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SAMPLING AND ANALYSIS PLAN FOR REMEDIAL INVESTIGATION AND FEASIBILITY STUDY

PART I - FIELD SAMPLING PLAN

STOUGHTON CITY LANDFILL
STOUGHTON, WISCONSIN

REVISION: 2

SUBMITTED BY:

STOUGHTON CITY LANDFILL STEERING COMMITTEE

NOVEMBER 28, 1988

PREPARED BY:

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1.0 INTRODUCTION

This Sampling and Analysis Plan (SAP) for the Stoughton City Landfill Remedial Investigation and Feasibility Study (RI/FS) has been developed and is being submitted in accordance with Article VIII (C) (2) of the Administrative Order by Consent (Consent Order). The Sampling and Analysis Plan consists of the Field Sampling Plan (FSP) and the Quality Assurance Project Plan (QAPP) which are being submitted as a single document. (They have been bound separately to facilitate use of the FSP in the field).

The Field Sampling Plan guides all field work by defining the sampling and data-gathering methods to be used for the Stoughton City Landfill RI in detail. The Field Sampling Plan was developed in conformance with the USEPA draft document "Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA" (RI/FS Guidance) dated March, 1988. Guidelines developed for the selection and definition of field methods, sampling procedures, and custody were based on the USEPA document "Compendium of Superfund Field Operations Methods" (Compendium) dated December, 1987. Data quality objectives (DQOs) were developed in accordance with USEPA publication "Data Quality Objectives for Remedial Response Activities" (DQO Guidance) dated March, 1987.

Environmental Resources Management-North Central (ERM-North Central) has been retained by the Stoughton City Landfill Steering Committee to conduct the RI/FS.

The general mutual objectives of the RI/FS, as stated in the Consent Order are to:

- fully determine the nature and extent, if any, of the release or threatened release of hazardous substances, pollutants, or contaminants from the Stoughton City Landfill site, and
- identify and evaluate alternatives for the appropriate extent, if any, of remedial action to prevent or mitigate the migration or release or threatened release of hazardous substances, pollutants, or contaminants from the site.

In response to these objectives, the Stoughton City Landfill RI/FS will be conducted using a phased process. Data will be collected in several stages and as the site and adjacent area are better characterized, subsequent data collection efforts will be focused to fill any existing gaps in the data. In this way, the scope of the overall site characterization effort can be continually updated to minimize the collection of unnecessary data and maximize the data quality.

Task 1 activities will take place during the initial phase of the RI. These activities will include ascertaining pertinent background data to identify potential migration pathways that will be studied in more detail during the site investigation phase (Task 2) of the RI. In addition to gathering general background information, limited field investigations are also proposed under Task 1 within the existing Landfill boundary and in the area just south of it. These investigations include: (1) geophysical surveys to delineate disposal area limits and areas potentially characterized by ground water contamination; (2) a soil gas investigation to evaluate the areal distribution of VOCs in the refuse, the near-surface soil, and in the ground water at the site, and (3) the installation of surface water staff gages and piezometers for the determination of ground water flow direction. The results of Task 1 activities will be compiled and interpreted in a technical memorandum which will be submitted to USEPA and WDNR for review prior to initiation of Task 2. Based on this review, appropriate modifications, in conformance with the objectives of the RI and FS, may be made to the Work Plan. These modifications may include the implementation of geophysical and/or soil gas surveys outside of the initial investigative area prior to the initiation of Task 2.

The second phase of the RI (Task 2) will include more detailed site investigation activities designed to characterize the site and its potential hazard to the public health and the environment. These studies will provide the additional data needed for the development and evaluation of remedial alternatives during the FS. The primary focus of initial site investigations will be a hydrogeological investigation. These investigations are designed to characterize contamination on-site and evaluate the suspected primary contaminant migration route (ground water). As part of the hydrogeological investigations, monitoring wells, water samples, water level measurements, in situ permeability tests and geotechnical testing of soil samples will be used to characterize the hydrogeologic environment of the site. Hydrogeological investigations will also first be focused within the initial investigative area and may be extended outside of this area following a review of Task 1 results and also the results of monitoring well sampling. Private water supply wells, which may be shown to be potentially at risk, will be sampled to evaluate the potential risk to public health and to provide additional off-site information regarding the potential extent of contamination. In addition, surface water and air investigations are proposed under Task 2.

Additional RI/FS tasks are discussed below along with a brief description of them.

Task 3 - Site Investigation Analysis

Site investigation analysis will consist of a Quality Assurance and Data Sufficiency Evaluation for the RI to validate the sufficiency and quality of the supporting data for the Endangerment Assessment and Feasibility Studies. Concurrent with and subsequent to the data sufficiency review, a thorough analysis and summary of all site investigations and results will be prepared for presentation in the RI final report.

Task 4 - Laboratory and Bench-Scale Studies

During the development and initial screening of alternatives conducted as part of the RI, specific laboratory and bench-scale studies, or modeling may be identified as necessary to determine implementability, operability, reliability, and effectiveness of any particular alternative. The need for and scope of these studies will be discussed with the USEPA and WDNR during the progress of the RI to ensure that necessary data are available for conducting the FS.

Task 5 - Remedial Investigation Report

During the course of the RI, monthly progress reports will be submitted. At the conclusion of the RI, a draft RI report will be produced to summarize conclusions drawn from all investigative areas and levels. All technical memoranda submitted during the RI will be included as appendices to the RI report.

Task 6 - Remedial Alternatives Screening

Task 6 entails the development and preliminary screening of feasible technologies to remediate the site. An alternatives array document will be prepared and submitted to the USEPA and the WDNR for review. This document will contain a detailed description of the proposed remedial alternatives including the expected extent of remediation, contaminant levels, and the treatment methods. The results of this task will provide a basis for development of the standards of performance required by the USEPA and the WDNR.

Task 7 - Remedial Alternatives Evaluation

Three (3) subtasks will be necessary to complete the evaluation of remedial alternatives for the Stoughton City Landfill site. The initial subtask will be to provide an individualized evaluation of each proposed alternative against the review criteria. Secondly, alternatives will be compared to develop a ranking for the criteria of effectiveness, implementability, and costs. Finally, at the conclusion of Task 7 and as a separate chapter in the FS final report, the preferred alternative or combination of alternatives will be discussed in detail with respect to all review criteria. In the case of combined alternatives, this section will present the rationale supporting the combination and discuss the interrelationship between the components of the combined remedy.

Task 8 - Feasbility Study Report

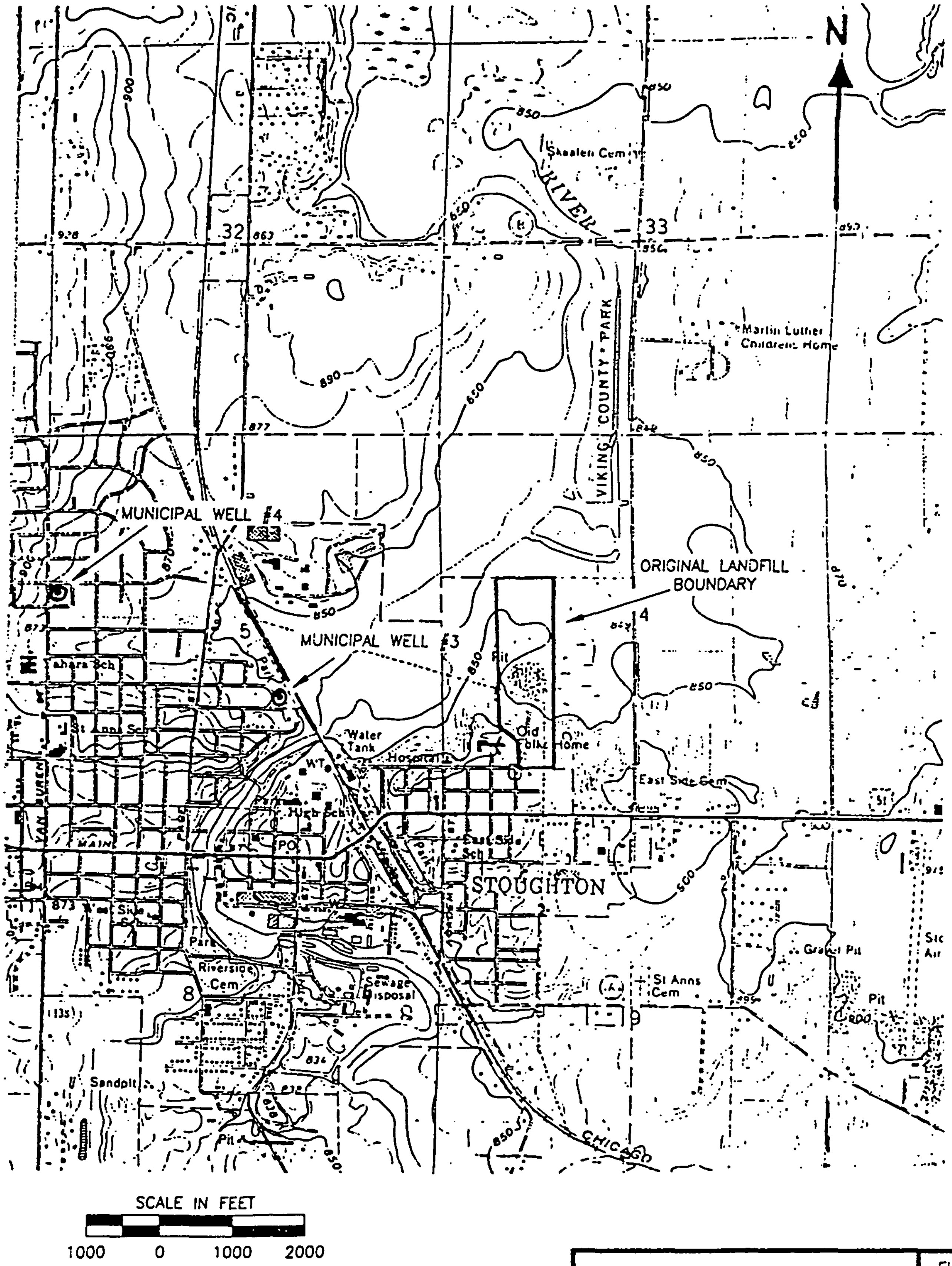
The FS report will summarize the findings of Task 6 and Task 7, and present a full and detailed description of the preferred remedy for the site. A final FS report will be prepared after discussions with the USEPA and the WDNR and at the conclusion of the public comment period.

2.0 SITE BACKGROUND

2.1 Site Location and History

The Stoughton City Landfill is located in the City of Stoughton, Dane County, Wisconsin and occupies portions of the S1/2 of the NW1/4 and the SW1/4 of Section 4, T5N, R11E (see Figure 2-1). Although the original Landfill property occupied approximately 40 acres, landfilling has occurred on only about 15 acres of the property. (See Figure 2-2). Since 1982, land exchanges between the City and an adjacent land owner have modified the original site boundary. (See Figure 2-2). Current ownership of adjacent land will be determined during the initial task of the RI.

The City of Stoughton purchased the original site in July, 1952 and then annexed it in September, 1952 after which landfill operations began. Between 1952 and 1972, the site was operated as an uncontrolled dumpsite. During this time, refuse was usually burned and at times covered by dirt. In 1972, the site began to be operated as a State-licensed landfill. In 1978, the Wisconsin Department of Natural Resources (WDNR) required that the site be closed according to State regulations. Closure activities included: construction of a trash transfer station, placement of cap material borrowed from the northwest portion of the site and from agricultural areas, application of topsoil also derived from an agricultural area, and seeding. From 1978 to 1982, only brick, rubble, etc. were accepted at the site while closure work was performed. The unit was officially closed in 1982.



SOURCE: USGS, 7.5 MINUTE STOUGHTON QUADRANGLE, DANE CO., WISCONSIN

STOUGHTON CITY LANDFILL LOCATION MAP

FIGURE 2-1

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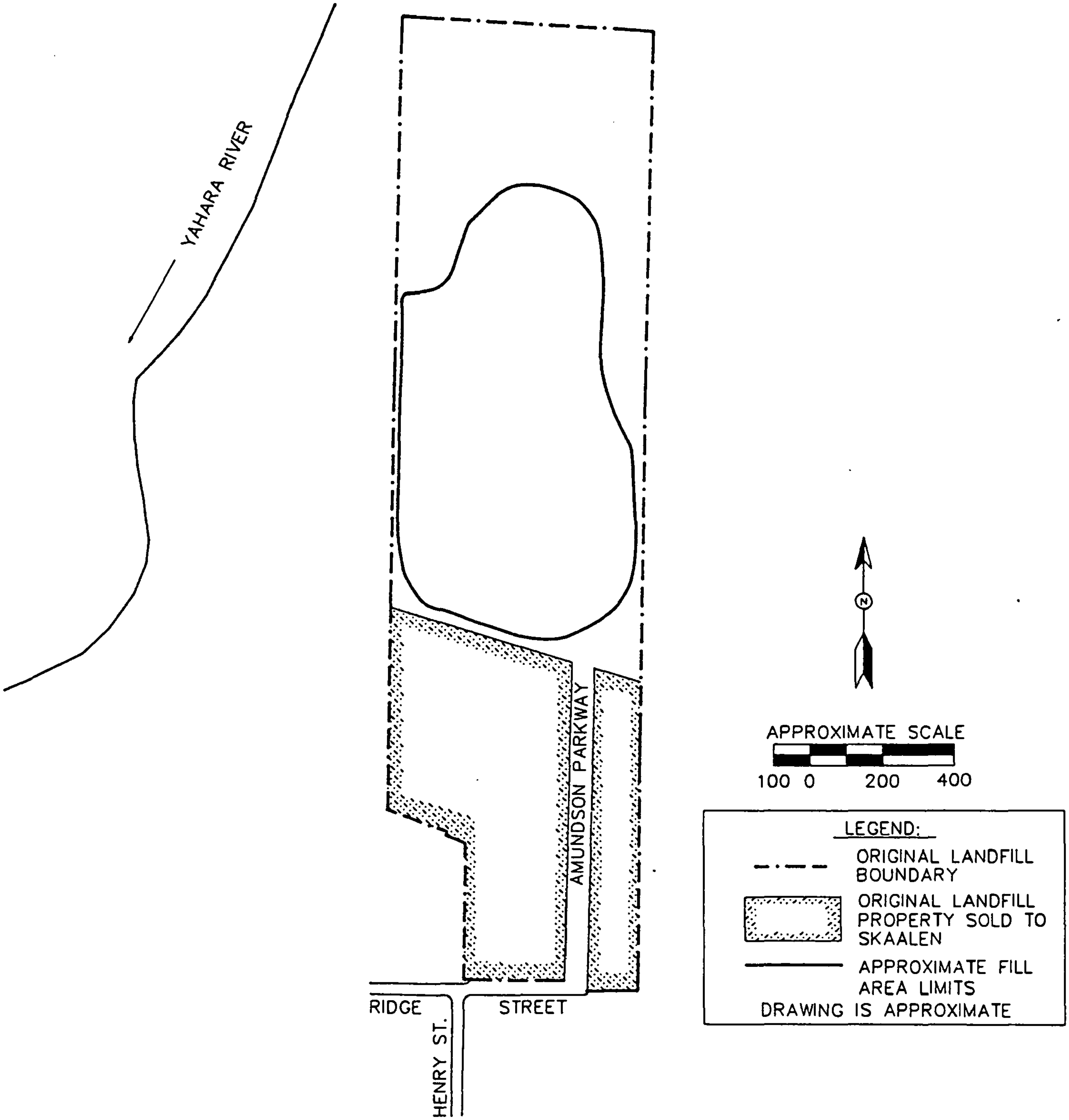

STOUGHTON CITY LANDFILL
PROPERTY BOUNDARIES

FIGURE
2–2

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The Landfill was established for use by City residents (including commercial establishments, industrial operations, major industries as well as smaller-scale machine shops, autobody/repair operations, dry cleaners, and other maintenance facilities). Uniroyal Plastics (formerly U.S. Rubber) disposed of liquid and solid waste from 1953 until late 1962. Most of these liquid wastes were disposed of by incinerating in the refuse burning areas; however, some were reported to have been dumped down boreholes drilled by a local firm which tested truck-mounted earth auger equipment on high ground within the west-central portion of the Landfill boundary. In 1962, the City contracted for the collection of garbage and rubbish from residences and commercial places of business, and this waste was reportedly disposed at a site other than the City-owned landfill. Large items of residential rubbish such as appliances, furniture, etc. were not picked up by the contractor but were carried to the Landfill by property owners. The City disposed of street refuse, trees, and grit from the wastewater treatment plant.

On November 17, 1983 the WDNR sampled monitoring wells at the Stoughton City Landfill site. The results showed elevated levels of volatile organic compounds (VOCs) in two of the six wells. Subsequent testing by the City of Stoughton found additional VOCs during routine sampling of the ground water. The site was added to the USEPA National Priorities List (NPL) in June, 1986.

The Stoughton City Landfill is currently an inactive facility. Vehicular access to the site is controlled by two gates that are locked at all times; however, security fencing is not in place around the site at this time.

2.2 Environmental Setting

The Stoughton City Landfill site is located in the northeast portion of the City of Stoughton and borders apparent wetland areas east of the Yahara River (Figure 2-1). Land surface elevation ranges from a high of about 900 feet above mean sea level (AMSL) in the southwestern portion of the Landfill to about 840 feet AMSL along the north border of the Landfill and in its central portion. An apparent wetland area in the east-central portion of the site -- bounded on the north, west, and south by higher ground -- was the primary area of waste disposal. The approximate north one quarter of the site also contained an area of lowland. Land exchanges since 1982 have modified the original property boundaries.

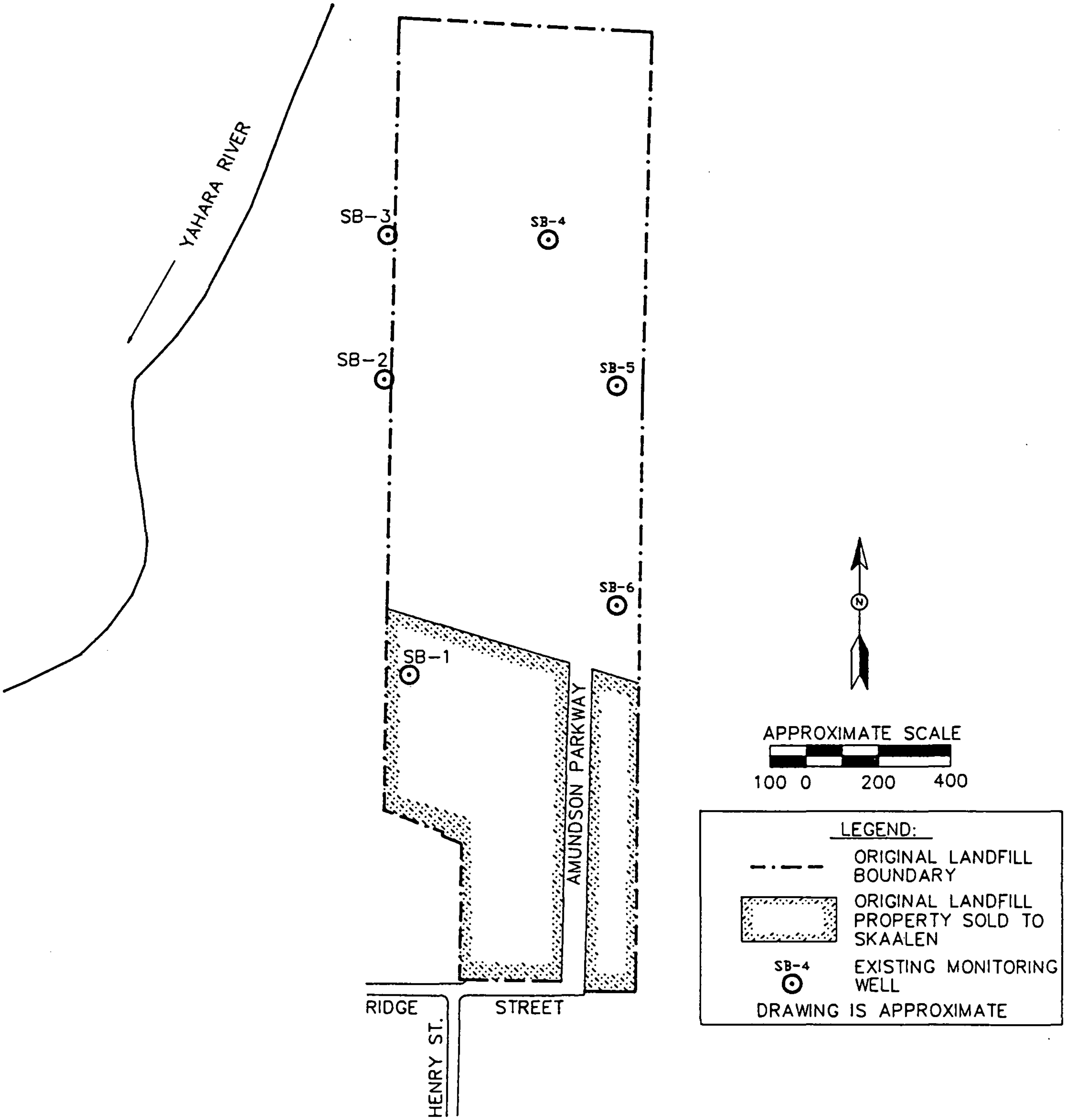
Surficial deposits in the vicinity of the site include ice-contact stratified deposits and lacustrine plain sediments (Mickelson and McCartney, 1979). Ice-contact stratified deposits generally include significant sand and gravel deposits and landforms such as kames and eskers. These deposits occupy higher ground within the Landfill. Lacustrine plain or glacial-lake bottom sediments are generally comprised of fine-grained silt and clay with some sand present near former shorelines and stream inlets. These areas are often flat, poorly drained, and show evidence of peat accumulation. Lacustrine plain deposits occupy the east-central portion of the site, which was developed for primary waste disposal and the low-lying north portion of the site. Approximately 150 to 250 feet of unconsolidated glacial sediments are reported to overlie Cambrian sandstone bedrock in the vicinity of the site.

Surface water drainage features of the site are limited to drainage ditches along the south portion of the primary disposal area and along the north property boundary. The Yahara River flows from northeast to southwest in the vicinity of the Stoughton City Landfill and then generally in a southerly direction towards the Rock River. The Yahara River flows within approximately 200 feet of the northwest corner of the property and is located approximately 800 feet west of the primary disposal area. Apparent wetlands exist adjacent to the east property boundary.

A total of six monitoring wells have been installed in and adjacent to the Stoughton City Landfill. These monitoring wells were installed in 1978 and were designated wells SB-1 thru SB-6. Four of these wells (SB-1, SB-4, SB-5, and SB-6) were destroyed by landfill closure operations and were replaced in 1982. Figure 2-3 shows the location of these existing monitoring wells and Table 2-1 lists construction details reported for them.

At least one of these wells, SB-6, is currently completed in landfill materials while others are screened in surficial sand, sand and gravel, or clay. Ground water flow direction within the upper surficial sediments is uncertain based on review of available data. Both northwest and southeast flow direction have been indicated.

Water supply for the City of Stoughton is derived from wells located in the deeper Cambrian sandstone strata. The closest City well is located about 3,000 feet due west of the Landfill



EXISTING MONITORING WELL LOCATIONS
STOUGHTON CITY LANDFILL

FIGURE 2-3

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TABLE 2-1

STOUGHTON CITY LANDFILL
REPORTED CONSTRUCTION DETAILS
OF
EXISTING MONITORING WELLS

Well	Total Depth (ft.)	Screened Interval (ft.)	Completion Material
SB-1	12.5	7 - 12	Sand
SB-2	28.0	23 - 28	Sand/Gravel
SB-3	20.0	15 - 20	Sand/Gravel
SB-4	15.0	6 - 11	Peat/Clay
SB-5	14.0	5 - 10	Sand
SB-6	11.5	4 - 9	Fill

Notes:

1) Data obtained from original boring logs prepared by Soils and Engineering Services, Inc. and Warzyn Engineering, Inc.

2) Well SB-2 construction altered due to grading operations associated with landfill closure and also was reported to have been vandalized prior to the placement of security casing/locks. Other wells also may have been affected by vandalism.

across the Yahara River and is designated Well No. 3 (Figure 2-1). This well penetrated a 75-foot - thick clay layer from 85 to 160 feet below ground surface. When Franconia Sandstone was encountered at a depth of 210 feet, casing was installed in Well No. 3. The remainder of the well is an open hole to a total depth of 950 feet.

2.3 Previous Site Investigations

Since 1983, sampling operations have been conducted on monitoring wells at the Stoughton City Landfill for volatile organic compounds (VOCs) by the City, its contractors or the WDNR. Analyses have been performed by commercial laboratories or the Wisconsin State Laboratory of Hygiene. Table 2-2 summarizes data for the period November 1983 to November 1984 for the most frequently detected VOCs. Well SB-1 has shown the presence of ethyl benzene, toluene and xylenes while Wells SB-2 and SB-3 have shown the presence of various chlorinated solvent compounds at low levels. In addition, tetrahydrofuran has been detected in Well SB-3 and dichlorodifluoromethane and trichlorofluoromethane have been qualitatively identified in samples from Wells SB-2 and SB-3. Toluene and tetrahydrofuran were detected in Well SB-4 on one occasion during the above period and 1,1-dichloroethene and tetrahydrofuran were measured once in Well SB-6. No VOCs were detected in Well SB-5 during the above period. The City of Stoughton is required by the WDNR to sample the site monitoring wells for limited physicochemical properties and inorganic parameters. Electrical conductivity data for November 1983 indicate a range of conductivity of 578 umhos/cm (SB-5) to 2,310 umhos/cm (SB-6). Water level measurements taken during this

TABLE 2-2

STOUGHTON CITY LANDFILL
SUMMARY OF MOST FREQUENTLY DETECTED VOCs IN GROUND WATER
NOVEMBER 1983 - NOVEMBER 1984

	Well SB-1		Well SB-2		Well SB-3	
Parameter (ug/l)	No. of Times Detected	Concentration Range	No. of Times Detected	Concentration Range	No. of Times Detected	Concentration Range
Ethyl Benzene	3/4	ND - 1,400	0/4	ND	0/4	ND
Toluene	3/4	ND - 113	1/4	ND - 7.3	0/4	ND
Xylene	4/4	3,400 - 12,200	0/4	ND	0/4	ND
Benzene	0/4	ND	2/4	ND - 4.5	0/4	ND
1,1-Dichloroethane	0/4	ND	4/4	2.0 - 7.7	1/4	ND - 7.6
Tetrachloroethene	0/4	ND	4/4	ND - 26.0	3/4	ND - 5.3
1,2-trans-Dichloroethene	0/4	ND	2/4	ND - 18.0	1/4	ND - 54
Trichloroethene	0/4	ND	4/4	7.1 - 14.0	1/4	ND - 8.7
Tetrahydrofuran	0/4	ND	1/4	ND - 11.3	3/4	ND - 1,000

Notes:

1) Data include those from a number of different laboratories; therefore, laboratory detection limits vary for particular sampling events.

2) ND - Not detected during any one sampling event at the method detection limit of the analyzing laboratory.

sampling event indicate a range of depth to ground water of 0.6 feet (SB-3) to 8.9 feet (SB-2). The water level in Well SB-3 has been measured above the land surface on other occasions.

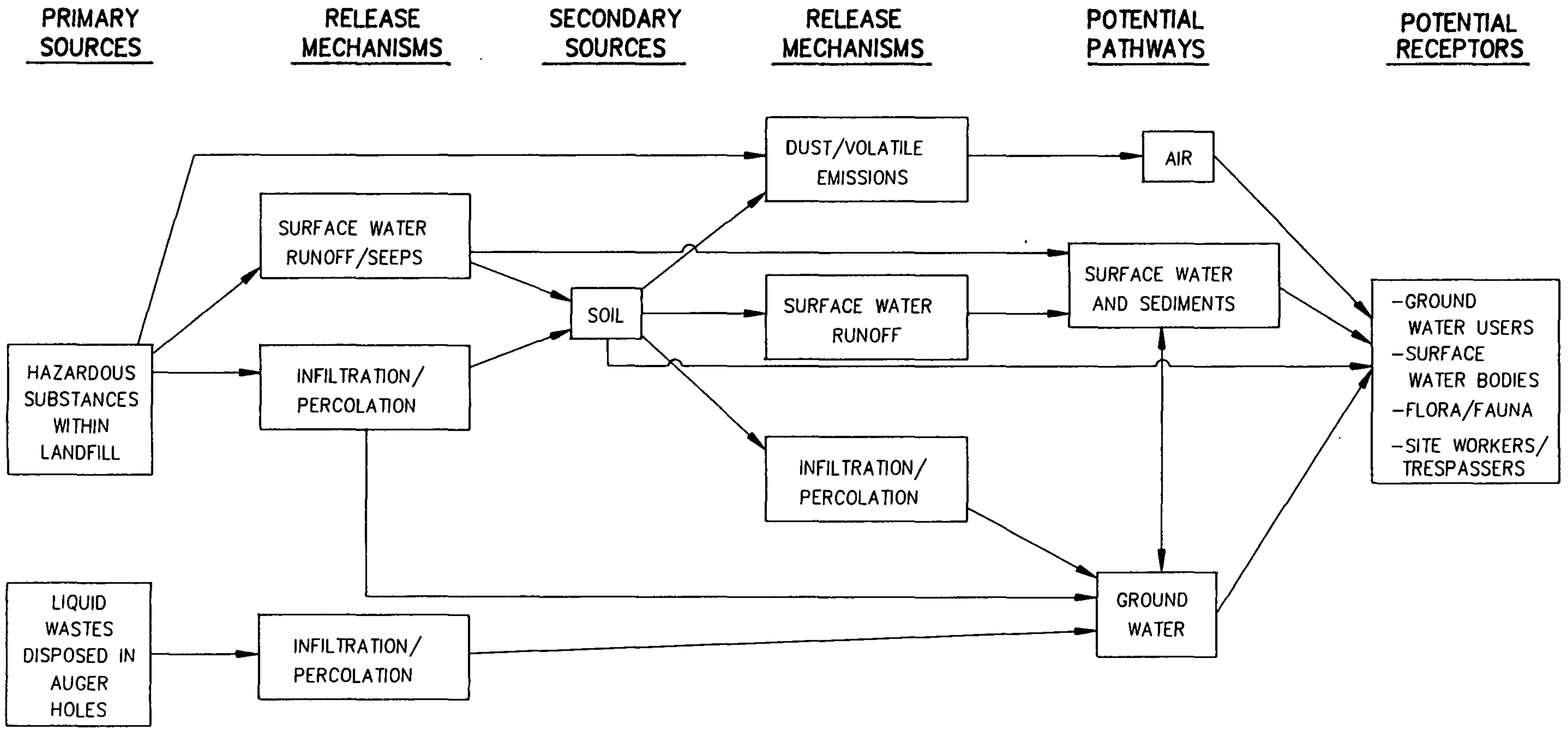
The WDNR sampled ground water from Municipal Well No. 5 in April 1982 and determined that "no synthetic industrial chemicals were detected in the well". In November 1983, the WDNR sampled the wells serving the City of Stoughton water system and found that none of the 45 VOCs that were analyzed were detected. In July 1986 the WDNR again sampled ground water from Municipal Wells 3, 4 and 5 for 45 VOCs and none were detected limit.

The City of Stoughton collected a single surface water sample on September 22, 1984 from the Yahara River. No VOCs were detected in that sample. During October, 1985, WDNR conducted ambient air sampling by using Tenax sampling tubes. No detected VOCs were found in the ambient air samples.

The potentially responsible parties (PRPs) recognize that these data may not have been collected or analyzed under currently rigorous protocols; therefore, the data must be further reviewed to evaluate them for quality and applicability. Furthermore, the sufficiency of the data may not be adequate to fully evaluate the actual or potential impact of the site on environmental receptors. Therefore, sample collection and analytical procedures for characterization of the above media will be reviewed during Task 1 to determine the utility and relevance of these results to the RI/FS.

2.4 Preliminary Conceptual Site Model

A preliminary conceptual site model is presented in Figure 2-4 and includes all known and suspected sources of contamination, potential routes of migration, and potential human and environmental receptors. Ground water users, and potentially surface water bodies, are anticipated to be the primary receptors of concern for contamination attributable to the Landfill proper or the suspected disposal of liquid waste down auger holes. However, other potential migration pathways such as air, will also be evaluated during the RI. The conceptual site model is poorly defined, primarily because of a lack of information on specific hazardous substances disposed at the site, ambiguous data pertaining to ground water flow direction, and a general lack of information on other potential pathways and receptors. Because of this, potential contaminant migration routes and receptors will be reevaluated during Task 1 of the RI using both field and nonfield methods to ensure sufficient scope for subsequent phases of the RI. Task 1 field investigations will be conducted in a phased manner. Initially, these investigations will be focused within the current Landfill boundary and in the area just south which encompasses Well SB-1. After Task 1 field data within these areas have been evaluated, Task 1 field investigations may be extended outside of these areas. In this way, the collection of unnecessary data will be minimized.



PRELIMINARY
CONCEPTUAL SITE MODEL
STOUGHTON CITY LANDFILL

FIGURE
2-4

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3.0 SAMPLING OBJECTIVES

The primary data uses for the Stoughton City Landfill will be for site characterization, risk assessment, and evaluation of alternatives; however, health and safety and engineering design of alternative uses are also anticipated. Under these data use categories, data of sufficient quality and quantity will be collected to provide an acceptable level of risk in remedial action decision making. Soil gas, soil, ground water, air, and surface water/sediment samples will be collected to determine the:

- Presence/absence and types of volatile contaminants in the Landfill and auger hole disposal source areas and in the potential outdoor air pathway and the presence/absence and types of contaminants in the other potential pathways including ground water and surface water/sediment.
- Mechanism of contaminant release to the various pathways.
- Direction of transport pathway(s).
- Horizontal/vertical boundaries of source(s) and pathways of contamination.
- Routes of exposure and potential environmental and public health threats.

The overall Data Quality Objective (DQO) is to collect high quality data in sufficient quantity to achieve the highest level of confidence and, therefore, the lowest level of uncertainty in remedial action decision making. The selection of both the sampling and the analytical approaches for the Stoughton City Landfill project was made to achieve this DQO as described in the following sections.

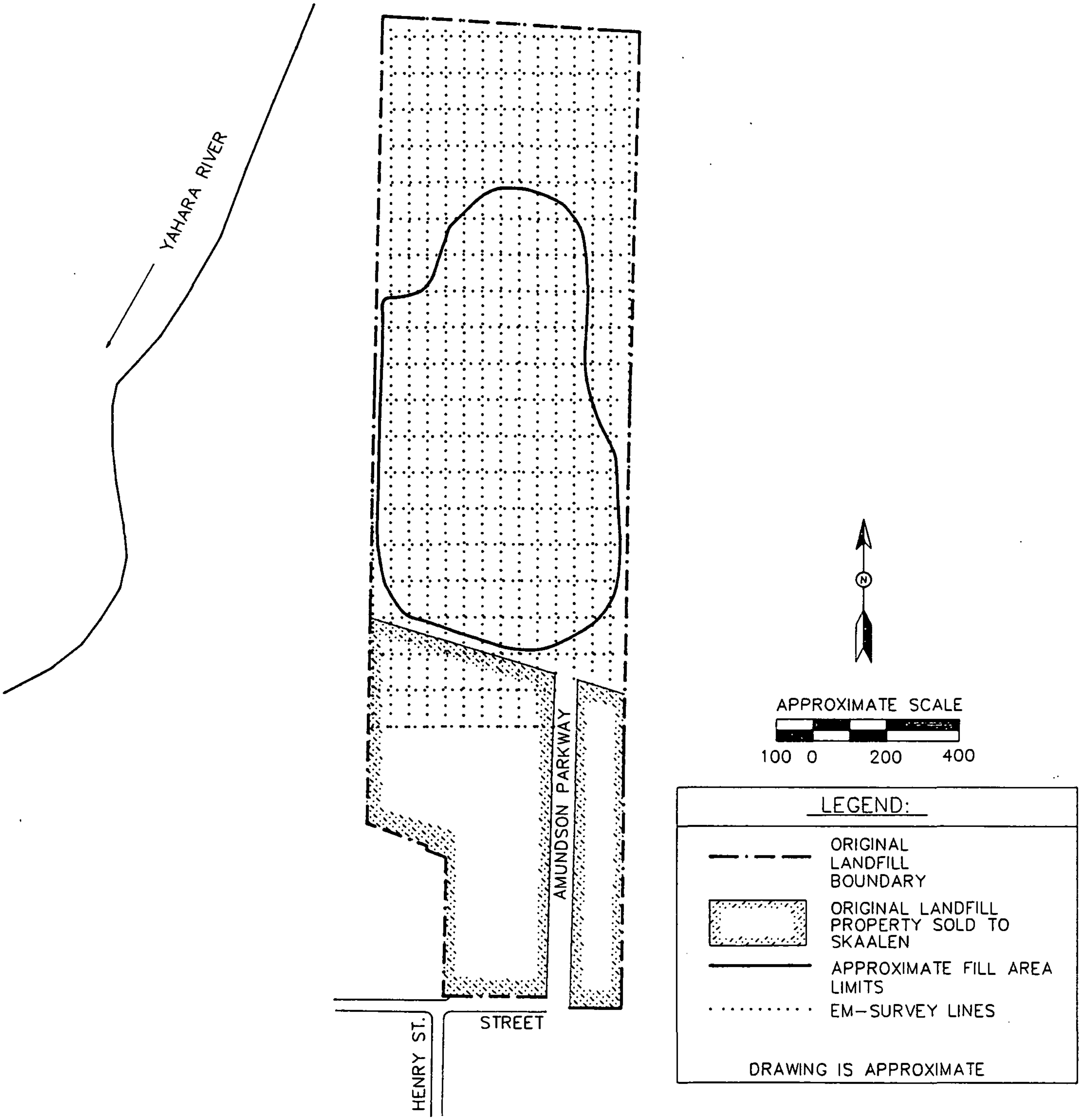
4.0 SAMPLE LOCATION AND FREQUENCY

Field investigations will include geophysical surveys, a soil gas survey, preliminary evaluation of ground water flow direction, soil sampling, ground water monitoring, potentially private well sampling, air sampling, and surface water/sediment sampling. Of these investigations, the geophysical and soil gas surveys will be performed during Task 1 using a phased approach. Initially, Task 1 investigations will be focused within the current Landfill boundary and in the area just south which encompasses existing monitoring Well SB-1. After Task 1 data have been collected and evaluated, geophysical and soil gas surveys may be extended outside these areas. Task 2 investigations will also be conducted using a phased approach. For example, for ground water, additional monitoring wells may be added outside of the initial investigative area based on Task 1 results and/or the initial monitoring well sampling results.

Where ascertainable, specific sampling locations associated with each field investigative technique are presented below along with the sampling frequency. Detailed procedures for sample collection for each media are presented in Section 6.0. Major equipment associated with sample collection are discussed in Appendix A.

4.1 Geophysical Surveys

Two survey techniques are proposed for the geophysical survey of the site. An Electromagnetic (EM) survey will be conducted along the grid pattern shown on Figure 4-1 utilizing an EM31-D. The



ELECTROMAGNETIC (EM)
SURVEY LOCATION
STOUGHTON CITY LANDFILL

FIGURE
4-1

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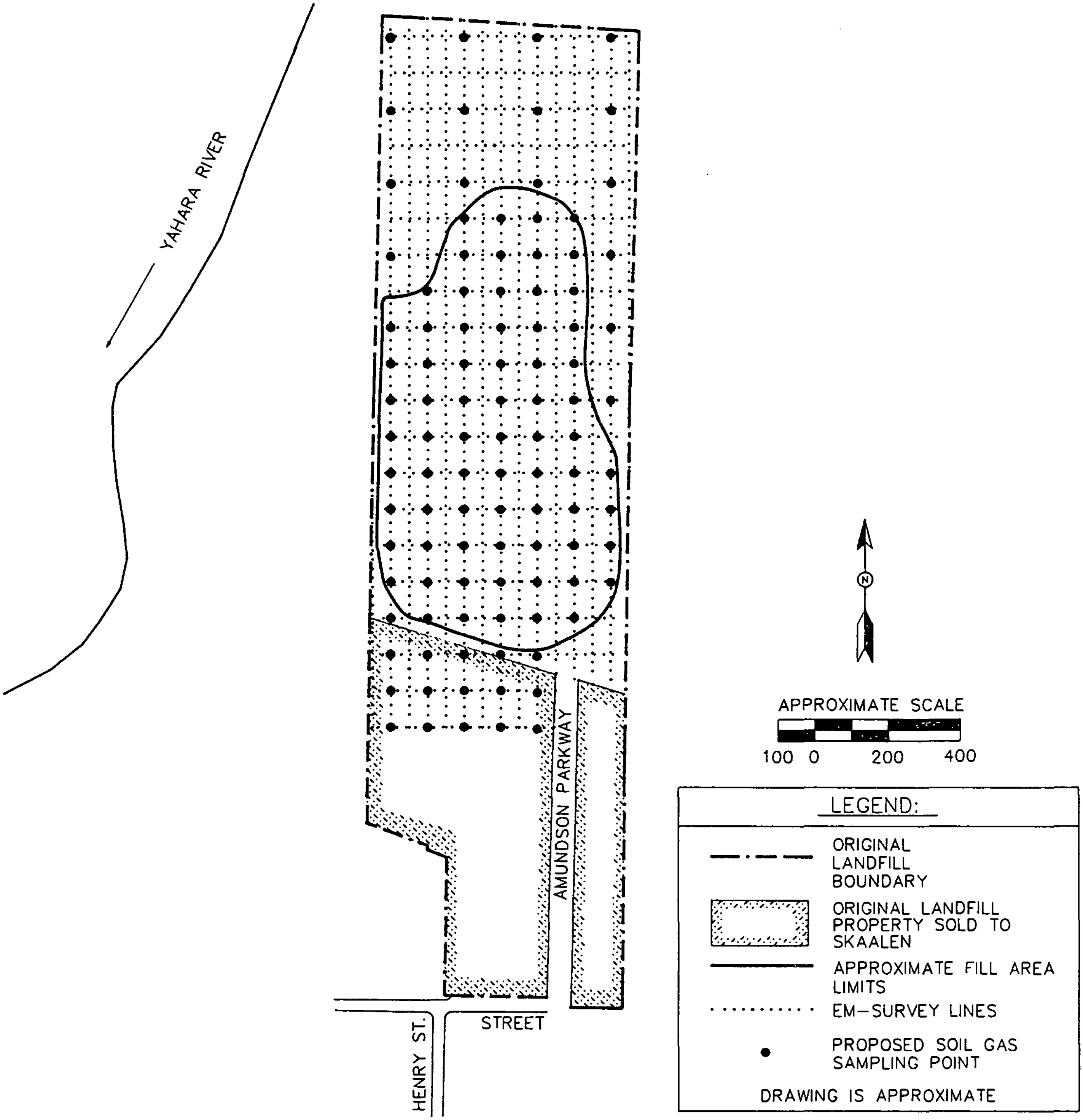
purpose of the EM survey is to map the disposal areas on site and to evaluate the perimeter of the mapped disposal areas for discrete ground water plumes.

In support of and to complement the EM survey, an electrical resistivity survey will also be conducted across disposal boundaries as mapped using the EM and around the perimeter of the site.

4.2 Soil Gas Investigation

A soil gas investigation will be conducted to evaluate the type and areal distribution of volatile organic contamination at the Stoughton City Landfill site. Soil gas sampling permits the measurement of organic vapors that volatilize from contamination in the subsurface soil or ground water and are present in the soil pores of the saturated zone. As a result of the quantitative analysis of specific volatile organic compounds, source areas, any zones of contaminated soil, and any potential ground water contaminant plume below the site can be determined and assessed.

Soil gas sampling locations will be established on a 100-foot grid system within the Landfill proper and in the area near Well SB-1 and on a 200-foot grid system outside the Landfill boundaries to the north and east as shown in Figure 4-2. Additional samples may be secured as described in Section 6.



SOIL GAS SAMPLING POINTS
STOUGHTON CITY LANDFILL

FIGURE
4-2

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Table 4-1 summarizes the data collection effort for the soil gas investigation. A total of 102 field investigative samples are proposed along with a number of Quality Assurance/Quality Control (QA/QC) samples. The number and type of QA/QC samples were selected following the guidelines presented in Appendix C, Part 6 of the USEPA DQO Guidance.

4.3 Evaluation of Ground Water Flow Direction

Ground water flow direction in the upper surficial deposits is uncertain based on a review of available data. Therefore, three to six piezometers will be installed to evaluate ground water flow direction and concomitantly the interrelationship of ground water and surface water within and adjacent to the Landfill. The number and actual location of piezometers and surface water staff gages will be determined following detailed review of site topographic surveys to establish current surface run-off patterns and the existing ground water elevation data. Final location of monitoring well clusters will be established based on these and other data generated during Task 1.

4.4 Soil Sampling

During the initial field investigation, soil sampling will be performed during the installation of the proposed six, two-well monitoring clusters. Soil samples from the shallow boring at each cluster will be screened in the field for trace gases (primarily volatile organics). The sample taken from above the water table from each boring exhibiting the highest concentration above background will be analyzed in a laboratory for the TCL

TABLE 4-1

DATA COLLECTION SUMMARY
SOIL GAS INVESTIGATION

Field Parameter	Laboratory Parameter	Investigative Samples(1)	QA/QC Samples (2) Collocated	QA/QC Samples (2) Field(3) Blanks	QA/QC Samples (2) Background	Matrix Total
HNu Reading	Target VOCs and other analyzable VOCs(4)	102	11	11	0	124

Notes: (1) Total number of investigative samples may increase depending upon HNu readings taken during soil gas investigation.

(2) QA/QC samples are as defined in Appendix C, Part 6 of the USEPA DQO Guidance.

(3) Field blanks will be obtained as described in Section 6.1.

(4) Target VOCs are those detected most frequently during previous site investigations and include: xylene (total), ethyl benzene, toluene, trichloroethene, tetrachloroethene, 1,1-dichloroethane, tetrahydrofuran, 1,2-dichloroethene (total), and dichlorodifluoromethane. Other analyzable VOCs are as defined in the Standard Operating Procedure for Soil Gas and Outdoor Air as presented in the QAPP).

(5) Trip blanks will be collected and anlyzed at a frequency of one (1) per shipping container.

compounds and tetrahydrofuran, trichlorofluoromethane, and dichlorodifluoromethane. In addition, a soil sample will be collected from the screened interval from each monitoring well installed at the site, and that sample will be submitted to a geotechnical laboratory for grain-size distribution analysis. If a potential confining layer is encountered during monitoring well drilling, an undisturbed sample will be taken for a laboratory hydraulic conductivity analysis. Soil boring/monitoring well locations will be determined following review of data obtained during limited field investigations planned for Task 1. Borings will begin in areas of suspected low contamination and advance to areas of higher suspected contamination based on Task 1 results. Table 4-2 presents data collection summary information for soil samples, specific procedures are discussed in Section 6.2.

4.5 Ground Water Monitoring

As noted above, six, two-well monitoring clusters will be initially installed during the field investigation. At each cluster, a shallow well will be constructed within the water table, and a deeper well will be screened at a depth of approximately 70 to 80 feet below ground level. Prior to ground water sampling, each well will be purged a minimum of three (3) well volumes and until indicator parameters have stabilized, or to dryness depending upon recovery rates. One round of ground water samples will be collected and analyzed for the complete Target Compound List (TCL), other organics, an appropriate QA/QC samples as presented in Table 4-3. The location of the monitoring well clusters will be finalized based on results from Task 1. Hydrologic properties to be evaluated during this phase

TABLE 4-2

DATA COLLECTION SUMMARY
SOIL SAMPLING PERFORMED DURING MONITORING WELL INSTALLATION

Field Parameters	Laboratory Parameter	Investigative Samples	QA/QC Samples (1) Replicates	QA/QC Samples (1) Field Blank	QA/QC Samples (1) Background	Matrix Total
HNu Screening	TCL(2) Organics					
Lithologic	Volatiles	6	1	0	2	9
Description	Base Neutrals	6	1	0	2	9
	Acid Extractables	6	1	0	2	9
	PCBs/Pesticides	6	1	0	2	9
	Other Organics (3)	6	1	0	2	9
	TCL Inorganics					
	Metals	6	1	0	2	9
	Cyanide	6	1	0	2	9
	Geotechnical Analysis					
	Particle Size Distribution	12	0	0	0	12
	Hydraulic Conductivity	TBD	0	0	0	TBD

(1) QA/QC samples are as defined in Appendix C, Part 6 of the USEPA DQO Guidance. The field blank is rinsate water from split-spoon sampler following decontamination.

(2) Target Compound List.

(3) Other organics include tetrahydrofuran, trichlorofluoromethane and dichlorodifluoromethane.

(4) Analysis dependent upon encountering confining layer during drilling.

(5) TBD - To be determined in the field depending upon the existence of a confining layer.

TABLE 4-3

DATA COLLECTION SUMMARY
GROUND WATER SAMPLING

			QA/QC Samples (1)			
Field Parameters	Laboratory Parameter	Investigative Samples	Replicates	Field Blank	Background	Matrix Total
pH	TCL(2) Organics					
Specific Conductance	Volatiles	10	2	2	2	16
	Base Neutrals	10	2	2	2	16
Temperature	Acid Extractables	10	2	2	2	16
	PCBs/Pesticides	10	2	2	2	16
	Other Organics (3)	10	2	2	2	16
	TCL Inorganics					
	Metals (Dissolved)	10	2	2	2	16
	Cyanide	10	2	2	2	16

(1) QA/QC samples are as defined in Appendix C, Part 6 of the USEPA DQO Guidance.

(2) Target Compound List.

(3) Other organics include tetrahydrofuran, trichlorofluoromethane, and dichlorodifluoromethane.

(4) Trip blanks will be collected and analyzed at a frequency of-one (1) per shipping container.

of the sampling program include the measurement of static water levels and the measurement of hydraulic conductivity by performing slug tests in the completed monitoring wells. Detailed procedures for water level measurement and hydraulic conductivity testing are described in Sections 6.5.2.1 and 6.5.3, respectively.

4.6 Private Water Well Sampling

Any private downgradient water wells from the site that may potentially be affected will be assessed for sampling. This sampling would occur after analytical results from the site monitoring wells are available and have been reviewed. Chosen wells would then be sampled and water analyzed for compounds attributable to the site. Standard Operating Procedures for the determination of these specific compounds will be submitted for USEPA/WDNR approval prior to initiation of private well sampling.

4.7 Air Sampling

The potential release of contaminants to air at the site will be monitored as part of the RI. Three downwind sampling locations will be established on the perimeter of the property based on readings obtained from portable wind direction/wind speed instrumentation. Two background sampling locations will be established upwind of the site. Table 4-4 summarizes data collection associated with air sampling.

TABLE 4-4

DATA COLLECTION SUMMARY
AIR SAMPLING

Laboratory Parameters	Investigative Samples	QA/QC Samples (1)		Matrix Total
		Collocated	Background	
Analyzable VOCs(2)	3	1	2	6

(1) QA/QC samples are as defined in Appendix C, Part 6 of the DQO Guidance.

(2) Analyzable VOCs are those that may be analyzed for using the soil gas and air Standard Operating Procedure outlined in Appendix A of the QAPP.

(3) Trip blanks will be collected and analyzed at a frequency of one (1) per shipping container.

4.8 Surface Water/Sediment Sampling

Surface water/sediment sampling locations will be established after reviewing the results of ground water sampling on site. Preliminary surface water/sediment sampling locations will be identified in the technical memorandum to be prepared following the completion of Task 1 activities. Potentially impacted areas include the Yahara River and apparent wetlands adjacent to the site. The number of sampling locations is not determined at this time and as noted, will be dependent upon the results of the ground water investigation. However, it is anticipated that at least one sample will be collected from the Yahara River and also from the apparent wetland area adjacent to the site. Background samples will also be taken from each of these locations. Surface water will be analyzed in the field for pH, specific conductance, and temperature, and both surface water and sediment samples will be analyzed for TCL compounds detected in the ground water (for metals, total metal concentration will be determined). In addition, surface water and sediment may be analyzed for tetrahydrofuran, trichlorofluoromethane and dichlorodifluoromethane if these compounds are detected in adjacent ground water.

5.0 SAMPLE DESIGNATION

A sample numbering system has been developed for the Stoughton City Landfill project. Each sample will be designated to include the following sequential information:

- Name of Site - Stoughton City Landfill (SCL).
- Sample or Well No. - Sample designations as follows with appropriate numbers, as necessary: Field Blank (FB), Field Replicate (FR), Trip Blank (TB), and Background (B). Other samples/wells as designated in field.
- Sampling Round.
- Sample Matrix-Soil Gas (SG), Soil(S), Ground Water (GW), Surface Water (SW), Sediment (SD), and Air (A).

For example, for a monitoring well designated MW1 in the first round of ground water sampling, the sampling number would be as follows: SCL-MW1-1-GW.

All field samples will be identified with sample identification labels consisting of gummed paper labels that include the above sample number and the following additional information:

- Name of collector.
- Affiliation of collector.
- Day and time of collection.
- Analysis request.
- analysis code

Further information on sample identification and chain-of-custody documentation is presented in the accompanying Data Management Plan.

6.0 SAMPLING PROCEDURES & EQUIPMENT

Detailed procedures for sample collection are presented below along with a general description of the proposed sampling equipment. Detailed information pertaining to major equipment operation, maintenance, and calibration is presented in Appendix A.

