TETRA TECH

November 19, 2019

Mr. Aaron Kent
Wisconsin Department of Natural Resources
Eau Claire Service Center
1300 W. Clairemont Street
Eau Claire, Wisconsin 54701

Re: Advanced Disposal Services – Seven Mile Creek Landfill
Sector 2 Northeast Expansion
Feasibility Report Addendum No. 1
Eau Claire, Wisconsin
WDNR License No. 3097 FID No. 61804545

Dear Mr. Kent:

On behalf of Advanced Disposal Services, Seven Mile Creek Landfill LLC, Cornerstone Environmental Group, a Tetra Tech Company, (Tetra Tech) is pleased to submit to the Wisconsin Department of Natural Resources (WDNR), Feasibility Report Addendum No.1 for the Sector 2 Northeast Expansion of the Seven Mile Creek Landfill. Additional copies of the Feasibility Report Addendum No.1 have been distributed according to the attached distribution list.

Advanced Disposal Services is requesting that the WDNR review and approve Feasibility Report Addendum No. 1 and deem the Feasibility Report Complete. To facilitate the WDNR's review, we are available to meet with you to discuss the contents of the Feasibility Report and Addendum No.1. Please feel free to call John Oswald at (630) 410-7224 with any questions or if you would like to set up a time to meet and discuss the Feasibility Report and Addendum No.1.

Certified mail receipts or delivery receipts for the transmittal of the Addendum No.1 to the municipalities and the library will be forwarded to the WDNR upon their return to Tetra Tech.

Sincerely,

CORNERSTONE ENVIRONMENTAL GROUP, LLC – A TETRA TECH COMPANY

John C. Oswald, P.G.
WI Operations Director/Senior Geologist

Enclosure: Sector 2 Northeast Expansion - Feasibility Report Addendum No.1

cc: Per attached Distribution List

TETRA TECH
8413 Excelsior Drive, Suite 160, Madison, WI 53717
Tel 877.633.5520 Fax 877.845.1456 tetratech.com

Advanced Disposal Services - Seven Mile Creek Landfill
Sector 2 Northeast Expansion - Feasibility Report-Addendum No. 1
Distribution List

Sent To:	Number of Copies:
Mr. Mark Vinall Advanced Disposal 8001 Olson Drive Eau Claire, WI 54703	3 hard copies, 1 electronic copy (Feasibility Report- Addendum No. 1)
Mr. Tim Curry Advanced Disposal 119 West Gundlach Road Columbia, IL 62236	1 electronic copy (Feasibility Report- Addendum No. 1)
Mr. Aaron Kent Wisconsin DNR – Eau Claire Service Center 1300 West Clairemont Avenue Eau Claire, WI 54701	2 hard copies, 1 electronic copy (Feasibility Report- Addendum No. 1)
Mr. Martin Herrick Wisconsin DNR – La Crosse Service Center 3550 Mormon Coulee Road La Crosse, WI 54601	1 hard copy (Feasibility Report- Addendum No. 1)
Ms. Valerie Joosten Wisconsin DNR – Green Bay Service Center 2984 Shawano Avenue Green Bay, WI 54313	1 hard copy (Feasibility Report- Addendum No. 1)
Mr. Joe Lourigan Wisconsin DNR 101 S. Webster Street Madison, WI 53703	1 hard copy (Feasibility Report- Addendum No. 1)
LE Phillips Memorial Public Library 400 Eau Claire Street Eau Claire, WI 54701	1 hard copy (Feasibility Report- Addendum No. 1)
Town of Seymour 6500 Tower Drive Eau Claire, WI 54703	1 hard copy (Feasibility Report- Addendum No. 1)

Advanced Disposal Services - Seven Mile Creek Landfill
Sector 2 Northeast Expansion - Feasibility Report-Addendum No. 1
Distribution List

City of Eau Claire 203 S. Farwell Street Eau Claire, WI 54701	1 hard copy (Feasibility Report- Addendum No. 1)
Eau Claire County Clerk 721 Oxford Avenue, Rm 3350 Eau Claire, WI 54703	1 hard copy (Feasibility Report- Addendum No. 1)
Mr. Timm Speerschneider Dewitt, LLP 2 E. Mifflin Street, Suite 600 Madison, WI 53703	1 electronic copy (Feasibility Report- Addendum No. 1)
Mr. John Oswald Cornerstone Environmental Group 8413 Excelsior Drive, Suite 160 Madison, WI 53717	1 hard copy (Feasibility Report- Addendum No. 1)
Mr. Mark Torresani Cornerstone Environmental Group 8413 Excelsior Drive, Suite 160 Madison, WI 53717	1 electronic copy (Feasibility Report- Addendum No. 1)

Feasibility Report – Addendum No. 1
Sector 2 Landfill - Northeast Expansion

Seven Mile Creek Landfill

Eau Claire, Wisconsin

NOVEMBER 19, 2019
208-190275

PREPARED FOR

Advanced Disposal Services Seven Mile Creek Landfill, LLC
8001 Olson Drive
Eau Claire, WI 54703

SUBMITTED BY

Cornerstone Environmental Group, LLC - A Tetra Tech Company
8413 Excelsior Drive, Suite 160
Madison, Wisconsin 53717

TETRA TECH
P +1.877.294.9070
tetratech.com

REPORT CERTIFICATION

I, Mark J. Torresani, hereby certify that I am a licensed professional engineer in the State of Wisconsin in accordance with the requirements of ch. A-E 4, Wis. Adm. Code; that this document has been prepared in accordance with the Rules of Professional Conduct in ch. A-E 8, Wis. Adm. Code; and that, to the best of my knowledge, all information contained in this document is correct and the document was prepared in compliance with all applicable requirements in chs. NR 500 to 538, Wis. Adm. Code.

Mark J. Torresani P.E.

Signature

Vice President / Engineer

Title

WISCONSIN
MARK J.
TORRESANI
E-29355
MIDDLETON
WI
11/19/19
PROFESSIONAL ENGINEER

I John C. Oswald, hereby certify that I am a licensed professional geologist in the State of Wisconsin in accordance with the requirements of ch. GHSS 2, Wis. Adm. Code; that the preparation of this document has not involved any unprofessional conduct as detailed in ch. GHSS 5, Wis. Adm. Code; and that, to the best of my knowledge, all information contained in this document is correct and the document was prepared in compliance with all applicable requirements in chs. NR 500 to 538, Wis. Adm. Code.

John C. Oswald

Signature

WI Operations Director/Senior Geologist

Title

WISCONSIN
JOHN C.
OSWALD
G-1126
MIDDLETON
WI
PROFESSIONAL GEOLOGIST
11-19-19

TABLE OF CONTENTS

REPORT CERTIFICATION ii

1.0 BACKGROUND 1-1

2.0 RESPONSES TO THE WDNR'S COMMENTS 2-1

2.1 PART A. INFORMATION NEEDED TO COMPLETE THE FEASIBILITY REPORT 2-1
2.2 PART B. ADDITIONAL INFORMATION REQUIRED FOR A FEASIBILITY DETERMINATION 2-4
2.3 PART C. GENERAL COMMENTS 2-6

3.0 RECOMMENDATION 3-1

4.0 LIMITATIONS 4-1

APPENDIX SECTIONS

ATTACHMENTS

Attachment 1 WDNR Correspondence
Attachment 2 Alternative Liner Paper
Attachment 3 Samens Well (PW-33) Information
Attachment 4 Revised Sampling and Analysis Plan
Attachment 5 Drawings

1.0 BACKGROUND

Advanced Disposal Services - Seven Mile Creek Landfill, LLC (SMCL) submitted a Feasibility Report (FR) to the Wisconsin Department of Natural Resources (WDNR) dated July 2019 for a proposed Sector 2 Northeast Expansion of the existing SMCL. The FR included information required to determine the feasibility for the proposed Sector 2 Northeast Expansion (Northeast Expansion) of the SMCL, Wisconsin Department of Natural Resources (WDNR) License No. 3097 (FID No. 618045450). Following their initial review of the FR, the WDNR sent an Incompleteness Determination of the FR letter to SMCL dated October 8, 2019 (Attachment A). The WDNR letter contained comments in three separate section – Parts A, B and C.

This Addendum contains responses that address the three items in Part A – Information Required to Complete the Feasibility Report, so that the WDNR can deem the Feasibility Report Complete and continue with their review of the Feasibility Report for the proposed Sector 2 Northeast Expansion. Additionally, this Addendum contains responses to Part B – Additional Information Required for a Feasibility Determination and Part C – General Comments.

2.0 RESPONSES TO THE WDNR'S COMMENTS

The WDNR's Letter of Incompleteness dated October 8, 2019 (Attachment A) is divided into three parts: Part A contains a list and explanation of the items needed to complete the FR in accordance with NR 512, Wis. Adm. Code, and Chapter 289 of the statutes, and chs. 500, 504, 507, and 512, Wis. Adm. Code; Part B is a description of additional information required for a feasibility determination; Part C contains general comments regarding the site, including permitting and annual report requirements.

2.1 PART A. INFORMATION NEEDED TO COMPLETE THE FEASIBILITY REPORT

1. ***General submittal requirements [s. NR 512.05, Wis. Adm. Code]****: Applicants proposing an alternate design shall include an analysis that predicts whether the proposed landfill will meet or exceed the performance standards of s. NR 504.04(4)(d), Wis. Adm. Code. An analysis was not provided in the feasibility report for the alternate liner design. Please provide an analysis for the alternate liner design and any other alternative designs pertaining to ss. NR 504.05 – 504.09, Wis. Adm. Code. This includes the proposed materials and components of the liner and the required separations from the bottom of the liner to the seasonal high groundwater level or the top of bedrock surface. The analysis should consider the accumulative effect from all requested liner design exemptions and all requested locational exemptions that may be affected, such as the distance to water supply wells.*

   The 10-foot separation requirement between the bottom of the clay component of the liner and top of the bedrock surface provides an attenuation buffer between the landfill bottom and the bedrock in the event of any release from the landfill. The requested exemption to the 10-foot separation of the bottom of the liner to the top of bedrock surface in the area of the proposed horizontal expansion does not include any proposed additional protective measures that would be taken in exchange for not maintaining the 10-foot separation between the liner and bedrock.

   Response:

   An analysis that predicts whether the proposed alternate composite landfill liner will meet or exceed the performance standards of Wisconsin Administrative Code (WAC) NR 504.04(4)(d), is included as Attachment 2 to this Addendum. This analysis was also provided to the WDNR at a meeting on October 22, 2019 and sent electronically on October 28, 2019. The provided analysis demonstrates beyond a reasonable probability that the proposed alternate composite landfill liner will perform better than a WAC NR 504.06(2) liner at meeting WAC NR 504.04(4)(d), which requires the protection of groundwater. In addition, the proposed alternate composite landfill liner will reduce environmental and social impacts to the surrounding area and communities when compared to the WAC NR 504.06(2) liner. The analysis provided in Attachment No. 2 considers the performance of a WAC NR 504.06(2) liner compared to the alternative composite liner proposed for the Sector 2 Northeast Expansion. The analysis shows that the proposed alternative composite liner, which includes a 2-foot clay compacted layer, a geosynthetic liner (GCL) and a 60-MIL HDPE geomembrane, reduces environmental and social impacts, and is an improved design compared to the liner specified by WAC NR 504.06(2).

   The geology in the vicinity of the proposed Northeast Expansion is characterized by permeable sandy soils (Alluvium) with a mean hydraulic conductivity of (4.8×10^{-3} cm/s). The Alluvium is underlain by Residual or weathered sandstone bedrock (1.4×10^{-3} cm/s) and subsequently sandstone bedrock

($9.6x10^{-4}$ cm/s). These units have similar permeability qualities as referenced. Groundwater levels and groundwater flow rates in the area of the proposed Northeast Expansion are not impacted to any substantial degree by bedrock fracturing or impermeable soil layers. The groundwater table generally occurs within the bedrock / weathered bedrock in the immediate vicinity of the proposed Northeast Expansion. The separation of the landfill liner subbase grades for the Northeast Expansion and the high groundwater table conditions in the footprint of the proposed Northeast Expansion is as much as 20-feet with a minimum separation distance of 12-feet.

The separation distance of 12 to 20 feet from the subbase of the proposed liner to the groundwater table in conjunction with the more protective alternate composite liner proposed, provides additional protective measures to allow for a variation from maintaining the 10-foot separation distance between the subbase of the liner and bedrock as required by WAC NR 504.06(2)(c). The request for a separation distance of less than 10 feet from the bedrock is also justified based on the weathered nature of the bedrock and the hydrogeology of the site where the bedrock and soil units have similar permeabilities and ground water flow is not influenced by fracturing within the bedrock. The separation distance to the groundwater table in conjunction with the proposed alternate liner protect groundwater resources as required by WAC NR 504.04(4)(d).

The region of Wisconsin in which the Sector 2 Northeast Expansion is located, is considered a unique area of the State. This area can be described as an area that is a transition between the glacial drift area to the north and the unglaciated driftless area to the south. The area where SMCL is located consists of rolling hills with floodplain terraces along river systems. The soil deposits in the area of the landfill consist of alluvial sand and gravel deposits overlying the Cambrian age sandstone bedrock. The alluvial material is 10 to 70 feet thick with occasional thin silt or clay layers in the Sector 2 Landfill area. Below the alluvium, is the sandstone bedrock. One of the features of this area is highly permeable soils and sandstone bedrock. Clay deposits in this unique geological area suitable for landfill liner construction are not reasonably available and are generally considered to be regionally scarce.

The uniqueness of this area geologically requires the consideration for alternative liners to be designed, permitted, and constructed to minimize the environmental, social and economic impacts associated with obtaining sufficient clay quantities of acceptable quality from a remote borrow area to construct a 4-foot clay composite liner.

Additionally, the groundwater flow conditions in the vicinity of the Sector 2 Landfill are unique in that a hydraulic barrier exists between the Landfill and the nearest downgradient private water supply wells. Although downgradient and within 1,200 feet of the Sector 2 Landfill footprint, the SMCL office water supply well is located approximately 1,800 feet from the horizontal footprint of the Northeast Expansion where the alternate composite liner would be constructed. An exemption to WAC NR 500 and a variance to WAC NR 812 have previously been granted by the WDNR for this well. Based on the typical groundwater flow conditions as documented on Plan Sheet 24 of the 2019 Feasibility Report and in prior Feasibility Reports, the office water supply well is located at the northern edge or just outside the flow path of groundwater emanating from the area beneath the proposed Northeast Expansion footprint. Furthermore, as has been discussed and documented in current and prior Feasibility Reports, Seven Mile Creek just to the west of the SMCL office, acts as a hydraulic barrier between the Sector 2 Landfill and the next nearest water supply wells beyond the office water supply well. These wells are located to the west of Seven Mile Creek. The groundwater flows to the southeast to the west of the Creek or toward the SMCL Sector 2 Landfill based on regional and site specific groundwater elevation data. Therefore, the water supply wells located west of the Creek are in a separate groundwater flow regime from the groundwater flowing beneath the Sector 2 Landfill including the Northeast Expansion.

Finally, should the WDNR provide an exemption to the clay liner thickness SMCL is prepared to submit a more thorough Construction Quality Assurance (CQA) Plan with the Plan of Operation submittal with the intent of further validating the integrity of the clay component of the liner system, but also the GCL as well as geomembrane liner by increasing the sampling frequency and densification of the sample locations.

2. ***Locational Criteria [s. NR 504.04(3)(f)****: A well construction report for private water supply well PW- 33 has not been obtainable and attempts at an alternative method of determining well construction has not been successful. As pointed out in the department's ISR opinion letter, s. NR 504.04 (2)(a), Wis. Adm. Code requires that well construction information be provided, to allow the department to grant the requested exemption from the 1,200-foot set-back required in s. NR 504.04 (3)(f), Wis. Adm. Code.*

   This exemption request should also address any accumulative effects from the expansion and the existing landfill, as well as any other exemption requests that may affect the layers of protection to the water supply wells.

   Response:

   Steven Samen and Linda Crandall currently own the vacant property on which well PW-33 is located. Upon receipt of additional well log information from the WDNR for the Section within which this parcel is located, coupled with a prior records search of the property deeds, it has been determined that there is a well log for this parcel. To further verify the correlation of the well log to this parcel, SMCL personnel visited the parcel and measured the physical attributes of the well. The combination of 1) the measurements align with the information presented on the well log and 2) the timing of the well installation of the well in conjunction with the property transfer records, indicates that the well log for this parcel has been located. A copy of the deed records and the well log are provided in Attachment 3.

   The well (PW-33) is located hydraulically upgradient from the Northeast Expansion. The construction of the Northeast Expansion will not cause a deviation in groundwater flow direction or conditions in the vicinity of the SMCL as evidenced by groundwater flow conditions which preceded the installation of the Sector 1 and Sector 2 landfills at the SMCL as compared to those conditions which exist now. Therefore, based on these hydraulic conditions and the available well log, the exemption for the setback of the well to the Sector 2 Landfill Northeast Expansion footprint is warranted.

3. ***Preliminary Design [s. NR 512.14(1)(d), Wis. Adm. Code]****: The sampling plan, including Plan Sheet 30, did not include all monitoring devices in accordance with s. NR 507.16, Wis. Adm. Code and other discrepancies were noted. The following needs to be addressed:*

   a. *All monitoring points (existing and proposed) need to be clearly shown. This includes gas probes, leachate head wells, gas extraction wells, and the leachate storage tank. Update tables within the sampling plan and on Plan Sheet 30 to include the proposed sample points, monitoring frequency and parameters.*

      Response:

      The locations and identifications for each proposed monitoring point and the frequency of monitoring are preliminary and will be further evaluated as part of the Plan of Operation and do not pertain to the Determination of Completeness or the Determination of Feasibility. The Sampling and Analysis Plan (SAP) has been revised to reflect the proposed monitoring program and is provided in Attachment 4. The Environmental Monitoring Plan (Plan Sheet 30) has been revised to include all existing and proposed monitoring points (on the map as well as the tables) and is provided in Attachment 5. The proposed leachate headwells, gas probes and gas extraction wells have been added to Plan Sheet 30.

b. *Leachate monitoring needs to be performed in accordance with s. NR 507.215, Wis. Adm. Code for leachate recirculation, quarterly leachate characteristics are required.*

Response:

The quarterly leachate monitoring requirements, when leachate recirculation is active at SMCL, have been added to the environmental monitoring program tables. The revised SAP and the revised Plan Sheet 30 (which includes the monitoring tables) are provide in Attachments 4 and 5, respectively.

c. *The plan discusses a composite gas sample collected near the blower; however, the composite gas sample is not included in the monitoring tables (tables on Plan Sheet 30 and within the sampling and analysis plan).*

Response:

The requirement to collect an annual composite gas sample from the blower has been added to the environmental monitoring program tables. The revised SAP and the revised Plan Sheet 30 (which includes the monitoring tables) are provided in Attachments 4 and 5, respectively.

2.2 PART B. ADDITIONAL INFORMATION REQUIRED FOR A FEASIBILITY DETERMINATION

1. *Section 8.5 of the report reads "the existing and proposed leachate collection system was designed to maintain less than 12 inches of hydraulic head at the hydraulically most remote location of the liner system." Please clarify what is considered to be the most remote location of the liner system.*

Response:

WAC NR 504.06 (5)(a) states, "A leachate collection system shall be included in each horizontal phase of the landfill. This system shall be designed to route leachate to the perimeter of the landfill in the most direct manner possible and limit the average leachate head level on the liner to one foot or less. The piping layout shall be such that leachate flows no more than 130 feet across the base of the liner before encountering a perforated leachate collection pipe. The department will consider greater flow distances for a well-designed composite landfill."

The proposed horizontal expansion area leachate collection system will be designed in accordance with WAC NR 504.06.(5)(a) and the final design will be included with the Plan of Operation.

2. *Section 8.11.3 of the report proposes intermediate waste grades that are 5 percent higher than final waste grades to allow for settlement. Provide a plan sheet that illustrates the intermediate waste grades and a plan sheet that depicts the proposed maximum final waste grades.*

Response:

Proposed intermediate waste grades (Plan Sheet 31) and proposed maximum final waste grades (Plan Sheet 32) are provided in Attachment 5 of this Addendum.

3. *Section 10.4.4 of the report discusses socioeconomic impacts. It was stated that specific impacts (such as taxes, traffic and roads, noise, consistency with local planning and zoning) to local residents and cultural groups and the communities and industries served by the landfill would not change. However, the increase in elevation, and the associated sightlines were not mentioned. Please discuss this and if there are not any impacts, then indicate this.*

   Response:

   There are no known socioeconomic impacts associated with sightlines as a result of the increased elevation of the landfill. The surrounding area is heavily forested, and the landfill is screened with natural vegetation and mature trees of considerable height. A site screening berm is also located near the intersection of County Highway Q and N. 75th Avenue. As was discussed throughout the Feasibility Report (Sections 1.3.2, 4.4, 7.1.4, 8.13, 10.4.5), line-of-sight drawings from the Tower Ridge Recreation Area and County Highway L were provided as Figure 7-1, 7-2 and 7-3. Based on these line-of-sight figures as it pertains to these Parks, the increased elevation will not impact socioeconomic factors.

   In addition, part of the design for this proposed expansion includes an alternative liner exemption request. The purpose of this alternative liner design is in part an effort to reduce the socioeconomic impacts the existing landfill facility has on the community. Compared to the activities of the currently permitted facility, if approved by WDNR, the proposed alternative liner will reduce heavy truck traffic, noise and air emissions pollution. These are all existing socioeconomic impacts that would be reduced as a result of the proposed expansion design compared to the existing permitted facility.

4. *In the plan sheets, the cross sections depict weathered bedrock as a major soil unit; however, this information does not correspond with some of the completed boring logs in Appendix H of the report. For example, the cross-section B-B' on sheet 06 shows weathered bedrock to include previously installed borings in the DH-22 nest. However, the boring logs for the wells indicates mostly SP "alluvium" at those depths and beyond and does not indicate weathered bedrock as a soil unit. Please provide clarification whether the boring logs for the installed wells need correcting; and whether or not the major soil units shown on the cross sections are accurate.*

   Response:

   The geologic cross sections in existing areas of the Sector 2 Landfill as presented in the 2019 Northeast Expansion Feasibility Report, are consistent with those presented in the 2003 Feasibility Report and the 2014 Feasibility Report and Addendums for the Sector 2 Landfill. The 2019 cross sections were modified to reflect the existing ground surface, the installed liners and final cover areas, the proposed Northeast Expansion liner and final cover areas as well as the soil lithology, well construction, geotechnical data, and hydraulic data collected from the borings and wells installed in December 2018. The soil and bedrock information of the existing wells/borings presented on previously approved cross sections were not modified as there was not sufficient justification to perform these edits from prior Feasibility Reports and the associated evaluations.

   It appears based on a review of the boring logs at the DH-22 well nest, that the reason weathered bedrock is shown at the depth indicated on Cross Sections B-B' and N-N' (Plan Sheets 06 and 19, respectively) is due to the presence of sandstone fragments in the samples collected at and below the indicated weathered bedrock demarcation line on the cross sections. Why the DH-22 boring logs indicate the geologic unit is alluvium is unclear at this time as these logs were completed in the mid-1980s. It is likely an error on the log. What is further apparent following a review of additional logs prepared for borings installed in the mid-1980s for the initial Sector 2 Landfill Expansion and for borings installed in the early 2000s for the Sector 2 North and East Horizontal and Vertical Expansions, is that the interpretation of the weathered bedrock "unit" in these borings included the presence of sandstone fragments and chips

amongst other lithologic conditions. The borings completed during the December 2018 subsurface investigation for the Northeast Expansion utilized the same method of interpretation (sandstone fragments – amongst other criteria and lithologic features) to define the presence of weathered bedrock. It has become apparent that between the 1986 Feasibility Report and the 2003 Feasibility Report a reinterpretation of what defines the weathered bedrock surface was performed at select borings for reasons unknown but likely associated with the indication and presence of sandstone fragments in the samples collected in borings performed in the 1970s and 1980s.

Based on these findings neither modifying the cross sections nor select borings logs is warranted at this time. Modifying a boring log is not practical as the log represents the interpretation of soil samples observed and characterized by the onsite geologist at the time the boring was completed. Prior modifications to select cross sections from the mid-1980s to early-2000s, appears to represent past and current interpretations of what defines the presence of weathered bedrock. Consequently, further modifications to the 2019 Feasibility Report or Plan Set Cross Sections are unwarranted.

2.3 PART C. GENERAL COMMENTS

1. *Section 8.5.3 of the report discusses leachate treatment and disposal. It is not clear from the information provided whether the proposed WWTPs currently have the capability to treat the anticipated quantity of leachate from the landfill and proposed expansion based on the 2014 letter from the City of Chippewa Falls and the two invoices. Provide a detailed evaluation of the capability of all proposed WWTPs to treat the anticipated quality and quantity of leachate. The evaluation needs to account for the anticipated volume of leachate from the current landfill and the proposed expansion.*

   Response:

   The City of Menomonie, the City of Chippewa Falls and the Rice Lake Utilities Wastewater Treatment Plants (WWTPs) have and/or currently accept leachate from SMCL. SMCL has provided information to these WWTPs detailing the expected quality and quantity of the leachate generated at SMCL and the proposed Northeast Expansion. These WWTPs are in the process of preparing letters that document their ability and concurrence to accept leachate from the SMCL. Upon receipt of the letters from the WWTPs, SMCL will forward the letters to the WDNR in an Addendum to the 2019 Northeast Expansion Feasibility Report.

2. *In Section 8.7, the feasibility report proposes stripping intermediate cover soils for slope reclamation. Note s. NR 514.07(3), Wis. Adm. Code requires no additional waste placement occur in areas which have reached final waste grades and received intermediate cover. A request for an exemption would be needed to place additional waste on slopes after intermediate cover is in place. This can be addressed in the plan of operation.*

   Response:

   An exemption request will be included in the Plan of Operation for the proposed expansion.

3. *Section NR 512.06 (2), Wis. Adm. Code, requires the submission of Initial Site Inspection (ISR) and feasibility reports to each participating municipality (i.e., Tn of Seymour, City of Eau Claire, Eau Claire County) and to notify the department of when and to whom the specified copies were submitted. This requirement was absent from the report, however the report indicated that this information would be*

submitted to department at a later date. This information was received by the department electronically on September 3, 2019.

Response:

The Initial Site Report (ISR) and Feasibility Report for the proposed Sector 2 Northeast Expansion were provided to each participating municipality and the local library. A letter and attached delivery confirmation receipts were provided to the Mr. Aaron Kent of the WDNR by letter dated September 3, 2019. Therefore, the WAC NR 512.06(2) requirement has been met.

4. *Section 8.12 of the report discusses a lower post closure monitoring frequency. It is important to note that monitoring frequency during post-closure is established within the plan of operation and would not be reduced unless otherwise approved by department.*

Response:

This statement was based on experience and knowledge of other closed landfills. It is not uncommon to have a reduced monitoring frequency at some point during the post-closure period of a landfill. It is understood that a change in the approved monitoring program would require a plan modification approval from the WDNR.

5. *It appears that baseline groundwater data collected for subtitle D monitoring well DH-22R did not include the select subtitle D list of baseline monitoring substances required in ch. NR 507, Appendix I, Table 3, Wis. Adm. Code (asterisked substances). Please address if these substances have been sampled for baseline data in DH-22R.*

Response:

Monitoring well DH-22R, installed on 9/29/2011, replaced DH-22 which was installed 4/16/1985. The proximity between DH-22 and DH-22R is such that the characterization of soil samples and baseline sampling of DH-22R was not necessary. A review of data on WDNR GEMS confirmed that no baseline sampling specific to Subtitle D monitoring requirements was performed at either well DH-22 or well DH-22R. Prior to 2011, DH-22 was not an approved Subtitle D monitoring well by the WDNR. The Monitoring Plan (provided on Drawing No. 23) of the 2011 Sector 2 Plan of Operation Plan Modification by Ayres (dated August 2011) included DH-22 as a Subtitle D monitoring well. The WDNR approved the Plan of Operation Plan Modification on October 24, 2011 (provided in Appendix B of the 2019 Feasibility Report). There was no indication that DH-22 was added as a Subtitle D monitoring point in that approval letter. However, DH-22R is listed as a Subtitle D well in the WDNR GEMS database and was included as a Subtitle D well in the October 2016 Plan of Operation Approval letter for the Sector 2 Vertical Expansion.

Since DH-22R is currently approved as a Subtitle D monitoring well, SMCL proposes to collect four rounds of the “asterisked substances” listed in WAC NR 507, Appendix I, Table 3, during the routine semiannual monitoring events which occur in April and October. The parameters (asterisked substances) to be sampled for and analyzed include antimony, beryllium, cobalt, nickel, thallium and vanadium. The need for additional rounds of sampling for these parameters beyond the first four initial rounds will be evaluated based on WAC NR 507.18(2) requirements. However, it should be noted that baseline sampling of DH-22R will not truly represent baseline conditions since the Sector 2 landfill has been upgradient of this monitoring well since 1989.

6. *The feasibility report included a request for an exemption to the requirements of ss. NR 504.06(1)(a) and NR 504.06(2)(e), Wis. Adm. Code, for the alternate liner design. An exemption request for s. NR 504.06(7), Wis. Adm. Code would also be required for the use of GCL within the liner of a MSW Landfill. These requests would need to be evaluated in conjunction with the plan of operation. In addition, please*

*note that s. NR 500.08(4), Wis. Adm. Code allows the department to grant an exemption from requirements of chs. NR 500 to NR 538, Wis. Adm. Code in "special cases" unless otherwise specified. For the department to evaluate whether this is a special case, the exemption requests related to the alternate liner should present a set of conditions that are distinguishable from other municipal waste landfills. The request should also demonstrate that the proposal will not result in environmental pollution. **Note that the review time specified in s. NR 500.07, Wis. Adm. Code for these design related exemptions would not begin until a complete plan of operation is submitted.*

Response:

An exemption is requested from WAC NR 504.06(7) to allow the proposed Sector 2 Northeast Expansion horizontal footprint, which would accept municipal solid waste (MSW), to be constructed using an alternative composite liner system that includes a GCL component. See the response to Part A Item 1 for additional details regarding the proposed alternative liner design. An exemption request to WAC NR 504.06(7) will also be evaluated and included as part of the Plan of Operation.

7. *The feasibility report included a request for an exemption from Wet Detention Pond Standard 1001. Note that the department's authority to grant exemptions under s. NR 500.08(4) is limited to the requirements of chs. NR 500 to 538, Wis. Adm. Code. However, if the pond is intended to function as an infiltration basin instead of a wet pond, refer to the infiltration basin design criteria in Technical Standard 1003.*

Response:

Stormwater management and basin design will be further evaluated as part of the Plan of Operation preparation. This evaluation will incorporate infiltration basin design criteria of Technical Standard 1003 since wet detention ponds are not practical for this site. This area is highly permeable soils and sandstone bedrock. Clay and other fine grained soil deposits in this unique geological area are not reasonably available and are generally considered to be regionally scarce limiting the ability to have a wet detention basin.

3.0 RECOMMENDATION

The SMCL believes that the responses presented in this Addendum satisfactorily address the additional information requested by the WDNR in their Incompleteness Letter dated October 8, 2019. The contents of this document enable the WDNR to complete the remaining portions of the feasibility review process in a timely manner to issue a completeness determination.

4.0 LIMITATIONS

The work product included in the attached was undertaken in full conformity with generally accepted professional consulting principles and practices and to the fullest extent as allowed by law we expressly disclaim all warranties, express or implied, including warranties of merchantability or fitness for a particular purpose. The work product was completed in full conformity with the contract with our client and this document is solely for the use and reliance of our client (unless previously agreed upon that a third party could rely on the work product) and any reliance on this work product by an unapproved outside party is at such party's risk.

The work product herein (including opinions, conclusions, suggestions, etc.) was prepared based on the situations and circumstances as found at the time, location, scope and goal of our performance and thus should be relied upon and used by our client recognizing these considerations and limitations. Cornerstone Environmental Group, LLC shall not be liable for the consequences of any change in environmental standards, practices, or regulations following the completion of our work and there is no warrant to the veracity of information provided by third parties, or the partial utilization of this work product.

ATTACHMENT 1

WDNR CORRESPONDENCE

State of Wisconsin
DEPARTMENT OF NATURAL RESOURCES
1300 W. Clairemont Ave
Eau Claire, WI 54701

Tony Evers, Governor
Preston D. Cole, Secretary
Telephone 608-266-2621
Toll Free 1-888-936-7463
TTY Access via relay - 711

October 8, 2019

Mark Vinall – General Manager
Advanced Disposal Services - Seven Mile Creek Landfill
8001 Olson Drive
Eau Claire, WI 54703

File Ref: FID # 618045450
Eau Claire County
SW/CORR

Subject: Incompleteness Determination of the Feasibility Report for the Proposed Seven Mile Creek Landfill – Sector 2 Northeast Expansion, License # 3097

Dear Mr. Vinall:

The Department of Natural Resources (department) has completed its review of the feasibility report entitled "Feasibility Report, Sector 2 Northeast Expansion, Seven Mile Creek Landfill". The report dated July 2019, was prepared by Cornerstone Engineering Group, a Tetra Tech Company (Cornerstone) on behalf of Advanced Disposal Services. The department received five copies of the report and plan sheets on July 25, 2019, in the Eau Claire Service Center and other locations. Additionally, on September 3, 2019, the department received confirmation of the submission of the Initial Site Report, the department's initial site report opinion, and the feasibility report to participating municipalities. An invoice for review fees was issued on August 6, 2019, payment was received in-full on August 26th, 2019. Based on our review, we have determined that the feasibility report does not contain the minimum information required by ch. NR 512, Wis. Adm. Code.

Part A of this letter identifies the information required to fulfill the minimum feasibility report requirements. Part B is additional information that we would need to make a determination of site feasibility. Part C identifies issues related to design, construction or operation.

The information that must be included in the feasibility report is specified in ss. 289.24 and 289.34, Wis. Stats., and chs. 500, 504, 507, and 512, Wis. Adm. Code. Please include this information as an addendum to the feasibility report. This information is intended for use by the public as well as the department in reviewing the proposal.

A. <u>The following information is required to complete the feasibility report:</u>

1. **General submittal requirements [s. NR 512.05, Wis. Adm. Code]:** Applicants proposing an alternate design shall include an analysis that predicts whether the proposed landfill will meet or exceed the performance standards of s. NR 504.04(4)(d), Wis. Adm. Code. An analysis was not provided in the feasibility report for the alternate liner design. Please provide an analysis for the alternate liner design and any other alternative designs pertaining to ss. NR 504.05 – 504.09, Wis. Adm. Code. This includes the proposed materials and components of the liner and the required separations from the bottom of the liner to the seasonal high groundwater level or the top of bedrock surface. The analysis should consider the accumulative effect from all requested liner design exemptions and all requested locational exemptions that may be affected, such as the distance to water supply wells.

The 10-foot separation requirement between the bottom of the clay component of the liner and top of the bedrock surface provides an attenuation buffer between the landfill bottom and the bedrock in the event of any release from the landfill. The requested exemption to the 10-foot separation of the bottom of the liner to the top of bedrock surface in the area of the proposed horizontal expansion does not include any proposed additional protective measures that would be taken in exchange for not maintaining the 10-foot separation between the liner and bedrock.

2. **Locational Criteria [s. NR 504.04(3)(f):** A well construction report for private water supply well PW-33 has not been obtainable and attempts at an alternative method of determining well construction has not been successful. As pointed out in the department's ISR opinion letter, s. NR 504.04 (2)(a), Wis. Adm. Code requires that well construction information be provided, to allow the department to grant the requested exemption from the 1,200-foot set-back required in s. NR 504.04 (3) f, Wis. Adm. Code.

   This exemption request should also address any accumulative effects from the expansion and the existing landfill, as well as any other exemption requests that may affect the layers of protection to the water supply wells.

3. **Preliminary Design [s. NR 512.14(1)(d), Wis. Adm. Code]:** The sampling plan, including Plan Sheet 30, did not include all monitoring devices in accordance with s. NR 507.16, Wis. Adm. Code and other discrepancies were noted. The following needs to be addressed:
   a. All monitoring points (existing and proposed) need to be clearly shown. This includes gas probes, leachate head wells, gas extraction wells, and the leachate storage tank. Update tables within the sampling plan and on Plan Sheet 30 to include the proposed sample points, monitoring frequency and parameters.
   b. Leachate monitoring needs to be performed in accordance with s. NR 507.215, Wis. Adm. Code for leachate recirculation, quarterly leachate characteristics are required.
   c. The plan discusses a composite gas sample collected near the blower; however, the composite gas sample is not included in the monitoring tables (tables on Plan Sheet 30 and within the sampling and analysis plan).

B. <u>The following Information is needed to make a feasibility determination:</u>

1. Section 8.5 of the report reads "the existing and proposed leachate collection system was designed to maintain less than 12 inches of hydraulic head at the hydraulically most remote location of the liner system." Please clarify what is considered to be the most remote location of the liner system.

2. Section 8.11.3 of the report proposes intermediate waste grades that are 5 percent higher than final waste grades to allow for settlement. Provide a plan sheet that illustrates the intermediate waste grades and a plan sheet that depicts the proposed maximum final waste grades.

3. Section 10.4.4 of the report discusses socioeconomic impacts. It was stated that specific impacts (such as taxes, traffic and roads, noise, consistency with local planning and zoning) to local residents and cultural groups and the communities and industries served by the landfill would not change. However, the increase in elevation, and the associated sightlines were not mentioned. Please discuss this and if there are not any impacts, then indicate this.

4. In the plan sheets, the cross sections depict weathered bedrock as a major soil unit; however, this information does not correspond with some of the completed boring logs in Appendix H of the

report. For example, the cross-section B-B' on sheet 06 shows weathered bedrock to include previously installed borings in the DH-22 nest. However, the boring logs for the wells indicates mostly SP "alluvium" at those depths and beyond and does not indicate weathered bedrock as a soil unit. Please provide clarification whether the boring logs for the installed wells need correcting; and whether or not the major soil units shown on the cross sections are accurate.

C. <u>The department has the following comments as it relates to proposed landfill design, construction and operation:</u>

1. Section 8.5.3 of the report discusses leachate treatment and disposal. It is not clear from the information provided whether the proposed WWTPs currently have the capability to treat the anticipated quantity of leachate from the landfill and proposed expansion based on the 2014 letter from the City of Chippewa Falls and the two invoices. Provide a detailed evaluation of the capability of all proposed WWTPs to treat the anticipated quality and quantity of leachate. The evaluation needs to account for the anticipated volume of leachate from the current landfill and the proposed expansion.

2. In Section 8.7, the feasibility report proposes stripping intermediate cover soils for slope reclamation. Note s. NR 514.07(3), Wis. Adm. Code requires no additional waste placement occur in areas which have reached final waste grades and received intermediate cover. A request for an exemption would be needed to place additional waste on slopes after intermediate cover is in place. This can be addressed in the plan of operation.

3. Section NR 512.06 (2), Wis. Adm. Code, requires the submission of Initial Site Inspection (ISR) and feasibility reports to each participating municipality (i.e., Tn of Seymour, City of Eau Claire, Eau Claire County) and to notify the department of when and to whom the specified copies were submitted. This requirement was absent from the report, however the report indicated that this information would be submitted to department at a later date. This information was received by the department electronically on September 3, 2019.

4. Section 8.12 of the report discusses a lower post closure monitoring frequency. It is important to note that monitoring frequency during post-closure is established within the plan of operation and would not be reduced unless otherwise approved by department.

5. It appears that baseline groundwater data collected for subtitle D monitoring well DH-22R did not include the select subtitle D list of baseline monitoring substances required in ch. NR 507, Appendix I, Table 3, Wis. Adm. Code (asterisked substances). Please address if these substances have been sampled for baseline data in DH-22R.

6. The feasibility report included a request for an exemption to the requirements of ss. NR 504.06(1)(a) and NR 504.06(2)(e), Wis. Adm. Code, for the alternate liner design. An exemption request for s. NR 504.06(7), Wis. Adm. Code would also be required for the use of GCL within the liner of a MSW Landfill. These requests would need to be evaluated in conjunction with the plan of operation. In addition, please note that s. NR 500.08(4), Wis. Adm. Code allows the department to grant an exemption from requirements of chs. NR 500 to NR 538, Wis. Adm. Code in "special cases" unless otherwise specified. For the department to evaluate whether this is a special case, the exemption requests related to the alternate liner should present a set of conditions that are distinguishable from other municipal waste landfills. The request should also demonstrate that the proposal will not result in environmental pollution. **Note that the review time specified in s. NR 500.07, Wis.

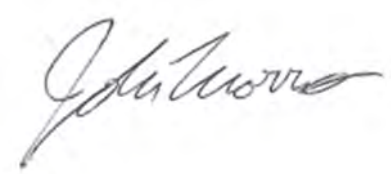
Adm. Code for these design related exemptions would not begin until a complete plan of operation is submitted.

7. The feasibility report included a request for an exemption from Wet Detention Pond Standard 1001. Note that the department's authority to grant exemptions under s. NR 500.08(4) is limited to the requirements of chs. NR 500 to 538, Wis. Adm. Code. However, if the pond is intended to function as an infiltration basin instead of a wet pond, refer to the infiltration basin design criteria in Technical Standard 1003.

This incompleteness determination is not a denial of your proposal, but merely indicates that additional information is needed to continue our review. Submittal of this information does not ensure approval, nor does it preclude the department from requiring additional information if continued review is necessary. We are would be available to meet with you to discuss the items in this letter with you and your consultant.

If you have any questions, please contact Aaron Kent, Hydrogeologist, who is the assigned lead reviewer for this project, at 715-839-3796 or aaron.kent@wisconsin.gov by email.

Sincerely,



John Morris, Professional Soil Scientist
Waste & Materials Management Program Supervisor
Northern and West Central Regions

cc: John Oswald, Cornerstone (ecopy)
Aaron Kent, DNR/WA (ecopy)
Marty Herrick, DNR/WA (ecopy)
Valerie Joosten, DNR/WA (ecopy)
Joe Lourigan, DNR/WA (ecopy)
File/DNR, Eau Claire
P. Duncan Moss, DNR/LS (ecopy)
Waste Facility Siting Board, 5005 University Ave., Suite 201, Madison, WI 53705

ATTACHMENT 2

ALTERNATIVE LINER PAPER

Wisconsin Municipal Solid Waste Landfill

NR 500 Alternative Landfill Liner Design Evaluation

REVISED

OCTOBER 28, 2019

PRESENTED TO

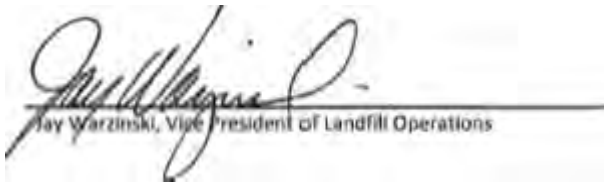
Wisconsin Department of Natural Resources

SUBMITTED BY

Tetra Tech
8413 Excelsior Drive, Suite 160
Madison, WI 53717

Advanced Disposal
90 Fort Wade Road
Ponte Vedra, FL 32081

The material and data in this report were prepared under the supervision and direction of the undersigned.



Mark J. Torresani P.E. Vice President / Engineer Tetra Tech, SWE	10/28/2019
Jay Warzinski Vice President of Landfill Operations Advanced Disposal	10/28/2019

TABLE OF CONTENTS

1.0 INTRODUCTION 1-3

2.0 EXISTING LINEAR/ LEACHATE COLLECTION SYSTEM DESIGNS 2-1

2.1 WI Landfill Liner History 2-1
2.2 NR 500 Liner and Leachate Designs 2-3
2.3 USEPA Region V Approved Liner and Leachate Collection Systems 2-3
2.4 Regulatory Authority for the WDNR to Allow Alternate Landfill Liners 2-4

3.0 EVALUATION OF LINER / LEACHATE COLLECTION SYSTEMS FOR GROUNDWTER PROTECTION 3-1

3.1 Performance 3-1

4.0 LINER EVALUATIONS AND COMPARISONS 4-1

4.1 Proposed Alternate NR 500 Liner Systems 4-1
4.2 Environmental Assessment 4-1
4.3 Social Assessment 4-2
4.4 Economic Assessment 4-3
4.5 Logistical Assessment 4-3
4.6 Design, Construction, Operating and Long-Term Care Assessment 4-4

5.0 CONCLUSION AND RECOMMENDATIONS 5-1

TABLES

Table 1 USEPA Region 5 Liner Comparison Summary
Table 2 Liner Impacts Analysis
Table 3 Alternate Liner Cost Comparison

FIGURES

Figure 1 Liner Details Michigan
Figure 2 Liner Details Ohio
Figure 3 Liner Details Indiana
Figure 4 Liner Details Minnesota
Figure 5 Liner Details Illinois
Figure 6 Liner Details Wisconsin
Figure 7 Landfill Liner Alternatives
Figure 8 Borrow Area Impact

APPENDICES

Appendix A Applicable Regulations

- WI NR 180
- WI NR 504
- USEPA Subtitle D

Appendix B Evaluation of Effectiveness of NR504 and Alternative Composite Liners

Appendix C History of Compacted Clay Liners in Wisconsin

1.0 INTRODUCTION

It is the intent of this paper to give the Wisconsin Department of Natural Resources (WDNR) the information necessary to approve an exemption for an alternative composite liner and leachate collection system design for a Municipal Solid Waste (MSW) landfill that will be, at a minimum, as protective to human health and the environment as well as provide social and economic benefits to the residents of the State of Wisconsin. The analysis of landfill liners and leachate collection systems will be presented as an integral system and not two separate components. The performance of the liner and leachate collection systems together is what determines the effectiveness in protecting groundwater aquifers.

The disposal of municipal solid waste and industrial waste, in what can be referred to as a “depression in the ground”, has taken place for centuries. Pre-1960 waste disposal areas in the United States were often in low lying areas such as wetlands, mines or soil borrow areas with no safety protections or consideration for protecting land, air, and water resources. Today waste disposal occurs in an engineered landfill with components to protect land, air, and water resources. The design and construction of modern landfills are based on similar design and construction methods developed from the early 1970s through the 1990s. The design and construction of early engineered landfills ranged from the excavation into low permeability soils prior to the placement of waste within this excavation to the construction of a low permeability soil layer following the completion of on-site soils combined with a method to collect and remove leachate prior to placement of waste over this low permeable layer.

In October of 1991 Federal Regulations (Subtitle D Title 40, parts 239 through 259, Appendix A) set minimum standards for the handling and disposal of nonhazardous solid waste. These minimum standards established design requirements for composite liners and the leachate collection system that were mandated for states to adopt. These design requirements involved the combined use of soil and geosynthetic materials in landfill liners in order to be protective of groundwater. Since the adoption of these regulations by the individual states there has been little to no change in the regulatory approach to managing MSW. In Wisconsin, the NR 500 (Appendix A) regulations were approved in the early 1990s (replacing NR180 regulations, Appendix A) to meet the requirements of Federal Subtitle D regulation.

It is the purpose of this paper to present an alternative MSW landfill composite liner and leachate collection system design in which the performance is equivalent to or exceeds the performance of the composite liner and leachate collection system design that are currently required in Wisconsin under the NR 500 regulations. The analysis presented in this paper provides the justification for the approval of an alternative to the currently required NR 500 liner and leachate collection system design. The analysis also includes a comparison of alternate composite liner and leachate collection system designs to the “standard” NR500 landfill liner and leachate collection system as well as the design required by the Federal Subtitle D regulations. The analysis is not limited to technical (Appendix B) and environmental elements, but also economic and social considerations that also must be factored into whether an alternative design is justified and beneficial. The analysis combined information not only obtained from academic and solid waste industry experts, including experience gained over the past 30 plus years of designing and constructing composite liner and leachate collection systems throughout the United States.

The alternative composite liner and leachate collection system design that is the focus of this paper has been derived from designs adopted and approved in other States within USEPA Region V. In every USEPA Region V State, except for WI, alternative liner designs to State and Federal regulations are allowed and have been constructed. These States have approved various liner designs acknowledging that ultimately liner performance based on protecting groundwater resources is the primary function of a liner. Alternative liner systems provide options that mitigate environmental and financial impacts in areas which lack sufficient reserves of clay soil within the near vicinity of the landfill, requiring clay soils to be trucked over long distances in order to construct a landfill liner.

2.0 EXISTING LINEAR/ LEACHATE COLLECTION SYSTEM DESIGNS

2.1 WI LANDFILL LINER HISTORY

Municipal Solid Waste (MSW) management in Wisconsin has progressed over the past 50 years from being managed at the community level in small "dumps" to being managed at large regional landfills supplemented by reuse and recycling programs. In the early 1980's there were over 900 landfills in Wisconsin accepting various solid and liquid wastes and often comingling MSW, industrial wastes, and liquid wastes. During this period landfill design and construction evolved from small unlined facilities to lined facilities that combine an engineered soil and/or composite liner overlain with a granular material to allow for the collection of leachate.

In 1967, the Wisconsin Legislature directed the then Department of Resource Development to "…no later than January 1, 1969, prepare and adopt minimum standards for the location, design construction, sanitation, operation and maintenance of solid waste disposal sites…". (See 1967 Wis. Stat. § 144.43). It also authorized the Department to license solid waste disposal facilities which met the minimum design, construction and operational requirements once adopted by the Department. (See 1967, Wis. Stat. § 144.44). Pursuant to that Legislative directive, the DNR adopted NR 51 (sometimes referred to as RD 51 and NR 151) which went into effective in May 1969. RD 51 is widely considered to be the first solid waste regulation in Wisconsin although there may have been some earlier, more general regulations enacted by the State Board of Health. Although RD 51 did not establish minimum design standards for liners, leachate collection systems, or gas extraction systems it did define locational and operational standards in an effort to protect surface water and groundwater. RD 51.09(4) and (5) established the following locational requirements:

> RD 51.09 Location requirement. Solid waste disposal operations are prohibited within the following areas unless written permission for use of such location is obtained from the department:
>
> *(4) Within an area from which solid waste or leaching therefrom may be carried into any surface water.*
>
> *(5) Within an area from which leaching from solid waste may have a detrimental effect on ground water.*
>
> (See also NR 151.09(4) and (5))
>
> Additionally, RD 51.10(2)(b) created the following operational standard:
>
> *(b) No solid waste shall be deposited in such a manner that materials or leachings therefrom will have a detrimental effect on any ground or surface water.*
>
> (See also NR 151.10(2)(b))

NR 151 was modified throughout the 1970s as the WDNR's knowledge of landfill designs developed. This is evident in the modifications that became effective in July 1973 that included provisions related to the management of landfill gas and leachate. The NR 151.12(5)(e) evolved to address monitoring systems and provided that DNR may require that plans and specifications for new or expanded landfills include

> *"…. groundwater monitoring wells and water quality sampling and analysis programs, provisions for gas monitoring and sampling, or provisions for protection against possible detrimental effects of leachate and gas production."*

The most significant change in Wisconsin landfill regulations occurred in 1978 when the Legislature established the basic regulatory permitting structure that generally remains in effect today; namely:

> (1) Feasibility Review
>
> (2) Plan of Operation Review

(3) Operating License

(1979 Wis. Stat. § 144.44 created by Chapter 377 laws of 1977)

It also directed DNR to adopt new rules to ensure compliance with the Resource Conservation and Recovery Act ("RCRA") which had been enacted by the Federal Government in 1976. In response to that legislative directive, DNR adopted NR 180 which became effective in February 1980. While NR 180 was far more comprehensive than its predecessors RD 51 and NR 151, it did not prescribe minimum design requirements for liners.

In 1984, a non-solid waste regulatory development of significance occurred when Wisconsin became one of the first states to address groundwater quality issues with the enactment of Chapter 160 of the Wisconsin Statutes (1983 Act 410). DNR adopted implementing regulations, NR 140, shortly thereafter. NR 140 became effective in October 1985. NR 140 established numeric groundwater quality standards (Preventive Action Limits & Enforcement Standards) and the regulatory framework to enforce them if exceedances were observed.

NR 180 was modified throughout the 1980s, ultimately being recreated and renumbered as NR 500 in 1988. It was at that time that the first minimum design and construction standards for liners, including the requirement of a five-foot minimum thickness low permeable soil layer "clay-liner" for MSW landfills was enacted (see Appendix A NR 504.05). A number of entities challenged the five-foot clay liner requirement as noted in the recorded public comments:

> *Comment #130 – Five feet of clay may be excessive, especially in areas of Wisconsin that are clay short – Dairyland Power, North West Regional Planning Commission, City of Superior and Becher-Hoppe.*
>
> *Response – The original draft of NR 504 contained requirements for different liner thicknesses depending on facility size and the hydrogeologic setting. The Technical Advisory Committee recommended using the 5-foot standard. The code does contain the ability for exemptions on a case-by-case basis.*
>
> (June 2, 1987 Response to Comments)

The initial version of NR 500 adopted in 1988 did not include a design standard for composite liner systems as they were still under development at that time.

As noted earlier, RCRA was enacted in 1976. It was significantly modified in 1984 by the Hazardous and Solid Waste Amendments ("HSWA"). Under the HSWA, EPA was required to prepare a report regarding solid waste landfills including an analysis of the design required to protect groundwater. EPA submitted the report in October 1988 and then promulgated minimum standards based upon that report in 1991 (See 1991 40 CFR Part 258). EPA's approach to the HSWA's requirement to enact standards for landfills was to enact both a performance standard and a uniform design standard:

The final rule approach selected by EPA includes two elements – a provision allowing site-specific designs in approved States and a uniform design standard. Specifically, today's final rule provides that new MSWLFs and lateral expansions must be construed with either (1) in approved States, a design that is approved by the Director of an approved State and meets the performance standard specified in § 258.40, or (2) a composite liner and leachate collection system. The rationale for each of these elements is discussed below.

(October 9, 1991 Federal Register at p. 51,059; See Federal Register excerpt and 40 CFR 258.40 attached as Exhibit A for a description of the performance standard and uniform design standard.)

The performance standard required numeric groundwater concentrations not be exceeded at specified distances from the landfill. The uniform design standard required a composite liner.

