shall be configured to allow the decontamination of the field crew while upwind of the Exclusion Zone. The HSC or his/her designee will assure that all personnel entering the Exclusion Zone wear the required protective equipment and that upgraded level of protection equipment is readily available.

A temporary decontamination area will be set up at the Site (as needed) where intrusive sampling activities will be performed. All decontamination materials and liquids from all areas will be properly collected until proper disposal occurs.

### B.4.3 Personal Protective Clothing and Respiratory Protection

The following scheme will be used to designate the required level(s) of personal protective equipment and respiratory protection: the alphabetical designations "B", "C", and "D" shall refer specifically to levels of respiratory protection, namely pressure-demand air supplying respirators with escape provisions, air purifying respirators, and no respiratory protection, respectively. Since potential dermal exposure hazards may require a wide variety of personal protective clothing without regard to the required level of respiratory protection, the numerical designations "1", "2", and "3" will be used to specify the level of protective clothing that is to be employed in addition to the designated level of respiratory protection as described below (i.e., the level of protective equipment can be completely defined by a designation of "D-1", "D-2", etc.). The required levels of protective equipment and upgrade criteria for each work task are specified in Table B-6. All equipment and clothing shall be inspected by the wearer prior to use. All suspect protective equipment will be rejected and disposed of as non-contaminated waste.

The initial level of personal protective clothing required during Site activities will be D-1 which consists of the following:

LEVEL D-1, PROTECTIVE CLOTHING

1. Standard work clothes (long pants and sleeved shirt);
2. Steel toed boots;
3. Safety glasses;
4. Orange safety vests (when working near public traffic);
5. Hard hats (when an overhead hazard is possible) and;
6. Hearing protection (during drilling and other noise producing activities).

Protective clothing will be upgraded during sampling activities and will consist of the following:

LEVEL D-1, MODIFIED PROTECTIVE CLOTHING

1. Level 1 protective clothing;
2. Inner latex gloves; and
3. Outer NBR gloves.

LEVEL D-2, PROTECTIVE CLOTHING

1. Level 1 protective clothing;
2. Inner latex gloves;
3. Outer NBR gloves; and
4. Polycoated Tyvek or Tyvek coveralls with taped openings.

LEVEL C PROTECTION

1. Full face air-purifying respirator[2];
2. Polycoated tyvek;
3. Boots: chemical protective, steel toed;
4. Chemical protective inner and outer gloves; and,
5. Hard hat (when overhead hazard is possible).

LEVEL B PROTECTION

1. Level C protective clothing; and,
2. Supplied air (open or closed circuit).

Field personnel may upgrade to Polycoated Tyvek or Tyvek coveralls (D-2) where it is probable that there will be substantial contact with subsurface soils or groundwater containing elevated levels of COPC. Polycoated Tyvek or Tyvek coveralls might also be worn when working in muddy conditions.

If conditions are found which are beyond the required Level(s) of Protection, personnel are to leave the area immediately and obtain the required protective equipment. Should the personnel suspect an inhalation hazard (e.g., unusual and continuous odors, dizziness, or respiratory irritation), they are to immediately move upwind from the area and promptly notify the HSC. Work will not proceed in these areas until the nature of the hazard has been assessed by air monitoring and additional protective measures are employed to the satisfaction of the HSC. Re-entry will be from an upwind position (when possible). Monitoring will proceed re-entry. Personnel who experienced symptoms will not re-enter the area until symptoms have subsided and additional equipment/precautions are employed as determined by the monitoring. An examination by a physician may be prudent depending on the symptoms and duration.

### B.4.4 Decontamination

Decontamination will involve two phases. Gross decontamination of personnel and equipment, comprising removal of mud by dry brushing or scraping, will take place in the CRZ established at the site of each intrusive activity. Soil removed in this way will be backfilled into the borehole or collected and secured in a fenced storage area. All personnel and equipment will undergo gross decontamination prior to moving to a new investigation location. Prior to leaving the Site,

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[2] Prior to use, Site personnel must have a qualitative respirator fit test.

personnel and equipment will undergo full decontamination at the temporary decontamination pad.

Decontamination Procedures

All personnel involved in intrusive activities and/or contaminated personnel shall decontaminate prior to leaving the Site. The Decontamination Pad area shall have plastic sheeting on the ground of sufficient size to contain the personnel, hand held equipment and decontamination materials required. A typical Decontamination Area will require:

- 2 wash tubs (1 wash, 1 rinse);
- several scrub brushes;
- disposable towels and plastic bags;
- decontamination solution (e.g. Alconox);
- hand soap;
- skin wash water source; and
- special rinse solutions for hand sampling tools (see SAP).

Personnel will follow the decontamination procedure below. At a minimum all personnel will wash their hands and face prior to eating, smoking or leaving the Site. The HSC shall inspect personnel and non-disposable protective equipment for cleanliness prior to release from the Site.

**Step 1: Equipment Drop**
Deposit equipment used on-site (hand tools, sampling devices and containers, monitoring instruments, clipboards, etc.) on plastic drop cloths. Segregation at the drop reduces the probability of cross contamination. During hot weather operations, a cool down station may be set up.

**Step 2: Outer Garment, Boots, and Gloves Wash and Rinse**
Scrub boots, outer gloves and splash garments (if worn) with decontamination solution. Rinse off with water.

**Step 3: Outer Glove Removal**
Remove outer gloves (if worn). Deposit in container with plastic liner.

**Step 4: Cartridge or Respirator Change (if applicable)**
If worker leaves exclusion zone to change cartridges (or respirator), this is the last step in the decontamination procedure. Worker's canister is exchanged, new outer gloves donned, joints taped, and worker returns to duty.

**Step 5: Boot, Gloves and Inner Garment Removal (if applicable)**
Boots, protective suit, inner gloves (if worn) removed and deposited in disposal containers.

**Step 6: Respirator Removal (if applicable)**
Respirator is removed. Avoid touching face with fingers, respirator deposited on plastic sheet.

**Step 7: Field Wash**
Hands and face are thoroughly washed. Shower as soon as possible.

Monitoring equipment and hand tools shall be retrieved and decontaminated using methods appropriate for the type of equipment. The HSC shall inspect the equipment for cleanliness.

Certain sampling equipment (e.g., hand sampling tools) may require specific decontamination procedures and/or chemicals. Site personnel are to refer to the SAP for this information.

All chemicals brought to the Site will have the appropriate MSDS provided to the HSC. This requirement also applies to drilling materials. The MSDS will be maintained in the field files at a location accessible to the Site field investigation team members and subcontractors. Any additional materials brought on Site will be accompanied by the appropriate MSDS, which will be provided to the HSC.

All disposable personal protective equipment will be double bagged in plastic bags and disposed of as municipal wastes. All decontamination materials will be drummed in 55-gallon drums. The solids and liquids will be separated and subsequently disposed as Investigation Derived Waste (IDW).

## B.5.0 CONTINGENCY AND EMERGENCY RESPONSE PLANS

If an unanticipated, potentially hazardous situation arises as indicated by visible contamination, unusual or excessive odors, Site personnel shall temporarily cease operations, move away to a safe area, and contact the HSC. The following procedures have been established to deal with emergency situations that might occur during field activities. Prior to starting work at a particular facility, the local emergency response services will be contacted and informed that field activities will be in progress. Site personnel will familiarize themselves with the location of the nearest phones and medical facilities on arrival at the Site. In the event of a serious emergency situation (e.g. medical problems beyond routine first aid, explosive gas concentrations, or fire beyond incipient stage), Site personnel shall contact the Cheiselhurst Police Department, inform them of the nature of the emergency, and then notify the HSO. When help arrives, Site personnel shall defer all emergency response authority to appropriate responding agency personnel. Emergency notification information is summarized in Table B-1.

### B.5.1 Medical Emergency Response Plan

The nature of chemical contamination on this project is not anticipated to present an immediate threat to human health. Other than removal of outer protective garments and gross contamination (e.g., mud), immediate emergency treatment of injuries should therefore generally take precedence over personal decontamination.

Should any person be injured or become ill during implementation of the field activities, initiate the following emergency response plan and notify the HSC as soon as possible:

1. If able, the injured person should proceed to the nearest available source of first aid. If the injured party is extremely muddy, remove outer garments and if necessary, wash the injured area with soap and water. If the "injury" involves a potential overexposure to hazardous gases or vapors, (headache, dizziness, nausea, disorientation), get the victim to fresh air and take him or her to the Kennedy Family Health Service, 1000 Industrial Drive, Waterford Works, NJ 08089, (856) 309-7700, for a complete physical examination as soon as possible.

   If the injury involves foreign material in the eyes, immediately flush the eyes with emergency eye wash solution and/or rinse with copious amounts of potable water. Obtain or administer first aid as required. If further medical treatment is required, seek professional medical assistance as discussed below.

Appropriate measures should be taken to protect the privacy of workers in connection with putting on and taking off of protective clothing. First aid providers shall wear latex gloves when providing any first aid. Severe injuries involving large quantities of blood require that first aid providers don Tyvek coveralls and safety glasses in addition to gloves.

2. If the victim is unconscious or unable to move, or if there is any evidence of spinal injury, do not move the injured person unless absolutely necessary to save his or her life, until the nature of the injury has been determined. Administer rescue breathing using a CPR barrier if the victim is not breathing, control severe bleeding and immediately seek medical assistance as discussed below.

3. If further medical treatment is required and

   a. the injury is not severe, contact Kennedy Family Health Service (856) 309-7700 and take the injured party to the hospital by private automobile.

      Directions to the Hospital from Route 73 near the site (see Figure B-2):

      - Travel South on Route 73 for approximately 0.6 miles
      - Turn left (east) onto Pump Branch Road
      - Drive 2.2 miles and turn right (south) onto U.S. 30
      - Drive 0.3 miles and turn left onto Dayton Avenue

   b. If the injury is severe, immediately call the Cheiselhurst Police Department at (856) 767-2768 or 911 using a standard phone.

   In both cases, if decontamination is not undertaken, appropriate precautions should be taken to avoid transfer of contaminants to vehicles and other facilities. This can be done by using plastic sheeting or the exposure blanket contained in the first aid kit.

4. Any injured person taken to the hospital shall be accompanied by an individual designated by the HSC to ensure prompt and proper medical attention. After proper medical treatment has been obtained, the designated companion should notify the HSO and prepare a written report. Site personnel shall maintain their medical insurance identification whenever they are on Site.

   In the event that any personnel are injured at a particular facility during any phase of the Investigation, all available technical information and supporting documentation shall be provided to any treating physicians, or treating health care workers or facilities.

### B.5.2 Fire and Explosions

Dry chemical fire extinguishers are effective for fires involving ordinary combustibles such as wood, grass, flammable liquids, and electrical equipment. They are appropriate for small, localized fires such as a drum of burning refuse, a small burning gasoline spill, a vehicle engine fire, etc. No attempt should be made to use these extinguishers for well established fires or large areas or volumes of flammable liquids.

In the case of fire, prevention is the best contingency plan. There will be no smoking at the Site except in pre-designated areas. In the event of a fire, personnel shall attempt to extinguish the fire with on-site fire extinguishers. If a fire cannot be controlled in this manner, personnel shall notify the HSC and follow the procedure outlined below.

Catalytic converters on the underside of vehicles are sufficiently hot to ignite dry grass. Personnel should avoid driving over dry grass that is higher than the ground clearance of the vehicle, and be aware of the potential fire hazard posed by the catalytic converter, at all times. Never allow a running vehicle to sit in a stationary position over dry grass or other combustible materials.

In the event of a fire or explosion:

1. If the situation can be readily controlled with available resources without jeopardizing the health and safety of Site personnel, take immediate action to do so. If not:
2. Isolate the fire to prevent spreading, if possible.
3. Clear the area of all personnel working in the immediate vicinity.
4. Immediately notify site emergency personnel and the Winslow Township Fire District. (609) 561-4225 or 911 using a standard phone.

### B.5.3 Chemical Exposure First Aid

In an event of exposure to chemicals through inhalation:

1. Move the victim to an up-wind location for fresh air.
2. Signal for help.
3. Initiate CPR to revive the victim, if necessary.
4. Contact the Cheiselhurst Police Department, if necessary.

For exposure through dermal route (including eyes):

1. Wash the affected area with copious fluids for at least fifteen (15) minutes (Signal for help if necessary).
2. If irritation persists, seek professional medical care.

For ingestion:

1. Drink a large amount of water to dilute the contaminant(s).
2. Transport the victim to the hospital. Take a copy of this HASP to the hospital.

If decontamination is not undertaken prior to transporting the victim to the hospital, appropriate precautions should be taken to avoid transfer of contaminants to vehicles and other Site.

### B.5.4 Unforeseen Circumstances

The health and safety procedures specified in this plan are based on the information available at the time. Unknown conditions may exist, and known conditions may change. This plan cannot account for every unknown or anticipate every contingency. Should personnel suspect or encounter areas of substantially higher levels of contamination, or should any situation arise which is obviously beyond the scope of the safety procedures specified herein, work activities shall be modified (such as by moving to another location) or halted pending discussions with the HSO and implementation of appropriate protective measures.

### B.5.5 Accident and Incident Reports

If an incident or accident occurs, the HSO and Project Manager shall be notified and the Incident Report (shown in Attachment B-4) shall be completed. The report shall be completed by an eye witness (if possible) along with assistance from the HSC. The report will be forwarded to the HSO as soon as possible for further investigation or follow-up.

### B.5.6 Emergency Contacts

Emergency notification information is summarized in Table B-1.

## TABLE B-1

## EMERGENCY RESPONSE NUMBERS

| | |
|---|---|
| Golder Associates Inc | 856-616-8166 |
| Site Location Address | 139 Route 73, Winslow Township, New Jersey |
| Mobile telephone located in | Field vehicles |

| | |
|---|---|
| Emergency | 911 if using standard phone |
| Ambulance | 911 if using standard phone |
| Fire (Winslow Township FD) | 609-561-4225 |
| Police (Chesilhurst PD) | 856-767-2768 |
| Hospital Name | Kennedy Family Health Services |
| Hospital Phone Number | 856-309-7700 |
| Project Manager | Robert J. Illes, P.G. (856-616-8166 ext. 390) |
| Site Health and Safety Coordinator | David Ley, P.G. (856-616-8166 ext.468) |
| Health and Safety Officer | Stuart Mitchell, P.G. (856-616-8166 ext. 478) |
| Client Contact | Robert J. Illes, P.G. (856-616-8166 ext. 390) |
| EPA Information Line | 800-424-8802 |
| State Agency, NJDEP Hot Line | 877-927-6337 |
| Poison Control Center | 800-962-1253 |

## UTILITY MARKER EMERGENCY TELEPHONE NUMBERS

| Utility | Color Code | Telephone Number |
|---|---|---|
| Water | Blue | 1-800-272-1000 |
| Gas | Yellow | 1-800-272-1000 |
| Electric | Red | 1-800-272-1000 |
| Telephone/Cable | Orange | 1-800-272-1000 |
| Sewer | Green | 1-800-272-1000 |
| NJ One Call System: 1-800-272-1000 | | |

## TABLE B-2
## POTENTIAL SITE HAZARDS

| Hazard | Drilling | Site Walk | Groundwater Sampling | Soil Sampling | Surface Water/Sediment Sampling |
|---|---|---|---|---|---|
| Contaminants of Potential Concern Exposure | X | | X | X | X |
| Mechanical Equipment/Construction | X | X | X | X | X |
| Lifting and Material Handling | X | | X | X | X |
| Slip/Trip/Fall | X | X | X | X | X |
| Electrical | X | | X | X | |
| Fire and Explosion | X | X | X | X | X |
| Heat/Cold Stress | X | X | X | X | X |
| Vehicular Traffic | X | X | X | X | |
| Noise | X | | | | |
| Exposure to sun | X | X | X | X | X |
| Poisonous Plants | X | X | X | X | X |
| Snakes/Spiders/Insects | X | X | X | X | X |

## TABLE B-3
## SITE CHEMICALS OF POTENTIAL CONCERN

| | | Estimated Site Specific Exposure Hazard Information | | | | | |
|---|---|---|---|---|---|---|---|
| Chemicals of Interest | CAS # | Gases/Vapors Dusts/Mists Inhalation Risks | Dermal Absorption of Solids or Liquids Risks | Ingestion Risks | Skin/Eye & Respiratory System Irritation Risk | Fire Hazard Risks | Reactivity/ Explosion Risks |
| Antimony | 7440-36-0 | Low | Low | Low | Low | Low | Low |
| Arsenic | 7440-38-2 | Low | Low | Moderate | Low | Low | Low |
| Benzene | 71-43-2 | Moderate | Moderate | Low | Low | Low | Low |
| Benzidine | 92-87-5 | Low-Mod | Low-Mod | Low-Mod | Low | Low | Low |
| Beryllium | 7440-41-7 | Low | Low | Moderate | Low | Low | Low |
| Cadmium | 7440-43-9 | Low | Low | Low | Low | Low | Low |
| Chromium | 7440-47-3 | Low | Low | Low | Low | Low | Low |
| 1,1-Dichloroethene | 75-35-4 | Moderate | Low | Low | Low | Low | Low |
| 1,2-Dichloroethene (cis) | 156-59-2 | Moderate | Low | Low | Low | Low | Low |
| 2,4-Dimethylphenol | 105-67-9 | Low-Mod | Low-Mod | Low | Low | Low | Low |
| 1,2-Diphenylhydrazine | 122-66-7 | Low-Mod | Low | Low | Low | Low | Low |
| Ethylbenzene | 100-41-4 | Moderate | Low | Low | Low | Low | Low |
| Isophorone | 78-59-1 | Low | Low | Low | Low | Low | Low |
| Lead | 7439-92-1 | Low | Low | Moderate | Low | Low | Low |
| Nickel | 7440-02-0 | Low | Low | Low | Low | Low | Low |
| Phthalate esters | 117-81-7 | Low | Low | Low | Low | Low | Low |
| Silver | 7440-22-4 | Low | Low | Low | Low | Low | Low |
| Tetrachloroethene | 127-18-4 | Moderate | Low | Low | Low | Low | Low |
| Toluene | 108-88-3 | Moderate | Moderate | Moderate | Low | Low | Low |
| Trichloroethene | 79-01-6 | Moderate | Low | Low | Low | Low | Low |
| Xylenes | 1330-20-7 | Moderate | Low | Low | Low | Low | Low |

Physical properties for the Chemicals of Potential Concern are shown on the MSDS in Attachment B-5.
Effects of exposure to the Chemicals of Potential Concern are shown on the MSDS in Attachment B-5.
Airborne Exposure Limits for the Chemicals of Potential Concern are shown on Table B-4.

## Table B-4
## Airborne Exposure Limits

| | NIOSH REL | | OSHA PEL | | | | ACGIH TLV | IDLH | Ionization Potential |
|---|---|---|---|---|---|---|---|---|---|
| **Chemical** | **TWA** | **STEL** | **TWA** | **STEL** | **Ceiling** | **max peak** | | | **(eVolts)** |
| Benzene | 0.1 ppm* | 1 ppm | 1 ppm | 5ppm | NE | NE | 0.5 ppm (TWA) | 500 ppm* | 9.24 |
| Dichloroethenes (1,2) | 200 ppm | NE | 200 ppm | NE | NE | NE | 200 ppm (TWA) | 1000 ppm | 9.65 |
| Ethylbenzene | 100 ppm | 125 ppm | 100 ppm | NE | NE | NE | 100 ppm (TWA)/125 ppm (STEL) | 800 ppm | 8.76 |
| Tetrachloroethene | Ca - minimize | NE | 100 ppm | NE | 200 ppm | 300 ppm (5min/3hour) | 25 ppm (TWA)/100 ppm (STEL) | 150 ppm* | 9.32 |
| Toluene | 100 ppm | 150 | 200 ppm | NE | 300 ppm | 500 ppm (10 min) | 50 ppm (TWA) | 500 ppm | 8.82 |
| Trichloroethene | 25 ppm | NE | 100 ppm | NE | 200 ppm | 300 ppm (5min/2hr) | 50 ppm (TWA)/100 ppm (STEL) | 1000 ppm* | 9.45 |
| Xylenes | 100 ppm | 150 | 100 ppm | NE | NE | NE | 100 ppm (TWA)/150 ppm (STEL) | 900 ppm | 8.56 |
| Isophorone | 4 ppm | NE | 25 ppm | NE | NE | NE | 5 ppm (Ceiling) | 200 ppm | 9.07 |
| 2,4-Dimethyl phenol (1) | | | | | | | | | |
| 1,2-Diphenyl hydrazine (1) | | | | | | | | | |
| Antimony | 0.5 mg/m3 | NE | 0.5 mg/m3 | NE | NE | NE | 0.5 mg sb/m3 (TWA) | 50 mg/m3 | NA |
| Arsenic | NE | 0.002 mg/m3 | 0.01 mg/m3 | NE | NE | NE | 0.01 mg As/m3 (TWA) | 5 mg As/m3 | NA |
| Cadmium | NE | NE | 0.005 mg/m3 | NE | NE | NE | 0.01 mg/m3 (total dust)/0.002 mg/m3 (respirable dust) | 9 mg/m3 | NA |
| Chromium (III) | 0.5 mg/m3 | NE | 0.5 mg/m3 | NE | NE | NE | 0.5 mg/m3 (TWA) | 25 mg/m3 | NA |
| Beryllium | 0.0005 mg/m3 (not to exceed) | | 0.002 mg/m3) | NE | 0.005 mg/m3 | 0.025 mg/m3 (30 min) | 0.002 mg/m3 (TWA) | 4 mg/m3 | NA |
| Lead | 0.05 mg/m3 | NE | 0.05 mg/m3 | NE | NE | NE | 0.05 mg/m3 (TWA) | 100 mg/m3 | NA |
| Nickel | 0.015 mg/m3 | NE | 1 mg/m3 | NE | NE | NE | 1.5 mg/m3, inhalable (TWA) | 10 mg/m3 | NA |
| Silver | 0.01 mg/m3 | NE | 0.01 mg/m3 | NE | NE | NE | 0.1 mg/m3 (metal)/0.01 mg/m3 (soluble compounds) | 10 mg/m3 | NA |

Notes:

(1) - No Data Available

All concentrations are expressed in ppm with the exception of IP which is presented in eV.

**NIOSH REL** - National Institute of Occupational Safety and Health Recommended Exposure Limit

**NIOSH TWA** - refers to the Time weighted average concentrations for up to a 10-hour workday during a 40-hour work week.

**OSHA PEL** - Occupational Safety and Health Adminstration Permissable Exposure Limit

**OSHA TWA** - refers to concentrations that must not be exceeded during any 8-hour workshift of a 40-hour workweek.

**STEL** - for both NIOSH and OSHA refers to the short-term exposure limit 15-minute TWA exposure that should not be exceeded at any time during a workday

**max peak** - refers to the amount of exposure above the ceiling value that is acceptable for the indicated time in minutes within a established period of time in a 8-hour workday. The amount of exposure should never exceed the maximum peak.

**Ceiling REL** - refers to the exposure concentration that should not be exceeded at any time.

**ACGIH TLV** - American Conference of Governmental Industrial Hygienists Threshold Limit Value

**IDLH** - Immediately Dangerous to Life or Health concentrations

**minimize** - minimize exposure to the lowest achievable concentration.

*** or Ca** - indicates that NIOSH considers the chemical to be a potential occupational carcinogen and the exposure limit is considered the lowest achievable exposure.

**NE** - none established

## Table B-5
## Comparative Risk Analysis

This table details site activities and anticipated associated risks by class: Biologial, Chemical, or Physical. Personal Protective Equipment level, weather, air temperature and season may effect the magnitude of some types of risk. Site personnel shall use prudent judgement at all times.

| Task/Activity | Hazard | | |
|---|---|---|---|
| | Biological | Chemical | Physical |
| Walk Through | L-M | L-M | L |
| Groundwater Sampling | L-M | L-M | L-M |
| Soil Sampling | L-M | L-M | L-M |
| Surface Water/Sediment Sampling | L-M | L-M | L-M |
| Drilling | L-M | L-M | L-H |

Many of the chemicals identified in the on site media can enter through the skin. This route of entry must be protected whenever skin contact is probable.

L: Low
M: Moderate
H: High

## Table B-6
## Air Monitoring and Associated Action Level Requirements

| Task | Initial Level of Protection | Air Monitoring Equipment | Upgrade Criteria | Upgraded Level of Protection | Remarks (See footnote 1) |
|---|---|---|---|---|---|
| Walk Through | D-1 | NA | Condition Dependent | Condition Dependent | |
| Soil Sampling<br>Groundwater Sampling<br>Surface Water Sampling<br>Sediment Sampling | Modified D-1 or D-2(2) | PID | VOCs continuously > than 5 ppm for more than 5 minutes above background or any peak > than 25 ppm above background | C | Section B3.3 |
| | | PID/Draeger Tube - Benzene | VOCs continuously > 1 ppm and < or = to 5 ppm above background level for more than 5 minutes, a detector tube for benzene shall be used to determine airborne concentrations. | Benzene > 1ppm Temporarily cease work until concentration subsides and evacuate immediate area or C2 | |
| | | PID/Draeger Tube - Benzene | Continuously greater than 25 ppm, or frequent peaks > than 50 ppm, or benzene concentrations > 100 ppm | Temporarily cease work until concentration subsides and evacuate immediate area or B2 | |
| Drilling/Well Installation and Development | D-1 or D-2(2) | PID | VOCs continuously > than 5 ppm for more than 5 minutes above background or any peak > than 25 ppm above background | C | Section B3.3 |
| | | PID/Draeger Tube - Benzene | VOCs continuously > 1 ppm and < or = to 5 ppm above background level for more than 5 minutes, a detector tube for benzene shall be used to determine airborne concentrations. | Benzene > 1ppm Temporarily cease work until concentration subsides and evacuate immediate area or C | |
| | | PID/Draeger Tube - Benzene | Continuously greater than 25 ppm, or frequent peaks > than 50 ppm, or benzene concentrations > 100 ppm | Temporarily cease work until concentration subsides and evacuate immediate area or B | |
| | | MIE PDM-3 miniram (or equivalent) | <2 $mg/m^3$ above background | Wear Level D-1(2) PPE | |
| | | | >2$mg/m^3$ to 100 $mg/m^3$ sustained for 10 minutes or peaks > 25 $mg/m^3$ | Use wet methods (water spray) or other engineering controls to reduce levels<br>Use Level C PPE if water spray fails to reduce dust concentrations | |
| | | | > 100 $mg/m^3$ peak or sustained | Cease work and contact the HSO | |
| Drill Rig/ Equipment Decontamination | D-2 | NA | NA | NA | |

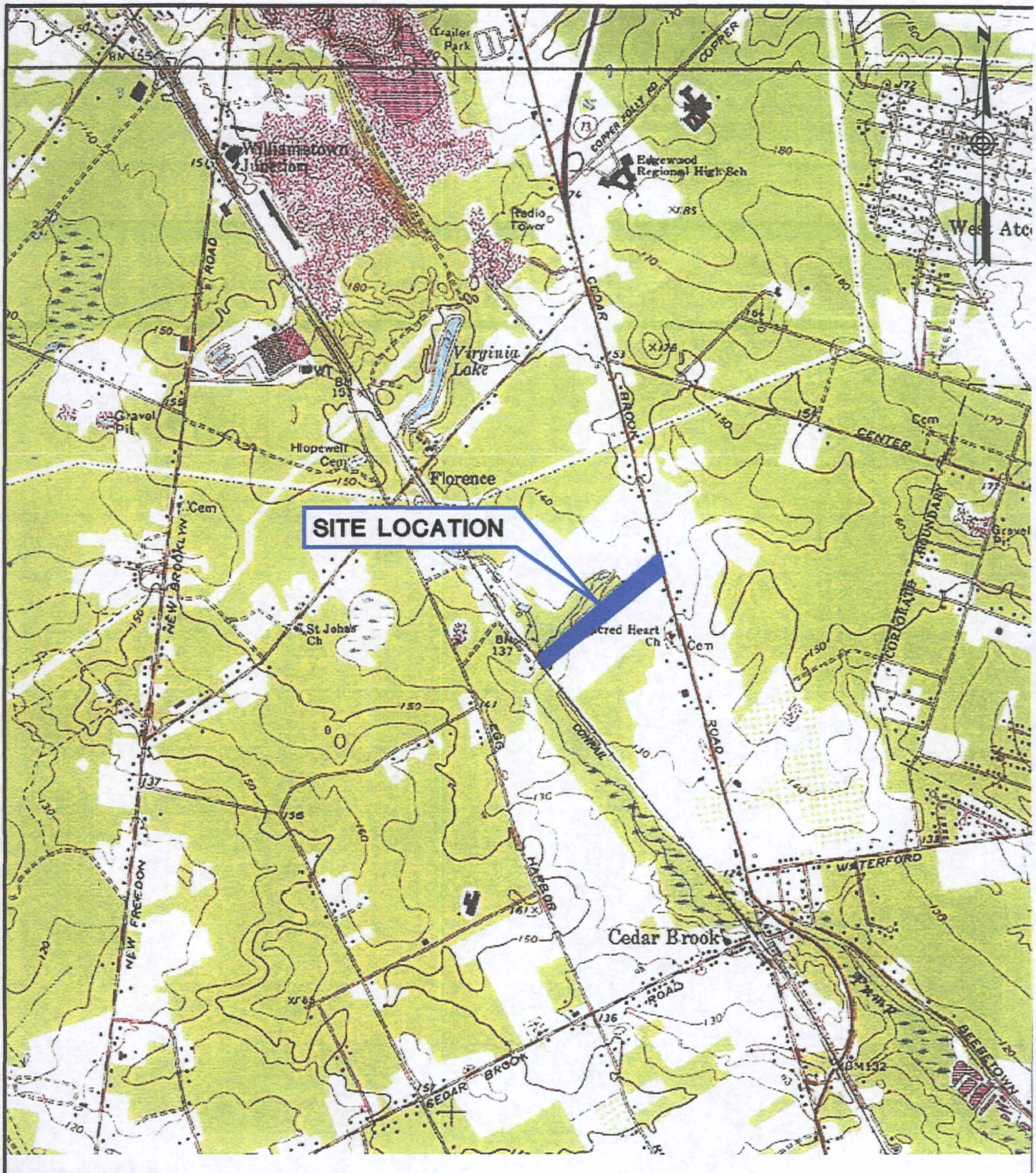
Notes:

(1) The HSO must be advised of conditions that warrant a change in PPE and approve the revised procedure.

(2) Field personnel may upgrade to polycoated Tyvek or Tyvek coveralls where it is probable that there will be substantial contact with subsurface soils or groundwater containing elevated levles of COPCs.

Condition Dependent: Personnel are to use prudent judgement and select additional PPE based on current Site conditions (e.g., wet or muddy) to prevent unnecessary contamination.

Site personnel are permitted, with HSO approval , to substitute protective aprons and/or gauntlets when exposure to water/sediment samples is readily controlled. This substitution is permitted to reduce the possibility of heat stress caused by working in full coverall protection.



## REFERENCE

1.) MAP TAKEN FROM U.S.G.S. 7.5 MINUTE QUADRANGLE OF WILLIAMSTOWN, NEW JERSEY, DATED 1981.

2000 0 2000

scale feet

| | | | |
|---|---|---|---|
| JOB No.: | 013-6054 | SCALE: | AS SHOWN |
| CAD BY: | AM | DATE: | 02/21/01 |
| CHK BY: | LAH | FILE No.: | NJ04-699 |
| REV BY: | | DR SUBTITLE: | 01 |

## SITE LOCATION MAP

**Golder Associates**

LIGHTMAN DRUM COMPANY

FIGURE **B-1**

©2001 MapQuest.com, Inc.; ©2001 GDT, Inc.

## REFERENCE

MAP TAKEN FROM MAPQUEST OF WILLIAMSTOWN, NEW JERSEY.

2400 0 2400
approximate scale feet

| | | | | |
|---|---|---|---|---|
| JOB No.: | 013-6054 | SCALE: | AS SHOWN | **HOSPITAL ROUTE MAP** |
| CAD BY: | AM | DATE: | 02/21/01 | |
| CHK BY: | LAH | FILE No.: | NJ04-700 | |
| REV BY: | | DR SUBTITLE: | 01 | |
| **Golder Associates** | | | LIGHTMAN DRUM COMPANY | FIGURE **B-2** |

# ATTACHMENT B-1

# FIELD PROCEDURE CHANGE AUTHORIZATION FORM

## ATTACHMENT B-1

## FIELD PROCEDURES CHANGE AUTHORIZATION

Instruction Number: ______ Date:_______

Duration of Authorization Requested ___ Today only

___ Duration of Task

---

Description of Procedures Modification:

---

Justification:

---

Person Requesting Change: Verbal Authorization Received From:

| | | |
|---|---|---|
| Name | Name | Time |
| Title | Title | |
| Signature | Approved By | |

(Signature of person named above to be obtained
within 48 hours of verbal authorization)

# ATTACHMENT B-2

# SITE HEALTH AND SAFETY PLAN ACKNOWLEDGEMENT

## ATTACHMENT B-2

## SITE HEALTH AND SAFETY PLAN ACKNOWLEDGEMENT

I have read understand and agree to follow the provisions detailed in the Health and Safety Plan for the Lightman Drum Company Site.

I am aware of emergency procedures, equipment locations, and emergency telephone numbers.

I understand that my failure to comply with these provisions may lead to disciplinary actions and/or my dismissal from the Site.

| Printed Name | Organization | Signature | Date |
|---|---|---|---|
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |

This form is to be kept on file on Site. Copies should be made available to personnel from all companies involved with Site work.

# ATTACHMENT B-3

# REPORT FORM FOR UNSAFE CONDITIONS AND PRACTICES

## ATTACHMENT B-3

## REPORT FORM FOR UNSAFE CONDITIONS AND PRACTICES

**DESCRIPTION OF UNSAFE CONDITION OR PRACTICE** ____________________

____________________________________________

____________________________________________

____________________________________________

____________________________________________

**DESCRIPTION OF CIRCUMSTANCES SURROUNDING UNSAFE CONDITION OR PRACTICE** ____________________________________________

____________________________________________

____________________________________________

____________________________________________

____________________________________________

**IS THIS AN EXISTING CONDITION OR POTENTIAL HAZARD?** ____________

**REPORTED TO** ____________________________________

**REPORTED BY** ______________ **DATE** ______________

**COMMENTS** ____________________________________________

____________________________________________

____________________________________________

____________________________________________

____________________________________________

**REPORT RECEIVED BY** ____________________**(Health and Safety Officer)**

**DATE** ______________ ______________________________
(Signed)

# ATTACHMENT B-4

# INCIDENT REPORT FORM

## ATTACHMENT B-4

## INCIDENT REPORT FORM

**In the event of any injury, accident or illness requiring medical attention beyond minor first aid, please complete this form. Retain two copies for your files and send the original to Karen Dierst in the Seattle office.**

Employee's office mailing address: ____________________

Location of office (if different): ____________________

### EMPLOYEE INFORMATION:

Employee's name:____________________

Length of time with Employer:____________________

S.S.#:______-______-______ Sex: M F Birth Date:____________________

Home address: ____________________

Occupation:____________________

Department or group:____________________

### PROJECT INFORMATION:

Project Manager: ____________________

Field Supervisor: ____________________

Project Description (briefly describe the project, location, employee's role, etc.): ____________________

## ACCIDENT/EXPOSURE INFORMATION:

Description of accident/incident (briefly describe how the accident/incident occurred, what task the employee was working on at the time, working conditions, etc.)

______________________________

______________________________

______________________________

______________________________

______________________________

## INJURY/ILLNESS INFORMATION:

Description of injury/illness (please describe the nature of the injury/illness, body part(s) affected, and the object/agent which caused the injury/illness):

______________________________

______________________________

______________________________

______________________________

______________________________

Name and address of attending physician:

______________________________

______________________________

______________________________

______________________________

Name and address of hospital (if admitted):

______________________________

______________________________

______________________________

______________________________

Report prepared by:______________________________

Title:______________________________

Date:____________________

# ATTACHMENT B-5

# MATERIAL SAFETY DATA SHEETS

24 Hour Emergency Telephone: 908-859-2151
CHEMTREC: 1-800-424-9300

National Response in Canada
CANUTEC: 613-996-6666

Outside U.S. and Canada
Chemtrec: 703-527-3887

**MSDS** *Material Safety Data Sheet*

*From:* **Mallinckrodt Baker, Inc.**
**222 Red School Lane**
**Phillipsburg, NJ 08865**

J.T.Baker

**NOTE:** CHEMTREC, CANUTEC and National Response Center emergency numbers to be used only in the event of chemical emergencies involving a spill, leak, fire, exposure or accident involving chemicals.

All non-emergency questions should be directed to Customer Service (1-800-582-2537) for assistance.

# Antimony

**MSDS Number: A7152 --- *Effective Date: 08/02/00***

## 1. Product Identification

**Synonyms:** Stibium, C.I. 77050
**CAS No.:** 7440-36-0
**Molecular Weight:** 121.75
**Chemical Formula:** Sb
**Product Codes:** 0848

## 2. Composition/Information on Ingredients

| Ingredient | CAS No | Percent | Hazardous |
|---|---|---|---|
| Antimony | 7440-36-0 | 90 - 100% | Yes |

## 3. Hazards Identification

**Emergency Overview**

**POISON! DANGER! MAY BE FATAL IF INHALED. CAUSES IRRITATION.**
**TARGET ORGAN(S): Respiratory system, cardiovascular system, eyes, skin.**

**J.T. Baker SAF-T-DATA**$^{(tm)}$ Ratings (Provided here for your convenience)

Health Rating: 3 - Severe (Poison)
Flammability Rating: 1 - Slight
Reactivity Rating: 2 - Moderate
Contact Rating: 1 - Slight
Lab Protective Equip: GOGGLES; LAB COAT; VENT HOOD; PROPER GLOVES
Storage Color Code: Blue (Health)

---

**Potential Health Effects**

---

**Inhalation:**
Is harmful may be fatal.
**Ingestion:**
None identified.
**Skin Contact:**
Prolonged contact may cause dermatitis.
**Eye Contact:**
None identified.
**Chronic Exposure:**
Kidney damage, liver damage.
**Aggravation of Pre-existing Conditions:**
No information found.

---

## 4. First Aid Measures

**Inhalation:**
If inhaled, remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Prompt action is essential.
**Ingestion:**
If large amounts were swallowed, give water to drink and get medical advice.
**Skin Contact:**
In case of contact, flush skin with water.
**Eye Contact:**
In case of eye contact, immediately flush with plenty of water for at least 15 minutes.

---

## 5. Fire Fighting Measures

**Fire:**
Not expected to be a fire hazard.
**Explosion:**
Can be an explosion hazard, especially when heated.
**Fire Extinguishing Media:**
Use extinguishing media appropriate for surrounding fire.
**Special Information:**
No information found.

## 6. Accidental Release Measures

Wear self-contained breathing apparatus and full protective clothing. With clean shovel, carefully place material into clean, dry container and cover; remove from area. Flush spill area with water.

## 7. Handling and Storage

Keep container tightly closed. Store in secure poison area. Keep product out of light. Containers of this material may be hazardous when empty since they retain product residues (dust, solids); observe all warnings and precautions listed for the product.

## 8. Exposure Controls/Personal Protection

**Airborne Exposure Limits:**
-OSHA Permissible Exposure Limit (PEL):
0.5 mg/m3 (TWA)

-ACGIH Threshold Limit Value (TLV):
0.5 mg/m3 (TWA)

**Ventilation System:**
A system of local and/or general exhaust is recommended to keep employee exposures below the Airborne Exposure Limits. Local exhaust ventilation is generally preferred because it can control the emissions of the contaminant at its source, preventing dispersion of it into the general work area. Please refer to the ACGIH document, *Industrial Ventilation, A Manual of Recommended Practices*, most recent edition, for details.

**Personal Respirators (NIOSH Approved):**
For conditions of use where exposure to the substance is apparent, consult an industrial hygienist. For emergencies, or instances where the exposure levels are not known, use a full-facepiece positive-pressure, air-supplied respirator. WARNING: Air purifying respirators do not protect workers in oxygen-deficient atmospheres.

**Skin Protection:**
Wear impervious protective clothing, including boots, gloves, lab coat, apron or coveralls, as appropriate, to prevent skin contact.

**Eye Protection:**
Use chemical safety goggles and/or full face shield where dusting or splashing of solutions is possible. Maintain eye wash fountain and quick-drench facilities in work area.

## 9. Physical and Chemical Properties

**Appearance:**

Silvery-white metal.
**Odor:**
No information found.
**Solubility:**
Negligible (< 0.1%)
**Specific Gravity:**
6.68
**pH:**
No information found.
**% Volatiles by volume @ 21C (70F):**
0
**Boiling Point:**
1635C (2975F)
**Melting Point:**
630C (1166F)
**Vapor Density (Air=1):**
4.2
**Vapor Pressure (mm Hg):**
Not applicable.
**Evaporation Rate (BuAc=1):**
No information found.

# 10. Stability and Reactivity

**Stability:**
Stable under ordinary conditions of use and storage.
**Hazardous Decomposition Products:**
No information found.
**Hazardous Polymerization:**
Will not occur.
**Incompatibilities:**
Strong oxidizing agents, strong acids, halogen acids, chlorine, fluorine.
**Conditions to Avoid:**
Heat, Light.

# 11. Toxicological Information

```
--------\Cancer Lists\------------------------------------------------------
                                          ---NTP Carcinogen---
Ingredient                                Known    Anticipated    IARC Category
------------------------------------      -----    -----------    -------------
Antimony (7440-36-0)                       No          No             None
```

# 12. Ecological Information

**Environmental Fate:**
No information found.
**Environmental Toxicity:**
No information found.

---

## 13. Disposal Considerations

Whatever cannot be saved for recovery or recycling should be managed in an appropriate and approved waste disposal facility. Processing, use or contamination of this product may change the waste management options. State and local disposal regulations may differ from federal disposal regulations. Dispose of container and unused contents in accordance with federal, state and local requirements.

---

## 14. Transport Information

Not regulated.

---

## 15. Regulatory Information

--------\Chemical Inventory Status - Part 1\--------

| Ingredient | TSCA | EC | Japan | Australia |
|---|---|---|---|---|
| Antimony (7440-36-0) | Yes | Yes | No | Yes |

--------\Chemical Inventory Status - Part 2\--------

| Ingredient | Korea | --Canada-- DSL | --Canada-- NDSL | Phil. |
|---|---|---|---|---|
| Antimony (7440-36-0) | Yes | Yes | No | Yes |

--------\Federal, State & International Regulations - Part 1\--------

| Ingredient | -SARA 302- RQ | -SARA 302- TPQ | ------SARA 313------ List | ------SARA 313------ Chemical Catg. |
|---|---|---|---|---|
| Antimony (7440-36-0) | No | No | Yes | Antimony com |

--------\Federal, State & International Regulations - Part 2\--------

| Ingredient | CERCLA | -RCRA- 261.33 | -TSCA- 8(d) |
|---|---|---|---|
| Antimony (7440-36-0) | 5000 | No | No |

Chemical Weapons Convention: No TSCA 12(b): No CDTA: No
SARA 311/312: Acute: Yes Chronic: Yes Fire: No Pressure: No
Reactivity: No (Pure / Solid)

**Australian Hazchem Code:** No information found.
**Poison Schedule:** No information found.
**WHMIS:**
This MSDS has been prepared according to the hazard criteria of the Controlled Products Regulations (CPR) and the MSDS contains all of the information required by the CPR.

---

## 16. Other Information

**Label Hazard Warning:**
POISON! DANGER! MAY BE FATAL IF INHALED. CAUSES IRRITATION. TARGET ORGAN(S): Respiratory system, cardiovascular system, eyes, skin.
**Label Precautions:**
Avoid contact with eyes, skin, clothing.
Do not breathe dust. Keep in tightly closed container. Use with adequate ventilation. Wash thoroughly after handling.
**Label First Aid:**
If inhaled, remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Prompt action is essential. In case of contact, immediately flush eyes or skin with plenty of water for at least 15 minutes. Remove contaminated clothing and shoes. Wash clothing before reuse.
**Product Use:**
Laboratory Reagent.
**Revision Information:**
No changes.
**Disclaimer:**
***************************************************************************

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**Prepared by:** Strategic Services Division
Phone Number: (314) 539-1600 (U.S.A.)

# International Chemical Safety Cards

## ARSENIC

**ICSC: 0013**

ARSENIC
Grey arsenic
Metallic arsenic
As
Atomic mass: 74.9

CAS # 7440-38-2
RTECS # CG0525000
ICSC # 0013
UN # 1558
EC # 033-001-00-X

| TYPES OF HAZARD/ EXPOSURE | ACUTE HAZARDS/ SYMPTOMS | PREVENTION | FIRST AID/ FIRE FIGHTING |
|---|---|---|---|
| FIRE | Combustible. Gives off irritating or toxic fumes (or gases) in a fire. | NO open flames. NO contact with strong oxidizers. NO contact with hot surfaces. | Powder, water spray, foam, carbon dioxide. |
| EXPLOSION | Risk of fire and explosion is slight if in the form of fine powder or dust when exposed to hot surfaces or flames. | Prevent deposition of dust; closed system, dust explosion-proof electrical equipment and lighting. | |
| EXPOSURE | | AVOID ALL CONTACT! | IN ALL CASES CONSULT A DOCTOR! |
| • INHALATION | Cough. Diarrhoea. Shortness of breath. Sore throat. Vomiting. Weakness. Grey skin. | Closed system and ventilation. | Fresh air, rest. Artificial respiration if indicated. Refer for medical attention. |
| • SKIN | Redness. | Protective gloves. Protective clothing. | Remove contaminated clothes. Rinse skin with plenty of water or shower. |
| • EYES | Redness. | or eye protection in combination with breathing protection if powder. | First rinse with plenty of water for several minutes (remove contact lenses if easily possible), then take to a doctor. |
| • INGESTION | Diarrhoea. Nausea. Sore throat. Unconsciousness. Vomiting (further see Inhalation). | Do not eat, drink, or smoke during work. Wash hands before eating. | Rinse mouth. Induce vomiting (ONLY IN CONSCIOUS PERSONS!). Refer for medical attention. |

| SPILLAGE DISPOSAL | STORAGE | PACKAGING & LABELLING |
|---|---|---|
| Evacuate danger area! Sweep spilled substance into sealable containers. Carefully collect remainder, then remove to safe place. Do NOT let this chemical enter the environment (extra personal protection: complete protective clothing including self-contained breathing apparatus). | Provision to contain effluent from fire extinguishing. Separated from strong oxidants, acids, halogens, food and feedstuffs. Well closed. Keep in a well-ventilated room. | Do not transport with food and feedstuffs.<br>T symbol<br>R: 23/25<br>S: (1/2-)20/21-28-45<br>UN Hazard Class: 6.1<br>UN Packing Group: II<br>Marine pollutant. |

**SEE IMPORTANT INFORMATION ON BACK**

**ICSC: 0013**

Prepared in the context of cooperation between the International Programme on Chemical Safety & the Commission of the European Communities © IPCS CEC 1993

# International Chemical Safety Cards

## ARSENIC

**ICSC: 0013**

**IMPORTANT DATA**

**PHYSICAL STATE; APPEARANCE:**
ODOURLESS, BRITTLE, GREY, METALLIC-LOOKING CRYSTALS.

**PHYSICAL DANGERS:**

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**CHEMICAL DANGERS:**
Upon heating, toxic fumes are formed. Reacts violently with strong oxidants and halogens causing fire and explosion hazard. Reacts with nitric acid, hot sulfuric acid. Toxic arsine gas may be formed in contact with acid or acidic substances and certain metals, such as galvanized or light metals.

**OCCUPATIONAL EXPOSURE LIMITS (OELs):**
TLV: ppm; 0.01 mg/m$^3$ (as TWA) A1 (ACGIH 1994-1995).

**ROUTES OF EXPOSURE:**
The substance can be absorbed into the body by inhalation of its aerosol, through the skin and by ingestion.

**INHALATION RISK:**
Evaporation at 20°C is negligible; a harmful concentration of airborne particles can, however, be reached quickly.

**EFFECTS OF SHORT-TERM EXPOSURE:**
The substance irritates the eyes, the skin and the respiratory tract. The substance may cause effects on the circulatory system, nervous system, kidneys and gastrointestinal tract, resulting in convulsions, kidney impairment, severe hemorrhage, losses of fluids, and electrolytes, shock and death. Exposure may result in death. The effects may be delayed. Medical observation is indicated.

**EFFECTS OF LONG-TERM OR REPEATED EXPOSURE:**
Repeated or prolonged contact with skin may cause dermatitis. Repeated or prolonged contact may cause skin sensitization. The substance may have effects on the mucous membranes, skin, kidneys, liver, resulting in neuropathy, pigmentation disorders, perforation of nasal septum and tissue lesions. This substance is carcinogenic to humans.

| | | |
|---|---|---|
| **PHYSICAL PROPERTIES** | Sublimation point: 613°C<br>Relative density (water = 1): 5.7 | Solubility in water: none |
| **ENVIRONMENTAL DATA** | The substance is toxic to aquatic organisms. It is strongly advised not to let the chemical enter into the environment because it persists in the environment. | |

**NOTES**

The substance is combustible but no flash point is available in literature. Depending on the degree of exposure, periodic medical examination is indicated. Do NOT take working clothes home. Refer also to cards for specific arsenic compounds, e.g., Arsenic pentoxide (ICSC # 0377), Arsenic trichloride (ICSC # 0221), Arsenic trioxide (ICSC # 0378), Arsine (ICSC # 0222).

**ADDITIONAL INFORMATION**

**ICSC: 0013** **ARSENIC**

# International Chemical Safety Cards

## BENZENE

ICSC: 0015

BENZENE
Cyclohexatriene
Benzol
$C_6H_6$
Molecular mass: 78.1

CAS # 71-43-2
RTECS # CY1400000
ICSC # 0015
UN # 1114
EC # 601-020-00-8

| TYPES OF HAZARD/ EXPOSURE | ACUTE HAZARDS/ SYMPTOMS | PREVENTION | FIRST AID/ FIRE FIGHTING |
|---|---|---|---|
| **FIRE** | Highly flammable. | NO open flames, NO sparks, and NO smoking. | Powder, AFFF, foam, carbon dioxide. |
| **EXPLOSION** | Vapour/air mixtures are explosive. Risk of fire and explosion: see chemical dangers. | Closed system, ventilation, explosion-proof electrical equipment and lighting. Do NOT use compressed air for filling, discharging, or handling. Use non-sparking handtools. | In case of fire: keep drums, etc., cool by spraying with water. |
| **EXPOSURE** | | AVOID ALL CONTACT! | |
| • **INHALATION** | Dizziness. Drowsiness. Headache. Nausea. Shortness of breath. Convulsions. Unconsciousness. | Ventilation, local exhaust, or breathing protection. | Fresh air, rest. Refer for medical attention. |
| • **SKIN** | MAY BE ABSORBED! Dry skin (further see Inhalation). | Protective gloves. Protective clothing. | Remove contaminated clothes. Rinse skin with plenty of water or shower. Refer for medical attention. |
| • **EYES** | | face shield, or eye protection in combination with breathing protection. | First rinse with plenty of water for several minutes (remove contact lenses if easily possible), then take to a doctor. |
| • **INGESTION** | Abdominal pain. Sore throat. Vomiting (further see Inhalation). | Do not eat, drink, or smoke during work. | Rinse mouth. Do NOT induce vomiting. Refer for medical attention. |

| SPILLAGE DISPOSAL | STORAGE | PACKAGING & LABELLING |
|---|---|---|
| Collect leaking and spilled liquid in sealable containers as far as possible. Absorb remaining liquid in sand or inert absorbent and remove to safe place. Do NOT wash away into sewer (extra personal protection: complete | Fireproof. Separated from food and feedstuffs, oxidants and halogens. | Do not transport with food and feedstuffs.<br>F symbol<br>T symbol<br>R: 45-11-48/23/24/25<br>S: 53-45 |

|  |  |  |
|---|---|---|
| protective clothing including self-contained breathing apparatus). |  | UN Hazard Class: 3<br>UN Packing Group: II |

**SEE IMPORTANT INFORMATION ON BACK**

**ICSC: 0015** Prepared in the context of cooperation between the International Programme on Chemical Safety & the Commission of the European Communities © IPCS CEC 1993

# International Chemical Safety Cards

## BENZENE

**ICSC: 0015**

|  |  |  |
|---|---|---|
| **IMPORTANT DATA** | **PHYSICAL STATE; APPEARANCE:**<br>COLOURLESS LIQUID , WITH CHARACTERISTIC ODOUR.<br>**PHYSICAL DANGERS:**<br>The vapour is heavier than air and may travel along the ground; distant ignition possible.<br>**CHEMICAL DANGERS:**<br>Reacts violently with oxidants and halogens causing fire and explosion hazard.<br>**OCCUPATIONAL EXPOSURE LIMITS (OELs):**<br>TLV: 10 ppm; 32 mg/m$^3$ (as TWA) A2 (ACGIH 1991-1992). | **ROUTES OF EXPOSURE:**<br>The substance can be absorbed into the body by inhalation and through the skin.<br>**INHALATION RISK:**<br>A harmful contamination of the air can be reached rather quickly on evaporation of this substance at 20°C; on spraying or dispersion, however, much faster.<br>**EFFECTS OF SHORT-TERM EXPOSURE:**<br>The substance irritates the skin and the respiratory tract. Swallowing the liquid may cause aspiration into the lungs with the risk of chemical pneumonitis. The substance may cause effects on the central nervous system. Exposure far above the occupational exposure limit may result in unconsciousness.<br>**EFFECTS OF LONG-TERM OR REPEATED EXPOSURE:**<br>The liquid defats the skin. The substance may have effects on the blood forming organs, liver and immune system. This substance is carcinogenic to humans. |
| **PHYSICAL PROPERTIES** | Boiling point: 80°C<br>Melting point: 6°C<br>Relative density (water = 1): 0.9<br>Solubility in water, g/100 ml at 25°C: 0.18<br>Vapour pressure, kPa at 20°C: 10<br>Relative vapour density (air = 1): 2.7 | Relative density of the vapour/air-mixture at 20°C (air = 1): 1.2<br>Flash point: -11°C (c.c.)°C<br>Auto-ignition temperature: about 500°C<br>Explosive limits, vol% in air: 1.2-8.0<br>Octanol/water partition coefficient as log Pow: 2.13 |
| **ENVIRONMENTAL DATA** |  |  |

**NOTES**

Use of alcoholic beverages enhances the harmful effect. Depending on the degree of exposure, periodic medical examination is indicated. The odour warning when the exposure limit value is exceeded is insufficient.