6.1 Geophysical Surveys

Two geophysical survey techniques will be utilized in Task 1 of the Stoughton City Landfill RI. These include electromagnetic (EM) and electrical resistivity surveys. The EM survey provides a means of measuring the electrical conductivity of subsurface soil, rock, and ground water. Electrical conductivity is a function of the type of soil and rock, its porosity, its permeability, and the fluid composition and saturation. In most cases, the conductivity of the pore fluids will be responsible for the measurement. Accordingly, the EM method applies to both the assessment of natural hydrogeologic conditions and to mapping of many types of contaminant plumes, either conductive or nonconductive (resistive). The mapping of a plume will usually define the local ground water flow direction of contaminants. Electrical resistivity surveys provide information about the subsurface distribution of the ground resistivity. The information can be used to infer ground water quality and lithologic and geologic information. Both horizontal (profiling) and vertical (sounding) changes in ground resistivity can be mapped by resistivity surveys. Among other things, both of these techniques can lead to the definition of a contaminant plume.

Therefore, data resulting from the application of both these techniques will be used to guide the location of monitoring wells to be installed as part of the site investigation.

EM surveys will be conducted along transect lines which are 50-feet apart and are coincident with the grid system established during the detailed site survey. The Geonics EM31-D will be utilized for the EM survey of the Stoughton City Landfill site (Appendix A-1). The operator will traverse each transect recording only for EM conductivity at 25-foot intervals along each transect. Data will be recorded on the geophysical measurement field data form which is presented in the Data Management Plan which accompanies this document. Once the EM31-D instrument has been turned on and checked for proper operations in accordance with the manufacturers' specifications, three (3) pre-set station locations will be occupied and readings will be recorded. The operator will then proceed to occupy stations along each transect. The same pre-set, three (3) stations will be occupied once every hour, each day of the survey. Data at the three base stations will also be recorded on the geophysical measurement form. Repeated occupation of the three, pre-set stations will enable an assessment of instrument drift during the course of the survey.

Electrical resistivity surveys will be conducted across disposal boundaries as mapped using the EM31-D and outside of these areas within the initial investigative area. The survey will consist of vertical electrical soundings to assist in the identification of subsurface lithologies, in addition to profiling to support the EM surveys.

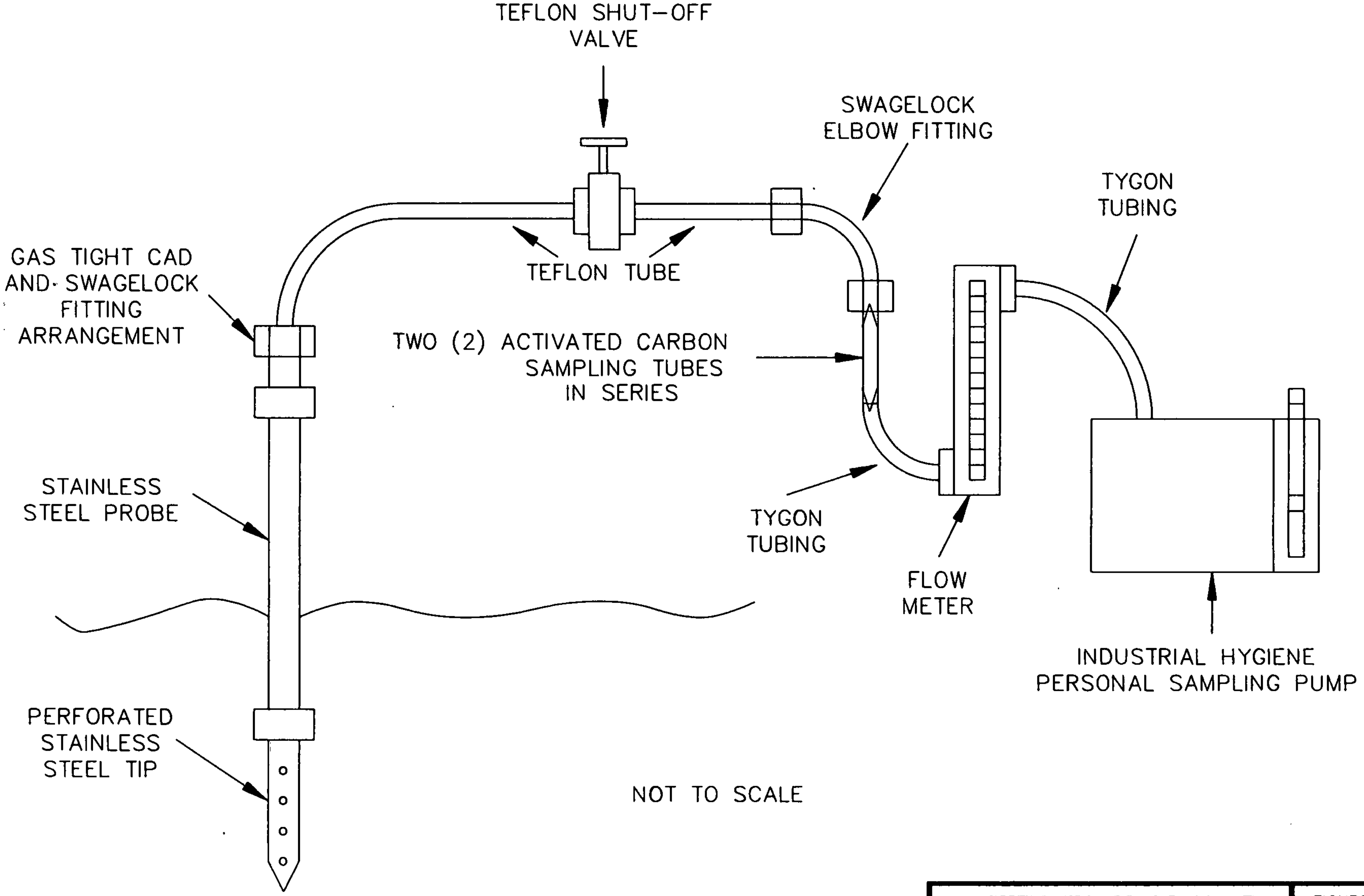
Sounding techniques are somewhat analogous to drilling. The results of a sounding consist of a vertical profile of units which are defined by their resistivity characteristics, similar to the lithologic profile developed from drilling data. Sounding will be conducted by incrementally increasing spacing between electrodes (the "A" - spacing), while maintaining a fixed electrode array centered about a fixed point. As the "A"-spacing increases, the depth of electrical sounding increases. Existing geologic data, if available, will be used to determine maximum electrode spacing during resistivity soundings. A maximum electrode spacing of 3 or more times the depth of interest is necessary to assure that sufficient data have been obtained. The apparent resistivity values will be plotted in the field as the survey progresses so that it can be determined whether the layers of interest have been reached. This procedure will also help identify anomalous resistivity readings. Sounding data will be plotted on log-log paper and will also be used for the determination of the constant spacings to be used for subsequent profiling. A Bison Instruments, Inc., Model 2365 Offset Sounding System will be used as an accessory to the Model 2350 Earth Resistivity Meter for acquisition of sounding data (Appendix A-1).

Lateral variations of the vertical-electric profile across the site are defined by profiling techniques. Profiling, or constant-spacing surveys, require a careful selection of the "A"-spacing, which is the fixed electrode separation. Selection of the "A"-spacing will be based upon the results of the resistivity soundings as previously noted. The Wenner array will be used for profiling surveys. An array will be set up and measurements taken. Then, the whole electrode array will be moved along the survey line without changing the electrode spacing. This process will be repeated until the entire area of interest is covered. At least two different electrode spacings will be used throughout the profiling survey in order to distinguish between shallow and deep effects. Profiling data will be plotted on standard graph paper. A Bison Instruments, Inc. Model 2350B Earth Resistivity Meter will be used for profiling (Appendix A-1).

6.2 Soil Gas Investigation

The soil gas procedure requires driving a perforated stainless steel probe into the soil and pulling a known quantity of soil vapor through a Teflon tube sampling train connected to activated carbon sampling tubes. Activated carbon sampling tubes will be sampled and analyzed as described in Appendix A of the Sampling and Analysis Plan, Part II - Quality Assurance Project Plan. The sampling train is designed to accommodate an HNu photoionization detector to enable field measurement of the trace gas (primarily volatile organics) concentrations in the soil gas. A schematic diagram of the soil gas sampling train is shown on Figure 6-1. The detailed sampling procedure is as follows:

1. A perforated stainless steel probe is driven into the soil to a minimum depth of 18 inches. Within the Landfill proper, a pilot hole will be hand augered through the Landfill cover material prior to driving the probe.



NOT TO SCALE

SCHEMATIC DIAGRAM OF
SOIL GAS SAMPLING TRAIN
STOUGHTON CITY LANDFILL

ERM-North Central, Inc.

FIGURE
6-1

2. A gas tight Teflon tubing arrangement is attached to the soil gas probe.

3. The Teflon tubing is connected to a flow meter/sampling pump system. The sampling train is initially purged for five minutes at a flow rate of two liters per minute, which results in a purged volume in excess of five times the volume of the soil gas sampling train.

4. Following completion of the presample purge, the shut-off valve is closed. The ends of two (2) activated carbon tubes are broken to provide an opening at least one-half the internal diameter of the tube (2mm). The smaller section of one charcoal tube will be used as a backup and will be positioned nearest the flow meter. Next, the other activated carbon tube is placed between the shut-off valve and the previously emplaced tube. The shut-off valve is then opened, and soil vapor is pulled through the activated carbon tubes at a flow rate of 0.2 liters per minute for a total of 50 minutes (sample volume = 10 liters). Upon completion of the sample interval, the shut-off valve is closed and the activated charcoal tubes are removed. The charcoal tubes will be immediately capped

with the supplied plastic caps. The backup tube will be labelled the secondary tube and the other the primary tube. The tubes will then be placed in a cooler. The sampling train is then repurged for one minute and the shut-off valve is closed again.

5. An HNu photoionization detector is attached to the sampling train immediately downstream of the shut off valve. Next, the valve is opened, and the photoionization meter is read for trace gas concentration, primarily volatile organic in nature. The use, maintenance, and calibration of the HNu PI-101 is presented in Section 15.2 of the Compendium. Section 15.2 of the Compendium has been reproduced and is included in Appendix A-2. The procedures for operation of the instrument as contained therein will be followed as part of the RI.

Decontamination activities will be carried out within the contamination reduction zone in a specially constructed decontamination area. A decontamination pad will be constructed by forming a sand berm around a small excavated area and placing a thick wall, plastic liner over the entire bermed area. The pad will be pitched to one end to allow the drainage and accumulation of decontamination waters that will be subsequently removed with a wet vacuum or a positive displacement pump and placed in 55-gallon drums. All decontamination wastewater generated during the RI will be stored in a secure area and disposed of as outlined in Section 3.2 of the Compendium (Control of Fieldwork-Generated Contaminated Material). The secure area for drum storage will be defined prior to the initiation of site activities. The following procedures will be used to decontaminate soil gas sampling equipment prior to any sampling and between sampling events:

1. The perforated stainless steel probe tip will be disconnected and steam cleaned to remove any residual contaminated soil.

2. The perforated probe tip will then be rinsed with detergent followed by distilled water and placed in a clean area to dry for approximately 15 minutes.

3. The Teflon tubing arrangement will be disconnected from the remaining probe section and purged with nitrogen to remove any residual soil vapor.

4. The remaining probe section will be steam cleaned.

5. The probe will be reassembled using Teflon pipe tape to ensure gas tight seals on all connections.

6. The entire soil gas sampling train will be reassembled and purged with nitrogen to remove any residual soil vapor.

Collocated samples will be taken at side-by-side locations within the soil gas investigation area. This will be accomplished by driving two stainless steel probes approximately one foot apart and simultaneously conducting the aforementioned soil gas sampling procedures. Collocated sampling will be distributed over the soil gas investigation area. Field blanks will be obtained by drawing ambient air from upwind, off-site areas through the decontaminated sampling train and collecting those samples on a carbon tube. Trip blanks will comprise unbroken activated carbon tubes that are kept with the investigative samples throughout the sampling event. These unbroken tubes will then be broken, capped, and packaged for shipment with the other investigative samples and sent for analysis. There will be two trip blanks included in each sample shipping container.

6.3 Evaluation of Ground Water Flow Direction

Three to six piezometers will be installed along with an appropriate number of surface water staff gages to evaluate shallow ground water flow direction within and adjacent to the site.

Piezometers will be installed using the following procedures:

- A borehole will be advanced using a nominal three-inch I.D. hollow stem auger approximately five (5) feet below the water table.

- The piezometer screen will be one-inch PVC with 0.010 inch manufactured slot openings. The screen will be five feet in length and a PVC plug will be fitted into the bottom of the piezometer before installation. The piezometer screen and riser will be installed in the boring prior to removal of the augers.

- The annular space around the piezometer screen will be backfilled with rounded, well-sorted silica sand to one foot above the top of the screen.

- Approximately two feet of compressed bentonite pellets will be placed above the sand pack to seal the annular space around the casing. The pellets will be hydrated with clean water.

- The remaining space above the bentonite seal will be filled with a cement-bentonite grout.

- The piezometer will be fitted with a vented cap.

- A reference point will be established on the piezometer from which water level measurements will be taken. The reference point elevation will be established by a survey taken with respect to US Datum mean sea level elevation to an accuracy of 0.01 feet.

Vertical staff gages will consist of commercially available, porcelain-enameled iron sections. These sections will be fixed to a backing board which will be securely seated into the underlying material. A reference point will be established on the gage and surveyed with respect to US Datum.

6.4 Soil Sampling

Soil above the water table in the shallow monitoring well boring will be logged using the Unified Soil Classification System (USCS) and sampled with a two-inch diameter split spoon sampler. Sample retrieval will be enhanced by fitting a spring retainer to the split spoon sampler. The sampler will be capable of obtaining a minimum sample of two feet in length. The Standard Penetration Test (SPT) blow counts will be recorded for each six-inch interval, and the "n" count will be the sum of the blows for the second and third intervals. Samples will be logged prior to being removed from the sampler. Composite soil samples will be removed from the soil sampler in two foot intervals and placed in both headspace and sampling jars. Headspace jars will consist of clean, one-pint or one-quart Mason jars. These jars will be filled about 1/4 full, sealed, shaken and allowed to equilibrate for approximately 10 minutes, at which time the concentration of organic vapors in the headspace above the soil sample will be measured using an HNu photoionization meter. The sampling jars will be filled prior to placement of the soil in the headspace jar. The two-foot composite soil sample above the water table, exhibiting the highest concentration of organic vapor above background will be selected for laboratory analysis of TCL compounds. In the event that there is no indication of organic vapor above background, at least one (1) two-foot composite soil sample above the water table will be selected for laboratory analysis of TCL compounds.

One replicate sample will be collected as part of the soil investigation. Background samples will be collected at two sampling intervals above the water table off the site and also upgradient, once the upgradient direction is determined.

Drilling augers will be steam cleaned and rinsed with detergent and distilled water between each boring and split spoon samplers will be similarly treated between each sample.

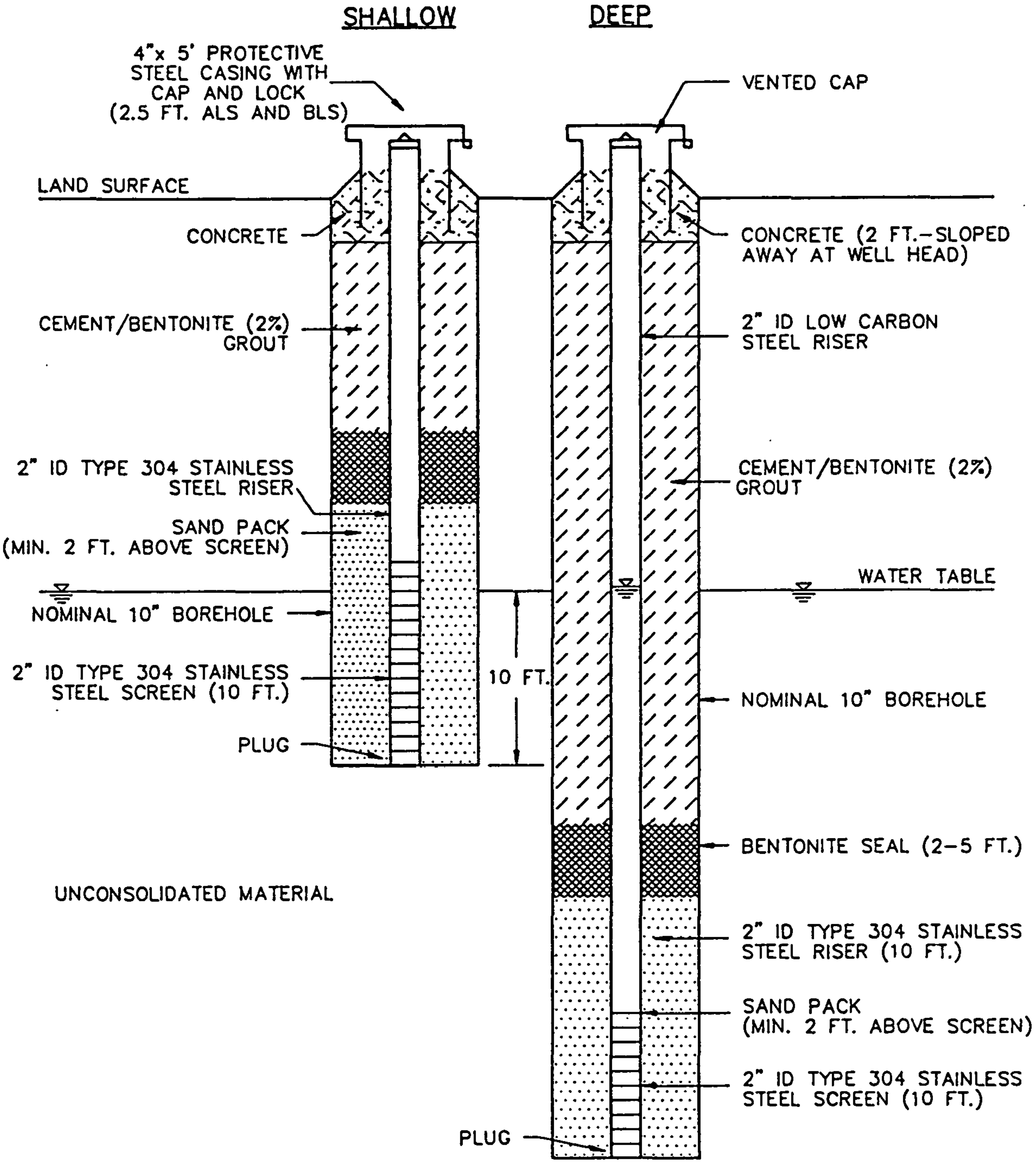
6.5 Ground Water Monitoring

This section details standard procedures and includes the design and installation of six, two-well monitoring clusters, ground water sampling, and field hydraulic conductivity testing. Additional monitoring wells may be installed outside the initial investigative area based on the review of Task 1 data and/or the initial well sampling results.

6.5.1 Monitoring Well Design and Installation

Two wells will be installed at each of the anticipated six monitoring well locations within the initial investigative area. One well will be installed in the water table, and the other will be completed at a depth of approximately 70 to 80 feet below ground surface. The shallow well will be screened in the upper 10 feet of the saturated zone, with the top of the screen positioned approximately 2 feet above the water table. The deep well will also have a screened interval of 10 feet. If during the drilling program a potential aquitard/aquiclude is located, drilling procedures for the deeper wells will be modified by setting and cementing steel casing into the aquitard/aquiclude and continuing the borehole through the casing, to prevent possible interaction between separate aquifers. In that instance, the deeper well will be finished in the uppermost portion of the lower aquifer. The details of a typical monitoring well cluster are shown schematically in Figure 6-2.

Monitoring wells will be constructed to comply with applicable federal, state, and local regulations concerning ground water monitoring of hazardous waste management sites.



NOTE: NOT TO SCALE

STOUGHTON CITY LANDFILL
SURFICIAL AQUIFER MONITORING
WELL-CONSTRUCTION DETAILS

FIGURE
6-2

ERM ERM-North Central, Inc.

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The following procedures will be used to install the monitoring well clusters:

- Wells will be advanced using a nominal six-inch I.D. hollow stem auger (nominal 10-inch borehole) to total depth.
- Soil above the water table in the shallow water table wells will be logged using the USCS and sampled with a two-inch diameter split spoon sampler as discussed in Section 6.2. Split spoon samples of the soil below the water table in the shallow, water table well and in the deeper monitoring well will be taken and logged every five feet.
- A single soil sample will be collected from the screened interval portion of each monitoring well installed at the site by using the split spoon sampler with a spring retainer attachment. This sample will be analyzed for particle size distribution using ASTM Method D 422.
- In the event that a potential confining layer is encountered during monitor well drilling, an undisturbed sample will be taken for laboratory measurement of hydraulic conductivity using a falling head permeameter.

- The well casing in the upper well will be constructed with two-inch I.D. flush joint, Type 304 stainless steel pipe. The well casing in the lower well will also have a 10-foot riser pipe above the screen of stainless steel. The remaining riser pipe will consist of 2-inch I.D. low carbon steel.

- The well screen will be two-inch stainless steel with a No. 10 (0.010 inch) manufactured slot openings. The well screen will be ten feet in length, and a stainless steel plug will be fitted into the bottom of the screen before installation. The well screen and riser will be installed in the boring prior to removal of the augers.

- The annular space around the screen will be backfilled with washed, rounded, well-sorted silica sand to two feet above the top of the screen. The sand will be free of silt and of an appropriate size for the well screen slot opening.

- A minimum of two feet of compressed bentonite pellets will be placed above the sand pack to seal the annular space around the casing. Above the water table, emplaced bentonite will be hydrated with clean water.

- The remaining space above the bentonite seal will be filled with a cement-bentonite grout placed with a tremie pipe. The grout seal shall be prepared of an approximate mixture of one bag of Portland cement, five pounds of bentonite powder, and ten gallons of water.
- The steel riser pipes will be fitted with a vented cap.
- A four-inch diameter protective steel casing with hinged locking steel cover will be cemented in place to a depth of 2.5 feet below the ground surface. The cement will be sloped away from the casing to promote drainage away from the well.
- All equipment used in construction of the well will be decontaminated prior to initiation of well construction. Drilling augers will be steam cleaned and rinsed with detergent followed by distilled water between each boring.

Following installation, monitoring wells will be developed no sooner than 24 hours following the grouting of the wells. Each well will be developed by surging and pumping until at least three well volumes have been removed and consistent values of pH, conductivity and temperature have been obtained. Equipment used in well development may include surge blocks, bailers, or pumps. Ground water removed during well development will be collected, stored in containers and handled as appropriate (Section 3.2 of the Compendium) based on results of chemical analysis.

6.5.2 Ground Water Sampling

One round of ground water samples will be collected from each well. The procedure for sampling the wells is outlined below.

6.5.2.1 Water Level Measurement

Static water levels will be measured and recorded at each sampling episode and on a monthly basis during field investigations. The water level surface will be measured prior to well development and sampling using a Solinst water level meter. Before lowering the probe in the well, the batteries will be checked by pressing the test button on the instrument for this purpose. The probe will be slowly lowered into the well until contact with the water surface is indicated. The probe will be withdrawn just above the water surface and a second reading will be taken prior to withdrawing the electric tape from the well. The reading will be recorded on the Ground Water Sampling Form as presented in the Data Management Plan.

Each well will have a reference point, indicated on the well casing, from which water level measurements will be taken. The reference point elevation on the well will be established by a survey with respect to US Datum mean sea level elevation to an accuracy of 0.01 feet for computation of ground water elevation.

6.5.2.2 Well Depth Measurement

The total depth of the well will be measured and recorded prior to well development and sampling. A weight tied to a rope of cotton cord will be used to tag the bottom of the well and the length of cord used will be measured to establish well depth.

6.5.2.3 Well Evacuation

Standing water in the wells will be removed prior to sampling by purging three (3) well volumes from each well and until stabilization of temperature, pH and specific conductance is achieved. If the well goes dry before three well volumes have been removed, samples will be taken as soon as the well recovers. The calculation of well volume will be calculated as follows:

- Measure well casing inside diameter.
- Determine the static water level below the measuring point.
- Determine the total depth of the well from the measuring point.
- Calculate the number of linear feet of static water (total depth of the well minus the static water level).

- Calculate the static volume in gallons. The static volume (well volume) is calculated in gallons as $\pi(r^2)(h)(7.48)$, where $\pi = 3.14$, r = well radius (ft.) and h = linear feet of static water (ft.).

Dedicated Teflon bailers will be used for purging the wells. Purged water will be placed in containers for subsequent handling based upon results of chemical analysis. Bailers, ropes, pumps and all equipment shall be decontaminated prior to insertion into the well.

6.5.2.4 Sample Withdrawal

During sample withdrawal, special care will be taken to avoid physically altering or chemically contaminating samples. Sampling will be performed with bottom filling Teflon bailers. Ground water pH, specific conductance, and temperature will be determined in the field on secured samples and field filtration will be performed for TCL metal parameters for ground water samples. Samples will be collected in the following order:

- TCL volatile organics
- Other volatile organics
- Cyanide
- TCL base neutral and acid extractable organics
- PCBs/Pesticides
- TCL metals

Samples for TCL metal and cyanide analysis will be prepared, preserved, and stored as listed in Table 7-1. One (1) replicate sample will be obtained for every ten (10) ground water samples collected.

The objective of ground water sampling for TCL metals is to determine the concentration of dissolved inorganic constituents. Therefore, ground water samples must be filtered through a non-metallic 0.45 micron membrane immediately after collection. The first 150 to 200 ml of filtrate will be used to rinse the filtration apparatus of any contaminants. This technique minimizes the risk of altering the composition of the samples by the filtering operation. The filtrate will be collected in a polyethylene bottle and immediately acidified to pH < 2 using nitric acid.

A maintenance and calibration program will be implemented to ensure that routine calibration and maintenance are performed on the instruments associated with ground water sampling. The program will be administered by the field team leader who will perform routine preventative maintenance (e.g., cleaning or other procedures identified in the instrument manual) on a weekly basis and calibration of field instruments on a daily basis. Calibration, operation, and maintenance of all field instruments will be documented in the field log book, and all field personnel will maintain their proficiency. Operating procedures outlined in the manuals for each respective instrument will be followed. For pH, pre-calibration will consist of using three (3) buffer solutions (pH 4, 7, and 10) and calibration verification at regular intervals (at least once a day). The two pH measurements must each be within ± 0.05 standard units of buffer solution values. The specific conductance meter will be calibrated using liquids of known specific conductance. Should specific conductance readings vary by more than 5% from the expected value, the unit will be repaired or replaced.

6.5.3 Hydraulic Conductivity Testing

Field slug tests will be conducted following well development and initial ground water sampling in order to estimate the hydraulic conductivity of the water bearing strata. The slug test will be either the falling head or rising head test, or both, depending upon field hydraulic head conditions at the time of testing. Testing procedures are outlined below:

1. The pretest static water level in the well will be measured.

2. A pressure transducer will be inserted below the static water level, sufficiently deep to avoid contact with the slug upon insertion.

3. A slug (calibrated cylinder of known volume) will be inserted into the well below the static water level. For the falling head test, water level readings will commence immediately following slug insertion. For the rising head test, the water level will be allowed to return to the original static level at which time the slug will be

withdrawn and water level readings will commence.

4. Water level readings will be taken with the pressure transducer at the following time intervals: 0.2 seconds from 0 to 2 seconds, 1 second from 2 to 20 seconds, 5 seconds from 20 to 120 seconds, 0.5 minutes from 2 to 10 minutes, and 2 minutes from 10 to 100 minutes.

5. Results will be plotted in the field to determine if the data are sufficient and reliable to enable computation of hydraulic conductivity.

6.6 Private Water Well Sampling

A survey of ground water utilization in the vicinity of the Stoughton City Landfill site will be conducted during Task 1 of the RI. Area ground water flow patterns and private well construction details will be evaluated to select suitable private wells to be sampled, if necessary. Standard operating procedures for the determination of these specific compounds will be submitted for USEPA/WDNR approval prior to initiation of private well sampling.

The following procedures will be used to obtain samples from private wells:

- If possible, the sample will be collected from an outdoor spigot.
- Water will be allowed to run through the tap for fifteen minutes to purge the water distribution system.
- Samples will be collected directly in the appropriate sample containers.
- Samples will be preserved according to procedures outlined in Section 7.0 with the exception that TCL metal samples will not be filtered prior to preservation.
- An additional sample will be collected to obtain field readings for pH, specific conductance, and temperature.
- One (1) replicate and one (1) blank sample will be collected during the private water well sampling program.

6.7 Air Sampling

The potential release of contaminants to the air at the Stoughton City Landfill site will be monitored as part of the RI by employing representative, gaseous air sampling to detect volatile organic compounds. Weathertronics, Inc. wind direction/wind speed instrumentation will be mounted atop a 10-foot portable tower and used to effectively locate two upwind and three downwind sampling locations. If shifts in wind direction occur, samplers will then be relocated. At each sampling location, air will be drawn through two (2) activated charcoal tubes located in series, as described for soil gas sampling (Section 6.2), for a period of eight hours using a Gilian Model HFS 113A high-low flow personal sampling pump. A flow rate of approximately 21 cc/min will be set on the pump to achieve the 10 liter sample volume of air. Upon removal of any organic contaminants from the charcoal tubes, the extract will be analyzed for target and analyzable VOCs as described in Appendix A of the QAPP.

6.8 Surface Water/Sediment Sampling

Surface water run-off or ground water discharge may potentially impact adjacent surface water bodies including apparent wetlands and the Yahara River. The number and location of surface water/sediment samples is indeterminate at this time and is dependent upon the results of field investigations conducted under Task 1 and the results of Task 2 hydrogeologic investigations.

It is anticipated that samples will be collected near the shore of the Yahara River and just inside the apparent wetlands. Surface water samples will be collected by submerging the sample container. The container mouth will be positioned so that it faces upstream, while the sampling personnel are standing downstream so as not to stir up any sediment to contaminate the sample. Sediment samples near shore will be collected using a stainless steel trowel. The trowel will be decontaminated prior to and between sampling locations.

Collocated, field blank and trip blank samples will be taken for surface water but only collocated samples will be taken for sediment. Background samples, both upstream in the Yahara River and in the apparent wetland area, will be also taken. The collocated sample will be collected at essentially the same time and from the same surface water sampling point. The surface water trip blank will be prepared prior to the sampling event and kept with the investigative samples throughout the sampling event.

7.0 SAMPLE HANDLING AND ANALYSIS

The required sample containers, preservation methods, maximum holding times, and filling instructions for each sample type are summarized on Table 7-1. Notations of which laboratory will be performing the analysis of the collected samples are also indicated on Table 7-1. Sample bottles, provided by CompuChem Laboratories, will be prepared using procedures required by the Contract Laboratory Program (CLP). Sample bottles, provided by Pace Laboratories, for the analysis of tetrahydrofuran, trichlorofluoromethane, and dichlorodifluoromethane will be prepared using procedures appropriate for the analyzation of these parameters using nonstandard methods. Sample containers for soil gas and air sampling are commercially available cartridges containing activated carbon. Table 7-1 also lists handling procedures appropriate for these samples. Detailed information concerning the sample preservation and custody procedures are contained in the accompanying documents: Quality Assurance Project Plan and Data Management Plan.

Waste generated on site will be properly handled and disposed of to prevent contamination of clean areas and to comply with existing regulations (Section 3.2 of the Compendium). If soil encountered during borehole drilling is suspected to be hazardous because of abnormal discoloration, odor or air monitoring levels, the soil cuttings will be containerized in a new, unused drum. Similarly, materials generated during decontamination procedures, including washwater and soil materials, will be disposed in

TABLE 7-1

SAMPLE CONTAINER AND PRESERVATION REQUIREMENTS

Soil Gas Parameters(1)	Container	Preservation	Maximum Holding Time	Filling Instructions
Target and Analyzable Volatile Organics	Activated Carbon Cartridge	Cool 4°C		Cap cartridge ends
Ground Water/Surface Water Parameters(2)				
TCL Volatile Organics	2 x 40 ml Glass Vials with Teflon-lined septum	Cool 4°C	14 days	Zero headspace, no air bubbles
TCL Base Neutral Organics and Acid Extractable Organics	3 x 1 liter amber glass bottles with Teflon-lined cap	Cool 4°C	7 days	Fill to neck of bottle
PCBs/Pesticides	2 x 1 liter amber glass bottles with Teflon-lined cap	Cool 4°C	7 days	Fill to neck of bottle
TCL Metals (3)	2 x 500 ml Polyethylene bottle	0.45 u Filtration Ground Water - Field Filtered Surface Water - Unfiltered $HN_{0}3$ to pH<2 Cool 4°C	6 months	Fill to neck of bottle
Cyanides	1 x 1 liter glass bottle with Teflon-lined cap	NaOH to pH>12 Cool 4°C	24 hours	Fill to neck of bottle
Other Volatile Organics (1,4)	2 x 40 ml Glass Vials with Teflon-lined septum	Cool 4°C	14 days	Zero headspace, no air bubbles

TABLE 7-1 (continued)

SAMPLE CONTAINER AND PRESERVATION REQUIREMENTS

Soil/Sediment Parameters(2)	Container	Preservation	Maximum Holding Time	Filling Instructions
TCL Volatile Organics	2 x 4 oz wide-mouth glass jars with Teflon-lined cap	Cool 4°C	10 days	Zero headspace, pack tightly
TCL Base Neutral Organics and Acid Extractable Organics	1 x 1 liter, wide-mouth amber glass jar with Teflon-lined cap	Cool 4°C	10 days	At least 3/4 full
PCBs/Pesticides	From semivolatile Organic Container	Cool 4°C	10 days	At least 3/4 full
TCL Metals (3)	1 x 1 liter, wide-mouth amber glass jar with Teflon-lined lid	Cool 4°C	6 months	At least 3/4 full
Cyanides	From TCL Metals Container	Cool 4°C	14 days	At least 3/4 full
Air Parameters(1)				
Analyzable Volátile Organics	Activated Carbon Cartridge	Cool 4°C		Cap cartridge ends

Note: All samples will be shipped by overnight carrier to their final laboratory destination under custody.

(1) Soil gas, air and other volatile organic parameters to be analyzed by Pace Laboratories.

(2) Ground water, surface water, and soil/sediment parameters to be analyzed by CompuChem Laboratories, excluding other volatile organics.

(3) Maximum holding time for mercury of 26 days.

(4) Other volatile organics include tetrahydrofuran, trichlorofluoromethane, and dichlorodifluoromethane.

drums. Composite samples will be collected from drum materials and tested by the Toxic Characteristic Leaching Procedure (TCLP) to determine if the cuttings should be disposed of as a hazardous waste.

REFERENCES

1. USEPA, 1988, "Draft Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA", March.

2. USEPA, 1987, "Compendium of Superfund Field Operations Methods", EPA/540/P-87/001, December.

3. USEPA, 1987, "Data Quality Objectives for Remedial Response Activities: Development Process", EPA/540/6-87/003, March.

4. Mickelson, D.M., and McCartney, M.C., 1979, "Glacial Geology of Dane County, Wisconsin", Univ. of Wisconsin - Extension Geological and Natural History Survey.

APPENDIX A

MAJOR EQUIPMENT
FOR USE IN REMEDIAL INVESTIGATION

APPENDIX A-1

GEOPHYSICAL SURVEYS

The Geonics Model EM31-D conductivity meter is proposed for use in conducting electromagnetic (EM) surveys at the Stoughton City Landfill site. Portions of the operating manual for the EM-31-D instrument which pertain to operation, instrument calibration, and survey technique are attached. These instructions and procedures will be followed during the course of the RI. Also, summary information for the Bison Instruments, Inc. Model 2350B Earth Resistivity Meter and the Model 2365 Offset Sounding System Resistivity Accessory are attached. These summary sheets discuss the applications, features, and specifications for these instruments. Both of these instruments will be operated in accordance with the respective operation manuals which will be reviewed prior to the initiation of the RI.

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Telex 06-968688
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OPERATING MANUAL
for
EM31-D
NON-CONTACTING
TERRAIN CONDUCTIVITY METER

Revised June 1984.

INDEX

EM31-D SPECIFICATIONS

Measured Quantities	(1) Apparent conductivity of the ground in millimhos per meter (2) Inphase component of the induced magnetic field
Primary Field Source	Self-contained dipole transmitter
Sensor	Self-contained dipole receiver
Intercoil Spacing	3.66 meters
Operating Frequency	9.8 kHz
Power Supply	8 disposable alkaline 'C' cells (approx. 20 hrs life continuous use)
Conductivity Ranges	3, 10, 30, 100, 300, 1000 mmhos/meter
Measurement Precision	± 2% of full scale
Measurement Accuracy	± 5% at 20 millimhos per meter
Noise Level	<0.1 millimhos per meter
Operator Controls	•Mode Switch •Conductivity Range Switch •Phasing Potentiometer •Coarse Inphase Compensation •Fine Inphase Compensation
Analog Output	Connector on EM31-D for dual channel analog recording of ground conductivity and inphase component
Dimensions	Boom : 4.0 meters extended 1.4 meters stored Console : 24 x 20 x 18 cm Shipping Crate: 155 x 42 x 28 cm
Weight	Instrument Weight: 9 kgm Shipping Weight: 23 kgm

1. INTRODUCTION

Measurement of ground resistivity is one of the oldest geophysical techniques. Table 1, taken directly from Heiland*, lists typical values of resistivity for a variety of geological materials (pages 4-7). The values given are in ohm-centimeters and must be divided by one hundred to give ohm-meters.

It will be observed that in most cases the actual resistivity itself is not diagnostic and a knowledge of the way in which the resistivity varies laterally and with depth is of great importance, since this permits us to "see" features as a result of their shape rather than their actual resistivity values. There is thus a requirement for instrumentation which permits the rapid and accurate measurement of terrain resistivity. Since the EM31 does not require electrical contact with the ground it fulfills this objective.

The basic principle of operation of the EM31 is simple. With reference to Fig. 1 a transmitter coil located at one end of the instrument induces circular eddy current loops in the earth. Under certain conditions fulfilled in the design of the EM31 the magnitude of any one of these current loops is directly proportional to the terrain conductivity in the vicinity of that loop. Each one of the current loops generates a magnetic field which is proportional to the value of the current flowing within that loop. A part of the magnetic field from each loop is intercepted by the receiver coil and results

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* Heiland, C.A. Geophysical Exploration. Hafner Publishing Co., New York 1968

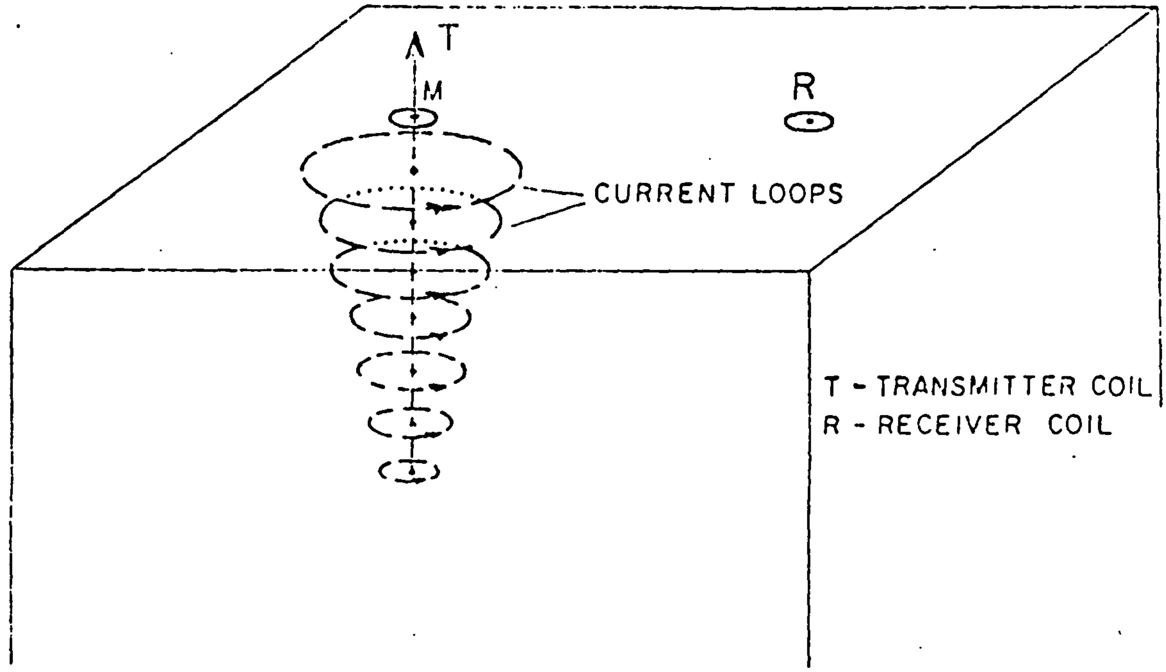


Fig. 1 INDUCED CURRENT FLOW IN GROUND

1. INTRODUCTION (cont'd)

in an output voltage which is therefore also linearly related to the terrain conductivity.

This instrument is calibrated to read the correct conductivity when the earth is uniform. In the event that the earth is layered, with each layer of different conductivity, the instrument will read an intermediate value as discussed in more detail in Section 5.2.

The unit of conductivity used is the millimho per meter. To obtain resistivity in ohm-meters the instrument reading is divided into 1000 - i.e., a reading of four millimhos per meter divided into 1000 gives two hundred and fifty ohm-meters.

Theoretical calculations show, as will be quickly evident to the operator, that the reading obtained is essentially independent of the orientation of the instrument with respect to the earth. There is, however, a small dependence on the height above the ground; lifting the instrument from the surface of a uniform earth to the normal operating height of about one meter results in a reduction in the reading of 12%. The calibration has been adjusted at the factory so that the instrument reads correctly over a uniform half-space when worn as shown in the data sheet. If the earth is layered, raising the instrument from the surface of the earth to the normal operating position can result in a reading which stays constant or even increases slightly with height. In general, readings made with the instrument at hip height will be sufficiently accurate, but for maximum accuracy the instrument can be laid on the ground as discussed in Section 5.2.

There are two components of the induced magnetic field measured by the EM31. The first is the quadrature-phase component which gives the ground conductivity measurement as described. The second is the inphase component used primarily in the EM31 for calibration purposes. The inphase component however is significantly more sensitive to large metallic objects and hence very useful when looking for buried metal drums. Although this component has been available in the standard EM31 by operating in the compensation mode (Section 2.2), both components are now available in the EM31-D from an analog output connector when coupled to a dual channel recorder.

TABLE 1A

RESISTIVITIES OF IGNEOUS & METAMORPHIC ROCKS

Rock	Locality	Investigator	Dir.	Freq.	Resistivity in ohm-cm							
					Intermediate Conductors							
					[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Specimens												
Diabase	Idaho	Sundberg	3				3.1					
Granite	Bavaria	Hunkel	3							1		
Devonian slate	Harz	Ebert					2					
" "	"	"						6.5				
Porphyry, schistose	S. Australia	Edge & Laby		100			3					
Serpentine		Eve & Keys					3-	-2				
Diorite	Bavaria	Hunkel	3					1				
Gabbro	Mineville	Lee & Boyer		D.C.					1.0	—	1.4	
Garnet gneiss	Bavaria	Hunkel	3						2			
Hornblende gneiss	Mineville	Lee		D.C.						1-6		
Gray biotite gneiss	"	Lee & Boyer		D.C.						4		
Syenite	Bavaria	Hunkel	3							1		
In Situ												
Graphitic schist	Normandy	Schlumberger		16	1-	1						
Schists	Missouri	Poldini			2-	6						
Hard calc. schist	Belgian Congo	Geoffroy & Charrin				2-	1.1					
Mica schist (hard packed)	Washington, D. C.	Gish & Rooney		16			1.3					
Quartz porphyry (slightly altered)	Newfoundland	Kihlstedt				3.4						
Keweenawan lavas	Michigan	Hotchkiss, *et. al.*		10-15		1.2	—	4.4				
Greenstone	"	Rooney		16			1.1					
Porous trap-rock	"	"		16		1.6						
Pre-Cambrian	Sweden	Sundberg					3-6					
Granite	Washington, D. C.	Gish & Rooney		16			5					
Slightly altered syenite	Ontario	Kihlstedt		200			2.4 3.7					
Massive vein quartz	"	"		200				2				
Diabase	Michigan	Rooney		16		4.5						
Serpentine	Ontario	Kihlstedt		200		2.1 5.3						

TABLE 1B

RESISTIVITIES OF CONSOLIDATED SEDIMENTS[11]

Rock	Locality	Investigator	Dir.	Freq.	n°	Resistivity in ohm-cm 10^2	10^3	10^4	10^5	10^6	10^7
Shales and Slates											
Chattanooga shale (Dev.)	Cent. & south Illinois	Hubbert		50			2-	—	1.4		
Shale & glacial drift	"	"		50			5				
Nonesuch shale	Houghton Co., Mich.	Hotchkiss, *et. al.*		10-15				1.8			
Shale	W. Hancock, Mich.	Rooney		60					2		
Slate		Lee, Joyce, & Boyer		0				6.4			
Clay (wet)	Jugoslavia	Lochnberg & Stern		D.C.			2.1				
Grinneld argillite	N½ sec. 23, T32N R20W, Flathead Co., Montana	Erdmann	dip 32°	16							
					10			1.7			
			‖ to stratification		20		9.6				
					20			1.1			
					30			1.0			
			⊥ to strike		10		8.7				
					20		7.4				
					40			1.1			
Grinneld argillite	" (Water's Edge)	"	dip 32°	16							
								1.3			
			‖ to strike		15			1.4			
					30			8.0			
								8.2			
					10			7.7			
Argillite (Missoula group); pre-Cambrian, thin-bedded, platy argillite; resembles Grinneld	Sec. 27, T 32N R20W, Flathead Co., Montana	"	dip 31°	16							
					10			1.4			
					20			1.6			
			⊥ to strike		30			1.5			
					40			1.4			
					50			1.5			
									1.1		
Conglomerates											
Great conglomerate outcrop	Eagle Harbor, Mich.	Hotchkiss, *et. al.*		10–15							
Calumet & Hecla conglomerates	Michigan	Rooney		60					2	1.3	
Sandstone											
Eastern sandstone	Michigan	Hotchkiss, *et al.*		10-15			3.5	-1.2			
Eastern sandstone	"	Rooney		16			4.3				
Muschelkalk ss. (Triassic)	Lorraine	Schlumberger		16			7				
Sandstone (Tertiary Oligocene); soft, friable; extremely fine grained ss.; pale green to yellowish and buff; contains thin beds of lignite	Coal Creek Road, Flat head Co., Montana	Erdmann	dip = almost 0	16	10		8.8				
							9.8				
					20		6.2				
							6.7				
					30		4.8				

TABLE 1B cont'd

RESISTIVITIES OF CONSOLIDATED SEDIMENTS

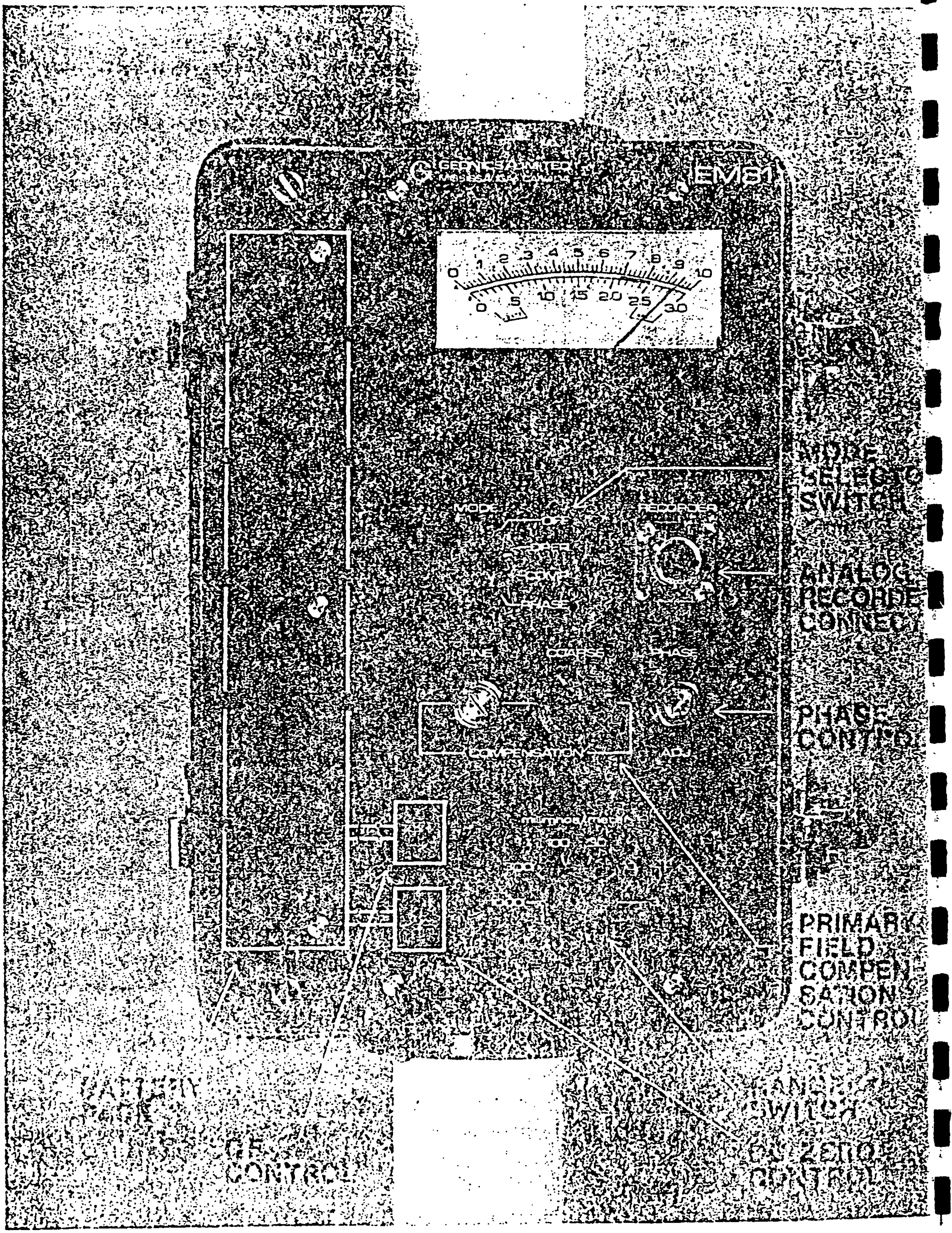
Rock	Locality	Investigator	Dir.	Freq.	a*	Resistivity in ohm-cm					
						10^3	10^4	10^5	10^6	10^7	10^8
Armorican ss. compact Siliceous-Ordovician	Normandy	Schlumberger						1			
Ferruginous sandstone (Jurassic)	Switzerland	Koenigsberger						4			
Limestone											
Muschelkalk ls. (Triassic)	Lorraine	Schlumberger		16		6					
Limestone with lenses of hematite	Algeria	"					1.2-4				
Muschelkalk oolitic ls. (Triassic)	Lorraine	"		16			1.8				
Limestone	Mississippian (Missouri)	Poldini					3-4				
Siyeh ls., hard homogeneous, dark bluish-gray, siliceous magnesium ls.; pre-Camb.	SW cor. sec. 5 T29N R18W Flathead Co., Montana	Erdmann	dip 54°	16							
					10		6.8	-1.4			
			∥ to strike		20			1.5			
					30			1.4			
			⊥ to strike		10		3.6				
					20		5.4 7.9				
					30		6.6 6.9				
					50		6.1 8.1				

TABLE 1C

RESISTIVITIES OF UNCONSOLIDATED FORMATIONS (MOSTLY QUARTERNARY)

Formation	Locality	Investigator	t°	Freq.	Resistivity in ohm-cm					
					10^3	10^4	10^5	10^6	10^7	10^8
Marls										
Marl & gypsum	Germany	Schlumberger		16	3-	1.2				
Marl & gypsum	Algeria	"		16		1-3				
Jarnisy marls	Lorraine	"		16		5				
Marls	"	Geoffroy				7				
Clay										
Clays with Mg salts	Australia	Rooney		16	1-2					
Clay (wet)	Palestine	Lochnberg		D.C.	5-	-4				
Boulder clay (no gravel)	Montana	Erdmann	10			2.1				
			20			2.3				
Marine clay	Ontario	Hawkins				3.6				
Dry clay	New Jersey	Feldman		40 mc.[b]		5.1				
Wet clay	" "	"				8				
Boulder clay (wet)	Montana	Erdmann	20				1.1			
Alluvium and Silt										
Alluvium (moist)	Montana	"	10			2.3				
Silt (dry)	"	"	5			2.0				
			10			1.3				
			20			1.4				
Glacial out-wash (dry)	Washington (state)	"	10				1.3			
" "	"	"	10				1.6			
" "	"	"	10				2.1			
Fluvio glacial till (wet)	"	"	20				8.4			
			40				5.7			
			60				4.9			
			100				3.9			
Glacial	Connecticut	Leonardon					5			
River gravel (wet)	Montana	Erdmann	10				1.2			
" " "	"	"	10				1.4			
Yellow river sand (3.3% moisture)		Sundberg					1.7			
Yellow river sand (0.86% moisture)		"					8.3			
Stream gravel (wet)	Montana	Erdmann	10				3.3			
			15				3.3			
			20				3.2			
River gravel (wet)	Colorado	"	10				4.8			
			10				6.5			
			10				4.8			
							8.9			

[b] mc. = megacycles = 10^6 cycles.


GEONICS LIMITED
EM31
0 1 2 3 4 5 6 7 8 9 10
0 5 10 15 20 25 30
MODE
RECORDER
PHASE
FINE
COARSE
PHASE
COMPENSATION
ADJ
MODE SELECTO SWITCH
ANALOG RECORDE CONNEC
PHASE CONTRO
PRIMARY FIELD COMPEN SATION CONTROL
SWITCH
ZERO CONTROL
BATTERY PACK
CONTROL

2. OPERATING INSTRUCTIONS

The EM31 can be used both to measure the electrical conductivity of the ground and to detect buried metal objects. Section 2.1 describes the procedure for measuring ground conductivity and section 2.2 for buried metal detection.

