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BUREAU OF SOLID WASTE MANAGEMENT

CITY OF STOUGHTON, WI

AMUNDSON PARK NPL SITE

ADDITIONAL RI WORK WORKPLAN

REVISION 1

STRAND ASSOCIATES, INC.
Consulting Engineers
910 West Wingra Drive
Madison, WI 53715

JANUARY 2, 1992

STRAND
ASSOCIATES, INC.
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910 West Wingra Drive
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January 2, 1992

Ms. Terese Van Donsel, Project Manager
MI/WI Section II
U.S. Environmental Protection Agency
230 S. Dearborn St.
Chicago, IL 60604

Re: Stoughton WI City Landfill Site
Workplan for Additional RI Work--Revision No. 1

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 subject workplan. Revisions have been made in response to EPA's comments received on December 4. Note that Table 2.01-1 has been added, which lists field and laboratory analytes, investigative samples, and QA/QC samples for the exploratory boring groundwater sampling and analysis work. Other tables have been added regarding personnel responsibilities and workschedule as the agencies have requested. Figures 2 and 3 have been replaced with our standard well details, as the previous figures prepared by ENSR are not consistent with NR 141. New language is shown highlighted and deleted language is shown with strike-out. Three additional copies are being sent directly to Ms. Robin Schmidt of the Wisconsin Department of Natural Resources.

We appreciate your comments on our draft Revision 1 which we discussed on December 31, and which we have addressed herein. If you or your staff have any questions concerning this revised workplan, do not hesitate to contact us.

Sincerely,

FOR THE STOUGHTON CITY LANDFILL STEERING COMMITTEE:

Michael D. Doran, P.E.

040-921/mdd:hs

cc Ms. Robin Schmidt/DNR, w/(3) encls.
cc Mr. Robert Kardasz/City of Stoughton, w/(2) encls.
cc Mr. Tim Wright/Jessup Group, w/encl.

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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.

Monitoring wells MW-7S and MW-7D will be installed using nominal 6 inch ID hollow stem augers. Air-rotary or mud-rotary methods may be required for MW-7D should construction not be practical by the hollow stem auger method.

For MW-7D, soils will be sampled continuously to the depth of the water table, and every five to ten feet below the water table, using split-spoon sampling in accordance with the approved FSP procedures for monitoring well design and installation (Section 6.5.1) described in the top two bullets on page 6-13 of the section (see Appendix A). Cuttings will be field characterized in the event that hollow stem auger construction cannot be employed. Soil classification will be consistent with the USCS.

For MW-7S and MW-7D, a soil sample will be obtained from the selected screen interval depth for analysis for particle size distribution (ASTM Method D422).

Well construction will be as for the previous wells, as specified in the FSP (Figure 6-2 and Section 6.5.1), using Type 304 stainless steel riser and screen material. See Appendix A. A five foot long screen will be used in MW-7D instead of the 10 ft long screen described in the SAP (Appendix A), to be consistent with NR 141.09 (see Appendix B). Low carbon steel riser material may be used in MW-7D ~~further than 10 ft~~ above the screen water table. Two feet of fine sand will be installed above the filter pack, consistent with Wisconsin Administrative Code NR 141.

B. Bedrock Wells

MW-3B and MW-7B will be bedrock wells constructed in the upper 20 feet of competent bedrock (about 200 to 250 ft below grade), unless the exploratory boring data indicate that a deeper setting is warranted.

It is anticipated that ~~cable-tool,~~ mud fluid-rotary or air-rotary methods will be employed for the construction of these wells. A nominal 8 inch casing will be advanced. If a potential confining layer is encountered, a nominal 6 inch casing will be installed within the 8 inch casing and firmly seated in the bedrock. The remaining bedrock will be drilled to a suitable depth to allow installation of the screen materials. Finished well construction will conform with NR 141. Riser and screen materials will be Type 304 stainless steel. Mild steel may be used for riser pipe ~~beyond 10 feet~~ above the screen water table. Two feet of fine sand will be installed above the filter pack, consistent with Wisconsin Administrative Code NR 141. A 5 ft screen will be used, rather than the 10 ft screen described in the FSP, to be consistent with NR 141.09. Refer to the approved FSP section on monitoring design and installation (Section 6.5.1) for additional requirements (see Appendix A).

Beginning at the ending depth of MW-3D or MW-7D, as appropriate, soils and bedrock will be logged at approximately 5 to 10 ft intervals by field characterization of cuttings. Cuttings will also be field screened at about 10 ft intervals by means of a PID. Soils will be classified in accordance with the USCS. See the approved SAP section on soil sampling (Section 6.4) for PID methods (Appendix A).

C. Decontamination Procedures

High pressure hot water and steam cleaning will be performed on all drilling equipment between construction of each groundwater monitoring well, consistent with NR 141.17(2). Steam cleaning will be followed by detergent and distilled water rinse in accordance with Section 6.5.1 (page 6-14) of the approved FSP (Appendix A).

D. Monitoring Well Development

Following installation, wells will be developed a minimum of 24 hours after their construction using bailers or pumps in accordance with the requirements of NR 141.21. Bailers will be used for developing shallow water table wells, while deeper wells will be developed by surging with a bailer and purging with a pump. All bailers, pumps, cable, and other down-well equipment will be decontaminated prior to use as described in Section 2.05 below.

2.03 HEALTH AND SAFETY

All field activities will be performed in accordance with a ~~site and work specific health and safety plan drafted for the performance of all on-site activities.~~ the previously prepared "Health and Safety Plan for Remedial Investigation at Stoughton City Landfill, Stoughton Wisconsin" (ERM, 1988), with the following exceptions to "Key Project Personnel" (Section 2.3 of the safety plan):

TITLE	NAME	AFFILIATION	PHONE NUMBER
Project Manager	M. D. Doran	Strand Assoc.	608/251-4843
Project Safety Officer	D. J. Wang	Strand Assoc.	608/251-4843
Backup Project Safety Officer	J. M. Carlson	Strand Assoc.	608/251-4843

All Strand Associates personnel entering "work zones" have received 40 hr health and safety training and are current with annual refreshers. Driller's personnel and other personnel intending to enter "work zones" will also be required to have had adequate health and safety training, and evidence of same will be required to be provided to Strand Associates prior to entering "work zones". "Work zones" will be defined by the Strand Associates Project Safety Officer, subject to upgrading by EPA in consultation with DNR, and no person will be allowed to enter "work zones" without producing copies of training certificates or other evidence satisfactory to the Project Safety Officer of required health and safety training.

2.04 RESIDUALS MANAGEMENT

A. CUTTINGS

Cuttings will be field screened using a PID, using the procedures described in Section 6.4 of the SAP, Part 1 - Field Sampling Plan (FSP)(see Appendix A). Cuttings having a reading below 10 ppm will be wasted on-site. Cuttings having a PID measurement above 10 ppm will be containerized for ultimate disposal. Contaminated cuttings (PID > 10 ppm) will be containerized in DOT-approved drums, and stored in the present fenced and locked on-site drum storage area, for ultimate disposal as part of the site remedial action.

B. HANDLING OF LIQUIDS

Liquids generated during decontamination, drilling and purging or development of exploratory borings and monitoring wells will be placed in temporary storage on-site, and ~~containerized for ultimate disposal, or~~ hauled off-site for suitable disposal at ~~a~~ the City of Stoughton POTW.

1) Exploratory Boring Liquids

An estimate of the average daily quantity of liquid during the exploratory boring work is as follows:

a. Water Produced During Drilling Exploratory Borings

Based on a drilling rate of 1 ft/min, and a water production rate of 50 gpm (estimates), about 75,000 gal of liquid would be produced from six exploratory borings (1,500 ft total) during drilling advance. Based on 20 field days, about 4,000 gal/day of water would be produced.

b. Exploratory Boring Purging Water

Based on an average of 500 gal/purging, 75 purgings, and 20 field days, purging water volume is estimated to be about 7,500 gal total or about 2,000 gal/day.

c. Decontamination Water

Water generated from steam cleaning and decontamination is estimated at about a volume equal to 4 to 6 drums per boring, or about 2,000 gal for six exploratory borings. Based on 20 field days for exploratory boring work, the volume would be approximately 100 gal/day.

Considering the above, the estimated quantity of liquid generated during the exploratory boring construction is about 6,000 gal/day. The daily volume could be somewhat higher or somewhat lower depending upon drilling production, characteristics of the formation, etc. Liquid generation during monitoring well construction (follows exploratory borings) in unconsolidated formations (shallow and deep wells), would be lower than

for the boring work, as purging and sampling with depth would not be anticipated, and since hollow stem auger construction methods are anticipated, at least for the water table (shallow) wells. Liquid generation during construction of the bedrock wells would be slightly lower than for the exploratory borings (no purge water) and is estimated to be about 4,000 gal/day.

Drilling and decontamination liquids will be handled as specified in "2221. HANDLING OF WASTES" as contained in the specifications for the drilling contract (Contract 3-91). This will entail discharge of "mud" from the drilling, purge water from sampling, and decon water to a settling basin. The settling basin will allow for separation of cuttings from the liquid. Liquid from the settling basin will flow to a sump for pumping to a 5,000 gal tank or tank trailer which will be located near the site gate. Liquids from the tank will be transferred to a 1,500 gal to 2,500 gal waste haul vehicle for delivery to the Stoughton POTW. Based on the above volumes, about 4 trips/day will be required for a 1,500 gal vehicle. A private hauler (Honey Wagon, Inc.) has indicated that they are able to perform this work. The POTW also has suitable equipment and manpower available. Hauling will be performed by Honey Wagon and/or City of Stoughton personnel. Transfer from the tank trailer to the hauling vehicle will be by submersible or (depending on equipment on hauling vehicle) vacuum pump.

If the actual volume produced exceeds the estimated 6,000 gal/day, additional equipment (storage tank and hauling vehicles) may be required. The City of Stoughton has made arrangements with the City of Janesville to use Janesville's 12,000 gal transportable "nurse" tank trailer in the event that additional on-site equalization/storage would be required. If hauling capacity requirements exceed that available with City and Honey Wagon equipment and personnel, the City will contract with additional waste hauling firms for transport of liquids to the Stoughton POTW.

At the end of each day, the system will be drained to protect from freezing (see Contract 3-91, Specification 2221.A.2.). Also, as specified, the driller is responsible for providing all pumps, piping, etc., necessary to accomplish liquid conveyance to the storage tank, and for operation and maintenance of the liquid transfer system.

Basins and sumps as needed for liquid handling will be provided utilizing livestock tankage, and constructing an impervious basin for handling liquids. The livestock tankage will be conventional tankage used in the agricultural industry. The impervious basin will be a dug basin, sloped to one corner for sumping, lined with welded joint (2" overlap) plastic ("flexalon" by Geotextiles, Inc., or equal) sheeting, with sheeting ballasted and covered with sand/gravel as a membrane protective measure, and with berming to prevent surface water inflow. This will be of the same general design as the basin previously constructed on the site for receiving decon water.

Until Shop Drawings are submitted by the Drilling Contractor, it is not known whether a livestock tank will be used or a lined earthen basin for

receiving the air/water/cuttings mixture from the drilling equipment. If a tank is used, it will be sized to allow settlement of cutting materials as well as to accommodate some settlings storage, and will include baffling of the inlet and overflow areas, or other provisions as may be required to minimize carryover of cuttings materials to the downstream tankage which will house the pump for transfer of the liquids to the on-site storage tank. A quiescent settling area having a hydraulic retention time of approximately 10 minutes would be provided with this approach. Should a lined earthen basin be employed, the surface area and depth would be sufficient to provide settlings storage and adequate quiescent hydraulic retention time (approx. 10 min) for good settling. With the earthen basin approach, it is anticipated that the bottom will be sloped to one corner of the basin where a sump would be located for pumping liquid to the on-site storage tank. Details of the final proposed installation (copies of approved Shop Drawings) will be provided to EPA and DNR when worked out with the Drilling Contractor.

2) Groundwater Monitoring Well Purge Water

About 500 gal of purge and decontamination water will be generated in one sampling round from the groundwater monitoring wells (assumes four new in addition to the twelve existing wells). This liquid will be containerized in DOT approved drums, clearly labeled, temporarily stored in the fenced and locked on-site drum storage area, sampled (composite) to verify acceptability at the City of Stoughton POTW (see Section 2.04 C. below), and hauled from the drum storage area to the POTW for disposal.

C. ACCEPTANCE OF LIQUIDS BY THE POTW

The City has computed limitations for acceptance of the liquids at the Stoughton POTW. These limitations were based upon available criteria (i.e. in the documentation for "PRELIM"-the software developed for EPA, issued DNR guidance on BETX, EPA "Quality Criteria for Water-1986", and NR 105/NR 106 based computations for potential toxics). Limitations were set for a list of pollutants of concern found in past groundwater sampling at the site. Note that barreled liquid wastes from previous RI work at the site was accepted at the Stoughton POTW following analysis which showed very low contaminant levels.

The DNR has drafted a WPDES Permit for re-issuance for the Stoughton POTW, which includes proposed effluent limitations for toxic substances based on NR 105 criteria. Final effluent limits (effective 1/1/94) are proposed for copper; zinc; mercury; pentachlorophenol; 1,2 diphenylhydrazine; hexachlorobenzene; benzo(a)pyrene; and total PAH. The proposed limits for copper, zinc and mercury are based on data which suggest that these substances may be present at levels which justify a limit. The need for limits for the remaining substances has not yet been established (no data), and data collected during the first monitoring period will be used to determine if there is a need for a limit.

In reviewing groundwater quality data from the previous RI work, and other available information, it was concluded by the City that: 1) mercury, zinc and copper were not detected; 2) no values for detected inorganics exceeded ambient water quality (NR 105) criteria; 3) pentachlorophenol was detected in one of 36

samples, at a qualified value less than 1/10 of the proposed limit; 4) PAH compounds were not detected; 5) hexachlorobenzene was not detected; 6) halomethanes were detected in some groundwater samples above NR 105 criteria, but at levels that would be reduced below criteria based on the dilution provided at the POTW headworks; 7) there are no NR 105 criteria for THF; and 8) no other organic compounds were detected at levels of concern relative to NR 105 criteria.