Transport Emergency Card: TEC (R)-7
NFPA Code: H2; F3; R0;

**ADDITIONAL INFORMATION**

| **ICSC: 0015** | **BENZENE** |
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# International Chemical Safety Cards

## BENZIDINE

ICSC: 0224

BENZIDINE
(1,1'-Biphenyl)-4,4'-diamine
4,4'-Diaminobiphenyl
p-Diaminodiphenyl
$C_{12}H_{12}N_2/NH_2C_6H_4\text{-}C_6H_4NH_2$
Molecular mass: 184.2

CAS # 92-87-5
RTECS # DC9625000
ICSC # 0224
UN # 1885
EC # 612-042-00-2

| TYPES OF HAZARD/ EXPOSURE | ACUTE HAZARDS/ SYMPTOMS | PREVENTION | FIRST AID/ FIRE FIGHTING |
|---|---|---|---|
| **FIRE** | Combustible. See Notes. Gives off irritating or toxic fumes (or gases) in a fire. | NO open flames. | Powder, carbon dioxide. |
| **EXPLOSION** | | | |
| **EXPOSURE** | | AVOID ALL CONTACT! | IN ALL CASES CONSULT A DOCTOR! |
| **• INHALATION** | | Closed system and ventilation. | Fresh air, rest. Refer for medical attention. |
| **• SKIN** | MAY BE ABSORBED! | Protective gloves. Protective clothing. | Remove contaminated clothes. Rinse skin with plenty of water or shower. Refer for medical attention. |
| **• EYES** | | Face shield or eye protection in combination with breathing protection if powder. | First rinse with plenty of water for several minutes (remove contact lenses if easily possible), then take to a doctor. |
| **• INGESTION** | | Do not eat, drink, or smoke during work. Wash hands before eating. | Rinse mouth. Give a slurry of activated charcoal in water to drink. Induce vomiting (ONLY IN CONSCIOUS PERSONS!). Refer for medical attention. |

| SPILLAGE DISPOSAL | STORAGE | PACKAGING & LABELLING |
|---|---|---|
| Evacuate danger area! Consult an expert! Sweep spilled substance into sealable containers; if appropriate, moisten first to prevent dusting. Carefully collect remainder, then remove to safe place. Do NOT let this chemical enter the environment (extra | Separated from strong oxidants, food and feedstuffs. Keep in the dark. Well closed. | Unbreakable packaging; put breakable packaging into closed unbreakable container. Do not transport with food and feedstuffs.<br>T symbol<br>R: 45-22<br>S: 53-45 |

| | | |
|---|---|---|
| personal protection: complete protective clothing including self-contained breathing apparatus). | | Note: E<br>UN Hazard Class: 6.1<br>UN Packing Group: II |

**SEE IMPORTANT INFORMATION ON BACK**

**ICSC: 0224**

Prepared in the context of cooperation between the International Programme on Chemical Safety & the Commission of the European Communities

# International Chemical Safety Cards

## BENZIDINE

**ICSC: 0224**

| | | |
|---|---|---|
| **IMPORTANT DATA** | **PHYSICAL STATE; APPEARANCE:**<br>WHITE OR REDDISH CRYSTALLINE POWDER, TURNS DARK ON EXPOSURE TO AIR AND LIGHT.<br>**PHYSICAL DANGERS:**<br>**CHEMICAL DANGERS:**<br>The substance decomposes on heating and on burning producing toxic fumes including nitrogen oxides. Reacts violently with strong oxidants, especially nitric acid.<br>**OCCUPATIONAL EXPOSURE LIMITS (OELs):**<br>TLV: ppm; mg/m$^3$ A1 (confirmed human carcinogen) (ACGIH 1994-1995). | **ROUTES OF EXPOSURE:**<br>The substance can be absorbed into the body by inhalation of its aerosol, through the skin and by ingestion.<br>**INHALATION RISK:**<br>Evaporation at 20°C is negligible; a harmful concentration of airborne particles can, however, be reached quickly when dispersed, especially if powdered.<br>**EFFECTS OF SHORT-TERM EXPOSURE:**<br>**EFFECTS OF LONG-TERM OR REPEATED EXPOSURE:**<br>This substance is carcinogenic to humans. |
| **PHYSICAL PROPERTIES** | Boiling point: 401°C<br>Melting point: 128°C (see Notes)°C<br>Relative density (water = 1): 1.25 | Solubility in water: none<br>Relative vapour density (air = 1): 6.36<br>Octanol/water partition coefficient as log Pow: 1.34 |
| **ENVIRONMENTAL DATA** | The substance is toxic to aquatic organisms. | |

**NOTES**

Given melting point when anhydrous and rapidly heated, when slowly heated: 115-120°C. Addition of small amounts of a flammable substance or an increase in the oxygen content of the air strongly enhances combustibility.

Transport Emergency Card: TEC (R)-61G11b

**ADDITIONAL INFORMATION**

| **ICSC: 0224** | **BENZIDINE** |
|---|---|

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| **IMPORTANT LEGAL NOTICE:** | Neither the CEC or the IPCS nor any person acting on behalf of the CEC or the IPCS is responsible for the use which might be made of this information. This card contains the collective views of the IPCS Peer Review Committee and may not reflect in all cases all the detailed requirements included in national legislation on the subject. The user should verify compliance of the cards with the relevant legislation in the country of use. |

# International Chemical Safety Cards

## BERYLLIUM

ICSC: 0226

BERYLLIUM
Glucinium
(powder)
Be
Atomic mass: 9.0

CAS # 7440-41-7
RTECS # DS1750000
ICSC # 0226
UN # 1567
EC # 004-001-00-7

| TYPES OF HAZARD/ EXPOSURE | ACUTE HAZARDS/ SYMPTOMS | PREVENTION | FIRST AID/ FIRE FIGHTING |
|---|---|---|---|
| **FIRE** | Combustible. | NO open flames. | Special powder, dry sand, NO other agents. |
| **EXPLOSION** | Finely dispersed particles form explosive mixtures in air. | Prevent deposition of dust; closed system, dust explosion-proof electrical equipment and lighting. | |
| **EXPOSURE** | | PREVENT DISPERSION OF DUST! AVOID ALL CONTACT! | IN ALL CASES CONSULT A DOCTOR! |
| • **INHALATION** | Cough. Shortness of breath. Sore throat. Weakness. Symptoms may be delayed (see Notes). | Local exhaust. Breathing protection. | Fresh air, rest. Refer for medical attention. |
| • **SKIN** | Redness. | Protective gloves. Protective clothing. | Remove contaminated clothes. Rinse skin with plenty of water or shower. |
| • **EYES** | Redness. Pain. | Face shield or eye protection in combination with breathing protection if powder. | First rinse with plenty of water for several minutes (remove contact lenses if easily possible), then take to a doctor. |
| • **INGESTION** | | Do not eat, drink, or smoke during work. Wash hands before eating. | Rinse mouth. Do NOT induce vomiting. Refer for medical attention. |

| SPILLAGE DISPOSAL | STORAGE | PACKAGING & LABELLING |
|---|---|---|
| Evacuate danger area! Consult an expert! Carefully collect the spilled substance into containers; if appropriate moisten first, then remove to safe place. Do NOT let this chemical enter the environment (extra personal protection: complete protective clothing including self-contained | Separated from strong acids, bases, chlorinated solvents, food and feedstuffs. | Unbreakable packaging; put breakable packaging into closed unbreakable container. Do not transport with food and feedstuffs.<br>T+ symbol<br>R: 49-25-26-36/37/38-43-48/23<br>S: 53-45<br>Note: E |

| | | |
|---|---|---|
| breathing apparatus). | | UN Hazard Class: 6.1<br>UN Subsidiary Risks: 4.1<br>UN Packing Group: II |

**SEE IMPORTANT INFORMATION ON BACK**

**ICSC: 0226**

Prepared in the context of cooperation between the International Programme on Chemical Safety & the Commission of the European Communities

# International Chemical Safety Cards

## BERYLLIUM

**ICSC: 0226**

### IMPORTANT DATA

**PHYSICAL STATE; APPEARANCE:**
GREY TO WHITE METAL OR POWDER.

**PHYSICAL DANGERS:**
Dust explosion possible if in powder or granular form, mixed with air.

**CHEMICAL DANGERS:**
Reacts with strong acids and strong bases forming combustible gas (HYDROGEN - see ICSC # 0001). Forms shock sensitive mixtures with some chlorinated solvents, such as carbon tetrachloride and trichloroethylene.

**OCCUPATIONAL EXPOSURE LIMITS (OELs):**
TLV (as TWA): ppm; 0.002 mg/m$^3$ A2 (Suspected Human Carcinogen) (ACGIH 1994-1995).

**ROUTES OF EXPOSURE:**
The substance can be absorbed into the body by inhalation of its aerosol and by ingestion.

**INHALATION RISK:**
Evaporation at 20°C is negligible; a harmful concentration of airborne particles can, however, be reached quickly when dispersed.

**EFFECTS OF SHORT-TERM EXPOSURE:**
The aerosol of this substance irritates the respiratory tract. Inhalation of dust or fumes may cause chemical pneumonitis. Exposure may result in death. The effects may be delayed. Medical observation is indicated.

**EFFECTS OF LONG-TERM OR REPEATED EXPOSURE:**
Repeated or prolonged contact may cause skin sensitization. Lungs may be affected by repeated or prolonged exposure to dust particles , resulting in chronic beryllium disease (cough, weight loss, weakness). This substance is carcinogenic to humans.

| | | |
|---|---|---|
| **PHYSICAL PROPERTIES** | Boiling point: above 2500°C<br>Melting point: 1287°C | Relative density (water = 1): 1.9<br>Solubility in water: none |
| **ENVIRONMENTAL DATA** | The substance is very toxic to aquatic organisms. | |

### NOTES

Depending on the degree of exposure, periodic medical examination is indicated.

Transport Emergency Card: TEC (R)-61G10
NFPA Code: H3; F1; R0

### ADDITIONAL INFORMATION

**ICSC: 0226** **BERYLLIUM**

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|---|---|
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# International Chemical Safety Cards

## CADMIUM

ICSC: 0020

CADMIUM
(powder)
Cd
Molecular mass: 112.4

CAS # 7440-43-9
RTECS # EU9800000
ICSC # 0020
UN # 2570 (cadmium compounds)

| TYPES OF HAZARD/ EXPOSURE | ACUTE HAZARDS/ SYMPTOMS | PREVENTION | FIRST AID/ FIRE FIGHTING |
|---|---|---|---|
| FIRE | Flammable in powder form. Gives off irritating or toxic fumes (or gases) in a fire. | NO open flames, NO sparks, and NO smoking. NO contact with heat or acids. | Dry sand. Special powder. No other agents. |
| EXPLOSION | Finely dispersed particles form explosive mixtures in air. | Prevent deposition of dust; closed system, dust explosion-proof electrical equipment and lighting. | |
| EXPOSURE | | PREVENT DISPERSION OF DUST! STRICT HYGIENE! | IN ALL CASES CONSULT A DOCTOR! |
| • INHALATION | Cough. Headache. Symptoms may be delayed (see Notes). | Local exhaust or breathing protection. | Fresh air, rest. Half-upright position. Artificial respiration if indicated. Refer for medical attention. |
| • SKIN | | Protective gloves. | Remove contaminated clothes. Rinse and then wash skin with water and soap. |
| • EYES | Redness. Pain. | Face shield or eye protection in combination with breathing protection. | First rinse with plenty of water for several minutes (remove contact lenses if easily possible), then take to a doctor. |
| • INGESTION | Abdominal pain. Diarrhoea. Headache. Nausea. Vomiting. | Do not eat, drink, or smoke during work. | Rest. Refer for medical attention. |

| SPILLAGE DISPOSAL | STORAGE | PACKAGING & LABELLING |
|---|---|---|
| Evacuate danger area! Extinguish ignition sources. Sweep spilled substance into containers; if appropriate, moisten first to prevent dusting. Carefully collect remainder, then remove to safe place (extra personal protection: P3 filter respirator for toxic particles). | Fireproof. Separated from strong oxidants, strong acids, food and feedstuffs. | Airtight. Unbreakable packaging; put breakable packaging into closed unbreakable container. Do not transport with food and feedstuffs.<br>UN Hazard Class: 6.1 |

**SEE IMPORTANT INFORMATION ON BACK**

**ICSC: 0020**

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# International Chemical Safety Cards

## CADMIUM

**ICSC: 0020**

**IMPORTANT DATA**

**PHYSICAL STATE; APPEARANCE:**
SOFT BLUE-WHITE METAL LUMPS OR GREY POWDER. MALLEABLE. TURNS BRITTLE ON EXPOSURE TO 80°C AND TARNISHES ON EXPOSURE TO MOIST AIR.

**PHYSICAL DANGERS:**
Dust explosion possible if in powder or granular form, mixed with air.

**CHEMICAL DANGERS:**
Reacts with acids giving off flammable hydrogen gas. Dust reacts with oxidants, hydrogen azide, zinc, selenium or tellurium, causing fire and explosion hazard.

**OCCUPATIONAL EXPOSURE LIMITS (OELs):**
TLV (as dust): ppm; 0.05 mg/m$^3$ as TWA (ACGIH 1991-1992).

**ROUTES OF EXPOSURE:**
The substance can be absorbed into the body by inhalation of its aerosol and by ingestion.

**INHALATION RISK:**
Evaporation at 20°C is negligible; a harmful concentration of airborne particles can, however, be reached quickly.

**EFFECTS OF SHORT-TERM EXPOSURE:**
The substance irritates the eyes and the respiratory tract. Inhalation of fume may cause lung oedema (see Notes). Inhalation of fume may cause metal fever. The effects may be delayed. Medical observation is indicated.

**EFFECTS OF LONG-TERM OR REPEATED EXPOSURE:**
Lungs may be affected by repeated or prolonged exposure to dust particles. The substance may have effects on the kidneys, resulting in proteinuria and kidney dysfunction. This substance is probably carcinogenic to humans.

**PHYSICAL PROPERTIES**

Boiling point: 765°C
Melting point: 321°C
Relative density (water = 1): 8.6
Solubility in water: none
Auto-ignition temperature: 250°C (cadmium metal dust)°C

**ENVIRONMENTAL DATA**

**NOTES**

Reacts violently with fire extinguishing agents such as water, foam, carbon dioxide and halons. Depending on the degree of exposure, periodic medical examination is indicated. The symptoms of lung oedema often do not become manifest until a few hours have passed and they are aggravated by physical effort. Rest and medical observation are therefore essential. Do NOT take working clothes home.

**ADDITIONAL INFORMATION**

**ICSC: 0020** **CADMIUM**

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|---|---|
| **LEGAL NOTICE:** | IPCS Peer Review Committee and may not reflect in all cases all the detailed requirements included in national legislation on the subject. The user should verify compliance of the cards with the relevant legislation in the country of use. |

# International Chemical Safety Cards

## CHROMIUM

**ICSC: 0029**

CHROMIUM
Chrome
(powder)
Cr (metal)
Atomic mass: 52.0

CAS # 7440-47-3
RTECS # GB4200000
ICSC # 0029

| TYPES OF HAZARD/ EXPOSURE | ACUTE HAZARDS/ SYMPTOMS | PREVENTION | FIRST AID/ FIRE FIGHTING |
|---|---|---|---|
| **FIRE** | Combustible if in very fine powder. Gives off irritating or toxic fumes (or gases) in a fire. | No open flames if in powder form. | In case of fire in the surroundings: all extinguishing agents allowed. |
| **EXPLOSION** | Finely dispersed particles form explosive mixtures in air. | Prevent deposition of dust; closed system, dust explosion-proof electrical equipment and lighting. | |
| **EXPOSURE** | | PREVENT DISPERSION OF DUST! STRICT HYGIENE! | |
| • **INHALATION** | Cough. | Local exhaust or breathing protection. | Fresh air, rest. |
| • **SKIN** | Redness. | Protective gloves. | Remove contaminated clothes. Rinse skin with plenty of water or shower. Refer for medical attention. |
| • **EYES** | Redness. | Face shield. | First rinse with plenty of water for several minutes (remove contact lenses if easily possible), then take to a doctor. |
| • **INGESTION** | | Do not eat, drink, or smoke during work. | Rinse mouth. |

| SPILLAGE DISPOSAL | STORAGE | PACKAGING & LABELLING |
|---|---|---|
| Vacuum spilled material. Carefully collect remainder, then remove to safe place (extra personal protection: P2 filter respirator for harmful particles). | Fireproof. Separated from strong oxidants. | |

**SEE IMPORTANT INFORMATION ON BACK**

**ICSC: 0029**

Prepared in the context of cooperation between the International Programme on Chemical Safety & the Commission of the European Communities

# International Chemical Safety Cards

# CHROMIUM

ICSC: 0029

| | | |
|---|---|---|
| I M P O R T A N T D A T A | **PHYSICAL STATE; APPEARANCE:**<br>STEEL GREY LUTROUS METAL.<br>**PHYSICAL DANGERS:**<br>Dust explosion possible if in powder or granular form, mixed with air.<br>**CHEMICAL DANGERS:**<br>Reacts violently with strong oxidants such as hydrogen peroxide, causing fire and explosion hazard. Reacts with diluted hydrochloric and sulfuric acids. Incompatible with alkalis and alkali carbonates.<br>**OCCUPATIONAL EXPOSURE LIMITS (OELs):**<br>TLV: ppm; 0.5 mg/m$^3$ (as TWA) (ACGIH 1994-1995). | **ROUTES OF EXPOSURE:**<br>The substance can be absorbed into the body by inhalation of its aerosol and by ingestion.<br>**INHALATION RISK:**<br>Evaporation at 20°C is negligible; a harmful concentration of airborne particles can, however, be reached quickly when dispersed.<br>**EFFECTS OF SHORT-TERM EXPOSURE:**<br>**EFFECTS OF LONG-TERM OR REPEATED EXPOSURE:**<br>Repeated or prolonged contact may cause skin sensitization. |
| **PHYSICAL PROPERTIES** | Boiling point: 2642°C<br>Melting point: 1900°C | Relative density (water = 1): 7.14<br>Solubility in water: none |
| **ENVIRONMENTAL DATA** | | |

## NOTES

Explosive limits are unknown in literature. Depending on the degree of exposure, periodic medical examination is indicated.

## ADDITIONAL INFORMATION

ICSC: 0029 CHROMIUM

| | |
|---|---|
| **IMPORTANT LEGAL NOTICE:** | Neither the CEC or the IPCS nor any person acting on behalf of the CEC or the IPCS is responsible for the use which might be made of this information. This card contains the collective views of the IPCS Peer Review Committee and may not reflect in all cases all the detailed requirements included in national legislation on the subject. The user should verify compliance of the cards with the relevant legislation in the country of use. |

# International Chemical Safety Cards

## VINYLIDENE CHLORIDE

**ICSC: 0083**

VINYLIDENE CHLORIDE
1,1-Dichloroethene
1,1-Dichloroethylene
VDC
$C_2H_2Cl_2/H_2C=CCl_2$
Molecular mass: 97

CAS # 75-35-4
RTECS # KV9275000
ICSC # 0083
UN # 1303 (inhibited)
EC # 602-025-00-8

| TYPES OF HAZARD/ EXPOSURE | ACUTE HAZARDS/ SYMPTOMS | PREVENTION | FIRST AID/ FIRE FIGHTING |
|---|---|---|---|
| **FIRE** | Extremely flammable. Gives off irritating or toxic fumes (or gases) in a fire. | NO open flames, NO sparks, and NO smoking. | Powder, water spray, foam, carbon dioxide. |
| **EXPLOSION** | Vapour/air mixtures are explosive. Vinyl chloride monomer vapours are uninhibited and may form polymers in vents or flame arresters of storage tanks, resulting in blockage of vents. | Closed system, ventilation, explosion-proof electrical equipment and lighting. Use non-sparking handtools. | In case of fire: keep drums, etc., cool by spraying with water. Combat fire from a sheltered position. |
| **EXPOSURE** |  | STRICT HYGIENE! |  |
| • **INHALATION** | Dizziness. Drowsiness. Unconsciousness. | Ventilation, local exhaust, or breathing protection. | Fresh air, rest. Artificial respiration if indicated. Refer for medical attention. |
| • **SKIN** | Redness. Skin burns. | Protective gloves. Protective clothing. | Remove contaminated clothes. Rinse and then wash skin with water and soap. |
| • **EYES** | Redness. Pain. | Safety goggles, or eye protection in combination with breathing protection. | First rinse with plenty of water for several minutes (remove contact lenses if easily possible), then take to a doctor. |
| • **INGESTION** | Abdominal pain. Sore throat (further see Inhalation). | Do not eat, drink, or smoke during work. Wash hands before eating. | Rinse mouth. Do NOT induce vomiting. Give plenty of water to drink. Rest. |

| SPILLAGE DISPOSAL | STORAGE | PACKAGING & LABELLING |
|---|---|---|
| Evacuate danger area! Consult an expert! Collect leaking and spilled liquid in sealable containers as far as possible. Absorb remaining liquid in sand or inert absorbent and remove to | Fireproof. Separated from incompatible materials (see Chemical Dangers). Cool. Keep in the dark. Store only if stabilized. | Airtight. Unbreakable packaging; put breakable packaging into closed unbreakable container. IMO: Marine Pollutant<br>F+ symbol |

| | | |
|---|---|---|
| safe place (extra personal protection: complete protective clothing including self-contained breathing apparatus). | | Xn symbol<br>R: 12-20-40<br>S: 7-16-29<br>Note: D<br>UN Hazard Class: 3<br>UN Packing Group: I |

**SEE IMPORTANT INFORMATION ON BACK**

**ICSC: 0083** Prepared in the context of cooperation between the International Programme on Chemical Safety & the Commission of the European Communities © IPCS CEC 1993

# International Chemical Safety Cards

## VINYLIDENE CHLORIDE

**ICSC: 0083**

**IMPORTANT DATA**

**PHYSICAL STATE; APPEARANCE:**
VOLATILE COLOURLESS LIQUID, WITH CHARACTERISTIC ODOUR.

**PHYSICAL DANGERS:**
The vapour is heavier than air and may travel along the ground; distant ignition possible.

**CHEMICAL DANGERS:**
The substance can readily form explosive peroxides. The substance will polymerize readily due to heating or under the influence of oxygen, sunlight, copper or aluminium, with fire or explosion hazard. May explode on heating or on contact with flames. The substance decomposes on burning producing toxic and corrosive fumes (hydrogen chloride, phosgene and chlorine). Reacts violently with oxidants.

**OCCUPATIONAL EXPOSURE LIMITS (OELs):**
TLV: 5 ppm; 20 mg/m$^3$ (STEL): 20 ppm; 79 mg/m$^3$ (ACGIH 1992-1993).

**ROUTES OF EXPOSURE:**
The substance can be absorbed into the body by inhalation, through the skin and by ingestion.

**INHALATION RISK:**
A harmful contamination of the air can be reached very quickly on evaporation of this substance at 20°C.

**EFFECTS OF SHORT-TERM EXPOSURE:**
The substance irritates the eyes, the skin and the respiratory tract. Swallowing the liquid may cause aspiration into the lungs with the risk of chemical pneumonitis. The substance may cause effects on the central nervous system.

**EFFECTS OF LONG-TERM OR REPEATED EXPOSURE:**
Repeated or prolonged contact with skin may cause dermatitis. The substance may have effects on the liver and kidneys.

**PHYSICAL PROPERTIES**

Boiling point: 32°C
Melting point: -122°C
Relative density (water = 1): 1.2
Solubility in water, g/100 ml at 25°C: 0.25
Vapour pressure, kPa at 20°C: 66.5
Relative vapour density (air = 1): 3.3
Relative density of the vapour/air-mixture at 20°C (air = 1): 2.5
Flash point: 5.6°C
Auto-ignition temperature: 570°C
Explosive limits, vol% in air: 5.6-16
Octanol/water partition coefficient as log Pow: 1.32

**ENVIRONMENTAL DATA**

This substance may be hazardous to the environment; special attention should be given to water organisms. In the food chain important to humans, bioaccumulation takes place, specifically in plants.

**NOTES**

Contains inhibitors (e.g. methoxyphenol). Depending on the degree of exposure, periodic medical examination is indicated. The odour warning when the exposure limit value is exceeded is insufficient. Do NOT use in the vicinity of a fire or a hot surface, or during welding.

Transport Emergency Card: TEC (R)-641

## ADDITIONAL INFORMATION

**ICSC: 0083** **VINYLIDENE CHLORIDE**

CHEM SERVICE -- TRANS-1,2-DICHLOROETHENE, O-660
MATERIAL SAFETY DATA SHEET
CHEM SERVICENSN: 681000N067797
Manufacturer's CAGE: 8Y898
Part No. Indicator: A
Part Number/Trade Name: TRANS-1,2-DICHLOROETHENE, O-660

============================================================================

## General Information

============================================================================

Company's Name: CHEM SERVICE INC
Company's P. O. Box: 3108
Company's City: WEST CHESTER
Company's State: PA
Company's Country: US
Company's Zip Code: 19381
Company's Emerg Ph #: 215-692-3026
Company's Info Ph #: 215-692-3026
Record No. For Safety Entry: 001
Tot Safety Entries This Stk#: 001
Status: SMJ
Date MSDS Prepared: 01SEP88
Safety Data Review Date: 27DEC95
MSDS Serial Number: CBGMP

============================================================================

## Ingredients/Identity Information

============================================================================

Proprietary: NO
Ingredient: ETHYLENE, 1,2-DICHLORO-, (E)-; (TRANS-1,2-DICHLOROETHYLENE) (SARA 313) (CERCLA)
Ingredient Sequence Number: 01
NIOSH (RTECS) Number: KV9400000
CAS Number: 156-60-5
OSHA PEL: 200 PPM (MFR)
ACGIH TLV: 200 PPM (MFR)

============================================================================

## Physical/Chemical Characteristics

============================================================================

Appearance And Odor: COLORLESS LIQUID
Boiling Point: 118F,48C
Melting Point: -58F,-50C
Specific Gravity: 1.257
Solubility In Water: INSOLUBLE

============================================================================

## Fire and Explosion Hazard Data

============================================================================

Flash Point: 42.8F,6.0C
Extinguishing Media: USE CARBON DIOXIDE, DRY CHEMICAL POWDER OR WATER SPRAY.
Special Fire Fighting Proc: WEAR NIOSH/MSHA APPROVED SCBA & FULL PROTECTIVE EQUIPMENT (FP N).
Unusual Fire And Expl Hazrds: NONE SPECIFIED BY MANUFACTURER.

============================================================================

## Reactivity Data

============================================================================

Stability: YES
Cond To Avoid (Stability): FLAMMABLE.
Materials To Avoid: INCOMPATIBLE WITH STRONG OXIDIZING AGENTS, STRONG BASES. REACTS WITH WATER AND MOST REACTIVE HYDROGEN COMPOUNDS.
Hazardous Decomp Products: DECOMPOSITION LIBERATES TOXIC FUMES. DECOMPOSITION PRODUCTS ARE CORROSIVE.

Hazardous Poly Occur: NO
Conditions To Avoid (Poly): NOT RELEVANT.

## Health Hazard Data

LD50-LC50 Mixture: LD50 (ORAL RAT): 7536 MG/KG.
Route Of Entry - Inhalation: YES
Route Of Entry - Skin: YES
Route Of Entry - Ingestion: YES
Health Haz Acute And Chronic: ACUTE: CAN BE HARMFUL IF ABSORBED THRU SKIN, INHALED/SWALLOWED. CAN CAUSE SKIN AND EYE IRRITATION. CAN BE IRRITATING TO MUCOUS MEMBRANES. VAPORS AND/OR DIRECT EYE CONTACT CAN CAUSE SEVERE EYE BURNS. CHRONIC: PROLONGED EXPOSURE MAY CAUSE NAUSEA, HEADACHE, DIZZINESS AND/OR EYE DAMAGE. CAN CAUSE LIVER & KIDNEY INJURY.
Carcinogenicity - NTP: NO
Carcinogenicity - IARC: NO
Carcinogenicity - OSHA: NO
Explanation Carcinogenicity: NOT RELEVANT.
Signs/Symptoms Of Overexp: SEE HEALTH HAZARDS.
Med Cond Aggravated By Exp: NONE SPECIFIED BY MANUFACTURER.
Emergency/First Aid Proc: AN ANTIDOTE IS A SUBSTANCE INTENDED TO COUNTERACT EFT OF POIS. IT SHOULD BE ADMIN ONLY BY MD/TRAINED EMER PERS. MED ADVICE CAN BE OBTAINED FROM POIS CTL CTR. EYES: FLUSH CONTINUOUSLY W/ WATER FOR AT LEAST 15 MIN. SKIN: FLUSH W/WATER FOR 15-20 MIN. IF NO BURNS HAVE OCCURRED, USE SOAP & WATER TO CLEANSE SKIN. INHAL: REMOVE TO FRESH AIR. ADMIN OXYGEN IF DFCLT BRTHG. IF BRTHG HAS STOPPED, (SUP DAT)

## Precautions for Safe Handling and Use

Steps If Matl Released/Spill: EVACUATE AREA. WEAR APPROPRIATE OSHA-REGULATED EQUIPMENT. VENTILATE AREA. ABSORB ON VERMICULITE OR SIMILAR MATERIAL. SWEEP UP AND PLACE IN AN APPROPRIATE CONTAINER. HOLD FOR DISPOSAL. WASH CONTAMINATED SURFACES TO REMOVE ANY RESIDUES.
Neutralizing Agent: NONE SPECIFIED BY MANUFACTURER.
Waste Disposal Method: BURN IN A CHEMICAL INCINERATOR EQUIPPED WITH AN AFTERBURNER AND SCRUBBER. DISPOSE OF IN ACCORDANCE W/LOCAL, STATE & FEDERAL REGULATIONS (FP N).
Precautions-Handling/Storing: ALL CHEMICALS SHOULD BE CONSIDERED HAZARDOUS. AVOID DIRECT PHYSICAL CONTACT! USE APPROPRIATE OSHA/MSMA APPROVED SAFETY EQUIPMENT.
Other Precautions: AVOID CONT W/SKIN, EYES, & CLTHG. KEEP TIGHTLY CLSD & STORE IN COOL DRY PLACE. STORE ONLY W/COMPATIBLE CHEM. PERS NOT SPECIFICALLY & PROPERLY TRAINED SHOULD NOT HANDLE THIS CHEM/ITS CONTR. THIS PROD IS FURNISHED FOR LAB USE ONLY! (SUP DAT)

## Control Measures

Respiratory Protection: USE NIOSH/MSHA APPROVED RESPIRATOR APPROPRIATE FOR EXPOSURE OF CONCERN (FP N).
Ventilation: THIS CHEMICAL SHOULD BE HANDLED ONLY IN A HOOD.
Protective Gloves: IMPERVIOUS GLOVES (FP N).
Eye Protection: ANSI APPRVD CHEM WORKERS GOGGS (FP N).
Other Protective Equipment: EMERGENCY EYEWASH & DELUGE SHOWER MEETING ANSI DESIGN CRITERIA (FP N).
Work Hygienic Practices: CONTACT LENSES SHOULD NOT BE WORN IN THE LABORATORY.
Suppl. Safety & Health Data: FIRST AID PROC: ADMIN ARTF RESP. IF PATIENT IN CARD ARREST, ADMIN CPR. CONTINUE LIFE SUPPORTING MEASURES UNTIL MED ASSIST HAS ARRIVED. INGEST: CALL MD IMMED (FP N). OTHER PREC: THIS PROD MAY NOT BE USED AS DRUGS, COSMETICS, AGRICULTURAL/PESTICIDAL PRODS, FOOD

ADDITIVES/AS HOUSEHOLD CHEMICALS.

## Transportation Data

## Disposal Data

## Label Data

Label Required: YES
Technical Review Date: 27DEC95
Label Date: 27DEC95
Label Status: G
Common Name: TRANS-1,2-DICHLOROETHENE, O-660
Chronic Hazard: YES
Signal Word: DANGER!
Acute Health Hazard-Moderate: X
Contact Hazard-Slight: X
Fire Hazard-Severe: X
Reactivity Hazard-Slight: X

CAN BE HARMFUL IF ABSORBED THRU SKIN, INHALED/SWALLOWED. CAN CAUSE SKIN AND EYE IRRITATION. CAN BE IRRITATING TO MUCOUS MEMBRANES. VAPORS AND/OR DIRECT EYE CONTACT CAN CAUSE SEVERE EYE BURNS. CHRONIC: PROLONGED EXPOSURE MAY CAUSE NAUSEA, HEADACHE, DIZZINESS AND/OR EYE DAMAGE. CAN CAUSE LIVER AND KIDNEY INJURY.

Protect Eye: Y
Protect Skin: Y
Protect Respiratory: Y
Label Name: CHEM SERVICE INC
Label P.O. Box: 3108
Label City: WEST CHESTER
Label State: PA
Label Zip Code: 19381
Label Country: US
Label Emergency Number: 215-692-3026

## **** SECTION 1 - CHEMICAL PRODUCT AND COMPANY IDENTIFICATION ****

MSDS Name: 2,4-Dimethylphenol, 99% (GC)
Catalog Numbers:
AC408450000, AC408450250, AC408451000
Synonyms:
2,4-Xylenol; 4,6-DImethylphenol Benzene; 1-Hydroxy-2,4-Dimethyl Benzene; M-Xylenol.

Company Identification (Europe): Acros Organics BVBA
Janssen Pharmaceuticalaan 3a
2440 Geel, Belgium

Company Identification (USA): Acros Organics
One Reagent Lane
Fairlawn, NJ 07410

For information in North America, call: 800-ACROS-01
For information in Europe, call: 0032(0) 14575211
For emergencies in the US, call CHEMTREC: 800-424-9300
For emergencies in Europe, call: 0032(0) 14575299

## **** SECTION 2 - COMPOSITION, INFORMATION ON INGREDIENTS ****

| CAS# | Chemical Name | % | EINECS# |
|---|---|---|---|
| 105-67-9 | 2,4-Dimethylphenol | 99% | 203-321-6 |

Hazard Symbols: XN
Risk Phrases: 21/22

## **** SECTION 3 - HAZARDS IDENTIFICATION ****

EMERGENCY OVERVIEW

Harmful in contact with skin and if swallowed.

Potential Health Effects

Eye:
Causes eye irritation.

Skin:
Causes skin irritation. May be harmful if absorbed through the skin.

Ingestion:
May cause irritation of the digestive tract. May cause kidney damage.

Inhalation:
May cause respiratory tract irritation.

Chronic:
Chronic ingestion may cause effects similar to those of acute ingestion. May cause kidney damage.

## **** SECTION 4 - FIRST AID MEASURES ****

Eyes:
Immediately flush eyes with plenty of water for at least 15 minutes, occasionally lifting the upper and lower eyelids. Get medical aid immediately.

Skin:
Get medical aid. Immediately flush skin with plenty of soap and water for at least 15 minutes while removing contaminated clothing and shoes. Wash clothing before reuse.

Ingestion:
Do NOT induce vomiting. If victim is conscious and alert, give 2-4 cupfuls of milk or water. Never give anything by mouth to an unconscious person. Get medical aid immediately.

Inhalation:
Remove from exposure to fresh air immediately. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Get medical aid if cough or other symptoms appear. Do NOT use mouth-to-mouth resuscitation. If breathing has ceased apply

artificial respiration using oxygen and a suitable mechanical device such as a bag and a mask.

Notes to Physician:

## **** SECTION 5 - FIRE FIGHTING MEASURES ****

General Information:

As in any fire, wear a self-contained breathing apparatus in pressure-demand, MSHA/NIOSH (approved or equivalent), and full protective gear. During a fire, irritating and highly toxic gases may be generated by thermal decomposition or combustion. Material will burn in a fire. Use water spray to keep fire-exposed containers cool. May polymerize explosively when involved in a fire. Contact with metals may evolve flammable hydrogen gas. Containers may explode when heated.

Extinguishing Media:

Do NOT get water inside containers. For small fires, use dry chemical, carbon dioxide, or water spray. For large fires, use dry chemical, carbon dioxide, alcohol-resistant foam, or water spray. Cool containers with flooding quantities of water until well after fire is out.

## **** SECTION 6 - ACCIDENTAL RELEASE MEASURES ****

General Information: Use proper personal protective equipment as indicated in Section 8.

Spills/Leaks:

Vacuum or sweep up material and place into a suitable disposal container. Avoid runoff into storm sewers and ditches which lead to waterways. Clean up spills immediately, observing precautions in the Protective Equipment section. Avoid generating dusty conditions. Provide ventilation.

## **** SECTION 7 - HANDLING and STORAGE ****

Handling:

Wash thoroughly after handling. Use with adequate ventilation. Minimize dust generation and accumulation. Avoid contact with eyes, skin, and clothing. Keep container tightly closed. Avoid ingestion and inhalation. Keep away from strong bases and metals.

Storage:

Store in a tightly closed container. Store in a cool, dry, well-ventilated area away from incompatible substances. Do not store in metal containers.

## **** SECTION 8 - EXPOSURE CONTROLS, PERSONAL PROTECTION ****

Engineering Controls:

Facilities storing or utilizing this material should be equipped with an eyewash facility and a safety shower. Use adequate ventilation to keep airborne concentrations low.

Personal Protective Equipment

Eyes:

Wear appropriate protective eyeglasses or chemical safety goggles as described by OSHA's eye and face protection regulations in 29 CFR 1910.133 or European Standard EN166.

Skin:

Wear appropriate protective gloves to prevent skin exposure.

Clothing:

Wear appropriate protective clothing to prevent skin exposure.

Respirators:

Follow the OSHA respirator regulations found in 29CFR 1910.134 or European Standard EN 149. Always use a

NIOSH or European Standard EN 149 approved respirator when necessary.

## **** SECTION 9 - PHYSICAL AND CHEMICAL PROPERTIES ****

Physical State: Crystals
Appearance: colorless or almost colorless
Odor: Characteristic phenolic odor.
pH: Not available.
Vapor Pressure: 10 mm Hg @92.3
Vapor Density: Not available.
Evaporation Rate: Not available.
Viscosity: Not available.
Boiling Point: 211 deg C
Freezing/Melting Point: 25.4-26C
Autoignition Temperature: Not available.
Flash Point: 96 deg C ( 204.80 deg F)
Explosion Limits, lower: 1.40 vol %
Explosion Limits, upper: Not available.
Decomposition Temperature:
Solubility: 0.5% (25&C)
Specific Gravity/Density: .9700g/cm3
Molecular Formula: C8H10O
Molecular Weight: 122.17

## **** SECTION 10 - STABILITY AND REACTIVITY ****

Chemical Stability:
  Stable under normal temperatures and pressures.
Conditions to Avoid:
  Incompatible materials, ignition sources, dust generation, excess heat.
Incompatibilities with Other Materials:
  Bases - acid chlorides - acid anhydrides - oxidizing agents - corrodes steel - brass - copper - copper alloys.
Hazardous Decomposition Products:
  Carbon monoxide, irritating and toxic fumes and gases, carbon dioxide.
Hazardous Polymerization: Has not been reported

## **** SECTION 11 - TOXICOLOGICAL INFORMATION ****

RTECS#:
  CAS# 105-67-9: ZE5600000
LD50/LC50:
  CAS# 105-67-9: Oral, mouse: LD50 = 809 mg/kg; Oral, rat: LD50 = 3200 mg/kg; Skin, rat: LD50 = 1040 mg/kg.
Carcinogenicity:
  2,4-Dimethylphenol -
  Not listed by ACGIH, IARC, NIOSH, NTP, or OSHA.
Epidemiology:
  No information available.
Teratogenicity:
  No information available.
Reproductive Effects:
  No information available.
Neurotoxicity:
  No information available.
Mutagenicity:
  No information available.
Other Studies:
  See actual entry in RTECS for complete information.

## **** SECTION 12 - ECOLOGICAL INFORMATION ****

Ecotoxicity:
  cfr. DOSE

### **** SECTION 13 - DISPOSAL CONSIDERATIONS ****

Dispose of in a manner consistent with federal, state, and local regulations.

### **** SECTION 14 - TRANSPORT INFORMATION ****

US DOT
Shipping Name: XYLENOLS
Hazard Class: 6.1
UN Number: 2261
Packing Group: II
Canadian TDG
No information available.

### **** SECTION 15 - REGULATORY INFORMATION ****

US FEDERAL
TSCA
CAS# 105-67-9 is listed on the TSCA inventory.
This material does not contain any Class 2 Ozone depletors.
Clean Water Act:
None of the chemicals in this product are listed as Hazardous Substances under the CWA.
CAS# 105-67-9 is listed as a Priority Pollutant under the Clean Water Act.
CAS# 105-67-9 is listed as a Toxic Pollutant under the Clean Water Act.
OSHA:
None of the chemicals in this product are considered highly hazardous by OSHA.
STATE
2,4-Dimethylphenol can be found on the following state right to know lists: California, New Jersey, Pennsylvania, Massachusetts.
California No Significant Risk Level:
None of the chemicals in this product are listed.
European/International Regulations
European Labeling in Accordance with EC Directives
Hazard Symbols: XN
Risk Phrases:
R 21/22 Harmful in contact with skin and if swallowed.
Safety Phrases:
S 2 Keep out of reach of children.
S 28A After contact with skin, wash immediately with plenty of water.
S 45 In case of accident or if you feel unwell, seek medical advice immediately (show the label where possible).
WGK (Water Danger/Protection)
CAS# 105-67-9: No information available.
United Kingdom Occupational Exposure Limits

Canada
CAS# 105-67-9 is listed on Canada's DSL List.
CAS# 105-67-9 is not listed on Canada's Ingredient Disclosure List.
Exposure Limits
CAS# 105-67-9: Not available.

### **** SECTION 16 - ADDITIONAL INFORMATION ****

MSDS Creation Date: 4/16/1999 Revision #1 Date: 8/02/2000

The information above is believed to be accurate and represents the best information currently available to us. However, we make no warranty of merchantability or any other warranty, express or implied, with respect to such information, and we assume no liability resulting from its use. Users should make their own investigations to determine the suitability of the information for their particular purposes. In no way shall the company be liable for any claims, losses, or damages of any third party or for lost profits or any special, indirect, incidental, consequential or exemplary damages, howsoever arising, even if the company has been advised of the possibility of such damages.

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# International Chemical Safety Cards

## 1,2-DIPHENYLHYDRAZINE

ICSC: 0263

1,2-DIPHENYLHYDRAZINE
Hydrazobenzene
Diphenylhydrazine
N,N'-Bianiline
$C_{12}H_{12}N_2$ / $C_6H_5$-NH-NH-$C_6H_5$
Molecular mass: 184.3

CAS # 122-66-7
RTECS # MW2625000
ICSC # 0263
EC # 007-021-00-4

| TYPES OF HAZARD/ EXPOSURE | ACUTE HAZARDS/ SYMPTOMS | PREVENTION | FIRST AID/ FIRE FIGHTING |
|---|---|---|---|
| FIRE | Combustible. Gives off irritating or toxic fumes (or gases) in a fire. | NO open flames. | Powder, water spray, foam, carbon dioxide. |
| EXPLOSION | | | |
| EXPOSURE | | AVOID ALL CONTACT! | IN ALL CASES CONSULT A DOCTOR! |
| • INHALATION | Cough. Sore throat. See Notes. | Local exhaust or breathing protection. | Fresh air, rest. See Notes. |
| • SKIN | See Notes. | Protective gloves. | Remove contaminated clothes. Rinse and then wash skin with water and soap. |
| • EYES | See Notes. | Safety spectacles, or eye protection in combination with breathing protection. | First rinse with plenty of water for several minutes (remove contact lenses if easily possible), then take to a doctor. |
| • INGESTION | See Notes. | Do not eat, drink, or smoke during work. Wash hands before eating. | Rest. Refer for medical attention. |

| SPILLAGE DISPOSAL | STORAGE | PACKAGING & LABELLING |
|---|---|---|
| Do NOT wash away into sewer. Sweep spilled substance into sealable containers; if appropriate, moisten first to prevent dusting. Carefully collect remainder, then remove to safe place (extra personal protection: P3 filter respirator for toxic particles). | Separated from food and feedstuffs. Cool. Dry. Keep in the dark. Keep in a well-ventilated room. Keep under inert gas. | Do not transport with food and feedstuffs.<br>T symbol<br>R: 45-22<br>S: 53-45 |

**SEE IMPORTANT INFORMATION ON BACK**

**ICSC: 0263**

Prepared in the context of cooperation between the International Programme on Chemical Safety & the Commission of the European Communities © IPCS CEC 1993

# International Chemical Safety Cards

## 1,2-DIPHENYLHYDRAZINE

**ICSC: 0263**

| | | |
|---|---|---|
| **IMPORTANT DATA** | **PHYSICAL STATE; APPEARANCE:**<br>WHITE TO YELLOW CRYSTALS.<br>**PHYSICAL DANGERS:**<br>**CHEMICAL DANGERS:**<br>The substance decomposes on heating or on burning producing toxic fumes including nitrogen oxides. Reacts with mineral acids forming benzidine (see ICSC # 0224).<br>**OCCUPATIONAL EXPOSURE LIMITS (OELs):**<br>TLV not established. | **ROUTES OF EXPOSURE:**<br>The substance can be absorbed into the body by inhalation and by ingestion.<br>**INHALATION RISK:**<br>Evaporation at 20°C is negligible; a harmful concentration of airborne particles can, however, be reached quickly.<br>**EFFECTS OF SHORT-TERM EXPOSURE:**<br>The substance irritates the respiratory tract.<br>**EFFECTS OF LONG-TERM OR REPEATED EXPOSURE:**<br>This substance is possibly carcinogenic to humans. |
| **PHYSICAL PROPERTIES** | Melting point: 125-131°C<br>Relative density (water = 1): 1.16 | Solubility in water, g/100 ml at 20°C: <0.1<br>Octanol/water partition coefficient as log Pow: 2.94 |
| **ENVIRONMENTAL DATA** | | |

**NOTES**

Insufficient data are available on the effect of this substance on human health, therefore utmost care must be taken.

Transport Emergency Card: TEC (R)-61G12b

**ADDITIONAL INFORMATION**

**ICSC: 0263** **1,2-DIPHENYLHYDRAZINE**

| | |
|---|---|
| **IMPORTANT LEGAL NOTICE:** | Neither the CEC or the IPCS nor any person acting on behalf of the CEC or the IPCS is responsible for the use which might be made of this information. This card contains the collective views of the IPCS Peer Review Committee and may not reflect in all cases all the detailed requirements included in national legislation on the subject. The user should verify compliance of the cards with the relevant legislation in the country of use. |

# International Chemical Safety Cards

## ETHYLBENZENE

ICSC: 0268

ETHYLBENZENE
Ethylbenzol
Phenylethane
EB
$C_8H_{10}/C_6H_5\text{-}C_2H_5$
Molecular mass: 106.2

CAS # 100-41-4
RTECS # DA0700000
ICSC # 0268
UN # 1175
EC # 601-023-00-4

| TYPES OF HAZARD/ EXPOSURE | ACUTE HAZARDS/ SYMPTOMS | PREVENTION | FIRST AID/ FIRE FIGHTING |
|---|---|---|---|
| **FIRE** | Highly flammable. | NO open flames, NO sparks, and NO smoking. | Powder, AFFF, foam, carbon dioxide. |
| **EXPLOSION** | Vapour/air mixtures are explosive. | Closed system, ventilation, explosion-proof electrical equipment and lighting. Do NOT use compressed air for filling, discharging, or handling. | In case of fire: keep drums, etc., cool by spraying with water. |
| **EXPOSURE** | | PREVENT GENERATION OF MISTS! | |
| • **INHALATION** | Cough. Dizziness. Drowsiness. Headache. | Ventilation, local exhaust, or breathing protection. | Fresh air, rest. Refer for medical attention. |
| • **SKIN** | Dry skin. Redness. | Protective gloves. | Remove contaminated clothes. Rinse and then wash skin with water and soap. |
| • **EYES** | Redness. Pain. Blurred vision. | Face shield or eye protection in combination with breathing protection. | First rinse with plenty of water for several minutes (remove contact lenses if easily possible), then take to a doctor. |
| • **INGESTION** | (further see Inhalation). | Do not eat, drink, or smoke during work. | Rinse mouth. Give a slurry of activated charcoal in water to drink. Refer for medical attention. |

| SPILLAGE DISPOSAL | STORAGE | PACKAGING & LABELLING |
|---|---|---|
| Ventilation. Collect leaking liquid in covered containers. Absorb remaining liquid in sand or inert absorbent and remove to safe place. Do NOT wash away into sewer (extra personal protection: A filter respirator for | Fireproof. Separated from strong oxidants. | F symbol<br>Xn symbol<br>R: 11-20<br>S: (2-)16-24/25-29<br>UN Hazard Class: 3 |

| | | |
|---|---|---|
| organic vapour). | | UN Packing Group: II |

**SEE IMPORTANT INFORMATION ON BACK**

**ICSC: 0268**

# International Chemical Safety Cards

## ETHYLBENZENE

**ICSC: 0268**

**IMPORTANT DATA**

**PHYSICAL STATE; APPEARANCE:**
COLOURLESS LIQUID , WITH AROMATIC ODOUR.

**PHYSICAL DANGERS:**
The vapour mixes well with air, explosive mixtures are easily formed.

**CHEMICAL DANGERS:**
Reacts with strong oxidants. Attacks plastic and rubber.

**OCCUPATIONAL EXPOSURE LIMITS (OELs):**
TLV (as TWA): 100 ppm; 434 mg/m$^3$; as STEL: 125 ppm; 543 mg/m$^3$ (ACGIH 1994-1995).
MAK: 100 ppm; 440 mg/m$^3$ (1994).

**ROUTES OF EXPOSURE:**
The substance can be absorbed into the body by inhalation of its vapour, through the skin andby ingestion.

**INHALATION RISK:**
A harmful contamination of the air will be reached rather slowly on evaporation of this substance at 20°C.

**EFFECTS OF SHORT-TERM EXPOSURE:**
The substance irritates the eyes, the skin and the respiratory tract. Swallowing the liquid may cause aspiration into the lungs with the risk of chemical pneumonitis. The substance may cause effects on the central nervous system. Exposure far above OEL could cause lowering of consciousness.

**EFFECTS OF LONG-TERM OR REPEATED EXPOSURE:**
Repeated or prolonged contact with skin may cause dermatitis.

**PHYSICAL PROPERTIES**

Boiling point: 136°C
Melting point: -95°C
Relative density (water = 1): 0.9
Solubility in water, g/100 ml at 20°C: 0.015
Vapour pressure, kPa at 20°C: 0.9
Relative vapour density (air = 1): 3.7
Relative density of the vapour/air-mixture at 20°C (air = 1): 1.02
Flash point: 18°C c.c.
Auto-ignition temperature: 432°C
Explosive limits, vol% in air: 1.0-6.7
Octanol/water partition coefficient as log Pow: 3.2

**ENVIRONMENTAL DATA**

The substance is harmful to aquatic organisms.

**NOTES**

The odour warning when the exposure limit value is exceeded is insufficient.