EPA initially proposed a design standard of a composite liner system consisting of an upper flexible membrane liner and a lower soil layer at least three feet thick with a hydraulic conductivity of no more than 1x10-7 cm/sec. EPA modified the initial proposal to require that the flexible membrane liner have a minimum thickness of 30 mil or if high density polyethylene (HDPE) is used, a minimum thickness at 60 mil. Additionally, EPA specified a minimum soil component of two feet rather than three feet. EPA explained its rationale for reducing the size of the soil component as follows:

> *Second, today's rule specifies a minimum lower soil component thickness of two feel rather than three feet, which is required for hazardous waste disposal facilities. The Agency's most recent data indicate: (1) With sound construction practices, a two foot thick soil liner can be constructed with a hydraulic conductivity of 1 x 10-7 cm/ sec; (2) soil liners less than two feet thick have a high probability of having a*

hydraulic conductivity greater than 1 x 10-7 cm/sec.; and (3) for composite liners, an extra foot of thickness (i.e., three foot versus two foot thickness) generally provides little improvement in liner performance, but may be appropriate to add as a "factor of safety" in certain cases. (see Note on Thickness of Compacted Soil Liners, Daniel, D.E., April 9, 1990).

EPA believes that requiring this "factor of safety" is appropriate as part of the liner system for hazardous waste disposal facilities, but not for MSWLFs. In comparison to hazardous waste disposal facilities, MSWLF's are located and needed in every region of the country. In some of these locations, clay materials for a soil liner are unavailable locally and must be shipped in from long distances. In many cases, shipping these materials in is very expensive for the community. While these communities will have the opportunity to use a site-specific design, as described: above, increasing the thickness of the soil component of the composite liner would likely make the composite liner option prohibitively expensive for these communities. Even assuming minimal shipping costs, EPA estimates that requiring an additional one fool "factor of safety" would increase the cost of a composite liner for a typical MSWLF by nearly 25 percent. Given the unique characteristics of MSWLFs, EPA believes a two-foot minimum soil layer provides the best balance between protection of human health and the environment and the practicable capabilities of MSWLF owners and operators.

(October 9, 1991 Federal Register at p. 51,060)

In 1996, WDNR modified NR 500 to reflect the new EPA standards, including the use of a composite liner system. Notably, Wisconsin required that the minimum thickness of the clay component of the composite liner be at least four feet instead of the two feet required by EPA. The irony is that Wisconsin's four-foot requirement is one foot more (33%) than the federal requirement of three feet ultimately adopted by EPA for hazardous waste landfills.

Based on our research, history of permitting and constructing projects in Wisconsin since the mid 1980's, and discussions with retired WDNR staff, the DNR's rationale for requiring four feet of clay instead of the two feet of clay in the federal rule was not supported by technical justification. Additional discussion on the rationale/process for adopting the standard for 4-feet of compacted clay is provided in Appendix C Composite Liner Performance Evaluation "HISTORY OF COMPACTED CLAY LINERS IN WISCONSIN" attached to this Report.

2.2 NR 500 LINER AND LEACHATE DESIGNS

Since the implementation of NR 500 regulations all MSW landfill liners in Wisconsin have consisted of the same primary components. A soil liner 4-feet thick with a minimum hydraulic conductivity of 1x10-7 cm/sec and a 60 mil HDPE geomembrane. Based on the authors of this paper there are no known alternative MSW liner systems that have been constructed or approved by the WDNR since NR 500 regulations were adopted. A cross sectional detail of a typical NR 500 liner is shown on Figure 6.

With the exception of several minor changes leachate collection system design required under NR500 have remained unchanged since NR 500 regulations were adopted. The clay component of the composite liner system are required to be contoured to have minimum slopes of 0.05 ft/ft (0.5%) to promote drainage through the granular drainage layer media which is required to have a maximum hydraulic conductivity of 1 x10^0 cm/sec. Initial composite liner design typically included liner penetrations through the sidewall of the landfill perimeter berm to gravity drain leachate from a landfill. This design is no longer allowed and has been replaced with a sideslope riser pipe to provide a conduit for the insertion of an extraction pump. The sideslope riser is set in a depressed area (sump) that is positioned at the lowest elevation of the liner area. Leachate is pumped from the sideslope riser pipe to a force main located near the perimeter of the landfill. Minimum design and construction criteria for landfill liners and leachate collection systems are in provided in NR 504.06.

2.3 USEPA REGION V APPROVED LINER AND LEACHATE COLLECTION SYSTEMS

USEPA region V includes the states of Ohio, Indiana, Illinois, Michigan, Wisconsin and Minnesota. All States in Region V have been promulgated to enforce Subtitle D and have adopted regulations that comply with Federal Subtitle D regulations. Within USEPA Region V, Wisconsin is the only State that does not permit MSW landfill liners limited to 2 feet of compacted clay.

A comparison of the MSW landfill liner and leachate collection systems currently permitted in USEPA Region V is significant given that each State is required to meet minimum Federal Subtitle D regulations. This comparison is also relevant given the climatic conditions (freeze/thaw) and precipitation events that the liner in these states are also subjected too. The various composite liner and leachate collection systems that have been approved in these states are shown on Figures 1 through 6. Individual States regulations in Region V include liners with a soil component of 1x10-7 cm/sec ranging from 5 feet thick to no soil component (Michigan allows a Geosynthetic Clay liner in place of a soil component). All states require a geomembrane component, typically comprised of a 60-mil HDPE.

2.4 REGULATORY AUTHORITY FOR THE WDNR TO ALLOW ALTERNATE LANDFILL LINERS

There are two options that the WDNR has to allow for the approval of an alternate composite liner and leachate collection system for a MSW landfill: (1) utilize the alternative design of provisions of NR 504.05(1) and (2); or (2) utilize the exemption provision of NR 500.08(4). DNR has been given broad authority to regulate solid waste in Wisconsin. It has express authority to promulgate rules establishing standards for the “design” of landfills. Consistent with that broad authority, WDNR’s rules have always included a provision allowing for alternative designs that meet those standards.

For example, the initial version of NR 504.05 provided:

> ***NR 505.05 Minimum design criteria.*** *Unless otherwise approved by the department in writing, the minimum design criteria set forth in this section apply to all new facilities and to the expansion of existing facilities for which the plan of operation was not approved before February 1, 1988. These criteria shall be used by the applicant to the greatest degree practical when preparing design plans for initial site reports, feasibility reports and plans of operation and for the submittal of any plan modification or closure plan. Facilities designed in substantial conformance with these design criteria are presumed to be capable of meeting the performance standards of s. NR 504.04(4)(d) regarding groundwater quality. If the proposed design differs from these requirements the applicant shall provide supporting justification for any differences.*
>
> *(1) GENERAL. (a) All solid waste land disposal facilities shall be designed to contain and collect leachate to the maximum practical extent unless the applicant can demonstrate -that no significant quantity of leachate will be generated do to the unique character of the waste or facility type.* ***This shall be accomplished by designing the facility to meet the standards contained in either sub. (3) or (4), unless the department approves the applicants alternative design, which provides an equivalent or better level of performance than the standards contained in this chapter.***

(1988 NR 504.05(1))

The current provisions of NR 500 likewise allow for alternative designs provided the applicant submits supporting justification (e.g., the performance standards are being met):

> *(1) Unless otherwise specified in this chapter, the minimum design criteria in ss. NR 504.06 to 504.09 apply to all new landfills and to the expansion of existing landfills for which the plan of operation was approved after July 1, 1996, as well as to proposed design changes for all landfills which are submitted after July 1, 1996. Landfills designed in substantial conformance with these design criteria are presumed to be capable of meeting the performance standards of s. NR 504.04 (4) (d) regarding groundwater quality.*
>
> ***(2) If the proposed design differs from the requirements in ss. NR 504.06 to 504.09, the applicant shall provide supporting justification for any differences.***

(1996 - current NR 504.05(1) & (2))

In responding to comments regarding the 1996 revisions to NR 500, DNR made clear that the above provision allowed for alternative liner designs:

> *RESPONSE: While most proposed designs we receive do not deviate from current design standards in NR 504, we agree that design flexibility is important and have approved a number of deviations from the*

required design standards since NR 504 was promulgated in 1988. The Department intends to maintain this same approach in the future. ***As one of the commenters noted, the Department believes that NR 504.05(2) provides the flexibility for site-specific modifications to any design or construction requirement.***

(See excerpt from January 26, 1996 Response to Comments attached as Exhibit B)

Additionally, DNR has broad authority to provide exemptions from its rules. Indeed, DNR's very first set of rules, RD 51, adopted in 1969, included the following language regarding exemptions:

> *(1)* ***The department may grant annual exemptions for any one or number of the requirements of this chapter.*** *In considering the granting of exemptions, the department shall take into account such factors as population of the area being served, average daily loadings, location of disposal site, nature of wastes, seasonal character of the disposal operation, and other significant factors. Licenses based on such an alternate plan of operation shall be reviewed annually, with particular regard to any potential nuisance or hazard to public health and safety.*

(NR 51.18(1))

The exemption language has evolved over time and its current form is set forth below:

> *(4) Exemptions from solid waste rules****. Exemptions from the requirements of chs. NR 500 to 538 may be granted in writing by the department in special cases except as otherwise provided.*** *A person may apply for an exemption by providing the department with a written request along with the appropriate documentation which demonstrates that the proposal will not cause environmental pollution as defined in s. 299.01 (4), Stats[1]. The department shall take into account such factors as the population of the area being served, the amount of waste being generated, the geologic and hydrogeologic conditions at the facility, the design of the facility, the operational history of the facility, the physical and chemical characteristics of the waste and any other information which may be appropriate. The department shall review and make a written determination on the exemption request within 65 business days after receipt of a complete request and the appropriate review fee under ch. NR 520 unless a different time period is provided by law.*

(NR 500.08(4))

Simply put, WDNR has ample authority to approve alternative liner systems through the exemption process.

---

[1] Environmental pollution is detailed at Wis. Stat. § 299.01(4) as follows:

(4) "Environmental pollution" means the contaminating or rendering unclean or impure the air, land or waters of the state, or making the same injurious to public health, harmful for commercial or recreational use, or deleterious to fish, bird, animal or plant life.

3.0 EVALUATION OF LINER / LEACHATE COLLECTION SYSTEMS FOR GROUNDWTER PROTECTION

3.1 PERFORMANCE

A technical evaluation of MSW composite liners was performed by Craig H. Benson, PhD, PE, NAE and James M. Tinjum, P.E., Ph.D. to determine the effectiveness in containing leachate and preventing contaminates from passing through the liner system and impacting groundwater. This evaluation considered the types of materials used for a liner, the thickness of material/barrier layers, and the slope of the leachate collection layer. This evaluation involved the two primary methods that contaminants can migrate through a liner system, advective flow and diffusive flow. The composite liner designs evaluated include a NR 500 liner, a RCRA/Federal Subtitle D minimum liner design and an alternative liner design, that includes a 2-foot clay layer a geosynthetic liner and a geomembrane proposed for the proposed expansion at Advanced Seven Mile Landfill. The cross section of the NR 500 and four alternative composite liner designs evaluated and considered for the proposed expansion are shown on (Figure 6 and 7) This results of the technical evaluation are included in Appendix B.

This technical evaluation shows that a NR 500 MSW composite liner with a 4-foot thick clay soil component, does not provide more protection of groundwater than the alternative liner designs selected for this comparison. An alternative composite liner with a 2-foot thick compacted clay soil component can perform better than a NR 500 liner when designed and constructed properly. The addition of a geosynthetic liner to the RSRA/Federal Subtitle D minimum requirements, as proposed for the Seven Mile Landfill expansion, performs better than currently required by NR 500 regulations and Federal regulations.

Beyond the comparison of the performance between the liner cross sections, WDNR should also take into consideration several other factors that have enhanced the effectiveness of the liner system since the adoption of both NR500 and RCRA/Federal Subtitle D. These enhancements have significantly increased the degree of confidence regarding the protectiveness of the liner system to groundwater. These enhancements include:

- Liner designs that have adopted manufacturing of geosynthetics that are superior to the products produced at the time of adoption of the current regulations. This is supported through the results of conformance testing conducted on the materials prior to delivery to the construction site.
- Improvements in installation of geosynthetic materials including deployment, welding technology, and construction quality assurance testing. This is supported through results of testing of samples obtained from liner construction projects. The failure rate of destruct samples has dramatically declined over the last 30 years.
- Design and documentation standards for landfills are now measured in 100/s of inches, and GPS guided construction equipment allow much greater precision in liner construction resulting in better liners than were previously possible.
- Addition of Electrical Resistivity testing prior to initial waste placement over newly constructed liners. Electrical Resistivity testing has provided the opportunity to conduct construction quality assurance testing following the installation of the granular drainage layer.

4.0 LINER EVALUATIONS AND COMPARISONS

4.1 PROPOSED ALTERNATE NR 500 LINER SYSTEMS

Four alternative composite liner designs and a NR 500 liner design were analyzed for overall impacts. The NR 500 and alternate liner designs were evaluated for their environmental impacts (including impacts at the clay borrow area), economic impacts, logistics, and sociological impacts. This analysis was done to determine the most practicable composite liner and leachate collection system design meeting or exceeding the performance requirements of Subtitle D regulations while minimizing overall impacts associated with the construction and performance of the liner system. This analysis is discussed below and shown on Table 2. The economic comparison of the liners evaluated is included on Table 3

Based on the Technical evaluation of liner performance and overall impacts, Alternate composite liner 2 is the preferred liner design for the proposed expansion at Seven Mile Landfill. Alternate composite liner 2 protects groundwater resources better than a NR500 composite liner and reduces other impacts by nearly 50% when compared to a composite liner with 4-feet of compacted clay.

The four alternate composite liner and leachate collection system design that were considered include the following and are shown in cross section on Figure 7, Liner components are listed from bottom to top. All liners include a 1-foot thick $1x10^0$ granular drainage layer:

- **NR 500 Composite Liner**:

4-foot-thick recompacted clay liner, 60- mil HDPE geomembrane, geotextile cushion fabric, gravel drainage layer with leachate collection pipes sloped at greater than 0.5%, and base grades sloped at greater than 2%

- **Alternate Composite Liner 1, Subtitle D**:

2-foot-thick recompacted clay soil liner, 60-mil HDPE geomembrane, geotextile cushion fabric, gravel drainage layer and base grade sloped at greater than 2%

- **Alternate Composite Liner 2, Proposed Seven Mile Expansion:**

2-foot thick recompacted clay liner, geosynthetic clay liner (GCL), 60-mil HDPE geomembrane, geotextile cushion fabric, gravel drainage layer and base grade sloped at greater than 2%

- **Alternate Composite Liner 3, Geosynthetic Only**:

Geosynthetic Clay Liner (GCL), Secondary 60-mil HDPE geomembrane, HDPE geonet drainage layer, Primary 60-mil HDPE geomembrane, geotextile cushion fabric, gravel drainage layer, and base grades sloped at greater than 2%

- **Alternate Composite Liner 4, Hybrid NR 500 / Subtitle D**:

2-foot-thick recompacted clay liner throughout the base grades increased to a 4-foot-thick clay liner at the leachate collection sumps, 60- mil HDPE geomembrane, geotextile cushion fabric, and base grades sloped at greater than 2%

4.2 ENVIRONMENTAL ASSESSMENT

Under NR 504.06 Wisconsin landfills are required to be design and constructed with four (4) feet of recompacted clay for the soil component of the composite liner system. Federal regulations for subtitle D landfills require only two (2) feet of recompacted clay for the soil component of the composite liner system. Based on previous studies performed on composite liners as well as the evaluations done for this technical paper there is no benefit in preventing contaminant leakage through a liner by adding 2 feet of additional recompacted clay over Subtitle D requirements. The volume of clay soil required to construct the additional 2-feet of the recompacted clay component of the NR 500 composite liner poses significant problems where clay soil reserves of suitable quality are limited or simply not available while providing little to no additional protection in preventing leachate leakage through the composite liner.

Our evaluation indicates that soil required for the clay component of the composite liner sourced from off-site borrow areas can result in more environmental impacts than the additional 2-foot soil thickness of the clay liner provides in protection to the environment. Quite frankly, the evaluation found that the more clay soil that is needed for liner construction the greater the impacts to the environment.

In order to obtain the soil required to construct the additional 2-foot thickness of the clay component the larger the land area of the borrow source that will be disturbed. It is not uncommon to find clay soil reserves on property that has an abundance of wetlands and other sensitive ecosystems as these soils perch surface water. For every acre of liner constructed, the volume of clay soil required to create this additional two feet of thickness represents approximately 3,200 cubic yards of clay soil. Under current NR 500 requirements a 10-acre liner construction project requires 64,000 cubic yards of clay. This additional two feet of clay equates to 32,000 cubic yards of soil greater than the RCRA/Federal Subtitle D requirement as well as the Alternative Composite Liner cross section evaluated herein. On borrow properties where the geology indicates a limited thickness of soil meeting liner geotechnical quality requirements this could require the disturbance and impact to an additional 5 acres or more of property. These impacts include the potential disturbance of wetlands, agricultural property, and wildlife habitat.

The transportation of an additional 32,000 cubic yards of clay soil for a 10-acre liner construction project, would require an additional 2,600 truckloads traveling to and from the borrow property to the landfill. At Seven Mile landfill for example, the hauling of 32,000 cubic yards of additional clay soil results in the combustion of 78,000 gallons of diesel fuel and the emission of 1,754,000 pounds of CO^2 to the atmosphere. The impacts to neighborhoods and communities that these trucks travel through to access the landfill include noise, exhaust emissions, and the production of greenhouse gases.

Direct impacts on a borrow area to construct a 40-acre landfill liner comprised of a 2-foot, and a 4-foot clay liner are shown on Figure 8. This simple figure shows the area disturbed to construct a 4-foot clay liner will be approximately 25% larger than required to construct a landfill with a 2-foot clay liner.

As shown in Table 2, the NR 500 liner with 4 feet of compacted clay has the overall largest environmental impact of all the liners evaluated.

4.3 SOCIAL ASSESSMENT

The evaluation also included an assessment of the social impacts that are attributed to the requirement of the additional 2 feet of soil for the clay component of the composite liner system. The hauling of the additional clay soil to meet the requirements of NR500 composite liner system design have a significant impact on a community where the borrow property is located as well as the residents of the communities throughout the haul route and the owners of the properties surrounding the landfill. Residents in these communities become frustrated with not only the landfill owner but also the contractor engaged to build the liner. Albeit short term, the acute impacts of the intense hauling activities associated with these liner construction projects creates a level of frustration and stress that are regularly voiced to landfill management, community leaders and Department of Natural Resources staff. Complaints are frequently voiced during siting and standing committee meetings, local governmental meetings, and public comment periods during the permitting process. Typical concerns and complaints raised by residents include;

- Clay falling from trucks
- Speeding of trucks,
- Noise from trucks

- Vibration in homes from trucks
- Increased traffic
- Damage to roads from trucks

This doesn't even take into consideration the increased possibility of a traffic accident that could tragically result in the loss of life. These complaints can be real or imagined and it is not uncommon for the complaints to continue well after the clay hauling activity is complete. Although the social impacts to a community from hauling clay activities can be mitigated through the reduction in the amount of clay required for the construction of the landfill liner they will not be eliminated. Although it must be acknowledged that composite liner systems comprised of additional layers of geosynthetic materials would still require transportation of geosynthetic materials it would only require several truckloads as compared to the hundreds of truckloads that would be involved in the hauling of clay soils. A reduction in the required clay thickness would also reduce the timeframe associated when comparing the time required for construction several weeks as opposed to a few months. Reducing the requirement of the compacted clay component of the composite liner system from four feet thick to- two feet thick would reduce overall impacts from clay hauling to communities by 50%.

4.4 ECONOMIC ASSESSMENT

In general, the cost for the construction for the geosynthetic components of a composite liner system consists of the following:

- Procurement of the material
- Labor and equipment costs for the installation

For the recompacted clay soil component of a composite liner system the cost structure generally consists of the following:

- Borrow property site preparation (surface water management, stripping of topsoil, restoration)
- Loading and hauling of the soil from the Borrow Property (either onsite or offsite)
- Placement of the clay (rough grading to achieve the maximum loose lift necessary for thorough compaction, moisture condition as necessary – drying or wetting – to achieve optimum moisture content)
- Finished grading to provide a uniform graded, contoured surface for the placement of the geosynthetic components of the composite liner system.

The economic analysis performed as part of this evaluation compared the NR 500 composite liner design consisting of the 4-foot recompacted clay soil component and 60 mil HDPE geomembrane component to the alternate liner designs including the proposed design (Alternate 3) for the proposed expansion at Seven Mile Landfill.

The analysis indicates that the costs of the recompacted clay liner is much greater per acre than all alternatives without providing additional environmental protection. The costs significantly increase as the haul distance from an offsite borrow property increases. The analysis did not take into consideration the costs and fees associated with borrow property acquisition or the purchase price of the clay soil from borrow properties not owned by the landfill. The analysis also did not consider the costs of permitting and costs to mitigate borrow property conditions, i.e. streams, wetlands, etc. These economic impacts are ultimately factored into the costs of disposal for residential, commercial, and special waste.

Table 3 provides a breakdown on the liner construction costs on a per acre basis. This table only takes into consideration the costs of the containment components of the composite liner system. Costs for the leachate collection system are not included as those do not differ between the NR 500 required design and the alternate composite liner design proposed for exemption. Cost summarized in Table 3 have been obtained from construction projects completed in 2018 and those under contract for 2019. As indicated in Table 3 the cost of the additional 2-feet of compacted clay thickness over a 40 acres landfill footprint would equal or exceed $4,803,851. This cost is ultimately passed on to the residents and businesses of the State of Wisconsin.

4.5 LOGISTICAL ASSESSMENT

The logistics associated with the required NR500 composite liner design and the alternate composite liner design evaluated is a function of the volume of clay soil needed and the distance the clay soil borrow property is from the

landfill liner construction site. As the clay volume for a given project increases the effort needed to coordinate all aspects of finding suitable clay soil sources, clay soil testing, permitting, clay soil hauling, placement, compaction testing and borrow site restoration increases. It is not uncommon for the clay component of the composite liner design required by NR 500 to be constructed with clay soils obtained from multiple borrow properties. The additional complexity associated with the different soil testing (Proctor) requirements result in complicated construction documentation process.

The time needed to place, compact and test 4-feet of recompacted clay soil as compared to 2-feet of recompacted clay soil is a critical issue in Wisconsin where the construction season is relatively short as compared to other areas with a more moderate climate. The extended duration to complete the construction of the 4-foot component of the clay liner system has resulted in delays to the precipitation events that would not occur if the clay component was limited to a 2-foot thickness. In the past decade alone construction delays encountered during the placement of clay liner soil have occurred due to more frequent and significant greater rainfall events. The delays have resulted in extending these projects into late October and November when placing clay soil and deployment of geosynthetics are more difficult due to the lower average daily temperatures and shorter daylight hours that inhibit effective moisture conditioning necessary to meet optimal compaction requirements. This can result in the clay components of liners being exposed to freezing conditions requiring retesting in the next spring. This testing often requires cutting through geomembranes to confirm and the recertification of clay soil permeability. The alternate composite liner composed of the 2-feet of clay soil would reduce the potential of the clay soil component being exposed to freezing conditions.

4.6 DESIGN, CONSTRUCTION, OPERATING AND LONG-TERM CARE ASSESSMENT

In comparing the long-term performance of the required NR500 composite liner design to the alternate composite liner design there is no evidence to suggests that the alternate composite liner design would fail to perform adequately during the operating life and long-term care period for the landfill. A combination of geosynthetic materials and soil liners is expected to provide the best protection when exposed to a variety of chemical compounds found in leachate. over this extended period of 100’’s of years.

5.0 CONCLUSION AND RECOMMENDATIONS

The State of Wisconsin has been the regulatory authority over the disposal of solid waste materials for over 50 years. During this period, solid waste went from being managed in small town dumps to large regional engineered landfills that have stringent design, construction, operational, and long-term care requirements. We believe that the level of effort and care in how Wisconsin manages solid waste needs to continue to evolve and embrace alternative methods and designs for these disposal facilities if they provide overall better environmental protection and benefits. The WDNR has the capacity and ability to approve alternative MSW composite liner designs from the current prescriptive requirements of NR 500 regulations. The information provided in this technical paper clearly indicates that there are alternative composite liner system designs that are more practicable and as protective to the groundwater while having less overall impact on the environment.

Given this ability to approved alternative composite liner system designs we request WDNR engineers, scientists and senior management to adopt the Alternate Composite Liner design proposed for exemption herein. NR 500 provides WDNR management to approve an alternative composite liner system design during the permitting process or as a Plan Modification for an existing MSW landfill. In addition, we encourage WDNR to continue the evaluation of alternate composite liner system designs similar to those proposed herein and as new products and designs are developed and research that supports their comparability to that required by NR500 provide exemptions for these alternatives.

TABLES

Table 1 USEPA Region 5 Liner Comparison Summary
Table 2 Liner Impacts Analysis
Table 3 Alternate Liner Cost Comparison

Summary of MSW Liner and Leachate Collection Rules in USEPA Region 5

Advanced Disposal Wisconsin Landfills Liner Evaluation

TETRA TECH

October 2019

State	MSWLandfill Liner Requirement				MSW Landfill Leachate Collection Requirement			
	Rule	Standard	Alternate A	Alternate B	Rule	Standard	Alternate A	Alternate B
MI	R 299.4422	For a Monitorable Unit, Single Composite Liner: 60 mil HDPE geomembrane (either 2' recompacted clay with k $\leq$ 1 x10^{-7} cm/sec or geosynthetic clay liner) over 10' natural soil barrier with k $\leq$ 1 x10^{-7} cm/sec	Double Liner System: secondary composite liner with 60 mil HDPE geomembrane and either 2' recompacted clay with k $\leq$ 1 x10^{-7} cm/sec or geosynthetic clay liner; secondary leachate collection layer; and primary composite liner of 60 mil HDPE geomembrane with either 2' recompacted clay with k $\leq$ 1 x10^{-7} cm/sec or geosynthetic clay liner	A natural soil barrier underlain by an uppermost aquifer that is sufficiently artesian to prevent the vertical migration of contaminants from the site to the uppermost aquifer by advection or dispersion. An owner or operator utilizing such a design shall demonstrate that sufficient controls exist to maintain artesian conditions for that period after closure specified by section 11518 of the act.	R 299.4423	Soil drainage layer 1-foot thick, k $\geq$ 1x10^{-2} cm/sec with protective geosynthetic layer or soil layer 1-foot thick, k $\geq$ 1x10^{-4} cm/sec	Soil drainage layer 1-foot thick, k $\geq$ 1x10^{-3} cm/sec used in conjunction with a geonet or other synthetic drainage material with k $\geq$ 1 cm/sec and a protective geosynthetic layer or soil layer 1-foot thick, k $\geq$ 1x10^{-4} cm/sec	Soil drainage layer 1-foot thick, k $\geq$ 1x10^{-3} cm/sec used in conjunction with a geocomposite drainage layer which serves as both the geonet and protective layer
OH	OAC 3745-27-08 (C)(8)-(10)	Single Composite Liner: 60 mil HDPE geomembrane with 5' recompacted clay with k $\leq$ 1 x10^{-7} cm/sec	Single Composite Liner: 60 mil HDPE geomembrane with 3' recompacted clay with k $\leq$ 1 x10^{-7} cm/sec and overlying geosynthetic clay liner	An alternate thickness, to be no less than one and one-half feet thick, based on the results of the calculations outlined in appendix I of this rule if used in conjunction with a geosynthetic clay liner that meets the specifications in paragraph (D)(9) of this rule.	OAC 3745-27-08 (C)(12)	Soil drainage layer 1-foot thick, k $\geq$ 1x10^{-2} cm/sec	A geosynthetic drainage net with a transmissivity to ensure that the leachate collection system meets the one foot of head of leachate requirement with at least 12 inches of overlying permeable protective material	An alternate material and/or thickness may be used provided that it is demonstrated to the satisfaction of the director or his authorized representative that the material meets the requirements of this paragraph
IN	329 IAC 10-17-2	In areas not located over an aquifer of significance or over an aquifer of significance where at least 10 feet of nonaquifer material : Single Composite Liner: 60 mil HDPE geomembrane with 3 feet of compacted soil with K $\leq$ 1x10^{-7} cm/sec with additional requirements in the vicinity of the sump	In areas located over an aquifer of significance: Two feet of compacted soil with K $\leq$ 1x10^{-6} cm/sec extended up the sideslope at least 2 feet above the highest temporal fluctuation of groundwater; a drainage layer; 3 feet of compacted soil with K $\leq$ 1x10^{-7} cm/sec; and a 60 mil HDPE geomembrane with additional requirements in the vicinity of the sump		329 IAC 10-17-8	Soil drainage layer 1-foot thick, k $\geq$ 1x10^{-2} cm/sec	Geosynthetic drainage material with transmissivity T > 3x10^{-5} m^2/sec using safety factors and considering creep	
MN	Minnesota Pollution Control Agency for Solid Waste 7035.2815 subpart 7	4 feet of natural soil barrier, K $\leq$ 1x10^{-7} cm/sec	Composite liner with 60 mil geomembrane and 2 feet compacted earth liner with k $\leq$ 1 x 10^{-7} cm/sec	A. An alternative liner system design may be used when approved by the commissioner. The commissioner's approval shall be based on the ability of the proposed liner system to control leachate migration, meet performance standards, and protect human health and the environment.	Minnesota Pollution Control Agency for Solid Waste 7035.2815 subpart 7	Soil drainage layer 1-foot thick, k $\geq$ 1x10^{-3} cm/sec	none	none
IL	35 Illinois Administrative Code 811 Subtitle G Section 811.306	5 feet compacted earth liner with k $\leq$ 1 x 10^{-7} cm/sec	Composite liner with 60 mil geomembrane and 3 feet compacted earth liner with k $\leq$ 1 x 10^{-7} cm/sec	Modified liner shall operate in conjunction with a leachate drainage and collection system to achieve equivalent or superior performance to the requirements of this subsection.	35 Illinois Administrative Code 811 Subtitle G Section 811.307	Soil drainage layer 1-foot thick, k $\geq$ 1x10^{-3} cm/sec	none	none
WI	NR 504.06 Minimum design and construction criteria for landfill liners and leachate collection systems.	4 feet of compacted clay, K < 1x10-7 cm/sec with 60 mil geomembrane	No alternate liners allowed to date for MSW waste landfills		NR 504.06 Minimum design and construction criteria for landfill liners and leachate collection systems.	Granular drainage layer 1-foot thick, k $\geq$ 1x10^{-0} cm/sec, minimum 2% base grade slopes, 0.5% leachate collection trench/pipe slopes	none	none

TABLE 2

TETRA TECH

MSW LANDFILL LINER IMPACTS COMPARISON

Advanced Disposal Wisconsin Landfills Liner Evaluation

October 2019

Parameter	WI NR 500 Liner		ALTERNATIVE 1 Subtitle D		ALTERNATIVE 2 Seven Mile Expansion		ALTERNATIVE 3, Geosynthetic		ALTERNATE 4, Hybrid NR 500/Subtitle D	
	NR 500 Liner, 4' clay and 60 mil Membrane, > 2% liner slopes		2' Clay, 60 MIL Membrane, > 2% liner slopes		2' Clay, GCL, 60 MIL Membrane, >2% liner slopes		Dual 60 MIL membrane, GeoNet, GCL, > 2% Liner Slopes		2'clay, 60MIL Membrane, 4' clay at Sumps, >2% Liner Slopes	
Groundwater Protection (Advective Flow)	Current WI Standard, Additional 2-feet of Clay over Federal Regulations, 1-foot of leachate head allowed	*2*	Adequate leak prevention and reduced leachate head on liner	*2*	Adequate leak prevention,	*2*	No clay as a backup to geosynthetics, potential for migration of VOCs	*2*	Adequate leak prevention and reduced leachate head on liner	*2*
Groundwater Protection (Diffusive Flow)	Current WI Standard, Additional 2-feet of Clay over Federal Regulations, 1-foot of leachate head allowed	*3*	Adequate leak prevention and reduced leachate head on liner	*3*	Inhanced leak prevention with addition of GCL	*2*	No clay as a backup to geosynthetics, potential for migration of VOCs through diffusion	*5*	Adequate leak prevention and reduced leachate head on liner	*3*
Impact to Waters of the State	Greatest potential to disturb wetlands due to increased size of Clay borrow areas	*5*	Reduced potential to disturb wetlands at clay borrow areas	*3*	Reduced potential to disturb wetlands at clay borrow areas	*3*	No direct or indirect impact to waters of the state.	*1*	Reduced potential to disturb wetlands at clay borrow areas	*3*
Impact to Properties off Site	Greatest potential to disturb land due to increased size of Clay borrow areas	*5*	Reduced need for borrow areas	*3*	Reduced need for borrow areas	*3*	No borrow areas required	*1*	Reduced need for borrow areas	*3*
Traffic Impacts	Highest Impact, clay hauling through business and residential areas, Significant issue in areas with little to no clay making long clay hauls a necessity.	*5*	Traffic impacts cut in half compared to NR 500 liner	*2*	Traffic impacts cut in half compared to NR 500 liner	*2*	Least Traffic Impacts, geosynthetics delivered on several semi loads	*1*	Traffic impacts reduced compared to NR 500 liner	*3*
Long Term Integrity	Yes	*3*	Yes	*3*	Yes	*3*	Dependent on long term stability of geoynthetics	*4*	Yes	*3*
Permitting - DNR Permits and Subtitle D Regulations	Currently accepted by WDNR and exceeds Federal Regulations	*1*	Variance from NR500 needed, meets Federal regulations	*2*	Variance from NR500 needed, meets Federal regulations	*2*	Variance from NR500 needed, does not meet Federal regulations	*5*	Variance from NR500 needed, meets Federal regulations	*2*
Disposal Capacity Impacts	Lowest volume of landfill disposal capacity of alternatives increases the need for more landfill disposal capacity	*5*	Increased disposal capacity of 145,200 CY for a 40 acre landfill reducing need for more landfills	*3*	Increased disposal capacity of 145,200 CY for a 40 acre landfill reducing the need for more landfills	*3*	Increased disposal capacity of 290,400 CY for a 40 acre landfill reducing the need for more landfills	*1*	Increased disposal capacity of 145,200 CY for a 40 acre landfill reducing the need for more landfills	*3*
Economic Impacts	Additional Clay adds to the cost of constructing liners compared to alternatives. Higher cost of constructing landfills than other USEPA Region 5 States, Significant cost when long clay hauls are required,	*5*	Reduced cost of liner construction compared to NR 500 liner	*3*	Reduced cost of liner construction compared to NR 500 liner, added cost of GCL	*4*	Dual Liner with Leak detection layer.	*2*	Reduced cost of liner construction compared to NR 500 liner	*4*
Logistical Impacts	Hauling, traffic, clay spills, truck emissions, noise impacts, speeding all greatest of options.	*5*	Reduced impacts to surrounding community and reduced coordination during construction of liner	*3*	Reduced impacts to surrounding community	*3*	Fastest construction, least impact on surrounding community	*1*	Reduced impacts to surrounding community and environment	*4*
Design, Construction, Operating and Long Term Care Impacts	Standard construction methods and designs, greatest thickness of clay with most potential for weather related impacts	*3*	Standard construction methods and designs	*2*	Standard construction methods and designs	*2*	Easiest to construct, no clay placement, compaction or testing required, fastest construction time	*1*	Standard construction methods and designs, slightly more complicated design due to variable clay thicknesses	*3*
Practicability / Score	Most Overall Negative Impacts of Liners Evaluated	*42*	Practicable	*29*	Practicable	*29*	Least negative impacts, does not Meet Subtitle D Regulations, Not Practicable	*24*	Practicable	*33*

Impact Rating is a relative ranking (5 = High Impact, 3 = Reduced Impact, 1 = No Impact)

"Practicable Alternatives" defined as: available and capable of being implemented after taking into consideration: environmental, cost, available technology and logistics in light of overall project purposes.

TETRA TECH

TABLE 3
ADVANCED DISPOSAL WISCONSIN LANDFILL LINER EVALUATION

October 2019

MSW LANDFILL LINER COST COMPARISON PER ACRE

Parameter	Price / acre	WI NR 500 Liner 4' clay and 60 mil Membrane, > 2% liner slopes	ALTERNATIVE 1 Subtitle D 2' Clay, 60 MIL Membrane, > 2% liner slopes	ALTERNATIVE 2 Seven Mile Expansion 2' Clay, GCL, 60 MIL Membrane, >2% liner slopes	ALTERNATIVE 3, Geosynthetic Dual 60 MIL Membrane, Geocomposite, GCL, > 2% Liner Slopes	ALTERNATE 4, Hybrid NR 500/Subtitle D 2'clay, 60MIL Membrane, 4' clay at Sumps, >2% Liner Slopes
Clay Liner ($37.22 / CY[1,2]) per 1 ft thickness	$60,048.14	$240,193.07	$120,096.53	$120,096.53	$0.00	$128,919.05
60 mil geomembrane - supply	$14,183.14	$14,183.14	$14,183.14	$14,183.14	$28,366.27	$14,183.14
60 mil geomembrane - install	$4,007.52	$4,007.52	$4,007.52	$4,007.52	$8,015.04	$4,007.52
Geosynthetic Clay Liner (GCL) - material	$11,634.88	$0.00	$0.00	$11,634.88	$11,634.88	$0.00
Geosynthetic Clay Liner (GCL) - install	$3,484.80	$0.00	$0.00	$3,484.80	$3,484.80	$0.00
Geocomposite - material	$23,496.26	$0.00	$0.00	$0.00	$23,496.26	$0.00
Geocomposite - install	$3,484.80	$0.00	$0.00	$0.00	$3,484.80	$0.00
Construction Quality Assurance[3]	varies	$25,838.37	$13,828.72	$15,340.69	$7,848.21	$14,710.97
Cost per Acre		$284,222.09	$152,115.91	$168,747.55	$86,330.26	$161,820.68

MSW LANDFILL LINER COST COMPARISON FOR 40 ACRE LANDFILL

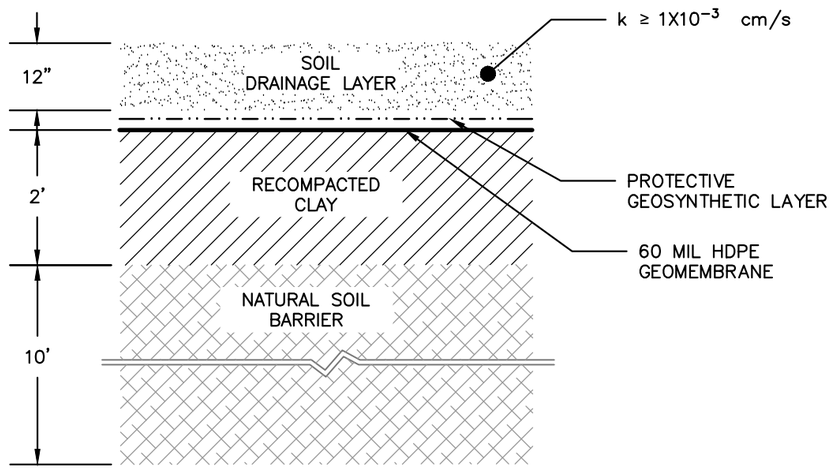
Parameter	Price	WI NR 500 Liner 4' clay and 60 mil Membrane, > 2% liner slopes	ALTERNATIVE 1 Subtitle D 2' Clay, 60 MIL Membrane, > 2% liner slopes	ALTERNATIVE 2 Seven Mile Expansion 2' Clay, GCL, 60 MIL Membrane, >2% liner slopes	ALTERNATIVE 3, Geosynthetic Dual 60 MIL Membrane, Geocomposite, GCL, > 2% Liner Slopes	ALTERNATE 4, Hybrid NR 500/Subtitle D 2'clay, 60MIL Membrane, 4' clay at Sumps, >2.0% Liner Slopes
Clay Liner ($37.22 / CY[1,2]) per 1 ft thickness	$2,401,925.70	$9,607,702.82	$4,803,851.41	$4,803,851.41	$0.00	$5,284,236.55
60 mil geomembrane - supply	$567,325.44	$567,325.44	$567,325.44	$567,325.44	$1,134,650.88	$567,325.44
60 mil geomembrane - install	$160,300.80	$160,300.80	$160,300.80	$160,300.80	$320,601.60	$160,300.80
Geosynthetic Clay Liner (GCL) - material	$465,395.04	$0.00	$0.00	$465,395.04	$465,395.04	$0.00
Geosynthetic Clay Liner (GCL) - install	$139,392.00	$0.00	$0.00	$139,392.00	$139,392.00	$0.00
Geocomposite - material	$939,850.56	$0.00	$0.00	$0.00	$939,850.56	$0.00
Geocomposite - install	$139,392.00	$0.00	$0.00	$0.00	$139,392.00	$0.00
Construction Quality Assurance[3]	varies	$1,033,532.91	$553,147.76	$613,626.47	$313,928.21	$601,186.28
Cost for 40 Acre Landfill Area		$11,368,861.96	$6,084,625.41	$6,749,891.16	$3,453,210.29	$6,613,049.07

Notes:

1. There is approximately 1,613.33 CY in an acre-ft
2. Clay Liner cost includes purchase and transportation costs from off site borrow source approximately 60 miles away from site, then place and compact.
3. Construction Quality Assurance is estimated at 10% of cost of line items under each alternate
4. Other landfill liner components including geotextile cushion, or leachate collection system components are not included in the costs above.
5. Off site borrow sources of suitable liner soils also require site restoration of the off-site borrow sources and additional area depending on the volume of soil required for construction.

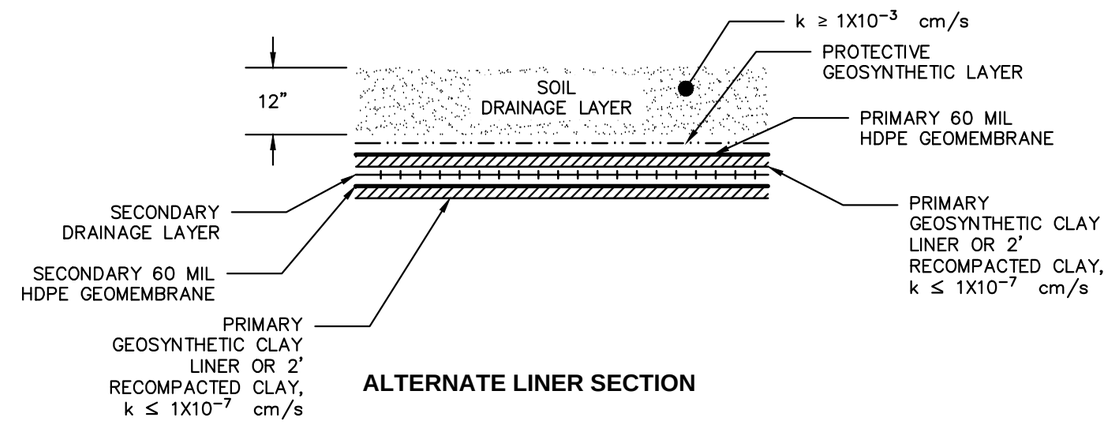
FIGURES

Figure 1	Liner Details Michigan
Figure 2	Liner Details Ohio
Figure 3	Liner Details Indiana
Figure 4	Liner Details Minnesota
Figure 5	Liner Details Illinois
Figure 6	Liner Details Wisconsin
Figure 7	Landfill Liner Alternatives
Figure 8	Borrow Area Impacts



STANDARD LINER SECTION

DETAIL 1/1
SCALE: NOT TO SCALE



ALTERNATE LINER SECTION

DETAIL 2/1
SCALE: NOT TO SCALE

This drawing represents intellectual property of Tetra Tech. Any modification to the original by other than Tetra Tech personnel violates its original purpose and as such is rendered void. Tetra Tech will not be held liable for any changes made to this document without express written consent of the originator.

TETRA TECH

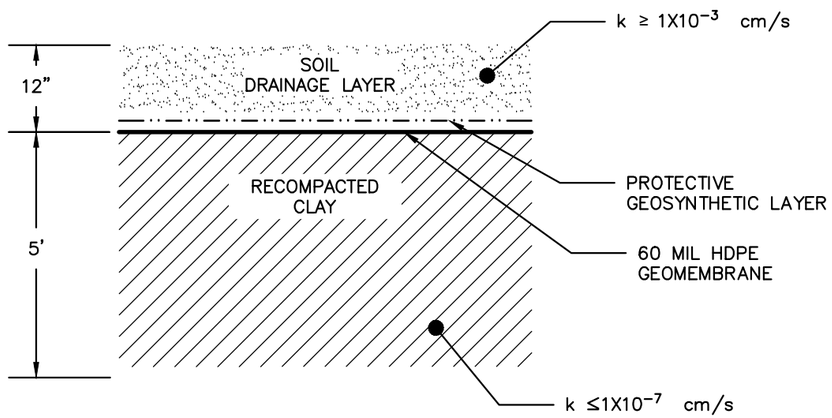
ALL PROFESSIONAL ENGINEERING WORK IS PERFORMED BY DULY LICENSED PROFESSIONAL ENGINEERS UNDER THE APPROPRIATE STATE REGISTERED PROFESSIONAL ENTITY.

MUNICIPAL SOLID WASTE
LINER ALTERNATIVES

LINER DETAILS
MICHIGAN

FIGURE NO.
1
PROJECT NO.

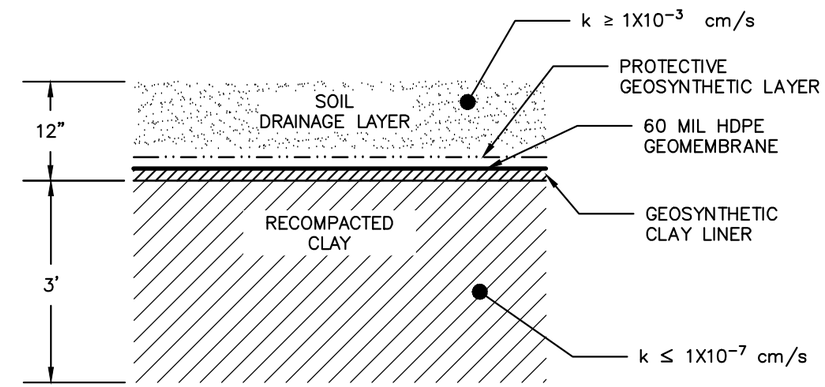
File: X:\PROJECTS\BD\STATE LINER DETAILS\LINER DETAILS.dwg Layout: MI 11x17 User: SCOTT.WILSON Oct 16, 2019 - 1:06pm



STANDARD LINER SECTION

DETAIL 1/2

SCALE: NOT TO SCALE



ALTERNATE LINER SECTION

DETAIL 2/2

SCALE: NOT TO SCALE

This drawing represents intellectual property of Tetra Tech. Any modification to the original by other than Tetra Tech personnel violates its original purpose and as such is rendered void. Tetra Tech will not be held liable for any changes made to this document without express written consent of the originator.

TETRA TECH

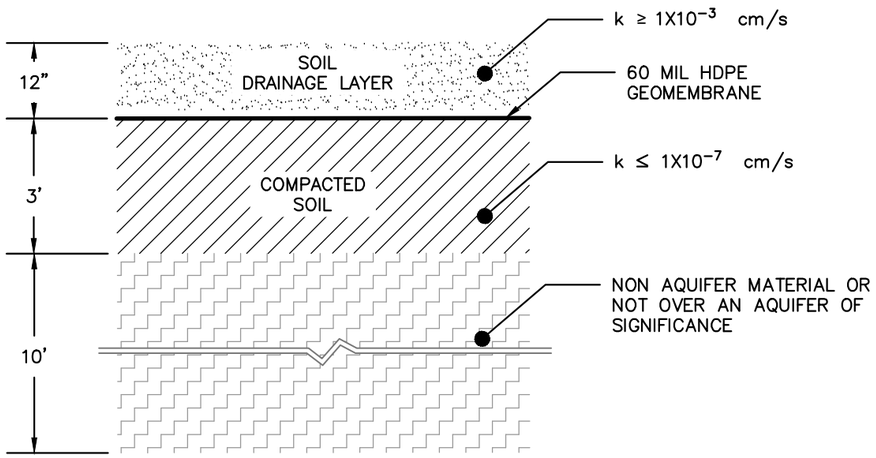
ALL PROFESSIONAL ENGINEERING WORK IS PERFORMED BY DULY LICENSED PROFESSIONAL ENGINEERS UNDER THE APPROPRIATE STATE REGISTERED PROFESSIONAL ENTITY.

MUNICIPAL SOLID WASTE
LINER ALTERNATIVES

LINER DETAILS
OHIO

FIGURE NO.
2
PROJECT NO.

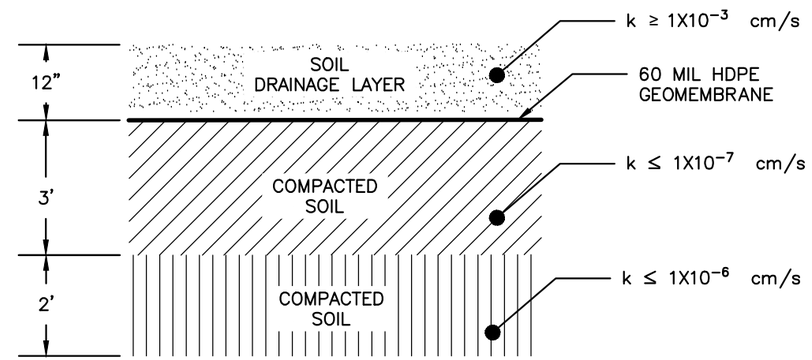
File: X:\PROJECTS\BD\STATE LINER DETAILS\LINER DETAILS.dwg Layout: OH 11X17 User: SCOTT.WILSON Oct 16, 2019 - 1:06pm



STANDARD LINER SECTION

DETAIL 1/3

SCALE: NOT TO SCALE



ALTERNATE LINER SECTION

DETAIL 2/3

SCALE: NOT TO SCALE

This drawing represents intellectual property of Tetra Tech. Any modification to the original by other than Tetra Tech personnel violates its original purpose and as such is rendered void. Tetra Tech will not be held liable for any changes made to this document without express written consent of the originator.

TETRA TECH

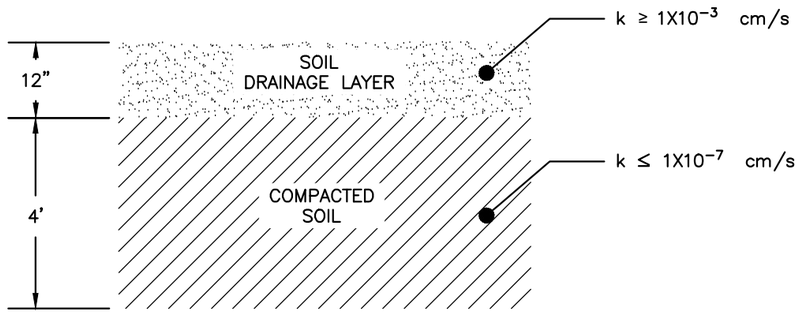
ALL PROFESSIONAL ENGINEERING WORK IS PERFORMED BY DULY LICENSED PROFESSIONAL ENGINEERS UNDER THE APPROPRIATE STATE REGISTERED PROFESSIONAL ENTITY.

MUNICIPAL SOLID WASTE
LINER ALTERNATIVES

LINER DETAILS
INDIANA

FIGURE NO.
3
PROJECT NO.

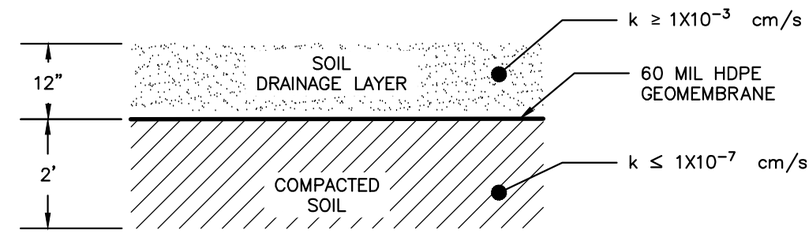
File: X:\PROJECTS\BD\STATE LINER DETAILS\LINER DETAILS.dwg Layout: IN 11X17 User: SCOTT.WILSON Oct 16, 2019 – 1:07pm



STANDARD LINER SECTION

DETAIL 1/4

SCALE: NOT TO SCALE



ALTERNATE LINER SECTION

DETAIL 2/4

SCALE: NOT TO SCALE

This drawing represents intellectual property of Tetra Tech. Any modification to the original by other than Tetra Tech personnel violates its original purpose and as such is rendered void. Tetra Tech will not be held liable for any changes made to this document without express written consent of the originator.

TETRA TECH

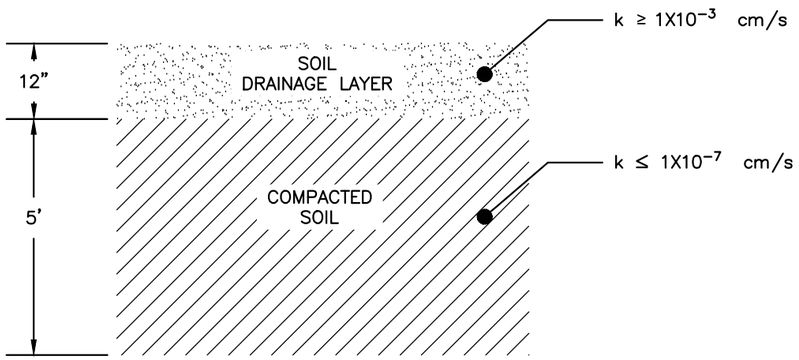
ALL PROFESSIONAL ENGINEERING WORK IS PERFORMED BY DULY LICENSED PROFESSIONAL ENGINEERS UNDER THE APPROPRIATE STATE REGISTERED PROFESSIONAL ENTITY.

MUNICIPAL SOLID WASTE
LINER ALTERNATIVES

LINER DETAILS
MINNESOTA

FIGURE NO.
4
PROJECT NO.

