Sampling Analysis Plan and Sampling Protocol
For

SKB Rosemount
Industrial Waste Facility
SW-383

SKB
ENVIRONMENTAL

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1.0 INTRODUCTION

This document defines the procedures to be used for obtaining ground water measurements, methane measurements and for collecting and handling ground water samples at **SKB Rosemount Industrial Waste Facility (SKB Rosemount)** beginning with the **Fall 2003** sampling event.

Deviations from these procedures may be required due to unforeseen circumstances. Any deviation will be approved by the field crew leader and will be clearly noted in the Field Log Book. The change in protocol will also be documented and evaluated in the Sampling and Analysis Report, as described in Section 5.4. If the change in sampling procedure is a major deviation from this protocol, then the sample may be collected but it will not be analyzed until the situation has been discussed with the MPCA hydrogeologist and the need for re-sampling has been evaluated.

A general outline of the sequence of field sampling activities is shown in Appendix E. The main body of this protocol presents a more detailed description of the steps to be followed at each sampling point.

2.0 ADVANCE PREPARATION FOR SAMPLING

Selection of analytical parameters, laboratory arrangements, the sampling order of wells, field measurement and sampling techniques, equipment selection, and other quality assurance measures are based on the sampling objectives presented in the this plan.

2.1 Sampling Schedule

The groundwater monitoring program at SKB Rosemount Industrial Waste Facility will consist of quarterly sampling on the following schedule:

Winter	January 1 to February 28
Spring	March 14 to April 21
Summer	July 1 to July 31
Fall	October 21 to November 21

Reporting Deadlines	Winter/Spring	June 30
	Summer	September 30
	Fall	February 1

2.2 Selection of Analytical Parameters

Analytical parameters were selected based on regulatory requirements and a review of site history. The site has been sampled for an extensive list of parameters since 1990, and the background water chemistry is well documented. Samples will be analyzed for the parameters shown in Appendix A, in order to assure the site is not impacting the groundwater. During the spring and fall the groundwater will be sampled to meet the requirements of MR 7035.2885 subp. 16 A(1) and A(2). During the summer sampling event the wells will be sampled for all additional parameters that have historically been found in leachate samples. As additional compounds are detected in the leachate samples, they will be added to the summer sampling list. Leachate will be sampled in the winter, spring, summer, and fall for the compounds listed in MR 7035.2885 subp. 16 B(1), and additional compounds as required by MCES permit (see Appendix A). Water levels will be measured in all wells during the spring, summer, and fall sampling events. In addition, methane will be monitored during the spring, summer, and fall events at all methane monitoring points.

Analytical techniques for trace metals and organic compounds were selected primarily on the ability to detect potential contaminants at low concentrations.

2.3 Practical Reporting Limits

The practical reporting limit (PRL) is the lowest concentration that can be reliably reported within specified limits of precision and accuracy during routine laboratory operating conditions. Practical reporting limits are shown in Appendix A.

2.4 Quality Assurance for Field Procedures

Special care will be taken in the field to prevent cross-contamination or background contamination of ground water samples due to the following mishaps:

- improper storage or transportation of equipment
- placing sample bottles on or near a potential source of contamination, such as on an uncovered surface or near vehicle exhaust
- handling bottles or equipment with dirty hands or gloves
- inadequate cleaning of well purging or sampling devices

Field personnel will work under the assumption that contamination exists in the nearby soil, ambient air, and rinse water, so exposure to these media will be minimized by taking the following precautions:

- The area surrounding the wellhead will be kept as clean as practical.
- A new pair of inert disposable gloves **will** be put on at each well before sampling activities begin. Gloves will be replaced if they become soiled while performing sampling activities.
- The sampling work surface *{e.g., the ground surface or interior of vehicle}* will be covered with a clean and dry sheet (or equivalent) of relatively inert plastic. If materials used in the sampling process must be put down, they will be placed on a clean portion of the plastic sheet.
- The length of time that sample bottles remain open will be minimized, to avoid exposure to airborne dust or volatile contaminants in ambient air.
- Sample containers will be filled upwind from any source of engine exhaust, such as a vehicle or generator. In the event of poor weather conditions; high wind, blowing dust, continuously falling precipitation, samples will be collected in a temporary shelter.
- The amount of rinse water left on washed materials will be minimized.

2.5 Sampling Containers and Preservatives

All sampling containers and preservatives are supplied by the laboratory. On arrival at the facility, all bottles will be checked to assure the proper number of bottles has arrived, that they are intact, and all bottles have preservative. Details regarding sample bottles and preservation methods are provided in Table 1. The Laboratory Quality Assurance Project Plan describes specific procedures for the cleaning, testing, labeling and storage of sample containers and for the preparation and addition of preservatives. All chemical preservatives are added in the laboratory before samples are collected. Field pH checks will be performed to assure proper preservation of samples.

2.6 Selection of Sample Collection Techniques

Sample collection techniques have been tailored to the goals of this sampling event and the specific characteristics of this site. A summary of the sampling goals and the pertinent site, monitoring well, or contaminant characteristics is given in the Sampling and Analysis Plan. The sampling techniques described herein are scientifically sound and widely used in this industry.

2.7 Purging and Sampling Equipment

Neither air lift pumps nor any other device that aerates well water or otherwise creates significant turbulence will be used at any time during the purging or sampling of wells. The same equipment will be used for both purging and sampling at any given well.

Well purging and sampling equipment includes the following:

- Dedicated Well Wizard T1200 1.5" stainless-steel and Teflon bladder pumps.
- Pump discharge lines consisting of dedicated Teflon® or Teflon® lined tubing.
- Air compressor and controllers.

A detailed description of sampling equipment is presented in Appendix B. Appendix C provides information on equipment maintenance and operation.

2.8 Decontamination, Storage and Transport of Equipment

The following sampling equipment is dedicated to individual wells and is therefore exempt from field decontamination: pumps, and tubing.

Field decontamination will be performed between each sampling point for all non-dedicated, non-disposable sampling equipment. After cleaning, the equipment will be inspected visually to detect sticky residues or other substances that may survive normal cleaning. If the inspection reveals that decontamination was insufficient, additional measures will be implemented as needed and documented in the Sampling and Analysis Report. The equipment will be handled in a manner that will minimize cross-contamination between wells and avoid introducing surface or ambient air contamination into the well.

Before mobilizing for field work or performing any decontamination, a source of control water and organic-free reagent grade deionized water for decontamination will be selected and evaluated. Control water is defined by ASTM D5088-90 as "water used for equipment washing and rinsing that has a known chemistry". An example of an acceptable source of control water is potable water from a municipal water supply system that has a known history of being free of contaminants. This water will be used for the wash and intermediate rinses of sampling equipment during field decontamination. The organic-free reagent grade deionized water will be used for the final rinse of sampling equipment which contacts sample water or the inside of the well (see procedures outlined below).

The inorganic desorbing agent referenced below will be 10% nitric acid solution made from reagent grade acid and deionized water. The organic desorbing agent referenced below will be pesticide grade isopropanol.

Equipment will be decontaminated in the field in the following manner:

A. Equipment that does <u>not</u> contact sample water or the inside of the well:

1. clean (inside and outside, where possible) with a phosphate-free detergent/clean-water solution, applied with a scrub brush
2. rinse with clean control water
3. inspect for remaining particles or surface film and repeat decontamination procedure if necessary

B. Equipment that <u>does</u> contact sample water or the inside of the well:

1. clean (inside and outside, where possible) with a phosphate-free detergent/clean-water solution, applied with a scrub brush made of inert material.
2. rinse with clean control water
3. inspect for remaining particles or surface film and repeat the first two steps, if necessary
4. rinse with an inorganic desorbing agent *{only if samples will be analyzed for inorganic chemicals.}*
5. rinse with clean control water
6. rinse with an organic desorbing agent *{only if samples will be analyzed for organic chemicals}*
7. rinse thoroughly with laboratory controlled deionized water
8. shake off remaining water and allow to air dry

2.9 Order of Sampling

Where the distribution of contaminants is not known, purging and sampling will begin with wells considered to be up-gradient from likely source(s) of contamination and finish with down-gradient wells closest to suspected contamination. Table 2 shows the sampling frequency for the site. Leachate will be sampled last.

The order in which wells will be sampled is shown in Table 3.

3.0 PRELIMINARY FIELD WORK

The following procedures will be implemented to ensure that the samples collected are representative of ground water quality conditions at the site.

3.1 Field Inspections and Field Decisions

Upon arrival at each monitoring point the well will be inspected to verify that the well apron, if present, is intact. Any well damage, tampering, or missing parts, labels, or locks will be noted. Field conditions will be recorded as described in Section 5.6 of this protocol. Any running vehicle or field generator will be located downwind of the sampling station. If any condition is discovered that may interfere with obtaining representative analytical results, the condition will be rectified before sampling proceeds.

The well will be unlocked. Protective gloves will be donned before removing the inner riser cap to a clean storage spot. The breathing zone around the well will be checked with an Organic Vapor Analyzer and this will be recorded on the Field Data Sheet. Any hint of odor or free product in the well will be noted on the Field Log Book and in the Sampling and Analysis Report.

Deviations from the approved protocol may be required due to unforeseen circumstances. Any change in protocol will be approved by the field crew leader and will be clearly noted in the Field Log Book. The change in protocol will also be documented and evaluated in the Sampling and Analysis Report, as described in Section 5.5. If the change in sampling procedure is a major deviation from the approved protocol, then the sample may be collected but it will not be analyzed until the situation has been discussed with the MPCA hydrogeologist and the need for re-sampling has been evaluated.

3.2 Detection of Immiscible Layers

Previous sampling at this facility indicates that this section is not applicable.

3.3 Water-Level Measurements

Initial static water levels will be measured and recorded at each well prior to any well evacuation or sampling. Additional water level measurements will be taken during or immediately after purging, and immediately after sampling is completed. These water levels and other pertinent field data will be recorded on the Field Data Sheet shown in Appendix D.

Measurement of the initial static water level in a well will include a minimum of two water level measurements. The water level probe will be raised to clear the water and re-lowered between measurements. If there is poor agreement between the first and second static water level measurements (i.e., a difference of more than 0.01 feet), the situation will be evaluated to determine the source of the discrepancy (measurement errors, etc.). If necessary, a third static water level measurement will be made.

Water levels will be measured with an electric water-level sensor probe that is calibrated annually. The electric water-level sensor probe will be lowered down the well until the light illuminates and a tone sounds, indicating contact of the probe with the water surface. Depth to water will be recorded to the nearest 0.01 feet.

The depth-to-water will be referenced to the top of the innermost well casing. Where a measuring point has not been marked, the measuring point will be assumed to be at the top of the innermost casing on the north side of the casing. The water column volume will be calculated based on the static water level and the nominal diameter of the inner well casing or from the packer depth and the nominal diameter of the inner wall casing and noted on the Field Data Sheet. When reporting water level elevation, the depth to water measurement will be converted to Mean Sea Level using the surveyed elevation of the measuring point.

Water level probes will be decontaminated by washing with a phosphate-free detergent, <10% nitric acid, and rinsing with deionized water and drying with clean laboratory-grade tissue before use in each well.

3.4 Field Water-Quality Measurements

Specific conductance, pH, temperature, turbidity, and dissolved oxygen will be measured in the field immediately before sample collection. Quality control measures (calibration and/or checks against standards, etc.) and all measurements will be recorded on the Field Data Sheet shown in Appendix D.

All measurements except for turbidity will be taken within a closed flow cell designed to allow measurement of these parameters while minimizing changes in temperature, pressure, and dissolved gases from the in-situ aquifer environment.

The flow cell has the following characteristics:

- air tight fittings for installation of all probes;
- an intake which is connected directly to the pump discharge line;
- a discharge line approximately 3 feet long that is connected to the flow cell with an air tight connection;
- a maximum volume of no greater than five times the per minute volumetric rate of inflow to the cell to maintain measurement sensitivity to temporal changes in water quality; and
- a minimum volume of 500 ml to provide enough thermal mass to minimize external temperature effects.