Limits for acceptance have been developed by the City for lead, zinc, mercury, nickel, halomethane, benzene, and total BETX based on a review of the previous RI groundwater data in conjunction with NR 105/NR 106 considerations. These limits are as follows:

Total BETX	30 mg/L
Benzene	10 mg/L
bis (2-ethylhexyl) Phthalate	no limit
Halomethanes	no limit
Tetrahydrofuran	no limit
Pentachlorophenol	20 µg/L
Benzoic Acid	no limit
Lead	40 mg/L
Mercury	3 µg/L
Nickel	125 mg/L
Zinc	200 mg/L

Note: Where "no limit" is indicated, there is no relevant surface water standard or/and computed limits are so high as to eliminate any grounds for concern.

Based on the above limits for acceptance, previous RI data, and the favorable analysis of the previous barreled waste, POTW acceptance of the liquid waste is not anticipated to be a concern.

To assess acceptability of the liquid waste generated during drilling operations, the following procedures have been developed by the City and will be followed:

1. Review 24 hr turnaround VOC/THF data from the exploratory boring samples (each set of data) for benzene, BETX, and halomethanes for acceptability relative to the established limits. A weighted average for the concentration of VOCs in the holding tank will be computed for each day on the basis of estimated liquid volume generated (from on-site tank measurements) associated with each groundwater sample from the exploratory borings.

2. Analyze initial sample (day 1) collected from storage tank, and daily composite samples (equal blend of samples from waste hauler tank), on a three times per week basis at DNR Certified Wastewater Laboratory-(Strand or RMT depending upon workload) for lead, zinc, mercury and nickel on a 48 hr turnaround basis; and compare data relative to established limits.

3. If data review (from above steps 1. and 2.) indicates that the running weekly average of data is below established limits, continue to accept liquid wastes at the POTW.

4. If the data review (from above steps 1. and 2.) indicates that the running weekly average of data for one or more parameters exceeds the established limits, collect samples of POTW effluent (three times per week) for analysis for the parameter(s) of concern to allow an assessment as to whether or not NR 105/NR 106 based plant effluent criteria are being met. Use RMT lab for VOCs and Strand or RMT for metals. Use 48 hr turnaround timeframe.

5. If POTW effluent criteria are being met, continue sampling as for 1., 2. and 4. above, and continue to accept liquid waste.

6. If POTW effluent criteria are not being met, reject liquid waste and suspend additional RI work until response action (e.g. pretreatment of liquid waste) can be put in place.

Previous RI groundwater data and data from the analysis of previous liquid wastes from site RI work, compared to levels of acceptability at the POTW, make it very unlikely that the liquid wastes from the Additional RI Work will not be acceptable at the Stoughton POTW. In the unlikely event that the wastes would be unacceptable, however, the following steps would be employed to minimize any delays in completing the additional RI work:

1. Work would be suspended prior to the accumulation of a waste volume (approx. 10,000 gal) of unacceptable liquid that would not be feasible to containerize (DOT approved drums) and store on-site.

2. Unacceptable containerized liquid would be stored at the present fenced and locked drum storage area (enlarged as may be needed to handle number of drums).

3. Recognizing that unacceptable (at POTW) liquids would be an indication of highly contaminated groundwater, such that the boundary of the impacted zone has not been defined by the boring location, step out to a greater distance from the site and continue the exploratory boring work.

4. Investigate on-site treatments that could be quickly implemented, such as aeration or chemical precipitation, to allow POTW acceptance of liquids and to allow the investigation to continue in the highly contaminated zone so that data on magnitude/extent can be collected.

2.05 WELL SAMPLING AND ANALYSIS

All monitoring wells (locations MW-1 through MW-7) will be sampled in the ~~winter of 1991/2~~ spring of 1992 and again in the spring summer of 1992 for all TCL inorganics and organics, and for the non-standard VOCs as tested for as part of the previous RI work. See Tables 1-3 and 1-4 of the QAPP (Appendix C).

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.

B. 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

STRAND
ASSOCIATES, INC.
ENGINEERS
910 West Wingra Drive
Madison, Wisconsin 53715
(608) 251-4843

FACSIMILE TRANSMISSION COVER LETTER

FACSIMILE # (608) 251-8655

ATTACHED ARE ....4..... PAGES INCLUDING THIS COVER LETTER, SHOULD YOU EXPERIENCE ANY PROBLEMS IN RECEIVING THESE PAGES, PLEASE CALL .....JANE..... AT (608) 251-4843

OFFICE COPY

DATE: ....1/6/92.....

STRAND ASSOCIATES JOB NUMBER: ....040-926.....

PARTY(S) TO RECEIVE FACSIMILE: ....Terese Van Donsel.....

FACSIMILE NUMBER: ....1-312-886-4071.....

PARTY SENDING FACSIMILE: ....Jane Carlson.....

PROJECT NAME: ....Stoughton City Landfill.....

NOTES: ....Terese, these figures go with the Work Plan Revision. We'll send you three "punched" copies by mail also, so they can be inserted in the report. Sorry we didn't get them in the original copies —

Jane

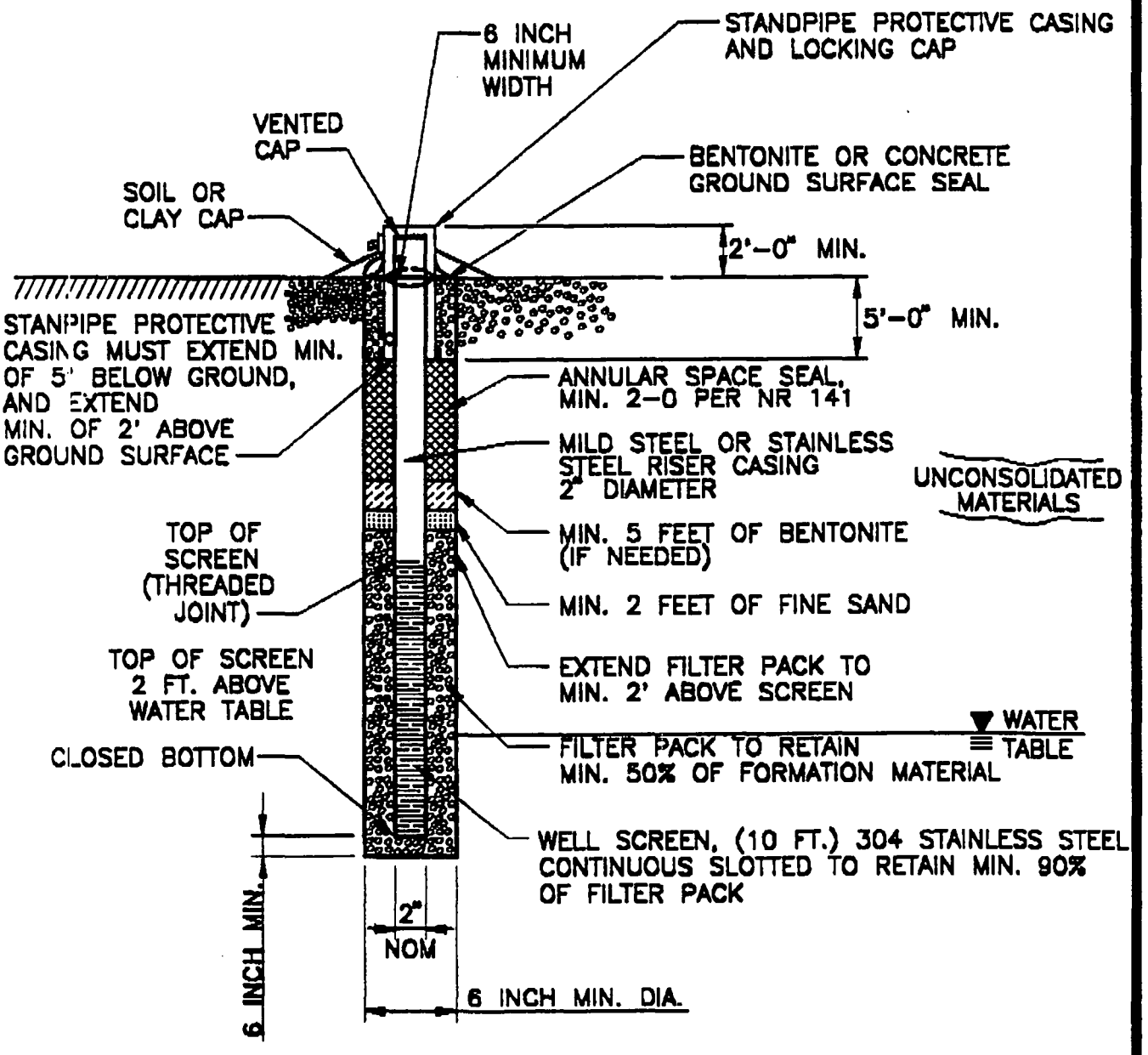


FIGURE No.

1A

01-975-155A

TYPICAL MONITORING WELL

NOT TO SCALE

STRAND ASSOCIATES, INC. ENGINEERS

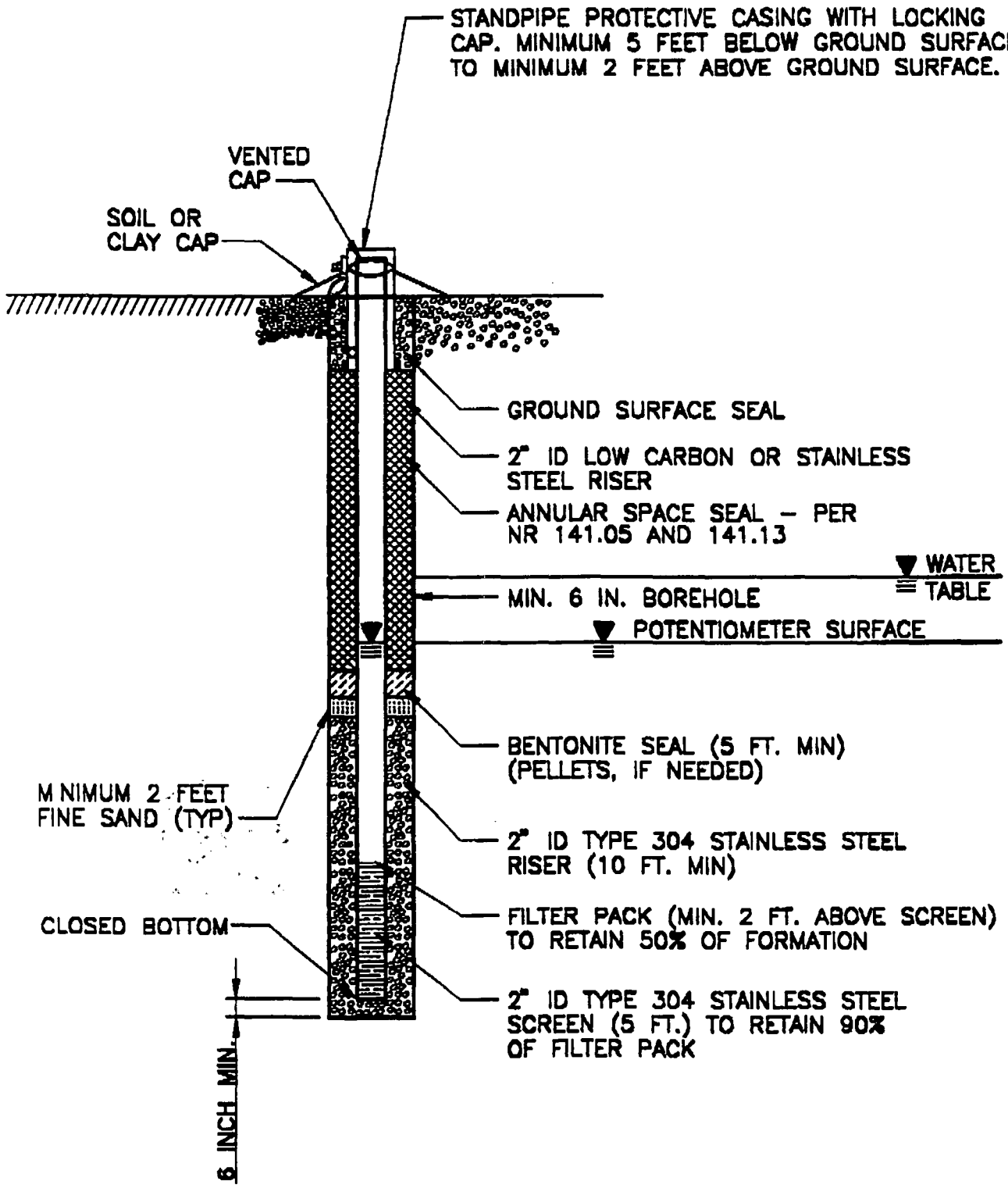


FIGURE No.