Transport Emergency Card: TEC (R)-522
NFPA Code: H2; F3; R0

**ADDITIONAL INFORMATION**

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|---|---|
| **IMPORTANT LEGAL NOTICE:** | Neither the CEC or the IPCS nor any person acting on behalf of the CEC or the IPCS is responsible for the use which might be made of this information. This card contains the collective views of the IPCS Peer Review Committee and may not reflect in all cases all the detailed requirements included in national legislation on the subject. The user should verify compliance of the cards with the relevant legislation in the country of use. |

# International Chemical Safety Cards

## ISOPHORONE

**ICSC: 0169**

ISOPHORONE
1,1,3-Trimethyl-3-cyclohexene-5-one
3,5,5-Trimethyl-2-cyclohexene-1-one
Isoacetophorone
$C_9H_{14}O$
Molecular mass: 138.2

CAS # 78-59-1
RTECS # GW7700000
ICSC # 0169
EC # 606-012-00-8

| TYPES OF HAZARD/ EXPOSURE | ACUTE HAZARDS/ SYMPTOMS | PREVENTION | FIRST AID/ FIRE FIGHTING |
|---|---|---|---|
| **FIRE** | Combustible. | NO open flames. | Powder, AFFF, foam, carbon dioxide. |
| **EXPLOSION** | Above 84°C explosive vapour/air mixtures may be formed. | Above 84°C use a closed system, ventilation. | |
| **EXPOSURE** | | PREVENT GENERATION OF MISTS! | |
| • **INHALATION** | Burning sensation. Cough. Dizziness. Headache. Nausea. Shortness of breath. | Ventilation, local exhaust, or breathing protection. | Fresh air, rest. Artificial respiration if indicated. Refer for medical attention. |
| • **SKIN** | Dry skin. Redness. | Protective gloves. | Remove contaminated clothes. Rinse and then wash skin with water and soap. |
| • **EYES** | Redness. Pain. Blurred vision. | Safety spectacles. | First rinse with plenty of water for several minutes (remove contact lenses if easily possible), then take to a doctor. |
| • **INGESTION** | Abdominal pain. Burning sensation (further see Inhalation). | Do not eat, drink, or smoke during work. | Rinse mouth. Give a slurry of activated charcoal in water to drink. Do NOT induce vomiting. |

| SPILLAGE DISPOSAL | STORAGE | PACKAGING & LABELLING |
|---|---|---|
| Collect leaking and spilled liquid in sealable containers as far as possible. Absorb remaining liquid in sand or inert absorbent and remove to safe place. | Separated from strong oxidants. | Xi symbol<br>R: 36/37/38<br>S: (2-)26 |

**SEE IMPORTANT INFORMATION ON BACK**

**ICSC: 0169**

# International Chemical Safety Cards

## ISOPHORONE

**ICSC: 0169**

| | | |
|---|---|---|
| **IMPORTANT DATA** | **PHYSICAL STATE; APPEARANCE:**<br>COLOURLESS LIQUID , WITH CHARACTERISTIC ODOUR.<br>**PHYSICAL DANGERS:**<br>**CHEMICAL DANGERS:**<br>Reacts with strong oxidants.<br>**OCCUPATIONAL EXPOSURE LIMITS (OELs):**<br>TLV: 5 ppm; 28 mg/m$^3$ (ceiling values) (ACGIH 1993-1994). | **ROUTES OF EXPOSURE:**<br>The substance can be absorbed into the body by inhalation, through the skin and by ingestion.<br>**INHALATION RISK:**<br>A harmful contamination of the air will be reached rather slowly on evaporation of this substance at 20°C.<br>**EFFECTS OF SHORT-TERM EXPOSURE:**<br>The substance and the vapour of this substance irritates the eyes, the skin and the respiratory tract. Exposure could cause lowering of consciousness.<br>**EFFECTS OF LONG-TERM OR REPEATED EXPOSURE:**<br>Repeated or prolonged contact with skin may cause dermatitis. Lungs may be affected by inhalation of high concentrations. The substance may have effects on the liver and kidneys. |
| **PHYSICAL PROPERTIES** | Boiling point: 215°C<br>Melting point: -8°C<br>Relative density (water = 1): 0.92<br>Solubility in water, g/100 ml at 25°C: 1.2<br>Vapour pressure, Pa at 20°C: 40 | Relative vapour density (air = 1): 4.8<br>Flash point: 84°C c.c.°C<br>Auto-ignition temperature: 460°C<br>Explosive limits, vol% in air: 0.8-3.8<br>Octanol/water partition coefficient as log Pow: 2.2 |
| **ENVIRONMENTAL DATA** | | |

**NOTES**

The occupational exposure limit value should not be exceeded during any part of the working exposure. Depending on the degree of exposure, periodic medical examination is indicated.

Transport Emergency Card: TEC (R)-621
NFPA Code: H 2; F 2; R 0;

**ADDITIONAL INFORMATION**

**ICSC: 0169** **ISOPHORONE**

| | |
|---|---|
| **IMPORTANT LEGAL NOTICE:** | for the use which might be made of this information. This card contains the collective views of the IPCS Peer Review Committee and may not reflect in all cases all the detailed requirements included in national legislation on the subject. The user should verify compliance of the cards with the relevant legislation in the country of use. |

# International Chemical Safety Cards

## LEAD

ICSC: 0052

LEAD
Lead metal
Plumbum
(powder)
Pb
Atomic mass: 207.2

CAS # 7439-92-1
RTECS # OF7525000
ICSC # 0052

| TYPES OF HAZARD/ EXPOSURE | ACUTE HAZARDS/ SYMPTOMS | PREVENTION | FIRST AID/ FIRE FIGHTING |
|---|---|---|---|
| FIRE | Not combustible. Finely divided lead powder is flammable. Gives off irritating or toxic fumes (or gases) in a fire. | NO open flames, NO sparks, and NO smoking (if in powder form). | In case of fire in the surroundings: all extinguishing agents allowed. |
| EXPLOSION | Finely dispersed particles form explosive mixtures in air. | Prevent deposition of dust; closed system, dust explosion-proof electrical equipment and lighting. | |
| EXPOSURE | | PREVENT DISPERSION OF DUST! STRICT HYGIENE! AVOID EXPOSURE OF (PREGNANT) WOMEN! AVOID EXPOSURE OF ADOLESCENTS AND CHILDREN! | IN ALL CASES CONSULT A DOCTOR! |
| • INHALATION | Abdominal cramps. Drowsiness. Headache. Nausea. Vomiting. Weakness. Wheezing. Pallor. Hemoglobinuria. Collapse. | Ventilation (not if powder). Avoid inhalation of fine dust and mist. Local exhaust or breathing protection. | Fresh air, rest. Refer for medical attention. |
| • SKIN | | | |
| • EYES | | | |
| • INGESTION | Abdominal cramps (further see Inhalation). | Do not eat, drink, or smoke during work. Wash hands before eating. | Rinse mouth. Induce vomiting (ONLY IN CONSCIOUS PERSONS!). Refer for medical attention. |

| SPILLAGE DISPOSAL | STORAGE | PACKAGING & LABELLING |
|---|---|---|
| Sweep spilled substance into containers; if appropriate, moisten first to prevent dusting. Carefully collect | Separated from strong oxidants, strong bases, strong acids, food and feedstuffs. | |

| | | |
|---|---|---|
| remainder, then remove to safe place. Do NOT let this chemical enter the environment (extra personal protection: P2 filter respirator for harmful particles). | | |

***SEE IMPORTANT INFORMATION ON BACK***

**ICSC: 0052**

# International Chemical Safety Cards

## LEAD

**ICSC: 0052**

**I M P O R T A N T D A T A**

**PHYSICAL STATE; APPEARANCE:**
BLUISH-WHITE OR SILVERY-GREY SOLID IN VARIOUS FORMS. TURNS TARNISHED ON EXPOSURE TO AIR.

**PHYSICAL DANGERS:**
Dust explosion possible if in powder or granular form, mixed with air.

**CHEMICAL DANGERS:**
Upon heating, toxic fumes are formed. Reacts with hot concentrated nitric acid, boiling concentrated hydrochloric and sulfuric acids. Attacked by pure water and by weak organic acids in the presence of oxygen.

**OCCUPATIONAL EXPOSURE LIMITS (OELs):**
TLV: ppm; 0.15 mg/m$^3$ (as TWA) (ACGIH 1993-1994).

**ROUTES OF EXPOSURE:**
The substance can be absorbed into the body by inhalation of its aerosol and by ingestion.

**INHALATION RISK:**
Evaporation at 20°C is negligible; a harmful concentration of airborne particles can, however, be reached quickly.

**EFFECTS OF SHORT-TERM EXPOSURE:**
The substance may cause effects on the gastrointestinal tract, blood, central nervous system and kidneys, resulting in colics, shock, anemia, kidney damage and encephalopathy. Exposure may result in death. The effects may be delayed. Medical observation is indicated.

**EFFECTS OF LONG-TERM OR REPEATED EXPOSURE:**
The substance may have effects on the gastrointestinal tract, nervous system, blood, kidneys and immune system, resulting in severe lead colics, paralysis of muscle groups of the upper extremities (forearm, wrist and fingers), anemia, mood and personality changes, retarded mental development, and irreversible nephropathy. May cause retarded development of the new-born. Danger of cumulative effect.

**PHYSICAL PROPERTIES**

Boiling point: 1740°C
Melting point: 327.5°C
Relative density (water = 1): 11.34
Solubility in water: none

**ENVIRONMENTAL DATA**

This substance may be hazardous to the environment; special attention should be given to air and water. In the food chain important to humans, bioaccumulation takes place, specifically in plants and water organisms, especially shellfish.

**NOTES**

Explosive limits are unknown in literature. Use of alcoholic beverages enhances the harmful effect. Depending on the degree of exposure, periodic medical examination is indicated. Do NOT take working clothes home. Refer also to cards for specific lead compounds, e.g., lead chromate (ICSC # 0003), lead(II) oxide (ICSC # 0288).

Transport Emergency Card: TEC (R)-61G12b

**ADDITIONAL INFORMATION**

| **ICSC: 0052** | **LEAD** |
|---|---|

| | |
|---|---|
| **IMPORTANT LEGAL NOTICE:** | Neither the CEC or the IPCS nor any person acting on behalf of the CEC or the IPCS is responsible for the use which might be made of this information. This card contains the collective views of the IPCS Peer Review Committee and may not reflect in all cases all the detailed requirements included in national legislation on the subject. The user should verify compliance of the cards with the relevant legislation in the country of use. |

# International Chemical Safety Cards

## NICKEL

**ICSC: 0062**

NICKEL
(powder)
Ni
Molecular mass: 58.7

CAS # 7440-02-0
RTECS # QR5950000
ICSC # 0062
EC # 028-002-00-7

| TYPES OF HAZARD/ EXPOSURE | ACUTE HAZARDS/ SYMPTOMS | PREVENTION | FIRST AID/ FIRE FIGHTING |
|---|---|---|---|
| **FIRE** | Flammable as dust. Toxic fumes may be released in a fire. | | Water in large amounts, foam, dry sand, NO carbon dioxide. |
| **EXPLOSION** | Finely dispersed particles form explosive mixtures in air. | Prevent deposition of dust; closed system, dust explosion-proof electrical equipment and lighting. | |
| **EXPOSURE** | | PREVENT DISPERSION OF DUST! STRICT HYGIENE! | |
| **• INHALATION** | | Local exhaust or breathing protection. | Fresh air, rest. |
| **• SKIN** | | Protective gloves. Protective clothing. | Remove contaminated clothes. Rinse and then wash skin with water and soap. |
| **• EYES** | | Safety spectacles or eye protection in combination with breathing protection. | First rinse with plenty of water for several minutes (remove contact lenses if easily possible), then take to a doctor. |
| **• INGESTION** | | Do not eat, drink, or smoke during work. | |

| SPILLAGE DISPOSAL | STORAGE | PACKAGING & LABELLING |
|---|---|---|
| Vacuum spilled material. Carefully collect remainder, then remove to safe place (extra personal protection: P2 filter respirator for harmful particles). | Separated from strong acids. | Xn symbol<br>R: 40-43<br>S: (2-)22-36 |

**SEE IMPORTANT INFORMATION ON BACK**

**ICSC: 0062**

# International Chemical Safety Cards

## NICKEL

**ICSC: 0062**

**I M P O R T A N T D A T A**

**PHYSICAL STATE; APPEARANCE:**
ODOURLESS SILVERY METALLIC SOLID IN VARIOUS FORMS.

**PHYSICAL DANGERS:**
Dust explosion possible if in powder or granular form, mixed with air.

**CHEMICAL DANGERS:**
Reacts violently, in powder form, with titanium powder and potassium perchlorate, and oxidants such as ammonium nitrate, causing fire and explosion hazard. Reacts slowly with non-oxidizing acids and more rapidly with oxidizing acids. Toxic gases and vapours (such as nickel carbonyl) may be released in a fire involving nickel.

**OCCUPATIONAL EXPOSURE LIMITS (OELs):**
TLV: ppm; 1 mg/m$^3$ (as TWA) (ACGIH 1993-1994).

**ROUTES OF EXPOSURE:**
The substance can be absorbed into the body by inhalation of the dust and by ingestion.

**INHALATION RISK:**
Evaporation at 20°C is negligible; a harmful concentration of airborne particles can, however, be reached quickly when dispersed.

**EFFECTS OF SHORT-TERM EXPOSURE:**
Inhalation of the fumes may cause pneumonitis.

**EFFECTS OF LONG-TERM OR REPEATED EXPOSURE:**
Repeated or prolonged contact with skin may cause dermatitis. Repeated or prolonged contact may cause skin sensitization. Repeated or prolonged inhalation exposure may cause asthma. Lungs may be affected by repeated or prolonged exposure. The substance may have effects on the nasal sinuses , resulting in inflammation and ulceration.

| | | |
|---|---|---|
| **PHYSICAL PROPERTIES** | Boiling point: 2730°C<br>Melting point: 1455°C | Relative density (water = 1): 8.9<br>Solubility in water: none |
| **ENVIRONMENTAL DATA** | | |

## NOTES

Depending on the degree of exposure, periodic medical examination is indicated. The symptoms of asthma often do not become manifest until a few hours have passed and they are aggravated by physical effort. Rest and medical observation are therefore essential. Anyone who has shown symptoms of asthma due to this substance should avoid all further contact with this substance.

## ADDITIONAL INFORMATION

**ICSC: 0062** **NICKEL**

**IMPORTANT LEGAL NOTICE:** Neither the CEC or the IPCS nor any person acting on behalf of the CEC or the IPCS is responsible for the use which might be made of this information. This card contains the collective views of the IPCS Peer Review Committee and may not reflect in all cases all the detailed requirements included in national legislation on the subject. The user should verify compliance of the cards with the relevant legislation in the country of use.

# International Chemical Safety Cards

## DI(2-ETHYLHEXYL) PHTHALATE

ICSC: 0271

DI(2-ETHYLHEXYL) PHTHALATE
Dioctylphthalate
bis-(2-Ethylhexyl)phthalate
DOP; DEHP
$C_6H_4(COOC_8H_{17})_2$
Molecular mass: 390.5

CAS # 117-81-7
RTECS # TJ0350000
ICSC # 0271

| TYPES OF HAZARD/ EXPOSURE | ACUTE HAZARDS/ SYMPTOMS | PREVENTION | FIRST AID/ FIRE FIGHTING |
|---|---|---|---|
| **FIRE** | Combustible. | NO open flames. | Powder, AFFF, foam, carbon dioxide. |
| **EXPLOSION** | | | |
| **EXPOSURE** | | | |
| • **INHALATION** | Cough. Sore throat. | Ventilation, local exhaust, or breathing protection. | Fresh air, rest. |
| • **SKIN** | | Protective gloves. | Remove contaminated clothes. Rinse skin with plenty of water or shower. |
| • **EYES** | | Safety goggles. | First rinse with plenty of water for several minutes (remove contact lenses if easily possible), then take to a doctor. |
| • **INGESTION** | | Do not eat, drink, or smoke during work. | Rinse mouth. Give plenty of water to drink. |

| SPILLAGE DISPOSAL | STORAGE | PACKAGING & LABELLING |
|---|---|---|
| Consult an expert! Collect leaking and spilled liquid in sealable containers as far as possible. Absorb remaining liquid in sand or inert absorbent and remove to safe place. | Separated from strong oxidants, acids, alkalis, nitrates. Cool. Dry. | |

**SEE IMPORTANT INFORMATION ON BACK**

**ICSC: 0271**

Prepared in the context of cooperation between the International Programme on Chemical Safety & the Commission of the European Communities

# International Chemical Safety Cards

## DI(2-ETHYLHEXYL) PHTHALATE

ICSC: 0271

| | | |
|---|---|---|
| **IMPORTANT DATA** | **PHYSICAL STATE; APPEARANCE:**<br>COLOURLESS TO LIGHT COLOURED VISCOUS LIQUID , WITH CHARACTERISTIC ODOUR.<br>**PHYSICAL DANGERS:**<br>**CHEMICAL DANGERS:**<br>Reacts with strong oxidants, acids, alkalis, and nitrates.<br>**OCCUPATIONAL EXPOSURE LIMITS (OELs):**<br>TLV: ppm; 5 mg/m$^3$ (as TWA); 10 mg/m$^3$(as STEL) (ACGIH 1989-1990).<br>MAK as total dust: ppm; 10 mg/m$^3$; III; C (1993). | **ROUTES OF EXPOSURE:**<br>The substance can be absorbed into the body by inhalation and by ingestion.<br>**INHALATION RISK:**<br>A harmful contamination of the air will not or will only very slowly be reached on evaporation of this substance at 20°C.<br>**EFFECTS OF SHORT-TERM EXPOSURE:**<br>The substance irritates the eyes, the skin, and the respiratory tract. The substance may cause effects on the gastrointestinal tract.<br>**EFFECTS OF LONG-TERM OR REPEATED EXPOSURE:**<br>Repeated or prolonged contact with skin may cause dermatitis. |
| **PHYSICAL PROPERTIES** | Boiling point: 385°C<br>Melting point: -50°C<br>Relative density (water = 1): 0.986<br>Solubility in water, g/100 ml at 25°C: 0.0001<br>Vapour pressure, kPa at 20°C: 0.001 | Relative vapour density (air = 1): 13.45<br>Flash point: 215°C o.c.<br>Auto-ignition temperature: 350°C<br>Explosive limits, vol% in air: 0.1-?<br>Octanol/water partition coefficient as log Pow: 3.98 |
| **ENVIRONMENTAL DATA** | | |

**NOTES**

NFPA Code: H 0; F 1; R 0;

**ADDITIONAL INFORMATION**

**ICSC: 0271** **DI(2-ETHYLHEXYL) PHTHALATE**

## **** SECTION 1 - CHEMICAL PRODUCT AND COMPANY IDENTIFICATION ****

MSDS Name: Silver
Catalog Numbers:
S80162, S163 10, S163-10, S16310, ZZS166C17
Synonyms:
Argentum.
Company Identification: Fisher Scientific
1 Reagent Lane
Fairlawn, NJ 07410
For information, call: 201-796-7100
Emergency Number: 201-796-7100
For CHEMTREC assistance, call: 800-424-9300
For International CHEMTREC assistance, call: 703-527-3887

## **** SECTION 2 - COMPOSITION, INFORMATION ON INGREDIENTS ****

| CAS# | Chemical Name | % | EINECS# |
|---|---|---|---|
| 7440-22-4 | Silver | 100 | 231-131-3 |

Hazard Symbols: None Listed.
Risk Phrases: 33

## **** SECTION 3 - HAZARDS IDENTIFICATION ****

### EMERGENCY OVERVIEW

Danger of cumulative effects.

Potential Health Effects
Eye:
May cause eye irritation.
Skin:
May cause skin irritation. May cause skin discoloration.
Ingestion:
May cause irritation of the digestive tract. Effects may be cumulative. Ingestion of silver compounds may cause abdominal pain, rigidity, convulsions and shock.
Inhalation:
May cause respiratory tract irritation. Inhalation of fumes may cause metal fume fever, which is characterized by flu-like symptoms with metallic taste, fever, chills, cough, weakness, chest pain, muscle pain and increased white blood cell count.
Chronic:
Chronic inhalation or ingestion may cause argyria characterized by blue-gray discoloration of the eyes, skin and mucous membrances. Chronic skin contact may cause permanent discoloration of the skin.

## **** SECTION 4 - FIRST AID MEASURES ****

Eyes:
Flush eyes with plenty of water for at least 15 minutes, occasionally lifting the upper and lower eyelids. If irritation develops, get medical aid.
Skin:
Flush skin with plenty of soap and water for at least 15 minutes while removing contaminated clothing and shoes. Get medical aid if irritation develops or persists. Wash clothing before reuse.
Ingestion:
Do NOT induce vomiting. If conscious and alert, rinse mouth and drink 2-4 cupfuls of milk or water. Wash mouth out with water. Get medical aid if irritation or symptoms occur.
Inhalation:
Remove from exposure to fresh air immediately. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Get medical aid if cough or other symptoms appear.

Notes to Physician:

## **** SECTION 5 - FIRE FIGHTING MEASURES ****

General Information:
As in any fire, wear a self-contained breathing apparatus in pressure-demand, MSHA/NIOSH (approved or equivalent), and full protective gear. During a fire, irritating and highly toxic gases may be generated by thermal decomposition or combustion. Non-combustible, substance itself does not burn but may decompose upon heating to produce corrosive and/or toxic fumes.

Extinguishing Media:
Substance is noncombustible; use agent most appropriate to extinguish surrounding fire. Use water spray, dry chemical, carbon dioxide, or appropriate foam.

## **** SECTION 6 - ACCIDENTAL RELEASE MEASURES ****

General Information: Use proper personal protective equipment as indicated in Section 8.

Spills/Leaks:
Vacuum or sweep up material and place into a suitable disposal container. Clean up spills immediately, observing precautions in the Protective Equipment section. Avoid generating dusty conditions. Provide ventilation.

## **** SECTION 7 - HANDLING and STORAGE ****

Handling:
Wash thoroughly after handling. Wash hands before eating. Avoid contact with eyes, skin, and clothing. Keep container tightly closed. Avoid ingestion and inhalation. Use with adequate ventilation.

Storage:
Store in a tightly closed container. Store in a cool, dry, well-ventilated area away from incompatible substances. No special precautions indicated.

## **** SECTION 8 - EXPOSURE CONTROLS, PERSONAL PROTECTION ****

Engineering Controls:
Facilities storing or utilizing this material should be equipped with an eyewash facility and a safety shower. Use adequate ventilation to keep airborne concentrations low.

Personal Protective Equipment

Eyes:
Wear appropriate protective eyeglasses or chemical safety goggles as described by OSHA's eye and face protection regulations in 29 CFR 1910.133 or European Standard EN166.

Skin:
Wear appropriate protective gloves to prevent skin exposure.

Clothing:
Wear appropriate protective clothing to minimize contact with skin.

Respirators:
A respiratory protection program that meets OSHA's 29 CFR :1910.134 and ANSI Z88.2 requirements or European Standard EN 149 must be followed whenever workplace conditions warrant a respirator's use.

## **** SECTION 9 - PHYSICAL AND CHEMICAL PROPERTIES ****

| | |
|---|---|
| Physical State: | Solid |
| Appearance: | white |

Odor: none reported
pH: Not available.
Vapor Pressure: 100 mm Hg @ 1865 C
Vapor Density: Not available.
Evaporation Rate: Not applicable.
Viscosity: Not available.
Boiling Point: 2212 deg C
Freezing/Melting Point: 961 deg C
Autoignition Temperature: Not applicable.
Flash Point: Not applicable.
Explosion Limits, lower: Not available.
Explosion Limits, upper: Not available.
Decomposition Temperature: Not available.
Solubility: Insoluble in water.
Specific Gravity/Density: 10.5
Molecular Formula: Ag
Molecular Weight: 107.8682

## **** SECTION 10 - STABILITY AND REACTIVITY ****

Chemical Stability:
Stable under normal temperatures and pressures.
Conditions to Avoid:
Incompatible materials, exposure to air.
Incompatibilities with Other Materials:
Strong acids, strong bases, ethyleneimine.
Hazardous Decomposition Products:
Irritating and toxic fumes and gases, silver fumes.
Hazardous Polymerization: Has not been reported.

## **** SECTION 11 - TOXICOLOGICAL INFORMATION ****

RTECS#:
CAS# 7440-22-4: VW3500000
LD50/LC50:
Not available.
Carcinogenicity:
Silver -
Not listed by ACGIH, IARC, NIOSH, NTP, or OSHA.
Epidemiology:
No data available.
Teratogenicity:
No data available.
Reproductive Effects:
No data available.
Neurotoxicity:
No data available.
Mutagenicity:
No data available.
Other Studies:
See actual entry in RTECS for complete information.

## **** SECTION 12 - ECOLOGICAL INFORMATION ****

Other
For more information, see "HANDBOOK OF ENVIRONMENTAL FATE AND EXPOSURE DATA."

## **** SECTION 13 - DISPOSAL CONSIDERATIONS ****

Dispose of in a manner consistent with federal, state, and local regulations.

## **** SECTION 14 - TRANSPORT INFORMATION ****

US DOT
No information available
Canadian TDG

No information available.

## **** SECTION 15 - REGULATORY INFORMATION ****

US FEDERAL
TSCA
CAS# 7440-22-4 is listed on the TSCA inventory.
This material does not contain any Class 2 Ozone depletors.
Clean Water Act:
None of the chemicals in this product are listed as Hazardous Substances under the CWA.
CAS# 7440-22-4 is listed as a Priority Pollutant under the Clean Water Act.
CAS# 7440-22-4 is listed as a Toxic Pollutant under the Clean Water Act.
OSHA:
None of the chemicals in this product are considered highly hazardous by OSHA.

STATE
Silver can be found on the following state right to know lists: California, New Jersey, Florida, Pennsylvania, Minnesota, Massachusetts.
California No Significant Risk Level:
None of the chemicals in this product are listed.

European/International Regulations
European Labeling in Accordance with EC Directives
Hazard Symbols: Not available.
Risk Phrases:
R 33 Danger of cumulative effects.
Safety Phrases:
S 28A After contact with skin, wash immediately with plenty of water.
S 37 Wear suitable gloves.
S 45 In case of accident or if you feel unwell, seek medical advice immediately (show the label where possible).

WGK (Water Danger/Protection)
CAS# 7440-22-4: 0
United Kingdom Occupational Exposure Limits
CAS# 7440-22-4: OES-United Kingdom, TWA 0.1 mg/m3 TWA

Canada
CAS# 7440-22-4 is listed on Canada's DSL List.
CAS# 7440-22-4 is listed on Canada's Ingredient Disclosure List.
Exposure Limits
CAS# 7440-22-4: OEL-AUSTRALIA:TWA 0.1 mg/m3
OEL-BELGIUM:TWA 0.1 mg/m3
OEL-DENMARK:TWA 0.01 mg/m3
OEL-FINLAND:TWA 0.1 mg/m3
OEL-FRANCE:TWA 0.1 mg/m3
OEL-GERMANY:TWA 0.01 mg/m3
OEL-RUSSIA:STEL 1 mg/m3
OEL-SWITZERLAND:TWA 0.01 mg/m3
OEL-UNITED KINGDOM:TWA 0.1 mg/m3
OEL IN BULGARIA, COLOMBIA, JORDAN, KOREA check ACGIH TLV
OEL IN NEW ZEALAND, SINGAPORE, VIETNAM check ACGI TLV

## **** SECTION 16 - ADDITIONAL INFORMATION ****

MSDS Creation Date: 12/12/1997 Revision #5 Date: 8/02/2000

The information above is believed to be accurate and represents the best information currently available to us. However, we make no warranty of merchantability or any other warranty, express or implied, with respect to such information, and we assume no liability resulting from its use. Users should make their own investigations to determine the suitability of the information for their particular purposes. In no way shall the company be liable for any claims, losses, or damages of any third party or for lost profits or any special, indirect, incidental, consequential or exemplary damages, howsoever arising, even if the company has been advised of the possibility of such damages.

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# International Chemical Safety Cards

## TETRACHLOROETHYLENE

**ICSC: 0076**

TETRACHLOROETHYLENE
1,1,2,2-Tetrachloroethylene
Perchloroethylene
Tetrachloroethene
$C_2Cl_4/Cl_2C=CCl_2$
Molecular mass: 165.8

CAS # 127-18-4
RTECS # KX3850000
ICSC # 0076
UN # 1897
EC # 602-028-00-4

| TYPES OF HAZARD/ EXPOSURE | ACUTE HAZARDS/ SYMPTOMS | PREVENTION | FIRST AID/ FIRE FIGHTING |
|---|---|---|---|
| **FIRE** | Not combustible. Gives off irritating or toxic fumes (or gases) in a fire. | | In case of fire in the surroundings: all extinguishing agents allowed. |
| **EXPLOSION** | | | |
| **EXPOSURE** | | STRICT HYGIENE! | |
| **• INHALATION** | Incoordination. Exhilaration. Dizziness. Drowsiness. Headache. Nausea. Weakness. Unconsciousness. | Ventilation, local exhaust, or breathing protection. | Fresh air, rest. Artificial respiration if indicated. Refer for medical attention. |
| **• SKIN** | Dry skin. Redness. Skin burns. Blisters. | Protective gloves. Protective clothing. | Remove contaminated clothes. Rinse and then wash skin with water and soap. |
| **• EYES** | Redness. Pain. | Safety goggles, face shield. | First rinse with plenty of water for several minutes (remove contact lenses if easily possible), then take to a doctor. |
| **• INGESTION** | Abdominal pain (further see Inhalation). | Do not eat, drink, or smoke during work. Wash hands before eating. | Rinse mouth. Do NOT induce vomiting. Give plenty of water to drink. Rest. |

| SPILLAGE DISPOSAL | STORAGE | PACKAGING & LABELLING |
|---|---|---|
| Ventilation. Collect leaking and spilled liquid in sealable containers as far as possible. Absorb remaining liquid in sand or inert absorbent and remove to safe place. | Separated from metals (see Chemical Dangers), food and feedstuffs. Keep in the dark. Ventilation along the floor. | Do not transport with food and feedstuffs. IMO: Marine Pollutant<br>Xn symbol<br>R: 40<br>S: 23-36/37<br>UN Hazard Class: 6.1<br>UN Packing Group: III |

**SEE IMPORTANT INFORMATION ON BACK**

Prepared in the context of cooperation between the International Programme on Chemical Safety & the

ICSC: 0076 Commission of the European Communities

# International Chemical Safety Cards

## TETRACHLOROETHYLENE

ICSC: 0076

| | | |
|---|---|---|
| IMPORTANT DATA | **PHYSICAL STATE; APPEARANCE:**<br>COLOURLESS LIQUID , WITH CHARACTERISTIC ODOUR.<br>**PHYSICAL DANGERS:**<br>The vapour is heavier than air.<br>**CHEMICAL DANGERS:**<br>On contact with hot surfaces or flames this substance decomposes forming toxic and corrosive fumes (hydrogen chloride, phosgene, chlorine). The substance decomposes slowly on contact with moisture producing trichloroacetic acid and hydrochloric acid. Reacts with metals such as aluminium, lithium, barium, berrylium.<br>**OCCUPATIONAL EXPOSURE LIMITS (OELs):**<br>TLV: 50 ppm; 339 mg/m$^3$ (STEL): 200 ppm; 1357 mg/m$^3$ (ACGIH 1992-1993). | **ROUTES OF EXPOSURE:**<br>The substance can be absorbed into the body by inhalation, through the skin and by ingestion.<br>**INHALATION RISK:**<br>A harmful contamination of the air will be reached rather slowly on evaporation of this substance at 20°C.<br>**EFFECTS OF SHORT-TERM EXPOSURE:**<br>The substance irritates the eyes, the skin and the respiratory tract. Swallowing the liquid may cause aspiration into the lungs with the risk of chemical pneumonitis. The substance may cause effects on the central nervous system.<br>**EFFECTS OF LONG-TERM OR REPEATED EXPOSURE:**<br>Repeated or prolonged contact with skin may cause dermatitis. The substance may have effects on the liver and kidney. Tumours have been detected in experimental animals but may not be relevant to humans (see Notes). |
| PHYSICAL PROPERTIES | Boiling point: 121°C<br>Melting point: -22°C<br>Relative density (water = 1): 1.6<br>Solubility in water, g/100 ml at 20°C: 0.015 | Vapour pressure, kPa at 20°C: 1.9<br>Relative vapour density (air = 1): 5.8<br>Relative density of the vapour/air-mixture at 20°C (air = 1): 1.09<br>Octanol/water partition coefficient as log Pow: 2.6 |
| ENVIRONMENTAL DATA | This substance may be hazardous to the environment; special attention should be given to indoor air and water. | |

### NOTES

Use of alcoholic beverages enhances the harmful effect. Depending on the degree of exposure, periodic medical examination is indicated. The odour warning when the exposure limit value is exceeded is insufficient.Do NOT use in the vicinity of a fire or a hot surface, or during welding. Technical grades may contain small amounts of carcinogenic stabilizers.

Transport Emergency Card: TEC (R)-722
NFPA Code: H2; F0; R0;

### ADDITIONAL INFORMATION

ICSC: 0076 TETRACHLOROETHYLENE

**IMPORTANT** Neither the CEC or the IPCS nor any person acting on behalf of the CEC or the IPCS is responsible for the use which might be made of this information. This card contains the collective views of the

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| **LEGAL NOTICE:** | IPCS Peer Review Committee and may not reflect in all cases all the detailed requirements included in national legislation on the subject. The user should verify compliance of the cards with the relevant legislation in the country of use. |

# International Chemical Safety Cards

## TOLUENE

ICSC: 0078

TOLUENE
Methylbenzene
Toluol
$C_6H_5CH_3/C_7H_8$
Molecular mass: 92.1

CAS # 108-88-3
RTECS # XS5250000
ICSC # 0078
UN # 1294
EC # 601-021-00-3

| TYPES OF HAZARD/ EXPOSURE | ACUTE HAZARDS/ SYMPTOMS | PREVENTION | FIRST AID/ FIRE FIGHTING |
|---|---|---|---|
| **FIRE** | Highly flammable. | NO open flames, NO sparks, and NO smoking. | Powder, AFFF, foam, carbon dioxide. |
| **EXPLOSION** | Vapour/air mixtures are explosive. | Closed system, ventilation, explosion-proof electrical equipment and lighting. Prevent build-up of electrostatic charges (e.g., by grounding). Do NOT use compressed air for filling, discharging, or handling. | In case of fire: keep drums, etc., cool by spraying with water. |
| **EXPOSURE** |  | STRICT HYGIENE! AVOID EXPOSURE OF (PREGNANT) WOMEN! |  |
| • **INHALATION** | Dizziness. Drowsiness. Headache. Nausea. Unconsciousness. | Ventilation, local exhaust, or breathing protection. | Fresh air, rest. Artificial respiration if indicated. Refer for medical attention. |
| • **SKIN** | Dry skin. Redness. | Protective gloves. | Remove contaminated clothes. Rinse and then wash skin with water and soap. Refer for medical attention. |
| • **EYES** | Redness. Pain. | Safety goggles or face shield. | First rinse with plenty of water for several minutes (remove contact lenses if easily possible), then take to a doctor. |
| • **INGESTION** | Abdominal pain. Burning sensation (further see Inhalation). | Do not eat, drink, or smoke during work. | Rinse mouth. Give a slurry of activated charcoal in water to drink. Do NOT induce vomiting. Refer for medical attention. |

| SPILLAGE DISPOSAL | STORAGE | PACKAGING & LABELLING |
|---|---|---|
| Collect leaking liquid in sealable containers. Absorb remaining liquid in sand or inert absorbent and remove to safe place. Do NOT wash away into | Fireproof. Separated from strong oxidants. | F symbol<br>Xn symbol<br>R: 11-20 |

| | | |
|---|---|---|
| sewer (extra personal protection: self-contained breathing apparatus). | | S: (2-)16-25-29-33<br>UN Hazard Class: 3<br>UN Packing Group: II |

**SEE IMPORTANT INFORMATION ON BACK**

**ICSC: 0078** Prepared in the context of cooperation between the International Programme on Chemical Safety & the Commission of the European Communities © IPCS CEC 1993

# International Chemical Safety Cards

## TOLUENE

**ICSC: 0078**

| | | |
|---|---|---|
| **IMPORTANT DATA** | **PHYSICAL STATE; APPEARANCE:**<br>COLOURLESS LIQUID , WITH CHARACTERISTIC ODOUR.<br>**PHYSICAL DANGERS:**<br>The vapour is heavier than air and may travel along the ground; distant ignition possible. As a result of flow, agitation, etc., electrostatic charges can be generated.<br>**CHEMICAL DANGERS:**<br>Reacts violently with strong oxidants causing fire and explosion hazard.<br>**OCCUPATIONAL EXPOSURE LIMITS (OELs):**<br>TLV: 50 ppm; 188 mg/m$^3$ (as TWA) (skin) (ACGIH 1993-1994). | **ROUTES OF EXPOSURE:**<br>The substance can be absorbed into the body by inhalation, through the skin and by ingestion.<br>**INHALATION RISK:**<br>A harmful contamination of the air can be reached rather quickly on evaporation of this substance at 20°C.<br>**EFFECTS OF SHORT-TERM EXPOSURE:**<br>The substance irritates the eyes and the respiratory tract. Exposure could cause central nervous system depression. Exposure at high levels may result in cardiac dysrhythmia, unconsciousness and death.<br>**EFFECTS OF LONG-TERM OR REPEATED EXPOSURE:**<br>Repeated or prolonged contact with skin may cause dermatitis. The substance may have effects on the central nervous system, resulting in decreased learning ability and psychological disorders. Animal tests show that this substance possibly causes toxic effects upon human reproduction. |
| **PHYSICAL PROPERTIES** | Boiling point: 111°C<br>Melting point: -95°C<br>Relative density (water = 1): 0.87<br>Solubility in water: none<br>Vapour pressure, kPa at 20°C: 2.9<br>Relative vapour density (air = 1): 3.2 | Relative density of the vapour/air-mixture at 20°C (air = 1): 1.06<br>Flash point: 4°C c.c.°C<br>Auto-ignition temperature: 480°C<br>Explosive limits, vol% in air: 1.1-7.1<br>Octanol/water partition coefficient as log Pow: 2.69 |
| **ENVIRONMENTAL DATA** | | |

**NOTES**

Depending on the degree of exposure, periodic medical examination is indicated.

Transport Emergency Card: TEC (R)-31
NFPA Code: H 2; F 3; R 0;

## ADDITIONAL INFORMATION

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**ICSC: 0078** **TOLUENE**

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|---|---|
| **IMPORTANT LEGAL NOTICE:** | Neither the CEC or the IPCS nor any person acting on behalf of the CEC or the IPCS is responsible for the use which might be made of this information. This card contains the collective views of the IPCS Peer Review Committee and may not reflect in all cases all the detailed requirements included in national legislation on the subject. The user should verify compliance of the cards with the relevant legislation in the country of use. |

# International Chemical Safety Cards

## TRICHLOROETHYLENE

ICSC: 0081

TRICHLOROETHYLENE
1,1,2-Trichloroethylene
Trichloroethene
Ethylene trichloride
$C_2HCl_3/ClCH=CCl_2$
Molecular mass: 131.4

CAS # 79-01-6
RTECS # KX4550000
ICSC # 0081
UN # 1710
EC # 602-027-00-9

| TYPES OF HAZARD/ EXPOSURE | ACUTE HAZARDS/ SYMPTOMS | PREVENTION | FIRST AID/ FIRE FIGHTING |
|---|---|---|---|
| FIRE | Combustible under specific conditions. See Notes. | | In case of fire in the surroundings: all extinguishing agents allowed. |
| EXPLOSION | Risk of fire and explosion (see Chemical Dangers). | | In case of fire: keep drums, etc., cool by spraying with water. |
| EXPOSURE | | | |
| • INHALATION | Dizziness. Drowsiness. Headache. Weakness. Unconsciousness. | Ventilation, local exhaust, or breathing protection. | Fresh air, rest. Artificial respiration if indicated. Refer for medical attention. |
| • SKIN | Dry skin. Redness. | Protective gloves. | Remove contaminated clothes. Rinse and then wash skin with water and soap. |
| • EYES | Redness. Pain. | Safety spectacles. | First rinse with plenty of water for several minutes (remove contact lenses if easily possible), then take to a doctor. |
| • INGESTION | Abdominal pain (further see Inhalation). | Do not eat, drink, or smoke during work. Wash hands before eating. | Rinse mouth. Do NOT induce vomiting. Give plenty of water to drink. Rest. |

| SPILLAGE DISPOSAL | STORAGE | PACKAGING & LABELLING |
|---|---|---|
| Ventilation. Collect leaking and spilled liquid in sealable containers as far as possible. Absorb remaining liquid in sand or inert absorbent and remove to safe place (extra personal protection: self-contained breathing apparatus). | Separated from metals (see Chemical Dangers), strong bases, food and feedstuffs. Dry. Keep in the dark. Ventilation along the floor. | Do not transport with food and feedstuffs. IMO: Marine Pollutant<br>Xn symbol<br>R: 40<br>S: 23-36/37<br>UN Hazard Class: 6.1<br>UN Packing Group: III |

**SEE IMPORTANT INFORMATION ON BACK**

Prepared in the context of cooperation between the International Programme on Chemical Safety & the

**ICSC: 0081**

# International Chemical Safety Cards

## TRICHLOROETHYLENE

**ICSC: 0081**

### IMPORTANT DATA

**PHYSICAL STATE; APPEARANCE:**
COLOURLESS LIQUID , WITH CHARACTERISTIC ODOUR.

**PHYSICAL DANGERS:**
The vapour is heavier than air. As a result of flow, agitation, etc., electrostatic charges can be generated.

**CHEMICAL DANGERS:**
On contact with hot surfaces or flames this substance decomposes forming toxic and corrosive fumes (phosgene, hydrogen chloride, chlorine). The substance decomposes on contact with strong alkali producing dichloroacetylene , which increases fire hazard. Reacts violently with metals such as lithium, magnesium aluminium, titanium, barium and sodium. Slowly decomposed by light in presence of moisture, with formulation of corrosive hydrochloric acid.

**OCCUPATIONAL EXPOSURE LIMITS (OELs):**
TLV: 50 ppm; 269 mg/m$^3$ (STEL): 200 ppm; 1070 mg/m$^3$ (ACGIH 1992-1993).

**ROUTES OF EXPOSURE:**
The substance can be absorbed into the body by inhalation, through the skin and by ingestion.

**INHALATION RISK:**
A harmful contamination of the air can be reached rather quickly on evaporation of this substance at 20°C.

**EFFECTS OF SHORT-TERM EXPOSURE:**
The substance irritates the eyes and the skin. Swallowing the liquid may cause aspiration into the lungs with the risk of chemical pneumonitis. The substance may cause effects on the central nervous system. Exposure could cause lowering of consciousness.

**EFFECTS OF LONG-TERM OR REPEATED EXPOSURE:**
Repeated or prolonged contact with skin may cause dermatitis. The substance may have effects on the liver and kidney (see notes).

### PHYSICAL PROPERTIES

Boiling point: 87°C
Melting point: -73°C
Relative density (water = 1): 1.5
Solubility in water, g/100 ml at 20°C: 0.1
Vapour pressure, kPa at 20°C: 7.8
Relative vapour density (air = 1): 4.5
Relative density of the vapour/air-mixture at 20°C (air = 1): 1.3
Auto-ignition temperature: 410°C
Explosive limits, vol% in air: 8-10.5
Octanol/water partition coefficient as log Pow: 2.42

### ENVIRONMENTAL DATA

This substance may be hazardous to the environment; special attention should be given to water organisms.

### NOTES

Combustible vapour/air mixtures difficult to ignite, may be developed under certain conditions. Use of alcoholic beverages enhances the harmful effect. Depending on the degree of exposure, periodic medical examination is indicated. The odour warning when the exposure limit value is exceeded is insufficient. Do NOT use in the vicinity of a fire or a hot surface, or during welding. Technical grades may contain small amounts of carcinogenic stabilizers.

Transport Emergency Card: TEC (R)-723
NFPA Code: H2; F1; R0;

### ADDITIONAL INFORMATION

ICSC: 0081 TRICHLOROETHYLENE

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|---|---|
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24 Hour Emergency Telephone: 908-859-2151
CHEMTREC: 1-800-424-9300

National Response in Canada
CANUTEC: 613-996-6666

Outside U.S. and Canada
Chemtrec: 703-527-3887

**MSDS** *Material Safety Data Sheet*

From: Mallinckrodt Baker, Inc.
222 Red School Lane
Phillipsburg, NJ 08865

Mallinckrodt CHEMICALS
J.T.Baker

NOTE: CHEMTREC, CANUTEC and National Response Center emergency numbers to be used only in the event of chemical emergencies involving a spill, leak, fire, exposure or accident involving chemicals.

All non-emergency questions should be directed to Customer Service (1-800-552-2537) for assistance.

# XYLENES

**MSDS Number: X2000 --- *Effective Date: 09/14/00***

## 1. Product Identification

**Synonyms:** Dimethyl benzene, xylol, methyltoluene
**CAS No.:** 1330-20-7
**Molecular Weight:** 106.17
**Chemical Formula:** $C_6H_4(CH_3)_2$
**Product Codes:**
J.T. Baker: 5377, 5810, 5813, 9483, 9489, 9490, 9493, 9494, 9499, 9516, X516
Mallinckrodt: 8664, 8668, 8671, 8672, 8685, 8802, V052

## 2. Composition/Information on Ingredients

| Ingredient | CAS No | Percent | Hazardous |
|---|---|---|---|
| m-Xylene | 108-38-3 | 40 - 65% | No |
| o-Xylene | 95-47-6 | 15 - 20% | No |
| p-Xylene | 106-42-3 | < 20% | No |
| Ethyl Benzene | 100-41-4 | 15 - 25% | Yes |

## 3. Hazards Identification

**Emergency Overview**

**DANGER! HARMFUL OR FATAL IF SWALLOWED. VAPOR HARMFUL.**

**AFFECTS CENTRAL NERVOUS SYSTEM. CAUSES SEVERE EYE IRRITATION. CAUSES IRRITATION TO SKIN AND RESPIRATORY TRACT. MAY BE HARMFUL IF ABSORBED THROUGH SKIN. CHRONIC EXPOSURE CAN CAUSE ADVERSE LIVER, KIDNEY, AND BLOOD EFFECTS. FLAMMABLE LIQUID AND VAPOR.**

**J.T. Baker SAF-T-DATA**$^{(tm)}$ Ratings (Provided here for your convenience)

-----------------------------------------------------------------------------------------------------

Health Rating: 2 - Moderate
Flammability Rating: 3 - Severe (Flammable)
Reactivity Rating: 0 - None
Contact Rating: 2 - Moderate
Lab Protective Equip: GOGGLES; LAB COAT; VENT HOOD; PROPER GLOVES; CLASS B EXTINGUISHER.
Storage Color Code: Red (Flammable)

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**Potential Health Effects**

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**Inhalation:**
Inhalation of vapors may be irritating to the nose and throat. Inhalation of high concentrations may result in nausea, vomiting, headache, ringing in the ears, and severe breathing difficulties which may be delayed in onset. Substernal pain, cough, and hoarseness are also reported. High vapor concentrations are anesthetic and central nervous system depressants.

**Ingestion:**
Ingestion causes burning sensation in mouth and stomach, nausea, vomiting and salivation. Minute amounts aspirated into the lungs can produce a severe hemorrhagic pneumonitis with severe pulmonary injury or death.

**Skin Contact:**
Skin contact results in loss of natural oils and often results in a characteristic dermatitis. May be absorbed through the skin.

**Eye Contact:**
Vapors cause eye irritation. Splashes cause severe irritation, possible corneal burns and eye damage.

**Chronic Exposure:**
Chronic inhalation can cause headache, loss of appetite, nervousness and pale skin. Repeated or prolonged skin contact may cause a skin rash. Repeated exposure of the eyes to high concentrations of vapor may cause reversible eye damage. Repeated exposure can damage bone marrow, causing low blood cell count. May damage the liver and kidneys.

**Aggravation of Pre-existing Conditions:**
Persons with pre-existing skin disorders or eye problems, or impaired liver, kidney, blood, or respiratory function may be more susceptible to the effects of the substance.

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## 4. First Aid Measures

**Inhalation:**

Remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Call a physician immediately.

**Ingestion:**

Aspiration hazard. If swallowed, vomiting may occur spontaneously, but DO NOT INDUCE. If vomiting occurs, keep head below hips to prevent aspiration into lungs. Never give anything by mouth to an unconscious person. Call a physician immediately.

**Skin Contact:**

Immediately flush skin with plenty of soap and water for at least 15 minutes while removing contaminated clothing and shoes. Get medical attention. Wash clothing before reuse. Thoroughly clean shoes before reuse.

**Eye Contact:**

Immediately flush eyes with plenty of water for at least 15 minutes, lifting lower and upper eyelids occasionally. Get medical attention immediately.

---

## 5. Fire Fighting Measures

**Fire:**

Flash point: 29C (84F) CC
Autoignition temperature: 464C (867F)
Flammable limits in air % by volume:
lel: 1.0; uel: 7.0

**Explosion:**

Above flash point, vapor-air mixtures are explosive within flammable limits noted above. Contact with strong oxidizers may cause fire. Sealed containers may rupture when heated. Sensitive to static discharge.

**Fire Extinguishing Media:**

Dry chemical, foam or carbon dioxide. Water spray may be used to keep fire exposed containers cool, dilute spills to nonflammable mixtures, protect personnel attempting to stop leak and disperse vapors.

**Special Information:**

In the event of a fire, wear full protective clothing and NIOSH-approved self-contained breathing apparatus with full facepiece operated in the pressure demand or other positive pressure mode. Vapors can flow along surfaces to distant ignition source and flash back.

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## 6. Accidental Release Measures

Ventilate area of leak or spill. Remove all sources of ignition. Wear appropriate personal protective equipment as specified in Section 8. Isolate hazard area. Keep unnecessary and unprotected personnel from entering. Contain and recover liquid when possible. Use non-sparking tools and equipment. Collect liquid in an appropriate container or absorb with an inert material (e. g., vermiculite, dry sand, earth), and place in a chemical waste container. Do not use combustible materials, such as saw dust. Do not flush to sewer! If a leak or spill has not ignited, use water spray to disperse the vapors, to protect personnel attempting to stop leak, and to flush spills away from exposures. US Regulations (CERCLA) require reporting spills and releases to soil, water and air in excess of reportable quantities. The toll free number for the US Coast Guard National Response Center is (800) 424-8802.

J. T. Baker SOLUSORB(R) solvent adsorbent is recommended for spills of this product.

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# 7. Handling and Storage

Protect against physical damage. Store in a cool, dry well-ventilated location, away from any area where the fire hazard may be acute. Outside or detached storage is preferred. Separate from incompatibles. Containers should be bonded and grounded for transfers to avoid static sparks. Storage and use areas should be No Smoking areas. Use non-sparking type tools and equipment, including explosion proof ventilation. Containers of this material may be hazardous when empty since they retain product residues (vapors, liquid); observe all warnings and precautions listed for the product. Do Not attempt to clean empty containers since residue is difficult to remove. Do not pressurize, cut, weld, braze, solder, drill, grind or expose such containers to heat, sparks, flame, static electricity or other sources of ignition: they may explode and cause injury or death.

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# 8. Exposure Controls/Personal Protection

**Airborne Exposure Limits:**
-OSHA Permissible Exposure Limit (PEL):
100 ppm (TWA) xylene
100 ppm (TWA) ethylbenzene
-ACGIH Threshold Limit Value (TLV):
100 ppm (TWA) 150 ppm (STEL) xylene
Carcinogen Category (xylene): A4
100 ppm (TWA) 125 ppm (STEL) ethyl benzene

**Ventilation System:**
A system of local and/or general exhaust is recommended to keep employee exposures below the Airborne Exposure Limits. Local exhaust ventilation is generally preferred because it can control the emissions of the contaminant at its source, preventing dispersion of it into the general work area. Please refer to the ACGIH document, *Industrial Ventilation, A Manual of Recommended Practices*, most recent edition, for details. Use explosion-proof equipment.

**Personal Respirators (NIOSH Approved):**
If the exposure limit is exceeded and engineering controls are not feasible, a half-face organic vapor respirator may be worn for up to ten times the exposure limit, or the maximum use concentration specified by the appropriate regulatory agency or respirator supplier, whichever is lowest. A full-face piece organic vapor respirator may be worn up to 50 times the exposure limit, or the maximum use concentration specified by the appropriate regulatory agency or respirator supplier, whichever is lowest. For emergencies or instances where the exposure levels are not known, use a full-face piece positive-pressure, air-supplied respirator. WARNING: Air-purifying respirators do not protect workers in oxygen-deficient atmospheres. Where respirators are required, you must have a written program covering the basic requirements in the OSHA respirator standard. These include training, fit testing, medical approval, cleaning, maintenance, cartridge change schedules, etc. See 29CFR1910.134 for details.

**Skin Protection:**
Wear impervious protective clothing, including boots, gloves, lab coat, apron or coveralls, as appropriate, to prevent skin contact.
**Eye Protection:**
Use chemical safety goggles and/or a full face shield where splashing is possible. Maintain eye wash fountain and quick-drench facilities in work area.

## 9. Physical and Chemical Properties

The following physical data is for xylene.
**Appearance:**
Clear, colorless liquid.
**Odor:**
Characteristic odor.
**Solubility:**
Insoluble in water.
**Specific Gravity:**
0.86 @ 20C/4C
**pH:**
Not applicable.
**% Volatiles by volume @ 21C (70F):**
100
**Boiling Point:**
137 - 140C (279 - 284F)
**Melting Point:**
-25C (-13F)
**Vapor Density (Air=1):**
3.7
**Vapor Pressure (mm Hg):**
8 @ 20C (68F)
**Evaporation Rate (BuAc=1):**
0.7

## 10. Stability and Reactivity

**Stability:**
Stable under ordinary conditions of use and storage.
**Hazardous Decomposition Products:**
Involvement in a fire causes formation of carbon monoxide and unidentified organic components.
**Hazardous Polymerization:**
Will not occur.
**Incompatibilities:**
Strong oxidizing agents and strong acids.
**Conditions to Avoid:**
Heat, flames, ignition sources and incompatibles.