The flow cell will reside in a water bath kept at a temperature close to the in-situ ground water temperature. The flow cell and lines will be shielded from strong winds and direct sunlight. The flow of ground water through the flow cell will be as continuous and steady as practical. Discharge velocities through the flow cell will be kept low to prevent problems of streaming potential with probes. All probes will be fully immersed without touching the sides of the non-metallic flow cell. The probes will be allowed to equilibrate with fresh aquifer water for a minimum of one minute before recording measurements.

At a minimum, the general care, maintenance, calibration procedures, and operation of each measurement device will follow the manufacturer's specifications described in the instruction/owner's manual for each device. Specific procedures for measurement of individual field water quality parameters are described below.

Specific Conductance

The conductivity cell will be stored in deionized water for at least one hour before use. The conductivity meter will be checked against known standards each day before taking measurements at the well. The conductivity cell will be inspected to be sure it is in good condition with no chips in the coating.

Temperature

At the beginning of each sampling day, the temperature probe will be inspected and compared in a water bath to a mercury thermometer capable of being read to the nearest 0.1 degrees Celsius to assure it is in good operating condition. The measured ground water temperature will be recorded to the nearest 0.1 degrees Celsius.

pH

Special care will be taken to protect the fragile glass bulb on the end of the pH electrode and to keep the electrode tip moist between sampling points. The electrode will not be allowed to freeze.

Before sampling is begun for the day, the pH meter will be calibrated by a two point calibration method, using a pair of buffers with pH values representative of the range of values expected in the field (pH = 4 and 7 or, alternately, pH = 7 and 10). If the meter is shown to hold its slope well over time, routine checks later in the day will be accomplished by using only one buffer. The single buffer check will normally be accomplished using a pH = 7 buffer. The pH meter will be checked before taking measurements at each new sampling point.

Only fresh buffer solutions will be used. Care will be taken not to dilute or contaminate the buffer solutions.

Before each measurement the electrode will be held by the cap and given a few downward shakes to clear any bubbles. The bulb will be checked to verify that the bulb has not dried out and that no air bubbles are present.

The meter will be calibrated per manufacturer's recommendations in Appendix C.

Dissolved Oxygen

Special care will be taken to store the probe in a moist environment and to otherwise protect the delicate membrane on the end of the probe. Before taking measurements, the membrane at the tip of the probe will be checked to verify that it is in good condition. The membrane will be replaced before each sampling event.

Prior to the first measurement, the dissolved oxygen probe will be allowed to equilibrate with a continuously replenished supply of fresh aquifer water for a minimum of five minutes. Readings will be reported to the nearest 0.1 mg/L dissolved oxygen. Readings should appear stable on the display to be considered valid. If fluctuating readings are observed, that condition will be documented in the Sampling and Analysis Report.

Turbidity

Operation of the turbidity meter will follow manufacturer recommendations. Measurements will be made inside a glass or transparent plastic bottle filled directly from well discharge in the same manner as samples are collected. Measurements will be taken immediately after filling the container to minimize bias due to particulate settling.

The meter will be calibrated per manufacturer's recommendations in Appendix C.

3.5 Methane Monitoring

Operation of the combustible gas meter will follow manufacturer recommendations. Measurements will be made a minimum of twelve inches inside the monitoring point riser pipes. Gas will be drawn into the instrument until the reading stabilizes. Readings will be recorded as %LEL and % Gas at perimeter monitoring points and % Gas at cell monitoring points. After the measurement is recorded the meter will be cleared by drawing background air until the meter returns to zero.

The meter will be calibrated per manufacturer's recommendations daily.

3.6 Well Purging and Stabilization

Before a water sample is collected for laboratory analyses, the well will be evacuated to ensure that samples contain fresh formation water. The time at which purging begins will be recorded on the **Field Data Sheet**

Care will be taken to minimize any turbidity which may result from purging the well. While the well is being purged, the field water quality parameters described above and the quantity of water evacuated will be recorded on the **Field Data Sheet**.

3.6.1 Pump Setting

A dedicated Well Wizard 1200 will be used as the default device for purging and sample collection. The pump intakes are set approximately eighteen inches from the bottom.

The water level in the well will be measured during or immediately following purging. The water level measurement will be compared to the original static water level. This comparison will be used to verify that drawdown is minimal at the designated purge rate. The purge rate will be adjusted, if necessary, so as to retain a sufficient water column in the well to allow collection of samples. Any adjustments to the purge rate will be recorded on the Field Log Book.

3.6.2 Purging Rate

A purging rate will be selected that minimizes drawdown while still allowing the well to be purged in a reasonable length of time. Care will be taken to avoid any significant amount of cascading or turbulence in the well. For newly installed wells, an appropriate purging rate will be determined prior to the first sampling event by observing the response of the well during the initial stabilization or recovery rate test that follows well development (*reference: Minn. R. 7035.2815, subp. 10, item N.*) For existing wells, an initial purging rate for a particular well will be estimated based on existing information, such as the type of aquifer material adjacent to the well screen, past slug test data, and the volume of water in the well. These initial estimates of purging rates are shown in Table 3. Purging rates will be adjusted during each sampling event and in subsequent events, if necessary, based on the observed response of the well. This procedure will continue until the optimum purge rate for each well has been found.

Actual purging rates will be recorded on the Field Data Sheet. The observed response of each well to the purging rate *{e.g., significant drawdown, minimal drawdown, etc.}* along with plans for future adjustment of the purging rate will be summarized in the Sampling and Analysis Report.

3.6.3 Methods of Purging and Stabilization

A. MEDIUM TO HIGH-YIELD WELLS

Wells that have adequate recharge rates will be purged and sampled as described below. Purging will be conducted in a manner that, to the extent practical, removes all "old" water in the well so it is replaced by fresh formation water. *{See Part B, below, for description of packer purging options}.*

- The well will be purged by withdrawing water from 18 inches off the bottom. Vertical adjustment of the pump intake should not be necessary because the purge rate should approximate the aquifer yield.
- A minimum of three water-column volumes must be purged before sampling. Field water quality parameters will be measured after each water-column volume.
- Sampling will immediately follow purging.
- Well evacuation will be continuous between purging and sampling.

B. PURGING WITH A PACKER TO MINIMIZE THE WATER COLUMN VOLUME

Purging with a packer is proposed for the following wells; U4D, U6D, U7D, D1D, D2D, D3D, D5D. All these wells are equipped with Well Wizard Purge Mizer® located fifteen feet from the bottom. The following special conditions apply to these wells.

- The water-column volume will be calculated based on the water volume below the packer.
- A minimum of three water-column volumes (as defined above) will be removed.

3.6.4 Criteria for Stabilization

Field water quality parameters will be measured after each water-column volume or if packer purging, after each partial water-column volume is purged. One water-column volume is defined as the volume of a cylinder with a height (h) equal to that of the static water-column inside the well and a diameter equal to the diameter of the well casing. Reviews of pipe specifications from manufacturers show that stainless steel actually has an inside diameter of 2.067 to 2.245 inches. Therefore SKB Rosemount uses 0.168 gallons per foot for the two-inch stainless steel I.D. pipe, making the formula:

$$\text{Volume} = 0.168h$$

Three consecutive measurements which meet the criteria listed below will be used to demonstrate stabilization:

- temperature +/- 0.1 degrees Celsius
- specific conductance (temperature corrected EC) +/- 5% of the most recent reading
- turbidity: less than or equal to 10 NTU or +/- 10% of the most recent reading if between 11 and 99 NTU, or +/- 5% if over 100 NTU.
- pH +/- 0.10 units
- dissolved oxygen +/-0.5 mg/l

Samples for laboratory analysis will be collected only after purging a minimum of three water-column volumes and achieving stabilization of field water-quality parameters. Stabilization parameters will be observed and recorded when throttling the pump down to the sampling rate. An additional well volume will be removed if field parameters change at the slower flow rate.

If field parameters do not stabilize after five water-column volumes, then field staff will verify that the probes and related equipment are functioning properly and that operator error is not an issue. Samples will be collected after five water-column volumes have been purged, even if field measurements have not stabilized. In such a case, the Field Data Sheet and Sampling and Analysis Report will clearly state that stabilization was not achieved. The Sampling and Analysis Report will evaluate the field measurements, well construction information, pump intake depth, etc. for clues as to why the well did not stabilize.

If the turbidity is greater than 10 Nephelometric turbidity units (NTU) after removing 5 water-column volumes, the well will be sampled; however, prior to the next sampling event, the MPCA hydrogeologist will be contacted to discuss the need for additional well development and/or changes in the sampling procedure in order to reduce turbidity to a more acceptable level. After the monitoring well has been redeveloped, at least 48 hours will be allowed to pass before purging and sampling the well.

Previous sampling results indicate that collection of purge water is not necessary at this facility.

4.0 SAMPLE COLLECTION

The same pump will be used for both purging and sampling. Pumping will be continuous and sampling will immediately follow purging under normal conditions. If pumping is not continuous it will be noted on the Field Log Book. If more than 24 hours has elapsed since wells have been purged, wells must be re-purged prior to sampling. For each well, the time at which sampling activities begin and end will be recorded on the field data sheet.

4.1 Sampling Rate

The sample collection pumping rate will be less than or equal to 500 ml/min. for analytes which are not flow-sensitive. Flow-sensitive analytes will be sampled at flow rates less than 200 ml/min.

Flow-sensitive

- Volatile organics
- Total metals

Not Flow-sensitive

- Organics: Base/Neutral Organics, Acid Organics, Pesticides, Herbicides, Phenols and PCB's;
- General Parameters: Total Dissolved Solids, Total Suspended Solids, Anions and Alkalinity;
- Ammonia, hardness
- Total Cyanide

4.2 Sample Filtration

All samples collected for metals analysis will be filtered with a 0.45 micron filter. The filter will be connected directly to the pump discharge line using positive pressure to force the sample through the filter. The flow will be routed directly from the filter into the sample container. Agitation and aeration of the sample will be minimized.

A new 0.45 micron filter will be used for each sample. The new filter will be flushed with fresh sample water for a minimum of two minutes before collecting a sample.

4.3 Filling Sample Containers

Table 1 summarizes the type of container, filling and preservation method, and holding time for each type of sample. The manner in which sample containers will be filled is described in greater detail below for each parameter group.

The potential for background or cross-contamination of samples will be minimized by following the Field Quality Assurance Procedures listed in Section 2.3. Sample bottles will not be opened until it is time to fill them. Sampling personnel will not touch the inside or rim of sample bottles or caps. If contact occurs, the sample bottle will be replaced.

Bottles will be labeled at the well by field personnel according to the procedures described in Section 5, "Documentation of Sampling Event". To prevent a mix up with sample bottle identification, no sampling point-specific information such as "well name" will be filled out in advance.

The order in which sample containers will be filled is listed below. Any replicate samples will be collected immediately after the corresponding primary sample.

1) Volatile organics
2) Total metals
3) Semi-volatiles/Phenols
4) Pesticides, PCB's, Herbicides
5) Cyanide
6) TDS/TSS
7) Anions, pH, Conductivity
8) Alkalinity
9) Ammonia

The end of the discharge tube will be held as close as possible to the sample bottle without allowing the tubing to contact the container. Sampling personnel will use their body to shield the sample bottle from wind and airborne dust while filling the bottle. When strong winds, heavy rain, or dusty conditions are present, additional protective measures will be implemented, such as use of a portable shelter at the well head.

Volatile Organics

The preservative, Hydrochloric Acid, will be added to sample bottles for volatile organics analysis at the laboratory prior to the sampling event. The 40-ml purge and trap vials will be filled in a manner that minimizes turbulence, entrapment of air and overfilling. They will be completely filled so that a positive meniscus forms at the top of the vial. The vials will be capped immediately.

A field preservation check sample will be checked with pH paper after acidification and then discarded. More acid will be added to the sample as necessary to reduce the pH to a value of 2 or less.

Metals

The preservative HNO_3 will be added to sample bottles for metals analyses at the laboratory prior to the sampling event. The acid will be produced/controlled within the applicable QA/QC program to ensure that it is pure enough with regard to metals to avoid a false positive analytical result.

A field preservation check sample will be checked with pH paper after acidification and then discarded. More acid will be added to the sample as necessary to reduce the pH to a value of 2 or less.