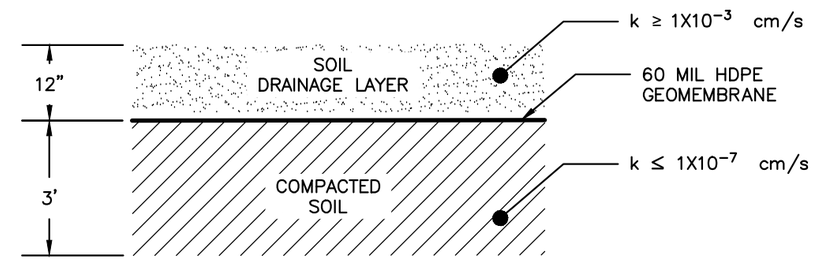
File: X:\PROJECTS\BD\STATE LINER DETAILS\LINER DETAILS.dwg Layout: MN 11X17 User: SCOTT.WILSON Oct 16, 2019 – 1:07pm



STANDARD LINER SECTION

DETAIL 1/5

SCALE: NOT TO SCALE



ALTERNATE LINER SECTION

DETAIL 2/5

SCALE: NOT TO SCALE

This drawing represents intellectual property of Tetra Tech. Any modification to the original by other than Tetra Tech personnel violates its original purpose and as such is rendered void. Tetra Tech will not be held liable for any changes made to this document without express written consent of the originator.

TETRA TECH

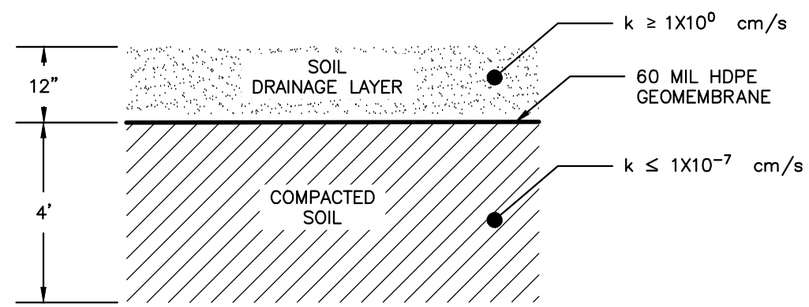
ALL PROFESSIONAL ENGINEERING WORK IS PERFORMED BY DULY LICENSED PROFESSIONAL ENGINEERS UNDER THE APPROPRIATE STATE REGISTERED PROFESSIONAL ENTITY.

MUNICIPAL SOLID WASTE
LINER ALTERNATIVES

LINER DETAILS
ILLINOIS

FIGURE NO.
5
PROJECT NO.

File: X:\PROJECTS\BD\STATE LINER DETAILS\LINER DETAILS.dwg Layout: IL 11X17 User: SCOTT.WILSON Oct 16, 2019 - 1:07pm



NR 500 LINER SECTION

DETAIL

SCALE: NOT TO SCALE

1
6

This drawing represents intellectual property of Tetra Tech. Any modification to the original by other than Tetra Tech personnel violates its original purpose and as such is rendered void. Tetra Tech will not be held liable for any changes made to this document without express written consent of the originator.

TETRA TECH

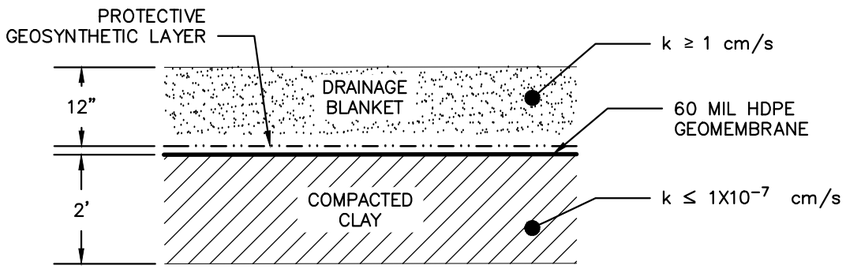
ALL PROFESSIONAL ENGINEERING WORK IS PERFORMED BY DULY LICENSED PROFESSIONAL ENGINEERS UNDER THE APPROPRIATE STATE REGISTERED PROFESSIONAL ENTITY.

MUNICIPAL SOLID WASTE
LINER ALTERNATIVES

LINER DETAILS
WISCONSIN

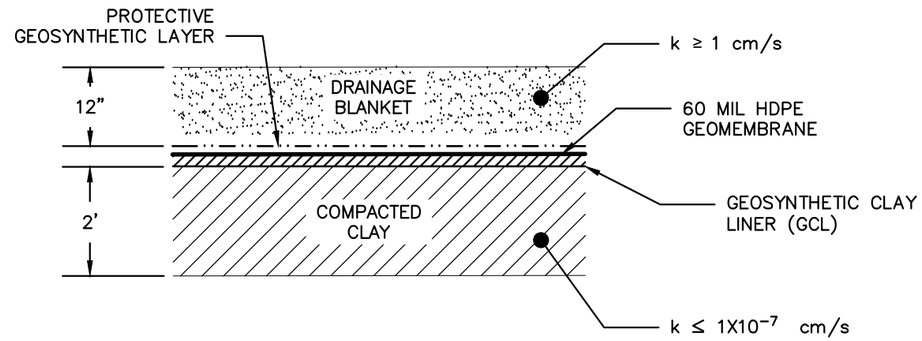
FIGURE NO.
6
PROJECT NO.

File: X:\PROJECTS\BD\STATE LINER DETAILS\LINER DETAILS.dwg Layout: WI 11X17 User: SCOTT.WILSON Oct 16, 2019 – 1:07pm



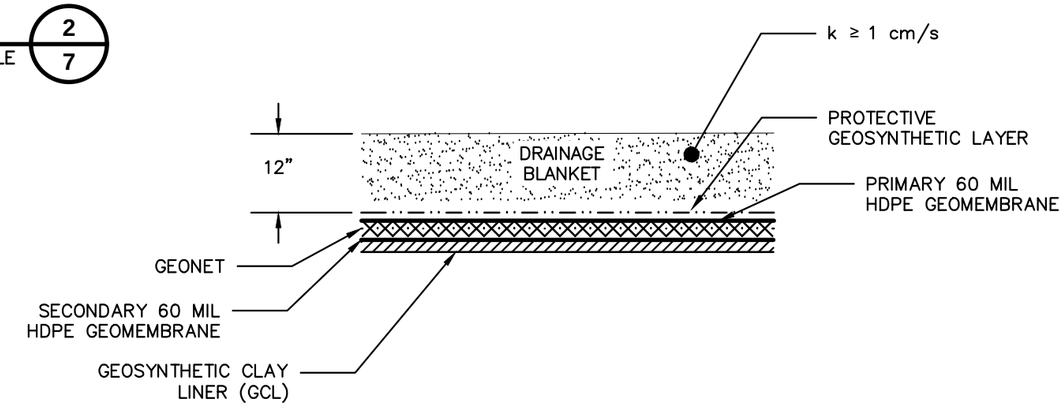
ALTERNATIVE 1
(Subtitle D)

DETAIL 1/7
SCALE: NOT TO SCALE



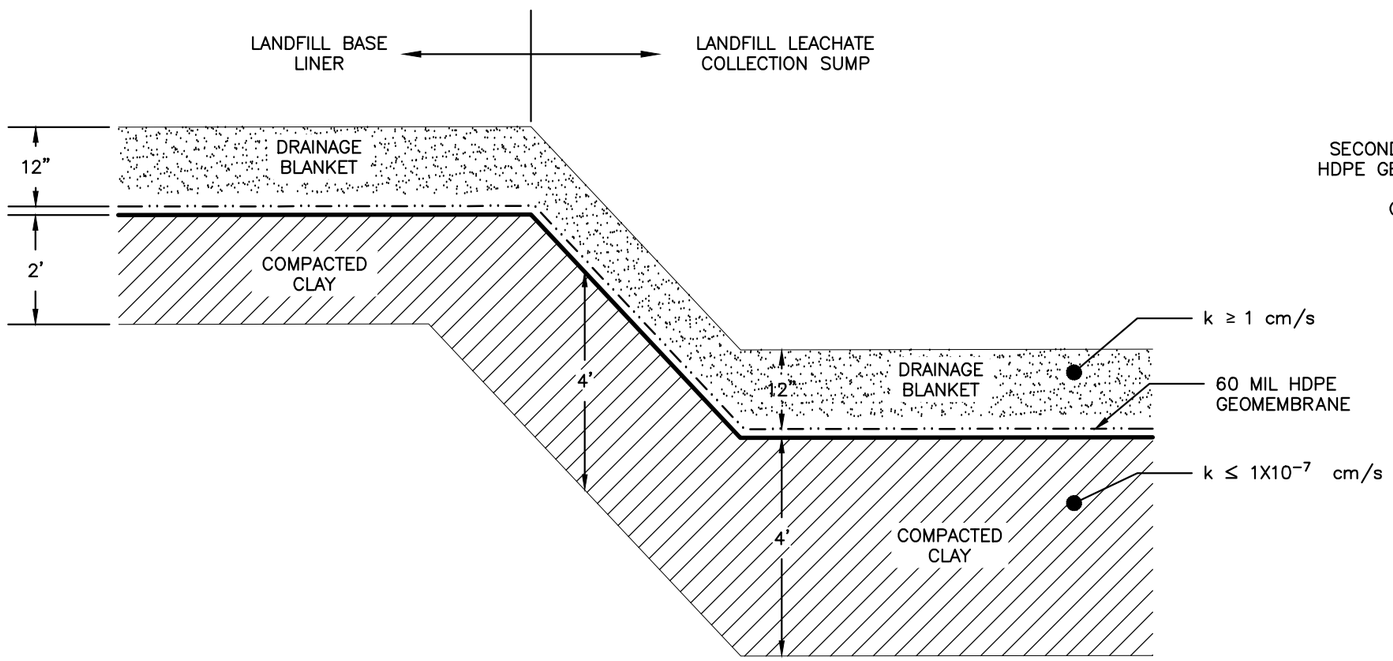
ALTERNATIVE 2
(Proposed Seven Mile Expansion)

DETAIL 2/7
SCALE: NOT TO SCALE



ALTERNATIVE 3
(Geosynthetic Only)

DETAIL 3/7
SCALE: NOT TO SCALE



ALTERNATIVE 4
(Hybrid NR500/Subtitle D)

DETAIL 4/7
SCALE: NOT TO SCALE

This drawing represents intellectual property of Tetra Tech. Any modification to the original by other than Tetra Tech personnel violates its original purpose and as such is rendered void. Tetra Tech will not be held liable for any changes made to this document without express written consent of the originator.

TETRA TECH

ALL PROFESSIONAL ENGINEERING WORK IS PERFORMED BY DULY LICENSED PROFESSIONAL ENGINEERS UNDER THE APPROPRIATE STATE REGISTERED PROFESSIONAL ENTITY.

MUNICIPAL SOLID WASTE
LINER ALTERNATIVES

LINER DETAILS
LANDFILL LINER ALTERNATIVES

FIGURE NO.
7
PROJECT NO.

File: M:\PROJECTS\BD\STATE LINER DETAILS\LINER DETAILS.dwg Layout: ALT 11X17 User: SCOTT.WILSON Oct 22, 2019 – 10:27am

APPENDIX A

APPLICABLE REGULATIONS

- **WI NR 180**
- **WI NR 504**
- **USEPA Subtitle D**

Chapter NR 180

SOLID WASTE MANAGEMENT

NR 180.01 Purpose (p. 685)
NR 180.02 Applicability (p. 685)
NR 180.03 Severability (p. 686)
NR 180.04 Definitions (p. 686)
NR 180.05 Fees (p. 686-6)
NR 180.06 General submittal requirements (p. 686-9)
NR 180.07 Storage sites and facilities (p. 686-10)
NR 180.08 Collection and transportation service requirements (p. 686-13)
NR 180.09 Transfer facilities (p. 686-15)
NR 180.10 Processing facilities (p. 686-19)
NR 180.11 Incinerators (p. 686-26)
NR 180.12 Air curtain destructors (p. 686-29)
NR 180.13 Land disposal sites and facilities (p. 686-31)
NR 180.14 Land spreading sites and facilities (p. 686-51)
NR 180.15 Long-term care (p. 686-58)
NR 180.16 Waste management fund (p. 686-63)
NR 180.17 Salvage yards (p. 686-64)
NR 180.18 Other (p. 686-66)
NR 180.19 Environmental impact (p. 686-67)
NR 180.20 Exemptions (p. 686-67)

NR 180.01 Purpose. The purpose of these rules is to help ensure that efficient, nuisance-free, and environmentally acceptable solid waste management procedures are practiced in Wisconsin. The rules are adopted pursuant to ss. 144.01, 144.025, 144.04, 144.045, 144.26, 144.54, and 227.014, Stats. (1977), ss. 144.43 to 144.47, Stats., (as affected or created by ch. 34, laws of 1979) and s. 26, ch. 377, laws of 1977.

History: Cr. Register, February, 1980, No. 290, eff. 3-1-80.

NR 180.02 Applicability. (1) These rules govern all solid waste disposal sites and facilities as defined by s. 144.43 (5), Stats. (as created by ch. 34, laws of 1979), except hazardous waste sites and facilities and except that metallic mining operations as defined in s. 144.81 (5), Stats., not licensed by the department and not mining prior to June 3, 1978, shall be exempt from the provisions of this chapter until May 21, 1980. These rules shall be applicable to all metallic mining operations after May 20, 1980 if the department has not adopted specific rules for the identification and regulation of metallic mining wastes pursuant to s. 144.43 (lm), Stats., by that date. When the department adopts rules pursuant to s. 144.43 (lm), Stats., the rules shall be applicable to metallic prospecting and mining operations in this state to the exclusion of this chapter except where this chapter or portions thereof are specifically adopted under s. 144.43 (lm), Stats. If prior to May 21, 1980, an application to mine is submitted, this chapter shall be applicable to that application until this chapter is superceded by rules adopted pursuant to s. 144.43 (lm), Stats.

(2) The provisions of this chapter are not applicable to the design, construction or operation of industrial wastewater facilities, sewerage systems and waterworks treating liquid wastes approved under s. 144.04, Stats., and/or permitted under ch. 147, Stats., nor to sites used solely for the disposal of liquid municipal or industrial wastes which have been approved under s. 144.04, Stats., and/or permitted under ch. 147, Stats., except for sites used for the ultimate disposal of solid waste.

Note: Pursuant to s. 26, ch. 377, laws of 1977, sites and facilities utilized for the storage, transportation, treatment and disposal of hazardous wastes are regulated by the toxic and

hazardous waste provisions in chapter NR 151, Wis. Adm. Code, until hazardous waste rules are adopted pursuant to ch. 377, laws of 1977.

History: Cr. Register, February, 1980, No. 290, eff. 3-1-80.

NR 180.03 Severability. Should any section, paragraph, phrase, sentence or clause of this chapter be declared invalid or unconstitutional for any reason, the remainder of this chapter shall not be affected thereby.

History: Cr. Register, February, 1980, No. 290, eff. 3-1-80.

NR 180.04 Definitions. The following special definitions are applicable to the terms used in this chapter:

(1) "Air curtain destructor" means a solid waste processing facility that combines a fixed wall, open pit and mechanical air supply which uses an excess of oxygen and turbulance to accomplish the smokeless combustion of clean wood wastes and similar combustible materials.

(2) "Bird hazard" means an increase in the likelihood of bird/aircraft collisions that may cause damage to the aircraft or injury to its occupants.

(3) "Closure" means those actions taken by the owner or operator of a solid waste site or facility to prepare the site for long-term care and to make it suitable for other uses.

(4) "Closure plan" means a written report and supplemental engineering plans detailing those actions that will be taken by the owner or operator to effect proper closure of a solid waste disposal site or facility.

(5) "Closing" means the time at which a solid waste disposal site or facility ceases to accept wastes, and includes those actions taken by the owner or operator of the facility to prepare the site for any required long-term care and make it suitable for other uses.

(6) "COD" means chemical oxygen demand.

(7) "Collection and transportation service" means a solid waste disposal operation which utilizes containers, vehicles or other means for the collection and transportation of solid waste.

(8) "Completeness" means a determination by the department that the minimum submittal requirements as established by this chapter for a plan or report have been met.

(9) "Construct" means to engage in a program of on-site construction, including but not limited to site clearing, grading, dredging or landfilling.

(10) "Construction observation report" means a written report submitted under the seal of a registered professional engineer advising that a solid waste disposal site or facility has been constructed in substantial compliance with a department approved plan of operation.

(11) "Containerized storage site or facility" means a mechanical or nonmechanical storage container, site or facility designed and operated for storage and containment of solid waste.

(12) "Critical habitat areas" mean any habitat determined by the department to be critical to the continued existence of any endangered species listed in chapter NR 27, Wis. Adm. Code.

(13) "Demolition material" means solid waste resulting from the demolition or razing of buildings, roads and other man-made structures. Demolition material typically consists of concrete, bricks, bituminous concrete, wood, masonry and plaster, alone or in combinations.

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

(15) "Design capacity" means the total volume in cubic yards of solid waste to be disposed of in a land disposal site or facility including the volume of daily and intermediate cover utilized in the facility, but not including final cover or topsoil.

(16) "Detrimental effect on ground or surface water" means having a significant damaging impact on ground or surface water quality for any present or future consumptive or nonconsumptive uses.

(17) "Discarded material" means material that is no longer of use to the generator of the material in the process from which it was generated.

(18) "Disposal" means the discharge, deposit, injection, dumping, or placing of any solid waste into or on any land or water so that such solid waste or any constituent thereof may enter the environment or be emitted into the air or discharged into any waters, including groundwaters.

(19) "Dredge material" means any earth material removed from the bed of any surface water.

(20) "Establish" means to bring a solid waste disposal site or facility into existence.

(21) "Expand an existing site or facility" means to dispose of solid waste on land not previously licensed, to dispose of solid waste not in accordance with a department issued plan approval, if one exists, or to dispose of solid waste in a manner significantly different from past operations.

(22) "Feasibility report" means a report for a specific solid waste disposal site or facility that describes the site, surrounding area, and proposed operation in terms of land use, topography, soils, geology, groundwater, surface water, proposed waste quantities and characteristics, and preliminary site or facility design concepts.

(23) "Fill area" means the area proposed to receive or which is receiving direct application of solid waste.

(24) "Floodplain" means the land which has been or may be hereafter covered by flood water during the regional flood as defined in chapter NR 116, Wis. Adm. Code, and includes the floodway and the flood fringe as defined in chapter NR 116, Wis. Adm. Code.

(25) "Food chain crops" means tobacco, crops grown for human consumption, and pasture, forage and feed grain for animals whose products are consumed by humans.

(26) "Garbage" means discarded materials resulting from the handling, processing, storage and consumption of food.

(27) "Hazardous waste" means any solid waste identified by the department as hazardous pursuant to criteria promulgated by the department. Under s. 144.62 (2) (a), Stats., the department criteria will be identical to the criteria promulgated by the United States environmental protection agency under s. 3001 (b) of the Resource Conservation and Recovery Act of 1976, P.L. 94-580.

(28) "Incinerator" means a solid waste facility designed and operated for controlled burning of solid wastes primarily to achieve volume and weight reduction and/or to change waste characteristics. Facilities which use solid waste as a supplemental fuel where less than 30 percent of the heat input to the facility is derived from such supplemental fuel are not classified as incinerators under this chapter.

(29) "Land disposal site or facility" means a solid waste disposal site or facility where solid waste is placed on land in a land spreading facility, a landfill, or surface impoundment facility for disposal purposes.

(30) "Landfill" means a solid waste land disposal site or facility, not classified as a landspreading facility or a surface impoundment facility, where solid waste is disposed on land without creating nuisances or hazards to public health or safety, by utilizing the principles of engineering to confine the solid waste to the smallest practical area, to reduce it to the smallest practical volume, and to cover it with a layer of earth at such intervals as may be necessary.

(31) "Landspreading facility" means a solid waste disposal facility where solid wastes are discharged, deposited, placed or injected in thin layers onto the land surface of the facility, or are incorporated into the top several feet of the surface soil, for agricultural, silvicultural and/or waste disposal purposes.

(32) "Leachate" means water or other liquid that has been contaminated by dissolved or suspended materials due to contact with solid waste or gases therefrom.

(33) "Long-term care" means the routine care, maintenance and monitoring of a solid waste land disposal facility following the closing of the facility.

(34) "Mining waste" means all waste soil, rock, mineral, liquid, vegetation and other material, directly resulting from or displaced by the prospecting or mining, and from the cleaning or preparation of minerals during prospecting or mining operations.

(35) "Municipal solid waste" means solid waste primarily generated by residential activities but may include minor amounts of commercial and industrial wastes that are in the total waste stream and are not hazardous.

(36) "Noncombustible materials" means solid waste which will not support combustion in the ambient atmosphere.

(37) "Noncontainerized storage site or facility" means a site or facility designed and operated for storage of solid waste, generally in volumes too large for containerized storage.

(38) "One-time disposal" means the disposal of small volumes of limited types of industrial, agricultural, or demolition solid waste on a one-

time basis. Examples are the disposal of concrete, brick, stone, asphalt, wood, trees, logs, brush and material from demolished buildings, generally involving no more than 10,000 cubic yards with disposal taking place over a project life of less than 3 months.

(39) "Open burning" means combustion of solid waste where the products of combustion are emitted directly into the ambient air without passing through a stack or chimney. Open burning does not include the combustion occurring at a properly operated air curtain destructor or incinerator.

(40) "Open dump" means a land disposal site or facility which is not a sanitary landfill.

(41) "Person" means an individual, trust, firm, cooperative, institution, joint stock company, corporation (including a government corporation), partnership, association, state, municipality, commission, political subdivision of a state, interstate body or federal department, agency, or instrumentality.

(42) "Plan of operation" means a report submitted for a solid waste disposal site or facility that describes its location, design, construction, sanitation, operation, maintenance, closing and long-term care.

(43) "Population equivalent" means the population equal to the sum of the population of the geographical area based on the most recent department of administration census data, plus the seasonal population as determined by the department and not included in the census data, plus one person per thousand pounds per year of industrial, commercial, and agricultural wastes accepted at the solid waste disposal site or facility in question.

(44) "Pollution" means the contaminating or rendering unclean or impure the waters of the state, or making the same injurious to public health, harmful for commercial or recreational use, or deleterious to fish, bird, animal or plant life.

(45) "Processing facility" means a solid waste disposal site or facility at which solid waste is baled, shredded, pulverized, composted, classified, separated or altered by some means to facilitate further transfer, processing, utilization or disposal. Processing facilities do not include operations conducted by scrap metal, paper, fiber or plastic processors excluded from the definition of "solid waste disposal sites and facilities" in this section.

(46) "Proof of financial responsibility" means a bond, deposit, proof of an established escrow account or trust account ensuring that sufficient funds will be available to comply with the closure and long-term care requirements of this chapter and the approved plan of operation.

(47) "Putrescible waste" for purposes of NR 180.13 (3) (a) 9 and NR 180.14 (3) (f) means solid waste which contains organic matter capable of being decomposed by microorganisms and of such a character and proportion as to be capable of attracting or providing food for birds.

(48) "Refuse" means combustible and noncombustible rubbish, including, but not limited to, paper, wood, metal, glass, cloth and products

thereof; litter and street rubbish, ashes; and lumber, concrete, and other debris resulting from the construction or demolition of structures.

(49) "Registered professional engineer" means a professional engineer registered as such with the Wisconsin examining board of architects, professional engineers, designers and land surveyors.

(50) "Salvageable material" means junk cars, machinery or equipment, scrap metal or other junk or scrap materials which are of further usefulness mainly as a raw material for reprocessing, or as imperfect stock from which replacement or spare parts can be extracted.

(51) "Salvage yard" means a solid waste disposal site or facility at which salvageable materials are stored or sold or at which wrecking, dismantling or demolition of salvageable materials are conducted. Salvage yards do not include operations conducted by scrap metal, paper, fiber or plastic processors excluded from the definition of "solid waste disposal sites and facilities" in this section, nor do salvage yards include small storage areas for equipment such as are normally found adjacent to industrial and commercial establishments.

(52) "Sanitary landfill" means a land disposal site or facility conforming to the applicable requirements of this chapter.

(53) "Seasonal population" means the seasonal transient population in an area over and above the year round population.

(54) "Sewerage system" means all structures, conduits and pipe lines by which sewage is collected and disposed of, except plumbing inside and in connection with buildings served, and service pipes from building to street main.

(55) "Sludge" means any solid, semi-solid, or liquid waste generated from a municipal, commercial or industrial wastewater treatment plant, water supply treatment plant, or air pollution control facility.

(56) "Soil" means material that has been physically and chemically derived from the bedrock by nature.

(57) "Solid waste" means any garbage, refuse, sludge from a waste treatment plant, water supply treatment plant, air pollution control facility and other discarded or salvageable material, including solid, liquid, semi-solid or contained gaseous material resulting from industrial, commercial, mining, and agricultural operations and from community activities, but does not include solid or dissolved material in domestic sewage, or solid or dissolved materials in irrigation return flows, or industrial discharges which are point sources subject to permits under ch. 147, Stats., or source, special nuclear or by-product material as defined under s. 140.52, Stats.

(58) "Solid waste disposal sites and facilities" means commercial and municipal establishments or operations such as, without limitation because of enumeration, sanitary landfills, dumps, land disposal sites, incinerators, auto junk yards, scrap metal salvage yards, transfer stations, storage facilities, collection and transportation services and other establishments or operations for the storage, collection, transportation, transfer, processing, treatment, recovery or disposal of solid waste. "Solid waste disposal sites and facilities" does not include a site or facility for

the processing of scrap iron, steel or nonferrous metal using large machines to produce a principal product of scrap metal for sale or use for remelting purposes; nor does the term include a site or facility which uses large machines to sort, grade, compact or bale clean wastepaper, fibers or plastics, not mixed with other solid waste, or sale or use for recycling purposes.

(59) "Solid waste management" means the systematic administration of activities which provide for collection, source separation, storage, transportation, transfer, processing, treatment and disposal of solid waste.

(60) "Stabilization of waste" means any chemical, physical, or thermal treatment of a waste, either alone or in combination with biological processes, which results in a significant reduction of pathogenic organisms including viruses.

(61) "Stabilization of a land disposal site or facility" means the process of waste settlement and associated land surface maintenance to insure that the majority of settlement has occurred, that pockets or depressions caused by settlement have been re-filled or re-graded, and that the final land surface contours represent a stable condition for closure and site maintenance purposes.

(62) "Storage site or facility" means a solid waste disposal site or facility for the storage of solid waste, on a temporary basis in such a manner as not to constitute ultimate disposal of solid waste.

(63) "Surface impoundment facility" means a natural topographic depression, artificial excavation, or dike arrangement which is used for storage or disposal of waste fluids or semi-solids.

(64) "Termination" means the final actions taken by an owner or operator of a solid waste land disposal site or facility when formal responsibilities for long-term care cease.

(65) "Topsoil" means natural loam, sandy loam, silt loam, silt clay loam or clay loam humus-bearing soils or other material that will easily produce and sustain dense growths of vegetation capable of preventing wind and water erosion of the material itself and other materials beneath.

(66) "Transfer facility" means a solid waste disposal site or facility at which transferring of solid waste from one vehicle or container to another, generally of larger capacity, occurs prior to transporting to the point of processing or disposal.

(67) "Treatment work" means any devices and systems used in the storage, treatment, recycling, and reclamation of municipal sewage or industrial waste of a liquid nature or necessary to recycle or reuse water at the most economical cost over the estimated life of the work, including intercepting sewers, outfall sewers, sewage appurtenances, extensions, improvements, remodeling, additions, and alterations thereof, elements essential to provide a reliable recycled supply such as standby treatment units and clear well facilities; and any works, including site acquisition of the land that will be an integral part of the treatment process or is used for ultimate disposal of residues resulting from such treatment. Additionally, "treatment work" means any other method or sys-

tem for preventing, abating, reducing, storing, treating, separating or disposing of municipal waste, including storm water runoff, or industrial waste, including waste in combined storm water and sanitary sewer systems.

(68) "USGS" means United States geological survey.

(69) "Waterworks" means all structures, conduits and appurtenances by means of which water is delivered to consumers except piping and fixtures inside buildings served, and service pipes from building to street main.

(70) "Well nest" means 2 or more wells installed within 10 feet of each other at the ground surface and constructed to varying depths.

(71) "Wetlands" means those areas that are inundated or saturated by surface or groundwater at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands generally include swamps, marshes, bogs, and similar areas. The permanent channels of streams and rivers and the open water of lakes and reservoirs are not included in this definition.

History: Cr. Register, February, 1980, No. 290, eff. 3-1-80.

NR 180.05 License periods and fees. (1) No person shall maintain or operate a solid waste disposal site or facility unless the person has obtained an operating license from the department, except as otherwise provided in this chapter. The license period shall be 2 years beginning on October 1 and terminating on September 30, 2 years later. The license period for land disposal sites and facilities shall begin on October 1 of even-numbered years. The license period for all other solid waste management sites or facilities shall begin on October 1 of odd-numbered years.

(a) Application for initial licensing of new solid waste disposal sites or facilities may be submitted at any time during the license period. Fees for initital licensing are proratable. The license period is divided into 4, 6-month periods, with ¼ of the 2 year license fee applied to each period. The applicant for initial licensing of a site or facility shall submit the appropriate fees as shown in Table 1, "Fee Schedule".

(b) Application for renewal of a solid waste disposal license shall be submitted to the department by June 1 preceding the license period being applied for. Applicants failing to submit the relicensing application by June 1 shall pay a late processing fee equal to 50% of the renewal fee or $150.00 whichever is less, in addition to the relicensing fee. The department shall transmit application forms to renewal applicants by April 1.

(c) Application for an operating license shall be submitted on forms supplied by the department and shall be accompanied by the appropriate fees as shown in Table 1, "Fee Schedule".

(d) License fees for solid waste disposal sites or facilities are not refundable.

(2) No person shall establish or construct a solid waste disposal site or facility prior to obtaining written approval from the department of

plans describing site or facility feasibility and/or operation, except as otherwise provided in this chapter. The plan review fee specified herein shall accompany all plans submitted to the department for approval. Plan review fees are not transferable, proratable or refundable.

(3) Following closure of a land disposal site or facility, the owner or any successor in interest shall be required to have a license during the period of owner responsibility indicated in s. 144.441, Stats. The license shall be issued in accordance with sub. (1) except that the fee shall be $50.00 per license period.

(4) For the purposes of plan review and license fees charged to land disposal facilities as provided in Table 1, the following shall apply:

(a) Plan review fees shall be charged on the basis of the maximum design capacity of the site, cell or module for which plans have been submitted. As a example, a feasibility report may be submitted for a 1 million cubic yard site requiring a review fee as specified for greater than 500,000 cubic yards; the plan of operation, however, may be submitted over a period of time in several modules. Each plan of operation review would be charged on the basis of the maximum design capacity of the module submitted.

(b) License fees shall be based on the total design capacity of the site being licensed including already deposited solid waste at the site. For sites which have not had a plan approval, the department shall make a reasonable estimate of the maximum design capacity of the site and shall charge a fee accordingly. For most township operated sites, the fee shall be as specified in the 0-50,000 cubic yard category.

History: Cr. Register, February, 1980, No. 290, eff. 3-1-80.

TABLE 1

FEE SCHEDULE

NR 180	FACILITY TYPE	License Required	Plan Review Necessary	Plan Review Fees: Feasibility	Plan Review Fees: Operating	License Fee Schedule: Initial License Period 0-6 mo.	6-12 mo.	12-18 mo.	18-24 mo.	All 2-yr Renewals
	STORAGE FACILITIES									
.07	Containerized	No	No							
	Non-containerized	Yes	Yes	75.	75.	25.	50.	> 5.		100.
.08	Collection & Transportation	Yes	No			12.50	25.	37.50		50.
.09	Transfer Facilities	Yes	Yes		100.	25.	50.	75.		100.
.10	Processing Facilities[1]	Yes	Yes	200.	200.	75.	150.	225.		300.
.11	Incineratprs[1]	Yes	Yes	200.	200.	75.	150.	225.		300.
.12	Air Curtain Destructors	Yes	Yes		125.	25.	50.	75.		100.
	LAND DISPOSAL FACILITIES									
	Landfill 0-50,000 yd^3*	Yes	Yes	100.	100.	37.50	75.	112.50		150.
	Landfill 50,000-500,000 yd^3*	Yes	Yes	350.	350.	125.	250.	375.		500.
.13	Landfill > 500,000 yd^3*	Yes	Yes	600.	600.	250.	500.	750.		1,000.
	Surface Impoundments	Yes	Yes	350.	350.	125.	250.	375.		500.
	Closure Plans	No	Yes		100.					
	*Maximum Design Capacity									
.14	Land Spreading Facilities	Yes	Yes	100.	100.	37.50	75.	112.50		150.
.17	Salvage Yards	Yes	Yes		100.	37.50	75.	112.50		150.
.18	Other	Yes	Yes	100.	100.	25.	50.	75.		100.

[1] If an applicant chooses not to submit a feasibility report for a processing facility or incinerator, but rather makes the initial submission the plan of operation, the fee for review of the plan of operation shall be increased by the amount of the fee indicated under feasibility in this table.

NR 180.06 General submittal requirements. (1) Unless otherwise specified in this chapter, all submittals for review and approval of any initial site report, feasibility report, plan of operation, construction observation report or closure plan shall include the following:

(a) The review fee specified in NR 180.05 in check or money order payable to the department (to be sent to the department district or area office as appropriate).

(b) A letter detailing the desired department action or response.

(c) Five copies of the plan or report prepared pursuant to the appropriate section of this chapter. Two copies shall be submitted to the department field office responsible for the area in which the site is located and 3 copies shall be submitted to the bureau of solid waste management in Madison. Review time starts when copies are received by the bureau. The plans and reports and all methods and procedures used to prepare them shall conform to the following:

1. Preparation. The submittal shall be under the seal of a registered professional engineer (except for salvage yards).

2. Investigation. All technical procedures used to investigate a solid waste disposal site or facility shall be the current standard procedures as specified by the American society for testing materials, USGS, standard methods for the examination of water and wastewater, or other equivalent or appropriate methods approved by the department. Test procedures used shall be specified. Any deviation from a standard method shall be explained in detail with reasons provided.

3. Format. All submittals shall include:

a. The required technical information as specified in this chapter.

b. Maps, figures, photographs and tables where applicable to clarify information or conclusions. The visuals shall be legible. All maps, plan sheets, drawings, isometrics, cross-sections and aerial photographs shall meet the following requirements:

1) Generally be no larger than 24 inches x 36 inches and no smaller than 8-½ inches x 11 inches.

2) Be of appropriate scale to show all required details in sufficient clarity.

3) Be numbered, referenced in the narrative, titled, have a legend of all symbols used, contain horizontal and vertical scales (where applicable), and specify drafting or origination dates.

4) Use uniform scales as much as practical.

5) Contain a north arrow.

6) Use USGS datum as basis for all elevations.

7) Plan sheets showing site construction, operation or closure topography, shall also show original topography.

8) Plan sheets for land disposal sites and facilities shall indicate a survey grid based on monuments established in the field specifically for that purpose.

9) All cross-sections shall show survey grid location and be referenced to major plan sheets.

c. An appendix listing names of all references, all necessary data, procedures and calculations.

(2) Unless otherwise specified in this chapter, no person shall operate or maintain a solid waste disposal site or facility without a license from the department.

(a) A submittal for initial licensing of any solid waste disposal site or facility shall include:

1. The license fee specified in NR 180.05 in check or money order payable to the department (to be sent to the department district or area office as appropriate).

2. A completed copy of the appropriate application form.

3. For all land disposal sites and facilities with plans of operation approved under this chapter and licensable land spreading facilities, proof of financial responsibility as specified in NR 180.15.

(b) A submittal for the relicensing of any solid waste disposal site or facility shall include:

1. The relicensing fee specified in NR 180.05 in check or money order payable to the department (to be sent to the department district or area office as appropriate).

2. A completed copy of the appropriate application form.

3. For all land disposal sites and facilities with plans of operation approved under this chapter and licensed land spreading facilities, proof of financial responsibility as specified in NR 180.15.

History: Cr. Register, February, 1980, No. 290, eff. 3-1-80.

NR 180.07 Storage facility requirements. (1) GENERAL. No person shall maintain or operate a solid waste storage site or facility unless the person has obtained an operating license from the department, except as otherwise provided in sub. (2). All waste shall be stored in containers unless its volume precludes practical containerized storage in which case it shall meet the noncontainerized storage requirements of this section.

(2) EXEMPTIONS. (a) The following facilities are exempt from all requirements of this section:

1. Garbage cans for household wastes located on property where waste is generated.

2. Containerized storage facilities for municipal solid waste serving apartments, commercial establishments, business establishments, and industries which are located on the premises served.

3. Pit silos used for the storage of by-products from fruit or vegetable processing operations where such by-products are to be used for animal feed.

(b) Noncontainerized storage sites or facilities meeting the following criteria are exempt from all feasibility and engineering plan requirements, site certification and licensing requirements of this section but shall be conducted according to all other noncontainerized storage requirements of this section. The exemption shall be issued by the department in writing if the operator demonstrates that the facility shall meet all the following criteria:

1. The solid waste to be stored shall not be putrescible waste such as garbage and municipal refuse.

2. The waste shall be free of noxious odors and either not readily transported by wind or water or stored in such a manner as to prevent such transport.

3. The site or facility shall exist less than 6 months from the time of initial waste storage at the facility to the time of removal of all waste.

4. The amount of waste stored at the site or facility shall not exceed 2,500 cubic yards at any time during the 6 month period.

5. The total amount of waste stored at the site or facility during the allowable 6 month period shall not exceed 5,000 cubic yards.

(3) FEASIBILITY REPORT. Unless specifically exempted in par. (2) (b), no person shall establish or construct a noncontainerized storage facility without first obtaining approval of a feasibility report detailing the physical conditions of the site and subsequently obtaining approval of a plan of operation from the department. The report shall contain the applicable material required by NR 180.13(6). The applicant is encouraged to prepare and submit an initial site report as outlined in NR 180.13(5). Because of the wide variety of potential noncontainerized storage proposals, the department may waive in accordance with NR 180.20 in writing any of the requirements of a complete feasibility report detailed in NR 180.13(6) if the content of the initial site report so warrants.

(4) PLAN OF OPERATION. Unless specifically exempted in par. (2) (b), no person shall establish or construct a noncontainerized storage facility or expand an existing operation until a plan of operation has been submitted in accordance with NR 180.06(1) and approved in writing by the department. The plan shall contain the applicable material required by NR 180.13(7). Because of the wide variety of potential noncontainerized storage proposals, the department may waive in accordance with NR 180.20 in writing any of the plan requirements of NR 180.13(7) depending on the specific site or facility as outlined in an approved initial site report or feasibility report for the facility.

(5) CONSTRUCTION OBSERVATION REPORT. The department may require submission by the applicant of a construction observation report pursuant to NR 180.06(1) for any noncontainerized storage site and facility. Where a report is required, operation of the site or facility shall not commence until the report is approved in writing by the department and until a license is issued.

(6) LOCATIONAL CRITERIA. Noncontainerized storage sites and facilities shall meet the locational criteria specified in NR 180.13(3) unless an exemption is granted. Storage sites proposed to be located in any area specified in NR 180.13(3) shall be designed to eliminate the problems inherent therein.

(7) OPERATIONAL REQUIREMENTS. No person shall operate or maintain a storage site or facility except in conformance with an approved plan of operation, if required, and the following minimum requirements:

(a) For containerized storage sites and facilities:

1. Containerized storage facilities shall be durable, rust resistant, nonabsorbent, leak-proof, and easily cleanable. If garbage or similar putrescible wastes are to be stored, the containers shall have close-fitting, fly tight covers, constructed of light-weight durable material.

2. Covers and containers shall be maintained in good condition.

3. Containers handling municipal solid waste shall be removed and emptied at least once per week, or more often if conditions warrant. Containers handling non-putrescible industrial waste shall be removed and emptied as necessary, but no less often than once every 90 days.

4. All weather access shall be provided and maintained.

5. Effective means shall be provided to control flies, rodents and other vectors.

6. Objects too large for the containers shall be stored in a nuisance-free manner.

7. Periodic clean-up and maintenance of the storage container and site shall be conducted to keep it aesthetically pleasing and nuisance-free. This maintenance shall be the responsibility of the property owner where the containers are located as well as the owner of the containers.

8. Access restrictions including a lockable gate and attendant may be required by the department if nuisance conditions develop or mechanical compaction equipment is part of the facility.

9. Final disposal of solid waste shall not be permitted at a storage facility.

10. No burning of solid waste shall be conducted.

11. The facility shall be operated and maintained in a sanitary, nuisance-free manner so as to protect the environment and the public health.

(b) For noncontainerized storage sites and facilities:

1. Sites and facilities shall be operated in accordance with any plan approval for the site or facility.

2. All weather access shall be provided and maintained.

3. Effective means shall be provided to control flies, rodents, and other vectors.

4. Periodic maintenance or clean-up of the site shall be conducted to keep it aesthetically pleasing and nuisance-free.

5. Gates, fencing and an attendant shall be provided as specified by the department.

6. Final disposal of solid waste shall be provided as specified by the department.

7. No burning of solid waste shall be conducted.

8. The facility shall be operated and maintained in a sanitary, nuisance-free manner so as to protect the environment and the public health.

9. Adequate drainage shall be maintained on and around the facility.

10. The facility shall be screened from view of residences, state trunk highways and public parks within 1,000 feet.

(8) MONITORING. Water and gas monitoring of noncontainerized storage sites and facilities may be required by the department. Monitoring shall be conducted and results shall be submitted to the department by the site operator or owner as specified by the department. Monitoring may be required after site or facility closure.

(9) CLOSURE. Any person who maintains or operates a noncontainerized storage site or facility or who permits the use of property for such purpose shall close the site in accordance with any plan approval issued by the department and the following minimum practices:

(a) At least 60 days prior to the closing of a site, the owner or operator shall notify the department in writing of the intent to close the site.

(b) All solid waste shall be removed from the site or facility in accordance with the conditions of the approved plan of operation. The waste shall be properly utilized or disposed in accordance with the requirements of this chapter.

(c) The surface of the site or facility shall be restored in conformity with the approved plan of operation, or restored to its original condition to the extent practicable.

History: Cr. Register, February, 1980, No. 290, eff. 3-1-80.

NR 180.08 Collection and transportation service requirements. (1) GENERAL. No person shall maintain or operate a collection or transportation service unless the person has obtained an operating license from the department, except as otherwise provided in sub. (2).

(2) EXEMPTIONS. The following services are exempt from all requirements of this section:

(a) Services collecting and transporting only salvageable material, gravel pit spoils, quarry materials or earth materials.

(b) Services collecting and transporting only ordinary solid waste from a single household or amounting to less than 20 tons per year.

(c) Services consisting solely of vehicles collecting and transporting sludge from municipal wastewater or water supply treatment plants provided it is handled in accordance with ch. 147, Stats.

(d) Services collecting and transporting only waste materials regulated by chapter NR 113, Wis. Adm. Code, and licensed thereunder.

(e) Governmental services consisting solely of vehicles used to collect and transport roadside litter from town, village, city, county, state, and federal rights-of-way. Such litter shall be disposed of at a licensed disposal site.

(f) Services collecting and transporting dredge material regulated by permit or contract under s. 30.20, Stats.

(g) Services owned by an industry generating the waste materials where such waste material is disposed of at a site owned by that same industry and providing the transportation vehicles do not travel on publicly owned roads.

(h) Services collecting and transporting only whey and/or waste materials from fruit or vegetable processing operations.

(3) OPERATIONAL REQUIREMENTS. No person shall operate or maintain a solid waste collection and transportation service except in accordance with the following minimum requirements:

(a) Each vehicle shall have lettered "WDNR" followed by the license number on the driver's door. The letters shall be at least 2 inches high with a mininmum ½ inch brush stroke. The lettering colors shall contrast with the background to make it easy to read.

(b) Solid waste shall be collected from, transported to and disposed of only at facilities meeting the requirements of this chapter.

(c) All vehicles or containers used for the collection and transportion of solid waste shall be durable, easily cleanable and leakproof, if necessary, considering the type of waste and its moisture content. These vehicles and containers shall be cleaned frequently to prevent nuisances or insect breeding and shall be maintained in good repair.

(d) Vehicles or containers used for the collection and transportation of solid waste shall be loaded and moved in such a manner that the contents will not fall, spill or leak therefrom. Covers shall be provided, as necessary, to prevent littering and spillage. If spillage does occur the operator shall immediately return spilled materials to the vehicle and shall properly clean the spill area.

(4) EXPANSION OR TERMINATION. The owner or operator shall notify the department in writing of any expansion or termination of a service or of any change in use of disposal sites 30 days prior to the effective date of such action.

(5) RESPONSIBILITY. Except as otherwise provided in this chapter, any person generating solid waste shall be responsible for the collection and transportation of the waste to a solid waste disposal site or facility li-

censed by the department unless the person contracts with a collection and transportation service licensed by the department for that purpose.

History: Cr. Register, February, 1980, No. 290, eff. 3-1-80.

NR 180.09 Transfer facilities. (1) GENERAL. No person shall maintain or operate a solid waste transfer site or facility unless the person has obtained an operating license from the department, except as otherwise provided in sub. (2) or if an exemption is granted pursuant to NR 180.20. Any person intending to establish or construct a solid waste transfer site or facility shall contact the department to arrange for an initial site inspection.

(2) EXEMPTIONS. Transfer facilities designed and operated to receive solid waste from individual users and from hand unloaded vehicles not exceeding one ton capacity are exempt from the plan approval and licensing requirements of this chapter but must be operated and maintained in conformance with the following practices:

(a) Containers shall be leakproof and manufactured of rot-proofed material. A closeable cover shall not be required unless specifically requested in writing by the department.

(b) Where mechanical equipment is a part of the operation, access shall be limited to those times that attendants are on duty. Access restrictions and/or attendants may be required in writing by the department for a nonmechanical facility.

(c) Containers shall be removed or emptied at least once per week and more frequently if conditions warrant.

(d) The transfer station and adjacent area shall be kept clean and free of litter.

(e) No open burning of solid waste shall be conducted.

(f) Effective means shall be provided to control flies, rodents and other insects or vermin.

(g) An all-weather access and parking area shall be provided and maintained.

(3) PLAN OF OPERATION. No person shall establish or construct a solid waste transfer site or facility or expand an existing operation unless the person has obtained approval of a plan of operation from the department, except as provided in sub. (2) or if an exemption is granted pursuant to NR 180.20. The plan of operation shall specify the intent and objectives of the proposal and indicate methods and procedures to minimize adverse environmental impacts of the proposed operation. The plan shall be submitted in accordance with NR 180.06 (1) and shall include plans and specifications denoting plant layout, building construction, equipment placement and material handling systems within the plant. The plan of operation shall contain, at a minimum, the following information:

(a) Introduction and general information including:

1. Legal description of the site and site boundaries.

2. Adjacent land ownership and land use within ½ mile of the proposed site.

3. The operator of the site.

4. Site size.

5. Proposed life expectancy of the facility.

(b) Surface features of the proposed site including:

1. USGS 7½ minute or 15 minute quadrangle map.

2. A vicinity map (s) indicating the following features within ¼ mile of the facility:

a. Property boundaries of the proposed site.

b. Predominant surface water drainage features.

c. Surface water bodies.

d. Wetlands, flood plain and shoreline areas.

e. Roads and highways.

f. Industrial, commercial and residential buildings.

(c) Plot plan (s) of the transfer facility including:

1. Site plan indicating locations of all buildings, roadways, parking and storage areas.

2. Existing and proposed final ground surface contours.

3. Location of receiving or unloading areas and exit or material removal areas.

4. Location of proposed utilities servicing the transfer station.

5. Means of limiting access such as fencing, gates, natural barriers or other methods.

6. Method of screening the facility from the surrounding area.

(d) Building and equipment plans and drawings including:

1. Plans of all structures proposed at the facility including foundations, walls, floor elevations, and other construction items.

2. Cross-section drawings through the facility indicating process flow lines.

3. Cross-section drawings of each major piece of mechanical equipment.

4. Plans and drawings of supplemental construction areas, fixed or moveable equipment, electrical systems, and any other drawings necessary to fully describe the facility.

(e) A narrative shall be prepared outlining facility operations and regulations. This report shall include at a minimum:

1. Consistency of facility development with areawide solid waste plans, land use plans, or other areawide plans. Alternatives considered in the project planning phase shall be discussed.

2. Population and area to be served by the facility and projections for increased use in the future.

3. Type and quantity of waste to be handled and specific waste types not accepted at the facility.

4. Persons responsible for structural improvements, building maintenance and daily operation and control of the facility.

5. Types of vehicles used to transport solid waste into and out of the station.

6. Vehicle traffic routing at the facility and provisions for access to connecting roadways.

7. Methods of water supply and wastewater treatment.

8. Methods of volume reduction such as compacting, grinding, compression or tamping.

9. Design criteria used to select equipment capacity and building configuration and sizing.

10. Daily clean-up procedures.

11. Names and locations of all solid waste disposal operations to which waste from the transfer station may be hauled.

12. Procedures for alternate routing of waste during inoperable periods at the facility.

13. Appurtenances and procedures to handle heavy or bulky items and store solid waste beyond the end of the working day.

14. Equipment and procedures designed to control dust, odors, noise, fire and windblown paper.

(4) LOCATIONAL CRITERIA. No person shall establish, construct, operate, maintain or permit the use of property for a transfer site or facility in wetlands.

(5) OPERATIONAL REQUIREMENTS. No person shall operate or maintain a transfer site or facility except in conformance with the approved plan of operation and the following minimum requirements:

(a) A sign, acceptable to the department, shall be posted at the entrance to the operation, which indicates the name, license number, and hours of use of the operation, penalty for unauthorized use, necessary safety precautions, and any other pertinent information specified by the department.

(b) A building, roofed and enclosed on at least 3 sides where applicable, or otherwise enclosed to satisfactorily control dust, papers, and other waste materials, shall be provided.

(c) Screening shall be provided for a transfer site or facility located within 500 feet of any residence.

(d) The site or facility shall be operated under the close supervision of responsible individuals who are thoroughly familiar with the requirements and the operational procedures of the transfer site or facility.

(e) Access shall be limited to those times that an attendant is on duty.

(f) There shall be no storage of solid waste in the building or yard for a period greater than 24 hours except in conformance with section NR 180.07 or in licensed collection and transportation units. Longer storage periods may be allowed for certain industrial and commercial waste depending on the design of the facility.

(g) Unloading of solid waste shall take place only within the enclosed structure and only in approved designated areas.

(h) Solid waste shall be confined to the unloading, loading and handling area.

(i) The transfer site or facility and adjacent area shall be kept clean and free of litter.

(j) Sewage solids or liquids or toxic or hazardous wastes in quantities detrimental to the normal operation of the transfer site or facility shall be excluded unless plans for special handling have been submitted to the department and approved in writing.

(k) Dust and odor generated by the unloading of solid waste and the operation of the transfer site or facility shall be controlled at all times.

(l) No open burning of solid waste shall be conducted.

(m) Solid waste which is burning or is at a temperature likely to cause fire or is of a highly flammable or explosive nature shall not be accepted at the transfer site or facility.

(n) Equipment shall be provided to control accidental fires and arrangements shall be made with the local fire protection agency to provide immediate services when needed.

(o) Means shall be provided to control flies, rodents, and other insects or vermin.

(p) Sanitary facilities shall be available for use by facility operators.

(q) Provision shall be made for needed maintenance of the transfer site or facility after each day of operation.

(r) Means of communication shall be provided for emergency purposes.

(s) An approved alternative method of waste processing or disposal shall be provided in the event that the transfer site or facility is rendered inoperable.

(6) CLOSURE. Any person who operates or maintains a transfer site or facility of who permits the use of property for such purpose shall close the site in accordance with any plan approval issued by the department and the following minimum practices:

(a) The operator shall notify the department and all users of the facility in writing at least 60 days prior to closure of the facility.

(b) Access shall be restricted through the use of a fence, gate, plantings, or other appropriate means upon closure of the facility.

(c) The operator shall provide a sign notifying users of the facility of closure upon termination of operations.

History: Cr. Register, February, 1980, No. 290, eff. 3-1-80.

NR 180.10 Solid waste processing facilities. (1) GENERAL. No person shall operate or maintain a solid waste processing site or facility unless the person has obtained an operating license from the department, except as provided in sub. (2). Any person intending to establish or construct a solid waste processing facility shall contact the department to arrange for an initial site inspection.

(2) EXEMPTIONS. (a) Composting operations used for processing solid waste from a single family or household, a member of which is the owner, occupant or lessee of the property used for the solid waste processing operation are exempt from the licensing requirements of this section.

(b) Sites or facilities for the processing of scrap iron, steel or nonferrous metal using large machines to produce a principal product of scrap metal for sale or use for remelting purposes and sites or facilities which use large machines to sort, grade, compact or bale clean wastepaper, fibers or plastics, not mixed with other solid waste, for sale or use for recycling purposes are exempt from all requirements of this section.

(3) FEASIBILITY REPORT. Any person may submit to the department a feasibility report in accordance with NR 180.06(1) to solicit a preliminary indication of potential for the processing facility to be licensed for operation. Favorable determination based on department review of the feasibility study does not insure approval of the plan of operation. A feasibility report for a solid waste processing facility shall contain, at a minimum, the following information:

(a) A narrative describing:

1. Legal description of the site.

2. Present ownership of the site.

3. Proposed site size and boundaries and present land use of the site and the area within ½ mile of the site. Particular note shall be made of parks, hospitals, nursing homes and areas of archaeological and historical significance.

4. Area served, including population and major industries.

5. Consistency of facility development with areawide solid waste plans and land use plans. All alternatives considered shall be discussed.

6. Predominant types of vegetation and wildlife within proposed site boundaries.

7. A complete materials balance for the facility, specifying amounts and characteristics of solid waste received and amounts and characteristics of products and wastes generated by the facility.

8. Types of vehicles and access routes used to transport solid waste into and out of the facility, an analysis of estimated traffic flow patterns

on access routes and within the facility site, and an analysis of increased quantities of traffic on access routes into and out of the facility.

9. Estimated quantities and characteristics of liquid wastes resulting from facility operation and methods of their treatment or disposal.

10. Person(s) responsible for plant construction and operation.

11. Quality and quantity of air discharge from plant operations.

12. Appurtenances and procedures intended to store solid waste beyond the end of the processing day; control dust, odors, fire, windblown materials and potential explosions; and handle refuse in the case of major processing facility breakdown.