1B

C1-975-155A

TYPICAL PIEZOMETER

NOT TO SCALE

STRAND ASSOCIATES, INC. ENGINEERS

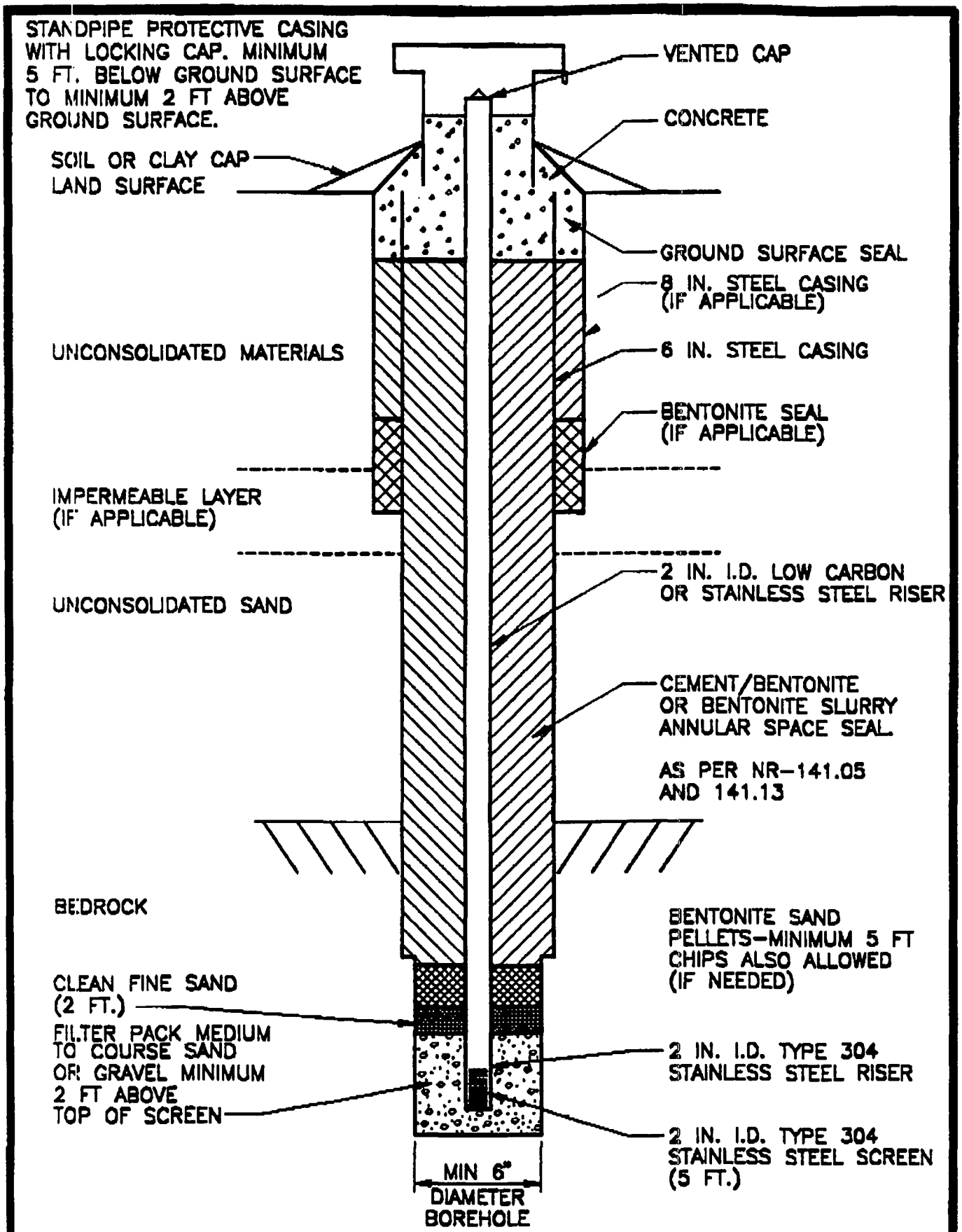


FIGURE No.

2

01-975-155A

BEDROCK MONITORING WELL

NOT TO SCALE

STRAND ASSOCIATES, INC. ENGINEERS

STRAND
ASSOCIATES, INC.
ENGINEERS
910 West Wingra Drive
Madison, Wisconsin 53715
(608) 251-4843

JAN -8 92
BUREAU OF SOLID WASTE MANAGEMENT

January 7, 1992

Ms. Terese Van Donsel
Project Manager
MI/WI Section II
U.S. Environmental Protection Agency
230 South Dearborn Street
Chicago, Illinois 60604

Re: Stoughton, Wisconsin City Landfill
Additional RI Work Workplan Figures

Dear Ms. Van Donsel:

Enclosed please find three copies of Figures 1, 2 (2A and 2B) and 3 for inclusion in the "Workplan for Additional RI Work - Revision 1" which was transmitted on January 2, 1992. These figures should be inserted after Table 2.09-1 and just before Appendix A.

We apologize that these did not arrive with the rest of the work plan. If you have any questions, please call.

Sincerely,

FOR THE STOUGHTON CITY LANDFILL STEERING COMMITTEE

Jane Carlson

Jane M. Carlson

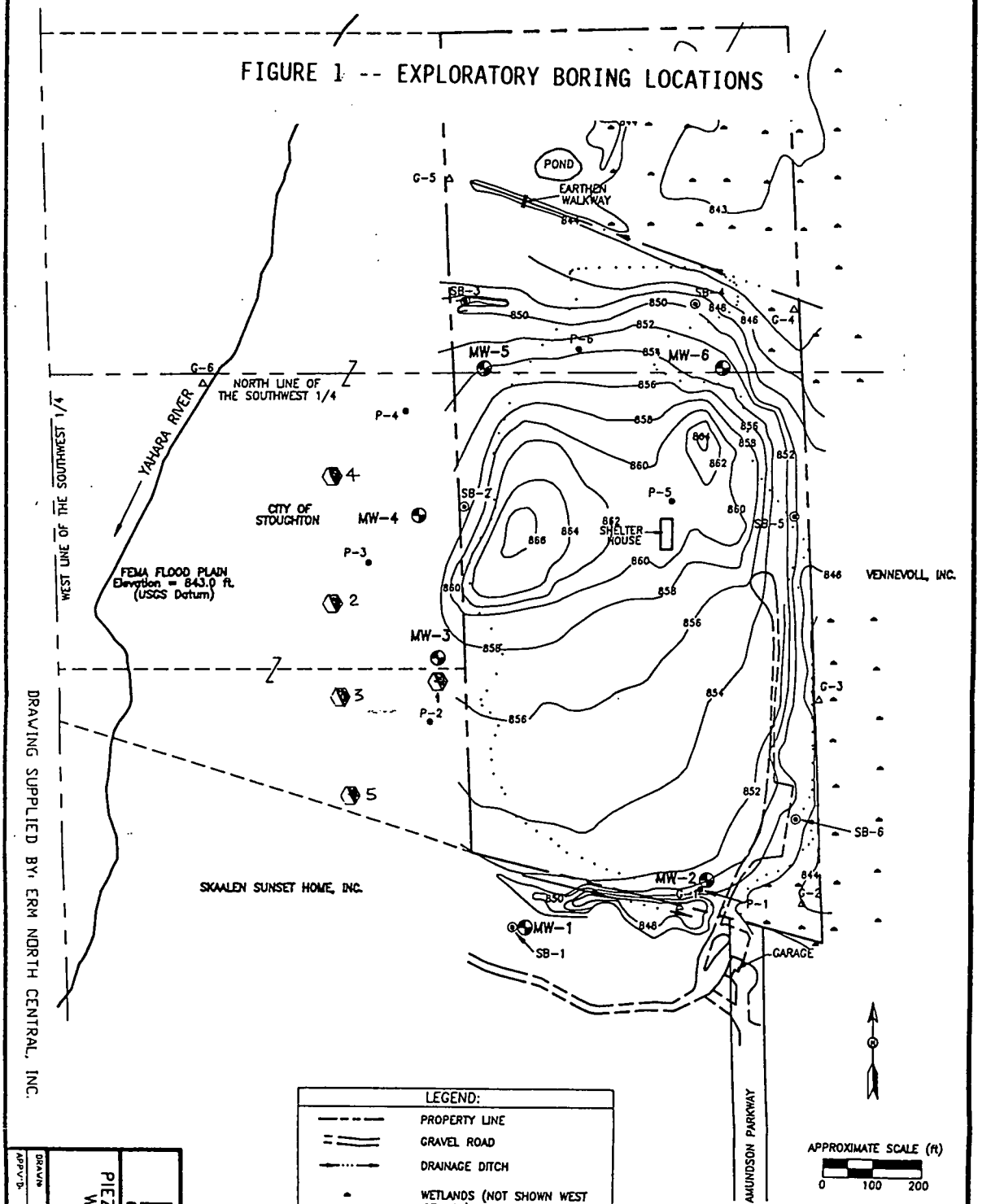
cc: Ms. Robin Schmidt, DNR w/(3) encl.
Mr. Robert Kardasz, City of Stoughton, w/(2) encl.
Mr. Tim Wright/Jessup Group, w/encl.

040-926/JMC:TK

\6885\OURS\TWD4

DANE COUNTY

FIGURE 1 -- EXPLORATORY BORING LOCATIONS



DRAWING SUPPLIED BY: ERM NORTH CENTRAL, INC.

LEGEND:

- PROPERTY LINE
- GRAVEL ROAD
- DRAINAGE DITCH
- WETLANDS (NOT SHOWN WEST OF SITE)
- SB-1 — PREEXISTING MONITORING WELL
- P-2 — PIEZOMETER
- G-3 — SURFACE WATER STAFF GAGE
- MW-1 — MONITORING WELL CLUSTER
- LANDFILL BOUNDARY (BASED ON RESULTS OF DRILLING AND GEOPHYSICAL SURVEYS)
- 858 — TOPOGRAPHIC CONTOUR

EXPLORATORY BORING

APPROXIMATE SCALE (ft)
0 100 200

NOTES:
1. ALL LAND IN SECTION 4, T.5 N., R.11 E.
2. TOPOGRAPHIC CONTOUR INTERVAL OF 2 FEET.

ENSR™
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PIEZOMETER AND MONITORING WELL CLUSTER LOCATIONS
STOUGHTON CITY LANDFILL
STOUGHTON, WISCONSIN

DRAWN	APP'VD	DATE	REVISED	PROJECT NUMBER	REV
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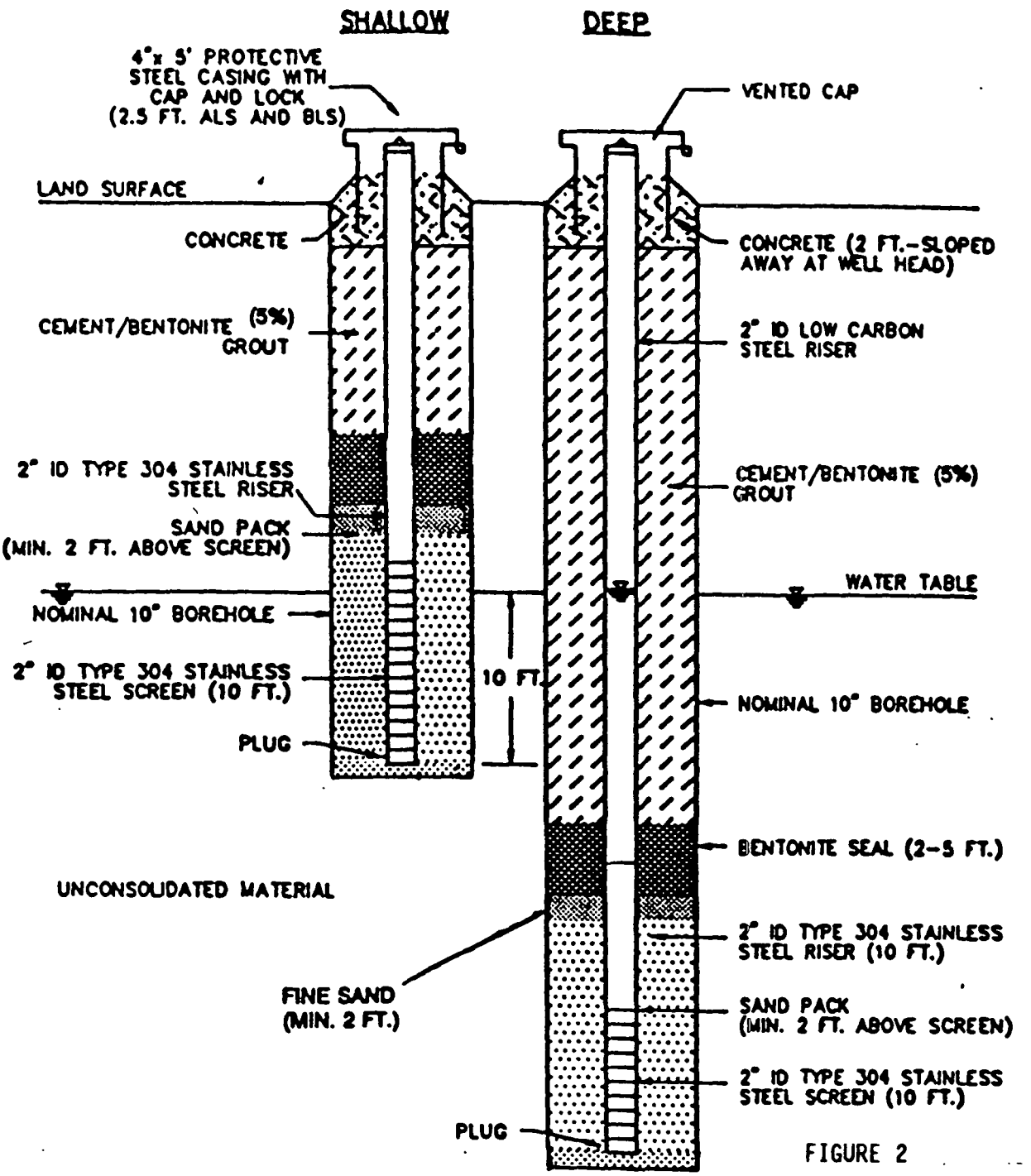

FIGURE 2

NOTE: NOT TO SCALE

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TYPICAL OVERBURDEN WELL CONSTRUCTION DIAGRAM
STOUGHTON CITY LANDFILL
STOUGHTON, WISCONSIN

