COLUMBIA CEMENT COMPANY, INC.
159 HANSE AVENUE
FREEPORT, NEW YORK 11520

SITE # 1-30-052

PHASE II REMEDIAL INVESTIGATION WORK PLAN

Prepared for:

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SIGNATURE PAGE

12/22/99

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Project Quality Assurance Officer

Date

12/22/99

Reviewed by John Brust
Project Manager

Date

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1.0 INTRODUCTION

1.1 PURPOSE

This document presents a work plan for implementation of the Phase II remedial investigation (RI) for Burmah Castrol (BC) at the Columbia Cement Co., (CCC) site (Site No. 1-30-052) located at 159 Hanse Avenue, Freeport, New York (Figure 1). Phase I of the remedial investigation has been completed and a draft Remedial Investigation Report dated May 1999 has been submitted to the New York State Department of Environmental Conservation (NYSDEC), the New York State Department of Health (NYSDOH) and the Nassau County Department of Health (NCDH) for review and comment. The Phase II RI work plan presented herein describes activities to be performed during Phase II of the RI to address additional data requirements.

A Field Health and Safety Plan (FHSP), Sampling and Analysis Plan (SAP) and a Citizen's Participation Plan (CPP) were developed by Delaware Engineering, P.C. (Delaware) for Phase I of the RI and have been previously provided. The site-specific FHSP is intended to ensure the health and safety of workers and the immediate community during performance of the RI. An addendum to the FHSP will be prepared to address the specific health and safety issues expected to be encountered during Phase II of the RI, which were not considered during Phase I (*e.g.*, working over water). The SAP contains both a Field Sampling Plan (FSP) and a Quality Assurance Project Plan (QAPP). It outlines data quality objectives and details the specific sampling procedures and the relevant sampling and analytical protocols to ensure that the data collected during the RI are of sufficient quality to support remedial decisions. Sampling and analysis issues specific to Phase II of the RI are addressed in Section 2 of this work plan. The CPP outlines activities to ensure adequate involvement of the community in the remedial process. As specified in the CPP, a fact sheet detailing the findings of the Phase I RI will be prepared following NYSDEC approval of the Phase I report.

1.2 SITE DESCRIPTION

The approximately two-acre site is located in an extensively developed industrial and commercial area in the Village of Freeport, Nassau County, New York. Site geographic coordinates are 40°38' 45" North latitude and 73°34' 21" West longitude.

On a regional scale, the Site is situated approximately 4,000 feet south of the Sunrise Highway and 2,000 feet west of the Meadowbrook State Parkway. Locally, the Site is east and north of Hanse Avenue, south of Rider Place and west of Buffalo Avenue Extension (Figure 1).

Industrial and commercial facilities bordering the Site include a Columbia Cement warehouse to the north, Lea Ronal Specialty Chemicals Worldwide (224-272 Buffalo Avenue Ext.) to the east, the Knickerbocker building to the south and Farber Plastics (162 Hanse Avenue) to the west. The Site is located approximately 500 feet east of the Freeport Creek, approximately 1,000 feet to the west of the Stadium Park Canal (also referred to as the Merrick River), and 4,000 feet to the northwest of Merrick Bay on the southeast shore of Long Island. The local storm-water drainage system, serving CCC, discharges into Freeport Creek approximately 1,000 feet northwest of the Site.

The Site is very flat, sloping gently from north to south, with all elevations greater than 5 feet and less than 10 feet above mean sea level. A survey benchmark was established by Rust Environment & Infrastructure (Rust) on utility pole F34, located along the middle of the eastern property line, and an assumed datum of 100.00 was applied. The range of elevations encountered at the Site is 97.63 to 99.07 feet.

CCC manufactured various grades of contact cement and other industrial/commercial adhesives at this location since 1969. The property is currently owned by Illinois Tool Works. The main building is improved with office space, a mill room, two mixing rooms, two filling rooms, two storage rooms, a hazardous waste containment area, a small warehouse/reuse station, a temporary storage area and an unloading/loading area. Fifteen-foot wide ingress and egress easements are located along the northern and southern property boundaries. A parking lot for employees is located west of the building. The southeastern portion of the Site is paved and serves as an unloading and storage area for process chemicals. Ten 8,000-gallon underground storage tanks (USTs) are present in this area.

1.3 SITE HISTORY

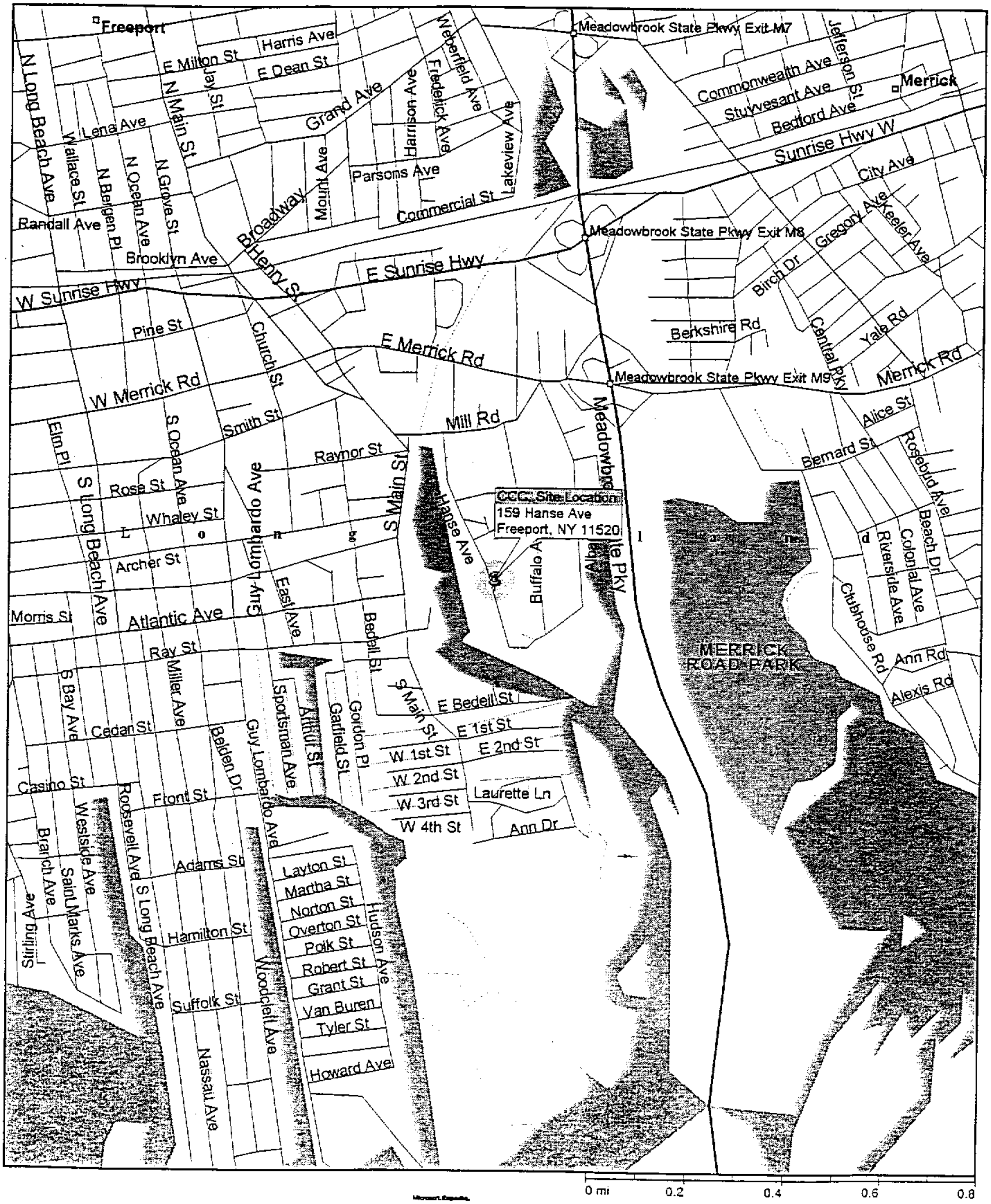
The Village of Freeport operated a municipal landfill within this area of Freeport prior to its development for commercial/industrial use. Representatives of the Village of Freeport indicate that the land filling ceased in the 1960's, and that development of this portion of Freeport began soon thereafter. The CCC operations are the first and only commercial/industrial activity at the Site since the land filling ceased.