2.1 Ground Conductivity Measurements

2.1.1 Initial Set-up Procedure

a) Using the identifying labels on the tubes select the transmitter coil tube, align it with respect to the main tube, insert it and fix it with the clamp.

b) Check the battery condition, plus and minus, by setting the Mode switch (MODE SELECTOR SWITCH) to the OPER position and the Range switch to the +B and -B positions respectively. If the needle reads inside the BATT mark on the meter, batteries are in good condition, otherwise replace the batteries with a fresh set of C size alkaline batteries.

c) Check the zero reading by setting the Mode switch to the OPER position and the Range switch to the least sensitive position 1,000 mmhos/meter (this minimizes any external noise interference while checking the zero position). If a zero adjustment is required adjust the DC ZERO CONTROL located under the front panel to obtain a zero reading. To do this the battery pack must be removed to gain access to the controls.

d) Align and connect the receiver coil tube to the main frame tube. The instrument is now ready to proceed with the functional checks.

2.1.2 Equipment Functional Checks

The Range switch should be set at 30 millimhos/meter position for all the following tests. (If the reading is off scale, i.e., greater than 30 millimhos/meter, see note.)

a) Set the Mode switch to the COMP position and adjust the meter reading to zero using the COARSE and FINE COMPENSATION controls.

b) To check the phasing of the instrument set the Mode switch to the PHASE position. Note the meter reading and rotate the COARSE control one step clockwise. If the meter reading remained the same, the phasing is already correct; return the COARSE control to its original position (one step counter clockwise) and no further adjustment is necessary.

If there was a difference in the meter readings taken before and after the COARSE control was rotated one step clockwise then a phase adjustment is required. With the COARSE control in its original position adjust the PHASE potentiometer about 1/4 turn clockwise and note the new meter reading. Rotate the COARSE control one step clockwise, take a reading, and return the COARSE control to its original position. If the <u>difference</u> in meter readings has decreased, repeat the procedure using a further clockwise adjustment, until rotating the COARSE control the one step clockwise produces no change in the meter reading.

If, on the other hand, the difference in meter readings was increased, the PHASE potentiometer should be rotated in a counter clockwise direction instead and the procedure described above repeated until there is no change in the meter readings. Always remember to set the COARSE control back to its original position. This can be confirmed by setting the Mode switch in the COMP position and checking that the meter reads zero. If it does not read zero, repeat steps (a) and (b).

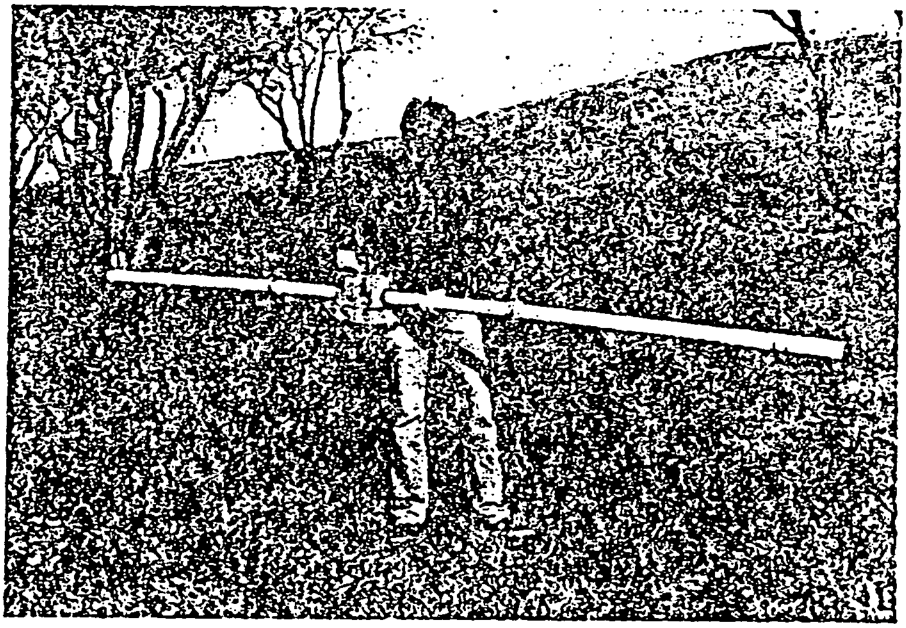
c) To check the sensitivity of the instrument, set the Mode switch to the COMP position and rotate the COARSE control clockwise one step. The meter should read between 75% and 85% (22 to 26 millimhos/meter) of full scale deflection (inside black mark). It is unlikely that the sensitivity of the instrument will vary, however it may be useful to record the actual meter reading for comparison at a later date.

Return the COARSE switch to its original position and the EM31 is now ready to make ground conductivity measurements.

NOTE: When conducting the functional tests over ground of higher conductivity than 30 millimhos/meter, the Range switch should be set at the appropriate level. At whatever level the Range switch is in, the reading taken in (c) should still be between 22 and 26 millimhos/meter.

2.1.3 Operating Procedure

a) Wearing the instrument with the shoulder strap adjusted so that the instrument rests comfortably on the hip as shown, switch the Mode switch to the OPER position and rotate the Range switch so that the meter reads in the upper two thirds of the scale. The full scale deflection is now indicated by the Range switch and the instrument is reading the terrain conductivity directly in millimhos per meter.



b) The EM31 can be operated continuously while moving from one measurement station to the next however, the instrument has a time constant of about one second for which the operator should adjust his walking speed to obtain greatest accuracy.

Alternatively, to extend battery life the instrument can be switched on at each measurement station when not using a recorder. The operator will notice that the type of integrator used results in a slight initial overshoot of the needle at turn on. This is normal, and that at least two seconds should be allowed after turn on before the measurement is taken.

2.2 Buried Metal Detection

2.2.1 Set-up and Operating Procedure

The inphase component of the magnetic field is significantly more sensitive to large metallic objects than the quadrature-phase component used for ground conductivity measurements.

a) The inphase component is readily measured with the EM31 by simply taking the reading with the Mode switch in the COMP position rather than in the OPER position.

It is recommended that the 30 mmho/m range be used since it usually gives adequate sensitivity, however more or less sensitive positions of the Range switch may also be used.

b) To carry out a survey measuring the inphase component set the Mode switch to the COMP position and adjust the COARSE and FINE compensation controls so that a meter deflection of about 20% of full scale deflection is obtained. (The procedure of adjusting to 20% of the full scale deflection rather than to zero is only a convenience to allow for negative readings on the meter and under certain conditions a possible change in the reference level. For example, a sudden jar to the instrument can result in a small positive or negative change in the inphase reference level).

The survey is then carried out exactly as if the conductivity were being measured.

c) This lack of a true zero reference should not cause any serious problems since when using the inphase component one is usually only looking for buried metallic objects.

These will be easily recognizable by relatively localized meter deflections occuring either singly or in a series of responses depending on the number of buried objects, their spacing and depth of burial.

Notes (1): The 20% offset should only be used when the inphase component only is being measured continuously. If both conductivity (quadrature phase) and inphase measurements are being made at each station the procedure described in 2.1.2 (a) should be used so that accurate ground conductivity measurements are obtained. If negative inphase measurements are obtained one should check the inphase reference level and/or the area for buried metallic objects or utilities.

(2) Similarly when the dual channel recorder is being used there should be no zero offset as described in 2.2.1 (b) and the meter reading set to zero using the COARSE and FINE controls as described in 2.1.2 (a).

A zero offset for negative inphase readings can however be allowed for on the recorder by setting the zero position of the pen at some arbitrary positive value when calibrating the recorder.

3. INSTRUMENT CALIBRATION

Prior to shipping, the instrument is calibrated in the factory to read properly. If necessary, calibration procedures are easily carried out as described below. IMPORTANT The most critical adjustment is the QF (quadrature fine) potentiometer which has been precisely adjusted at the factory.

Before any adjustments are made it is strongly recommended that the instrument first be set up at a fixed height over a known location and the ground conductivity carefully noted. If this adjustment is misaligned the instrument will have to be recalibrated over ground of known conductivity.

3.1 Null Calibration

The zero setting of the EM31 can be readily set by following the procedure described in section 2.1.1 (c).

3.2 Absolute Calibration

Absolute instrument calibration is easily achieved if an area of ground is available of known and constant conductivity down to the depth of penetration of the instrument. The procedure is simple; the instrument is located over the known area at the usual operating height (approximately 1m) and the QF compensation control is adjusted until the meter reads the correct terrain conductivity. If the ground conductivity is high the graph of Fig. 3 must be used to correctly set the instrument reading.

It is wise to maintain such an area as a calibration check area even if the variation of the conductivity with depth at that area is not accurately known. This is useful for cross checking with future measurements.

Note:

The QF and NULL controls are located under the front panel. Battery pack should be removed to have access.

4. SURVEY TECHNIQUE

Surveying with the EM31 is straightforward. As pointed out in a previous section, measurements may be made either continuously or on a station-by-station basis. In either case it is always recommended, as for any other geophysical survey, that survey lines and measurement stations be carefully laid out, and the survey performed in a systematic fashion with the resulting data accurately plotted for each measurement station. The most common survey error is to have the survey lines too short, in which case they do not extend sufficiently far off the supposedly anomalous region to permit the operator to establish the background values of terrain conductivity.

The EM31 yields good spatial resolution and measurement stations should be ten meters apart if the maximum resolution is to be employed. In many cases this spacing will be smaller than necessary, and twenty or perhaps forty meters will be adequate. The decision as to the correct spacing will be based on a knowledge of the lateral dimensions of the anticipated resistivity anomaly. To ensure the correct spacing it is useful, at the start of the survey, to continuously observe the conductivity values that are encountered as the operator moves down the survey line.

The resolution in conductivity of the EM31 is also high, with changes of 5% being quickly perceived. This instrument is capable of giving an extremely precise survey with information on small variations in the terrain conductivity.

4. SURVEY TECHNIQUE (cont'd)

It was seen in Section 1 that current flow within the earth consists of a series of concentric circles, assuming that the conductivity is laterally uniform. Therefore in the case of a uniform half-space, rotation of the instrument in a horizontal plane about the transmitter coil as a pivot will produce no change in the meter reading. Conversely, any change in the reading as this procedure is carried out is an indication of lateral inhomogeneities in conductivity. It is simpler and usually sufficiently accurate for the operator to rotate the instrument through 90° using himself as pivot at each measurement station. Thus if the lines are in a north-south direction the operator would normally walk along the line with the instrument pointing in a north-south direction; at each measurement station he can also take a reading with the instrument pointing east-west to check that this is essentially the same as the north-south reading. In the event that this reading is significantly different it may be worthwhile for the operator to then rotate the instrument to the points where the conductivity reading is both a maximum and a minimum, and to record both values. The average value can then be used for the data reduction.

The EM31 is somewhat sensitive to underground conductors such as large pipes, etc. These are usually easily recognized by the large meter fluctuations which occur within a short distance, as shown in Fig. 2. In an actual survey, since the negative-going peak is often off-scale, it is not possible to use it to locate the pipe; finding the point half way between the two positive-

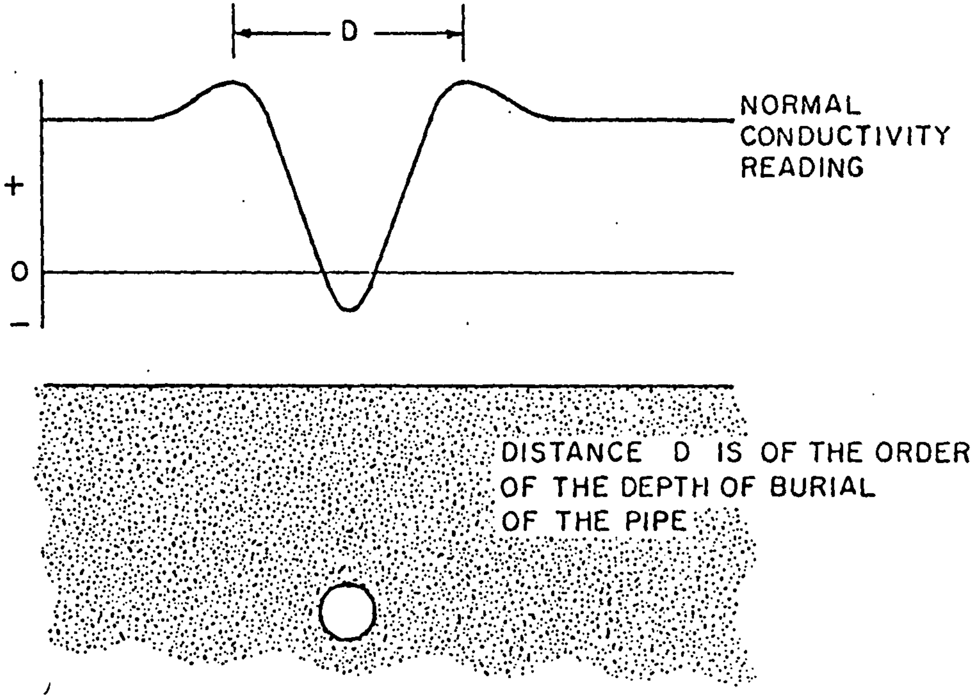


Fig. 2 TYPICAL RESPONSE OVER A PIPE

4. SURVEY TECHNIQUE (cont'd)

going peaks approximately performs the same task. It is then possible to accurately determine the location and strike direction (azimuth) of the conductor axis as follows: the approximate location is determined as above, and a traverse is then made over the conductor with the EM31 pointing in the approximate direction of the conductor axis. The meter reading will now be a positive maximum when the instrument is both directly over the conductor and pointing accurately along the conductor axis.

The instrument is relatively unaffected by fences, overhead power lines, and other nearby metallic objects. In order to determine whether the reading is influenced by such structures the operator should rotate the instrument to check for changes in reading, becoming suspicious if a maximum or minimum occurs when the instrument points either perpendicular or parallel to the structure. Before recording the measurement the operator should move away from the structure until no evidence of lateral inhomogeneity is seen when the instrument is rotated.

It should be remembered that the EM31 is an electromagnetic tool and care should be taken near obvious conductors until the operator has satisfied himself as to their possible affect. In every case this is determined by rotating the instrument and determining whether there is a maximum and minimum which appears to be realted to the structure. If a structure is giving such an effect it is not advisable to take the average value of the two readings as an indicator of the terrain conductivity.

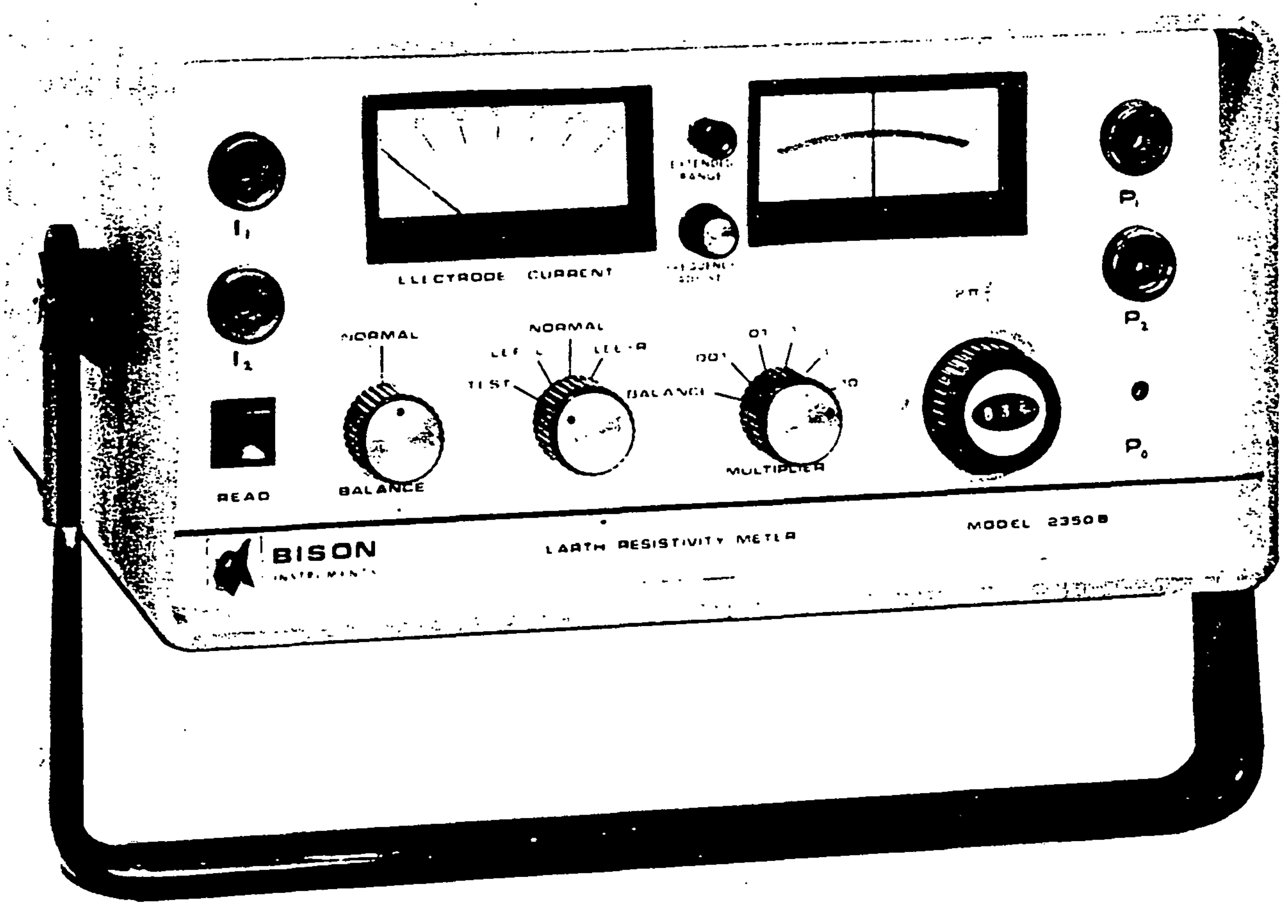
4. SURVEY TECHNIQUE (cont'd)

In general the conductivity readings obtained with the EM31 will vary smoothly from one region to another. In some cases however, as for example where a well defined vertical contact separates a poor conductor from a very good conductor, edge effects may be seen in which the readings vary rapidly with position and are no longer a good indicator of the terrain conductivity. Edge effects may also occur where a very good conductor (a few ohm-meters or less) has dimensions of the order of the intercoil spacing, and again the indicated readings may not accurately reflect the true terrain conductivity. In any circumstance where the apparent conductivity varies significantly in a distance which is short compared with the intercoil spacing the possible presence of edge effects or local subsurface conductors must be considered.

Finally, particularly during mid-summer afternoons, electrical static (electromagnetic radiation from local or distant thunderstorms) may cause the meter readings to become noisy. This is usually evidenced by sudden flicks of the meter needle, however in very severe cases the meter may simply wander about an average reading. Should this occur it is recommended that measurements cease until the "spherics" are over, usually later in the afternoon. Similarly, noisy readings may also be noted when making measurements near large power lines.

BISON
INSTRUMENTS

EARTH RESISTIVITY METER
MODEL 2350B



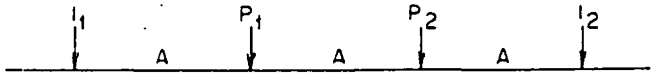
The Bison Model 2350B Earth Resistivity Meter and System is designed for extended shallow depth earth exploration, pollution monitoring, and archaeological problems. Exploration projects include the location of ground water aquifers, gravel or rock deposits, ore bodies, topographic highs or lows on a bedrock surface, areas of weathered bedrock on an otherwise solid rock surface; or determining the variations in depth of subsurface conditions, for example, soil layer overlying gravel or bedrock, or sand overlying clay over bedrock. Pollution monitoring includes continuing studies of ground water levels and salinities, delineation of pollutant plumes, monitoring of landfills, leakage monitoring of storage lagoons, and studies of the movement of organic pollutants. Archaeological sites have been successfully mapped in detail before excavation. Users include geophysicists, geologists, environmentalists, civil engineers, hydrologists, sand and gravel operators, sanitary engineers, mining engineers, highway engineers, contractors, quarry operators, drillers, and archaeologists.

BISON MODEL 2350B SPECIFICATIONS

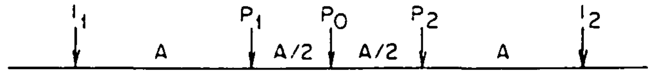
Can be used with ALL electrode spreads.

(including Dipole/Dipole and Bristow)

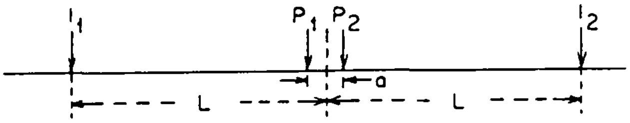
WENNER SOUNDING



LEE MODIFICATION OF WENNER



SCHLUMBERGER SOUNDING



SPECIFICATIONS — MODEL 2350B

High Voltage: 720 Volts (peak to peak).

Nominal Excitation Frequency: 11 Hz to minimize cable coupling and skin effect.

Frequency Control Adjustment: ±15% to minimize extraneous "beat frequency" earth current interference.

Direct Digital Reading of Resistance: Quantity Measured $=2\pi\frac{V}{I}$

Resolution: One part in 10,000 maximum.

Accuracy: ±2% per range setting.

Electrode Balance Circuit: On 0.001 multiplier range, to maximize accuracy at high electrode resistance.

Five Range Scales: 0.001; 0.01; 0.1; 1.0; 10.0. To cover all types of sub-surface materials and situations.

Range Extension: Exclusive with Bison instruments (center black push button on panel). For use when unusually high precision is required or when contact resistance at potential electrodes is unusually high (frozen ground or very dry surface condition).

All Solid State: Integrated circuit construction for long service life and stability.

Current: Automatically controlled to a nominal 28 milliamperes.

Current Monitor: Separate 0-30 Milliampere Meter for continuous monitoring of electrode current.

Five Terminal System: The Bison Model 2350B can be used with all electrode spreads: Wenner, Lee, Schlumberger, Dipole-Dipole, Bristow, Pole-Dipole, Mise-a-la-Masse, Gradient, and others.

Operates at the touch of a button automatically without a separate power switch.

Test Circuit: Built in to check operation at any time.

Portable and Lightweight: Weight: 14 lbs. (6.4 kg.). Packaged in a Bison designed weather resistant case, 6 x 12 x 10 inches (152 x 305 x 254 mm). Complete with self-contained power pack.

Model 2350B Earth Resistivity Meter: Provided complete with batteries, instructions and interpretation procedures.

ACCESSORIES

Model 2225 Heavy Duty Reel-Electrode Accessory Kit includes four 24" zinc plated electrodes, four reels with copper-weld vinyl nylon insulated cable for 300 feet (90 meters) "A" spacing plus Lee electrode and cable. 30 lbs. (13.6 Kg.) shipping weight.

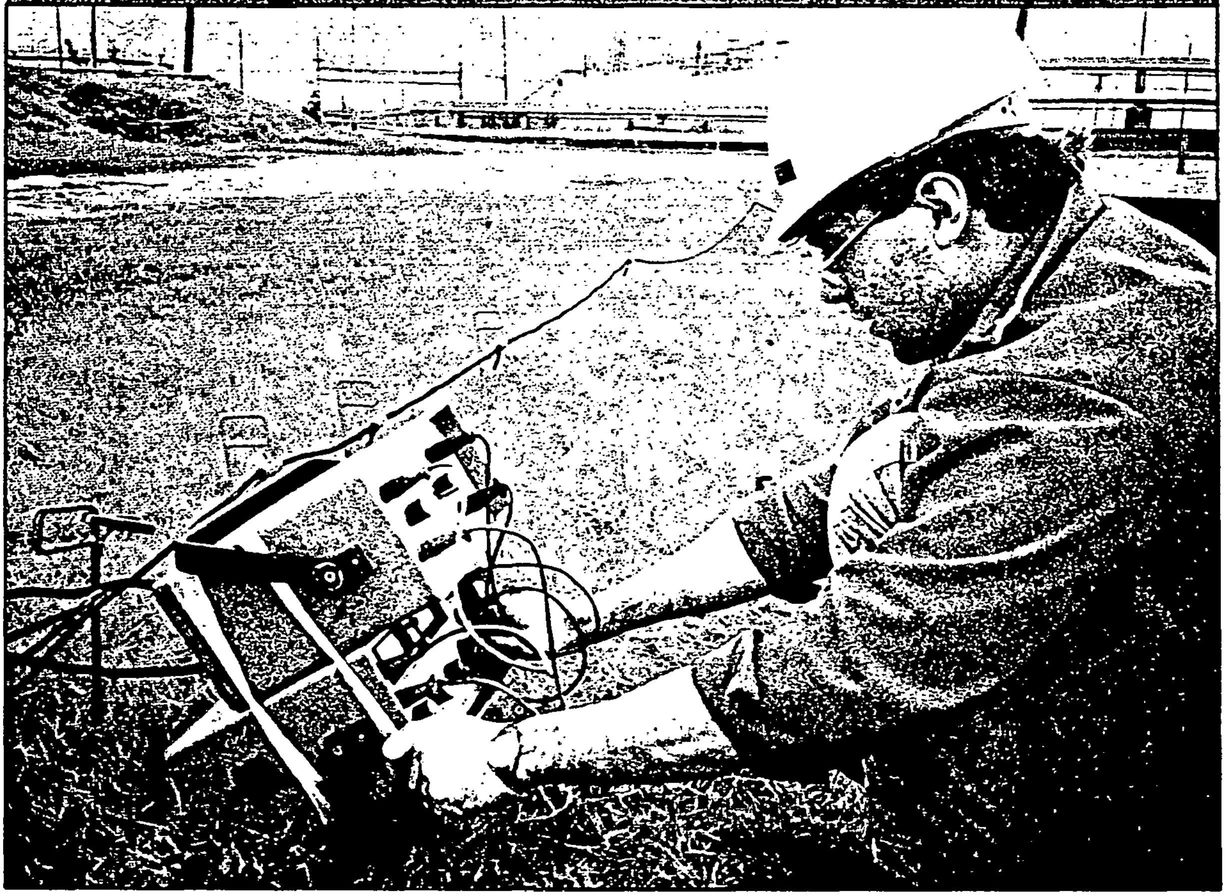
Specifications subject to change without notice.

BISON INSTRUMENTS, INC.
5708 W. 36th St., Minneapolis, MN 55416
Telephone: (612) 926-1846 • Telex - 29-0208

CABLE: GEOPRO

Printed in USA

BISON
INSTRUMENTS Inc.



Bison Model 2365
Bison Offset Sounding System ("BOSS")
Resistivity Accessory

APPLICATIONS:

- **Rapid, low-cost acquisition of resistivity sounding data.**
- **Environmental, geologic, and civil engineering.**
- **Water resource and pollution studies.**
- **Sand, gravel, and clay exploration.**
- **Mining, archaeology, and corrosion studies.**

FEATURES:

Five-electrode, offset Wenner configuration.

Measures resistivity using four different electrode configurations: CPPC, CCPP, CPCP, and two-offset CPPC's.

Significant reduction of near-surface lateral resistivity effects.

18-conductor, electrode-spread cable.

Computer program listing for rapid reduction of data.

In-field data consistency checks.

The Bison Offset Sounding System, or "BOSS", is a revolutionary new field system which obtains resistivity sounding data quickly, with higher quality and fewer personnel than with traditional systems. The savings in field time are dramatic. A crew of two, often can do work formerly done by three or four in less time. Therefore, the number of soundings per day can be significantly increased and costs can be reduced. The BOSS quickly pays for itself.

(continued on back)

(continued from front)

The BOSS is ideal for most geological investigations because it incorporates three major innovations offering key advantages over standard Wenner or Schlumberger systems:

1. Readings for each electrode spacing are taken at two different locations, called "offsets", which can be used to cancel many errors arising from near-surface variations of lateral resistivity. (See Figures 1 and 2.)

2. By choosing electrode spacings in multiples of two, half as many electrode positions can be used for several arrangements and spacings. For example, a 16-point Wenner sounding curve requires 38 electrode positions. The BOSS requires only 19 electrode positions, nine on either side of a central electrode. All electrodes are implanted before starting the measurements, which are quickly taken by rotating switches on the control box. No further electrode position changes are necessary.

The BOSS offers two more bonuses: (1) The electrode configurations allow immediate in-field checks of data quality. (2) The BOSS can be used with any battery powered electrical resistivity unit, new or old.

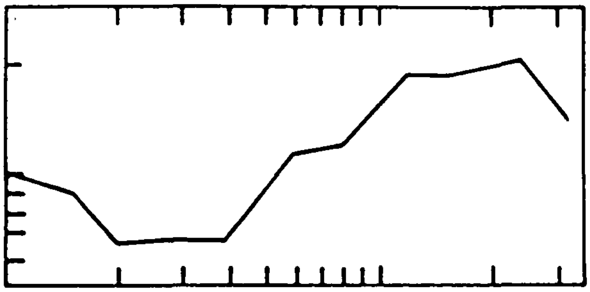


FIGURE 1: A sounding curve obtained by conventional methods.

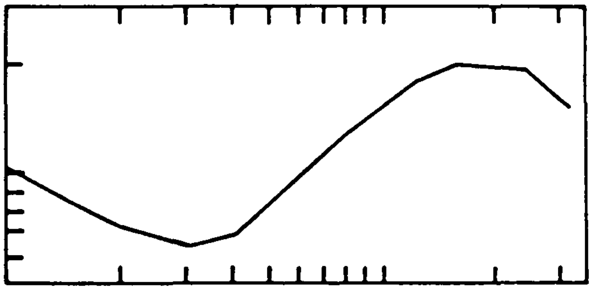


FIGURE 2: A sounding curve produced by the Bison Offset Sounding System, or "BOSS". The curve is smoother, allowing easier analysis of data.

BOSS 2365 SPECIFICATIONS:

Multi-Conductor Cables: 2 nylon-covered, with standard takeout at each electrode.

Electrodes: 21 lightweight steel with connectors.

Switchbox: molded, weatherproof (central control box).

Computer Program Listing: for rapid reduction of data.

Wenner Resistances: 16 at standard spacings of .5, 1, 2, 4, 8, 16, 32, and 64 meters.

Extension Cable: which permits an actual Wenner resistance measurement at a spacing of 128 meters.

ACCESSORIES:

Standard: Operation manual and description of BOSS technique.

Specifications subject to change without notice.

The theory of the offset sounding system was developed by Dr. R.D. Barker, University of Birmingham, England. Bison is licensed to sell the system by agreement with Barker Geophysical Soundings of Birmingham, England.

BISON
INSTRUMENTS, Inc.

5708 WEST 36TH STREET, MINNEAPOLIS, MINNESOTA 55416 U.S.A.
TELEPHONE: (612) 926-1846 ■ TELEX: 29-0208 ■ CABLE: GEOPRO

APPENDIX A-2
SOIL GAS SURVEYS

The major equipment associated with conducting the soil gas survey at the Stoughton City Landfill site includes a flow meter, a sampling pump, and a photoionization detector.

Flow meters utilized for soil gas sampling are Cole-Palmer variable-area flow meters. Each flow meter comes with a calibration data sheet provided by the manufacturer. Prior to the start-up of the soil gas investigation at the Stoughton City Landfill site, these calibration data will be verified by Clean Air Engineering of Palatine, Illinois for each flow meter. Daily maintenance for the flow meters will include inspection to ensure that the floats in the flow meters are moving freely and that no foreign materials have become lodged in either the entry or exhaust port. To ensure continued calibration during the test, a single flow meter will be maintained at the site and not used in the soil gas investigation. This flow meter will have been calibrated along with the other flow meters to be used during the investigation. At the start of each day the response of the unused flow meter will be compared to the responses of the flow meters being used for the investigation to verify that flow rate calibration is maintained.

Sampling pumps to be used for the soil gas investigation are the MSA Model G sampling pumps. This pump is a rechargeable battery-operated diaphragm pump which supplies a vacuum source. The flow rate is adjustable and will be adjusted using the flow meter previously discussed to achieve the desired flow rate of 0.2 liters per minute during the course of the sampling period. For maintenance, the valve stems for adjusting the air flow will be cleaned periodically and the pump and charger will be stored in the supplied container when not in use. Pumps will be recharged daily.

The HNu Systems, Inc. Model PI-101 trace gas analyzer will be used to detect and measure the concentration of trace gases in the soil gas. Section 15.2 of the "Compendium of Superfund Field Operations Methods" manual discusses the use, maintenance, and calibration of the HNu PI-101 meter. This section of the Compendium has been reproduced for inclusion in this Appendix. Guidelines presented therein will be implemented as part of the Stoughton City Landfill RI.

United States
Environmental Protection
Agency

Office of Emergency and
Remedial Response
Washington DC 20460

EPA/540/P-87/001
(OSWER Directive 9355.0-14)
December 1987

Superfund

EPA

A Compendium of Superfund Field Operations Methods

5. A 10- to 20-minute stabilization period may be required because the carrier gas flow is temporarily interrupted when the septum is changed.

15.1.6.8 Troubleshooting

A list of common troubleshooting techniques for the Photovac 10A10 is provided in Exhibit 15-3.

15.1.7 Region-Specific Variances

No region-specific variances have been identified; however, all future variances will be incorporated in subsequent revisions to this compendium. Information on variances may become dated rapidly. Thus, users should contact the regional EPA RPM for full details on current regional practices and requirements.

15.1.8 Information Sources

Horgan, L. Proposed Guidelines for Photovac 10A10 for the Surveillance and Analysis Division. U.S. Environmental Protection Agency. 1983.

Photovac Incorporated. *Photovac 10A10 Operating Manual.*

15.2 HNU PI-101

15.2.1 Purpose

Subsection 15.2 discusses the use, maintenance, and calibration of the HNU PI-101.

15.2.2 Definitions

None.

15.2.3 Theory and Limitations

15.2.3.1 Theory

The HNU is a portable, nonspecific, vapor / gas detector employing the principle of photoionization to detect a variety of chemical compounds, both organic and inorganic.

The HNU contains an ultraviolet (UV) light source within its sensor chamber. Ambient air is drawn into the chamber with the aid of a small fan. If the ionization potential (IP) of any molecule present in the ambient air is equal to or lower than the energy of the UV light source, ionization will take place, causing a deflection in the meter. Response time is approximately 90 percent at 3 seconds. The meter reading is expressed in parts per million (ppm). All readings must be stated as equivalent readings that depend on the calibration gas being used. For example, the standard gas used to calibrate the HNU is benzene, which allows the instrument to provide results in benzene equivalence. Exhibit 15-4, modified from the "*Instruction*

Manual for Model PI-101 Photoionization Analyzer" HNU Systems Inc., 1975, lists the relative sensitivities for various gases.

15.2.3.2 Limitations

1. If the IP of a chemical contaminant is greater than the UV light source, this chemical will not be recorded. Some contaminants cannot be determined by any sensor / probes.

2. It should be noted, specifically, that the HNU will not detect methane.

3. During cold weather, condensation may form on the UV light source window, resulting in erroneous results.

4. Instrument readings can be affected by humidity and powerlines, making it difficult to interpret readings.

5. Total concentrations are relative to the calibration gas (usually benzene) used.Therefore, true contaminants and their quantities cannot be identified. Also, while the instrument scale reads 0 to 2,000 ppm, response is linear (to benzene) from 0 to about 600 ppm. Greater concentrations may be "read" at a higher or lower level than the true value.

6. Wind speeds of greater than 3 miles an hour may affect fan speed and readings, depending on the position of the probe relative to wind direction.

15.2.4 Applicability

This procedure is applicable to HNU PI-101 instruments used for air monitoring.

15.2.5 Responsibilities

The SM is responsible for monitoring the implementation of these procedures.

15.2.6 Records

Training records, maintenance records, and calibration records will be generated and maintained by the responsible organization. The maintenance, calibration, and results obtained in the field will be recorded in the site logbook.

15.2.7 Procedure

15.2.7.1 Maintenance and Calibration Responsibilities

The instrument user is responsible for properly calibrating and operating the instrument. When the instrument is scheduled for or requires maintenance, these functions should be conducted only by qualified individuals. If possible, maintenance responsibilities should be restricted to one or two individuals who will also bear responsibilities for logging the equipment in and out. Documentation of instrument user, dates of

Exhibit 15-4
RELATIVE SENSITIVITIES FOR VARIOUS GASES
(10.2 eV Lamp)

Species	Photoionization Sensitivity*
P-xylene	11.4
M-xylene	11.2
Benzene	10.0 (reference standard)
Toluene	10.0
Diethyl sulfide	10.0
Diethyl amine	9.9
Styrene	9.7
Trichloroethylene	8.9
Carbon disulfide	7.1
Isobutylene	7.0
Acetone	6.3
Tetrahydrofuran	6.0
Methyl ethyl ketone	5.7
Methyl isobutyl ketone	5.7
Cyclohexanone	5.1
Naptha (86% aromatics)	5.0
Vinyl chloride	5.0
Methyl isocyanate	4.5
Iodine	4.5
Methyl mercaptan	4.3
Dimethyl sulfide	4.3
Allyl alcohol	4.2
Propylene	4.0
Mineral spirits	4.0
2,3-Dichloropropene	4.0
Cyclohexene	3.4
Crotonaldehyde	3.1
Acrolein	3.1
Pyridine	3.0
Hydrogen sulfide	2.8
Ethylene dibromide	2.7
N-octane	2.5
Acetaldehyde Oxime	2.3

Exhibit 15-4
(continued)

Species	Photoioniztion Sensitivity*
Hexane	2.2
Phosphine	2.0
Heptane	1.7
Allyl chloride (3-chloropropene)	1.5
Ethylene	1.0
Ethylene oxide	1.0
Acetic anhydride	1.0
Alpha pinene	0.7
Dibromochloropropane	0.7
Epichlorohydrin	0.7
Nitric oxide	0.6
Beta pinene	0.5
Citral	0.5
Ammonia	0.3
Acetic Acid	0.1
Nitrogen dioxide	0.02
Methane	0.0
Acetylene	0.0
Ethylene	0.0

---

*Expressed in ppm (v/v).

Source: *Instruction Manual for Model PI-101 Photoionization Analyzer,* HNU Systems, Inc., 1975.

use, instrument identification number, maintenance and calibration functions, and project identification should be maintained.

15.2.7.2 Operator Qualifications

The HNU, although a relatively simple instrument to use, can be incorrectly operated if the user is not thoroughly familiar with its operation. An appropriate training and certification procedure must be developed and incorporated into the responsible organization's training procedures. The users must complete the training and be certified for HNU operation before using the instrument in the field. Refresher courses should be obligatory every 6 months. Courses are given by the manufacturer, by commercial entities, and by EPA at their Cincinnati, Ohio, and Edison, New Jersey, facilities.

15.2.7.3 Startup / Shutdown Procedures

Startup

1. Check the FUNCTION switch on the control panel to make sure it is in the OFF position. Attach the probe to the readout unit. Match the alignment key, and twist the connector clockwise until a distinct locking is felt.

2. Turn the FUNCTION switch to the BATTERY CHECK position. Check that the indicator reads within or beyond the green battery arc on the scale plate. If the indicator is below the green arc, or if the red LED comes on, the battery must be charged before using.

3. To zero the instrument, turn the FUNCTION switch to the STANDBY position and rotate the ZERO POTENTIOMETER until the meter reads zero. Wait 15 to 20 seconds to confirm that the zero adjustment is stable. If it is not, then readjust.

4. Check to see that the SPAN POTENTIOMETER is set at the appropriate setting for the probe being used (5.0 for 9.5 eV probe, 9.8 for 10.2 eV, and 5.0 for 11.7 eV).

5. Set the FUNCTION switch to the desired ppm range. A violet glow from the UV lamp source should be observable at the sample inlet of the probe / sensor unit. (Do not look directly at the glow, since eye damage could result.)

6. Listen for the fan operation to verify fan function.

7. Check instrument with an organic point source, such as a "magic marker," before survey to verify instrument function.

Shutdown

1. Turn FUNCTION switch to OFF.

2. Disconnect the probe connector.

3. Place the instrument on the charger.

15.2.7.4 Maintenance and Calibration Schedule

Function	Frequency
• Perform routine calibration	Prior to each use*
• Initiate factory checkout and calibration	Yearly or when malfunctioning or after changing UV light source
• Wipe down readout unit	After each use
• Clean UV light source window	Every month or as use and site conditions dictate
• Clean the ionization chamber	Monthly
• Recharge battery	After each use

---

* During extended field use, the HNU PI-101 must be calibrated at least once every three days.

15.2.7.5 Calibration Procedure No. 1

For HNU calibration canisters without regulators:

1. Run through startup procedures as in Subsection 15.2.7.3.

2. Fill a sampling bag with HNU calibration gas of known contents.

3. Connect HNU probe to sampling bag by using flexible tubing.

4. Allow sample bag contents to be drawn into the probe, and check response in ppm.

5. Adjust the span potentiometer to produce the concentration listed on the span gas cylinder.This procedure shall be followed only until the span potentiometer reaches the following limits:

Probe	Initial Span Pot. Setting	Maximum Acceptance Span Pot Setting
9.5 eV	5.0	1.0
10.2 eV	9.8	8.5
11.7 eV	5.0	2.0

6. If these limits are exceeded, the instruments must be returned for maintenance and recalibration. This maintenance will be done only by qualified individuals.

7. Each responsible organization must develop a mechanism for the documentation of calibration results. This documentation includes the following:

a. Date Inspected

b. Person who calibrated the instrument

c. The instrument number (Serial number or other ID number)

d. The results of the calibration (ppm, probe eV, span potentiometer setting)

e. Identification of the calibration gas (source, type, concentration)

15.2.7.6 Calibration Procedure No. 2

For HNU calibration canisters equipped with a regulator:

1. Run through startup procedures as described in Subsection 15.2.6.3.

2. Connect a sampling hose to the regulator outlet and the other end to the sampling probe of the HNU.

3. Crack the regulator valve.

4. Take a reading after 5 to 10 seconds.

5. Adjust span potentiometer using the steps outlined in step No. 5 of Subsection 15.2.7.5.

6. Calibration documentation should be as in step No. 7 in Subsection 15.2.7.5.

15.2.7.7 Cleaning the UV Light-Source Window

1. Turn the FUNCTION switch to the OFF position, and disconnect the sensor / probe from the Readout / Control unit.

2. Remove the exhaust screw located near the base of the probe. Grasp the end cap in one hand and the probe shell in the other. Separate the end cap and lamp housing from the shell.

3. Loosen the screws on the top of the end cap, and separate the end cap and ion chamber from the lamp and lamp housing, taking care that the lamp does not fall out of the lamp housing.

4. Tilt the lamp housing with one hand over the opening so that the lamp slides out of the housing into your hand.

5. The lamp window may now be cleaned using lens paper with any of the following compounds:

   a. Use HNU Cleaning Compound on all lamps except the 11.7 eV.

b. Clean the 11.7 eV lamp with a freon or chlorinated organic solvent. Do not use HNU cleaner, water, or water miscible solvents (i.e., acetone and methanol).

6. Following cleaning, reassemble by first sliding the lamp back into the lamp housing. Place the ion chamber on top of the housing, making sure the contacts are properly aligned.

7. Place the end cap on top of the ion chamber, and replace the two screws. Tighten the screws only enough to seal the O-ring. Do not overtighten.

8. Line up the pins on the base of the lamp housing with pins inside the probe shell, and slide the housing assembly into the shell.It will fit only one way.

9. Replace the exhaust screw.

15.2.7.8 Cleaning the Ionization Chamber

1. Turn the FUNCTION switch to the OFF position, and disconnect the sensor/probe from the Readout / Control unit.

2. Remove the exhaust screws located near the base of the probes. Grasp the end cap in one hand and the probe shell in the other. Separate the end cap and lamp housing from the shell.

3. Loosen the screws on the top of the end cap, and separate the end cap and ion chamber from the lamp and lamp housing, taking care that the lamp does not fall out of the lamp housing.

4. The ion chamber may now be cleaned according to the following sequence:

    a. Clean with methanol using a Q-tip.

    b. Dry gently at 50°C to 60°C for 1/2 hour.

5. Place the ion chamber on top of the housing, making sure the contacts are properly aligned.

6. Place the end cap on top of the ion chamber and replace the two screws. Tighten the screws only enough to seal the O-ring. Do not overtighten.

7. Line up the pins on the base of the lamp housing with pins inside the probe shell, and slide the housing assembly into the shell. It will fit only one way.

15.2.7.9 Troubleshooting

The following steps should be performed only by a qualified technician:

1. The meter does not respond in any switch position (including BATT CHK).

    a. Meter movement is broken.

(1) Tip instrument rapidly from side to side. Meter needle should move freely and return to zero.

b. Electrical connection to meter is broken

(1) Check all wires leading to meter.

(2) Clean the contacts of quick-disconnects.

c. Battery is completely dead.

(1) Disconnect battery.

(2) Check voltage with a volt-ohm meter.

d. Check 2 mp fuse.

e. If none of the above solves the problem, consult the factory.

2. Meter responds in BATT CHK position, but reads zero or near zero for all others.

a. Power supply is defective.

(1)Check power supply voltages as shown in Figure 11 of the HNU *Instruction Manual*. If any voltage is out of specification, consult the factory.

b. Input transistor or amplifier has failed.

(1) Rotate zero control; meter should deflect up or down as control is turned.

(2) Open probe. Both transistors should be fully seated in sockets.

c. Input signal connection is broken in probe or readout.

(1) Check input connector on printed circuit board. The input connector should be firmly pressed down.

(2) Check components on back of printed circuit board. All connections should be solid, and no wires should touch any other object.

(3) Check all wires in readout for solid connections.

3. Instrument responds correctly in BATT CHK and STBY but not in measuring mode.

a. Check to see that the light source is on. Do not look directly at UV light source, since eye damage could result.

(1) Check high-voltage power supply.

(2) Open end of probe, remove lamp, and check high voltage on lamp ring.

(3) If high voltage is present at all above points, light source has probably failed. Consult the factory.

4. Instrument responds correctly in all positions, but signal is lower than expected.

    a. Check span setting for correct value.

    b. Clean window of light source.

    c. Double check preparation of standards.

    d. Check power supply 180 V output.

    e. Check for proper fan operation. Check fan voltage.

    f. Rotate span setting. Response should change if span potentiometer is working properly.

5. Instrument responds in all switch positions, but is noisy (erratic meter movement).

    a. Open circuit in feedback circuit.Consult the factory.

    b. Open circuit in cable shield or probe shield. Consult the factory.

6. Instrument response is slow and/or irreproducible.

    a. Fan is operating improperly. Check fan voltage.

    b. Check calibration and operation.

7. The battery indicator is low.

    a. Indicator comes on if battery charge is low.

    b. Indicator also comes on if ionization voltage is too high.

15.2.8 Region-Specific Variances

No region-specific variances have been identified; however, all future variances will be incorporated in subsequent revisions to this compendium. Information on variances may become dated rapidly. Thus, users should contact the regional EPA RPM for full details on current regional practices and requirements.

15.2.9 Information Sources

HNU Systems, Inc.*Instruction Manual for Model PI-101 Photoionization Analyzer.* 1975.

Ecology and Environment.*FIT Operation and Field Manual: HNU Systems PI-101 Photoionization Detector and Century Systems (Foxboro) Model OVA-128 Organic Vapor Analyzer.* 1981.

Personal Communication with Fran Connel, HNU Systems, Inc. 4 January 1984.

CH2M HILL. *Field Surveillance Equipment.* 1984.

Rabin, Linda J."Selective Application of Direct-Reading Instruments at Hazardous Waste Sites," presented at American Industrial Hygiene Conference, Dallas, Texas. 1986.

15.3 ORGANIC VAPOR ANALYZER (OVA-128)

15.3.1 Scope and Purpose

The purpose of this subsection is to discuss the use, maintenance, and calibration of the OVA-128.

15.3.2 Definitions

None.

15.3.3 Theory and Limitations

15.3.3.1 Theory

The OVA uses the principle of hydrogen flame ionization for the detection and measurement of organic compounds. The OVA contains a diffusion flame of hydrogen and air that is free of ions and is nonconducting. When a sample of organic material is introduced into the flame, ions are formed, causing the flame to become conductive. Eventually this conductivity provides a meter reading because of a change in current.

15.3.3.2 Limitations

1. The OVA will not see any inorganics.

2. The OVA will "see" methane, which is explosive but relatively nontoxic. The user should determine if the contaminant involved is or is not methane.

3. DOT shipping regulations are strict for the OVA when shipped containing pressurized hydrogen.

4. A relative humidity greater than 95 percent will cause inaccurate and unstable responses.

APPENDIX A-3

WATER LEVEL MEASUREMENTS/WATER SAMPLING

Water level measurement prior to ground water sampling will be made with the Solinst Model 101 flat tape water level meter.

Equipment for the measurement of pH, specific conductance, temperature, and field filtration of ground water samples associated with water sampling for the Stoughton City Landfill site have not been purchased to date. Upon purchase, operation manuals or instructions for the various meters and apparatus will be sent to the USEPA and WDNR. These instruments will be operated in accordance with the manufacturers' specifications.

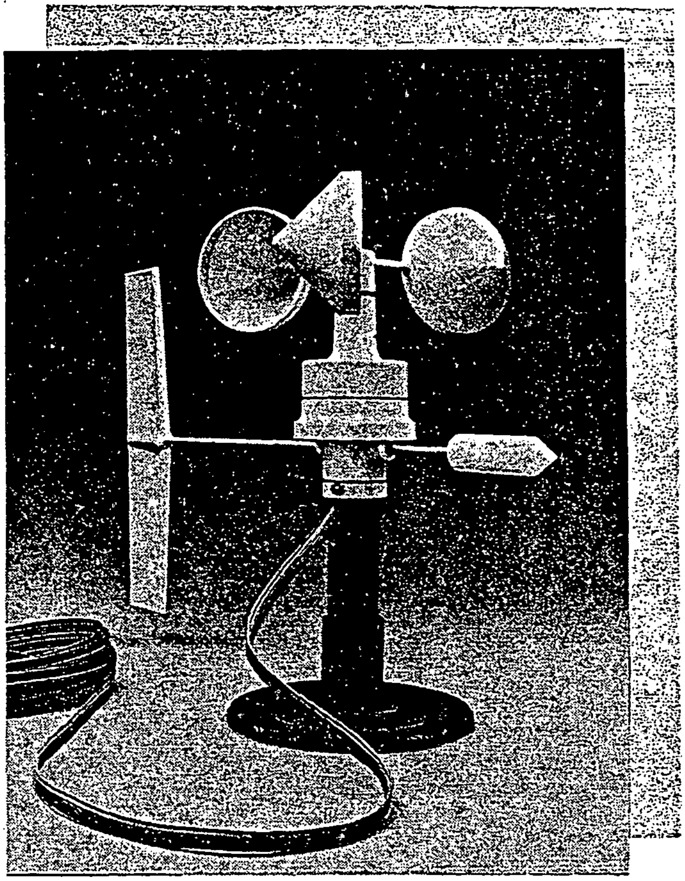
APPENDIX A-4
AIR SAMPLING

Major sampling equipment associated with air sampling will be wind direction/wind speed instrumentation and a sampling pump. Wind speed/direction will be measured using the Weathertronics, Inc. combination wind speed/direction sensor. This sensor will be mounted atop a ten-foot portable tower. The attached sheet lists specifications of the combination wind speed/direction sensor.

A Gilian Model HFS-113A sampling pump will be utilized to collect the air sample. This sampling pump features a low flow operating range required for use during the RI.3

COMBINATION WIND SPEED/DIRECTION SENSOR

- Low cost wind monitoring
- Rugged materials
- Easy to install
- Separate vane and anemometer available



The Model 2132 wind sensor is designed for applications where accuracy is not critical and cost is a consideration. This is a combination wind speed and direction sensor, with a 3-cup anemometer and an airfoil vane mounted on a common vertical axis. All major structural components are fabricated from tough polycarbonate or anodized aluminum. The sensor includes a mounting collar for simple and direct mounting to a 3/4-inch (19 mm) O.D. mast (Model 85007). A 50-foot length of signal cable is provided. Up to 500 feet of cable can be used.

The cup assembly of the anemometer is coupled to an AC generator transducer. The generator produces an output voltage which is directly proportional to wind speed. The measuring range is 0 to 100 mph (0 to 45 m/s) with an accuracy of ±3%. The lightweight vane is attached to a long-life, conductive plastic potentiometer. Rotation of the vane moves a precious metal wiper to produce an output voltage corresponding to the vane position within the 0 to 360° range.

Both the anemometer and the vane can also be purchased separately for applications that require measurement of only wind speed or wind direction. The Model 2612 anemometer and the Model 2134 vane both include 50 feet of cable and mount directly to a 3/4-inch (19 mm) O.D. mast.

All three of these sensors are excellent for home use, office or lobby displays, or school weather stations.