13. Names and locations of all solid waste disposal sites and facilities at which solid waste from the processing plant will be disposed.

14. Overall facility layout including conceptual building design, sizing of receiving area, methods of processing, and sizing of major process equipment and/or process areas.

15. Potential markets for recovered solid wastes and potential contractual arrangements for recovered products.

16. A timetable for facility construction, shakedown and operation.

17. Operating schedule.

18. Provisions for protection of groundwater and surface waters during facility construction and operation.

19. Number of employes.

20. Conceptual design of equipment indicating capacity or size.

(b) The narrative shall be supplemented by the following maps and/or plans:

1. USGS quadrangle map. This shall be a 7½ minute, topographic map, if available. The radius of coverage shall be sufficient to show sources of waste or a minimum of 3 miles. If impractical to show the facility locations relative to the source(s) of waste, a separate locaton map displaying this information shall be provided.

2. Plat map. This shall indicate property boundaries and zoning within ½ mile of the proposed facility and anticipated traffic routes within 2 miles of the facility.

3. Existing site conditions map. The extent of coverage shall be the entire site and the area within ½ mile of the site boundaries. The minimum scale shall be 1″=400′. Map details shall include proposed site boundary, property lines, easements and rights-of-way; buildings, foundations, roads, utilities and other structures; topography (for site only unless needed to define drainage patterns around facility), drainage swales, surface waters, wetlands, flood plains and similar drainage features; wooded areas; location of soil borings and test pits; features of historical and archaeological significance; and other physical site features as appropriate.

4. Proposed facility plan. This plan shall include proposed facility access roads and traffic patterns, buildings, scales, utility lines, drainage diversion, screening, means of access control, final topography, areas to be cleared of vegetation, and other design features. The extent of coverage and scale shall be the same as that for the existing site conditions.

5. Proposed process layout. The extent of coverage shall include the receiving, processing, and loadout areas. The minimum scale shall be 1″=20′. Plan details shall include conceptual design for receiving area configuration and traffic flow patterns, processing area and equipment configuration, loadout area and equipment configuration, traffic flow patterns, and other pertinent design features.

6. Cross-sections. At least one cross section shall be drawn through the receiving, processing (each process line, where applicable), and loadout areas indicating existing topography, limits of excavation, proposed final grades, conceptual design of building foundations and structure, conceptual design of processing equipment, major soil types, groundwater table and bedrock surface configuration, if encountered during surface investigations, and other pertinent design features. More cross-sections may be necessary depending on complexity of facility design.

(4) PLAN OF OPERATION. No person shall establish or construct a processing facility or expand an existing operation prior to obtaining approval in writing from the department of a plan of operation for the facility. If a feasibility report has not been submitted for department review, the plan of operation shall contain the minimum requirements of the feasibility report specified in sub. (3) as well as the minimum requirements of the plan of operation. The plan of operation for a solid waste processing facility shall be submitted in accordance with NR 180.06(1) and shall contain, at a minimum, the following information:

(a) Complete construction plans and specifications detailing the exact configurations, locations, elevations, dimensions and construction and installation procedures for all structures, equipment and site modifications. Where practical, the minimum scales utilized shall be 1″=20′ for buildings, equipment, and structures, and 1″=100′ for site plans. To facilitate review, the construction plans and specifications shall include separate engineering drawings for the following:

1. Existing site conditions. The extent of coverage and plan details shall be the same as that required for a solid waste processing facility feasibility report set forth in sub. (3).

2. Construction conditions. A plot plan shall be submitted which indicates the appearance of the site during facility construction. The extent of coverage and scale shall be identical to the existing site conditions plot plan. The plot plan shall show limits of construction, areas to be cleared of vegetation and topsoil, demolition of existing structures, areas of borrow and fill, temporary or permanent drainage diversion, soil erosion protection measures, construction access roads, soil and stripped vegetation stockpiles or storage areas, equipment storage areas, and other details necessary to determine the impacts during facility construction.

3. Proposed facility plan. A plot plan shall be submitted showing the facility at completion of construction. The extent of coverage and scale

shall be the same as the existing site conditions plot plan. Plan details shall include those required for the existing site conditions and any modifications thereto plus means of limiting access such as fencing, gates or natural barriers; method of screening the facility from the surrounding area; general layout of receiving, processing and loadout areas and equipment; traffic flow patterns; access roads; location of existing and proposed utilities to the facility; drainage flow patterns and structures; scales; signs; general processing flow patterns and other appropriate facility details; and location of discrete air contaminant discharges.

(b) *Design report.* The construction plans and specifications shall be supplemented with a design report providing a discussion of design features and logic not previously discussed in the feasibility report. The report shall discuss and, where applicable, show calculations for size and configuration of receiving area; size and configuration of processing equipment and/or areas, conveyors, blowers or other transport equipment, air pollution control units and associated duct work, methods of handling liquid wastes resulting from operations such as floor drains, sewers and water treatment facilities; heat balances, residence time and process temperature for incinerators, digestors, or other thermal processing equipment; size and configuration of loadout and storage facilities for process outputs; sizing of surface water drainage control structures; traffic queuing and flow patterns; design life of facility equipment, buildings and appurtenances; timetable for construction; methods of controlling windblown materials; and methods of screening the facility from the surrounding area.

(c) *Operations and maintenance manual.* A manual shall be prepared with separate sections specifying operating and maintenance procedures for the following:

1. Facility startup and process line shakedown. This shall include a discussion of personnel training; solid waste sources, quantities and characteristics to be processed; process line startup procedures and equipment performance evaluations; fire, dust and odor control systems; performance evaluations; process raw materials on hand at startup; process outputs testing; and other appropriate startup procedures.

2. Normal operations. This shall include a discussion of operating personnel responsibilities; hours of operation; daily processing schedule; routine process monitoring including monitoring quantity and quality of waste input; process output testing; equipment maintenance schedules; methods of controlling explosions, fire, odors, and windblown materials; special waste handling procedures; method of controlling access; daily cleanup procedures; facility bypass procedures during major breakdowns and alternative means of disposal; person responsible for operation; facility licensee and owner; record keeping; emergency procedures for handling of freezeup during cold weather; methods to prevent solid waste from burning; and other pertinent information.

3. Amendments. After startup and shakedown, the manual may be amended to reflect actual operating conditions.

(5) LOCATIONAL CRITERIA. No person shall establish, construct, operate, maintain or permit the use of property for a solid waste processing facility within wetlands.

(6) MINIMUM REQUIREMENTS FOR FACILITY DESIGN AND OPERATION. (a) *New and existing facilities.* No person shall operate or maintain a solid waste processing site or facility except in conformance with the following requirements and with the terms and conditions of any plan approval for the facility:

1. A sign, acceptable to the department, shall be posted at the entrance to the facility which indicates the name, license number, and hours of use of the facility, penalty for unauthorized use, necessary safety precautions; and other pertinent information.

2. Screening shall be provided for any processing site or facility located within ¼ mile of any residence.

3. Access to the processing site or facility shall be limited to those times that an attendant is on duty.

4. A processing site or facility shall be operated under the close supervision of responsible individuals who are thoroughly familiar with the requirements and operational procedures of the plant.

5. All solid waste, with the exception of that in the process line, shall be stored in conformance with NR 180.07.

6. Unloading of solid waste shall take place only in approved, designated areas.

7. The processing facility and adjacent area shall be kept clean and free of litter.

8. Liquids and sludges in quantities which may be detrimental to the normal operation of the processing facility shall be excluded unless plans specifically addressing the handling of these materials have been submitted to the department and approved in writing. This provision does not preclude a processing site or facility operator from excluding any other material from the processing facility.

9. Access to the processing site or facility shall be limited by means of fencing, natural barriers or other methods. Access roads utilized shall be of all-weather construction.

10. All processing sites or facilities located within a flood plain shall conform to the requirements of chapter NR 116, Wis. Adm. Code.

11. Equipment shall be provided to control accidental fires and arrangements shall be made with the local fire protection agency to provide immediate services when needed.

12. Effective means shall be taken to control flies, rodents and other insects or vermin.

13. An approved alternative method shall be provided for solid waste disposal in the event that the processing site or facility is rendered inoperable or is not able to completely process the solid waste.

14. By-products or residues shall be disposed of in sites established to receive such waste or be handled by an alternate method approved by the department.

15. The operation shall be conducted in a manner to prevent public health hazards and nuisances.

16. All wastewater resulting from the process shall be discharged into a sanitary sewer or other system approved by the department.

17. Odors resulting from the unloading of solid waste and the operation of the processing facility shall be controlled.

18. Solid waste which is of a highly flammable or explosive nature shall not be accepted at the processing site or facility.

19. No open burning of solid waste shall be conducted.

20. Materials resulting from composting or similar processes and offered for sale shall be stabilized to minimize the number of pathogenic organisms, shall be processed so as not to reheat upon standing, and shall be processed so as to contain no sharp particles which could cause injury to persons handling the compost.

21. Means of communication with emergency facilities shall be provided.

22. Dust generated by the unloading of solid waste and the operation of the processing site or facility shall be controlled in accordance with section NR 154.11, Wis. Adm. Code, so as not to create nuisance conditions.

23. Thermal processing facilities shall be designed and operated to provide adequate temperature and residence time in the combustion chamber to assure complete processing and be equipped with necessary air pollution control equipment to produce a noncombustible residue, result in no noxious odors and meet state air pollution control regulations.

24. Permanent records of facility performance shall be maintained and submitted to the department with the relicensing application or as specified in the plan approval. Such records shall indicate types, sources and amounts of solid waste processed, minor plant modifications performed, process monitoring data, amounts and characterization testing of process outputs, and other data as required by the department when granting the license.

(b) *Additional requirements applicable to new and expanded facilities.* No person shall construct, establish, operate or maintain a new solid waste processing site or facility or an expansion of an existing site or facility except in accordance with the requirements of par. (a), the approved plan of operation, and following additional requirements:

1. All access roads shall be constructed with a maximum grade no greater than 10%. The intersection of the access road with an existing highway shall be designed to provide sufficient site distance and provide for minimum interference with traffic on existing highways.

2. All installed processing equipment shall be enclosed to prevent nuisance conditions from developing.

3. All buildings enclosing processing equipment shall have a sloped concrete floor with floor drains connected to a sanitary sewer or other system approved by the department.

4. Maximum soil slopes for disturbed areas shall be 3 horizontal to 1 vertical.

5. All disturbed areas not used for facility access shall be graded, covered with 6 inches of topsoil and seeded or otherwise protected from soil erosion.

6. All borrow areas shall be abandoned in accordance with Wisconsin department of transportation procedures.

7. Processing, receiving or storage areas not covered by buildings shall be graded at a minimum 1% slope and surfaced with a material which will adequately support heavy equipment, resist frost action, provide a wearing surface and prevent contamination of groundwater. Runoff from such areas shall be directed to a sanitary sewer or other system approved by the department.

8. All facilities operated more than 4 hours per day shall be equipped with a toilet and wash basin or have such facilities available within a reasonable distance.

9. Explosion-prone equipment such as primary shredders shall be placed in a separate room with explosion venting and/or explosion suppression equipment.

10. The receiving area and all dry processing units such as shredders, screens, air classification devices, magnetic separators and similar equipment and all conveyor transfer points where dust is generated shall be shrouded and equipped with dust collection and removal equipment. Any air collected in this manner shall be directed through appropriate air pollution control equipment before being discharged.

(7) MONITORING. Specific monitoring requirements and testing procedures in the monitoring program will be determined by the department based on a review of the nature and extent of the potential for environmental pollution. The department may require the owner or operator of any processing site or facility or any person who permits the use of property for such purpose to conduct monitoring as follows:

(a) Air quality monitoring and analysis.

(b) Product quality testing and analysis. The frequency of testing and parameters to be analyzed will be determined based on a review of the proposal and complexity of the product. The quality control program will correlate with the nature of the solid waste to be processed and final uses proposed for the material.

(c) Groundwater and surface water quality monitoring and analysis. The frequency and type of monitoring and analysis will be determined based on a review of the project.

(d) Periodic assessments of plant operation, process feasibility, and marketability analyses of processed materials.

(8) CLOSURE. Any person who maintains or operates a processing site or facility or who permits the use of property for such purpose shall close the site or facility in accordance with the following practices unless otherwise specified by the department in writing:

(a) The operator shall notify the department and all users of the facility in writing at least 60 days prior to ceasing to accept solid waste.

(b) A sign shall be placed at the entrance to the site or facility notifying all users that the site is no longer accepting solid waste.

(c) Access to the site or facility shall be restricted through the use of a fence, gate or other appropriate means.

(d) The department may require the continuance of groundwater, surface water, and air quality monitoring after closure of the facility.

(e) The operator shall submit to the department for approval at least 60 days prior to facility closure, a plan for facility closure. The department will review the plan and notify the operator of the acceptability and completeness of the plan. If additional items are needed to properly close the facility the operator will be notified and appropriate additions shall be made to the closure plan.

(f) All aspects of facility closure other than monitoring shall be completed within 6 months after ceasing to accept solid waste.

History: Cr. Register, February, 1980, No. 290, eff. 3-1-80.

NR 180.11 Incinerators. (1) GENERAL. No person shall operate or maintain an incinerator unless the person has obtained an operating license from the department except as provided in sub. (2). Any person intending to establish or construct an incinerator site or facility shall contact the department to arrange for an initial site inspection.

(2) EXEMPTIONS. A license shall not be required for incinerators having a capacity of 1,000 pounds per hour or less except for incinerators used for the degradation of hazardous wastes. However, exempt incinerators shall be designed and operated in a manner to conform to emission limitations of state air pollution control regulations.

(3) FEASIBILITY REPORT. Any person may submit to the department a feasibility report in accordance with NR 180.06(1) to solicit a preliminary indication of potential for the incinerator facility to be licensed for operation. Favorable determination based on department review of the feasibility report does not insure approval of the plan of operation. The feasibility report for an incinerator facility shall contain, at a minimum, the following information:

(a) A map or aerial photograph of the area showing land use and zoning within ¼ mile of the site. The map or aerial photograph shall be of sufficient scale to show all homes, industrial buildings, roads, and other applicable details and such details shall be identified and indicated on the map or aerial photograph.

(b) A plot plan of the incinerator site including means of limiting access such as fencing, gates, natural barriers; method of acceptably screening the facility from the surrounding area; general layout of equip-

ment and flow pattern; road access; location of existing and proposed utilities serving the incinerator.

(c) A report which shall include the following information:

1. Population, area and facilities to be served by the incinerator.

2. Anticipated type and quantity of waste to be handled in the incinerator.

3. Persons responsible for incinerator operations.

4. Methods of treating or disposing of any liquid wastes or waste waters resulting from operation of the incinerator.

(4) PLAN OF OPERATION. No person shall establish or construct an incinerator facility or expand an existing incinerator prior to obtaining approval in writing from the department of a plan of operation for the facility. If a feasibility report has not been submitted for department review, the plan of operation shall contain the minimum requirements of the feasibility report specified in sub. (3) as well as the minimum requirements of the plan of operation. The plan of operation for an incinerator shall contain, at a minimum, the following information:

(a) Appurtenances and procedures intended to store refuse beyond the end of the working day and to control dust, odors, fire outside the burning chamber, and windblown materials.

(b) Methods of volume reduction including compaction, compression, bailing, shredding, grinding, tamping, separating, or classifying.

(c) Daily clean-up procedures.

(d) Incinerator inspection and maintenance schedule and procedures.

(e) Detailed drawings and specifications of all structures, equipment and site.

(f) A report which includes furnace design criteria and expected performance data, including emission data.

(g) The site at which ash residue will be disposed and alternative sites available for use when the primary site is inoperative.

(5) OPERATIONAL REQUIREMENTS. No person shall operate or maintain an incinerator except in conformance with the following minimum requirements and with the terms and conditions of any plan approval for the facility:

(a) The incinerator shall be so situated, equipped, operated, and maintained as to minimize interference with other activities in the area.

(b) Adequate shelter and sanitary facilities shall be available for personnel.

(c) A sign shall be posted at the entrance to the operations, which indicates the name, license number, and hours of operation of the facility.

(d) All solid waste disposed at the incinerator shall be confined to the designated storage area.

(e) Solid waste except for that in the process line shall be stored in conformance with NR 180.07.

(f) Dust shall be controlled in the unloading and charging areas.

(g) Permanent records shall be maintained including the weights of material incinerated, the quantity of resulting residue, hours of plant operation, combustion temperatures, residence time, and other pertinent information.

(h) Appropriate fire-fighting equipment shall be available in the storage and charging areas and elsewhere as needed.

(i) Arrangements shall be made with the local fire protection agency to provide adequate emergency fire-fighting forces.

(j) Means of communication with emergency facilities shall be provided.

(k) Adequate equipment shall be provided in the storage and charging areas and elsewhere as needed to allow cleaning after each day of operation or as may be required in order to maintain the plant in a sanitary condition.

(l) The charging openings as well as all equipment throughout the plant shall be provided with adequate safety equipment as prescribed in chapter Ind 1, Wis. Adm. Code.

(m) The incinerator shall be so designed and operated that it will not cause a nuisance because of the emission of noxious odors, gases, contaminants or particulate matter or exceed emission limitations established by state air pollution control regulations.

(n) Residue shall be disposed of at a solid waste disposal site or facility licensed by the department or be handled by an alternate method approved in writing by the department.

(o) All waste water from the incinerator shall be discharged into a sanitary sewer or other system approved in writing by the department.

(p) Upon completion of construction of a new incinerator and at least 10 days prior to initial operation, the department shall be notified to allow inspection of the incinerator both prior to and during any performance tests and initial operation.

(q) Performance tests of the incinerator may be required by the department. If required, a report covering the results of the performance tests with supporting data shall be prepared by the design engineer of the project and submitted to the department for approval.

(r) No open burning of solid waste shall be conducted.

(s) If for any reason the incinerator is rendered inoperable, an approved alternative method shall be used for solid waste disposal.

(6) CLOSURE. The owner or operator shall notify the department 60 days prior to the termination of operation of an incinerator and shall

submit any further information deemed necessary by the department to prevent environmental pollution.

History: Cr. Register, February, 1980, No. 290, eff. 3-1-80.

NR 180.12 Air curtain destructors. (1) GENERAL. No person shall operate or maintain an air curtain destructor site or facility unless the person has obtained an operating license from the department, except if an exemption is granted pursuant to NR 180.20. Any person intending to establish or construct an air curtain destructor site or facility shall contact the department to arrange for an initial site inspection.

(2) PLAN OF OPERATION. No person shall establish or construct an air curtain destructor or expand an existing air curtain destructor prior to obtaining approval in writing from the department of a plan of operation for the facility. The air curtain destructor shall comply with all applicable requirements of chapters NR 154 and NR 155, Wis. Adm. Code. The plan of operation shall include at a minimum the following:

(a) A map or aerial photograph of the area showing land use, zoning, homes, industrial buildings, and roads within ¼-mile of the site.

(b) A plot plan of the air curtain destructor facility showing means of limiting access, method of screening the facility from the surrounding area, general layout of equipment and flow pattern, access roads, and waste material storage areas.

(c) Construction plans of the burning pit.

(d) Plans and specifications of the blower unit and appurtenances.

(e) A report indicating the type and quantity of waste material to be consumed, planned method of charging, startup procedures, safety features to be used at the facility both during and after burning, proposed pit clean-out procedures, and methods to be employed in conforming to the minimum requirements of chapter NR 154, Wis. Adm. Code.

(f) The site at which ash residue will be disposed and alternative sites available for use when the primary site is inoperative.

(3) OPERATIONAL REQUIREMENTS. No person shall construct, operate or maintain an air curtain destructor except in conformance with the following minimum requirements and with the terms and conditions of any plan approval for the facility:

(a) The burning pit shall be made of a material which will result in a pit of permanent dimensions. Maintenance shall be performed on the pit to keep its dimensions constant so as to keep the air curtain working properly.

(b) The burning pit floor shall be constructed in a manner which provides for proper drainage.

(c) The burning pit shall be oriented perpendicular to the prevailing wind with the plenum chamber and blower on the downwind side.

(d) The charging area shall be paved with a concrete pad for a distance of at least 10 feet from the edge of the burning pit and sloped away from the chamber. Adequate safety devices shall be provided to prevent loading equipment from falling into the burning pit.

(e) Only clean wood wastes and similar combustible materials shall be burned in an air curtain destructor.

(f) The main stockpile of waste material shall be kept a minimum of 100 feet from the burner.

(g) Charging shall be conducted in such a manner as to prevent waste material from protruding through the air curtain.

(h) Start-up shall be accomplished by using kindling material to ignite larger materials rather than using fuel oil, tires, or other rubber materials. If no kindling materials are included in the wastes, the burner operators shall obtain a large enough quantity of lightweight wood material to facilitate burner start-up. Where sufficient quantities of kindling material are unobtainable, other methods approved by the department in writing may be used.

(i) Burning shall be conducted only during daylight hours. Quantities of materials to be burned shall be restricted to allow for complete burnout while the site is attended.

(j) Fire-fighting equipment shall be kept at the site in case of emergency. Arrangements shall be made with the local municipality to provide fire protection. Fire breaks shall be provided where necessary.

(k) The burning pit shall be cleaned out on a regular schedule. In no case shall ashes be allowed to accumulate to a depth of greater than 3 feet, or such lesser depth as the manufacturer recommends.

(l) A minimum separating distance of 300 feet shall be maintained between the burner and the nearest residence. In the case of an air curtain destructor located at an existing land disposal operation, a minimum separating distance of 200 feet shall be maintained between the burner and the working face of the land disposal operation.

(m) The burner location shall be screened from the surrounding area.

(n) An air curtain destructor shall be surrounded by a fence with a lockable gate. The gate to the burner shall be kept locked when no attendant is on duty.

(o) An attendant shall be on duty at all times when the blower unit is in operation.

(p) Warning signs shall be posted at intervals around the entire air curtain destructor installation notifying people to keep out of the area.

(q) A sign, acceptable to the department shall be posted at the entrance to the operation which indicates the name, license number, and hours of use of the operation, penalty for nonauthorized use, necessary safety precautions, and any other pertinent information.

(r) Surface water shall be diverted away from the active operating area, the storage area and access areas.

(s) Ash resulting from the operation shall be disposed of at a facility approved by the department to receive such material.

(t) The facility shall be operated in a nuisance-free manner consistent with this chapter and in accordance with chapter NR 154, Wis. Adm. Code.

(4) CLOSURE. Any person who operates or maintains an air curtain destructor, or permits the use of property for such purpose, shall close the site in accordance with any plan approval issued by the department and the following minimum practices:

(a) The pit shall be cleaned out, removed and properly backfilled.

(b) Provisions for alternate disposal of solid waste shall be provided.

(c) The facility area shall be cleaned up and all debris and litter collected and properly disposed.

(d) The department shall be notified in writing at least 60 days prior to the proposed closure date.

History: Cr. Register, February, 1980, No. 290, eff. 3-1-80.

NR 180.13 Solid waste land disposal sites and facilities. (1) GENERAL. No person shall operate or maintain a solid waste land disposal site or facility unless the person has obtained an operating license from the department, except as otherwise provided in sub. (2).

Note: Solid waste land spreading sites and facilities are regulated under NR 180.14. Surface impoundments are regulated under this section unless they are for temporary storage, in which case they are regulated under NR 180.07.

(2) EXEMPTIONS. (a) The following sites and facilities are exempt from all requirements of this section:

1. Sites and facilities used for the disposal of solid waste from a single family or household on the property where it is generated.

2. Solid waste land spreading sites and facilities regulated under NR 180.14.

3. Industrial wastewater facilities, sewerage systems and waterworks treating liquid wastes approved under s. 144.04, Stats., and/or permitted under ch. 147, Stats. Such exemption does not apply to the disposal of sludges or other solid waste produced during the treatment process.

4. Riprapping projects using inert solid waste materials approved by the department under s. 30.12, Stats.

(b) The following sites and facilities must be established in conformance with the locational requirements of sub. (3) (a) 5, 6, 7, and 8 and must be operated and maintained in a nuisance-free and aesthetic manner but are exempt from licensing and the other requirements of this section:

1. Sites and facilities where only earth containing less than 25% by volume of concrete and building stone are disposed.

2. Sites and facilities for the one time disposal of industrial, agricultural or demolition solid waste. Although licensing is not required for this type of site or facility, written approval by the department is required prior to establishment of the operation. These sites and facilities shall be constructed, established, maintained, operated and closed in ac-

cordance with department requirements and consistent with the provisions of this chapter.

3. Sites and facilities for the exclusive disposal of spoils from sand, gravel or stone and crushed stone quarry operations and similar nonmetallic earth materials.

4. Sites and facilities for the land disposal of dredge materials except for the following sites and facilities which must be licensed unless an exemption is granted pursuant to par. (c).

a. Sites and facilities for the disposal of more than 3,000 cubic yards of dredge materials from Lake Michigan, Lake Superior, the Wisconsin river, the Fox river, the Mississippi river, or from any inland lake or pond which has been treated with arsenicals for aquatic nuisance control.

b. Sites and facilities for the disposal of dredge materials where the department determines, based on available information, that a potential for ground or surface water pollution exists.

5. Sites and facilities for the disposal of wood residue from a saw mill, debarker or equivalent industry which produces less than 5,000 board feet of lumber per year or equivalent and the total disposal site volume is less than 500 cubic yards of wood residue.

(c) The department may grant an exemption in writing from any of the requirements of this section other than the locational requirements of sub. (3) (a) 7 and 8 for any site or facility for the land disposal of dredge materials not otherwise exempt under this subsection based upon a determination by the department that disposal of the dredge material will not result in environmental pollution as defined in s. 144.30(9), Stats. No exemptions shall be granted under this paragraph prior to field evaluation by the department. Based upon the field evaluation, the department may request and the owner or operator shall submit for review prior to a department determination a report identifying all contaminants believed to be present in the dredge material, based upon a survey of known or suspected sources of contamination, as well as representative tests for contaminant existence and concentration and, when appropriate, a description of potential contaminant leaching and movement through soil and water regimes.

(d) Any operator engaged in mining as defined under s. 144.81(5), Stats., on May 21, 1978, may, but shall not be required to, seek approval of any feasibility report or plan of operation for any site for the disposal of solid waste resulting from such mining operations.

(3) LOCATIONAL CRITERIA. (a) No person shall establish, construct, operate, maintain, or permit the use of property for a solid waste land disposal site or facility within the following areas:

1. Within 1,000 feet of any navigable lake, pond or flowage.

2. Within 300 feet of a navigable river or stream.

3. Within a flood plain.

4. Within 1,000 feet of the nearest edge of the right-of-way of any state trunk highway, interstate or federal aid primary highway or the bound-

ary of any public park, unless the site is screened by natural objects, plantings, fences or other appropriate means so as not to be visible from the highway or park.

5. Within wetlands.

6. Within critical habitat areas.

7. Within an area where the department after investigation finds that there is a reasonable probability that disposal of solid waste within such an area will have a detrimental effect on any surface water.

8. Within an area where the department after investigation finds that there is a reasonable probability that disposal of solid waste within such an area will have a detrimental effect on groundwater quality.

9. Within 10,000 feet of any airport runway used or planned to be used by turbojet aircraft or within 5,000 feet of any airport runway used only by piston type aircraft or within such other areas where a substantial bird hazard to aircraft would be created, unless a waiver is granted by the federal aviation administration, but this criteria is only applicable where such site or facility is used for disposing of putrescible waste such that a bird hazard to aircraft would be created.

10. Within 1,200 feet of any public or private water supply well.

(b) An applicant for an initial license or for approval of an expansion of an existing land disposal site or facility shall demonstrate to the department that the proposed site will be in compliance with all of the locational standards of this section for which no exemption has been granted. No exemptions from compliance with par. (a) 7 and 8 will be granted by the department. Exemptions from compliance with par. (a) 1, 2, 3, 4, 6, 9, and 10 may be granted only upon demonstration by the applicant of circumstances which warrant such an exemption. Exemptions from compliance with par. (a) 5 may be granted only in accordance with the standards to be applied in decisions affecting wetlands set forth in section NR 1.95, Wis. Adm. Code. The factors which will be considered by the department in determining whether or not to grant an exemption include waste types and characteristics, site or facility design and operational considerations, availability of other environmentally suitable alternatives, compliance with other state and federal regulations and the public health, safety and welfare.

(4) INITIAL SITE INSPECTION. Any person intending to establish a land disposal site or facility or expand an existing site shall contact the department to arrange for an initial site inspection.

(5) INITIAL SITE REPORT. (a) Any person, prior to submitting a feasibility report, may submit an initial site report in accordance with NR 180.06 (1) to the department. The purpose of submitting this report is to obtain a preliminary opinion from the department on the potential of the site for development and the advisability of spending additional time and funds to prepare a feasibility report. The department will review and respond to the initial site report within 90 days of receipt and at no cost to the applicant. A favorable determination under this section does not guarantee a favorable determination of site feasibility.

(b) An initial site report may be as detailed as the applicant chooses to make it. The greater the detail, the more certain the department can be in its response. For guidance purposes, the following indicates the type and extent of information that might be submitted in an initial site report:

1. General site information. The report should identify project title; name, address and phone number of primary contact persons for department correspondence; consultant (s); present property owner; proposed disposal site owner and operator; site location by quarter section; total acreage of property and proposed licensed acreage; proposed site life and disposal capacity; municipalities, industries and collection and transportation agencies to be served; estimated waste types and estimated weekly quantities to be disposed; anticipated covering frequency and mode of operation.

2. Regional geotechnical information. A discussion of the regional site setting should be included to provide a basis for comparison and interpretation of any site specific information obtained through field investigations. The discussion should be limited to information available from publications although some field verification and updating may be desirable. The term "regional" as utilized herein is intended to include that area which may affect or be affected by the proposed site. In most instances this will be the proposed site, and the area within a ½-mile radius for sites with 50,000 cubic yards capacity or less and a one-mile radius for larger sites. The discussions should be supplemented by maps or cross-sections, where appropriate. The following items should be addressed:

a. Topography, including predominant topographic features.

b. Hydrology, including surface water drainage patterns and significant hydrologic features such as surface waters, springs, drainage divides and wetlands.

c. Geology, including the nature and distribution of bedrock and unconsolidated deposits.

d. Hydrogeology, including depth to groundwater, groundwater flow directions, recharge and discharge areas, groundwater divides, aquifers and the identification of the aquifer used by public and private wells within 1,200 feet of the proposed site.

e. Ground and surface water quality.

3. Land use information. A discussion of the present land use of the site and surrounding area should be included. The radius of coverage should extend to all areas that may affect or be affected by the proposed site. In most instances, this will be the proposed site and the area within ½-mile for sites with 50,000 cubic yards capacity or less and a one-mile radius for larger sites. The discussion should be supplemented by maps, where appropriate. The following items should be addressed:

a. Identification of adjacent landowners.

b. Zoning.

c. Present land uses with particular emphasis on known recreational, historic or archaeological areas.

d. Present or proposed access roads and weight restrictions.

4. Site specific geotechnical information. Where the applicant chooses to gather site specific data, the following should be considered:

a. Field investigations should be performed to define the site specific topography, soil types, and depth to bedrock and groundwater. These investigations should include:

1) A partial topographic survey of the area. This map should show the proposed fill area, property boundaries, proposed site boundary, soil borings performed and wells installed. The minimum scale should be one-inch = 500 feet with the contour interval sufficient to show site relief. It is recommended that this map consist of a blowup of a USGS map (7½ or 15 minute topographical), with supplemental information added as appropriate.

2) Soil borings extending to bedrock or 25 feet below the anticipated site base grade, whichever is less. The borings should be distributed in a grid pattern throughout the area. A minimum of 5 borings is recommended.

3) Three of the borings should be developed into groundwater observation wells where groundwater is within 25 feet of the anticipated base grade. Otherwise, one of the borings should be extended to 50 feet below the anticipated base grade or to groundwater or bedrock whichever is less and an observation well established.

4) Each major soil layer encountered during boring investigations should be analyzed for grain-size distribution and classified according to the unified soil classification system.

b. The results of the subsurface investigations should be summarized utilizing a series of geologic sections which connect the soil borings performed. Each section should show present topography, borings, wells, major soil layers, water table and bedrock.

5. Data analysis. The results of the field investigations, regional geotechnical information and land use information should be analyzed and preliminary conclusions and recommendations on site development made. This should include a discussion of the potential for the site to meet the locational requirements in sub. (3) and potential limitations on site development.

6. Appendix. The site boundaries should be shown on all maps included in the appendix. The appendix should include:

a. All raw data such as boring logs, soil tests, well construction data and water level measurements.

b. A plat map of the area.

c. A USGS quadrangle of the area, updated with locations of applicable wells installed after preparation of the quadrangle.

d. A soil conservation service soil map and interpretation, if available.

e. References.

(6) FEASIBILITY REPORT. (a) No person shall establish or construct a land disposal site or facility or expand an existing site or facility without first obtaining approval of a feasibility report describing the physical conditions of the proposed site and subsequently obtaining approval of a plan of operation from the department. The purpose of the feasibility report is to determine whether the site has potential for use as a solid waste disposal facility and to identify any conditions which the applicant must include in the plan of operation. The feasibility report shall be submitted in accordance with NR 180.06(1).

(b) For sites for the disposal of only municipal solid waste having a proposed capacity of 50,000 cubic yards or less, an initial site report prepared in accordance with sub. (5) (b) shall qualify as a complete feasibility report. Sites for the disposal of industrial or commercial solid waste having a proposed capacity of 50,000 cubic yards or less may utilize the initial site report in lieu of a complete feasibility report depending upon the waste type to be disposed and the disposal location. Such allowance shall be at the discretion of the department. Where an initial site report is utilized in lieu of a complete feasibility report, all of the information specified in sub. (5) (b) shall be provided to the department, as well as the information required in sub. (6) (c) 9.

(c) For sites other than those described in par. (b), the feasibility report shall contain, at a minimum, the following information:

1. All information specified in sub. (5) (b) shall be submitted. Where an initial site report has been submitted this information may be included by reference with additional information addressing department review comments.

2. An existing site conditions plan sheet shall be prepared. This shall be a detailed topographic survey of the area of investigation. The minimum scale of this plan shall be one inch = 200 feet with a maximum 2-foot contour interval. All elevations shall be related to USGS datum. The plan shall indicate the property boundaries, proposed site boundary, fill area, survey grid and north arrow, homes, buildings, water supply wells, utility lines, man-made features, soil boring locations, observation well locations and other pertinent information.

3. Field and laboratory investigations shall be performed to further define site physical characteristics including soils, bedrock and groundwater. At a minimum, these investigations shall include:

a. Sufficient soil borings to adequately define the soil, bedrock, and groundwater conditions at the site. Under most site conditions, 5 soil borings for the first 5 acres and 3 borings for each additional 5 acres or portion thereof should be performed. A lesser number of borings may be made based on specific site conditions and site design. The borings shall be located in a grid pattern such that there is a minimum of one boring in each major geomorphic feature (e.g. ridges, lowlands and drainage swales). All borings shall extend a minimum of 25 feet below the anticipated site base grade or to bedrock, whichever is less.

b. Where soil conditions permit, soil samples shall be collected utilizing standard undisturbed soil sampling techniques. Samples shall not be composited for testing purposes. Soil samples shall be collected from

each soil layer encountered and at maximum 5-foot intervals. All soil samples shall be described.

c. Boring logs shall be recorded for all borings. Each log shall include soil and rock descriptions and method of sampling, sample depth, date of boring, water level measurements and dates, and soil test data. All elevations shall be corrected to USGS datum.

d. For each major soil layer encountered, at least 3 soil samples shall be analyzed for grain size distribution (mechanical and/or hydrometer as appropriate to the soil type) and classified according to the unified soil classification system.

e. A minimum of 3 permeability tests shall be conducted for each major soil layer. At least one of the 3 tests shall be performed utilizing in-field testing procedures.

f. Soil borings shall be converted to water table observation wells and well nests in accordance with the following schedule:

1) Three water table observation wells and one well nest for the first 5 acres or portion thereof.

2) One observation well for each additional 5 acres or portion thereof.

3) One well nest for each additional 10 acres or portion thereof.

g. The construction of each well shall be recorded on logs. Well log information shall include the elevations of the ground surface, the bottom of the boring, well seals, and screened interval, and a description of well construction materials.

h. Upon completion, each well shall be properly developed by successive pumpings and back flushings until clear when soil conditions permit.

i. Once developed, all wells shall be pumped and successive water level measurements shall be made until stabilized readings are obtained.

j. Where public or private wells are present, stabilized water level readings from these wells may be required.

k. All soil borings and monitoring wells constructed for the purpose of gathering information for the initial site report or feasibility report shall be backfilled with bentonite Portland cement slurry when such borings or wells are abandoned.

4. Data shall be presented as follows:

a. All raw data such as boring logs, well logs, soil tests and water level measurements shall be included in the report appendix.

b. A series of geologic cross-sections passing through all borings shall illustrate existing topography, soil borings, soil classification and other properties, interpreted soil stratigraphy, bedrock, well and stabilized water level readings.

c. A water table map shall be constructed based on stabilized water level readings. The existing site conditions plan shall be used as a base for this map. Seasonal changes in groundwater levels shall be predicted.

d. When more than 2 well nests have been constructed, groundwater flow net sections shall be prepared to illustrate horizontal and vertical flow directions. Where appropriate, this information may be illustrated on the geologic sections.

5. A preliminary water budget shall be prepared for the periods of time before construction, during active operations and after site closure. Factors to be considered in preparation of the water budget are precipitation, evaporation, runoff, infiltration, evapotranspiration, soil and solid waste moisture holding capacity and groundwater flow velocities and volume. The water budget information shall be related to the leachate generation rate and the effect of the site on groundwater water levels and quality.

6. The anticipated types, amounts, and characteristics of the solid waste to be disposed at the site shall be described. Except for municipal solid waste, the physical and chemical characteristics of the waste shall be analyzed and described.

7. Recommendations on design constraints for development of the site considering all available data, shall be made and reasons given for such recommendations. This shall include a discussion of the potential for the site to meet locational requirements in sub. (3). For expansion of existing facilities, the report shall include sufficient information to assess the effectiveness of the existing facility design and operation.

8. Based on the conclusions resulting from site analysis, a proposed site design shall be prepared. This shall consist of preliminary engineering plans and a general discussion of proposed operating procedures. This section of the report shall include, at a minimum, the following information:

a. A plan sheet showing proposed access, lateral extent of filling, and phases of site development. The existing site conditions map shall be utilized as a base for this sheet.

b. A series of north-south and east-west cross-sections showing present topography, proposed base grades and final grades. This information may be displayed on the geologic sections.

c. Preliminary cover balance calculations.

d. Proposed methods for leachate and gas control.

e. Proposed operating procedures including covering frequency, method of site development, method of access control, control of surface water, screening, and other special design features.

f. Proposed groundwater and other monitoring.

g. Proposed final use.

h. Proposed method of demonstrating financial responsibility and anticipated long-term care requirements.

9. To aid in determining the need for an environmental impact report or environmental impact statement, the feasibility report shall include a brief discussion of the following:

a. The purpose and need for the proposed project and for the recommended site shall be evaluated.

b. The probable adverse and beneficial physical, biological, social, economic and other impacts of proposed site development shall be identified and evaluated.

c. The probable adverse impacts of site development that cannot be avoided shall be identified and evaluated.

d. The irreversible or irretrievable commitments of resources if the site is developed as proposed shall be identified and evaluated.

e. The alternatives to the proposed site development shall be identified and evaluated.

f. The direct, indirect and cumulative effects of the proposed site development shall be identified and evaluated.

(d) Within 30 days after a feasibility report is submitted, the department shall either publish notice under s. 144.44 (2) (d), Stats., that the report is complete or notify the applicant in writing that the report is not complete, specifying the information which must be submitted before the report is deemed complete. The department will determine whether or not the feasibility report is complete by determining whether or not the minimum requirements of this subsection have been met. Additional feasibility information may be required of the applicant after a determination that the feasibility report is complete only if the department establishes that a detailed review of the feasibility report indicates that site feasibility cannot be determined in the absence of such additional information.

(e) The department may by order require the submittal of any of the information specified in this section for any existing landfill.

(7) PLAN OF OPERATION. (a) *General.* No person shall establish or construct a site or facility for the land disposal of solid waste or expand an existing land disposal site or facility until a plan of operation has been submitted in accordance with NR 180.06 (1) and approved in writing by the department, except as otherwise provided herein. No person shall establish, construct, operate, maintain, close, provide long-term care for, or terminate a site or facility for the land disposal of solid waste except in accordance with this section and with the approved plan of operation, if required by this section. Only persons who have obtained a favorable determination of site feasibility from the department may submit a plan of operation for review and approval.

(b) *Content.* All plans of operation for land disposal sites and facilities shall contain complete plans and specifications necessary for the construction, operation, monitoring, closing, long-term care and termination of the project and any additional information the department may require for the analysis of environmental impacts of the project. Because these documents are to be used for the day-to-day operation of the site, it is imperative that the information be presented in a manner that is clear and understandable. The plan of operation shall contain, at a minimum, the following information:

1. Engineering plans consisting of the following:

a. A title sheet indicating the project title, who prepared the plans, the person for whom the plans were prepared, a table of contents, and a location map showing the location of the site and the area to be served.

b. An existing site conditions plan sheet indicating site conditions prior to development. The details and extent of coverage shall be the same as that required for the existing site conditions map in subd. (6) (c) 2.

c. A base grade plan sheet indicating site base grades or the appearance of the site if it were excavated in its entirety to the base elevation, before installation of any engineering modifications or the beginning of any filling.

d. An engineering modifications plan sheet indicating the appearance of the site after installation of engineering modifications. More than one plan sheet may be required for complicated sites. This plan is required only for those sites with engineering modifications.

e. A final site topography plan sheet indicating the appearance of the site at closing including the details necessary to prepare the site for long-term care.

f. A series of phasing plan sheets showing the progression of site development through time. At a minimum, a separate plan shall be provided for initial site preparations and for each subsequent major phase or new area where substantial site preparation must be performed. Each such plan shall include a list of construction items and quantities necessary to prepare the phase indicated.

g. A site monitoring plan sheet showing the location of all devices for the monitoring of leachate production, groundwater quality and gas production and venting. This plan shall include a table indicating the parameters to be monitored for and the frequency of monitoring before and during site development. This plan sheet is required only for sites with a design capacity of more than 50,000 cubic yards.

h. A long-term care plan sheet showing the site at the completion of closing and indicating those items anticipated to be performed during the period of long-term care for the site. The plan shall include a table listing the items and the anticipated schedule for monitoring and maintenance. In many instances this information can be presented on the final site topography sheet.

i. When applicable, the following information shall be presented on the plan sheet(s):

1) All information required for the existing site conditions map as described in sub. (6) (c) 2, unless including this information leads to confusion with the data intended for display. However, in all instances, existing site topography shall be sketched lightly or otherwise indicated on the plan sheets required in pars. (c), (d), (e) and (f).

2) A survey grid with base lines and monuments to be used for field control.

3) Limits of filling for each major waste type or fill area.

4) All drainage patterns and surface water drainage control structures both within the actual fill area and at the site perimeter. Such structures may include berms, ditches, sedimentation basins, pumps, sumps, culverts, pipes, inlets, velocity breaks, sodding, erosion matting, or other methods of erosion control.

5) The direction and sequence of filling within each phase.

6) Ground surface contours at the time represented by the drawing. Spot elevations should be indicated for key features.

7) Areas to be cleared and grubbed and stripped of topsoil.

8) Borrow areas for liner materials, gas venting materials, berms, roadway construction, daily cover and final cover.

9) All soil stockpiles including daily and final cover, topsoil, liner materials, gas venting materials and other excavation.

10) Access roads and traffic flow patterns to and within the active fill area.

11) All temporary and permanent fencing.

12) The methods of screening such as berms, vegetation or special fencing.

13) Leachate collection, control and treatment systems which may include pipes, manholes, trenches, berms, collection sumps or basins, pumps, risers, liners and liner splices.

14) Gas, leachate and groundwater monitoring devices and systems.

15) Severe weather disposal areas.

16) Support buildings, scale, utilities, gates and signs.

17) Special waste handling areas.

18) Construction notes and references to details.

19) Other appropriate site features.

j. A series of site cross-sections shall be drawn perpendicular and parallel to the site base line at a maximum distance of 500 feet between cross-sections and at points of grade break and important construction features. The location of the cross-sections shall be shown on the appropriate plan sheet(s) and the section labeled using the site grid system. Where applicable, each cross-section shall show existing, proposed base and final grades; soil borings and monitoring wells which the section passes through or is adjacent to; soil types, bedrock and water table; leachate control, collection and monitoring systems; gas venting and monitoring systems; limits of filling for each major waste type; drainage control structures; access roads and ramps on the site perimeter and within the active fill area; the filling sequence or phases; and other appropriate site features.

k. Detailed drawings and typical sections for, as appropriate, drainage control structures, access roads, fencing, leachate and gas control systems and monitoring devices, buildings, signs and other construction details.

2. An operations manual and design report consisting of the following information:

a. The report shall identify the project title; engineering consultant (s); site owner, licensee and operator; proposed licensed acreage; site life and capacity; municipalities, industries and collection and transportation agencies served; waste types and quantities to be disposed; and any exemptions applied for.

b. Specifications for site construction and operation shall be presented, including detailed instructions to the site operator for all aspects of site construction and operation. References to specifications on the plan sheet shall be pointed out as well as additional instructions included, where appropriate. The specifications shall include, at a minimum the following information:

1) Initial site preparations including specifications for clearing and grubbing, topsoil stripping, other excavations, berm construction, drainage control structures, leachate collection system, access roads and entrance, screening, fencing, groundwater monitoring and other special design features.

2) A plan for initial site preparations including a discussion of the field measurements, photographs to be taken, sampling and testing procedures to be utilized to verify that the in-field conditions encountered were the same as those defined in the feasibility report, and to document that the site was constructed according to the engineering plans and specifications submitted for department approval.

3) Daily operations including a discussion of the timetable for development, waste types accepted or excluded, typical waste handling techniques, hours of operation, traffic routing, drainage and erosion control, windy, wet and cold weather operations, fire protection equipment, manpower, methods for handling of unusual waste types, methods for vector, dust and odor control, daily clean-up, direction of filling, salvaging, record keeping, parking for visitors and employes, monitoring, abandonment of filled areas, gas and leachate control methods, backup equipment with names and telephone numbers where equipment may be obtained, and other special design features. This may be developed as a removable section to improve accessibility for the site operator.

4) Development of subsequent phases consisting of a discussion of those items in subds. 2.b. 1), 2), and 3), above as they relate to the development of subsequent phases of the site.

5) Site closing information consisting of a discussion of the anticipated sequence of events for site closing and a discussion of those actions necessary to prepare the site for long-term care and final use.

6) Long-term care information including a discussion of the procedures to be utilized for the inspection and maintenance of runoff control structures, settlement, erosion damage, gas and leachate control feasibilities, monitoring for gas, leachate and groundwater, and other long-term care needs.

7) An economic analysis including an engineer's cost estimate for the construction of each major phase of site development, daily operation, site closing, and long-term care.

c. A design report shall be submitted which shall include supplemental discussions and design calculations to facilitate department review and provide supplemental information on financial responsibility and long-term care as required by ss. 144.44 and 144.441, Stats., including the following information:

1) A discussion of the reasoning and logic behind the design of the major features of the site, such as traffic routing, base grade and relationships to subsurface conditions, anticipated waste types and characteristics, phases of development, liner design, facility monitoring, and similar design features shall be provided. A list of the conditions of site development as stated in the department determination of site feasibility and the measures taken to meet the conditions shall be included. A discussion of all calculations, such as refuse-cover balance computations, stockpile sizing estimates, estimate of site life and runoff and leachate volume estimates shall be included. The calculations shall be summarized with the detailed equations presented in the appendix.

2) A detailed analysis in accordance with NR 180.15 shall be made of the financial responsibility for long-term care from the time of site closing to termination.

d. An appendix shall be submitted which shall include any additional data not previously presented, calculations, material specifications, operating agreements, leachate treatment agreements, documents related to long-term care funding and other appropriate information.

(c) *Completeness.* Within 30 days after a plan of operation is submitted, the department shall notify the applicant in writing that the plan is either complete or not complete, specifying the information which must be submitted before the report is deemed complete: The department will determine if the plan of operaton is complete by determining whether or not the minimum requirements of this subsection have been met. Additional plan of operation information may be required of the applicant after a determination that the plan of operation is complete only if the department establishes that a detailed review of the plan of operation indicates that the plan of operation is insufficient in the absence of such additional information.

(8) The department may require that a registered professional engineer document site construction and render an opinion whether the site has been constructed and/or operated in substantial conformance with the plan of operation.

(9) Prior to licensing the owner or operator shall submit proof that a notation of the existence of the site has been recorded in the office of the register of deeds in each county in which a portion of the site is located.

(10) Minimum requirements for land disposal site or facility design and operation. (a) *New and existing sites and facilities.* No person shall operate or maintain a new or existing land disposal site or facility except in conformance with any approved plan of operation and the following minimum requirements:

1. Open burning is prohibited, except where all of the following criteria are satisfied:

a. The site or facility serves a population equivalent of less than 2,500 or, if the operation is controlled by more than one municipality, a population equivalent of less than 2,500 for each such municipality. The department shall give consideration to seasonal variations in population in granting partial yearly burning exemptions.

b. All portions of the licensed site are greater than ¼-mile from any residence or place of public gathering, or written consent is obtained from all residents and proprietors within ¼-mile of the burning operation at the time the site is initially licensed.

c. The open burning does not include the burning of wet combustible rubbish, garbage, oily substances, asphalt, plastic or rubber products.

d. The burning operation is supervised by an attendant.

e. The burning is accomplished in a nuisance-free manner and does not create hazards for adjacent properties.

f. Adequate firebreaks are provided and provision is made to obtain the services of the local fire protection agency if needed.

g. The open burning is not in violation of any federal air pollution control rules, or any state air pollution control rules required to be adopted under applicable federal laws or regulations.

h. The operation is not located in one or more of the following counties: Kenosha, Milwaukee, Ozaukee, Racine, Walworth, Washington or Waukesha.

2. No solid waste shall be deposited in such a manner that the solid waste or leachings therefrom will have a detrimental effect on any ground or surface water.

3. Deposition of solid waste shall be confined to as small an area as practical.

4. The deposition and active area shall be provided with facilities to confine windblown material within that area.

5. At the conclusion of each day of operation, all windblown material shall be collected, returned to the deposition area, and properly disposed of in accordance with the provisions of this section unless the operator establishes, to the satisfaction of the department,that all the following criteria are satisfied:

a. All windblown material cannot be collected using reasonable efforts because of conditions beyond the control of the operator.

b. The operator has collected and properly disposed of all windblown materials which can be collected using such reasonable efforts.

c. Nuisance conditions do not exist.

6. To provide for maximum compaction, each single layer of municipal solid waste shall be spread and compacted in 2-foot layers.

7. All unprocessed municipal solid waste shall be compacted and covered at the end of each operating day with a compacted layer of 6 inches

of soil, except that the department may grant an exemption in writing for less frequent covering if the following criteria are satisfied:

a. For operations serving a population equivalent of less than 2,500:

1) All portions of the licensed operation shall be greater than ¼-mile from any residence or place of public gathering or written consent shall be obtained from all residents and proprietors living within ¼-mile of the operation at the time the site is initially licensed.

2) Potential nuisance conditions shall not be created.

3) The solid waste shall be compacted and covered with at least 6 inches of soil, no less frequently than once per month, except for the months of December, January, February and March.

b. For operations serving a population equivalent of 2,500 or greater:

1) All portions of the licensed operation shall be greater than ¼-mile from any residence or place of public gathering or written consent shall be obtained from all residents and proprietors living within ¼-mile of the operation at the time the site is initially licensed.

2) The operation does not receive any garbage or other putrescible wastes.

3) Potential nuisance conditions shall not be created.

4) The solid waste shall be compacted and covered with at least 6 inches of soil, no less frequently than once per month.

8. All processed municipal solid waste, industrial waste and commercial waste shall be compacted and covered at the end of each operating day with a compacted layer of 6 inches of soil, except the department may grant an exemption in writing for less frequent covering. In granting such exemptions, the department shall consider the characteristics of the solid waste, the leaching potential of the solid waste, and the potential for nuisance conditions if other than daily covering is utilized.

9. Surface water drainage shall be diverted away from the working area and off of the landfill operation.

10. Putrescible materials such as spoiled foods and animal carcasses shall be immediately covered and compacted.

11. Access to the facility shall be restricted through the use of fencing, natural barriers, or other methods approved in writing by the department.

12. Effective means shall be taken to limit access to the active disposal area to minimize exposure of the public to hazards.

13. Effective means shall be taken to control flies, rodents, and other insects and vermin.

14. All access roads to the active area of the operation shall be of all-weather construction and shall be maintained in good condition.

15. Equipment shall be provided to control accidental fires and arrangements shall be made with the local fire protection agency to acquire its services when needed.

16. An attendant shall be on duty at the operation at all times while it is open for public use.

17. A gate shall be provided at the entrance to the operation and it shall be kept locked when an attendant is not on duty.

18. The gate area shall be policed at the beginning of each day of operation to remove any solid waste which may have been indiscriminately dumped during periods when the site was closed.

19. A sign, acceptable to the department, shall be posted at the entrance to the operation of any site operated for public use which indicates the name, license number, and hours of use of the operation, penalty for unauthorized use, necessary safety precautions, and any other pertinent information.

20. The site shall be surrounded with rapidly growing trees, shrubbery, fencing, or other appropriate means to screen it from the surrounding area and to provide a wind break.

21. Effective means shall be utilized to prevent the migration of explosive gases from within the limits of waste fill. At no time shall the concentration of explosive gases in any facility structures (excluding gas control or recovery system components) or in the soil at or beyond the site property boundary exceed the lower explosive limit for such gases.

22. Any area to be utilized for the disposal of solid waste or borrow areas shall first be stripped of all topsoil and the topsoil shall be stockpiled to insure that adequate amounts are available for closure.

23. Effective means shall be taken to control dust resulting from site operation.

24. All soil borings and monitoring wells shall be backfilled with a bentonite Portland cement slurry when such borings or wells are abandoned.