Spill Incident

On April 28, 1988, Quadrel Brothers of Rahway, New Jersey delivered approximately 3,500 gallons of TCA to the Site. During delivery, the truck became over pressurized causing the tanker to buckle. As a result, TCA spilled onto the adjacent pavement. The NYSDEC was promptly notified, and emergency response to the spill incident was provided by NYSDEC's Region 1 Spill Response Unit.

The material remaining in the tank trailer (approximately 1,740 gallons of TCA) was recovered in 55-gallon drums. The remaining material (approximately 1,760 gallons) flowed towards an on-site storm drain. As a result, an undetermined amount of spilled material entered the Site storm drains. The storm drains ultimately drain into Freeport Creek approximately 1,000 feet to the northwest of the TCA Spill Area. Immediate clean-up activities consisted of the following: 1) Removing liquid and approximately ten yards of soil from the noted storm drain and 2) Removing liquid material from the storm drain system. The drainage system was purged until

Figure 1 Columbia Cement Site Location



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sampling results showed concentrations of TCA below 50 parts per billion (ppb). At this time, three exploratory soil borings were advanced and one shallow overburden monitoring well was installed. Split spoon samples taken from two of the borings revealed TCA concentrations in soil ranging from 67 parts per million (ppm) to 42,649 ppm.

Following the TCA Spill, a new (northern) underground tank farm, comprised of five 8000-gallon tanks, was installed to the north of the aforementioned storm drain. After completion of the northern underground tank farm installation, a concrete pad was installed over the northern and southern tank farms. In February of 1989, the concrete pad was removed and replaced with a thicker concrete pad because of cracking noted in the original pad.

1.4 SUMMARY OF PHASE I RI FINDINGS

This section summarizes the information obtained from the Phase I RI investigation and provides conclusions based on this information. The Phase I RI data and the conclusions presented in this section provide answers to the Site environmental data gaps which implementation of the Phase I RI field investigation was intended to fill.

- The sub-surface boring soil data show that with the exception of the sub-surface soil in the vicinity of the original spill (SB-98-2, SB-98-3), sub-surface soil volatile organic concentrations do not significantly exceed the site-specific RSCOs and sub-surface soils are not significantly impacted. The SB-98-2 and SB-98-3 sub-surface boring samples indicate that sub-surface soils in the vicinity of the original 1,1,1-trichloroethane spill continue to represent a source of volatile organics (1,1,1-trichlorethane, 1,1-dichloroethane, 1,1-dicloroethene, ethylbenzene, toluene and xylene).

- The volatile data from borings SB-98-2, SB-98-3, SB-98-4, MW-98-8D, MW-98-9D and MW-98-10D and the groundwater analytical data, confirm the absence of DNAPL pools on the Tidal Marsh and Gray Silt & Clay units. Any potential discrete zones of disconnected residual ganglia trapped within pores of the sub-surface soil below the water table is limited to the Fill unit in the vicinity of SB-98-2 and SB-98-3.

- The sub-surface boring data indicate that semi-volatile organic, pesticides, PCBs and metals are not parameters of concern in Site soils.

- The MW-98-8S and MW-98-8D groundwater data indicate that groundwater data east of the spill area has not been significantly impacted by volatile organic compounds. No volatile organic compounds were detected in the MW-8S groundwater sample. With the exception of chloroethane, no volatile organic compounds were detected above the groundwater standard in groundwater from MW-98-8D

- Groundwater data from monitoring wells MW-97-1S, MW-97-2S, MW-98-9D and MW-98-10D show that groundwater along the western perimeter of the Site has not been significantly impacted by volatile organic compounds. Data indicate that with the exception of chloroethane (southwest) and chlorobenzene (northwest), groundwater at the western Site boundary does not exhibit volatile organic compounds at concentrations above the groundwater standard.

- Groundwater flow direction during high tide is primarily to the west with a slight northwest component of flow in the northwest quadrant of the Site. During low tide flow in the vicinity of the spill area is to the south and southeast. Although there is a component of groundwater flow in a southeasterly direction in the vicinity of the spill area, this appears to occur only during low tide conditions. The net movement of groundwater is to the west with a slight northwesterly component in the northwestern quadrant of the Site.

- The groundwater flow data indicate that the monitoring wells pairs (MW-97-1S/MW-98-9D and MW-97-2S/MW-98-10D) along the western perimeter of the Site are positioned such that they would intercept any significant dissolved phase volatile organic compounds that originated from the spill area. Data indicate that additional monitoring wells on the western perimeter of the Site are not necessary. However, due to the southeasterly flow of groundwater during low tide conditions, an additional deep overburden monitoring well south of the spill area may be necessary to define the lateral extent of any groundwater plume.

- The apparent low vertical hydraulic conductivity of the Fill and Tidal Marsh Silt unit, when present, suggests that these units may locally restrict flow between the Fill and upper Gravelly Sand unit. This characteristic most likely functioned to limit the movement of 1,1,1-trichloroethane from the spill area.

- Groundwater flow rates and chemical retardation factors indicate a minimum of 18 years for 1,1,1-trichoroethane and degradation products to reach the western Site boundary. Data indicate that chemicals in the spill area would not have reached the western site perimeter via movement along the groundwater table gradient.