Plastic bottles will be used for sample collection. Containers will be filled approximately 95% full (up to the neck). Containers will not be rinsed or overfilled. Samples will be collected in a manner that minimizes turbulence and aeration.

The sample bottles for metals analyses will be clearly labeled as "Totals" or "Dissolved", in accordance with the filtration criteria described in Section 4.2.

Nitrogen Series

Sample containers for nitrate/nitrite and ammonia analyses will be prepared in advance by the laboratories with H2SO4 as a preservative. The containers will be filled approximately 95% full with unfiltered water.

Containers will not be rinsed or overfilled. To verify that the pH has been lowered to less than or equal to pH=2, the pH of the sample will be checked in the field by pouring a small volume of sample water onto pH paper.

General Parameters
The sample containers for laboratory analyses of general parameters - anions, total dissolved solids, total suspended solids, pH, alkalinity and conductivity - will not be rinsed in the field or allowed to overflow excessively during sample collection. Samples will be collected by delivering water to the bottom of the container via tubing until it overflows. The containers will be filled completely.

Semi-Volatile Organics
As defined here, semi-volatile organics (meaning organic compounds that are not highly volatile) include the following sets of parameters: base-neutral/acid extractable organics, phthalate esters, polychlorinated biphenyls (PCBs), phenols, polynuclear aromatic hydrocarbons, chlorinated herbicides, organochlorinated pesticides, and organophosphorus pesticides. Sample containers used for semi-volatile organics analysis will not be rinsed in the field or allowed to overflow excessively during sample collection. Containers will be filled completely.

4.4 Leachate Samples

Samples will be collected from the leachate sumps through a valve connected to the output port. Samples from the individual sumps will be combined into one composite sample for each cell. Samples will also be collected from the leachate storage tank as needed through a faucet connected to the input port. Prior to sample collection the tank will have leachate added to mix the tank and assure representative samples. Leachate sample containers will be filled as described in section 4.2. Leachate samples will be collected after all ground water samples.

4.5 Field Blanks and Replicates

All quality assurance/quality control (QA/QC) samples will be collected in the same manner and type of container as the corresponding primary samples. A field method (equipment) blank and an ambient air field blank will be collected to detect method or background contamination. Replicate samples will be collected to evaluate variability in analytical methods. These QA/QC samples will be collected at sampling points suspected to have relatively high levels of contamination in order to provide meaningful information for blank or replicate sample evaluation. Trip blanks will accompany VOC sample vials at all times in order to detect contaminants that may leak into the vials during transportation or storage.

QA/QC samples will be assigned identification aliases on the sample bottle label and on the chain of custody sheet to avoid alerting laboratories that the sample is a blank or replicate sample. The true identity of the QA/QC samples will be recorded in the Field Sampling Log and in the Sampling and Analysis Report.

Trip Blanks
One trip blank (composed of three replicate vials) will accompany each shipment of VOC samples. The trip blank vials will be filled and sealed by the Laboratory with laboratory-controlled, organic-free water. The pre-filled 40-ml purge and trap vials will accompany the sample vials to and from the field in the cooler, to the well head, etc., so that the blanks are exposed to precisely the same conditions as the actual samples. The trip blanks will not be opened until they are analyzed in the laboratory along with the VOC samples they have accompanied.

Field Methods & Equipment Blanks
One field methods blank will be collected during up gradient sampling and one field methods blank will be collected during down gradient well sampling. Field methods blanks will be analyzed for the same parameters as the primary samples during that sampling event. Sample containers and preservatives used for each blank

will be the same as those used for each primary sample. All containers shall be pre-cleaned according to the laboratory's QA/QC program, in the same manner as primary sample bottles. The sample blank containers will be filled in the field in a manner that simulates actual field sampling methods. Blank samples for organic analyses will be filled with laboratory-controlled organic-free water. Trace metals blanks will be filled with laboratory-prepared, triple deionized water through a metals filter. One equipment blank will be collected during each sampling event from the depth sounder for VOC's. Also, one bottle blank will be collected at the laboratory.

Replicate Samples
One replicate set will be collected during sampling of up gradient wells and one replicate set will be collected during sampling of down gradient wells. Replicates will be collected and analyzed for the same parameters as the primary samples.

Replicate samples for each parameter group will be collected immediately after the corresponding primary sample, with a sampling stream that is steady and continuous. *{Note: All replicates are not sampled together, but are sampled immediately after the primary sample from each parameter group.}* The time of replicate sample collection will be recorded in the Field Log Book. The time that each individual container was filled will be recorded on the container and on the Chain of Custody form, in the same manner as primary samples.

5.0 DOCUMENTATION OF SAMPLING EVENT

5.1 Forms

Appendix D contains a copy of each form that will be used for sampling-related activities at the site. These forms have been designed for documentation of field activities and collection of data. They also provide a means to verify whether or not this protocol was followed during a number of key steps in the ground water sampling event.

All entries for a given sampling point will be completed before leaving that sampling point. This includes filling in all appropriate blanks and circling or checking all choices which appear on the forms.

5.2 Sample Identification

Each sample bottle will be labeled with the following information, using a waterproof marker on a firmly affixed, water-resistant label:

site name
monitoring well name
date and time of sample collection
initials of person collecting sample
totals or dissolved (for metals analyses)
parameter names/groups to be analyzed
preservation method

For containers which receive preservatives in advance, laboratory staff will enter "parameter names" and "preservation method" onto labels prior to the sampling event. All other information will be recorded on the label by field personnel at the time of sample collection.

5.3 Chain of Custody

All signatures related to sample custody will be made in ink on the COC form. Each time responsibility for custody of the samples changes, the new and previous custodians will sign the record and note the date and time. A copy of the signed record will be made by the receiving laboratory. The final signed COC will be submitted with analytical results in the Sampling and Analysis Report.

Field Chain of Custody Documentation

One or more signatures will be entered to identify the field sampling crew. A sample will be considered to be in custody if it is in one of the following states:

- in actual physical possession
- in plain view of the custodian
- in a secured area, restricted to authorized personnel

A secured area such as a locked storage shed or locked vehicle may be used for temporary storage of samples prior to shipment. When using such an area, the location, date, and time interval will be recorded on the COC form.

Chain of Custody During Shipping and Transfer of Samples

When samples are shipped, the person sealing the shipping container will enter the time, date and their signature on the COC record. A post office receipt, bill of lading, or similar document from the shipper will be retained as part of the permanent chain-of-custody documentation.

A custody seal will be affixed over the opening of the shipping container in a manner that precludes opening the container without breaking the seal. The seal will be inscribed with the signature of the person sealing the container and the date and time at which it was sealed.

The laboratory will be instructed to note whether or not the container seals are intact and to sign in the appropriate blank on the COC form at the time of receipt. They will also be instructed to keep a copy of the COC and return the original form to the project manager. The final signed COC will be submitted along with the analytical results in the Sampling and Analysis Report.

5.4 Field Log Book

A Daily Field Log of sampling activities will be kept by the field crew leader. This field log will supplement information entered on the Field Data Sheet. At a minimum, the log will contain a record of the following items:

- list of field personnel present
- field conditions as described below in Section 5.6
- summary of how samples were transferred/transported to laboratories
- description of exceptions to this protocol, including which samples may have been compromised
- if needed, an alias cross-reference list for QA/QC samples
- for each well sampled: the well name and Minnesota unique well number, the date and time that sampling began and ended, and a list of primary and QA/QC samples sent to each laboratory.

5.5 Exceptions to Sampling Protocol

This protocol defines the procedures to be followed during every sampling event. Exceptions to this protocol will be noted in the Field Log Book. The Sampling and Analysis Report will include the following details for each deviation from the protocol:

- reason for the change
- identification of all samples and parameters that may have been impacted, either in terms of the quantitative or legal integrity of their reported values
- significance of the potential impact on data integrity

If there has been any potentially significant impact on sample integrity, then it will appear as a footnote to each affected parameter whenever the results are reported or referred to in the Sampling and Analysis Report.

5.6 Field Conditions

Field conditions during the sampling event will be recorded on the field data sheet. Details will be noted in the Field Sampling Log and summarized in the Sampling and Analysis Report. The Sampling and Analysis Report will include a statement regarding the likelihood that any unusual field conditions had a significant impact on data integrity.

At a minimum, the following field conditions will be recorded:

- air temperature
- wind direction
- precipitation
- ambient odors
- airborne dust

6.0 SAMPLE PRESERVATION, HANDLING AND TRANSPORT

This section describes the procedures that will be followed between the time samples are collected and the time they are either shipped or delivered to an analytical laboratory.

6.1 Sample Preservation

Samples will be preserved as shown in Table 1. All chemical preservatives will be produced and controlled within the laboratory's QA/QC program, as described in the Laboratory Monitoring Protocol (QAPP). Field supplies of preservatives and sample containers with pre-dosed preservatives will be discarded and replaced with fresh preservatives no later than 6 months after receipt from the laboratory.

All samples will be kept cool by placing them in an insulated ice chest containing uncontaminated ice or ice substitute immediately after sample collection. The ice will be placed inside leak-proof plastic containers and the chain-of-custody will be sealed inside a watertight plastic bag. The ice chest containing volatile organic compound samples will be checked for temperature upon receipt at the laboratory, to verify whether or not samples are kept refrigerated at approximately 4 degrees C.

6.2 Sample Handling and Transport

All ice chests will be accompanied by a chain-of-custody form and contain a complete destination address and return address on both the inside and outside of the cooler. The samples will be kept cool (at approximately 4 degrees C) during transport to the laboratory. Before shipping the samples, field personnel will perform the following tasks:

- Verify that laboratory personnel will be present to receive the samples when they arrive.
- Verify that laboratory personnel understand the specific chain of custody and storage/preservation requirements.
- Check labeling and documentation to ensure that sample identity will be clear to laboratory personnel.

- Pack with ice or ice substitute and material to prevent breakage.

Table 1: Sample Containers, Filling Method, Preservation and Holding Times

Parameter Group[1]	*Bottle Volume and Type*[2]	*Fill Method*[3]	*Preservation*[4]	*Holding Time*
CYANIDE	500 ml; Polyethylene	Leave head space	NaOH to pH>12; Lab Cool	14 days
METALS (filtered)	500 ml; Polyethylene	Filter 0.45 micron Leave head space	HNO_3 to pH<2; Lab Cool	6 months (*except for mercury)*
MERCURY	*Water for mercury analysis will be collected in the same container as other metals, above.*			*Holding time for mercury is 28 days.*
ALKALINITY	1 Liter; Polyethylene	No head space	Cool	48 hours
TDS, TSS	1 Liter; Polyethylene	No head space	Cool	
VOLATILE ORGANICS purgeable halocarbons purgeable aromatics non-halogenated volatiles	40 ml; P&T (*set of three vials*)	Positive meniscus	HCl to pH<2; Field Cool	14 days to analysis
AMMONIA	500 ml; Polyethylene	Leave Head Space	H_2SO_4 to pH< 2, Cool	28 days
NITRATE AND NITRITE	1 Liter; Polyethylene	No head space		48 hours
SEMI-VOLATILE ORGANICS base-neutral/acid extractable organics phthalate esters phenols polynuclear aromatic	4 X 1 Liter; AG	No head space	Cool	7 days to extraction 40 days to analysis
ANIONS, pH, CONDUCTIVITY	1 Liter; Polyethylene		Cool	72 hours

(1) PARAMETER NAMES/GROUPS

Some of these parameter names (*e.g., "trace metals*") actually represent groups of several individual analytes. Specific analytes for each category are listed in Appendix A.

(2) BOTTLE TYPE

ml: milliliters
P & T: 40 ml purge and trap vial fitted with a Teflon® septum
AG: amber glass bottle fitted with Teflon®-lined cap

(3) FILL METHOD

Positive meniscus: Fill vial completely with zero head space, resulting in a positive meniscus. Ensure that no air bubbles are present in vial. Add acid and cap container quickly.
No head space: Fill container completely. Container will not be rinsed or overfilled.
Leave head space: Fill container about 90 to 95 % full. Do not allow preservative (if present) to be diluted by overfilling container.
Filter 0.45 micron: Filter in-line with positive pressure through a filter with 0.45 micron pore size.