DRAWN:	EDH	DATE: 8/29/91	JOB NUMBER:	REV.
APP'D:	TVA	REVISED: X	6885-002	0

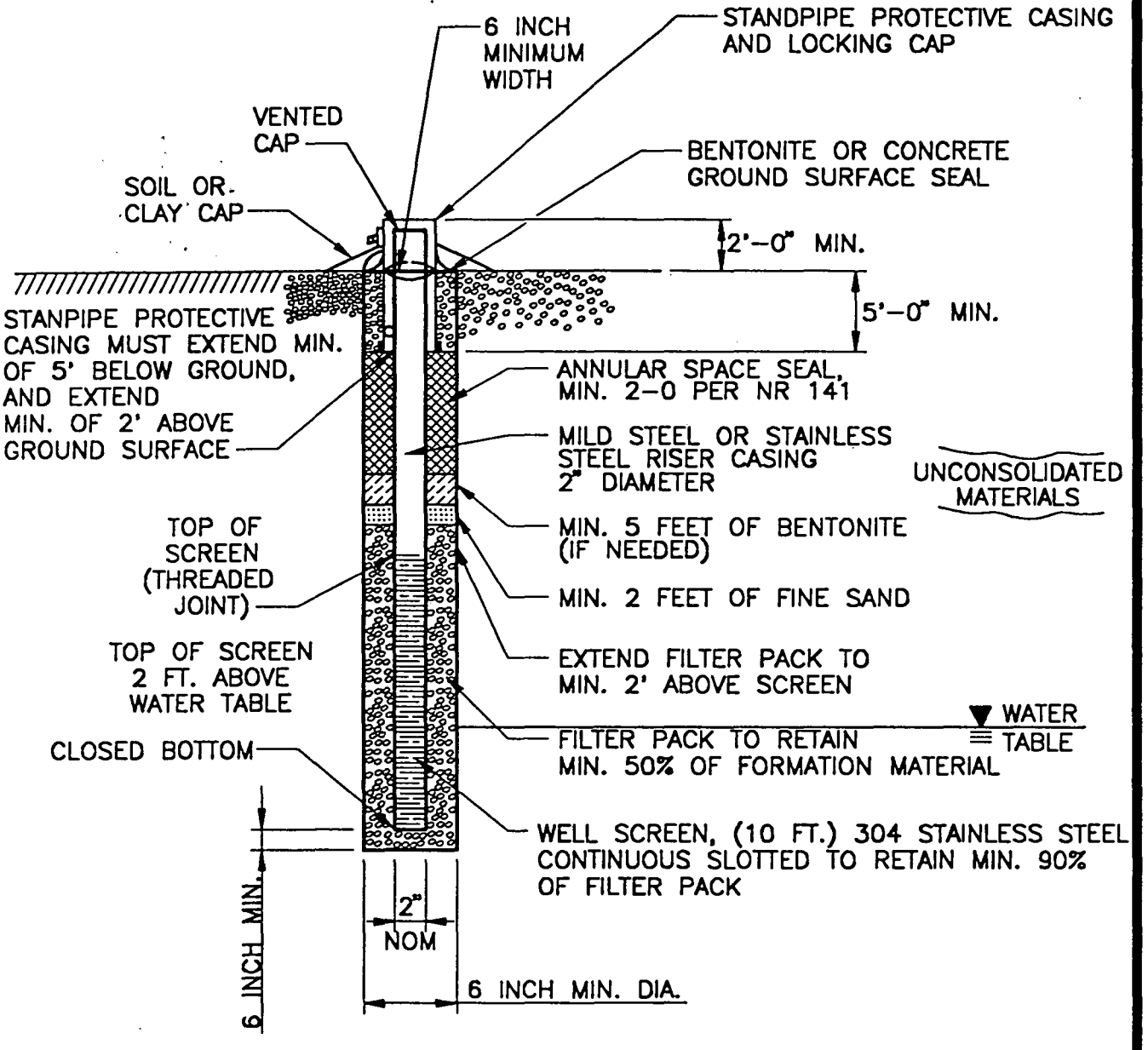


FIGURE No.

2A

01-975-155A

TYPICAL MONITORING WELL

NOT TO SCALE

STRAND ASSOCIATES, INC. ENGINEERS

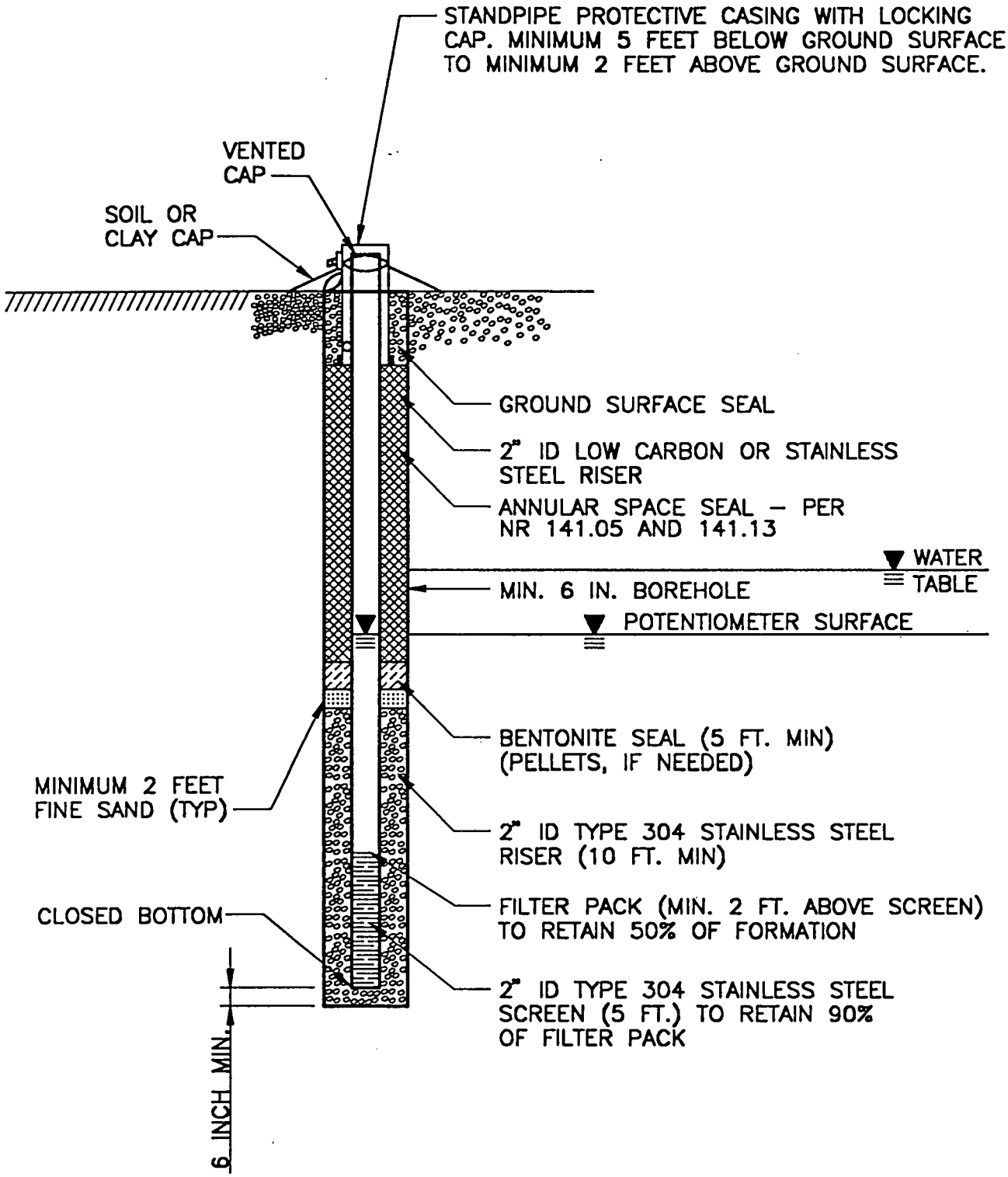


FIGURE No.

2B

01-975-155A

TYPICAL PIEZOMETER
NOT TO SCALE

STRAND ASSOCIATES, INC. ENGINEERS

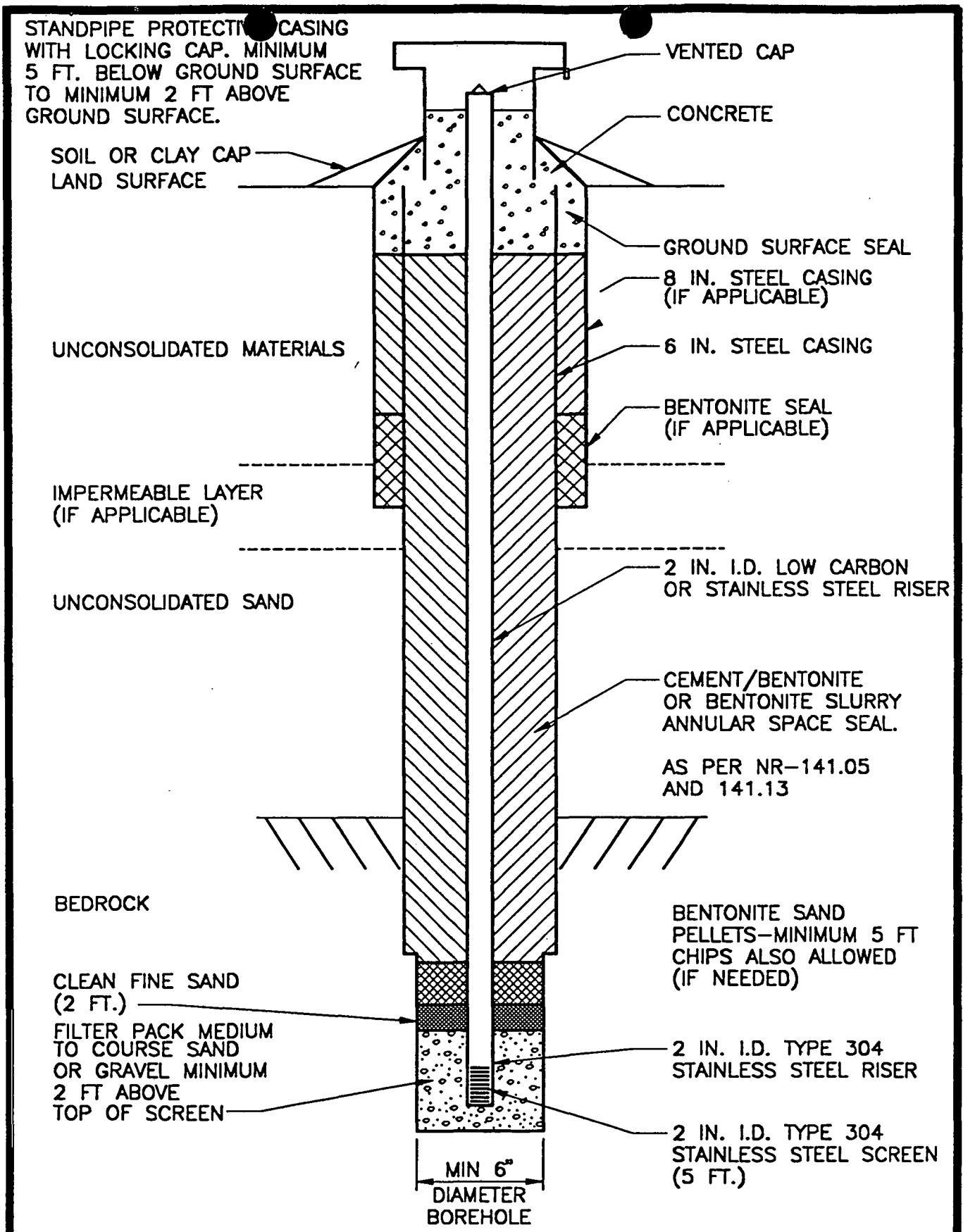


FIGURE No.

3

01-975-155A

BEDROCK MONITORING WELL

NOT TO SCALE

STRAND ASSOCIATES, INC. ENGINEERS

APPENDIX A

EXCERPTS FROM FSP

- 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.

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.

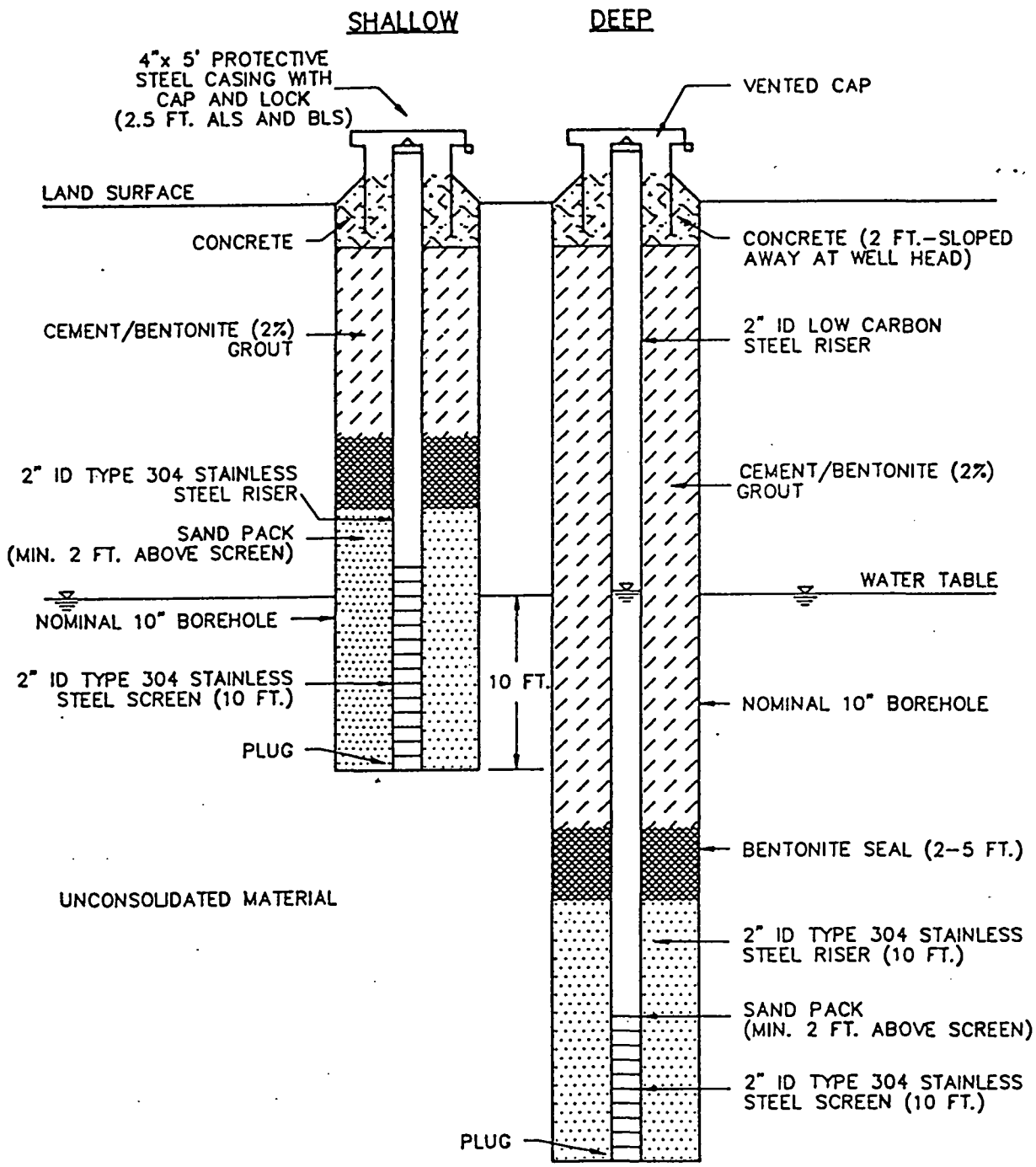
6.5.1 Monitoring Well Design and Installation

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.