25. Facility monitoring shall be performed in accordance with sub. (10) [(11)].

26. Site closure shall be accomplished in accordance with the approved plan of operation or, for those sites with no approved plan of operation, in accordance with sub. (11) [(12)].

27. Scavenging within the active disposal area is prohibited when such activity interferes with site operation.

28. Provisions for back-up equipment in the event of operating equipment breakdown shall be made.

29. A minimum separation distance of 20 feet shall be maintained between the limits of waste filling and adjacent property.

30. All topsoil within the site construction limits shall be salvaged and stored on-site in a nuisance-free manner for use in site closure.

31. Provisions shall be made for leachate treatment for all sites designed to contain and collect leachate.

32. Only wastes types and sources listed on the license or otherwise approved by the department in writing shall be accepted for disposal.

(b) *Additional requirements applicable to new and expanded sites and facilities.* No person shall construct, establish, operate or maintain a new land disposal site or facility or an expansion of an existing site or facility except in accordance with the requirements of par. (a), the approved plan of operation, and the following additional requirements.

1. All access roads shall be constructed with a maximum grade no greater than 10%. The intersection of the access road with an existing highway shall be designed to provide sufficient sight distance and provide for minimum interference with traffic on existing highways.

2. All surface water drainage ditches, culverts and other drainage control structures shall be designed for a 10 year, 24-hour rainfall event as defined in section NR 205.05, Wis. Adm. Code.

3. All base grades shall be designed and constructed with a minimum slope of one percent.

4. The final slopes of a completed land disposal site or facility shall be no less than 2% and no greater than 3 horizontal to one vertical unless the site or facility is specifically designed for a final use compatible with other slopes.

5. All sites shall have a final cover designed to minimize infiltration and subsequent leachate production.

6. All borrow areas shall be abandoned in accordance with Wisconsin department of transportation procedures.

7. A minimum separation distance of 100 feet shall be maintained between the limits of waste filling and adjacent property.

(11). MONITORING. The department may require the owner or operator of any land disposal site or facility, or any person who permits the use of property for such purpose, to conduct monitoring of groundwater, leachate, gas, surface water, or other physical features.

(a) *Groundwater and leachate monitoring.* The department may require the installation of groundwater and leachate monitoring wells, lysimeters, moisture probes, and similar devices, and water quality sampling and analysis programs to detect the effects of leachate on groundwater. The location of such monitoring devices shall be approved in writing by the department.

1. The number of required wells shall be approved by the department based on the site size, waste type(s), site design and the hydrogeologic and geologic setting of the site. Unless otherwise specified by the department, the minimum number of monitoring wells shall be in accordance with the following:

TABLE 3

Site Size (maximum design capacity)	Up-gradient Wells	Down-gradient Wells	Well Nests
0-50,000 cubic yards	1	2	0
50,000-500,000 cubic yards	2	2	1
500,000-up	2	4	2

2. Water level measurements and sampling of monitoring wells shall be accomplished in accordance with the schedule set forth in the plan of operation. This schedule may vary depending on site geology, hydrogeolgy and design. Sampling and test schedules for other groundwater monitoring devices shall be approved by the department. The results of all water elevation measurement and sampling shall be reported to the department within 60 days of sampling. All data shall be submitted on forms supplied by the department. Unless otherwise specified by the department, the minimum frequency shall be as follows:

TABLE 4

Site Size (maximum design capacity)	Within 15 days of:	Parameters (See Table 5)
50,000 cubic yards or less	March 15	All
	September 15	All
Greater than 50,000 cubic yards	March 15	All
	June 15	All
	September 15	All
	December 15	All

3. The methods of groundwater and leachate sample collection, preservation, and analysis shall be accomplished in accordance with standard methods for the examination of water and wastewater or other methods approved in writing by the department.

4. All monitoring wells shall be constructed utilizing a minimum 2-inch inside diameter PVC pipe or similar inert material.

5. The department may require the operator to sample public or private wells as part of a regular monitoring program or to determine the extent of groundwater contamination.

6. If for any reason a monitoring well or other monitoring device is destroyed or otherwise fails to properly function, the site operator shall immediately notify the department in writing. All such devices shall be properly abandoned and replaced with a functioning device within 60 days of notification to the department unless the operator is notified otherwise in writing by the department.

7. Sampling parameters shall be in accordance with Table 5 unless otherwise specified by the department. In most instances, additional parameters will be specified for paper mill sludge, fly or bottom ash, and foundry waste depending on the waste characteristics and process raw materials utilized. In all cases, the physical appearance of the water sample including odor, color and turbidity at the time of sampling shall be recorded.

TABLE 5

Waste Type Handled at Land Disposal Site	Parameters
Municipal Solid Waste	Water elevation, field pH, field conductivity, COD, dissolved iron, hardness, chloride, alkalinity.
Paper Mill Sludge	Same as above.
Fly or Bottom Ash	Water elevation, field pH, field conductivity, COD, hardness, alkalinity, sulfates, dissolved iron, boron.
Wood Waste	Water elevation, field pH, field conductivity, COD, hardness, dissolved iron, alkalinity.
Foundry Wastes	Water elevation, COD, field pH, field conductivity, hardness, sodium, alkalinity.
Other Solid Waste	As specified by the department.

8. No person shall begin filling operations at a new solid waste disposal site or facility until background groundwater quality in accordance with the parameters in Table 5 has been determined and results of such analyses submitted to the department.

(b) *Gas monitoring.* The department may require the installation of gas monitoring devices and sampling and analysis programs for protection against potential detrimental effects of gas production and to monitor the effectiveness of gas venting systems. Sample collection and analysis techniques shall be in accordance with standard methods.

(c) *Surface water monitoring.* The department may require monitoring of surface water runoff, leachate seeps, sump pumpings, sedimentation ponds and other surface water discharges resulting from site operation and of surface waters which may be affected by such discharges. Sampling times and parameters shall be as specified by the department.

(d) *Monitoring of physical features.* The department may require monitoring of air quality, landfill settlement, berm stability, vegetation growth, drainage control structures, or other aspects of site operation.

(e) *Operations report.* The department may request the owner or operator of any land disposal site or facility, or any person who permits the use of property for such purpose, to submit an operations report to assess the effectiveness and environmental acceptability of site operations. The contents of the report may include a discussion and analysis of entrance and access roads, windblown debris, confinement of active area, analysis of gas and leachate and other monitoring, cover to refuse ratios, surface water control and erosion control, revegetation, settlement, volume utilized, site users, leachate quantity and quality, slope stability, equipment performance and volume and type of waste accepted.

(12) CLOSURE. (a) Any person who maintains or operates a land disposal site or facility, or who permits use of property for such purpose shall, when the fill area or a portion thereof reaches final grade, or when the department determines that closure is required, cease to accept waste and close the site or portion thereof in accordance with any plan approval issued by the department and the following minimum practices:

1. At least 120 days prior to the closing of the site, the owner or operator shall notify the department in writing of intent to close the site. At

the same time, or preferably prior to this date, the owner or operator shall notify all users of the facility of intent to close the site.

2. Within 10 days after ceasing to accept waste, the following shall be accomplished at a minimum:

a. Access shall be restricted by the use of gates, fencing or other appropriate means to insure against further use of the site. In the event the site final use allows access, such access shall be restricted until site closure has been completed and approved by the department.

b. Notification of closure shall be posted at the gate by proper signs indicating date of closure and alternative disposal site (s).

c. Notice shall be published in a local newspaper and a copy of the notice shall be provided to the department within 10 days of the date of publication.

3. Within 60 days after ceasing to accept waste, closure shall be accomplished in the following manner:

a. The entire area previously used for disposal purposes shall be covered with at least 2 feet of compacted earth sloped adequately to allow surface water runoff. A specific soil type may be required by the department for this 2-foot layer. Fine grain soils should be utilized to minimize infiltration. Top slopes shall be no less than 2%. Side slopes shall be no steeper than 33%.

b. Surface water shall be diverted to limit potential for erosion and sedimentation. Wherever possible, surface water shall be diverted around previously filled areas. Where it is necessary to divert drainage over previously filled areas, drainage shall be conveyed by clay lined drainage swales having a minimum depth of 2 feet.

c. The finished surface of the filled area shall be covered with a minimum of 6 inches of topsoil.

4. Within 90 days after ceasing to accept waste, seeding, fertilizing and mulching of the finished surface shall be accomplished in accordance with the site final use. The seed type and amount of fertilizer shall be selected depending on the type and quality of topsoil and compatability with native vegetation.

5. Following closure of the land disposal site, the site shall be inspected and maintained by the owner or operator until it becomes stabilized or until the responsibility of the owner or operator terminates in accordance with the plan approval. The department may require installation of groundwater and leachate monitoring wells or other devices, groundwater and leachate quality sampling and analysis programs, gas monitoring and sampling and provisions for the protection against detrimental effects of leachate and gas migration from any land disposal site.

(13) Closure plans may be required by the department for sites and facilities not approved under this section. The department may require that the plans address any or all of the information outlined in subs. (6), (7), (10), and (11).

History: Cr. Register, February, 1980, No. 290, eff. 3-1-80.

NR 180.14 Solid waste land spreading sites and facilities. (1) GENERAL. No person shall operate or maintain a solid waste land spreading site or facility unless the person has obtained an operating license from the department, except as otherwise provided in sub. (2).

(2) EXEMPTIONS. (a) The following land spreading sites and facilities are exempt from the requirements of this section, but must be developed, operated and maintained in a safe, nuisance-free manner:

1. Sites used for the land spreading of nonhazardous solid waste from a single family or household, a member of which is the owner, occupant, or lessee of the property used for solid waste disposal.

2. Farms on which only nonhazardous agricultural solid wastes resulting from the operation of a farm, including farm animal manure, are disposed.

3. Sites receiving only sludge from a publicly-owned treatment work or a privately-owned domestic sewage treatment work having a permit under ch. 147, Stats., providing the sludge disposal is accomplished in accordance with the requirements of the permit.

4. Sites used exclusively for the disposal of waste regulated under chapter NR 113, Wis. Adm. Code.

5. Sites used for the disposal of treated liquid municipal or industrial wastewater approved under s. 144.04, Stats., and/or permitted under ch. 147, Stats.

6. Sites used for the land spreading of whey providing the whey is applied as a soil conditioner or fertilizer in accordance with accepted agricultural practices.

7. Sites used for the land spreading of by-products from canned, frozen or preserved fruit and vegetable processing operations providing the by-products are applied as soil conditioners or fertilizers in accordance with accepted agricultural practices.

8. Nonagricultural or nonsilvicultural sites used for the land spreading of solid waste or solid waste derived products with demonstrated soil conditioning or fertilizer value providing the material is applied for soil amendment purposes. Examples of such sites are golf courses or public parks where compost material is land spread.

9. Sites used for the land spreading of lime sludges from papermills providing the sludge its applied as a soil conditioner or fertilizer in accordance with accepted agricultural practices.

10. Sites used for the land spreading of other wastes similar in nature to those identified in subds. 1-9 providing written approval is obtained from the department.

(b) The following land spreading sites and facilities are exempt from the licensing requirements of this section, but must obtain approval in writing from the department pursuant to sub. (4) prior to their establishment and operation and must meet all other applicable provisions of this section:

1. Agricultural or silvicultural sites used for the land spreading of non-hazardous solid waste demonstrated to have soil conditioning and/or fertilizer value, providing the waste is applied as a soil conditioner or fertilizer in accordance with accepted agricultural practices.

2. Land spreading sites utilized on a limited, controlled, experimental basis for the purpose of studying the feasibility of using a solid waste as a soil conditioner or fertilizer.

(c) Land spreading sites used solely for research purposes under the direction of a Wisconsin registered professional engineer or a scientist employed by a university located within this state are exempt from the licensing and plan submittal requirements of this section provided that they meet the following requirements:

1. The net plot area, excluding plot borders and buffer strips, shall not exceed 4 acres.

2. The available nitrogen and heavy metal additions averaged over the total plot area shall not exceed the rates recommended by the department for municipal sewage sludges.

3. The site shall be developed, operated, and maintained in a safe, nuisance-free manner consistent with the intent of this section.

4. Copies of the research proposal shall be provided to the department in advance of initiating the research and all reports and research publications pertaining to the site shall be provided to the department.

(3) LOCATIONAL CRITERIA. No person shall establish, construct, operate, maintain or permit the use of property as a land spreading site or facility within the following areas:

(a) Within wetlands

(b) Within 100 feet of any navigable body of water. A vegetative buffer strip shall be maintained between the navigable water and the application site.

(c) Within critical habitat areas.

(d) Within an area where the department after investigation finds that there is a reasonable probability that disposal of solid waste within such an area will have a detrimental effect on any surface water.

(e) Within an area where the department after investigation finds that there is a reasonable probability that disposal of solid waste within such an area will have a detrimental effect on groundwater quality.

(f) Within 10,000 feet of any airport runway used or planned to be used by turbojet aircraft or within 5,000 feet of any airport runway used only by piston type aircraft or within such other areas where a substantial potential bird hazard to aircraft would be created, unless a waiver is granted by the federal aviation administration, but this criteria is only applicable where such site or facility is used for disposing of putrescible waste such that a bird hazard to aircraft would be created.

(g) Within 1,000 feet of public water supply wells and/or 200 feet of private water supply wells.

(h) Within 500 feet of any residence, except that this distance may be reduced for the residence of the property owner on whose land solid waste is spread.

(4) SOLID WASTE LAND SPREADING PLAN. No person shall establish or construct a solid waste land spreading site or facility or expand an existing site or facility without first obtaining written approval from the department of a solid waste land spreading plan except as otherwise provided herein. The land spreading plan shall include in a detailed and understandable fashion the following:

(a) A description and analysis of each waste type proposed for deposition at a land spreading facility. Data on waste types shall include, at a minimum the following information:

1. The sources, processes, and/or treatment systems from which the wastes originate.

2. Waste pretreatment or waste processing techniques required prior to land spreading.

3. The volumes of solid waste to be land spread, stored, and/or disposed.

4. The physical and chemical characteristics of the waste obtained from representative waste samples. The parameters to be analyzed for shall be consistent with the waste material and shall in general, include but not be limited to, the following:

a. Physical characteristics including solids fraction and organic fraction.

b. pH.

c. Nutrient content including nitrogen, phosphorous, and potassium.

d. Metals content including arsenic, cadmium, chromium, copper, lead, mercury, nickel and zinc.

e. Salt content including chlorides, fluorides and sulfates.

f. Biological populations including total coliform, fecal coliform and any virus known to exist in the waste material.

g. Other parameters such as oils and greases, phenolics, pesticides, toxic substances and persistent organics, if present in the waste material.

(b) An assessment and analysis of data including conclusions drawn concerning the potential benefits and adverse effects of the land spreading program. Such assessment shall include a demonstration that the waste has value as a soil conditioner or fertilizer. Demonstration methods may include:

1. Documentation of previous successful uses of the solid waste, or other solid wastes with similar compositions, properties, and characteristics.

2. Documentation of compliance with existing Wisconsin department of agricultural, trade and consumer protection regulations pertaining to the licensing and marketing of fertilizers or soil conditioners.

3. Successful completion of an approved experimental solid waste land spreading program.

4. Other justification for use of the solid waste subject to written department approval.

(c) A description of information on the characteristics of the sites to be used for the land spreading program including, at a minimum, the following:

1. The site locations including copies of soils maps, plat maps and USGS topographic maps.

2. A description of the contracts or agreements covering use of the land including owner's name, address and telephone number.

3. A description of on-site land uses and current land uses on surrounding properties.

4. A description of the geology and hydrogeology of the site including the identification of all homes and/or private wells located within ¼ mile of the site.

5. A description of the crops to be grown or dominant vegetation on the site.

6. Soil test results from samples taken on-site. Parameters to be analyzed shall include soil pH, organic matter, available phosphorus, available potassium, and other parameters deemed necessary for analysis and design of the proposed operation.

7. A description of other soil additives to be used.

(d) Information on site design, site development and operating plans including, at a minimum, the following:

1. Provisions for interim waste storage and/or disposal when normal land spreading sites are unavailable or inaccessible, including:

a. Type of storage or disposal

b. Location of storage or disposal facility

c. Capacity of storage or disposal facility

d. Construction details

e. Property interest or contractual agreement allowing use of the storage or disposal facility.

f. Future anticipated use of the storage or disposal facility.

g. Evaluation of environmental effects resulting from use of the storage or disposal facility.

2. Proposed mode of waste transportation, including:

a. The transporter of the waste

b. The method of transportation

c. The type of vehicle used for waste transportation

d. Spill contingency plans and notification procedures

3. Proposed waste application rates, techniques, disposal frequencies and locations.

4. Proposed maximum rates of application (annual and cumulative) for nitrogen, cadmium, and other heavy metals.

5. Proposed crop monitoring, soil, groundwater and surface water monitoring.

6. Proposed record keeping and reporting procedures to be used for monitoring waste volumes applied, application rates, disposal locations, and cumulative waste loading applied to each site.

(e) For sites and facilities required to be licensed, proposed site closure, maintenance, and long-term care procedures, and final land use plans for each land spreading site.

(f) For sites and facilities required to be licensed, proof of financial responsibility as specified in NR 180.15.

(5) OPERATING REQUIREMENTS. No person shall operate or maintain a solid waste land spreading site or facility, except in conformance with an approved solid waste land spreading plan, if required, and the following minimum requirements:

(a) Only approved waste types shall be disposed at the site. Plans to accept additional waste types require separate written approval from the department.

(b) The solid waste land spreading plan may be amended at any time, subject to written approval of the department. Any proposed amendment shall contain the same type of information required in the original land spreading plan. The amended plan may not be put into effect until it has been approved by the department.

(c) No solid waste shall be land spread in a manner that causes detrimental effects on ground or surface water quality.

(d) Depending on the type of operation to be conducted, solid waste materials shall be plowed, disced, or otherwise incorporated into the surface soil layer at appropriate intervals as specified in the solid waste land spreading plan to minimize surface water runoff and surface leaching and to control objectionable odors.

(e) No solid waste shall be deposited in areas containing ponded or standing water.

(f) Maximum one time and/or cumulative application rates for cadmium and/or other heavy metals shall be strictly observed for disposal on land used for growing food chain crops.

(g) Waste materials with significant pathogen contents shall be properly stabilized prior to land spreading.

(h) Food chain crops grown on solid waste land spreading sites which have received waste applications containing pesticides or persistent organic materials shall not be marketed or used for human or animal consumption unless the crops meet all applicable contaminant levels as established by the United States food and drug administration.

(6) MONITORING. The owner or operator of every solid waste land spreading facility with an approved solid waste land spreading plan shall submit monitoring reports to the department on a frequency established in the land spreading plan. The report shall include the following information for each site utilized during the preceding reporting period:

(a) The amount of solid waste applied in tons per acre on a dry weight basis.

(b) The amount of nitrogen applied in pounds per acre on a dry weight basis.

(c) The amount of cadmium applied in pounds per acre on a dry weight basis.

(d) The total amount of each specific metal applied in pounds per acre as requested by the department on a dry weight basis.

(e) Other site monitoring results as specified in the approved land spreading plan.

(f) A description of any adverse environmental, health, or social effects that occurred due to solid waste disposal.

(g) A description of any action not in conformance with the approved land spreading plan.

(7) CLOSURE. Any person who operates or maintains a licensed land spreading facility, or permits the use of property for such purpose shall accomplish closure, maintenance and long-term care of the facility in accordance with any solid waste land spreading plan approval issued by the department and with the following minimum practices:

(a) At least 120 days prior to the closing of a licensed solid waste land spreading facility, the owner or operator shall notify the department, in writing, of the intent to close the site. This notice shall include the following information:

1. The proposed final date by which all solid waste disposal or land spreading operations will be terminated.

2. The current waste types, sources, and volumes of solid wastes being deposited at the site.

3. The cumulative volumes of waste which were applied to the site during active operations.

4. The reasons and/or intent for closing the site.

5. The proposed future land uses of those areas previously used for waste deposition.

6. Special precautions to be utilized, if appropriate, to limit access to the facility, and to insure that no further solid waste materials are deposited after the closure date.

7. The proposed site closure, site monitoring, and long-term care procedures to be implemented following site closure. These procedures shall be in accordance with the approved solid waste land spreading plan or any proposed modifications to the plan.

8. The alternate licensed sites or approved facilities to be utilized for waste disposal and/or land spreading purposes following closure of the facility.

(b) The department will review the notice of intent to close the facility and will approve or disapprove in writing the proposed closure procedures. The departmemt may require additional information, or may require additional closure, maintenance, and/or long-term care procedures to be implemented to insure proper closure of the site.

1. If the facility to be closed was initially licensed under this section, site closure, maintenance, and long-term care procedures shall be conducted in accordance with the approved solid waste land spreading plan unless subsequently modified, or unless otherwise specified by the department.

2. If the facility to be closed was not initially licensed under this section, a final site closure and long-term care and monitoring plan shall be prepared and submitted to the department for approval as part of the notice of intent for site closure.

(c) No person shall deposit any solid waste materials at a closed site without the prior written authorization of the department, and the approval of the site owner.

(d) Within 90 days of the final closure date of a site, all closure work shall be completely and finally performed in accordance with this subsection.

(e) Complete and proper final closure of a land spreading site may include, but not be limited to, the following:

1. Discing, plowing, or otherwise incorporating all deposited solid waste materials into the surface soil layers, or covering all land spreading areas with an adequate thickness of final earth cover material.

2. Providing for the control of surface water runoff to minimize adverse effects on surface and/or groundwater quality.

3. Establishing a vegetative cover to promote evapotranspiration and to control soil erosion, and/or otherwise preparing the land surface for the intended future land use.

4. Continuing to grow crops and conducting the associated monitoring work.

5. Performing the required environmental monitoring work associated with the approved final closure and long-term care plans.

(f) The department shall require long-term care as defined in s. 144.441, Stats., only of licensed land spreading facilities for which waste

management fund monies may be expended in accordance with s. 144.44 (3), Stats. The department may require the following provisions:

1. Erosion control and maintenance of vegetation.

2. Control of surface drainage.

3. Ground and/or surface water quality monitoring.

4. Gas monitoring.

5. Soils and/or crop testing programs.

6. The preparation and submittal of monitoring data and/or reports.

(8) WASTE MANAGEMENT FUND. Land spreading sites and facilities which are exempt from licensing are not required to contribute to the waste management fund.

(9) PUBLIC PARTICIPATION. For sites requiring approval of a solid waste land spreading plan, the department prior to approval shall prepare an environmental impact assessment screening worksheet and provide opportunity for public comment according to the procedures established in chapter NR 150, Wis. Adm. Code, except that the notice shall be published as a class 1 notice under ch. 985, Stats. The department shall hold a hearing on the proposed land spreading plan if a written request for a hearing is filed by any county, city, village or town, or by any 6 persons within 30 days from the time the notice is published. A hearing under this subsection shall be held within 60 days after receipt of the request and shall be conducted as provided in s. 227.022, Stats. The hearing shall be held in an appropriate place designated by the department in one of the counties, cities, villages or towns which could be affected by the operation of a proposed site.

(10) Prior to licensing a site, the owner or operator shall submit proof that a notation of the existence of the site has been recorded in the office of the register of deeds in each county in which a portion of the site is located.

History: Cr. Register, February, 1980, No. 290, eff. 3-1-80.

NR 180.15 Long-term care. (1) Owners of sites for the land disposal of solid wastes which are approved and licensed after May 20, 1978, or which were initially licensed between May 21, 1975, and May 20, 1978, and whose owner successfully applies before May 21, 1980, for a determination by the department that the site's design and plan of operation comply substantially with the requirements of this chapter, shall be responsible for the long-term care of the site for either 20 or 30 years after site closure, except as otherwise provided, unless the owner's responsibility is terminated earlier in accordance with s. 144.441 (2) (d), Stats. The owner shall specify at the time of submittal of the plan of operation whether the owner chooses, subject to department approval, to be responsible for 20 years or 30 years.

(2) (a) Owners responsible for closure and long-term care of sites shall submit as part of the initial license application a bond payable to the state of Wisconsin, department of natural resources in the amount determined according to this section conditioned upon faithful perfor-

mance by the owner and any successor in interest of all closure and long-term care requirements of the approved plan of operation.

(b) Bonds shall be issued by a surety company licensed to do business in this state. At the option of the owner, a performance bond or a forfeiture bond may be filed. Surety companies may have the opportunity to complete the closure and long-term care of the site in lieu of cash payment to the department.

(c) Each bond shall provide that the bond shall not be cancelled by the surety, except after not less than 90 days notice to the department in writing by registered or certified mail. Not less than 30 days prior to the expiration of the 90 day notice period, the owner must deliver to the department a replacement bond in absence of which all disposal operations shall immediately cease. If the surety company's license to do business is revoked or suspended, the site owner shall, within 30 days after receiving written notice thereof, deliver to the department a replacement bond in absence of which all disposal operations shall immediately cease.

(d) In lieu of a bond, the owner may deposit cash, certificates of deposit, or government securities with the department in the amount determined according to this section. Deposits placed with the department will be segregated and, if applicable, invested in an interest bearing account. The department shall have the right to use part or all of the funds to carry out the closure and long-term care requirements of the approved plan of operation if the owner or operator fails to do so. The department shall mail notification of its intent to use funds for that purpose to the last known address of the owner or operator. If the owner or operator requests a hearing in writing within 60 days thereafter, the department shall prior to using the funds, hold a hearing pursuant to s. 277.064, [227.064] Stats., for the purpose of determining whether or not the long-term care requirements of the approved plan of operation have been carried out.

(e) In lieu of a bond or deposit, the owner may establish an escrow account with a bank licensed to do business in this state in the amount determined according to this section. The escrow account shall consist of cash, certificates of deposit, or government securities. The department shall be a party to the escrow agreement, which shall provide that there shall be no withdrawals from the escrow account except as authorized in writing by the department. The escrow agreement shall further provide that the department shall have the right to withdraw and use part or all of the funds in the escrow account to carry out the closure and long-term care requirements of the approved plan of operation if the owner or operator fails to do so. The department shall mail notification of its intent to use funds for that purpose to the last known address of the owner or operator. If the owner or operator requests a hearing in writing within 60 days thereafter, the department shall prior to using the funds, hold a hearing pursuant to s. 227.064, Stats., for the purpose of determining whether or not the long-term care requirements of the approved plan of operation have been carried out.

(f) In lieu of a bond, deposit, or escrow account, the owner may create an irrevocable trust exclusively for the purpose of ensuring that the owner and any successor in interest will comply with the closure and long-term care requirements of the approved plan of operation. The trust

agreement shall designate a bank licensed to do business in this state as trustee and the state of Wisconsin, department of natural resources, as sole beneficiary. The trust corpus shall consist of cash, certificates of deposit or government securities in the amount determined according to this section. The trust agreement shall further provide that sufficient monies shall be paid from the trust fund to the beneficiary in the event that the owner or any successor in interest fails to complete such requirements. A copy of the trust agreement shall be submitted to the department for approval prior to issuance of the initial license. The department shall mail notification of its intent to use funds for that purpose to the last known address of the owner or operator. If the owner or operator requests a hearing in writing within 60 days thereafter, the department shall prior to using the funds, hold a hearing pursuant to s. 227.064, Stats., for the purpose of determining whether or not the long-term care requirements of the approved plan of operation have been carried out.

(g) For the purpose of determining the amount of financial responsibility, the owner shall estimate the total cost of closure and the annual cost of long-term care of the site in current year dollars and submit the same together with all necessary justification to the department for approval.

(h) 1. To provide proof of financial responsibility to assure compliance with the closure requirements of the plan of operation, the owner shall deposit into an escrow account or trust account, cash, certificates of deposit or government securities equal to the cost estimate for closure, multiplied by the appropriate present value factor from table 6. If site life exceeds 20 years, the present value factor shall be determined by using the following formula: $PVF = \frac{1}{(1.02)^{SL}}$

where PVF equals the present value factor and SL equals the site life in years. If the owner chooses to utilize a bond or a deposit with the department, the amount of the bond or deposit shall be equal to the cost estimate for closure multiplied by the appropriate present value factor multiplied by the appropriate compound amount factor determined by using the following formula: $CAF = (1 + i)^{SL}$ where CAF equals the compound amount factor, i equals the interest rate payable on long-term certificates of deposit by a bank or other financial institution, and SL equals the site life in years. If the site is to be closed in phases during the active site life, the department shall not require proof of financial responsibility to assure compliance with the closure requirements in an amount exceeding that amount which will be necessary to complete closure of the next phase to be closed, discounted by the appropriate present value factor.

TABLE 6

Site Life in Years	Present Value Factor
1	.980
2	.961
3	.942
4	.924
5	.906
6	.888
7	.871
8	.853
9	.837
10	.820
11	.804
12	.788
13	.773
14	.758
15	.743
16	.728
17	.714
18	.700
19	.686
20	.673

2. When an owner has completed closure of any portion of the site other than a site which is to be closed in phases over the active site life, the owner may apply to the department for release of that portion of the bond or return of that amount of money held on deposit, in escrow, or in trust for closure of that portion of the site. Such application must be accompanied by an itemized list of costs incurred. Upon determination that a portion of the site has been satisfactorily closed, the department may authorize release of a portion of the funds or approve a reduction in the bond provided, however, that the amount remaining shall not be reduced to less than 120% of the estimated cost of completing closure of the landfill until complete closure is accomplished. Upon determination by the department that complete closure has been accomplished, the department shall authorize release and/or return of all funds accumulated in such accounts or give written permission for cancellation of the bond. Such determination shall be concluded within 90 days of the application. In the case of a site which is to be closed in phases, upon completion of closure of a phase and prior to operation of the next succeeding phase, the owner shall provide proof of financial responsibility to assure closure of the next phase.

3. The bond, deposit, escrow account or trust account in the amount calculated in subd. (h) 1. shall be established and proof of establishment submitted to the department as part of the initial license application.

(i) 1. To provide proof of financial responsibility to assure compliance with the long-term care provisions of the plan of operation, the owner shall deposit into an escrow account or trust account an annual cash payment which shall be calculated by multiplying the annual cost of long-term care of the site by 16.35 if the owner chooses to be responsible for the site for 20 years, or 22.40 if the owner chooses to be responsible for 30 years, and dividing that product by the sum of annuity factor from table 7 appropriate to the site life. If the site life exceeds 20 years, the sum of annuity factor can be determined by using the following formula:

$$SA = \frac{(1.02)^{SL} - 1}{.02}$$ where SA equals

the sum of annuity factor, and SL equals the site life in years. If the owner chooses to utilize a bond or a deposit with the department, the amount of the bond or deposit shall be adjusted on an annual basis such that it is equal to the annual cost of long-term care of the site multiplied by either 16.35 or 22.40 (20 or 30-year owner responsibility, respectively), with that product divided by the appropriate sum of annuity factor, and that dividend multiplied by the appropriate compound amount factor as defined in subd. (h) 1.

TABLE 7

Site Life in Years	Sum of Annuity Factor
1	1.00
2	2.020
3	3.060
4	4.122
5	5.204
6	6.308
7	7.434
8	8.583
9	9.755
10	10.950
11	12.169
12	13.412
13	14.680
14	15.974
15	17.293
16	18.639
17	20.012
18	21.412
19	22.841
20	24.297

2. One year after closure and annually thereafter for the period of owner responsibility, the owner, who has carried out all necessary long-term care during the preceding year, may make application to the department for reimbursement from the escrow account, trust account, or deposit with the department, or for reduction in the bond equal to the estimated costs for long-term care for that year. Such application must be accompanied by an itemized list of costs incurred. Upon determination that the expenditures incurred are in accordance with the long-term care requirements anticipated in the approved plan of operation, the department may authorize release of the funds or approve a reduction in the bond provided, however, that the amount remaining shall not be reduced to less than 20% of the total cost of long-term care during the period of owner responsibility until termination of that responsibility pursuant to s. 144.441, Stats. Such determination shall be concluded within 90 days of the application. Any funds remaining in the escrow account, trust account, or on deposit with the department at the termination of owner responsibility shall be released to the owner.

3. The bond, deposit, escrow account or trust account in the amount calculated in this paragraph shall be established prior to the issuance of the initial license and proof of increase in value in accordance with this paragraph shall be submitted to the department as part of each relicensing application.

(3) Any person acquiring rights of ownership, possession or operation of a licensed site shall be responsible for the closure and long-term care

of the site and shall provide such assurance as the department shall require in this regard prior to the issuance of a new operating license.

History: Cr. Register, February, 1980, No. 290, eff. 3-1-80.

NR 180.16 Waste management fund. (1) All owners or operators of licensed land disposal sites shall contribute to the waste management fund established by s. 25.45, Stats., for each ton of solid waste received and disposed of at the site from May 21, 1978, until the site is closed and no longer receives waste, except as otherwise provided in s. 144.44 (3), Stats.

(2) The owner or operator of a licensed land disposal site shall certify on a form provided by the department the amount of solid waste received and disposed of during the preceding reporting period. The department shall specify the term of the reporting period on the certification form. The certification form shall be completed and returned to the department with the appropriate fee within 30 days after mailing of the form by the department to the owner or operator.

(3) (a) For all sites with an approved plan of operation under s. 144.44 (3), Stats., the owner may choose to be responsible for the long-term care of the site for either 20 years or 30 years after site closure. The fees to be paid into the fund shall be as follows for specific waste types:

Waste type	Rate of payment 20 Years	Rate of payment 30 Years
1. Municipal solid waste	3.5¢/ton	1.5¢/ton
2. Ashes and sludges from electric and process steam generating facilities	3.5¢/ton	1.5¢/ton
3. Pulp or paper mill sludges produced by waste treatment or manufacturing processes	3.5¢/ton	1.5¢/ton
4. Manufacturing process solid waste from foundries	3.5¢/ton	1.5¢/ton
5. Sludges produced by municipal wastewater treatment plants	3.5¢/ton	1.5¢/ton
6. All other solid wastes not designated as hazardous	3.5¢/ton	1.5¢/ton

(b) For sites initially licensed between May 21, 1975 and May 20, 1978 for which the owner successfully applies before May 21, 1980 for a determination by the department that the site's design and plan of operation comply substantially with the requirements necessary for plan approved under s. 144.44 (3), Stats., the owner may choose to be responsible for the long-term care of the site for either 20 years or 30 years after site closure. The fees to be paid into the fund shall be as specified in par. (a).

(4) For all land disposal sites and facilities not approved as set forth in sub. (3), the fees to be paid shall be those indicated under the 30 year rate of payment in sub. (3) (a).

(5) Only sites with an approved plan of operation under s. 144.44 (3), Stats., or sites initially licensed between May 21, 1975 and May 20, 1978 for which the owner successfully applies before May 21, 1980 for a determination by the department that the site's design and plan of operation comply substantially with the requirements necessary for plan approval under s. 144.44 (3), Stats., are eligible for use of the money accumulated in the waste management fund. The owner or operator of any land disposal site or facility licensed and in existence on May 21, 1978 may, but shall not be required to seek approval of the site's plan of operation under s. 144.44 (3) Stats. The monies in the waste management fund shall be expended exclusively as set forth in s. 144.441, Stats.

(6) (a) The department may reduce or waive the fees specified in sub. (3) for mining operations if the owner or operator of a site for the land cdisposal of mining wastes successfully demonstrates that the reclamation bonding and other requirements of ss. 144.81 to 144.94, Stats., are sufficient to accomplish the purposes of the waste management fund. Such demonstration may be made at a hearing conducted as provided in s. 227.022, Stats., as an uncontested case.

(b) The owner or operator of a site for the land disposal of mining waste who requests a reduction or waiver shall make such application in writing. Upon receipt of the application, the department shall mail copies to those listed in s. 144.836 (3) (b) 1., Stats., accompanied by a statement that unless written objection is filed with the department within 30 days after the mailing of the application, the department may take action to grant the application without public hearing. If timely objection is filed, or the applicant requests it, the department shall set the application for a contested public hearing pursuant to s. 227.01 (2), Stats. Notice of such hearing shall be given pursuant to the provisions of s. 144.836 (3) (b) 1. and 2., Stats., except the hearing may be scheduled with 30 days notice.

(c) The decision following the hearing shall be in writing accompanied by findings of fact and conclusions of law. The burden of proof to establish that the reclamation bonding and other requirements are sufficient to accomplish the purposes of the waste management fund shall be on the owner or operator.

History: Cr. Register, August, 1979, No. 284, eff. 9-1-79.

NR 180.17 Salvage yards. (1) GENERAL. No person shall operate or maintain a salvage yard unless the person has obtained an operating license from the department, except as otherwise provided in sub. (2).

(2) EXEMPTIONS. Operations used exclusively for the storage of less than 7 junked automobiles are exempt from the requirements of this section.

(3) LOCATIONAL CRITERIA. No person shall establish, operate, maintain or permit the use of property for a salvage yard within the following areas:

(a) Within 1,000 feet of any navigable lake, pond or flowage.

(b) Within 300 feet of a navigable river or stream.

(c) Within a flood plain.

(d) Within an area from which the department after investigation finds there is a reasonable probability that solid waste or leachings therefrom may have a detrimental effect on any surface water.

(e) Within an area from which the department after investigation finds there is a reasonable probability that solid waste or leachings therefrom may have a detrimental effect on groundwater quality.

(f) Within 1,000 feet of the nearest edge of the right-of-way of any interstate or federal aid primary highway or the boundary of any public park, unless the site is screened by natural objects, plantings, fences or

other appropriate means so as not to be visible from the highway or park.

(g) Within wetlands.

(h) Within a critical habitat area.

(4) PLAN OF OPERATION. No person shall establish a new salvage yard or expand an existing salvage yard until a plan of operation has been submitted to and approved by the department in writing. The plan of operation shall include at a minimum the following:

(a) A map or aerial photograph of the area showing land use and zoning within ¼-mile of the salvage yard boundaries. The map or aerial photograph shall be of sufficient scale to show all salvage yard boundaries, all homes industrial buildings, roads, water courses, and other applicable details. All such details, plus the topography, and direction shall be identified and indicated on the map or aerial photograph.

(b) A plot plan of the site showing direction, dimensions, elevations, surface drainage, access roads, fencing, means for limiting access, method of screening, and proposed layout of operation covering location of salvage material processing area, nonsalvageable material storage area, and liquid material handling and storage area.

(c) A report indicating the following:

1. The type, expected quantity and source of material to be brought to the yard.

2. Present quality and types of salvage materials in inventory.

3. The type and amount of equipment to be provided at the yard for processing purposes.

4. The outlet for the salvaged material.

5. The means for on-site storage of nonsalvageable items and the means for disposal.

6. The means for on-site handling and storage of liquids generated or handled as part of the salvage yard operation and the outlet for these materials. These liquids may include but are not limited to gasoline, oils, fluids, antifreeze, acids, caustics and similar materials which require special handling and disposal to protect the environment.

7. Types and means for fencing and screening of the salvage yard property.

8. Procedures and types of emergency fire control.

9. Persons responsible for actual operation and maintenance of the yard.

10. Operation procedures which detail how compliance will be achieved with sub. (5).

(5) OPERATIONAL REQUIREMENTS. No person shall operate or maintain a salvage yard except in conformance with the approved plan of operation and the following practices:

(a) Garbage or similar putrescible material shall not be present at a salvage yard.

(b) No salvage yard shall be operated at a solid waste land disposal operation unless both operations are completely separated or fenced.

(c) No open burning of solid waste shall be conducted.

(d) The boundaries of the salvage yard shall be marked with a fence or other object(s) to clearly define the boundary of the licensed acreage.

(e) An attendant shall be on duty at the yard at all times while the yard is open for business.

(f) The yard shall be surrounded by a solid fence, rapidly growing trees, shrubbery or other appropriate means to screen it from the surrounding area. If trees are used, they shall be capable of screening the yard all year or other methods shall be used in combination with the trees to provide screening during all seasons.

(g) A sign, acceptable to the department, shall be posted at the entrance which indicates the name and license number of the operation. The letters and numbers shall be a minimum of 2 inches high with ½-inch minimum width and in a color distinct from its background.

(h) The storage of nonsalvageable materials shall be conducted in compliance with NR 180.07.

(i) Any windblown material resulting from operation of the yard shall be collected daily and properly disposed.

(j) The operation shall be conducted in an orderly and aesthetic manner.

(6) CLOSURE. Any person who maintains or operates a salvage yard or who permits use of property for such purpose shall, when the yard is closed by the operator or property owner, or when the department determines that closure is required, close the yard by removing all salvageable materials within a time period specified by the department, which shall be no greater than 120 days. The operator shall notify the department, in writing, 60 days prior to the date of closing a salvage yard.

History: Cr. Register, February, 1980, No. 290, eff. 3-1-80.

NR 180.18 Other facility requirements not specifically covered by this chapter. Before any method of solid waste handling, processing, or disposal not otherwise provided for in this chapter is established, the department may require the applicant to conduct a feasibility study as outlined in this chapter. If the facility is determined by the department to be feasible, complete plans, specifications, and design data for the project detailing such areas as site locations, preparation, operation, monitoring, closure, and long-term care shall be submitted to and be approved in writing by the department prior to the commencement of operations. All such information shall be prepared and submitted by a registered professional engineer. An initial plan review fee and the annual license fee, as provided in NR 180.05, shall be submitted for each newly established method of solid waste handling, processing and disposal. Prior to operation of such a facility, a solid waste disposal operation

license is required. The site and its operation shall conform to any department approved plan.

History: Cr. Register, February, 1980, No. 290, eff. 3-1-80.

NR 180.19 Environmental impact. Every application for licensing under this chapter will be reviewed to determine whether the department will require the applicant to submit an environmental impact report pursuant to s. 23.11(5), Stats., or whether the department is required to prepare an environmental impact statement pursuant to chapter NR 150, Wis. Adm. Code.

History: Cr. Register, February, 1980, No. 290, eff. 3-1-80.

NR 180.20 Exemptions. Exemptions from the requirements of this chapter may be granted in special cases except as otherwise provided. A person may apply for an exemption by providing the department with a request in writing and documentation justifying the need for the exemption. Before granting exemptions, the department shall take into account such factors as population of the area being served, amounts of waste generated, location of the disposal operation, nature of wastes, seasonal character of the disposal operation, and other significant factors. Exemptions may be granted to encourage the beneficial utilization of solid waste if the department finds that the waste utilization proposed would not result in environmental pollution and that regulation under this chapter would discourage such beneficial utilization or would not be warranted in light of the potential hazard to public health or the environment. All exemptions pertaining to a solid waste disposal operation will be granted in writing by the department. Exemptions shall be reviewed periodically with particular regard to any potential nuisance, hazard to public health and safety, or potential degradation of the environment.

History: Cr. Register, February, 1980, No. 290, eff. 3-1-80.

Chapter NR 504

LANDFILL LOCATION, PERFORMANCE, DESIGN AND CONSTRUCTION CRITERIA

NR 504.01 Purpose.
NR 504.02 Applicability.
NR 504.03 Definitions.
NR 504.04 Landfill locational criteria and performance standards.
NR 504.05 General design and construction criteria.
NR 504.06 Minimum design and construction criteria for landfill liners and leachate collection systems.
NR 504.07 Minimum design and construction criteria for final cover systems.
NR 504.075 Soil borrow sources.
NR 504.08 Minimum design and construction criteria for landfill gas extraction systems.
NR 504.09 Storm water management and miscellaneous design and construction criteria for landfills.
NR 504.095 Design criteria for landfills that recirculate leachate.
NR 504.10 Alternative design criteria for landfills accepting high volume industrial wastes.
NR 504.11 Minimum design and construction criteria for landfills accepting residue produced by burning municipal solid waste.

Note: Corrections made under s. 13.93 (2m) (b) 7., Register, August, 1997, No. 500.

NR 504.01 Purpose. The purpose of this chapter is to help ensure that efficient, nuisance–free and environmentally acceptable solid waste management procedures are practiced in this state and to provide information on locational criteria, performance standards and the minimum design and construction requirements for landfills. This chapter is adopted under ch. 289, Stats., and s. 227.11, Stats.

History: Cr. Register, January, 1988, No. 385, eff. 2–6–88; am., Register, June, 1996, No. 486, eff. 7–1–96.

NR 504.02 Applicability. (1) Except as otherwise provided, this chapter governs all landfills as defined in s. 289.01 (20), Stats., except landspreading facilities regulated under ch. NR 518, small demolition waste landfills regulated under ch. NR 503, hazardous waste facilities as defined in s. 291.01 (8), Stats., and regulated under chs. NR 660 to 679; metallic mining operations for nonferrous minerals as defined in s. 293.01 (9), Stats., and regulated under ch. NR 182; and metallic mining operations for ferrous minerals as defined in s. 295.41 (26), Stats., including mining wastes and mining waste sites as defined in s. 295.41 (30) and (31), Stats., and regulated under subch. III of ch. 295, Stats.

(2) This chapter does not apply to the design, construction or operation of industrial wastewater facilities, sewerage systems and waterworks treating liquid wastes approved under s. 281.41, Stats., or permitted under ch. 283, Stats., nor to facilities used solely for the disposal of liquid municipal or industrial wastes which have been approved under s. 281.41, Stats., or permitted under ch. 283, Stats., except for facilities used for the disposal of solid waste.

Note: Owners or operators proposing to site a new or expand an existing municipal solid waste landfill within a 5 mile radius of any airport runway end used by turbojet or piston type aircraft must notify the owner or operator of the affected airport and the federal aviation administration (FAA).

History: Cr. Register, January, 1988, No. 385, eff. 2–6–88; correction in (1) made under s. 13.93 (2m) (b) 7., Stats., Register, May, 1995, No. 473; am. (1), Register, June, 1996, No. 486, eff. 7–1–96; am. (1), Register, August, 1997, No. 500, eff. 9–1–97; correction in (2) made under s. 13.93 (2m) (b) 7., Stats., Register March 2003 No. 567; correction in (1) made under s. 13.93 (2m) (b) 7., Stats., Register December 2006 No. 612; CR 13–057: am. (1) Register July 2015 No. 715, eff. 8–1–15.

NR 504.03 Definitions. The terms in this chapter are defined in s. NR 500.03.

History: Cr. Register, January, 1988, No. 385, eff. 2–6–88.

NR 504.04 Landfill locational criteria and performance standards. (1) GENERAL. As part of the feasibility report required under ch. NR 512 an applicant shall demonstrate to the department that the proposed landfill will comply with all of the locational criteria and performance standards of this section unless an exemption is granted.

(2) EXEMPTIONS. (a) Exemptions from compliance with subs. (3) (a), (b), (d), (e), (f), (g), (h), (i) and (4) (b), (e) and (f) may be granted by the department only upon demonstration by the applicant of circumstances which warrant an exemption. Compliance with sub. (4) (a) shall be evaluated in accordance with the standards in ch. NR 103. For the purpose of determining whether there is a practicable alternative to a proposed landfill expansion under s. NR 103.08, the department may allow an applicant to limit its analysis of alternatives to alternatives within the boundaries of the property where the existing landfill is located and on property immediately adjacent to the existing landfill. Exemptions from compliance with subs. (3) (c) and (4) (c) may not be granted. Exemptions from compliance with sub. (4) (d) may be granted only according to the procedures set forth in chs. NR 507 and 140. Exemptions from compliance with sub. (3) (f) will be based on an evaluation of the information contained in par. (b). However, no exemptions from sub. (3) (f) may be granted unless information on the well location, current and immediate past well owners, well driller, well log and construction details, the general hydrogeologic setting and a completed s. NR 812.43 variance request is submitted to the department. Exemptions from sub. (3) (f) shall be requested by the applicant and re–evaluated for each subsequent expansion proposal. Exemptions from sub. (3) (i) may be granted only if the applicant demonstrates that engineering measures have been incorporated into the landfill's design to ensure that the integrity of the structural components of the landfill will not be disrupted.

Note: Contact the groundwater expert or water supply specialist in the local DNR office to obtain a list of the current requirements for a completed s. NR 812.43 variance request. To determine who is the appropriate contact in a particular part of the state either call (608) 266–0821 or e–mail the Drinking Water and Groundwater program at DG.Mail@dnr.state.wi.us.

(b) Additional factors which may be considered by the department in determining whether or not to grant exemptions under this section include waste types, characteristics and quantities; the geology and hydrogeology of the landfill; the proposed landfill design and operation; the availability of other environmentally suitable alternatives; status of the s. NR 812.43 variance application; compliance with other state and federal regulations and the health, safety and welfare of the public. Requests for exemptions and information needed to demonstrate the circumstances that warrant exemptions shall be addressed by the applicant in the feasibility report.

(3) LOCATIONAL CRITERIA. No person may establish, construct, operate, maintain or permit the use of property for a landfill where the limits of filling are or would be within the following areas:

(a) Within 1,000 feet of any navigable lake, pond or flowage not including landfill drainage or sedimentation control structures.

(b) Within 300 feet of any navigable river or stream.

(c) Within a floodplain.

(d) Within 1,000 feet of the nearest edge of the right–of–way of any state trunk highway, interstate or federal aid primary highway or the boundary of any public park or state natural area, unless

the landfill is screened by natural objects, plantings, fences or other appropriate means so that it is not visible from the highway, park or natural area.

(e) Within an area where the design or operation of the landfill would pose a significant bird hazard to aircraft.

1. A landfill which is proposed to be located within 10,000 feet of any airport runway end designed or planned to be designed and used by turbojet aircraft or within 5,000 feet of any airport runway end designed for and used only by piston type aircraft and which is proposed to be used for the disposal of putrescible waste shall be presumed to pose a significant bird hazard to aircraft unless the applicant can demonstrate to the satisfaction of the department that the landfill will not pose a significant bird hazard to aircraft.

2. A landfill used for the disposal of putrescible waste which is in existence on July 1, 1996, and which is located within 10,000 feet of any airport runway end used or planned to be used by turbojet aircraft or within 5,000 feet of any runway end used by only piston–type aircraft shall be closed by October 9, 1996 unless the owner or operator of the landfill demonstrates to the satisfaction of the department that the landfill will not pose a significant hazard to aircraft. The deadline for closure may be extended by the department by up to 2 years if the owner or operator demonstrates that there is no available alternative disposal capacity and there is no immediate threat to human health and the environment.

Note: Owners or operators proposing to site a new or expand an existing municipal solid waste landfill within a 5 mile radius of any airport runway end used by turbojet or piston type aircraft must notify the owner or operator of the affected airport and the federal aviation administration (FAA).

(f) Within 1,200 feet of any public or private water supply well.

(g) Within 200 feet of a fault that has had displacement in Holocene time.

(h) Within seismic impact zones.

(i) Within unstable areas.

(4) PERFORMANCE STANDARDS. No person may establish, construct, operate, maintain or permit the use of property for a landfill if there is a reasonable probability that the landfill will cause:

(a) A significant adverse impact on wetlands as provided in ch. NR 103.

(b) A take of an endangered or threatened species in accordance with s. 29.604, Stats.

(c) A detrimental effect on any surface water.

(d) A detrimental effect on groundwater quality or will cause or exacerbate an attainment or exceedance of any preventive action limit or enforcement standard at a point of standards application as defined in ch. NR 140. For the purposes of design the point of standards application is defined by s. NR 140.22 (1).

(e) The migration and concentration of explosive gases in any landfill structures excluding the leachate collection system or gas control or recovery system components in excess of 25% of the lower explosive limit for such gases at any time. The migration and concentration of explosive gases in the soils outside of the limits of filling within 200 feet of the landfill property boundary or beyond the landfill property boundary in excess of the lower explosive limit for such gases at any time. The migration and concentration of explosive gases in the air outside of the limits of filling within 200 feet of the landfill boundary or beyond the landfill property boundary in excess of the lower explosive limit for such gases at any time.

(f) The emission of any hazardous air contaminant exceeding the limitations for those substances contained in s. NR 445.07.

Note: Sections NR 445.04 and 445.05 were repealed effective 8–1–08.

History: Cr. January, 1988, No. 385, eff. 2–6–88; am. (1), (2) (a), (b), (3) (intro.), (a), (d), (4) (intro.), (a) (e), r. and recr. (3) (e), cr. (3) (g) to (i), Register, June, 1996, No. 486, eff. 7–1–96; am. (2) (a), Register, May, 1998, No. 509, eff. 6–1–98; CR 05–020: am. (2) (a), (b), (3) (d), (4) (b) and (f) Register January 2006 No. 601, eff. 2–1–06; **correction in (4) (f) made under s. 13.92 (4) (b) 7., Stats., Register April 2017 No. 736.**

NR 504.05 General design and construction criteria. (1) Unless otherwise specified in this chapter, the minimum design criteria in ss. NR 504.06 to 504.09 apply to all new landfills and to the expansion of existing landfills for which the plan of operation was approved after July 1, 1996, as well as to proposed design changes for all landfills which are submitted after July 1, 1996. Landfills designed in substantial conformance with these design criteria are presumed to be capable of meeting the performance standards of s. NR 504.04 (4) (d) regarding groundwater quality.

(2) If the proposed design differs from the requirements in ss. NR 504.06 to 504.09, the applicant shall provide supporting justification for any differences.

(3) The design capacity of all proposed landfills, except landfills that are exempted in s. 289.28 (2), Stats., shall be determined such that the projected operating life of the landfill is not less than 10 years nor more than 15 years. Expansions of existing landfills are not subject to the 10–year minimum design capacity requirement. Waste approved for use in construction of landfill components is not considered part of the design capacity.

History: Cr. Register, January, 1988, No. 385, eff. 2–6–88; r. and recr., Register, June, 1996, No. 486, eff. 7–1–96.

NR 504.06 Minimum design and construction criteria for landfill liners and leachate collection systems. (1) GENERAL. (a) All major phases of landfills initially accepting municipal solid waste after July 1, 1996, shall be designed with a composite liner and a leachate collection system capable of limiting the average leachate head level on the composite liner to one foot or less during operation and after closure of the landfill, except as provided in s. NR 504.10 (1) (c). The composite liner shall consist of 2 components; the upper component shall consist of a nominal 60–mil or thicker geomembrane liner with no thickness measurements falling below the minimum industry accepted manufacturing tolerances, and the lower component shall consist of a minimum 4 foot thick layer of compacted clay meeting the specifications of s. NR 504.06 (2) (a). The geomembrane component shall be installed in direct and uniform contact with the compacted clay soil component, and the landfill shall meet or exceed the standards in the applicable portions of subs. (2), (3) and (4). All other landfills shall be designed to contain and collect leachate to the maximum practical extent. This shall be accomplished by designing the landfill to meet the standards contained in the applicable portions of subs. (2), (3) and (4), unless the department approves the applicant's alternative design as per s. NR 504.10, which provides an equivalent or better level of performance than the standards contained in this chapter.