(4) PRESERVATION

Cool: Place sample bottle inside sealed inert plastic bag. Place in cooler with sufficient ice to quickly achieve and maintain a sample temperature of four degrees Centigrade until received by laboratory personnel.

HNO_3 to pH<2: Add a predetermined amount of high-purity HNO_3 to bring the sample pH down to 2 or less.
HCL to pH<2: Add a predetermined amount of high-purity HCL to bring the sample pH down to 2 or less.
NaOH to pH>12: Add a predetermined amount of high-purity NaOH to bring the sample pH up to 12 or greater. For Cyanide, use 50% NaOH solution and add ascorbic acid if oxidizing agents are present.

Field: Preservative is added to container in the field by the sampling crew.
Lab: Preservative is added to container in the laboratory before going into the field.

Table 2: Monitoring Plan

Monitoring Well ID	*Sampling Frequency*
Upgradient Outwash Unit	
U-5S	3 Times/year
U-4S	3 Times/year
U-3S	Note[1]
Upgradient Prairie Du Chien	
U-5D	3 Times/year
U-4D	3 Times/year
Downgradient Outwash Unit	
D-1S	3 Times/year
D-2S	3 Times/year
D-3S	3 Times/year
D-4S	3 Times/year
D-5S2	3 Times/year
D7	3 Times/year
D8	3 Times/year
D9	Proposed
Downgradient Prairie Du Chien	
D-1D	1 Time/summer
D-2D	1 Time/summer
D-3D	1 Time/summer
D-4D	1 Time/summer
D-5D	1 Time/summer
Water Levels only	
D-6	4 Times/year
D-1VD	4 Times/year
D-2VD	4 Times/year
U-8	4 Times/year
U-3D	Note[1]
U-1	4 Times/year
U-7S	4 Times/year
U-2S	4 Times/year
U-6D	4 Times/year
U-7D	4 Times/year
U-2D	4 Times/year
CW1-1	Note[1]
CW1-2	Note[1]
CW2-1	Note[1]
CW2-2	Note[1]
Industrial Leachate Sumps	
C1W	4 Times/year[3]
C1WS	4 Times/year[4]
C1E	4 Times/year[3]
C1ES	4 Times/year[4]
C2A	4 Times/year[3]

Table 2: Monitoring Plan (cont.)

C2AS	4 Times/year[4]
C2A2	4 Times/year[3]
C2B	4 Times/year[3]
C2BS	4 Times/year[4]
C2C	4 Times/year[3]
C2CS	4 Times/year[4]
C3A	4 Times/year[3]
C3AS	4 Times/year[4]
C3B	4 Times/year[3]
C3BS	4 Times/year[4]
Ash Leachate Sumps	
C4W	4 Times/year[3]
C4WS	4 Times/year[4]
C4E	4 Times/year[3]
C4ES	4 Times/year[4]
C4B	4 Times/year[3]
C4BS	4 Times/year[4]
C&D Leachate Sump	
C5	4 Times/year[3]
Mixed Leachate	
Tank 1	4 Times/year[4]
Tank 2	4 Times/year[4]
Tank 3	4 Times/year[4]
TANK SUMP	4 Times/year
Methane Monitoring Points	
MP-1 through MP-13	4 Times/year for methane

- [1] Wells abandoned.
- [2] Points not to be sampled in the future.
- [3] Samples from individual sumps will be combined into one composite sample per cell.
- [4] Secondary Sumps or Tanks will be sampled only if water is present.

Table 3: Order of Purging and Sampling of Wells

Monitoring Point (in sampling order)	*Criteria**	*TOC** Elevation (FOSL)*	*Screen Length (feet)*	*Well Depth (feet)*	*Packer*
U5S	UP GRADIENT	848.09	10	44	no
U5D	UP GRADIENT	849.67	10	99	no
U4S	UP GRADIENT	836.62	10	32	no
U4D	UP GRADIENT	837.32	10	89	yes
U3S	UP GRADIENT	902.60	10	102	no
D5S2	DOWN GRADIENT	891.72	10	126	no
D5D	DOWN GRADIENT	893.20	10	155.5	yes
D3S	DOWN GRADIENT	886.55	10	133	no
D3D	DOWN GRADIENT	885.77	10	148.2	yes
CW4-1	NEAREST POTENTIAL SOURCE	878.12	10	85.0	no
D1S	DOWN GRADIENT	872.75	10	135	no
D1D	DOWN GRADIENT	871.50	10	161	yes
D2S	DOWN GRADIENT	884.23	10	132	no
D2D	DOWN GRADIENT	884.03	10	161.48	yes
D4D	DOWN GRADIENT	885.21	10	131	no
D4S	DOWN GRADIENT	883.70	10	111.8	no
D7	DOWN GRADIENT	899.0	10	109.11	no
D8	DOWN GRADIENT	906.22	10	130.1	no
D9	DOWN GRADIENT				
Leachate	HIGHEST CONTAMINANT LEVELS	SAMPLED AT SUMPS AND STORAGE TANKS			

* All wells are at background levels

** TOC = Top of casing of inner riser

All wells are two inch diameter

Table 4: Sample Collection Depths, Initial Purging Rates, And Sampling Rates

Monitoring Point (in sampling order)	*Sample Collection Depth (feet)*	*Purging Rate (ml/min)*	*Sampling Rate* (ml/min)*	*Sampling Rate** (ml/min)*
U5S	42.5	1500	100	1500
U5D	97.5	1500	100	1500
U1	37.6	1500	100	1500
U6D	84.5	1500	100	1500
U7S	31.5	1500	100	1500
U7D	131.5	1500	100	1500
U2S	28.8	1500	100	1500
U2D	89	1500	100	1500
U4S	30.5	1500	100	1500
U4D	87.5	1500	100	1500
U3S	100.5	1500	100	1500
D5S2	124.5	1000	100	1000
D5D	154	1000	100	1000
D3S	131.5	1000	100	1000
D3D	146.7	1000	100	1000
D1S	133.5	1000	100	1000
D1D	159.5	1000	100	1000
D2S	130.5	1000	100	1000
D2D	160	1000	100	1000
D4S	110.3	1000	100	1000
D4D	129.5	1000	100	1000
D7	105.0	1000	100	1000
D8	125.1	1000	100	1000

* Flow sensitive analytes
** Non-flow sensitive analytes

Table 5: Monitoring Well U5D Drawdown test

APRIL 1, 1996

PUMP RATE = 2721.6 ml/min

TIME (minutes)	*DEPTH TO WATER feet below TOC*
0.00	34.50
0.15	35.21
0.30	36.09
0.45	35.24
1.00	36.10
1.30	35.55
2.00	35.05
3.00	*34.3 - **35.9
4.00	35.0 - 36.0
5.00	34.8 - 36.3
6.00	34.8 - 36.7
7.00	34.9 - 36.7
8.00	34.8 - 36.1
9.00	34.9 - 36.2
10.00	34.9 - 36.3
11.00	34.9 - 36.2
12.00	34.9 - 36.2
13.00	34.9 - 36.3
14.00	34.9 - 36.3
15.00	34.9 - 36.3
16.00	34.9 - 36.3
17.00	34.8 - 36.3
18.00	34.8 - 36.3
19.00	34.9 - 36.4
20.00	34.9 - 36.4
21.00	34.9 - 36.5
22.00	34.9 - 36.5
23.00	34.9 - 36.4
24.00	34.9 - 36.4
25.00	34.9 - 36.4

NOTES:

TOC	Top of casing
*	Measurement during discharge cycle
**	Measurement during refill cycle

Figure 1: Location of Sampling Points

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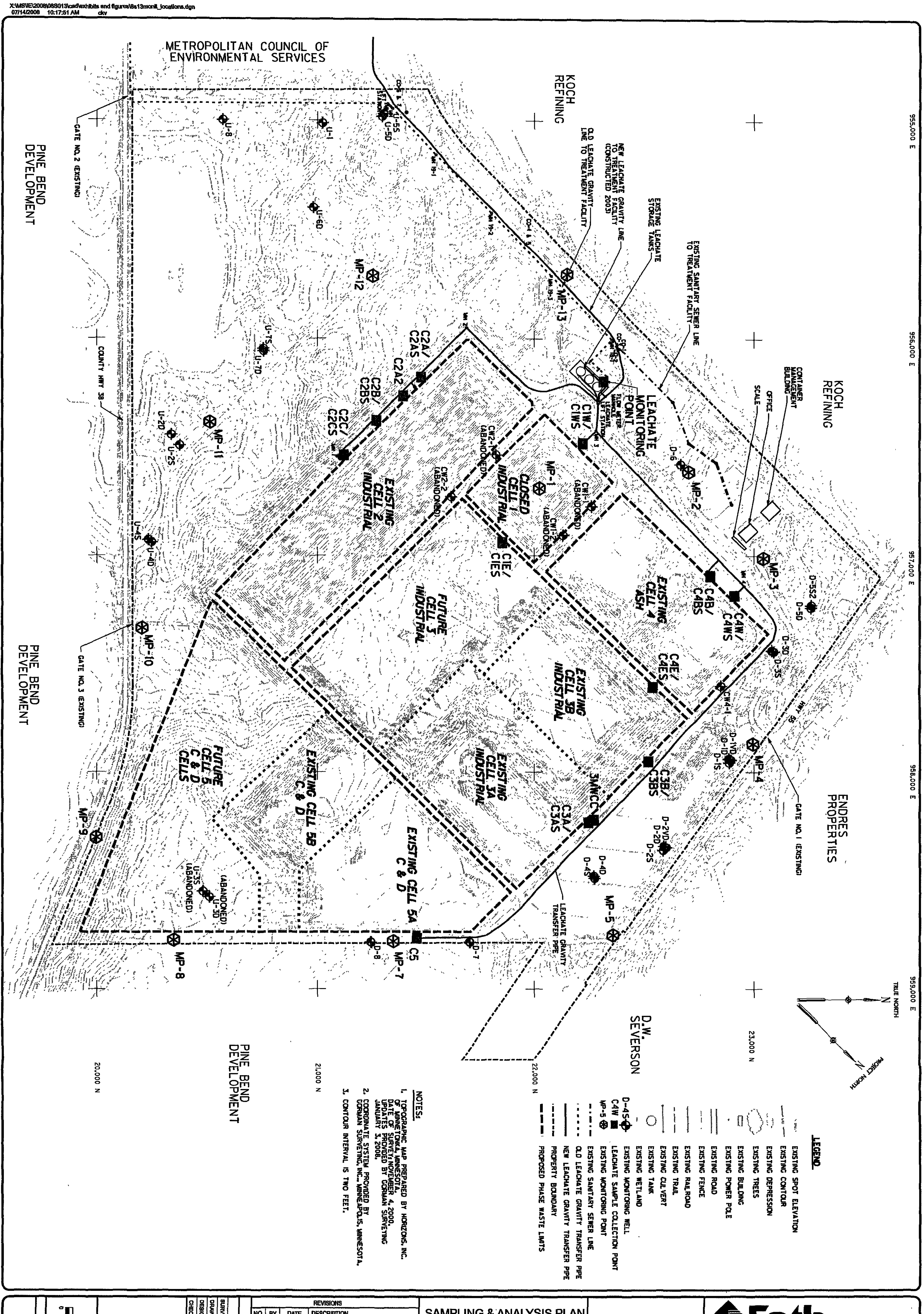

LEGEND

	EXISTING SPOT ELEVATION
	EXISTING CONTOUR
	EXISTING DEPRESSION
	EXISTING TREES
	EXISTING BUILDING
	EXISTING POWER POLE
	EXISTING ROAD
	EXISTING FENCE
	EXISTING RAILROAD
	EXISTING TRAIL
	EXISTING CULVERT
	EXISTING TANK
	EXISTING WETLAND
D-4S	EXISTING MONITORING WELL
C4W ■	LEACHATE SAMPLE COLLECTION POINT
MP-5	EXISTING MONITORING POINT
	EXISTING SANITARY SEWER LINE
	OLD LEACHATE GRAVITY TRANSFER PIPE
	NEW LEACHATE GRAVITY TRANSFER PIPE
	PROPERTY BOUNDARY
	PROPOSED PHASE WASTE LIMITS

NOTES:

1. TOPOGRAPHIC MAP PREPARED BY HORIZONS, INC. OF MINNETONKA, MINNESOTA. DATE OF SURVEY: NOVEMBER 4, 2000. UPDATES PROVIDED BY GORMAN SURVEYING JANUARY 3, 2008.
2. COORDINATE SYSTEM PROVIDED BY GORMAN SURVEYING, INC., MINNEAPOLIS, MINNESOTA.
3. CONTOUR INTERVAL IS TWO FEET.