ORDERING INFORMATION

Model	
2132	**Combination Wind Speed and Direction Sensor;** includes 50′ of 5-conductor flat cable
2132-A	Same as 2132 except with 100′ of 5-conductor flat cable
2134	**Wind Direction Sensor only;** includes 50′ of 3-conductor flat cable
2612	**Wind Speed Sensor only;** includes 50′ of 2-conductor flat cable
85007	Vertical Mast to mount 2132 on Model 8500 tripod tower; 5′ long × 1.5″ O.D.; includes reducer to 3/4″ O.D.
T600802	Additional 2-conductor flat cable
T600803	Additional 3-conductor flat cable
T600806	Additional 5-conductor flat cable

NOTE: *This instrument was formerly known as Model W200-SD in the WeatherMeasure line.*

SPECIFICATIONS

Wind Speed:	
Sensor	3-cup assembly, polycarbonate, 2.7″ dia. cups
Transducer	AC generator
Output	10.70 VAC nominal at 100 mph
Range	0-100 mph (0-45 m/s)
Accuracy	±3%
Wind Direction:	
Sensor	Counterbalanced airfoil vane
Transducer	500-ohm plastic potentiometer
Range	0-360°
Accuracy	±5%
Input voltage	5 VDC typical
Materials	Anodized aluminum and polycarbonate
Mounting	Direct to 3/4″ (19 mm) O.D. mast
Cable	5-conductor flat, 50′ (15.2 m) supplied, 500′ max.
Size	6.25″ H × 16″ L (159 × 406 mm), 10.5″ (267 mm) turning radius
Weight/shipping	1.5 lbs./4 lbs. (0.7 kg/1.8 kg)

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BUREAU OF SOLID -
HAZARDOUS WASTE MANAGEMENT

SAMPLING AND ANALYSIS PLAN FOR REMEDIAL INVESTIGATION AND FEASIBILITY STUDY

PART II - QUALITY ASSURANCE PROJECT PLAN

REVISION: 2

STOUGHTON CITY LANDFILL
STOUGHTON, WISCONSIN

NOVEMBER 28, 1988

PREPARED BY:

ERM-NORTH CENTRAL, INC.
102 WILMOT ROAD, SUITE 300
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PRP TECHNICAL COMMITTEE CHAIRMAN

USEPA REMEDIAL PROJECT MANAGER

ERM PROJECT MANAGER

USEPA QA OFFICER

ERM QA MANAGER

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1.0 PROJECT DESCRIPTION

1.1 Introduction

This Sampling and Analysis Plan (SAP) for the Stoughton City Landfill Remedial Investigation and Feasibility Study (RI/FS) has been developed and is being submitted in accordance with Article VII (C) (2) of the Administrative Order by Consent (Consent Order). The Sampling and Analysis Plan consists of two parts which include the Field Sampling Plan (FSP) and the Quality Assurance Project Plan (QAPP). The FSP and QAPP are submitted as a single document; however, they have been bound separately to facilitate use of the FSP in the field.

This QAPP presents the policies, organization, objectives, Quality Assurance (QA), and Quality Control (QC) activities designed to achieve the specific data quality objectives associated with the RI/FS at the Stoughton City Landfill site. The plan has been prepared in accordance with the USEPA document "Internal Guidelines and Specifications for Preparing Quality Assurance Project Plans" (QAMS 005/80) and "Content Requirements for Quality Assurance Project Plans" prepared by Dr. Chen-Wen Tsai of USEPA Region V.

Environmental Resources Management-North Central (ERM-North Central) has been retained by the Stoughton City Landfill Steering Committee to conduct the RI/FS. Two laboratories--CompuChem Laboratories and Pace Laboratories--will perform chemical analyses as part of the RI/FS. CompuChem Laboratories will analyze all ground water/surface water, soil/sediment, and potential private well samples obtained during the RI. Should private well sampling be required, Standard Operating Procedures (SOPs) for the proposed analyses will be submitted as an addendum to this QAPP. In performing these analyses, CompuChem Laboratories will follow all procedures specified in the 8/87 Statement of Work (SOW) for organics and in the 7/85 SOW for inorganics as required under USEPA's Contract Laboratory Program (CLP). Although a 7/87 SOW exists for inorganics, its analytical requirements are essentially the same as those of the 7/85 SOW for inorganics. CompuChem intends to eventually perform both organic and inorganic analyses under the new SOW expected in early 1989. Pace Laboratories will conduct nonstandard method analyses for three additional volatile organic compounds (VOCs) in water and soil/sediment and also analyze activated carbon tubes collected during the soil gas and outdoor air sampling portions of the RI. Pace Laboratories has prepared SOPs for these analyses and their procedures are contained in appendices to this QAPP. In addition, Soils and Engineering Services Company (SES) of Madison, Wisconsin will perform laboratory geotechnical analyses on soils using either ASTM or other standard methods as appropriate.

The general mutual objectives of the RI/FS, as stated in the Consent Order are to:

- fully determine the nature and extent, if any, of the release or threatened release of hazardous substances, pollutants, or contaminants from the Stoughton City Landfill site, and

- identify and evaluate alternatives for the appropriate extent, if any, of remedial action to prevent or mitigate the migration or release or threatened release of hazardous substances, pollutants, or contaminants from the site.

In response to these objectives, the Stoughton City Landfill RI/FS will be conducted using a phased process. Data will be collected in several stages and as the site and adjacent area are better characterized, subsequent data collection efforts will be focused to fill any existing gaps in the data. In this way, the scope of the overall site characterization effort can be continually updated to minimize the collection of unnecessary data and maximize the data quality.

Task 1 activities will take place during the initial phase of the RI. These activities will include ascertaining pertinent background data to identify potential migration pathways that will be studied in more detail during the site investigation phase (Task 2) of the RI. In addition to gathering general background information, limited field investigations are also proposed under Task 1 within the existing Landfill boundary and in the area just south of it. Task 1 investigations may be extended outside of this initial investigation area depending upon the results of Task 1. These investigations include: (1) geophysical surveys to delineate disposal area limits and areas potentially characterized by ground water contamination; (2) a soil gas investigation to evaluate the areal distribution of VOCs in the refuse, the near-surface soil, and in the ground water at the site, and (3) the installation of surface water staff gages and piezometers for the determination of ground water flow direction. Activated carbon tubes will be generated during this phase of the RI for subsequent analysis by Pace Laboratories.

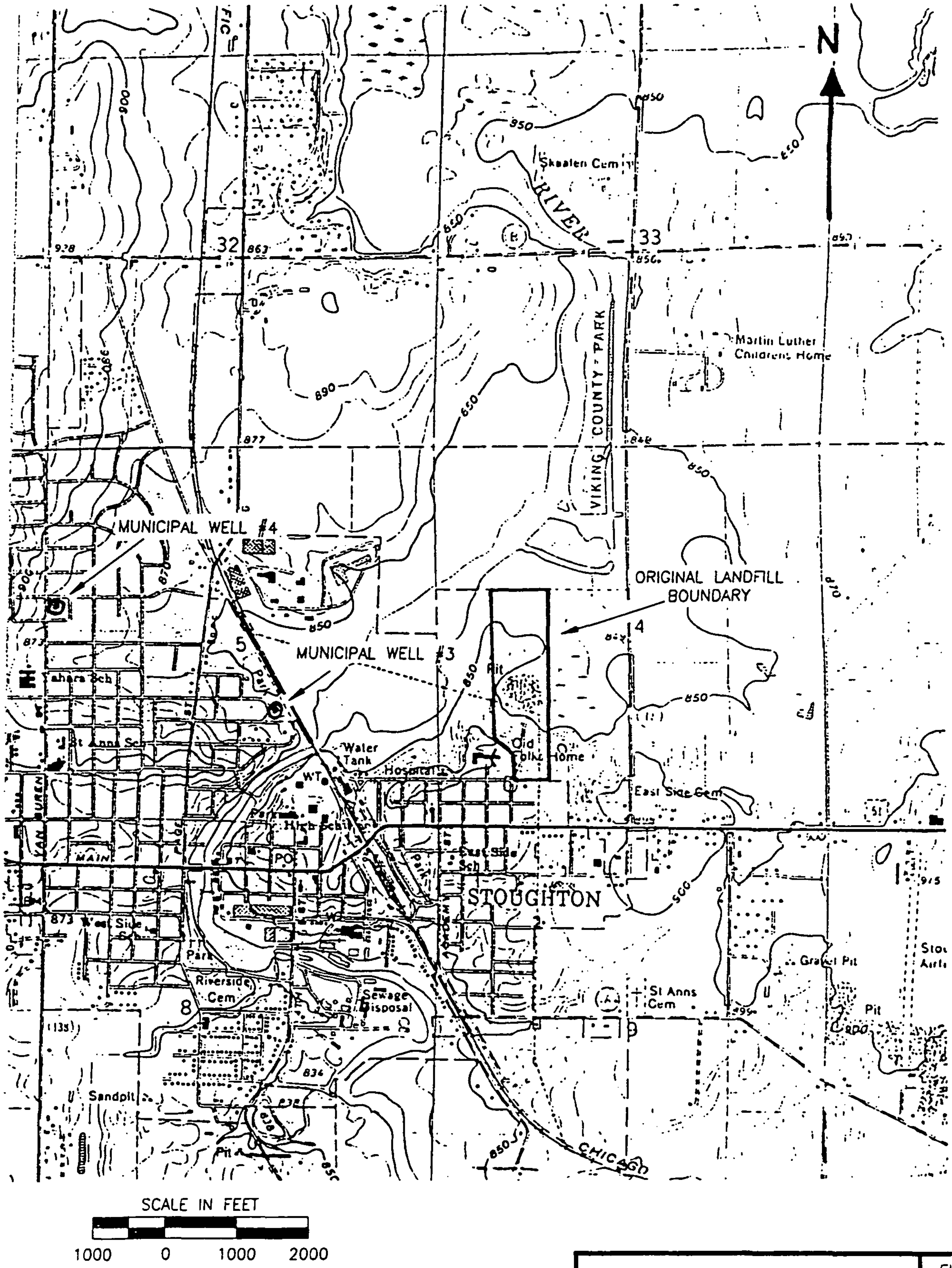
The second phase of the RI will include more detailed site investigation activities. The primary focus of initial site investigations will be hydrogeological investigations. These investigations will first be focused within the initial investigative area and may be extended outside of this area following a review of Task 1 results and also the results of monitoring well sampling. Samples that will be generated for laboratory analysis by CompuChem Laboratories during this phase of the RI may include ground water, surface water, soil, and sediment. In addition, other volatile organics in ground water, surface water, soil and sediment will be analyzed by Pace Laboratories using nonstandard methods; and private water well samples may possibly be taken for laboratory analysis. In addition, outdoor air samples will be collected on activated carbon tubes for analysis of certain VOCs by Pace Laboratories during this phase. Lastly, particle-size analysis and possibly laboratory hydraulic conductivity will be determined on soils by Soils and Engineering Services, Inc.

1.2 Site Description

1.2.1 Site Location and History

The Stoughton City Landfill is located in the City of Stoughton, Dane County, Wisconsin and occupies portions of the S1/2 of the NW1/4 and the SW1/4 of Section 4, T5N, R11E (see Figure 1-1). Although the original Landfill property occupied approximately 40 acres, landfilling has occurred on only about 15 acres of the property. (See Figure 1-2). Since 1982, land exchanges between the City and an adjacent land owner have modified the original site boundary. (See Figure 1-2). Current ownership of adjacent land will be determined during the initial task of the RI.

The City of Stoughton purchased the original site in July, 1952 and then annexed it in September, 1952 after which landfill operations began. Between 1952 and 1972, the site was operated as an uncontrolled dumpsite. During this time, refuse was usually burned and at times covered by dirt. In 1972, the site began to be operated as a State-licensed landfill. In 1978, the Wisconsin Department of Natural Resources (WDNR) required that the site be closed according to State regulations. Closure activities included: construction of a trash transfer station, placement of cap material borrowed from the northwest portion of the site and from agricultural areas, application of topsoil also derived from an agricultural area, and seeding. From 1978 to 1982, only brick, rubble, etc. were accepted at the site while closure work was performed. The unit was officially closed in 1982.

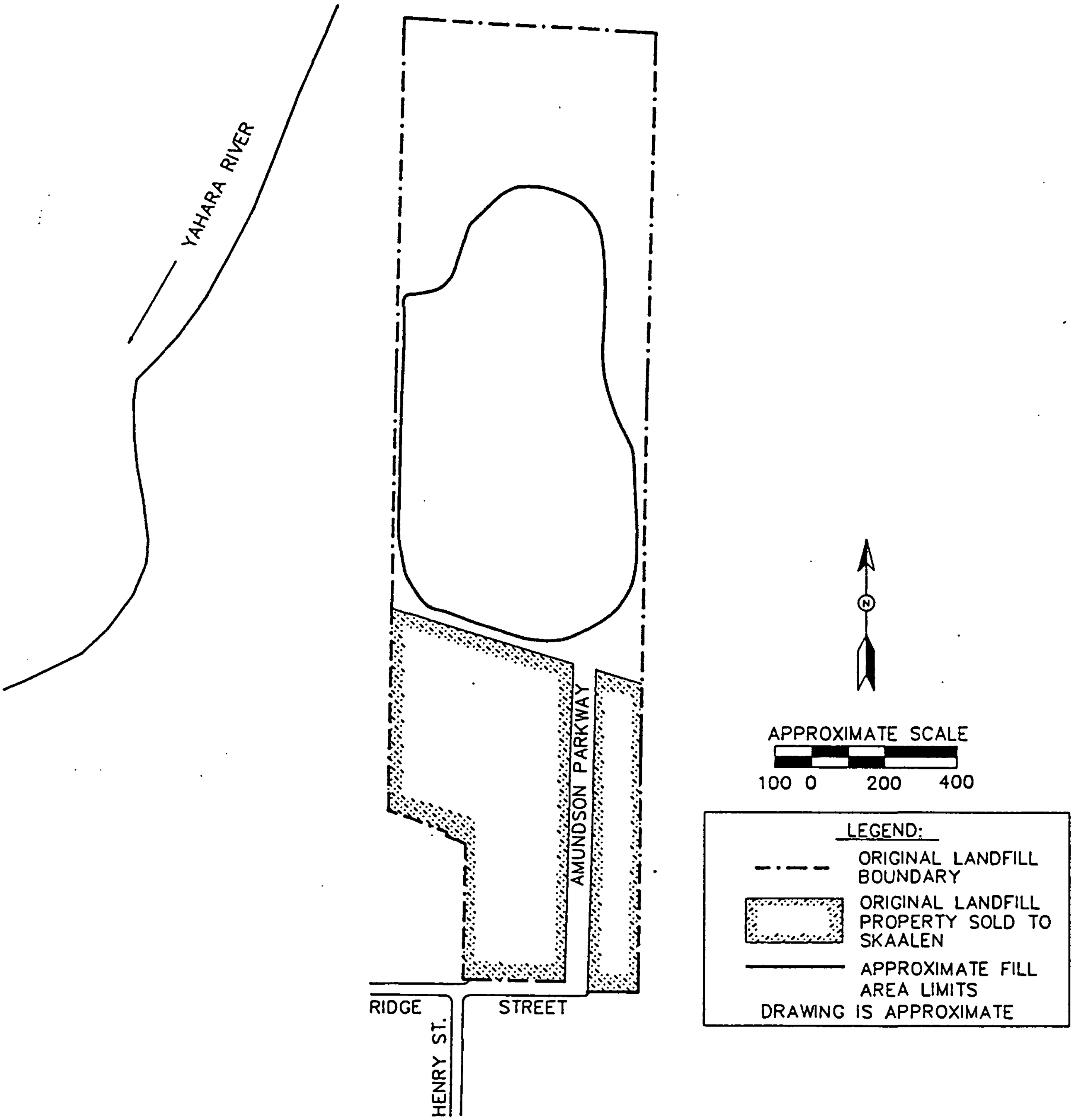


SOURCE: USGS, 7.5 MINUTE STOUGHTON QUADRANGLE, DANE CO., WISCONSIN

STOUGHTON CITY LANDFILL
LOCATION MAP

ERM ERM–North Central, Inc.

FIGURE
1–1



STOUGHTON CITY LANDFILL
PROPERTY BOUNDARIES

FIGURE
1-2

ERM ERM-North Central, Inc.

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The Landfill was established for use by City residents (including commercial establishments, industrial operations, major industries as well as smaller-scale machine shops, autobody/repair operations, dry cleaners, and other maintenance facilities). Uniroyal Plastics (formerly U.S. Rubber) disposed of liquid and solid waste from 1953 until late 1962. Most of these liquid wastes were disposed of by incinerating in the refuse burning areas; however, some were reported to have been dumped down boreholes drilled by a local firm which tested truck-mounted earth auger equipment on high ground within the west-central portion of the Landfill boundary. In 1962, the City contracted for the collection of garbage and rubbish from residences and commercial places of business, and this waste was reportedly disposed at a site other than the City-owned landfill. Large items of residential rubbish such as appliances, furniture, etc. were not picked up by the contractor but were carried to the Landfill by property owners. The City disposed of street refuse, trees, and grit from the wastewater treatment plant.

On November 17, 1983 the WDNR sampled monitoring wells at the Stoughton City Landfill site. The results showed elevated levels of volatile organic compounds (VOCs) in two of the six wells. Subsequent testing by the City of Stoughton found additional VOCs during routine sampling of the ground water. The site was added to the USEPA National Priorities List (NPL) in June, 1986.

The Stoughton City Landfill is currently an inactive facility. Vehicular access to the site is controlled by two gates that are locked at all times; however, security fencing is not in place around the site at this time.

1.2.2 Environmental Setting

The Stoughton City Landfill site is located in the northeast portion of the City of Stoughton and borders apparent wetland areas east of the Yahara River (Figure 1-1). Land surface elevation ranges from a high of about 900 feet above mean sea level (AMSL) in the southwestern portion of the Landfill to about 840 feet AMSL along the north border of the Landfill and in its central portion. An apparent wetland area in the east-central portion of the site -- bounded on the north, west, and south by higher ground -- was the primary area of waste disposal. The approximate north one quarter of the site also contained an area of lowland. Land exchanges since 1982 have modified the original property boundaries.

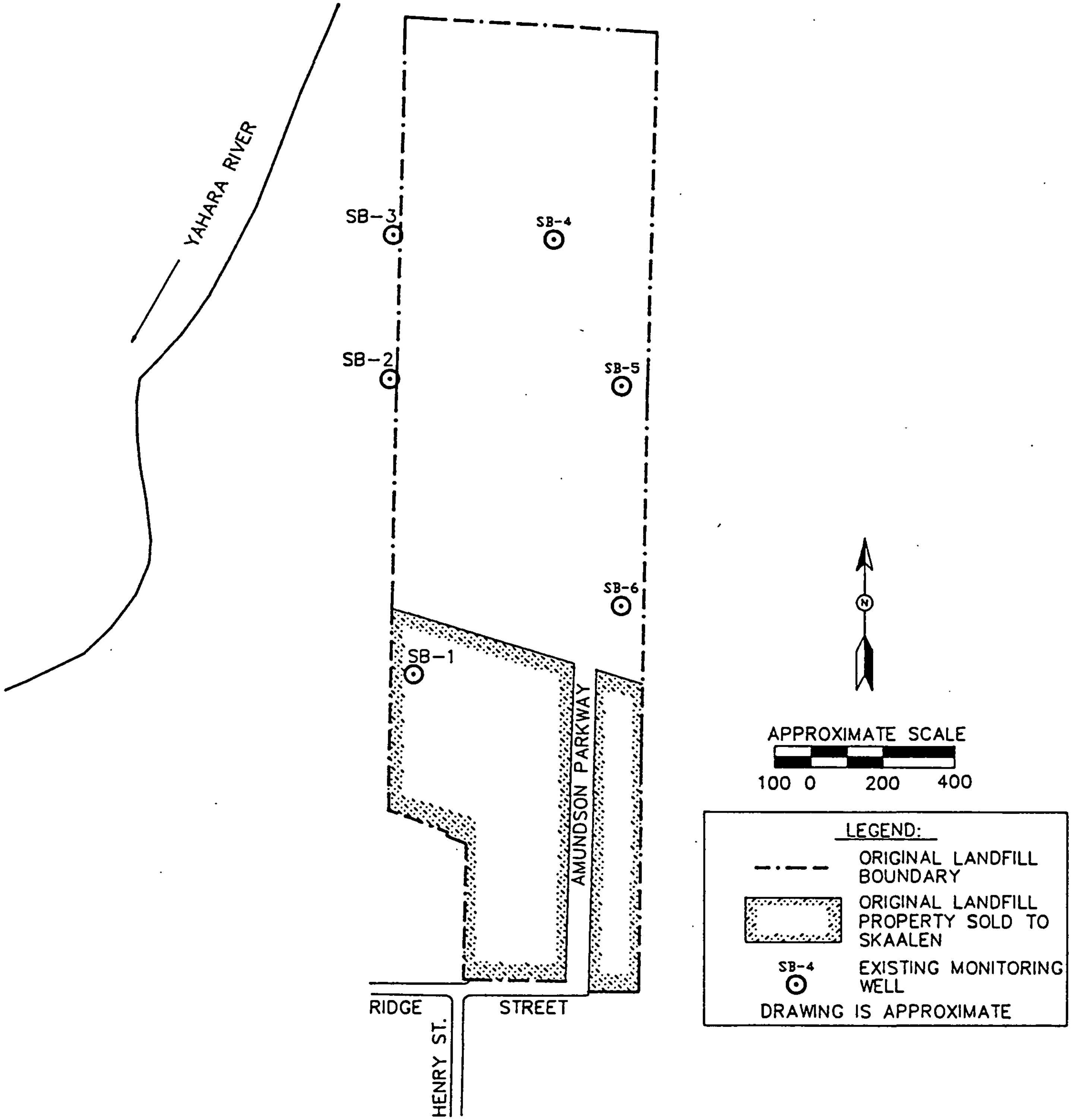
Surficial deposits in the vicinity of the site include ice-contact stratified deposits and lacustrine plain sediments (Mickelson and McCartney, 1979). Ice-contact stratified deposits generally include significant sand and gravel deposits and landforms such as kames and eskers. These deposits occupy higher ground within the Landfill. Lacustrine plain or glacial-lake bottom sediments are generally comprised of fine-grained silt and clay with some sand present near former shorelines and stream inlets. These areas are often flat, poorly drained, and show evidence of peat accumulation. Lacustrine plain deposits occupy the east-central portion of the site, which was developed for primary waste disposal and the low-lying north portion of the site. Approximately 150 to 250 feet of unconsolidated glacial sediments are reported to overlie Cambrian sandstone bedrock in the vicinity of the site.

Surface water drainage features of the site are limited to drainage ditches along the south portion of the primary disposal area and along the north property boundary. The Yahara River flows from northeast to southwest in the vicinity of the Stoughton City Landfill and then generally in a southerly direction towards the Rock River. The Yahara River flows within approximately 200 feet of the northwest corner of the property and is located approximately 800 feet west of the primary disposal area. Apparent wetlands exist adjacent to the east property boundary.

A total of six monitoring wells have been installed in and adjacent to the Stoughton City Landfill. These monitoring wells were installed in 1978 and were designated wells SB-1 thru SB-6. Four of these wells (SB-1, SB-4, SB-5, and SB-6) were destroyed by landfill closure operations and were replaced in 1982. Figure 1-3 shows the location of these existing monitoring wells and Table 1-1 lists construction details reported for them.

At least one of these wells, SB-6, is currently completed in landfill materials while others are screened in surficial sand, sand and gravel, or clay. Ground water flow direction within the upper surficial sediments is uncertain based on review of available data. Both northwest and southeast flow direction have been indicated.

Water supply for the City of Stoughton is derived from wells located in the deeper Cambrian sandstone strata. The closest City well is located about 3,000 feet due west of the Landfill



EXISTING MONITORING WELL
LOCATIONS
STOUGHTON CITY LANDFILL

FIGURE
1-3

ERM ERM-North Central, Inc.

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TABLE 1-1

STOUGHTON CITY LANDFILL
REPORTED CONSTRUCTION DETAILS
OF
EXISTING MONITORING WELLS

Well	Total Depth (ft.)	Screened Interval (ft.)	Completion Material
SB-1	12.5	7 - 12	Sand
SB-2	28.0	23 - 28	Sand/Gravel
SB-3	20.0	15 - 20	Sand/Gravel
SB-4	15.0	6 - 11	Peat/Clay
SB-5	14.0	5 - 10	Sand
SB-6	11.5	4 - 9	Fill

Notes:

1) Data obtained from original boring logs prepared by Soils and Engineering Services, Inc. and Warzyn Engineering, Inc.

2) Well SB-2 construction altered due to grading operations associated with landfill closure and also was reported to have been vandalized prior to the placement of security casing/locks. Other wells also may have been affected by vandalism.

across the Yahara River and is designated Well No. 3 (Figure 1-1). This well penetrated a 75-foot - thick clay layer from 85 to 160 feet below ground surface. When Franconia Sandstone was encountered at a depth of 210 feet, casing was installed in Well No. 3. The remainder of the well is an open hole to a total depth of 950 feet.

1.2.3 Previous Site Investigations

Since 1983, sampling operations have been conducted on monitoring wells at the Stoughton City Landfill for volatile organic compounds (VOCs) by the City, its contractors or the WDNR. Analyses have been performed by commercial laboratories or the Wisconsin State Laboratory of Hygiene. Table 1-2 summarizes data for the period November 1983 to November 1984 for the most frequently detected VOCs. Well SB-1 has shown the presence of ethyl benzene, toluene and xylenes while Wells SB-2 and SB-3 have shown the presence of various chlorinated solvent compounds at low levels. In addition, tetrahydrofuran has been detected in Well SB-3 and dichlorodifluoromethane and trichlorofluoromethane have been qualitatively identified in samples from Wells SB-2 and SB-3. Toluene and tetrahydrofuran were detected in Well SB-4 on one occasion during the above period and 1,1-dichloroethene and tetrahydrofuran were measured once in Well SB-6. No VOCs were detected in Well SB-5 during the above period. The City of Stoughton is required by the WDNR to sample the site monitoring wells for limited physicochemical properties and inorganic parameters. Electrical conductivity data for November 1983 indicate a range of conductivity of 578 umhos/cm (SB-5) to 2,310 umhos/cm (SB-6). Water level measurements taken during this

TABLE 1-2

STOUGHTON CITY LANDFILL
SUMMARY OF MOST FREQUENTLY DETECTED VOCs IN GROUND WATER
NOVEMBER 1983 - NOVEMBER 1984

Parameter (ug/l)	Well SB-1 No. of Times Detected	Well SB-1 Concentration Range	Well SB-2 No. of Times Detected	Well SB-2 Concentration Range	Well SB-3 No. of Times Detected	Well SB-3 Concentration Range
Ethyl Benzene	3/4	ND - 1,400	0/4	ND	0/4	ND
Toluene	3/4	ND - 113	1/4	ND - 7.3	0/4	ND
Xylene	4/4	2,100 - 12,200	0/4	ND	0/4	ND
Benzene	0/4	ND	2/4	ND - 4.5	0/4	ND
1,1-Dichloroethane	0/4	ND	4/4	2.0 - 7.7	1/4	ND - 7.6
Tetrachloroethene	0/4	ND	4/4	8.0 - 26.0	2/4	ND - 5.3
1,2-trans-Dichloroethene	0/4	ND	2/4	ND - 18.0	1/4	ND - 54
Trichloroethene	0/4	ND	4/4	7.1 - 14.0	1/4	ND - 8.7
Tetrahydrofuran	0/4	ND	1/4	ND - 11.3	3/4	ND - 1,000

Notes:

1) Data include those from a number of different laboratories; therefore, laboratory detection limits vary for particular sampling events.

2) ND - Not detected during any one sampling event at the method detection limit of the analyzing laboratory.

sampling event indicate a range of depth to ground water of 0.6 feet (SB-3) to 8.9 feet (SB-2). The water level in Well SB-3 has been measured above the land surface on other occasions.

The WDNR sampled ground water from Municipal Well No. 5 in April 1982 and determined that "no synthetic industrial chemicals were detected in the well". In November 1983, the WDNR sampled the wells serving the City of Stoughton water system and found that none of the 45 VOCs that were analyzed were detected. In July 1986 the WDNR again sampled ground water from Municipal Wells 3, 4 and 5 for 45 VOCs and none were detected.

The City of Stoughton collected a single surface water sample on September 22, 1984 from the Yahara River. No VOCs were detected in that sample. During October, 1985, WDNR conducted ambient air sampling by using Tenax sampling tubes. No detected VOCs were found in the ambient air samples.

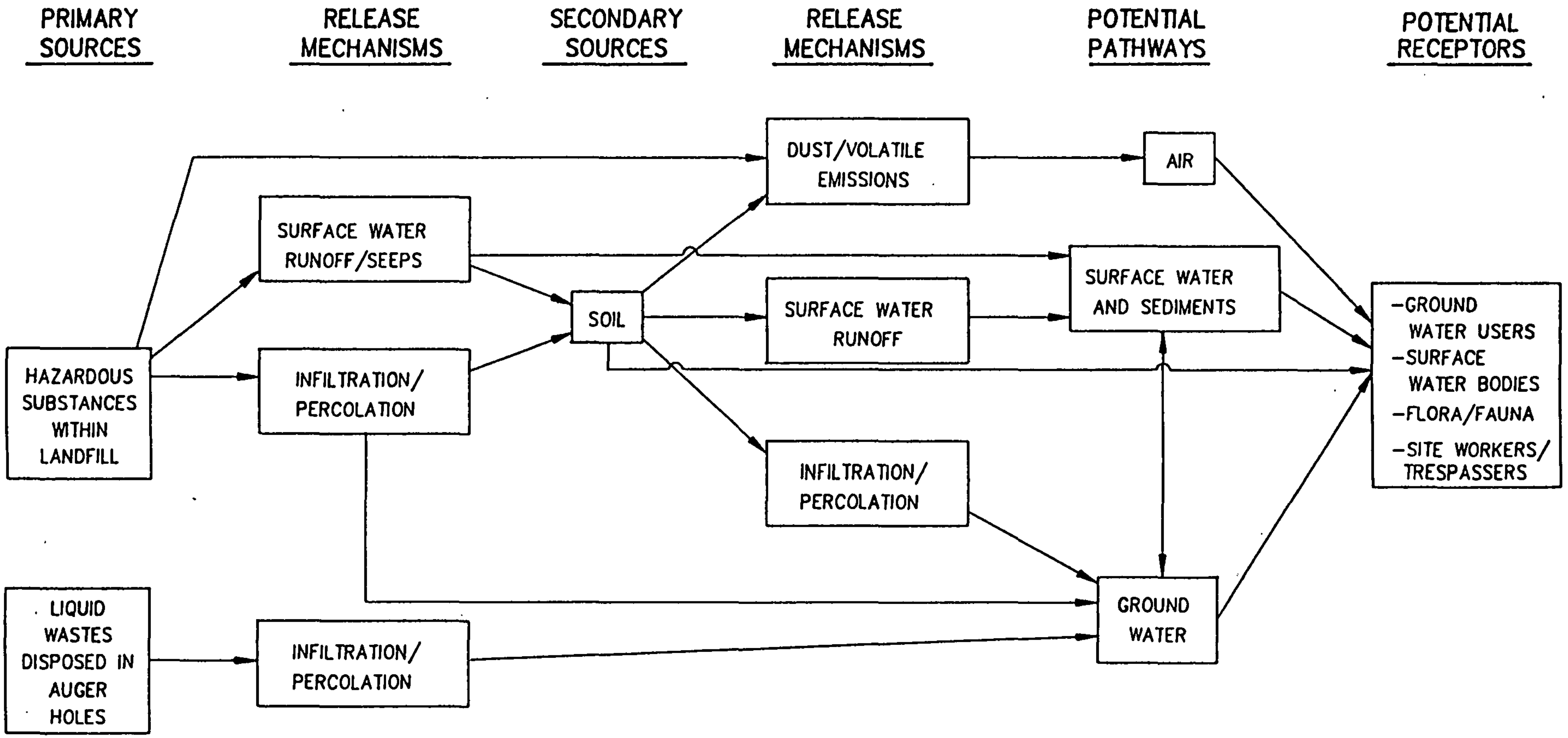
The potentially responsible parties (PRPs) recognize that these data may not have been collected or analyzed under currently rigorous protocols; therefore, the data must be further reviewed to evaluate them for quality and applicability. Furthermore, the sufficiency of the data may not be adequate to fully evaluate the actual or potential impact of the site on environmental receptors. Therefore, sample collection and analytical procedures for characterization of the above media will be reviewed during Task 1 to determine the utility and relevance of these results to the RI/FS.

1.2.4 Preliminary Conceptual Site Model

A preliminary conceptual site model is presented in Figure 1-4 and includes all known and suspected sources of contamination, potential routes of migration, and potential human and environmental receptors. Ground water users, and potentially surface water bodies, are anticipated to be the primary receptors of concern for contamination attributable to the Landfill proper or the suspected disposal of liquid waste down auger holes. However, other potential migration pathways such as air, will also be evaluated during the RI. The conceptual site model is poorly defined, primarily because of a lack of information on specific hazardous substances disposed at the site, ambiguous data pertaining to ground water flow direction, and a general lack of information on other potential pathways and receptors. Because of this, potential contaminant migration routes and receptors will be reevaluated during Task 1 of the RI using both field and nonfield methods to ensure sufficient scope for subsequent phases of the RI. Task 1 field investigations will be conducted in a phased manner. Initially, these investigations will be focused within the current Landfill boundary and in the area just south which encompasses Well SB-1. After Task 1 field data from these areas have been evaluated, Task 1 field investigations may be extended outside of these areas. In this way, the collection of unnecessary data will be minimized.

1.3 Target Compounds

Based on sample results from previous site investigations and the nature of the disposal facility, target compounds for the



PRELIMINARY
CONCEPTUAL SITE MODEL
STOUGHTON CITY LANDFILL

FIGURE
1-4

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Stoughton City Landfill RI/FS will include volatile and semi-volatile organic compounds, pesticides/PCBs, inorganic compounds and cyanide in water and soil/sediment; tetrahydrofuran, trichlorofluoromethane, and dichlorodifluoromethane in water and soil/sediment; and, target and other analyzable VOCs in soil gas and outdoor air. Table 1-3 contains the Target Compounds List (TCL) and the Contract Required Quantitation Limits (CRQL) for water and soil/sediment samples. The three VOCs to be determined by nonstandard methods including their detection limits are listed in Table 1-4, and target VOCs and other potentially analyzable VOCs in soil gas and air and their respective detection limits are indicated in Table 1-5.

1.4 Project Objective

In addition to the general project objectives stated in Section 1.1, specific objectives include the following:

- Characterize the nature of potential contamination at the site.
- Locate and delineate contaminant sources at the site.
- Evaluate the vertical and horizontal extent of contamination originating from the Stoughton City Landfill site.
- Identify and evaluate potential contaminant migration characteristics.

TABLE 1-3

TARGET COMPOUND LIST (TCL) AND CONTRACT REQUIRED QUANTITATION LIMITS (CRQL)(1,2)

I.	Volatiles	CAS Number	Quantitation Limits(3) Water ug/l	Low Soil/Sediment(4) ug/kg
1.	Chloromethane	74-87-3	10	10
2.	Bromomethane	74-83-9	10	10
3.	Vinyl Chloride	75-01-4	10	10
4.	Chloroethane	75-00-3	10	10
5.	Methylene Chloride	75-09-2	5	5
6.	Acetone	67-64-1	10	10
7.	Carbon Disulfide	75-15-0	5	5
8.	1,1-Dichloroethene	75-35-4	5	5
9.	1,1-Dichloroethane	75-34-3	5	5
10.	1,2-Dichloroethene (total)	540-59-0	5	5
11.	Chloroform	67-66-3	5	5
12.	1,2-Dichloroethane	107-06-2	5	5
13.	2-Butanone	78-93-3	10	10
14.	1,1,1-Trichloroethane	71-55-6	5	5
15.	Carbon Tetrachloride	56-23-5	5	5
16.	Vinyl Acetate	108-05-4	10	10
17.	Bromodichloromethane	75-27-4	5	5
18.	1,2-Dichloropropane	78-87-5	5	5
19.	cis-1,3-Dichloropropene	10061-01-5	5	5
20.	Trichloroethene	79-01-6	5	5
21.	Dibromochloromethane	124-48-1	5	5
22.	1,1,2-Trichloroethane	79-00-5	5	5
23.	Benzene	71-43-2	5	5
24.	trans-1,3-Dichloropropene	10061-02-6	5	5
25.	Bromoform	75-25-2	5	5
26.	4-Methyl-2-pentanone	108-10-1	10	10
27.	2-Hexanone	591-78-6	10	10
28.	Tetrachloroethene	127-18-4	5	5
29.	Toluene	108-88-3	5	5
30.	1,1,2,2-Tetrachloroethane	79-34-5	5	5

TABLE 1-3

TARGET COMPOUND LIST (TCL) AND CONTRACT REQUIRED QUANTITATION LIMITS (CRQL)[1,2]

(continued)

I. Volatiles	CAS Number	Quantitation Limits[3] Water ug/l	 Low Soil/Sediment[4] ug/kg
31. Chlorobenzene	108-90-7	5	5
32. Ethyl Benzene	100-41-4	5	5
33. Styrene	100-42-5	5	5
34. Xylenes (Total)	1330-20-7	5	5

(1) 7/87 SOW for CLP Program.

(2) Specific quantitation limits are highly matrix dependent. The quantitation limits listed herein are provided for guidance and may not always be achievable.

(3) Quantitation limits listed for soil/sediment are based on wet weight. The quantitation limits calculated by the laboratory for soil/sediment, calculated on dry weight basis as required by the contract, will be higher.

(4) Medium Soil/Sediment Contract Required Quantitation Limits (CRQL) for Volatile TCL Compounds are 125 times the individual Low Soil/Sediment CRQL.

TABLE 1-3

TARGET COMPOUND LIST (TCL) AND CONTRACT REQUIRED QUANTITATION LIMITS (CRQL) (continued)

II. Semivolatiles	CAS Number	Quantitation Limits(1) Water ug/l	Quantitation Limits(1) Low Soil/Sediment(2) ug/kg
35. Phenol	108-95-2	10	330
36. bis(2-Chloroethyl)ether	111-44-4	10	330
37. 2-Chlorophenol	95-57-8	10	330
38. 1,3-Dichlorobenzene	541-73-1	10	330
39. 1,4-Dichlorobenzene	106-46-7	10	330
40. Benzyl alcohol	100-51-6	10	330
41. 1,2-Dichlorobenzene	95-50-1	10	330
42. 2-Methylphenol	95-48-7	10	330
43. bis(2-Chloroisopropyl) ether	108-60-1	10	330
44. 4-Methylphenol	106-44-5	10	330
45. N-Nitroso-di-n-dipropylamine	621-64-7	10	330
46. Hexachloroethane	67-72-1	10	330
47. Nitrobenzene	98-95-3	10	330
48. Isophorone	78-59-1	10	330
49. 2-Nitrophenol	88-75-5	10	330
50. 2,4-Dimethylphenol	105-67-9	10	330
51. Benzoic acid	65-85-0	50	1600
52. bis(2-Chloroethoxy)methane	111-91-1	10	330
53. 2,4-Dichlorophenol	120-83-2	10	330
54. 1,2,4-Trichlorobenzene	120-82-1	10	330
55. Napthalene	91-20-3	10	330
56. 4-Chloroaniline	106-47-8	10	330
57. Hexachlorobutadiene	87-68-3	10	330
58. 4-Chloro-3-methylphenol (para-chloro-meta-cresol)	59-50-7	10	330
59. 2-Methylnaphthalene	91-57-6	10	330
60. Hexadchlorocyclopentadiene	77-47-4	10	330
61. 2,4,6-Trichlorophenol	88-06-2	10	330
62. 2,4,5-Trichlorophenol	95-95-4	50	1600
63. 2-Chloronaphthalene	91-58-7	10	330
64. 2-Nitroaniline	88-74-4	50	1600
65. Dimethylphthalate	131-11-3	10	330
66. Acenaphthylene	208-96-8	10	330
67. 2,6-Dinitrotoluene	606-20-2	10	330
68. 3-Nitroanline	99-09-2	50	1600
69. Acenaphthene	83-32-9	10	330

TABLE 1-3

TARGET COMPOUND LIST (TCL) AND CONTRACT REQUIRED QUANTITATION LIMITS (CRQL) (continued)

		Quantitation Limits(1)	
II. Semivolatiles	**CAS Number**	**Water ug/l**	**Low Soil/Sediment(2) ug/kg**
70. 2,4-Dinitrophenol	51-28-5	50	1600
71. 4-Nitrophenol	100-02-7	50	1600
72. Dibenzofuran	132-64-9	10	330
73. 2,4-Dinitrotoluene	121-14-2	10	330
74. Diethylphthalate	84-66-2	10	330
75. 4-Chlorophenyl-phenyl ether	7005-72-3	10	330
76. Fluorene	86-73-7	10	330
77. 4-Nitroaniline	100-01-6	50	1600
78. 4,6-Dinitro-2-methylphenol	534-52-1	50	1600
79. N-nitrosodiphenylamine	86-30-6	10	330
80. 4-Bromophenyl-phenylether	101-55-3	10	330
81. Hexachlorobenzene	118-74-1	10	330
82. Pentachlorophenol	87-86-5	50	1600
83. Phenanthrene	85-01-8	10	330
84. Anthracene	120-12-7	10	330
85. Di-n-butylphthalate	84-74-2	10	330
86. Fluoranthene	206-44-0	10	330
87. Pyrene	129-00-0	10	330
88. Butylbenzylphthalate	85-68-7	10	330
89. 3,3'-Dichlorobenzidine	91-94-1	20	660
90. Benzo(a)anthracene	56-55-3	10	330
91. Chrysene	218-01-9	10	330
92. bis(2-Ethylhexyl)phthalate	117-81-7	10	330
93. Di-n-octylphthalate	117-84-0	10	330
94. Benzo(b)fluoranthene	205-99-2	10	330
95. Benzo(k)fluoranthene	207-08-9	10	330
96. Benzo(a)pyrene	50-32-8	10	330
97. Indeno(1,2,3-cd)pyrene	193-39-5	10	330
98. Dibenz(a,h)anthracene	53-70-3	10	330
99. Benzo(g,h,i)perylene	191-24-2	10	330

(1) Quantitation limits listed for soil/sediment are based on wet weight. The quantitation limits calculated by the laboratory for soil/sediment, calculated on dry weight basis as required by the contract, will be higher.

(2) Medium Soil/Sediment Contract Required Quantitation Limits (CRQL) for Semi-Volatile TCL Compounds are 60 times the individual Low Soil/Sediment CRQL.

TABLE 1-3

TARGET COMPOUND LIST (TCL) AND CONTRACT REQUIRED QUANTITATION LIMITS (CRQL) (continued)

II.	Pesticides/PCBs	CAS Number	Quantitation Limits(1) Water ug/l	 Low Soil/Sediment(2) ug/kg
100.	alpha-BHC	319-84-6	0.05	8.0
101.	beta-BHC	319-85-7	0.05	8.0
102.	delta-BHC	319-86-8	0.05	8.0
103.	gamma-BHC (Lindane)	58-89-9	0.05	8.0
104.	Heptachlor	76-44-8	0.05	8.0
105.	Aldrin	309-00-2	0.05	8.0
106.	Heptachlor epoxide	1024-57-3	0.05	8.0
107.	Endosulfan I	959-98-8	0.05	8.0
108.	Dieldrin	60-57-1	0.10	16.0
109.	4,4'-DDE	72-55-9	0.10	16.0
110.	Endrin	72-20-8	0.10	16.0
111.	Endosulfan II	33213-65-9	0.10	16.0
112.	4,4'-DDD	72-54-8	0.10	16.0
113.	Endosulfan sulfate	1031-07-8	0.10	16.0
114.	4,4'-DDT	50-29-3	0.10	16.0
115.	Methoxychlor	72-43-5	0.5	80.0
116.	Endrin ketone	53494-70-5	0.10	16.0
117.	alpha-Chlordane	5103-71-9	0.5	80.0
118.	gamma-Chlordane	5103-74-2	0.5	80.0
119.	Toxaphene	8001-35-2	1.0	160.0
120.	Aroclor-1016	12674-11-2	0.5	80.0
121.	Aroclor-1221	11104-28-2	0.5	80.0
122.	Aroclor-1232	11141-16-5	0.5	80.0
123.	Aroclor-1242	53469-21-9	0.5	80.0
124.	Aroclor-1248	12672-29-6	0.5	80.0
125.	Aroclor-1254	11097-69-1	1.0	160.0
126.	Aroclor-1260	11096-82-5	1.0	160.0

(1) Quantitation limits listed for soil/sedimient are based on wet weight. The quantitation limits calculated by the laboratory for soil/sediment, calculated on dry weight basis as requried by the contract, will be higher.

(2) Medium Soil/Sediment Contract Required Quantitation Limits (CRQL) for Pesticide/PCB TCL compounds are 15 times the individual Low Soil/Sediment CRQL.

TABLE 1-3

TARGET COMPOUND LIST (TCL) AND CONTRACT REQUIRED QUANTITATION LIMITS (CRQL) (continued)

IV. Inorganics	Quantitation Limit (1,2) ug/l
1. Aluminum	200
2. Antimony	60
3. Arsenic	10
4. Barium	200
5. Beryllium	5
6. Cadmium	5
7. Calcium	5000
8. Chromium	10
9. Cobalt	50
10. Copper	25
11. Iron	100
12. Lead	5
13. Magnesium	5000
14. Manganese	15
15. Mercury	0.2
16. Nickel	40
17. Potassium	5000
18. Selenium	5
19. Silver	10
20. Sodium	5000
21. Thallium	10
22. Vanadium	50
23. Zinc	20
24. Cyanide	10

(1) Elements determined by inductively coupled plasma emission or Atomic Absorption (AA) spectroscopy.

(2) Quantitation limits for water.

TABLE 1-4

NONSTANDARD METHOD VOCs

VOCs	Detection Limit Water (ug/l)	Detection Limit Soil/Sediment(mg/kg)
Tetrahydrofuran	15	1.9
Trichlorofluoromethane	0.4	0.05
Dichlorodifluoromethane	1.5	0.19

TABLE 1-5

TARGET AND OTHER POTENTIALLY ANALYZABLE VOCs FOR SOIL GAS AND OUTDOOR AIR

Target VOCs	Detection Limit (Vppm)(1)
Dichlorodifluoromethane	0.02
1,1-Dichloroethane	0.02
cis-1,2-Dichloroethene	0.03
trans-1,2-Dichloroethene	0.03
Ethyl benzene	0.02
Tetrachloroethene	0.01
Tetrahydrofuran	0.04
Trichloroethene	0.02
Toluene	0.03
Xylene (total)	0.02

Other Analyzable VOCs	
Methylene Chloride	0.03
1,1,1-Trichloroethane	0.02
Methyl Ethyl Ketone	0.23
Cumene	0.02
Chlorobenzene	0.02
1,1,2,2-Tetrachloroethane	0.01
Benzene	0.03
Methyl Isobutyl Ketone	0.03

(1) Assuming a 10 liter sample volume

- Collect sufficient data to support a baseline risk assessment and feasibility study of the Stoughton City Landfill site.

- Perform a baseline risk assessment to determine the risk to human health and environment to the site in the absence of any remedial action.

- Identify remedial alternatives to remove or treat contaminated soil and ground water and to mitigate contaminant migration.

- Evaluate remediation alternatives consistent with the National Contingency Plan and other regulatory requirements and guidelines.

In order to achieve these specific objectives, data quality objectives (DQO) have been established to ensure that the data collected are sufficient and of adequate quality for their intended uses. The primary data uses for the Stoughton City Landfill will be for site characterization, risk assessment and evaluation of alternatives; however, health and safety and engineering design of alternative uses are also anticipated. The priority of data uses, beyond those health and safety data used to establish the level of protection needed for investigators at the site, are for site characterization, risk assessment and in the evaluation of alternatives. These data use will require the highest level of confidence, and therefore the lower level of uncertainty. These low limits of uncertainty have driven the selection of both the analytical and sampling approaches for the Stoughton City Landfill project.

Based on these intended data uses and the desired level of certainty, the Level IV analytical support option has been chosen for water and soil/sediment analyses. This level, which is characterized by rigorous QA/QC protocols and documentation, provides qualitative and quantitative analytical data. In addition, the Level V analytical support option will include nonstandard method analyses for the following: tetrahydrofuran, trichlorofluoromethane, and dichlorodifluoromethane for water and gas and outdoor air. Lastly, field screening activities--such as the determination of pH, specific conductance, temperature, and VOC concentration using the HNu photoionization meter--are categorized as Level I analytical support.

The use of the three foregoing analytical support levels will assure achievement of both the overall and specific project objectives established for the Stoughton City Landfill RI/FS.

1.5 Sample Network and Rationale

As previously noted, the conceptual site model for the Stoughton City Landfill is poorly defined. Because of this, potential contaminant migration routes and receptors will be reevaluated during Task 1 of the RI to ensure the proper scope of investigations conducted during subsequent phases of the RI. Source characterization, through geophysical surveys and soil gas sampling, will be implemented to identify refuse disposal areas and areas characterized by near-surface soil contamination that are possible sources of ground water contamination. In addition, areas potentially characterized by ground water contamination will be investigated. These investigative surveys will be initially conducted over the entire existing, landfill boundary and in the area to the south which encompasses Well SB-1 to determine contaminants at the site or those that pose a risk due to contact exposure. These investigations may be extended outside of the above areas following a review of both the geophysical and soil gas survey data. In addition, ground water flow direction in the upper surficial deposits will also be evaluated during the limited field investigation undertaken during Task 1. It is anticipated that the primary focus of more detailed site investigations under Task 2 will be hydrogeologic investigations. These investigations are designed to characterize contamination on site and to evaluate the suspected primary contaminant migration route (ground water). These investigations will also be focused in the initial investigative areas described above, but may be extended outside of the initial area following review of Task 1 data and the results of monitoring well sampling results. Soil sampling will be performed as part of monitoring well installation, and surface water/sediment and air quality evaluations will also take place during Task 2. Table 1-6 summarizes the sampling and analysis program for the Stoughton City Landfill RI.

TABLE 1-6
SUMMARY OF SAMPLING AND ANALYSIS PLAN
FOR STOUGHTON CITY LANDFILL RI

				QA/QC Samples (1)			
Sample Matrix	Field Parameters	Laboratory Parameters	Investigative Samples	Collocated or Replicate	Field Blanks	Background	Matrix Total
Soil Gas	HNu Screening	Analyzable VOCs(2) (Nonstandard Methods)	102	11	11	0	124
Soil	HNu Screening	TCL Volatiles (CLP protocol)	6	1	0	2	9
	Lithologic Description	TCL Semivolatiles (CLP protocol)	6	1	0	2	9
	Electromagnetic/ Electrical Resistivity Survey	TCL Pesticides/PCBs (CLP protocol)	6	1	0	2	9
		TCL Metals (CLP protocol)	6	1	0	2	9
		Other Organics(3) (Nonstandard Methods)	6	1	0	2	9
		Particle-Size Analysis (ASTM D422)	12	0	0	0	12
		Hydraulic Conductivity (Standard Methods)	TBD	0	0	0	TBD
Ground Water	pH	TCL Volatiles(5) (CLP protocol)	10	2	2	2	16
	Specific Conductance	TCL Semivolatiles(5) (CLP protocol)	10	2	2	2	16
	Temperature	TCL Pesticides/PCBs(5) (CLP protocol)	10	2	2	2	16
	Electromagnetic/ Electrical Resistivity Survey	TCL Metals (Field Filtered-CLP protocol)	10	2	2	2	16
		Other Organics(5) (Nonstandard Methods)	10	2	2	2	16
	Field Hydraulic Conductivity	Cyanide	10	2	2	2	16
	Water Levels/ Flow Direction						

TABLE 1-6 (continued)
SUMMARY OF SAMPLING AND ANALYSIS PLAN
FOR STOUGHTON CITY LANDFILL RI

Sample Matrix	Field Parameters	Laboratory Parameters	Investigative Samples	QA/QC Samples (1)			
				Collocated or Replicate	Field Blanks	Background	Matrix Total
Surface(4) Water	pH	TCL Volatiles(5) (CLP protocol)	2	1	1	2	6
	Specific Conductance	TCL Semivolatiles(5) (CLP protocol)	2	1	1	2	6
	Temperature	TCL Pesticides/PCBs(5) (CLP protocol)	2	1	1	2	6
	Water Levels	TCL Metals (Unfiltered-CLP protocol)	2	1	1	2	6
		Other Organics(5) (Nonstandard Methods)	2	1	1	2	6
		Cyanide	2	1	1	2	6
Sediment(4)	None	TCL Volatiles (CLP protocol)	2	1	0	2	5
		TCL Semivolatiles (CLP protocol)	2	1	0	2	5
		TCL Pesticides/PCBs (CLP protocol)	2	1	0	2	5
		TCL Metals (CLP protocol)	2	1	0	2	5
		Other Organics (Nonstandard Methods)	2	1	0	2	5
Air	None	Analyzable VOCs (Nonstandard Methods)	3	1	NA	2	6

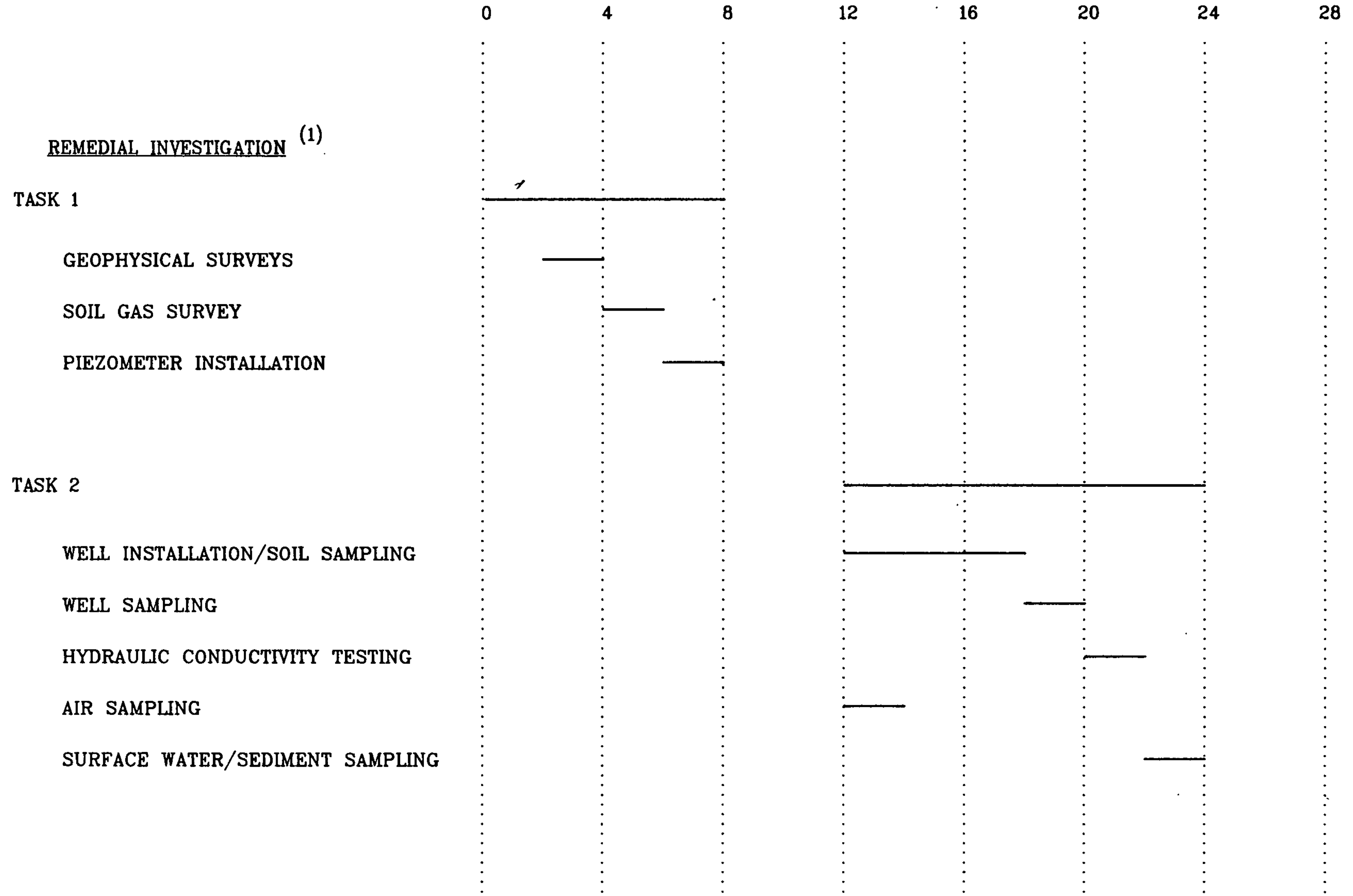
(1) TBD - To be determined on the basis of field investigation results. NA - Not applicable
(2) Analyzable VOCs as listed in Table 1-3.
(3) Other organics as listed in Table 1-2.
(4) The total number of surface and sediment samples taken will be dependent upon the results of field investigation.
(5) Samples for matrix spike/matrix spike duplicate (MS/MSD) analysis will be collected at a frequency of one per group of 20 or fewer investigative samples. Samples for MS/MSD will be collected triple the normal volumes for TCL volatiles, and double the normal volumes for TCL extractables (semivolatiles), and pesticides and PCBs.
(6) Trip blanks will be collected and analyzed at a frequency of 1 per shipping container.