(b) If the applicant does not complete construction of the first major phase of the landfill within 2 years from the date of the plan of operation approval, the applicant shall reapply to the department for approval to construct the landfill. This application does not constitute a feasibility report as defined in s. 289.24, Stats. The department may require additional conditions of approval and require redesign of the landfill in accordance with state–of–the–art design criteria.

(2) COMPOSITE OR CLAY LINED LANDFILLS. All landfills designed with a composite liner or a clay liner shall meet the following requirements:

(a) All clay used in liner construction shall meet the following specifications:

1. A minimum of 50% by weight which passes the 200 sieve.

2. A saturated hydraulic conductivity of $1x10^{-7}$ cm/sec or less, when compacted to required moisture contents and densities based on the modified Proctor method, standard Proctor method, or a line of optimums method approved by the department.

3. An average liquid limit of 25 or greater with no values less than 20.

4. An average plasticity index of 12 or greater with no values less than 10.

(b) The separation distance between the seasonal high groundwater table and the bottom of the clay component of a composite liner or a clay liner shall be at least 10 feet except for zone–of–saturation landfills.

(c) The separation distance between the top of the bedrock surface and the bottom of the clay component of a composite liner or a clay liner shall be at least 10 feet.

(d) The slope of the liner surface toward the leachate collection lines shall be at least 2%.

(e) The minimum thickness of the clay component of a composite liner at all locations shall be at least 4 feet. The minimum thickness of a clay liner at all locations shall be at least 5 feet.

(f) The clay component of a composite liner or a clay liner shall be constructed in the following manner:

1. All clay layers in the liner shall be constructed in lift heights no greater than 6 inches after compaction using footed compaction equipment having feet at least as long as the loose lift height. As needed, clay shall be disked or otherwise mechanically processed prior to compaction to break up clods and allow for moisture content adjustment. Clod size shall be no greater than 4 inches. All compaction equipment utilized shall have a minimum static weight of 30,000 pounds. Lighter equipment may be used in small areas where it is not possible to use full size equipment. Alternative procedures or equipment may be proposed for approval by the department.

2. A sufficient number of passes of the compaction equipment shall be made over each lift of clay to ensure complete remolding of the clay.

3. All clay shall be compacted to 90% modified or 95% standard Proctor density at a moisture content at least 2% wet of optimum if using the modified Proctor method and wet of optimum if using the standard Proctor method, based on the characteristics of the appropriate Proctor curve for the clay being placed. As clay placement proceeds, the minimum density and moisture content targets shall be adjusted as necessary. The department recommends use of an alternate method of determining adequate density and moisture content based on a line of optimums method. However, this method may not be used unless it has been previously detailed in a landfill's plan of operation or a proposed plan modification and approved in writing by the department. At a minimum, any such proposal shall address how the line of optimums would be defined, as well as how the minimum dry unit weight needed to ensure adequate shear strength of the clay soils proposed would be determined.

(g) The slope of the interior sidewalls of a landfill may not exceed 3 horizontal to one vertical nor be less than 5 horizontal to one vertical.

(h) The clay component of a liner in adjacent phases shall be keyed together to form a continuous clay seal. This shall be accomplished by excavating steps along the edge of the existing lined phase and overlapping them with the lifts of clay being placed for the liner of the new phase. A minimum of 4 steps shall be included, with the total width of the spliced area measuring a minimum of 15 feet.

(3) COMPOSITE–LINED LANDFILLS. All landfills designed with a composite liner shall meet the following additional requirements for the geomembrane component of the liner:

(a) All geomembranes shall be fabricated from resins specifically formulated for waste containment purposes. Nominal geomembrane thickness shall be 60 mils or greater with no thickness measurements falling below the minimum industry accepted manufacturing tolerances.

(b) Additional protection shall be provided for the geomembrane component of the composite liner along areas subject to traffic or other concentrated activity during construction or operation. This shall include sumps, sideslope risers and entry ramps.

(c) For slopes in excess of 10%, geomembrane panels shall be installed such that all seams run perpendicular to the contour lines of the slope to the extent possible.

(d) Prior to geomembrane placement, the clay surface shall be rolled and graded so it is free of irregularities, protrusions, loose soil and abrupt changes in grade. The surface shall also be free of stones, grade stakes and construction debris which may be damaging to the geomembrane and shall contain no areas excessively softened by high water content. The clay surface shall be sufficiently dry and dense such that the construction equipment used to place the geomembrane panels do not rut the clay surface. All depressions and large cracks shall be filled in with tamped clay.

(e) Geomembrane panels made of polyethylene resins shall be welded by double–tracked, fusion welding machines for all linear seams. Corners, butt seams and long repairs shall be fusion welded where possible. Extrusion or fusion welding shall be used for all other repairs, detail work and patches. Department approval shall be obtained prior to use of any other welding method for either panel seaming, repairs or construction of details.

(f) The geomembrane component of a composite liner constructed in phases adjacent to each other shall be welded together to form a continuous membrane surface. The liner extending beyond the proposed edge of waste at a phase junction shall be protected from traffic and weather.

(g) Wrinkles in the geomembrane component which are higher than they are wide, shall be smoothed or cut out and repaired prior to covering with soil. Guidance to machine operators placing soil on the geomembrane component shall be provided by the use of an observer with an unobstructed view of the advancing lift of soil.

(h) The minimum thickness of soil which must be present over the geomembrane component before vehicular traffic may occur shall be one foot for vehicles with ground pressure less than 5 pounds per square inch and 2 feet for all other tracked vehicles and flotation tire equipped vehicles. Trucks and other wheeled hauling equipment shall be confined to corridors or locations with a soil thickness of 3 or more feet over the geomembrane component.

(i) In order to lessen desiccation effects, the base of the landfill and the lower 10 vertical feet of the sideslope shall be covered with a drainage blanket within 30 days after completing quality control and quality assurance testing of the installation. The remaining sideslope shall be covered with either drainage material or a geotextile to prevent damage to the geomembrane.

(j) To prevent movement and folding of wrinkles, placement of soil over the membrane shall be performed during cooler temperature periods to the extent possible using methods of placement which minimize wrinkling.

(k) Anchor trenches shall be designed and constructed around the perimeter of the landfill to secure the permanent edges of the geomembrane. The geomembrane shall be seamed completely to the ends of all panels to minimize the potential of tear propagation along the seam.

(4) ZONE–OF–SATURATION LANDFILLS. All landfills proposed with base grades beneath the groundwater table shall meet the following requirements:

(a) The landfill shall be located in a fine–grained soil environment.

Note: Fine–grained soil environment is defined in s. NR 500.03 (86).

(b) The landfill shall meet the requirements in sub. (2) (a), (d), (e), (f), (g) and (h), and if the landfill will accept municipal solid waste, sub. (3).

(c) An analysis shall be performed of the effect which groundwater flow may have on uplift of the liner and the short and long–term stability of the geomembrane component of the composite

liner. The analysis shall evaluate the effect of an underdrain or other dewatering system.

(d) Borings, backhoe pits or other means of exposing subsoils shall be performed on a 100–foot grid to a minimum depth of 5 feet below the gradient control layer, if part of the design, or a minimum depth of 5 feet below the subbase grades of the liner. All detected granular or silty soils within this 5 foot depth shall be removed and replaced with compacted, fine–grained soils.

(5) LEACHATE COLLECTION SYSTEMS. All leachate collection systems shall incorporate the following design features:

(a) A leachate collection system shall be included in each horizontal phase of the landfill. This system shall be designed to route leachate to the perimeter of the landfill in the most direct manner possible and limit the average leachate head level on the liner to one foot or less. The piping layout shall be such that leachate flows no more than 130 feet across the base of the liner before encountering a perforated leachate collection pipe. The department will consider greater flow distances for well designed composite landfills.

(b) The minimum slope on all leachate collection pipes at the base of the landfill shall be a constant 0.5%. The department recommends that greater pipe slopes be utilized whenever possible.

(c) The minimum diameter of all leachate collection or transfer pipes shall be 6 inches. Schedule 80 PVC pipe or an approved substitute shall be used.

(cm) Pipe fittings selected for use with PVC and HDPE pipe shall be secured to the leachate collection pipe. PVC fittings and pipe shall be solvent–welded. HDPE fittings and pipe shall be fusion welded.

(d) Leachate collection trenches for clay liners shall be designed as rectangular trenches. Leachate collection trenches for composite liners shall be designed as vee–trenches, with a minimum depth of 18 inches and with sideslopes no steeper than 3 horizontal to one vertical. The clay component of vee–trenches shall be smooth–drum rolled such that the clay in the trenches is smooth prior to placement of the membrane.

(dm) A geotextile shall be used to line the base and sidewalls of all leachate collection trenches and shall be placed directly over the geomembrane component of a composite liner or the clay component of a clay liner. The geotextile shall have a minimum weight of 12 oz/yd^2, and may not be overlapped over the top of the trench. The geotextile specifications, including manufacturer's data for grab and puncture strength, shall be used to demonstrate that the geotextile can resist damage due to impact and puncture when aggregate is placed over the geotextile.

(e) The bedding material utilized in backfilling the leachate collection pipe trenches shall have a uniformity coefficient of less than 4, a maximum particle diameter of 1½ inches, a maximum of 5% of the material which passes the number 4 sieve and consist of rounded to subangular gravel. A minimum depth of 4 inches of gravel shall be placed in the trenches prior to installation of the leachate pipes. The backfill shall also be placed such that a minimum of 6 inches of material exists above the top of the pipe and within the trenches. An additional 12 inches of material shall be mounded above the trench. In cases where the particle size of the drainage blanket is significantly less than the collection trench bedding, a properly designed graded soil filter or geotextile shall be utilized to minimize the migration of the drainage blanket material into the collection trenches. Limestone and dolomite may not be used in the leachate collection system unless no other suitable material is reasonably available.

(f) The sizing of sand, gravel, geotextiles and pipe openings shall be analyzed for control of piping of soil materials. The gradation of sand and gravel, the apparent opening size of geotextiles, and the pipe opening sizes shall be selected to achieve a stable and self–filtering structure under all conditions of leachate flow.

(g) All leachate collection lines shall have cleanout access points installed on both ends of each line and may not exceed 1,200 feet from the end of one cleanout to the toe of the opposite slope.

(h) Leachate lines, manholes and other engineering structures may not penetrate the liner in the vertical direction. For clay lined landfills, leachate transfer lines may penetrate the liner in the horizontal direction only. The number of liner penetrations shall be kept to a minimum. Composite lined landfills shall be designed without any perforations in the liner and in accordance with par. (j).

(i) Any leachate line that penetrates a clay liner shall have a 4 foot by 4 foot anti–seep collar placed around it. A minimum of 5 feet of compacted clay, as measured from the pipe, shall be placed around the collar in all directions.

(j) All composite lined landfills shall be designed and constructed with sumps and sideslope risers as part of their leachate removal system rather than utilizing systems which penetrate the composite liner sidewall. The leachate removal system shall meet the following requirements:

1. The volume of the sump and the capacity of the pump shall be sized so that accumulation of leachate outside the sump does not occur based on an assumed annual leachate collection rate of 6 inches. The volume of the sump shall take into account the potential buildup of solids over time.

2. The base of the leachate collection sumps shall be protected by the use of a thick polyethylene plate or other means acceptable to the department which is placed prior to the installation of the sideslope riser and backfill.

3. The leachate discharge pipes between the sideslope risers and collection tank shall be equipped with valves to prevent backflow into the waste disposal area.

4. The minimum diameter of the sideslope riser shall be 18 inches. The geometry of the sideslope riser at the junction of the sump and sidewall shall be selected to assure passage of the pump and associated hardware and to assure correct positioning of the intake of the pump.

5. The area of the sump and depth of gravel fill shall be sized to allow remedial installation of access and hardware for removal of leachate in the event of failure of the sideslope riser and pump system. The base of the sump shall be protected by polyethylene plate.

(k) All leachate lines transporting leachate out of the landfill by gravity shall be constructed with valves so the flow of leachate can be controlled. The valves shall be compatible with the leachate and be capable of being operated from the ground surface.

(L) All leachate transfer lines located outside of the composite lined or clay lined area shall be designed to assure groundwater protection through the use of double–cased pipe or by using another approved secondary containment method. All leachate transfer line piping shall be pressure tested prior to use. Unless otherwise approved by the department, the upslope end of the secondary pipe shall be sealed and the downslope end shall be open to allow any collected liquid to flow into the manhole.

(m) All leachate transfer lines, manholes, lift stations and other structures which transfer or store leachate outside the limits of waste shall be designed as shallow as practical and located far enough from the limits of filling so that excavations associated with repair of these devices would not infringe on the landfill cover system or sidewall liner. Each of these devices shall be constructed above the seasonal high groundwater table unless it is not technically feasible to do so and the design meets the requirements of par. (L).

(n) Leachate collection tanks and manholes shall be designed with a secondary containment system to prevent the discharge of leachate to ground and surface waters in the event of a leak or spill. Means shall be provided to monitor the tank and manholes within the secondary containment system unless other means for leak detection are approved by the department.

(o) All leachate collection tanks shall be designed to contain the volume of leachate which is generated by the landfill over a 4 day period and to withstand the soil and liquid loads that will be encountered during installation and use. The installation of the tanks shall follow the recommendations of the consultant and manufacturer.

(p) Measures shall be proposed to prevent accidental discharges at the leachate loadout station from entering groundwater or surface water. Unless an alternate method is approved by the department, the leachate loading station shall be paved with a concrete or asphalt pad and sloped to a catch basin to direct all spills back into the leachate holding tank.

(q) All manholes and enclosed structures for leachate and gas control systems shall be designed to allow for proper venting and access control. For landfills designed with active gas recovery systems, these devices shall be designed to minimize air intrusion into the landfill.

(r) All control systems such as pumps, valves and meters shall be designed to be operated from the ground surface.

(s) All leachate and groundwater collection systems shall be designed to accurately monitor the volume of liquid removed by the system.

(t) A minimum one foot thick granular drainage blanket shall be placed on top of the geomembrane component of a composite liner and on top of the clay component of a clay liner. For composite lined landfills, if the drainage blanket contains gravel greater than 1/4 inch, then a nonwoven geotextile shall be installed below the drainage blanket. The geotextile shall have a minimum weight of 12 oz/yd^2 and shall be certified to be needle–free. The granular drainage blanket shall contain no more than 5% material by weight which passes the number 200 sieve.

(tm) Leachate collection blankets shall have a minimum hydraulic conductivity of 1 cm/sec for any site that accepts any amount of municipal solid waste and $1x10^{-2}$ cm/sec for landfills which do not accept municipal solid waste. The gradation of the granular drainage blanket and associated hydraulic conductivity shall be selected to maintain the maximum head in the drain within the drain thickness.

(u) All major horizontal clay lined phases above the saturated zone shall be designed with a collection basin lysimeter to monitor the unsaturated zone except for composite lined landfills.

(6) ADDITIONAL REQUIREMENTS FOR LANDFILLS WITH EXTENDED COLLECTION LINES. (a) Landfills shall meet the requirements of pars. (b) to (f) where they will accept municipal solid waste and contain leachate collection lines that exceed 1,200 feet from the end of each cleanout to the toe of the opposite slope. Where the requirements of this subsection differ from other requirements of this chapter, these requirements shall take precedence.

(b) The maximum length of leachate collection lines from the access point at one end to the toe of the opposite slope may not exceed 2,000 feet.

(c) The minimum slope on all leachate collection pipes and associated pipe trenches at the base of the landfill shall be designed and constructed to be 0.5% after accounting for primary and secondary settlement of the subgrade. The minimum design slope shall be selected following computation of 100% of the primary consolidation settlement and the secondary consolidation settlement of the compressible materials beneath the facility, which includes, as applicable, in–situ soil, added geologic material, structural fill material, and compacted clay liner. Secondary settlement shall be calculated using a 100–year time frame.

(d) Pipe bedding material shall be composed of coarse, uniform gravel with a hydraulic conductivity that is greater than or equal to the hydraulic conductivity of the leachate collection blanket specified in s. NR 504.06 (5) (tm), in addition to meeting the other requirements of s. NR 504.06 (5) (e).

(e) The maximum anticipated construction, operation and post–closure overburden loads over the leachate collection piping shall be calculated and utilized in selecting the pipe material and wall thickness, based on 6–inch pipe diameter and an appropriate in–field consolidated density.

(f) All components of the leachate collection system shall incorporate all of the following design features:

1. Sweep bends at all changes of alignment, using a minimum radius of 10 pipe diameters, consisting of prefabricated PVC sweep bends or smooth pipe bends or prefabricated sweep bends for HDPE or other pipe materials.

2. Pipe alignments that minimize horizontal and vertical alignment changes for the entire leachate collection pipe length.

3. Elimination or minimization of obstructions or artifacts of construction which impose drag on pipe cleaning jetter hose or nozzles.

(7) COMPOSITE–LINED LANDFILLS USING GCLS. Use of GCLs in construction of a composite liner may not be used except in landfills which do not accept municipal solid waste, unless the GCL is used as a pad for the upper surface of the 4 foot clay component of a composite liner for a municipal solid waste landfill. The GCL and soil barrier layer components of a barrier system shall meet all of the following requirements:

(a) The hydraulic performance of the GCL shall be assessed by the use of compatibility testing. The testing protocol shall be provided to the department for review and concurrence prior to the initiation of compatibility testing. The compatibility testing shall utilize percolation fluids that simulate the leachate that will be produced by the landfill.

(b) The GCL shall meet the specifications of s. NR 504.07 (4) (a) 1. to 11.

(c) The GCL shall be underlain by a soil barrier layer that is a minimum of 2 feet thick and that meets the specifications of s. NR 504.07 (4) (a) 12. to 17.

History: Cr. Register, January, 1988, No. 385, eff. 2–6–88; r. and recr., Register, June, 1996, No. 486, eff. 7–1–96; am. (5) (e) and (t), Register, August, 1997, No. 500; CR 04–077: cr. (5) (cm), (dm), (j) 4., 5., (tm) and (6), am. (5) (d), (e), and (t) Register November 2005 No. 599, eff. 12–1–05; CR 05–020: cr. (7) Register January 2006 No. 601, eff. 2–1–06; correction made under s. 13.93 (2m) (b) 1., Stats., Register January 2006 No. 601; CR 06–026: am. (5) (dm) and (e), Register December 2006 No. 612, eff. 1–1–07.

NR 504.07 Minimum design and construction criteria for final cover systems. (1) GENERAL. (a) All final cover systems shall be designed to minimize leachate generation by limiting the amount of percolation through the cap system, reduce landfill maintenance by stabilizing the final surface through design of compatible slopes and establishment of vegetation, account for differential settlement and other stresses on the capping layer, minimize the climatic effects of freeze–thaw and desiccation on the clay capping layer of the final cover system, and provide removal of leachate and venting of gas from those landfills which accept wastes with a high moisture content or which readily biodegrade.

(b) All new landfills and expansions of existing landfills shall be designed with a final cover system meeting the requirements in subs. (2) to (9) unless it is established to the satisfaction of the department that portions of the final cover system are not needed based on the proposed waste types and the proposed design. The geomembrane component in sub. (5) does not apply to landfills designed exclusively for the disposal of high volume industrial waste, or to other landfills which are not designed to accept municipal solid waste unless the landfill is composite lined.

(c) Any phases of an existing landfill which have been designed and constructed with a composite liner shall be designed and constructed with a final cover system meeting the requirements in subs. (2) to (9), except that the requirement for the geomembrane layer in sub. (5) does not apply to composite lined

phases of existing landfills which have completed final cover placement by July 1, 1996.

(d) Landfills which accept papermill sludges or other industrial solid wastes with high water contents and low strength may propose alternate final cover systems if the strength of the waste mass will not allow for the construction of the cover system required in this section.

(2) GRADING LAYER. A minimum 6 inch thick grading layer shall be designed over the final waste elevation of landfills proposing to accept municipal solid waste to attain the required slope and provide for a stable base for subsequent system components. Daily and intermediate cover may be used for this purpose.

(3) SUPPORT LAYER FOR LOW–STRENGTH WASTES. A support layer shall be designed for stabilization, reinforcement and removal of leachate and gas over the final waste elevations for landfills which accept industrial solid wastes with high water contents and low strength.

(4) CLAY CAPPING LAYER. A minimum 2 foot thick clay cap shall be designed to provide a low hydraulic conductivity barrier to percolation. Clay used for this layer shall meet the specifications in s. NR 504.06 (2) (a). The clay capping layer shall be constructed according to s. NR 504.06 (2) (f). Final cover systems that are required to include a geomembrane layer may be designed with the following alternatives to the clay component of the composite capping layer:

(a) The clay component of the capping layer may be replaced by a GCL overlying a minimum of 2 feet of soil barrier layer. This GCL layer and the soil barrier layer shall meet the following material and construction specifications:

1. The GCL shall consist of a layer of sodium bentonite clay encapsulated between 2 geotextiles.

2. The GCL shall be covered with a geomembrane the same day that it is unpacked and placed in position. The GCL may not be installed in standing water or during rain. The GCL shall be dry when installed and covered. A GCL exhibiting unconfined swelling shall be removed and replaced.

3. The GCL shall be installed in a relaxed condition and shall be free of tension or stress upon completion of the installation. The GCL may not be stretched to fit.

4. Adjoining panels of a GCL shall be laid with a minimum of 6 inches of overlap on the longitudinal seams and a minimum 20 inches of overlap on the panel end seams.

5. Irregular shapes, cuts or tears in the installed GCL shall be covered with a GCL patch that provides a minimum 12 inch overlap onto adjacent GCL surfaces.

6. A seal of loose bentonite granules shall be placed in seam overlaps at a minimum rate of one quarter pound per linear foot of seam for all panel end seams and longitudinal seams. The seal of loose bentonite may be deleted, with concurrence by the department, for longitudinal seams where the manufacturer has processed the overlap area to enhance sealing. The seal may not be deleted for any longitudinal seams that are transitions between construction phases.

7. Loose bentonite or bentonite amended soil shall be placed at all patches and penetrations.

8. GCL panels shall be certified needle–free through magnetic and metal detection tests.

9. The GCL shall be placed in direct contact with a soil barrier layer.

10. Vehicle traffic on the subgrade of the GCL and on the GCL shall be restricted to the minimum weight and number of machines needed to deploy the GCL and geomembrane. Vehicles shall be operated to minimize the formation of ruts and surface deformations and to prevent damage to the GCL and geomembrane. Deployment methods shall be selected to prevent any tearing or combing out of fibers of the GCL.

11. Soil cover placement over the geosynthetics shall be completed in the same construction season as the geosynthetic construction.

12. The soil barrier layer shall consist of fine–grained soil or a well graded sandy soil with fines, meeting the USCS soil types ML, CL, CH, SM, or SC or dual–symbol classifications of these soils, with at least 25% by weight passing the P200 sieve size. The upper one foot shall have a maximum particle size of 2 inches or less. The lower one foot shall have a maximum particle size of 4 inches or less.

13. The soil barrier layer shall be compacted in lift heights of no greater than 12 inches after compaction using footed compaction equipment with feet at least 6 inches long. Each lift shall be disked or otherwise mechanically processed prior to compaction to break up clods and allow for moisture content adjustment. Clod size shall be no greater than 4 inches.

14. A sufficient number of passes of the compaction equipment shall be made over each lift to ensure complete remolding of the soil. All compaction equipment utilized shall have a minimum static weight of 30,000 pounds. Compaction equipment with static weight that exceeds 15,000 pounds may be utilized where it utilizes vibration to achieve dynamic compaction that exceeds 30,000 pounds of compaction energy. Lighter equipment may be used in small areas where it is not possible to use full size equipment. Alternative procedures or equipment may be proposed for approval by the department.

15. All soil shall be compacted to 90% modified or 95% standard Proctor density or greater at a moisture content at or wet of optimum. As soil placement proceeds, the minimum density and moisture content targets shall be adjusted as necessary.

16. Each lift shall be keyed into clay or soil barrier layer soils in adjacent phases to form a continuous seal. This shall be accomplished by excavating steps with a minimum width of 2 feet along the edge of the existing phase and overlapping them with lifts being placed for the new phase. A minimum of 2 steps shall be included.

17. The surface of the top lift shall be graded or compacted to be smooth and firm and shall be inspected for removal of coarse gravel, cobbles and debris prior to placement of a GCL.

(b) For industrial solid waste landfills that predominantly accept compressible wastes or wastes with high water contents and low strength, the clay layer may be replaced by a GCL overlying a minimum of a one foot sand layer. The gradation of the sand layer shall be a uniform sand selected to vent gas, drain leachate and provide hydration water to the GCL.

(c) For industrial solid waste landfills that predominantly accept ash, the clay layer may be replaced by a GCL overlying a minimum of 2 feet of soil barrier layer. The soil barrier layer shall meet the requirements of par. (a) 13. to 17. The upper foot of soil barrier layer shall also meet the requirements of par. (a) 12. The lower foot shall be designed to provide a capillary break between the ash and the upper one foot of soil barrier layer.

(d) The lower one foot of the clay layer may be replaced with a minimum of one foot of foundry green sand system sand with a bentonite content of greater than 6%, a liquid limit of greater than 20, a plasticity index of greater than 6, and a hydraulic conductivity of less than $1x10^{-7}$ cm/sec. The green sand system sand shall be compacted to 90% modified or 95% standard Proctor density or greater at a moisture content at or wet of optimum.

(5) GEOMEMBRANE LAYER. A geomembrane layer shall be designed to provide a low hydraulic conductivity barrier to percolation. The design and construction of the geomembrane component of the final cover system shall meet the requirements of s. NR 504.06 (3) (c) to (j) and the following:

(a) The nominal geomembrane thickness shall be 40 mils or greater, with no thickness measurements falling below industry accepted manufacturing tolerances.

(b) The geomembrane shall be installed in direct contact with the clay capping layer.

(c) Penetrations of the geomembrane, such as gas extraction wells, shall be fitted with prefabricated collars of pipe and membrane or plate and welded at the same angles which the penetrations make with the final cover slope. Methods of fixing membrane boots to vertical pipes extending above the geomembrane shall allow for differential settlement of the waste with respect to the piping without damage to the membrane seal.

(6) DRAINAGE AND ROOTING ZONE LAYER. A minimum 2.5 foot thick drainage and rooting zone layer shall be designed above the geomembrane layer or clay capping layer. This layer shall include a rooting zone to provide additional rooting depth for vegetation and to protect the geomembrane layer or the clay capping layer from freeze–thaw damage and other environmental effects. It shall also include a drainage layer to allow for the drainage of liquid infiltrating through the cap. Soils available on or near the proposed landfill property may be proposed for the rooting zone portion of this layer. This layer may not be densely compacted.

(a) For all landfills, a drainage layer shall be designed immediately above the capping layer. The drainage layer shall consist of a minimum of one foot of sand with a minimum hydraulic conductivity of $1x10^{-3}$ cm/sec or a geosynthetic drain layer of equivalent or greater flow capacity. The design shall include an analysis which demonstrates whether the maximum head in the drain layer will be confined within the thickness of the drain. Drain calculations shall include infiltration rates based on saturated characteristics of the topsoil and rooting zone and a hydraulic gradient of one through the topsoil and rooting zone.

(b) A perimeter drain pipe shall be placed at the low end of all final cover sideslopes. The drain pipe shall be surrounded by a minimum of 6 inches of gravel or sand with a minimum hydraulic conductivity of $1x10^{-2}$ cm/sec. The drain pipe shall be sloped to a series of outlets at spacings no further than every 200 feet. Modeling may be submitted to the department which supports the proposal of a different spacing.

(7) TOPSOIL. A minimum of 6 inches of topsoil shall be designed over the cover layer to support the proposed vegetation. Fertilizer and lime shall be added in accordance with section 630, Wisconsin department of transportation standard specifications for road and bridge construction or other appropriate specifications in order to establish a thick vegetative growth.

(8) REVEGETATION. The seed type and amount of fertilizer applied shall be proposed depending on the type and quality of topsoil and compatibility with both native vegetation and the final use. Unless otherwise approved by the department in writing, seed mixtures and sowing rates shall be those specified for right–of–ways according to section 630, 2003 edition of the Wisconsin department of transportation standard specifications for highway and structure construction and the 2004 supplemental specifications. Application rates for fertilizer and mulch shall also be specified.

Note: The 2003 edition of the Wisconsin department of transportation standard specifications for highway and structure construction and any annual supplemental specifications are available at http://www.dot.wisconsin.gov/business/engrserv/procedures.htm or can be obtained from the department of natural resources, bureau of waste management, 101 S. Webster Street, P.O. Box 7921, Madison, WI 53707–7921, (608) 266–2111, waste.management@dnr.state.wi.us. Copies are also available for inspection at the offices of the legislative reference bureau and the secretary of state.

(9) FINAL USE. The proposed final use shall be compatible with the final cover system. The following activities are prohibited at solid waste disposal landfills which are no longer in operation unless specifically approved by the department in writing.

(a) Use of the waste disposal area for agricultural purposes.

(b) Establishment or construction of any buildings over the waste disposal area.

(c) Excavation of the final cover or any waste materials.

History: Cr. Register, January, 1988, No. 385, eff. 2–6–88; am. (1) (a), (b), (2), cr. (1) (c), (d), (5), (6) (a), (b), r. and recr. (3), (4), r. (5) (a) to (c), renum. (5) to (8) to be (6) to (9) and am. (6) (intro.), (7), (9) (intro.), (a), (b), Register, June, 1996, No. 486, eff. 7–1–96; CR 04–077: am. (6) (a) Register November 2005 No. 599, eff. 12–1–05; CR 05–020: r. and recr. (4), am. (8) Register January 2006 No. 601, eff. 2–1–06.

NR 504.075 Soil borrow sources. (1) GENERAL. This section applies to all soil borrow sources developed for the purpose of constructing, operating or closing landfills. Written approval from the department shall be obtained prior to initiating soil borrow activities at any borrow source subject to these requirements.

(2) EXEMPTIONS. (a) The following activities are exempt from the requirements of this section:

1. Production of processed aggregate products.

2. Excavation of soils from construction projects off of the landfill property, provided the soils will be used for purposes other than a compacted clay liner or capping layer, soil barrier layer, leachate collection layer or final cover drain layer.

(b) Soil borrow sources which are exclusively within the proposed or approved limits of filling for a landfill or areas where soils are obtained from excavation projects developed primarily for purposes other than construction, operation or closure of a landfill are not subject to the requirements of subs. (3) and (4) (b).

(3) INITIAL SITE INSPECTION. An initial site inspection shall be conducted in accordance with s. NR 509.04 for each proposed soil borrow source.

(4) LOCATIONAL INFORMATION. (a) Submittals for soil borrow sources shall include a description of total acreage, ownership, location by quarter – quarter section and by parcel corner using a coordinate system and datum acceptable to the department, present land uses, transportation routes, any access restrictions and travel distance to and from the landfill.

(b) Submittals for soil borrow sources shall include site–specific surface water drainage patterns and significant hydrologic features such as surface waters, springs, drainage divides and wetlands; areas of special natural resource interest; and historical or archaeological areas within and adjacent to the proposed limits of excavation.

(5) FIELD AND LABORATORY INVESTIGATIONS FOR CLAY BORROW SOURCES AND SOIL BARRIER LAYER SOURCES. Submittals for soil borrow sources shall include field and laboratory investigations to define the physical characteristics of any clay borrow source or soil barrier layer source designated to be used for a liner or final cover for the landfill. An alternative geotechnical investigation program may be used if it is approved by the department in writing prior to performing the field and laboratory investigations. An alternative geotechnical investigation program may be submitted in cases where previous information exists regarding the proposed soil borrow source. Submittals for soil borrow sources shall include justification for any reduction in sampling or testing frequency required by this section or by an approved alternative geotechnical investigation.

(a) A minimum of 10 test pits or borings for the first 5 or less acres and one test pit or boring for each additional 3 or less acres shall be excavated or drilled on a uniform grid pattern across each proposed borrow source to document the depth, lateral extent and uniformity of the clay or soil barrier layer. The department recommends using test pits as the method of borrow source investigation. Logs identifying the geologic origin, testing results, USCS classification and a visual description of each major soil unit encountered shall be included with the submittals for soil borrow sources.

(b) A minimum of 2 representative samples from each test pit or boring shall be analyzed by a soils laboratory for Atterberg limits and grain size distribution to the 0.002 millimeter particle size using mechanical and hydrometer methods. Each sample shall be classified according to the USCS.

(c) A minimum of one representative sample from each major soil unit shall be tested for the relationship of water content to dry

density using either the modified or standard Proctor method. For uniform clay deposits or uniform soil barrier layer source deposits, no fewer than 3 samples shall be tested. Each Proctor curve shall be developed with a minimum of 5 points. If the line of optimums method is anticipated to be used in construction, both the standard and modified Proctor curves shall be developed for each representative sample.

(d) A minimum of one laboratory hydraulic conductivity test shall be conducted on each sample used to develop the Proctor curves. The samples tested shall be at or above the optimum moisture content. This requirement does not apply if the soil borrow source is contiguous with a previously approved borrow source for clay or soil barrier layer soils and all field observations and laboratory test results support an interpretation that the soil borrow source occupies the same soil horizon and has the same genesis as the previously approved borrow source. Support for such a conclusion shall be provided in the submittals for soil borrow sources.

(6) STOCKPILING. Stockpiling of soils obtained from clay borrow sources and soil barrier layer sources for landfill liner or final cover construction shall be conducted in an organized manner that minimizes mixing of dissimilar soil types. Soils shall be segregated into stockpiles based on similar USCS soil type, soil gradation, Atterberg limits and compaction specifications. Soils from differing sources may not be commingled unless soil properties are similar.

(7) DATA PRESENTATION FOR ALL CLAY BORROW SOURCES AND SOIL BARRIER LAYER SOURCES. Submittals for soil borrow sources for clay and soil barrier layers shall include all of the following:

(a) The calculated volume of soil needed and the volume of acceptable soil available.

(b) Property boundaries and any test pit or boring locations, shown on a topographic map with a scale of 1 inch = 500 feet and provided in a digital format acceptable to the department. The mapped area shall extend a minimum of 500 feet beyond the proposed borrow source.

(c) An isopach map showing the thickness of acceptable soil.

(d) A description of the methods to be used for separating the acceptable soil from any unacceptable soil.

(e) A proposal for maintaining drainage and sedimentation control.

(f) All data obtained from the testing program.

(8) DATA PRESENTATION FOR OTHER BORROW SOURCES. Submittals for soil borrow sources other than those used for clay and soil barrier layers shall include all of the following:

(a) Property boundaries shown on a topographic map with a scale of 1 inch = 500 feet and provided in a digital format acceptable to the department. The mapped area shall extend a minimum of 500 feet beyond the proposed borrow source.

(b) A proposal for maintaining drainage and sedimentation control.

(9) STORMWATER MANAGEMENT. Submittals for soil borrow sources shall include a stormwater management plan that complies with the requirements of s. NR 504.09 (1) (a) to (f) and (h) to (j), unless the borrow source is subject to other permits with equivalent authority and requirements, such as a stormwater discharge permit or non–metallic mining reclamation permit.

(10) RECLAMATION OF BORROW SITES. Submittals for soil borrow sources shall include a reclamation plan detailing the actions to be taken to achieve successful reclamation of the borrow source.

(a) Reclamation plans for borrow sources on the property where the landfill is located shall specify a post–mining land use that is integrated with the existing and proposed drainage, surface water discharge requirements, grades and final use of the landfill. The reclamation plan shall be prepared consistent with the applicable standards in ss. NR 135.06 to 135.12.

(b) Soil borrow areas that are not on the landfill property are subject to the provisions of ch. NR 135 and, if required, shall submit a reclamation plan and obtain a nonmetallic mining reclamation permit from the appropriate regulatory authority.

(11) OTHER REQUIREMENTS. (a) Clay borrow sources and soil barrier layer sources proposed for a liner or final cover that have less than a 5 foot but greater than 2 foot uniform thickness may be approved if the applicant demonstrates an excavation methodology and a documentation procedure to ensure that all soil used meets soil index properties required by this chapter.

(b) Submittals for soil borrow sources shall include a description of any necessary measures to be taken to comply with wetlands protection requirements, runoff and sediment controls and surface water discharge permit requirements and to minimize effects on areas of special natural resource interest and historical or archaeological areas within and adjacent to the proposed limits of excavation.

Note: It may be necessary to obtain federal, state or local permits prior to excavating soil from a borrow source near surface waters or wetlands. For example, s. 30.19 (1g) (c), Stats., requires a permit for grading or removing top soil from the bank of any navigable stream, lake or body of navigable water where the area exposed by such grading or removal will exceed 10,000 square feet. It is the responsibility of the applicant or property owner to obtain any federal, state or local permits that are required and to provide reference to those other permit applications in the submittals for soil borrow sources.

History: CR 05–020: cr. Register January 2006 No. 601, eff. 2–1–06.

NR 504.08 Minimum design and construction criteria for landfill gas extraction systems. (1) GENERAL. All landfills accepting wastes with the potential to generate gas shall be designed to prevent the migration of explosive gases generated by the waste fill.

(2) ACTIVE GAS EXTRACTION AND TREATMENT. In order to efficiently collect and combust hazardous air contaminants, all landfills which accept municipal solid waste shall be designed with an active gas recovery system. All gas recovery systems shall include the following design features, unless otherwise approved by the department:

(a) Vertical gas extraction wells shall be proposed throughout the entire landfill with a maximum radius of influence of 150 feet per well and lesser radii proposed for wells located near the perimeter of the landfill. The radii of influence of adjacent wells shall overlap. Alternate well spacings may be proposed if site specific data is obtained through performance of pump tests.

(b) All vertical gas extraction wells shall extend to 10 feet above the leachate collection system and shall be placed in 36 inch diameter boreholes. An exemption may be proposed to allow for placement of gas extraction wells closer to the leachate collection system.

(c) The pipe in the borehole shall be a minimum 6 inch diameter, Schedule 80 polyvinylchloride or an approved alternate.

(d) The lower 2/3 to 3/4 of the pipe in the borehole shall be slotted or perforated pipe.

(e) The backfill around the slotted or perforated pipe in the borehole shall be one to one and 1/2 inch washed stone. The top 10 feet of the borehole shall be sealed.

(f) Each gas extraction well shall have a flow control valve and sampling access port.

(g) The gas header system shall be looped to allow alternative flow paths for the gas.

(h) The minimum slope on the header pipe shall be 2% for pipes over the waste mass.

(i) Polyethylene pipe shall be used for header and lateral pipes.

(j) The sizing of the blower, header and laterals shall ensure that a minimum vacuum of 10 inches water column is available in the header adjacent to those wells located furthest from the blower.

(k) A drip leg or equivalent shall be installed immediately before the blower to separate condensate from gas while preserv-

ing the suction at the wells while under maximum operating vacuum.

(L) All condensate transfer piping and gas transfer piping located outside of the limits of waste shall be designed to be fully encased in at least 2 feet of clay, double–cased pipe or by using another approved secondary containment method except for systems with multiple drip legs within the landfill where the bulk of the condensate has been removed.

(m) The system shall be designed to have the ability to collect and treat all condensate, measure volumes and collect samples.

(n) A flare shall be designed to meet the requirements of ch. NR 445.

(3) GAS MONITORING WELLS. A minimum of one gas monitoring well shall be located on each side of the landfill. The wells shall be constructed according to s. NR 507.11.

(4) PASSIVE GAS EXTRACTION SYSTEMS. Landfills which accept only industrial waste or other nonmunicipal solid waste with the potential to generate gas and which do not utilize an active gas extraction system shall be designed with a system which allows gas venting from the entire landfill surface. An analysis shall be performed to determine the spacing needed between gas venting trenches for an effective system and also to ensure that ch. NR 445 limits for hazardous air contaminants will not be exceeded. The system shall be designed with a continuous layer below the capping layer which allows surficial venting from the waste final surface. This layer may be part of the support layer required in s. NR 504.07 (3). This layer shall consist of a minimum of one foot of granular soil with a minimum hydraulic conductivity of $1x10^{-3}$ cm/sec and a series of flexible, perforated pipes connected to a series of outlets.

History: Cr. Register, May, 1992, No. 437, eff. 6–1–92, r. and recr., Register, June, 1996, No. 486, eff. 7–1–96; CR 05–020: r. (2) (e) Register January 2006 No. 601, eff. 2–1–06.

NR 504.09 Storm water management and miscellaneous design and construction criteria for landfills. **(1)** STORM WATER MANAGEMENT. (a) Storm water drainage ditches, structures and sedimentation basins shall be designed such that the construction of these items shall occur during the initial stage of construction to control rainfall runoff and limit entrained sediment from reaching surface water bodies.

(b) All landfills shall incorporate the following concepts in the design of both temporary and permanent erosion and sediment control measures:

1. Grading and construction shall be scheduled to minimize soil exposure.

2. Existing vegetation shall be retained whenever feasible.

3. Disturbed areas shall be vegetated and mulched.

4. Runoff shall be diverted away from disturbed areas and active fill areas.

5. Runoff velocities shall be minimized.

6. Drainageways and outlets shall be prepared to handle concentrated or increased runoff.

7. Sediment shall be trapped on site.

8. Runoff control structures shall be inspected and maintained.

(c) The design calculations required in pars. (d), (e) and (f) shall each be performed for the period in the landfill's development where the combination of surface conditions and contributing acreage would result in the greatest runoff volume.

(d) All temporary and permanent storm water drainage ditches, swales, conveyance channels, channel linings, outlet protection, culverts and other storm water control structures handling flow onto or off the landfill shall be designed to accommodate peak flow rates from a 25 year, time of concentration storm event.

(e) Temporary and permanent sediment control measures shall be designed to settle 0.015 mm size particles for all storms up to and including the 25 year, 6–hour storm. The surface area for sediment basins shall be calculated using the rainfall intensity over the 25 year, 6–hour storm event for the landfill. Principal spillways, and outlet protection for sediment basins shall be designed to pass a 25 year, time of concentration storm event. Emergency spillways for sedimentation basins shall be designed to pass a 100 year, time of concentration storm event. The design of the dewatering structures for sediment basins shall be selected such that the basin is dewatered in no less than 3 days. An analysis shall be performed to document compliance with this requirement.

(f) Storm water shall be diverted away from the active fill area of the landfill and any borrow areas to a sedimentation control structure.

(g) Containment berms placed around active fill areas shall be designed to control and collect the liquid volume resulting from the 25 year, 24–hour storm event. The design shall consider the volume of liquid generated from active fill areas which shall include areas with exposed solid waste or areas with waste covered by daily cover. Storm water in contact with active fill areas shall be handled and treated as leachate in accordance with ch. NR 506.

(h) Storm water drainage ditches, structures and sedimentation basins shall discharge along existing drainage patterns capable of accepting the anticipated flow volume. An analysis shall be performed to determine the amount and velocity of runoff prior to landfill development and to document compliance with this requirement.

(i) Storm water diversion and construction at a landfill shall be designed to minimize impacts on adjacent property, such as erosion, sedimentation and flooding.

(j) Design of all storm water management features shall comply with other applicable requirements of the department. Such requirements include, but are not limited to, ch. NR 103, and permits required by ch. 30, Stats.

(2) MISCELLANEOUS. All landfills shall be designed to meet the following requirements:

(a) A method of controlling any dust or windblown debris shall be included in the landfill design. The factors which will be considered by the department when evaluating alternative provisions for controlling dust and windblown debris includes the remoteness of the landfill, natural screening, windbreaks and waste types.

(b) Access to the landfill shall be restricted through the use of fencing, natural barriers or other methods approved in writing by the department.

(c) All access roads for the landfill, including those leading to the active area, shall be designed for all weather operation.

(d) All access roads which are used by over the highway vehicles shall be designed with a maximum grade no greater than 10%. The intersection of the landfill access road with an existing highway shall be designed to provide sufficient sight distance and minimum interference with traffic on the highway.

(f) A minimum separation distance of 100 feet shall be maintained between the limits of filling and adjacent property line. A minimum distance of 50 feet shall be maintained between any permanent berms or excavations associated with the landfill, excluding storm water diversion structures and the adjacent property line.

(g) The landfill shall be designed so that final grades in each phase are reached as soon as possible, and the open area used for refuse filling is minimized.

(h) The final slopes of all landfills shall be equal to or greater than 5%, but may not exceed 4 horizontal to one vertical. Landfills primarily designed for the acceptance of papermill or waste-

water treatment plant sludge shall have final slopes no greater than 6 horizontal to one vertical.

(i) A minimum of 2 leachate head wells shall be proposed for each major horizontal phase of the landfill unless otherwise approved by the department.

(j) All landfills which accept municipal solid waste shall be supplied with a weight scale.

(k) All landfills shall be designed with properly protected permanent benchmarks for horizontal and vertical control. Elevations shall be tied to USGS datum and horizontal control shall be referenced to the property boundary.

History: Cr. Register, June, 1996, No. 486, eff. 7–1–96; am. (1) (e), Register, September, 1998, No. 513, eff. 10–1–98; CR 05–020: r. (2) (e) Register January 2006 No. 601, eff. 2–1–06.

NR 504.095 Design criteria for landfills that recirculate leachate. (1) GENERAL. Leachate recirculation systems shall be designed to meet the following requirements:

(a) Leachate recirculation shall be limited to municipal solid waste landfills that are designed with a composite liner and leachate collection system meeting the minimum requirements of s. NR 504.06.

(b) Leachate recirculation shall be limited to areas of the landfill where the leachate collection drainage blanket has a hydraulic conductivity of 1 cm/sec or greater. The department may approve leachate recirculation in existing cells with lower permeability leachate collection blankets, provided that the operator can demonstrate that the maximum leachate head on the liner can be maintained at less than 12 inches and that the recorded leachate head has not exceeded 12 inches in the past.

(c) Leachate shall be recirculated only in areas of the landfill which are connected to the active gas extraction systems and are capable of collecting the additional gas expected to be generated. Active gas extraction shall commence in those areas no later than the initiation of leachate recirculation.

(d) Leachate recirculation distribution systems may not discharge leachate within 100 lateral feet of the exterior sideslope final grades unless otherwise approved by the department in writing.

(e) A minimum depth of 20 feet of waste shall be maintained between the landfill base and lowest point of leachate distribution.

(f) Operating controls and instructions for leachate recirculation distribution systems shall be prepared to apply to operations expected to be encountered in all weather and seasons. Instructions shall include cessation of leachate recirculation upon discovery of seeps and other surface expressions of recirculated leachate, excessive pressures within the waste mass, saturated conditions in the waste mass, inadequate shear strength of the waste mass or other conditions indicative of instability.

(2) SURFACE APPLICATION. In addition to the general requirements, surface application systems for leachate recirculation shall meet the following requirements:

(a) The leachate distribution system shall be designed so that leachate is not introduced into the waste in a manner that causes ponding or surface runoff of leachate. Open surface trenches or ponds shall not be utilized.

(b) The leachate distribution system shall be designed to minimize evaporation of the leachate and volatilization of compounds in leachate. The leachate distribution system shall be designed to distribute the leachate in a manner that results in its absorption into the waste mass after application. Spray irrigation systems that are designed to promote evaporation may not be utilized.

(3) VERTICAL DISTRIBUTION SYSTEMS. Vertical distribution systems for leachate recirculation shall meet the following requirements:

(a) Wells designed solely for the gas extraction system shall not be used for leachate recirculation.

(b) Vertical distribution systems shall utilize vertical wells placed into the waste mass. Distribution well design need not comply with the requirements of s. NR 504.08 (1) or ch. NR 141 or 812. Well spacing shall be determined based on leachate flow rates, pumping characteristics, permeability of the waste mass, and ability of the waste to accept liquid without being pressurized.

(c) Leachate distribution wells shall be designed with a surface seal to control odors and landfill gas.

(d) Pumping pressures and pumping intervals for distribution wells shall be designed to prevent surface emergence of leachate. Pumping pressures and hydrostatic pressures shall be limited to prevent excessive pressures to prevent separation of waste layers or short–circuiting of leachate to the leachate collection system.

(e) The leachate distribution system shall be designed to achieve a uniform distribution of leachate throughout the zone of influence of the wells.

(f) Leachate distribution wells may be designed to also extract landfill gas.

(4) HORIZONTAL DISTRIBUTION SYSTEMS. Horizontal distribution systems shall meet the following requirements:

(a) The leachate distribution piping shall be designed to distribute the leachate consistently along its length.

(b) Distribution systems shall be designed with a permeable bedding material that is capable of rapidly dissipating recirculated leachate into the waste mass.

(c) Distributions systems shall be designed with bedding material which is capable of maintaining its structure and characteristics during the expected operational life of the system.

(d) Distribution systems shall be designed to operate with specific distribution periods with landfill gas extracted in the interval between those distribution periods, unless otherwise approved by the department in writing. The length of the leachate distribution periods and the intervals of gas extraction shall be determined in a manner that minimizes uncontrolled landfill gas emissions.

(e) Pumping pressures and pumping intervals shall be designed to prevent surface emergence of leachate. Pumping pressures shall be limited to prevent excessive pressures to prevent separation of waste layers or seeps or other leachate discharges.

History: CR 04–077: cr. Register November 2005 No. 599, eff. 12–1–05; CR 06–026: am. (1) (d) and (2) (b), Register December 2006 No. 612, eff. 1–1–07.

NR 504.10 Alternative design criteria for landfills accepting high volume industrial wastes. This section applies to landfills designed principally for high volume industrial waste, wood residue and minor amounts of other wastes as approved by the department. This section applies to all new landfills and to the expansion of existing landfills for which the plan of operation was approved after February 1, 1988.

(1) GENERAL. (a) An applicant may design a high volume industrial waste landfill to meet the standards contained in ss. NR 504.05 to 504.09 or may propose an alternative design in accordance with the provisions of this section.

(b) If the applicant does not complete construction of the first major phase of the landfill within 2 years from the date of the plan of operation approval, the applicant shall reapply to the department for approval to construct the landfill. This application does not constitute a feasibility report as defined in s. 289.24, Stats. The department may require additional conditions of approval and require redesign of the landfill in accordance with state–of–the–art design criteria.

(c) An owner or operator of a landfill which is designed primarily for disposal of high volume industrial waste may accept up to 10% by weight of municipal waste such as packaging which is generated in conjunction with the manufacturing process, and not be subject to the design requirements of s. NR 504.05 (1). Household and plant waste not generated as a direct result of the manufacturing process such as office and cafeteria waste, may not be

disposed of in a landfill which does not meet the requirements of s. NR 504.05 (1).

(2) DESIGN CAPACITY. Design capacity shall be in accordance with s. NR 504.05 (3).

(3) DESIGN CRITERIA. An applicant seeking approval of an alternative design under this section shall demonstrate in the feasibility report required in ch. NR 512 that the alternative design adequately protects public health, welfare and the environment and meets or exceeds the location and performance standards of s. NR 504.04. The applicant may include the following types of information as a part of such a demonstration:

(a) Landfill characteristics including regional and specific information on land use, geology, hydrology, hydrogeology and soils.

(b) Waste characteristics including quantity and physical and chemical analyses of the waste and its leachate.

(c) An analysis of any design to control geologic or hydrogeologic conditions of the site.

(d) Field demonstration data.

(e) Design and performance data for other similarly designed and constructed landfills.

(f) Accepted scientific or engineering analyses or field studies, field plots, research, manufacturer's data or demonstrations.

(4) APPROVAL CRITERIA. The department shall approve the alternative design proposed by the applicant if the department determines to a reasonable degree of certainty that the alternative design adequately protects public health, welfare and the environment and meets or exceeds the location and performance standards of s. NR 504.04.

History: Cr. Register, June, 1996, No. 486, eff. 7–1–96.

NR 504.11 Minimum design and construction criteria for landfills accepting residue produced by burning municipal solid waste. (1) APPLICABILITY. This section applies to landfills designed for residue produced by the burning of municipal solid waste as approved by the department. This section applies to all new and existing landfills.

(2) LANDFILL DESIGN CRITERIA FOR RESIDUE PRODUCED BY BURNING MUNICIPAL SOLID WASTE. (a) All landfills that accept municipal solid waste combustor residue that tests below the limits specified in s. NR 502.13 (6) (g) shall be designed as composite lined monofill cells according to the following criteria:

1. The composite liner shall consist of a minimum 60 mil geomembrane overlying a minimum thickness of 4 feet of compacted clay meeting the specifications of s. NR 504.06.

2. The leachate collection system shall be designed such that the leachate from the residue monofill cell can be sampled and collected separately from non–residue disposal areas.

3. The department may approve alternate designs such as double liners if it finds that the design provides equivalent protection.

(b) All landfills that accept municipal solid waste combustor residue that exceeds the limits specified in s. NR 502.13 (6) (g) shall be designed as a double composite lined monofill cell according to the following criteria. The department may approve alternate designs if it finds that the design provides equivalent protection.

1. The double composite liner shall be designed with 2 separate composite liners with each liner consisting of a minimum 60 mil geomembrane overlying a minimum thickness of 4 feet of compacted clay meeting the specifications of s. NR 504.06.

2. The composite liners shall be separated by a leachate detection layer consisting of a minimum one foot layer of granular material.

3. Separate leachate collection systems shall be designed above and between the composite liners. The leachate collection system shall be designed such that the leachate from the leachate detection layer can be sampled and collected separately from the upper leachate collection system and from the non–residue disposal areas.

(c) All landfills which accept municipal solid waste combustor residue shall be approved by the department in accordance with s. NR 514.07 (5) prior to accepting each specific residue waste stream.

History: Cr. Register, June, 1996, No. 486, eff. 7–1–96.

ENVIRONMENTAL PROTECTION AGENCY

40 CFR Part 258

[F–97–FLXP–FFFFF–5865–4]

RIN 2050–AE24

Revisions to Criteria for Municipal Solid Waste Landfills

AGENCY: Environmental Protection Agency.

ACTION: Proposed rule.