## 11. Toxicological Information

**Toxicological Data:**
Xylene: oral rat LD50: 4300 mg/kg; inhalation rat LC50: 5000 ppm/4H; skin rabbit LD50: > 1700 mg/kg; Irritation eye rabbit: 87 mg mild (Std. Draize); irritation skin rabbit 500 mg/24 moderate (Std. Draize); investigated as a tumorigen, mutagen, reproductive effector.
Ethyl benzene: oral rat LD50: 3500 mg/kg; skin rabbit LD50: 17800 uL/kg; investigated as a tumorigen, mutagen, reproductive effector.
**Reproductive Toxicity:**
May cause teratogenic effects.

```
--------\Cancer Lists\------------------------------------------------------
                                              ---NTP Carcinogen---
Ingredient                                    Known    Anticipated     IARC Category
------------------------------------          -----    -----------     -------------
m-Xylene (108-38-3)                            No          No                3
o-Xylene (95-47-6)                             No          No                3
p-Xylene (106-42-3)                            No          No                3
Ethyl Benzene (100-41-4)                       No          No                2B
```

## 12. Ecological Information

**Environmental Fate:**
Following data for xylene: When released into the soil, this material may evaporate to a moderate extent. When released into the soil, this material is expected to leach into groundwater. When released into the soil, this material may biodegrade to a moderate extent. When released into water, this material may evaporate to a moderate extent. When released into water, this material may biodegrade to a moderate extent. When released into the air, this material may be moderately degraded by reaction with photochemically produced hydroxyl radicals. When released into the air, this material is expected to have a half-life of less than 1 day. This material is not expected to significantly bioaccumulate. (mixed xylenes: octanol / water partition coefficient 3.1 - 3.2; bioconcentration factor = 1.3, eels)
**Environmental Toxicity:**
For xylene: This material is expected to be slightly toxic to aquatic life. The LC50/96-hour values for fish are between 10 and 100 mg/l.

## 13. Disposal Considerations

Whatever cannot be saved for recovery or recycling should be handled as hazardous waste and sent to a RCRA approved incinerator or disposed in a RCRA approved waste facility. Processing, use or contamination of this product may change the waste management options. State and local disposal regulations may differ from federal disposal regulations. Dispose of container and unused contents in accordance with federal, state and local requirements.

---

## 14. Transport Information

**Domestic (Land, D.O.T.)**

-----------------------

**Proper Shipping Name:** XYLENES
**Hazard Class:** 3
**UN/NA:** UN1307
Packing Group: III
**Information reported for product/size:** 398LB

**International (Water, I.M.O.)**

-----------------------------

**Proper Shipping Name:** XYLENES
**Hazard Class:** 3.3
**UN/NA:** UN1307
Packing Group: III
**Information reported for product/size:** 398LB

---

## 15. Regulatory Information

--------\Chemical Inventory Status - Part 1\---------------------------------

| Ingredient | TSCA | EC | Japan | Australia |
|---|---|---|---|---|
| m-Xylene (108-38-3) | Yes | Yes | Yes | Yes |
| o-Xylene (95-47-6) | Yes | Yes | Yes | Yes |
| p-Xylene (106-42-3) | Yes | Yes | Yes | Yes |
| Ethyl Benzene (100-41-4) | Yes | Yes | Yes | Yes |

--------\Chemical Inventory Status - Part 2\---------------------------------

| | | --Canada-- | | |
|---|---|---|---|---|
| Ingredient | Korea | DSL | NDSL | Phil. |
| m-Xylene (108-38-3) | Yes | Yes | No | Yes |
| o-Xylene (95-47-6) | Yes | Yes | No | Yes |
| p-Xylene (106-42-3) | Yes | Yes | No | Yes |
| Ethyl Benzene (100-41-4) | Yes | Yes | No | Yes |

--------\Federal, State & International Regulations - Part 1\----------------

| | -SARA 302- | | ------SARA 313------ | |
|---|---|---|---|---|
| Ingredient | RQ | TPQ | List | Chemical Catg. |
| m-Xylene (108-38-3) | No | No | Yes | No |
| o-Xylene (95-47-6) | No | No | Yes | No |
| p-Xylene (106-42-3) | No | No | Yes | No |
| Ethyl Benzene (100-41-4) | No | No | Yes | No |

--------\Federal, State & International Regulations - Part 2\----------------
-RCRA- -TSCA-

| Ingredient | CERCLA | 261.33 | 8(d) |
|---|---|---|---|
| m-Xylene (108-38-3) | 1000 | No | No |
| o-Xylene (95-47-6) | 1000 | No | No |
| p-Xylene (106-42-3) | 100 | No | Yes |
| Ethyl Benzene (100-41-4) | 1000 | No | No |

```
Chemical Weapons Convention:  No     TSCA 12(b):  No     CDTA:  No
SARA 311/312:  Acute: Yes      Chronic: Yes  Fire: Yes Pressure: No
Reactivity: No          (Mixture / Liquid)
```

**Australian Hazchem Code:** 3[Y]
**Poison Schedule:** No information found.
**WHMIS:**
This MSDS has been prepared according to the hazard criteria of the Controlled Products Regulations (CPR) and the MSDS contains all of the information required by the CPR.

---

# 16. Other Information

**NFPA Ratings:** Health: **2** Flammability: **3** Reactivity: **0**
**Label Hazard Warning:**
DANGER! HARMFUL OR FATAL IF SWALLOWED. VAPOR HARMFUL. AFFECTS CENTRAL NERVOUS SYSTEM. CAUSES SEVERE EYE IRRITATION. CAUSES IRRITATION TO SKIN AND RESPIRATORY TRACT. MAY BE HARMFUL IF ABSORBED THROUGH SKIN. CHRONIC EXPOSURE CAN CAUSE ADVERSE LIVER, KIDNEY, AND BLOOD EFFECTS. FLAMMABLE LIQUID AND VAPOR.
**Label Precautions:**
Keep away from heat, sparks and flame.
Avoid contact with eyes, skin and clothing.
Keep container closed.
Use only with adequate ventilation.
Avoid breathing vapor.
Wash thoroughly after handling.
**Label First Aid:**
Aspiration hazard. If swallowed, vomiting may occur spontaneously, but DO NOT INDUCE. If vomiting occurs, keep head below hips to prevent aspiration into lungs. Never give anything by mouth to an unconscious person. Call a physician immediately. If inhaled, remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. In case of contact, immediately flush eyes or skin with plenty of water for at least 15 minutes while removing contaminated clothing and shoes. Wash clothing before reuse. In all cases get medical attention immediately.
**Product Use:**
Laboratory Reagent.
**Revision Information:**
MSDS Section(s) changed since last revision of document include: 8, 11.
**Disclaimer:**
**************************************************************************

**************************************************************************************

**Prepared by:** Strategic Services Division
Phone Number: (314) 539-1600 (U.S.A.)

SCOTT SPECIALTY GASES -- ISOBUTYLENE
MATERIAL SAFETY DATA SHEET
SCOTT SPECIALTY GASESNSN: 683000N042744
Manufacturer's CAGE: 51847
Part No. Indicator: A
Part Number/Trade Name: ISOBUTYLENE

## General Information

Company's Name: SCOTT SPECIALTY GASES
Company's Street: ROUTE 611
Company's City: PLUMSTEADVILLE
Company's State: PA
Company's Country: US
Company's Zip Code: 18949
Company's Emerg Ph #: 215-766-8861
Company's Info Ph #: 215-766-8861
Record No. For Safety Entry: 001
Tot Safety Entries This Stk#: 001
Status: SMJ
Date MSDS Prepared: 14SEP89
Safety Data Review Date: 13SEP95
MSDS Serial Number: BSXZH
Hazard Characteristic Code: G2

## Ingredients/Identity Information

Proprietary: NO
Ingredient: PROPENE, 2-METHYL-; (ISOBUTYLENE)
Ingredient Sequence Number: 01
Percent: 100
NIOSH (RTECS) Number: UD0890000
CAS Number: 115-11-7
OSHA PEL: N/K (FP N)
ACGIH TLV: N/K (FP N)

## Physical/Chemical Characteristics

Appearance And Odor: COLORLESS, ETHEREAL ODOR.
Boiling Point: 19.6F,-6.9C
Vapor Pressure (MM Hg/70 F): 2.65@21.1C
Vapor Density (Air=1): 1.947
Specific Gravity: 0.588 (H2O=1)
Evaporation Rate And Ref: NOT APPLICABLE
Solubility In Water: SLIGHT
Percent Volatiles By Volume: 100

## Fire and Explosion Hazard Data

Flash Point: -105F,-76C
Lower Explosive Limit: 1.8%
Upper Explosive Limit: 9.6%
Extinguishing Media: DO NOT EXTING BURNING GAS IF FLOW CANNOT BE SHUT OFF. USE WATER SPRAY TO KEEP FIRE EXPOS CYLS COOL. MOVE CYL (SUPDAT)
Special Fire Fighting Proc: USE NIOSH/MSHA APPROVED SCBA & FULL PROTECTIVE EQUIPMENT (FP N). FLAMMABLE HIGH PRESSURE LIQUID OR GAS.
Unusual Fire And Expl Hazrds: DANGEROUS. VAP MAY TRAVEL CONSIDERABLE DIST TO SOURCE OF IGNIT & FLASH BACK. MAY FORM EXPLO MIXTS W/AIR. CAN REACT VIGOROUSLY W/OXIDIZING MATLS.

## Reactivity Data

Stability: YES
Cond To Avoid (Stability): NONE SPECIFIED BY MANUFACTURER.
Materials To Avoid: OXIDIZING MATERIALS.
Hazardous Decomp Products: CARBON MONOXIDE, CARBON DIOXIDE.
Hazardous Poly Occur: NO
Conditions To Avoid (Poly): NOT RELEVANT

## Health Hazard Data

LD50-LC50 Mixture: NONE SPECIFIED BY MANUFACTURER.
Route Of Entry - Inhalation: YES
Route Of Entry - Skin: NO
Route Of Entry - Ingestion: NO
Health Haz Acute And Chronic: ACUTE:ASPHYXIANT. SYMPTOMS INCLUDE RAPID RESPIRATION, MUSCULAR INCOORDINATION, FATIGUE, NAUSEA & VOMITING. LOSS OF CONSCIOUSNESS & DEATH MAY OCCUR. CONTACT W/LIQUID MAY RESULT IN SYMPTOMS OF FROSTBITE. CHRONIC:NONE.
Carcinogenicity - NTP: NO
Carcinogenicity - IARC: NO
Carcinogenicity - OSHA: NO
Explanation Carcinogenicity: NOT RELEVANT
Signs/Symptoms Of Overexp: SEE HEALTH HAZARDS.
Med Cond Aggravated By Exp: NONE
Emergency/First Aid Proc: INGEST:CALL MD IMMED (FP N). INHAL:IMMED REMOVE VICTIM TO FRESH AIR. IF BREATHING HAS STOPPED, GIVE ARTIFICIAL RESPIRATION. IF BREATHING IS DIFFICULT, GIVE OXYGEN. SKIN:IMMED FLUSH W/ COPIOUS AMOUNTS OF WATER FOR AT LEAST 15 MINUTES WHILE REMOVING CONTAM CLTHG. IF FROSTBITE OCCURS, WARM AFFECTED AREA W/WATER OR TOWEL. EYE:IMMED FLUSH W/COPIOUS AMOUNTS OF WATER FOR AT LEAST 15 MINUTES.

## Precautions for Safe Handling and Use

Steps If Matl Released/Spill: EVACUATE & VENTILATE AREA. REMOVE LEAKING CYLINDER TO EXHAUST HOOD OR SAFE OUTDOORS AREA IF THIS CAN BE DONE SAFELY.
Neutralizing Agent: NONE SPECIFIED BY MANUFACTURER.
Waste Disposal Method: DISP MUST BE I/A/W FED, STATE & LOC REGS (FP N). RETURN CYLS TO SUPPLIER FOR PROPER DISP W/ANY VALVE OUTLET PLUGS/CAPS SECURED & VALVE PROT CAP IN PLACE. DO NOT REUSE CYL. EMPTY CYL WILL CONTAIN HAZ RESIDUE.
Precautions-Handling/Storing: STORE IN WELL VENTED ABOVE-GROUND AREA AWAY FROM HEAT & IGNIT SOURCES & OXIDIZING MATLS. PROT CNTNRS FROM PHYSICAL DMG. DO NOT DEFACE CYLS/LABELS.
Other Precautions: KEEP VALVE PROT CAP ON CYLS WHEN NOT IN USE & SECURE CYL WHEN USING TO PROT FROM FALLING. USE SUITABLE HAND TRUCK TO MOVE CYLS. CYLS SHOULD BE REFILLED BY QUALIFIED PRDCRS OF COMPRESSED GASES. SHIPMENT OF COMPRESSED GAS CYL WHICH (SUPDAT)

## Control Measures

Respiratory Protection: USE NIOSH/MSHA APPROVED SCBA IN CASE OF EMERGENCY OR NON-ROUTINE USE.
Ventilation: PROVIDE ADEQUATE & LOCAL EXHAUST VENTILATION TO MAINTAIN CONCENTRATION BELOW EXPOSURE LIMITS.
Protective Gloves: IMPERVIOUS GLOVES (FP N).
Eye Protection: SAFETY GOGGLES.
Other Protective Equipment: SAFETY SHOES WHEN HANDLING CYLINDERS.
Work Hygienic Practices: NONE SPECIFIED BY MANUFACTURER.
Suppl. Safety & Health Data: EXTING MEDIA:AWAY FROM FIRE IF THERE IS NO

RISK. OTHER PREC:HAS NOT BEEN FILLED BY THE OWNER OR W/HIS WRITTEN CONSENT IS A VIOLATION OF FEDERAL LAW (49 CFR).

## Transportation Data

## Disposal Data

## Label Data

Label Required: YES
Technical Review Date: 08SEP93
Label Date: 23AUG93
Label Status: G
Common Name: ISOBUTYLENE
Chronic Hazard: NO
Signal Word: DANGER!
Acute Health Hazard-Moderate: X
Contact Hazard-Slight: X
Fire Hazard-Severe: X
Reactivity Hazard-None: X
Special Hazard Precautions: EXTREMELY FLAMMABLE HIGH PRESSURE LIQUID OR GAS. ACUTE:ASPHYXIANT. SYMPTOMS INCLUDE RAPID BREATHING, MUSCULAR INCOORDINATION, FATIGUE, NAUSEA & VOMITING. LOSS OF CONSCIOUSNESS & DEATH NONE LISTED BY MANUFACTURER.
Protect Eye: Y
Protect Skin: Y
Protect Respiratory: Y
Label Name: SCOTT SPECIALTY GASES
Label Street: ROUTE 611
Label City: PLUMSTEADVILLE
Label State: PA
Label Zip Code: 18949
Label Country: US
Label Emergency Number: 215-766-8861

**MSDS** *Material Safety Data Sheet*

*From:* Mallinckrodt Baker, Inc.
222 Red School Lane
Phillipsburg, NJ 08865

Mallinckrodt CHEMICALS

J.T.Baker

24 Hour Emergency Telephone: 908-859-2151
CHEMTREC: 1-800-424-9300

National Response in Canada
CANUTEC: 613-996-6666

Outside U.S. and Canada
Chemtrec: 703-527-3887

**NOTE:** CHEMTREC, CANUTEC and National Response Center emergency numbers to be used only in the event of chemical emergencies involving a spill, leak, fire, exposure or accident involving chemicals.

All non-emergency questions should be directed to Customer Service (1-800-582-2537) for assistance.

# ISOPROPYL ALCOHOL (90 - 100%)

**MSDS Number: I8840** --- ***Effective Date: 07/21/00***

## 1. Product Identification

**Synonyms:** 2-Propanol; sec-propyl alcohol; isopropanol; sec-propanol; dimethylcarbinol
**CAS No.:** 67-63-0
**Molecular Weight:** 60.10
**Chemical Formula:** (CH3)2 CHOH
**Product Codes:**
J.T. Baker: 5082, 9037, 9080, U298
Mallinckrodt: 0562, 3027, 3031, 3032, 3035, 3037, 3043, 4359, 6569, H604, H982, V345, V555, V566

## 2. Composition/Information on Ingredients

| Ingredient | CAS No | Percent | Hazardous |
|---|---|---|---|
| Isopropyl Alcohol | 67-63-0 | 90 - 100% | Yes |
| Water | 7732-18-5 | 0 - 10% | No |

## 3. Hazards Identification

### Emergency Overview

**WARNING! FLAMMABLE LIQUID AND VAPOR. HARMFUL IF SWALLOWED**

**OR INHALED. CAUSES IRRITATION TO EYES AND RESPIRATORY TRACT. AFFECTS CENTRAL NERVOUS SYSTEM. MAY BE HARMFUL IF ABSORBED THROUGH SKIN. MAY CAUSE IRRITATION TO SKIN.**

**J.T. Baker SAF-T-DATA$^{(tm)}$** Ratings (Provided here for your convenience)

-----------------------------------------------------------------------------------------------------------

Health Rating: 1 - Slight
Flammability Rating: 4 - Extreme (Flammable)
Reactivity Rating: 2 - Moderate
Contact Rating: 2 - Moderate
Lab Protective Equip: GOGGLES; LAB COAT; VENT HOOD; PROPER GLOVES; CLASS B EXTINGUISHER
Storage Color Code: Red (Flammable)

-----------------------------------------------------------------------------------------------------------

**Potential Health Effects**

----------------------------------

**Inhalation:**
Inhalation of vapors irritates the respiratory tract. Exposure to high concentrations has a narcotic effect, producing symptoms of dizziness, drowsiness, headache, staggering, unconsciousness and possibly death.
**Ingestion:**
Can cause drowsiness, unconsciousness, and death. Gastrointestinal pain, cramps, nausea, vomiting, and diarrhea may also result. The single lethal dose for a human adult = about 250 mls (8 ounces).
**Skin Contact:**
May cause irritation with redness and pain. May be absorbed through the skin with possible systemic effects.
**Eye Contact:**
Vapors cause eye irritation. Splashes cause severe irritation, possible corneal burns and eye damage.
**Chronic Exposure:**
Chronic exposure may cause skin effects.
**Aggravation of Pre-existing Conditions:**
Persons with pre-existing skin disorders or impaired liver, kidney, or pulmonary function may be more susceptible to the effects of this agent.

## 4. First Aid Measures

**Inhalation:**
Remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Get medical attention.
**Ingestion:**
Give large amounts of water to drink. Never give anything by mouth to an unconscious person. Get medical attention.
**Skin Contact:**
Immediately flush skin with plenty of water for at least 15 minutes. Call a physician if

irritation develops.
**Eye Contact:**
Immediately flush eyes with plenty of water for at least 15 minutes, lifting lower and upper eyelids occasionally. Get medical attention immediately.

---

## 5. Fire Fighting Measures

**Fire:**
Flash point: 12C (54F) CC
Autoignition temperature: 399C (750F)
Flammable limits in air % by volume:
lel: 2.0; uel: 12.7
Listed fire data is for Pure Isopropyl Alcohol.
**Explosion:**
Above flash point, vapor-air mixtures are explosive within flammable limits noted above. Contact with strong oxidizers may cause fire or explosion. Vapors can flow along surfaces to distant ignition source and flash back. Sensitive to static discharge.
**Fire Extinguishing Media:**
Water spray, dry chemical, alcohol foam, or carbon dioxide. Water spray may be used to keep fire exposed containers cool, dilute spills to nonflammable mixtures, protect personnel attempting to stop leak and disperse vapors.
**Special Information:**
In the event of a fire, wear full protective clothing and NIOSH-approved self-contained breathing apparatus with full facepiece operated in the pressure demand or other positive pressure mode.

---

## 6. Accidental Release Measures

Ventilate area of leak or spill. Remove all sources of ignition. Wear appropriate personal protective equipment as specified in Section 8. Isolate hazard area. Keep unnecessary and unprotected personnel from entering. Contain and recover liquid when possible. Use non-sparking tools and equipment. Collect liquid in an appropriate container or absorb with an inert material (e. g., vermiculite, dry sand, earth), and place in a chemical waste container. Do not use combustible materials, such as saw dust. Do not flush to sewer! If a leak or spill has not ignited, use water spray to disperse the vapors, to protect personnel attempting to stop leak, and to flush spills away from exposures.

J. T. Baker SOLUSORB(R) solvent adsorbent is recommended for spills of this product.

---

## 7. Handling and Storage

Protect against physical damage. Store in a cool, dry well-ventilated location, away from any area where the fire hazard may be acute. Outside or detached storage is preferred.

Separate from incompatibles. Containers should be bonded and grounded for transfers to avoid static sparks. Storage and use areas should be No Smoking areas. Use non-sparking type tools and equipment, including explosion proof ventilation. Containers of this material may be hazardous when empty since they retain product residues (vapors, liquid); observe all warnings and precautions listed for the product. Small quantities of peroxides can form on prolonged storage. Exposure to light and/or air significantly increases the rate of peroxide formation. If evaporated to a residue, the mixture of peroxides and isopropanol may explode when exposed to heat or shock.

---

## 8. Exposure Controls/Personal Protection

**Airborne Exposure Limits:**
For Isopropyl Alcohol (2-Propanol):
-OSHA Permissible Exposure Limit (PEL):
400 ppm (TWA)

-ACGIH Threshold Limit Value (TLV):
400 ppm (TWA), 500 ppm (STEL)

**Ventilation System:**
A system of local and/or general exhaust is recommended to keep employee exposures below the Airborne Exposure Limits. Local exhaust ventilation is generally preferred because it can control the emissions of the contaminant at its source, preventing dispersion of it into the general work area. Please refer to the ACGIH document, *Industrial Ventilation, A Manual of Recommended Practices*, most recent edition, for details.

**Personal Respirators (NIOSH Approved):**
If the exposure limit is exceeded, a full facepiece respirator with organic vapor cartridge may be worn up to 50 times the exposure limit or the maximum use concentration specified by the appropriate regulatory agency or respirator supplier, whichever is lowest. For emergencies or instances where the exposure levels are not known, use a full-facepiece positive-pressure, air-supplied respirator. WARNING: Air purifying respirators do not protect workers in oxygen-deficient atmospheres.

**Skin Protection:**
Wear impervious protective clothing, including boots, gloves, lab coat, apron or coveralls, as appropriate, to prevent skin contact. Neoprene and nitrile rubber are recommended materials.

**Eye Protection:**
Use chemical safety goggles and/or a full face shield where splashing is possible. Maintain eye wash fountain and quick-drench facilities in work area.

---

## 9. Physical and Chemical Properties

**Appearance:**
Clear, colorless liquid.

**Odor:**
Rubbing alcohol.

**Solubility:**

Miscible in water.
**Specific Gravity:**
0.79 @ 20C/4C
**pH:**
No information found.
**% Volatiles by volume @ 21C (70F):**
100
**Boiling Point:**
82C (180F)
**Melting Point:**
-89C (-128F)
**Vapor Density (Air=1):**
2.1
**Vapor Pressure (mm Hg):**
44 @ 25C (77F)
**Evaporation Rate (BuAc=1):**
2.83

---

## 10. Stability and Reactivity

**Stability:**
Stable under ordinary conditions of use and storage. Heat and sunlight can contribute to instability.
**Hazardous Decomposition Products:**
Carbon dioxide and carbon monoxide may form when heated to decomposition.
**Hazardous Polymerization:**
Will not occur.
**Incompatibilities:**
Heat, flame, strong oxidizers, acetaldehyde, acids, chlorine, ethylene oxide, hydrogen-palladium combination, hydrogen peroxide-sulfuric acid combination, potassium tert-butoxide, hypochlorous acid, isocyanates, nitroform, phosgene, aluminum, oleum and perchloric acid.
**Conditions to Avoid:**
Heat, flames, ignition sources and incompatibles.

---

## 11. Toxicological Information

Oral rat LD50: 5045 mg/kg; skin rabbit LD50: 12.8 gm/kg; inhalation rat LC50: 16,000 ppm/8-hour; investigated as a tumorigen, mutagen, reproductive effector.

```
--------\Cancer Lists\------------------------------------------------------
                                          ---NTP Carcinogen---
Ingredient                                Known    Anticipated    IARC Category
------------------------------------      -----    -----------    -------------
Isopropyl Alcohol (67-63-0)                No          No               3
Water (7732-18-5)                          No          No              None
```

## 12. Ecological Information

**Environmental Fate:**
When released into the soil, this material is expected to quickly evaporate. When released into the soil, this material may leach into groundwater. When released into the soil, this material may biodegrade to a moderate extent. When released to water, this material is expected to quickly evaporate. When released into the water, this material is expected to have a half-life between 1 and 10 days. When released into water, this material may biodegrade to a moderate extent. This material is not expected to significantly bioaccumulate. When released into the air, this material is expected to be readily degraded by reaction with photochemically produced hydroxyl radicals. When released into the air, this material is expected to have a half-life between 1 and 10 days. When released into the air, this material may be removed from the atmosphere to a moderate extent by wet deposition.

**Environmental Toxicity:**
The LC50/96-hour values for fish are over 100 mg/l. This material is not expected to be toxic to aquatic life.

## 13. Disposal Considerations

Whatever cannot be saved for recovery or recycling should be handled as hazardous waste and sent to a RCRA approved incinerator or disposed in a RCRA approved waste facility. Processing, use or contamination of this product may change the waste management options. State and local disposal regulations may differ from federal disposal regulations. Dispose of container and unused contents in accordance with federal, state and local requirements.

## 14. Transport Information

**Domestic (Land, D.O.T.)**

-----------------------

**Proper Shipping Name:** ISOPROPANOL
**Hazard Class:** 3
**UN/NA:** UN1219
Packing Group: II
**Information reported for product/size:** 355LB

**International (Water, I.M.O.)**

-----------------------------

**Proper Shipping Name:** ISOPROPANOL
**Hazard Class:** 3.2
**UN/NA:** UN1219
Packing Group: II

## 15. Regulatory Information

--------\Chemical Inventory Status - Part 1\--------

| Ingredient | TSCA | EC | Japan | Australia |
|---|---|---|---|---|
| Isopropyl Alcohol (67-63-0) | Yes | Yes | Yes | Yes |
| Water (7732-18-5) | Yes | Yes | Yes | Yes |

--------\Chemical Inventory Status - Part 2\--------

| | | --Canada-- | | |
|---|---|---|---|---|
| Ingredient | Korea | DSL | NDSL | Phil. |
| Isopropyl Alcohol (67-63-0) | Yes | Yes | No | Yes |
| Water (7732-18-5) | Yes | Yes | No | Yes |

--------\Federal, State & International Regulations - Part 1\--------

| | -SARA 302- | | ------SARA 313------ | |
|---|---|---|---|---|
| Ingredient | RQ | TPQ | List | Chemical Catg. |
| Isopropyl Alcohol (67-63-0) | No | No | Yes | No |
| Water (7732-18-5) | No | No | No | No |

--------\Federal, State & International Regulations - Part 2\--------

| Ingredient | CERCLA | -RCRA- 261.33 | -TSCA- 8(d) |
|---|---|---|---|
| Isopropyl Alcohol (67-63-0) | No | No | No |
| Water (7732-18-5) | No | No | No |

Chemical Weapons Convention: No TSCA 12(b): Yes CDTA: Yes
SARA 311/312: Acute: Yes Chronic: Yes Fire: Yes Pressure: No
Reactivity: No (Mixture / Liquid)

**Australian Hazchem Code:** 2[S]2
**Poison Schedule:** No information found.
**WHMIS:**
This MSDS has been prepared according to the hazard criteria of the Controlled Products Regulations (CPR) and the MSDS contains all of the information required by the CPR.

## 16. Other Information

**NFPA Ratings:** Health: **2** Flammability: **3** Reactivity: **0**
**Label Hazard Warning:**
WARNING! FLAMMABLE LIQUID AND VAPOR. HARMFUL IF SWALLOWED OR INHALED. CAUSES IRRITATION TO EYES AND RESPIRATORY TRACT. AFFECTS

CENTRAL NERVOUS SYSTEM. MAY BE HARMFUL IF ABSORBED THROUGH SKIN. MAY CAUSE IRRITATION TO SKIN.

**Label Precautions:**

Keep away from heat, sparks and flame.
Keep container closed.
Use only with adequate ventilation.
Wash thoroughly after handling.
Avoid breathing vapor or mist.
Avoid contact with eyes, skin and clothing.

**Label First Aid:**

If swallowed, give large amounts of water to drink. Never give anything by mouth to an unconscious person. If inhaled, remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. In case of contact, immediately flush eyes or skin with plenty of water for at least 15 minutes. Remove contaminated clothing and shoes. Wash clothing before reuse. In all cases, get medical attention.

**Product Use:**

Laboratory Reagent.

**Revision Information:**

MSDS Section(s) changed since last revision of document include: 7.

**Disclaimer:**

**************************************************************************

**Mallinckrodt Baker, Inc. provides the information contained herein in good faith but makes no representation as to its comprehensiveness or accuracy. This document is intended only as a guide to the appropriate precautionary handling of the material by a properly trained person using this product. Individuals receiving the information must exercise their independent judgment in determining its appropriateness for a particular purpose. MALLINCKRODT BAKER, INC. MAKES NO REPRESENTATIONS OR WARRANTIES, EITHER EXPRESS OR IMPLIED, INCLUDING WITHOUT LIMITATION ANY WARRANTIES OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE WITH RESPECT TO THE INFORMATION SET FORTH HEREIN OR THE PRODUCT TO WHICH THE INFORMATION REFERS. ACCORDINGLY, MALLINCKRODT BAKER, INC. WILL NOT BE RESPONSIBLE FOR DAMAGES RESULTING FROM USE OF OR RELIANCE UPON THIS INFORMATION.**

**************************************************************************

**Prepared by:** Strategic Services Division
Phone Number: (314) 539-1600 (U.S.A.)

# APPENDIX C

# HISTORICAL SOIL DATA

## LEGEND

▨ WOODED AREA

▨ UNWOODED / ACTIVE AREA

POTENTIAL SOURCE AREAS

TREELINE

— — — PROPERTY LINE

MW-4 ◆ EXISTING GROUNDWATER MONITORING WELL LOCATION (SOIL SAMPLES COLLECTED PRIOR TO INSTALLATION)

S-38 ▲ PHASE II REMEDIAL INVESTIGATION SOIL SAMPLE LOCATION

SS-13 ■ PHASE I REMEDIAL INVESTIGATION SOIL SAMPLE LOCATION

## NOTES

1.) ONLY EXCEEDANCES OF GENERIC SOIL SCREENING LEVELS ARE SHOWN ON THIS FIGURE.

2.) LOW PART-PER-BILLION RANGE DETECTIONS OF METHYLENE CHLORIDE ARE NOT SHOWN ON THIS FIGURE AS THEY ARE RELATED TO BLANK CONTAMINATION.

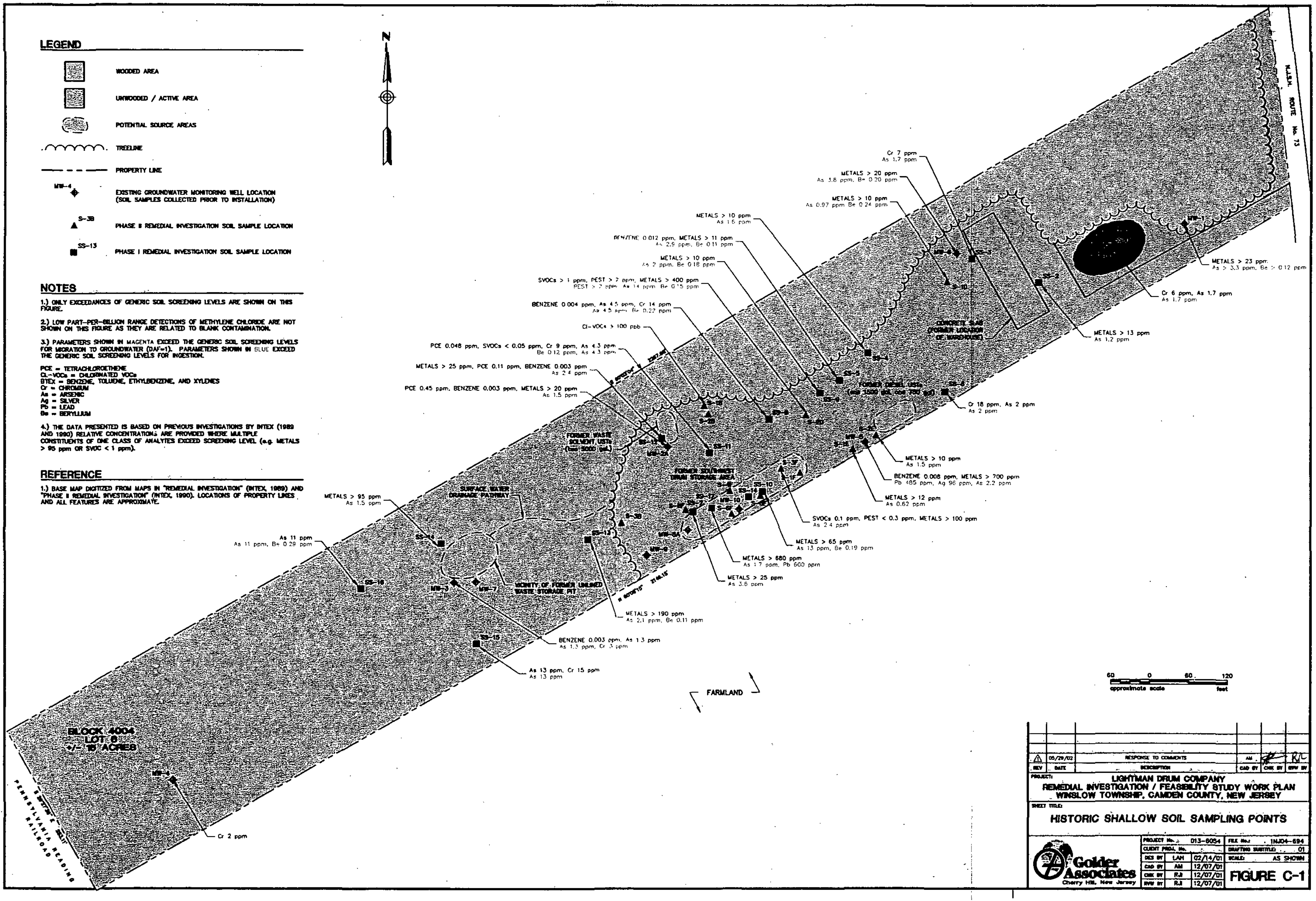
3.) PARAMETERS SHOWN IN MAGENTA EXCEED THE GENERIC SOIL SCREENING LEVELS FOR MIGRATION TO GROUNDWATER (DAF=1). PARAMETERS SHOWN IN BLUE EXCEED THE GENERIC SOIL SCREENING LEVELS FOR INGESTION.

PCE = TETRACHLOROETHENE
CL-VOCs = CHLORINATED VOCs
BTEX = BENZENE, TOLUENE, ETHYLBENZENE, AND XYLENES
Cr = CHROMIUM
As = ARSENIC
Ag = SILVER
Pb = LEAD
Be = BERYLLIUM

4.) THE DATA PRESENTED IS BASED ON PREVIOUS INVESTIGATIONS BY INTEX (1989 AND 1990) RELATIVE CONCENTRATIONS ARE PROVIDED WHERE MULTIPLE CONSTITUENTS OF ONE CLASS OF ANALYTES EXCEED SCREENING LEVEL (e.g. METALS > 95 ppm OR SVOC < 1 ppm).

## REFERENCE

1.) BASE MAP DIGITIZED FROM MAPS IN "REMEDIAL INVESTIGATION" (INTEX, 1989) AND "PHASE II REMEDIAL INVESTIGATION" (INTEX, 1990). LOCATIONS OF PROPERTY LINES AND ALL FEATURES ARE APPROXIMATE.



| REV | DATE | DESCRIPTION | CAD BY | CHK BY | RVW BY |
|---|---|---|---|---|---|
| 1 | 05/29/02 | RESPONSE TO COMMENTS | AM |  | RJ |

PROJECT:
**LIGHTMAN DRUM COMPANY**
**REMEDIAL INVESTIGATION / FEASIBILITY STUDY WORK PLAN**
**WINSLOW TOWNSHIP, CAMDEN COUNTY, NEW JERSEY**

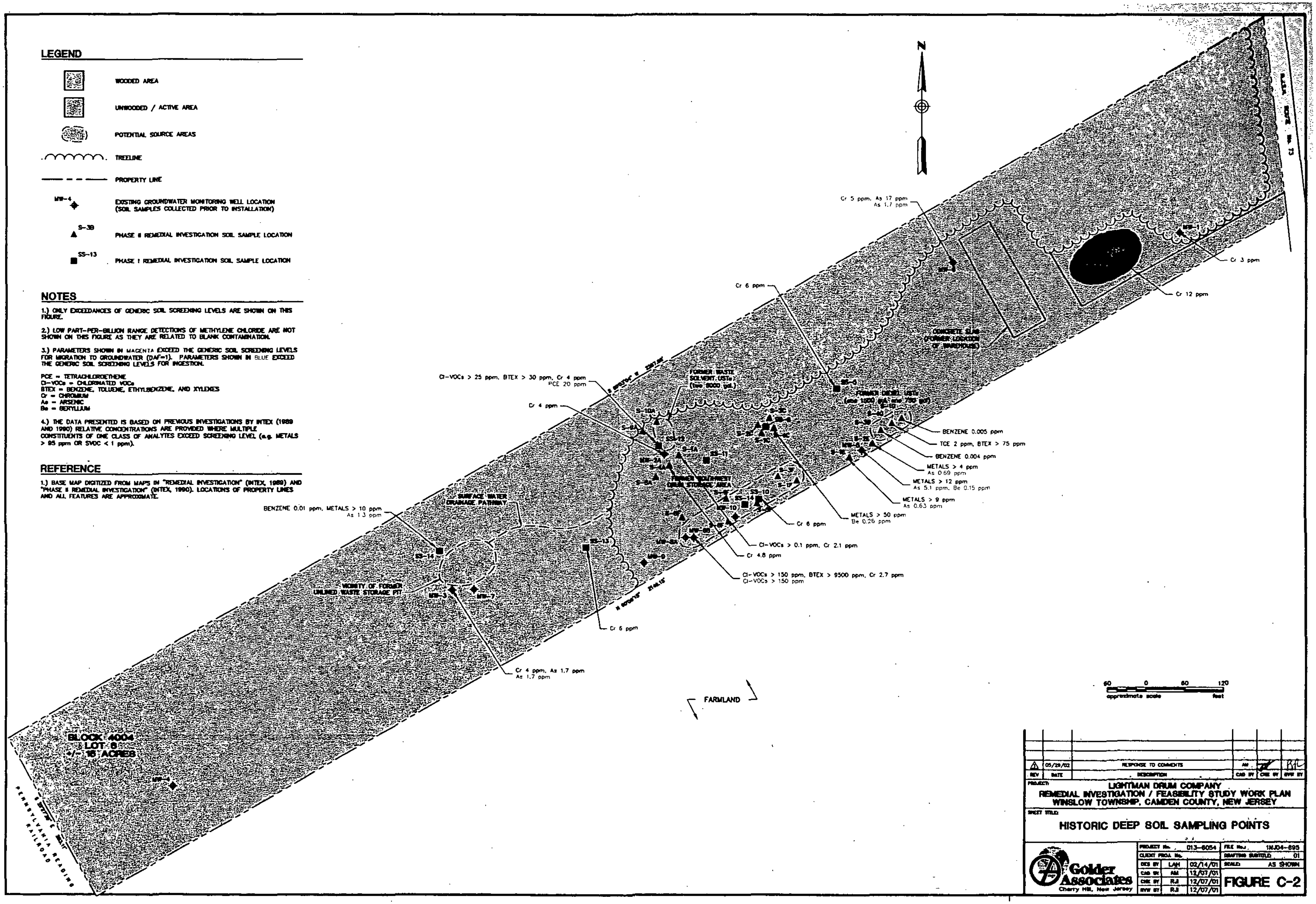
SHEET TITLE:

### HISTORIC SHALLOW SOIL SAMPLING POINTS

Golder Associates
Cherry Hill, New Jersey

|  |  |  |  |  |
|---|---|---|---|---|
| PROJECT No. | 013-6054 |  | FILE No. | 1NJ04-694 |
| CLIENT PROJ. No. |  |  | DRAFTING SUBTITLE | 01 |
| DES BY | LAH | 02/14/01 | SCALE: | AS SHOWN |
| CAD BY | AM | 12/07/01 |  |  |
| CHK BY | RJ | 12/07/01 |  |  |
| RVW BY | RJ | 12/07/01 |  |  |

**FIGURE C-1**



## LEGEND

| | |
|---|---|
| ▨ | WOODED AREA |
| ▨ | UNWOODED / ACTIVE AREA |
| ▨ | POTENTIAL SOURCE AREAS |
| ⌒⌒⌒ | TREELINE |
| — — — | PROPERTY LINE |
| MW-4 ◆ | EXISTING GROUNDWATER MONITORING WELL LOCATION (SOIL SAMPLES COLLECTED PRIOR TO INSTALLATION) |
| S-3B ▲ | PHASE II REMEDIAL INVESTIGATION SOIL SAMPLE LOCATION |
| SS-13 ■ | PHASE I REMEDIAL INVESTIGATION SOIL SAMPLE LOCATION |

## NOTES

1.) ONLY EXCEEDANCES OF GENERIC SOIL SCREENING LEVELS ARE SHOWN ON THIS FIGURE.

2.) LOW PART-PER-BILLION RANGE DETECTIONS OF METHYLENE CHLORIDE ARE NOT SHOWN ON THIS FIGURE AS THEY ARE RELATED TO BLANK CONTAMINATION.

3.) PARAMETERS SHOWN IN MAGENTA EXCEED THE GENERIC SOIL SCREENING LEVELS FOR MIGRATION TO GROUNDWATER (DAF=1). PARAMETERS SHOWN IN BLUE EXCEED THE GENERIC SOIL SCREENING LEVELS FOR INGESTION.

PCE = TETRACHLOROETHENE
Cl-VOCs = CHLORINATED VOCs
BTEX = BENZENE, TOLUENE, ETHYLBENZENE, AND XYLENES
Cr = CHROMIUM
As = ARSENIC
Be = BERYLLIUM

4.) THE DATA PRESENTED IS BASED ON PREVIOUS INVESTIGATIONS BY INTEX (1989 AND 1990) RELATIVE CONCENTRATIONS ARE PROVIDED WHERE MULTIPLE CONSTITUENTS OF ONE CLASS OF ANALYTES EXCEED SCREENING LEVEL (e.g. METALS > 95 ppm OR SVOC < 1 ppm).

## REFERENCE

1.) BASE MAP DIGITIZED FROM MAPS IN "REMEDIAL INVESTIGATION" (INTEX, 1989) AND "PHASE II REMEDIAL INVESTIGATION" (INTEX, 1990). LOCATIONS OF PROPERTY LINES AND ALL FEATURES ARE APPROXIMATE.

| REV | DATE | DESCRIPTION | CAD BY | CHK BY | RVW BY |
|---|---|---|---|---|---|
| | | | | | |
| | | | | | |
| | | | | | |
| ⚠ | 05/29/02 | RESPONSE TO COMMENTS | AM | | RJ |

PROJECT:
LIGHTMAN DRUM COMPANY
REMEDIAL INVESTIGATION / FEASIBILITY STUDY WORK PLAN
WINSLOW TOWNSHIP, CAMDEN COUNTY, NEW JERSEY

SHEET TITLE:
HISTORIC DEEP SOIL SAMPLING POINTS

Golder Associates
Cherry Hill, New Jersey

| | | |
|---|---|---|
| PROJECT No. | 013-6054 | |
| CLIENT PROJ. No. | | |
| DES BY | LAH | 02/14/01 |
| CAD BY | AM | 12/07/01 |
| CHK BY | RJ | 12/07/01 |
| RVW BY | RJ | 12/07/01 |

FILE No. 1NJ04-895
DRAFTING SUBTITLE 01
SCALE: AS SHOWN

FIGURE C-2

# APPENDIX D

# TANK DOCUMENTATION

# UNDERGROUND WASTE STORAGE TANKS REMOVAL INFORMATION

Part VI.

Page 3 of 4

NEW JERSEY DEPARTMENT OF ENVIRONMENTAL PROTECTION
MANIFEST SECTION
GENERATOR ANNUAL REPORT 1984

1. Generator Name: LIGHTMAN DRUM CO EPA ID No. NJD 014743678

Site Address: RTE. 73 CEDARBROOK, NJ 08018

2. Transporter Name: CONTINENTAL VANGUARD EPA ID No. NJD 067387514

3. TSD Facility Name: DELAWARE CONTAINER EPA ID No. PAD 064375470

TSDF Address: W. 11th AVE. + VALLEY RD. COATESVILLE, PA 19320

4. Waste Information:

| Waste Type | Waste Description | DOT Haz Class | Total Quantity | Units |
|---|---|---|---|---|
| D001 | HAZARDOUS WASTE SOLID N.O.S. (IGNITABLE PAINT SLUDGE) | NA9189 | 15 | CU. YDS. |

NOTE: For each combination of transporter and TSD facility, list the total quantity manifested for each waste type.

ER-SWM-51
See cover sheet for instructions
Please TYPE or PRINT clearly using
a ball point pen—PRESS HARD

COMMONWEALTH OF PENNSYLVANIA
DEPARTMENT OF ENVIRONMENTAL RESOURCES

# HAZARDOUS WASTE MANIFEST

DOCUMENT NO. PA A 3177941

PART A:

| NAME | SITE ADDRESS | PHONE NO. | EPA I.D. NO. |
|---|---|---|---|
| GENERATOR<br>[illegible] | P.O. Box 21,<br>[illegible] | 609/767-[illegible]64 | [illegible] |
| TRANSPORTER NO 1<br>[illegible] VANGUARD | 204 Harding Ave.,<br>[illegible] | [illegible] | [illegible] |
| TRANSPORTER NO 2 (IF ANY) | | | |
| TREATMENT, STORAGE OR DISPOSAL (TSD) FACILITY<br>[illegible] | W. 11th Ave. & Valley Rd.<br>[illegible] | [illegible] | [illegible] |

IF MORE THAN TWO TRANSPORTERS ARE TO BE UTILIZED. FILL OUT THE FOLLOWING AS APPROPRIATE

THIS FORM IS NO. ____ OUT OF A TOTAL OF ____ THE FIRST MANIFEST DOCUMENT NO IS PA ☐☐☐☐☐☐☐☐

| PROPER US DOT SHIPPING NAME | US DOT HAZARD CLASS | UN NUMBER | FORM: SOLID | FORM: LIQUID | FORM: GAS | QUANTITY | UNITS: GALLONS | UNITS: CU YDS | UNITS: POUNDS | UNITS: TONS | CONTAINERS: NO | CONTAINERS: TYPE | EPA HAZ CODE | EPA WASTE TYPE |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Hazardous Waste Solid [illegible] [illegible] Sludge) | ORM-E | NA9189 | X | | | 15 | | X | | | [illegible] | ROLL OFF | [illegible] | [illegible] |
| | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | |

SPECIAL HANDLING INSTRUCTIONS INCLUDING CONTAINER EXEMPTION (i.e. IDENTIFICATION OF ADDITIONAL WASTES OF A NON-HAZARDOUS NATURE INCLUDED IN SHIPMENT WHICH DO NOT HAVE TO BE MANIFESTED)

[illegible]

GENERATOR'S CERTIFICATION. This is to certify that the above named materials are properly classified, described, packaged, marked and labelled and are in proper condition for transportation according to the applicable regulations of the Department of Transportation, U S EPA, and the State. The wastes described above were consigned to the transporter named. The TSD Facility can and will accept the shipment of hazardous waste, and has a valid permit to do so. I certify that the foregoing is true and correct to the best of my knowledge.

| | | | |
|---|---|---|---|
| GENERATOR'S SIGNATURE | TITLE | DATE SHIPPED | EXPECTED ARRIVAL DATE<br>MONTH DAY YEAR |
| DATE RECEIVED<br>MONTH DAY YEAR | TRANSPORTER NO 1 SIGNATURE AND CERTIFICATION OF RECEIPT OF SHIPMENT | TRANSPORTER NO. 1 H.W.T. ID (License) No. | PA ☐☐☐☐☐☐<br>NUMBER |

COPY 3 Generator - Retained By Generator.

TEAR AT THIS PERFORATION

PART B:

| | |
|---|---|
| TRANSPORTER NO 1 SIGNATURE AND CERTIFICATION OF DELIVERY AND NON-TAMPERING WITH SHIPMENT | DATE DELIVERED<br>MONTH DAY YEAR |

| | | | |
|---|---|---|---|
| DATE RECEIVED<br>MONTH DAY YEAR | TRANSPORTER NO 2 SIGNATURE AND CERTIFICATION OF RECEIPT OF SHIPMENT | TRANSPORTER NO 2 H.W.T. ID (License) No. | PA ☐☐☐☐☐☐<br>NUMBER |

| | |
|---|---|
| TRANSPORTER NO. 2 SIGNATURE AND CERTIFICATION OF DELIVERY AND NON-TAMPERING WITH SHIPMENT | DATE DELIVERED<br>MONTH DAY YEAR |

TREATMENT STORAGE OR DISPOSAL FACILITY INDICATION OF ANY DIFFERENCES BETWEEN MANIFEST AND SHIPMENT OR LISTING REASONS FOR AND DISPOSITION OF REJECTED MATERIALS

| HANDLING METHOD | | | |
|---|---|---|---|
| 1 | [illegible] | | |
| 2 | | | |
| 3 | | | |
| 4 | | | |

GENERATOR'S EPA I.D. NO. [illegible]

EXPECTED DISPOSAL DATE ____

| | | |
|---|---|---|
| TSD FACILITY SIGNATURE AND CERTIFICATION OF RECEIPT OF SHIPMENT | TITLE | DATE RECEIVED/REJECTED<br>MONTH DAY YEAR |

In case of an emergency or spill Immediately call the National Response Center (800) 424-8802 and the PA DER (717) 787-4343

DOCUMENT NO. PA A 3177941

# DIESEL TANK REMOVAL INFORMATION

For Stat se Only

Date Rec'd. ________
Auth ________
Routing ________
UST NO. ________

State of New Jersey
**DEPARTMENT OF ENVIRONMENTAL PROTECTION**
**DIVISION OF WATER RESOURCES**
CN 029
TRENTON, NEW JERSEY 08625
ATTN: BUST Program
(609) 984-3156

## STANDARD REPORTING FORM
for the:
Installation/Abandon/[✓ Remove]/Sale-Transfer/Substantial Modification
Circle Only One — Use One Form Per Activity

Answer questions 1 through 5 and others as applicable.

1. Company name and address: (as it appears on registration questionnaire)
Lightman Drum·Comp ny, Inc.
P.O. Box 22
Berlin, NJ 08009

2. Facility name and location: (If different from above)
Lightman Drum Company Inc.
Rt 73 at 12 mile mark
Cedar Brook, NJ 0801

3. Contact person for this activity: Jerome Lightman
Telephone Number: ( 609 ) 767-6644

4. The identification number of the affected tank as it appears in Question Number 12 on the Registr on Questionnaire: E1, E2 2000-gallon, 1,000-gallon

5. Registration Number (if known): UST - 0254081

6. **For TRANSFER OF OWNERSHIP:**

New Company Name ______________________

New Facility Name ______________________

Address ______________________

______________________

New owner/operator (print) ______________________

Signature ______________________

7. **For ABANDONMENT or REMOVAL:**

a. Describe the proposed procedure in detail on an attached sheet.

b. Specify the product last stored in the tank: #2 Diesel Fuel both tanks

c. Date abandoned or removed 5/31/90

d. Is Site Assessment Compliance Statement being completed? [✓ Yes] or No Form MUST be complete and retu
within 90 days of tank closure (per 40 CFR 280.72)

8. **For SUBSTANTIAL MODIFICATIONS:**

a. Describe the reason for the modification and, in detail, the proposed procedure to be used on an attached sheet.

b. Specify the product presently stored in the tank: ______________________

c. Specify the product to be stored in the tank: ______________________

9. **For NEW OR REPLACEMENT INSTALLATIONS:**

a. Attach the specifications as required by the attached instructions.

b. Specify the product (s) to be stored in the tank: ______________________

---

## CERTIFICATION

****** This registration form shall be signed by the highest ranking individual at the facility with overall responsibility for that facility. (7:14B-2.3 (a) 1). ******

*"I certify under penalty of law that the information provided in this document is true, accurate and complete. I am aware that there are significant civil and criminal penalties for submitting false, inaccurate or incomplete information, including fines and/or imprisonment."*

Signature: Jerome Lightman

Name (print or type): Jerome Lightman

Title: President Date: 5/8/90

SRF - 4/89

STATE OF NEW JERSEY
DEPARTMENT OF ENVIRONMENTAL PROTECTION
Bureau of Underground Storage Tanks
CN-029, Trenton, NJ 08625

Date Rec'd. __/__/__
Auth __
Routing __
UST NO. __

## SITE ASSESSMENT COMPLIANCE STATEMENT

Supplement to the New Jersey Standard Reporting Form
(Complete for ALL regulated UST abandonments or removals)

Within ninety (90) days of completing the UST closure of any State or Federally-regulated tank, the owner or operator must submit this completed form to the NJDEP Bureau of Underground Storage Tanks. If the facility is located in one of the counties listed on the back, a copy of this form must also be sent to the Health Agency indicated.

The owner or operator of any Federally-regulated tank must also comply with the following:

40 CFR Part 280.72 Assessing the site at closure or change-in-service

"(a) Before permanent closure or a change-in-service is completed, owners and operators must measure for the presence of a release where contamination is most likely to be present at the UST site. In selecting sample types, sample locations, and measurement methods, owners and operators must consider the method of closure, the nature of the stored substance, the type of backfill, the depth to ground water, and other factors appropriate for identifying the presence of a release."

FACILITY Lightman Drum Company, Inc. UST # 0254081

Check off the following items as appropriate for the site.

✓ The UST facility is only regulated by State law, therefore a site assessment is not mandatory.

___ The UST facility is regulated by Federal law and a site assessment was conducted.

The results of the site assessment indicate:

___ There was NO release from the UST system.

___ There was a release from the UST system and it was reported to the DEP Environmental Hotline (609-292-7172).

NOTE: The results of the site assessment are not to be submitted to the DEP or Health Agency unless requested to do so. The results are to be available for inspection at the UST facility.