1.6 Project Schedule

The schedule for completion of Tasks 1 and 2 of the RI/FS is presented in Figure 1-5. The anticipated start and completion dates for each major project task are indicated as the number of weeks following the Work Plan/Project Plan approval.

Technical memoranda will be prepared and submitted to the USEPA and WDNR during the course of the RI and FS, prior to the preparation and submittal of RI or FS reports. The technical memoranda anticipated during the Stoughton City Landfill RI/FS and the expected preparation dates, in terms of weeks from initiation of the project, are listed in Table 1-7.

ESTIMATED PROJECT SCHEDULE
STOUGHTON CITY LANDFILL
WEEKS FROM EFFECTIVE DATE OF WORK PLAN APPROVAL



(1) REMEDIAL INVESTIGATION TO BE CONDUCTED USING PHASED APPROACH.

ESTIMATED PROJECT SCHEDULE TASKS 1 AND 2	FIGURE 1-5
ERM ERM-North Central, Inc.	11/18/88 cs

TABLE 1-7

ESTIMATED SUBMITTAL DATES FOR TECHNICAL MEMORANDA DURING THE STOUGHTON CITY LANDFILL RI and FS

TITLE	SUBMITTAL DATE*(WEEKS)
Task 1 Technical Memorandum	8
1.1 Site Boundary Survey, Current Ownership Determination, Detailed Land Survey and Site Control Measures	
1.2 Historical Aerial Photo Analysis	
1.3 Area Ground Water Usage Survey	
1.4 History of Response Actions and Evaluation of Existing Data	
1.5 Geophysical and Soil Gas Surveys	
1.6 Review of Air Sampling Data	
1.7 Surface Water Evaluation	
1.8 Ground Water Flow Direction Evaluation	
Report of Monitoring Well Installation	20
Results of Ground Water Sampling at Landfill	28**
Results of Soil Sampling at Landfill	28**
Results of Residential Well Sampling (If necessary)	32**
Results of Surface Water Sampling (If necessary)	32**
Results of Air Sampling	32**
Results of Remedial Alternative Screening	44

* Dates are in reference to effective date for Work Plan approval.

** Estimated submittal, actual date will be 4 weeks after receipt of laboratory results to enable validation.

2.0 PROJECT ORGANIZATION AND RESPONSIBILITY

As the primary contractor to the Stoughton City Landfill Steering Committee, ERM-North Central has the overall responsibility for all phases of the RI/FS.

2.1 Management

Operational responsibilities involving execution and direct management of the technical and administrative aspects of this project have been assigned as follows:

Briand C. Wu, PRP Project Coordinator
Uniroyal Plastics Company, Inc.

James W. Polich, Project Manager
ERM-North Central

Mike Valentino, Remedial Project Manager
USEPA, Region V

2.2 Field Activity

ERM-North Central will perform or supervise all field investigations including sample collection, and conduct a receptor-based baseline risk assessment using both existing, relevant data and valid data generated during the RI.

2.3 Laboratory Analysis

Three laboratories, CompuChem Laboratories, Pace Laboratories, and Soils and Engineering Services, Inc. will act as subcontractors to ERM-North Central. CompuChem Laboratories, which currently participates in USEPA's Contract Laboratory Program (CLP), will perform all chemical analyses (with the exception of soil gas and air carbon tube analysis and other volatile organic analysis as identified in Section 1.3) required as part of the RI/FS. Review of Tentatively Identified Compounds (TICs) and final data review by CompuChem is performed in a two-step process involving first the Lab Technical Reviewers and then the Report Integration Technical Reviewers. Pace Laboratories, also a CLP laboratory, will conduct the analysis of carbon tubes collected during the soil gas investigation and the outdoor air sampling phase of the RI and also analyses of three additional VOCs in water and soil/sediment using nonstandard methods. Mr. William Scruton will be responsible for final data and TIC review for Pace and was responsible for SOP development for soil gas/outdoor air and nonstandard method analyses. Soil and Engineering Services, Inc. will perform soil geotechnical analyses.

2.4 Quality Assurance

Overall Quality Assurance (QA) responsibility will be held by the Quality Assurance Officer (QAO) of ERM-North Central. All subcontractors to ERM will provide appropriate project management, and ERM-North Central will furnish administrative oversight and QA/QC for all deliverables. Environmental

Standards, Inc. will be responsible for data validation and subsequent report preparation. All deliverables will be issued by ERM-North Central. The Quality Assurance Office of the USEPA, Region V will provide review of the QAPP.

2.5 Performance and System Audits

Performance and system audits for field operations will be performed by the QAO of ERM-North Central. In addition, evidence audits will also be performed by the QAO of ERM-North Central. The Central Regional Laboratory of USEPA Region V will be responsible for performance and system audits of analytical laboratories.

3.0 QUALITY ASSURANCE OBJECTIVES

The overall quality assurance objective is to develop and implement procedures for sampling, laboratory analysis, field measurement and reporting that will provide data to a degree of quality consistent with its intended use and defensible in a court of law. This section defines the goals for levels of QC effort and the accuracy, precision, sensitivity, completeness, representativeness, and comparability of laboratory analyses.

3.1 Level of QC Effort

Quality Control samples--including collocated or replicate samples, background samples, and field and trip blanks--will be submitted to the respective analytical laboratories to assess the quality of the data resulting from field sampling investigations. Collocated samples, and to a lesser extent replicate samples, assess the precision of the sampling activities. One (1) collocated/field duplicate sample is required per ten (10) or fewer investigative samples. Trip blanks, which will be kept with investigative samples throughout the sampling event, assess the cross-contamination due to VOC migration during shipment. Two trip blank samples per shipment container are required to be sent by the laboratory to the site or sampler. The analysis of one of these trip blanks is required. The other is for use as backup. All trip blank samples must remain sealed until analysis. Field blanks will be used to assess the overall procedural contamination due to sampling activities. One field blank sample is required per ten or fewer investigative water and soil gas samples. Field blanks are not available for air analysis, and trip blanks will only be provided for water, soil gas, and air analysis of VOCs. The specific level of QC effort is summarized by sample matrix and parameter in Table 1-6.

The analytical laboratories selected for sample analysis are participants in the USEPA Contract Laboratory Program (CLP) for organic and inorganic testing. The level of QC effort provided by CompuChem Laboratories will be equivalent to the level of QC efforts specified under the 7/85 and 8/87 SOWs for the CLP program as appropriate. The level of QC effort by Pace Laboratories for the analysis of the three additional VOCs in water and soil/sediment using nonstandard methods and the analysis of VOCs in soil gas and air is outlined in the SOPs contained in Appendix A and B, respectively.

The level of QC effort for field measurement of pH will consist of precalibration using three buffer solutions (pH 4, 7 and 10) and calibration verification at regular intervals (at least once a day). Calibration activities will be recorded in a project log book. QC effort for field conductivity measurements will consist of initial and continuing (at least once a day) calibration verification using a standard solution of known specific conductance. QC effort for HNu screening will consist of initial and continuing (at least every day) calibration verification using a standard reference gas.

3.2 Accuracy, Precision, and Sensitivity of Analyses

The QA objectives of analyses with respect to accuracy, precision, and sensitivity are to achieve acceptable data based on specified performance criteria. Accuracy and precision requirements and method detection limits for CLP protocol analyses are described in the 7/85 and 8/87 SOWs for the CLP program as appropriate. Accuracy and precision criteria and required detection limits for VOC analyses by Pace Laboratories are presented in Appendices A and B.

Analytical accuracy will be assessed through the collection of organic samples for matrix spike/matrix spike duplicate and surrogate spike analyses. A matrix effect is a phenomenon that occurs when other sample components interfere with the analysis of the contaminants of interest. Percentage recovery information obtained from matrix spikes will be used to address the amount of bias present in the measurement system (accuracy). In addition, surrogate spike recovery will be evaluated by determining whether the concentration (measured as percent recovery) falls inside the contract required recovery limits. This surrogate spike recovery information will be used to indicate the systematic error in the analytical method. If recovery of any one surrogate compound falls outside of the contract surrogate spike recovery limits, the laboratory must take appropriate actions in accordance with the 8/87 SOW for the CLP program to ensure accuracy of the analytical method. For metals analysis, interference check samples must be run to ensure accuracy in the analytical method.

The accuracy of field measurements of pH will be assessed through premeasurement calibrations and post-measurement verifications using at least two standard buffer solutions. The two measurements must each be within ±0.05 standard units of buffer solution values. Precision will be assessed through duplicate measurements. (The electrode will be withdrawn, rinsed with deionized water, and reimmersed between each duplicate). The instrument used will be capable of providing measurements to 0.1 standard unit. The accuracy of the specific conductance and HNu photoionization meters will be assured by daily calibration verification with check standards. If readings vary more than 5 percent from an expected value, the units will be replaced.

3.2.1 Data Completeness, Representativeness, and Comparability

It is expected that the TCL organic and TCL inorganic parameters analyzed consistent with CLP procedures will provide data meeting the QC acceptance criteria for 95% of all samples analyzed. Upon request, the completeness of an analysis will be documented by the laboratory with items such as chromatograms, spectra, and QC data to allow the data user to assess the quality of the results.

The sampling and analysis program is designed to provide data representative of site conditions. During the development of this program, special consideration was given to past disposal practices, existing analytical data from previous site investigations, and the physical setting of the site to ensure the representativeness of the data generated by the RI.

Data comparability will be assured by using identical sampling procedures, analytical procedures, and by reporting results in identical units of measurement.

3.2.2 Documentation

The documentation system will comply with the requirements of CLP protocol.

3.2.3 Quality Control Requirements

The sampling activities will include the following procedures for purpose of quality control:

- Collection of field duplicates, including collocated and replicate samples.
- Collection of field blanks.
- Inclusion of trip blanks in sample shipments for the analysis of VOCs in water, soil gas, and air.

The specific level of QC effort is summarized by the sample matrix and parameter in Table 1-6 and is discussed in Section 3.1.

4.0 SAMPLING PLAN

The Field Sampling Plan (FSP), presented as Part I of this Sampling and Analysis Plan, contains all appropriate information pertinent to field sampling procedures.

5.0 SAMPLE CUSTODY PROCEDURES

Sample custody procedures will be consistent with Attachment 4 of the USEPA Region V Guidance "Content Requirements for Quality Assurance Project Plans."

A sample will be considered under the person's custody if: (1) it is in a person's physical possession, (2) in view of the person after he has taken possession, (3) secured by that person so that no one can tamper with the sample, or (4) secured by that person in an area that is restricted to authorized personnel. The sample packaging and shipment procedures summarized below will assure that the samples will arrive at the laboratory with the chain-of-custody intact.

Field procedures are as follows:

- The field sampler will be personally responsible for the care and custody of the samples until they are transferred or properly dispatched. As few people as possible will handle the samples.
- All samples will be tagged with sample numbers and locations.
- Sample tags will be completed for each sample using water proof ink unless prohibited by weather conditions.

Transfer of custody and shipment procedures will be as follows:

- Samples will be accompanied by a properly completed chain-of-custody form. The sample numbers and locations will be listed on the chain-of-custody form. When transferring the possession of samples, the individuals relinquishing and receiving will sign, date and note the time on the records. This record documents the transfer of custody of samples from the sampler to another person, to a permanent laboratory, or to/from a secure storage area.

- Samples will be classified as environmental samples and are anticipated to be of low concentration. They will be properly packaged according to appropriate Department of Transportation (DOT) regulations for shipment and dispatched by overnight carrier to the appropriate laboratory for analysis, with a separate signed custody record enclosed in each sample box or cooler. Shipping containers will be secured with strapping tape and custody seals for shipment to the laboratory.

- A sample analysis request form will accompany each shipment of samples to the analytical laboratory. A description of the requested analysis and the specific laboratory analysis code will be included on this form.

- A standardized sample tracking form will also be completed to establish sample custody prior to shipment to the laboratory and to document specific sample preservation methods.

Copies of all sample custody forms will be maintained in the project files along with copies of all field measurement data and sample-specific information recorded in the field log book and on field data forms. Field custody procedures are further described in the Data Management Plan.

The specifications for chain-of-custody and document control for both CompuChem and Pace Laboratories will comply with the CLP requirements and be carried out in accordance with the 7/85 and 8/87 SOWs for CLP analyses as appropriate.

CompuChem Laboratories will provide all sample containers necessary for field sampling and QC requirements. Each lot of sample containers will be checked for cleanliness by the laboratory and sealed to prevent contamination. Samples will be received at the laboratory by the sample custodian, who will examine each sample to ensure that no damage occurred during shipment and that the chain-of-custody record is complete and accurate. The sample custodian will also ensure that each sample has been preserved in a manner required by the particular test and stored according to the correct procedure (see Table 7-1, Part I). Samples will be preserved by storage in a cooler maintained at 4°C until the analysis begin.

Pace Laboratories will provide all of the activated carbon tubes necessary for the soil gas and air sampling programs, and also containers for the sampling of the three additional VOCs to be determined by nonstandard methods. For soil gas and air sampling, each tube will be sealed with specially designed end caps and labelled to indicated the sample number, location, time and date. Preservation of tubes will involve maintaining a storage temperature of 4°C. Carbon tubes will be received at the laboratory by the sample custodian who will examine all tubes to ensure that they are properly sealed. The sample custodian will also cross-check the chain-of-custody record with sample labels to ensure that the documentation is complete and accurate. Carbon tubes will be stored at 4°C until analysis begin.

ERM-North Central will maintain the RI files along with all relevant records, reports, logs, field notebooks, pictures, subcontractor reports, and data reviews in a secured, limited access area and under the custody of the site manager.

6.0 CALIBRATION PROCEDURES AND FREQUENCY

This section presents the calibration procedures and information for all major measurement systems including field and analytical laboratory testing.

6.1 Field Instruments

A maintenance and calibration program will be implemented to ensure that routine calibration and maintenance are performed on all field instruments. The program will be administered by the field team leader who will perform routine preventative maintenance (e.g., cleaning or other procedures identified in the instrument manual) on a weekly basis and calibration of field instruments on a daily basis. Calibration activities will include the use of buffer solutions for calibrating the pH meter, liquids of known conductance for calibrating the specific conductance meter, and a standardized reference gas (isobutylene) for calibration of the HNu photoionization meter.

Calibration, operation, and maintenance of all field instruments will be documented in the field log book, and all field personnel will maintain their proficiency. Operating procedures outlined in the manual for each instrument will be followed. If field equipment should fail, the field team leader will be contacted immediately and will either provide replacement equipment or have the malfunction repaired immediately.

6.2 Laboratory Equipment

CompuChem will perform calibration and preventative maintenance procedures for laboratory equipment in accordance with the 7/85 and 8/87 SOWs for the CLP program as appropriate. Pace Laboratories' calibration and maintenance procedures are described in Appendices A and B.

7.0 ANALYTICAL PROCEDURES

Water and soil/sediment samples collected will be analyzed for the complete Target Compound List (TCL) consistent with CLP procedures. If necessary, private well samples will be analyzed only for TCL compounds detected in the monitoring well samples. The complete list of TCL parameters is shown on Table 1-3. The TCL analyses will be conducted by CompuChem Laboratories using methods specified in the 7/85 and 8/87 SOWs for CLP laboratories.

Other VOCs for water and soil/sediment (Table 1-4), and analyzable VOCs for soil gas and air (Table 1-5) will be analyzed by Pace Laboratories in accordance with Level V nonstandard methods as outlined in Appendix A (soil gas and air) and Appendix B (additional VOCs in water and soil/sediment).

8.0 INTERNAL QUALITY CONTROL CHECKS

8.1 Analytical Laboratories

Quality control at CompuChem Laboratories will be carried out in accordance with the 7/85 and 8/87 SOWs for CLP laboratories. Quality control at Pace Laboratories will be carried out as described in Appendices A and B.

8.2 Field Quality Control

Field quality control will be carried out during all field activities such as soil sampling, ground water sampling, surface water/sediment sampling, and well drilling and installation by an experienced ERM-North Central geologist or engineer. The on-site supervisor will be present during all sampling activities and subcontracted activities such as drilling. All field quality control procedures will be carried out according to the QAPP and documented in the field notebook.

9.0 DATA REDUCTION, VALIDATION AND REPORTING

Procedures for documenting sample collection and custody, validating analytical data, and reporting the results of each phase of the RI/FS are covered in this section.

9.1 Documentation

Information pertaining to sample collection, sample custody, analyses to be performed, field measurements, and other field observations will be documented and stored in accordance with procedures contained in the Data Management Plan.

Field measurements and sample collection data will be recorded on specific field data forms and in a field log book. Sample custody and requests for analytical tests to be performed will be documented on sample tracking forms, chain-of-custody records, and sample analysis request forms.

Data received from the analytical laboratories will be validated, organized under specific project headings, and stored in the project files maintained at ERM-North Central offices.

9.2 Data Validation

CompuChem Laboratories and Pace Laboratories will perform in-house analytical data reduction and validation under the direction of their respective laboratory QA officers. The laboratory review will include checks for the attainment of QC criteria as outlined in CLP procedures and established EPA methods. The validity of analytical data will also be assessed by comparing the analytical results of duplicate and blank samples.

Additionally, the laboratories will critique their own analytical programs by using spiked addition recoveries, established detection limits, precision and accuracy control charts and by keeping accurate records of the calibration of instruments.

ERM-North Central will review all sample collection procedures and laboratory data validations to insure that QA/QC has been maintained. Environmental Standards, Inc. (ESI) will perform a final data validation. The data validation analysis will be conducted in accordance with USEPA guidance documentation such as "Laboratory Data Validation Functional Guidelines" (February, 1988 for organics and July, 1988 for inorganics).

9.3 Reporting

Results from the data validation and QA/QC analysis will be summarized in a technical memorandum for submittal to the USEPA and WDNR. The ESI data validation report will be submitted as an addendum to this memorandum. All site investigation data will be analyzed, and a summary interpretation will be developed for the type and extent of contamination from the site. The summaries will be submitted as technical memoranda at the completion of each RI task and included as appendices of the RI report.

9.4 Data Package/Data Deliverables

CompuChem will provide the standard CLP data package required under the appropriate SOWs. Pace Laboratories will provide a similar data package to include chromatograms and intergration printouts for a 5-point standard for all raw data and for laboratory blanks (12 hour). This information will be presented in a CLP format including a case narrative, surrogate spike recoveries, all recoveries, matrix spike/matrix spike duplicate recoveries, summary of method blanks, GC run time chronology and order, sample results and all raw data for method blanks.

10.0 PERFORMANCE AND SYSTEM AUDITS

ERM-North Central's Quality Assurance Officer will monitor and audit the performance of QA/QC procedures to insure that the RI/FS is executed in accordance with this QAPP.

10.1 Laboratory

All laboratory performance and system audits will be carried out according to CLP requirements which includes external audits by the Contract Project Management Section (CPMS) of the Central Regional Laboratory (CRL).

10.2 Field Activities

QA audits of field measurements procedures, sample collection, sample custody procedures, and monitoring well installation will be conducted on a periodic basis to document that field activities are performed in accordance with the Field Sampling Plan. These audits will be scheduled to allow oversight of as many field activities as possible and will be performed by ERM-North Central's field team leader.

11.0 PREVENTATIVE MAINTENANCE

11.1 Laboratory Equipment

All equipment at the laboratories will be maintained in accordance with the 7/85 and 8/87 SOWs for CLP laboratories as appropriate.

11.2 Field Equipment

Preventative maintenance procedures for the HNu photoionization meter, pH meter and conductivity meter will be carried out in accordance with operating manuals for the respective instruments and will be recorded in the field log book.

12.0 SPECIFIC ROUTINE PROCEDURES USED TO ASSESS DATA PRECISION, ACCURACY AND COMPLETENESS

Both CompuChem and Pace Laboratories will comply with the 7/85 and 8/87 SOWs for CLP laboratories, as appropriate, to assess data precision, accuracy and completeness. Additionally, 40 CFR Part 136, Section 7.1 - 8.7 (pp 43375-43377) will be applied as necessary in the assessment.

13.0 CORRECTIVE ACTION

13.1 Analytical Laboratories

Corrective actions for CompuChem Laboratory will be carried out in accordance with procedures outlined in the 7/85 and 8/87 SOWs for CLP laboratories, as appropriate.

13.2 Field Work

Corrective action indicated by audit results or detection of unacceptable data will be determined by ERM-North Central's Project Manager in consultation with the Stoughton City Landfill Steering Committee, USEPA, and WDNR. Corrective action may include, but is not limited to:

- Resampling and reanalyzing samples if holding time criteria are exceeded.
- Evaluating and amending sampling and analytical procedures.
- Accepting data with an acknowledged level of uncertainty.
- Eliminating outliers identified by the validation task.

The proposed corrective action will be implemented only after full agreement to the type of action required by the regulatory agencies and the Stoughton City Landfill Steering Committee is achieved.

14.0 QUALITY ASSURANCE REPORTS TO MANAGEMENT

Quality assurance reports will be issued by ERM-North Central as part of RI/FS technical memoranda. These reports will include the results of QA audits and any necessary corrective action procedures. In addition, the data validation and data sufficiency task will be incorporated into the technical memoranda.

REFERENCES

USEPA, 1980, "Interim Guidelines and Specifications for Preparing Quality Assurance Project Plans", QAMS-005/80, Washington D.C., December 29.

Mickelson, D.M., and McCartney, M.C., 1979, "Glacial Geology of Dane County, Wisconsin", Univ. of Wisconsin - Extension Geological and Natural History Survey.

USEPA, Undated, "Content Requirements for Quality Assurance Project Plan", Draft Copy, Dr. Chen-Wen Tsai, Region V.

APPENDIX A

THE DETERMINATION OF VOLATILE ORGANIC COMPOUNDS IN SOIL GAS

1. Scope and Application

1.1 This method covers the determination of a number of volatile organic compounds. The following parameters may be determined by this method:

Parameter	CAS Number
Dichlorodifluoromethane	75-71-8
1,1-Dichloroethene	75-35-4
cis-1,2-Dichloroethene	156-59-4
trans-1,2-Dichloroethene	156-60-5
Ethyl benzene	100-41-4
Tetrachloroethene	127-18-4
Tetrahydrofuran	109-99-9
Trichloroethene	79-01-6
Toluene	108-88-3
Xylene (total)	1330-20-7

1.2 This is a gas chromatographic method applicable to the determination of the compounds listed above in soil gas and outdoor air. The method describes analytical conditions for dual capillary column/dual flame ionization detection which allows for qualitative and quantitative confirmation of results on a single injection.

1.3 The estimated method detection limit (MDL) for each parameter is listed in Table 1. The MDL for a specific sample may differ from those listed, depending upon the nature of interferences in the sample matrix.

1.4 Other compounds may also be determined by this method. These compounds include but are not limited to: methylene chloride, 1,1,1-trichlorethane, methyl ethyl ketone, cumene, chlorobenzene, 1,1,2,2-tetrachloroethane, benzene, and methyl isobutyl ketone.

2. Summary of Method

2.1 Volatile organic compounds are collected on charcoal, desorbed with carbon disulfide, and analyzed by dual capillary column gas chromatography with dual flame ionization detectors. Qualitative identification of the parameters of interest is performed using the retention times from two dissimilar capillary columns. Quantitative analysis is performed using internal standard techniques and extraction efficiency is monitored using a surrogate spike.

3. Interferences

3.1 Method interferences may be caused by contaminants in solvents, reagents, and other sample processing hardware that lead to discrete artifacts and/or elevated baselines in the detector outputs. All of these materials must be routinely demonstrated to be free from interferences under the conditions of the analysis by running laboratory reagent blanks.

3.2 The use of high priority reagents and solvents helps to minimize interference problems.

3.3 Matrix interferences may be caused by contaminants that co-extracted from the sample. The extent of matrix interferences will vary considerably from source to source.

4. Safety

4.1 The toxicity or carcineogenicity of each reagent used in this method has not been precisely defined; however, each chemical compound should be treated as a potential health hazard. The laboratory maintains a reference file of material safety data sheets for the analyst's use.

4.2 Safety glasses should be worn when opening the sealed ends of charcoal tubes to avoid injury to the eyes from glass splinters.

5. Apparatus and Materials

5.1 A calibrated personal sampling pump whose flow can be determined within ±5% at the recommended flow rate.

5.2 Charcoal tubes - Presently using charcoal tubes provided by SKC, Inc. (known as NIOSH tubes). These are glass tubes with both ends flame sealed, 7 cm long with a 6-mm OD and 4-mm ID, containing 2 sections of 20/40 mesh activated charcoal separated by a 2-mm portion of urethane foam. The adsorbing section contains 100 mg of charcoal, and the back-up section 50 mg. A 3-mm portion of urethane foam is placed between the outlet end of the tube and the back-up section. A plug of silylated glass wool is placed in front of the adsorbing section.

5.3 Two milliliter vials with crimp-on caps which contain Teflon-lined septa.

5.4 Microliter syringes: Ten-microlite for GC injections and 25-microliter and 100-microliter for standard preparation.

5.5 Pipets for dispensing desorbing solvent.

5.6 Volumetric flasks - Ten-milliter.

5.7 Glass tube cutter.

5.8 Gas chromatograph - An analytical system complete with a temperature programmable gas chromatograph and all required accessories including syringes, analytical columns and gases. The injection port must be designed for split injection (Hewlett Packard 5880A GC or equivalent).

5.9 Columns for dual capillary analysis:

5.9.1 Fused silica, 15 m x 0.32 mm ID, 1 um film thickness, 5% phenyl, 94% methyl, 1% vinyl silicone bonded phase (J&W DB-5 or equivalent)

5.9.2 Fused silica, 15 m x 0.32 mm ID, 1 um film thickness, 14% cyanopropylphenyl bonded phase (J&W DB-1701 or equivalent)

5.9.3 Both columns are installed in the same injection port using a two-hole graphite ferrule.

5.10 Two Hewlett-Packard 5880A GC terminals or equivalent.

5.11 Injections are made with a Hewlett-Packard 7673A autosampler or equivalent. The autosampler is programmed to be rinsed in carbon disulfide between injections.

6. Reagents

6.1 Carbon disulfide - chromatographic grade

6.2 Stock standard solutions

6.2.1 Prepare approximately 50,000 ug/mL standards by adding 500 uL of each analyte to 10 mL volumetric flasks partially filled with carbon disulfide. Fill the volumetric flasks to the mark and invert three for proper mixing. Correct concentration for density and purity.

6.2.2 Transfer the stock standard solutions to Teflon-sealed screw-cap bottles. Store with minimal headspace at -10 to -20°C and protect from light. All standards must be replaced after one month or sooner if comparison with check standards indicates a problem.

6.3 Secondary dilution standards - Using stock solutions, prepare secondary dilution standards in carbon disulfide that contain the compounds of interest, either singly or mixed together, plus the surrogate standard. The secondary dilution standards should be prepared at the following concentrations: 1000, 5000, and 10,000 ug/mL.

6.4 Internal standard solution - Prepare a 5000 ug/mL solution of bromofluorobenzene in carbon disulfide as described in Section 6.2. The addition of 10 uL of this solution to 1 mL of sample or standard is equivalent to 50 ug/mL.

6.5 Surrogate standard spiking solution - Prepare a 5000 ug/mL solution of decane in carbon disulfide. The addition of 10 uL of this solution to charcoal with desorption 1 mL of carbon disulfide is equivalent to 50 ug/mL.

6.6 Quality control check sample - Prepare a QC check sample at a concentration of 10,000 ug/mL for each analyte of interest (see 1.1). The addition of 5 uL of this solution to charcoal followed by desorption with 1 mL of carbon disulfide is equivalent to 50 ug/mL. The QC check sample concentrates must be prepared by the laboratory using standards prepared independently from those used for calibration.

6.7 Matrix Spiking Solution - Prepare a matrix spiking solution at a concentration of 5,000 ug/mL for each analyte of interest. The addition of 10 uL of this solution to charcoal followed by desorption with 1 mL of carbon disulfide is equivalent to 50 ug/mL. The matrix spiking solution concentrates must be prepared by the laboratory using standards prepared independently from those used for calibration.

7. Calibration

7.1 Establish the following gas chromatographic operating conditions:

Initial column temperature - 40°C,
hold for 5 minutes,
ramp at 20°C/minute to 220°C,
carrier gas-helium at 3 mLs/min. split ratio - 1:5
Detectors - dual flame ionization at 250°C
Injector temperature-250°C

7.2 Internal Standard Calibration Procedure

7.2.1 Prepare calibration standards so that the addition of 5-10 uL of the standard solution to charcoal and desorption with 1 mL of carbon disulfide spans the expected range of sample concentrations (5,10, 50, 100, and 500 ug/mL) for each compound of interest plus the surrogate spike compound. After desorption, add 10 uL of bromofluorobenzene (I.S.). The internal standard concentration is 50 ug/mL in the desorbed standard.

7.2.2 Inject 1.0 uL into the GC system, analyze according to Section 7.1 and tabulate peak area against concentration for each compound and internal standard. Calculate response factors for each compound using Equation 1.

Equation 1

$$RF = \frac{(A_S)(C_{IS})}{(A_{IS})(C_S)}$$

where:

A_S = area for the parameter of interest

A_{IS} = area for the internal standard

C_S = concentration of the parameter of interest (ug/mL)

C_{IS} = concentration of the internal standard (ug/mL)

If the RF value over the working range is a constant (<30% RSD), the RF can be assumed to be invariant and the average RF can be used for calculations. The RF corrects for desorption efficiency for each compound of interest.

7.3 The working calibration curve (or RF) must be verified on each working day by the measurement of a 50 ug/mL calibration standard. Calculate the % difference for each compound using Equation 2.

Equation 2

$$\% D = \frac{RF_{IC} - RF_C}{RF_{IC}} \times 100$$

where:

RF_{IC} = response factor from the initial calibration
RF_C = current response factor

If the %D for any parameter is greater than ±25%, a new calibration curve must be prepared.

8. Quality Control

8.1 Before processing any samples, the analyst must analyze a laboratory reagent blank (carbon disulfide) to demonstrate that interferences from the analytical system are under control. Each time a set of samples is desorbed, a laboratory reagent blank must be processed. The reagent blank must contain less than or equal to the MDL of any analyte of interest.

8.2 Before processing any samples, the analyst must analyze a charcoal tube from the same lot as the sample tubes for a method blank to demonstrate that interferences from the analytical system are under control. Each time a set of samples is desorbed, a method blank must be processed. The method blank must contain less than or equal to the MDL of any analyte of interest.

8.3 The laboratory must spike a minimum of 10% of all samples with the analytes of interest (see 1.1). The addition of 10 uL of the matrix spiking solution to charcoal followed by desorption with 1 mL of carbon disulfide is equivalent to 50 ug/mL for each analyte of interest.

8.4 The laboratory must daily demonstrate that the operation of the measurement system is in control by analyzing a quality control sample at the 50 ug/mL level.

8.5 The surrogate spike recoveries, the matrix spike recoveries, and the quality control sample recoveries must agree within ±25% of the true values.

9. Sampling (See Section 6.2 of Part I)

9.1 Technique

9.1.1 Immediately before sampling, break the ends of the tube to provide an opening at least one-half the internal diameter of the tube (2 mm).

9.1.2 The smaller section of charcoal is used as a backup and should be positioned nearest the sampling pump.

9.1.3 Connect two charcoal tubes in series in order to distinguish breakthrough from migration.

9.1.4 Do not exceed the recommended air volume.

9.1.5 The charcoal tubes should be capped with the supplied plastic caps immediately after sampling. Under no circumstances should rubber caps be used.

9.1.6 One tube should be handled in the same manner as the sample tube (break, seal and transport) except that no air is sampled through this tube. This tube should be labeled as a travel blank and be treated as a regular sample. Results for travel blanks will be submitted with samples.

9.1.7 Label as primary and secondary tube.

9.2 All samples must be iced or refrigerated at 4°C from the time of collection until desorption.

9.3 All samples must be analyzed within 14 days of collection.

10. Sample Desorption

10.1 The status of the seals on each charcoal tube is noted and recorded as intact, broken, or none.

10.2 The field identification number and the laboratory identification number on each sample seal are checked with those on the sample identification sheets.

10.3 Remove front and back charcoal sections from each primary tube and place in separate sample vials.

10.4 Add 10 uL of surrogate spiking solution to each sample, blank or standard.

10.5 One milliliter of the desorbing solvent is dispensed into each sample vial. The vial is immediately sealed. Each vial is swirled for 20 minutes to aid the desorption process.

11. Gas Chromatography

11.1 Section 7.1 summarizes the recommended operating conditions for the gas chromatograph. Table 1 contains retention times from the two capillary columns.

11.2 Calibrate the system daily as described in Section 7.

11.3 The internal standard must be added to the sample extract and mixed thoroughly immediately before injection into the gas chromatograph.

11.4 Inject 1 uL of the sample extract or standard into the gas chromatograph. Record the volume injected, the total extract volume, and the resulting peak size in area or peak height units.

11.5 Identify the parameters in the sample by comparing the retention times of the peaks in the sample chromatogram with the peaks in the standard chromatograms. The width of the retention time window used to make identifications is the mean retention time window from the initial calibration ± three standard deviations. Daily adjustments to the retention time window will be made based on the retention time of the daily calibration standard ± three standard deviations as determined during initial calibration.

11.6 If the response for a peak exceeds the working range of the system for any compound of interest, dilute the extract and reanalyze.

11.7 If there are other non-target peaks present with responses greater than 10% of the internal standard, tentatively identify using retention time indexes.

12. Calculations

12.1 Determine the concentration of individual compounds in the front and back sections of the charcoal tube.

12.2 Calculate the concentration in air by the following equation:

$$\text{Concentration (mg/cubic meter)} = \frac{(A_S)\,(C_{IS})}{(A_{IS})\,(RF)}\ \frac{X\ 1ML}{V}$$

$$X\ 0.001\ \text{mg/ug}\ X 1000\text{L/cubic meter}$$

where: A_S = area for the parameter of interest

A_{IS} = area for the internal standard

C_{IS} = concentration of the internal standard (ug/ml)

RF = average response factor for the parameter of interest

V = air volume sampled, in liters

1ML = volume of desorption solvent

$$\text{Concentration (ppm in air)} = \text{Concentration (mg/cubic meter)}\ \frac{\text{X}\ 24.45\ \text{X}\ 760\ \text{X}\ (T + 273)}{\text{MW}\ \ \text{X}\ \ P\ \ \text{X}\ \ 298}$$

where: MW = molecular weight of the parameter of interest

P = pressure (mm Hg) of air sample

T = temperature (°C) of air sample

760 = standard pressure (mm Hg)

298 = standard temperature (°K)

24.45 = molar volume (liter/mole) at 25°C and 760 mm Hg.

12.3 If the back section of the charcoal tube contains compounds of interest at greater than 25% of the front section, the second tube must also be analyzed.

12.4 Calculate the concentrations in air of non-target peaks by setting the response factor for the non-target peak equal to the response factor for the internal standard, use a MW equal to 100, and assume the desorption efficiency equals 100%.

13. References

13.1 "NIOSH Manual of Analytical Method," ed. 2 Vol. 1-4, National Institute of Occupational Safety and Health, U.S. Government Printing Office, Washington, D.C. (1977-78).

13.2 "NIOSH Manual of Analytical Method," ed. 3 Vol. 1-2, U.S. Department of Health and Human Services, U.S. Government Printing Office, Washington, D.C. Publication No. 84-100, 1984.

13.3 "Statement of Work for Organic Analysis", USEPA, 10/86, Rev: 7/87.

13.4 Code of Federal Regulations, 40 CFR 136, Appendix A, July 1, 1987.

TABLE 1

Target Compounds

Parameter	Column 1	Column 2	Estimated MDL (1) (ppm in air)
Dichlorodifluoromethane	0.84	0.78	0.02
1,1-Dichloroethene	1.20	*	0.02
cis-1,2-Dichloroethene	1.93	1,84	0.03
trans-1,2-Dichloroethene	1.93	1.47	0.03
Tetrachloroethene	6.45	6.11	0.01
Tetrahydrofuran	1.47	1.41	0.04
Trichloroethene	3.34	3.26	0.02
Toluene	5.60	3.40	0.03
Xylenes (total)	8.08	7.61	0.02
	8.40	7.98	----
Bromofluorobenzene (IS)	8.38	*	----
Decane (SS)	9.30	*	----

Non-Target Compounds

Parameter	Column 1	Column 2	Estimated MDL (1) (ppm in air)
Methylene chloride	1.20	*	0.03
1,1,1-Trichloroethane	2.30	2.39	0.02
Ethyl benzene	6.77	7.63	0.02
Methyl ethyl ketone	2.27	1.71	0.23
Cumene	7.53	8.43	0.02
Chlorobenzene	7.19	7.49	0.02
1,1,2,2-Tetrachloroethane	8.23	9.14	0.01
Benzene	2.55	2.68	0.03
Methyl isobutyl ketone	4.35	5.84	0.03

* To be determined

Column 1 - DB-5

Column 2 - DB-1701

(1) Estimates based on a sample size of 10 L.

IS = Internal Standard

SS = Surrogate Spike

APPENDIX B

TABLE OF CONTENTS

The Determination of Volatile Organic Compounds in Water
By Gas Chromatography/PID/HECD

TABLE OF CONTENTS (Continued)

The Determination of Volatile Organic Compounds in Water By Gas Chromatography/PID/HECD

The Determination of Volatile Organic Compounds in Water By Gas Chromatography/HECD

I. SUMMARY

A. Analytes

This method covers the determination of a number of volatile organics. The following parameters may be determined by this method:

PARAMETER	STORET NUMBER	CAS NUMBER
DICHLORODIFLUOROMETHANE	34668	75-71-8
TRICHLOROFLUOROMETHANE	34488	75-69-4
TETRAHYDROFURAN	-	109-99-9

B. Matrix

This is a purge and trap gas chromatographic/Photo-ionization detector/Hall Electrolytic Conductivity detector method applicable to the determination of the compounds listed above in ground water, surface water and drinking water.

C. Other Purgeable Organics

These can also be determined by this method (see 40 CFR Part 136, Appendix A).

D. General Method

An inert gas is bubbled through a 5-mL water sample contained in a specially-designed purging chamber at ambient temperature. The purgeables are efficiently transferred from the aqueous phase to the vapor phase. The vapor is swept through a sorbent trap where the purgeables are trapped. After purging is complete, the trap is heated and backflushed with the inert gas to desorb the purgeables onto a gas chromatographic column. The gas chromatograph is temperature programmed to separate the purgeables which are then detected with a photo-ionization detector and then a halide-specific detector (connected in series). This method is based on EPA Method 601.

II. INTERFERENCES, ANALYSIS RATE, AND SAFETY

A. Interferences

1. Impurities in the purge gas, organic compounds outgassing from the plumbing ahead of the trap, and solvent vapors in the laboratory account for the majority of contamination problems. The analytical system must be demonstrated to be free from contamination under the conditions of the analysis by running laboratory reagent blanks.

2. Samples can be contaminated by diffusion of volatile organics (particularly fluorocarbons and methylene chloride) through the septum seal into the sample during shipment and storage. A field reagent blank prepared from reagent water and carried through the sampling and handling protocol can serve as a check on such contamination.

3. Contamination by carry-over can occur whenever high level and low level samples are sequentially analyzed. To reduce carry-over, the purging device and sample syringe must be rinsed with reagent water between sample analyses. Whenever an unusually concentrated sample is encountered, it should be followed by an analysis of reagent water to check for cross contamination. For samples containing large amounts of water-soluble materials, suspended solids, high boiling compounds or high purgeable levels, it may be necessary to wash the purging device with a detergent solution, rinse it with distilled water, and then dry it in a 105° oven between analyses. The trap and other parts of the system are also subject to contamination, therefore, frequent bakeout and purging of the entire system may be required.

B. Analysis Rate

On a day when it is necessary to run an initial calibration curve, it would be possible to analyze approximately 10-12 samples in a 24 hour period. It would take about 7 hours to construct the calibration curve.

If it is not necessary to construct an initial calibration curve it would be possible to run an additional 7 samples in a 24 hour period bringing the total to 17 to 19.

C. Safety Information

The toxicity or carcinogenicity of each reagent used in this method has not been precisely defined; however, each chemical compound should be treated as a potential health hazard. From this viewpoint, exposure to these chemicals must be reduced to the lowest possible level by whatever means available. The laboratory is responsible for maintaining a current awareness file of OSHA regulations regarding the safe handling of the chemicals specified in this method. A reference file of material data handling sheets should also be made available to all personnel involved in the chemical analysis. Additional references to laboratory safety are available and have been identified for the information of the analyst.

The following parameters have been tentatively classified as known or suspected, human or mammalian carcinogens: carbon tetrachloride, chloroform, 1,4-dichlorobenzene, and vinyl chloride. Primary standards of these toxic compounds should be prepared in a hood. A NIOSH/MESA approved toxic gas respirator should be worn when the analyst handles high concentrations of these toxic compounds.

III. APPARATUS AND CHEMICALS

A. Glassware/Hardware

1. Vial--40-mL capacity, equipped with a screw cap with a hole in the center. Detergent wash, rinse with tap and distilled water, and dry at 105°C before use.

2. Septum-Teflon-faced silicone. Detergent wash, rinse with tap and distilled water, and dry at 105° for 1 hr. before use.

3. Syringes--5-mL, glass hypodermic with Luerlok end.

4. Micro syringes--10-uL, 25-uL, 100-uL, 0.006 in. ID needle.

5. Syringe valve--2-way, with Luer ends.

6. Vial--15-mL, crimp-cap, with Teflon cap liner.

7. Balance--Analytical, capable of accurately weighing 0.0001g.

8. 10 mL and 100 mL volumetric flasks - class A, with ground glass stoppers.

B. Instrumentation/Operating Conditions

1. A purge and trap autosampler manufactured by Tekmar (LSC-II with ALS autosampler) is used to purge the samples. The autosampler has 10 sparge vessels that accept 5 mL samples for purging. The trapping system consists of a 25 cm long 1/8" O.D. stainless tube packed with 8 cm of activated charcoal, 8 cm of silica gel, 8 cm of TENAX, and 1 cm of 3% OV-1. This trap can be rapidly heated to 180°C and desorbed via a six port valve onto the GC analytical column for analysis.

The operating conditions are:

a. Purge for 11 minutes with helium at a flow of 40 mL/min.

b. Desorb for 4 minutes at 180°C.

c. Bake the traps for 32 minutes at 180°C.

2. A gas chromatograph manufactured by Hewlett-Packard (Model 5880A) or Tracor (Model 540) is utilized. This gas chromatograph is temperature programmable and can utilize packed or capillary columns.

The operating conditions for the 1% SP-1000 packed column are:

a. Helium carrier gas at 40 mL/minute.

b. The oven temperature program is 45°C for 3 minutes then 8°C/minute to 220°C; hold for 24 minutes.

c. Injector temperature is 250°C.

The operating conditions for the N-octane confirmation column are:

d. Helium carrier gas at 40 mL/minute.

e. The oven temperature program is 45°C for 3 minutes then 6°C/minute to 130°C; hold for 20 minutes.

f. Injector temperature is 250°C.

3. Columns

   a. 1/8" x 8'-stainless steel column packed with 1% SP-1000 on carbopack B.

   b. 1/8" x 6'-stainless steel column packed with N-octane on porisil C are utilized.

4. Detectors

   a. Photo-ionization detector (hNU, Inc. Model 52 or Tracor Model 703) operated under the following conditions:

      1. Detector temperature is 250°C

      2. Detector Lamp is 10.2 EV

      3. Lamp intensity setting is 1.

   b. Hall 700A Electrolytic Conductivity detector operated under the following conditions:

      1. Detector temperature is 250°C.

      2. Reactor temperature is 850°C.

      3. Solvent flow of n-propanol is 0.5 mL/minute.

      4. Hydrogen flow is 30 mL/minute.

      5. Electrometer range setting is 100.

5. Data system - A Hewlett-Packard 5880A series GC terminal with Level Four capability or a Nelson Analytical Data System based on IBM-compatible software.

6. The retention times for the analytes of interest (using the operational conditions specified) and the method detection limits are:

Analyte	1% SP-1000	N-Octane	MDL (ug/L)
Dichlorodifluoromethane	3.24	1.17	1.5
Trichlorofluoromethane	8.53	2.91	0.4
Tetrahydrofuran	10.49	7.11	15
Bromochloromethane (I.S.)	9.47	9.93	-
a,a,a-Trifluorotoluene (I.S.)	23.03	14.15	-

7. The method detection limit (MDL) is defined as the minimum concentration of a substance that can be measured and reported with 99% confidence that the value is above zero[G]. The MDL concentration listed were obtained using reagent water. The MDL actually achieved in a given analysis will vary depending on instrument sensitivity and matrix effects.

C. Reagents and SARM's

1. **Reagent water --** Reagent water is defined as a water in which an interferent is not observed at or above the MDL of the parameters of interest.

   Reagent water is generated by passing de-ionized water through a carbon filter bed containing about 1 lb. of activated carbon (Filtrasorb-300, Calgon Corp., or equivalent). Reagent water should meet the following criteria to qualify as ASTM Type II water:

Grade of Water	Maximum Total Matter (mg/L)	Maximum Electrical Conductivity at 25C (umho/cm)	Maximum Electrical Resistivity at 25C (m cm)	Maximum Color Retention Time of KM_nO_4 (min.)
Type II	0.1	1.0	1.0	60

2. Sodium thiosulfate--(ACS) Granular. Baker Chemical.

3. Trap materials:

   a. 2,6-Diphenylene oxide polymer--Tenax, (60/80 mesh), chromatographic grade. Supelco, Inc.

   b. Methyl silicone packing--3% OV-1 on Chromosorb-W (60-80 mesh). Supelco, Inc.

   c. Silica gel--35/60 mesh, Davison, grade-15. Supelco, Inc.

   d. Coconut charcoal -- 6/10 mesh seived to 26 mesh. Supelco, Inc.

4. Methanol--Pesticide quality. Burdick & Jackson.

5. Standard Reference Materials

Compound	Source	Purity
Dichlorodifluoromethane	Alpha Gaz	99.0%
Trichlorofluoromethane	Chem Serv	99+%
Tetrahydrofuran	Burdick & Jackson	>99.9%
Bromochloromethane (I.S.)	Aldrich Chemical	99%
a,a,a-Trifluorotoluene (I.S.)	Chem Serv	98%

6. All off-the-shelf materials will be positively identified by mass spectrometry and will have their purities estimated by gas chromatography/flame ionization detection.

IV. CALIBRATION

A. Initial Calibration

1. Preparation of Standards
    a. Stock standard solutions - Stock standard solutions may be prepared from pure standard materials or purchased as certified solutions. Prepare stock standard solutions in methanol using assayed liquids or gases as appropriate. Because of the toxicity of some of the organohalides, primary dilutions of these materials should be prepared in a hood. A NIOSH/MESA approved toxic gas respirator should be used when the analyst handles high concentrations of such materials.

        1. Place about 9.8 mL of methanol into a 10-mL ground glass stoppered volumetric flask. Allow the flask to stand, unstoppered, for about 10 min. or until all alcohol wetted surfaces have dried. Weigh the flask to the nearest 0.1 mg.

        2. Add the assayed reference material:

            a. Liquid - Using a 100 uL syringe, immediately add two or more drops of assayed reference material to the flask, then reweigh. Be sure that the drops fall directly into the alcohol without contacting the neck of the flask.

b. Gases - To prepare standards for any of the six halocarbons that boil below 30° C (bromomethane, chloroethane, chloromethane, dichlorodifluoromethane, trichlorofluoromethane, vinyl chloride), fill a 5-mL valved gas-tight syringe with the reference standard to the 5.0-mL mark. Lower the needle to 5 mm above the methanol meniscus. Slowly introduce the reference standard above the surface of the liquid (the heavy gas will rapidly dissolve into the methanol).

3. Reweigh, dilute to volume, stopper, then mix by inverting the flask several times. Calculate the concentration in ug/uL from the net gain in weight. When compound purity is assayed to be 96% or greater, the weight can be used without correction to calculate the concentration of the stock standard. Commercially prepared stock standards can be used at any concentration if they are certified by the manufacturer or by an independent source.

4. Store standards at -10°C in septum capped bottles, the stock standards must be replaced each month. Diluted solutions must be replaced each week.

5. All standards prepared for use throughout the laboratory are assigned a code number. The standard code number is entered in the standard notebook with

b. Gases - To prepare standards for any of the six halocarbons that boil below 30° C (bromomethane, chloroethane, chloromethane, dichlorodifluoromethane, trichlorofluoromethane, vinyl chloride), fill a 5-mL valved gas-tight syringe with the reference standard to the 5.0-mL mark. Lower the needle to 5 mm above the methanol meniscus. Slowly introduce the reference standard above the surface of the liquid (the heavy gas will rapidly dissolve into the methanol).

3. Reweigh, dilute to volume, stopper, then mix by inverting the flask several times. Calculate the concentration in ug/uL from the net gain in weight. When compound purity is assayed to be 96% or greater, the weight can be used without correction to calculate the concentration of the stock standard. Commercially prepared stock standards can be used at any concentration if they are certified by the manufacturer or by an independent source.

4. Store standards at -10°C in septum capped bottles, the stock standards must be replaced each month. Diluted solutions must be replaced each week.

5. All standards prepared for use throughout the laboratory are assigned a code number. The standard code number is entered in the standard notebook with

all information regarding the preparation of that standard, i.e., date, analyst, name of each compound and amount used, final volume, solvent used and date disposed. All standard containers are labeled with the standard's code, date and analyst's initials.

6. The instrument response obtained for each compound in a newly prepared standard is compared to the response obtained from the previously prepared standard before they are used in the method.

2. Instrument Calibration

a. Using the stock standards, prepare two calibration standards (one for the compounds of interest and one for the internal standards) at the following levels:

Compound	Concentration Level in Methanol (ug/mL)
Dichlorodifluoromethane	10
Trichlorofluoromethane	10
Tetrahydrofuran	100
Bromochloromethane (I.S.)	5
a,a,a-Trifluorotoluene (I.S.)	10

b. Prepare a three-point calibration curve by adding 2.0, 10, and 20 uL of calibration standard to 5.0 mL of reagent water. This is equivalent to 4.0, 20, and 40 ug/L of dichlorodifluoromethane and trichlorofluoromethane, and 40, 200, and 400 ug/L of tetrahydrofuran.

c. 10 uL of internal standard spiking solution is added to each 5.0 mL of calibration standard. This is equivalent to 10 ug/L of bromochloromethane and 20 ug/L of a,a,a-trifluorotoluene.

Calculations are performed by the Internal Standard procedure. The response of bromochloromethane is used to quantify dichlorodifluoromethane and trichlorofluoromethane and the response of trifluorotoluene is used to quantify tetrahydrofuran. Equations for performing the Internal Standard procedure are provided in Section VIII. Calculations.

3. The Analysis of Calibration Data

If samples are analyzed on the same day that Initial Calibration is performed, a mid-level calibration check standard must be analyzed after sample analyses are complete. The calibration check standard must be prepared by the laboratory using stock standards prepared independently from those used for calibration. The response must agree within ± 25% of the mean response as determined from the Initial Calibration. After seven calibrations the response must agree within +/- two standard deviations. If the response fails, the mid-level standard should be reanalyzed. If the standard fails a second time all samples analyzed since the last satisfactory calibration should be reanalyzed after repeating the Initial Calibration.