- Low concentrations of volatile organic compounds in the storm drains on the south side of the building and the potential preferential movement of dissolved phase volatile organics (via groundwater) along the storm drain line, may potentially represent a partial source of the volatile organics detected in groundwater from monitoring wells MW-97-6S, MW-97-1S and MW-98-9D.

- The Phase I soil gas investigation showed that soil vapor volatile organic concentrations at the Site perimeter were below NIOSH occupational standards and do not represent a health concern to on-site workers. Additional samples, with a reporting limit of 10 ug/m^3 will be collected along the southern perimeter of the Site, and compared to typical background indoor air concentrations.

- Data indicate the SD-1 storm drain represents a potential source of dissolved phase volatile organics to the storm drain system and Freeport Creek.

- Low concentrations of volatile organic compounds were detected in the SD-8 storm drain.

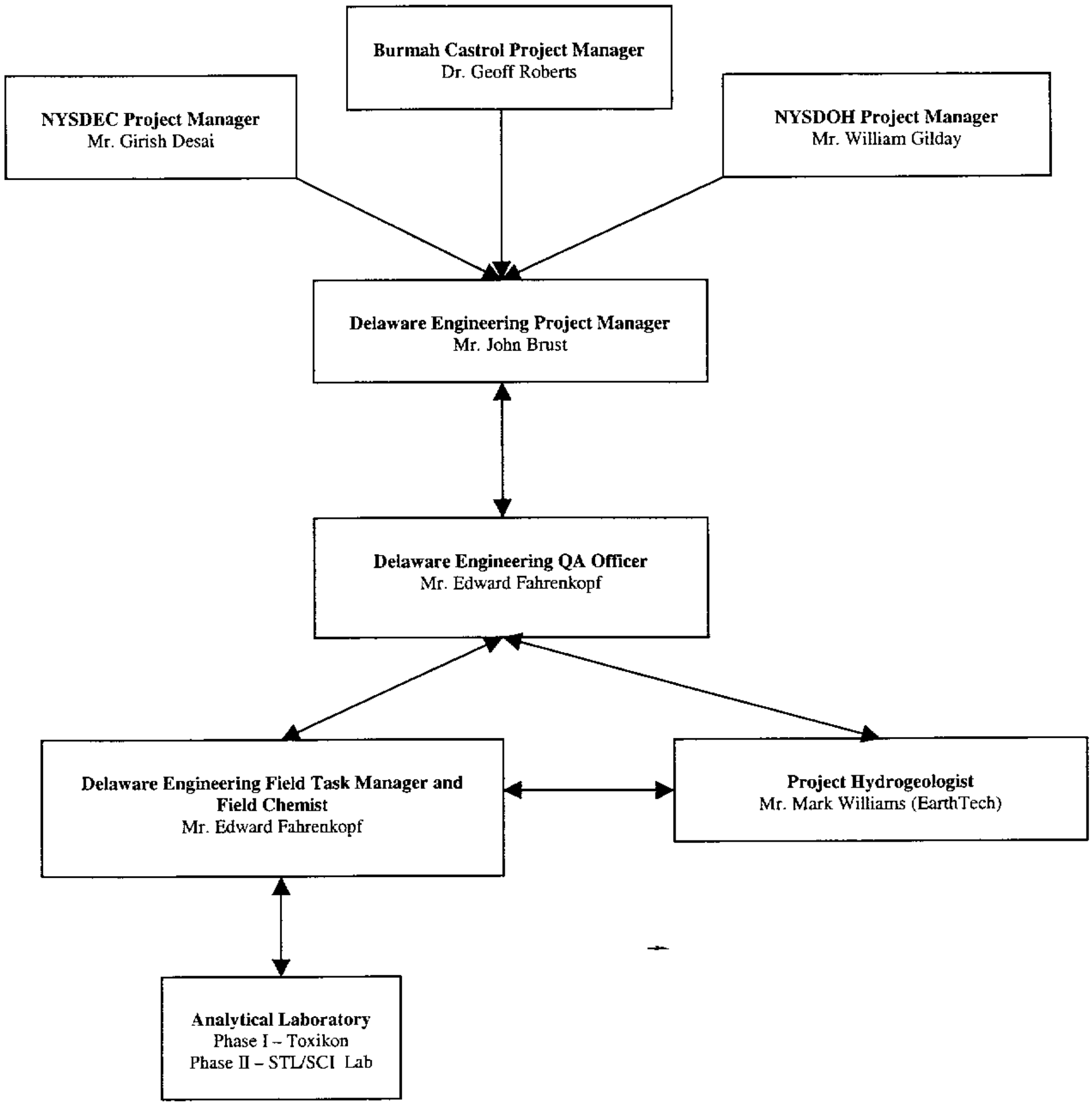
1.5 REMEDIAL INVESTIGATION PROJECT ORGANIZATION

Burmah Castrol Trading Limited has retained Delaware to perform the RI/FS investigation at the Columbia Cement Site. The Delaware personnel involved in the project have extensive experience in conducting environmental investigations. The project organization is provided below. Resumes were presented in Appendix A of the Phase I Remedial Work Plan, with the exception of the Severn Trent Laboratories (STL) Project Manager and STL QA officer, which are presented in the STL Quality Assurance Plan (Appendix A of this work plan).

Mr. John Brust is the RI/FS project manger for Delaware Engineering and is responsible for overall coordination and implementation of the project. Mr. Brust will continue to report to the Burmah Castrol project manager (Dr. Geoff Roberts) on a routine basis, and Mr. Brust or his designee will also continue keep the NYSDEC (Mr. Girish Desai) and the NYSDOH (Mr. William Gilday) updated on the status of the RI/FS.

Mr. Edward Fahrenkopf serves as the Quality Assurance Officer for Delaware Engineering. As necessary, Mr. Fahrenkopf will perform a field and sampling audit and interface with both laboratory and field personnel. Field personnel and the laboratory will bring any quality assurance/quality control concerns to Mr. Fahrenkopf's attention. Mr. Fahrenkopf will work with the Delaware project chemist and data validator to develop a project specific data usability report for Phase II of the RI.

ORGANIZATION CHART



2.0 PHASE II REMEDIAL INVESTIGATION ACTIVITIES

Based on the information obtained during the Phase I RI and previous agreements between Burmah Castrol and the NYSDEC, the following tasks will be implemented during the Phase II RI:

- The collection and analysis of surface water samples from Freeport Creek ;
- The collection and analysis of sediment samples from Freeport Creek;
- In-situ monitoring of groundwater elevations in on-site monitoring wells to further define groundwater flow patterns;
- Drill and install one deep monitoring well within the spill area that will be screened below the clay layer. Collect continuous split spoon soil samples, field photoionization detector (PID) screening of all samples and laboratory analysis of all split spoon samples below the Tidal Marsh Unit for volatile organics. The split spoon data will be used to determine the vertical extent of impacted soil within the spill area.
- Drill and install one deep monitoring well between MW-4S and MW-5S. The well will be screened at the top of the clay layer. Collect a grab groundwater sample below the clay layer from the boring using a hydropunch procedure;
- Perform in-situ hydraulic conductivity testing in the two new monitoring wells;
- The collection and analysis of groundwater samples from all on-site monitoring wells. The groundwater sample from the deep (below clay) monitoring well in the spill area and the hydropunch sample south of the spill area, will determine if groundwater below the clay layer has been impacted;
- Collection and analysis of three soil gas samples along the southern property line with low detection limits to allow comparison of the data to the NYSDOH and USEPA database of background indoor air contaminant concentrations;
- Preparation of a Human Health Exposure Assessment (HHEA); and,
- Preparation of a Fish and Wildlife Impact Analysis (FWIA).