SUMMARY: The Land Disposal Program Flexibility Act of 1996 (LDPFA) directed the Administrator of the U.S. Environmental Protection Agency (EPA) to provide additional flexibility to the Director of Approved States for the owners and operators of landfills that receive 20 tons or less of municipal solid waste per day. The additional flexibility pertains to alternative frequencies of daily cover, frequencies of methane monitoring, infiltration layers for final cover, and means for demonstrating financial assurance. The additional flexibility will allow the owners and operators of small municipal solid waste landfills (MSWLFs) the opportunity to reduce the cost of MSWLF operation while still protecting human health and the environment. This proposal recognizes, as did Congress in enacting LDPFA, that these decisions are best made at the State and local level and, therefore, offers this flexibility to approved States.

In the final rules Section of today's **Federal Register**, EPA is promulgating this amendment as a final rule without prior proposal because EPA views this as a noncontroversial action that in effect, codifies a legislative directive. Thus, we anticipate no adverse comments. A detailed rationale for the amendment is set forth in the preamble to the direct final rule. If no adverse comments are received in response to this proposal, no further activity is contemplated regarding this proposed rule. If EPA receives adverse comments, EPA will withdraw the final rule and all public comments received will be addressed in a subsequent final rule based on the proposed rule. EPA will not institute a second comment period on this action.

DATES: Comments on this proposed rule must be received on or before August 28, 1997. An adverse comment will be considered to be any comment substantively criticizing the proposal on a basis not already provided to EPA in comment.

ADDRESSES: Commenters must send an original and two copies of their comments referencing docket number F–97–FLXP–FFFFF to: RCRA Docket Information Center, Office of Solid Waste (5305G), U.S. Environmental Protection Agency Headquarters (EPA, HQ), 401 M Street, SW, Washington, DC 20460. Hand deliveries of comments should be made to the Arlington, VA, address below. Comments may also be submitted electronically through the Internet to: rcra-docket@epamail.epa.gov. Comments in electronic format should also be identified by the docket number F–97–FLXP–FFFFF. All electronic comments must be submitted as an ASCII file avoiding the use of special characters and any form of encryption. Commenters should not submit electronically any confidential business information (CBI). An original and two copies of CBI must be submitted under separate cover to: RCRA CBI Document Control Officer, Office of Solid Waste (5305W), U.S. EPA, 401 M Street, SW, Washington, DC 20460.

Public comments and supporting materials are available for viewing in the RCRA Information Center (RIC), located at Crystal Gateway I, First Floor, 1235 Jefferson Davis Highway, Arlington, VA. The RIC is open from 9 a.m. to 4 p.m., Monday through Friday, excluding federal holidays. To review docket materials, it is recommended that the public make an appointment by calling 703 603–9230. The public may copy a maximum of 100 pages from any regulatory docket at no charge. Additional copies cost $0.15/page. The index and some supporting materials are available electronically. See the **SUPPLEMENTARY INFORMATION** section for information on accessing them.

FOR FURTHER INFORMATION CONTACT: For general information, contact the RCRA Hotline at 800 424–9346 or TDD 800 553–7672 (hearing impaired). In the Washington, DC, metropolitan area, call 703 412–9810 or TDD 703 412–3323.

For more detailed information on specific aspects of this rulemaking, contact Mr. Allen J. Geswein, U. S. Environmental Protection Agency, Office of Solid Waste (5306W), 401 M Street, SW, Washington, DC 20460, 703 308–7261, [GESWEIN.ALLEN @EPAMAIL.EPA.GOV].

SUPPLEMENTARY INFORMATION: The index and the following supporting materials are available on the Internet:

Memorandum to: RCRA Docket
From: Allen J. Geswein, Environmental Engineer
Subject: Daily Cover Requirements for MSWLFs

Memorandum to: RCRA Docket
From: Allen J. Geswein, Environmental Engineer
Subject: Landfill Gas Monitoring Requirements for MSWLFs

Memorandum to: RCRA Docket
From: Allen J. Geswein, Environmental Engineer
Subject: Infiltration Layer Requirements for MSWLFs

Memorandum to: RCRA Docket
From: Allen J. Geswein, Environmental Engineer
Subject: Financial Assurance Requirements for MSWLFs

Follow these instructions to access the information electronically:

WWW: http://www.epa.gov/epaoswer/nonhazardous waste

FTP: ftp.epa.gov

Login: anonymous

Password: your Internet address

Files are located in /pub/gopher/OSWRCRA.

The official record for this action will be kept in paper form. Accordingly, EPA will transfer all comments received electronically into paper form and place them in the official record, which will also include all comments submitted directly in writing. The official record is the paper record maintained at the address in **ADDRESSES** at the beginning of this document.

EPA responses to comments, whether the comments are written or electronic, will be in a notice in the **Federal Register** or in a response to comments document placed in the official record for this rulemaking. EPA will not immediately reply to commenters electronically other than to seek clarification of electronic comments that may be garbled in transmission or during conversion to paper form, as discussed above.

Regulated Entities

Entities potentially regulated by this action are public or private owners or operators of municipal solid waste landfills (MSWLFs) that dispose of 20 tons or less of municipal solid waste per day, based on an annual average. Regulated categories and entities include:

Category	Examples of regulated entities
Industry	Owners or operators of small MSWLFs
Municipal Governments	Owners or operators of small MSWLFs

This table is not intended to be exhaustive, but rather provides a guide for readers regarding entities likely to be regulated by this action. This table lists the types of entities the EPA is now aware could potentially be regulated by this action. Other types of entities not listed in the table could also be regulated. To determine whether your facility would be regulated by this action, you should carefully examine the applicability criteria in the proposal. If you have questions regarding the applicability of this action to a particular facility, consult the person listed in the preceding **FOR FURTHER INFORMATION CONTACT** section.

Preamble Outline

I. Authority
II. Background
III. Additional Information
IV. Consideration of Issues Related to Environmental Justice
V. Impact Analysis
A. Executive Order 12866
B. Regulatory Flexibility Act
C. Paperwork Reduction Act
D. Executive Order 12875
E. Unfunded Mandates

I. Authority

The Agency is proposing these regulations under the authority of sections 1008(a)(3), 2002(a), 4004(a), and 4010(c) of the Resource Conservation and Recovery Act (RCRA), as amended, 42 U.S.C. 6907(a)(3), 6912(a), 6944(a), and 6949a(c).

II. Background

As set out in detail in the related direct final rule, EPA is proposing to issue rules that grant the Director of an Approved State the flexibility to establish alternative requirements for certain criteria for small MSWLFs. EPA is promulgating revisions to existing criteria which would allow a Director of an Approved State, after public review and comment, to establish for small MSWLFs, alternative frequencies of daily cover application, frequencies of methane gas monitoring, and infiltration layers for final cover. Alternative means for demonstrating financial assurance for small MSWLFs are also discussed in the related direct final rule. When establishing these alternative requirements, the Director of an Approved State must, after public review and comment, consider the unique characteristics of small communities, take into account climatic and hydrogeologic conditions, and ensure that any alternative standard is protective of human health and the environment.

III. Additional Information

For additional information, see the corresponding direct final rule published in the final rules section of this **Federal Register**. All persons who may wish to comment should review the preamble discussion in the direct final rule **Federal Register** notice.

IV. Consideration of Issues Related to Environmental Justice

EPA is committed to addressing environmental justice concerns and is assuming a leadership role in environmental justice initiatives to enhance environmental quality for all residents of the United States. The Agency's goals are to ensure that no segment of the population, regardless of race, color, national origin, or income bears disproportionately high and adverse human health and environmental effects as a result of EPA's policies, programs, and activities, and all people live in clean and sustainable communities.

The Agency does not currently have data on the demographics of populations surrounding the small MSWLFs affected by today's rule. The Agency does not believe, however, that today's rule granting additional flexibility to owners and operators of small MSWLFs will have a disproportionately high and adverse environmental or economic impact on any minority or low-income group, or on any other type of affected community. In addition, any minority group or low-income group affected by alternative requirements will have an opportunity to review and comment on the alternative requirement proposed by the Director of the Approved State prior to its implementation. The Agency believes that this rulemaking will enable some minority and/or low-income communities to continue to be served by a local landfill at the lowest possible cost to residents, including minority and low income residents.

V. Impact Analysis

A. Executive Order 12866

Under Executive Order 12866, EPA must determine whether a regulatory action is significant and therefore subject to OMB review and the other provisions of the Executive Order. A significant regulatory action is defined by Executive Order 12866 as one that may:

(1) Have an annual effect on the economy of $100 million or more or adversely affect in a material way the economy, a sector of the economy, productivity, competition, jobs, the environment, public health or safety, or State, local, or tribal governments or communities;

(2) Create a serious inconsistency or otherwise interfere with an action taken or planned by another agency;

(3) Materially alter the budgetary impact of entitlements, grants, user fees, or loan programs or rights and obligations or recipients thereof; or

(4) Raise novel legal or policy issues arising out of legal mandates, the President's priorities, or the principles set forth in Executive Order 12866.

The Agency believes that this proposed rule does not meet the definition of a major regulation because it does not have an annual effect on the economy of $100 million or more; nor does the rule fall within the other definitional criteria for a significant regulation described above. The proposed rule is deregulatory and will result in requirements applicable to specific MSWLFs that are protective of human health and the environment at a lower cost than would be the case without the additional flexibility afforded by these amendments. For this reason, the Agency is not conducting a Regulatory Impact Analysis.

B. Regulatory Flexibility Act

The Regulatory Flexibility Act (5 U.S.C. 601 et seq.), as amended by the Small Business Regulatory Enforcement Fairness Act of 1996 (SBREFA), generally requires an agency to prepare, and make available for public comment, a regulatory flexibility analysis that describes the impact of a proposed or final rule on small entities (i.e., small businesses, small organizations, and small governmental jurisdictions). However, no regulatory flexibility analysis is required if the head of an agency certifies the rule will not have a significant adverse impact on a substantial number of small entities.

SBREFA amended the Regulatory Flexibility Act to require Federal agencies to provide a statement of the factual basis for certifying that a rule will not have a significant economic impact on a substantial number of small

entities. The following discussion explains EPA's determination.

Implementation of the various requirements imposes increased costs on small MSWLFs and the small communities, including Tribes, that they serve. MSWLFs that dispose of 20 TPD of waste generally serve populations of 10,000 persons or less (based on a waste generation rate of 4 pounds per person per day). Because these owners/operators may lack practicable solid waste management alternatives, such as the option of joining regional waste management systems, these communities may have been required to absorb higher than necessary costs of compliance in the absence of the additional flexibility afforded by today's proposed rule.

The effect of this proposed rule is to provide small entities with additional flexibility to meet the requirements of Part 258. The proposal would not impose any new burdens on small entities. Therefore, pursuant to 5 U.S.C. 605(b), I certify that this proposed rule would not have a significant adverse impact on a substantial number of small entities. This proposed rule, therefore, does not require a regulatory flexibility analysis.

C. Paperwork Reduction Act

The Agency has determined that there are no new reporting, notification, or recordkeeping provisions associated with today's proposed rule.

D. Executive Order 12875

Under Executive Order 12875, Federal agencies are charged with enhancing intergovernmental partnerships by allowing State and local governments the flexibility to design solutions to problems the citizenry is facing. Executive Order 12875 calls on Federal agencies to either pay the direct costs of complying with Federal mandates or to consult with representatives of State, local, or tribal governments prior to formal promulgation of the requirement. The Executive Order also relates to increasing flexibility for State, Tribal, and local governments through waivers. Today's proposed rule grants additional flexibility in complying with the MSWLF criteria, does not impose unfunded federal mandates on State, Tribal, and local governments, and is being undertaken to ensure that EPA is providing maximum flexibility to States, Tribes, and local governments. Additionally, the Agency has maintained dialog with States, Tribes, and local governments regarding ways of ensuring appropriate flexibility while maintaining protection of human health and the environment for small MSWLFs. Therefore, the Agency believes that this consultation with States, Tribes, and local governments, in addition to the public comment period provided in the proposed rules Section of today's **Federal Register**, satisfies the requirement of this Executive Order.

E. Unfunded Mandates

Title II of the Unfunded Mandates Reform Act of 1995 (UMRA), Public Law 104–4, establishes requirements for Federal agencies to assess the effects of regulatory actions on State, local, and Tribal governments, and the private sector. Under section 202 of the UMRA, EPA generally must prepare a written statement, including a cost-benefit analysis, for proposed and final rules with ''Federal mandates'' that may result in expenditures to State, local, and tribal governments, in the aggregate, or to the private sector, of $100 million or more in any one year. Before promulgating an EPA rule for which a written statement is needed, section 205 of the UMRA generally requires EPA to identify and consider a reasonable number of alternatives and adopt the least costly, most cost effective or least burdensome alternative that achieves the objective of the rule. The provisions of section 205 do not apply when they are inconsistent with applicable law. Moreover, section 205 allows EPA to adopt an alternative other than the least costly, most cost-effective or least burdensome alternative if the Administrator publishes with the final rule an explanation why that alternative was not adopted. Before EPA establishes any regulatory requirements that may significantly or uniquely affect small governments, including tribal governments, it must have developed under section 203 of the UMRA a small government agency plan. The plan must provide for notifying potentially affected small governments, enabling officials of affected small governments to have meaningful and timely input in the development of EPA regulatory proposals with significant Federal intergovernmental mandates, and informing, educating, and advising small governments on compliance with the regulatory requirements.

EPA has determined that this proposed rule does not include a Federal mandate that may result in estimated costs of $100 million or more to either State, local, or tribal governments in the aggregate, or to the private sector. In fact, today's proposed rule provides States with additional flexibility that would lower the cost of compliance with the Criteria for Municipal Solid Waste Landfills. In accordance with section 203, EPA has shared this proposal with State governments and asked for comment.

List of Subjects in 40 CFR Part 258

Environmental protection, Reporting and recordkeeping requirements, Waste treatment and disposal.

Dated: July 23, 1997.

Carol M. Browner,

Administrator.

[FR Doc. 97–19941 Filed 7–28–97; 8:45 am]

BILLING CODE 6560–50–U

APPENDIX B

EVALUATION OF EFFECTIVENESS OF NR504 AND ALTERNATIVE COMPOSITE LINERS

October 22, 2019

Advanced Disposal:
Mr. Jay Warzinski / Mr. Tim Curry
90 Fort Wade Road
Ponte Vedra, FL 32081

Subject: Evaluation of Effectiveness of NR504 and Alternative Composite Liners

Dear Jay and Tim:

Please find attached the writeup on the evaluation we performed to compare the effectives of a Wisconsin NR 504 composite liner to alternative liners in preventing leakage and diffusion of contaminants into underlying ground water resources. The evaluation performed considered the various aspects of liner design, construction and long-term integrity. We understand this report will be submitted to the WDNR for their consideration in approving an alternative to NR 504 MSW liner requirements. Should you or the WDNR have questions regarding the information provided in the attached, do not hesitate to contact us.

Sincerely,

James M. Tinjum, P.E., PhD, F.A.S.C.E

Craig H. Benson, PhD, PE, NAE

CC: Mark Torresani - Tetra Tech
Tyler Field – Tetra Tech

Evaluation of Effectiveness of NR504 and Alternative Composite Liners

Craig H. Benson, PhD, PE, NAE
James M. Tinjum, P.E., Ph.D

October 22, 2019

INTRODUCTION

Composite liners for municipal solid waste landfills (MSW) have been in use for approximately 30 years. MSW landfill composite liners in Wisconsin include a 60-mil (1.5 mm) HDPE geomembrane placed directly on a 4-foot compacted clay layer, as described in Section NR504 of the Wisconsin Administrative Code. The NR504 composite liner has been highly effective in protecting groundwater in Wisconsin, and is based on research and field experience that evolved since composite liners were first introduced in the early 1980s. Advances in liner materials and construction methods over the last 25 years have made a variety of composite liner configurations highly effective, as described in state-of-practice reviews commissioned by USEPA (Bonaparte et al. 2002) and the National Academies (Mitchell et al. 2007). The information presented herein indicates that there are alternative composite liners that protect groundwater equal or better than the composite liner currently required under NR504 regulations.

This memorandum provides background on how the thickness of NR504 liners evolved in Wisconsin based on experience, and describes an analysis of four alternative composite liners in terms of their effectiveness relative to the composite liner currently required in NR504. The analysis includes a conventional assessment of “equivalency” based on leakage rate to assess whether leakage from an alternative liner is equal to or less than the leakage rate from the NR504 composite liner. This analysis is followed by an assessment of “protectiveness,” where a contaminant transport analysis is conducted to evaluate if the alternative liner is equally protective of groundwater quality. The contaminant transport analysis includes advective and diffusive transport processes in the liner and the vadose zone.

These analyses are used to answer the following questions:

- Is the leakage rate from an alternative composite liner less than or equal to leakage rate from the NR504 composite liner (i.e., is the alternative liner “equivalent”?)?

- Does the alternative composite liner provide equal or better protection of groundwater quality than the NR504 composite liner (i.e., is the alternative liner “equally protective”)?

The leakage rate calculations and contaminant transport analyses conducted in this study indicate that composite liners with a 2-foot compacted clay layer can perform as well as if not better than a NR504 composite liner with a 4-foot compacted clay layer.

BACKGROUND ON LINER THICKNESS

In the mid- to late-70's, the Wisconsin Department of Natural Resources (WDNR) began requiring liners and leachate collection systems (LCS) for larger landfills. Because WDNR was unsure of capabilities of contractors, inspectors, and engineering staff to apply proper construction methods or to conduct construction quality control processes, they took a conservative approach when formulating minimum criteria for liners. They settled on a 5-ft-thick compacted clay liner (CCL) with hydraulic conductivity no greater than $1x10^{-7}$ cm/s overlain by a 1-ft-thick leachate collection layer with hydraulic conductivity no less than 10^{-3} cm/s. A thick CCL was selected to ensure redundancy so that defects within individual lifts would not impact the overall hydraulic conductivity of the liner. This liner requirement was introduced before geomembranes and other geosynthetics were used in landfill construction. A detailed description of this history based on interviews with WDNR personnel is in the Appendix C.

The appropriate thickness for CCLs was a concern of USEPA in the 1980s. Hydraulic analyses of CCLs conducted by Wong (1977) and WDNR staff (Kmet et al. 1997) demonstrated that the benefits of increasing the liner thickness diminished substantially when the thickness was increased beyond 2 ft because of a greatly diminishing hydraulic gradient. However, the issue of periodic defects and heterogeneity in the clay liner remained a concern when specifying a minimum thickness for CCLs. Consequently, in the mid-1980s, when USEPA was contemplating minimum standards for Subtitle D of the Resource Conservation and Recovery Act (RCRA), they commissioned a study to evaluate the impact of localized defects in CCLs on overall hydraulic conductivity hydraulic conductivity. This study, which is the basis for the 2-ft CCL in a Subtitle D composite liner, demonstrated that the impact of local defects became negligible if a CCL contained at least four lifts (Benson and Daniel 1994a, b). Nevertheless, given the success of 5-ft CCLs in Wisconsin, and with concern about volatile organic compounds (VOCs) in leachate, WDNR followed a conservative approach and retained the 5-ft-thick CCL in NR504.

Promulgation of RCRA Subtitle D in 1993 required that MSW landfills in all states incorporate a composite liner with a geomembrane overlying a CCL at least 2-ft thick and having hydraulic conductivity no greater than 10^{-7} cm/s. Given this change in federal regulations, and the additional protection afforded by the geomembrane, WDNR's adopted a composite liner with a 4-ft-thick CCL overlain by a 60-mil geomembrane. WDNR retained a 4-ft CCL rather than the 2-ft CCL in RCRA Subtitle D to provide additional conservatism. WDNR's favorable experience protecting groundwater with a 5-ft-thick CCL provided a good basis for a thicker composite liner than required by RCRA Subtitle D, given that composite liners for MSW landfill were relatively new when Subtitle D was promulgated.

LEAKAGE RATE ANALYSIS

The leakage rate analysis was conducted to compare leakage rates anticipated for the four alternative composite liners to the leakage rate anticipate for the NR504 composite liner for the purpose of assessing whether the alternative liners were "equivalent" to the NR504 liner in terms

of reducing leakage (Fig. 1). Flow in composite liners occurs through defects in the geomembrane, between the geomembrane and the underlying soil liner in an interfacial zone, and then downward through the soil liner (Fig. 2). The leakage rate is controlled by the area over which the flow spreads in the interfacial zone, the depth of liquid on the surface of the liner (d_L), and the saturated hydraulic conductivity of the soil liner component (K_S) (Giroud 1997, Touze-Foltz et al. 1999, Foose et al. 2001). The area of spreading in the interfacial zone is controlled by the size of defects in the geomembrane and the transmissivity of the interface, which is affected by the stiffness of the geomembrane, the texture of the surface of the soil liner component, and the overburden stress on the surface of the liner (Foose et al. 2001, Rowe 2012). More flexible geomembranes, smoother soil liner surfaces, and higher overburden stresses result in better contact between the geomembrane and the soil component, which results in lower interface transmissivity and lower leakage rate. For this reason, geotextiles are not placed between a geomembrane and soil liner in a composite liner, as the geotextile would create a more transmissive interface, greater spreading of flow, and higher leakage rate.

Giroud's equation is the most common method to predict the leakage rate for a composite liner (Rowe 2012):

$$Q = C\left[1 + \frac{1}{10}\left(\frac{d_L}{t_L}\right)^{0.95}\right] a^{0.1} d_L^{0.9} K_s^{0.74} \tag{1}$$

where Q is the leakage rate per hole in the composite liner, a is the area (m^2) of the hole, and C is a contact factor (Giroud 1997). The contact factor characterizes the intimacy of contact between the geomembrane and underlying soil liner, with higher C corresponding to a more transmissive interface. Equation 1 is a semi-empirical expression developed by Giroud (1997) that is the most widely used equation to compute the leakage rate from composite liners. Equation 1 is based on the empirical equation originally developed by Giroud et al. (1989), with modifications wto address the effects of liner thickness and depth of liquid on the liner, which is accounted for by the term d_L/t_L which resembles a hydraulic gradient (Giroud 1997). Because Equation 1 is based on an empirical expression, the variables must be in a specific set of SI units: Q - m^3/s, d_L – m, t_L – m, a – m^2, and K_s – m/s. The gradient term (d_L/t_L) in Equation 1 generally is valid for $d_L < 3$ m.

Foose et al. (2001) evaluated the efficacy of the equations by Giroud (1997) by comparing leakage rates predicted by Equation 1 to leakage rates computed with a three-dimensional finite-difference model developed with minimal simplifying assumptions. The model explicitly accounted for multidimensional flow in the interfacial zone and soil liner, and allowed different hydraulic properties to be assigned throughout the model domain. Leakage rates predicted by the Giroud equation were higher than those predicted by the three-dimensional finite-difference model, sometimes more than a factor of 10 higher. That is, the Giroud equation overpredicts the leakage rate (i.e., the predictions are "conservative"). Giroud's equation is broadly used because of its simplicity combined with the "conservative" aspect of the predictions (Rowe 2005).

Input

Leakage rates were computed using Eq. 1. assuming five circular holes per hectare, with each hole 10 mm in diameter. Giroud and Bonaparte (2001) recommend this hole size and frequency for engineering design computations assuming typical quality assurance during construction. “Good” contact between the GM and underlying soil liner was assumed (C = 0.21, Giroud 1997).

Thickness and hydraulic conductivity of the soil component of the composite liner were set at 1.22 m (4 ft) and $1x10^{-7}$ cm/s for the NR504 liner, 0.61 m (2 ft) and $1x10^{-7}$ cm/s for Alternative A1, and 6 mm and $1x10^{-9}$ cm/s for Alternative A3. The thickness and hydraulic conductivity of the GCL for Alternative A4 were based on recommendations in Bradshaw et al. (2013) for stresses corresponding to liner conditions in MSW landfills. For Alternative A2, the thickness of the soil liner component was set equal to the combined thickness of the GCL and compacted clay liner (0.616 m or 2.02 ft) and the hydraulic conductivity was set equal to the harmonic mean of the hydraulic conductivities of the GCL and compacted clay liners weighted by the thickness of each component. The harmonic mean is used for vertical flow through horizontal layers (Benson and Daniel 1994a), and yielded an effective hydraulic conductivity of $5.09x10^{-8}$ cm/s.

The depth of leachate on the liner in Equation 1 was computed assuming sheet flow in the leachate collection system (Giroud et al. 2000):

$$d_L = \frac{pL}{K_{sL} \sin\beta} \tag{2}$$

where p is the leachate impingement rate on the leachate collection layer, L is the maximum distance of flow to the leachate collection pipe, β is the slope angle for the liner, and K_{sL} is the saturated hydraulic conductivity of the leachate collection layer. Impingement rates corresponding to 100, 300, 500, and 700 mm/yr were used in Eq. 2 to compute the leachate depths. This range of impingement rates captures the range reported in Bareither et al. (2010) for municipal solid waste (MSW) landfills in humid regions with a broad range of leachate recirculation and/or liquid addition rates, with the lowest impingement rate corresponding to conditions without recirculation or liquid addition to the MSW. Hydraulic conductivity of the leachate collection stone was assumed to be 1 cm/s, as required in NR504.06 for MSW landfills. The slope was varied from 0.5 to 4% (2% is the default minimum in NR504.06, although site-specific provisions for composite liners are identified in NR504.06 and slopes as low as 0.5% are employed for composite-lined landfills in Wisconsin).

No contribution of the upper geomembrane was considered when computing the leakage rates for Alternative A3. If the upper geomembrane is punctured or leaks, the geonet will flood and the leakage rate would be controlled by the underlying composite liner with a geomembrane over a GCL. If the upper geomembrane retains some or complete effectiveness, the leakage rates would be lower than those shown in Table 1 for Alternative A3.

Alternative 4 is a combination of the NR500 liner and Alternative 1. Thus, no leakage rate calculations were made for Alternative A4 assuming that the leakage rate would be no greater than the leakage rate for Alternative A1, and probably less.

Results

Leakage rates computed using Giroud's equation are summarized in Table 1 for the NR504 liner and Alternatives A1-A3. A graph comparing the leakage rates is shown in Fig. 2 for a liner slope of 0.5% and the range of leachate impingement rates used in the analysis. The leakage rates in Table 1 and Fig. 2 are generally consistent with those reported in Bonaparte et al. (2002) and Mitchell et al. (2007).

All of the leakage rates are very low, typically being less than 0.2 L/ha-d (~0.02 gall/ac-d) at the highest impingement rates. The leakage rates are very low because the leachate depth in the leachate collection system is very low (on the order of a few mm) and the composite barrier is highly effective in constraining flow. The high hydraulic conductivity of the leachate collection layer provides for efficient transmission of leachate, resulting in very low leachate depths.

Comparison of the leakage rates indicates that the NR504 liner has the highest leakage rates of all liners. Alternative A1 has comparable leakage rate as the NR504 liner, whereas Alternatives A2 and A3 are considerably lower. These findings indicate that the thickness of the composite liner is not particularly important in terms of controlling the leakage rate.

The leakage rate for Alternative A3 is lower than for A2, even though both include a GCL, with the GCL backed up by a compacted clay liner in A2. This reflects an anomaly in how the hydraulic gradient is applied in Giroud's equation (Eq. 1), as the leakage rate for Alternative A2 is expected to be less than or equal than the leakage rate computed for Alternative A3 given that the upper geomembrane Alternative A3 was ignored in the analysis. For all practical purposes, leakage rates for Alternatives A2 and A3 should be comparable when the upper geomembrane in A3 is ignored. For this reason, the leakage rates reported for A2 and A3 in Fig. 2 and Table 1 for a given leachate impingement rate can be considered a range of possible leakage rates for either liner.

The effect of liner slope on the leakage rates is shown in Fig. 3. The leakage rate diminishes modestly as the liner slope increases, with the greatest change as the slope increases from 0.5 – 2.0%. The leakage rates for Alternatives A1 show similar sensitivity to slope as the NR504 liner. In contrast, the leakage rates for Alternatives A2 and A3 are less sensitive to liner slope because the soil component of the composite liner is less permeable.

CONTAMINANT TRANSPORT ANALYSIS

A contaminant transport analysis was conducted to evaluate whether two of the alternative liners were equally protective of groundwater as the NR504 composite liner. For composite liners,

diffusion is the most important mechanism affecting contaminant transport because diffusion can occur across the entire surface, whereas leakage only occurs at those locations where defects exist in the geomembrane. The cross-sectional area of the defects is orders of magnitude lower than the total cross-sectional area of the liner surface. Thus, the area for diffusion is orders of magnitude larger than the area engaged in leakage (Foose et al. 2002). Diffusion is most significant for organic compounds, particularly VOCs, as they readily partition into the geomembrane and can be transported by diffusion through the liner.

For diffusive transport of VOCs, the material and transport properties of the solute, GM, clay and natural soil are of significance whereas leachate head and number of holes/defects are of much less significance (seepage velocity is nil compared to diffusive transport processes, Foose et al. 2002). As VOC transport occurs over the entire surface of a GM, the process can be modeled one dimensionally (1D). In saturated soil, 1D mass transport of a non-decaying solute via diffusion can be expressed as (Hashimoto et al. 1964; Freeze and Cherry 1979):

$$\frac{\partial C_s}{\partial t} = \frac{D^*}{R}\frac{\partial^2 C_s}{\partial z^2} \tag{3}$$

where C_s is the concentration of the organic compound in the pore water of the soil liner, z is the distance along the direction of mass transport, t is elapsed time, R is the retardation factor, and D^* is the effective diffusion coefficient. The effective diffusion coefficient can be related to the free solution diffusion coefficient (D) by:

$$D^* = D\,\tau_a \tag{4}$$

where τ_a is apparent tortuosity, which is typically 0.01 to 0.5 for clay (Shackelford and Daniel 1990, Tinjum et al. 1997). The retardation factor is computed as:

$$R = 1 + \frac{\rho_b K_d}{n} \tag{5}$$

where K_d is the clay-water partition coefficient, ρ_b is the dry density of the clay liner, and η is the porosity of the clay.

Partitioning in the geomembrane is described by the solute-geomembrane partition coefficient (K_{gm}):

$$K_{gm} = \frac{C_{gm}}{C_s} \tag{6}$$

where C_{gm} is the concentration sorbed to the geomembrane and C_s is the solute concentration in solution. Diffusion through the GM is described using Eq. 3 with D*/R replaced by D_{gm}, the diffusion coefficient for the geomembrane(Park and Nibras 1993; Park et al. 1996; Sangam and Rowe 2001b; Joo et al. 2004, 2005; Park et al. 2012a, b)

$$\frac{\partial C_{gm}}{\partial t} = D_{gm}\frac{\partial^2 C_{gm}}{\partial z^2} \quad (7)$$

For soil-solute systems, K_d is obtained (Blume et al. 1990; Nelson and Sommers 1996) by:

$$K_d = f_{oc} K_{oc} \quad (8)$$

where K_{OC} is the organic carbon partition coefficient and f_{oc} is the fraction of organic carbon in the clay. K_{OC} is computed from the octanol-water partition coefficient, K_{OW}, as (Karickhoff et al. 1979; Kim et al. 2001; Lake and Rowe 2005):

$$\log K_{oc} = 0.92+0.36\log K_{ow} \quad (9)$$

when f_{oc} is in the range of 0.1–6%, as is commonly found in clay liner soils. Toluene is commonly used as a representative VOC in transport analysis for MSW liners given that toluene is ubiquitous in MSW landfill leachates.

For the unsaturated zone beneath the liner, the effective diffusion coefficient, D*, is a function of the degree of saturation, S (Porter et al. 1960; Romkens and Bruce 1964; Rowell et al. 1967; Warncke and Barber 1972; Barraclough and Tinker 1981, Lim et al. 1998).

Transport Modeling

A diffusive solute transport analysis incorporating the liner and underlying vadose zone was conducted using the COMSOL finite-element package. COMSOL provides a numerical solution of Equations 3-9 for a given set of input simulations. Results obtained from COMSOL were validated using the Crank-Nicolson finite-difference method in Microsoft Excel spreadsheets (Foose 2002; Foose et al. 2001, 2002; Park et al. 2012b; Eun et al. 2014).

Leachate from MSW contains a wide range of VOCs (see Table 2) in addition to inorganic compounds. Klett et al. (2005) examined VOC concentrations in MSW landfill leachates throughout Wisconsin for lined landfills (CCLs or composite liners). Average concentrations of five VOCs in leachates from Klett et al. (2005) are shown in Table 3 that represent a range of VOC types. Toluene (an arene, K_{ow} = 2.69) is the most widely detected VOC (49 of 54 cells) with one of the highest concentrations(C_{avg} = 83.5 ug/L). For this reason, toluene was used as the representative solute in this analysis.

Transport parameters used in the modeling are summarized in Table 4. The toluene concentration in the leachate was assumed to be constant at 100 µg/L, which is higher than the geometric mean concentration of toluene reported by Klett et al. (2005) for leachate in Wisconsin landfills (83.5 µg/L). The lower boundary condition was set at a concentration of 0 and was assumed to be time invariant.

Results

Concentrations at the groundwater table predicted by the model are shown in Fig. 6 for a period of 125 yr. Toluene concentrations are zero for over 100 years and remain exceptionally low throughout the entire simulation period (i.e., orders of magnitude below regulatory levels). Moreover, the highest concentrations are obtained from the NR504 composite liner due to the longer diffusion distance through the unsaturated silty sand subgrade beneath the thinner alternative composite liners. This analysis ignored biodegradation of the toluene. If degradation had been included, concentrations at the groundwater table would have been zero throughout the entire duration of the simulation.

REFERENCES

Bareither, C., Benson, C., Barlaz, M., Edil, T., and Tolaymat, T. (2010), Performance of North American Bioreactor Landfills: I. Leachate Hydrology and Waste Settlement, J. Environmental Engineering, 136(8), 824–838.

Barraclough, P.B. and Tinker, P.B. (1981). “The determination of ionic diffusion coefficients in field soils I. Diffusion coefficients in sieved soils in relation to water content and bulk density.” *Journal of Soil Science*. 32, 225–236.

Benson, C. and Daniel, D. (1994a), Minimum Thickness of Compacted Soil Liners: I-Stochastic Models, *J. Geotech. Eng.,* 120(1), 129-152.

Benson, C. and Daniel, D. (1994b), Minimum Thickness of Compacted Soil Liners: II-Analysis and Case Histories, *J. Geotech. Eng.,* 120(1), 153-172.

Benson, C.H. and Gurdal, T. (2013). “Hydrologic properties of final cover soils.” Foundation Engineering in the Face of Uncertainty, *GSP No. 229*, J. Withiam et al., Eds., ASCE, Reston VA, 283–297.

Blume, L.J., B.A. Schumacher, P.W. Shaffer *et al.* 1990. *Handbook of Methods for Acid Deposition Studies Laboratory Analyses for Soil Chemistry*. EPA/600/4-90/023. U.S. Environmental Protection Agency, Las Vegas, NV.

Bonaparte, R., Koerner, R., and Daniel, D. (2002). Assessment and Recommendations for Improving the Performance of Waste Containment Systems, Office of Research and Development, US Environmental Protection Agency, Washington, DC.

Bradshaw, S., Benson, C., and Scalia, J. (2013). Cation Exchange During Subgrade Hydration and Effect on Hydraulic Conductivity of Geosynthetic Clay Liners, J. Geotech. and Geoenvironmental Eng., 139(4), 526–538.

Mueller, W., Jakob, R., Tatzky-Gerth, R., August, H., 1998. Solubilities, diffusion and partition coefficients of organic pollutants in HDPE geomembranes: experimental results and calculations. In: Proceedings of the Sixth International Conference on Geosynthetics, Atlanta, Industrial Fabrics Association International, St. Paul, MN, pp. 239–248.

Edil, T. B., Wambold, W. S., and Park, J. K. (1995). “Partitioning of VOCs in clay liner materials.” Geoenvironment 2000, ASCE GSP 46, 775–790. 20.

Edil, T. B. (2003) “A review of aqueous-phase VOC transport in modern landfill liners.” Waste Management, 23(7), 561–571.

Edil, T. B. (2007). “Is aqueous-phase VOC transport from modern landfills a potential environmental problem?” *Proceeding*, Sardinia 2007, *11th Int. Landfill Symposium*, Cagliari, Italy.

Eun, J. (2014). “Volatile organic compounds and methane transport through composite barriers with co-extruded geomembrane containing ethylene vinyl alcohol.” Ph.D. dissertation, Dept. of Civil and Environmental Engineering, Univ. of Wisconsin at Madison, Madison, WI.

Eun, J., Tinjum, J.M., Benson, C.H., and Edil, T.B. (2017). “Comparison of Volatile Organic Compound Transport in Composite Liners with HDPE and Ethylene-Vinyl Alcohol Co-Extruded Geomembranes.” J. Geotech. and Geoenviron. Eng. 143(6).

Foose, G., Benson, C., and Edil, T. (2001), Predicting Leakage Through Composite Landfill Liners, *Journal of Geotechnical and Geoenvironmental Engineering*, 127(6), 510-520.

Foose, G. J., Benson, C. H., Edil, T. B. (2002). “Comparison of Solute Transport in Three Composite liners.” *Journal of Geotechnical and Geoenvironmental Engineering,* 128(5), 1-13.

Freeze, R. A., and Cherry, J. A. (1979). “Ground water.” Prentice-Hall, Englewood Cliffs, New Jersey.

Giroud, J. and Bonaparte, R. (1989), Leakage Through Liners Constructed with Geomembranes – Parts I and II. Geomembrane Liners, J. Geotextiles and Geomembranes, 8, 27-67.

Giroud, J., Khatami, A., and Badu-Tweneboah, K. (1989), Evaluation of the Rate of Leakage Through Composite Liners, J. Geotextiles and Geomembranes, 8, 337-340.

Giroud, J. (1997), Equations for Calculating the Rate of Liquid Migration Through Composite Liners due to Geomembrane Defects, Geosynthetics International, 4(3-4) 335-348.

Giroud, J., Zornberg, J., and Zhao, A. (2000), Hydraulic Design of Geosynthetic and Granular Liquid Collection Layers, Geosynthetics International, 7(4-6), 285-380.

Giroud, J. and Bonaparte, R. (2001). Geosynthetics in Liquid Containing Structures, Geotechnical and Geoenvironmental Engineering Handbook. Kluwer Academic Publishing, Norwell, Massachusetts, 789–824.

Hashimoto, I., Deshpande, K. B., Thomas, H. C. (1964). “Peclet numbers and retardation factors for ion exchange columns.” *Industrial and Engineering Chemistry Fundamentals*, 3 (3), 213-218.

Joo, J. C., Kim, J. Y., Nam, K. (2004). “Mass transfer of organic compounds in dilute aqueous solutions into high density polyethylene geomembranes.” *Journal of Geotechnical and Geoenvironmental Engineering*, 130 (2), 175-183.

Joo, J. C., Nam, K., Kim, J. Y. (2005). “Estimation of mass transport parameters of organic compounds through high density polyethylene geomembranes using a modified double-compartment apparatus.” *Journal of Geotechnical and Geoenvironmental Engineering*, 131 (5), 790-799.

Kalbe, U., Muller, W., Berger, W., Eckardt, J., 2002. Transport of organic contaminants within composite liner systems. Applied Clay Science 21, 67–76.

Karickhoff, S. W., Brown, D. S., and Scott, T. A. (1979) “Sorption on hydrophobic pollutants on natural sediments.” Water Resources Research, 13, 241-248.

Katsumi, T., Benson, C.H., Foose, G.J., and Kamon, M. (2001). “Performance-Based Design of Landfill Liners.” *Engineering Geology*, 60, 139-148.

Kim, J. Y., Edil, T. B., and Park, J. K. (2001). “Volatile organic compound (VOC) transport through compacted clay.” *Journal of Geotechnical and Geoenvironmental Engineering*, 127 (2), 126-134.

Kim, J. Y., Shin, M., Park, J., Nam, K. (2003). “Effect of soil solids concentration in batch tests on the partition coefficients of organic pollutants in landfill liner-soil materials.” *Journal of Material Cycles and Waste Management*, 5 (1), 55-62.

Klett, N., Edil, T. B., Benson, C. H., and Connelly, J. (2005). “Evaluation of volatile organic compounds in Wisconsin landfill leachate and lysimeter samples.” *Final Report to the University of Wisconsin System Groundwater Research Program*, Department of Civil and Environmental Engineering, University of Wisconsin at Madison, Madison, WI.

Lake, C. B., and Rowe, R. K. (2005). “A comparative assessment of volatile organic compound (VOC) sorption to various types of potential GCL bentonites.” *Geotextiles and Geomembranes,* 23 (4), 323–347.

Lim, P.C., Barbour, S.L., and Fredlund, D.G. 1998. “The influence of degree of saturation on the coefficient of aqueous diffusion.” *Canadian Geotechnical Journal.* 35: 811–827.

Mitchell, J. et al. (2007), Assessment of the Performance of Engineered Waste Containment Barriers, National Research Council of the National Academies, Washington, DC.

Mueller, W., Jakob, R., Tatzky-Gerth, R., August, H., 1998. Solubilities, diffusion and partition coefficients of organic pollutants in HDPE geomembranes: experimental results and calculations. In: Proceedings of the Sixth International Conference on Geosynthetics, Atlanta, Industrial Fabrics Association International, St. Paul, MN, pp. 239–248.

Nelson, D.W. and Sommers. L. E. (1996) “Total carbon, organic carbon, and organic matter” In: Methods of Soil Analysis, Part 2, 2nd Ed., A.L. Page et al., Agronomy Monograph, 9, 961-1010.

Nefso, E. K. and Burns, S. E. (2007) “Comparison of the equilibrium sorption of five organic compounds to HDPE, PP, and PVC geomembranes.” *Geotextiles and Geomembranes*, 25, 360-365.

Park, J. K., and Nibras, M. (1993). “Mass flux of organic chemicals through polyethylene geomembranes.” *Water Environment Research*, 65 (3), 227-237.

Park, J. K., Sakti, J. P., Hoopes, J. A. (1996). “Transport of organic compounds in thermoplastic geomembranes, I: Mathematical model.” *Journal of Environmental Engineering*, 122 (9), 800-806.

Park, M. G., Benson, C. H., and Edil T. B. (2012a). “Comparison of batch and double compartment tests for measuring VOC transport parameters in geomembranes.” *Geotextiles and Geomembranes*, 31 (1), 15–30.

Park, M. G., Edil T. B. and Benson, C. H. (2012b). “Modeling volatile organic compound transport in composite liners.” *Journal of Geotechnical and Geoenvironmental Engineering*, 138(6), 641-657.

Porter, L.K., Kemper, W.D., Jackson, R.D., and Stewart, B.A.(1960). “Chloride diffusion in soils as influenced by moisture content.” *Soil Science Society of America Proceedings*. 24, 460–463.

Richardson, G., 1997. GCL’s: alternative subtitle D systems. Geotechnical Fabrics Report, Industrial Fabrics Association, St. Paul MN 15 (5), 36–42.

Romkens, M.J.M., and Bruce, R.R. (1964). “Nitrate diffusivity in relation to moisture content of non-adsorbing porous media.” *Soil Science*. 98, 332–337.

Rowe, R. K., 1987. Pollutant transport through barriers. Geotechnical Practice for Waste Disposal, GSP No. 26, ASCE, R. Woods, ed., pp. 159–181.

Rowe, R. (2005), Long-term Performance of Contaminant Barrier Systems, Geotechnique, 55(9), 631–678.

Rowe, R. (2012), Short- and Long-Term Leakage Through Composite Liners, The 7th Arthur Casagrande Lecture, Can. Geotech. J., 49, 141–169.

Rowell, D.L., Martin, M.W., and Nye, P.H. (1967). “The measurement and mechanism of ion diffusion in soils. III. The effect of moisture content and soil solution concentration on the self diffusion of ions in soils.” *Journal of Soil Science*. 18, 204–222.

Sangam, H. P. and Rowe, R. K. (2001a). “Migration of dilute aqueous organic pollutants through HDPE geomembranes.” *Geotextiles and Geomembranes*, 19, 329-357.

Sangam, H. P. and Rowe, R. K. (2001b). “The role of HDPE geomembranes in retarding the diffusive migration of organic contaminants through composite liner systems.” *Proceeding*, Sardinia 2001, *8th Int. Landfill Symposium*, Cagliari, Italy.

Shackelford, C.D., 1990. Transit-time design of earthen barriers. Engineering Geology, Elsevier Publishing, Amsterdam 29, 79–94.

Shackelford, C. D. and Daniel, D. E. (1991). “Diffusion in saturated soil I: Background.” *Journal of Geotechnical Engineering*, 7 (3), 467-484.

Tinjum, J.M., Benson, C.H., and Blotz, L.R. 1997. “Soil Water Characteristic Curves for Compacted Clays.” *ASCE Journal of Geotechnical & Geoenvironmental Engineering*. 123(11). 1060–1069.

Touze-Foltz, N., Rowe, R., and Duquennoi, C. (1999), Liquid Flow Through Composite Liners due to Geomembrane Defects: Analytical Solutions for Axi-Symmetric and Two-Dimensional Problems. Geosynthetics International, 6(6), 455–479.

Warncke, D.D., and Barber, S.A. (1972). “Diffusion of zinc in soil: I. The influence of soil moisture.” *Soil Science Society of America Proceedings*. 36, 39–42.

Wisconsin Department of Natural Resources (2019). “LANDFILL LOCATION, PERFORMANCE, DESIGN AND CONSTRUCTION CRITERIA.” Chapter NR 504.

Table 1. Leakage rates for NR504 composite and proposed alternative liners computed with Equation 1.

Impingement Rate (mm/y)	Liner Slope (%)	Leakage Rate (L/ha-d)			
		NR504	A1	A2	A3
100	0.5	0.035	0.035	0.021	0.001
300	0.5	0.095	0.095	0.058	0.004
500	0.5	0.150	0.150	0.091	0.006
700	0.5	0.203	0.204	0.124	0.009
100	1.0	0.019	0.019	0.011	0.001
300	1.0	0.051	0.051	0.031	0.002
500	1.0	0.080	0.080	0.049	0.003
700	1.0	0.109	0.109	0.066	0.004
100	2.0	0.010	0.010	0.006	0.000
300	2.0	0.027	0.027	0.017	0.001
500	2.0	0.043	0.043	0.026	0.002
700	2.0	0.058	0.058	0.035	0.002
100	3.0	0.007	0.007	0.004	0.000
300	3.0	0.019	0.019	0.011	0.001
500	3.0	0.030	0.030	0.018	0.001
700	3.0	0.041	0.041	0.025	0.001
100	4.0	0.005	0.005	0.003	0.000
300	4.0	0.015	0.015	0.009	0.000
500	4.0	0.023	0.023	0.014	0.001
700	4.0	0.031	0.031	0.019	0.001

Table 2. Percent VOC detections in leachates of Massachusetts (Friedman 1988) and Wisconsin (Klett et al. 2005).

Parameter	Percent landfills with VOC detections in leachate	
	Massachusetts	Wisconsin
Styrene	5	14
Vinyl chloride	16	0
Chlorobenzene	16	0
Trichloroflouromethane	26	0
Chloroform	26	14
Methyl ethyl ketone	37	86
1,2-dichloroethane	42	0
1,4-dichlorobenzene	42	0
1,2-dichloroethylene (trans)	42	29
1,1,1-trichloroethane	47	14
Chloroethane	58	14
Tetrahydrofuran	58	14
Tetrachloroethylene	58	14
1,1-dichloroethane	63	29
Trichloroethylene	63	29
Benzene	63	43
Xylene, o-	84	71
Ethylbenzene	84	71
Toluene	95	86

Table 3. Summary of VOCs in MSW landfills in Wisconsin along with the Wisconsin enforcement standard, the preventative action limit, and the USEPA maximum contaminant level (units of μg/l)

Type	Type	PAL[1]	ES[2]	MCL[3]	Avg. Max Conc. in Lysimeter	Avg. Conc. in Lysimeter
MC	Alkane	0.5	5	5	87.4	15.4
MTBE	Ether	12	60	-	30	10.8
TCE	Alkene	0.5	5	5	42.8	10.5
TOL	Aromatic	200	1000	1000	74.7	15.9
CB	Aromatic	20	100	100	58.5	19.9

[1]PAL = Preventative Action Limit
[2]ES = Enforcement Standard
[3]MCL = USEPA Maximum Contaminant Level

Table 4. Transport properties used in contaminant transport analysis.

Layer	K_d (L/kg)	D* ($x10^{-13}$ m^2/s)	η	τ_a	ρ_d (g/cm^3)	K_{sat} (m/s)
1.5-mm EVOH	83.21	0.140	-	-	-	-
1.5-mm HDPE	88.56	4.06	-	-	-	-
CCL	0.75	2000	0.37	0.24	1.24	$1.0x10^{-9}$
GCL	0.12	600	0.70	0.074	0.79	$1.0x10^{-11}$
Natural Soil, SM	0.62	3000 at 100% S 2400 at 80% S 1800 at 55% S 1350 at 45% S 1050 at 32.5% S 750 at 15% S	0.375	0.35	1.24	$1.0x10^{-7}$
Amended Base	1.55	2500	0.375	0.30	1.24	$1.0x10^{-8}$

*S = Degree of Saturation in percentage, EVOH = ethylene vinyl alcohol geomembrane. After Eun (2014); Foose et al. (2002); Kim et al. (2001); Lake and Rowe (2005); Lim et al. (1998); Park et al. (2012a); Tinjum et al. (1997). Hyphen indicates not applicable.

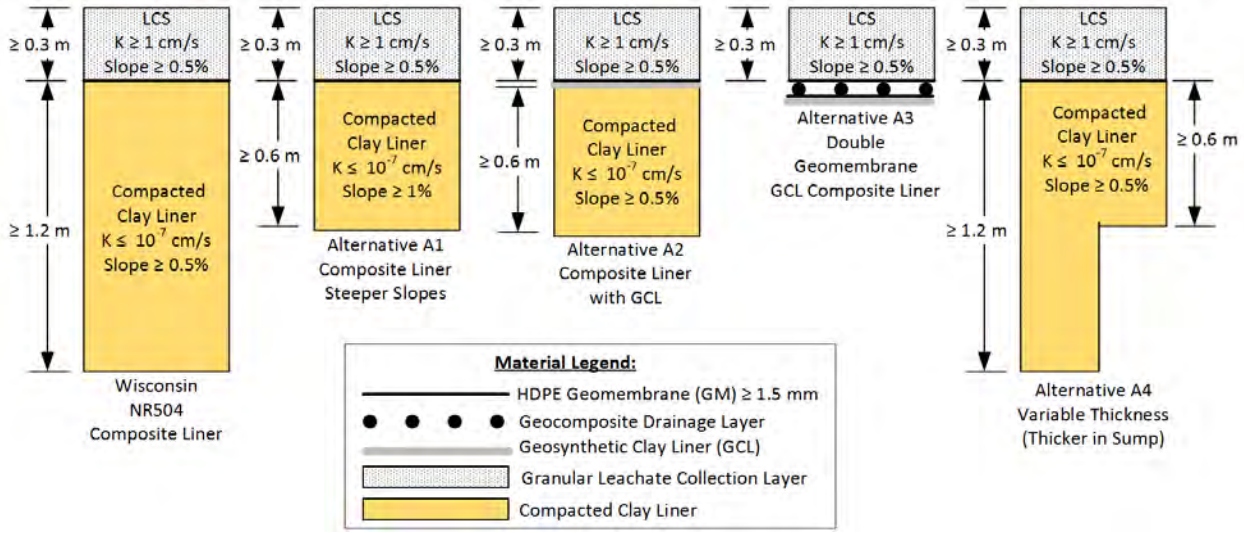


Fig. 1. NR504 composite liner and alternative liners consider in leakage rate comparison.

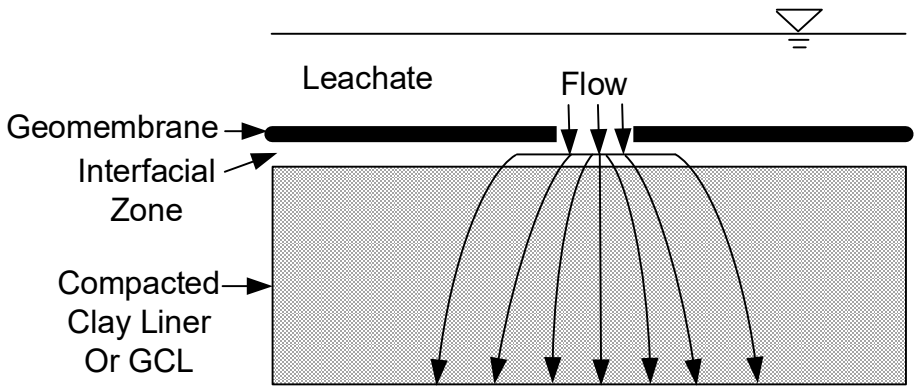


Fig. 2. Flow processes in a composite liner: flow downward through the geomembrane defect, laterally in the interfacial zone between the geomembrane and soil liner, and downward through the soil liner.

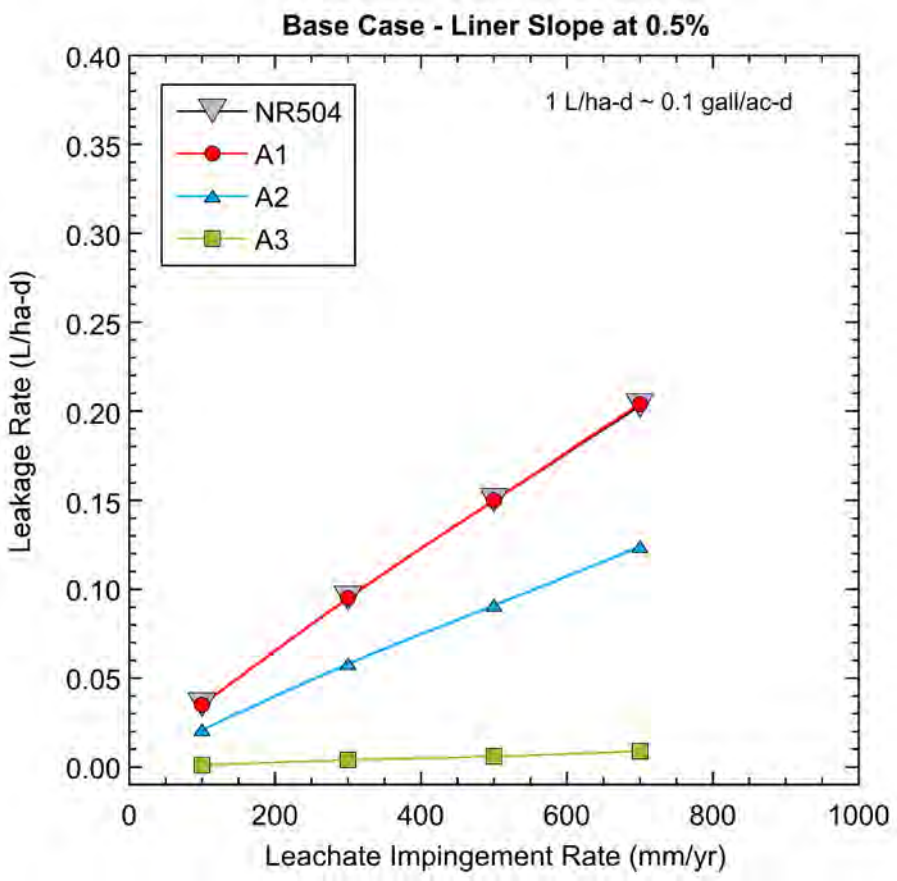


Fig. 3. Leakage rates for NR504 composite liner and Alternatives A1-A3 as a function of impingement rate. Liner slope at 0.5% for all scenarios. 1 L/ha-d = 0.1 gall/ac-d.