B. Daily Calibration

1. Preparative standards

   Standards are prepared as in section IV.A.1.

2. Instrument Calibration

   The daily calibration curve as established in section IV.A.2. is utilized.

   The working calibration curve or RF must be verified on each working day by the measurement of a QC check sample at the midpoint of the calibration curve. The response must be within ± 25%.

3. Analysis of Calibration Data

   Calibration standards shall be analyzed each day to verify that instrument response has not changed from previous calibration. Before sample analysis each day, the mid-level standard shall be analyzed. The response must fall within ± 25% of the mean response from prior Initial/Daily Calibrations. If the response fails this test, the daily standard shall be reanalyzed. If the response from the second analysis is not within ± 25% of the mean response from prior Initial/Daily Calibrations, Initial Calibration must be performed before analyzing samples.

   After sample analyses are completed each day, the mid-level standard shall be analyzed again. The response must again meet the criteria outlined above. If, after two tries the mid-level check standard still does not fall within ± 25% of the mean response, the system is considered to have failed. Initial Calibration must be performed and all samples analyzed since the last acceptable calibration must be reanalyzed.

V. SAMPLE HANDLING STORAGE

A. Sampling Procedure

1. All water samples must be iced or refrigerated at 4°C from the time of collection until analysis. If the sample contains residual chlorine, add sodium thiosulfate preservative (10 mg/40 mL is sufficient for up to 5 ppm Cl_2). EPA Methods 330.4 and 330.5 may be used for measurement of residual chlorine. Field test kits can be used for this purpose.

2. Grab samples must be collected in glass containers having a total volume of at least 25 mL. Fill the sample bottle just to overflowing in such a manner that no air bubbles pass through the sample as the bottle is being filled. Seal the bottle so that no air bubbles are entrapped. If preservative has been added, shake vigorously for 1 minute. Maintain the hermetic seal on the sample bottle until time of analysis.

B. Containers

o **40-ml Vials**

a) Scrub and wash bottles in detergent.
b) Rinse with copious amounts of distilled water.
3) Rinse with acetone.
4) Rinse with methylene chloride (Nanograde or equivalent).
5) Rinse with hexane (Nanograde or equivalent).
6) Air dry.
7) Heat to 200°C.
8) Allow to cool.
9) Cap with clean caps with Teflon liners.

- **Bottle Caps**
  1) Remove paper liners from caps.
  2) Wash with detergent.
  3) Rinse with distilled water.
  4) Dry at 40°C.

- **Teflon Liners (avoid contact with fingers)**
  1) Wash with detergent.
  2) Rinse with distilled water.
  3) Rinse with acetone.
  4) Rinse with hexane (Nanograde or equivalent).
  5) Air day.
  6) Place liners in cleaned caps.
  7) Heat to 40°C for 2 hours.
  8) Allow to cool.
  9) Use to cap cleaned bottles.

C. Storage Conditions

Store samples at 4°C until analysis.

D. Holding time limits.

All samples must be analyzed within 14 days of collection.

E. Solution Verification

Whenever new stock solutions are prepared, the response is verified versus the old standards and must be within ± 25 percent. New stock solutions are typically prepared every two months.

VI. Procedure

A. Separations

Section III.B.2. summarizes the gas chromatograph operating conditions. Section III.B.6. shows the approximate retention times on a 1% SP1000 column under these conditions.

B. Instrumental Analysis

1. Calibrate the system daily as described in Section IV.B.

2. Adjust the purge gas (helium) flow rate to 40 mL/min. Attach the trap inlet to the purging device, and set the purge and trap system to purge. Open the syringe valve located on the purging device sample introduction needle.

3. Allow the sample to come to ambient temperature prior to introducing it to the syringe. Remove the plunger from a 5-mL syringe and attach a closed syringe valve. Open the sample bottle and carefully pour the sample into the syringe barrel to just short of overflowing. Replace the syringe plunger and compress the sample. Open the syringe valve and vent any residual air while adjusting the sample volume to 5.0 mL. Since this process of taking an aliquot destroys the validity of the sample for future analysis, the analyst should fill a second syringe at this time to protect against possible loss of data. Add 10.0 uL of the internal standard spiking solution through the valve bore, then close the valve.

4. Attach the syringe-syringe valve assembly to the syringe valve on the purging device. Open the syringe valves and inject the sample into the purging chamber.

5. Close both valves and purge the sample for 11.0 ± 0.1 min. at ambient temperature.

6. After the 11-min. purge time, attach the trap to the chromatograph, adjust the purge and trap system to the desorb mode and begin to temperature program the gas chromatograph. Introduce the trapped materials to the GC column by rapidly heating the trap to 180°C while backflushing the trap with an inert gas between 20 and 60 mL/min. for 4 min.

7. While the trap is being desorbed into the gas chromatograph, empty the purging chamber using the sample introduction syringe. Wash the chamber with two 5-mL flushes of reagent water.

8. After desorbing the sample for 4 min., recondition the trap by returning the purge and trap system to the purge mode. The trap temperature should be maintained at 180°C. After approximately 7 min. turn off the trap heater and open the syringe valve to stop the gas flow through the trap. When the trap is cool, the next sample can be analyzed.

9. Identify the parameters in the sample by comparing the retention times of the peaks in the sample chromatogram with those of the peaks in standard chromatograms. The width of the retention time window used to make identifications is the mean absolute retention time window from certification +/- three standard deviations. Daily adjustments to the retention time window will be made based on the retention time of the daily calibration standard +/- three standard deviations as determinations during certification.

10. If the response for a peak exceeds the working range of the system, prepare a dilution of the sample with reagent water from the aliquot in the second syringe and reanalyze.

VII. Calculations

A. To determine the concentration of individual compounds in the sample, use the internal standard calibration procedure. Tabulate peak area responses against concentration for each compound and the internal standard, and calculate response factors (RF) for each compound using Equations 1 and 2.

Equation 1

$$\mathrm{RF} = \frac{(\mathrm{As})(\mathrm{Cis})}{(\mathrm{Ais})(\mathrm{Cs})}$$

where:

As = Response for the parameter to be measured.
Ais = Response for the internal standard.
Cis = Concentration of the internal standard (ug/L).
Cs = Concentration of the parameter to be measured (ug/L).

Equation 2

$$\text{Concentration (ug/L)} = \frac{(\mathrm{As})(\mathrm{Cis})}{(\mathrm{Ais})(\mathrm{RF})}$$

where:

As = Response for the parameter to be measured.
Ais = Response for the internal standard.
Cis = Concentration of the internal standard (ug/L).

B. Report results in ug/L without correction for recovery data. All QC data obtained should be reported with the sample results.

VIII. DAILY QUALITY CONTROL

A. Control Samples

1. The following types of QC samples shall be included in each analytical lot:

   a. Each 12-hour shift, a reagent water method blank must be analyzed to verify that the laboratory is not a source of sample contamination.

   b. The laboratory must spike 10% of all samples in duplicate with control analytes at the midpoint level of the calibration curve to verify performance (accuracy and precision).

2. Spiking stock solutions are prepared separately from the calibration stock solutions. The same standard reference materials outlined in Section III.C.5. are used.

3. Using the spiking stock solutions, prepare a working matrix spike at the following levels:

Compound	Concentration Level in Methanol (ug/ml)
Dichlorodifluoromethane	10
Trichlorofluoromethane	10
Tetrahydrofuran	100

4. Analyze one 5-ml sample aliquot to determine the background concentration (B) of each parameter. Spike a second 5-mL aliquot with 10 uL of the working matrix spike solution and analyze it to determine the concentration after spiking (A) of

each parameter. Calculate each percent recovery (%R) as 100 (A-B)%/T where T is the true value of the spike. Compare the percent recovery (%R) for each parameter with the corresponding acceptance criteria found in Table 1.

5. If any individual %R falls outside the range for recovery, that parameter has failed the acceptance criteria. A QC check standard containing each parameter that failed must be prepared and analyzed.
    a. Prepare the QC check standard by adding 10 uL of QC check sample concentrate (Section VIII.A.3.) to 5 mL of reagent water. The QC check standard needs only to contain the parameters that failed criteria in the test in Section VIII.A.4.
    b. Analyze the QC check standard to determine the concentration measured (A) of each parameter. Calculate each percent recovery as 100 (A/T)%, where T is the true value of the standard concentration.
    c. Compare the percent recovery (%R) for each parameter with the corresponding QC acceptance criteria found in Table 1. Only parameters that failed the test need to be compared with these criteria. If the recovery of any such parameter falls outside the designated range, the laboratory performance for that parameter is judged to be out of control, and the problem must be immediately identified and corrected. The analytical result for that parameter in the unspiked sample is suspect and may not be reported for regulatory compliance purposes.

6. Repeat the analysis for the matrix spike duplicate. The corresponding acceptance criteria for percent recovery (%R) must

be met and the relative percent difference between duplicate data must be less than 30%. To calculate the relative percent difference, use the following formula:

$$\%D = \frac{A_1 - A_2}{(A_1 + A_2)/2} \times 100\%$$

7. Field duplicates may be analyzed to assess the precision of the environmental measurement.

B. Control Charts

As part of the QC program for this project, Shewhart control charts will be generated for accuracy and precision.

TABLE 1 - QC Acceptance Criteria

Parameter	Range for %R
Dichlorodifluoromethane	42-142
Trichlorofluoromethane	78-124
Tetrahydrofuran	64-140

IX. REFERENCES

A. "Determination of Volatile Organics in Water by Purge and Trap Method," Method 465-B, Minnesota Department of Health

B. Federal Register, Vol. 44, No. 231, Thursday, Nov. 29, 1979

C. Federal Register, Vol. 44, No. 233, Monday, December 3, 1979

D. "The Determination of Halogenated Chemicals in Water By The Purge and Trap Method," Method 502.1, EPA #600/4-81-059

E. Federal Register, Vol. 49, No. 209, Friday, Oct. 26, 1984

F. USATHAMA QA Program, 2nd Edition, March 1987

G. 40 CFR Part 136, Appendix B.

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The Determination of Volatile Organic Compounds in Soil By Gas Chromatography/PID/HECD

I. SCOPE AND APPLICATION

A. Analytes

This method covers the determination of a number of volatile organics. The following parameters may be determined by this method:

PARAMETER	CAS NUMBER
DICHLORODIFLUOROMETHANE	75-71-8
TRICHLOROFLUOROMETHANE	75-69-4
TETRAHYDROFURAN	109-99-9

B. Matrix

This is a purge and trap gas chromatographic/Photo-ionization detector/Hall Electrolytic Conductivity detector method applicable to the determination of the compounds listed above in soil or sediment.

C. Other Purgeable Organics

These can also be determined by this method (see SW-846, Method 8010 and 8020, September, 1986).

D. General Method

A portion of the sample is dispersed in methanol to dissolve the volatile organic constituents. A portion of the methanolic solution is combined with water in a specially designed purging chamber. It is then analyzed by purge-and-trap GC following the normal water method.

An inert gas is bubbled through a 5-mL water sample contained in a specially-designed purging chamber at ambient temperature. The purgeables are efficiently transferred from the aqueous phase to the vapor phase. The vapor is swept through a sorbent trap where the purgeables are trapped.

After purging is complete, the trap is heated and backflushed with the inert gas to desorb the purgeables onto a gas chromatographic column. The gas chromatograph is temperature programmed to separate the purgeables which are then detected with a photo-ionization detector and then a halide-specific detector (connected in series). This method is based on Method 5030, 8010 and 8020, SW-846 (Third Edition).

II. INTERFERENCES, ANALYSIS RATE, AND SAFETY

A. Interferences

1. Impurities in the purge gas, organic compounds outgassing from the plumbing ahead of the trap, and solvent vapors in the laboratory account for the majority of contamination problems. The analytical system must be demonstrated to be free from contamination under the conditions of the analysis by running laboratory reagent blanks.
2. Samples can be contaminated by diffusion of volatile organics (particularly fluorocarbons and methylene chloride) through the septum seal into the sample during shipment and storage. A field reagent blank prepared from reagent water and carried through the sampling and handling protocol can serve as a check on such contamination.
3. Contamination by carry-over can occur whenever high level and low level samples are sequentially analyzed. To reduce carry-over, the purging device and sample syringe must be rinsed with reagent water between sample analyses. Whenever an unusually concentrated sample is encountered, it should be followed by an analysis of reagent water to check for cross contamination. For samples containing large amounts of water-soluble materials, suspended solids, high boiling compounds or high purgeable levels, it may be necessary to wash the purging device with a detergent solution, rinse it with distilled water, and then dry it in a 105° oven between analyses. The trap and other parts of the system are also subject to contamination, therefore, frequent bakeout and purging of the entire system may be required.

B. Analysis Rate

On a day when it is necessary to run an initial calibration curve, it would be possible to analyze approximately 10-12 samples in a 24 hour period. It would take about 7 hours to construct the calibration curve.

If it is not necessary to construct an initial calibration curve it would be possible to run an additional 7 samples in a 24 hour period bringing the total to 17 to 19.

C. Safety Information

The toxicity or carcinogenicity of each reagent used in this method has not been precisely defined; however, each chemical compound should be treated as a potential health hazard. From this viewpoint, exposure to these chemicals must be reduced to the lowest possible level by whatever means available. The laboratory is responsible for maintaining a current awareness file of OSHA regulations regarding the safe handling of the chemicals specified in this method. A reference file of material data handling sheets should also be made available to all personnel involved in the chemical analysis. Additional references to laboratory safety are available and have been identified for the information of the analyst.

The following parameters have been tentatively classified as known or suspected, human or mammalian carcinogens: carbon tetrachloride, chloroform, 1,4-dichlorobenzene, and vinyl chloride. Primary standards of these toxic compounds should be prepared in a hood. A NIOSH/MESA approved toxic gas respirator should be worn when the analyst handles high concentrations of these toxic compounds.

III. Apparatus and Chemicals

A. Glassware/Hardware

1. Vial--40-mL capacity, equipped with a screw cap with a hole in the center. Detergent wash, rinse with tap and distilled water, and dry at 105°C before use.
2. Septum-Teflon-faced silicone. Detergent wash, rinse with tap and distilled water, and dry at 105° for 1 hr. before use.
3. Syringes--5-mL, glass hypodermic with Luerlok end.
4. Micro syringes--10-uL, 25-uL, 100-uL, 0.006 in. ID needle.
5. Syringe valve--2-way, with Luer ends.
6. Vial--15-mL, crimp-cap, with Teflon cap liner.
7. Balance--Analytical, capable of accurately weighing 0.0001g, and a top-loading balance capable of weighing 0.1 g.
8. 10 mL and 100 mL volumetric flasks - class A, with ground glass stoppers.
9. Vials--2 mL, for GC autosampler.
10. Spatula--stainless steel.

B. Instrumentation/Operating Conditions

1. A purge and trap autosampler manufactured by Tekmar (LSC-II with ALS autosampler) is used to purge the samples. The autosampler has 10 sparge vessels that accept 5 mL samples for purging. The trapping system consists of a 25 cm long 1/8" O.D. stainless tube packed with 8 cm of activated charcoal, 8 cm of silica gel, 8 cm of TENAX, and 1 cm of 3% OV-1. This trap can be rapidly heated to 180°C and desorbed via a six port valve onto the GC analytical column for analysis.

   The operating conditions are:
   a. Purge for 11 minutes with helium at a flow of 40 mL/min.
   b. Desorb for 4 minutes at 180°C.
   c. Bake the traps for 32 minutes at 180°C.
2. A gas chromatograph manufactured by Hewlett-Packard (Model 5880A) or Tracor (Model 540) is utilized. This gas chromatograph is temperature programmable and can utilize packed or capillary columns.

The operating conditions for the 1% SP-1000 packed column are:

a. Helium carrier gas at 40 mL/minute.

b. The oven temperature program is 45°C for 3 minutes then 8°C/minute to 220°C; hold for 24 minutes.

c. Injector temperature is 250°C.

The operating conditions for the N-octane confirmation column are:

d. Helium carrier gas at 40 mL/minute.

e. The oven temperature program is 45°C for 3 minutes then 6°C/minute to 130°C; hold for 20 minutes.

f. Injector temperature is 250°C.

3. Columns
   a. 1/8" x 8'-stainless steel column packed with 1% SP-1000 on carbopack B.
   b. 1/8" x 6'-stainless steel column packed with N-octane on porisil C are utilized.
4. Detectors
   a. Photo-ionization detector (hNU, Inc. Model 52 or Tracor Model 703) operated under the following conditions:
      1. Detector temperature is 250°C
      2. Detector Lamp is 10.2 EV
      3. Lamp intensity setting is 1.
   b. Hall 700A Electrolytic Conductivity detector operated under the following conditions:
      1. Detector temperature is 250°C.
      2. Reactor temperature is 850°C.
      3. Solvent flow of n-propanol is 0.5 mL/minute.
      4. Hydrogen flow is 30 mL/minute.
      5. Electrometer range setting is 100.
5. Data system - A Hewlett-Packard 5880A series GC terminal with Level Four capability or a Nelson Analytical Data System based on IBM-compatible software.

6. The retention times for the analytes of interest (using the operational conditions specified) and the method detection limits are:

Analyte	1% SP-1000	N-Octane	MDL (mg/kg)
Dichlorodifluoromethane	3.24	1.17	0.19
Trichlorofluoromethane	8.53	2.91	0.050
Tetrahydrofuran	10.49	7.11	1.9
Bromochloromethane (I.S.)	9.47	9.93	-
a,a,a-Trifluorotoluene (I.S.)	23.03	14.15	-

7. The Method detection limit (MDL) is define as the minimum concentration of a substance that can be measured and reported with 99% confidence that the value is above zero[H]. The MDL concentrations listed were obtained using a standard soil.

C. Reagents and SARM's

1. Reagent water -- Reagent water is defined as a water in which an interferent is not observed at or above the MDL of the parameters of interest.

Reagent water is generated by passing de-ionized water through a carbon filter bed containing about 1 lb. of activated carbon (Filtrasorb-300, Calgon Corp., or equivalent). Reagent water should meet the following criteria to qualify as ASTM Type II water:

Grade of Water	Maximum Total Matter (mg/L)	Maximum Electrical Conductivity at 25C (umho/cm)	Maximum Electrical Resistivity at 25C (m cm)	Maximum Color Retention Time of KM_nO_4 (min.)
Type II	0.1	1.0	1.0	60

2. Sodium thiosulfate--(ACS) Granular. Baker Chemical.

3. Trap materials:
    a. 2,6-Diphenylene oxide polymer--Tenax, (60/80 mesh), chromatographic grade. Supelco, Inc.
    b. Methyl silicone packing--3% OV-1 on Chromosorb-W (60-80 mesh). Supelco, Inc.
    c. Silica gel--35/60 mesh, Davison, grade-15. Supelco, Inc.
    d. Coconut charcoal -- 6/10 mesh seived to 26 mesh. Supelco, Inc.

4. Methanol--Purge and trap grade, Burdick & Jackson.

5. Standard Reference Materials

Compound	Source	Purity
Dichlorodifluoromethane	Alpha Gaz	99.0%
Trichlorofluoromethane	Chem Serv	99+%
Tetrahydrofuran	Burdick & Jackson	>99.9%
Bromochloromethane (I.S.)	Aldrich Chemical	99%
a,a,a-Trifluorotoluene (I.S.)	Chem Serv	98%

6. All off-the-shelf materials will be positively identified by mass spectrometry and will have their purities estimated by gas chromatography/flame ionization detection.

IV. Calibration

A. Initial Calibration

1. Preparation of Standards
    a. Stock standard solutions - Stock standard solutions may be prepared from pure standard materials or purchased as certified solutions. Prepare stock standard solutions in methanol using assayed liquids or gases as appropriate. Because of the toxicity of some of the organohalides, primary dilutions of these materials should be prepared in a hood. A NIOSH/MESA approved toxic gas respirator should be used when the analyst handles high concentrations of such materials.
        1. Place about 9.8 mL of methanol into a 10-mL ground glass stoppered volumetric flask. Allow the flask to stand, unstoppered, for about 10 min. or until all alcohol wetted surfaces have dried. Weigh the flask to the nearest 0.1 mg.
        2. Add the assayed reference material:
            a. Liquid - Using a 100 uL syringe, immediately add two or more drops of assayed reference material to the flask, then reweigh. Be sure that the drops fall directly into the alcohol without contacting the neck of the flask.
            b. Gases - To prepare standards for any of the six halocarbons that boil below 30° C (bromomethane, chloroethane, chloromethane, dichlorodifluoromethane, trichlorofluoromethane, vinyl chloride), fill a 5-mL valved gas-tight syringe with the reference standard to the 5.0-mL mark. Lower the needle to 5 mm above the methanol meniscus. Slowly introduce the reference standard above the surface of the liquid (the heavy gas will rapidly dissolve into the methanol).

3. Reweigh, dilute to volume, stopper, then mix by inverting the flask several times. Calculate the concentration in ug/uL from the net gain in weight. When compound purity is assayed to be 96% or greater, the weight can be used without correction to calculate the concentration of the stock standard. Commercially prepared stock standards can be used at any concentration if they are certified by the manufacturer or by an independent source.
4. Store standards at -10°C in septum capped bottles, the stock standards must be replaced each month. Diluted solutions must be replaced each week.
5. All standards prepared for use throughout the laboratory are assigned a code number. The standard code number is entered in the standard notebook with all information regarding the preparation of that standard, i.e., date, analyst, name of each compound and amount used, final volume, solvent used and date disposed. All standard containers are labeled with the standard's code, date and analyst's initials.
6. The instrument response obtained for each compound in a newly prepared standard is compared to the response obtained from the previously prepared standard.

2. Instrument Calibration

a. Using the stock standards, prepare two calibration standards (one for the compounds of interest and one for the internal standards) at the following levels:

Compound	Concentration Level in Methanol (ug/mL)
Dichlorodifluoromethane	10
Trichlorofluoromethane	10
Tetrahydrofuran	100
Bromochloromethane (I.S.)	5
a,a,a-Trifluorotoluene (I.S.)	10

b. Prepare a three-point calibration curve by adding 2.0, 10, and 20 uL of calibration standard to 5.0 mL of reagent water. This is equivalent to 0.5, 2.5, and 5.0 mg/kg of dichlorodifluoromethane and trichlorofluoromethane, and 50, 25, and 50 mg/kg of tetrahydrofuran.

c. 10 uL of internal standard spiking solution is added to each 5.0 mL of calibration standard. This is equivalent to 1.2 mg/kg of bromochloromethane and 2.5 mg/kg of a,a,a-trifluorotoluene.

Calculations are performed by the Internal Standard procedure. The response of bromochloromethane is used to quantify dichlorodifluoromethane and trichlorofluoromethane while the response of trifluorotoluene is used to quantify tetrahydrofuran. Equations for performing the Internal Standard procedure are provided in Section VIII. Calculations.

3. The Analysis of Calibration Data

If samples are analyzed on the same day that Initial Calibration is performed, a mid-level calibration check standard must be analyzed after sample analyses are complete. The calibration check standard must be prepared by the laboratory using stock standards prepared independently from those used for calibration. The response must agree within ± 25% of the mean response as determined from the Initial Calibration. After seven calibrations the response must agree within +/- two standard deviations. If the response fails, the mid-level standard should be reanalyzed. If the standard fails a second time all samples analyzed since the last satisfactory calibration should be reanalyzed after repeating the Initial Calibration.

B. Daily Calibration

1. Preparative standards
2. Instrument Calibration

   The daily calibration curve as established in section IV.A.2. is utilized.

   The working calibration curve or RF must be verified on each working day by the measurement of a QC check sample at the midpoint of the calibration curve. The response must be within ± 25%.

3. Analysis of Calibration Data

   Calibration standards shall be analyzed each day to verify that instrument response has not changed from previous calibration. Before sample analysis each day, the mid-level standard shall be analyzed. The response must fall within ± 25% of the mean response from prior Initial/Daily Calibrations. If the response fails this test, the daily standard shall be reanalyzed. If the response from the second analysis is not within ± 25% of the mean response from prior Initial/Daily Calibrations, Initial Calibration must be performed before analyzing samples.

After sample analyses are completed each day, the mid-level standard shall be analyzed again. The response must again meet the criteria outlined above. If, after two tries the mid-level check standard still does not fall within ± 25% of the mean response, the system is considered to have failed. Initial Calibration must be performed and all samples analyzed since the last acceptable calibration must be reanalyzed.

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Revision No. I
Date: July 1988
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Doc No. WPPMTHU015

V. Sample Handling Storage

A. Sampling Procedure

1. Samples are collected in the 40 ml sample bottles. Refer to Chapter Four, SW-846 (3rd Edition).

B. Containers

o 40-ml Vials

1) Scrub and wash bottles in detergent.
2) Rinse with copious amounts of distilled water.
3) Rinse with acetone.
4) Rinse with methylene chloride (Nanograde or equivalent).
5) Rinse with hexane (Nanograde or equivalent).
6) Air dry.
7) Heat to 200°C.
8) Allow to cool.
9) Cap with clean caps with Teflon liners.

o Bottle Caps

1) Remove paper liners from caps.
2) Wash with detergent.
3) Rinse with distilled water.
4) Dry at 40°C.

o Teflon Liners (avoid contact with fingers)

1) Wash with detergent.
2) Rinse with distilled water.
3) Rinse with acetone.
4) Rinse with hexane (Nanograde or equivalent).
5) Air day.
6) Place liners in cleaned caps.
7) Heat to 40°C for 2 hours.
8) Allow to cool.
9) Use to cap cleaned bottles.

C. Storage Conditions

Store samples at 4^{O}C until analysis.

D. Holding time limits.

All samples must be analyzed within 14 days of collection.

E. Solution Verification

Whenever new stock solutions are prepared, the response is verified versus the old standards and must be within ± 25 percent. New stock solutions are typically prepared every two months.

Section No. VI
Revision No. I
Date: July 1988
Page: 1 of 3
Doc No. WPPMTHU015

VI. Procedure

A. Separations

Section III.B.2. summarizes the gas chromatograph operating conditions. Section III.B.6. shows the approximate retention times on a 1% SP1000 column under these conditions.

B. Instrumental Analysis

1. Calibrate the system daily as described in Section IV.B.
2. Adjust the purge gas (helium) flow rate to 40 mL/min. Attach the trap inlet to the purging device, and set the purge and trap system to purge. Open the syringe valve located on the purging device sample introduction needle.
3. The sample (for volatile organics) consists of the entire contents of the sample container. Do not discard any supernatant liquids. Mix the contents of the sample container with a narrow metal spatula. Weigh 4g (wet weight) into a tared 15 mL vial. Use a top loading balance. Note and record the actual weight to the nearest 0.1 g. Determine the percent moisture as in B.15.
4. Quickly add 10 mL of methanol. Cap and shake for 2 minutes. NOTE: Steps 1 and 2 must be performed rapidly to avoid loss of volatile organics. These steps must be performed in a laboratory free of solvent fumes.
5. Using a disposable pipette, transfer approximately 1 mL of extract into a GC vial for storage. The remainder may be disposed of. Transfer approximately 1 mL of the reagent methanol to a GC vial for use as the method blank for each case or set of 20 samples, whichever is more frequent. These extracts may be stored in the dark at 4°C (±2°C) prior to analysis.
6. Remove the plunger from a 5 mL "Luerlock" type syringe equipped with a syringe valve and fill until overflowing with reagent

water. Replace the plunger and compress the water to vent trapped air. Adjust the volume to 4.9 mL. Pull the plunger back to 5 mL to allow volume for the addition of sample and standards. Add 10 uL of the internal standard solution. Also add 100 uL of methanol extract.

7. Attach the syringe-syringe valve assembly to the syringe valve on the purging device. Open the syringe valve and inject the water/methanol sample into the purging chamber.
8. Close both valves and purge the sample for 11.0 ± 0.1 min. at ambient temperature.
9. After the 11-min. purge time, attach the trap to the chromatograph, adjust the purge and trap system to the desorb mode and begin to temperature program the gas chromatograph. Introduce the trapped materials to the GC column by rapidly heating the trap to $180^{O}C$ while backflushing the trap with an inert gas between 20 and 60 mL/min. for 4 min.
10. While the trap is being desorbed into the gas chromatograph, empty the purging chamber using the sample introduction syringe. Wash the chamber with two 5-mL flushes of reagent water.
11. After desorbing the sample for 4 min., recondition the trap by returning the purge and trap system to the purge mode. The trap temperature should be maintained at $180^{O}C$. After approximately 7 min. turn off the trap heater and open the syringe valve to stop the gas flow through the trap. When the trap is cool, the next sample can be analyzed.
12. Identify the parameters in the sample by comparing the retention times of the peaks in the sample chromatogram with those of the peaks in standard chromatograms. The width of the retention time window used to make identifications is the mean absolute retention time window from certification +/- three standard deviations. Daily adjustments to the retention time window will be made based on the retention time of the daily calibration standard

+/- three standard deviations as determinations during certification.

13. If the response for a peak exceeds the working range of the system, prepare a dilution of the sample with reagent water from the aliquot in the second syringe and reanalyze.
14. For a matrix spike in sediment/soil samples, add 9.0 mL of methanol and 1.0 mL of matrix spike solution (see IV.A.2.). Add a 100 uL aliquot of this extract to 5 mL of water for purging.
15. To determine percent moisture, weigh 5-10 g of the soil or sediment into a tared weighing boat. Determine the percent moisture by drying overnight at 105° C. Allow to cool in a desiccator before weighing. Concentrations of individual analytes will be reported relative to the dry weight of sediment.

Percent moisture:

$$\frac{\text{g of sample} - \text{g of dry sample}}{\text{g of sample}} \times 100 = \%\ \text{moisture}$$

16. For a method blank, add 10 mL of methanol to a 15 mL vial. Cap and shake for 2 minutes. Add 100 uL of this extract to 5 mL of water for purging. If immediate analysis is not possible, transfer approximately 1 mL of extract to a GC vial, cap, and store in the dark at 4°C.

VII. Calculations

A. To determine the concentration of individual compounds in the sample, use the internal standard calibration procedure. Tabulate peak area responses against concentration for each compound and the internal standard, and calculate response factors (RF) for each compound using Equations 1 and 2.

Equation 1

$$RF = \frac{(As)(Cis)}{(Ais)(Cs)}$$

where:

As = Response for the parameter to be measured.

Ais = Response for the internal standard.

Cis = Concentration of the internal standard.

Cs = Concentration of the parameter to be measured.

Equation 2

$$\text{Concentration (ug/kg)} = \frac{(As)(Iis)(Vt)}{(Ais)(RF)(WS)(D)(Vi)}$$

where:

As = Response for the parameter to be measured.

Ais = Response for the internal standard.

Iis = Amount of the internal standard added in namograms (ng).

Ws = Weight of sample extracted (g)

$D = \frac{100 - \%\ \text{moisture}}{100}$

Vt = Volume of total extract (uL)

Vi = Volume of extract added (uL)

B. Report results in ug/kg without correction for recovery data. All QC data obtained should be reported with the sample results.

VIII. Daily Quality Control

A. Control Samples

1. The following types of QC samples shall be included in each analytical lot:
   - Method Blank, to verify that the laboratory is not a source of sample contamination; and
   - Spike 10% of all samples in duplicate with control analytes at the midpoint level of the calibration curve to verify performance (accuracy and precision).
2. A spiking stock solution is prepared separately from the calibration stock. The same standard reference materials outlined in Section III.C.5. are used.

3. Using the spiking stock solutions, prepare a working matrix spike at the following levels:

Compound	Concentration Level in Methanol (ug/ml)
Dichlorodifluoromethane	10
Trichlorofluoromethane	10
Tetrahydrofuran	100

4. Add 9.0 mL of methanol and 1.0 mL of the working matrix spiking solution to 4g of soil/sediment in a 15 mL vial. Cap and shake for 2 minutes.

5. Add a 100 uL aliquot of this extract to 5 mL of reagent water for purging.

6. Analyze a 100uL sample aliquot to determine the background concentration (B) of each parameter. Analyze a 100uL matrix spike aliquot to determine the concentration after spiking (A) of each parameter. Calculate each percent recovery (%R) as 100 (A-B)%/T where T is the true value of the spike. Compare the percent recovery (%R) for each parameter with the corresponding acceptance criteria found in Table 1.

7. If any individual %R falls outside the range for recovery, that parameter has failed the acceptance criteria. A QC check standard containing each parameter that failed must be prepared and analyzed.
    a. Prepare the QC check standard by adding 1.0 mL of QC check sample concentrate (Section VIII.A.3.) to 9.0 mL of methanol. The QC check standard needs only to contain the parameters that failed criteria in the test in Section VIII.A.4.
    b. Analyze a 100 uL aliquot of this extract to determine the concentration measured (A) of each parameter. Calculate each percent recovery as 100 (A/T)%, where T is the true value of the standard concentration.
    c. Compare the percent recovery (%R) for each parameter with the corresponding QC acceptance criteria found in Table 1. Only parameters that failed the test need to be compared with these criteria. If the recovery of any such parameter falls outside the designated range, the laboratory performance for that parameter is judged to be out of control, and the problem must be immediately identified and corrected. The analytical result for that parameter in the unspiked sample is suspect and may not be reported for regulatory compliance purposes.

8. Repeat the analysis for the matrix spike duplicate. The corresponding acceptance criteria for percent recovery (%R) must be met and the relative percent difference between duplicate data must be less than 30%. To calculate the relative percent difference, use the following formula:

$$\%D = \frac{A_1 - A_2}{(A_1 + A_2)/2} \times 100\%$$

9. Field duplicates may be analyzed to assess the precision of the environmental measurement.

B. Control Charts

As part of the QC program for this project, Shewhart control charts will be generated for accuracy and precision.

TABLE 1 - QC Acceptance Criteria

Parameter	Range for %R
Dichlorodifluoromethane	29-159
Trichlorofluoromethane	71-131
Tetrahydrofuran	45-160

IX. References

A. "Determination of Volatile Organics in Water by Purge and Trap Method," Method 465-B, Minnesota Department of Health

B. Federal Register, Vol. 44, No. 231, Thursday, Nov. 29, 1979

C. Federal Register, Vol. 44, No. 233, Monday, December 3, 1979

D. "The Determination of Halogenated Chemicals in Water By The Purge and Trap Method," Method 502.1, EPA #600/4-81-059

E. Federal Register, Vol. 49, No. 209, Friday, Oct. 26, 1984

F. USATHAMA QA Program, 2nd Edition, March 1987

G. USEPA "Test Methods for Evaluating Solid Waste - Physical/Chemical Methods" SW-846, September, 1986.

H. 40 CFR Part 136, Appendix B.

AMENDMENT TO
SAMPLING AND ANALYSIS PLAN

PART II
QUALITY ASSURANCE PROJECT PLAN
FOR ADDITIONAL RI WORK

EXPLORATORY BORINGS

STOUGHTON CITY LANDFILL
STOUGHTON, WISCONSIN
JANUARY 23, 1992

RECEIVED

JAN 24 1992

BUREAU OF SOLID
HAZARDOUS WASTE MANAGEMENT

STRAND ASSOCIATES, INC.
Consulting Engineers
910 West Wingra Drive
Madison, WI 53715

JANUARY 1992

STRAND
ASSOCIATES, INC.
ENGINEERS
910 West Wingra Drive
Madison, Wisconsin 53715
(608) 251-4843

January 23, 1992

Ms. Terese Van Donsel, Project Manager
MI/WI Section II
U. S. Environmental Protection Agency
230 South Dearborn Street
Chicago, IL 60604

Re: Stoughton, Wisconsin City Landfill Site
SAP QAPP Amendment - Exploratory Borings

Dear Ms. Van Donsel:

Enclosed for your review, as requested by your agency and the Wisconsin Department of Natural Resources, are three copies of the Amended Quality Assurance Project Plan (QAPP) for Exploratory Boring Work at the referenced site. Three additional copies are being sent directly to Ms. Robin Schmidt of the Wisconsin Department of Natural Resources.

If you or your staff have any questions concerning this document, do not hesitate to contact us.

Sincerely,

STRAND ASSOCIATES, INC.

Michael D. Doran, P.E.

040-921/MDD:ME

CC: Ms. Robin Schmidt/DNR (w/3 enc)
Mr. Robert Kardasz/City of Stoughton (w/2 enc)
Mr. Tim Wright/Jessup Group (w/enc)

EXPLORATORY BORINGS
QAPP AMENDMENT

SECTION 1
PROJECT DESCRIPTION

1.01 INTRODUCTION

The U.S. Environmental Protection Agency (EPA) and the Wisconsin Department of Natural Resources (DNR) have requested that the Stoughton City Landfill potentially responsible parties (PRPs) perform additional work to better define the extent of groundwater impacts to the west of the site. Although EPA and DNR had indicated in correspondence to the PRPs that the additional work should also include collection of more data on surface water and sediment quality to the east of the site, discussions held during a meeting on October 18, 1991 with representatives of EPA and DNR concluded that additional surface water and sediment data is not necessary at this time, and that the additional work should focus on the groundwater impacts at the site.

The objectives of the additional work are to describe the vertical and horizontal extent of groundwater contamination. Although all target compound list (TCL) inorganics and organics, as well as non-standard volatile organic compounds (VOCs) previously tested for during the remedial investigation (RI) work will be analyzed for in groundwater samples to be collected, special emphasis will be given to the compound tetrahydrofuran (THF). THF was found at levels of concern in samples from two of the groundwater monitoring wells previously installed and monitored as part of the RI work. Please refer to the Additional RI Work Workplan, Revision 1, dated January 2, 1992, for detailed information on the scope of the additional work and for field procedures.

This Sampling and Analysis Plan (SAP) Amendment amends the SAP Part II - Quality Assurance Project Plan (QAPP), September 22, 1988, prepared by ERM-North Central, Inc. This portion of the QAPP Amendment has been developed for the groundwater screening in exploratory borings described in the Additional RI Work Workplan (Strand, January 2, 1992). Pertinent portions of the workplan are included in Appendix A. Excerpts from the SAP Part I - Field Sampling Plan and Part II - Quality Assurance Project Plan (ERM, Inc., 1988) are included in Appendix B.

This QAPP Amendment presents the policies, organization, objectives, Quality Assurance (QA), and Quality Control (QC) activities designed to achieve the specific data quality objectives associated with the Additional RI work at the Stoughton City Landfill site.

Strand Associates, Inc. (SAI) has been retained by the Stoughton City Landfill Steering Committee to conduct additional RI work as described in the Additional Remedial Investigation Work Workplan dated January 2, 1992 ("Additional RI"). Residual Management Technologies, Inc.'s (RMT) laboratory will perform chemical analyses as part of the Additional RI. Information on RMT's laboratory services is submitted along with this document. RMT will analyze all groundwater screening samples obtained during the Additional RI. RMT will conduct volatile organic compound (VOC) analysis of groundwater samples collected from exploratory borings in accordance with USEPA method 601/602 for wastewater.

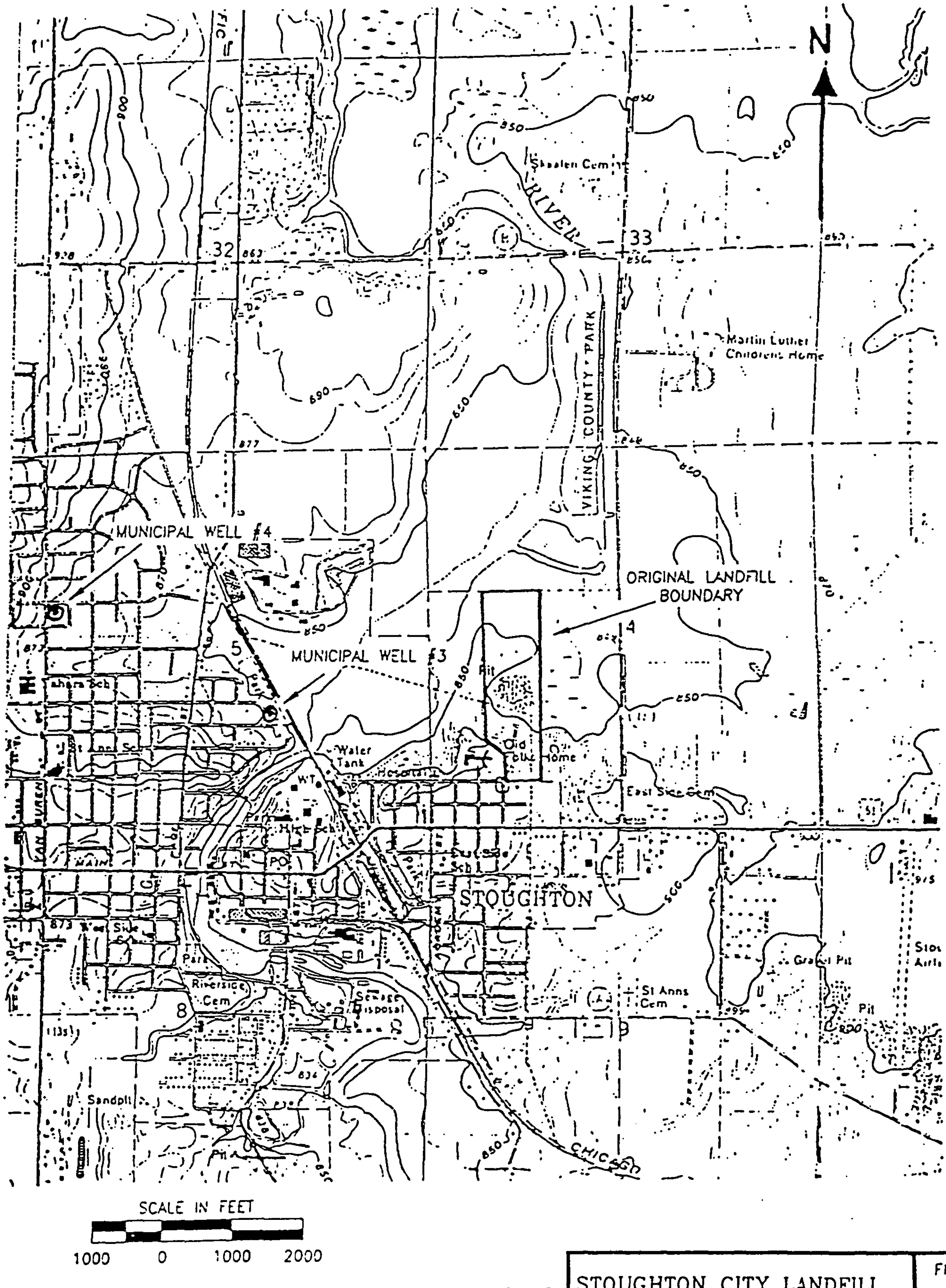
In response to the Additional RI work objectives stated above, the Additional RI will be conducted in phases. The first phase will involve the installation of exploratory borings with screening of groundwater samples for VOCs to identify the horizontal and vertical extent of groundwater contamination west of the site. This information will be used to locate one or more well nests at the limits of contamination. This QAPP Amendment is for sampling and analysis associated with the VOC screening. A separate QAPP Amendment has been submitted for work related to groundwater analysis for monitoring well and municipal well samples, which is Phase 2 and 3 of the Additional RI.

1.02 SITE DESCRIPTION

The Stoughton City Landfill is located in the City of Stoughton, Dane County, Wisconsin and occupies portions of the S 1/2 of the NW 1/4 and the SW 1/4 of Section 4, T5N, R11E (see Figure 1-1). Landfilling has occurred on about 15 acres of the property (see Figure 1-2).

Between 1952 and 1972, the site was operated as an uncontrolled dump site. During this time, refuse was usually burned and at times covered by dirt. In 1972, the site began to be operated as a state-licensed landfill. In 1978, the Wisconsin Department of Natural Resources (WDNR) required that the site be closed according to state regulations. From 1978 to 1982, only brick, rubble, etc., were accepted at the site while closure work was performed. The unit was officially closed in 1982. Please refer to the QAPP for additional information on site history, environmental setting, and sampling by the WDNR and City of Stoughton (Appendix B).

An RI/FS was conducted by the PRPs to characterize the nature and extent of contamination originating from the site, and to identify alternatives for site remediation. The results of the RI/FS may be found in documents prepared by ENSR dated June 14, 1991 (RI), and June 20, 1991 (FS). Of particular note was the detection of THF at levels up to 660 parts per billion (ppb) in the groundwater at the western edge of the landfill. The State Groundwater Enforcement Standard is 50 ppb at the point of standards application.

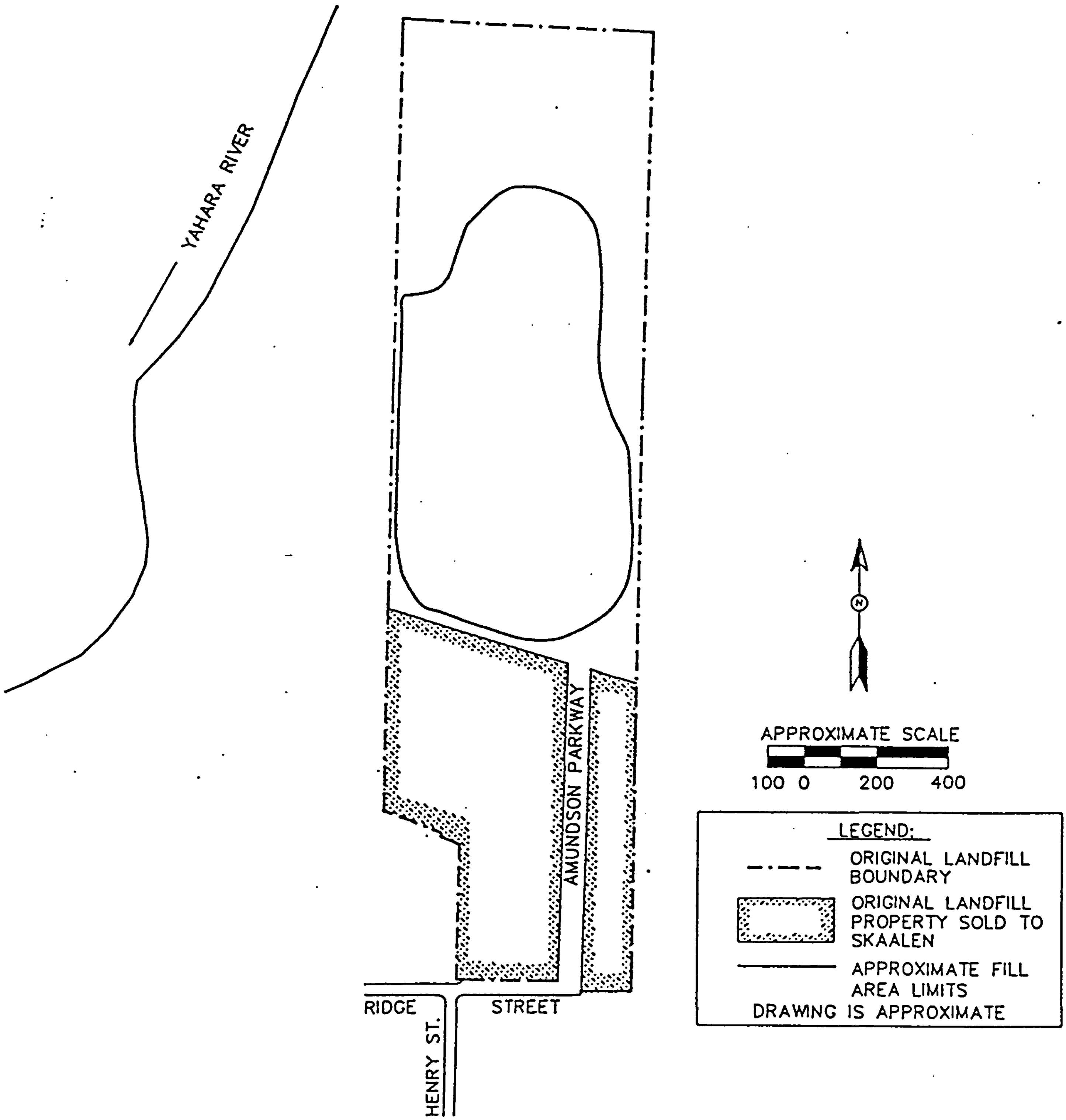


SOURCE: USGS, 7.5 MINUTE STOUGHTON QUADRANGLE, DANE CO., WISCONSIN

STOUGHTON CITY LANDFILL
LOCATION MAP

ERM ERM-North Central, Inc.

FIGURE
1-1



STOUGHTON CITY LANDFILL
PROPERTY BOUNDARIES

FIGURE
1–2

ERM ERM–North Central, Inc.

9/15/88
mo

1.03 TARGET COMPOUNDS

Compounds identified for the Additional RI groundwater screening are shown in Table 1.03-1. These compounds are as specified in EPA method 601/602 for wastewaters, plus tetrahydrofuran. Preliminary sample results from the first dilution of sample analyzed will be provided within 24 hours of sample receipt by the laboratory. Final results confirmed through subsequent dilutions as necessary will be provided within two weeks of sample receipt by the laboratory. This procedure is described in further detail in the Additional RI Workplan (Appendix A).

1.04 PROJECT OBJECTIVE

In addition to the general project objectives stated in Section 1.01, specific objective is to evaluate the vertical and horizontal extent of groundwater contamination west of the Stoughton City Landfill site.

In order to achieve this specific objective, data quality objectives (DQO) have been established to ensure that the data collected are sufficient and of adequate quality for their intended use. These DQO are described in detail in Section 1.4 of the QAPP (Appendix B). The specific DQO for the groundwater screening samples are for site characterization.

1.05 SAMPLE NETWORK AND RATIONALE

Soil cutting screening will be performed as part of exploratory boring installation. Cuttings will be screened and classified at approximately 5-foot intervals. Groundwater samples will be collected at approximately 20-foot intervals from exploratory borings after purging the borings, as described in the Additional RI Workplan (Appendix A). Table 1.05-1 summarizes the sampling and analysis program for the Stoughton City Landfill Additional RI related to exploratory borings.

1.06 PROJECT SCHEDULE

Please refer to Section 2.09 of the Additional RI Work Workplan (Appendix A) for the Project Schedule.

TABLE 1.03-1

EPA METHOD 601/602

STOUGHTON CITY LANDFILL, RI

Analyte	Detection Limit (µg/L)
chloromethane	2.0
bromomethane	2.0
vinyl chloride	1.0
Dichlorodifluoromethane	2.0
chloroethane	2.0
methylene chloride	1.0
Fluorotrichloromethane	2.0
1,1-dichloroethylene	1.0
1,1-dichloroethane	1.0
1,2-dichloroethylene total	1.0
Chloroform	1.0
1,2-dichloroethane	1.0
1,1,1-trichloroethane	2.0
Carbon tetrachloride	1.0
Bromodichloromethane	1.0
1,2-dichloropropane	1.0
cis-1,3-dichloropropylene	2.0
Trichloroethylene	2.0
Benzene	1.0
1,1,2-trichloroethane	1.0
trans-1,3-dichloropropylene	2.0
Chlorodibromomethane	1.0
2-Chloroethylvinyl ether	5.0
Bromoform	1.0
Tetrachlorethylene	2.0
1,1,2,2-Tetrachloroethane	2.0
Toluene	1.0
Chlorobenzene	1.0
Ethylbenzene	1.0
1,3-dichlorobenzene	1.0
1,2-dichlorobenzene	1.0
1,4-dichlorobenzene	1.0
Tetrahydrofuran	5.0

Note: µg/L = parts per billion

TABLE 1.05-1

SUMMARY OF SAMPLING AND ANALYSIS PLAN
EXPLORATORY BORING GROUNDWATER SAMPLES

				QA/QC Samples				
Sample Matrix	Field Parameters	Laboratory Parameters	Investigative Samples(1)	Collocated or Replicate	Field Blanks	Trip Blanks	Back-ground	Matrix Total
Soil Cuttings	HNu Screening Lithologic Description (USCS)		300(6)	0	0	0	0	300(6)
EB Groundwater	pH Specific Conductance Temperature	VOC, THF(3,5)	72	8(4)	8(4)	40(4)	0	128

(1) Assumes 12 groundwater samples per exploratory boring (EB) and six EBs total. Exploratory borings are to be made to a minimum of 20 feet into bedrock, with samples collected at 20-foot intervals. The sample number may increase or decrease with the number and depth of borings.

(2) Field parameters will be measured during and after purging and prior to collecting VOC/THF samples.

(3) EPA Method 601/602 for VOCs and THF.

(4) Two trip blanks will be obtained each field day. One trip blank will be analyzed and one will serve as backup, per QAPP Section 3.0. The number of trip blanks shown assumes 20 field days. One collocated and one field blank will be collected for each ten (or less) investigative samples. The number shown is based on 72 investigative samples.

(5) The VOC samples will be preserved with 0.75 mL 1:1 hydrochloric acid per sample vial.

(6) Assumes six EBs to a depth of 250 feet with soil cuttings sampled every 5 feet.

SECTION 2
PROJECT ORGANIZATION AND RESPONSIBILITY

As the primary contractor to the Stoughton City Landfill Steering Committee, Strand Associates, Inc. has the overall responsibility for all phases of the Additional RI.

2.01 MANAGEMENT

Operational responsibilities involving execution and direct management of the technical and administrative aspects of the Additional RI have been assigned as follows:

Robert P. Kardasz, P.E., Member Landfill Steering Committee
Michael D. Doran, P.E., Project Manager, Strand Associates, Inc.
Terese A. Van Donsel, Remedial Project Manager, USEPA, Region V
Robin Schmidt, Remedial Project Manager, WDNR

2.02 FIELD ACTIVITY

Strand Associates will perform or supervise all field investigations including sample collection during the Additional RI. RMT, Inc. will analyze data generated during the Additional RI.

2.03 LABORATORY ANALYSIS

RMT will act as a subcontractor to Strand Associates, Inc. during the Additional RI, and will perform all chemical analyses required as part of the Additional RI. RMT Laboratories is a CLP laboratory.