The following sections detail the data collection tasks that will be implemented during Phase II of the RI. If during implementation of the RI the field conditions indicate a need for additional information, Delaware Engineering will confer with Burmah Castrol on the collection and analysis of additional samples.

A summary of the analyses that will be performed is presented in Table 1. Samples (except soil gas) will be analyzed by Severn Trent Laboratories (STL) of Monroe, Connecticut and SCI Lab of Albany, New York. STL and SCI LAB are New York State Department of Health (NYSDOH) ELAP ASP/CLP approved laboratories and will be required to maintain this certification throughout the RI. Copies are available upon request. The soil gas samples will be analyzed by Performance Analytical (Canoga Park California). A copy of the STL and SCI LAB Quality Assurance Plan (QAP) have been previously provided. Copies of all three laboratories QAPs are available upon request.

The samples will be collected and handled under proper chain of custody protocol. The chain of custody form will record the sample and container type, identification, a description, date and time of sampling, sampler name, method of transport and analysis requested. A complete NYSDEC ASP CLP deliverable package will be provided for all analyses.

2.1 SURFACE WATER SAMPLING AND ANALYSIS

Our objective will be to determine the presence, nature, and extent of volatile organic compounds (VOCs) in the surface water of Freeport Creek potentially associated with the reported 1988 TCA spill at the Site. A total of ten surface water samples will be collected from five locations within the creek, with two samples collected from discrete depths at each location. The proposed sampling locations are depicted in Figure 2 and described below:

1. At the outfall in Freeport Creek;

2. 50' upstream of the outfall, 25' from the eastern bank of the creek or at the point where the bank drops off, whichever is closer to shore;

3. 50' upstream of the outfall, approximately in the center of the creek;

4. 100' downstream of the outfall, 25' from the eastern bank of the creek or at the point where the bank drops off, whichever is closer to shore; and,

5. 100' downstream of the outfall, approximately in the center of the creek.

At each location, a Kemmerer bottle sampler will be used to collect a grab sample from the creek at two discrete depths: One sample will be collected from approximately one half the total depth of the creek while the second will be collected just above the bottom of the creek.

The Kemmerer sampler is a stainless steel cylinder with silicone stoppers that leave the ends open while being lowered in a vertical position to allow free passage of water through the cylinder. A messenger is sent down the line when the sampler is at the designated depth, causing the stoppers to close the cylinder, which is then raised. This allows discrete sampling with depth. Water is removed through a valve to fill the sample bottles. The Kemmerer sampler will be

Table 1

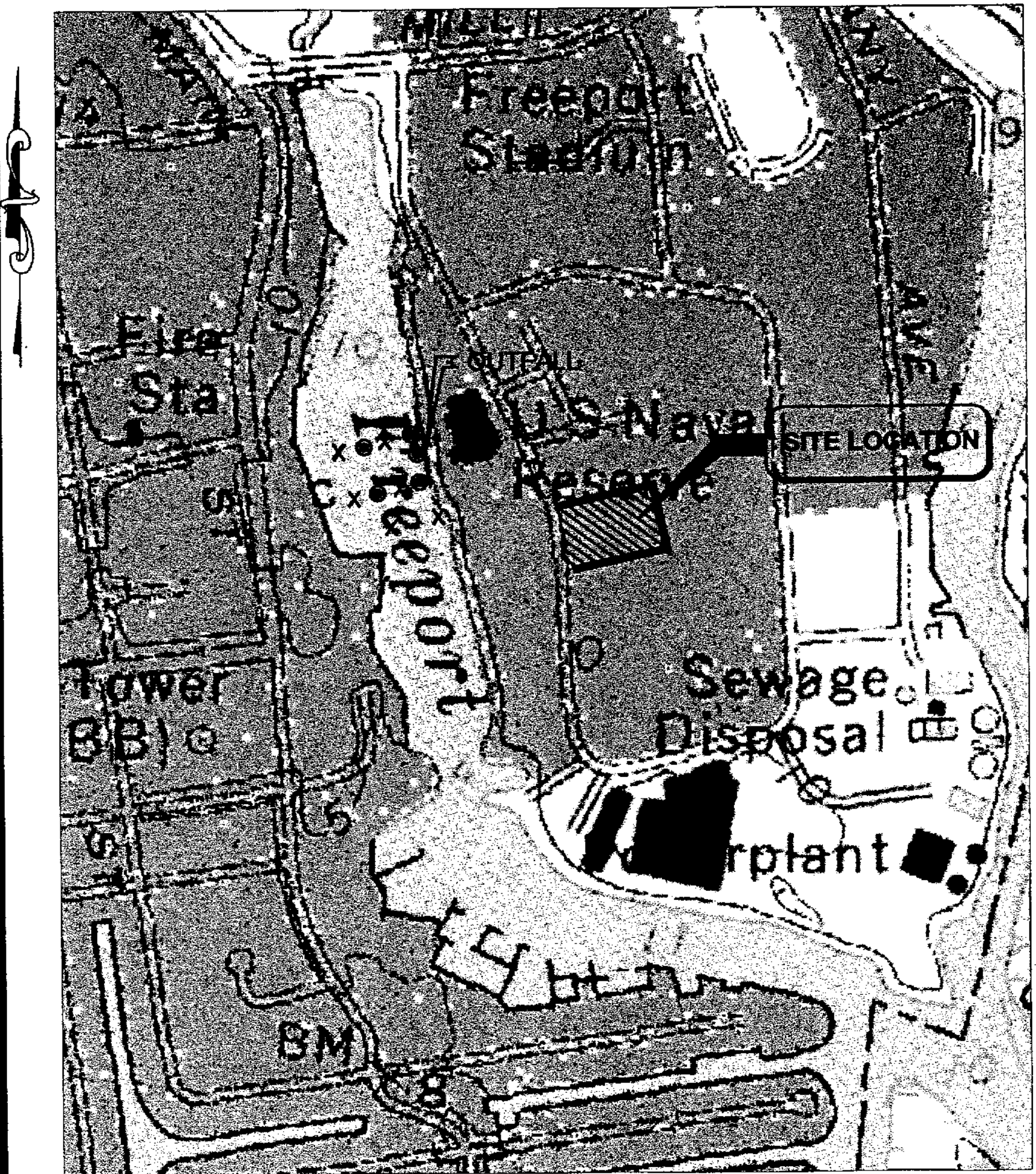
Phase II Remedial Investigation - Sample and Analysis Summary