FIGURE NO.
1

PROJECT ID 08S013

HORIZONTAL SCALE:
0 200 400

SAMPLING LOCATIONS

	BY	DATE
SURVEYED		
DRAWN	CKV	7-14-08
DESIGNED		
CHECKED		

DATE OF PREPARATION

REVISIONS

NO.	BY	DATE	DESCRIPTION
1	XXX	A	A
2	A	A	A
3	A	A	A
4	A	A	A

RECORD DRAWING OF COMPLETED CONSTRUCTION BY

RECORD DRAWINGS OF COMPLETED CONSTRUCTION CONFORMING TO CONTRACTOR AND/OR OWNERS RECORDS.
BY ______ DATE ______

SAMPLING & ANALYSIS PLAN
FOR THE SKB ROSEMOUNT
INDUSTRIAL WASTE FACILITY

DAKOTA COUNTY ROSEMOUNT, MINNESOTA

Foth

Foth Infrastructure & Environment, LLC
Eagle Point II
8550 Hudson Boulevard North, Suite 105
Lake Elmo, MN 55042

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Table 6: Groundwater Monitoring System Status

Well I.D.		Location Coordinates		Elevations*					
Present I.D.	MN Unique Number	Northing	Easting	Ground	Inner Riser	Outer Casting	Construction Material	Aquifer Monitored	Status
Upgradient Wells									
U-1	462710	21022.58	955014.24	846.6	849.33	849.55	SS	SWT	MW
U-2S	462711	20376.75	956494.94	836.5	839.59	NS	SS	SWT	MW
U-2D	493016	20337.02	956445.80	836.0	838.11	838.08	SS	DA/PdC	MW
U-3S	462712	20480.17	958549.83	899.2	902.62	NS	SS/BS	SWT	Ab
U-3D	445969	20509.47	958575.19	898.8	901.27	NS	PVC	SWT	Ab
U-4S	493021	20235.36	956929.03	834.5	836.73	836.75	SS/BS	SWT	MW
U-4D	463714	20249.38	956939.33	835.5	837.30	837.24	SS/BS	DA/PdC	MW
U-5S	493018	21303.59	954968.89	846.0	848.29	848.34	SS/BS	SWT	MW
U-5D	493015	21296.72	954981.73	847.3	849.67	849.79	SS/BS	DA/PdC	MW
U-6D	493020	20980.50	955400.58	837.7	840.11	840.08	SS/BS	DA/PdC	MW
U-7S	493017	20754.04	956047.25	832.2	835.15	835.12	SS/BS	SWT	MW
U-7D	005678	20754.74	956058.15	832.5	835.60	NS	SS	DA/PdC	MW
U-8	445966	20590.38	954955.60	828.7	830.52	NS	PVC	SWT	PZM
Cell Wells									
CW1-1	517505	22263.53	956772.48	875.8	879.76	879.83	SS/BS	SWT	Ab
CW1-2	517506	22132.91	956906.21	876.2	879.99	879.99	SS/BS	SWT	Ab
CW2-1	541849	21828.19	956532.06	877.00	879.94	NS	SS/BS	SWT	Ab
CW2-2	646922	21617.90	956730.30	878.22	880.68	NS	SS/BS	SWT	Ab
CW4-1	599659	22851.96	957600.54	876.00	878.12	NS	SS/BS	SWT	MW
Downgradient Wells									
D-1S	493014	22888.31	957956.48	NS	900.44	900.92	SS/BS	SWT	MW
D-1D	482883	22886.36	957937.97	NS	897.39	897.96	SS/BS	Da/PdC	MW
D-1VD#	463716	22895.05	957944.26	NS	898.20	899.04	SS/BS	SWT	PZM
D-2S	493013	22589.82	958360.57	NS	899.58	900.12	SS/BS	SWT	MW
D-2D	482882	22593.50	958341.98	NS	898.52	898.99	SS/BS	DA/PdC	MW
D-2VD#	490054	22602.41	958346.69	NS	899.38	899.82	SS/BS	SWT	PZM
D-3S	462920	23090.68	957443.06	883.9	886.42	886.10	SS	DS/PdC	MW
D-3D	482884	23081.57	957437.99	882.3	885.76	886.12	SS/BS	DA/PdC	MW
D-4S	469358	22273.07	958478.20	881.1	883.79	883.82	SS	SWT	MW
D-4D	462921	22276.46	958488.36	881.7	885.21	884.93	SS	DA/PdC	MW
D-5S2	463715	23260.73	957240.28	889.3	891.59	891.59	SS/BS	DA/PdC	MW
D-5D	482885	23260.08	957228.90	890.1	891.18	893.46	SS/BS	DA/PdC	MW
D-6	445962	22668.95	956584.82	869.7	872.32	NS	PVC	SWT	MW
D-7	703406	21702.46	958784.74	899.0	900.99	901.17	SS/BS	SWT	MW
D-8	727735	21245.67	958785.82	906.22	907.92	908.20	SS/BS	SWT	MW

DA/PdC- Well completed in Deep Alluvium/Prairie du Chien Aquifer.
SWT- Well Completed in Shallow Water Table Aquifer.
SS/BS- Stainless steel construction in and to a minimum of 5 feet above water-bearing interval with black steel riser- denotes as monitoring point.
Status- Piezometer (PZM) denotes water level measurements only.
Monitoring Well (MW) denotes groundwater sampling point.
- D-1VD and D-2VD - SS/BS construction - could denote use as monitoring well as required.
* Mean Sea Level
NS Not Surveyed
Ab-Abandoned

APPENDIX A

Analytical Parameters, Method Numbers, And Practical Reporting Limits

SKB Rosemount Volatile Organic Compounds
Groundwater

Compound	*Method*	*Spring*	*Summer*	*Fall*	*PRL ppb*
1,1,1,2-Tetrachloroethane	EPA 8260	X	X	X	5.0
1,1,1-Trichloroethane	EPA 8260	X	X	X	5.0
1,1,2,2-Tetrachloroethane	EPA 8260	X	X	X	5.0
1,1,1-Trichloroethane	EPA 8260	X	X	X	5.0
1,1,2-Trichlorotrifluoroethane	EPA 8260	X	X	X	5.0
1,1-Dichoroethane	EPA 8260	X	X	X	5.0
1,1-Dichloroethylene	EPA 8260	X	X	X	5.0
1,1-Dichoropropene	EPA 8260	X	X	X	5.0
1,2-(trans-) Dichloroethylene	EPA 8260	X	X	X	5.0
1,2,3,-Trichlorobenzene	EPA 8260	X	X	X	5.0
1,2,3,-Trichloropropane	EPA 8260	X	X	X	5.0
1,2,4,-Trichlorobenzene	EPA 8260	X	X	X	5.0
1,2,4,-Trimethylbenzene	EPA 8260	X	X	X	5.0
1,2- Dibromoethane (EDB)	EPA 8260	X	X	X	5.0
1,2-Dichlorobenzene (ortho-)	EPA 8260	X	X	X	5.0
1,2-Dichloroethane	EPA 8260	X	X	X	5.0
1,2-Dichloroethlyene (cis-)	EPA 8260	X	X	X	5.0
1,2-Dichloropropane	EPA 8260	X	X	X	5.0
1,2-dimethylbenzene	EPA 8260	X	X	X	5.0
1,3,5-Trimethylebenzene	EPA 8260	X	X	X	5.0
1,3-Dichlorobenzene (meta-)	EPA 8260	X	X	X	5.0
1,3-Dichloropropane	EPA 8260	X	X	X	5.0
1,4-Dichlorobenzene (para-)	EPA 8260	X	X	X	5.0
2,2-Dichloropropane	EPA 8260	X	X	X	5.0
2-Chlorotoulene (ortho-)	EPA 8260	X	X	X	5.0
4-Chlorotoulene (para-)	EPA 8260	X	X	X	5.0
Acetone	EPA 8260	X	X	X	25.0
Allyl chloride	EPA 8260	X	X	X	5.0
Benzene	EPA 8260	X	X	X	5.0
Bromobenzene	EPA 8260	X	X	X	5.0
Bromochloromethane	EPA 8260	X	X	X	5.0
Bromodichloromethane	EPA 8260	X	X	X	5.0
Bromoform	EPA 8260	X	X	X	5.0
Bromomethane	EPA 8260	X	X	X	5.0
Carbon tetrachloride	EPA 8260	X	X	X	5.0
Chlorobenzene	EPA 8260	X	X	X	5.0
Chlorodibromomethane	EPA 8260	X	X	X	5.0
Chloroethane	EPA 8260	X	X	X	5.0
Chloroform	EPA 8260	X	X	X	5.0
Chloromethane	EPA 8260	X	X	X	5.0
cis-1,3-Dichloropropene	EPA 8260	X	X	X	5.0
Cumene (Isopropylbenzene)	EPA 8260	X	X	X	5.0
Dibromochloropropane (DBCP)	EPA 8260	X	X	X	5.0
Dibromomethane	EPA 8260	X	X	X	5.0
Dichlorodifluoromethane	EPA 8260	X	X	X	5.0
Dichlorofluoromethane	EPA 8260	X	X	X	5.0
Dichloromethane (Methylene chloride)	EPA 8260	X	X	X	5.0
Ethylbenzene	EPA 8260	X	X	X	5.0

SKB Rosemount Volatile Organic Compounds
Groundwater

Compound	***Method***	***Spring***	***Summer***	***Fall***	***PRL ppb***
Ethyl Ether	EPA 8260	X	X	X	5.0
Methyl ethyl ketone (MEK)	EPA 8260	X	X	X	5.0
Methyl isobutyl ketone	EPA 8260	X	X	X	5.0
Methyl Tert-Butyl Ether	EPA 8260	X	X	X	5.0
n-Butyl Benzene	EPA 8260	X	X	X	5.0
n-Propyl Benzene	EPA 8260	X	X	X	5.0
p-Isopropyltoluene	EPA 8260	X	X	X	5.0
Sec-Butyl Benzene	EPA 8260	X	X	X	5.0
Styrene	EPA 8260	X	X	X	5.0
Tert-Butyl Benzene	EPA 8260	X	X	X	5.0
Tetrachloroethylene	EPA 8260	X	X	X	5.0
Tetrahydrofuran	EPA 8260	X	X	X	10.0
Toluene	EPA 8260	X	X	X	5.0
trans-1,3-Dichloropropene	EPA 8260	X	X	X	5.0
Trichloroethene	EPA 8260	X	X	X	5.0
Trichlorofluoromethane	EPA 8260	X	X	X	5.0
Vinyl chloride	EPA 8260	X	X	X	5.0
Xylenes(m-&p)	EPA 8260	X	X	X	5.0
Xylenes (Total)	EPA 8260	X	X	X	5.0

SKB Rosemount Semi-Volatile Organic Compounds
Groundwater

Compound	***Method***	***Spring***	***Summer***	***Fall***	***PRL ppb***
1,2,4,-Trimethylbenzene	EPA 8270	X		X	10.0
m-Cresol	EPA 8270	X		X	20.0
Naphthalene	EPA 8270	X		X	10.0
Phenol	EPA 8270	X		X	10.0