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.



NOTE: NOT TO SCALE

STOUGHTON CITY LANDFILL SURFICIAL AQUIFER MONITORING WELL-CONSTRUCTION DETAILS	FIGURE 6-2
ERM ERM-North Central, Inc.	9/15/88 mo

- 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.

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

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 slug3upon 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, 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.

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.

APPENDIX B

NR 141

Chapter NR 141

GROUNDWATER MONITORING WELL REQUIREMENTS

NR 141.01 Purpose. The purpose of this chapter is to establish minimum acceptable standards for the design, installation, construction, abandonment and documentation of groundwater monitoring wells. These rules are adopted under chs. 144, 160 and 227, Stats.

History: Cr. Register, January, 1990, No. 409, eff. 2-1-90.

NR 141.03 Applicability. This chapter applies to all persons installing and abandoning groundwater monitoring wells and boreholes for purposes regulated by the department under ch. 144, 147 or 160, Stats., or in permits, plan approvals, licenses or orders issued under those chapters. In addition, this chapter applies to all persons installing groundwater monitoring wells and boreholes in fulfillment of terms of a contract with the department. All wells and boreholes installed for purposes regulated by the department under this chapter shall be abandoned according to s. NR 141.25. All other wells and boreholes shall be abandoned according to the provisions of ch. NR 112.

Note: Additional requirements concerning soil testing and groundwater sampling are located in other chapters regulating wastewater and solid and hazardous waste disposal, see chs. NR 110, 206, 213, 214, 508, 512, 550 and the 600 series.

History: Cr. Register, January, 1990, No. 409, eff. 2-1-90; am. Register, June, 1991, No. 426, eff. 7-1-91.

NR 141.05 Definitions. In this chapter:

(1) "Air rotary drilling" means a drilling method whereby the borehole is advanced using a circular rotating action applied to a string of drilling rods which have a diffused discharge bit attached to the bottom of the rods. Pressurized air is forced through the drilling rods and cools the drilling tools and removes the cuttings from the borehole.

(2) "Annular space seal" means the following:

(a) For wells constructed with filter packs, it is the material placed above the top of the filter pack or the filter pack seal up to the surface seal and between the well casing and the adjacent formation; or

(b) For wells constructed into bedrock formations and without well screens, it is the material placed from the bottom of the enlarged borehole up to the surface seal, between the well casing and the adjacent formation.

(2m) "Aquifer test well" means a well installed to provide information on the hydraulic conductivity, transmissivity, storage coefficient, capture zone, specific capacity, radius of influence or other physical parameters of an aquifer, defined geologic unit, or water bearing formation through the imposition of a sustained stress on the aquifer by removal of water.

(3) "ASTM" means american society for testing and materials.

(5) "Bedrock" means the solid rock underlying any loose surficial material such as soil, alluvium or glacial drift. Bedrock includes but is not limited to limestone, dolomite, sandstone, shale and igneous and metamorphic rock.

(6) "Bentonite" means a clay consisting of at least 85% sodium montmorillonite. Bentonite is available in the following forms:

(a) "Bentonite powder" means 200 mesh pure bentonite, without additives.

(b) "Bentonite granules" means 8 mesh pure bentonite, without additives.

(c) "Bentonite pellets" means commercially manufactured tablets made by compressing pure bentonite, without additives, into forms greater than ¼" in size.

(d) "Bentonite chips" means commercially processed angular fragments of pure bentonite, without additives.

(7) "Bentonite - cement grout" means a mixture with the ratio of 5 pounds of bentonite with 94 pounds of Portland cement and 8.5 gallons of water from a known safe and uncontaminated source.

(8) "Bentonite - fine sand slurry" means a mixture with the minimum ratio of 50 pounds of bentonite with 100 gallons of water from a known safe and uncontaminated source and 10-25% sand by volume for a mud weight of 11 pounds per gallon.

(9) "Borehole" means a circular hole deeper than it is wide, constructed in earth material for the purpose of either installing a well or obtaining geologic or groundwater related data. Boreholes are also referred to as drillholes.

(10) "Clay" means an inorganic soil with low permeability characteristics and a plasticity index of 7 or more.

(11) "Coarse sand" means a well sorted sand with a predominant grain size between 4.76mm and 2.0mm as established by the unified soil classification system.

(12) "Concrete" means a slurry mixture with a ratio of 94 pounds of cement, equal volumes of dry sand and gravel and 5 to 6 gallons of water from a known safe and uncontaminated source. The ratio of sand and gravel to cement may not exceed 3 parts to one.

(13) "Department" means the department of natural resources.

(14) "Driven point well" means a well constructed by joining a drive point with lengths of pipe and driving the assembly into the ground with

percussion equipment or by hand, without first removing material below the 10 foot depth.

(15) "Filter pack" means the sand, gravel or both placed in direct contact with the well screen.

(16) "Filter pack seal" means the sealing material placed in the annular space above the filter pack and below the annular space seal to prevent the migration of annular space sealant into the filter pack.

(17) "Fine sand" means a well sorted sand with a predominant grain size between .42mm and .074mm, as established by the unified soil classification system.

(18) "Granular bentonite slurry" means a thoroughly blended mixture of up to 30 pounds of untreated bentonite powder added to 100 gallons of water from a known safe and uncontaminated source with a minimum of 100 pounds of untreated bentonite granules mixed together by a Venturi-hopper mud mixer or other equivalent high shear mixer.

(19) "Gravel" means an unconsolidated material with the predominant grain size being between 76.2mm and 4.76mm, as established by the unified soil classification system.

(20) "Groundwater" means any waters of the state, as defined in s. 144.01 (19), Stats., occurring in a saturated geologic formaton of rock or unconsolidated material.

(21) "Groundwater monitoring well" means any cased excavation or opening into the ground made by digging, boring, drilling, driving, jetting or other methods for the purpose of determining the physical, chemical, biological or radiological properties of groundwater. Groundwater monitoring wells may be piezometers, water table observation wells or both.

(21m) "High-solids grout" means a thoroughly blended mixture of water from a known safe and uncontaminated source with untreated bentonite, without additives, which has been approved by the department.

(22) "Hollow stem auger drilling" means a drilling method where continuous flighting is welded to a hollow stem pipe. The flighting carries drill cuttings to the surface as the flighting is rotated and pushed down into the earth.

(23) "Inside diameter" means the horizontal distance between the inner walls of a well casing, hollow stem auger or tremie pipe.

(24) "Medium sand" means a well sorted sand with a predominant grain size between 2.0mm and .42mm, as established by the unified soil classification system.

(25) "Montmorillonite" means a group of expanding lattice clay minerals of the general formula: $R.33Al_2Si_4O_{10}(OH)_2 \cdot H_2O$, where R means one or more cations of sodium, potassium, magnesium or calcium and where Al means aluminum, Si means silicon, O means oxygen and H means hydrogen.

(26) "Mud rotary drilling" means a drilling method whereby a borehole is advanced by using a circular rotating action applied to a string of

drilling rods which have a diffused discharge bit attached to the bottom of the string. A bentonite and water mud slurry is used to provide borehole stability, to cool the bit and to carry cuttings to the ground surface.

(27) "Neat cement grout" means a slurry mixture with a ration of 94 pounds of Portland cement mixed with 5 to 6 gallons of water from a known safe and uncontaminated source.

(28) "Percussion drilling" means a drilling method using a cable tool drilling machine or a drilling method whereby the permanent or temporary well casing is driven, or is set into a borehole and then driven.

(29) "Permanent groundwater monitoring well" means any groundwater monitoring well in place for 60 days or longer.

(30) "Piezometer" means a groundwater monitoring well, sealed below the water table, installed for the specific purpose of determining either the elevation of the potentiometric surface or the physical, chemical, biological or radiological properties of groundwater at some point within the saturated zone or both.

(31) "Potentiometric surface" or "piezometric surface" means an imaginary surface representing the total head of groundwater and is the level to which water will rise in a well.

(32) "Psi" means pounds per square inch.

(33) "Purge" means an action that removes water from the well, commonly accomplished by using a pump or bailer.

(33m) "Recovery well" means a well intended and designed to capture and remove contaminated groundwater or non-aqueous phase liquids from the subsurface.

(34) "Rotary wash drilling" means a drilling method whereby metal temporary casing is advanced into the borehole by driving. At selected intervals, the temporary casing is cleaned out using rotary drilling tools by pumping clean water through the rod to flush out accumulated cuttings. This drilling method is also known as wash bore or wash down drilling.

(35) "Sand-cement grout" means a mixture of cement, sand and water in the proportion of 94 pounds of Portland cement, one cubic foot of dry sand and 5 to 6 gallons of water from a known safe and uncontaminated source.

(36) "Sediment" means any solid material dropping from suspension in water, including clay, silt, sand and gravel sized particles.

(37) "Solid stem auger drilling" means a drilling method where continuous flighting is welded onto a solid stem pipe. The flighting carries drill cuttings to the surface as the flighting is rotated and pushed down into the earth. The borehole is created by a cutting bit located at the tip of the lead auger.

(38) "Specific gravity" means the weight of a particular volume of substance compared to the weight of an equal volume of water at a reference temperature.

(39) "Surge" means an action causing water to move rapidly in and out of the well screen, thereby removing fine material from the surrounding aquifer.

(40) "Temporary groundwater monitoring well" means any groundwater monitoring well in place for less than 60 days.

(41) "Top of bedrock" or "top of firm rock" means at least 70% of the drill cuttings being either:

(a) Angular rock fragments, as in the case of crystalline rock; or

(b) Rock fragments composed of individual grains or rock particles that are cemented together to form an aggregate as opposed to a single sediment particle.

(42) "Tremie pipe" means a pipe or hose used to install well construction materials in an annular space or a borehole.

(43) "Unconsolidated material" means that material found above firm bedrock, composed of single sediment particles, individual grains or rock fragments. Unconsolidated material includes but is not limited to clay, silt, sand, gravel, loess, peat and organic soil.

(44) "Unified soil classification system" means the soil designation system based on the physical properties of the soil developed from the airfield classification system in 1952 and adopted by the American society for testing and materials in standard test method D2487-83.

Note: A copy of this publication is available for inspection at the offices of the department of natural resources, the secretary of state and the rivisor of statutes and may be obtained for personal use from the American Society for Testing and Materials, 1916 Race Street, Philadelphia, Pennsylvania 19103.

(45) "Water table" means the surface of unconfined groundwater where the water pressure is equal to atmospheric pressure.

(46) "Water table observation well" means any groundwater monitoring well, in which the screen or open borehole intersects a water table, which is installed for the specific purpose of determining either the elevation of the water table or the physical, chemical, biological or radiological properties of groundwater at the water table or both.

Note: Construction of a typical water table observation well is depicted in Figure 1.

(47) "Well" means any borehole or other excavation or opening in the ground deeper than it is wide constructed for the purpose of obtaining or monitoring groundwater.

(48) "Well depth" means the distance from the ground surface to the bottom of the well screen or to the bottom of the open hole when a well screen is not used.

(49) "Well volume" means the volume of water contained in the well casing and the filter pack.

History: Cr. Register, January, 1990, No. 409, eff. 2-1-90; am. (7), (8) and (18), cr. (2m), (21m) and (33m), Register, June, 1991, No. 426, eff. 7-1-91.

NR 141.055 Borehole protection. If a borehole is left open, protective measures shall be taken to prevent the borehole from acting as a conduit for contamination or becoming a safety hazard.

History: Cr. Register, January, 1990, No. 409, eff. 2-1-90.

NR 141.06 Soil testing. Specific soil sampling and testing procedures are specified in other chapters related to wastewater and solid and hazardous waste disposal facilities.

Note: See chs. NR 110, 181, 206, 214, 508, 512 and 550.

History: Cr. Register, January, 1990, No. 409, eff. 2-1-90.

NR 141.065 Well location. (1) Monitoring wells installed where prior department approval is required shall be installed at the locations indicated on plans and specifications approved by the department prior to installation.

(2) Following installation of the wells, an as-built plan map shall be submitted specifying the exact vertical and horizontal location of the wells. All monitoring well locations shall be reported to the department on a plan map drawn to a specific scale. The map shall indicate structure boundaries, property boundaries, any nearby surface waters and a north arrow. The plan shall show the wells in relation to each other, to property and structure boundaries, and to a common reference point on a horizontal grid system. The origin of the grid system shall be located according to latitude and longitude or according to the state plane coordinate system. The exact vertical location of the top of the well casing shall be referenced to the nearest benchmark for the national geodetic survey datum to an accuracy of 0.01 feet. This plan map shall show the exact location of the installed well on a horizontal grid system which is accurate to within one foot. Direction of groundwater flow shall be indicated. In addition, an 8.5-inch by 11-inch site map drawn to scale according to the horizontal grid system shall be submitted showing the location of wells and structures on the site.

(3) The well casings for wells constructed in a floodplain or floodway shall terminate a minimum of 2 feet above the regional flood elevation for the well site.

History: Cr. Register, January, 1990, No. 409, eff. 2-1-90; am. (2), Register, June, 1991, No. 426, eff. 7-1-91.