Columbia Cement Company, Inc. Facility
Freeport, New York

Media	Number of Samples	Number of QA/QC Samples				Total Number of Samples	Analysis[5]
		MS/MSD[1]	Field Dup[2]	Equip Blank[3]	Trip Blank[4]		
Freeport Creek Surface Water	10	2	1	1	1	15	VOCs (95-1)
Freeport Creek Sediments	11	2	1	1		15	VOCs (95-1) and TOC
Monitoring Well Installation Soil Borings							
Top of Clay Well (Between MW-4S/5S)	3	2	1	1		7	VOCs (95-1) and TOC
Spill Area boring below clay[8]	9					9	
Groundwater Monitoring Wells	15	2	1		2	20	VOC's, 95-1
Groundwater Hydropunch Sample[6]	1					1	VOC's, 95-1
Soil Gas Samples[7]	3						TCL VOC's

Notes:

1) QA/QC samples will include a matrix spike (MS) and matrix spike duplicate (MSD) sample at a frequency of not less than 5% (one MS/MSD pair per every 20 samples collected) for each matrix (aqueous and soil).
2) A blind field duplicate sample will be collected at a frequency of one per every 20 samples for each matrix (aqueous and soil).
3) Equipment blanks are not required when dedicated sampling equipment is used. If non-dedicated sampling equipment is used in the soil sampling program, equipment blanks will be analyzed at a frequency of not less than 5% (one equipment blank per every 20 samples collected).
4) One trip blank will submitted for analysis for each day aqueous matrix volatile organic samples are collected. A trip blank will be included in each cooler that contains aqueous matrix volatile organic samples; therefore all volatile organic samples and containers will be shipped to and from the laboratory in the smallest number of coolers possible in order to minimize the number of trip blanks required.
5) The analytical laboratory contracted to perform the sample analyses will be a New York State Department of Health (NYSDOH), Environmental Laboratory Approval Program (ELAP) certified laboratory holding the Analytical Services Protocol (ASP) certification.
6) Sample submitted for twenty-four hour turnaround
7) Tedalar bag sample. Reporting limits 10 ug/m^3
8) Estimated number of samples.



LEGEND

◉ PROPOSED SAMPLING LOCATIONS – SURFACE WATER & SEDIMENT

X PROPOSED SAMPLING LOCATIONS – SEDIMENT ONLY

SAMPLING LOCATION

0' 250' 500'

FILENAME: SAMPLING.DWG

DELAWARE ENGINEERING, P.C.

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REVISED 12-7-99

FIGURE 2

APPROXIMATE SAMPLING LOCATIONS

FREEPORT CREEK

FORMER COLUMBIA CEMENT COMPANY SITE

FREEPORT, N.Y.

JUNE 24, 1999

decontaminated following the procedures detailed in the QAPjP between sampling locations to prevent cross-contamination. Each of the surface water samples collected will be submitted for laboratory analysis of the NYSDEC TCL VOCs using the NYSDEC ASP CLP Method 95-1.

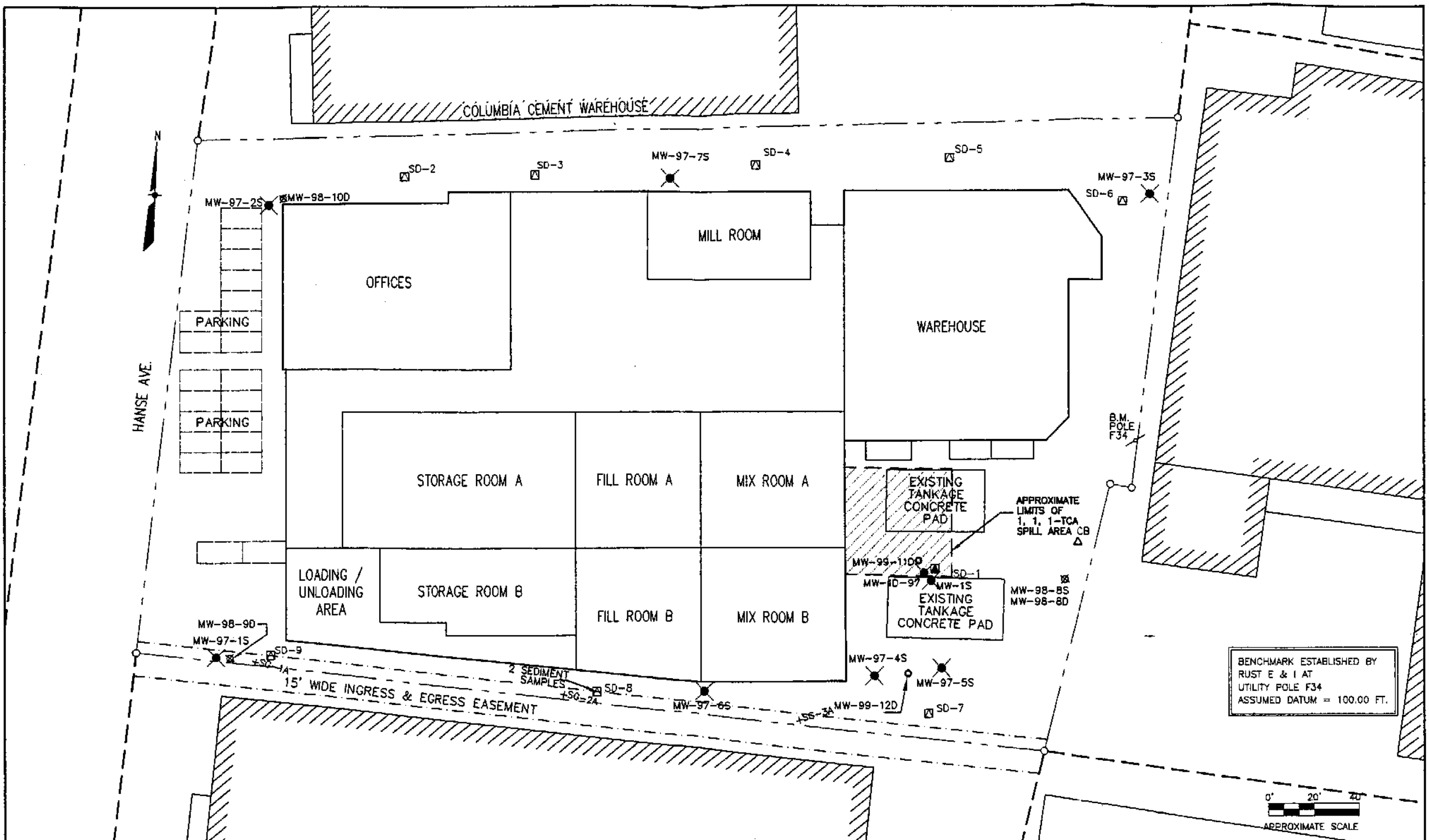
2.2 SEDIMENT SAMPLING AND ANALYSIS

The objective of this task is to determine the presence, nature, and extent of volatile organic compounds (VOCs) in the sediments of Freeport Creek potentially associated with the reported 1988 TCA spill at the Site.