Metals and General Chemistry Parameters
Groundwater

Compound	*Method*	*Spring*	*Summer*	*Fall*	*PRL ppm*
Appearance					
Alkalinity	SM 2320	X	X	X	10.0
Aluminum	EPA 6010	X	X	X	200.0
Ammonia Nitrogen	EPA 350.1	X	X	X	0.10
Arsenic	EPA 6010	X	X	X	0.01
Barium	EPA 6010	X	X	X	0.01
Boron	EPA 6010	X	X	X	0.15
Cadmium	EPA 6010	X	X	X	0.001
Calcium	EPA 6010	X	X	X	0.50
Chloride	EPA 352.2	X	X	X	1.0
Chromium (total)	EPA 6010	X	X	X	0.01
Copper	EPA 6010	X	X	X	0.01
Iron	EPA 6010	X	X	X	0.05
Lead	EPA 6010	X	X	X	0.006
Magnesium	EPA 6010	X	X	X	0.50
Manganese	EPA 6010	X	X	X	0.005
Mercury	EPA 7470	X	X	X	0.0002
Nickel	EPA 6010	X	X	X	0.02
Nitrate + Nitrite, as N	EPA 353.1	X	X	X	0.10
pH	EPA 150.1	X	X	X	0.1 units
Potassium	EPA 6010	X	X	X	2.50
Selenium	EPA 6010	X	X	X	0.015
Silver	EPA 6010	X	X	X	0.015
Sodium	EPA 6010	X	X	X	1.00
Specific Conductance	EPA 120.1	X	X	X	1.00 umhos/cm
Sulfate	EPA 375.4	X	X	X	1.00
Temperature	Field	X	X	X	1° C
Tin	EPA 6010	X	X	X	0.015
Total Dissolved Solids	EPA 160.1	X	X	X	10.00
Total Suspended Solids	EPA 160.2	X	X	X	10.00
Turbidity	Field	X	X	X	0.1
Zinc	EPA 6010	X	X	X	0.02

SKB Rosemount Leachate Parameters

VOLATILE ORGANICS	*Spring*	*Summer*	*Fall*	*Winter*
1,1,1-trichloroethane	X	X	X	X
1,1,2,2-tetrachloroethane	X	X	X	X
1,1,2-trichloroethane	X	X	X	X
1,1-dichloroethane	X	X	X	X
1,1-dichloroethylene (Vinylidene chloride)	X	X	X	X
1,2-dichloroethane	X	X	X	X
1,2-dichloropropane	X	X	X	X
1,2-Dimethylbenzene	X	X	X	X
1,2-trans-dichloroethylene	X	X	X	X
1,3-dichloropropene	X	X	X	X
2-chloroethyl vinyl ether	X	X	X	X
4-methyl-2-pentanone	X	X	X	X
Acetone	X	X	X	X
Acetonitrile	X	X	X	X
Acrolein	X	X	X	X
Acrylonitrile	X	X	X	X
Benzene	X	X	X	X
Bromoform	X	X	X	X
Carbon disulfide	X	X	X	X
Carbon tetrachloride	X	X	X	X
Chlorobenzene	X	X	X	X
Chlorodibromomethane	X	X	X	X
Chloroethane	X	X	X	X
Chloroform	X	X	X	X
Chloromethane (methyl chloride)	X	X	X	X
cis-1,3-dichloropropene	X	X	X	X
Cyclohexane	X	X	X	X
Dichlorobromomethane	X	X	X	X
Dichloromethane (methylene chloride)	X	X	X	X
Ethyl ether	X	X	X	X
Ethylbenzene	X	X	X	X
Isobutyl alcohol	X	X	X	X
m-&p-Xylenes	X	X	X	X
Methyl bromide	X	X	X	X
Methyl chloride	X	X	X	X
Methyl ethyl ketone	X	X	X	X
Methyl isobutyl ketone	X	X	X	X
Methyl tert-butyl ether	X	X	X	X
o-xylene	X	X	X	X
Styrene	X	X	X	X
Tetrachloroethylene	X	X	X	X
Tetrahydrofuran	X	X	X	X
Toluene	X	X	X	X
trans-1,3-dichloropropene	X	X	X	X
Trichloroethylene	X	X	X	X
Vinyl chloride	X	X	X	X
Xylene (total)	X	X	X	X

SKB Rosemount Leachate Parameters (cont.)

SEMI-VOLATILE ORGANICS	*Spring*	*Summer*	*Fall*	*Winter*
1,2,4,-trimethylbenzene	X	X	X	X
1,2,4-trichlorobenzene	X	X	X	X
1,2-dichlorobenzene	X	X	X	X
1,2-diphenyl-hyrazine	X	X	X	X
1,3-dichlorobenzene	X	X	X	X
1,4-dichlorobenzene	X	X	X	X
2,3,7,8-TCDD**			X	
2,4,6-trichlorophenol	X	X	X	X
2,4-dichlorophenol	X	X	X	X
2,4-dimethylphenol	X	X	X	X
2,4-dinitrophenol	X	X	X	X
2,4-dinitrotoluene	X	X	X	X
2,6-dinitrotoluene	X	X	X	X
2-chloronaphthalene	X	X	X	X
2-chlorophenol	X	X	X	X
2-nitrophenol	X	X	X	X
3,4-benzofluoranthene	X	X	X	X
4,6-dinitro-o-cresol	X	X	X	X
4-bromophenyl-phenyl ether	X	X	X	X
4-chlorophenyl-phenyl ether	X	X	X	X
4-nitrophenol	X	X	X	X
Acenaphthene	X	X	X	X
Acenaphthylene	X	X	X	X
Acetophenone	X	X	X	X
Anthracene	X	X	X	X
Benzidine	X	X	X	X
Benzo(a)anthracene	X	X	X	X
Benzo(a)pyrene	X	X	X	X
Benzo(b)fluoranthene	X	X	X	X
Benzo(g,h,i)perylene	X	X	X	X
Benzo(k)fluoranthene	X	X	X	X
bis(2-chloroethoxy)methane	X	X	X	X
bis(2-chloroethyl)ether	X	X	X	X
bis(2-chloroisopropyl)ether	X	X	X	X
bis(2-ethylhexyl)phthalate (DEHP)	X	X	X	X
Butyl benzyl phthalate	X	X	X	X
Chrysene	X	X	X	X
Dibenzo (a,h)anthracene	X	X	X	X
Diethyl phthalate	X	X	X	X
Dimethylphthalate	X	X	X	X
Di-n-butyl phthalate	X	X	X	X
Di-n-octylphthalate	X	X	X	X
Fluoranthene	X	X	X	X
Fluorene	X	X	X	X
Heptachlorodibenzodioxin**			X	
Heptachlorodibenzofuran**			X	
Hexachlorobenzene	X	X	X	X
Hexachlorobutadiene	X	X	X	X
Hexachlorocyclopentadiene	X	X	X	X

SKB Rosemount Leachate Parameters (cont.)

indeno(1,2,3-cd)pyrene	X	X	X	X
Isophorone	X	X	X	X
m-cresol	X	X	X	X
Naphthalene	X	X	X	X
Nitrobenzene	X	X	X	X
N-nitrosodiethylamine	X	X	X	X
N-nitrosodimethylamine	X	X	X	X
N-nitrosodi-n-propylamine	X	X	X	X
N-nitrosodiphenylamine	X	X	X	X
N-nitrosodipropylamine	X	X	X	X
p-chloro-m-cresol (4-Chloro-3methylphenol)	X	X	X	X
p-cresol	X	X	X	X
Pentachlorodibenzodioxin**			X	
Pentachlorodibenzofuran**			X	
Pentachlorophenol	X	X	X	X
Phenanthrene	X	X	X	X
Phenol	X	X	X	X
Pyrene	X	X	X	X
Pyridine	X	X	X	X
Tetrachlorodibenzodioxin**			X	
Tetrachlorodibenzofuran**			X	
PESTICIDES AND PCB'S	*Spring*	*Summer*	*Fall*	*Winter*
4,4'-DDD	X	X	X	X
4,4'-DDE	X	X	X	X
4,4'-DDT	X	X	X	X
Aldrin	X	X	X	X
Alpha-BHC	X	X	X	X
Beta-BHC	X	X	X	X
Chlordane, tech .	X	X	X	X
Delta-BHC	X	X	X	X
Dieldrin	X	X	X	X
Endosulfan I	X	X	X	X
Endosulfan II	X	X	X	X
Endosulfan sulfate	X	X	X	X
Endrin	X	X	X	X
Endrin aldehyde	X	X	X	X
Gamma-BHC (Lindane)	X	X	X	X
Heptachlor	X	X	X	X
Heptachlor epoxide	X	X	X	X
PCB-1016 (arochlor 1016)	X	X	X	X
PCB-1221 (arochlor 1221)	X	X	X	X
PCB-1232 (arochlor 1232)	X	X	X	X
PCB-1242 (arochlor 1242)	X	X	X	X
PCB-1248 (arochlor 1248)	X	X	X	X
PCB-1254 (arochlor 1254)	X	X	X	X
PCB-1260 (arochlor 1260)	X	X	X	X
Toxaphene	X	X	X	X

SKB Rosemount Leachate Parameters (cont.)

METALS AND GENERAL CHEM	*Spring*	*Summer*	*Fall*	*Winter*
Alkalinity	X	X	X	X
Aluminum	X	X	X	X
Ammonia nitrogen	X	X	X	X
Antimony	X	X	X	X
Appearance	X	X	X	X
Arsenic	X	X	X	X
Barium	X	X	X	X
Beryllium	X	X	X	X
BOD	X	X	X	X
Boron	X	X	X	X
Cadmium	X	X	X	X
Calcium	X	X	X	X
Chloride	X	X	X	X
Chromium	X	X	X	X
COD	X	X	X	X
Copper	X	X	X	X
Iron	X	X	X	X
Lead	X	X	X	X
Magnesium	X	X	X	X
Manganese	X	X	X	X
Mercury	X	X	X	X
Nickel	X	X	X	X
Nitrate + Nitrite, as n	X	X	X	X
pH	X	X	X	X
Potassium	X	X	X	X
Selenium	X	X	X	X
Silver	X	X	X	X
Sodium	X	X	X	X
Specific Conductance	X	X	X	X
Sulfate	X	X	X	X
Temperature	X	X	X	X
Thallium	X	X	X	X
Tin	X	X	X	X
Total dissolved solids	X	X	X	X
Total suspended solids	X	X	X	X
Zinc	X	X	X	X

** Sampled one time per year on an ash leachate composite sample.

APPENDIX B

Equipment Descriptions and Specifications

Equipment Descriptions & Specifications

Equipment	Make/Model	Material	Accuracy
Pumps	Well Wizard 1200 series	Stainless/Teflon	
Tubing/fittings		Teflon/polypropylene	
Controllers	Well Wizard 3013		
Compressor	Well Wizard 41000		
Flow cell	Geotech #0930 1350CC	Polycarbonate	
pH Meter	VWR SympHony SP80PD (pH/DO)		0.01 pH
Conductivity meter	Orion 128/ VWR SympHony		0.1 µs/cm
Turbidity meter	HF Scientific DRT-15CE		0.1 NTU
Dissolved Oxygen Meter	VWR SympHony SP80PD (pH/DO)		0.1% or 0.01 mg/l
OVM	Thermo Environmental 580 B		0.01 ppm
Depth sounder	Keck 900		0.01 feet

APPENDIX C

Equipment Maintenance, Calibration, and Operation

I. Pump Removal, Certification and Replacement

It may be necessary from time to time to remove pumps for repair or replacement. Dedicated pumps will be placed in new or original wells only if they can be certified to be clean and operational. A dedicated pump needing maintenance may later be placed back in the same well without the cleaning described below if the pump has been handled using clean procedures. The following procedures will be used to remove the pump and to certify that it is clean and operational upon replacement:

A. Pump Removal and Shipping

- See section 3.1 for well opening procedures.
- Pumps, tubing, and fittings will be carefully removed from the well casing, inspected, and placed in a plastic bag or wrapped in plastic. Care will be exercised not to damage the pump, tubing, or fittings and not to drop or leave any part of the pump equipment in the well. If the intention is to repair the pump at the site and immediately return the pump to the well, the pump must be handled with clean vinyl gloves and care must be taken to prevent contact of the pump, tubing or fittings with any potentially contaminated surface.
- After the pump and tubing have been removed and placed in the plastic bag, it will be packaged in a shipping carton and sent to the laboratory or the manufacturer.

B. Pump Cleaning

- After receipt, the pump will be decontaminated by cleaning outside and inside with decontamination fluids described in section 2.7 B. The inside will be cleaned by circulating the decontamination fluids through the system.
- Clean vinyl gloves will be worn from this point on when handling pump.