NR 141.07 Well casing. (1) SPECIFICATIONS. All permanent groundwater monitoring wells shall be constructed of new polyvinyl chloride (PVC) well casing materials except in situations where the rock, soil or groundwater may react with PVC, in which case an approval under s. NR 141.31 for alternative materials shall be requested. All PVC casing materials shall meet national sanitation foundation standard 14 and ASTM D1785 specifications for any one of the following cell classifications: 12454-B, 12454-C, 11443-B, 14333-D, 13233 or 15223-B. All casing shall have a minimum inside diameter of 1.9 inches. In unconsolidated geologic formations, all wells less than or equal to 100 feet in depth shall be constructed of at least schedule 40 PVC casing and all wells greater than 100 feet in depth shall be constructed of at least schedule 80 PVC casing. Groundwater monitoring wells shall be installed with well casing no larger than a 4-inch inside diameter. Groundwater monitoring wells shall have a vented cap except as provided in s. NR 141.13 (4) (b).

(2) REFERENCE. The listed national sanitation foundation and ASTM references are available for inspection at the offices of the department of natural resources, the secretary of state and the revisor of statutes and may be obtained for personal use from the National Sanitation Foundation, 3475 Plymouth Road, P.O. Box 1468, Ann Arbor, Michigan 48106, and the American Society for Testing and Materials, 1916 Race Street, Philadelphia, Pennsylvania 19103.

(3) ASSEMBLY AND INSTALLATION. All casing couplings shall be constructed of flush threaded joints. Solvent welded joints may not be used without prior written approval by the department. The casing shall be centered in the borehole.

(4) INSPECTION. Prior to use, the casings and couplings shall be inspected for cuts, deformations, gouges, deep scratches, damaged ends and other imperfections. Any casing or coupling having such a defect may not be used.

History: Cr. Register, January, 1990, No. 409, eff. 2-1-90; am. (1), Register, June, 1991, No. 426, eff. 7-1-91.

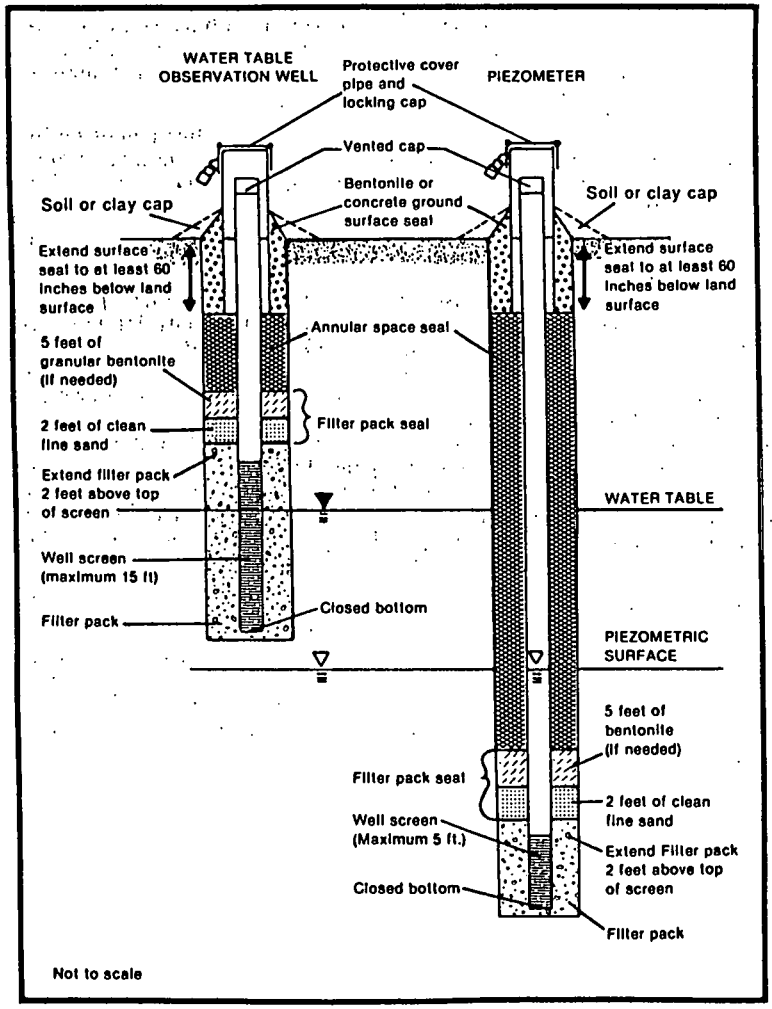
NR 141.09 Well screen. (1) SPECIFICATIONS. All permanent groundwater monitoring well screens shall be constructed of material which is nonreactive with the constituents in soils and groundwater at the monitoring location. The well screen may not be hand cut and may not be wrapped with filter cloth. The well screen slot size shall be sized to retain at least 90% of the grain size of the collapsed formation, based on a sieve analysis, when collapsed formation is used as filter pack material or at least 90% of the grain size of the filter pack, based on a sieve analysis, if material other than collapsed formation is used. Well screens on water table observation wells may not exceed 15 feet in length. Well screens on piezometers installed for the purpose of determining the elevation of the potentiometric surface may not exceed 5 feet in length.

Note: Well screens for wells other than the water table observation wells and piezometers identified above may vary in length.

(2) ASSEMBLY AND INSTALLATION. All well screens shall be permanently joined to the well casing by flush threaded joints. All joints shall be watertight. All well screens shall be centered in the borehole. Monitoring wells installed in bedrock using an open borehole may be constructed without a well screen.

Figure 1.

Typical water table observation well and piezometer construction details.



History: Cr. Register, January, 1990, No. 409, eff. 2-1-90; am. (1), Register, June, 1991, No. 426, eff. 7-1-91.

NR 141.10 Tremie pipes and sealing procedures. (1) MATERIALS. The tremie pipe used for the placement of sealant materials shall be one of the following materials:

(a) Metal pipe,

(b) Rubber-covered hose reinforced with braided fiber or steel and rated for at least 300 psi, or

(c) Thermoplastic pipe rated for at least 100 psi including:

1. Polyvinyl chloride (PVC)

2. Chlorinated polyvinyl chloride (CPVC),

3. Polyethylene (PE),

4. Polybutylene (PB), and

5. Acrylonitrite butadiene styrene (ABS).

(2) PROCEDURES. This subsection describes department approved sealant placement methods when a tremie pipe is used.

(a) The estimated and actual volume of sealing material used shall be calculated and reported to the department.

(b) The sealant material shall be placed in one continuous operation in such a manner as to not disturb the integrity of the filter pack and seal.

(c) When a tremie pipe is used, the bottom end shall be kept submerged in the sealant material throughout the sealing process.

(d) The sealant material shall be brought up to the ground surface seal. The density of the sealant material in the annular space or borehole at the bottom of the ground surface seal shall be the same as the density of the sealant material being placed. Any settling of the sealant material shall be topped off.

(e) Tremie pipe - gravity. As depicted in Figure 2, sealing material may flow by gravity through a funnel or hopper connected to a tremie pipe. The tremie pipe shall be lowered to the bottom of the annular space or borehole to be sealed and the sealing material placed from the bottom up. The end of the tremie pipe shall be kept submerged in the grout or slurry at all times.

(f) Tremie pipe - pumped. As depicted in Figure 3, the sealing material shall be placed by a pump through a tremie pipe into the annular space or borehole. Tremie pipes used for the placing of pumped slurry or grout shall be fitted with a J-hook end or a closed end with side discharge ports.

Note: The J-hook end or closed end with side discharge ports of the tremie pipe will direct the flow of the materials to the side or upward.

Figure 2.

Conductor (tremie) pipe — gravity method

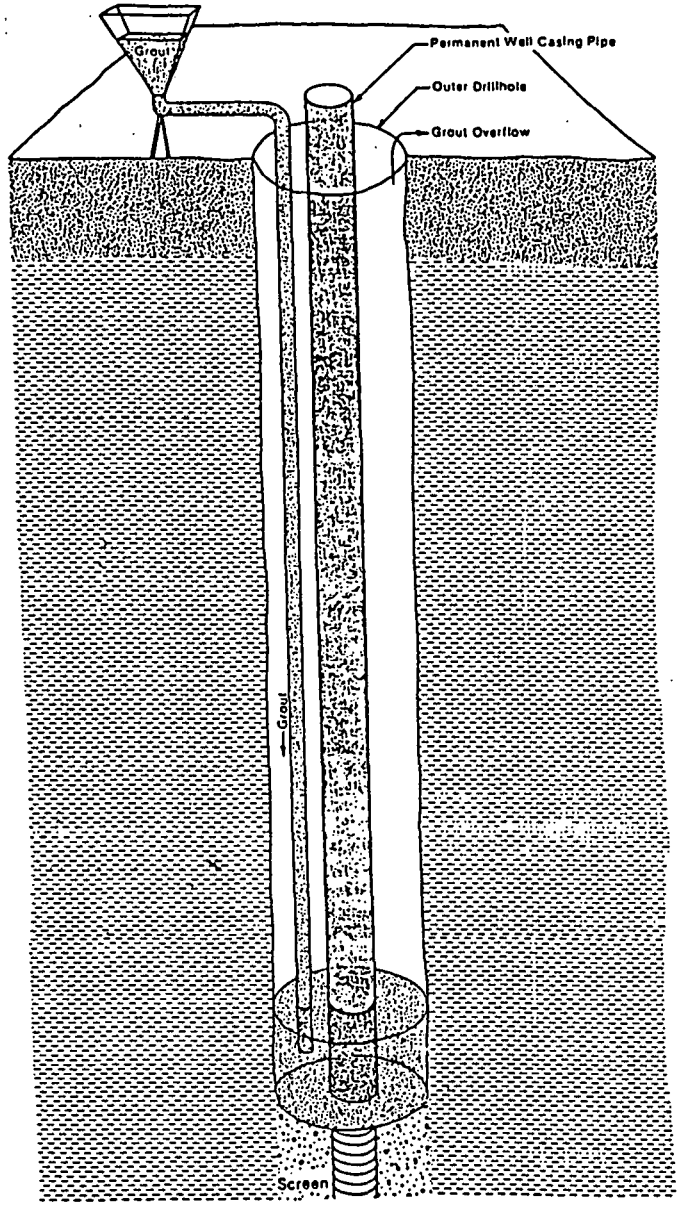
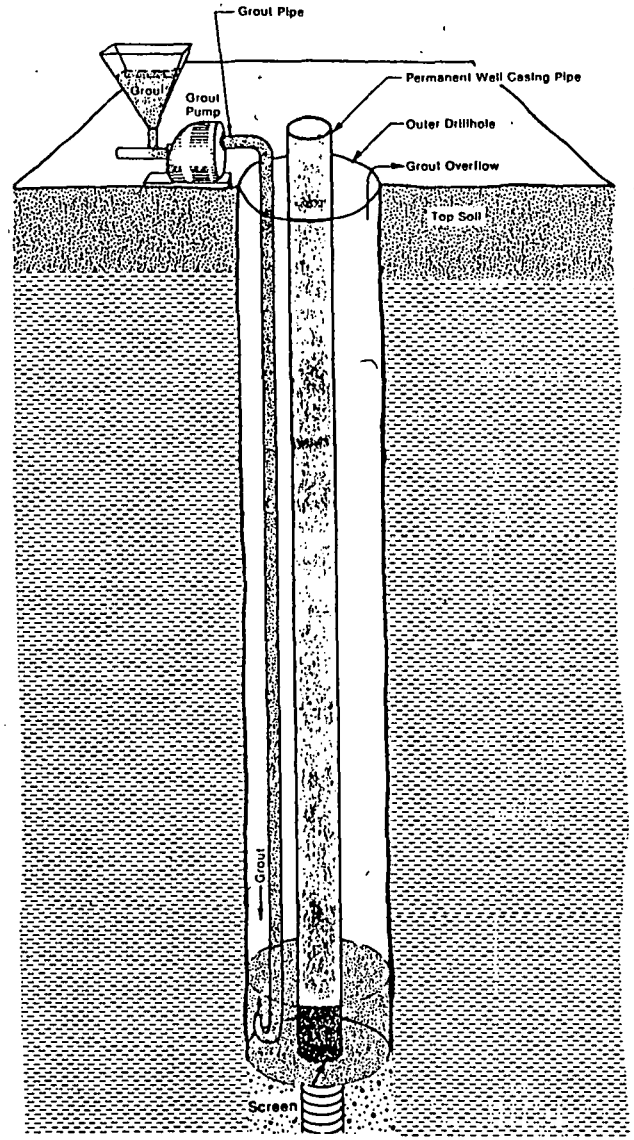


Figure 3.

Conductor (tremie) pipe — pumped method



History: Cr. Register, January, 1990, No. 409, eff. 2-1-90; am. (2) (d) and (f), Register, June, 1991, No. 426, eff. 7-1-91.

NR 141.11 Filter packs. All permanent groundwater monitoring wells installed in unconsolidated material and used for the collection of water quality samples shall be constructed with filter packs. Permanent groundwater monitoring wells installed in bedrock may be constructed with filter packs. When used, the filter pack shall be the only material in contact with the well screen. The estimated and actual volume of filter pack material used shall be calculated and reported to the department. All commercially prepared filter packs installed in permanent groundwater monitoring wells shall meet the requirements in sub. (1). All other filter packs shall meet the requirements in sub. (3).

(1) SPECIFICATIONS. The filter pack shall be a well sorted, silica based sand or gravel. The sand or gravel used for filter packs shall be hard and durable and shall have an average specific gravity of not less than 2.50. The sand and gravel shall be visibly free of clay, dust and micaceous and organic matter. Not more than 5% of the sand or gravel shall be soluble in a 10% hydrochloric acid solution. Thin, flat or elongated pieces of gravel, the maximum dimension of which exceeds 3 times the minimum dimension, may not constitute more than 2% of the material by weight. The filter pack for wells installed in unconsolidated material shall be sized to retain at least 50% of the surrounding formation based on a sieve analysis. In formations which are predominantly silt and clay, the filter pack shall be a fine sand. In bedrock, the filter pack shall be a medium or coarse sand or gravel. Crushed limestone, dolomite or any material containing clay or any other material that will adversely impact on the performance of the monitoring well may not be used as filter pack.