Questions can be directed to the Bureau at (609) 984-3156.

*** This registration form shall be signed by the highest ranking individual at the facility with overall responsibility for the facility (7:14B-2.3 (a) 1). ***

"I certify under penalty of law that the information provided in this document is true, accurate and complete. I am aware that there are significant civil and criminal penalties for submitting false, inaccurate or incomplete information, including fines and/or imprisonment.

______________________ (date)
(Signature)

______________________
(Print or type name)

______________________
(Title)

SACS-2,1/89

CHECKLIST FOR THE CLOSURE OF UNDERGROUND STORAGE TANKS

OWNER/ADDRESS/PHONE # OF TANK: ______________________

______________________

ADDRESS/PHONE # OF SITE: ______________________

______________________

BLOCK AND LOT #: ______________________

INSTALLER/ADDRESS/PHONE #: ______________________

______________________

The items on this checklist are practices currently accepted by the Department of Environmental Protection. Further explanation can be found in Appendix B of NFiPA and the American Petroleum Institute's Bulletin 1604 entitled "Recommended Practic for Abandonment or Removal of Used Underground Service Station Tanks."

__✓__ 1. Owner/Contractor reports that the tank was properly cleaned of residual mater

_____ a. Observed?

__✓__ 2. Owner/Contractor reports that all residual material including water used in cleaning, was properly containerized for proper offsite disposal.

__✓__ 3. Does contractor provide fire extinguisher minimum 20BC rating?

__✓__ 4. Inspection reveals that all affected piping was disconnected.

_____ a. Piping removed?

5. For abandonment in place:

_____ a. Tank was observed to be filled and sealed with an appropriate inert mater

6. For removal:

__✓__ a. Owner/Contractor has determined the proper disposal of the tank.

_____ b. The tank was rendered free of flammable vapors.

__✓__ *c. The excavation was observed to be free of obvious evidence of contaminati (e.g. odors, stained soil, free product)

_____ d. Contaminated soil is properly staged on plastic and covered with plastic equivalent.

__✓__ *e. The removed tank was free of obvious corrosion holes or structural failur

*If NO then immediately contact the 24 hour DEP Hotline at (609)292-7172 to report leak. It is recommended that an excavation which indicates contamination remain op for investigation where possible. It should; however, be secured for safety reasons.

NOTES AND COMMENTS: ______________________

______________________

______________________

______________________

______________________

Inspector's Signature ______________ Date of Inspection ______________

**ENVIRONMENTAL RECYCLING ASSOCIATES, INC.**
16 WILSON ROAD • MONROE, NEW YORK 10950
TOLL FREE 1-800-526-5335 • FAX 914-783-0595

INVOICE #

DATE: 7-10-90

TERRITORY: CAMDEN COUNT

DRIVER: Jim [illegible]

CUSTOMER P.O. #: 0777059

MANIFEST #:

**CUSTOMER/LOCATION**

NAME: LIGHTMAN DRUM
ADDRESS: RT 73
CITY/STATE: CLEARBROOK NJ ZIP
TEL. #: 767-6644
ATTENTION:
CUSTOMER #:

**BILL TO (IF DIFFERENT FROM LOCA N)**

NAME:
ADDRESS:
CITY/STATE: ZIP
TEL. #:
ATTENTION:

| DESCRIPTION | DATA/CODE | QUANTITY | PRICE | SERVICE CHARGE | TAX | SU OTAL |
|---|---|---|---|---|---|---|
| USED OIL (TRANSPORT SERVICE) | 1270<br>X721 | 100 | N/C | | | N/C |
| OILY WATER DISPOSAL | | | | | | |
| PUMPING TIME<br>$______per hr. X______hrs. | | | | | | |
| DEMURRAGE | | | | | | |
| SERVICE CHARGE | | | | | | |
| | | | TOTAL | $ | $ | $ N/C |

CUSTOMER CERTIFIES AND REPRESENTS THAT THE MATERIALS PROVIDED TO ENVIRONMENTAL RECYCLING ASSOCIATES, INC. HEREUNDER HAVE NOT BEEN MIXED, COMBINED, OR OTHERWISE BLENDED IN ANY QUANTITY WITH MATERIALS CONTAINING POLYCHLORINATED BIPHENYLS (PCB) OR ANY OTHER MATERIAL DEFINED AS A HAZARDOUS WASTE UNDER APPLICABLE LAWS, INCLUDING BUT NOT LIMITED TO 40 CFR PART 261. CUSTOMER AGREES TO INDEMIFY AND HOLD ENVIRONMENTAL RECYCLING ASSOCIATES, INC. HARMLESS FOR ANY DAMAGES, COSTS, ATTORNEY'S FEES, ETC. ARISING OUT OF OR IN ANY WAY RELATED TO A BREACH OF THE ABOVE WARRANTY BY THE CUSTOMER.

X Van Buren
CUSTOMER SIGNATURE

CHARGE MY ACCOUNT FOR THIS TRANSACTION UNLESS OTHERWISE INDICATED IN THE PAYMENT RECEIVED SECTION.
INVOICES REFLECTING CHARGES TO CUSTOMER ARE SUBJECT TO AN INTEREST RATE OF THE LESSER OF 1 1/2% PER MONTH (18% PER ANNUM) OR THE MAXIMUM RATE ALLOWED BY LAW ON ANY INVOICES THAT ARE NOT PAID WITHIN 30 DAYS. IN THE EVENT OF DEFAULT, ENVIRONMENTAL RECYCLING ASSOCIATES, INC. SHALL BE ENTITLED TO RECOVER COSTS OF COLLECTION.

X
CUSTOMER SIGNATURE

**PAYMENT RECEIVED SECTION**

| CHECK NUMBER | TOTAL REC VED |
|---|---|
| | $ N/C |
| APPLY TO TODAY'S SERVICE<br>AMOUNT $______ | APPLY TO PREVIOUS LANCE:<br>INV. #______<br>AMOUNT $______ |

CUSTOMER COPY

EAG
**Environmental Assurance Group, Inc.**
Longships Complex • 180 Township Line Road • Belle Mead, NJ 08502 • (201) 874-788

# SITE REMEDIATION REPORT

DATE OF REPORT: May 31, 1990

FILE/ACCOUNT: Lightman Drum Company, Inc.

PROJECT: Removal of Underground Storage Tanks

SITE LOCATION: Rt. 73 South, Milepost 12, Winslow Twp., NJ.

On May 30, 1990, one (1) 2,000-gallon underground diesel fuel tank nd one (1) 1,000-gallon underground diesel fuel tank were excavated a removed from the above referenced site.

Upon removal, a 2 1/2 X 2 1/2 foot inspection port was cut in one d of each tank. the tanks were then entered, water washed and squeeg clean of all residual product and sludge. Two (2) 55-gallon drums residual waste were generated as a result of the cleaning of the tanks.

Visual inspection of both tanks revealed no holes, cracks, punctur or substantial corrosion. Upon removal of the tanks, no noticeable oders or visual contamination were evident in the excavated area. a precautionary measure the excavation was lined with burlap prior t backfilling. All sampling and site assessment functions were perfo ed by client's consultants, Intex.

The cleaned, empty tanks, along with the two (2) drums of residual waste were left on-site as requested by client.

# APPENDIX E

# INTEX REPORTS

# REMEDIAL INVESTIGATION
# LIGHTMAN DRUM COMPANY,
# BERLIN, NJ.

---

Prepared for:

Lightman Drum Company

INTERNATIONAL EXPLORATION, INC.
577 SACKETTSFORD ROAD
WARMINSTER, PA 18974-1396
(215) 598-7137

September, 1989

REF. NO. 6, p. 1 of 81

INTernational EXploration, INC.

577 SACKETTSFORD ROAD
WARMINSTER, PA 18974-1398
215 - 598-7137
W.U. MAIL BOX 62909666
TELEX 510-601-0152
FAX 215-598-0847

September 11, 1989

Mr. Jerome Lightman
LIGHTMAN DRUM CO., INC.
P.O. Box 22
Berlin, NJ 08009

Dear Mr. Lightman:

Enclosed, please find 5 copies of the Remedial Investigation Report prepared by INTEX, Inc. in response to the Administrative Order issued by the New Jersey Department of Environmental Protection, dated April 12, 1988. You should see that 4 copies of this report, and 1 copy of the Tier II Chemical Analysis package for the soil and groundwater samples are sent to:

Mr. David Sweeney, Section Chief
Bureau of Case Management
Dept. of Environmental Protection
401 E. State Street
CN 028
Trenton, NJ 08625-0028

If you have any questions concerning this report, please contact us.

Sincerely,

INTEX, Inc.

Gay Deamer

Gay Deamer
Project Hydrogeologist

GD:cnh

Enc.

cc: Mr. Joseph Jacobsen

REF. NO. 6, p. 2 of 81

## TABLE OF CONTENTS

PAGE NO.

REF. NO. 6 p.3 of 81

## TABLE OF CONTENTS CONT'D

PAGE NO.

SITE HYDROLOGY

APPENDICES

## FIGURES, TABLES AND EXHIBIT

## TABLE OF CONTENTS CONT'D

PAGE NO.

REF. NO. 6, p. 5 of 81

# INTRODUCTION

INTEX, Inc. was contracted by Mr. Jerome Lightman, owner and operator of Lightman Drum Co., Inc. in Berlin, Camden County, New Jersey (Figure 1) to prepare a Remedial Investigation Workplan, conduct the work as outlined by the approved Workplan, and prepare a Remedial Investigation Report as required by a New Jersey Department of Environmental Protection Administrative Order dated April 12, 1988. The driller for the project was John Mathes and Associates, the surveyors were Lippincott Engineering Associates, and chemical analysis was performed by Environmental Testing & Technologies, Inc. All subcontracting was handled by Mr. Lightman.

The purpose of this report is to outline the results of the Remedial Investigation (RI) conducted at the Lightman Drum Co., Inc. The intent of the investigation is to characterize the types and possible sources of waste material which may be contributing to pollution (water, soil or air) at the site, to investigate the horizontal and vertical extent of contamination, to determine migration paths of the contaminants, and identify potential receptors of any contamination.

This RI report describes the results of the initial soil and groundwater investigation conducted at Lightman Drum Co. During this phase of the investigation, the intent was to delineate

REF. NO. 6, P. 6 OF 81

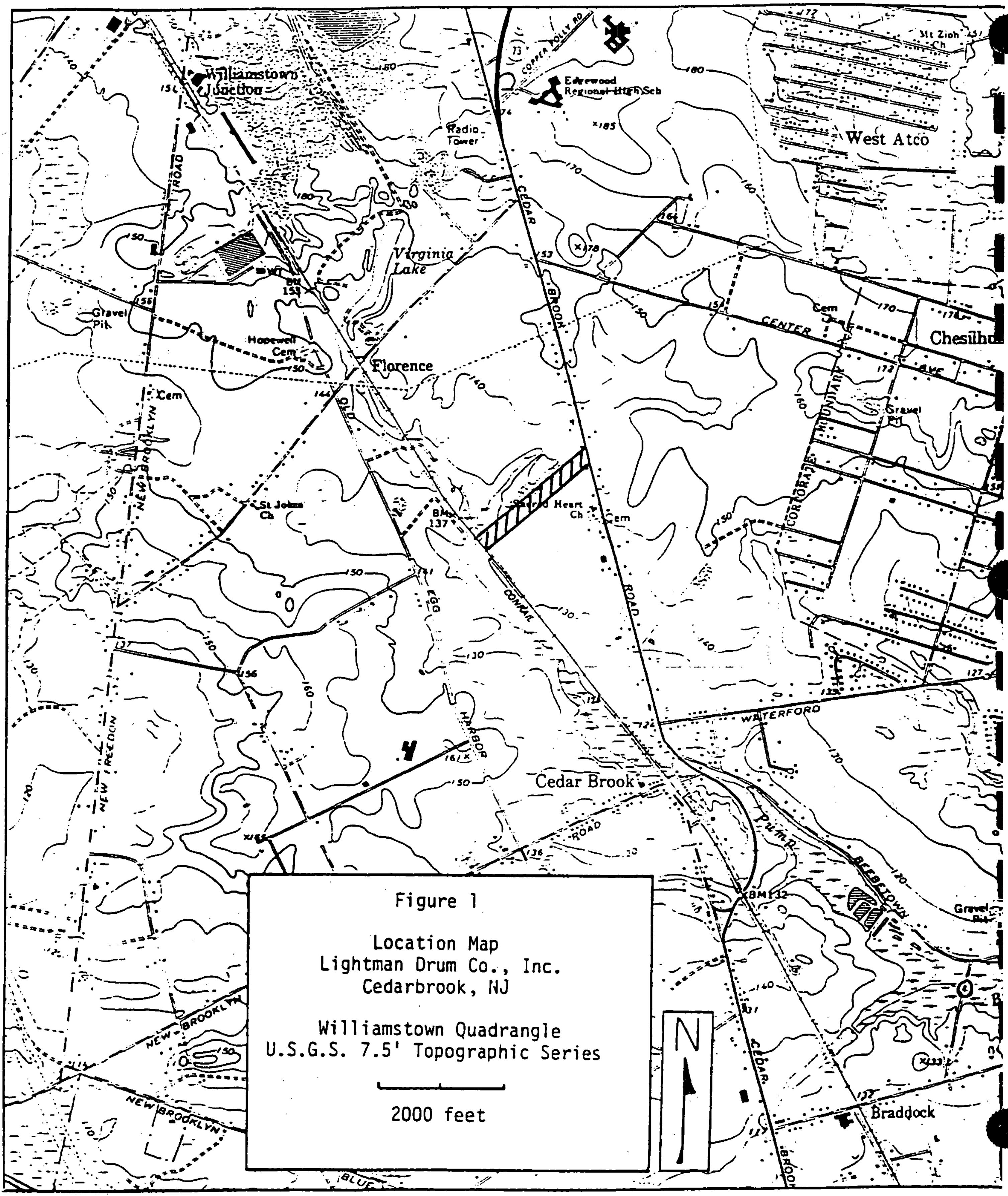


Figure 1

Location Map
Lightman Drum Co., Inc.
Cedarbrook, NJ

Williamstown Quadrangle
U.S.G.S. 7.5' Topographic Series

2000 feet

REF NO. 6, p. 7 of 81

areas on-site which may contain contamination of the soil or groundwater, to propose additional sampling if necessary to more accurately define contaminated areas, or propose corrective action if the aerial extent can be estimated.

## BACKGROUND INFORMATION

### ON-SITE STORAGE FACILITIES

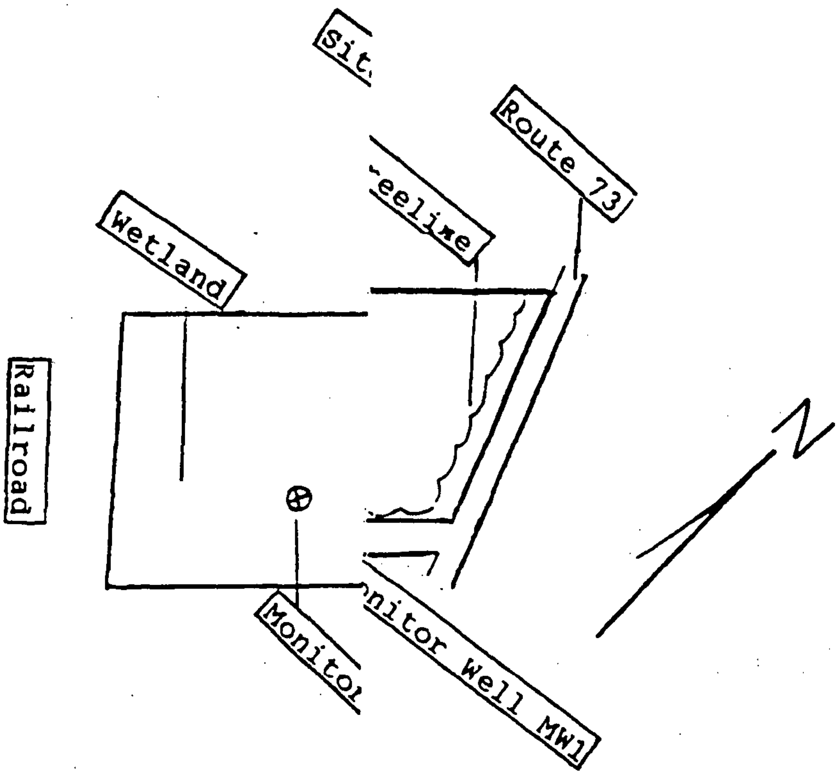
### Underground Diesel Fuel Tanks

Two fiberglass underground storage tanks for diesel fuel were reportedly installed in 1976 (Figure 2). They hold 1000 and 2000 gallons of fuel. They have never been tested for integrity, however, the level of fuel is periodically monitored with a dip stick, and the level is recorded. The levels have apparently not indicated the presence of leak in either of the tanks. These tanks are reportedly empty, and have not been in use since November, 1988.

### Unlined Waste Disposal Pit

It was reported that in 1976, a tank trailer disposed of what was reported to be paint waste and possibly oil into an unlined pit in an area of the property identified in Figure 2 as the "unlined waste storage pit". The contents reportedly remained in the pit for several weeks before being pumped out and disposed of. There are no known records or manifests concerning this waste. Three piezometers were installed in the vicinity of the pit between 1977

REF. NO.6, p.8 of 81



REF. NO. 6. P. 9 of 81

and 1978, but neither Mr. Lightman nor representatives from the NJDEP who were questioned knew whether groundwater samples were ever collected from the piezometers. Apparently, no records of groundwater samples being collected from these piezometers exist.

Underground Waste Storage Tanks

From November 2, 1978 until April 30, 1979, two 5000 gallon underground storage tanks were used to store waste paint pigment, ink sludge, and thinners. On May 28, 1979, 5000 gallons of material were pumped from the tanks and disposed of as hazardous waste. Mr. Lightman has retained the manifest record of the disposal of this material. The tanks were reportedly not used for waste storage after May 28, 1979, although they were thought to hold some residual waste material. On August 18, 1983, additional material (rainwater mixed with residual pigment and thinner) was pumped from the tanks and disposed of as hazardous waste.

The tanks were subsequently excavated in 1984 from an area shown in Figure 2 as the "tank excavation area". After excavation, they were examined on August 9, 1984, by representatives of the NJDEP. During this inspection it was noted that one of the tanks appeared to be unsound, based on the presence of holes, staining of the side of the tank, and soil staining beneath the tank. At the same time, NJDEP representatives noted a dumpster containing sludge from the underground tanks, with discolored soil beneath it.

## Warehouse

Prior to 1985, drums containing wastes collected from non-empty incoming drums were stored in a warehouse. In September 1985, the warehouse was destroyed by a fire. Due to the nature of the facility, the fire created some concern about the possibility of release of contaminants to the environment. The firefighters noted that water used to put out the fire might be dispersing some of the chemicals stored in the warehouse. In the process of containing the fire, some unidentified materials were observed to be escaping from the warehouse onto the ground. Particular concern was expressed for the west end of the warehouse, where it was believed that hazardous materials had been stored.

## PRIOR INVESTIGATIONS

On August 3 and August 8, 1987, DEP representatives analyzed active portions of the site using a photoionization detector (H-nu). The results of the photoionization detector survey revealed the presence of volatile organic chemicals (VOC) as high as 300 ppm in the vicinity of the excavated underground waste storage tanks, and 50 ppm in both active and inactive areas of the site. Based on the results of the H-nu survey, soil and water samples were subsequently collected and analyzed. Soil samples were collected at the following locations: underground storage tank location; an active drum storage area along the southern boundary of the site, where a chromic acid spill was thought to have occurred; an area of surface water drainage behind the active area of the site; and

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in the unlined waste storage pit. The soil samples were analyzed for volatile organics, semivolatile organics, EPA/NIH/NBS Mass spectral library search, pesticides and PCB's, metals, cyanides and phenols, and total solids. The analyses indicated the following compounds, in locations described in a letter from NJDEP representatives to Mr. Lightman, dated April 12, 1988.

## Table 1

Soil Samples Collected by NJDEP, 9/87
Chemical Analysis Results

| Sample | Sample Depth | Chemical | Amount Present |
|---|---|---|---|
| Excavated Tank | 3 ft | | |
| Sample #1 | | Tetrachloroethene | 31,000 ug/kg |
| | | Total xylenes | 110,000 " |
| | | 1,2 Dichlorobenzene | 4,600 " |
| | | 1,3 Dichlorobenzene | 1,600 " |
| | | 1,4 Dichlorobenzene | 7,900 " |
| | | 1,2,4 Trichlorobenzene | 45,000 " |
| | | Butyl Benzyl Phthlate | 2,000 " |
| | | bis(2-ethylhexyl) Phthlate | 4,000 " |
| | | Ethyl Benzene | 14,000 " |
| Drum Storage | 1 ft | | |
| Sample #3 | | Butyl Benzyl Phthlate | 6,300 ug/kg |
| | | bis(2-ethylhexyl) Phthlate | 30,000 " |
| | | Di-n-octyl Phthlate | 920 " |
| | | Chlordane | 800 " |
| | | Chromium | 200 mg/kg |
| | | Cadmium | 9 " |
| | | Lead | 190 " |
| Unlined Waste Storage Pit Sample #4 | 5 ft | bis(2-ethylhexyl) Phthalate | 30,000 ug/kg |
| | | Di-n-octyl Phthalate | 2,900 " |
| | | Chlordane | 630 " |
| | | Arachlor 1254 (PCB) | 1,400 " |
| Surface Water Drainage Sample #2 | 1-1.5 ft | 1,2,4 Trichlorobenzene | 1,900 ug/kg |
| | | bis(2-ethylhexyl) Phthalate | 1,400 " |

Groundwater samples were collected from two off-site domestic wells, one upgradient (north) of the site, and one southwest of the site, across the tributary of the Great Egg Harbor River from the property. The second sample was collected from a well located across the tributary which is the presumed natural discharge location for the site. Neither sample was found to contain contamination, according to the interpretation of the DEP.

Based on the results of the soil samples, the NJDEP determined that Lightman Drums had discharged pollutants into the waters or land of New Jersey, in violation of the Water Pollution Control Act, N.J.S.A. 58:10A-1 et seq. An Administrative Order was issued to Jerome Lightman on April 12, 1988, requiring the initiation of a Remedial Investigation/Feasibility Study of the site conditions.

## REGIONAL GEOLOGY AND HYDROGEOLOGY

The site is located in the Atlantic Coastal Plain Province of the eastern United States, which consists of a series of unconsolidated Cretaceous through Quaternary aged sands and clay sediments overlying Precambrian crystalline rocks. The sediments form a southeasterly-dipping wedge which gradually thickens from the outcrop areas near the Delaware River east toward the Atlantic Ocean (Hardt and Hilton, 1969).

The site is mapped as being underlain by the outcrop area of the Cohansey Sand (Zapecza, 1984), which is described as a light grey to yellow-brown coarse to fine-grained quartzose sand, containing lenses of clay and gravel. The Cohansey Sand is underlain by the Kirkwood Formation, which consists of clay, silt, and light grey to yellow very fine to medium-grained micaceous quartz sand (Rush, 1968).

In this area, there are no mapped continuous confining layers between the two formations, which form the Cohansey-Kirkwood aquifer. This aquifer is almost always unconfined, although local clay units in the Cohansey Sand occasionally create confined conditions. The unit is also confined in peninsula portions of Cape May County. The base of the aquifer is approximately 25 feet below sea level, and it is estimated to be approximately 170 feet thick (Zapecza, 1984). Beneath the Cohansey-Kirkwood aquifer is approximately 200 feet of the composite confining bed, which overlies the Wenonah-Mt. Laurel aquifer.

Transmissivities are generally high in the Cohansey-Kirkwood aquifer; Hardt and Hilton (1969) list transmissivities of about 60,000 gpd/foot in Glouster County, and Rush (1968) lists transmissivity values of 150,000 and 98,000 gpd/foot obtained during pumping tests in Burlington County, and Rooney (1971) reports a value of 30,000 gpd/foot in Salem County. Storage coefficient values of 0.2 (Rush, 1968) and 0.3 (Rooney, 1971) are reported for unconfined aquifer conditions. The aquifer is also capable of providing very high yields to wells; large supply wells

(300-1200 gpm) can be obtained from wells less than 200 feet deep (Rooney, 1971).

Because of the greater depth to other water-bearing units, the Cohansey-Kirkwood aquifer is used extensively for wells, primarily for domestic and farm-irrigation uses. Recharge to the unit is high, due to its high permeability, and therefore, the quantity of water available for use is substantial (Rooney, 1971).

## SITE TOPOGRAPHY

The site location is topographically flat, with a maximum elevation range of 15 feet (125-140 feet above sea level). The highest point of elevation is along the northern boundary of the property, near the site of the burned-down warehouse. From this point south, the site slopes south to southwest, toward a small wetlands area located on the southeastern end of the property, and an adjacent farm directly to the south.

## SURFACE WATER

A branch of the Great Egg Harbor River approaches the southwest property boundary, flowing parallel to the edge of the property to the west of the railroad tracks. An intermittent tributary to the this branch flows southwest, parallel to and north of the northern boundary of the property.

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It is reported that surface water south of the warehouse drains toward the southern end of the property, however, surface water northeast of the warehouse tends to drain either north into the drainage basin, or off the southeastern property boundary.

## SOILS

Most of the property is mapped as being underlain by Downer loamy sand, Klej loamy sand, and Leon soil. All three are well-drained soils which have poor filtering capacity (Markely, 1966).

Much of the active area of the facility has been covered with fill material of varying thicknesses. The fill is fairly impermeable in some areas, as evidenced by the presence of large puddles after rainstorms which remain for as long as several days after the rain. However, there has apparently been a certain amount of redistribution of the fill, since in some areas where soil samples were collected or monitor wells installed, it was observed that there is apparently very little fill material left on the surface.

## LOCAL LAND AND WATER USE

Lightman Drum Co. is located in an area which is primarily agricultural, although a variety of businesses are located along Route 73 between Berlin and Cedar Brook. The property south of the site is used as farmland, as is most of the area along Route 73, and across the branch of the Great Egg Harbor River. A used truck facility is located directly across Route 73 from Lightman

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Drum Co., but land adjacent to the truck facility is also farmed. The property north of the site contains what appears to be a small quarry for sand or gravel, but other parts of the property are wooded and/or farmed.

There are no public supply water systems near the Lightman site, and it is believed that most of the water used near the site is extracted from wells. The primary use of water is thought to be domestic, although some groundwater may be used for crop irrigation.

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# REMEDIAL INVESTIGATION

## SCOPE OF WORK

The remedial investigation consisted of collection of 37 soil samples from depths ranging from the surface to seventeen feet, and installation of six groundwater monitor wells for sampling groundwater, according to the procedures outlined in the INTEX, Inc. "Revised Work Plan for Remedial Investigation, Lightman Drum Co., Inc.", dated January, 1989 and approved by the NJDEP on Feb. 22, 1989 (Exhibit I).

In addition to work outlined in the Revised Work Plan, a survey of inactive portions of the site using a photoionization detector (H-nu) was conducted with representatives of the NJDEP. This work was completed prior to the installation of wells and collection of soil samples at the site. It was instigated at the request of the NJDEP representatives, after an unusually high H-nu reading was noted at the proposed site of the MW4 monitoring well. Details of the field work conducted by INTEX are described below.

## FIELD PROCEDURES

### H-nu Survey Procedure

H-nu monitoring of predominantly wooded areas of the site was conducted on April 4, 1989 with representatives of the NJDEP. The purpose of this sampling was to try to determine the source of unusually high H-nu readings measured during collection of the shallow soil sample (using a hand auger) at the then-proposed

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monitor well MW4 location. At the time this sample was being collected, a volatile organic reading of 31 ppm was measured with the H-nu in the auger hole at a depth of 6 inches from the surface. The concentration of volatiles in the hole was found to drop rapidly, and eventually it returned to a background level of 0-1 ppm.

The NJDEP representatives, who were on-site to approve soil sampling locations, were informed of these results, and they requested that additional holes be augered in the vicinity of the MW4 location (MW4 had not been installed at this time). As a result, holes were hand augered at various locations and depths near the MW4 location, and additional auger holes were completed in the wetlands area near the railroad tracks. The survey eventually traversed northwest toward the unlined storage pit area, and from there toward the excavated underground storage tank area. The survey ended approximately 100 feet northwest of the excavated storage tank area.

The measurements were made by removing sand in approximately 6 inch increments from the surface, and inserting the H-nu probe in the hole for a measurement. Each time the hole was extended, a new reading was taken. Holes were extended to a depth of 4 to 5 feet maximum, and after measurement, the holes were filled in with the soil and unconsolidated sediments removed from the hole with the auger.

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## Soil Sampling Procedure

Soil sampling was conducted according to the procedures outlined in the Revised Work Plan. No significant deviations from the Work Plan occurred during the collection of soil samples.

Soil sample collection began on April 4, 1989 and ended on April 19, 1989, with the exception of soil sample 1D2, which was collected on May 5, 1989. This sample was collected from the retention pond, and until this later date, the soil in this area was too wet to support the drill rig.

## Soil Sampling Locations

Table 2 lists the individual soil sampling locations, and the particular reason that location was sampled. Note that soil samples collected in the monitor well bores are denoted as MW#(1) or (2), where "#" indicates the monitor well number, and (1) or (2) indicates the shallow or deep sampling location. These soil samples should not be confused with groundwater samples which are designated simply as "MW#". The soil sample locations are shown on the attached site map.

Several of the shallow soil sampling locations were moved at the request of NJDEP representatives prior to the collection of samples, based on the presence of visible soil staining.

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## Table 2

### Soil Sampling Locations and Reasons for Sampling

| # | Depth (ft) | Location | Reason for Sampling |
|---|---|---|---|
| 1D (1) | 0.5-1 | Retention Pond | Runoff from site, possib. contamination |
| (2) | 8-8.5 | | |
| 2S | 0.5-1 | NE edge warehouse | Poss. contamination of soil from fire |
| 3S | 0.5-1 | SE edge warehouse | Poss. contamination of soil from fire |
| 4S | 0.5-1 | Trailer parking | NJDEP concern |
| 5D (1) | 0.5-1 | Trailer parking | NJDEP concern |
| (2) | 12-14 | | |
| 6S | 0.5-1 | Transfer area | NJDEP concern |
| 7S | 0-0.5 | Drum storage | Stained soil |
| 8S | 0.5-1 | Drum storage | NJDEP concern |
| 9S | 0.75-1 | Drum storage | NJDEP concern |
| 10D (1) | 0.5-1 | Drum storage | NJDEP concern |
| (2) | 12-14 | | |
| 11D (1) | 0.5-1 | Drum storage | NJDEP concern |
| (2) | 12-14 | | |
| 12D (1) | 0.5-1 | Tank excavation | Contamination from UST |
| (2) | 10.5-12.5 | | |
| 13D (1) | 0-0.5 | Surface drainage | Poss. contamination from site runoff into woods |
| (2) | 5.75-6.25 | | |
| 14D (1) | 0-0.5 | Waste storage pit | Poss. contamination from waste in unlined pit |
| (2) | 4-4.5 | | |
| 15S | .25-.75 | Truck turnaround | NJDEP concern |
| 16S | .25-.75 | SE of unlined pit | Poss. contamination from unlined pit |
| 17S | 0-0.5 | Drum stacking area | Stained soil |
| MW1 (1) | 0-1 | Upgradient | Background soil |
| (2) | 15-17 | | |
| MW2 (1) | 0.5-1 | Tank excavation | Poss. contamination from UST |
| (2) | 14-16 | | |
| (3) | 10-12 | | |
| MW3 (1) | 0-0.5 | Waste storage pit | Poss. contamination from waste in unlined pit |
| (2) | 10-12 | | |
| MW4 (1) | 0-0.5 | Downgradient | Downgradient soil quality |
| MW5 (1) | 0-1.5 | Underground tank | Poss. contamination from UST for diesel fuel |
| (2) | 10-12 | | |
| MW6 (1) | .75-1 | NW corner warehouse | Poss. contamination from fire |
| (2) | 10-12 | | |

### Monitor Well Installation

Monitor wells were installed according to the Revised Work Plan. The only major deviation from the Work Plan involved the alteration of the depth of the screened interval in monitor well MW4 from a water table depth to a depth of 38-48 feet below ground surface. This change was made at the request of NJDEP personnel.

Drilling and installation of monitor wells began on April 5 and was finished on April 19, 1989.

### Monitor Well Locations

Monitor wells were installed in the locations outlined in the Revised Work Plan, and are shown in the attached site plan map. No significant changes to the Revised Work Plan locations were made.

### Hydraulic Conductivity Testing

On May 8, 1989, falling head piezometer tests (slug tests) were performed on monitoring wells #1, #3, #4, #5, and #6. Piezometer tests were conducted in lieu of pumping tests because of the possibility that the groundwater in the wells might be contaminated, and piezometer tests do not generate large quantities of water which must be disposed of. Monitoring well #2 was not tested due to high levels of volatile organic compounds detected in the head space of this well using an H-nu photoionizer.

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Prior to the test, the static water level of each well was measured. Fifteen gallons of well water were removed from each well for use as the water slug, and the wells were then allowed to recover to their static level. The fifteen gallon slug was then introduced into the well, and as the water level fell, timed water levels were measured using a stopwatch and a Fisher M-scope water level indicator. Water levels were measured until the pre-test static water level was reached. Due to the extremely rapid rate of recovery in the wells, duplicate slug tests were performed to confirm the data collected.

Recovery in wells MW1, MW4, and MW6 occurred too rapidly to obtain reliable data. Only the tests conducted in wells MW3 and MW5 provided reliable results.

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# RESULTS OF INVESTIGATION

## On-Site Stratigraphy

During the installation of monitor wells, a careful record of soil and sand characteristics was made, and samples of different sand lithologies were collected. Several types of unconsolidated sand units were recognizable throughout the site, although each unit was not present at each monitor well location, and the units varied in depth and thickness. The most obvious means of differentiating the units was by color, since the color changes were distinctive. However, within similarly colored units, the sand units varied in terms of grain size, sorting, and presence of pebbles. The well logs for each well are shown in Appendix 1. The logs list grain size changes, and H-nu readings for the entire depth of each monitor well.

The sand units range from fine to very coarse sand, with some layers containing either silt or (rarely) clay, or pebbles. The colors range from brown (usually near the surface), to tan, orange-brown or white, and occasional thin clay layers are encountered, although these could not be considered confining layers due to their thinness and non-continuous nature. The grain size and sorting characteristics of the layers change rapidly with depth. Brief descriptions of the lithology of each well bore are also contained in Appendix 1.

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## H-nu Survey

The results of the H-nu survey revealed a pattern of high volatile organic levels present above the water table in different areas on the site. The results of the survey indicated that within an area extending about 50 feet north from the proposed MW4 well location, higher than background H-nu levels were present (background = 0-1 ppm at the site). The highest reading (50 ppm) was obtained approximately 30 feet northwest from the MW4 location. The levels decreased in other directions from the MW4 location.

As mentioned previously, the areas of the site which were investigated using the H-nu were limited to wooded, inactive portions of the property. A sketch showing approximate locations at which H-nu measurements were taken is shown in Figure 3. The results are outlined below.

1. The area around the MW4 location had measured values of up to 50 ppm.
2. Wetlands area at the southwest end of the property had measured H-nu values of 2-3 ppm at a depth of approximately one foot.
3. Along southern property boundary west of the MW4 location, a maximum reading of 5 ppm was measured at a depth of approximately two feet.
4. An area south and southwest of the unlined waste storage pit area, at depths of 1-4 feet had readings of 0-8 ppm.

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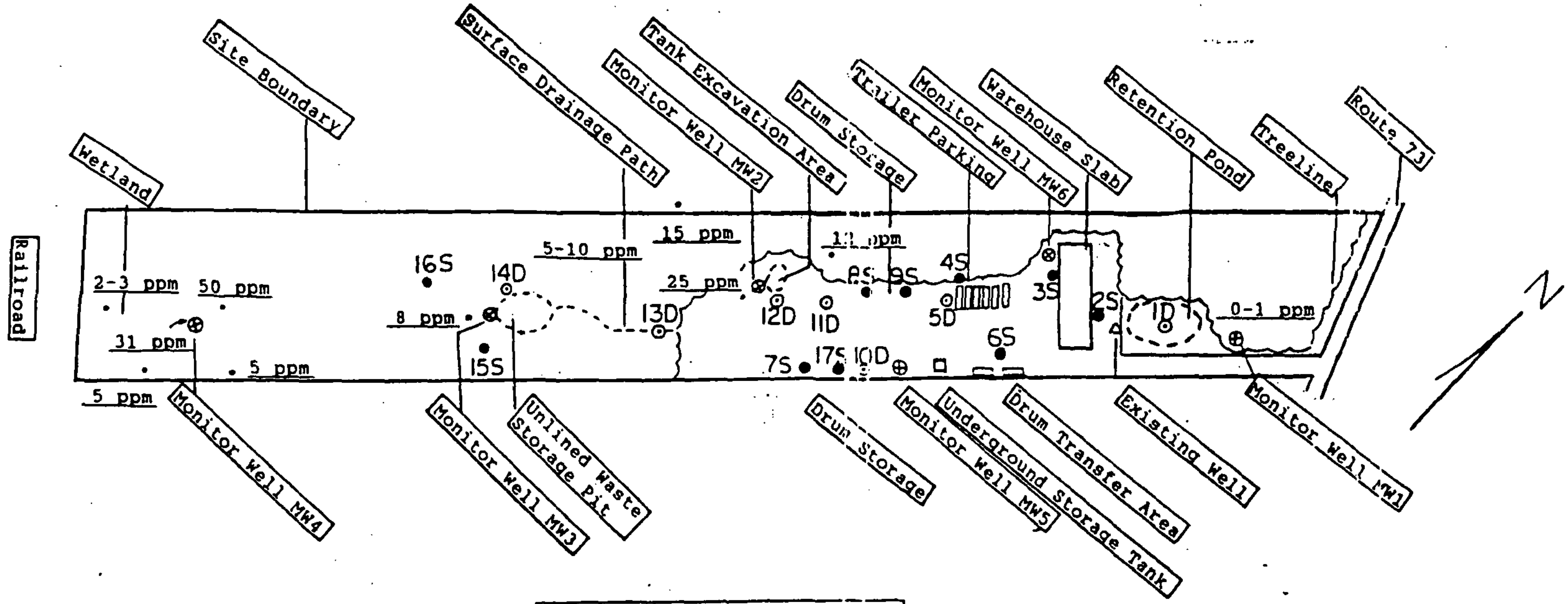

Figure 3

H-nu Measurements
Lightman Drum Co.

○ Monitor Wells

7S ● Shallow Soil Samples

1D ⊙ Deep Soil Samples

Scale: 1" = 200'

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5. The wooded area south, west and north of the excavated underground storage tank location had measured readings of up to 25 ppm, although the readings varied at different depths and locations. The maximum reading north of the tank area was 15 ppm at a depth of approximately two feet; west of the tank, readings were generally low (1-5 ppm), and south of the tank, measurements ranged 0-6 ppm. The maximum reading in this area of 25 ppm was measured near the tank, approximately 30 feet southeast of it.

Several observations were made during this survey. First, although the H-nu readings were found to increase near the excavated storage tank, there did not appear to be any direct correlation between the presumed downgradient groundwater flow direction and the highest H-nu readings. That is, it was expected that there would be a correlation between high H-nu readings and the downgradient direction, assuming that groundwater contamination had occurred. The expectation was that a contaminant plume containing high concentrations of volatile organics would slowly lose the volatiles over time, and the volatiles would migrate into the sediments above the plume. However, this was not the case; for example, readings as high as 15 ppm were measured in the woods north of the excavated storage tank, in an upgradient direction.

In addition, it was noted that higher readings were encountered in locations which contained vegetation and ground cover, as opposed

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to locations where measurements were taken below bare soil or sand. This observation was first made by one of the NJDEP representatives, and several trial measurements were conducted to test this observation. Several locations having vegetated and non-vegetated cover positioned within 2 feet of each other were chosen to conduct H-nu measurements, and in each case, the vegetated location was determined to have the higher reading.

It was also noted that in many of the auger holes, particularly in the vicinity of the MW4 location, the highest readings were encountered in a particular layer of sand which had a very characteristic white color.

## Chemical Analyses of Soil and Groundwater Samples

The chemical parameters tested in the samples collected for this investigation are not consistent with the sampling parameters listed in the Revised Work Plan, due to an error on the part of the analytical laboratory. As a result, the soil and groundwater samples were analyzed for volatile and semivolatile organics, using EPA Method 624 and 625. The soil samples were also analyzed for priority pollutant metals, cyanides and phenols, and the groundwater samples were analyzed for total iron, manganese, pH, conductivity, and total solids. Neither groundwater nor soil samples were analyzed for PCB's or pesticides.

Assessment of the degree of soil and groundwater contamination by

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volatile and semivolatile organics was complicated by the presence of contamination in many of the method blanks, and extensive concentrations of tentatively identified compounds (TIC) in some samples, which necessitated the application of different criteria for assessing the level of contamination in the sample. Ultimately, the final judgement on whether a sample contained "excessive" levels of contamination was based on NJDEP Guidelines for evaluating possible ECRA cleanup requirements, as listed below:

> Soil samples: A level of 10 ppm total semivolatile concentration or 1 ppm total volatile concentration.
>
> Groundwater samples: A level of 50 ppb total semivolatile concentration and 10 ppb volatile concentration.

Determination of whether a high level of contamination was present in a sample also required comparison of the amounts of contaminants present in individual samples with the amounts present in the laboratory method blanks. In samples in which the method blank contained contamination, the guidelines listed in the Laboratory Data Validation Functional Guidelines for Evaluating Organic Analysis, prepared for the USEPA, were used:

> If the contaminant was present in the sample at a concentration less than five times the amount present in the method blank, it was considered to be non-detected in the sample (the 5x guideline). The exceptions to this is contamination of the method blank by either methylene chloride or bis(2-ethylhexyl) phthalate, which are listed as common lab contaminants. For these contaminants, the sample concentration was considered to be non-detected when the concentration in the sample was less than ten times the concentration in the method blank. For tentatively identified compounds (TIC's), a comparison was made of the retention time (RT) for each TIC with the RT values for compounds present in the method blank.

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> If an individual TIC RT matched within 0.02 time units of a method blank RT as presented in Appendix 2, it was assumed that the sample TIC and the blank TIC compound were due to the presence of the same compound, and the 5x guideline was applied to the compound to determine whether it was to be considered non-detected. The 0.02 time unit is considered to be an arbitrary but conservative assumption. In the "Laboratory Data Validation Functional Guidelines for Evaluation Organics Analyses", no specific guidelines are presented for this comparison; this document refers only to "similar relative retention time" criteria.

Using the above guidelines, the sampling locations were used to delineate areas of 1) high priority concern, 2) areas of moderate concern which slightly exceed the above-listed contamination levels and might require additional investigation, and 3) areas of in which little or no contamination was found. It is anticipated that no additional work will be necessary in the areas comprising the third category.

1) Areas of High Priority Concern

*Excavated Underground Storage Tank*

The area having the highest levels of contamination in both soil and groundwater is the area in the vicinity of the excavated underground storage tank. The major contaminants found in the soil samples (12D1, 12D2, MW2(1), MW2(2), and MW2(3)) included benzenes, phthalates, dichloromethane, trichloroethene, tetrachloroethene, and ethylbenzene. The levels of contamination were considerably higher in the 12D soil samples than in the MW2 soil samples, although this is probably due to differences in the sampling depths

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in the two locations. Contaminants in the groundwater at this location were primarily volatile organics, including dichloromethene, trichloroethene, benzene, tetrachloroethene, toluene, chlorobenzene, ethylbenzene, 1,2 dichloroethene, and 1,1,1 trichloroethane. The total levels of volatiles present in the groundwater exceeded 30,000 ppb. The contaminants present in these samples are shown in Table 3.

The groundwater sample was tested for additional parameters, including total iron, manganese, total dissolved solids, total suspended solids, pH, and specific conductance. There were differences in these parameter values for the contaminated groundwater from MW2 as compared to the values for the other groundwater samples. Both total iron and manganese were higher in MW2, total suspended solids were lower, total dissolved solids were higher, and the specific conductance was also higher. The pH of the MW2 sample was marginally lower than the other samples.

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### Table 3

### Laboratory Analyses on Samples From Excavated Underground Storage Tank Area

| Sample # | Compound | Concentration (ug/kg) |
|---|---|---|
| 12D1 (soil) | Di-n-butylphthalate | 820 |
| | bis(2-Ethylhexl)phthalate | 1500 |
| | Methylene Chloride | 11 |
| | Benzene | 3 |
| | Tetrachoroethene | 110 |
| | Total semi volatile TIC | 18300 |

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## Table 3 Cont'd

| | | |
|---|---|---|
| 12D2 (soil) | 1-4-Dichlorobenene | 210 |
| | Butylbenzylphthalate | 1200 |
| | 1,2,4-Trichlorobenzene | 3600 |
| | Naphthalene | 81 |
| | Di-n-butylphthalate | 360 |
| | 1-2-Dichlorobenzene | 140 |
| | bis(2-Ethylhexl)phthalate | 620 |
| | Methylene Chloride | 800 |
| | Trichloroethene | 5100 |
| | Benzene | 640 |
| | Tetrachloroethene | 20000 |
| | Toluene | 16000 |
| | Ethylbenzene | 15000 |
| | Total semi volatile TIC | 4900 |
| | Total volatile TIC | 660000 |
| MW2(1) (soil) | Diethylphthalate | 89 |
| | Di-n-butylphthalate | 620 |
| | bis(2-Ethylhexl)phthalate | 800 |
| | Methylene Chloride | 10 |
| | Chloroform | 4 |
| | Benzene | 3 |
| | Tetrachloroethene | 450 |
| | Total semi volatile TIC | 10830 |
| MW2(2) (soil) | 2-4-Dimethylphenol | 55 |
| | Diethylphthalate | 52 |
| | Di-n-butylphthalate | 5300 |
| | Methylene Chloride | 12 |
| | Chloroform | 11 |
| | Trichloroethene | 4 |
| | Benzene | 9 |
| | Toluene | 20 |
| | Ethylbenzene | 74 |
| | Total semi volatile TIC | 9030 |
| | Total volatile TIC | 1030 |
| MW2(3) (soil) | Di-n-butylphthalate | 2500 |
| | bis(2-Ethylhexyl)phthalate | 620 |
| | Methylene Chloride | 13 |
| | Total semi volatile TIC | 520 |

## Table 3 Cont'd

| | | |
|---|---|---|
| MW2 (Groundwater) | 2-4-Dimethylphenol | 520 |
| | Diethylphthalate | 6 |
| | Nitrobenzene | 7 |
| | Methylene Chloride | 190 |
| | Chloroform | 11 |
| | Trichloroethene | 6500 |
| | Benzene | 1300 |
| | Tetrachloroethene | 3400 |
| | Toluene | 5600 |
| | Chlorobenzene | 310 |
| | Ethylbenzene | 12000 |
| | 1,1-Dichloroethene | 2 |
| | 1,1-Dichloroethane | 3 |
| | 1,2-Dichloroethene | 310 |
| | 1,1,1-Trichloroethane | 460 |

*Underground Diesel Fuel Storage Tanks Area*

Soil samples collected during the installation of monitor well MW5 contained high levels of tentatively identified, semi-volatile compounds. In the shallow soil sample from MW5, the primary TIC's were benzenes (18,000 ug/kg), alkanes (2100 ug/kg), chlordanes (14,600 ug/kg), and hexanedioic acid (44,000 ug/kg). The deep soil sample contained lower concentrations of the same contaminants: benzenes (6800 ug/kg), alkanes (2000 ug/kg), and hexanedioic acid (22,000 ug/kg). The groundwater sample collected from this monitor well also contained a large number of semivolatile TIC's, however, most of the listed TIC's found in the sample were also found in the method blank at levels similar to those in the sample, suggesting laboratory contamination. This suggestion is reinforced by the fact that most of the TIC's listed for the monitor well were not

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the ones found in the contaminated soil samples. It is therefore believed that although contamination is present in the soil, it is not present in the groundwater. Higher levels of contaminants were found near the surface than at the deeper sampling location, which suggests the possibility that the source of contamination may be from the surface rather than from the tank. Surface contamination is possible at this location, because this is also a drum storage area. Table 4 lists the contaminants and concentrations present in these samples.

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## Table 4

### Laboratory Analyses of Samples From Underground Gasoline Storage Tank Area

| Sample # | Compound | Concentration (ug/kg) |
|---|---|---|
| MW5(1) (soil) | Di-n-butylphthalate | 1200 |
| | bis(2-Ethylhexyl)phthalate | 890 |
| | Methylene Chloride | 11 |
| | Chloroform | 12 |
| | Benzene | 8 |
| | Total semivolatile TIC | 89980 |
| | Total volatile TIC | 30 |
| | Chromium | 125 mg/kg |
| | Lead | 485 " |
| | Silver | 96 " |
| MW5(2) (soil) | Diethylphthalate | 15 |
| | Di-n-butylphthalate | 580 |
| | 1-2-Dichlorobenzene | 29 |
| | Methylene Chloride | 9 |
| | Chloroform | 7 |
| | Total semivolatile TIC | 14110 |

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*Drum Storage Area - South Side of Active Site Area*

Four soil samples, 7S, 17S, 10D1 and 10D2, contained high levels of TIC semivolatile organics, and sample 7S also has elevated levels of several TIC volatile organics. In sample 7S, the total level of semivolatile identified compounds was 11,000 ug/kg of diethylphthalate and bis (2-ethylhexyl) phthalate, and the concentration of TIC semivolatiles was approximately 100,000 ug/kg of primarily cyclohexane and hexanedioic acid. In sample 17S, the identified semivolatiles had a level of 49,000 ug/kg of phthalates and a small amount of naphthalene, and the TIC semivolatiles were present at a total concentration of approximately 67,000 ug/kg of mostly unknown compounds, although phosphoric acid was present at a level of 19,000 ug/kg. In sample 10S (6-12 inches depth), identified semivolatiles (phthalates, naphthalene, and 1,2-Dichlorobenzene) were present in total concentrations of 7700 ug/kg, and TIC semivolatiles were present at a total level of about 25,000 ug/kg in a wide variety of alkanes, ethanes and unknowns. Sample 10D (collected at a depth of 12-14 feet) contained approximately 230 ug/kg of identified phthalates, and a total of 5000 ug/kg of TIC alkanes, ethanes, propanoic acid, and other compounds. These three soil sampling areas are all located in an active drum storage area of the site along the south property boundary between the gasoline storage tank and the treeline. In each sampling location, the list of contaminants present (particularly TIC's) are substantially different from each other, suggesting the possibility that each

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sample represents a separate source, rather than a single source covering a very wide area. The contamination levels in the deeper 10D sample are lower than in the shallow location, suggesting that contamination is primarily surficial. There are no monitor wells in this area (other than monitor well #5, discussed above), so that it is not known whether contamination from the soil in this area has migrated to the groundwater. The levels of contaminants found in these soil samples are listed in Table 5.

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## Table 5

### Laboratory Analyses on Samples From Drum Storage Area - South Side of Active Site Area

| Sample # | Compound | Concentration (ug/kg) |
|---|---|---|
| 7S (soil) | Diethylphthalate | 2800 |
| | Di-n-butylphthalate | 4200 |
| | bis-(2-Ethylhexyl)phthalate | 7800 |
| | Methylene Chloride | 33 |
| | Chloroform | 11 |
| | Trichloroethene | 3 |
| | Total semivolatile TIC | 103300 |
| | Total volatile TIC | 60 |
| 17S (soil) | Butylbenzylphthalate | 3700 |
| | Naphthalene | 120 |
| | Di-n-butylphthalate | 24000 |
| | bis(2-Ethylhexyl)phthalate | 21000 |
| | Methylene Chloride | 10 |
| | Chloroform | 5 |
| | Benzene | 5 |
| | Total semivolatile TIC | 67900 |
| | Total volatile TIC | 16 |
| | Lead | 600 mg/kg |
| 10D1 (soil) | Naphthalene | 76 |
| | Diethylphthalate | 23 |
| | Di-n-butylphthalate | 6600 |
| | 1-2-Dichlorobenzene | 27 |
| | bis(2-Ethylhexyl)phthalate | 950 |

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## Table 5 Cont'd

| | | |
|---|---|---|
| | Methylene Chloride | 7 |
| | Chloroform | 6 |
| | Total semivolatile TIC | 24580 |
| 10D2 (soil) | Diethylphthalate | 11 |
| | Di-n-butylphthalate | 140 |
| | bis(2-Ethylhexyl)phthalate | 78 |
| | Methylene Chloride | 10 |
| | Ethylbenzene | 2 |
| | Total semivolatile TIC | 3170 |

## 2) Areas of Moderate Concern

### *Unlined Waste Storage Pit Area*

The soil and groundwater samples from the waste storage pit area (14D1, 14D2, MW3(1) and MW3(2)) contain elevated levels of primarily semivolatile TIC contaminants. The levels are higher than the previously indicated guidelines, however, these samples are not as severely contaminated as the high priority areas. This area is somewhat confusing because of the lack of consistency among the various contaminants and samples. There tends to be a wide variety of semivolatile organics and TIC's present in the soil samples (#14D, both depths, and MW3 soil samples, both depths), and elevated levels of some volatiles in the sample 14D(2). The groundwater sample from MW3, however, appeared to contain lower levels of contamination. MW3 contained 6 ug/L of tetrachloroethene, and 31 ug/L of other TIC volatile organics. The concentrations of contaminants present in the soil samples are listed in Table 6.