C. Certification

- The pump will be certified to perform according to the original manufacturer's specifications by placing the pump in a tub of deionized/distilled water and starting the pump controller. The pump should meet or exceed the manufacturer's volume flow specifications. If the pump does not pass the appropriate parts need to be replaced. The testing will be repeated until the flow requirements are met or the pump will be replaced.
- New pumps will be confirmed contaminate free and certified by the manufacturer
- The pump and tubing will be certified to be "contamination free" by allowing the deionized /distilled water to flow through the system, and analyzing it for Research Monitoring Parameters. Concurrent with the pump samples, a set of samples from the feed water will also be taken. Certification will occur if all parameters in the pump sample are at or below the feed water concentrations or show positive parameter values no greater than twice the analytical detection limit. If any analytes are detected above these limits, the decontamination will be repeated.
- Following certification, the pump will be wrapped in clean aluminum foil (shiny side out). Pump and tubing will then be placed in clean plastic bag.
- The pump will then be installed in the well casing following the manufacturer's recommendations.

II. Instrument Calibration and Operation

See attached manufacturers recommended procedures.

Equipment Descriptions & Specifications

Equipment	Make/Model	Material	Accuracy
Pumps	Well Wizard 1200 series	Stainless/Teflon	
Tubing/fittings		Teflon/polypropylene	
Controllers	Well Wizard 3013		
Compressor	Well Wizard 41000		
Flow cell	Geotech #0930 1350CC	Polycarbonate	
pH Meter	VWR SympHony SP80PD (pH/DO)		0.01 pH
Conductivity meter	Orion 128/ VWR SympHony		0.1 µs/cm
Turbidity meter	HF Scientific DRT-15CE		0.1 NTU
Dissolved Oxygen Meter	VWR SympHony SP80PD (pH/DO)		0.1% or 0.01 mg/l
OVM	Thermo Environmental 580 B		0.01 ppm
Depth sounder	Keck 900		0.01 feet

Conductivity Measurement"
(Page 13)
(Page 4-7)

Excerpt from:

Orion
Models 128, 130 and 135 Conductivity Meters
Instruction Manual

VWR sympHony Meter
Abridged User's Guide

Conductivity Measurement

Model 128

1. Rinse the cell in deionized water and blot dry.
2. Immerse the cell into the sample solution.
3. Use the selector switch to select measurement range corresponding to the required resolution.

   (*If *OFL* is displayed, select the next higher measurement range on the selector switch.)
4. Record measurement value on display.

Model 130 & 135

1. Rinse the cell in deionized water and blot dry.
2. Immerse the cell into the sample solution.
3. Press the χ key until conductivity mode is displayed. Conductivity measurement is done continuously.
4. Record measurement value displayed.
5. If *OFL* is displayed, see **Troubleshooting** section.

NOTE: Cell constant, temperature coefficient, and reference temperature must be properly set to obtain an accurate reading.

Conductivity Calibration

It is recommended to calibrate the cell constant against known conductivity standards as the conductivity cell constant may shift with time. Calibration frequency depends upon the type of cell in use as well as the particular application. The most common methods of calibrations are a Manual Calibration or AutoCal.

An **AutoCal** is performed by entering the nominal cell constant and then measuring the VWR calibration standard(s). When the reading stabilizes, the nominal calibration standard value is displayed. Whether using a temperature sensor or manual temperature entry, the meter corrects for temperature internally. For best results, calibrate at the chosen reference temperature.

A **Manual Cal** is performed by placing the electrode into the conductivity standard and then scrolling in the cell constant until the desired conductivity measurement is obtained.

Note: *Refer to specific meter instruction manual for step-by-step instructions for both Manual Cal and AutoCal.*

Electrode Maintenance

VWR Four Cell Conductivity Probe Cleaning recommendations

Cleaning Contaminant	Cleaning Solution	Recommended Time
• Water soluble contaminants	• Rinse with distilled water	• Epoxy Cells – no limit • Stainless Steel Cells – no limit • Glass Cells – no limit
• Lubricants, oils	• Warm water and liquid household detergent	• Epoxy Cells – no limit • Stainless Steel Cells – no limit • Glass Cells – no limit
	• Ethanol or acetone	• Epoxy Cells – 5 min. max. • Stainless Steel Cells – 5 min. max. • Glass Cells – no limit
• Lime or hydroxide coating	• 10% Acetic Acid or 10% Hydrochloric Acid	• Epoxy Cells – no limit • Stainless Steel Cells – no limit • Glass Cells – no limit

VWR Two Cell Conductivity Probe Cleaning recommendations

Cleaning Contaminant	Cleaning Solution	Recommended Time
• Water soluble contaminants	• Rinse with DI water	No limit
• Lubricants, oils	• Warm water and liquid household detergent	10 to 30 minutes
• Ethanol or acetone (glass cells only)		10 to 30 minutes
• Lime or hydroxide coating	• 10% Acetic Acid or 10% Hydrochloric Acid	10 to 30 minutes

VWR Two Cell Conductivity Probes ONLY – Replatinizing

Platinized electrodes are covered with platinum black to create a more effective surface area for conductivity measurements. The platinum deposit is quite durable and usually resistant to contamination and removal. However, replatinization of the cell may be required when measurements become slow, erratic or inconsistent, or when the cell constant has shifted beyond the stated specification. Platinizing the cell produces a complete, fresh layer of platinum black to be deposited on the plate surface, which restores performance and reliability.

Electrode Storage

For overnight or longer, **all** conductivity cells should be stored clean and dry. Storage in water is acceptable while in use.

Troubleshooting

The most important principle in troubleshooting is to isolate the components of the system and check each in turn. The components of the system are: 1) Meter 2) Electrode(s) 3) Standard and 4) Sample.

Meter

The meter is the easiest component to eliminate as a possible cause of error. VWR sympHony meters are provided with an instrument checkout procedure in the instruction manual. Consult the manual for complete instructions and verify that the instrument operates as indicated and is stable in all steps.

Electrode(s)

Rinse electrode(s) thoroughly with distilled water and follow the prescribed cleaning procedures in the Electrode Maintenance section. If readings continue to be erratic and unstable, you may need to replatinize the 2-Cell Platinum Electrode.

Standard

The quality of results depends greatly upon the quality of the standards. ALWAYS prepare fresh standards when problems arise – it could save hours of frustrating troubleshooting!

Sample

If the electrodes work properly in standards but not in the sample, look for possible interferences, or substances that could affect response or physically damage the sensing electrode or the reference electrode. If possible, determine the composition of the samples and check for problems.

Assistance

After troubleshooting all components of your measurement system, contact VWR technical service at 1(800) 897-7877. For the most current contact information, visit www.vwr.com.

Warranty

For the most current warranty information, visit www.vwr.com.

“Sections V.-VII”
(Pages 4-7)

Excerpt from:

H F Scientific, Inc.
DRT-15CE Portable Turbidimeter
Operating & Maintenance Manual

V. RECORDER OUTPUT

The DRT-15CE has a 0-1 mA Recorder Output. The jack is located on right side of the chassis (refer to J2 on figure 2). To use, connect the 1/8" miniplug provided to your recorder. Adjust R17 (pot nearest jack) to obtain a full scale output compatible to a full scale reading on the DRT-15CE. Once this adjustment is made, the DRT-15CE will always be set up for this recorder. Use 10, 100 or 1000 NTU standard in appropriate range.

VI. CRITICAL MEASURING AREA

The critical measuring area of the sample cuvettes is the 3/4" wide band starting 5/8" above the bottom. Keep this area clean and free of scratches or abrasion. Handle by the top part only. (See Figure 1).

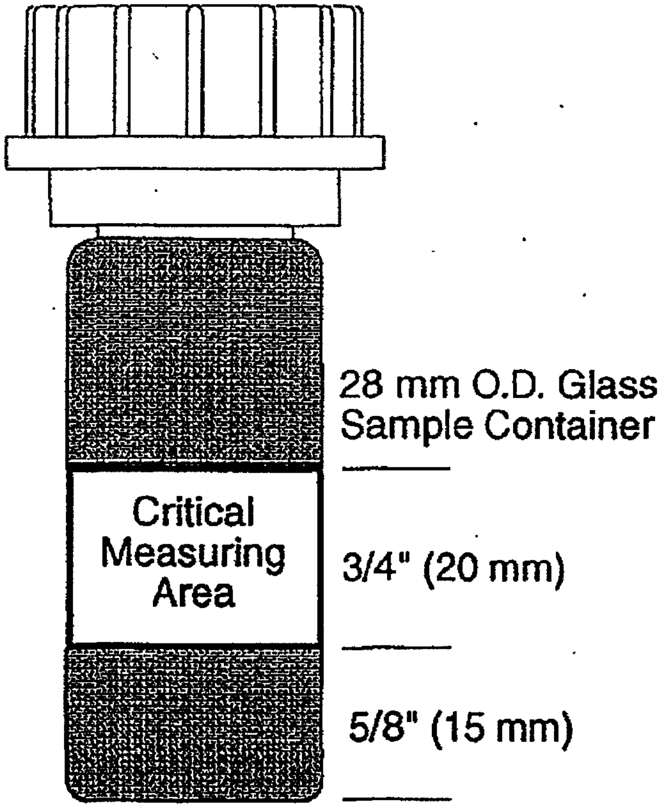


Figure 1

VII. CALIBRATION PROCEDURES

1. Calibration Standards

A. Secondary Standard Set (optional) Catalog No. 19071

HF Secondary Standards are recommended and certified by HF scientific. They are traceable to freshly prepared formazin primary standards. These standards are very easy to use off the shelf anytime without preparation making them an ideal turbidity standard. A Certificate of Traceability is available on request to HF scientific Customer Service Department. HF Secondary Standards may be used for calibration of HF turbidimeters. Order from HF scientific, inc.

NOTE: Do not freeze standards.
Do not leave standards in the measuring well for extended periods.
Do not shake standards.

Specific instructions for using certified Secondary Standards are included with the kit.

Each Secondary Standard Kit contains:

- Instructions
- 0.02 Reference Standard
- Certified Secondary Standards 10.00, 100.0, 1000 NTU Standards are contained in preselected cuvettes with light shield caps.
- A sturdy storage case

B. Standard Formazin Solutions

Calibration of this instrument is based on Formazin, a material which is made by polymerization.

Calibration samples may be obtained by diluting Formazin stock suspension using "Turbidity-Free" water. Formazin stock suspension can be prepared by the user (Reference Standard Methods For Examination of Water and Wastewater) or a kit can be purchased from, HF scientific, inc., Catalog No. 50040.

Each kit contains:

- Instruction manual
- 1 liter of 4000 NTU Stock Suspension
- 1 Gallon (3.79 liters) turbidity-free water
- 4 Sample cuvettes (28 mm)
- 4 Light Shield Caps
- Graduated Pipettes 1 ea. in 1 ml, 10 ml, & 25 ml
- 1 Reference Standard

The following table gives the recommended dilutions of the stock suspension. Be sure to adequately mix the stock suspension prior to removing a portion for dilution.

PROCEDURE

NTU Value	Pipette	Amount	Base Formazin	Volumetric Flask
10.0 NTU	10.0ml	2.5ml	of 4000 NTU	1000ml
100.0 NTU	10.0ml	5.0ml	of 4000 NTU	200ml
1000.0 NTU	25.0ml	25.0ml	of 4000 NTU	100ml

NOTE: 1. When the prepared samples start to flocculate, they are unreliable and fresh ones must be made. This will occur more rapidly for the lower value diluted suspensions. Prepare 40 NTU and lower standards daily.

2. ELECTRONIC CALIBRATION USING FACTORY CERTIFIED SECONDARY STANDARDS (CAT. NO. 19071)

The DRT Turbidimeters have been carefully calibrated at the factory. However, should the Electronic P.C. Board, the Photo Detectors, or the Light Source be replaced recalibration may be easily accomplished at your facility.

To carry out a complete calibration the following Secondary Standard values are required:

1000 NTU, 100 NTU & 10 NTU	- Keep the outside surface of cuvettes clean. - When placing any standards in the well, always use the screw cap/ shield to cover the well in order to keep out ambient light.