(2) INSTALLATION. The filter pack shall extend from 6 inches beneath the bottom of the well to 2 feet above the top of the well screen. For water table observation wells constructed in areas where the depth to water table is less than 7 feet, the required filter pack height above the top of the well screen may be reduced to 6 inches to allow for the required amount of annular space sealant to be placed. To ensure that the filter pack is installed evenly surrounding the well screen and casing over the proper depth interval, a tape measure, measurng rod or similar device shall be used to measure the height of the filter pack. The tape measure, measuring rod or similar device shall be carefully raised and lowered while the filter pack is being installed to identify bridging. If bridging occurs the filter pack material shall be tamped into place, surrounding the well screen and casing, using a measuring rod or similar device.

(3) COLLAPSED FORMATION. Collapsed formation may be used as filter pack material if the collapsed formation will limit the passage of formation fines into the well screen and either an artificial filter pack cannot be installed or the formation grain size is greater than or equal to fine sand sized grains. The grain size distribution of the collapsed formation shall be such that at least 90% of the formation will be retained by the well screen based on a sieve analysis. Analysis of the collapsed formation for specific gravity and particle size shall be performed and documentation shall be submitted to the department to support its use as an acceptable filter pack. Following review of the submitted information, the department may require new well construction if the collapsed formation analysis is not consistent with the filter pack specifications.

History: Cr. Register, January, 1990, No. 409, eff. 2-1-90; am. (1) to (3), Register, June, 1991, No. 426, eff. 7-1-91.

NR 141.13 Sealing requirements. All materials and procedures used in the installation of seals for permanent groundwater monitoring wells shall meet the requirements of this section. The calculated and actual volume of sealant material used for the filter pack seal and annular space seal shall be reported to the department.

(1) FILTER PACK SEAL. (a) *Specifications.* All permanent groundwater monitoring wells installed with filter packs shall be constructed with a filter pack seal. For all water table observation wells and piezometers, the filter pack seal shall extend 2 feet upward from the top of the filter pack and shall consist of 2 feet of clean fine sand. When high-solids grout, granular bentonite slurry, bentonite-cement grout or neat cement grout is used as the annular space sealant, 5 feet of bentonite shall be placed on top of the clean fine sand seal. Bentonite chips no greater than ⅜ inch in diameter or bentonite pellets shall be used for seals placed below the water table. Bentonite granules may be used for seals when there is no standing water above the filter pack and the borehole is less than 25 feet or in areas where the depth to water table is less than 7 feet. For water table observation wells constructed in areas where the depth to water table is less than 16 feet, the filter pack seal shall be reduced to 2 feet of bentonite to allow for the required amount of annular space sealant to be placed. For water table observation wells constructed in areas where the depth to water table is less than 7 feet, the required fitler pack seal may be reduced to allow for the required amount of annular space sealant to be placed.

(b) *Installation.* A tape measure, measuring rod or similar device shall be used to ensure that the filter pack seal is installed over the proper depth interval. The tape measure, measuring rod or similar device shall be carefully raised and lowered while the filter pack seal material is being placed to identify bridging. If bridging occurs the filter pack seal material shall be tamped into place, surrounding the well casing, using a measuring rod or similar device. When a tremie pipe is used to place the filter pack seal the procedures of s. NR 141.10 (2) shall be followed. Bentonite pellets, bentonite chips or bentonite granules shall be hydrated in 2 foot lifts as placed in the borehole when placed above the water table.

(2) ANNULAR SPACE SEAL. (a) *Specifications.* All permanent groundwater monitoring wells shall be installed with an annular space seal designed to achieve a permeability of 1×10^{-7} centimeters per second or less. For permanent groundwater monitoring wells constructed with filter packs, the annular space seal shall extend from the filter pack seal to the ground surface seal and shall be at least 2 feet in length. For water table observation wells constructed in areas where the depth to water table is less than 7 feet, the annular space seal shall be bentonite granules. For monitoring wells constructed into bedrock formations and without well screens, the annular space seal shall extend from the bottom of the outer borehole to the ground surface seal and shall be at least 2 feet in length. Sealant materials may not contain additives. These requirements may be met by:

Note: The department does not recommend the use of neat cement grout or cement mixtures in fractured formations because they may impact water quality.

1. Bentonite granules slurry may be used as an annular space sealant in any type of monitoring well except where the depth to the water table is less than 7 feet.

2. Bentonite sand slurry may be used as an annular space sealant in any type of monitoring well except where the depth to the water table is less than 7 feet.

3. Bentonite pellets, bentonite chips or bentonite granules may be used to seal the annular space under the following conditions:

a. Bentonite granules may be used when there is no standing water in the well above the filter pack and the total well depth is less than 25 feet or the depth to water table is less than 7 feet.

b. Bentonite chips with diameter no larger than ⅜ inch or bentonite pellets may be used when the depth of standing water in the well is less than 30 feet and the total depth of the annular space seal is less than 50 feet except where the depth to the water table is less than 7 feet.

4. High-solids grout approved by the department, bentonite-cement grout or neat-cement grout may be used to seal the annular space in which a bentonite filter pack seal has been placed except where the depth to the water table is less than 7 feet.

(b) *Installation.* 1. When bentonite chips with diameter no larger than ⅜ inch, bentonite pellets or granules are used to seal the annular space, they may either be poured freely down the borehole or added through a tremie pipe, provided the specifications of par. (a) are met. When a tremie pipe is used to place the annular space sealant the procedures of s. NR 141.10 (2) (a) and (b) shall be followed.

2. When grouts or slurries are used to seal the annular space, the material may be poured freely down a tremie pipe or pumped down a borehole with the use of a tremie pipe, provided the specifications of par. (a) are met. For wells 100 feet in depth or greater the sealant material shall be pumped down the borehole with the use of a tremie pipe. When a tremie pipe is used to place the annular space sealant the procedures of s. NR 141.10 (2) shall be followed.

3. When any slurry or grout is used, there shall be a 12-hour period between the time the annular space seal is installed and the time the protective cover pipe is installed. Any settling in the annular space seal shall be topped off before the protective cover pipe is installed.

4. The top of the well casing shall be covered with a protective cap.

(3) GROUND SURFACE SEAL AND PROTECTIVE COVER PIPE. (a) *Ground surface seal.* All permanent groundwater monitoring wells shall be constructed with a bentonite or concrete ground surface seal. The ground surface seal shall extend to a minimum of 60 inches below the land surface, and the top shall be sloped away from the well casing. If bentonite is used, the top of the surface seal shall terminate 2 inches below the land surface and shall be covered with top soil or native soil to prevent drying out. The ground surface seal shall be installed around the protective cover and may not be placed between the protective cover pipe and the well casing. If the monitoring well depth is such that both a minimum 2 foot annular space seal and a minimum 5 foot ground surface seal cannot both be placed, the ground surface seal may be shortened.

Note: Certain soils are prone to frost heave and the department does not recommend use of concrete as a ground surface seal in these situations.

(b) *Protective cover pipe.* The protective cover pipe shall consist of a metal casing at least 2 inches larger in diameter than the well casing with a locking cap. The protective cover pipe shall extend from the bottom of the ground surface seal to a minimum of 24 inches above the ground surface except as provided in sub. (4). There may be no more than 4 inches between the top of the well casing and the top of the protective cover pipe. The protective cover pipe shall always extend above the top of the well casing. For water table observation wells constructed in areas where the depth to water table is less than 7 feet, the required length of protective cover shall be reduced and may not extend through the annular space seal or into the filter pack. If the monitoring well is located in a floodplain, the protective cover pipe shall be watertight. The department may require additional protective devices, such as rings of brightly colored posts around the well, as necessary. Weep holes or vents may be used in protective cover pipes.

(4) GROUND SURFACE SEAL AND FLUSH MOUNTED PROTECTIVE COVER PIPE. (a) *Ground surface seal.* All permanent groundwater monitoring wells with a flush mounted protective cover pipe shall be constructed with a concrete ground surface seal. The ground surface seal shall extend to, but not beyond, the total depth of the flush mounted protective cover pipe. The ground surface seal shall be installed around the flush mounted protective cover pipe and may not be placed between the flush mounted protective cover pipe and the well casing.

(b) *Flush mounted protective cover pipe.* The flush mounted protective cover pipe may be installed only in high vehicular traffic areas and may not be installed in areas subject to ponding or flooding. The flush mounted protective cover's lid shall have the wording "monitoring well" on its outer surface. Flush mounted protective cover pipes shall be installed through an impervious surface such as asphalt or concrete. If an impervious surface does not exist one shall be created which will support the weight of the traffic in the area. The flush mounted protective cover pipe shall consist of a watertight metal casing with an inside diameter at least 4 inches greater than the inside diameter of the monitoring well casing. The flush mounted protective cover pipe shall be one continuous metal piece or 2 metal pieces which are joined with a continuous weld. The flush mounted protective cover pipe shall be a minimum of 12 inches in length. There may be no more than 8 inches between the top of the monitoring well casing and the top of the flush mounted protective cover pipe after installation. The flush mounted protective cover pipe shall have an exterior flange or lugs. The flush mounted protective cover pipe may not extend beyond the annular space seal. The flush mounted protective cover pipe or the monitoring well shall have a locking mechanism. The monitoring well installed within any flush mounted protective cover pipe shall have a watertight cap.

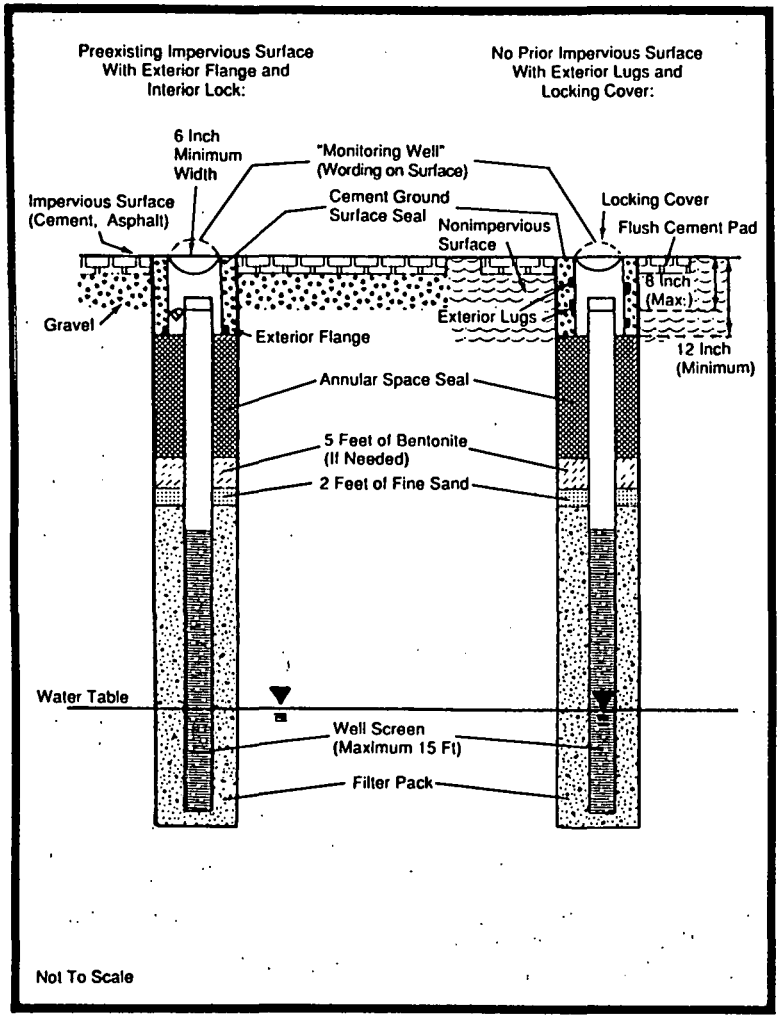
Note: Figure 4 depicts 2 typical flush mounted protective cover pipes after installation.

Note: An exterior flange or lugs will aid in the stabilization of the flush mounted protective cover pipe within the ground surface seal.

Note: After removing the watertight cap and prior to taking a pressure head measurment a waiting period is recommended to enable the water level to stabilize.

Figure 4.

Two typical flush mounted protective cover pipes after installation.



History: Cr. Register, January, 1990, No. 409, eff. 2-1-90; am. (1), (2) (a) (intro.), 1., 2. and 3. and (b) 1. and 4. and (3), r. and recr. (2) (a) 4., r. (2) (a) 5. and 6., cr. (4), Register, June, 1991, No. 426, eff. 7-1-91.

NR 141.15 Drilling methods and fluids. The drilling method shall introduce the least possible amount of foreign material into the borehole, produce the least possible disturbance to the formation and permit the proper construction and development of the required diameter well. Only air, water from a known safe source free of bacterial and chemical contamination or bentonite drilling muds, mixed with water from a known safe and uncontaminated source, may be used as drilling fluids. The water used for drilling shall be stored in such a manner as to prevent contamination of the clean water. The department may require chemical analysis of the water used to produce drilling fluids. Hammer drill lubricants, used with air rotary drill rigs, may not be used for installing groundwater monitoring wells. If air is used as a drilling fluid, the air shall be filtered by a coalescing air filter. If water is used, the source of the water shall be reported. Drilling fluid additives may not be used without prior written department approval.

History: Cr. Register, January, 1990, No. 409, eff. 2-1-90.

NR 141.16 Cross contamination. Precautions shall be taken to prevent cross contamination of aquifers or uncontaminated zones.

History: Cr. Register, June, 1991, No. 426, eff. 7-1-91.

NR 141.17 Disposal and decontamination. (1) All drill cuttings and fluids and surge and wash waters from borehole and groundwater monitoring well construction and development shall be disposed of in a manner approved by the department.

(2) All borehole and groundwater monitoring well construction and development equipment shall be decontaminated by washing and triple rinsing or high pressure heat cleaning to prevent cross-contamination of boreholes or groundwater monitoring wells.

History: Cr. Register, January, 1990, No. 409, eff. 2-1-90.

NR 141.19 Borehole diameter. (1) BOREHOLES IN UNCONSOLIDATED GEOLOGIC FORMATION. For all permanent groundwater monitoring wells in unconsolidated geologic formations, the borehole diameter shall meet the following requirements:

(a) If hollow stem augers are used, their inside working diameter shall be at least 2¼ inches greater than the inside diameter of the permanent well casing.