## Table 6

### Laboratory Analyses on Samples From Unlined Waste Storage Pit Area

| Sample # | Compound | Concentration (ug/kg) |
|---|---|---|
| 14D1 (soil) | Di-n-butylphthalate | 360 |
| | bis(2-Ethylhexyl)phthalate | 15000 |
| | Methylene Chloride | 9 |
| | Chloroform | 8 |
| | Total semivolatile TIC | 45000 |
| 14D2 (soil) | Di-n-butylphthalate | 690 |
| | bis(2-Ethylhexyl)phthalate | 260 |
| | Methylene Chloride | 10 |
| | Chloroform | 0.7 |
| | Benzene | 10 |
| | Toluene | 3 |
| | Chloromethane | 11 |
| | Total semivolatile TIC | 3170 |
| MW3(1) (soil) | Di -n-butylphthalate | 740 |
| | bis-(2-Ethylhexyl)phthalate | 370 |
| | Methylene Chloride | 9 |
| | Benzene | 3 |
| | Total semivolatile TIC | 10270 |
| MW3(2) (soil) | Di-n-butylphthalate | 1700 |
| | bis(2-Ethylhexyl)phthalate | 710 |
| | Methylene Chloride | 15 |
| | Chloroform | 4 |
| | Total semivolatile TIC | 2410 |
| MW3 (groundwater) | Tetrachloroethene | 6 ug/L |
| | Total Volatile TIC | 31 |

The levels of volatile organics suggest that there is some groundwater contamination in this area, but the levels are not excessive. There is a possibility that this monitor well is not located to intercept the highest contamination levels from the

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appears to be localized, since nearby samples 11D and 9S did not contain significant levels of contamination. Substances present included semivolatile identified phthalates (850 ug/kg), and a small amount of 1,2-dichlorobenzene. In addition, a large amount of methylene chloride (100 ug/kg) was identified. There was also a variety of semivolatile TIC's, including alkanes, ethanes, propanoic acid and hexanedioic acid (total semivolatile concentration was 27,000 ug/kg). Concentrations of contaminants found in sample 8S are listed in Table 8.

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Table 8

Laboratory Analyses on Samples From Drum Storage Area

| Sample # | Compound | Concentration (ug/kg) |
|---|---|---|
| 8S (soil) | Diethylphthalate | 59 |
| | Di-n-butylphthalate | 360 |
| | 1-2-Dichlorobenzene | 24 |
| | bis(2-Ethylhexyl)phthalate | 770 |
| | Methylene Chloride | 100 |
| | Chloroform | 4 |
| | Benzene | 4 |
| | Total semivolatile TIC | 28760 |
| | Total volatile TIC | 61 |

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### 3) Areas of Little or No Concern

It is recognized that there are other areas of the property which contain some degree of soil contamination, primarily areas where drums are or have been stored. However, the levels of contamination were found to be low (based on the above-listed

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guidelines), even near the surface, and it is expected that these areas do not need to be addressed by further investigation. These areas are represented by soil samples 1D, 2S, 3S, 4S, 5D, 6S, 9S, 11D, 13D, 15S, and 16S. This does not mean that there is no contamination at these locations, but rather that the levels of contamination are lower than the referenced guidelines. The contamination present in these soil samples is extremely diverse, and where present, consists primarily of TIC semivolatiles. Table 9 lists the contaminants present in these soil samples.

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Table 9

Laboratory Analyses of Samples From
Low Level Contamination Areas

| Sample # | Compound | Concentration (ug/kg) |
|---|---|---|
| 1D1 (soil) | bis (2-ethylhexyl)phthalate | 1200 |
| | Total semivolatile TIC | 2250 |
| 2S (soil) | bis (2-ethylhexyl)phthalate | 1400 |
| | Total semivolatile TIC | 3630 |
| | Total volatile TIC | 43 |
| 3S (soil) | Chloroform | 1 |
| | Total semivolatile TIC | 1450 |
| | Total volatile TIC | 2 |
| 4S (soil) | bis (2-ethylhexyl)phthalate | 370 |
| | Methylene chloride | 12 |
| | Total semivolatile TIC | 1090 |
| | Total volatile TIC | 200 |
| 5D1 (soil) | Benzene | 12 |
| | Toluene | 4 |
| | Total semivolatile TIC | 2510 |
| 5D2 (soil) | bis (2-ethylhexyl)phthalate | 100 |
| | Total semivolatile TIC | 1420 |

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## Table 9 Cont'd

| | | |
|---|---|---|
| 6S (soil) | Butylbenzylphthalate | 240 |
| | Diethylphthalate | 31 |
| | bis (2-ethylhexylphthalate) | 750 |
| | Total semivolatile TIC | 17930 |
| 9S (soil) | Methylene chloride | 13 |
| | Total semivolatile TIC | 4220 |
| | Total volatile TIC | 114 |
| 11D1 (soil) | 1,4 Dichlorobenzene | 17 |
| | 1,2 Dichlorobenzene | 42 |
| | Total semivolatile TIC | 7400 |
| | Arsenic | 43 mg/kg |
| 11D2 (soil) | 1,2 Dichlorobenzene | 21 |
| | Diethylphthalate | 13 |
| | bis (2-ethylhaxylphthalate | 110 |
| | Methylene Chloride | 9 |
| | Ethylbenzene | 2 |
| | Total semivolatile TIC | 170 |
| 13D1 (soil) | bis (2-ethylhexyl)phthalate | 2200 |
| | Methylene chloride | 17 |
| | Chloroform | 7 |
| | Chromium | 130 mg/kg |
| 13D2 (soil) | 1,2 Dichlorobenzene | 22 |
| | Methylene chloride | 10 |
| | Chloroform | 3 |
| | Total semivolatile TIC | 820 |
| 15S (soil) | 1,2 Dichlorobenzene | 12 |
| | Methylene chloride | 2 |
| | Total semivolatile TIC | 2500 |
| | Total volatile TIC | 135 |
| 16S (soil) | Diethylphthalate | 77 |
| | Methylene chloride | 14 |
| | Chloroform | 21 |
| | Total semivolatile TIC | 3080 |
| | Total volatile TIC | 28 |

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## Background Levels of Contamination

### *Monitor Well MW1*

It was anticipated that groundwater from MW1 would serve as an indication of background groundwater quality, since this well was located both upgradient, and in an area where no known site activity had taken place. There is very little contamination in the groundwater in this location (5 ppb of TIC volatile organics), however, the shallow soil sample collected from the MW1 location indicated the presence of approximately 5000 ppb of semivolatile TIC's. The deep soil sample from this location was not analyzed for organics, due to an error at the laboratory. Therefore, although the groundwater appears to represent adequate background conditions, the soil in this location probably does not.

## Downgradient levels of Contamination

### *Monitor Well MW4*

This location was chosen because it was thought to be in a downgradient location, at a distant enough location to not be severely contaminated by any site activities. However, small amounts of volatiles were detected in the shallow soil sample collected at this location, and elevated arsenic concentrations (34-41 mg/kg) were found in both the deep and shallow soil samples. The groundwater contained 5 ppb of TIC volatile organics, and it is unknown whether the arsenic levels are also elevated in the groundwater, because, as mentioned previously, the groundwater samples were not tested for metals. Although the arsenic could be naturally occurring, the presence of volatiles suggests that this area cannot be considered to be completely unaffected by upgradient activities. It should also be pointed out that as a result of this investigation, it appears likely that this well is not located in a position where it would intercept a groundwater contaminant plume migrating from active portions of the site (discussed in "Site Hydrology" section).

### Areas Originally Investigated by the NJDEP

Of the four areas from which the NJDEP collected samples in 1987, this investigation has confirmed the presence of contamination in three of the locations: 1) the excavated underground storage tank; 2) the drum storage area along the southern boundary of the site (NJDEP sample area #3); 3) the unlined waste storage pit. In all three cases, the types of constituents found were similar, although they did not always overlap.

In the other area, substantial contamination was not confirmed. The surface water drainage area (INTEX sample #13D) contained small amounts of volatiles and semivolatiles, and the near-surface sample contained an elevated chromium concentration, however, the levels present did not constitute a serious concern. The chromium, which was present at a concentration of 170 mg/kg at the surface decreased to 6 mg/kg in the deep sample.

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## SITE HYDROLOGY

### Introduction

The purpose of determining site hydrological characteristics is to allow an estimate of the direction and velocity of groundwater flow. The velocity can be used to determine what is normally considered to be a "worst case" distance for the transportation of contaminants in the groundwater. That is, except under very unusual circumstances, it is assumed that contamination in the groundwater can travel only as quickly as the groundwater itself, so that determining the velocity of groundwater through the aquifer also determines the maximum velocity of contaminants. Several factors tend to mitigate the transport of contamination, however, so that contaminant transport is usually delayed with respect to groundwater transport, and groundwater velocity is therefore assumed to be a very conservative, "worst case" estimate of contaminant transport.

Darcy's Law is the most straightforward method of estimating the velocity of groundwater flow. Darcy's Law is expressed:

$$V = K\ (dH/dL)/n$$

where $V$ = groundwater velocity (ft/sec)
$K$ = hydraulic conductivity (ft/sec)
$dH/dL$ = hydraulic gradient
$n$ = porosity of the unit

The application of Darcy's Law depends on making a variety of assumptions, many of which are not met in natural systems. Nonetheless, the type of aquifer system found on the property

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(unconsolidated, low clay content sediments) lends itself to use of this equation, with the expectation that the calculated velocity will be reasonably accurate.

The investigation of the site hydrology, then, is designed to determine those factors in Darcy's Law which will allow the estimation of groundwater velocity, specifically, hydraulic conductivity, hydraulic gradient, and effective porosity.

## Site Hydrologic Data

### *Hydraulic Gradient and Groundwater Flow Direction*

Water level measurements were collected at each well location at the time the monitor wells were drilled in April, however, since the wells were drilled over the period of a week, these static levels were not used to calculate hydraulic gradient. A round of water level measurements was conducted at the wells on May 5, 1989, and these measurements were used to calculate the hydraulic gradient at the site. Elevations of the top of the casing of each well was supplied by Lippincott Engineers. Elevations of the well casings, and water levels in the wells (measured both at the time of drilling and on May 5) are shown in Table 10.

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## Table 10

### Well Casing and Water Level Elevations

| Well # | Water Level (ft. BTC) 4/89 | 5/89 | Casing Elevation (ft. above S.L.) | Water Table Elev. (ft. above S.L.) |
|---|---|---|---|---|
| 1 | 16.70 | 16.48 | 139.70 | 123.22 |
| 2 | 15.80 | 16.05 | 139.09 | 123.04 |
| 3 | 12.28 | 12.12 | 134.94 | 122.82 |
| 4 | 6.10 | 6.03 | 128.51 | 122.48 |
| 5 | 17.32 | 17.10 | 140.14 | 123.04 |
| 6 | 16.65 | 16.44 | 139.74 | 123.30 |

The hydraulic gradient and direction were determined using a three point solution method (Heath, 1983) shown in Appendix 2 from data collected for monitor wells MW1, MW2, MW3, MW5 and MW6. The mean hydraulic gradient (dH/dL) is calculated by measuring the maximum change in water level elevation (dH) over a given distance between measuring points (dL). The mean direction of flow is assumed to be perpendicular to the hydraulic gradient lines (Appendix 2). Using this solution, the mean gradient was calculated to be $9.1 \times 10^{-4}$, and the resultant mean direction of groundwater flow was S16°E. This calculated flow direction is only an approximate direction, however, it indicates that groundwater apparently flows diagonally across the width of the property. It should be emphasized that this direction is calculated in the horizontal plane only. Although vertical gradients are not expected in this

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area, their possibility cannot be ruled out without additional testing.

## Falling Head Piezometer Tests

The piezometer tests used to estimate hydraulic conductivity of the aquifer can be extremely approximate, because the values obtained are dependent only on the aquifer characteristics immediately surrounding the well bore. This means that the data collected during piezometer tests are reliable only for a very small part of the aquifer.

Hvorslev's method (Freeze and Cherry, 1979) was used to analyze the data collected during the piezometer tests. Graphs of the data showing Hvorslev's method and sample calculations are shown in Appendix 2, and a list of the resultant calculated hydraulic conductivities is in Table 11.

Table 11

Hydraulic Conductivities

| Test Designation | Hydraulic Conductivity (ft/sec) |
|---|---|
| MW3, Run 1 | $7.29 \times 10^{-5}$ |
| MW3, Run 2 | $9.90 \times 10^{-5}$ |
| MW5, Run 1 | $1.24 \times 10^{-4}$ |
| MW5, Run 2 | $1.14 \times 10^{-4}$ |
| Mean | $1.02 \times 10^{-4}$ |

Estimates of the aquifer's transmissivity can be calculated from hydraulic conductivity using an approximated saturated thickness

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of 165 feet for the Cohansey-Kirkwood aquifer (U.S.G.S. Open File Report 84-730). This results in an average transmissivity of 10,921 gpd/ft for the aquifer material in which the tested wells are located. This value is consistent with values listed for the Cohansey in different areas of New Jersey. Rush (1968) lists a range of transmissivities between 15,000 to 150,000 gpd/ft in Burlington County, and Rooney (1971) references a measured transmissivity of 2700 gpd/ft.

As mentioned previously, the recovery rate in three of the wells was too rapid to obtain accurate measurements, suggesting that in some areas of the site, the hydraulic conductivity is higher than is indicated by the results of the piezometer tests.

Groundwater Velocity

Using values for K and dH/dL listed above, and an average porosity for medium-coarse sand gravel of 0.2-0.35 (Fetter, 1980), the maximum groundwater velocity (using a porosity value of 0.2) was estimated using Darcy's Law to be $4.6 \times 10^{-7}$ ft/sec, or 14.6 ft/year. Although this velocity is dependent on an estimated porosity, it is thought to be a reasonable estimate for two reasons: 1) Even poorly-sorted sand has a porosity of at least 0.2 (Fetter, 1980), so it is unlikely that the porosity in this sand is less than 0.2. Any higher porosity would result in a lower velocity (for example, using a porosity of 0.35 results in a yearly velocity of 8.4 ft), so that the velocity estimated using this

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porosity is thought to be a conservative estimate; 2) One published value for storativity for Cohansey sand was 0.2 (Rush, 1968). Since porosity approximates storativity values in water table aquifers, it is believed that use of this value for porosity is reasonable. However, the velocity is also directly dependent on the hydraulic conductivity determined from data collected during the piezometer tests, which, as mentioned, may be higher than indicated by the results of the tests.

## Contaminant Behavior in Groundwater

The wide variety of contaminants present in the soil samples, as well as the large number of unknown TIC's, make predictions for site-specific contaminant behavior very difficult. Some of the contaminants, particularly benzene and ethylbenzene, are lighter and less viscous than water, and therefore have the ability to "float" along the water table surface. Other types of contaminants, however, are denser than water, and have a range of viscosities which are both higher and lower than water. These materials may sink in place rather than be carried along with groundwater.

Attenuation of contaminant concentration occurs in many environments, due to a variety of factors. However, at this site, several of the most reliable factors commonly contributing to retardation and reduction of contaminant migration are missing. There is a definite scarcity of both organic material and clay

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content in the substrate. This will probably reduce any mitigating effects from either sorption or biodegradation. Microbes are no doubt present in the sand, however, it is impossible to determine their effect on the pollutants.

As in all cases of contaminant migration, the most conservative assumption with respect to the distance the contamination has travelled is that it flows at the same velocity as the groundwater, even though this is unlikely. The underabundance of factors known to retard contaminants in this area, however, makes this assumption less conservative than it might be in other environments.

## Potential Receptors of Contamination

The southeasterly direction of groundwater flow indicates that contamination of groundwater beneath the adjacent southern property could eventually take place. If the only source of groundwater contamination is from the excavated storage tank area, it is possible, considering an estimated velocity of approximately 14 ft/yr, that off-site contamination has not yet occurred. Based on this velocity, it is estimated that in the ten years since the tanks were installed, contaminated groundwater could have travelled a maximum of approximately 140 feet. Considering the direction of flow, a travel distance of 140 feet would put the front of the contaminant plume very close to the southern property boundary, and perhaps over the site boundary. None of the monitoring wells installed on-site are located in a position to determine the extent

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of the contaminant plume, so that this analysis, which depends on many assumptions, may not be accurate, and it is a real possibility that contamination has passed the site boundary.

In addition, it is not certain that groundwater contamination has not occurred from other sources, particularly the unlined waste storage pit. The pit reportedly held waste for several weeks before it was removed; some of the waste was probably lost through the bottom of the pit, which is even closer to the southern site boundary than the excavated underground storage tank. Although contamination from the pit may have taken longer to reach the water table than waste from the tanks, the waste from the pit has also had more time (since 1976) to migrate past the site boundary.

Finally, there is also the possibility that groundwater contamination has occurred in the drum storage area along the southern boundary of the property. The chemical analyses from the deep soil samples 10D(2) and 5D(2) suggest that the contamination is more highly concentrated near the surface, however, both deep samples have some degree of contamination. Since it is impossible to determine how long this area has been contaminated, it is also impossible to estimate whether groundwater has become contaminated. If groundwater contamination has occurred from this area, it would not take many years to migrate off-site.

Eventually, if not remediated, contaminated groundwater from the

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property would be expected to discharge into the branch of the Great Egg Harbor River which flows southeast past the south end of the site, although the discharge would likely occur approximately one-half mile south of the Lightman property. There are no known water wells located between the site and the presumed discharge area; it is believed that all of the residences are located along Route 73, and the groundwater flow from the site would not appear to intersect any of these homes or businesses. If off-site migration has occurred, there are no known human receptors in the immediate path of migration.

There is some concern for bioaccumulation of the contaminants in the food chain with respect to the crops growing on the farm located south of the site. The existing contamination from the excavated storage tanks is not expected be a concern, since if this source has migrated off-site, it is expected to be below the water table, at a depth which would prevent uptake by most of the crops growing in the adjacent fields. However, there is a possibility that surface contamination from the drum storage area located along the south boundary of the site could runoff into the farm to the south and become incorporated into these crops. At this time, it is not certain where this area drains, although the general surface gradient is in the direction of the farm.

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## CONCLUSIONS

1. Contamination of both soil and groundwater has occurred in the area of the excavated underground storage tank. The contamination consists primarily of volatile organics, and the contamination is more severe with depth, substantiating the tank as the source.

2. Extensive soil contamination has occurred near the diesel fuel underground tanks. The contamination in this area consists primarily of semivolatile benzenes present in the soil samples. It is uncertain what the source of this contamination is, since higher concentrations of contaminants are present near the surface than at depth (an unlikely scenario, if the tanks are the source). However, many of the contaminants present are benzene-derivative TIC's, which would be expected in diesel fuel. The source could be spillage of diesel fuel on the ground, or leaking from a near-surface pipe. The groundwater from the monitor well in this location did not exhibit contamination.

3. Less extensive, although still significant soil contamination has occurred in the drum storage area southwest of the underground storage tanks. The contamination is represented by four soil samples from this area, three shallow and one from a deep location. The contaminants are primarily semivolatile organics (both identified and TIC's). It is not known whether contamination has reached the groundwater in this area, since no monitor wells were

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installed here. However, the deep soil sample contained substantially lower concentrations of contaminants than the surface samples, suggesting that groundwater contamination from this source may not be present.

4. The drum storage area around sample 8S contains high levels of contaminants, however, several nearby samples are comparatively uncontaminated. It is thought that the contamination in this area is therefore localized, and may be due to an isolated spill or leak from a drum.

5. A limited amount of contamination has occurred in the groundwater sampled in monitor well MW6. The contamination is not present in the soil above the groundwater, and the primary type of contamination is TIC semivolatiles. The contaminants found in this well were not found in well MW5, located downgradient from MW6.

6. The remainder of the areas represented by other soil sampling locations are not completely free from contamination, however, their levels are relatively low.

7. The determination of high H-nu readings in various wooded areas of the site have not corresponded with either soil or groundwater contamination in those areas (as evidenced by monitor well #4 data). The rapidity with which the concentrations dissipated suggest that the volatiles were present as an intergranule gaseous

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phase in the unconsolidated sand. The fact that the measurements were higher beneath vegetated locations suggest that these areas prevented more rapid venting of the gas which occurred in non-vegetated locations. It is also possible that the more highly vegetated areas tend to give off gases which could have had an effect on the H-nu measurements. It is believed that the volatiles migrated through preferred, high porosity units (particularly the white sand unit), causing unusual patterns of high and low measurements in different areas.

8. The site hydraulic gradient, based on water level measurements collected from the monitoring wells, was found to be small, approximately 9.1 x $10^{-4}$. The hydraulic conductivity was estimated from falling head piezometer tests to be approximately 1.02 x 10-4 ft/sec. These values are based on limited data, and should not be considered actual average values for the site. The groundwater velocity, based on the estimates of hydraulic gradient and hydraulic conductivity, was calculated to be approximately 14.6 ft/yr, but this value should also be considered an estimate only. Considering changes in the lithology occurring both horizontally and vertically, it is likely that there is a considerable range in conductivity and velocity values across the site. The flow direction is southeast, in a diagonal direction across the property.

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9. There are no known human receptors of contamination in the approximate downgradient direction from the property, for at least a half-mile to the likely discharge area in the wetlands south of the site, although it is not known yet whether contamination has migrated off-site.

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## RECOMMENDATIONS FOR ADDITIONAL WORK

1. All of the monitoring wells should be resampled, and analyzed for the priority pollutant parameters which were not analyzed during this investigation: priority pollutant metals, PCB's and pesticides, cyanides and phenols. This is particularly important for MW4, where unusually high levels of arsenic were found in the soil samples.

2. It is recommended that an electrical resistivity survey be conducted in an attempt to delineate the horizontal extent of contamination from this source. It is thought that considering the uniformity of the unconsolidated sediments beneath the site, even a small variation in specific conductance of a contaminant plume will be visible with an electrical resistivity survey. At a minimum, two vertical electrical soundings (VES) and 5-6 profiles should be completed in this area. When the results of this survey are completed, locations for additional wells (which may eventually be used as recovery wells) will be recommended. Regardless of the results of the resistivity survey, however, a monitoring well should be installed downgradient from the excavated storage tank location along the southern site boundary to determine whether contamination from the tanks has migrated off-site. An additional monitoring well should be installed near monitor well MW2, but screened at a greater depth from the surface, to determine whether there is vertical migration of contaminants, either from the

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presence of a vertical hydraulic gradient, or due to the higher density of some of the contaminants. The locations of the two additional proposed wells are shown in Figure 4.

3. Additional deep and shallow soil samples should be collected around the drum storage area near the southern boundary of the property in an attempt to delineate the extent of contamination found in soil samples 7S, 17S, and 10D. A minimum of three-four samples should be collected around the area defined by the above referenced soil samples, with both deep and shallow samples collected at each location. These soil samples should be tested for all priority pollutant + 40 parameters. The locations of these proposed soil samples are shown in Figure 4.

4. The underground diesel fuel tanks and associated piping should be hydrostatically tested for integrity. If they are sound, it can be assumed that the source of contamination in this area is either from above-ground storage of drums, or spillage during filling of the tanks, and additional soil samples should be collected from this area. However, until the source of this contamination is determined, a detailed sampling proposal cannot be recommended for this area of concern.

5. A monitor well should be installed in a downgradient direction from the unlined waste storage pit in the woods, since the monitor well already installed there is not located in a truly downgradient

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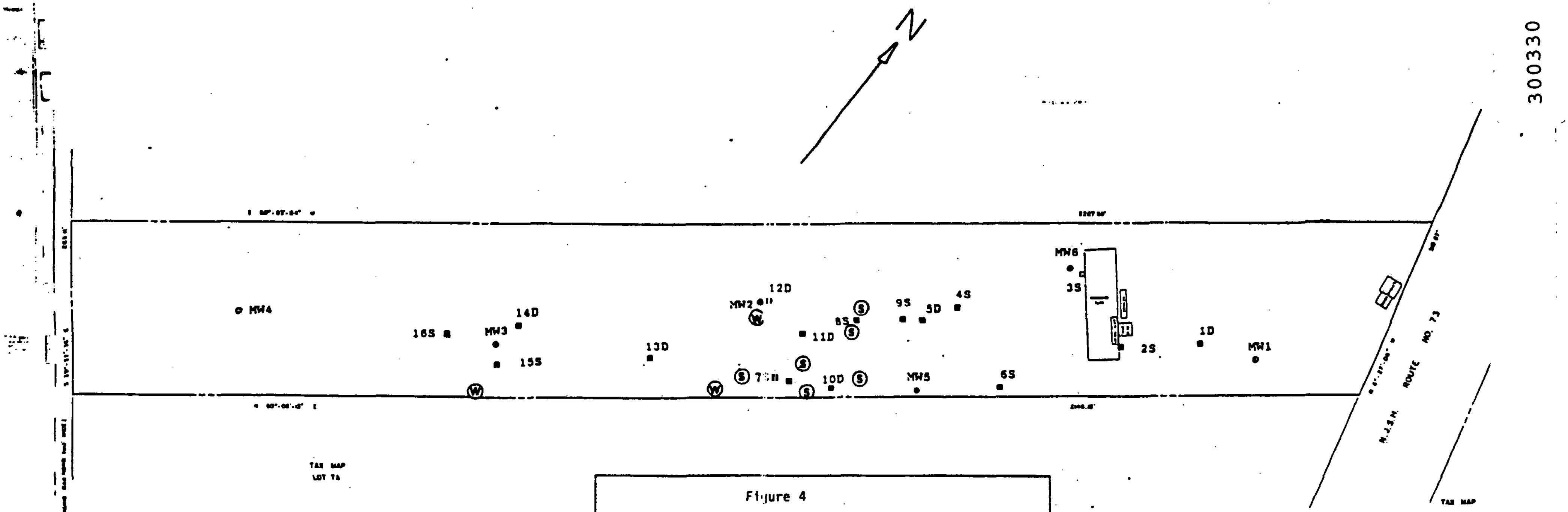

Figure 4

Locations for Proposed Sampling

MW4 ● Existing Monitor Wells

10D ■ Existing Soil Sample Locations

Ⓦ Proposed Monitor Well Locations

Ⓢ Proposed Soil Sample Locations

Scale: 1" = 170'

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# APPENDIX 1:

## MONITOR WELL CONSTRUCTION SUMMARIES

## LITHOLOGIC DESCRIPTIONS OF MONITOR WELL BORES

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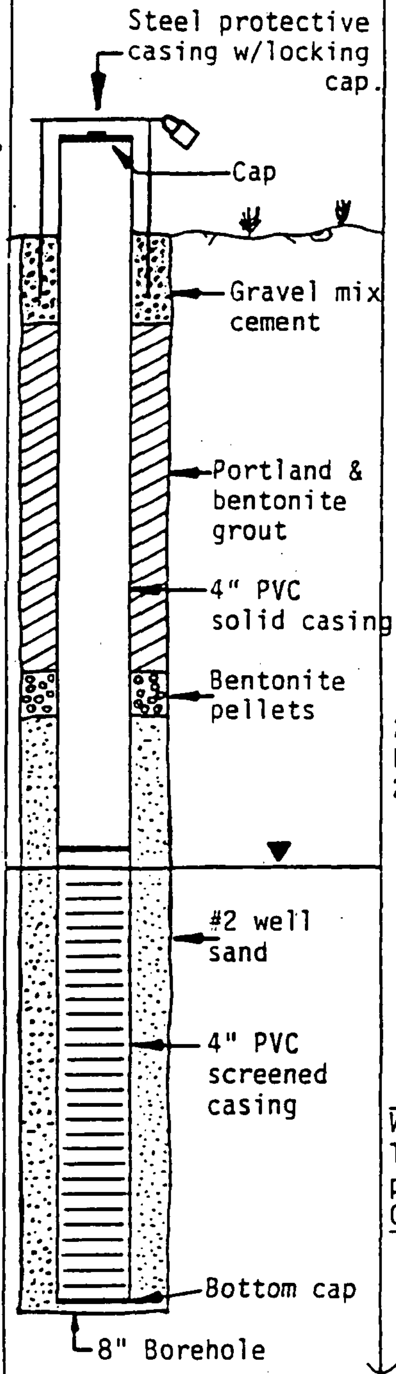
# WELL CONSTRUCTION SUMMARY

WELL: MW #1
PROJECT: Lightman Drum

| Well Depth | Geology |
|---|---|
| - 2' | Brown silty medium sand, orange-brown medium sand (Hnu in split spoon: 0.7 ppm, background) |
| - 7' | Orange-brown medium sand, at 6-7' dark gray 1/8" banding. (Hnu spoon: backgorund). |
| -12' | Orange-brown medium sand, few large cobbles shattered by split spoon. (Hnu spoon: background). |
| -17' | Orange-brown coarse to very coarse sand, some 1/8" pebbles. (Hnu spoon: background). |
| -22' | Tan coarse sand. (Hnu spoon: background). |
| -27' | Tan coarse sand to 26.5', then orange-brown medium sand. (Hnu spoon: background). |

Well Cross Section with water zones



SCALE:
Vertical: 1" = 4'
Horizontal: 1" = 1'

Construction Details

Location: Cedarbrook Twp., NJ

Driller: J. Mathes & Assoc., Inc.
Date Started: 4/18/89
Date Completed: 4/18/89

Driller's file name:

George Volosky

Yield: 10 gpm
How Determined: Pump, bucket & stopwatch

Total Well Depth: 23.8'

Static Water Level: 16.70' BTC
Date: 4/19/89

Casings:

| Diameter | Depth |
|---|---|
| 4" PVC | 0 - 13.8' |
| 4" PVC screened | 13.8-23.8' |
| 6" Steel Protective | +2.5-1.5' |

Grouting Details: 4 bgs. #2 sand: 23.8-10.8', 1' bentonite pellets, 2 bgs. portland + 1 bg. bentonite: 10.2', 1 bg. gravel mix: 2-0'.

Water Bearing Zones:

| Depths | Yield |
|---|---|

WATER QUALITY:
Temperature: 15°C
pH: 6.3
Conductivity: 90 umhos/cm

Water Quality:

Data provided by:

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577 SACKETTSFORD ROAD
WARMINSTER, PA 18974-1398
(215) 398-7137

Date:

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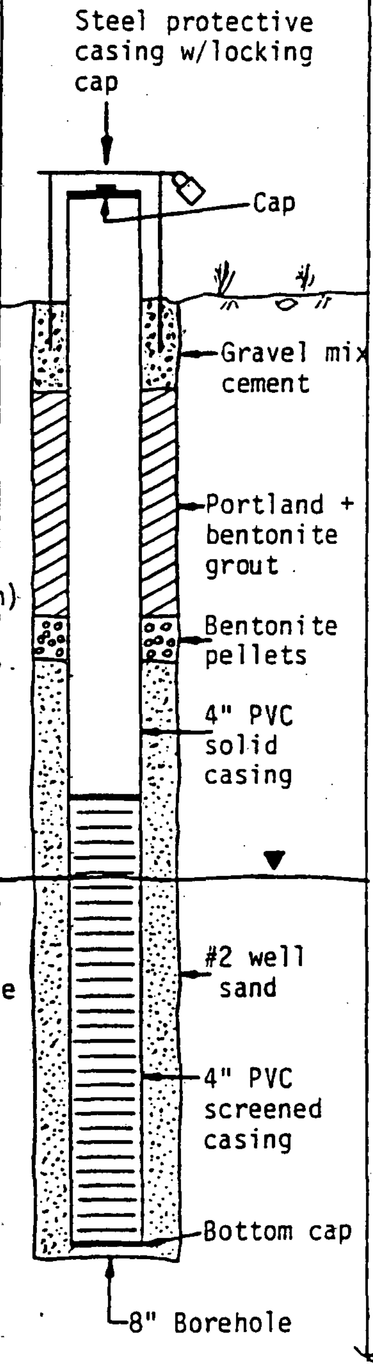
# WELL CONSTRUCTION SUMMARY

WELL: MW#2
PROJECT: Lightman Drum

| Well Depth | Geology |
|---|---|
| - 2' | Brown silty medium sand, some small pebbles. (Hnu in split spoon:0.6 ppm) |
| - 4' | Brown silty medium sand, some small pebbles. (Hnu spoon: 1.0 ppm) |
| - 6' | Brown silty medium sand, some purplish fine deposit at contact of brown sand & a white coarse sand w/some clay. (Hnu spoon: 2.5 ppm, in hole 0-6' left by split spoon: 38 ppm). |
| - 8' | White coarse sand (Hnu spoon: 1.0 ppm). |
| -10' | White medium-fine sand, 1/8" rust colored banding present. (Hnu spoon:1.4ppm) |
| -12' | White coarse sand to 11.6 then orange-brown fine-medium sand (Hnu spoon: 40 ppm, 1'down auger stem: 12 ppm, cuttings:2ppm, 1' above auger stem: background). |
| -14' | White medium sand, solvent smell (Hnu spoon:420ppm). |
| -16' | Orange-brown fine to coarse sand, some small pebbles, solvent smell (Hnu spoon: 18ppm, 1'down auger stem: 54ppm, 4"above auger stem: 1.4ppm). |
| -18' | Orange-brown very fine to medium sand, some small pebbles(Hnu spoon:10ppm) |
| -20' | (1'blowback up auger stem, so sample is from 19-20'). Brown fine to coarse sand some small pebbles (Hnu spoon:180ppm, 1'down auger stem:3ppm, 1'above stem: 0.8ppm, cuttings:18ppm). |
| -23' | White coarse sand, brown medium sand (Hnu spoon:1.0ppm) |

## Well Cross Section with water zones



SCALE
Vertical: 1" = 4'
Horizontal: 1" = 1'

## Construction Details

Location: Cedarbrook Twp., NJ

Driller: J. Mathes & Assoc., Inc.
Date Started: 4/11/89
Date Completed: 4/12/89

Driller's file name:
George Volosky

Yield: 3 gpm
How Determined: Pump, bucket & stopwatch

Total Well Depth: 21'

Static Water Level: 15.80'BTC
Date: 4/13/89

Casings:

| Diameter | Depth |
|---|---|
| 4" PVC | 0 - 11' |
| 4" PVC Screened | 11'-21' |
| 6" Steel Protective | +2.8-1.2' |

Grouting Details: 4 bgs.#2 sand: 21-8', 1'bentonite pellets, 4 bgs. portland + 1 bg.bentonite: 7-2', 1 bg.gravel mix: 2-0'.

Water Bearing Zones:

| Depths | Yield |
|---|---|

WATER QUALITY:
Temperature: 15°C
pH: 4.8
Conductivity: 125 umhos/cm

Water Quality:

Data provided by:

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377 SACKETTSFORD ROAD
WARMINSTER, PA 18974-1398
(215) 398-7137

Date:

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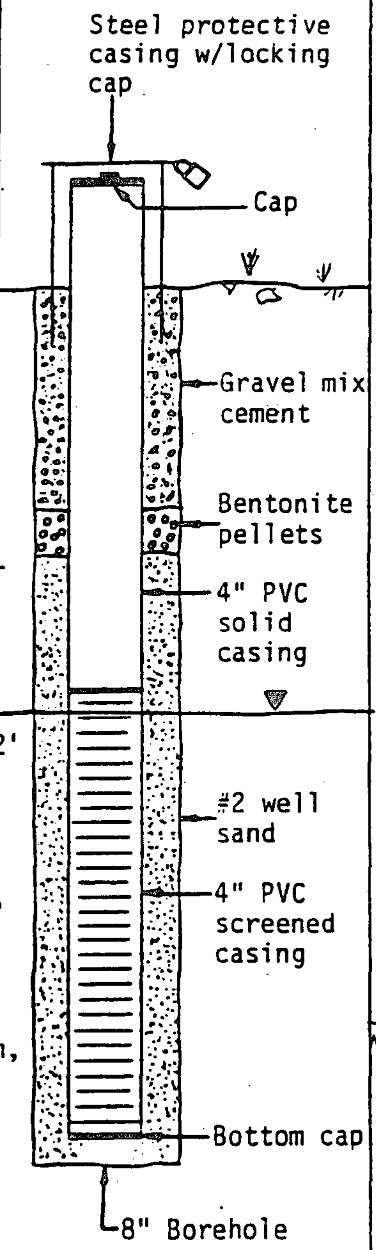
# WELL CONSTRUCTION SUMMARY

WELL: MW#3
PROJECT: Lightman Drum C

| Well epth | Geology |
|---|---|
| - 2' | Brown medium sand, few pebbles (Hnu in split spoon: 1.0ppm). |
| - 4' | Brown medium sand, few ½" rounded pebbles (Hnu spoon:1.0ppm, down auger stem:1.0ppm). |
| - 6' | Tan-brown medium-coarse sand, some 1/8" pebbles (Hnu spoon:1.2ppm, down auger stem: 1.4ppm). |
| - 8' | Tan coarse sand, some ⅓" pebbles, 1" rust colored band at 6.5' (Hnu spoon: 0.8ppm, auger:0.8ppm) |
| 0' | Tan coarse to very coarse sand, some 1" rounded pebbles (Hnu spoon:0.8ppm, auger: 1.2 ppm). |
| -12' | Tan very coarse sand,1/8" pebbles 10-11', tan-brown fine sand, very damp 11-12' (Hnu spoon:0.8ppm, auger: 1.0ppm) |
| -14' | Tan fine sand, some 1/8" pebbles (Hnu spoon:0.8ppm, auger:0.8ppm, cuttings: 0.8 ppm). |
| 16' | Tan fine sand, some 1/8" pebbles (Hnu spoon: 0.8ppm, auger:0.8ppm, Cuttings: 0.8 ppm) |
| -18' | White-tan medium fine sand (Hnu spoon:0.8ppm) |
| .5-20' | White fine to coarse sand 18.5-19.0', tan fine sand w/brown banding 19.0-20.0' (Hnu spoon:0.8ppm, auger: 0.8 ppm). |

## Well Cross Section with water zones



SCALE:
Vertical: 1" = 4'
Horizontal: 1" = 1'

## Construction Details

Location: Cedarbrook Twp., NJ

Driller: J. Mathes & Assoc., Inc.
Date Started: 4/14/89
Date Completed: 4/14/89

Driller's file name:
George Volosky

Yield: 10 gpm
How Determined: Pump, bucket & stopwatch

Total Well Depth: 19'

Static Water Level: 12.28' BTC
Date: 4/18/89

Casings:

| Diameter | Depth |
|---|---|
| 4" PVC | 0 - 9' |
| 4" PVC Screened | 9-19' |
| 6" Steel Protective | +2.75-1.25' |

Grouting Details: 4 bgs. #2 sand: 19-6', 1' bentonite pellets, gravel mix cement to surface.

Water Bearing Zones:

| Depths | Yield |
|---|---|

WATER QUALITY:
Temperature: 16°C
pH: 5.8
Conductivity: 110 umhos/cm

Water Quality:

Data provided by:

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577 SACKETTSFORD ROAD
WARMINSTER, PA 18974-1398
(215) 598-7137

Date:

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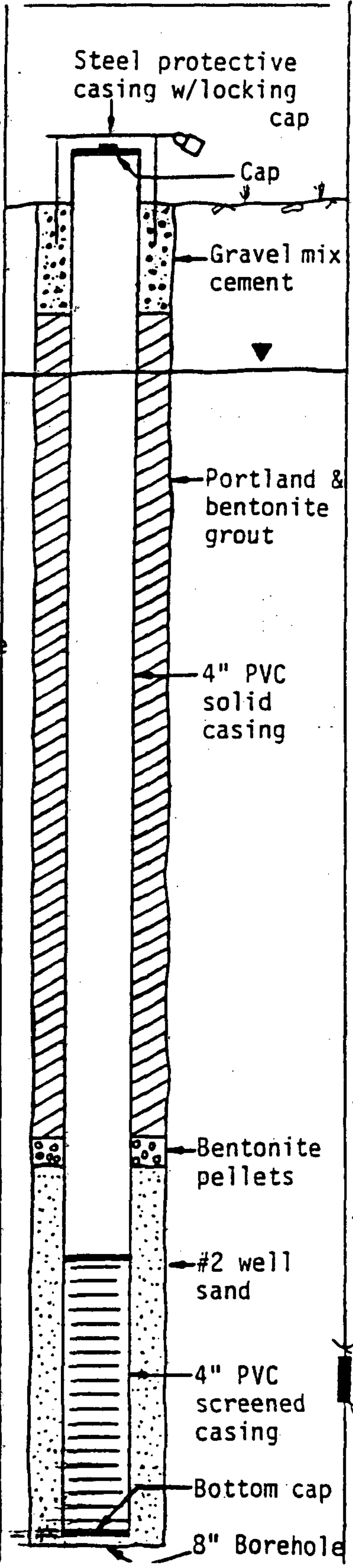
# WELL CONSTRUCTION SUMMARY

WELL: MW #4
PROJECT: Lightman Drum

| Well Depth | Geology |
|---|---|
| 0 - 3' | Brown-gray medium sand. |
| 3 - 5' | Brown coarse sand to 4.5'; 4.5-5.0' white very coarse sand w/small pebbles. (Hnu in split spoon: 0.2 ppm) |
| 0-11' | White coarse sand w/½-1" rounded cobbles (Hnu spoon: 0.2 ppm). |
| 5-16' | Orange-brown fine to medium silty sand, some small pebbles (Hnu spoon: 0.2 ppm) |
| 21-23' | Brown medium to coarse sand, few small pebbles (Hnu spoon: 0.2 ppm) |
| 25-27' | Tan-brown medium to coarse sand, some clay (Hnu spoon: 0.2 ppm) |
| 30-32' | Brown medium to fine sand w/small amounts of clay, white coarse sand bands (Hnu spoon: 0.2 ppm) |
| 35-37' | Brown and white medium sand, some small pebbles (Hnu spoon: 0.2 ppm) |
| 0-42' | Brown fine to medium sand few small deposits of clay 1/8" thick. (Hnu spoon: 0.2 ppm) |
| 5-47' | Brown medium sand, white coarse sand. |
| 50-52' | White coarse sand, only a small amount came up w/split spoon. (Hnu spoon: 0.2 ppm). |

SCALE:
Vertical: 1" = 6'
Horizontal: 1" = 1'

Well Cross Section with water zones



## Construction Details

Location: Cedarbrook Twp., NJ

Driller: J. Mathes & Assoc., Inc.
Date Started: 4/5/89
Date Completed: 4/11/89

Driller's file name:
George Volosky

Yield: 15 gpm
How Determined: Pump, bucket and stopwatch

Total Well Depth: 48'

Static Water Level: 6.1' BTC
Date: 4/11/89

Casings:

| Diameter | Depth |
|---|---|
| 4" PVC | 0 - 38' |
| 4" PVC Screened | 38 - 48' |
| 6" Steel Protective | +2.3-1.7' |

Grouting Details: 2 1/3 bgs. #2 sa 48-35', 1' bentonite pellets, 6 bg portland & 1 bg. bentonite: 34-4', 4 bgs. gravel mix: 4-0'.

Water Bearing Zones:

| Depths | Yield |
|---|---|

WATER QUALITY:
Temperature: 11°C
pH: 6.6
Conductivity: 29 umhos/cm

Water Quality:

Data provided by:

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Date:

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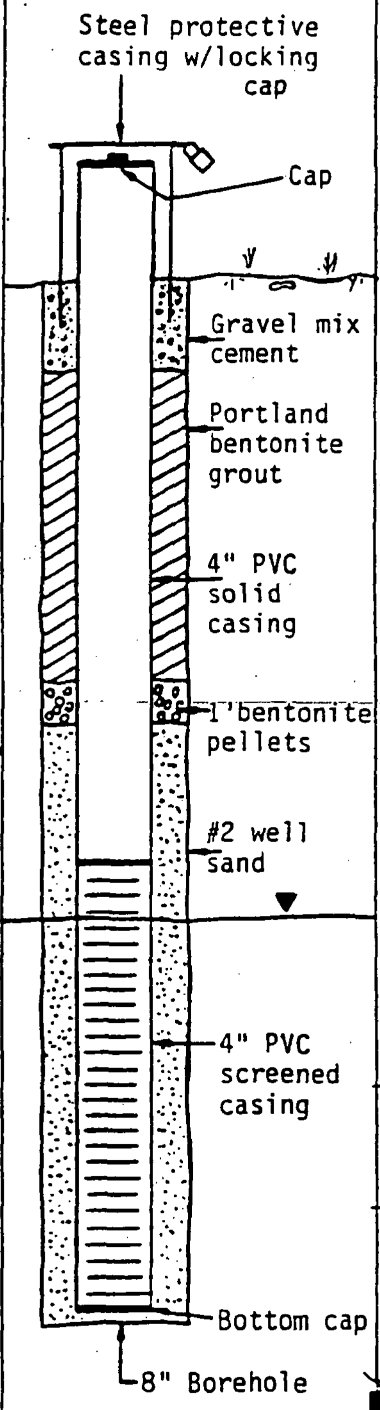
# WELL CONSTRUCTION SUMMARY

WELL: MW #5
PROJECT: Lightman Drum C

| Well epth | Geology |
|---|---|
| - 2' | Orange-brown medium silty sand, small pebbles. Encountered red powdery substance dispersed in spoon (Hnu in split spoon: 4 ppm - only near surface: 0-4") |
| - 7' | Orange-brown medium sand (Hnu spoon: background) |
| 0-12' | Orange-brown medium sand (Hnu spoon: background). |
| 17' | Orange-brown fine to medium sand, wet. (Hnu spoon: background). |
| 0-21' | Orange-brown medium sand, some small pebbles. (Hnu spoon: background) |

Well Cross Section with water zones



SCALE:
Vertical: 1" = 4'
Horizontal: 1" = 1'

Construction Details

Location: Cedarbrook Twp., NJ

Driller: J. Mathes Assoc., Inc.
Date Started: 4/12/89
Date Completed: 4/13/89

Driller's file name:
George Volosky

Yield: 8 gpm
How Determined: Pump, bucket & stopwatch.

Total Well Depth: 23'

Static Water Level: 17.32' BTC
Date: 4/17/89

Casings:

| Diameter | Depth |
|---|---|
| 4" PVC | 0 - 13' |
| 4" PVC Screened | 13 - 23' |
| 6" Steel Protective | +3.0 - 1.0' |

Grouting Details: 4 bgs. #2 sand: 2 10', 1'bentonite pellets, 2 bgs. portland & ½ bg. bentonite:10-2' gravel mix: 2-0'.

Water Bearing Zones:

| Depths | Yield |
|---|---|

WATER QUALITY:
Temperature: 18°C
pH: 5.3
Conductivity: 76 umhos/cm

Water Quality:

Data provided by:

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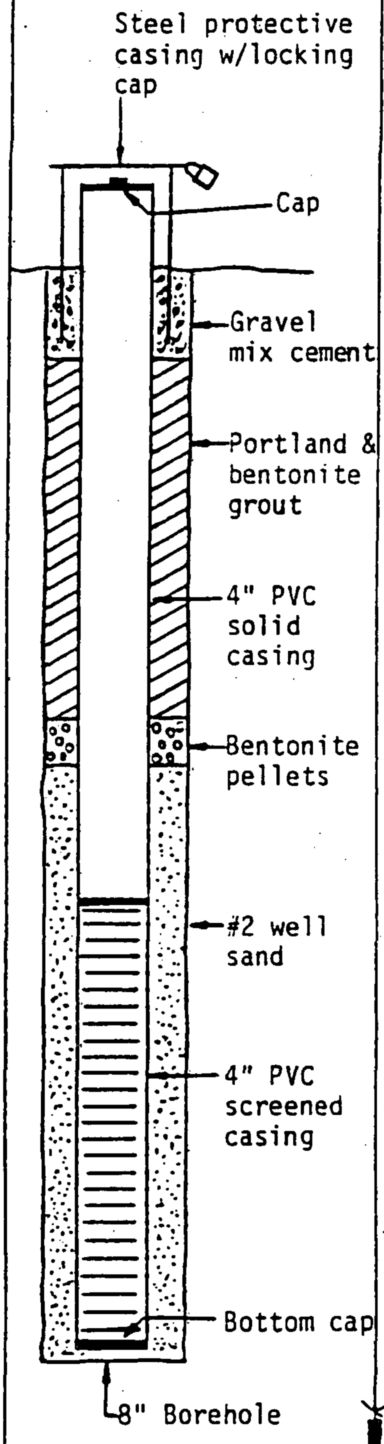
Date: REF. NO. 6, p.70 of 81

## WELL CONSTRUCTION SUMMARY

WELL: MW #6
PROJECT: Lightman Drum

| Well Depth | Geology |
|---|---|
| 0 - 5' | Orange-brown silty medium sand, small pebbles (Hand augered, Hnu:0.6 ppm - background). |
| 5 - 7' | Orange-brown medium to coarse sand, 1/8" rust colored banding. (Hnu spoon: background) |
| 10-12' | Orange-brown medium to coarse sand, 1" band of white coarse sand at 11.5' (Hnu spoon: background). |
| 15-17' | Orange-brown medium to coarse sand, 1.5" band darker brown medium sand at 16.5' (Hnu spoon: background). |
| 20-22' | Orange-brown very coarse sand (Hnu spoon: background, down auger stem: background). |

Well Cross Section with water zones



SCALE:
Vertical: 1" = 4"
Horizontal: 1" = 1'

Construction Details

Location: Cedarbrook Twp, NJ

Driller: J. Mathes Assoc., Inc.
Date Started: 4/13/89
Date Completed: 4/13/89

Driller's file name: George Volosky

Yield: 10 gpm
How Determined: Pump, bicket & stopwatch

Total Well Depth: 24'

Static Water Level: 17.45' BTC
Date: 4/19/89

Casings:

| Diameter | Depth |
|---|---|
| 4" PVC | 0 - 14' |
| 4" PVC Screened | 14 - 24' |
| 6" Steel Protective | +2.15 - 1.85' |

Grouting Details: 4 bgs.#2 sand:2 11', 1'bentonite pellets, 3 bgs. portland & 1 bg. bentonite:10-2', 3 bgs.gravel mix: 2-0'.

Water Bearing Zones:

| Depths | Yield |
|---|---|

WATER QUALITY:
Temperature: 16°C
pH: 6.4
Conductivity: 64 umhos/cm

Water Quality:

Data provided by:

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377 SACKETTSFORD ROAD
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(215) 598-7137

Date:

REF. NO. 6, P71 of 81

## WELL LOG DESCRIPTIONS, LIGHTMAN DRUM CO. WELLS

### MONITORING WELL #1

From the surface to 20' below the surface, the sand of monitoring well #1 was orange-brown in color, coarse to very coarse grained, slightly rounded, with generally poor sorting, except the first 7', which was uniformly coarse. This zone contained some small pebbles and traces of dark minerals.

The next zone, from 20' to 52', was tan in color. At 20' to 35', the sand was coarse to medium, and very poorly sorted. From 35' to 52', the sand became medium grained with good sorting. All sand in the 20' to 52' range was slightly rounded, containing small traces of dark minerals. Only the 50' to 52' zone yielded any pebbles; those were 2 mm to 3 mm in size.

### MONITORING WELL #2

The top five feet of monitoring well #2 consisted of a brown silty sand. The sand was medium grained and fairly sorted, with some 5 mm pebbles.

The layer from 5' to 14' consisted of a white coarse sand, very poorly sorted. This white sand was interrupted from 8' to 10' by some 1/8" rust colored banding, and again at 11.5' by a 6" bed of medium grained, poorly sorted, orange-brown sand. Traces of clay were found in the upper portion of the white sand zone.

From 14' to 23', the sand was orange-brown in color and medium to coarse grained, with very poor sorting. This zone contained some 5 mm pebbles and

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traces of clay were found in the 18' to 20' range.

All sands of monitoring well #2 contained at least traces of dark minerals.

## MONITORING WELL #3

A brown, medium grained, poorly sorted sand was found in the top 4' of monitoring well #3. The sand contained some 1 mm to 2 mm pebbles, and traces of dark minerals, and was also slightly rounded.

The rest of the sand in the well, from 4' to 20' was tan in color. The zone from 4' to 11' was medium grained with generally fair sorting, except from 4' to 6', which was poorly sorted. This zone exhibits slight rounding, and contained traces of dark minerals and pebbles in the 2 mm to 5 mm range. After 11', the sand became fine grained, with sorting starting off good at 11' to 13', and going to poor sorting at the bottom of the well at 20'. The sand in this zone was slightly rounded, contained traces of dark minerals, and 1 mm pebbles only at 14' to 16'. From 19' to 20', some brown banding was encountered.

## MONITORING WELL #4

From the surface to 4.5', the sand of well #4 was brown, coarse grained, poorly sorted and contained some 5 mm pebbles. After 4.5', continuing to 35', the sand turns to orange-brown. This zone is coarse grained and poorly sorted, except for the 15' to 20' layer, which is medium grained and poorly sorted, and the 30' to 35' layer, which is fine grained and fairly sorted. Sand in the zone was slightly rounded with traces of dark minerals ad pebbles i the 2 mm to 5 mm range.

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The layer from 35' to 52' contained tan sands. The sands varied in grain size and sorting was as follows: 35-40' coarse grained, poorly sorted; 40-45' medium grained, fairly sorted; 45-52' coarse grained, good sorting. Traces of clay were evident from 30-35' and from 45-52'. The sand was slightly rounded throughout and contained traces of dark minerals from 30-35'. A few 5 mm pebbles were found from 35'-40'.

## MONITORING WELL #5

All of the sand in monitoring well #5, from the surface to 22' below surface, was orange-brown in color. From the surface to 11' the sand was medium grained and poorly sorted. After 11', continuing to 22', the sand was coarse grained and poorly sorted. All sand was slightly rounded and contained pebbles in the 2 mm to 5 mm range. Traces of dark minerals were found throughout the well, except in the 20' to 22' range.