A total of eleven sediment samples will be collected from within the creek. The proposed sampling locations are depicted in Figure 2 and described below:

1. At point of the outfall discharge to Freeport Creek;
2. 50' upstream of the outfall, 25' from the eastern bank of the creek or at the point where the bank drops off, whichever is closer to shore;
3. 50' upstream of the outfall, approximately one quarter of the way across the creek;
4. 50' upstream of the outfall, approximately in the center of the creek;
5. 50' upstream of the outfall, approximately three quarters of the way across the creek;
6. 100' downstream of the outfall, 25' from the eastern bank of the creek or at the point where the bank drops off, whichever is closer to shore;
7. 100' downstream of the outfall, approximately one quarter of the way across the creek;
8. 100' downstream of the outfall, approximately in the center of the creek;
9. 100' downstream of the outfall, approximately three quarters of the way across the creek;
10. 200' downstream of the outfall, 25' from the eastern bank of the creek or at the point where the bank drops off, whichever is closer to shore; and,
11. 200' downstream of the outfall, approximately in the center of the creek.

A Ponar dredge will be used to collect a grab sample of the first few inches of sediment from the bottom of the creek at each location. The Ponar dredge sampler will be decontaminated in accordance with the procedures detailed in the QAPjP between sampling locations to prevent cross-contamination. Dredges generally consist of a clam shell arrangement of two buckets. The buckets may either close upon impact or be activated by use of a messenger. A Peterson dredge is used when the bottom is rocky, in very deep water, or when the flow velocity is high. The dredge should be lowered very slowly as it approaches bottom, because it can force out and miss finer-



LEGEND:

EXISTING MONITORING WELL LOCATION (MW-97-5S)	STORM DRAIN
MANHOLE/STORM DRAIN	SOIL GAS SAMPLE
CONCRETE CATCH BASIN	MONITORING WELL
BORING LOCATION	MONITORING WELL/ BORING LOCATION (MW-99-11D)

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DATE: 11-08-99
REVISED 12-7-99
PROJ. NO: 98-014

BURMAH CASTROL, INC.
(COLUMBIA CEMENT COMPANY, INC.)
159 HANSE AVENUE
FREEPORT, N.Y.

FIGURE 3
PHASE II – ON-SITE RI SAMPLING LOCATIONS

FILE NAME : FIG-7.DWG

grained materials if allowed to drop freely. The Ponar dredge is a Peterson dredge modified by the addition of side plates and a screen on the top of the sample compartment. The screen over the sample compartment permits water to pass through the sampler as it descends thus reducing the "shock wave" and permitting direct access to the desired sample without opening the closed jaws. The Ponar dredge is easily operated by one person in the same fashion as the Peterson dredge and is one of the most effective samplers for general use on all types of substrates.

Each of the sediment samples collected will be submitted for laboratory analysis of the NYSDEC TCL VOCs using the NYSDEC ASP CLP Method 95-1 and total organic carbon (TOC).

2.2.1 Sampling Procedures for the Collection of Sediment with a Ponar Dredge

The sampling procedures for the collection of sediment with a Ponar dredge may be summarized as follows:

1. Consult the project-sampling program and select the sample location. Record the sample point orientation on a field map of Freeport Creek.

2. Using a weighted measuring tape, obtain a measurement to the bottom of the creek. Enter the depth in the field logbook.

3. Place the jaws of the dredge in the locked-open position.

4. Secure a rope, cord, or cable to allow the dredge to reach from field person to the sediment material. The end of the cord or cable should be fixed to the boat, raft, or dock from which the dredge is being lowered.

5. Position the dredge directly above the point where the sample is collected. For streams and small brooks where wading is needed, stand downstream from the sample point and take care not to disturb the bottom materials directly upstream of or on the sample collection area.

6. Check to be sure that the jaws of the dredge are open and that the connection cord or line is free to follow the dredge. Drop the dredge into the water and allow it to progress downward to the bottom.

7. When the dredge has reached the bottom, tug the connection cord hard three times quickly. (In shallower water, it will probably be sufficient to tug only once and then slowly raise the sampler.) Raise the dredge very slowly for the first few feet, at a rate comfortable for the field person. Take care not to let the dredge bounce while raising it.

8. When the dredge is raised, place it on clean polyethylene sheeting. Position the dredge on its side and open slowly.

9. If sediment material is found inside the dredge, place selected sediment portions in the appropriate sample container(s) according to the sample volumes required for analyses. NOTE: If the dredge is empty, make a second and third effort at the same point and then attempt additional points in the vicinity.

10. At the completion of work at each sediment sample point, decontaminate the sampling materials prior to the start of sampling at the next point.

2.3 DRILLING AND MONITORING WELL INSTALLATION

2.3.1 Deep Monitoring Well Below the Clay Layer

One monitoring well will be installed in the spill area in the vicinity of boring SB-98-3 and screened in the sand and gravel sediments that underlie the Gray Clay and Silt stratigraphic unit ("lower sand and gravel"). The well will be drilled and installed utilizing a "double telescope" method, so that both the shallow fill soil and gravelly sand hydrogeologic unit are individually sealed off prior to advancing the borehole through underlying low-permeability units. Proposed boring locations are depicted in Figure 3. As detailed in the Phase I RI Health and Safety Plan (Delaware Engineering, November 1998), during all sub-surface investigations continuous monitoring for volatile organic vapors will be conducted with a field PID instrument. Air monitoring will conform to the NYSDOH Community Air Monitoring Plan (Ground Intrusive Activities).

First, 81/4-inch inside diameter (I.D.) hollow stem augers (HSAs) will be advanced to one foot below the top of the Tidal Marsh Silt layer. A cement-bentonite grout will be tremied into the augers. A length of 6-inch I.D. Schedule 40 PVC pipe sufficient to leave 2 feet of stickup will be inserted with a wooden plug on the base to the bottom of the grout-filled borehole. The HSAs will then be withdrawn. After allowing the cement-bentonite grout to set overnight, the boring will be advanced through the Gravelly Sand hydrogeologic unit and to a depth of one foot into the Gray Clay and Silt unit utilizing 57/8-inch diameter mud-rotary drilling methods. The borehole will be filled with cement-bentonite grout and a length of 4-inch I.D. Schedule 40 PVC pipe sufficient to leave approximately 2 feet of stick-up will be inserted, with a wooden plug at the base, to the bottom. After allowing the cement-bentonite grout to set overnight, drilling will resume by advancing nominal 3-inch diameter steel drill casing through the Gray Clay and Silt unit and into the lower sand and gravel, using drive-and-wash drilling methods. The boring will be advanced 15 feet into the lower sand and gravel (total depth estimated at 65 feet) at which depth a standard 2-inch PVC monitoring well with a 10-foot screen will be installed.