(b) If solid stem augers are used, their outside diameter shall be at least 4 inches greater than the inside diameter of the permanent well casing.

(c) If an air or mud rotary method is used, the borehole diameter shall be at least 4 inches greater than the inside diameter of the permanent well casing. If a temporary outer casing is used, the inside diameter of the temporary outer well casing shall be at least 4 inches greater than the inside diameter of the permanent well casing. The temporary outer casing shall be pulled as the annular space is being sealed.

Note: The dual-tube or triple-tube reverse rotary systems are rotary methods.

(d) If percussion methods, including the rotary wash, wash down and wash bore methods, with a temporary outer casing are used, in unconsolidated geologic formations, the inside diameter of the temporary outer casing shall be at least 4 inches greater than the inside diameter of the

permanent well casing. The temporary outer casing shall be removed during the sealing of the annular space.

(2) BOREHOLES IN BEDROCK GEOLOGIC FORMATIONS. For all permanent groundwater monitoring wells installed deeper than 2 feet past the top of the bedrock, the borehole diameter shall meet the following requirements:

(a) If an air or mud rotary method is used to construct the monitoring well, the requirements of sub. (1) (c) shall be followed.

(b) If percussion methods are used to construct the monitoring well, the requirements of sub. (1) (d) shall be followed.

History: Cr. Register, January, 1990, No. 409, eff. 2-1-90.

NR 141.20 Aquifer test or recovery wells. The installation, location and construction of any aquifer test well or recovery well installed for a purpose regulated by the department under ch. 144, 147 or 160, Stats., shall be approved by the department program responsible for overseeing work at the site prior to installation. Unless another time period is specified by law, the department shall complete its review and make a determination on all applications for approval within 65 business days after receipt of the complete application for approval. Applications may be included with other submittals for work to be performed at the site. The start of the 65 day review period will not begin until a complete application is received by the department. All requests for approval shall be in writing, except that for situations that require immediate response, an approval may be requested verbally and an advanced verbal approval may be granted by the department and followed up with a written confirmation. Aquifer test wells or recovery wells may be used for pressure head monitoring or water quality monitoring only with the approval of the department. All aquifer test and recovery wells shall be abandoned according to s. NR 141.25 and documented according to s. NR 141.23.

Note: See ch. NR 112 for additional requirements that apply to aquifer test wells and recovery wells.

History: Cr. Register, June, 1991, No. 426, eff. 7-1-91.

NR 141.21 Well development. All permanent groundwater monitoring wells shall be developed according to the requirements of section. Wells sealed with grout or slurry shall be developed after a minimum waiting period of 12 hours after installation is completed. The goal of well development is to produce water free of sediment and all drill cuttings and drilling fluids.

(1) WELLS THAT CANNOT BE PURGED DRY. All permanent groundwater monitoring wells that cannot be purged dry shall be developed by the following procedure:

(a) Alternately surge and purge the well for a minimum of 30 minutes. The surge and purge cycle shall consist of several minutes of surging followed by several minutes of purging to remove the material collecting in the bottom of the well. The surging shall move formation water in and out of the well screen. The surging shall be accomplished by using either a bailer or surge block or by pumping the well sufficiently to cause a drawdown and then allowing the well to recover and repeating the process.

Note: When a surge block is used, care should be taken to avoid drawing the annular space seal material into the filter pack or well screen.

(b) After the final surge and purge cycle is completed, the well shall be pumped or bailed until 10 well volumes of water are removed or until the well produces sediment free water. If sediment free water is not obtained any remaining sediment shall be removed from the bottom of the well. Well volume shall be calculated in the following manner:

$V_1 + V_2$ = well volume

V_1 = volume of water in well casing

$$V_1 = \Pi \left(\frac{D}{2}_1\right)^2 H_1^3$$

V_2 = volume of water in filter pack

$$V_2 = N \Pi H_2 \left[\left(\frac{D}{2}_3\right)^2 - \left(\frac{D}{2}_2\right)^2\right]$$

N = porosity of filter pack

D_1 = inside diameter of well casing

D_2 = outside diameter of well casing

D_3 = diameter of borehole

H_1 = height of water column

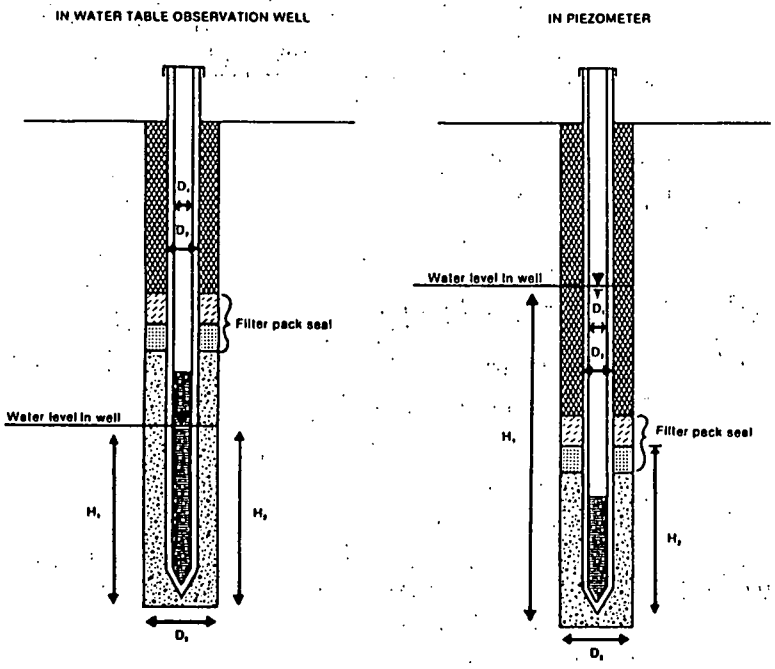
H_2 = length of sand used in filter pack and fine sand filter pack seal or the height of the water column in water table observation wells.

Note: There are 7.48 gallons per cubic foot.

H_1 = height of water column

H_2 = length of filter pack or the height of the water column in water table observation wells.

CALCULATION OF WELL VOLUME



(2) WELLS THAT CAN BE PURGED DRY. All permanent groundwater monitoring wells that can be purged dry shall be developed in a manner which limits agitation by slowly purging the well dry. Wells which can be purged dry may not be surged and no water may be added to the well.

History: Cr. Register, January, 1990, No. 409, eff. 2-1-90; am. (intro.), (1) (a) and (b) and (2), Register, June, 1991, No. 426, eff. 7-1-91.

NR 141.23 Well and borehole construction documentation. (1) All permanent groundwater monitoring well construction shall be reported to the department, using forms and instructions provided by the department, within 60 days after the well has been installed. The completed report shall include the following information:

(a) Well location,

(b) Well casing material and installation procedures,

(c) Well screen materials and installation procedures,

(d) Filter pack materials and installation procedures,

(e) Sealing materials and installation procedures,

(f) Drilling methods and fluids used for installation,

(g) Borehole diameter,

(h) Well development procedures,

(i) Sieve analysis, and

(j) Any other information deemed necessary by the department.

(2) All permanent groundwater monitoring wells installed after February 1, 1990 shall be labeled with labels supplied by the department.

(3) All borehole construction data shall be reported to the department using forms and instructions supplied by the department within 60 days after construction. The completed report shall include the following data: the results of any soil tests done and a description of the soil structure, soil color, mottling, moisture content, layering, jointing, lenses, fractures, organic matter and voids and any other information deemed necessary by the department. The constructor shall report any decontamination procedures used between borehole installations.

History: Cr. Register, January, 1990, No. 409, eff. 2-1-90; am. (1) (h), renum. (1) (i) to (j), cr. (1) (i), Register, June, 1991, No. 426, eff. 7-1-91.

NR 141.25 Abandonment requirements. The following requirements apply to the abandonment of all boreholes greater than 10 feet deep or which intersect a water table and all groundwater monitoring wells. The department may require, by order or other appropriate means, that any borehole or monitoring well be abandoned. The department shall consider the following factors in determining whether a borehole or monitoring well should be abandoned: purpose, location, groundwater quality, age and condition of the well or borehole potential for groundwater contamination and well or borehole construction.

(1) TIMELINES FOR ABANDONMENT. (a) A borehole shall be abandoned within 3 working days after its use has been discontinued.

(b) Any permanent groundwater monitoring well no longer being used to gather information on geologic or groundwater properties shall be abandoned within 60 days after its use has been discontinued.

(c) Any groundwater monitoring well found by the department to be acting as a conduit for groundwater contamination shall be abandoned within 15 working days after written notification by the department.

(d) Any groundwater monitoring well constructed after February 1, 1990 not meeting the requirements of this chapter shall be abandoned and replaced with a monitoring well meeting the requirements of this chapter or any department approval granted under this chapter within 60 days after installation of the noncomplying well or 15 days after written notification by the department that the well is noncomplying.

(2) ABANDONMENT PROCEDURES. (a) *Boreholes.* Any borehole intersecting the water table or greater than 10 feet deep, whose use has been discontinued, shall be abandoned according to the requirements of par. (d).

(b) *Monitoring wells - impermeable annular space seals.* A permanent groundwater monitoring well known to be constructed with an impermeable annular space seal shall be abandoned according to the requirements of par. (d) after the protective cover pipe and ground surface seal have been removed and the well casing cut off at least 30 inches below the ground surface. The well casing may be completely removed during abandonment by pulling the well casing, overdrilling around the casing and then pulling the well casing out of the ground or by drilling out the well casing completely. If the well casing is to be removed, the well shall be sealed as the casing is removed.

(c) *Monitoring wells - permeable annular space seals and wells in waste areas.* A groundwater monitoring well not known to be constructed with an impermeable annular space seal or located in an existing or planned future waste disposal or treatment area shall be abandoned by removing the protective cover pipe and the ground surface seal and then completely removing the well casing. The well casing shall be pulled out of the ground as the well is filled according to the requirements of par. (d).

(d) *Sealing requirements.* Boreholes and groundwater monitoring wells shall be abandoned by complete filling with neat cement grout, bentonite-cement grout, sand-cement grout, concrete or bentonite-sand slurry. When a tremie pipe is used to place the sealing material, the procedures of s. NR 141.10 (2) shall be followed. A tremie pipe shall be used to abandon groundwater wells and boreholes greater than 30 feet in depth or with standing water. Groundwater monitoring wells and boreholes greater than 100 feet in depth shall be sealed with a tremie pipe-pumped method. Bentonite may be used as a sealing material without the use of a tremie pipe under the following conditions:

1. Bentonite granules may be used for abandonment of boreholes and groundwater monitoring wells less than 25 feet deep and when there is no standing water above the filter pack seal.

2. Bentonite chips no greater than ⅜ inch in diameter or bentonite pellets may be used for abandonment of boreholes and groundwater monitoring wells less than 50 feet deep and the depth of standing water is less than 30 feet.

3. Bentonite chips no greater than ⅜ inch in diameter or bentonite pellets may be used for abandonment of boreholes and groundwater monitoring wells which are greater than 4 inches in diameter and less than 250 feet deep and the depth of standing water is less than 150 feet.

(3) SEALANT SETTLEMENT. Any settling of the sealant material shall be topped off. Sealing material may be terminated 30 inches below the ground surface in agricultural areas to avoid interference with agricultural activities. A native soil plug shall be placed on top of the settled sealing material in such cases.

(4) ABANDONMENT DOCUMENTATION. All borehole and permanent groundwater monitoring well abandonments shall be reported to the department within 60 days of the abandonment on forms supplied by the department. In addition to the information required on the form, the person performing the abandonment shall report any decontamination procedures used between borehole and well abandonments.

History: Cr. Register, January, 1990, No. 409, eff. 2-1-90; am. (2) (b), (2) (d) 1 to 3 and (3), Register, June, 1991, No. 426, eff. 7-1-91.

NR 141.27 Driven point wells. Driven point wells with galvanized steel drive pipes and contaminant compatible well screens may be used as permanent groundwater monitoring wells if prior department approval is obtained. Written documentation shall be supplied to the department prior to installation indicating:

(1) That the well is to be used only for water table elevation measurements or to monitor for parameters for which the well casing and screen material will not interfere with the analytical results;

(2) That the well will not provide a conduit for contaminants to enter the groundwater; and

(3) That information on subsurface stratigraphy is not needed. In situations where subsurface geologic information is needed, a separate borehole shall be constructed to collect the required data.

History: Cr. Register, January, 1990, No. 409, eff. 2-1-90.

NR 141.29 Temporary groundwater monitoring wells. Temporary groundwater monitoring wells may be installed according to less stringent standards than specified for permanent groundwater monitoring wells. Any temporary monitoring well construction shall be approved by the department prior to its installation. All temporary monitoring wells shall be abandoned in accordance with s. NR 141.25 within 120 days after their installation.

History: Cr. Register, January, 1990, No. 409, eff. 2-1-90.

NR 141.31 Special circumstances and exceptions. (1) The department may require or approve more restrictive or alternative well material, assembly, installation, development or abandonment if the contaminant concentrations or geologic setting require alternative construction. Prior written approval is required before any alternative materials are used in monitoring well installation.

(2) Exceptions to the requirements of this chapter may be approved by the department prior to installation or abandonment. An exception request shall state the reasons why compliance with the rule requirements is infeasible. The department may conditionally approve an exception by

requiring materials or procedures which safeguard against contamination and result in groundwater monitoring well construction which is substantially equivalent to the requirements of this chapter. Failure to comply with the conditions of an exception voids the department's approval of the exception.

History: Cr. Register, January, 1990, No. 409, eff. 2-1-90.

APPENDIX C

EXCERPTS FROM QAPP

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

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)

II. Semivolatiles	CAS Number	Quantitation Limits[1] 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)

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)	Soil/Sediment(mg/kg)
Tetrahydrofuran	1.5	1.9
Trichlorofluoromethane	0.4	0.05
Dichlorodifluoromethane	1.5	0.19

- 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

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 actvities. 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 7/87 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

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 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 7/87 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^{o}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.

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 7/87 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).