2.04 QUALITY ASSURANCE

Strand Associates will issue all deliverables for the Additional RI. USEPA, Region V, will provide review of the QAPP Amendment.

2.05 PERFORMANCE AND SYSTEM AUDITS

Performance and system audits for field operations will be performed by Strand Associates' Quality Assurance Officer. The Contract Project Management Section of the Central Regional Laboratory of USEPA Region V will be responsible for performance and system audits of analytical laboratories.

SECTION 3
QUALITY ASSURANCE OBJECTIVES

The overall quality assurance objective is to develop and implement procedures for sampling, laboratory analysis, field measurement and reporting that will provide data to a degree of quality consistent with its intended use and defensible in a court of law. This section defines the goals for levels of QC effort and the accuracy, precision, sensitivity, completeness, representativeness, and comparability of laboratory analyses.

3.01 LEVEL OF QC EFFORT

Quality Control samples--including collocated or replicate samples, background samples, and field and trip blanks--will be submitted to the analytical laboratory to assess the quality of the data resulting from field sampling investigations. Collocated samples, and to a lesser extent replicate samples, assess the precision of sampling activities. One (1) collocated/field duplicate sample is required per ten (10) or fewer investigative samples. Trip blanks, which will be kept with investigative samples throughout the sampling event, assess the cross-contamination due to VOC migration during shipment. Two trip blank samples per day are required to be sent by the laboratory to the site or sampler. The analysis of one of these trip blanks is required. The other is for use as backup. All trip blank samples must remain sealed until analysis. Field blanks will be used to assess the overall procedural contamination due to sampling activities. One field blank sample is required per ten or fewer investigative groundwater samples. The specific level of QC effort is summarized by sample matrix and parameter in Table 1.05-1.

The analytical laboratory selected for sample analysis is a participant in the USEPA Contract Laboratory Program (CLP) for organic and inorganic testing. The level of QC effort provided by RMT will be equivalent to the level of QC efforts specified under the EPA Method 601/602.

The level of QC effort for field measurement of pH will consist of precalibration using three buffer solutions (pH 4, 7 and 10) and calibration verification at regular intervals (at least once a day). Calibration activities will be recorded in a project log book. QC effort for field conductivity measurements will consist of initial and continuing (at least once a day) calibration verification using a standard solution of known specific conductance. QC effort for HNu screening will consist of initial and continuing (at least every day) calibration verification using an isobutylene reference gas.

3.02 ACCURACY, PRECISION, AND SENSITIVITY OF ANALYSES

The QA objectives of analyses with respect to accuracy, precision, and sensitivity are to achieve acceptable data based on specified performance criteria. Accuracy and precision requirements and method detection limits are described in the EPA Method 601/602.

Analytical accuracy will be assessed through the collection of aqueous organic samples for matrix spike/matrix spike duplicate analyses. A matrix effect is a phenomenon that occurs when other sample components interfere with the analysis of the contaminants of interest. The magnitude of the matrix effect is best assessed through the use of matrix spikes. Percentage recovery information obtained from matrix spikes will be used to address the amount of bias present in the measurement system (accuracy).

The accuracy of field measurements of pH will be assessed through premeasurement calibrations and post-measurement verifications using at least two standard buffer solutions. The two measurements must each be within ±0.05 standard units of buffer solution values. Precision will be assessed through duplicate measurements. (The electrode will be withdrawn, rinsed with deionized water, and reimmersed between each duplicate). The instrument used will be capable of providing measurements to 0.01 standard unit. The accuracy of the specific conductance and HNu photoionization meters will be assured by daily calibration verification with check standards. If readings vary more than 5% from an expected value, the units will be replaced.

A. Comparability

It is expected that the TCL organic and TCL inorganic parameters analyzed consistent with CLP procedures will provide data meeting the QC acceptance criteria for 95% of all samples analyzed. Upon request, the completeness of an analysis will be documented by the laboratory with items such as chromatograms, spectra, and QC data to allow the data user to assess the quality of the results.

The sampling and analysis program is designed to provide data representative of site conditions. During the development of this program, special consideration was given to past disposal practices, existing analytical data from previous site investigations, and the physical setting of the site to ensure the representativeness of the data generated by the Additional RI.

Data comparability will be assured by using identical sampling procedures, analytical procedures, and by reporting results in identical units of measurement.

B. Documentation

The documentation system will comply with the requirements of CLP protocol.

C. Quality Control Requirements

The sampling activities will include the following procedures for purpose of quality control:

- Collection of field duplicates, including collocated and replicate samples.
- Collection of field blanks.
- Inclusion of trip blanks in sample shipments for the analysis of VOCs in water.

The specific level of QC effort is summarized by the sample matrix and parameter in Table 1.05-1 and is discussed in Section 3.01.

SECTION 4
SAMPLING PLAN

The Field Sampling Plan (FSP), presented as Part I of the Sampling and Analysis Plan (ERM, Inc., 1988), as amended by the Additional RI Work Workplan (Strand, 1992), contains all appropriate information pertinent to field sampling procedures.

SECTION 5
SAMPLE CUSTODY PROCEDURES

Sample custody procedures will be consistent with Attachment 4 of the USEPA Region V Guidance "Content Requirements for Quality Assurance Project Plans."

A sample will be considered under the person's custody if: (1) it is in a person's physical possession, (2) in view of the person after he has taken possession, (3) secured by that person so that no one can tamper with the sample, or (4) secured by that person in an area that is restricted to authorized personnel. The sample packaging and shipment procedures summarized below will assure that the samples will arrive at the laboratory with the chain-of-custody intact.

Field procedures are as follows:

- The field sampler will be personally responsible for the care and custody of the samples until they are transferred or properly dispatched. As few people as possible will handle the samples.

- All samples will be tagged with sample numbers and locations.

- Sample tags will be completed for each sample using waterproof ink unless prohibited by weather conditions.

Transfer of custody and shipment procedures will be as follows:

- Samples will be accompanied by a properly completed chain-of-custody form. The sample numbers and locations will be listed on the chain-of-custody form. When transferring the possession of samples, the individuals relinquishing and receiving will sign, date and note the time on the records. This record documents the transfer of custody of samples from the sampler to another person, to a permanent laboratory, or to/from a secure storage area.

- Samples will be properly packaged according to appropriate Department of Transportation (DOT) regulations for shipment and dispatched by courier or overnight carrier to the appropriate laboratory for analysis, with a separate signed custody record enclosed in each sample box or cooler. Shipping containers will be secured with strapping tape and custody seals for shipment to the laboratory.

- A sample analysis request form will accompany each shipment of samples to the analytical laboratory. A description of the requested analysis and the specific laboratory analysis code will be included on this form.

- A standardized sample tracking form will also be completed to establish sample custody prior to shipment to the laboratory and to document specific sample preservation methods.

Copies of all sample custody forms will be maintained in the project files along with copies of all field measurement data and sample-specific information recorded in the field log book and on field data forms.

The specifications for chain-of-custody and document control for RMT will comply with the CLP requirements and be carried out in accordance with the 2/88 and 3/90 SOWs for CLP analysis as appropriate.

RMT, Inc. will provide all sample containers necessary for field sampling and QC requirements. Each lot of sample containers will be checked for cleanliness by the laboratory and sealed to prevent contamination. Samples will be received at the laboratory by the sample custodian, who will examine each sample to ensure that no damage occurred during shipment and that the chain-of-custody record is complete and accurate. The sample custodian will also ensure that each sample has been preserved in a manner required by the particular test and stored according to the correct procedure (see Table 7-1 of the FSP, attached). Volatile Organic Compound (VOC) samples will be preserved with 0.75 ml 1:1 hydrochloric acid in addition to the requirements in Table 7-1. Samples will be preserved by storage in a cooler maintained at 4°C until the analysis begins.

Strand Associates will maintain the RI files along with all relevant records, reports, logs, field notebooks, pictures, subcontractor reports, and data reviews in a secured, limited access area and under the custody of the project manager.

SECTION 6

CALIBRATION PROCEDURES AND FREQUENCY

This section presents the calibration procedures and information for all major measurement systems including field and analytical laboratory testing.

6.01 FIELD INSTRUMENTS

A maintenance and calibration program will be implemented to ensure that routine calibration and maintenance are performed on all field instruments. The program will be administered by the field team leader who will perform routine preventative maintenance (e.g., cleaning or other procedures identified in the instrument manual) on a weekly basis and calibration of field instruments on a daily basis. Calibration activities will include the use of buffer solutions for calibrating the pH meter, liquids of known conductance for calibrating the specific conductance meter, and a standardized reference gas (isobutylene) for calibration of the HNu photoionization meter. Copies of manufacturer's calibration instructions will be kept on-site for ready reference, for pH meter, specific conductance meter, and HNu meter calibration.

Calibration, operation, and maintenance of all field instruments will be documented in the field log book, and all field personnel will maintain their proficiency. Operating procedures outlined in the manual for each instrument will be followed. If field equipment should fail, the Project Manager will be contacted immediately and will either provide replacement equipment or have the malfunction repaired immediately.

6.02 LABORATORY EQUIPMENT

RMT will perform calibration and preventative maintenance procedures for laboratory equipment in accordance with EPA Method 601/602.

SECTION 7

ANALYTICAL PROCEDURES

Groundwater samples collected from exploratory borings will be analyzed for VOCs including THF by EPA Method 601/602 for wastewater. The complete list of parameters is shown on Table 1.03-1. The analyses will be conducted by RMT, Inc. using methods specified in EPA Method 601/602.

SECTION 8
INTERNAL QUALITY CONTROL CHECKS

8.01 ANALYTICAL LABORATORIES

Quality Control at RMT will be carried out in accordance with EPA Method 601/602.

8.02 FIELD QUALITY CONTROL

Field quality control will be carried out during the Additional RI field activities, such as soil cutting sampling and groundwater sampling, and exploratory boring drilling by an experienced Strand Associates' geologist or engineer who will be present during all sampling activities and subcontracted activities such as drilling. All field quality control procedures will be carried out according to this QAPP Amendment and documented in the field notebook.

SECTION 9
DATA REDUCTION, VALIDATION AND REPORTING

Procedures for documenting sample collection and custody, and reporting the results of each phase of the RI/FS are covered in this section.

9.01 DOCUMENTATION

Information pertaining to sample collection, sample custody, analyses to be performed, field measurements, and other field observations will be documented and stored in accordance with procedures contained in the Data Management Plan (ERM, 1988).

Field measurements and sample collection data will be recorded on specific field data forms and in a field log book. Sample custody and requests for analytical tests to be performed will be documented on sample tracking forms, chain-of-custody records, and sample analysis request forms.

Data received from the analytical laboratories for the Additional RI will be checked, organized under specific project headings, and stored in the project files maintained at Strand Associates' offices.

9.02 DATA VALIDATION

RMT, Inc. will perform in-house analytical data reduction under the direction of their laboratory QA officer. The laboratory review will include checks for the attainment of QC criteria as outlined in CLP procedures and established EPA methods. The validity of analytical data will also be assessed by comparing the analytical results of duplicate and blank samples.

Additionally, the laboratory will critique its own analytical programs by using spiked addition recoveries, established detection limits, precision and accuracy control charts and by keeping accurate records of the calibration of instruments.

Strand Associates will review all sample collection procedures and laboratory data to ensure that QA/QC has been maintained.

9.03 REPORTING

Results from the data QA/QC analysis will be summarized in a technical memorandum for submittal to the USEPA and WDNR. All site investigation data will be analyzed, and a summary interpretation will be developed for the type and extent of contamination from the site. The summaries will be submitted as technical memoranda at the completion of each Additional RI task and included as appendices of the RI report. Data from the exploratory borings will be used to locate additional monitoring wells at the site.

9.04 DATA PACKAGE/DATA DELIVERABLES

RMT, Inc. will provide the standard CLP data package required under EPA Method 601/602. This information will be presented in a CLP format including a case narrative, surrogate spike recoveries, all recoveries, matrix spike/matrix spike duplicate recoveries, summary of method blanks, GC run time chronology and order, sample results and all raw data for method blanks.

SECTION 10
PERFORMANCE AND SYSTEM AUDITS

Strand Associates' Quality Assurance Officer will monitor and audit the performance of QA/QC procedures to ensure that the Additional RI is executed in accordance with this QAPP Amendment.

10.01 LABORATORY

All laboratory performance and system audits will be carried out according to CLP requirements which includes external audits by the Contract Project Management Section (CPMS) of the Central Regional Laboratory (CRL).

10.02 FIELD ACTIVITIES

QA audits of field measurements procedures, sample collection; sample custody procedures, and monitoring well installation will be conducted on a periodic basis to document that field activities are performed in accordance with the Field Sampling Plan. These audits will be scheduled to allow oversight of as many field activities as possible. Field activities related to the Additional RI will be audited by Strand Associates.

SECTION 11
PREVENTATIVE MAINTENANCE

11.01 LABORATORY EQUIPMENT

All equipment at RMT's laboratory will be maintained in accordance with the 2/88 SOW for CLP laboratories.

11.02 FIELD EQUIPMENT

Preventative maintenance procedures for the HNu photoionization meter, pH meter and conductivity meter will be carried out in accordance with operating manuals for the respective instruments and will be recorded in the field log book.

SECTION 12

SPECIFIC ROUTINE PROCEDURES USED TO ASSESS DATA PRECISION, ACCURACY AND COMPLETENESS

RMT will comply with EPA Methods 601/602 to assess data precision, accuracy and completeness.

SECTION 13
CORRECTIVE ACTION

13.01 ANALYTICAL LABORATORIES

Corrective actions for RMT, Inc. will be carried out in accordance with procedures outlined in EPA Method 601/602.

13.02 FIELD WORK

Corrective action indicated by audit results or detection of unacceptable data will be determined by Strand Associates' Project Manager in consultation with the Stoughton City Landfill Steering Committee, USEPA, and WDNR. Corrective action may include, but is not limited to:

- Resampling and reanalyzing samples if holding time criteria are exceeded.
- Resampling and analyzing site areas in question.
- Evaluating and amending sampling and analytical procedures.
- Accepting data with an acknowledged level of uncertainty.
- Eliminating outliers identified by the validation task.

The proposed corrective action will be implemented only after full agreement to the type of action required by the regulatory agencies and the Stoughton City Landfill Steering Committee is achieved.

SECTION 14
QUALITY ASSURANCE REPORTS TO MANAGEMENT

Quality assurance reports will be included by Strand Associates as part of Additional RI technical memoranda. These reports will include the results of QA audits and any necessary corrective action procedures. In addition, the data validation and data sufficiency task will be incorporated into the RI technical memoranda.

APPENDIX A

EXCERPTS FROM ADDITIONAL RI WORK WORKPLAN
(STRAND ASSOCIATES, 1992)

SECTION 1

INTRODUCTION

The U.S. Environmental Protection Agency (EPA) and the Wisconsin Department of Natural Resources (DNR) have requested that the Stoughton City Landfill potentially responsible parties (PRPs) perform additional work to better define the extent of groundwater impacts to the west of the site. Although EPA and DNR had indicated in correspondence to the PRPs that the additional work should also include collection of more data on surface water and sediment quality to the east of the site, discussions held during a meeting on October 18, 1991 with representatives of EPA and DNR concluded that additional surface water and sediment data is not necessary at this time, and that the additional work should focus on the groundwater impacts west of the site. This was confirmed in a letter dated October 24 from Mary Pat Tyson of EPA to Robert Kardasz of the City.

The objectives of the work presented herein are to describe the vertical and horizontal extent of groundwater contamination northwest, west and southwest of the site. Although all target compound list (TCL) inorganics and organics, as well as non-standard volatile organic compounds (VOCs) previously tested for during the remedial investigation (RI) work will be analyzed for in groundwater samples to be collected, special emphasis will be given to the compound tetrahydrofuran (THF). THF was found in levels of concern in samples from two of the groundwater monitoring wells previously installed and monitored as part of the RI work.

In the development of this workplan, maximum reliance is made on the previously approved Sampling and Analysis Plan for Remedial Investigation and Feasibility Study (SAP) (ERM, Inc., 1988), Part I - Field Sampling Plan (FSP) and Part II - Quality Assurance Project Plan (QAPP). Excerpts from Part I - Field Sampling Plan are included in Appendix A, and excerpts from Part II - Quality Assurance Project Plan are included in Appendix C, for ready reference. All activities conducted as part of this additional work shall comply with Wisconsin Administrative Code NR 141, except as specifically noted herein, and a copy of NR 141 is included in Appendix B for ready reference.

1.01 SCOPE OF WORK

Consistent with the above objective, the scope of work is as follows:

1. installation of a bedrock monitoring well at existing monitoring well cluster MW-3, designated MW-3B (for bedrock well);

2. exploratory borings at the MW-3 cluster location and at locations northwest, west and southwest of the MW-3 location, with analysis of groundwater samples retrieved at various depths and with completion of the test borings within the bedrock, to provide information as to the vertical and horizontal distribution of THF and potentially other VOCs in the groundwater west of the site;

3. installation of a three-well cluster at a point downgradient of the MW-3 cluster (new well designation MW-7S, MW-7D and MW-7B), at the approximate

western edge of the area of groundwater contamination, based on the exploratory boring results;

4. two rounds of groundwater sampling from the existing and the new monitoring wells (MW-1S, MW-1D, MW-2S, MW-2D, MW-3S, MW-3D, MW-3B, MW-4S, MW-4D, MW-5S, MW-5D, MW-6S, MW-6D, MW-7S, MW-7D, MW-7B) for organic and inorganic compounds as defined in the Quality Assurance Project Plan (Part II of the SAP) (see Appendix C.) to be conducted in the spring and summer of 1992; and

5. a round of sampling of City of Stoughton public water supply wells No. 3 and No. 6 for THF to be conducted in the spring of 1992.

The above scope of work assumes that contaminants of concern have not migrated extensively in groundwater west of the site proper. Should the additional RI work determine that this is not the case, additional exploratory borings and monitoring wells may be required to adequately define the vertical and horizontal extent of groundwater impacts. It is understood that the investigation may need to be pursued on neighboring properties and potentially on the west side of the Yahara River. The City has obtained permission from the property owner to the southwest of the site (Skaalen). City property and Right-of-Way is available on the west side of the Yahara River.

1.02 ABBREVIATIONS

The following abbreviations are provided as an aid to the reader:

DNR	Wisconsin Department of Natural Resources
EPA	U.S. Environmental Protection Agency
ERM	Environmental Resources Management, Inc.
FSP	Field Sampling Plan (Part I of SAP), ERM, 1988
ID	internal diameter
MW	groundwater monitoring well
NR141	Wisconsin Administrative Code governing the construction of groundwater monitoring wells
PID	photoionization detector
POTW	publicly owned treatment works
ppm	parts per million
QAPP	Quality Assurance Project Plan (Part II of the SAP), ERM, 1988
RI	remedial investigation
SAP	Sampling and Analysis Plan, ERM, 1988
TCL	target compound list
THF	tetrahydrofuran
VOCs	volatile organic compounds

SECTION 2

METHODS AND PROCEDURES

Methods and procedures for the previous site investigation work are described in ERM's "Sampling and Analysis Plan" (SAP) (ERM, 1988). It is intended that the additional work as described herein be completed in conformance with those methods and procedures except as specified. Refer to Appendix A, for excerpts from the FSP and to Appendix C for excerpts from the QAPP, as referenced in this section. See Appendix B, for references to NR 141 relative to groundwater monitoring well construction methods and details.

2.01 EXPLORATORY BORINGS

Exploratory borings will be given the numeric designation EB-1, EB-2, etc. Water samples collected from the exploratory borings will be have a "WEB" prefix, indicating a water sample collected from an exploratory boring, and a two or three digit suffix designating the depth (in feet) below grade from which the water sample was collected. WEB-1-30, for example, would represent a water sample from EB-1 collected at a depth of 30 ft below grade.

For the exploratory borings, analysis of groundwater samples, duplicates and blanks will be performed using EPA wastewater methods 601/602 for THF and other identifiable VOCs. A "fast turn around" arrangement will be made with a local qualified analytical laboratory to facilitate field decisions as to locations and completed depths of exploratory borings. ~~Alternatively, on-site testing may be performed if a suitable service for such testing is identified and if on-site detection limits equivalent to laboratory limits can be accomplished.~~

Arrangements have been made with the analytical laboratory performing the exploratory boring groundwater lab analyses (RMT, Inc., located approximately 45 minutes from the site), for 24 hr turn around of handwritten preliminary results and for formal reporting of results within two weeks of sample delivery. The "fast turn around" data reports must be considered preliminary, because the laboratory reserves the right to make additional analytical runs at different dilutions as may be necessary to optimize results, or to make additional analytical runs as may be dictated by quality control. The laboratory advises that preliminary results near levels of detection can be relied on to a greater extent than elevated results. In the case of elevated results, initial runs may be outside ranges of calibration of the instrumentation and subsequent analysis at different dilutions may need to be made. With this in mind, the preliminary results should be reliable for the iterative process of decisionmaking relative to greater depth into bedrock or additional exploratory borings, as will be necessary to define the edge of the impacted groundwater zone where pollutant concentrations will be near or below levels of detection.

Exploratory borings will be constructed by air-rotary methods, with installation of a drill casing advanced with the boring. A hollow drill string of sufficient internal diameter (nominal 2 inch) for installation of pumping and sampling equipment will be used.

In unconsolidated material, groundwater samples will be collected from near the surface of the water table and about every 25 20 ft in depth below the water table. Groundwater samples in unconsolidated material will be collected as follows:

- flush hole using air-lift to remove cuttings and debris from drilling;
- insert decontaminated stainless steel sample pipe with well screen and point to depth of hole;
- withdraw drill casing and drill assembly sufficiently to allow the unconsolidated material to collapse around the well point and screen;
- purge well by pumping or bailing; and
- collect groundwater sample using decontaminated stainless steel or teflon bailer.

If stability of the formation ~~the-drilling-equipment-employed~~ does not allow insertion of the sampling pipe past the drill bit, sampling in unconsolidated zones will be as follows:

- flush hole using air-lift to remove cuttings and debris from drilling;
- purge hole by pumping or bailing; and
- collect groundwater sample using decontaminated stainless steel or teflon bailer, having integral screen section.

In bedrock, groundwater samples will be collected as follows:

- set drill casing in top of bedrock;
- drill to desired depth in bedrock, leaving open hole;
- flush hole using air-lift to remove cuttings and debris from drilling;
- remove drill assembly;
- isolate sample zone with double packer assembly (e.g. Tigre-Tierra); and
- purge and sample using decontaminated submersible pump.

As part of the purging and sampling process, only decontaminated bailers, pumps, cable and other equipment shall be placed in the well. Refer to Section 6.5.2.3 (Well Evacuation) and Section 6.5.2.4 (Sample Withdrawal) of the SAP (Appendix A) for additional details on purging and sampling procedures. As stated in the

SAP (Section 6.5.2.3), purging will be conducted until a minimum of three well or borehole volumes have been evacuated, or until stabilization of pH, conductivity and temperature is achieved. As indicated in the FSP (Section 6.5.2.4), pH, conductivity and temperature measurements of the sample will be made in the field at the time of sample collection. Well and borehole volumes will be calculated based on the size of the borehole less the volume taken up by casings, screens, and filter pack (if any), as described in NR 141.21(1)(b).

Samples for laboratory analysis will be collected in VOC vials in the field, and kept on ice until delivery to the laboratory. Chain of custody documentation procedures will be employed in sample handling consistent with those procedures in the approved QAPP. Table 2.01-1 summarizes the data collection effort for groundwater sampling of exploratory borings. It is important to recognize that, due to non-QAPP methods employed for the collection and analysis of these samples (e.g. samples not taken from NR 141 monitoring wells and unvalidated lab data), the results must be considered semi-quantitative and suitable for screening purposes only. The purpose for the collection of these data is ~~primarily~~ to allow a determination as to the vertical and horizontal extent of groundwater impacts west of the site, and to allow a determination to be made as to the proper location for the new well nest (MW-7 location) west of the site as well as additional exploratory borings and monitoring wells as may be required to complete the investigation.

The above procedure will be employed at a minimum to a 20 ft depth into the bedrock for each exploratory boring, or to a depth where no detectable THF is observed.

Should field observations and VOC/THF methods 601/602 analyses indicate that adjustment can or should be made to the 25 20 ft proposed groundwater sampling interval, either to reduce unnecessary expense or to obtain more useful information, appropriate adjustments will be made following consultation with and ~~concurrence~~ approval by the EPA ~~and DNR project managers~~ in consultation with DNR.

During construction of the exploratory borings, geologic classification will be accomplished in the field, at approximately ten foot intervals, on the basis of characterization of the cuttings. Soils will be classified in accordance with the Unified Soil Classification System (USCS). In addition, cuttings will be field screened with a photoionization (PID) meter at approximately 10 ft intervals. Cuttings will be sampled, handled and field screened (PID) in accordance with the procedures described in the FSP (Section 6.4). See Appendix A.

High pressure water and steam cleaning of drilling equipment will be performed between construction of exploratory borings, in accordance with NR 141.17(2). Sampling equipment will be cleaned with detergent followed by distilled water rinse between collection of groundwater samples, in accordance with procedures specified in the Field Sampling Plan (FSP), Sections 6.4 and 6.5 (See Appendix A) (ERM-North Central, Sampling and Analysis Plan, Part I-Field Sampling Plan, 1988).

TABLE 2.01-1

DATA COLLECTION SUMMARY
EXPLORATORY BORING GROUNDWATER SAMPLES

Field Parameter	Laboratory Parameter	Investigative[1] Samples
pH, Conductivity, temperature[2]	VOC, THF[3,5]	72

QA/QC Samples				Matrix
Collocated	Field Blanks	Trip Blanks	Background	Total
8[4]	8[4]	40[4]	0	128

[1] Assumes 12 samples per exploratory boring (EB) and six EBs total. Exploratory borings are to be made to a minimum of 20 ft into bedrock, with samples collected at 20 ft intervals. The sample number may increase or decrease with the number and depth of borings.

[2] Field parameters will be measured during and after purging and prior to collecting VOC/THF samples.

[3] EPA Method 601/602 for VOCs and THF.

[4] Two trip blanks will be obtained each field day. One trip blank will be analyzed and one will serve as backup, per QAPP Section 3.1 (see Appendix C). The number of trip blanks shown assumes 20 field days. One collocated and one field blank will be collected for each ten (or less) investigative samples. The number shown is based on 72 investigative samples.

[5] THF/VOC samples will be preserved with 0.75 mL 1:1 hydrochloric acid per sample vial.

Figure 1 shows the hypothetical location of the exploratory borings. Initially, it is proposed that the indicated exploratory borings be constructed. EB-1 would provide information as to the depth of THF contamination at the MW-3 location, which is the location where groundwater THF values were found to be the highest during the RI. Data from EB-2 through EB-5 would indicate if contamination (horizontal or vertical) has extended to the distance of the exploratory boring. If not, one or two additional exploratory borings would be constructed to the east for the purpose of identifying gradients in groundwater THF concentrations. If so, additional exploratory borings would be constructed to the west as necessary to identify the extent of the area of groundwater impact. The intent would be ultimately to locate the necessary borings northwest, west and southwest of the existing MW-3, MW-4 and MW-5 locations, in the area west of the site, to define the vertical and horizontal extent of groundwater impact. An iterative process will be used, incorporating judgement on the basis of previous RI data and VOC data from groundwater samples collected from the exploratory borings, to locate such additional borings as needed to "surround" the area of groundwater contamination with exploratory borings (both horizontally and vertically) northwest, west and southwest of the site. In general, the exploratory borings would be constructed radially away from the site to the distance necessary for "no detects" on the basis of the VOC/THF 24 hour turnaround testing of groundwater samples retrieved, so as to define the horizontal extent of contamination. Similarly, at a particular boring location, exploratory borings would continue with depth a minimum of 20 ft or until "no detect" was reported for VOC/THF for the 24 hr turnaround data.

It is intended that EB-1, EB-2~~-and~~ EB-3, and EB-5 be constructed initially. The proposed location of EB-2~~-and~~ EB-3 and EB-5 is approximately in the direction from MW-4~~-and~~ MW-3 to the most proximate City well, and also approximately in the direction of shallow groundwater flow. Depending upon the results at these locations, the other exploratory boring locations may require adjustment, or additional exploratory borings may be required.

Upon completion, and collection of groundwater analysis data, exploratory boreholes will be abandoned, by filling with bentonite chips (if standing water is less than 150 ft deep) or by pumping grout through a tremie pipe, in accordance with NR 141.25 (see Appendix B).

2.02 GROUNDWATER MONITORING WELLS

A total of four additional monitoring wells are proposed to be installed, unless the extent of contamination dictates that additional wells are needed. One of the wells (MW-3B) will be located at the MW-3 monitoring well cluster. This well will extend into the Cambrian sandstone bedrock in order to assess potential contamination at that depth. The remaining three wells will be designated as the MW-7 monitoring well cluster. These wells will be clustered in the same manner as for the MW-3 wells unless different depths are justified as a result of the groundwater sampling data collected as part of the exploratory boring work. Attached Figures 2 and 3 show well construction details.

All groundwater monitoring wells will be constructed in accordance with NR 141 (see Appendix B), except that stainless steel riser pipe and screen will be used in lieu of PVC and that mild steel riser pipe may be used above the water table. Stainless steel riser and casing was used in the wells previously constructed during the RI, as required by EPA and DNR. A variance has been requested of DNR for this modification to NR 141 requirements for the monitoring well construction herein described.

A. Glacial Drift Wells

MW-7S will be a shallow water table well screened to intersect the water table. MW-7D will be a deeper piezometer, screened at approximately 70 to 80 ft below grade unless groundwater data collected as part of the exploratory boring work dictates alternative depths.

City of Stoughton municipal wells No. 3 and 6 will be sampled in the early spring of 1992, with analysis for THF. If THF is detected in either of the wells, that well will be resampled with analysis for all TCL inorganics and organics and non-standard VOCs previously tested for as part of the RI.

Samples will be handled and preserved in accordance with Table 7-1 of the FSP (Appendix A) except that VOC samples will be preserved with 0.75 mL of 1:1 hydrochloric acid per sample vial.

Monitoring well sampling will be conducted in accordance with the procedures contained in the approved FSP section on groundwater sampling (Section 6.5.2), except that the electric tape manufacturer is the Slope Indicator Co. (Seattle WA). See Appendix A. Teflon or stainless steel bailers will be used for purging and sampling monitoring wells, except that a submersible pump may be used for purging and sampling deep and bedrock wells. As stated in the FSP, field measurements will be made for water level (before purging), pH, conductivity and temperature at the time of sample collection. All pumps, bailers, cable, and other equipment used for sampling shall be decontaminated with detergent followed by a distilled water rinse prior to use and between sampling of individual wells.

City well sampling will be conducted in accordance with the procedures contained in the approved FSP section on private well sampling (Section 6.6). See Appendix A. Samples will be collected from the spigots on the well pump discharge piping.

2.06 SURVEY CONTROL

The location and ground surface elevation for borings and monitoring wells will be established by survey methods in accordance with the QAPP FSP. Monitoring wells will be located and mapped in accordance with NR 141.065(2). The top of the well casing will be referenced to the National Geodetic Survey Datum to an accuracy of 0.01 ft. Wells and borings will be located to the nearest ft and referenced to the State Plane Coordinate System.

2.07 REPORTING

A. GENERAL

The following reports and data presentations are planned:

- during drilling of the exploratory borings, the EPA and DNR project managers will be advised of progress and results of the work, and will be consulted relative to the locations of additional exploratory borings (see Section 2.07 B., below, for additional discussion of procedures for information transfer and consultation with EPA and DNR during exploratory boring work);
- upon completion of the exploratory boring program, the EPA and DNR project managers will be consulted relative to the location proposed for the MW-7 cluster (see Section 2.07 B., below, for additional discussion of procedures for information transfer and consultation with EPA and DNR regarding monitoring well placement);

- within 60 days of completion of the exploratory boring and monitoring well construction work, a construction report will be submitted to the EPA and DNR, in accordance with NR 141.23 including:
  - mapping and elevations of borings and monitoring wells,
  - boring and monitoring well geologic logs,
  - particle size distribution data (ASTM Method D.422.) for MW-7S and MW-7D for the soil at the well screen depth,
  - results of field hydraulic conductivity (slug) tests,
  - PID data and groundwater analysis data (THF and VOCs using wastewater methods 601/602),
  - a written description of methods employed and significant observations made, and
  - well development procedures and documentation;
- following completion and validation of analytical results from the first round (early spring ~~winter~~ of ~~1991/~~1992) of groundwater monitoring well sampling and sampling of City wells 3 and 6, a report of data and validation results will be submitted; and
- following completion and validation of analytical results from the second round (~~spring~~ early summer of 1992) of groundwater sampling ~~and sampling of City wells 3 and 6~~, a report of data and validation results will be submitted.

8. CONSULTATION WITH AGENCIES DURING EXPLORATORY BORING AND PRIOR TO MONITORING WELL PLACEMENT

Close communication between Strand Associates personnel, the laboratory, and representatives of the EPA and DNR will be essential for effective and timely decisionmaking regarding exploratory boring placement. This communication will require an efficient system of management and transfer of information. During the drilling work, the Strand project manager will advise the EPA and DNR project managers of his whereabouts during business hours by leaving a contact telephone number with the Strand receptionist; or if he is unavailable, the name and contact telephone number of his designee for decisionmaking. Strand will maintain contact between field and office staff by means of a field telephone. Throughout the duration of the work, the EPA and DNR project managers will provide the Strand project manager with a current hierarchical list of contact names and telephone numbers for decisionmaking.

The following approach is proposed during exploratory boring drilling:

1. Strand Associates obtains 24 hr turn around groundwater sample data in hardcopy form (telecopy or hand pickup) from laboratory.

2. Strand Associates maintains a work area map, to scale, showing boring locations together with 24 hr turn around data indicated on the map (updated for formal final data) for each boring (i.e. sample result and depth for each result for each boring); and keeps the work area map updated upon receipt of new laboratory data.

3. To facilitate EPA/DNR consultation on boring placement, Strand telecopies an updated work area map to each of the EPA and DNR project managers at a minimum of once every two field working days, for their use during the consultations.

4. At least four business hours prior to consultation, Strand telecopies to each of the EPA and DNR project managers (or their designees) an updated work area map, showing the location proposed for the next boring, together with a written explanation of the rationale for the boring placement.

5. Strand Associates initiates a teleconference with the EPA project manager or designee to discuss the location proposed for exploratory boring construction.

6. Following approval by the EPA project manager (or designee), in consultation with DNR, as to the location of exploratory boring construction, Strand Associates telecopies to each of the EPA and DNR project managers (or their designees) an updated work area map showing the boring location.

7. Should approval by EPA (in consultation with DNR) not be possible by teleconference, verbally, by telecopy or in writing within one business day, Strand Associates will proceed with construction of the boring as recommended (step 4 above).

Prior to construction of the new groundwater monitoring wells, Strand Associates will prepare written recommendations concerning the location and depth of the new wells, together with the rationale for the proposed well placement. An updated copy of the exploratory boring groundwater data will be provided at that time showing the proposed well placement. The proposed locations and depths of the new wells will be based upon the results of the exploratory boring work and professional judgement.

With respect to gaining EPA approval of the proposed well placement, Strand Associates will proceed following steps 5. through 7. (above), except that two business days will be provided for obtaining EPA approval.

2.08 DUTIES OF PERSONNEL AND ORGANIZATIONS

In general, the Drilling Contractor (ETI, Inc.) will be responsible for boring and monitoring well construction, providing on-site decon facilities and toilets, waste handling, preparation of DNR-required boring and monitoring well construction documentation forms, preparation of soil and well construction logs, purging prior to sampling, well development, assisting Strand Associates personnel with groundwater sampling, soil laboratory testing, and project site security.

In general, Strand Associates will be responsible for project coordination, providing an on-site hydrogeologist during all drilling operations, collection of soil and groundwater samples, field classification of earth materials, performing slug tests of completed wells, field testing for on-site tests at the time of sample collection, acting as the PRP Steering Committee's representative on site, coordination of field and lab QA/QC activities, arranging for laboratory work to be performed by the laboratory (RMT) and initiating chain-of-custody documentation, liaison with agency representatives and with representatives of the PRPs, providing project safety officer (and backup), and preparation of interim, draft and final reports and documentation.

The City of Stoughton will provide services related to transport of liquids generated during drilling (to City of Stoughton POTW), overall site security, and will secure the right of entry to adjacent lands as may be required during the completion of the work.

The laboratory (RMT, Inc.) will provide sample containers and preservatives for groundwater and City well samples requiring analysis, will perform validation of data from the City wells and from the groundwater monitoring wells, and will provide a backup hydrogeologist in the event that Strand's hydrogeologist is ill or otherwise unavailable.

Agency representatives will provide oversight/review of on-site and other activities during completion of the work.

See Table 2.08-1 for a summary of the duties and responsibilities of the organizations and key staff members involved in the work.

Table 2.08-1 indicates backup responsibilities of certain personnel. Ms. Carlson will provide backup to Mr. Doran if Mr. Doran is unavailable. Mr. Doran will provide backup to Ms. Carlson if she is unavailable. Should Mr. Wang be unavailable on a day with scheduled drilling, drilling will be suspended for that day and will resume within two business days with Mr. Wang again on-site or with the backup (RMT staff) hydrogeologist present and with Ms. Carlson present as health and safety officer. Resume's of RMT staff which may be utilized for field hydrogeological work will be provided to EPA and DNR prior to initiation of field work.

2.09 PROJECT SCHEDULE

Table 2.09-1 is a schedule for completion of the work described herein. The schedule will be updated as may be required as the work proceeds. Should events occur during completion of the work, such as the need for more exploratory borings (six) or new monitoring wells (4) than anticipated or other circumstances not now anticipated, EPA will be consulted for its approval (in consultation with DNR) of any required schedule revisions.

TABLE 2.08-1

RESPONSIBILITIES OF KEY PROJECT PERSONNEL

Party	Responsibilities
EPA	Project Oversight/Review and Approval
DNR	Project Oversight/Review and Consultation with EPA
City of Stoughton	Arrange Access to Off-Site Properties; Transport or Arrange for Transport of Liquid Wastes Off-Site to City of Stoughton POTW; Sample Transport: Site Security
Strand Assoc:	
Michael D. Doran	Project Management; EPA/DNR/PRP Liaison Internal Quality Control; Drilling Contract Administration; Direct other Strand Staff and Consult with Agencies re. Boring and Monitoring Well Construction
Jane M. Carlson	Backup Project Management; Backup Safety Officer; Data Analysis and Reporting; Laboratory Contract Administration and Laboratory Liaison
David J. Wang	Field Geology and Hydrogeology; Observe Drilling (present during all drilling operations); City On-Site Representative for Drilling Contract; Perform or Direct On-Site Soil, Groundwater and Water Well Testing; Well and Boring Documentation; Sample Chain of Custody Documentation; Consult with Project Management Personnel re. Boring and Well Construction
Stephen L. Arnold	Site Survey
Steven Karklins	Geology/Hydrogeology/Sampling Support
Staff	Sample Transport, Support Services
RMT, Inc:	Backup Hydrogeologist; Provide sample containers and preservatives; Laboratory Analysis and Data Validation
ETI, Inc:	Boring and Monitoring Well Construction and Abandonment; Waste Handling; Boring and Monitoring Well Purging and Development; Boring and Monitoring Well Construction and Soil/Geologic Logs, and DNR Forms Completion; Testing of Soils (SAP-Approved Lab - SES, Inc.); Provide On-Site Decon and Toilet Facilities; Project Site Security.

TABLE 2.09-1

PROJECT SCHEDULE
STOUGHTON CITY LANDFILL ADDITIONAL RI WORK

Work Item	Completion Date
PRPs Submit Revised Workplan	January 3, 1992
EPA/DNR Approve Revised Workplan	January 17, 1992
PRPs Submit Revised QAPP	January 24, 1992
EPA/DNR Approve Revised QAPP	February 21, 1992
Field Work Initiated On-Site	March 2, 1992
Exploratory Boring Field Work Completed	April 3, 1992
New Monitoring Well Construction Completed	May 1, 1992
First Round of Well (MWs and City Wells) Sampling	May 15, 1992
PRPs Submit Report of Data from First Round of Well Sampling	June 19, 1992
PRPs Submit NR 141.23 Documentation on Boring and Well Construction	June 26, 1992
PRPs Submit Validation of Data from First Round of Well Sampling	July 17, 1992
Second Round of Well (MWs) Sampling	August 14, 1992
PRPs Submit Report of Data from Second Round of Well Sampling	September 18, 1992
PRPs Submit Validation of Data from Second Round of Well Sampling	October 16, 1992

APPENDIX B

EXCERPTS FROM SAP PART I - FSP AND PART II - QAPP
(ERM, 1988)

7.0 SAMPLE HANDLING AND ANALYSIS

The required sample containers, preservation methods, maximum holding times, and filling instructions for each sample type are summarized on Table 7-1. Notations of which laboratory will be performing the analysis of the collected samples are also indicated on Table 7-1. Sample bottles, provided by CompuChem Laboratories, will be prepared using procedures required by the Contract Laboratory Program (CLP). Sample bottles, provided by Pace Laboratories, for the analysis of tetrahydrofuran, trichlorofluoromethane, and dichlorodifluoromethane will be prepared using procedures appropriate for the analyzation of these parameters using nonstandard methods. Sample containers for soil gas and air sampling are commercially available cartridges containing activated carbon. Table 7-1 also lists handling procedures appropriate for these samples. Detailed information concerning the sample preservation and custody procedures are contained in the accompanying documents: Quality Assurance Project Plan and Data Management Plan.

Waste generated on site will be properly handled and disposed of to prevent contamination of clean areas and to comply with existing regulations (Section 3.2 of the Compendium). If soil encountered during borehole drilling is suspected to be hazardous because of abnormal discoloration, odor or air monitoring levels, the soil cuttings will be containerized in a new, unused drum. Similarly, materials generated during decontamination procedures, including washwater and soil materials, will be disposed in

TABLE 7-1

SAMPLE CONTAINER AND PRESERVATION REQUIREMENTS

Soil Gas Parameters(1)	Container	Preservation	Maximum Holding Time	Filling Instructions
Target and Analyzable Volatile Organics	Activated Carbon Cartridge	Cool 4°C		Cap cartridge ends
Ground Water/Surface Water Parameters(2)				
TCL Volatile Organics	2 x 40 ml Glass Vials with Teflon-lined septum	Cool 4°C	14 days	Zero headspace, no air bubbles
TCL Base Neutral Organics and Acid Extractable Organics	3 x 1 liter amber glass bottles with Teflon-lined cap	Cool 4°C	7 days	Fill to neck of bottle
PCBs/Pesticides	2 x 1 liter amber glass bottles with Teflon-lined cap	Cool 4°C	7 days	Fill to neck of bottle
TCL Metals (3)	2 x 500 ml Polyethylene bottle	0.45 u Filtration (Ground Water Only) HN_03 to pH<2 Cool 4°C	6 months	Fill to neck of bottle
Cyanides	1 x 1 liter glass bottle with Teflon-lined cap	NaOH to pH>12 Cool 4°C	24 hours	Fill to neck of bottle
Other Volatile Organics (1,4)	2 x 40 ml Glass Vials with Teflon-lined septum	Cool 4°C	14 days	Zero headspace, no air bubbles

TABLE 7-1 (continued)

SAMPLE CONTAINER AND PRESERVATION REQUIREMENTS

Soil/Sediment Parameters(2)	Container	Preservation	Maximum Holding Time	Filling Instructions
TCL Volatile Organics	2 x 4 oz wide-mouth glass jars with Teflon-lined cap	Cool 4°C	10 days	Zero headspace, pack tightly
TCL Base Neutral Organics and Acid Extractable Organics	1 x 1 liter, wide-mouth amber glass jar with Teflon-lined cap	Cool 4°C	10 days	At least 3/4 full
PCBs/Pesticides	From semivolatile Organic Container	Cool 4°C	10 days	At least 3/4 full
TCL Metals (3)	1 x 1 liter, wide-mouth amber glass jar with Teflon-lined lid	Cool 4°C	6 months	At least 3/4 full
Cyanides	From TCL Metals Container	Cool 4°C	14 days	At least 3/4 full
Air Parameters(1)				
Analyzable Volatile Organics	Activated Carbon Cartridge	Cool 4°C		Cap cartridge ends

Note: All samples will be shipped by overnight carrier to their final laboratory destination under custody.

(1) Soil gas, air and other volatile organic parameters to be analyzed by Pace Laboratories.

(2) Ground water, surface water, and soil/sediment parameters to be analyzed by CompuChem Laboratories, excluding other volatile organics.

(3) Maximum holding time for mercury of 26 days.

(4) Other volatile organics include tetrahydrofuran, trichlorofluoromethane, and dichlorodifluoromethane.

drums. Composite samples will be collected from drum materials and tested by the Toxic Characteristic Leaching Procedure (TCLP) to determine if the cuttings should be disposed of as a hazardous waste.

1.0 PROJECT DESCRIPTION

1.1 Introduction

This Sampling and Analysis Plan (SAP) for the Stoughton City Landfill Remedial Investigation and Feasibility Study (RI/FS) has been developed and is being submitted in accordance with Article VII·(C) (2) of the Administrative Order by Consent (Consent Order). The Sampling and Analysis Plan consists of two parts which include the Field Sampling Plan (FSP) and the Quality Assurance Project Plan (QAPP). The FSP and QAPP are submitted as a single document; however, they have been bound separately to facilitate use of the FSP in the field.

This QAPP presents the policies, organization, objectives, Quality Assurance (QA), and Quality Control (QC) activities designed to achieve the specific data quality objectives associated with the RI/FS at the Stoughton City Landfill site. The plan has been prepared in accordance with the USEPA document "Internal Guidelines and Specifications for Preparing Quality Assurance Project Plans" (QAMS 005/80) and "Content Requirements for Quality Assurance Project Plans" prepared by Dr. Chen-Wen Tsai of USEPA Region V.

Environmental Resources Management-North Central (ERM-North Central) has been retained by the Stoughton City Landfill Steering Committee to conduct the RI/FS. Two laboratories--CompuChem Laboratories and Pace Laboratories--will perform chemical analyses as part of the RI/FS. CompuChem Laboratories will analyze all ground water/surface water, soil/sediment, and potential private well samples obtained during the RI. Should private well sampling be required, Standard Operating Procedures (SOPs) for the proposed analyses will be submitted as an addendum to this QAPP. In performing these analyses, CompuChem Laboratories will follow all procedures specified in the 7/87 Statement of Work (SOW) for organics and in the 7/85 SOW for inorganics as required under USEPA's Contract Laboratory Program (CLP). Although a 7/87 SOW exists for inorganics, its analytical requirements are essentially the same as those of the 7/85 SOW for inorganics. CompuChem intends to eventually perform both organic and inorganic analyses under the new SOW expected in early 1989. Pace Laboratories will conduct nonstandard method analyses for three additional volatile organic compounds (VOCs) in water and soil/sediment and also analyze activated carbon tubes collected during the soil gas and outdoor air sampling portions of the RI. Pace Laboratories has prepared SOPs for these analyses and their procedures are contained in appendices to this QAPP. In addition, Soils and Engineering Services Company (SES) of Madison, Wisconsin will perform laboratory geotechnical analyses on soils using either ASTM or other standard methods as appropriate.

The general mutual objectives of the RI/FS, as stated in the Consent Order are to:

- fully determine the nature and extent, if any, of the release or threatened release of hazardous substances, pollutants, or contaminants from the Stoughton City Landfill site, and

- identify and evaluate alternatives for the appropriate extent, if any, of remedial action to prevent or mitigate the migration or release or threatened release of hazardous substances, pollutants, or contaminants from the site.

In response to these objectives, the Stoughton City Landfill RI/FS will be conducted using a phased process. Data will be collected in several stages and as the site and adjacent area are better characterized, subsequent data collection efforts will be focused to fill any existing gaps in the data. In this way, the scope of the overall site characterization effort can be continually updated to minimize the collection of unnecessary data and maximize the data quality.

Task 1 activities will take place during the initial phase of the RI. These activities will include ascertaining pertinent background data to identify potential migration pathways that will be studied in more detail during the site investigation phase (Task 2) of the RI. In addition to gathering general background information, limited field investigations are also proposed under Task 1 within the existing Landfill boundary and in the area just south of it. Task 1 investigations may be extended outside of this initial investigation area depending upon the results of Task 1. These investigations include: (1) geophysical surveys to delineate disposal area limits and areas potentially characterized by ground water contamination; (2) a soil gas investigation to evaluate the areal distribution of VOCs in the refuse, the near-surface soil, and in the ground water at the site, and (3) the installation of surface water staff gages and piezometers for the determination of ground water flow direction. Activated carbon tubes will be generated during this phase of the RI for subsequent analysis by Pace Laboratories.

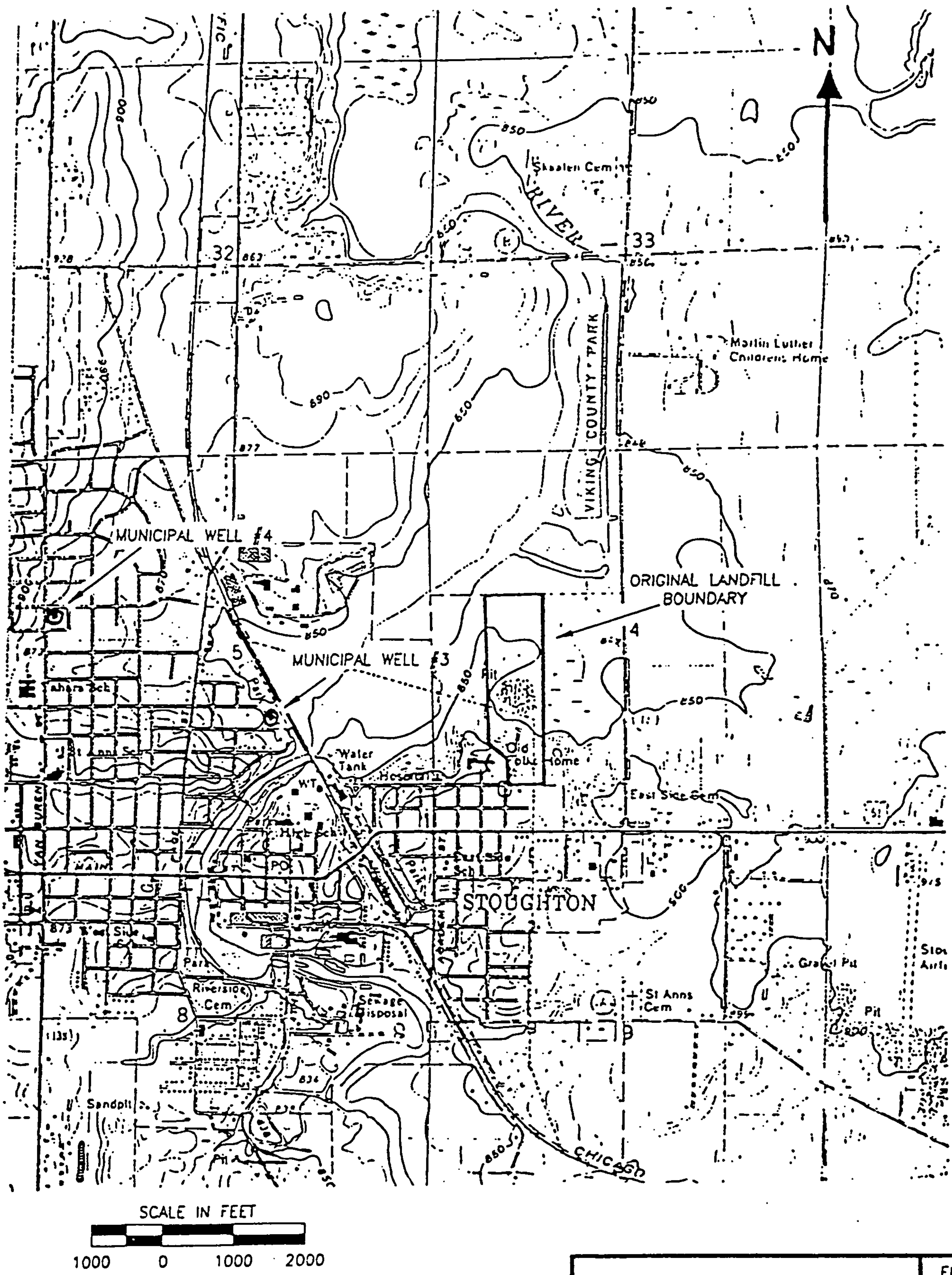
The second phase of the RI will include more detailed site investigation activities. The primary focus of initial site investigations will be hydrogeological investigations. These investigations will first be focused within the initial investigative area and may be extended outside of this area following a review of Task 1 results and also the results of monitoring well sampling. Samples that will be generated for laboratory analysis by CompuChem Laboratories during this phase of the RI may include ground water, surface water, soil, and sediment. In addition, other volatile organics in ground water, surface water, soil and sediment will be analyzed by Pace Laboratories using nonstandard methods; and private water well samples may possibly be taken for laboratory analysis. In addition, outdoor air samples will be collected on activated carbon tubes for analysis of certain VOCs by Pace Laboratories during this phase. Lastly, particle-size analysis and possibly laboratory hydraulic conductivity will be determined on soils by Soils and Engineering Services, Inc.

1.2 Site Description

1.2.1 Site Location and History

The Stoughton City Landfill is located in the City of Stoughton, Dane County, Wisconsin and occupies portions of the S1/2 of the NW1/4 and the SW1/4 of Section 4, T5N, R11E (see Figure 1-1). Although the original Landfill property occupied approximately 40 acres, landfilling has occurred on only about 15 acres of the property. (See Figure 1-2). Since 1982, land exchanges between the City and an adjacent land owner have modified the original site boundary. (See Figure 1-2). Current ownership of adjacent land will be determined during the initial task of the RI.