2.3.2 Deep Monitoring Well South of Spill Area

A second deep soil boring will be drilled south of the Spill area between existing monitoring wells MW-97-4S and MW-97-5S. This boring will provide for the collection of a grab-type groundwater sample from the lower sand and gravel unit (below the Gray Clay and Silt unit) and for the subsequent installation of a monitoring well in the Gravelly Sand hydrogeologic unit above the clay.

The grab water sample will be submitted to the laboratory for volatile organic analysis with a 48 hour turnaround. If the grab sample volatile organic results are significantly above groundwater standards (in the 100 ug/L range) a second well screened in the lower sand and gravel will be installed at this location, using the procedures previously described.

Drilling of the boring between MW-4S and MW-5S will first involve installing a permanent 6-inch I.D. PVC casing from ground surface to the top of the Tidal Marsh Silt unit, in the same manner as that described above for the first boring. After allowing the grout to set overnight, nominal 4-inch drill casing will be advanced with drive and wash methods to a depth of one foot into the Gray Clay and Silt unit. Nominal 3-inch diameter steel drill casing will then be advanced using drive and wash techniques an additional 1 to 3 feet into the Gray Clay and Silt unit. The 3-inch casing will provide a secondary temporary seal of the Gravelly Sand hydrogeologic unit while the boring is advanced through the Gray Clay and Silt unit and the grab-type groundwater sample is collected in the lower sand and gravel. Soil sampling will be conducted through the Gray Clay and Silt unit to the top of the lower sand and gravel using a GeoProbe™ (or equivalent) direct push sampling technique. The sampling will be conducted in advance of the 3-inch drill casing and will dictate the depth (i.e., 1 to 3 feet) to which the secondary casing will be advanced into the Gray Clay and Silt unit. Once the lower sand and gravel is encountered, a GeoProbe™ SP-15 screen point sampler (or equivalent) will be driven into the lower sand and gravel. Water will be purged from the sampler and a grab groundwater sample will be collected.

Following collection of the grab sample, the portion of borehole through the Gray Clay and Silt will be permanently sealed. The Gray Clay and Silt unit will be sealed with bentonite pellets or slurry that will be emplaced as the 3-inch diameter drill casing is extracted from the borehole. A standard 2-inch diameter PVC monitoring well will then be installed in the overlying gravelly sand hydrogeologic unit, as the 4-inch drill casing is extracted from the borehole.

Procedures for all monitoring well installations, including placement of filter packs, bentonite seal and cement bentonite grout will be performed in accordance with the approved Work Plan for the 1998 Phase I RI..

2.3.3 Split Spoon Soil Sampling and Analysis

At both drilling locations, soil samples will be collected at two-foot intervals from ground surface until the upper portion of the sand and gravel beneath the Gray Clay and Silt unit has been sufficiently characterized. Sample collection, description and headspace screening will be similar to the procedures used in the 1998 Phase I RI.

To further characterize the vertical extent of 1,1,1-TCA in sub-surface soils in the spill area, all split spoon samples from the spill area boring, from the Tidal Marsh unit to the Gray Silt and Clay unit will be submitted for TCL volatile organic analysis (CLP Method 95-1). Sample results from the fill and top of Tidal Marsh have exhibited 1,1,1-TCA concentrations above the NYSDEC Recommended Soil Cleanup Objective.

From the boring between MW-4S and MW-5S, three subsurface soil samples will be submitted to the laboratory and analyzed for the TCL volatile organics (CLP Method 95-1). This includes the sample from the top of the Tidal Marsh Silt unit, a sample from the top of the Gray Clay and Silt unit and the sample which exhibits the highest field PID reading.

2.3.4 Monitoring Well Development

The newly installed monitoring wells will be developed prior to sampling in order to remove residual silts, sands and clays, increase the hydraulic conductivity immediately around the well, and reduce the turbidity of groundwater samples. Well development will continue until a turbidity goal of less than or equal to 50 Nephelometric Turbidity Units (NTUs) is obtained. If this goal cannot be obtained, well development will continue until an amount of groundwater equivalent to 10 well volumes has been removed. This will help ensure that the groundwater samples, and other hydraulic information obtained from these wells, are representative of sub-surface conditions.

All groundwater and sediments resulting from well development will be managed as described in Section 2.11 of this Work Plan. Wells will be developed using the procedures presented in the Sampling and Analysis Plan.

2.4 HYDRAULIC CONDUCTIVITY TESTING

After sufficient time has elapsed for hydraulic stabilization of the newly installed wells, they will be tested to estimate hydraulic conductivity of the screened formation. This estimate will be used to estimate groundwater flow rates, assess the potential rate of contaminant transport, and screen potential remedial options, if necessary. The hydraulic conductivity testing will consist of in-situ slug and/or bail tests using pressure transducers. Test procedures are described in the Phase I RI Sampling and Analysis Work Plan.

2.5 GROUNDWATER SAMPLING AND ANALYSIS

Groundwater will be collected from the new monitoring wells and 13 existing monitoring wells (*i.e.*, MW-1, MW-1D-97, MW-97-1S, MW-97-2S, MW-97-3S, MW-97-4S, MW-97-5S, MW-97-6S, MW-97-7S, MW-98-8S, MW-98-8D, MW-98-9D and MW-98-10D. The groundwater samples will be collected in accordance with the procedures presented in the Phase I RI Sampling and Analysis Plan. Each sample will be analyzed for the TCL VOCs (NYSDEC ASP CLP method 95-1) and a NYSDEC CLP deliverable package will be provided for all analyses. Excess groundwater generated from the sampling activity will be managed as discussed in Section 2.11 of this Work Plan.

2.6 GROUNDWATER ELEVATION FLOW DIRECTION MONITORING

The Phase I RI data indicated that the constant alternating low and high tides appears to cause a cyclical shift in groundwater flow direction; east to west with a northwest trend in the northwest quadrant of the Site during high tide and east or southeast in the east half of the Site during low tide. A definitive determination of the length of time groundwater flows in each direction could not be determined based on the Phase I data, however, the Phase I data indicated that the overall net groundwater flow direction is from east to west and that groundwater flow to the east and southeast is a minor component of the overall groundwater flow pattern.

To further evaluate the overall direction and timing of groundwater movement in the shallow subsurface flow regime, groundwater elevations in all overburden monitoring wells will be monitored over a twenty-four hour period. Solinst data logging pressure transducers will be used to record water levels every five minutes for twenty-four hours.