## MONITORING WELL #6

The sand found in well #6 was orange-brown, medium grained and poorly sorted throughout. It contained traces of clay and dark minerals. The sand was slightly rounded and contained pebbles in the 2 mm to 5 mm range. The only exception was the first foot, which was closer to brown in color and was silty.

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# APPENDIX 2:

## HYDROLOGIC CHARACTERISTICS

1. PIEZOMETRIC TEST DATA
2. HVORSLEV METHOD GRAPHS
3. SAMPLE CALCULATIONS: HVORSLEV METHOD
4. THREE-POINT SOLUTION FOR DETERMINATION OF HYDRAULIC GRADIENT AND FLOW DIRECTION

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# PIEZOMETER TEST (FALLING HEAD) DATA

MW3 Run 1
H (Static) = 11.70
Ho = 10.79

| Time (min) | W.L. (ft.B.T.C.) | $\frac{H-h}{H-Ho}$ |
|---|---|---|
| .166 | 10.79 | 1 |
| .34 | 11.05 | .71 |
| .5 | 11.20 | .559 |
| .67 | 11.22 | .527 |
| .83 | 11.29 | .41 |
| 1.0 | 11.34 | .396 |
| 1.17 | 11.41 | .319 |
| 1.34 | 11.44 | .286 |
| 1.5 | 11.46 | .264 |
| 1.67 | 11.46 | .264 |
| 1.83 | 11.50 | .220 |
| 2.17 | 11.50 | .220 |
| 2.5 | 11.52 | .198 |
| 3.0 | 11.54 | .176 |
| 4.0 | 11.56 | .131 |

MW3 Run 2
H = 11.72
Ho = 10.70

| Time (min) | W.L. (ft.B.T.C.) | $\frac{H-h}{H-Ho}$ |
|---|---|---|
| .2 | 10.7 | 1 |
| .37 | 11.08 | .63 |
| .50 | 11.20 | .45 |
| .67 | 11.29 | .40 |
| .83 | 11.30 | .39 |
| 1.0 | 11.36 | .33 |
| 1.17 | 11.43 | .26 |
| 1.33 | 11.47 | .23 |
| 1.5 | 11.49 | .21 |
| 1.67 | 11.50 | .20 |
| 1.83 | 11.51 | .19 |
| 2.0 | 11.52 | .18 |
| 2.25 | 11.53 | .17 |
| 2.5 | 11.55 | .15 |
| 3.0 | 11.58 | .12 |
| 3.5 | 11.59 | .11 |
| 4.0 | 12.0 | .10 |

MW5 Run 1
H = 16.87
Ho = 16.40

| Time (min) | W.L. (ft.B.T.C.) | $\frac{H-h}{H-Ho}$ |
|---|---|---|
| .166 | 16.4 | 1 |
| .34 | 16.51 | .77 |
| .50 | 16.60 | .57 |
| .67 | 16.69 | .38 |
| .83 | 16.74 | .28 |
| 1.0 | 16.78 | .19 |
| 1.17 | 16.82 | .11 |
| 1.34 | 16.84 | .06 |
| 1.5 | 16.86 | .02 |
| 1.67 | 16.87 | 0 |
| 1.83 | 16.88 | 0 |
| 2.0 | 16.88 | 0 |

MW5 Run 2
H = 16.94
Ho = 16.36

| Time (min) | W.L. (ft.B.T.C.) | $\frac{H-h}{H-Ho}$ |
|---|---|---|
| .2 | 16.94 | 1 |
| .33 | 16.50 | .76 |
| .5 | 16.59 | .6 |
| .67 | 16.69 | .43 |
| .83 | 16.75 | .33 |
| 1.0 | 16.80 | .24 |
| 1.17 | 16.84 | .17 |
| 1.33 | 16.86 | .14 |
| 1.5 | 16.88 | .10 |
| 1.67 | 16.90 | .07 |
| 1.83 | 16.91 | .05 |
| 2.0 | 16.91 | .05 |

H - Static water level (ft.B.T.C.)
Ho = Water level after introducing slug (ft.B.T.C.)
h = Water levels at times t

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## Sample Calculations for Determination of Permeability and Transmissivity of an Aquifer Using the Hvorslev Method (Freeze & Cherry, 1979, 340 p.)

$$K = \frac{r^2 \ln (L/R)}{2 L To}$$

Where: K = permeability (ft./sec.)
r = radius of casing (ft.)
L = length of screening submerged (ft.)
R = radial distance from center of well to outer edge of gravel pack (ft.)
To = basic time lag (min.) (determined graphically)

Data for MW5, Run 1:

r = .166 ft.
L = 9.13'
R = .333'
To = .68 min. (40.8 sec.)

$$K = \frac{(.167)^2 \ln (9.13/.333)}{2(9.13)(40.8)} = 1.24 \times 10^{-4} \text{ ft/sec.}$$

$1.24 \times 10^{-4}$ ft/sec x $6.46 \times 10^5$ = 80.10 gpd/ft$^2$ x 165 ft. = 13,217 gpd/ft.

So: T = 13,217 gpd/ft. assuming 165 ft. thickness of aquifer.

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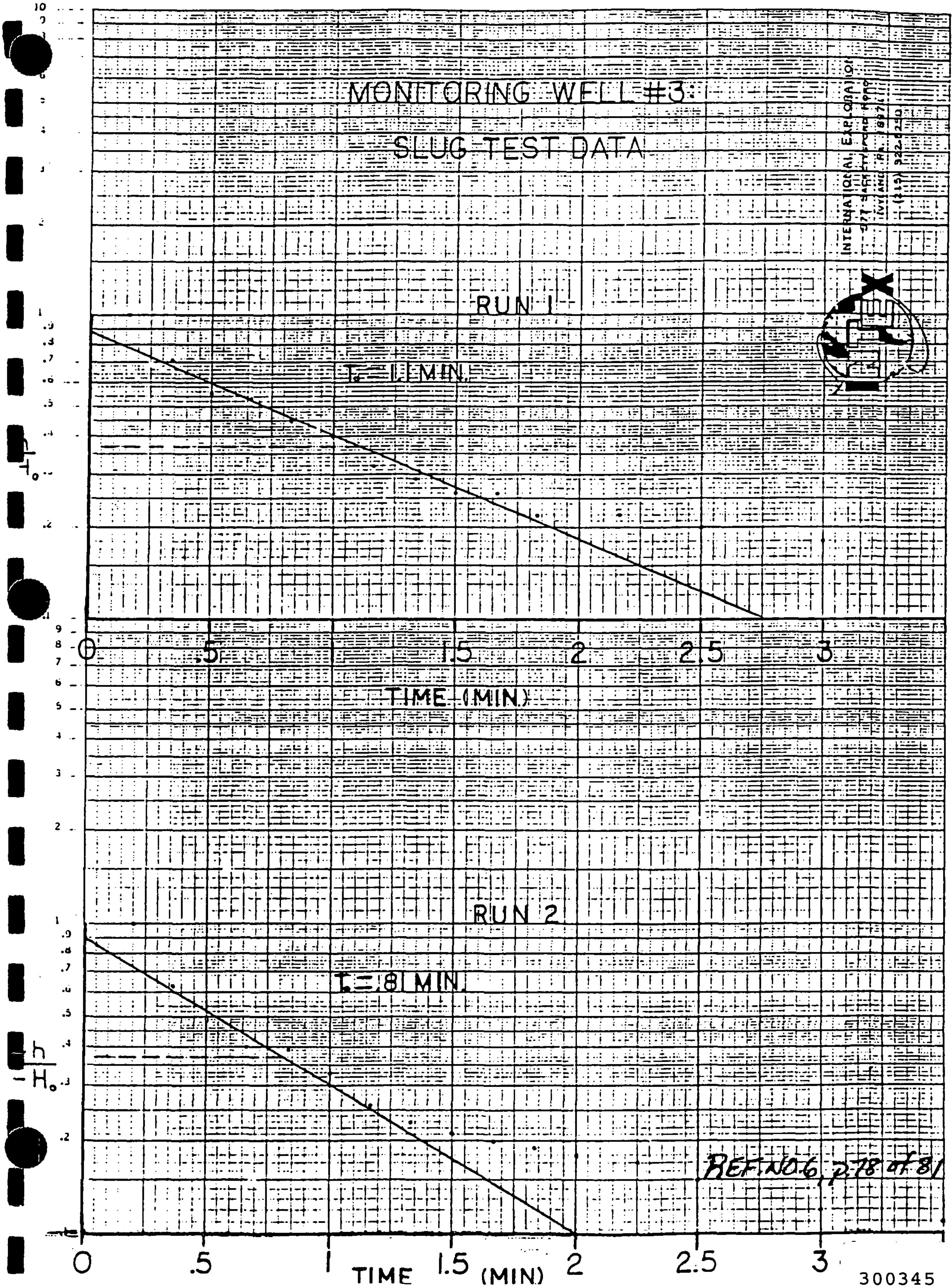
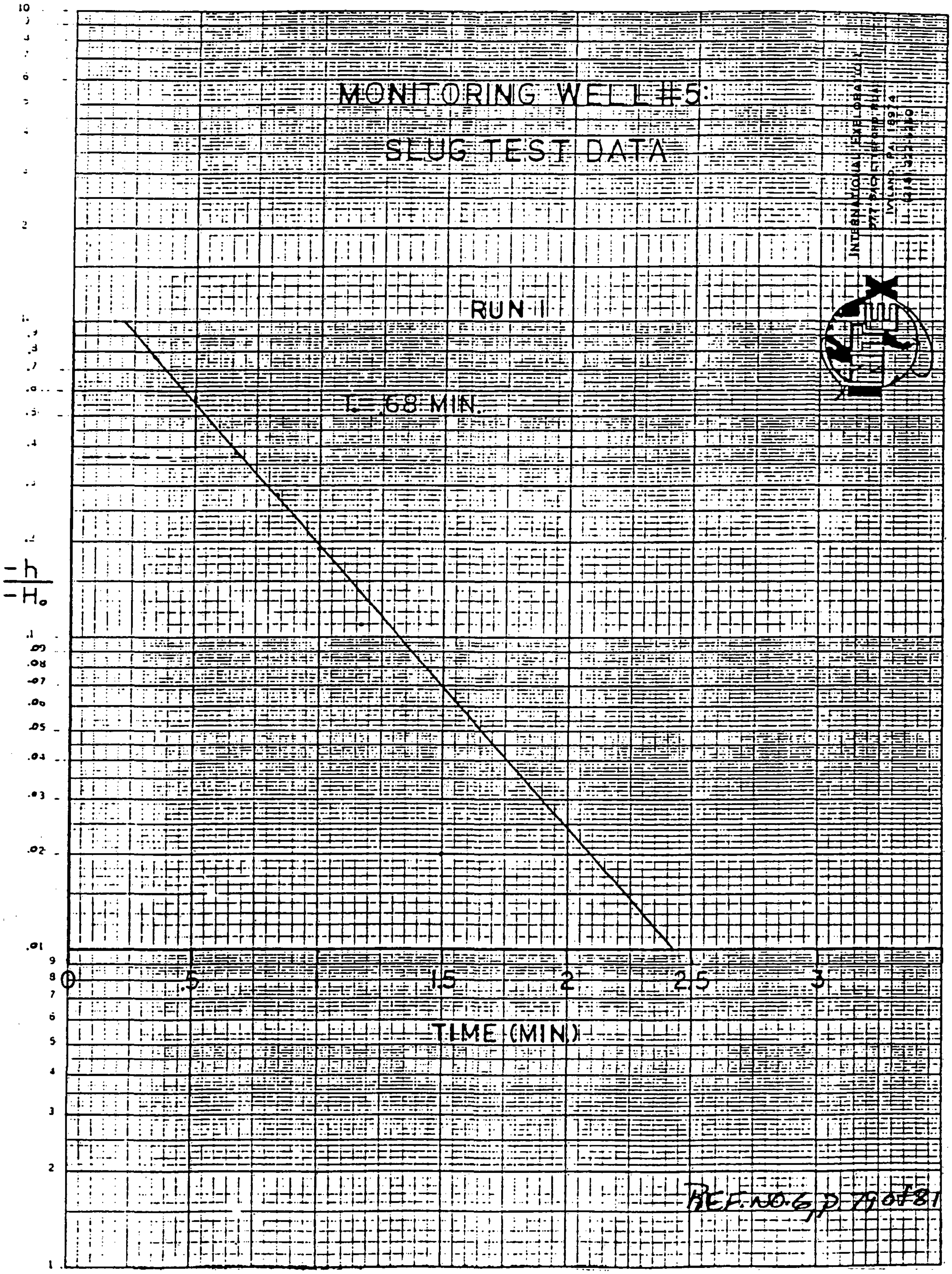
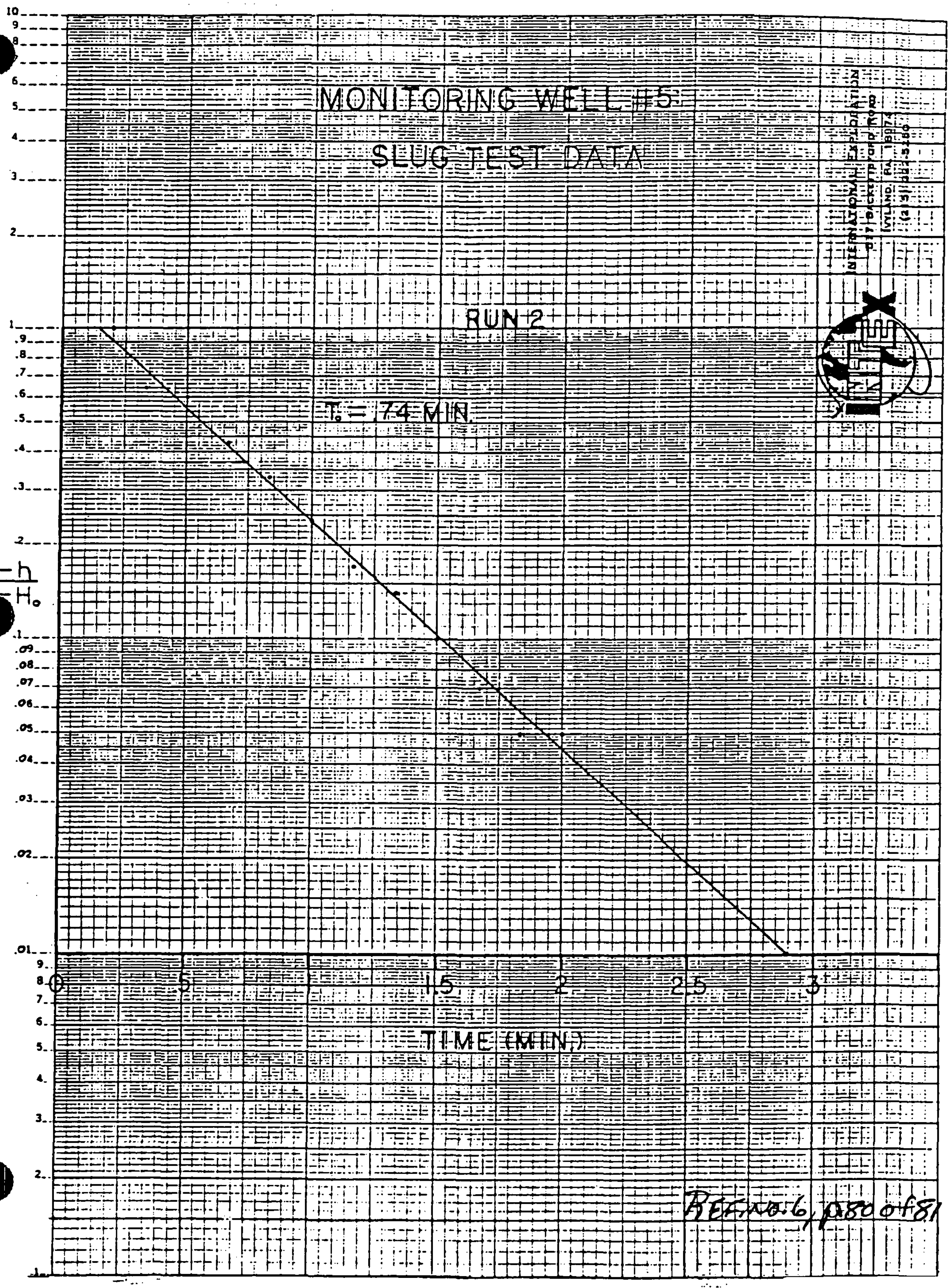
# MONITORING WELL #3: SLUG TEST DATA



REF. NO. 6, p. 78 of 81



REF. NO. 6, P. 79 of 81



MONITORING WELL #5
SLUG TEST DATA

RUN 2

$T_o$ = .74 MIN.

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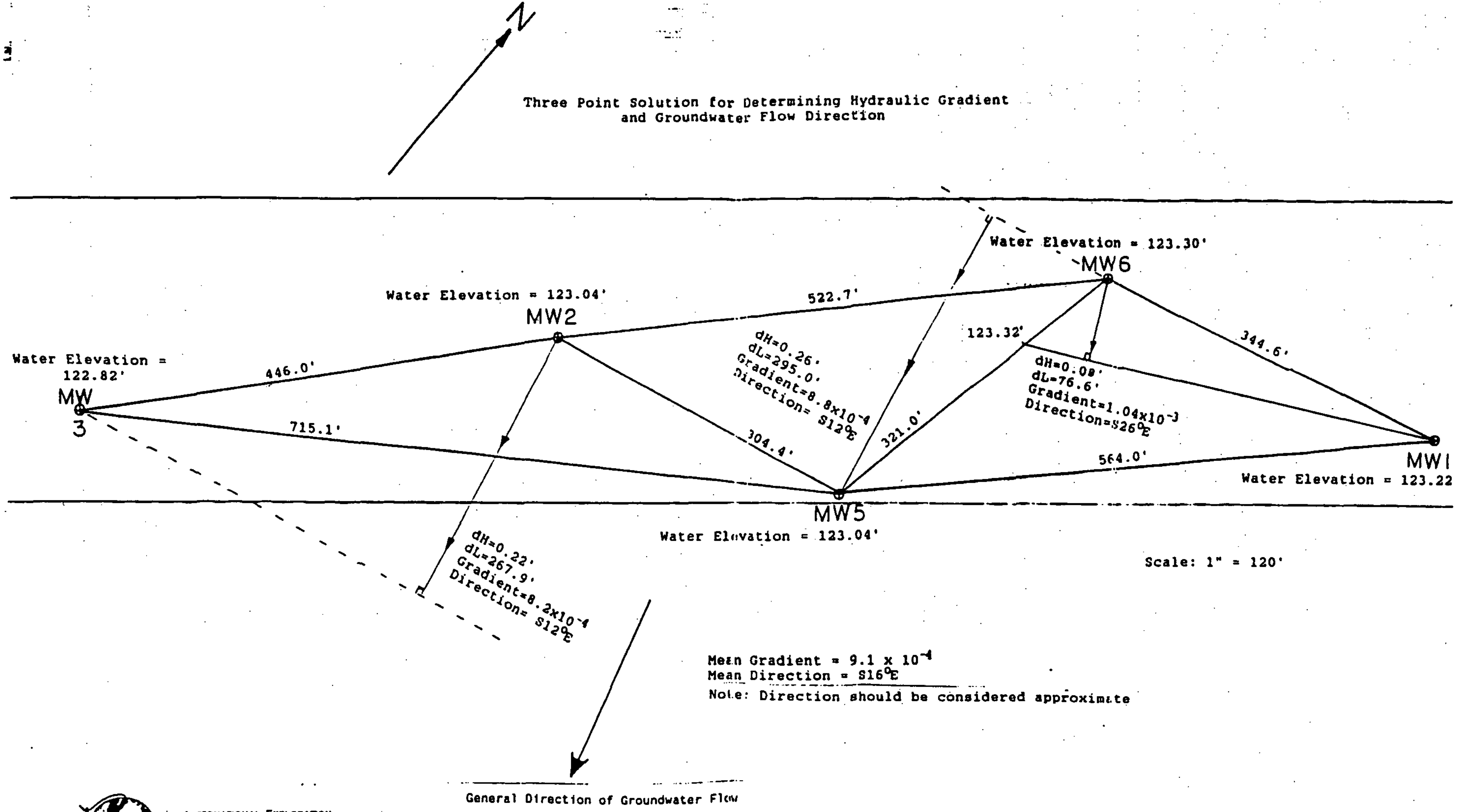
## Three Point Solution for Determining Hydraulic Gradient and Groundwater Flow Direction



Mean Gradient = $9.1 \times 10^{-4}$
Mean Direction = S16°E
Note: Direction should be considered approximate

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IVYLAND, PA. 18974
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REF. NO.6, p. 81 of 81

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Dept. Environmental Protection
Division of Water Resources
Ground Water Quality Control

# PHASE II
# REMEDIAL INVESTIGATION
# LIGHTMAN DRUM CO.
# WINSLOW TOWNSHIP, NJ

Prepared for:

Lightman Drum Co.

INTERNATIONAL EXPLORATION, INC.
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October, 1990

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## FIGURES AND TABLES

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# INTRODUCTION

This report outlines the results of Phase II of the Remedial Investigation conducted at the Lightman Drum Co. facility located in Winslow Township, NJ (figure 1). The Phase II work was initiated when soil and groundwater samples collected at the site during Phase I activities revealed the presence of volatile and semivolatile organic compounds. The Phase II work was intended to help delineate the horizontal and vertical extent of soil and groundwater contamination. The work consisted of the installation of additional groundwater monitoring wells, collection and analysis of groundwater and soil samples, hydraulic conductivity testing of all monitoring wells, and a door-to-door well search within a one-mile radius of the Lightman facility. An electromagnetic survey, intended to locate the extent of a possible plume originating from the excavated underground waste storage tanks, was also conducted. The results of the survey are outlined in an report earlier report ("Geophysical Survey, Lightman Drum Co., Berlin, NJ), dated March, 1990, and will therefore not be repeated in this report.

Background information concerning the Lightman facility is included in the report prepared by INTEX titled "Remedial Investigation, Lightman Drum Co., Berlin, NJ", dated September, 1989, and revised in December, 1989. The scope of the Phase I work included the following:

1. Collection of 37 soil samples from areas of the site where hazardous materials had possibly been spilled or distributed.
2. Installation of six monitoring wells in locations designed to intercept possibly contaminated groundwater.
3. Piezometer testing of the six wells to estimate aquifer permeability.

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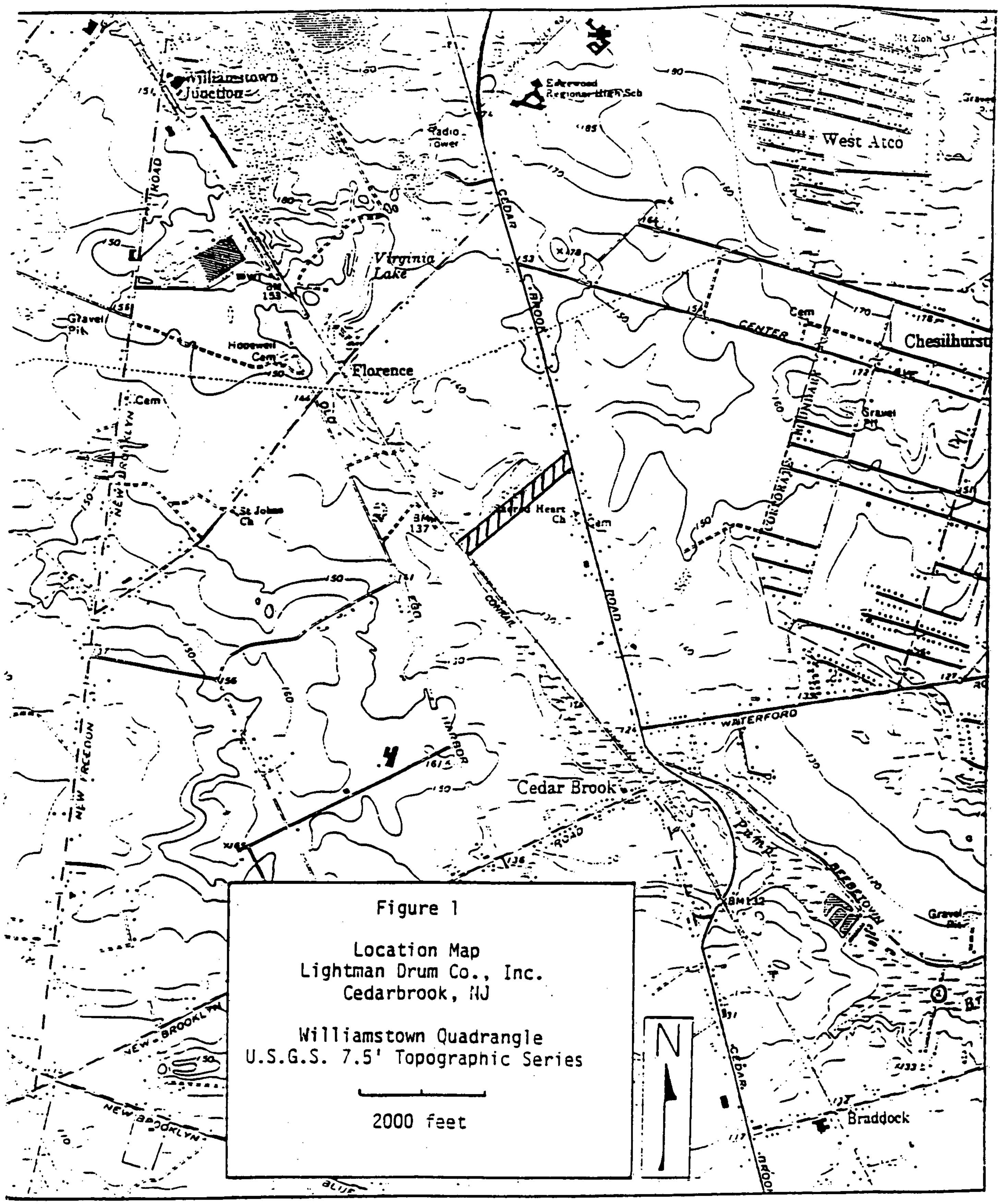

Figure 1

Location Map
Lightman Drum Co., Inc.
Cedarbrook, NJ

Williamstown Quadrangle
U.S.G.S. 7.5' Topographic Series

2000 feet

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# REMEDIAL INVESTIGATION

## SCOPE OF WORK

Phase II work was conducted according to the approved Work Plan, revised in December, 1989.

Soil samples were collected both from areas identified during the Phase I investigation as containing elevated levels of volatile and semivolatile organics, or areas identified as possible sources of these compounds. Additional soil samples were also collected from the excavation of two underground diesel fuel storage tanks. Six monitoring wells were installed on-site; four of the wells were intended to track a possible contaminant plume migrating from an underground waste storage tank (wells 2b, 8a, 8b, and 9), one well was installed downgradient from an unlined waste storage pit (well 7), and one well was installed downgradient from an area having high concentrations of primarily semivolatile organic compounds (well 10). An off-site domestic well was also sampled and analyzed for the presence of contamination (Filokowski).

The hydraulic conductivity of the aquifer around each monitoring well was estimated using piezometer tests (slug testing), and the resultant transmissivity of the sand unit surrounding each well was estimated.

A door-to-door well search for operating wells within one mile downgradient from the Lightman facility was conducted. Where possible, these wells were correlated with well records found during the NJDEP well search. Appendix 1 lists the results of the well search.

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## FIELD PROCEDURES

### Soil Sampling

Two underground storage tanks (1500 and 750 gallons) containing diesel fuel were excavated from the site by a company contracted by the site owner, Mr. Lightman. Soil samples were collected from the bottom and sides of the excavation, and field screened for aromatic hydrocarbons using a Hanby Field Test Kit, as described in the work plan. Samples from the bottom of the excavation were then collected for laboratory analysis.

Soil sampling in the other sampling areas was conducted according to the procedures outlined in the Revised Phase II work plan, at approximate locations shown in Figure 2. Samples were collected using either a hand auger or trowel. Samples were collected in jars and shuttle containers provided by the laboratory, and refrigerated until picked up by the courier service provided by the laboratory. Analysis of samples was-conducted by ETC (Environmental Testing and Certification Corp.) of Edison, NJ. The analysis required for samples collected from each area varied depending on the type of compounds detected during the Phase I analysis. The Phase II work plan outlined the required analysis for soil samples.

### Monitoring Well Installation

Six monitoring wells were installed according to the Revised Phase II work plan, although the locations of two of the monitoring wells were altered per the request of NJDEP personnel. The final locations of the monitoring wells are shown in the site map (Exhibit 1, back cover). The well locations and rationale for placements are listed below:

1. Well MW7 was located downgradient from the unlined waste storage pit, because of concern that well MW3, installed during Phase I work, was not

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DEC 1990

# FIGURE 2
# SOIL SAMPLING LOCATIONS, LIGHTMAN DRUM CO.

**LEGEND**

- ◇ Excavated Storage Tank Area Sample
- ◫ Woods Area Samples
- ✚ SS Area Samples
- ● Random Trailer Parking Area Sample
- △ MW5 Area Samples
- ▯ SS-10 Area Samples
- ○ UST Area Samples

North

**CAVATED STORAGE TANK AREA:**

◇
1-CA3761
DUP 4-CA3766
4-CA4044
8-CA3763
9-CA3896
10-CA3897

**WOODS AREA:**

◫
1-CA3900
2-CA3901
3-CA3902

▣ **S-11 AREA:** CA3903

**SS-10 AREA:**

▯

| SHALLOW | DEEP |
|---|---|
| 1-CA3796 | 1-CA3795 |
| 3-CA3765 | 3-CA3804 |
| DUP 3-CA3791 | 4-CA3800 |
| 4-CA3799 | 5-CA3790 |
| 5-CA3801 | 6-CA3805 |
| 6-CA3803 | 8-CA3807 |
| 8-CA3806 | |
| SS-10-CA3787 | |
| SS-17-CA3788 | |
| SS-7-CA3789 | |

**TRAILER PARKING AREA:**

●
1-CA3764
2-CA3898

**MW-5 AREA:**

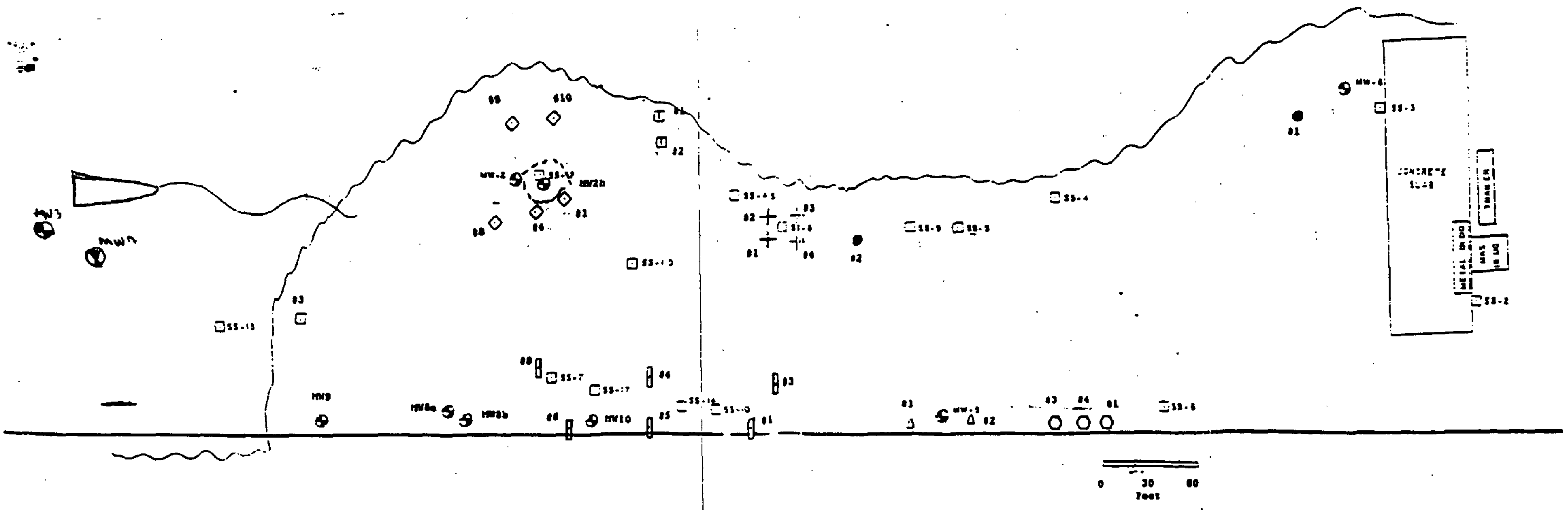
△
SHALLOW 1-CA3905
DEEP 1-CA3907
SHALLOW 2-CA3904
DEEP 2-CA3906

**UNDERGROUND DIESEL FUEL TANK**

○
1-CA3813
3-CA3812
4-CA3815

**SS-8 AREA:**

✚
1-CA3793
2-CA3794
3-CA3768
4-CA3899
SS-8-CA3755



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in a truly downgradient direction.

2. Well MW2b was placed adjacent to MW2, and screened at a depth of 33-48 feet, in order to monitor the vertical migration of organic compounds encountered in MW2, which was screened at the water table.

3. Wells MW8a and MW8b were placed in a directly downgradient direction from the excavated underground storage tank area, at the property boundary. These wells were intended to monitor the water quality as a possible contaminant plume traversed the site boundary. Well MW8a was screened at the water table, and MW8b was screened at a depth of 30-40 feet, to monitor vertical migration of compounds.

4. Well MW9 was placed at the property boundary, approximately 80 feet from the MW8 pair, in order to monitor the horizontal extent of a possible contaminant plume.

5. Well MW10 was placed at the property boundary downgradient from an area defined by the Phase I sampling as containing elevated levels of volatile and semivolatile compounds in the soil. The well was intended to monitor possible groundwater contamination from the compounds present in the soil. It is also located about 90 feet from the MW8 well pair.

Well construction summaries and permits are contained in Appendix 2. Well construction details are listed in Table 1.

Table 1

Monitoring Well Construction Details

| Well # | Well Depth | Casing Diameter | Screened Interval | Materials Encountered |
|---|---|---|---|---|
| 2b | 50 feet | 4" PVC | 30-40 feet | fine to coarse grained sand |
| 7 | 21 feet | 4" PVC | 3-16 feet | fine to coarse grained sand |
| 8a | 19.5 feet | 4" PVC | 9-19 feet | fine to coarse grained sand |
| 8b | 41 feet | 4" PVC | 28-40 feet | fine to coarse grained sand; minor clay |
| 9 | 21 feet | 4" PVC | 9-19 feet | fine to coarse grained sand; some pebbles |
| 10 | 21 feet | 4" PVC | 9-19 feet | fine to coarse sand; thin clay layers |

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Sampling of wells was completed a minimum of two weeks after installation, using dedicated, decontaminated stainless steel bailers. A minimum of three well volumes were removed from each well prior to sampling. Samples were collected in appropriate bottles and shuttles provided by the laboratory; after completion of sampling, the samples were picked up by the laboratory's courier.

Hydraulic Conductivity Testing

Falling head piezometer tests (slug tests) were performed on each monitoring well. Prior to introducing the slug of water, a pressure transducer attached to a data logger was placed in the well to allow rapid, continuous measurements of water level changes during the test. A minimum slug volume consisting of the volume of water from the water level in the casing to the top of casing was used for each test.

## SOIL SAMPLING RESULTS

Results of the chemical analyses of soil samples collected in each area are listed and discussed below, by area. Appendix 3 contains sampling data information for each collected sample.

### Underground Diesel Fuel Tank Area

The two tanks removed from the excavation were 750 and 1500 gallons in size. The larger tank was located south of the smaller tank. A cross section of the excavation wall consisted of about eight inches of dark topsoil at the surface; the remainder of the pit (7-9 feet total depth) was described as reddish brown coarse sand containing little clay. No soil staining was

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observed in the excavation; examination of the tanks as they were removed from the ground revealed no holes, pitting, cracks, or staining. Soil samples from the bottom and sides of the excavation were collected for field screening for aromatic hydrocarbons. One sample (#2), located beneath the larger tank, revealed the presence of hydrocarbons during field screening with the Hanby test kit, therefore, additional soil was excavated from this location. Sample #4, which was approximately two feet deeper than #2, did not reveal the presence of aromatic hydrocarbons during field screening.

Three samples were subsequently collected from the underground diesel fuel tank excavation for laboratory analysis. Each sample was analyzed for volatile organics per EPA method 624 + 15, modified for calibration for xylenes, and semivolatile organics per EPA method 625 + 15 (base/neutrals and acid extractables). The location of each sample and analytical results are listed in Table 2. Only parameters with concentrations exceeding the minimum detectable limits are listed in Table 2 and subsequent tables.

---

Table 2

Analytical Results, Underground Diesel Fuel Tank

| Sample # and Location | Compound | Concentration (ug/kg) |
|---|---|---|
| #1 (CA 3813) | Volatile Organics | |
| | Methylene Chloride | 2.95 |
| East side of excavation below 750 gal. tank | Benzene | 5.18 |
| | Volatile Organic TIC* | |
| | Hexane | 5.00 |
| | Semivolatile Organics | |
| | Bis(2-Ethylhexyl) Phthalate | 747.00 |
| | Semivolatile TIC (total) | 19300.00 |

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Table 2 (cont'd)

Analytical Results, Underground Diesel Fuel Tank

| Sample # and Location | Compound | Concentration (ug/kg) |
|---|---|---|
| #3 (CA 3815) | Volatile Organics | |
| | Methylene Chloride | 4.50 |
| Center of excavation | Benzene | 3.87 |
| | Volatile Organic TIC (total) | 380.00 |
| | Semivolatile Organics | |
| | Bis(2-Ethylhexyl)Phthalate | 1630.00 |
| | Pyrene | 606.00 |
| | Phenanthrene | 370.00 |
| | Semivolatile TIC (total) | 94500.00 |
| #4 (CA 3813) | Volatile Organics | |
| | Trichloroethylene | 1950.00 |
| West side of excavation below 1500 gal. tank | Toluene | 4240.00 |
| | Ethylbenzene | 10500.00 |
| | Total xylenes | 62900.00 |
| | Semivolatile Organics | |
| | Bis(2-ethylhexyl)phthalate | 496.00 |
| | Semivolatile TIC (total) | 7074.00 |

* TIC = tentatively identified compound

---

The results of the laboratory analysis indicate that volatile organics typically found in petroleum hydrocarbon products were present in the excavation. Concentrations of toluene, ethylbenzene, trichloroethylene and xylene were particularly high beneath the 1500 gallon tank (west side of excavation). Semivolatile organics were present at all three locations, although the levels are highest in the center of the excavation.

Drum Storage: Soil Sample 8S area

Five soil samples were collected from this area (Figure 2), which was identified as an area of concern during the Phase I investigation. In addition to resampling the original 8S location, four samples were collected

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around the original location from a depth of 3-5 feet below the surface. Of the five samples, one was analyzed for pesticides/PCB's, cyanides and phenols, two were analyzed for the entire PP+40 package, and two were analyzed for EPA method 624/625 + 40. The results of the analysis are listed in Table 3.

### Table 3

### 8S Sampling Area

| Sample # and Location | Compound | Concentration (ug/kg) |
|---|---|---|
| #3 (CA 3768) Analyzed for Pesticides/PCB's, cyanides and phenols<br>depth = 4-5 feet | Total Phenols | <2.60 |
| | Total Cyanides | <0.53 |
| #2 (CA 3794) Analyzed for 624/625<br>depth = 4-5 feet | Semivolatile Organics | |
| | Di-N-butyl phthalate | 62.90 |
| | Bis(2-ethylhexyl)phthalate | 34.60 |
| #1 (CA 3793) Analyzed for 624/625<br>depth = 4-5 feet | Volatile Organics | |
| | Methylene Chloride | 4.77 |
| | Semivolatile Organics | |
| | Di-N-Butyl phthalate | 128.00 |
| | Bis(2-ethylhexyl)phthalate | 249.00 |
| | Semivolatile TIC*(total) | 606.00 |
| #4 (CA 3899) Analyzed for PP+40<br>depth = 4-5 feet | Volatile Organics TIC (total) | 913.00 |
| | Metals | |
| | Arsenic | 1500.00 |
| | Beryllium | 260.00 |
| | Cadmium | 3300.00 |
| | Chromium | 54000.00 |
| | Copper | 4800.00 |
| | Lead | 19000.00 |
| | Mercury | 77.00 |
| | Nickel | 4800.00 |
| | Zinc | 23000.00 |

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## Table 3 (cont'd)

### 8S Sampling Area

| Sample # and Location | Compound | Concentration (ug/kg) |
|---|---|---|
| #8S (CA 3755) Analyzed for PP+40<br>depth = 4-5 feet | Semivolatile Organics | |
| | Di-N-butyl phthalate | 102.00 |
| | Bis(2-ethylhexyl)phthalate | 72.80 |
| | Semivolatile TIC (total) | 153.00 |
| | Metals | |
| | Arsenic | 280.00 |
| | Beryllium | 47.00 |
| | Cadmium | 110.00 |
| | Chromium | 1800.00 |
| | Copper | 370.00 |
| | Lead | 1100.00 |
| | Zinc | 3300.00 |

The sample collected at the 8S location during the Phase I work contained primarily semivolatile organic TIC's; the Phase II analysis revealed substantially lower levels of both volatile and semivolatile organic compounds compared to the original analysis.

The types of compounds present are not the same in each location; samples 8S, #2 and #1 contain semivolatiles, but #4 contains much higher levels of volatile organics and metals. The presence of volatiles is apparently not related to the #8S sampling location, which contained only 4 ppb of benzene and 61 ppb of volatile organic TIC's during the Phase I sampling.

<u>Drum Storage: Soil Samples 10D, 7S and 17S Area (SS 10 Area)</u>

Soil samples were collected around the 10D, 7S, and 17S drum storage soil sampling locations identified during Phase I sampling (Figure 2). Results of the Phase I sampling indicated that compounds detected were primarily semivolatile organics (mostly TIC's), and appeared to be located surficially rather than at depth. Samples collected during Phase II sampling were located around the area defined by these three sampling points, to form an approximate rectangle around the points in an attempt to delineate the extent of the detectable compounds. The corners of the rectangle were sampled at the surface (0-2 feet) and at a depth of 5-7 feet. The original 7S, 17S and 10D (shallow) locations were also resampled. The results of the analyses of these samples are shown in Table 4.

---

Table 4

Analytical Results, SS-10 Area

| Sample # and Location | Compound | Concentration (ug/kg) |
|---|---|---|
| #3 Shallow DUP (CA3765)<br>Analyzed for PP+40<br>depth = 0.5-2 feet | Volatile Organics | |
| | Methylene Chloride | 5.94 |
| | Semivolatile Organics | |
| | Di-N-Butyl Phthalate | 645.00 |
| | Bis(2-Ethylhexyl)Phthalate | 11000.00 |
| | Benzoic Acid | 2320.00 |
| | Diethyl Phthalate | 142.00 |
| | Butyl Benzyl Phthalate | 2230.00 |
| | Di-N-Octyl Phthalate | 995.00 |
| | Isophorene | 44.70 |
| | Benzo(b)Fluoranthene | 54.40 |
| | Semivolatiles TIC (total) | 18435.00 |
| | Pesticides/PCB's | |
| | Alpha Chlordane | 180.00 |
| | Gamma Chlordane | 150.00 |
| | Dieldrin | 17.90 |
| | Metals | |
| | Antimony | 10000.00 |
| | Arsenic | 2400.00 |
| | Beryllium | 56.00 |
| | Cadmium | 8500.00 |
| | Chromium | 83000.00 |
| | Copper | 31000.00 |
| | Lead | 12 x $10^4$.00 |
| | Mercury | 360.00 |
| | Nickel | 13000.00 |
| | Selenium | 860.00 |
| | Silver | 70000.00 |

## Table 4 (cont'd)

## Analytical Results, SS-10 Area

| Sample # and Location | Compound | Concentration (ug/kg) |
|---|---|---|
| #3 Shallow DUP (cont'd) | Phenolics | < 2.70 |
| | Cyanide | < 0.54 |
| #3 Shallow (CA3791)<br>Analyzed for BNA;<br>PST/PCB; CN; PN<br>depth = 0.5-2 feet | Semivolatile Organics | |
| | Di-N-Butyl Phthalate | 557.00 |
| | Bis (2-ethylhexyl)Phthalate | 12300.00 |
| | Butyl Benzyl Phthalate | 375.00 |
| | Pesticides/PCB's | |
| | Alpha Chlordane | 374.00 |
| | Gamma Chlordane | 299.00 |
| #1 Shallow (CA3796)<br>Analyzed for BNA<br>depth = 0.5-2 feet | Semivolatile Organics (TCL) | |
| | Di-N-Butyl Phthalate | 89.90 |
| | Bis(2-Ethylhexyl)Phthalate | 111.00 |
| | Diethyl Phthalate | 54.00 |
| | Semivolatiles TIC (total) | 197.00 |
| #1 Deep (CA3795)<br>Analyzed for BNA<br>depth = 5-7 feet | Not detected | |
| #4 Shallow (CA3799)<br>Analyzed for BNA<br>depth = 0.5-2 feet | Semivolatile Organics (TCL) | |
| | Di-N-Butyl Phthalate | 189.00 |
| | Bis(2-Ethylhexyl)Phthalate | 725.00 |
| | Di-N-Octyl Phthalate | 70.00 |
| | Semivolatiles TIC (total) | 4155.00 |
| #4 Deep (CA3800)<br>Analyzed for BNA<br>depth = 5-7 feet | Semivolatile Organics (TCL) | |
| | Di-N-Butyl Phthalate | 112.00 |
| | Bis(2-Ethylhexyl)Phthalate | 179.00 |
| | Semivolatiles TIC (total) | 1130.00 |
| #5 Shallow (CA3801)<br>Analyzed for BNA<br>depth = 0.5-2 feet | Semivolatile Organics (TCL) | |
| | Di-N-Butyl Phthalate | 132.00 |
| | Bis(2-Ethylhexyl)Phthalate | 387.00 |
| | Butyl Benzyl Phthalate | 59.30 |
| #5 Deep (CA3790)<br>Analyzed for BNA;<br>PST/PCB; CN; PN<br>depth = 5-7 feet | Semivolatile Organics (TCL) | |
| | Bis-N-Butyl Phthalate | 46.60 |

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The analytical results for the SS 10 area (which is also a drum storage area) indicate that elevated levels of organics are present across most of the area from which the samples were collected. As in the Phase I investigation, the compounds are concentrated close to the surface in all samples, and consist primarily of semivolatile compounds, particularly TIC's. The concentration of compounds present (with the possible exception of sample #3) are not as high as were present in the original soil samples (17S, 7S, and 10D1), but all of the new samples contained some volatile or semivolatile compounds. Sample #3 has particularly high levels of metals, as well as some pesticides. Two of the samples collected near the property boundary (#5 and #1) contained relatively lower levels of compounds than samples collected in the more active areas. Sample #6, however, also located on the property boundary, contained about 10,000 ppb of various semivolatile organics. The deeper samples in each location again appear to contain lower concentrations of detected organics.

---

Monitor Well #5 Area:

Four soil samples were collected around monitoring well #5 (Figure 2) because of contaminated soil samples collected from the monitoring well during Phase I drilling. The results of the Phase I analysis indicated the presence of primarily semivolatile compounds, with highest levels of these compounds concentrated near the surface. The results of the analysis are listed in Table 5.

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## Table 5

## Analytical Results, MW-5 Area

| Sample # and Location | Compound | Concentration (ug/kg) |
|---|---|---|
| #1 Shallow (CA3905)<br>Analyzed for BNA; metals<br>depth = 0.5-2 feet | Semivolatile (TCL) | |
| | Di-N-Butyl Phthalate | 231.00 |
| | Bis(2-Ethylhexyl)Phthalate | 545.00 |
| | Benzoic Acid | 44.70 |
| | Diethyl Phthalate | 23.80 |
| | Butyl Benzyl Phthalate | 132.00 |
| | Semivolatile TIC (total) | 2500.00 |
| | Metals | |
| | Arsenic | 620.00 |
| | Beryllium | 81.00 |
| | Cadmium | 5200.00 |
| | Chromium | 7400.00 |
| | Copper | 2800.00 |
| | Lead | 27000.00 |
| | Mercury | 48.00 |
| | Nickel | 3000.00 |
| | Silver | 270.00 |
| | Zinc | 29000.00 |
| #2 Shallow (CA3904)<br>Analyzed for BNA; metals<br>depth = 0.5-2 feet | Semivolatile Organics (TCL) | |
| | Di-N-Butyl Phthalate | 97.20 |
| | Bis(2-Ethylhexyl)Phthalate | 301.00 |
| | Semivolatiles TIC (total) | 3029.00 |
| | Metals | |
| | Arsenic | 1500.00 |
| | Beryllium | 98.00 |
| | Cadmium | 1100.00 |
| | Chromium | 7600.00 |
| | Copper | 3400.00 |
| | Lead | 21000.00 |
| | Mercury | 25.00 |
| | Nickel | 2400.00 |
| | Zinc | 6200.00 |
| #1 Deep (CA3907)<br>Analyzed for BNA; metals<br>depth= 5-7 feet | Semivolatile Organics (TCL) | |
| | Di-N-Butyl Phthalate | 190.00 |
| | Bis(2-Ethylhexyl)Phthalate | 473.00 |
| | Semivolatiles TIC (total) | 16510.00 |
| | Metals | |
| | Antimony | 1300.00 |
| | Arsenic | 630.00 |
| | Beryllium | 68.00 |
| | Cadmium | 1100.00 |

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## Table 5 (Cont'd)

### Analytical Results, MW-5 Area

| Sample # and Location | Compound | Concentration (ug/kg) |
|---|---|---|
| #1 Deep (cont'd) | Chromium | 7200.00 |
| | Copper | 2500.00 |
| | Lead | 1500.00 |
| | Nickel | 1100.00 |
| | Silver | 360.00 |
| | Zinc | 5400.00 |
| #2 Deep (CA3906)<br>Analyzed for BNA;<br>metals<br>depth = 5-7 feet | Semivolatile Organics (TCL) | |
| | Bis(2-Ethylhexyl)Phthalate | 621.00 |
| | Semivolatiles TIC (total) | 27000.00 |
| | Metal | |
| | Arsenic | 690.00 |
| | Beryllium | 31.00 |
| | Cadmium | 730.00 |
| | Chromium | 3500.00 |
| | Copper | 1100.00 |
| | Lead | 1700.00 |
| | Nickel | 460.00 |
| | Silver | 300.00 |
| | Zinc | 2300.00 |

Analysis of Phase II samples (collected from both shallow and deep locations) again indicate the presence of substantial levels of semivolatile TIC's, although this time, the higher concentrations were detected at the deeper locations in both samples. The total concentration of semivolatile TIC's in the deeper samples is comparable to that obtained during the Phase I sampling; the concentration of metals is somewhat lower.

Soil Samples from Area Around Excavated Waste Storage Tank:

Five samples were collected from the vicinity of the excavated underground solvent storage tank (Figure 2), in order to investigate the extent of soil contamination around the tank. The results of the analyses for these samples are listed in Table 6.

## Table 6

### Analytical Results, Excavated Storage Tank Area

| Sample # and Location | Compound | Concentration (ug/kg) |
|---|---|---|
| #4 (CA3766) | Volatile Organics (TCL) | |
| Analyzed for PP+40 | Methylene Chloride | 8.67 |
| depth = 9.5-10 feet | Volatile Organics TIC (total) | 14.00 |
| | Semivolatile Organics (TCL) | |
| | Di-N-Butyl Phthalate | 166.00 |
| | Bis(2-Ethylhexyl)Phthalate | 342.00 |
| | Semivolatiles TIC (total) | 18510.00 |
| | Metals | |
| | Arsenic | 260.00 |
| | Cadmium | 170.00 |
| | Chromium | 4800.00 |
| | Copper | 1700.00 |
| | Lead | 2600.00 |
| | Nickel | 510.00 |
| | Silver | 390.00 |
| | Zinc | 3500.00 |
| | Phenolics | < 3.10 |
| | Cyanide | < 0.62 |
| #4 DUP (CA4044) | Volatile Organics (TCL) | |
| | Methylene Chloride | 7.93 |
| | Acetone | 14.00 |
| | Volatile Organics TIC (total) | 6.00 |
| | Semivolatile Organics (TCL) | |
| | Di-N-Butyl Phthalate | 119.00 |
| | Bis(2-Ethylhexyl)Phthalate | 106.00 |
| | Semivolatiles TIC (total) | 18843.00 |
| | Metals | |
| | Arsenic | 250.00 |
| | Chromium | 1900.00 |
| | Copper | 440.00 |
| | Lead | 2400.00 |
| | Silver | 360.00 |
| | Zinc | 1100.00 |
| | Phenolics | < 2.80 |
| | Cyanide | < 0.55 |
| #9 (CA3896) | Semivolatile Organics (TCL) | |
| Analyzed for PP+40 | Di-N-Butyl Phthalate | 112.00 |
| depth = 10 feet | Metals | |
| | Chromium | 1600.00 |
| | Copper | 470.00 |
| | Lead | 16000.00 |
| | Zinc | 1200.00 |
| | Phenolics | < 3.10 |
| | Cyanide | <0.62 |

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## Table 6 (Cont'd)

## Analytical Results, Excavated Storage Tank Area

| Sample # and Location | Compound | Concentration (ug/kg) |
|---|---|---|
| #10 (CA3897)<br>Analyzed for PP+40<br>depth = 10-10.5 feet | Semivolatile Organics (TCL) | |
| | Di-N-Butyl Phthalate | 121.00 |
| | Bis(2-Ethylhexyl)Phthalate | 198.00 |
| | Metals | |
| | Chromium | 800.00 |
| | Lead | 1000.00 |
| | Phenolics | < 2.60 |
| | Cyanide | < 0.52 |
| #1 (CA3761)<br>Analyzed for PP+40<br>depth = 10-10.5 feet | Volatile Organics (TCL) | |
| | Methylene Chloride | 3.50 |
| | 1,1,1-Trichloroethane | 5.66 |
| | Trichloroethylene | 62.60 |
| | Tetrachloroethylene | 79.10 |
| | Volatile Organics TIC (total) | 40.00 |
| | Semivolatile Organics (TCL) | |
| | Di-N-Butyl Phthalate | 87.20 |
| | Bis(2-Ethylhexyl)Phthalate | 43.60 |
| | Semivolatiles TIC (total) | 155.00 |
| | Metals | |
| | Arsenic | 340.00 |
| | Chromium | 2100.00 |
| | Copper | 370.00 |
| | Lead | 910.00 |
| | Zinc | 1300.00 |
| #8 (CA3763)<br>Analyzed for PP+40<br>depth = 10-10.5 feet | Semivolatile Organics (TCL) | |
| | Di-N-Butyl Phthalate | 89.70 |
| | Bis(2-Ethylhexyl)Phthalate | 60.10 |

The analyses indicate that the area north of the tank (samples #9 and #10) contain relatively low concentrations of compounds, primarily from semivolatiles. The relatively low concentration of detectable compounds in these samples is consistent with the known location of the tank, and suggests that the area roughly north of the tank was probably not actively used.