The City of Stoughton purchased the original site in July, 1952 and then annexed it in September, 1952 after which landfill operations began. Between 1952 and 1972, the site was operated as an uncontrolled dumpsite. During this time, refuse was usually burned and at times covered by dirt. In 1972, the site began to be operated as a State-licensed landfill. In 1978, the Wisconsin Department of Natural Resources (WDNR) required that the site be closed according to State regulations. Closure activities included: construction of a trash transfer station, placement of cap material borrowed from the northwest portion of the site and from agricultural areas, application of topsoil also derived from an agricultural area, and seeding. From 1978 to 1982, only brick, rubble, etc. were accepted at the site while closure work was performed. The unit was officially closed in 1982.

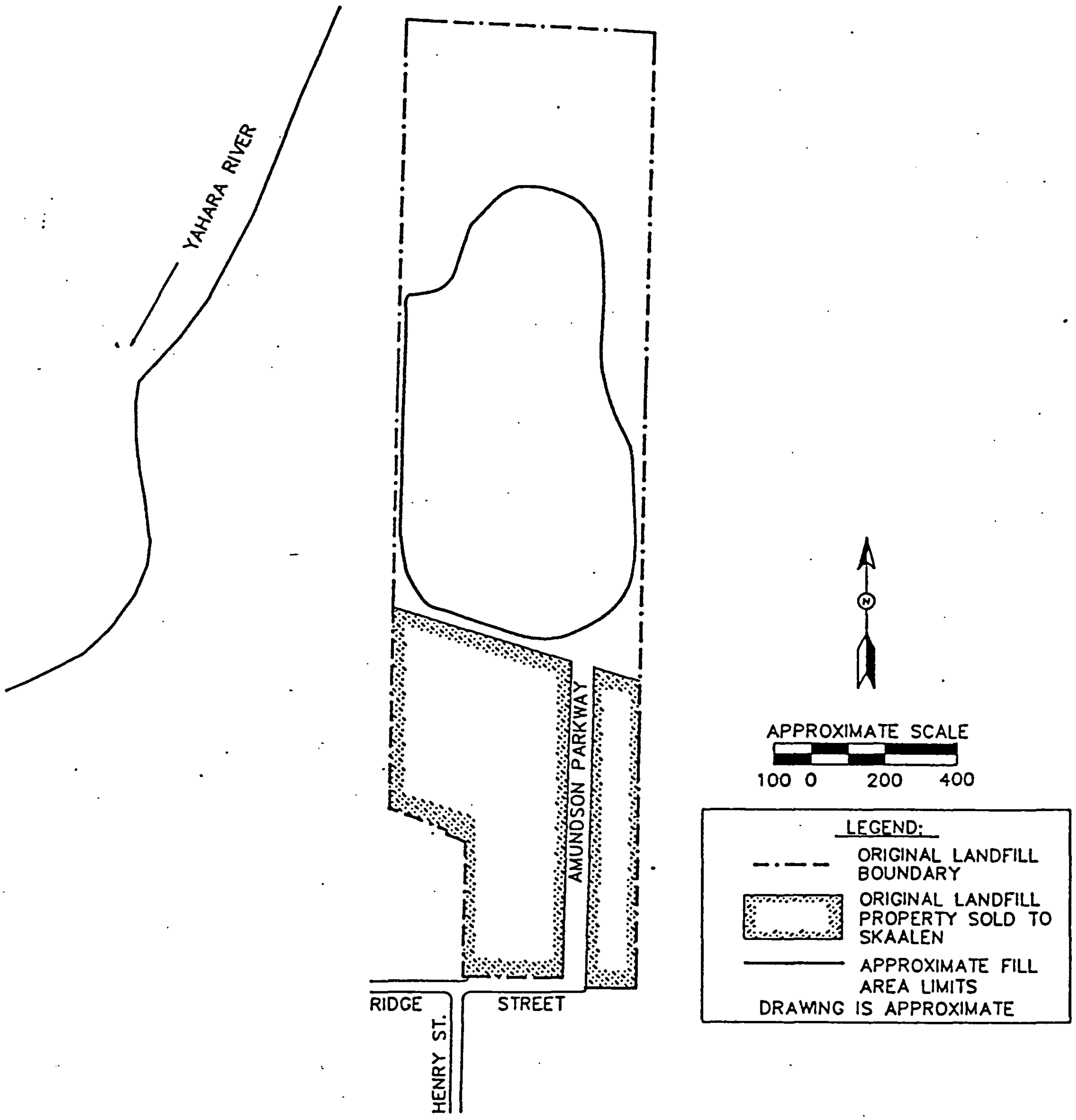


SOURCE: USGS, 7.5 MINUTE STOUGHTON QUADRANGLE, DANE CO., WISCONSIN

STOUGHTON CITY LANDFILL
LOCATION MAP

ERM ERM–North Central, Inc.

FIGURE
1–1



STOUGHTON CITY LANDFILL
PROPERTY BOUNDARIES

FIGURE
1-2

ERM-North Central, Inc.

9/15/88
mo

The Landfill was established for use by City residents (including commercial establishments, industrial operations, major industries as well as smaller-scale machine shops, autobody/repair operations, dry cleaners, and other maintenance facilities). Uniroyal Plastics (formerly U.S. Rubber) disposed of liquid and solid waste from 1953 until late 1962. Most of these liquid wastes were disposed of by incinerating in the refuse burning areas; however, some were reported to have been dumped down boreholes drilled by a local firm which tested truck-mounted earth auger equipment on high ground within the west-central portion of the Landfill boundary. In 1962, the City contracted for the collection of garbage and rubbish from residences and commercial places of business, and this waste was reportedly disposed at a site other than the City-owned landfill. Large items of residential rubbish such as appliances, furniture, etc. were not picked up by the contractor but were carried to the Landfill by property owners. The City disposed of street refuse, trees, and grit from the wastewater treatment plant.

On November 17, 1983 the WDNR sampled monitoring wells at the Stoughton City Landfill site. The results showed elevated levels of volatile organic compounds (VOCs) in two of the six wells. Subsequent testing by the City of Stoughton found additional VOCs during routine sampling of the ground water. The site was added to the USEPA National Priorities List (NPL) in June, 1986.

The Stoughton City Landfill is currently an inactive facility. Vehicular access to the site is controlled by two gates that are locked at all times; however, security fencing is not in place around the site at this time.

1.2.2 Environmental Setting

The Stoughton City Landfill site is located in the northeast portion of the City of Stoughton and borders apparent wetland areas east of the Yahara River (Figure 1-1). Land surface elevation ranges from a high of about 900 feet above mean sea level (AMSL) in the southwestern portion of the Landfill to about 840 feet AMSL along the north border of the Landfill and in its central portion. An apparent wetland area in the east-central portion of the site -- bounded on the north, west, and south by higher ground -- was the primary area of waste disposal. The approximate north one quarter of the site also contained an area of lowland. Land exchanges since 1982 have modified the original property boundaries.

Surficial deposits in the vicinity of the site include ice-contact stratified deposits and lacustrine plain sediments (Mickelson and McCartney, 1979). Ice-contact stratified deposits generally include significant sand and gravel deposits and landforms such as kames and eskers. These deposits occupy higher ground within the Landfill. Lacustrine plain or glacial-lake bottom sediments are generally comprised of fine-grained silt and clay with some sand present near former shorelines and stream inlets. These areas are often flat, poorly drained, and show evidence of peat accumulation. Lacustrine plain deposits occupy the east-central portion of the site, which was developed for primary waste disposal and the low-lying north portion of the

Stoughton City Landfill RI/FS will include volatile and semi-volatile organic compounds, pesticides/PCBs, inorganic compounds and cyanide in water and soil/sediment; tetrahydrofuran, trichlorogluoromethane, and dichlorodifluoromethane in water and soil/sediment; and, target and other analyzable VOCs in soil gas and outdoor air. Table 1-3 contains the Target Compounds List (TCL) and the Contract Required Quantitation Limits (CRQL) for water and soil/sediment samples. The three VOCs to be determined by nonstandard methods including their detection limits are listed in Table 1-4, and target VOCs and other potentially analyzable VOCs in soil gas and air and their respective detection limits are indicated in Table 1-5.

1.4 Project Objective

In addition to the general project objectives stated in Section 1.1, specific objectives include the following:

- Characterize the nature of potential contamination at the site.
- Locate and delineate contaminant sources at the site.
- Evaluate the vertical and horizontal extent of contamination originating from the Stoughton City Landfill site.
- Identify and evaluate potential contaminant migration characteristics.

TABLE 1-3

TARGET COMPOUND LIST (TCL) AND CONTRACT REQUIRED QUANTITATION LIMITS (CRQL)(1,2)

I. Volatiles	CAS Number	Quantitation Limits(3)	
		Water ug/l	Low Soil/Sediment(4) ug/kg
1. Chloromethane	74-87-3	10	10
2. Bromomethane	74-83-9	10	10
3. Vinyl Chloride	75-01-4	10	10
4. Chloroethane	75-00-3	10	10
5. Methylene Chloride	75-09-2	5	5
6. Acetone	67-64-1	10	10
7. Carbon Disulfide	75-15-0	5	5
8. 1,1-Dichloroethene	75-35-4	5	5
9. 1,1-Dichloroethane	75-34-3	5	5
10. 1,2-Dichloroethene (total)	540-59-0	5	5
11. Chloroform	67-66-3	5	5
12. 1,2-Dichloroethane	107-06-2	5	5
13. 2-Butanone	78-93-3	10	10
14. 1,1,1-Trichloroethane	71-55-6	5	5
15. Carbon Tetrachloride	56-23-5	5	5
16. Vinyl Acetate	108-05-4	10	10
17. Bromodichloromethane	75-27-4	5	5
18. 1,2-Dichloropropane	78-87-5	5	5
19. cis-1,3-Dichloropropene	10061-01-5	5	5
20. Trichloroethene	79-01-6	5	5
21. Dibromochloromethane	124-48-1	5	5
22. 1,1,2-Trichloroethane	79-00-5	5	5
23. Benzene	71-43-2	5	5
24. trans-1,3-Dichloropropene	10061-02-6	5	5
25. Bromoform	75-25-2	5	5
26. 4-Methyl-2-pentanone	108-10-1	10	10
27. 2-Hexanone	591-78-6	10	10
28. Tetrachloroethene	127-18-4	5	5
29. Toluene	108-88-3	5	5
30. 1,1,2,2-Tetrachloroethane	79-34-5	5	5

TABLE 1-3

TARGET COMPOUND LIST (TCL) AND CONTRACT REQUIRED QUANTITATION LIMITS (CRQL)(1,2)

(continued)

I. Volatiles	CAS Number	Quantitation Limits(3) Water ug/l	 Low Soil/Sediment(4) ug/kg
31. Chlorobenzene	108-90-7	5	5
32. Ethyl Benzene	100-41-4	5	5
33. Styrene	100-42-5	5	5
34. Xylenes (Total)	1330-20-7	5	5

(1) 7/87 SOW for CLP Program.

(2) Specific quantitation limits are highly matrix dependent. The quantitation limits listed herein are provided for guidance and may not always be achievable.

(3) Quantitation limits listed for soil/sediment are based on wet weight. The quantitation limits calculated by the laboratory for soil/sediment, calculated on dry weight basis as required by the contract, will be higher.

(4) Medium Soil/Sediment Contract Required Quantitation Limits (CRQL) for Volatile TCL Compounds are 125 times the individual Low Soil/Sediment CRQL.

TABLE 1-3

TARGET COMPOUND LIST (TCL) AND CONTRACT REQUIRED QUANTITATION LIMITS (CRQL) (continued)

		Quantitation Limits(1)	
II. Semivolatiles	CAS Number	Water ug/l	Low Soil/Sediment(2) ug/kg
35. Phenol	108-95-2	10	330
36. bis(2-Chloroethyl)ether	111-44-4	10	330
37. 2-Chlorophenol	95-57-8	10	330
38. 1,3-Dichlorobenzene	541-73-1	10	330
39. 1,4-Dichlorobenzene	106-46-7	10	330
40. Benzyl alcohol	100-51-6	10	330
41. 1,2-Dichlorobenzene	95-50-1	10	330
42. 2-Methylphenol	95-48-7	10	330
43. bis(2-Chloroisopropyl) ether	108-60-1	10	330
44. 4-Methylphenol	106-44-5	10	330
45. N-Nitroso-di-n-dipropylamine	621-64-7	10	330
46. Hexachloroethane	67-72-1	10	330
47. Nitrobenzene	98-95-3	10	330
48. Isophorone	78-59-1	10	330
49. 2-Nitrophenol	88-75-5	10	330
50. 2,4-Dimethylphenol	105-67-9	10	330
51. Benzoic acid	65-85-0	50	1600
52. bis(2-Chloroethoxy)methane	111-91-1	10	330
53. 2,4-Dichlorophenol	120-83-2	10	330
54. 1,2,4-Trichlorobenzene	120-82-1	10	330
55. Napthalene	91-20-3	10	330
56. 4-Chloroaniline	106-47-8	10	330
57. Hexachlorobutadiene	87-68-3	10	330
58. 4-Chloro-3-methylphenol (para-chloro-meta-cresol)	59-50-7	10	330
59. 2-Methylnaphthalene	91-57-6	10	330
60. Hexadchlorocyclopentadiene	77-47-4	10	330
61. 2,4,6-Trichlorophenol	88-06-2	10	330
62. 2,4,5-Trichlorophenol	95-95-4	50	1600
63. 2-Chloronaphthalene	91-58-7	10	330
64. 2-Nitroaniline	88-74-4	50	1600
65. Dimethylphthalate	131-11-3	10	330
66. Acenaphthylene	208-96-8	10	330
67. 2,6-Dinitrotoluene	606-20-2	10	330
68. 3-Nitroanline	99-09-2	50	1600
69. Acenaphthene	83-32-9	10	330

TABLE 1-3

TARGET COMPOUND LIST (TCL) AND CONTRACT REQUIRED QUANTITATION LIMITS (CRQL) (continued)

II. Semivolatiles	CAS Number	Quantitation Limits(1) Water ug/l	 Low Soil/Sediment(2) ug/kg
70. 2,4-Dinitrophenol	51-28-5	50	1600
71. 4-Nitrophenol	100-02-7	50	1600
72. Dibenzofuran	132-64-9	10	330
73. 2,4-Dinitrotoluene	121-14-2	10	330
74. Diethylphthalate	84-66-2	10	330
75. 4-Chlorophenyl-phenyl ether	7005-72-3	10	330
76. Fluorene	86-73-7	10	330
77. 4-Nitroaniline	100-01-6	50	1600
78. 4,6-Dinitro-2-methylphenol	534-52-1	50	1600
79. N-nitrosodiphenylamine	86-30-6	10	330
80. 4-Bromophenyl-phenylether	101-55-3	10	330
81. Hexachlorobenzene	118-74-1	10	330
82. Pentachlorophenol	87-86-5	50	1600
83. Phenanthrene	85-01-8	10	330
84. Anthracene	120-12-7	10	330
85. Di-n-butylphthalate	84-74-2	10	330
86. Fluoranthene	206-44-0	10	330
87. Pyrene	129-00-0	10	330
88. Butylbenzylphthalate	85-68-7	10	330
89. 3,3'-Dichlorobenzidine	91-94-1	20	660
90. Benzo(a)anthracene	56-55-3	10	330
91. Chrysene	218-01-9	10	330
92. bis(2-Ethylhexyl)phthalate	117-81-7	10	330
93. Di-n-octylphthalate	117-84-0	10	330
94. Benzo(b)fluoranthene	205-99-2	10	330
95. Benzo(k)fluoranthene	207-08-9	10	330
96. Benzo(a)pyrene	50-32-8	10	330
97. Indeno(1,2,3-cd)pyrene	193-39-5	10	330
98. Dibenz(a,h)anthracene	53-70-3	10	330
99. Benzo(g,h,i)perylene	191-24-2	10	330

(1) Quantitation limits listed for soil/sediment are based on wet weight. The quantitation limits calculated by the laboratory for soil/sediment, calculated on dry weight basis as required by the contract, will be higher.

(2) Medium Soil/Sediment Contract Required Quantitation Limits (CRQL) for Semi-Volatile TCL Compounds are 60 times the individual Low Soil/Sediment CRQL.

TABLE 1-3

TARGET COMPOUND LIST (TCL) AND CONTRACT REQUIRED QUANTITATION LIMITS (CRQL) (continued)

			Quantitation Limits(1)	
II.	Pesticides/PCBs	CAS Number	Water ug/l	Low Soil/Sediment(2) ug/kg
100.	alpha-BHC	319-84-6	0.05	8.0
101.	beta-BHC	319-85-7	0.05	8.0
102.	delta-BHC	319-86-8	0.05	8.0
103.	gamma-BHC (Lindane)	58-89-9	0.05	8.0
104.	Heptachlor	76-44-8	0.05	8.0
105.	Aldrin	309-00-2	0.05	8.0
106.	Heptachlor epoxide	1024-57-3	0.05	8.0
107.	Endosulfan I	959-98-8	0.05	8.0
108.	Dieldrin	60-57-1	0.10	16.0
109.	4,4'-DDE	72-55-9	0.10	16.0
110.	Endrin	72-20-8	0.10	16.0
111.	Endosulfan II	33213-65-9	0.10	16.0
112.	4,4'-DDD	72-54-8	0.10	16.0
113.	Endosulfan sulfate	1031-07-8	0.10	16.0
114.	4,4'-DDT	50-29-3	0.10	16.0
115.	Methoxychlor	72-43-5	0.5	80.0
116.	Endrin ketone	53494-70-5	0.10	16.0
117.	alpha-Chlordane	5103-71-9	0.5	80.0
118.	gamma-Chlordane	5103-74-2	0.5	80.0
119.	Toxaphene	8001-35-2	1.0	160.0
120.	Aroclor-1016	12674-11-2	0.5	80.0
121.	Aroclor-1221	11104-28-2	0.5	80.0
122.	Aroclor-1232	11141-16-5	0.5	80.0
123.	Aroclor-1242	53469-21-9	0.5	80.0
124.	Aroclor-1248	12672-29-6	0.5	80.0
125.	Aroclor-1254	11097-69-1	1.0	160.0
126.	Aroclor-1260	11096-82-5	1.0	160.0

(1) Quantitation limits listed for soil/sedimient are based on wet weight. The quantitation limits calculated by the laboratory for soil/sediment, calculated on dry weight basis as requried by the contract, will be higher.

(2) Medium Soil/Sediment Contract Required Quantitation Limits (CRQL) for Pesticide/PCB TCL compounds are 15 times the individual Low Soil/Sediment CRQL.

TABLE 1-3

TARGET COMPOUND LIST (TCL) AND CONTRACT REQUIRED QUANTITATION LIMITS (CRQL) (continued)

IV. Inorganics	Quantitation Limit (1,2) ug/l
1. Aluminum	200
2. Antimony	60
3. Arsenic	10
4. Barium	200
5. Beryllium	5
6. Cadmium	5
7. Calcium	5000
8. Chromium	10
9. Cobalt	50
10. Copper	25
11. Iron	100
12. Lead	5
13. Magnesium	5000
14. Manganese	15
15. Mercury	0.2
16. Nickel	40
17. Potassium	5000
18. Selenium	5
19. Silver	10
20. Sodium	5000
21. Thallium	10
22. Vanadium	50
23. Zinc	20
24. Cyanide	10

(1) Elements determined by inductively coupled plasma emission or Atomic Absorption (AA) spectroscopy.

(2) Quantitation limits for water.

TABLE 1-4

NONSTANDARD METHOD VOCs

VOCs	Detection Limit Water (ug/l)	Detection Limit Soil/Sediment(mg/kg)
Tetrahydrofuran	1.5	1.9
Trichlorofluoromethane	0.4	0.05
Dichlorodifluoromethane	1.5	0.19

→ SW
ERS
#133

ERM-North Central, Inc.
Environmental Resources Management

102 Wilmot Road • Suite 300 • Deerfield, Illinois 60015 ☎ (312) 940-7200

January 9, 1989

Michael A. Valentino
Remedial Project Manager
U.S. Environmental Protection Agency
Region V
Mail Code: 5HS-11
230 S. Dearborn Street
Chicago, IL 60604

Re: Transmittal of Final Revisions for Stoughton City Landfill RI/FS

Dear Mr. Valentino:

In accordance with your letter of December 16, 1988, enclosed please find final revision pages for the Work Plan, QAPP, and Field Sampling Plan (FSP) for the Stoughton City Landfill RI/FS on behalf of the Stoughton City Landfill Steering Committee. In accordance with your letter, five (5) copies of these revisions are being submitted in the form of inserts for only those pages, figures, and tables identified as requiring modification. In addition, enclosed please find the QAPP signature sheet which has been signed by ERM-North Central personnel.

If you have any questions, please do not hesitate to contact me.

Sincerely,

ERM-North Central, Inc.

Louis H. Meschede

Louis H. Meschede
Senior Hydrologist

jas
Enc.

cc: Briand Wu, Uniroyal Plastics Company
Robert Kardasz, City of Stoughton
Mark Giesfeldt, Wisconsin DNR
Michael Doran, Strand & Associates

B. Daily Calibration

1. Preparative standards

   Standards are prepared as in section IV.A.1.

2. Instrument Calibration

   The daily calibration curve as established in section IV.A.2. is utilized.

   The working calibration curve or RF must be verified on each working day by the measurement of a QC check sample at the midpoint of the calibration curve. The response must be within ≤ 25%.

3. Analysis of Calibration Data

   Calibration standards shall be analyzed each day to verify that instrument response has not changed from previous calibration. Before sample analysis each day, the mid-level standard shall be analyzed. The response must fall within ≤ 25% of the mean response from prior Initial/Daily Calibrations. If the response fails this test, the daily standard shall be reanalyzed. If the response from the second analysis is not within ≤ 25% of the mean response from prior Initial/Daily Calibrations, Initial Calibration must be performed before analyzing samples.

   After sample analyses are completed each day, the mid-level standard shall be analyzed again. The response must again meet the criteria outlined above. If, after two tries the mid-level check standard still does not fall within ≤ 25% of the mean

- **Bottle Caps**
  1) Remove paper liners from caps.
  2) Wash with detergent.
  3) Rinse with distilled water.
  4) Dry at 40°C.

- **Teflon Liners (avoid contact with fingers)**
  1) Wash with detergent.
  2) Rinse with distilled water.
  3) Rinse with acetone.
  4) Rinse with hexane (Nanograde or equivalent).
  5) Air day.
  6) Place liners in cleaned caps.
  7) Heat to 40°C for 2 hours.
  8) Allow to cool.
  9) Use to cap cleaned bottles.

C. Storage Conditions

Store samples at 4°C until analysis.

D. Holding time limits.

All samples must be analyzed within 7 days of collection.

E. Solution Verification

Whenever new stock solutions are prepared, the response is verified versus the old standards and must be within ± 25 percent. New stock solutions are typically prepared every two months.

SAMPLING AND ANALYSIS PLAN FOR REMEDIAL INVESTIGATION AND FEASIBILITY STUDY

PART II - QUALITY ASSURANCE PROJECT PLAN

REVISION: 2

STOUGHTON CITY LANDFILL
STOUGHTON, WISCONSIN

NOVEMBER 28, 1988

PREPARED BY:

ERM-NORTH CENTRAL, INC.
102 WILMOT ROAD, SUITE 300
DEERFIELD, ILLINOIS 60015

12/19/88
PRP TECHNICAL COMMITTEE CHAIRMAN

Michael A. Valentino 12-15-88
USEPA REMEDIAL PROJECT MANAGER

ERM PROJECT MANAGER

James H. Adams, Jr. (Acting) 12/7/88
USEPA QA OFFICER

ERM QA MANAGER

TABLE OF CONTENTS

TABLE 7-1

SAMPLE CONTAINER AND PRESERVATION REQUIREMENTS

Soil Gas Parameters(1)	Container	Preservation	Maximum Holding Time	Filling Instructions
Target and Analyzable Volatile Organics	Activated Carbon Cartridge	Cool 4°C	7 days	Cap cartridge ends
Ground Water/Surface Water Parameters(2)				
TCL Volatile Organics	2 x 40 ml Glass Vials with Teflon-lined septum	Cool 4°C	10 days	Zero headspace, no air bubbles
TCL Base Neutral Organics and Acid Extractable Organics	3 x 1 liter amber glass bottles with Teflon-lined cap	Cool 4°C	5 days	Fill to neck of bottle
PCBs/Pesticides	2 x 1 liter amber glass bottles with Teflon-lined cap	Cool 4°C	5 days	Fill to neck of bottle
TCL Metals (3)	2 x 500 ml Polyethylene bottle	0.45 u Filtration (Ground Water Only) HN_03 to pH<2 Cool 4°C	6 months	Fill to neck of bottle
Cyanides	1 x 1 liter glass bottle with Teflon-lined cap	NaOH to pH>12 Cool 4°C	14 days	Fill to neck of bottle
Other Volatile Organics (1,4)	2 x 40 ml Glass Vials with Teflon-lined septum	Cool 4°C	7 days	Zero headspace, no air bubbles

TABLE 7-1 (continued)

SAMPLE CONTAINER AND PRESERVATION REQUIREMENTS

Soil/Sediment Parameters(2)	Container	Preservation	Maximum Holding Time	Filling Instructions
TCL Volatile Organics	2 x 4 oz wide-mouth glass jars with Teflon-lined cap	Cool 4°C	10 days	Zero headspace, pack tightly
TCL Base Neutral Organics and Acid Extractable Organics	1 x 1 liter, wide-mouth amber glass jar with Teflon-lined cap	Cool 4°C	10 days	At least 3/4 full
PCBs/Pesticides	From semivolatile Organic Container	Cool 4°C	10 days	At least 3/4 full
TCL Metals (3)	1 x 1 liter, wide-mouth amber glass jar with Teflon-lined lid	Cool 4°C	6 months	At least 3/4 full
Cyanides	From TCL Metals Container	Cool 4°C	14 days	At least 3/4 full
Air Parameters(1)				
Analyzable Volatile Organics	Activated Carbon Cartridge	Cool 4°C	7 days	Cap cartridge ends

Note: All samples will be shipped by overnight carrier to their final laboratory destination under custody.

(1) Soil gas, air and other volatile organic parameters to be analyzed by Pace Laboratories.

(2) Ground water, surface water, and soil/sediment parameters to be analyzed by CompuChem Laboratories, excluding other volatile organics.

(3) Maximum holding time for mercury of 26 days.

(4) Other volatile organics include tetrahydrofuran, trichlorofluoromethane, and dichlorodifluoromethane.

8.0 FIELD QUALITY CONTROL SAMPLES

o Field blank samples are defined as samples which are obtained by running analyte-free ionized water through sample collection equipment (bailer, pump, auger, etc.) after decontamination. These samples must be collected and analyzed at a frequency of one per group of 10 or fewer investigative samples.

o Trip blank samples, which are required for aqueous volatile organic samples only, are prepared in the laboratory prior to the sampling event in actual sample containers and shipped with empty sample containers to the field. They are kept capped throughout the sampling event. When the sampling event is completed, they are shipped with investigative samples back to the lab for analysis. Trip blank samples are collected at a frequency of one per shipping cooler.

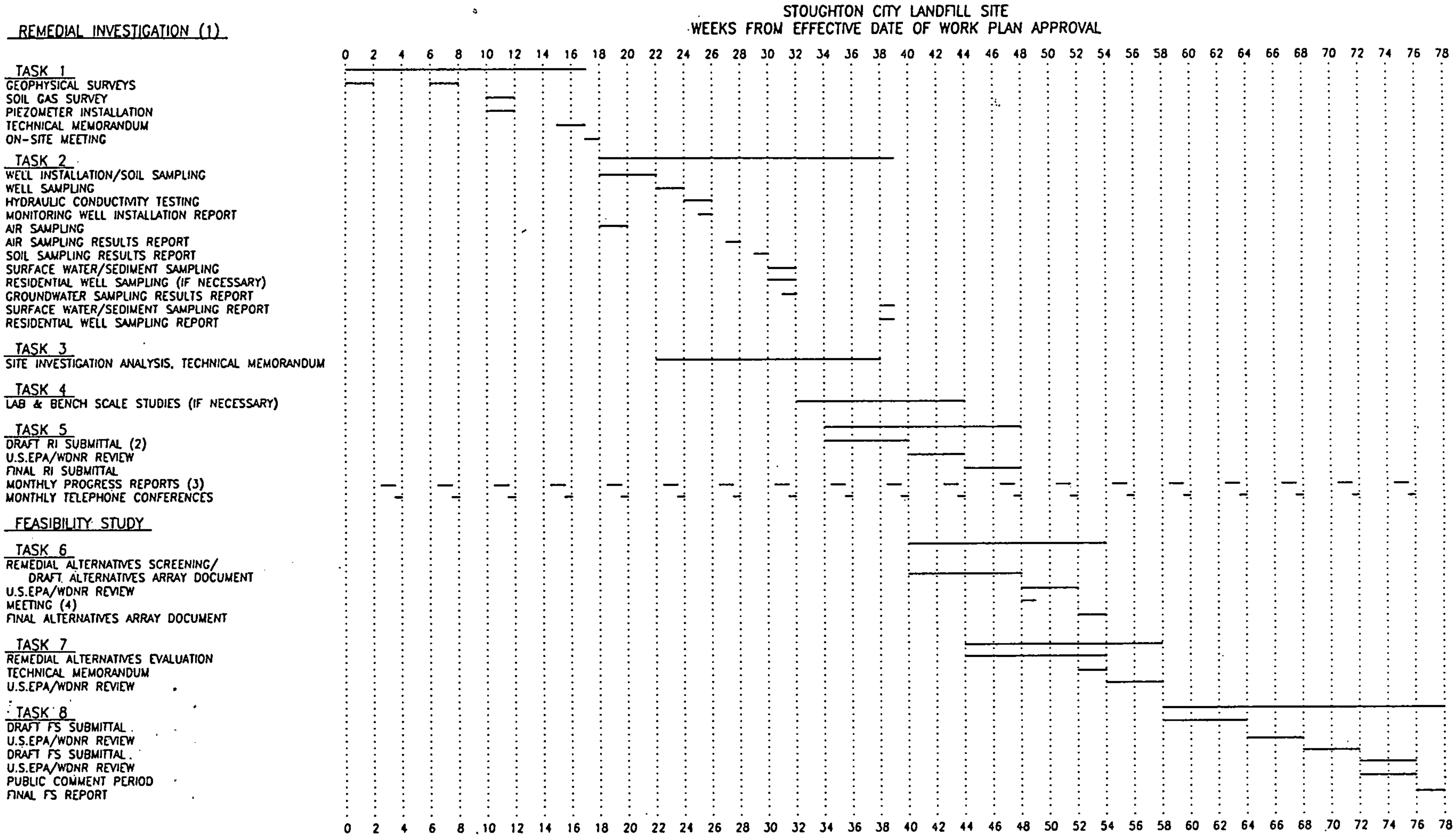
TABLE 6-1

ESTIMATED SUBMITTAL DATES FOR TECHNICAL MEMORANDA DURING THE STOUGHTON CITY LANDFILL RI AND FS

TITLE	SUBMITTAL DATE* (WEEKS)
Task 1 Technical Memorandum	17
1.1 Site Boundary Survey, Current Ownership Determination, Detailed Land Survey, and Site Control Measures	
1.2 Historical Aerial Photo Analysis	
1.3 Area Ground Water Usage Survey	
1.4 History of Response Actions and Evaluation of Existing Data	
1.5 Geophysical and Soil Gas Surveys	
1.6 Review of Air Sampling Data	
1.7 Surface Water Evaluation	
1.8 Ground Water Flow Direction Evaluation	
Report of Monitoring Well Installation	26
Results of Air Sampling	28**
Results of Soil Sampling at Landfill	30**
Results of Ground Water Sampling at Landfill	32**
Results of Site Investigation Analysis	38**
Results of Residential Well Sampling (If Necessary)	39**
Results of Surface Water Sampling (If Necessary)	39**
Results of Remedial Alternative Screening	48

* Dates are in reference to effective date for Work Plan approval.

** Estimated submitted, actual date will be 4 weeks after receipt of laboratory results to enable validation.



(1) REMEDIAL INVESTIGATION TO BE CONDUCTED USING PHASED APPROACH.
(2) DRAFT RI REPORT MAY NOT INCLUDE DATA EVALUATION AND BASELINE RISK ASSESSMENT FOR SURFACE WATER, SEDIMENT AND RESIDENTIAL WELL RECEPTORS. IF SO, AN INTERIM REPORT DETAILING THIS INFORMATION WILL BE SUBMITTED WITHIN 42 WEEKS OF THE EFFECTIVE DATE OF WORK PLAN APPROVAL.
(3) AS REQUIRED BY ADMINISTRATIVE ORDER BY CONSENT. SHOWN FOR PURPOSES OF CLARIFICATION.
(4) MEETING TO BE HELD AMONG RESPONDENTS AND THEIR REPRESENTATIVES, U.S.EPA AND WDNR TO DISCUSS THE RESULTS OF THE RESPONDENTS' REMEDIAL ALTERNATIVES SCREENING PROCESS. LOCATION, DATE AND TIME TO BE DETERMINED.

ESTIMATED RI/FS PROJECT SCHEDULE	FIGURE NO. 6-1
ERM ERM-North Central, Inc.	1/6/89 cs

potential private well samples obtained during the RI. Should private well sampling be required, Standard Operating Procedures (SOPs) for the proposed analyses will be submitted as an addendum to this QAPP. In performing these analyses, CompuChem Laboratories will follow all procedures specified in the 7/87 Statement of Work (SOW) for organics and in the 7/87 SOW for inorganics as required under USEPA's Contract Laboratory Program (CLP). CompuChem intends to eventually perform both organic and inorganic analyses under the new SOW expected in early 1989. Pace Laboratories will conduct nonstandard method analyses for three additional volatile organic compounds (VOCs) in water and soil/sediment and also analyze activated carbon tubes collected during the soil gas and outdoor air sampling portions of the RI. Pace Laboratories has prepared SOPs for these analyses and their procedures are contained in appendices to this QAPP. In addition, Soils and Engineering Services Company (SES) of Madison, Wisconsin will perform laboratory geotechnical analyses on soils using either ASTM or other standard methods as appropriate.

The general mutual objectives of the RI/FS, as stated in the Consent Order are to:

- fully determine the nature and extent, if any, of the release or threatened release of hazardous substances, pollutants, or contaminants from the Stoughton City Landfill site, and

TABLE 1-7

ESTIMATED SUBMITTAL DATES FOR TECHNICAL MEMORANDA DURING THE STOUGHTON CITY LANDFILL RI and FS

TITLE	SUBMITTAL DATE*(WEEKS)
Task 1 Technical Memorandum	17
1.1 Site Boundary Survey, Current Ownership Determination, Detailed Land Survey and Site Control Measures	
1.2 Historical Aerial Photo Analysis	
1.3 Area Ground Water Usage Survey	
1.4 History of Response Actions and Evaluation of Existing Data	
1.5 Geophysical and Soil Gas Surveys	
1.6 Review of Air Sampling Data	
1.7 Surface Water Evaluation	
1.8 Ground Water Flow Direction Evaluation	
Report of Monitoring Well Installation	26
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Results of Surface Water Sampling	39**
Results of Remedial Alternative Screening	48

* Dates are in reference to effective date for Work Plan approval.

** Estimated submittal, actual date will be 4 weeks after receipt of laboratory results to enable validation.

on specified performance criteria. Accuracy and precision requirements and method detection limits for CLP protocol analyses are described in the 7/87 SOWs for organic and inorganic analysis. Accuracy and precision criteria and required detectionlimits for VOC analyses by Pace Laboratories are presented in Appendices A and B. Precision and accuracy for inorganic water and soil sample analysis will be determined by using duplicate samples for precision and matrix spike samples for accuracy.

Analytical accuracy will be assessed through the collection of organic samples for matrix spike/matrix spike duplicate and surrogate spike analyses. A matrix effect is a phenomenon that occurs when other sample components interfere with the analysis of the contaminants of interest. Percentage recovery information obtained from matrix spikes will be used to address the amount of bias present in the measurement system (accuracy). In addition, surrogate spike recovery will be evaluated by determining whether the concentration (measured as percent recovery) falls inside the contract required recovery limits. This surrogate spike recovery information will be used to indicate the systematic error in the analytical method. If recovery of any one surrogate compound falls outside of the contract surrogate spike recovery limits, the laboratory must take appropriate actions in accordance with the 8/87 SOW for the CLP program to ensure accuracy of the analytical method. For metals analysis, interference check samples must be run to ensure accuracy in the analytical method.

The accuracy of field measurements of pH will be assessed through premeasurement calibrations and post-measurement verifications using at least two standard buffer solutions. The two measurements must each be within ±0.05 standard units of buffer solution values. Precision will be assessed through duplicate measurements. (The electrode will be withdrawn, rinsed with deionized water, and reimmersed between each duplicate). The instrument used will be capable of providing measurements to 0.1 standard unit. The accuracy of the specific conductance and HNu photoionization meters will be assured by daily calibration verification with check standards. If readings vary more than one (1) percent from an expected value, the units will be replaced.

3.2.1 Data Completeness, Representativeness, and Comparability

It is expected that the TCL organic and TCL inorganic parameters analyzed consistent with CLP procedures will provide data meeting the QC acceptance criteria for 95% of all samples analyzed. Upon request, the completeness of an analysis will be documented by the laboratory with items such as chromatograms, spectra, and QC data to allow the data user to assess the quality of the results.

The sampling and analysis program is designed to provide data representative of site conditions. During the development of this program, special consideration was given to past disposal practices, existing analytical data from previous site investigations, and the physical setting of the site to ensure the representativeness of the data generated by the RI.

Data comparability will be assured by using identical sampling procedures, analytical procedures, and by reporting results in identical units of measurement.

- A sample analysis request form will accompany each shipment of samples to the analytical laboratory. A description of the requested analysis and the specific laboratory analysis code will be included on this form.

- A standardized sample tracking form will also be completed to establish sample custody prior to shipment to the laboratory and to document specific sample preservation methods.

Copies of all sample custody forms will be maintained in the project files along with copies of all field measurement data and sample-specific information recorded in the field log book and on field data forms. Field custody procedures are further described in the Data Management Plan.

The specifications for chain-of-custody and document control for both CompuChem and Pace Laboratories will comply with the CLP requirements and be carried out in accordance with the 7/87 SOWs for CLP analyses for organics and inorganics.

CompuChem Laboratories will provide all sample containers necessary for field sampling and QC requirements. Each lot of sample containers will be checked for cleanliness by the laboratory and sealed to prevent contamination. Samples will be received at the laboratory by the sample custodian, who will examine each sample to ensure that no damage occurred during shipment and that the chain-of-custody record is complete and

6.2 Laboratory Equipment

CompuChem will perform calibration and preventative maintenance procedures for laboratory equipment in accordance with the 7/87 SOWs for organic and inorganic analysis. Pace Laboratories' calibration and maintenance procedures are described in Appendices A and B.

7.0 ANALYTICAL PROCEDURES

Water and soil/sediment samples collected will be analyzed for the complete Target Compound List (TCL) consistent with CLP procedures. If necessary, private well samples will be analyzed only for TCL compounds detected in the monitoring well samples. The complete list of TCL parameters is shown on Table 1-3. The TCL analyses will be conducted by CompuChem Laboratories using methods specified in the 7/87 SOWs for organics and inorganics.

Other VOCs for water and soil/sediment (Table 1-4), and analyzable VOCs for soil gas and air (Table 1-5) will be analyzed by Pace Laboratories in accordance with Level V nonstandard methods as outlined in Appendix A (soil gas and air) and Appendix B (additional VOCs in water and soil/sediment).

8.0 INTERNAL QUALITY CONTROL CHECKS

8.1 Analytical Laboratories

Quality control at CompuChem Laboratories will be carried out in accordance with the 7/87 SOWs for organics and inorganics. Quality control at Pace Laboratories will be carried out as described in Appendices A and B.

8.2 Field Quality Control

Field quality control will be carried out during all field activities such as soil sampling, ground water sampling, surface water/sediment sampling, and well drilling and installation by an experienced ERM-North Central geologist or engineer. The on-site supervisor will be present during all sampling activities and subcontracted activities such as drilling. All field quality control procedures will be carried out according to the QAPP and documented in the field notebook.

11.0 PREVENTATIVE MAINTENANCE

11.1 Laboratory Equipment

All equipment at the laboratories will be maintained in accordance with the 7/87 SOWs for organic and inorganic analysis.

11.2 Field Equipment

Preventative maintenance procedures for the HNu photoionization meter, pH meter and conductivity meter will be carried out in accordance with operating manuals for the respective instruments and will be recorded in the field log book.

12.0 SPECIFIC ROUTINE PROCEDURES USED TO ASSESS DATA PRECISION, ACCURACY AND COMPLETENESS

Both CompuChem and Pace Laboratories will comply with the 7/87 SOWs for organic and inorganic analysis, as appropriate, to assess data precision, accuracy and completeness. Additionally, 40 CFR Part 136, Section 7.1 - 8.7 (pp 43375-43377) will be applied as necessary in the assessment.

13.0 CORRECTIVE ACTION

13.1 Analytical Laboratories

Corrective actions for CompuChem Laboratory will be carried out in accordance with procedures outlined in the 7/87 SOWs for organics and inorganic analysis.

13.2 Field Work

Corrective action indicated by audit results or detection of unacceptable data will be determined by ERM-North Central's Project Manager in consultation with the Stoughton City Landfill Steering Committee, USEPA, and WDNR. Corrective action may include, but is not limited to:

- Resampling and reanalyzing samples if holding time criteria are exceeded.
- Evaluating and amending sampling and analytical procedures.
- Accepting data with an acknowledged level of uncertainty.
- Eliminating outliers identified by the validation task.

Equation 1

$$RF = \frac{(A_S)(C_{IS})}{(A_{IS})(C_S)}$$

where:

A_S = area for the parameter of interest

A_{IS} = area for the internal standard

C_S = concentration of the parameter of interest (ug/mL)

C_{IS} = concentration of the internal standard (ug/mL)

If the RF value over the working range is a constant (<30% RSD), the RF can be assumed to be invariant an the average RF can be used for calculations. The R corrects for desorption efficiency for each compound interest.

7.3 The working calibration curve (or RF) must be verified on ea working day by the measurement of a 50 ug/mL calibrati standard. Calculate the % difference for each compound usi Equation 2.

Equation 2

$$\% D = \frac{RF_{IC} - RF_C}{RF_{IC}} \times 100$$

where:

RF_{IC} = response factor from the initial calibration
RF_C = current response factor

If the %D for any parameter is greater than ≤25%, a new calibration curve must be prepared.

9.1.5 The charcoal tubes should be capped with the supplied plastic caps immediately after sampling. Under no circumstances should rubber caps be used.

9.1.6 One tube should be handled in the same manner as the sample tube (break, seal and transport) except that no air is sampled through this tube. This tube should be labeled as a travel blank and be treated as a regular sample. Results for travel blanks will be submitted with samples.

9.1.7 Label as primary and secondary tube.

9.2 All samples must be iced or refrigerated at 4°C from the time of collection until desorption.

9.3 All samples must be analyzed within 7 days of collection.

10. Sample Desorption

10.1 The status of the seals on each charcoal tube is noted and recorded as intact, broken, or none.

10.2 The field identification number and the laborator identification number on each sample seal are checked wit those on the sample identification sheets.

10.3 Remove front and back charcoal sections from each primary tube and place in separate sample vials.

10.4 Add 10 uL of surrogate spiking solution to each sample, blank or standard.

10.5 One milliliter of the desorbing solvent is dispensed into each sample vial. The vial is immediately sealed. Each vial is swirled for 20 minutes to aid the desorption process.

11. Gas Chromatography

11.1 Section 7.1 summarizes the recommended operating conditions for the gas chromatograph. Table 1 contains retention times from the two capillary columns.

11.2 Calibrate the system every 12 hours.

11.3 The internal standard must be added to the sample extract and mixed thoroughly immediately before injection into the gas chromatograph.

11.4 Inject 1 uL of the sample extract or standard into the gas chromatograph. Record the volume injected, the total extract volume, and the resulting peak size in area or peak height units.

11.5 Identify the parameters in the sample by comparing the retention times of the peaks in the sample chromatogram with the peaks in the standard chromatograms. The width of the retention time window used to make identifications is the mean retention time window from the initial calibration ± three standard deviations. Daily adjustments to the retention time window will be made based on the retention time of the daily calibration standard ± three standard deviations as determined during initial calibration.

11.6 If the response for a peak exceeds the working range of the system for any compound of interest, dilute the extract and reanalyze.

11.7 If there are other non-target peaks present with responses greater than 10% of the internal standard, tentatively identify using retention time indexes.

12. Calculations

12.1 Determine the concentration of individual compounds in the front and back sections of the charcoal tube.

12.2 Calculate the concentration in air by the following equation:

$$\text{Concentration (mg/cubic meter)} = \frac{(A_S)\ (C_{IS})\ \text{X}\ 1\text{ML}}{(A_{IS})\ (RF)\qquad V}$$

$$\text{X}\ 0.001\ \text{mg/ug}\ \text{X}1000\text{L/cubic meter}$$

SAMPLING AND ANALYSIS PLAN FOR REMEDIAL INVESTIGATION AND FEASIBILITY STUDY

PART II - QUALITY ASSURANCE PROJECT PLAN

AMENDMENT NO. 1

STOUGHTON CITY LANDFILL
STOUGHTON, WISCONSIN

NOVEMBER 12, 1991

PREPARED BY:

STRAND ASSOCIATES, INC.
910 WEST WINGRA DRIVE
MADISON, WISCONSIN 53715

AMENDMENT NO. 1 TO
QUALITY ASSURANCE PROJECT PLAN

STOUGHTON CITY LANDFILL
STOUGHTON, WISCONSIN

This amendment is proposed to modify the original Quality Assurance Project Plan dated September 22, 1988.

1.0 PROJECT DESCRIPTION

1.1 Introduction, page 1-2.

ADD the following paragraph:

Strand Associates, Inc. (SAI) has been retained by the Stoughton City Landfill Steering Committee to conduct additional RI work as described in the Additional Remedial Investigation Work Workplan transmitted on October 31, 1991 ("Additional RI"). Residual Management Technologies, Inc.'s (RMT) laboratory will perform chemical analyses as part of the Additional RI. RMT will analyze all ground water/surface water, soil/sediment, and municipal well samples obtained during the Additional RI. In performing these analyses, RMT will follow all procedures specified in the 2/88 Statement of Work (SOW) for organics and in the 3/90 SOW for inorganics as required under USEPA's Contract Laboratory Program (CLP). Although a 3/90 SOW exists for organics, some of the compounds have changed from SOWs used previously for RI/work at the site. The 2/88 SOW for organics is the most recent SOW containing the compounds which were previously analyzed for. RMT will also conduct nonstandard method analyses for three additional volatile organic compounds (VOCs) in water and soil/sediment as described in Appendix B.

1.1 Introduction, page 1-4.

ADD the following sentence to the last paragraph:

Samples that will be collected for laboratory analysis by RMT during the additional RI work may include groundwater, surface water, soil, sediment and private/municipal well water.

1.6 Project Schedule, page 1-16.

ADD the following paragraph:

The anticipated schedule for the Additional RI is as follows:

Boring/Monitoring Well Installation	1/92
Boring/Monitoring Well Construction Report	2/92
Round 1 Groundwater Results/Data Validation, Technical Memorandum	3/92
Round 2 Groundwater Results/Data Validation, Additional RI report	6/92

2.0 PROJECT ORGANIZATION AND RESPONSIBILITY

Introductory paragraph, page 2-1.

ADD the following sentence:

Strand Associates, Inc. has the overall responsibility for the Additional RI.

2.1 Management, page 2-1.

ADD the following:

Operational responsibilities involving execution and direct management of the technical and administrative aspects of the Additional RI have been assigned as follows:

Robert P. Kardasz, P.E., Member Landfill Steering Committee

Michael D. Doran, P.E., Project Manager, Strand Associates, Inc.

Terese A. Van Donsel, Remedial Project Manager, USEPA, Region V

2.2 Field Activity, page 2-1.

ADD the following sentence:

Strand Associates, Inc. will perform or supervise all field investigations including sample collection, during the Additional RI.

2.3 Laboratory Analysis, page 2-2.

ADD the following paragraph:

RMT Laboratories will act as a subcontractor to Strand Associates, Inc. during the Additional RI, and will perform all chemical analyses required as part of the Additional RI. RMT Laboratories is a CLP laboratory.

2.4 Quality Assurance, page 2-3.

ADD the following sentence:

RMT will be responsible for data validation for the Additional RI. Strand Associates, Inc. will issue all deliverables for the Additional RI.

3.0 QUALITY ASSURANCE OBJECTIVES

3.1 Level of QC Effort, page 3-2.

ADD the following sentence to the first full paragraph:

The level of QC effort provided by RMT will be equivalent to the level of QC efforts specified under the CLP 2/88 SOW for organics and the CLP 3/90 SOW for inorganics, as appropriate.

3.1 Level of QC Effort, page 3-3.

ADD the following sentence to the first partial paragraph:

Accuracy and precision requirements and method detection limits for CLP protocol analyses are described in the 2/88 organics SOW and the 3/90 inorganics SOW for the CLP program as appropriate.

5.0 SAMPLE CUSTODY PROCEDURES, PAGE 5-3

ADD the following paragraph:

The specifications for chain-of-custody and document control for RMT will comply with the CLP requirements and be carried out in accordance with the 2/88 and 3/90 SOWs for CLP analysis as appropriate. RMT will provide all sample containers as necessary for the Additional RI sampling and QC.

page 5-4

ADD the following sentence to the last paragraph:

Strand Associates, Inc. will maintain the Additional RI files along with all relevant records, reports, logs, field notebooks, pictures and data reviews in a secured, limited access area and under custody of the site manager.

6.0 CALIBRATION PROCEDURES AND FREQUENCY

6.2 Laboratory Equipment, page 6-2.

ADD the following sentence:

RMT will perform calibration and preventative maintenance procedures for laboratory equipment in accordance with the 2/88 and 3/90 SOWs for the CLP program as appropriate.

7.0 ANALYTICAL PROCEDURES, page 7-1

ADD the following sentence to the first paragraph:

The TCL analysis for the Additional RI will be conducted by RMT using methods specified in the 2/88 and 3/90 SOWs for CLP laboratories.

Other VOCs for water (Table 1-4) will be analyzed by RMT in accordance with Level V nonstandard methods as outlined in Appendix B.

8.0 INTERNAL QUALITY CONTROL CHECKS

8.1 Analytical Laboratories, page 8-1.

ADD the following sentence:

Quality Control at RMT will be carried out in accordance with the 2/88 and 3/90 SOWs for CLP laboratories.

8.2 Field Quality Control, page 8-1

ADD the following sentence:

Field quality control will be carried out during the Additional RI field activities, such as, soil sampling, groundwater sampling, surface water/sediment sampling, and well drilling and installation by an experienced Strand Associates, Inc. geologist or engineer.

9.0 DATA REDUCTION, VALIDATION AND REPORTING

9.1 Documentation, page 9-1.

ADD the following sentence to last paragraph.

Data received from the analytical laboratories for the Additional RI will be validated, organized under specific project headings, and stored in the project files maintained at Strand Associates, Inc. offices.

9.2 Data Validation, page 9-1.

ADD the following sentence:

RMT will perform in-house analytical data reduction and validation under the direction of their laboratory QA officer.

page 9-2.

ADD the following paragraph at the end of Section 9.2:

Strand Associates, Inc. will review all sample collection procedures and laboratory data validations to assure that QA/QC has been maintained.

9.3 Reporting, page 9-2.

ADD the following:

Results from the Additional RI data validation and QA/QC analysis will be included in the Additional RI report.

9.4 Data Package/Data Deliverables, page 9-3.

ADD the following:

RMT will provide the standard CLP data package required under the appropriate SOWs.

10.0 PERFORMANCE AND SYSTEM AUDITS

Introductory paragraph, page 10-1.

ADD the following:

Strand Associates, Inc. Quality Assurance Officer will monitor and audit the performance of QA/QC procedures to insure that the Additional RI is executed in accordance with this QAPP.

10.2 Field Activities, page 10-1.

ADD the following sentence:

Field activities related to the Additional RI will be audited by Strand Associates, Inc.

11.0 PREVENTATIVE MAINTENANCE

11.1 Laboratory Equipment, page 11-1.

ADD the following sentence:

All equipment at RMT's laboratory will be maintained in accordance with the 2/88 and 3/90 SOWs for CLP laboratories as appropriate.

12.0 SPECIFIC ROUTINE PROCEDURES USED TO ASSESS DATA PRECISION, ACCURACY AND COMPLETENESS, page 12-1.

ADD the following:

RMT will comply with the 2/88 and 3/90 SOWs for CLP laboratories, as appropriate, to assess data precision, accuracy and completeness. Additionally, 40-CFR Part 136, Section 7.1-8.7 (pp 43375-43377) will be applied as necessary in the assessment.

13.0 CORRECTIVE ACTION

13.1 Analytical Laboratories, page 13-1.

ADD the following:

Corrective actions for RMT will be carried out in accordance with procedures outlined in the 2/88 and 3/90 SOWs for CLP laboratories, as appropriate.

13.2 Field Work, page 13-1.

ADD the following:

Corrective action indicated by audit results or detection of unacceptable data for the Additional RI will be determined by Strand Associates, Inc. Project Manager in consultation with the Stoughton City Landfill Steering Committee, USEPA, and WDNR.

14.0 QUALITY ASSURANCE REPORTS TO MANAGEMENT, page 14-1.

ADD the following:

Quality assurance reports will be included by Strand Associates as part of the Additional RI reports. These reports will include the results of QA audits and any necessary corrective action procedures. In addition, the data validation and data sufficiency task will be incorporated into the RI reports.