2.7 SOIL GAS SAMPLE COLLECTION AND ANALYSIS

Three soil gas samples will be collected along the southern perimeter of the property, north of the Knickerbocker building. Samples will be submitted to the Laboratory for TCL volatile organic analysis. The reporting limit for all compounds will be 10 ug/m^3. Samples will be collected following the procedures in the Phase I RI, Sampling and Analysis Plan. Sampling locations are depicted in Figure 3.

2.8 HUMAN HEALTH EXPOSURE ASSESSMENT (HHEA)

The human health exposure assessment (HHEA) will consist of an evaluation of the potential routes of human exposure to site related chemicals. The following items will be addressed within the HHEA scope of work:

- evaluation of Site history, chemical, hydrologic, demographic and other information;
- identification and evaluation of potential exposure pathways through a review of data collection activities, analytical protocols, current and surrounding land use, populations-at-risk and other related data; and,
- characterization of completed exposure pathways by the evaluation of chemical release sources, fate and transport, human exposure (contact) points and chemical intake routes.

The human exposure routes that present a potential toxic concern will be identified. Potential human exposures will be characterized using principles and procedures consistent with the following U.S. Environmental Protection Agency (EPA) documents:

- *Risk Assessment Guidance for Superfund, Volume I: Human Health Evaluation Manual, Interim Final, Part A* (December 1989, EPA/540/1-89/002)
- *Guidance on Risk Characterization for Risk Managers and Risk Assessors.* Memorandum. February 26, 1992
- *Guidance for Data Usability in Risk Assessment, Interim Final* (October 1990, EPA/540/G-90/008)
- *Superfund Exposure Assessment Manual* (April 1988, EPA/540/1-88/001)
- *Exposure Factors Handbook* (March 1990, EPA/600/8-89/043).

2.8.1 Exposure Pathway Analysis

The purpose of the exposure assessment is to identify pathways through which people can be exposed under current and potential future use scenarios. The exposure assessment utilizes the current conditions at the Site and surrounding area in determining exposure scenarios and exposure concentrations. Additionally, future uses of the Site and surrounding area are also considered.

2.9 FISH AND WILDLIFE IMPACT ANALYSIS (FWIA)

The fish and wildlife impact analysis (FWIA) will be performed following the NYSDEC FWIA procedures presented in the NYSDEC Division of Fish and Wildlife document "Fish and Wildlife Impact Analysis for Inactive Hazardous Waste Sites" (dated October, 1994). The Step I (Site Description) and the pathway analysis and criteria-specific sections of the Step II (Contaminant-Specific Impact Analysis) analysis will be performed.

The objective of the Step I site description is to identify the fish and wildlife resources, land-use and habitat types that exist in the vicinity of the Site. In addition, fish and wildlife species that may utilize habitats that could potentially be impacted by site-related contaminants are identified. This information is necessary to allow identification of potential pathways of contaminant migration that could impact fish and wildlife resources.

The objective of the Step II contaminant specific impact is to determine the impacts, if any, of site-related contaminants on fish and wildlife resources. The pathway analysis evaluates and identifies potential contaminants of concern, sources of contaminants, potential pathways of contaminant migration and potential for fish and wildlife resources to be impacted by site-related contaminants. The criteria-specific analysis determines if reported chemical concentrations represent a potential threat to aquatic life and wildlife.

2.10 DECONTAMINATION

All non-disposable equipment will be decontaminated prior to and after the field activities. All disposable sampling equipment will be discarded between samples. The purpose of equipment decontamination is to minimize the potential for compromising data validity by reducing the possibility of cross-contamination.

2.11 HANDLING OF INVESTIGATION DERIVED WASTES

Field activities will produce investigation-derived waste (IDW) which will require appropriate management. This IDW includes the following:

- Decontamination fluids and sediments which may settle out of such fluids; and
- Personnel protective equipment (PPE) and associated debris resulting from the field activities.

The management of these materials is discussed below.

2.11.1 Decontamination Fluids

Decontamination fluids will be containerized in appropriate 55-gallon drums and temporarily stored on-site. Upon completion of field activities, this material will be properly characterized and, after receiving the analytical results and necessary approvals from Burmah Castrol and NYSDEC, will be discharged onto the ground surface at the Site or transported off-Site for treatment and/or disposal at a permitted facility.

2.11.2 PPE and Associated Debris

Used PPE and other associated debris (*e.g.*, disposable sampling equipment) will be containerized in appropriate 55 gallon drums and stored temporarily on-site. At the conclusion of field activities, these materials will be appropriately characterized and after receiving the necessary approvals from Burmah Castrol and the NYSDEC, will be transported off-Site for disposal at an appropriate facility.

2.12 DATA USABILITY REPORT

A Data Usability Summary Report (DUSR) will be prepared for all analytical data generated during the RI. The DUSR will be completed following the NYSDEC guidance for DUSRs, a copy of which is included in Appendix B of the Sampling and Analysis Plan. The DUSR will be prepared by a Delaware Engineering chemist (Mr. Anthony Noce).

2.13 RI REPORT

A Phase II RI report will be prepared which details the results of Phase II of the RI. The Phase II report will incorporate the Phase I RI data by reference and provide a complete interpretation of Site conditions. The extent of contamination, both areally and vertically, will be discussed and presented graphically for all environmental media sampled.

3.0 FEASIBILITY STUDY

Upon completion and approval of the Final RI report by the NYSDEC, a Feasibility Study (FS) will be performed utilizing the approach outlined in NYSDEC TAGM HWR-90-4043. The first step involves the development of remedial action alternatives. These alternatives are screened, as necessary or appropriate, during the second step. The third and final step involves the detailed analysis of the remaining remedial alternatives according to the selection criteria specified in the National Contingency Plan (NCP). This process culminates in the recommendation of one or more remedial alternatives in the FS Report.

3.1 DEVELOPMENT OF REMEDIAL ALTERNATIVES

The development of remedial alternatives will involve the following six-step process:

- Development of remedial action objectives specifying the contaminants and media of interest, exposure pathways, receptors and acceptable contaminant levels for each exposure route;

- The media of interest will be determined by the nature and extent of contamination as well as appropriate NYS Standards Criteria and Guidelines (SCGs) and any federal standards that are more stringent than State standards;

- Development of general response actions for each medium of interest, defining containment, treatment, excavation, pumping, or other general actions which might satisfy the remedial action objectives;

- Identification of the volume of material or area(s) of contamination to which the general response actions might be applied;

- Identification and screening of technology types applicable to each general response action to eliminate those that are not implementable; and,

- Assembly of the technologies and process options into remedial alternatives, preserving a range of treatment and containment choices.

In the above process, data gathered during the RI is used to identify and screen technology types and process options. Technologies that could prove difficult to implement, might not achieve the remedial action objectives within a reasonable time frame, or might not be applicable or feasible based on site-specific conditions, are eliminated from further consideration. Also, results can be used to guide additional site characterization work, if necessary.