Of the three samples collected south and southeast of the tank, two samples

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contained high levels of either semivolatiles (#4) or volatile organics (#1). Because similar types of compounds were detected at the UST location, it is likely that compounds originally present in the tank has extended to the area south of the tank. The depth at which the samples were collected (9.5 feet minimum) suggests that the source of the compounds is not surficial; in addition, samples collected during the Phase I sampling contained lower concentrations of analyzed compounds than deeper samples.

Miscellaneous Trailer Parking Areas:

Two "random" soil samples were collected from an area where a row of truck trailers (used for storage) are parked (Figure 2). One location was sampled because of soil staining observed beneath a trailer (#1), and the other location (#2) was sampled because of the presence of an area (about two feet in diameter) consisting of unusually soft, wet soil. The results of the laboratory analysis of samples collected in this area are given in Table 7.

---

Table 7

Analytical Results, Trailer Parking Area

| Sample # and Location | Compound | Concentration (ug/kg) |
|---|---|---|
| #1 (CA3764) | Volatile Organics | |
| Analyzed for PP+40 | Methylene Chloride | 3.34 |
| depth = 0.5-2 feet | Semivolatile Organics (TCL) | |
| | Di-N-Butyl Phthalate | 91.90 |
| | Bis(2-Ethylhexyl)Phthalate | 78.50 |
| | Semivolatile TIC (total) | 894.00 |
| | Metals | |
| | Arsenic | 970.00 |
| | Beryllium | 240.00 |
| | Cadmium | 2000.00 |
| | Chromium | 9000.00 |
| | Copper | 2800.00 |
| | Lead | 7400.00 |

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## Table 7, con't

### Analytical Results, Trailer Parking Area

| Sample # and Location | Compound | Concentration (ug/kg) |
|---|---|---|
| #1 (cont'd) | Mercury | 69.00 |
| | Nickel | 3700.00 |
| | Selenium | 110.00 |
| | Zinc | 13000.00 |
| | Phenolics | < 2.70 |
| | Cyanide | < 0.54 |
| #2 (CA3898) | Semivolatile Organics (TCL) | |
| Analyzed for PP+40 | Di-N-Butyl Phthalate | 873.00 |
| depth = 0.5-2 feet | Bis(2-Ethylhexyl)Phthalate | 18000.00 |
| | Di-N-Octyl Phthalate | 2010.00 |
| | Isophorone | 1290.00 |
| | Semivolatile TIC (total) | 4870.00 |
| | Pesticides/PCB's (TCL) | |
| | Beta-BHC | 83.20 |
| | 4,4-DDE | 115.00 |
| | Alpha Chlordane | 1430.00 |
| | Gamma Chlordane | 1230.00 |
| | Metals | |
| | Arsenic | 14000.00 |
| | Beryllium | 150.00 |
| | Cadmium | 5200.00 |
| | Chromium | 44000.00 |
| | Copper | 33000.00 |
| | Lead | 19 x $10^4$.00 |
| | Mercury | 660.00 |
| | Nickel | 9000.00 |
| | Silver | 2700.00 |
| | Zinc | 95000.00 |
| | Phenolics | < 2.60 |
| | Cyanide | < 0.53 |

The chemical analysis results indicate relatively low concentrations of detectable parameters present at location #1. However, high levels of semivolatile organic TIC, metals, and pesticides were detected at location #2. It is not known whether the presence of these parameters contributed to the unusual soil condition at this location.

## Soil Samples from Woods Areas:

Three soil samples were collected from wooded areas not necessarily associated with active portions of the site (Figure 2). Two samples (#1 and #2) were collected near a concrete form which had originally been used to assist unloading materials from trucks into the underground waste storage tank. The two sample locations were random, and did not correspond to any obvious visual evidence of contamination. Sample #3 was randomly located near the south end of the active portion of the site, where surface drainage occurred. The results of the laboratory analysis of these samples is listed in Table 8.

Table 8
Analytical Results, Woods Area

| Sample # and Location | Compound | Concentration (u//kg) |
|---|---|---|
| #1 (CA3900) | Volatile Organics (TCL) | |
| Analyzed for VOC; BNA | Methylene Chloride | 5.82 |
| depth = 0.5-1.5 feet | Carbon Disulfide | 9.16 |
| | Trichloroethylene | 15.90 |
| | Tetrachloroethylene | 97.20 |
| | Volatile Organics TIC (total) | 250.00 |
| | Semivolatile Organics (TCL) | |
| | Bis(2-Ethylhexyl)Phthalate | 678.00 |
| | 1,2-Diphenylhydrazine | 381.00 |
| | Semivolatiles TIC (total) | 30780.00 |
| | Phenolics | < 2.60 |
| | Cyanide | < 0.51 |
| #2 (CA3901) | Volatile Organics (TCL) | |
| Analyzed for VOC; BNA | Methylene Chloride | 4.10 |
| depth = 0.5-2 feet | Semivolatile Organics (TCL) | |
| | Di-N-Butyl Phthalate | 65.10 |
| | Bis(2-Ethylhexyl)Phthalate | 114.00 |
| | 1,2-Diphenylhydrazine | 35.40 |
| | Semivolatiles TIC (total) | 746.00 |
| #3 (CA3902) | Semivolatile Organics (TCL) | |
| Analyzed for VOC; BNA | Di-N-Butyl Phthalate | 151.00 |
| depth = 0.5-2 feet | Bis(2-Ethylhexyl)Phthalate | 1030.00 |
| | Benzoic Acid | 35.40 |
| | Diethyl Phthalate | 85.90 |
| | Butyl Benzyl Phthalate | 61.20 |
| | Di-N-Octyl Phthalate | 40.10 |
| | Semivolatiles TIC (total) | 1290.00 |

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The results of the analysis indicate relatively higher concentrations of compounds from sample #1, particularly from semivolatile TIC's, although volatile organic compounds are also present. Sample #2 contained almost no volatiles, and substantially lower semivolatiles. Sample #3 contained semivolatile TIC's and phthalates, also in relatively low concentrations.

Sample 11D

Soil sample 11D, which was collected during the Phase I investigation, was resampled during Phase II at the request of personnel from the NJDEP. The laboratory analysis results are shown in Table 9.

**Table 9**

**Analytical Results, Sample 11D**

| Sample # and Location | Compound | Concentration (ug/kg) |
|---|---|---|
| #SS-11 (CA 3903) | Volatile Organics (TCL) | |
| Analyzed for VOA; BNA | Tetrachloroethylene | 48.10 |
| depth = 0.5-1 feet | Semivolatile Organics (TCL) | |
| | Di-N-Butyl Phthalate | 281.00 |
| | Bis(2-Ethylhexyl)Phthalate | 2410.00 |
| | Diethyl Phthalate | 70.90 |
| | Butyl Benzyl Phthalate | 93.70 |
| | Di-N-Octyl Phthalate | 43.10 |
| | Isophorone | 43.40 |
| | Benzo(b)Fluoranthene | 54.40 |
| | Pyrene | 81.80 |
| | Chrysene | 39.40 |
| | Semivolatiles TIC (total) | 51539.00 |
| | Phenolics | < 2.70 |
| | Cyanide | < 0.55 |

The results of the chemical analysis of this sample is somewhat similar to the original shallow sample collected from this location. During Phase I testing, this sample contained 59 ppb total of dichlorobenzenes (a volatile organic) and semivolatile TIC's (7400 ppb). It is apparent that there is a different

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group of semivolatiles present during the present Phase II sampling (primarily TCL parameters, as opposed to TIC's), as well as higher concentrations of compounds.

Soil Samples from Monitoring Wells

Soil samples were collected from two wells where elevated volatile organic readings measured with a photoionization detector were obtained during drilling. Samples were collected in well 8b at depths of 8-17 feet and 19-26 feet, and in well 25 at a depth of 48-50 feet. Table 10 lists the results of the analysis of these samples.

---

**Table 10**

**Analytical Results, Soil Samples from Monitoring Wells**

| Sample # and Location | Compound | Concentration (ug/kg) |
|---|---|---|
| MW 8b (CA 3759)<br>depth = 8-17 feet | Volatile Organics | |
| | Trichlorethylene | 73000.00 |
| | Tetrachlorotheylene | 83100.00 |
| | Toluene | 221000.00 |
| | Ethylbenzene | 1210000.00 |
| | m-Xylene | 4000000.00 |
| | o+p-Xylene | 4190000.00 |
| | Semivolatile Organics (TCL) | |
| | Bis(2-ethylhexyl)phthalate | 131.00 |
| | 1,2-Diphenylhydrazine | 1941.00 |
| | Benzoic Acid | 102.00 |
| | Butyl Benzyl Phthalate | 184.00 |
| | 1,2,4-Trichlorobenzene | 569.00 |
| | Semivolatile (TIC) total | 9780.00 |
| | Metals | |
| | Chromium | 2700.00 |
| | Copper | 380.00 |
| | Lead | 2100.00 |
| | Mercury | 43.00 |
| | Zinc | 4000.00 |
| | Phenolics | <3.38 |
| | Cyanide | <0.68 |

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## Table 10, con't

## Analytical Results, Soil Samples from Monitoring Wells

| Sample # and Location | Compound | Concentration (ug/kg) |
|---|---|---|
| MW 8b (CA 3760)<br>depth = 19-26 feet | Volatile Organics | |
| | Methylene Chloride | 25.30 |
| | Carbon Disulfide | 8.76 |
| | 1,1 Dichloroethylene | 10.30 |
| | 1,1 Dichloroethane | 13.30 |
| | 1,2 Trans-dichloroethylene | 11.00 |
| | Chloroform | 11.50 |
| | Benzene | 14.50 |
| | Toluene | 14.90 |
| | Ethylbenzene | 23.00 |
| | m-Xylene | 74.90 |
| | o+p Xylene | 90.30 |
| | 1,1,1 Trichlorothane | 10.30 |
| | Semivolatile organics | |
| | Bis(2-ethylhexyl)phthalate | 131.00 |
| | 1,2-Diphenylhydrazone | 1940.00 |
| | Benzoic Acid | 102.00 |
| | Butyl benzyl phthalate | 184.00 |
| | 1,2,4-Trichlorobenzene | 569.00 |
| | Semivolatile Organics (TIC) total | 4540.00 |
| | Metals | |
| | Arsenic | 1700.00 |
| | Cadmium | 520.00 |
| | Chromium | 6900.00 |
| | Copper | 680.00 |
| | Lead | 1000.00 |
| | Mercury | 29.00 |
| | Zinc | 2500.00 |
| MW 2b (CA 3757)<br>depth = 48-50 feet | Volatile Organics | |
| | Methylene Chloride | 4.76 |
| | Trichloroethylene | 9.50 |
| | Tetrachloroethylene | 7.12 |
| | 1,1 Dichloroethylene | 2.37 |
| | 1,1 Dichloroethane | 2.36 |
| | Chloroform | 2.21 |
| | Benzene | 6.38 |
| | Toluene | 21.00 |
| | Ethylbenzene | 76.30 |
| | m-Xylene | 237.00 |
| | o+p Xylene | 287.00 |
| | Semivolatile Organics (TIC) total | 2560.00 |

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## Table 10, con't

### Analytical Results, Soil Samples from Monitoring Wells

| Sample # and Location | Compound | Concentration (ug/kg) |
|---|---|---|
| MW2b, con't | Metals | |
| | Chromium | 980.00 |
| | Lead | 1300.00 |
| | Mercury | 19.00 |
| | Zinc | 2500.00 |

The soil sample collected from near the water table in monitoring well 8b contained particularly high levels of volatile organics (0.98% total volatiles). The deeper sample from 8b contained much lower levels of volatile and semivolatile organics. Monitoring well 2b contained somewhat lower concentrations of parameters than were found present in the shallower soil samples collected during drilling of well MW2 (Phase I).

**MONITORING WELL SAMPLING RESULTS**

The results of the groundwater samples collected from the monitoring wells are shown in Table 11. Most of the groundwater analyses obtained from the original six monitoring wells are at least comparable to their original Phase I analyses. For example, monitor wells MW4 and MW6 contain very low or no levels of organics, similar to the results of the first round of sampling. Well MW1 contained 24 ppb of dichlorofloromethane in the second round of sampling which was not detected during the first round, although this compound was possibly the only parameter present (several compounds were also detected in the rinsate or laboratory method blank). MW5 was found to contain 302 ppb of 1,2 dichloroethane and 17.7 ppb of methylene chloride which were not detected during the initial sampling; the levels of semivolatile TIC's were lower in the second sample. MW2 exhibited similar levels of primarily

# TABLE 11

# CHEMICAL ANALYSIS OF GROUNDWATER SAMPLES

*Lightman Drum Co., Inc.*

*CHEMICAL ANALYSIS OF GROUNDWATER SAMPLES*

| PARAMETER<br>Volatile Organics (ug/l) | Sample #<br>MW1<br>CA3784 | MW2<br>CA3773 | MW2B<br>CA3775 | MW3<br>CA3996 | MW4<br>CA3998 | MW5<br>CA3785 | MW6<br>CA3786 |
|---|---|---|---|---|---|---|---|
| METHYLENE CHLORIDE | 2.97 | 795.00 | 4.51 | 3.93 | 1.33 | 17.70 | |
| ACETONE | 2.74 | 744.00 | 4.15 | 2.94 | | | |
| 1.2-TRANS-DICHLOROETHYLENE | | | | 16.20 | | | |
| 1.1.1-TRICHLOROETHANE | | | | | | | |
| TRICHLOROETHYLENE | | 2500.00 | 4.01 | 4.01 | | | |
| TETRACHLOROETHYLENE | | 2010.00 | 3.79 | 18.20 | | | |
| CHLOROFORM | | | | | | | |
| CHLOROBENZENE | | | | 219.00 | | | |
| DICHLORODIFLUOROMETHANE | 24.00 | | | | | | |
| 1.2-DICHLOROETHANE | | | | | | 302.00 | |
| BENZENE | | 364.00 | | | | | |
| TOLUENE | | 2750.00 | | 25.30 | | | |
| ETHYLBENZENE | | 4800.00 | | 7.74 | | | |
| M-XYLENE | | 19000.00 | | 6.05 | | | |
| O+P-XYLENES | | 22500.00 | 7.57 | 17.50 | | | |
| | | | | | | | |
| **Volatile Organics (TIC)** | | | | | | | |
| NONE | | | | | | | |
| | | | | | | | |
| **Semivolatile organics (ug/l)** | | | | | | | |
| PHENOL | | 55.40 | | | | | |
| 1.3-DICHLOROBENZENE | | 16.50 | | | | | |
| 1.4-DICHLOROBENZENE | | 31.90 | | | | | |
| 1.2-DICHLOROBENZENE | | 19.30 | | | | | |
| 2-METHYLPHENOL | | 26.10 | | | | | |
| 4-METHYLPHENOL | | 40.10 | | | | | |
| BENZOIC ACID | | 11.90 | | | | | |
| 1.2.4-TRICHLOROBENZENE | | 45.20 | | | | | |
| BIS(2-ETHYLHEXYL) PHTHALATE | | | | | | | |
| 1.2-DIPHENYLHYDRAZINE | | 38.90 | | | | | |
| 2.4-DIMETHYLPHENOL | | 50.10 | | | | | |
| NAPHTHALENE | | 2.44 | | | | | |
| 2-CHLOROPHENOL | | | | 3.01 | | | |
| | | | | | | | |
| **Semivolatile organics (TIC)** | | | | | | | |
| BENZENE-DIMETHYL | | 3790.00 | 105.00 | 33.00 | | | |
| BENZENE-METHYL | 2000.0* | 1300.0* | 990.0* | 1100.0* | 1000.0* | 1900.0* | 910.0* |
| PENTANONE-METHYL | | | | | | | |
| BENZENAMINE. N.N-DIMETHYL | | | | | | | |
| ETHENE. TETRACHLORO | | 450.00 | | 11.00 | | | |
| ACETIC ACID. ETHYL ESTER | 1400.0* | 120.0* | 510.0* | 560.0* | 470.0* | 1200.0* | 510.0* |
| (3-CYCLOHEXANE-1-METHANOL. | | | | | | | |

* Compound found in method blank

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TABLE [illegible] (cont'd)

## CHEMICAL ANALYSIS OF GROUNDWATER SAMPLES

| METER | MW7 | MW8a | MW8b | MW9 | MW10 | FILO | DUPLICATE | RINSATE |
|---|---|---|---|---|---|---|---|---|
| le Organics (ug/l) | CA3763 | CA3775 | CA3777 | CA3730 | CA3779 | CA3624 | CA4003 | CA3999 |
| YLENE CHLORIDE | | 1400 | 1.37 | 3.29 | 3.33 | 3.04 | 6.54 | 2.32 |
| ONE | | 1020 | 5.90 | 2.38 | 6.20 | 2.24 | | |
| RANS-DICHLOROETHYLENE | 13.50 | 390 | | | | | | |
| -TRICHLOROETHANE | 1.97 | 454 | | | 3.05 | | | |
| HLOROETHYLENE | 23.40 | 4900 | 2.85 | | 104.00 | | | |
| ACHLOROETHYLENE | 21.10 | 1210 | 1.43 | 2.41 | 112.00 | | | |
| ROFORM | | | 0.628 | | 1.56 | | | |
| ROBENZENE | 2.97 | | | | | | | |
| LORODIFLUOROMETHANE | | | | | | | | |
| ICHLOROETHANE | | | | | | | | |
| ENE | | 10100 | 1.53 | | | | | |
| ENE | | 3160 | | | | | | |
| LBENZENE | | 2950 | | | | | | |
| LENE | | 10500 | | | | | | |
| XYLENES | | 12500 | 1.32 | | | | | |
| | | | | | | | | |
| e Organics (TIC) | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| olatile organics (ug/l) | | | | | | | | |
| OL | | 385.00 | | | | | | |
| LOROBENZENE | | 4.95 | | | | | | |
| HLOROBENZENE | | 19.80 | | | | | | |
| CHLOROBENZENE | | 11.90 | | | | | | |
| THYLPHENOL | | 97.30 | | | | | | |
| THYLPHENOL | | 339.00 | | | | | | |
| OIC ACID | | 110.00 | | | | | | |
| TRICHLOROBENZENE | | 30.20 | | | | | | |
| -ETHYLHEXYL) PHTHALATE | | 2160.00 | 4320.00 | 3980.00 | 3890.00 | | 3380.00 | 4200.00 |
| PHENYLHYDRAZINE | | 4.39 | | | | | | |
| METHYLPHENOL | | 42.70 | | | | | | |
| THALENE | | | | | | | | |
| LOROPHENOL | | | | | | | | |
| | | | | | | | | |
| olatile organics (TIC) | | | | | | | | |
| ENE-DIMETHYL | | 2000.00 | | | | | | |
| ENE-METHYL | 1100.0* | 1000.0* | 1100.0* | 1100.0* | 1700.0* | 1200.0* | | 2100* |
| ANONE-METHYL | | 380.00 | | | | | | |
| ENAMINE. N.N-DIMETHYL | | 150.00 | | | | | | |
| NE. TETRACHLORO | 13.00 | 200.00 | | | 42.00 | | | |
| C ACID. ETHYL ESTER | 450.0* | 110.0* | 390.0* | 300.0* | 290.0* | 540.0* | | 410* |
| CLOHEXANE-1-METHANOL. | | 39.00 | | | | | | |

* Compound found in method blank

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## TABLE 11 (cont'd)

## CHEMICAL ANALYSIS OF GROUNDWATER SAMPLES

|  | MW1 | MW2 | MW2D | MW3 | MW4 | MW5 | MW6 |
|---|---|---|---|---|---|---|---|
| Semivolatile organics (TIC), con't | CA3784 | CA3778 | CA3776 | CA3996 | CA3998 | CA3785 | CA3786 |
| ALPHA, ALPHA 4-TRIMETHYL) |  |  |  |  |  |  |  |
| ETHANONE, 1-PHENYL |  | 33.00 |  |  |  |  |  |
| METHANAMINE,N-(1-PHENYLLETHYLIDENE) |  | 300.00 |  |  |  |  |  |
| PHENYL-ETHYL |  |  |  |  |  |  |  |
| ANILINE |  | 180.00 |  |  |  |  |  |
| CARBAMIC ACID,PHENYL,ETHYL ESTER |  |  |  |  |  |  |  |
| BENZENE, CHLORO |  | 71.00 |  | 220.00 |  |  |  |
| BENZENE-ETHYL-METHYL |  | 175.00 |  |  |  |  |  |
| PHTHALIC.ANHYDRIDE |  |  |  |  |  |  |  |
| BENZENEACETONITRILE |  |  |  |  |  |  |  |
| ACETONE DIMER | 150.0* |  | 73.0* |  | 58.0* | 140.0* | 63.0* |
| PENTEN-2-ONE |  |  |  |  |  | 12.00 |  |
| PHTHALATE |  |  |  |  |  |  |  |
| BENZENE-ETHYL |  | 610.00 |  | 14.00 |  |  |  |
| BENZENE, TRICHLORO |  | 220.00 |  |  |  |  |  |
| PHENOL,4-(PHENYLAZO) |  | 89.00 |  |  |  |  |  |
| PHENOL,2-ETHYL |  | 50.00 |  |  |  |  |  |
| BENZOIC ACID, METHYL |  | 69.00 |  |  |  |  |  |
| ISOBENZOFURANONE |  | 41.00 |  |  |  |  |  |
| 3-PENTEN-2-ONE |  |  |  |  |  |  | 14.00 |
| CYCLOPENTANE-ETHYL-METHYL |  |  |  |  |  |  |  |
| UNKNOWN (TOTAL, ALSO FOUND IN BLANK | 59 |  | 16 | 45 | 59 | 64 | 47 |
| UNKNOWN (TOTAL) |  | 51 |  |  |  |  |  |

| PARAMETER | Sample # |  |  |  |  |  |  |
|---|---|---|---|---|---|---|---|
| Metals (ug/l) | CA3784 | CA3778 | CA3776 | CA3996 | CA3998 | CA3785 | CA3786 |
| ANTIMONY | ND | ND | ND | ND | ND | ND | ND |
| ARSENIC | ND | ND | 5.50 | 3.40 | ND | 2.70 | ND |
| BERYLLIUM | 0.52 | ND | 0.39 | 0.35 | ND | 0.61 | ND |
| CADMIUM | 11.00 | 9.00 | 9.90 | 11.00 | ND | 17.00 | 1.00 |
| CHROMIUM | 35.00 | ND | 34.00 | 19.00 | ND | 47.00 | 4.80 |
| COPPER | 15.00 | ND | 13.00 | 9.90 | ND | 16.00 | ND |
| IRON | 55200.00 | 4100.00 | 49800.00 | 27500.00 | 230.00 | 77500.00 | 3600.00 |
| LEAD | 4.80 | ND | 5.50 | 5.00 | ND | 7.70 | 1.40 |
| MANGANESE | 22.00 | 270.00 | 58.00 | 82.00 | 3.30 | 30.00 | 30.00 |
| MERCURY | 0.14 | ND | 0.19 | ND | ND | 0.18 | ND |
| NICKEL | ND | 4.10 | ND | 13.00 | ND | 7.00 | ND |
| SELENIUM | ND | ND | ND | ND | ND | ND | ND |
| SILVER | ND | ND | ND | 2.20 | ND | 2.70 | ND |
| THALLIUM | ND | ND | ND | ND | ND | ND | ND |
| ZINC | 30.00 | 180.00 | 38.00 | 57.00 | 8.20 | 64.00 | 27.00 |
|  |  |  |  |  |  |  |  |
| PHENOLICS, TOTAL (mg/l) | <.05 | 0.16 | <.05 | <.05 | <.05 | <.05 | <.05 |
| CYANIDE, TOTAL (mg/l) | <.01 | <.01 | <.01 | <.01 | <.01 | <.01 | <.01 |
| SPECIFIC CONDUCTANCE (um/cm) | 52.00 | 90.00 | 112.00 | 53.00 | 20.00 | 58.00 | 43.00 |
| pH | 5.31 | 4.96 | 5.38 | 5.59 | 5.75 | 5.26 | 5.80 |

* Compound found in method blank

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TABLE [illegible] (CONT'D)

## CHEMICAL ANALYSIS OF GROUNDWATER SAMPLES

| | MW7 | MW8a | MW8b | MW9 | MW10 | FILO | DUPLICATE | RINSATE |
|---|---|---|---|---|---|---|---|---|
| nvolatile organics (TIC), con't | CA3783 | CA3775 | CA3777 | CA3780 | CA3779 | CA3824 | CA4003 | CA3999 |
| PHA. ALPHA.4-TRIMETHYL) | | | | | | | | |
| HANONE. 1-PHENYL | | 52.00 | | | | | | |
| THANAMINE.N-(1-PHENYLLETHYLIDENE) | | 27.00 | | | | | | |
| ENYL-ETHYL | | 27.00 | | | | | | |
| ILINE | | 40.00 | | | | | | |
| RBAMIC ACID.PHENYL.ETHYL ESTER | | 23.00 | | | | | | |
| NZENE. CHLORO | | 37.00 | | | | | | |
| NZENE-ETHYL-METHYL | | 35.00 | | | | | | |
| THALIC.ANHYDRIDE | | 19.00 | | | | | | |
| IZENEACETONITRILE | | 18.00 | | | | | | |
| ETONE DIMER | 80.0* | | 95.0* | 73.0* | 72.00 | 91.0* | | 99* |
| NTEN-2-ONE | | | 14.00 | | | | | 30 |
| HALATE | | | 530.00 | | | | | 520 |
| IZENE-ETHYL | | | | | | | | |
| NZENE. TRICHLORO | | | | | | | | |
| ENOL.4-(PHENYLAZO) | | | | | | | | |
| ENOL.2-ETHYL | | | | | | | | |
| NZOIC ACID. METHYL | | | | | | | | |
| BENZOFURANONE | | | | | | | | |
| ENTEN-2-ONE | | | | | | 10.00 | | |
| CLOPENTANE-ETHYL-METHYL | | | | | | | | 15 |
| KNOWN (TOTAL. ALSO FOUND IN BLANK | 49 | | 14 | 47 | 40 | 37 | 72 | 45 |
| KNOWN (TOTAL) | | 28 | | 41 | 18 | | | 44 |

| METER | | | | | | | DUPLICATE | RINSATE |
|---|---|---|---|---|---|---|---|---|
| als (ug/l) | CA3783 | CA3775 | CA3777 | CA3780 | CA3779 | CA3824 | CA4003 | CA3999 |
| IMONY | ND | ND | ND | ND | ND | ND | 12.00 | ND |
| ENIC | ND | 2.70 | ND | ND | 3.40 | ND | ND | ND |
| RYLLIUM | ND | 0.26 | ND | 0.52 | 0.47 | ND | 0.58 | ND |
| MIUM | 6.70 | 3.00 | ND | 0.42 | 5.80 | ND | 13.00 | ND |
| ROMIUM | 8.50 | 44.00 | 2.60 | 140.00 | 1110.00 | ND | 41.00 | ND |
| PPER | 3.20 | 6.60 | ND | 3.80 | 9.60 | 77.00 | 15.00 | ND |
| N | 13000.00 | 18800.00 | 2900.00 | 1700.00 | 19200.00 | 500.00 | 63000.00 | ND |
| D | 3.00 | 2.50 | 1.40 | 1.20 | 5.90 | 1.80 | 6.40 | 1.20 |
| NGANESE | 200.00 | 340.00 | 30.00 | 65.00 | 160.00 | 38.00 | 24.00 | ND |
| RCURY | ND | ND | ND | 0.10 | 0.83 | ND | 0.14 | ND |
| KEL | 9.50 | 40.00 | ND | 21.00 | 7.90 | ND | ND | ND |
| ENIUM | ND | ND | ND | ND | ND | ND | ND | ND |
| VER | ND | ND | 2.00 | ND | 2.10 | ND | ND | ND |
| LLIUM | ND | ND | ND | ND | ND | ND | ND | ND |
| : | 41.00 | 34.00 | 11.00 | 260.00 | 130.00 | 13.00 | 31.00 | 7.00 |
| | | | | | | | | |
| NOLICS. TOTAL (mg/l) | <.05 | .08 | <.05 | <.05 | <.05 | <.05 | <.05 | <.05 |
| NIDE. TOTAL (mg.l) | <.01 | <.01 | <.01 | <.01 | <.01 | <.01 | <.01 | <.01 |
| CIFIC CONDUCTANCE (um/cm) | 56.00 | 224.00 | 51.00 | 107.00 | 115.00 | 139.00 | 50.00 | 6.00 |
| | 5.01 | 5.14 | 5.36 | 4.79 | 5.07 | 5.57 | 5.75 | 7.52 |

* Compound found in method blank

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volatile organics, although a group of targeted semivolatiles were detected during the second round which were not found initially.

Monitoring well MW3, in which originally only 6 ppb tetrachloroethane and 38 ppb of volatile organic TIC's were detected, this time was found to contain targeted volatile organics, including chlorobenzene (219 ppb), toluene (25.3 ppb), and several other compounds (several of which exceeded New Jersey drinking water standards). Several semivolatile TIC's, primarily benzene derivatives, were also detected. Monitoring well MW7, which was installed near MW3 and was also intended to monitor groundwater quality downgradient from the unlined waste storage pit, contained low levels (<30 ppb) of several volatile organics (although NJ drinking water standards were exceeded for several compounds), and lower levels of semivolatile TIC's compared to MW3.

Monitoring well MW8a, located directly downgradient from the excavated waste solvent tank, and screened at the water table, contained levels and types of compounds similar to MW2. However, the two associated wells screened at deeper intervals, MW2b and MW8b, contained concentrations of compounds which were orders of magnitude lower. The volatile organics in these two wells totalled less than 25 ppb, compared to approximately 50,000 ppb in the shallow wells adjacent to them. Levels of semivolatiles were also proportionately lower in the deep wells. New Jersey drinking water standards for several compounds were greatly exceeded in the two shallow wells located downgradient from the excavated storage tank.

Monitoring well MW9, which was installed to partially delineate the horizontal extent of the contaminant plume from the excavated waste storage tank,

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contained almost no organics. A total of less than 10 ppb of volatile organics was detected in the well, and less than 100 ppb of semivolatile TIC's. The concentration of tetrachloroethylene exceeded the NJ drinking water standards by 1.4 ppb.

Monitoring well MW10 was installed to determine water quality downgradient from high levels of organics associated with the drum storage area delineated by soil samples 10D, 17S and 7S. This well contained approximately 225 ppb of volatile organic compounds (including 104 ppb of trichloroethylene, and 112 ppb of tetrachloroethylene, both of which exceed NJ drinking water standards), and some semivolatile TIC's. The types of volatiles detected in the well are similar to those found in MW2 and MW8, although the levels were substantially lower. The types of compounds are not similar to the compounds found in the soil samples collected from this area, which consisted primarily of semivolatile phthalates.

In addition to organic compounds, many of the wells exceeded one or more inorganic parameter levels for New Jersey drinking water standards. Iron, in particular, was detected at levels over 300 ppb in all except one of the monitoring wells. The iron levels ranged across two orders of magnitude, and was present at a concentration of over 50,000 ppb in MW1, which is generally free from organic compounds and therefore is can probably be considered an upgradient (background) well. At the other end of the site, MW4, which is also remote from known site activity, the iron level is only 280 ppb (the only well with an iron concentration below the NJ drinking water standard). About half of the wells contained high manganese contents. In general, the higher manganese levels correlated with high concentrations of other organic

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compounds; the wells in which manganese exceeded drinking water standards were MW2, MW2b (exceeded by 8 ppb), MW3, MW7, MW8a, MW9, and MW10. Cadmium drinking water standards were exceeded slightly in three wells (MW1, MW3 and MW5), and chromium levels were high in MW9 and MW10.

No PCB's or pesticides were detected in any groundwater samples.

The off-site Filokowski well contained methylene chloride (3.04 ppb) and acetone (2.24 ppb), both of which are common laboratory contaminants. Also present were several semivolatile organic compounds which were detected in the method blank. The well did contain 10 ppb of a semivolatile organic TIC, 3-penten-2-one, which cannot be attributed to laboratory contamination. This compound was also detected at a similar concentration in MW6.

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## DISCUSSION OF SAMPLING RESULTS

The results of the soil sampling indicate that delineation of the extent of elevated levels of PP+40 compounds in targeted areas of concern will probably not be possible. Although some of the samples intended to delineate areas of concern were relatively free of detectable compounds, other sampling locations contained as high or higher concentrations of compounds than the original sample. Of the sampling which has been completed to date, it can be demonstrated that isolated areas containing high levels of organics or other parameters exist, but the extent of each area does not appear to be readily identified. Even if each of the identified areas of concern was delineated, it could be argued that additional random sampling would reveal additional areas of concern which would need to be addressed.

The results of the groundwater sampling indicate that despite relatively high levels of targeted compounds in the soil in several drum storage areas, the quality of the groundwater in those areas does not necessarily reflect a similar degree of groundwater degradation. For example, despite the presence of semivolatile organics in the drum storage area around soil sample 10S, the groundwater in monitoring well MW10 did not exhibit the presence of this type of compound. A similar situation exists near monitor well MW5; although deep soil samples collected near the monitoring well contained over 10,000 ppb of semivolatile TIC's, almost no semivolatile TIC's were detected in the groundwater sample collected from MW5 (although the levels of 1,2 Dichloroethane and methylene chloride exceed New Jersey drinking water standards).

Presumably, all (or at least a substantial portion) of the compounds

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currently present in the groundwater originated from percolation of recharge in the form of precipitation through the soil. The pattern of high levels of compounds in the soil, and much lower concentrations in the groundwater suggests that the compounds have remained in the soil. The soil contains high enough levels of targeted compounds, however, to continue to contribute to groundwater degradation, and as long as the soil remains exposed to percolating surface water, the quality of the groundwater is unlikely to improve.

The areas of particular concern are associated with the two locations where direct introduction of substantial quantities of free product occurred: the unlined waste storage pit, and the excavated waste storage tank. The soil in both locations still contains high levels of organics (soil around the waste pit was sampled during Phase I work), and although neither area has been actively used for at least several years, the compounds apparently present in the soil still act as a continuing source for groundwater contamination.

Unlined Waste Storage Pit:

The groundwater samples collected downgradient from the unlined waste storage pit in the inactive portion of the site revealed concentrations of compounds which are greater than had previously been detected (based on the initial analysis of MW3). Tetrachloroethylene, trichloroethylene, methylene chloride and chlorobenzene exceed New Jersey drinking water standards in one or both of the wells. Although no additional soil samples were collected from this area during Phase II work, the samples collected both from the pit area and from MW3 during drilling (Phase I) suggest that the soil, particularly near the surface, contains compounds which may leach into the groundwater. The levels

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of the organics from this area are not as high as the concentrations downgradient from the excavated waste storage pit; the lower concentrations may be attributable to any of a number of reasons. For example, the compounds may have resided in the pit for a much shorter time than in the storage tanks, or the materials in the pit may have contained lower concentrations of organic compounds, or it may reflect a longer period of time since the pit was used. In addition, the pit appears to be lined with a semi-impermeable layer of clay; it frequently contains water long after storm water in other areas of the site has disappeared. A combination of these factors all may contribute to the comparatively low levels of organics downgradient of the storage pit. Nonetheless, the concentration of organics are sufficiently high that some clean-up action is warranted, and because the original area of the pit is both well defined and relatively limited is size, it is reasonable to consider removal of soil from this area to prevent additional release of compounds to the groundwater. This will be discussed later in the Recommendations section of the report.

Excavated Underground Waste Storage Tanks:

The results of the analyses of the wells in this area revealed several characteristics about the contaminant plume, particularly concerning its horizontal and vertical extent. Although the Phase I remedial investigation report indicated the possibility that a plume may not have migrated past the property boundary, this is clearly not the case. This possibility was based partially on values for hydraulic conductivity which were revised during the Phase II testing (discussed later); the level of contamination in well MW8a (located on the property boundary) eliminates any possibility that a plume has been restricted to on-site boundaries.

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On the other hand, the horizontal extent of the plume can be demonstrated by wells MW9 and 10. Both wells are located downgradient, and slightly cross gradient, to monitor the transverse migration of the plume. MW9 contained almost no detectable compounds, even though it is located only about 90 feet south along the property boundary from MW8a. The lack of organics in MW9 suggests that the contaminant plume from the excavated storage tank for some reason has not dispersed as readily in a transverse direction, at least toward the south. MW10, positioned on the property boundary north of MW8, contains some of the same contaminants as were present in MW8 and MW2, such as trichloroethylene and tetrachloroethylene, although BTEX, present in large concentrations in MW2 and MW8, are absent in MW10. It is possible that the compounds in MW10 did not originate from the excavated storage tank, but as mentioned previously, the compounds present in MW10 also do not match those present in the soil. It is therefore considered likely that MW10 is monitoring the water quality of a portion of the plume created by the excavated UST. The relatively low concentration of organics (compared to MW8 and MW2) suggests that MW10 is near the horizontal extent of the plume.

The soil sample collected from MW8b was collected at depths just above and just below the water table; the concentration of compounds in the soil sample was orders of magnitude higher than the groundwater in well 8a, and probably represents high concentrations of organics water present at the water table surface. The ethylbenzene, toluene and xylenes present in the soil sample are all lower density than water, and therefore presumably float on the water table. There may also be a buildup of organics in the near-water table sediments either from increases and decreases in the water table which leave residues in the soil, or from volatilization of organics from the water table into the soil. It is unlikely that the compounds in the groundwater originate in the soil at MW8; it is more likely that the high concentrations of compounds in the soil originate in the water.

## HYDROLOGIC ANALYSIS

### Hydraulic Gradient and Groundwater Flow Direction

Water level measurements were collected at each well location prior to conducting slug tests on the wells (June 19), and prior to collection of groundwater samples (June 13). These water level measurements, and elevations of the wells were used to estimate the hydraulic gradient at the site. Elevations of the casings of the new wells, and water levels in the wells collected on both days are shown in Table 12.

Table 12

Well Casing and Water Level Elevations

| Well # | Water Level (ft. BTC) 6/13 | 6/19 | Casing Elevation (ft. above S.L.) | Water Elevation (6/19) (ft. above S.L.) |
|---|---|---|---|---|
| 1 | 13.18 | 13.29 | 139.70 | 126.41 |
| 2a | 13.39 | 13.42 | 139.09 | 125.67 |
| 2b | 12.31 | 12.27 | 138.00 | 125.73 |
| 3 | 9.99 | 10.10 | 134.94 | 124.84 |
| 4 | 4.00 | 4.01 | 128.51 | 124.50 |
| 5 | 14.46 | 14.35 | 140.14 | 125.79 |
| 6 | 13.56 | 13.40 | 139.74 | 126.34 |
| 7 | 9.61 | 9.62 | 133.59 | 123.97 |
| 8a | 13.31 | 13.39 | 138.76 | 125.37 |
| 8b | 13.32 | 13.25 | 138.65 | 125.40 |
| 9 | 12.69 | 12.88 | 138.20 | 125.32 |
| 10 | 13.50 | 13.61 | 139.11 | 125.50 |

The horizontal hydraulic gradient and direction were determined using a three point solution method (Heath, 1983) shown in Appendix 4 from data collected from various combinations of monitor wells. The mean hydraulic gradient (dH/dL) was calculated by measuring the maximum change in hydraulic head (dH) over a given distance (dL). The mean direction of flow was assumed to be perpendicular to the hydraulic gradient. Using this solution, the mean gradient was estimated to be $1.65 \times 10^{-3}$, and the mean direction of flow was S7°W.

The presence of vertical gradients was investigated by the installation of two sets of "nested" wells, consisting of two adjacent wells screened at different elevations within the saturated zone. Wells 2 and 2b are screened at depths of 11 feet to 21 feet and at 33 feet to 48 feet, respectively. Wells 8a and 8b are screened at depths of 9 feet to 19 feet, and at 30 feet to 40 feet, respectively. The water levels listed in Table 11, above, indicate that in the well pair 2 and 2b, the groundwater level in the deeper well (2b) is higher than in the shallow well. Because the gradient is in the direction of high to low hydraulic head, the vertical gradient appears to be slightly upward, although the differences in head are very slight. In the well pair 8a and 8b, the water levels are very similar, although again, the head in the deeper well is slightly higher, suggesting a small upward vertical gradient. An upward vertical gradient would help to retard downward migration of compounds, thus helping to prevent contamination of deeper portions of the aquifer.

<u>Falling Head Piezometer Tests</u>

Piezometer tests, which were conducted on wells 1-6 during the Phase I investigation, were repeated on both the newly installed wells, and the existing wells. A pressure transducer connected to a data logger was used to

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measure the change in water level during the test. Appendix 4 lists the data collected during the tests.

Hvorslev's method (Freeze and Cherry, 1979) was used to analyze the data collected during the piezometer tests. The graphs illustrating the method are shown in Appendix 4, and a list of the hydraulic conductivity values calculated from the test is contained in Table 13. Each well was tested two or three times, depending on the repeatability of the test; Table 13 lists the average hydraulic conductivity value for each well.

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Table 13

Hydraulic Conductivity and Transmissivity Values

| Well # | Test # | Hydraulic Conductivity (ft/sec) | Mean | Transmissivity (ft2/sec) |
|---|---|---|---|---|
| 1 | 1 | 1.70 E-4 | 4.97 E-4 | 8.2 E-2 |
| | 2 | 7.93 E-4 | | |
| | 3 | 5.29 E-4 | | |
| 2 | 1 | 1.92 E-4 | 2.33 E-4 | 3.8 E-2 |
| | 3 | 2.74 E-4 | | |
| 2b | 1 | 5.91 E-4 | 5.65 E-4 | 9.3 E-2 |
| | 2 | 5.38 E-4 | | |
| 3 | 1 | 5.55 E-4 | 6.85 E-4 | 1.1 E-1 |
| | 2 | 7.07 E-4 | | |
| | 3 | 7.94 E-4 | | |
| 4 | 1 | 2.16 E-3 | 1.53 E-3 | 2.6 E-1 |
| | 2 | 1.25 E-3 | | |
| | 3 | 1.19 E-3 | | |
| 5 | 1 | 5.51 E-4 | 5.60 E-4 | 9.2 E-2 |
| | 2 | 5.68 E-4 | | |
| 6 | 1 | 6.81 E-4 | 6.40 E-4 | 1.1 E-1 |
| | 2 | 6.81 E-4 | | |
| | 3 | 5.58 E-4 | | |
| 7 | 1 | 8.85 E-4 | 8.85 E-4 | 1.5 E-1 |
| | 2 | 8.85 E-4 | | |
| 8a | 1 | 1.18 E-3 | 1.03 E-3 | 1.7 E-1 |
| | 2 | 8.81 E-4 | | |
| 8b | 1 | 8.81 E-4 | 8.37 E-4 | 1.4 E-1 |
| | 2 | 7.93 E-4 | | |

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Table 13, con't

Hydraulic Conductivity and Transmissivity Values

| Well # | Test # | Hydraulic Conductivity (ft/sec) | Mean | Transmissivity (ft2/sec) |
|---|---|---|---|---|
| 9 | 1 | 3.44 E-4 | | |
| | 2 | 4.11 E-4 | 3.67 E-4 | 6.1 E-2 |
| | 3 | 3.47 E-4 | | |
| 10 | 1 | 1.80 E-3 | | |
| | 2 | 1.44 E-3 | 1.62 E-3 | 2.7 E-2 |

Estimates of the hydraulic conductivity were used to estimate transmissivity of the Cohansey aquifer using an estimated saturated thickness of 165 feet in this area (Zapecza, 1984). The resultant transmissivity values are also listed in Table 13. These values overall are higher than the values obtained during Phase I testing, presumably due to greater accuracy obtained using the data logger system. The transmissivity of various wells ranged from 0.038 ft2/sec (24,800 gpd/ft) to 0.26 ft2/sec (170,000 gpd/ft). The mean transmissivity for the site was 0.11 ft2/sec (68,200 gpd/ft), which is within the range listed for the Cohansey aquifer within Burlington County (15,000 to 150,000 gpd/ft), as reported by Rush, 1968. It should be noted that this hydraulic conductivity is very high, and is probably best measured using pumping tests rather than piezometer tests.

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## CONCLUSIONS

1. Delineation of high concentrations of primarily volatile and semivolatile organics (although metals and pesticides were also present) in the soil in active areas of the site was not successful. Phase II soil sampling locations were chosen for the purpose of delineating "hot spots" identified during Phase I sampling. However, many of the Phase II locations also contained elevated concentrations of targeted compounds.

2. The installation of six additional monitoring wells was intended to provide a more complete representation of groundwater quality associated with specific areas identified during Phase I sampling. Four wells (MW2b, MW8a, MW8b and MW9), were intended to track the horizontal and vertical extent of contaminated groundwater from the excavated underground waste storage tanks. MW7 was installed downgradient from the unlined waste storage pit, and MW10 was intended to monitor groundwater downgradient from a drum storage area containing high levels of primarily semivolatile compounds. Four of the six wells were located along the downgradient property boundary, and therefore provided information concerning the quality of groundwater migrating off-site.

   The results of the monitoring well sampling indicated that the contaminant plume migrating from the excavated waste storage tanks still has high levels of contaminant compounds near the source, and at the property boundary. The plume appears to be somewhat constrained horizontally, as indicated by the very low levels of compounds present in MW9, and the comparatively low concentrations in MW10. The vertical

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migration of contaminants has also apparently been retarded by the lack of vertical downward hydraulic gradients within the aquifer. The retardation of downward migration of organics has been demonstrated by the relatively low concentrations of these compounds in the samples collected from wells MW2b and MW8b, which have been screened at depths of 28 feet and 30 feet.

The longitudinal extent of the plume has not been delineated; it had been thought possible that the plume had been largely contained within the property boundaries, but the high concentrations of organics in MW8a indicate that the downgradient extent of the plume has migrated off-site.

3. The groundwater downgradient from the unlined waste storage pit appears to contain higher concentrations of organic compounds than were indicated during Phase I sampling. Both wells MW3 and MW7 contained volatile and semivolatile organics, several of which exceed New Jersey drinking water standards.

4. The results of the sampling of MW10 and MW5, which are downgradient from drum storage areas containing relatively high concentrations of targeted compounds in the soil, contained only low levels of the compounds present in the drum storage area soil. This result suggests that the soil in the drum storage areas, which presumably has been exposed to surface releases of materials contained in the drums, does not contribute to substantial groundwater contamination.

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5. Hydraulic conductivity testing of the aquifer through the use of slug tests indicated that the resultant hydraulic conductivity is higher than was measured during Phase I work; this is possibly due to the use of a data logger and pressure transducer to measure the water levels during the test. The conductivity values are very high, but are within published ranges listed for the Cohansey-Kirkwood aquifer. The direction of groundwater flow was found to be similar to the direction estimated during the Phase I work.

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## RECOMMENDATIONS

For the purpose of considering alternatives for remediation and/or some additional investigation, the site is divided into four areas which will be addressed separately.

### 1. Diesel Fuel Tanks

Soil samples collected from the diesel fuel tank excavation contained levels of contamination indicating a tank leak or similar release. The excavation should be treated as a standard UST investigation using NJDEP guidelines: the contaminated soil should be removed from the excavation, and the downgradient monitoring well (MW5) should be resampled and analyzed for EPA 624+15 (including xylene) and 625+15.

### 2. Drum Storage/Active Area

The soil in the various drum storage areas contains isolated locations with high levels of primarily volatile and semivolatile compounds. Although there are no standards or limits for defining soil contamination, the compounds detected in the soil samples represent a possible threat to groundwater quality. It should be noted that it has not been established that groundwater quality has been severely impacted by site activity. Nonetheless, the presence of organic compounds at elevated levels indicates that alternatives for dealing with the soil should be discussed. Alternatives for the soil include: 1) No action other than continued groundwater monitoring; 2) Locating, delineating and removing each "hot spot"; 3 Capping the area to retard movement of water through the unsaturated zone.

Alternative 1 (no action other than continued groundwater monitoring) is

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included as an alternative because although the levels of soil contamination in some spots are high, the groundwater downgradient from the drum storage areas does not appear to be impacted by this contamination. Nonetheless, because relatively little is known about the conditions under which the soil contamination occurred, it is not considered reasonable to ignore it.

Alternative 2, locating and removing each "hot spot", would be impractical. Even using a grid to sample random locations in order to identify these spots would not guarantee that each spot has been identified. The cost involved in additional sampling, analysis, and removal would be extremely expensive for a possibly negligible benefit. Therefore, this is not considered a reasonable solution.

Capping the active portion of the site where drums and trailers have been stored to prevent or retard infiltration through the contaminated soil (alternative 3) is intended to prevent a substantial amount of contamination from reaching the water table. In the drum storage areas, where soil contamination is predominantly surficial, this option would seem to be both reasonable and effective. This method, combined with periodic monitoring of groundwater quality, should prevent or at least detect off-site migration of contaminants. Another advantage of capping the active portion of the site with macadam or other material would be to largely prevent any subsequent spills from drums to enter the soil.

3. Unlined Waste Storage Pit

Alternatives for handling the contamination from the unlined waste storage pit include: 1) No action other than continued groundwater monitoring; 2)

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Excavation of soil from the pit to remove the presumed source of contamination; 3) Collection and treatment of the groundwater contaminant plume emanating from the area.

The first alternative is not considered feasible for several reasons. Although the levels of groundwater contamination downgradient from the unlined waste storage pit are not high relative to other areas of the site, several parameters exceed the NJ drinking water standards. In addition, even though no monitoring wells are located so as to intercept groundwater downgradient from the storage pit at the property boundary, the downgradient wells MW3 and MW7 are not far from the site boundary, and it is possible that contaminated groundwater from the area has migrated off-site.

Removal of contaminated soil from the ground surface to the water table (Alternative 2) may be a reasonable alternative for eliminating the presumed source of contamination. Because of the limited area of the original pit (which can be visually inferred), removal of soil from the pit could be accomplished. However, very little is known about the extent or concentration of compounds in the soil beneath the pit. It would be difficult to even attempt to determine how much soil would need to be removed without additional sampling. Analysis of soil samples from Phase I sampling suggests that organic compounds may be present at higher concentrations at the surface, but is present at depth in the soil. Therefore, although removal of soil from the pit to eliminate or at least reduce the source of contamination is believed to be viable, this option should be undertaken only after some additional sampling takes place.

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Although pumping and treating the groundwater plume is an option (Alternative 3), it is considered more important at this time to eliminate the source of contamination. If the source can be isolated and removed, a decrease in levels of parameters present can be expected. If the concentration of parameters does not rapidly decrease, then identification and treatment of the groundwater plume should be considered. In the meantime, periodic sampling of the downgradient wells MW3 and MW7 is recommended.

### 4. Excavated Underground Storage Tank

The contaminant plume migrating from this area represents the most serious problem on the site, primarily because of the very high levels of volatile and semivolatile compounds present in both soil and groundwater. Contaminated soil left in the original excavation appears to represent the source of the contamination, and the soil should be removed.

The extent of off-site migration of the plume must be established to allow a groundwater recovery system to be effective. The geophysical survey conducted earlier in the spring did not adequately delineate the plume, and installing additional monitoring wells without some indication of the plume's extent would be extremely random. A soil vapor survey using a field gas chromatograph is recommended as a possible method for determining the extent of the plume.

Contaminated soil appears to persist along the path of the plume for some distance downgradient from the tank location. It is not possible to determine whether the soil is a major contributor to groundwater contamination, and therefore a discussion of remediation of the soil in this area is premature.

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After the soil in the tank area is excavated and groundwater remediation is initiated, an analysis of the contributory effect of the soil along the plume may be easier.

It is premature to discuss remediation options in detail for this area. Because no pumping tests have been conducted yet, it is not possible to even estimate operating flow rates for any particular system. The variety and concentrations of compounds will require the consideration of several types of treatment for water and soil. In the meantime, at least one short term pumping test should be conducted on the site to analyze the effect of pumping on the aquifer. When the pumping test(s) is concluded, a feasibility study of options for treating the groundwater should be completed.

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