To gain access to the trimpots, remove the accessories from the foam holder. Refer to figure 2 for trimpot identification during the next few steps.

1. Turn the DRT-15CE to the 0 - 10 Range.
2. Insert the reference standard and index as described in "Operation and Description".
3. Set the Reference Adjust to the maximum "up" position.
4. Adjust R2, Ref. Offset trimpot, until the display reads 0.18 NTU.
5. Set the Reference Adjust to 0.02 NTU.
6. Insert the 10 NTU standard and index. Adjust R11 (0 - 10 NTU gain) to obtain a reading of 10.00 NTU.
7. Rotate the range switch to the 100 NTU range. Replace the 10 NTU standard with the 100 NTU standard and index.
8. Adjust R12 (0 - 100 gain) to obtain a reading of 100.0 NTU.
9. Rotate the range switch to the 1000 NTU range. Replace the 100 NTU standard with the 1000 NTU standard and index.
10. Adjust R13 (0 - 1000 gain) to obtain a reading of 1000 NTU.
11. It is not necessary to adjust R37 (low battery indicator). This is factory set to indicate a low battery condition when the battery voltage is below 5.6 V.
12. **WARNING:** R41 is factory set. Adjustment of this trimpot could cause damage to battery and/or DRT-15CE.

This completes the calibration of the DRT-15CE.

“Dissolved Oxygen Technique—Chapter VII” (Pages 29-34)

Excerpt from:

VWR sympHony Meter
Abridged User’s Guide

Chapter VII
Dissolved Oxygen Technique

Dissolved Oxygen Setup

The following table describes dissolved oxygen setup.

Description	Display	Range of Values	Default Value	Method Specific
Dissolved Oxygen % Saturation Resolution	dO rES 0.1	**1, 0.1** DO % saturation resolution	0.1	Yes
Dissolved Oxygen Concentration Resolution	dO rES 0.01	**0.1, 0.01** DO concentration "mg/L" resolution	0.01	Yes
Dissolved Oxygen Barometric Pressure Compensation Selection	dO bAr AUtO	**AUtO, mAn** Selects internal barometer or manual pressure	AUtO	Yes
Dissolved Oxygen Manual Barometric Pressure Setting	dO PrES 760.0	**450.0 - 850.0** Manual pressure compensation value	760.0	Yes
Dissolved Oxygen Salinity Correction Selection	dO SAL AUtO	**AUtO, mAn** Selects method of salinity correction; meters with conductivity function only	AUtO	Yes
Dissolved Oxygen Manual Salinity Correction Factor	dO SALF 0	**0 - 45** Manual salinity correction factor	0	Yes
Dissolved Oxygen Calibration Type Selection	dO CALt AIr	**AIr, H2O, mAn, SEt0** AIr = Water sat. air H2O = Air sat. water mAn = Manual SEt0 = Zero point	AIr	Yes

DO Setup Steps

1. From the measurement mode, press .
2. Press / to scroll through the setup menu until dO is displayed on the top line.
3. Press to confirm the setting and move the arrow icon to the middle line.
4. Press / to scroll through:
   a. rES + **% Sat** = % Saturation Resolution
   b. rES + **mg/L** = Concentration Resolution
   c. bAr = Barometer Type (Auto/Manual)
   d. PrES = Manual Pressure Compensation
   e. SAL = Automatic/Manual Salinity Compensation
   f. SALF = Manual Salinity Correction
   g. CALt = Calibration Type
5. Press to select the option and move the arrow icon to the bottom line.
6. Press / and to enter the value. The previous table identifies what you will see on the display and the range of values which may be entered.
7. After entering a value, press to complete programming of that option and move the arrow icon to the top line. Repeat steps 3 through 6 for all options.
8. Press to return to measurement mode.

DO Calibration

Prior to calibration, the probe must be prepared and polarized.

- The DO probe is continuously polarized when connected to the meter. When first connected, or if more than 60 minutes has elapsed with the probe disconnected, re-connect the probe and allow 30 to 60 minutes for polarization. If the probe readings are stable, probe disconnections of less than one hour will require 5 to 25 minutes for polarization.

  Note: *The sympHony meters will supply a polarization current to the DO probe even with the power off. To maximize battery life in the meter, unplug the DO probe if it will not be used for an extended period.* ▲

- Zeroing the probe – a DO probe can generate a 0.02 to 0.05 mg/L positive error in an oxygen free (anoxic) solution. If this error is unacceptable, then zero the probe when using a new sensing membrane, using fresh filling solution, or when measuring dissolved oxygen below 1 mg/L or 10% saturation.

An air calibration should be done prior to the zero calibration.

1. In the measurement mode press ◎.
2. Press △ / ▽ until dO is shown on the top line.
3. Press ☰ to confirm the setting and move the arrow to the middle line.
4. Press △ / ▽ to scroll to CALt.
5. Press ☰ to select setting and move arrow icon to the bottom line.
6. Press △ / ▽ to select one of the following calibration modes.

   a. A Ir denotes calibration performed in water saturated air using the air calibration sleeve. This is the simplest and most accurate calibration method.

It is also the meter's default setting. If the calibration selection in ◎ has not been changed, then pressing ↙ will automatically perform an air calibration. Due to the inherent differences between water-saturated air and air-saturated water, upon stability, the air standard is set to 102.3% saturation.

   i. The highest possible accuracy is reached when calibration temperature is the same as the measuring temperature.

   ii. Moisten the sponge or absorbent cloth in the calibration sleeve with distilled water and insert the probe into the sleeve, but without touching the water saturated material. For BOD measurements, this calibration can be performed in a BOD bottle.

   iii. For oxygen levels below 1 mg/L, a zero calibration point is often required.

   b. H2O denotes calibration performed using a water sample that is 100% saturated with air. It is the least commonly used calibration method.

   c. mAn denotes manual calibration using a water sample with a known concentration of dissolved oxygen. It can be used to calibrate the sensor to the value achieved by a Winkler titration.

   i. A Winkler calibration involves performing a manual Winkler titration and then using that sample as a standard. The titration oxygen level result is entered in a Winkler calibration as the DO standard value. This correlates the meter input to the Winkler titration. Note, this method is inherently less accurate due to the possibility of titration errors introduced when the calibration is set to the titration test results.

   d. SEtO denotes a zero calibration, which is used for very low level DO measurements. It is not generally required unless you are making measurements below 5% Saturation or 0.5 mg/L.

7. Press ☰ to accept selection and return the arrow icon to the top line.

8. Press 🌡 to return to measurement mode.

9. The probe and calibration standard (water-saturated air or air-saturated water) should be allowed to reach equilibrium before the system is calibrated.

    a. Press ↙.

    b. Wait for reading to stabilize.

    c. Meter will display 102.3% and return to measurement mode.

DO Measurement

1. Rinse the DO probe, as well as stirrer if being used, in deionized water. Blot dry with a lint-free tissue.

2. Place the DO probe *in your sample.*

    a. If you are in continuous measurement mode, the instrument will start measuring immediately. If you are using the benchtop meter and the stirrer *control is enabled, then pressing* ▣ *will start the stirrer.*

    The 🌡 will flash until the reading is stable. Once the reading is stable you can log and print the measurement by pressing 🌡. If you are recording *the data into a notebook, record the DO as well as the* temperature at which the DO reading is taken. If the stirrer is in motion, press ▣ to turn off the stirrer before removing the stirrer from the sample.

    b. If you are in AUTO-READ™ mode then press 🌡 to start the measurement. Once the reading is stable the meter will automatically log and print the results and freeze the display. If the stirrer is enabled, then the stirrer will turn on when 🌡 is pressed and turn off once the reading has stabilized.

    When using the AUTO-STIR™ BOD probe, pressing the button on the probe will start the AUTO-READ measurement.

    c. If you are in timed measurement mode then the meter will start making measurements as soon as it goes into measurement mode at the frequency *selected in setup. It will automatically log and print each measurement.* If you are using the benchtop meter and the stirrer control is enabled then pressing ▣ will start the stirrer. Pressing ▣ again will turn off the stirrer.

3. Remove the DO probe from the sample *and rinse with deionized water,* then place it in your next sample and repeat step 2.

4. When all samples have been measured, rinse the DO probe with deionized water and blot dry. Consult your DO probe manual for proper electrode storage instructions.

“pH Technique—Chapter VI”
(Pages 25-28)

Excerpt from:

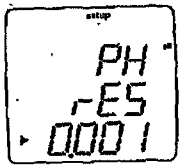
VWR sympHony Meter
Abridged User’s Guide

Chapter VI
pH Technique

pH Setup

The following table describes pH setup.

Description	Display	Range of Values	Default Value	Method Specific
pH Resolution	PH rES 0.01	**0.1, 0.01, 0.001**	0.01	Yes
pH Buffer Set	PH bUF USA	**USA** (USA Buffers) 1.68, 4.01, 7.00, 10.01, 12.46 **EUrO** (Euro Buffers) 1.68, 4.01, 6.86, 9.18	USA	Yes



1. In the measurement mode press 🔧.
2. Press △/▽ to scroll through the setup menu until *PH* is displayed on the top line.
3. Press ▤ to confirm setting and move the arrow icon to the middle line.
4. Press △/▽ to select *rES* for resolution.
5. Press ▤ to select option and move the arrow icon to the bottom line.
   a. Use △/▽ to set the desired resolution.

6. Press ▤ to accept the selection and move the arrow icon to the top line.
7. Press ▤ to move to middle line and press △/▽ to select *bUF* for Auto-Buffer-Recognition setting and press ▤ again to move to the bottom line.
8. Press △/▽ to select either *USA* or *EU-O*; press ▤ to accept the selection.
9. Press ʃ to return to measurement mode.

pH Calibration

1. Prepare the electrode for use according to the instructions received with the electrode.

2. In setup mode select the buffer set of NIST (USA) or DIN (EUr-D) being used for the proper buffer recognition to occur, if not set previously.

3. Press (☰) until the arrow icon is pointing to the pH measurement line.

4. Press (↙).

5. Rinse the electrode and ATC probe and place into the buffer.

6. Wait for the **pH** to stop flashing.
    a. Auto-Buffer-Recognition – When the **pH** stops flashing the meter will display the temperature-corrected pH value for the buffer.
    b. Manual Calibration – When the **pH** stops flashing the meter will display the actual buffer value read by the pH electrode. Use the (⊞) and (△)/(▽) to change the pH value to the temperature-corrected pH value for the buffer.

7. Once the correct buffer value is shown on the meter display, press (↙) to proceed to the next calibration point and repeat steps 5 through 6 or press (↧) to save the calibration.

8. The slope will be displayed before the meter returns to the measurement mode. SLP is displayed in the lower field and the actual electrode slope, in percent, is displayed in the main field.
    a. On a 1 point calibration use the (⊞) and (△)/(▽) to edit the slope then press (↧) to return to the measurement mode.
    b. On the 2 or more point calibration the meter will automatically go to the measurement mode 2 seconds after display of SLP.

pH Measurement

1. Rinse the electrode in deionized water. Shake off any excess water and blot dry with lint-free tissue.

2. Place the electrode in your sample.
    a. If you are in continuous measurement mode, the instrument will start measuring immediately. If you are using the benchtop meter and the stirrer control is disabled, then pressing (▤) will start the stirrer. The **pH** will flash until the reading is stable. Once the reading is stable you can log and print the measurement by pressing (↧). If the stirrer is on, press (▤) to turn off the stirrer before removing the stirrer from the sample.
    b. If you are in AUTO-READ™ mode then press (↧) to start the measurement. Once the reading is stable the meter will automatically log and print the results and freeze the display. If the stirrer is enabled then the stirrer will turn on when (↧) is pressed and turn off once the reading has stabilized.
    c. If you are in timed measurement mode then the meter will start making measurements at the frequency you have specified during setup. It will automatically log and print each measurement. If you are using the benchtop meter and the stirrer control is enabled, then pressing (▤) will start the stirrer. Pressing (▤) again will turn off the stirrer.

3. Remove the electrode from the sample and rinse with deionized water, shake or blot dry, then place it in your next sample and repeat step 2.

4. Once you are finished measuring samples, rinse the electrode with deionized water and blot dry. Then consult your electrode manual for proper electrode storage instructions.