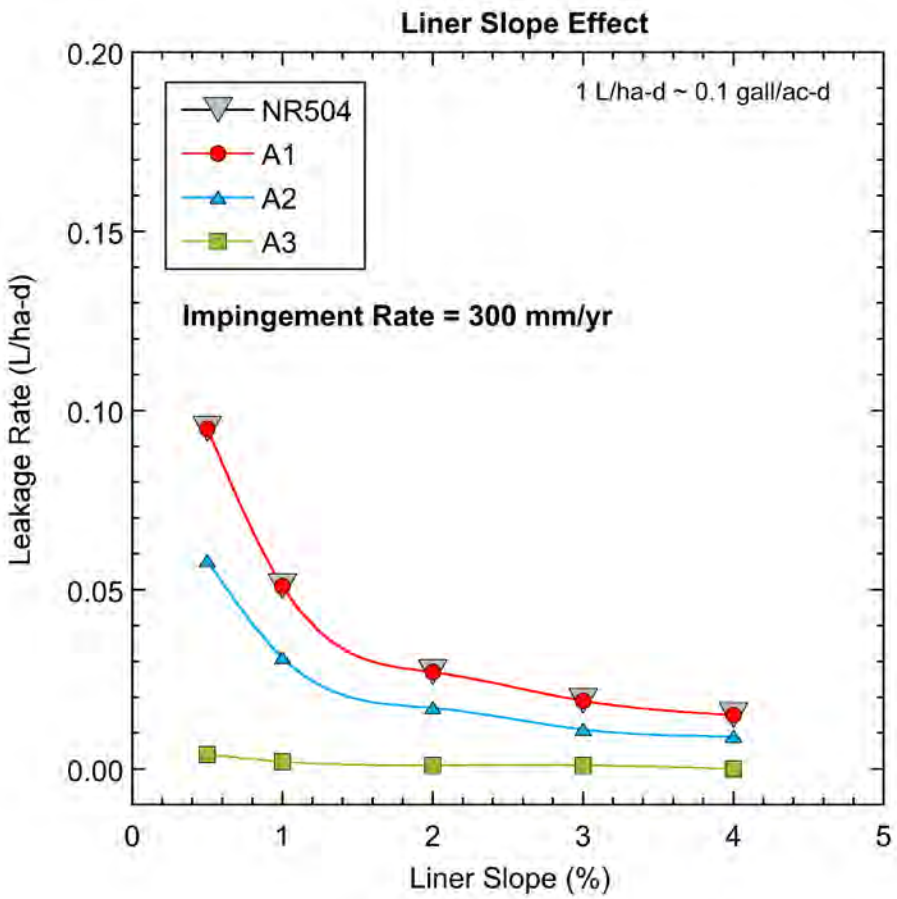


Fig. 4 Leakage rates for the NR504 composite liner and Alternatives A1-A3 as a function of liner slope. Impingement rate = 300 mm/yr for all scenarios. 1 L/ha-d = 0.1 gall/ac-d.

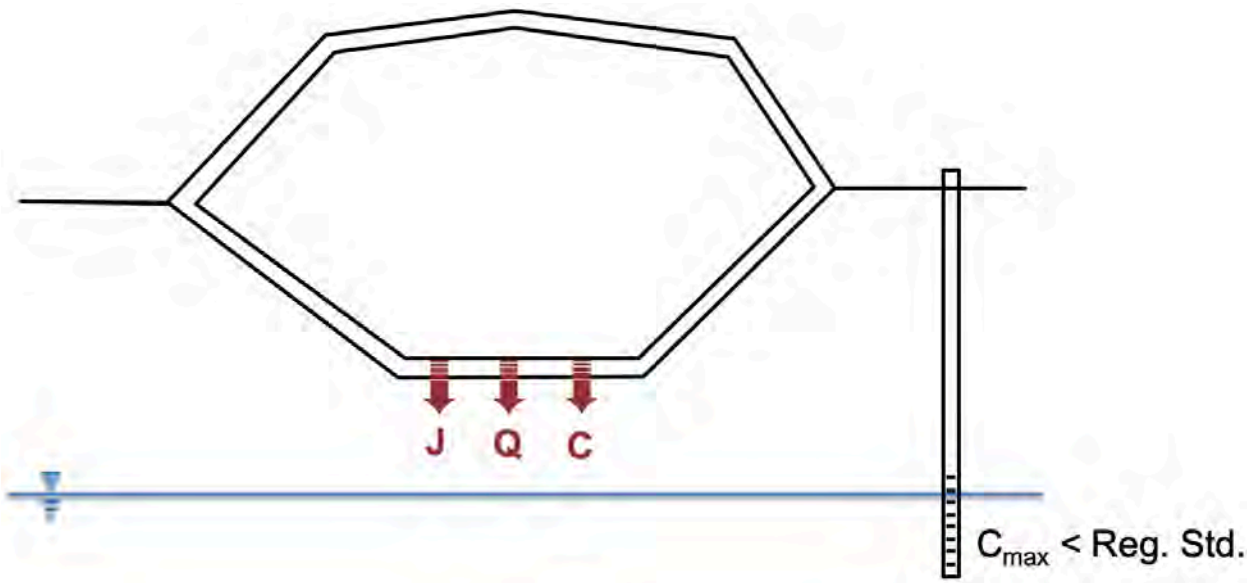


Fig. 5. Considerations for performance-based landfill liner design where J is solute flux, Q is rate of leakage, and C is concentration of chemical/solute at a point of compliance.

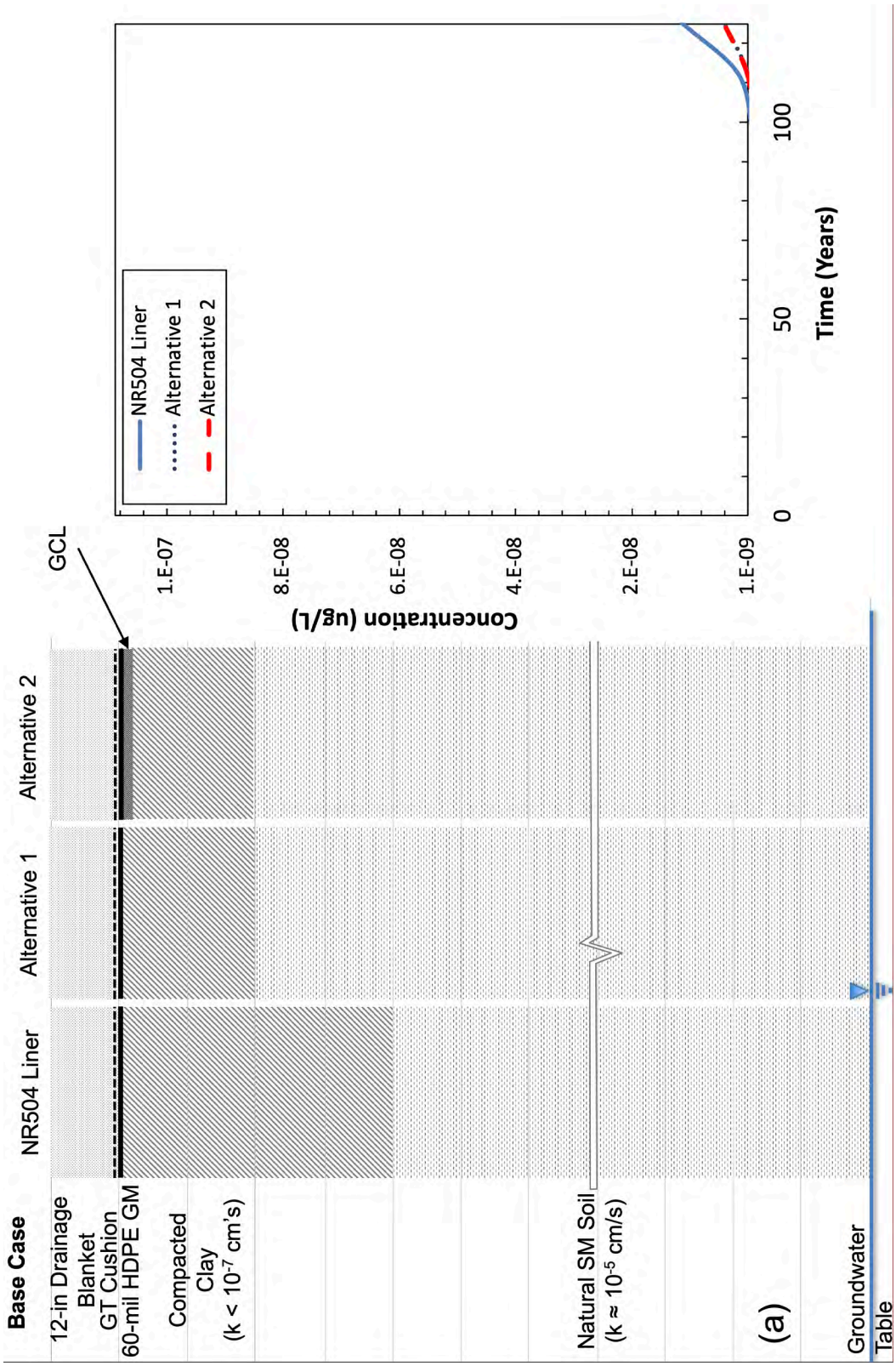


Fig. 6. NR504 alternative liner sections evaluated for performance-based diffusive flux (a) and diffusive flux concentration profiles with the annual high groundwater table being the point of compliance (b).

APPENDIX C

HISTORY OF COMPACTED CLAY LINERS IN WISCONSIN

HISTORY OF COMPACTED CLAY LINERS IN WISCONSIN

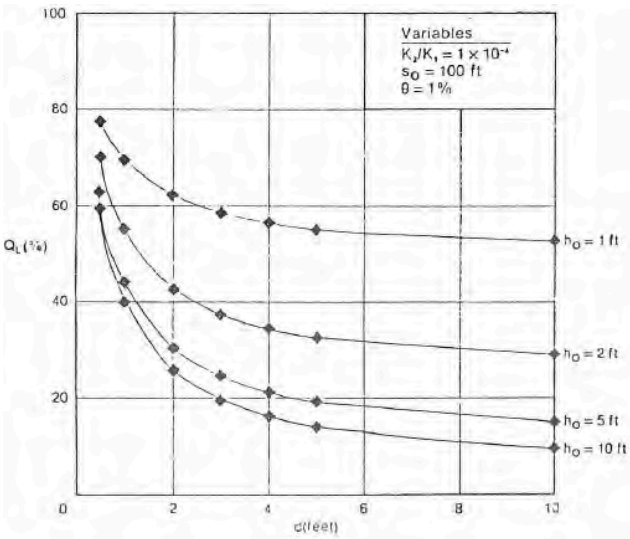
The history of formal environmental containment, siting, and management regulation in the State of Wisconsin is relatively recent, with the formation of the Wisconsin Department of Natural Resources (WDNR) occurring just over 50 years ago in 1967. In the very early history, landfill liner materials, methods, and thickness evolved from staff efforts within WDNR to define what should take the place of local practice at the time and while requirements from the United States Environmental Protection Agency, USEPA, were vague. In 1967, Chapter 83 represented Wisconsin's first law that addressed solid waste, and then Chapter NR 51, Wisconsin Administrative Code, was adopted by the Wisconsin Natural Resources Board in 1969, actually preceding the establishment of the USEPA in 1971. In Chapter NR 51, licensing of solid waste disposal sites and facilities was initiated, along with minimum standards, plans of operations, and the requirement that new landfills required WDNR approval.

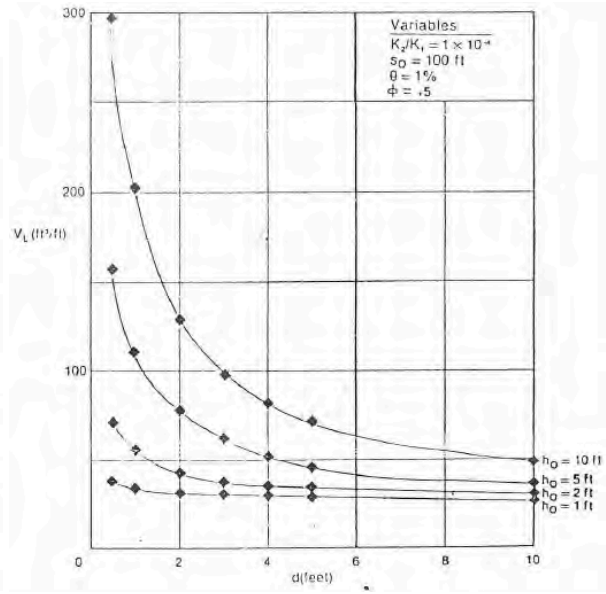
Landfill design, in the early days, evolved from empirical observations and feedback from early designs. Some of the earliest examples of larger-scale, "engineered" landfills included Brown County East Landfill (upgraded to a 5-ft-thick clay liner) and Marathon County Landfill with a 4-ft-thick CCL, 1-ft-thick natural sand, final clay cover, and a leachate collection system with PVC collection piping. The development of specifications for low-permeability, recompacted, fine-grained soil liners were initially led by Mark Gordon, Staff Engineer, and Paul Huebner, Lead Hydrogeologist within the WDNR. These specifications were formed out of similarities to the compaction procedures of clay in earth-dam cores thus leading to wet-of-optimum compaction with pad-foot compactors in 6-inch-thick lifts with moisture/density control for compacted clay liners (CCL). However, in these early days, the WDNR noted that compaction for "permeability control" was a "hard sell." Furthermore, in the 70's and early 80's, natural attenuation designs were being proposed by agricultural and wastewater engineers which, ultimately, were not achievable or believed by the WDNR, especially with the later discovery of VOCs in leachate and landfill gas. With all of this background, the WDNR was largely gravitating towards the need for a thick, redundant, recompacted clay liner as the standard-of-practice.

In the mid- to late-70's, liners and leachate collection systems (LCS) were required for larger and newer landfills. ***Given WDNR's lack of confidence in technical expertise within the State, the 5-ft-thick CCL was born*** because the WDNR did not know the identify or capabilities of contractors, inspectors, and engineering staff to conduct proper field QC and construction documentation. For example, there were instances in which the owner 'swore' that they laid down

3 ft of clay but for which field inspections only showed 6 inches in places. Furthermore, the WDNR documented systems in which the slopes on collection pipes were much less than designed and approved. The WDNR believed that there was ready access to clay soil throughout the State based on reports from the Wisconsin Geological and Natural History Survey (WGNHS), County Ag. Soil Surveys…This 5-ft-thick CCL was redundant where individual, out-of-code lifts would not impact the overall performance of the system. The initial thickness requirements thus developed as 5-ft-thick CCLs with hydraulic conductivity of 10^{-7} cm/s or less and a 1-ft-thick sand drain of 10^{-3} cm/s or greater. Note that these standards were defined before geomembranes and geosynthetics in general were introduced to the profession and before the advent of composite liners (required beginning in the mid 90's).

Circa 1980, justification was sought for the mandatory 5-ft-thick CCL by owners, contractors, and engineers alike. Within WDNR, Ken Quinn, Senior Hydrogeologist, and Peter Kmet, Acting Section Chief, led the effort to quantify and justify this requirement. Based largely on the work initially published by J. Wong (1977) titled "The Design of a System for Collecting Leachate from a Lined Landfill Site," Kmet, Quinn, and Slavik published a follow-on paper in 1981 at the Madison Waste Conference titled "Analysis of Design Parameters Affecting the Collection Efficiency of Clay Lined Landfills." In this groundbreaking paper, Kmet et al. (1981) improved certain simplifying assumptions, corrected an error in the derivation of the core equation, and also corrected the parameters to include porosity. They then ran a sensitivity analysis and noted that the hydraulic conductivity of the CCL and the material overlying the liner, including the initial head and conductivity, were the most critical design parameters. Two of the exemplifying graphs in this formative WDNR assessment and publication follow in which percent leakage and total volume of leakage are plotted against the CCL thickness and various initial heads.





You will note in these graphs that ***leachate head is a significant parameter and that there are significant improvements going to at least 2 ft of CCL, but significantly decreasing improvements thereafter, especially for 1 ft of head***. Later in the evolution and maintenance of these redundantly thick CCLs, significant papers published circa 1988 about the existence of wide-ranging synthetic organics and volatile organic compounds (VOCs) in landfill leachate led the WDNR to stick to their philosophy that it is “better to be safe than sorry.”

Eventually, in the mid 90’s, geomembranes and composite liners were evolving into standard-of-practice. This led to WDNR’s ‘acceptance’ of the change of the standard 5-ft-thick CCL to a 4-ft-thick CCL with a 60-mil HDPE GM. This was explained to be an artifact of introducing modifications to the original NR 504 to accommodate these composite liners. The WDNR ‘assuaged’ landfill owners about the cost impacts of installing the 60-mil HDPE GM by reducing the CCL thickness and, internally, justified to themselves via a ‘qualitative assessment’ that not much protection was lost if the GM was compromised or “worthless.” However, the full benefits of the composite liner system were not necessarily calculated quantitatively nor were the continued and significant improvements in compaction equipment, QA/QC methods, engineering specifications and technical experience in the State assessed against the history and evolution of the original requirements. There continued to be a list of evolving concerns about the integrity of CCLs and composite liners in the mid-90s into the 21st century ranging from the detrimental impact of freeze-thaw cycling, diffusion of VOCs, and studies that found VOCs and leachate in lysimeters below composite liner systems (via holes, defects, diffusion…) thus guiding the WDNR, once again, to stay consistent with their “better to be safe than sorry” approach. Finally, the lack of any

significant groundwater contaminant plumes emanating from modern-day Wisconsin landfills designed with thick CCLs or composite systems thereof has convinced the leadership that whatever they are doing is working, so why change?

ATTACHMENT 3

SAMENS WELL (PW-33) INFORMATION

No. 8-9. Warranty Deed—Short Form (Sec. 235.16, Wis. Statutes) (STATE OF WISCONSIN) Form No. 9 Published by Eau Claire Book & Stationery Co

Received for Record Document No. 362579
July 2, 1968 at 3:45 P.M.
Byron J. Loken, Register

VOL 321 PAGE 674

This Indenture, *Made by* HUGH R. TOY and EVA TOY, husband and wife as joint tenants

grantor s *, of* Eau Claire *County, Wisconsin, hereby conveys and warrants to* REED H. TOY and WILMA L. TOY, husband and wife as joint tenants

grantee s *, of* Eau Claire *County, Wisconsin, for the sum of* One Dollar and Other Good and Valuable Consideration *the following tract of land in* Eau Claire *County, State of Wisconsin:*

The SW¼ of the NW¼ of Section 9, Township 27 North, Range 8, West, except as follows:

Excepting a parcel of land in the SE corner more particularly described as follows:

Commencing at the SE corner of said 40; thence North 16 rods; thence West 10 rods; thence South 16 rods; thence East 10 rods to the point of beginning consisting of one acre more or less.

In Witness Whereof, *the said grantor* s *have hereunto set* their *hand* s *and seal* s *this* 2nd *day of* July *, A. D., 19* 68.

Signed and Sealed in Presence of

John P. Thornton
John P. Thornton

Mary Jane McCain
Mary Jane McCain

Hugh R. Toy (SEAL)
Hugh R. Toy

Eva Toy (SEAL)
Eva Toy

(SEAL)

(SEAL)

State of Wisconsin, Eau Claire County. } ss.

Personally came before me, this 2nd *day of* July *, A. D., 19* 68. *the above named* Hugh R. Toy and Eva Toy, husband and wife as joint tenants *to me known to be the person* s *who executed the foregoing instrument and acknowledged the same*

John P. Thornton
John P. Thornton
Notary Public, Eau Claire *County, Wis*
My commission expires ~~*, A. D., 19*~~ is permanent.

Drafted by John P. Thornton, Attorney at Law, Eau Claire, Wisconsin.

(N.B.—Ch. 59 Wis. Stats. provides that all instruments to be recorded shall have plainly printed or typewritten thereon the names of the grantors, grantees, witnesses and notary.)

DOCUMENT NO.

521472

WARRANTY DEED
STATE BAR OF WISCONSIN FORM 2 — 1982

VOL 592 PAGE 722

THIS SPACE RESERVED FOR RECORDING

'84 JUN 26 PM 4 12

VOL 592 PAGE 722

CAROLYN A. PETERSON
Register of Deeds
P.O. Box 5001
Eau Claire, Wisconsin 54702

Carolyn A. Peterson

521472

RETURN TO CVLT

Clg 34.00

Eva Toy aka Eva A. Toy, a single woman

conveys and warrants to Steven J. Samens and Linda K. Crandall as tenants in common

the following described real estate in Eau Claire County, State of Wisconsin:

Tax Parcel No: .....

A parcel of land in the SW 1/4 of the NW 1/4 of Section 9, Township 27 North, Range 8 West, described as follows:

Commencing at the Southeast corner of said forty; thence North 16 rods; thence West 10 rods; thence South 16 rods; thence East 10 rods to the point of beginning.

TRANSFER
$ 73.50
FEE

This ....is.... homestead property.
(is) (is not)

Exception to warranties: Easements, Restrictions & Roadways of Record

Dated this 23rd day of June, 19.84.

.....(SEAL) Eva Toy (SEAL)
* ..... * Eva Toy
.....(SEAL) .....(SEAL)
* ..... * .....

AUTHENTICATION

Signature(s) .....

authenticated this .....day of....., 19.....

*.....

TITLE: MEMBER STATE BAR OF WISCONSIN
(If not, authorized by § 706.06, Wis. Stats.)

THIS INSTRUMENT WAS DRAFTED BY
Eva Toy

(Signatures may be authenticated or acknowledged. Both are not necessary.)

ACKNOWLEDGMENT

STATE OF WISCONSIN } ss.
Eau Claire County.

Personally came before me this 23rd day of June, 19.84 the above named Eva Toy

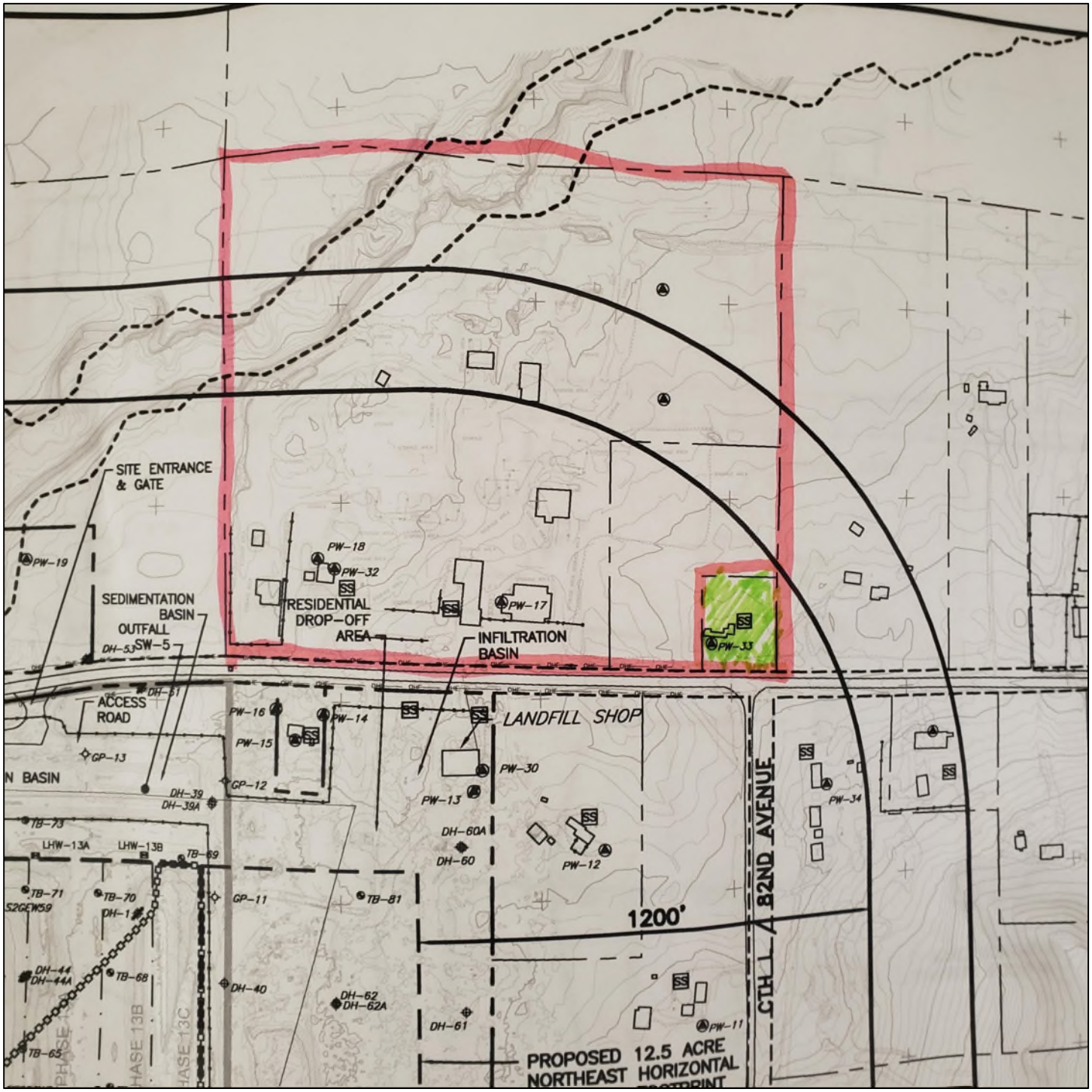
to me known to be the person who executed the foregoing instrument and acknowledge the same.

Gerald R. Ritsch

*Gerald R. Ritsch
Notary Public Eau Claire County, Wis.
My Commission is permanent. (If not, state expiration date: Jan. 19, 1986.)

*Names of persons signing in any capacity should be typed or printed below their signatures.

Map with Toy Property (pink highlighted boundary) and Samen Property (green highlight), dated 10/9/2019.



Well Log provided by Aaron Kent of WDNR on 10/9/2019 email to John Oswald of Tetra Tech.
Probable well log for PW-33.

36

STATE OF WISCONSIN

WELL CONSTRUCTOR'S REPORT

DEPARTMENT OF RESOURCE DEVELOPMENT

Wel 6

1. COUNTY: Eau Claire

CHECK ONE: ☒ Town ☐ Village ☐ City NAME: Seymour

2. LOCATION (Number and Street or ¼ section, section, township and range. Also give subdivision name, lot and block numbers when available.)
S.W. 1/4 of N.W. 1/4 Sec. 9 T.27.N. R.8.W.

3. OWNER AT TIME OF DRILLING: Hugh Day

4. OWNER'S COMPLETE MAIL ADDRESS: Rt. 1 Eau Claire, Wis.

5. Distance in feet from well to nearest: (Record answer in appropriate block)

BUILDING	SANITARY SEWER C. I.	SANITARY SEWER TILE	FLOOR DRAIN C. I.	FLOOR DRAIN TILE	FOUNDATION DRAIN SEWER CONNECTED	FOUNDATION DRAIN INDEPENDENT	WASTE WATER DRAIN C. I.	WASTE WATER DRAIN TILE
5'	18'							

CLEAR WATER DRAIN C. I.	CLEAR WATER DRAIN TILE	SEPTIC TANK	PRIVY	SEEPAGE PIT	ABSORPTION FIELD	BARN	SILO	ABANDONED WELL	SINK HOLE
		47'		57'					

OTHER POLLUTION SOURCES (Give description such as dump, quarry, drainage well, stream, pond, lake, etc.)

6. Well is intended to supply water for: Household use

7. DRILLHOLE

Dia. (in.)	From (ft.)	To (ft.)	Dia. (in.)	From (ft.)	To (ft.)
4"	Surface	69'			

8. CASING, LINER, CURBING, AND SCREEN

Dia. (in.)	Kind and Weight	From (ft.)	To (ft.)
4"	Steel T&C 11 lbs	Surface	52'

9. GROUT OR OTHER SEALING MATERIAL

Kind	From (ft.)	To (ft.)
	Surface	

10. FORMATIONS

Kind	From (ft.)	To (ft.)
Sand	Surface	47'
Sand stone	47'	69'

Well construction completed on 7/9/ 1968

Well is terminated 10 inches ☒ above ☐ below final grade

Well disinfected upon completion ☒ Yes ☐ No

Well sealed watertight upon completion ☒ Yes ☐ No

11. MISCELLANEOUS DATA

Yield test: 3 Hrs. at 15 GPM

Depth from surface to normal water level 42 ft.

Depth to water level when pumping 49 ft.

Water sample sent to Eau Claire, Wis. laboratory on: 7/9/ 1968

Your opinion concerning other pollution hazards, information concerning difficulties encountered, and data relating to nearby wells, screens, seals, type of casing joints, method of finishing the well, amount of cement used in grouting, blasting, subsurface pumprooms, access pits, etc., should be given on reverse side.

SIGNATURE: Dave Olson Registered Well Driller

COMPLETE MAIL ADDRESS: OLSON BROS. WELL DRILLING CO. R #1 EAU CLAIRE, WIS.

3231

Please do not write in space below

COLIFORM TEST RESULT	GAS — 24 HRS.	GAS — 48 HRS.	CONFIRMED	REMARKS

Samens Property Well - Field Measurement Photos by Mark Vinall of SMCL.

Photo 1: Distance measurement from Southwest corner of house to water supply well.

Photo taken: 11/12/2019.

Photo 2: Distance measurement from Southwest corner of house to water supply well.

Photo taken: 11/12/2019.

Close up from Photo 1 of measurement tape at water supply well.

Photo 3: Well height above ground surface measurement.

Photo taken: 10/10/2019.

Photo 4: Well casing circumference measurement.

Photo taken: 10/10/2019.

Diameter = Circumference / pi = 14.25 inches / 3.14 = 4.5 inch outer diameter well casing.

Photo 5: Well head.

Photo taken: 10/10/2019.

ATTACHMENT 4

REVISED SAMPLING AND ANALYSIS PLAN

Environmental Sampling and Analysis Plan

Advanced Disposal
Seven Mile Creek Landfill, L.L.C.
Groundwater, Lysimeter, Surface Water, Leachate, and Gas Environmental Sampling and Analysis Plan

1.0 Project Site Overview....3

2.0 Site Map and Sampling Schedule....3

3.0 Field Measurements....3

4.0 Groundwater Well Purging Procedures....5

5.0 Sample and Field Data Collection Procedures....5

6.0 Quality Control Procedures....9

7.0 Private Well Monitoring....10

8.0 Lysimeter Monitoring....10

9.0 Leachate Monitoring....11

10.0 Landfill Gas Monitoring....11

11.0 Surface Water Monitoring....12

12.0 Air Monitoring....12

13.0 Chain-of-Custody Guidelines....12

List of Attachments

Attachment 1 Site Map Drawing and Table 1 – Summary of Monitoring Program
Attachment 2 Manufacturer's Manual for YSI 556 Meter
Attachment 3 Manufacturer's Manual for Hanna Multimeter HI 98130
Attachment 4 Field Record Form
Attachment 5 Sample Preservation Methods
Attachment 6 Example Chain-of-Custody Record and Procedures

Procedures for Environmental Monitoring and Analysis

1.0 Project Site Overview

This Environmental Monitoring and Analysis Plan (Plan) has been prepared to comply with Wisconsin Administrative Code (WAC) NR 507.16. It pertains to the Advanced Disposal Seven Mile Creek Landfill (Landfill) located in the City of Eau Claire, Eau Claire County, WI. The Landfill is primarily for disposal of municipal waste. The site WDNR License Number is 03097 and the WDNR Facility ID Number is 618045450.

Prior to initiation of routine or special groundwater sampling events at the Landfill, the Plan should be reviewed by sampling team members. Site conditions or site-specific regulatory requirements may necessitate a deviation from the Plan as described herein. Deviations from this Plan must be documented by the sampling team.

2.0 Site Map and Sampling Schedule

In accordance with NR 507.16(1) (a) and (b), a drawing is included in Attachment 1 which shows the site and the locations of sampling points and devices. Also summarized in Attachment 1 Table 1 is the sampling schedule, including the months when samples are to be collected, the sampling period, and the list of parameters to be analyzed for at each monitoring point. The sampling locations and the monitoring program are also shown on the Site Map Drawing in Attachment 1.

WDNR General Monitoring Procedures are available in a published document entitled Groundwater Sampling Desk Reference PUBL-DG-03796 and Groundwater Sampling Field Manual, PUBL-DG-03896; both dated September 1996. Both manuals are available on the WDNR website. Specifically, the following procedures will be followed at the Landfill.

3.0 Field Measurements

Order of Sampling

Field measurements should begin with wells with the least potential for detections or wells with the lowest historical detections. If no historical trends in groundwater quality are apparent, groundwater should be sampled from up-gradient to down-gradient. For the Landfill, sampling should start on the northeast or east side and progress radially to the southwest.

Measuring Static Water Level

Static water levels will be measured in each well prior to purging and sampling. Groundwater levels will be measured using a reference point established on the well casing. The reference point will be a permanently marked point of the PVC well casing.

A battery-operated water level indicator (Solinst water level indicator or suitable substitute) will be the primary device for water level measurements. The indicator is a self-contained transistorized instrument equipped with a cable and sensor that activates a buzzer and a light when it contacts the water. The depth to water is read

from permanent 0.01-foot increment markings on the cable.

In case of instrument failure, depth to groundwater will be measured by a plopper tape that is a bell- or cup-shaped weight attached to a nylon-coated stainless-steel measuring tape. When lowered into the well, a “plopping” or "popping" sound is made when the weight strikes the surface of the water. An accurate reading can be determined by lifting and lowering the weight in short strokes, and reading the tape when the weight just strikes the water. The total depth of the wells will be measured using the plopper tape or similar device. Depth to water will be recorded to the nearest 0.01 foot prior to any purging of groundwater

In order to prevent cross-contamination between wells, the water level measuring device will be decontaminated by rinsing with a soapy water solution (e.g., Alconox and distilled water) then distilled water.

Groundwater Monitoring Well Condition and Maintenance

In order to assess problems and possible damage to the monitoring wells, field technicians will visually inspect wells at the time of sampling. Wells will be inspected for the following items:

- Adequate security (lock in place and in working order)
- Surface seal condition
- Presence of well cap
- Damage to the protective casing (e.g., evidence that it has been hit by heavy machinery)
- Amount of sediment in well (detected by measuring depth to bottom)
- Legible labels
- Condition of dedicated bailers, pumps, or tubing

Field technicians will provide a written inspection report to Advanced Disposal so that appropriate action may be taken if needed.

Equipment and procedures for field sample measurements is summarized in Section 5.0.

4.0 Groundwater Well Purging Procedures

The monitoring wells will be purged by removing stagnant water so that the samples collected are of fresh formation water. Before purging each well, the amount of water in four well volumes will be calculated. The steps to calculate the purge volumes are as follows:

1. Measure the depth to water and the depth to the bottom of the well, or use the last measurement of the depth to the bottom if a dedicated pump exists and the pump is not removed during the event.
2. Subtract the depth to water from the depth to the bottom of the well.
3. All wells are 2-inch–diameter; therefore, multiply the result obtained in Step 2 by 0.163 gallon/foot, and multiply that by 4.
4. Purging will be performed utilizing dedicated pumps or bailers at each well.

The groundwater monitoring wells at the SMCL are purged and sampled with Monsoon pumps and/or dedicated bailers. Dedicated tubing is left in each of the wells where the Monsoon pumps are utilized. Two types of Proactive Monsoon® pumps (Mini Monsoon and Mega Monsoon) are currently utilized for sampling of most wells at SMCL. Both pumps are submersible, are impeller driven, and are operated from a 12 volt battery. The Mini-Monsoon pump used at SMCL has a constant pumping rate while the Mega-Monsoon pump has a flow control device with low flow capabilities. When the Mini-Monsoon is used at selected monitoring wells, bailers are utilized to collect the groundwater analytical samples for VOCs. When the Mega-Monsoon pump is utilized, flow can be reduced to collect the analytical samples.

Groundwater samples should be collected in the shortest possible time subsequent to purging the well. Some wells at the Landfill are slow to recharge. Wells that do not recharge should be pumped or bailed dry on the first day so they can be sampled the following day.

5.0 Sample and Field Data Collection Procedures

Samples will be collected immediately after purging. If a well pumps/bails dry, the sampler will wait until the well has sufficiently recovered to obtain a sample. The steps to sampling the monitoring wells are as follows:

1. Prepare bottles by labeling with the well number, the date, the name of the sampler, and the time of day at which the sample is collected.
2. Set up filtering equipment.
3. Collect samples using the dedicated bailers or discharge tubing.
4. Fill VOC vials first, followed by other unfiltered bottles in order of volatilization potential.
5. After filling unfiltered bottles, collect a sample for filtering and performing field measurements.
6. Bottle size and quantity will be determined by the laboratory based on analytical needs.

The instruments used in the field and their calibration procedures are described below.

Temperature and Specific Conductance

A sample for specific conductance and temperature will be selected immediately after purging and placed in a clean polypropylene beaker for measurement. A portable specific conductance meter, Hanna Multimeter HI 98130, or equivalent, will be used to measure the temperature and specific conductance of the groundwater sample. Each meter will be checked/calibrated before each field trip and daily while in the field. Batteries will be checked, and conductivity cells will be cleaned and checked for accuracy against a known standard (e.g., specific conductance calibration solution of 12.88 mS/cm). Decontamination of the conductivity probe between samples in the field will be achieved by rinsing it several times with deionized or distilled water.

HI 98130 series meter - Specifications

	Temperature	Specific Conductance
Range:	0 – 60.0ºC	0 - 20.00 mS/cm
Meter accuracy:	±0.5ºC	± 2%
Resolution:	0.1ºC	0.01 mS/cm
Calibration:	-	1 point (12.88 mS/cm)

pH

The pH of the sample will be measured in the groundwater sample collected from the well in the same beaker used for specific conductance and temperature, with all three measurements being taken concurrently. The measurements will be made electronically using a glass combination electrode automatic temperature compensation probe included with the HI 98130, or equivalent. The measurements will be recorded to the nearest 0.1 pH unit. The meter will be checked before each field trip and daily while in the field for any mechanical or electrical failures, weak batteries, and cracked or fouled electrodes. The meter and electrode will also be checked/calibrated against standard buffer solutions of known pH values (e.g., 4.01, 7.01, and 10.01). While in the field, the meter will be checked at least prior to starting, and at the end of the day with fresh buffers. In case of an apparent discrepancy in a pH measurement, the electrode will be checked with pH 7.01 buffer and rebuffered to the closest reference buffer to the pH of the sample. Decontamination of the pH probe will be done at each well by rinsing with deionized or distilled water. A clean beaker for the field measurements will be used for each sample so as to prevent cross-contamination. The breaker will be rinsed three times with a portion of the next sample prior to obtaining a reading.

HI 98130 series meter - Specifications

Range:	0 to 14.00 standard units
Resolution:	0.01 units
Accuracy:	±0.01 units
Calibration:	Up to 3 points (pH of 4.01, 7.01, and 10.01)

A log of meter calibrations and checks should be maintained during each sampling event. The calibration and checks should be performed a minimum of two times a day following the procedures specified in the meter manuals. A copy of the manufacturer's manual for the Hanna Multimeter is attached (Attachment 3).

Color/Odor/Turbidity

Complete color, odor, and turbidity observations as follows:

1. Color: Note color before filtration against a white background.
2. Odor: Carefully wave your hand over the opening of the sample container and note any distinct smell. Do not smell the sample directly, particularly when dealing with hazardous or unknown materials.
3. Turbidity: Comment on turbidity (e.g., cloudy, turbid, clear).

Data collected during the field monitoring should be recorded on the form in Attachment 4.

Field Filtering

Filtering in the field will be required for the inorganic parameters, in order to prevent changes due to precipitation or biological activity and to collect a more representative sample of the water. In many cases, there may be a small amount of silt or clay in the water after purging the well. This sediment is not representative of constituents transported in groundwater flow systems in porous media. The filtering is performed in the field because even short delays may drastically change the water chemistry. Field filtering is performed by attaching a disposable self-encapsulated paper 0.45-micron barrel filter to the discharge of the bailer, or pump. Well water is run through the filter and collected directly into the sample container. Private well samples will be collected for total analysis (not field filtered).

Equipment Cleaning Procedure Between Sampling Events

Equipment used for sampling that is not dedicated or discarded after use (meters and water level measuring devices, etc.) is decontaminated before the sampling event using the following steps:

1. Prepare a soapy water bath using laboratory-grade detergent (Alconox or equivalent).
2. Wash equipment with soapy water bath.
3. Unwind water level measuring devices, soak in soapy water, and wipe clean with a cloth.
4. Rinse equipment with tap water.
5. Rinse equipment with deionized water (ASTM Type II).
6. Air-dry equipment.

Equipment Cleaning Procedure Between Monitoring Wells

The procedure to be followed for cleaning water level indicators and nylon-clad steel tapes in the field between wells is as follows:

1. Rinse equipment with soapy water using laboratory-grade detergent (Alconox).
2. Rinse equipment with deionized or distilled water (ASTM Type II).

Sample Preservation Methods[1]

The preservation methods for the parameters to be analyzed are listed in Attachment 5. Each of the bottles contains a premeasured volume of preservative, as needed.

6.0 Quality Control Procedures

Trip Blanks

Trip blank samples will be prepared in the laboratory by filling the appropriate clean sample container(s) with reagent-grade water and adding any applicable chemical preservative. The containers will be labeled “Trip Blank.” Trip blanks will be shipped from the laboratory in the cooler to the field and back to the laboratory along with the other samples for that parameter for a given sampling event. The trip blanks are analyzed to identify contamination that may occur from the containers, coolers, cleaning procedures, or chemical preservatives used. Trip blanks will be used and analyzed at a frequency of at least one per sampling event/cooler.

Field Blanks

Field blank samples will be prepared in the field at a routine sample collection point during a monitoring event by filling the appropriate sample containers from the field supply of reagent-grade or distilled water. The reagent-grade/distilled water will be provided by the laboratory. The field blank will be analyzed for contamination that may occur as a result of site ambient air conditions and serves as an additional check for possible contamination in the containers or coolers, and also for possible contamination owing to the cleaning procedures or the chemical preservatives used. Field blanks will be collected and analyzed as part of the sampling program.

Equipment (Rinsate) Blank

Equipment or rinsate blanks will be prepared in the field immediately following decontamination of nondedicated or nondisposable field equipment used for purging, sampling, or sample filtration. Following decontamination, reagent-grade water will be passed through the equipment using the same procedures followed in collecting a groundwater sample. The equipment blank confirms proper field decontamination procedures. Equipment or rinsate blanks will be collected and analyzed as part of the sampling program for the field filtering equipment. Generally, one equipment of rinsate blank will be collected per sample event, as appropriate.

Field Duplicate

Field duplicate samples are extra samples collected at a random monitoring point and labeled as “Duplicates.” This is an additional sample collected from the same source, stored in separate containers, and analyzed independently. The samples will be collected in proper alternating order for the sample point and field duplicate for each parameter (e.g., first collect VOC sample, then duplicate VOC sample; then collect first metals sample, then duplicate metals sample, and so on). Field duplicates are

[1] Some parameters analyzed in leachate, condensate, surface water, and/or gradient control.

used to document the precision of the sampling and analytical process. Field duplicates will be collected and analyzed as part of the sampling program. One duplicate sample will be collected per sample event.

Matrix Spike/Matrix Spike Duplicate

Matrix spike and matrix spike duplicate samples are collected in the same manner as field duplicates, but allow for sufficient volume to perform both matrix spike and matrix spike duplicate analyses (triple sample volume total). To conduct a matrix spike analysis, a known amount of a target analyte is added to the sample at the laboratory prior to sample preparation and analysis. The matrix spike is used to evaluate the bias of a method in a given sample matrix.

Matrix spike duplicate samples are intra-laboratory split samples spiked with identical concentrations of target analytes. The spiking occurs at the laboratory prior to laboratory sample preparation and analysis. Matrix spike duplicate samples are used to evaluate the precision and bias of a method in a given sample matrix. Matrix spikes/matrix spike duplicates may be collected and analyzed if an expanded list of compounds requires this level of QA/QC.

7.0 Private Well Monitoring

Private wells will be purged and sampled from an outside tap, or if necessary from an inside tap located before the pressure tank or treatment devices, if possible. The well will be purged for at least ten minutes, prior to collecting the sample for laboratory analysis. Sample collection will be the same as a groundwater monitoring well. Private well samples will analyzed as total (unfiltered). Field measurements should be taken as required for groundwater sampling.

(Note: Document in the field notes exactly where the samples were taken from. The well owner should also be asked about any treatment equipment installed in the system. Softening, iron removal, pH adjustment, and other equipment are often used. Basement and outside faucets will usually not produce such treated water.)

8.0 Lysimeter Monitoring

The volume of liquid discharged from the lysimeters will be monitored monthly and reported semiannually. The liquid will be sampled annually and the monitoring parameters and frequency are shown on Site Monitoring Map and are summarized in Attachment 1. Sample collection will be directly from the collection line manhole or sample port. Lysimeter samples are handled and analyzed in the same manner as the groundwater samples, but they are not filtered.

9.0 Leachate Monitoring

Leachate levels will be measured monthly at the leachate head wells, and leachate samples will be collected at the leachate storage tank (Site Monitoring Map) at the prescribed frequency provided in Table 1. Leachate head will be measured in the leachate head wells using a plopper tape, electronic water level tape, transducers or bubbler system. The elevation measurements shall be recorded as an actual numeric value to nearest inch of head above the liner unless well is dry (e.g., if the reading on the head well indicates 1” of liquid head exists at the invert head well elevation, 1” will be reported). The leachate sample will be

obtained using a PVC bailer or other sampling device. The leachate monitoring device will not be purged prior to obtaining samples. The samples will be treated and analyzed as described for groundwater samples, except that the leachate samples will not be filtered. Leachate volumes will be recorded monthly from the panel meter or flow meter during pumping.

10.0 Landfill Gas Monitoring

The percent methane (CH4) and oxygen (O2) will be monitored quarterly at gas probe locations and monthly at gas extraction wells as shown on the Site Monitoring Map and Attachment 1. The following additional information will be recorded at each monitoring event:

- Temperature
- Ground condition
- Probe condition
- Barometric pressure and information as to whether the barometric pressure is rising or falling.
- Gas pressure

A portable Landtec GEM 2000 or similar gas meter will be used to perform the gas monitoring. The meter will be checked and calibrated before each field trip according to the procedures specified in the user's manual.

After the collection of the percent methane (CH4), balance gas, and oxygen at each probe or gas extraction well, the gas monitor should be purged with fresh air to ensure that the monitor and sensor housing are free from retained gas. The percent methane and oxygen readings obtained, along with the information recorded pertaining to temperature, barometric pressure, and ground and probe condition, will be reported semiannually, along with the electronic data results.

A composite landfill gas sample, collected at the blower outlet, will be sampled annually using analytical EPA method TO15 or equal. The gas sample will be collected in a Summa® Passivated Stainless-Steel Canister after allowing the system to run for at least 1 hour.

11.0 Surface Water Monitoring

This section of the Plan is applicable to sampling surface water from sources such as discharge points, rivers, streams, ponds, and lakes. Prior to commencing with surface water sampling activities, the sampler should note any areas of dead or distressed vegetation, odors, discolored water, oily sheen, weather conditions, wind direction, nearby activities, etc. on the field forms. Field measurements for pH, conductivity, temperature and dissolved oxygen may be collected at each sample point prior to sampling, unless otherwise specified in the approved monitoring plan or on the laboratory information sheets. Results shall be recorded on a field form.

The instruments used in the field for surface water monitoring include the Hanna Instruments HI9813 (or similar) and the YSI 556 (or similar). The Hanna Multimeter measures temperature, conductivity and pH, as described in Section 5. The YSI 556 measures dissolved oxygen. Attachment 2 provides the user manual for the YSI 556.

If sampling is necessary, the location of the sample point should be selected with care to ensure that a representative sample of water is obtained for testing. The sample point should be selected to avoid intrusion of bottom sediments into the sample container. Samples collected from shallow depth can readily be obtained by merely submerging the sample container below the water surface. Surface water samples are not to be field-filtered, unless specified under local and/or state regulations or as otherwise stated in the sites operating permit or the approved Groundwater Monitoring Plan. Sample preservation, storage and shipment procedures should follow those described previously in this Plan.

12.0 Air Monitoring

The air pollution control operation permit (Permit No. 618045450-P11) for SMCL dated April 12, 2018 is current through December 5, 2019. Monitoring and sampling procedures are defined within this permit and are followed by SMCL.

13.0 Chain-of-Custody Guidelines

A Chain-of-Custody Record provides a written record of sample bottle possession and transference. An example of a typical Chain-of-Custody Record and the procedures for completing the chain of custody are provided in Attachment 6.

Attachment 1
Site Map Drawing and Table 1 – Summary of Monitoring Program

SECTOR 2 LANDFILL

GROUNDWATER WELLS

WELL ID			FREQUENCY	PARAMETERS
DH-4R	DH-36	DH-47	Semiannual (April, October)	Field Temperature Field Conductivity Field pH Odor Groundwater Elevation Color Chloride Turbidity Hardness, Total, Dissolved Alkalinity, Total, Dissolved
DH-18A	DH-38	DH-47A		
DH-18B	DH-39	DH-48		
DH-22A	DH-39A	DH-49		
DH-22B	DH-40 (1)	DH-49A		
DH-32	DH-41	DH-52		
DH-33	DH-43	DH-60		
DH-33A	DH-43A	DH-60A	Annual (April)	VOCs (8260 or 8021)
DH-34	DH-45	DH-61		
DH-35A	DH-46A			
DH-62 (1)	DH-62A (1)	DH-63 (1)	Semiannual	Groundwater Elevation (until abandoned)
(Subtitle D Wells) DH-18 DH-22R DH-35 DH-46 (1) Wells to be abandoned during Phase 14A construction.			Semiannual (April, October)	Field Temperature Turbidity Field Conductivity Odor Field pH Color Groundwater Elevation Chloride Hardness, Total, Dissolved Alkalinity, Total, Dissolved VOCs (8260 or 8021)

PRIVATE WELLS

WELL ID	FREQUENCY	PARAMETERS
Advanced Office Well (PW-28) Advanced Shop Well (PW-30) Thompson Dahlby Residence (PW-2) Lee Residence (PW-26)	Semiannual (April, October)	Field Temperature Field Conductivity Field pH Alkalinity, Total (unfiltered) Hardness, Total (unfiltered) Chloride, Total VOC (SW8A method 524.2)
Up to 8 Additional Wells per Local Agreement and designated by SMCL	Annual (October)	VOC (EPA 524.2 extended list)

LEACHATE

MONITORING POINT			FREQUENCY	PARAMETERS	
Sector 2 Leachate Lift Station (DNR Point ID 430)			Monthly (reported semiannually)	Leachate Volume Pumped/Removed (in 1000s of gallons)	
Sector 2 Leachate Tank (DNR Point ID 425)			Semiannual (April and October)	Odor, Color, Turbidity	Total Suspended Solids
				Field Conductivity	Total Alkalinity
				Field pH	Total Hardness
				BOD5	Total Ammonia Nitrogen
				Total Sodium	Total Iron
				Total Kjeldahl Nitrogen	Total Lead
				Total Chloride	Total Manganese
				Total Mercury	Total Sulfate
				Total Cadmium	Field Temperature
				VOCs (8260 or 8021)	
				PCBs (See 40 CFR Part 761.358)	
			Annual (April)	SVOCs (See NR 507, Appendix IV)	
Monitoring requirements when bachate recirculation is active per NR 507.215					
Sector 2 Leachate Tank (DNR Point ID 425)			Quarterly (January, April, July, October)	BOD5	Total Alkalinity
				COD	Total Hardness
				Total Ammonia Nitrogen	Field conductivity
				Field pH	Field Temperature
VLHW-1A	LHW-6A	LWH-10B	Monthly (reported semiannually)	Leachate Head Elevation (feet MSL) Leachate Depth (in feet)	
VLHW-2A (1)	LHW-6B	LHW-11			
VLHW-3A	LHW-7A	LHW-12			
LHW-4A	LHW-7B	LHW-13A			
LHW-4B	LHW-8	LHW-13B			
LHW-5A	LHW-9	LHW-14A (2)			
LHW-5B	LHW-10A	LHW-14B (2)			
(1) Proposed for abandonment per 5/29/2019 Plan Modification. (2) To be installed during Phase construction.					

LYSIMETERS

MONITORING POINT	FREQUENCY	PARAMETERS	
L-1A L-2 L-3 L-4	Monthly (reported semiannually)	Lysimeter Discharge (gallons) Depth to Liquid	
	Semiannual (April, October)	Field Conductivity	Total Kjeldahl Nitrogen
		Field pH	Total Sulfate
		Total Alkalinity	Elevation
		Total Hardness	Odor
		Total Sodium	Color
		Total Chloride	Turbidity
		Field Temperature	
	Annual (April)	VOCs (8260 or 8021)	

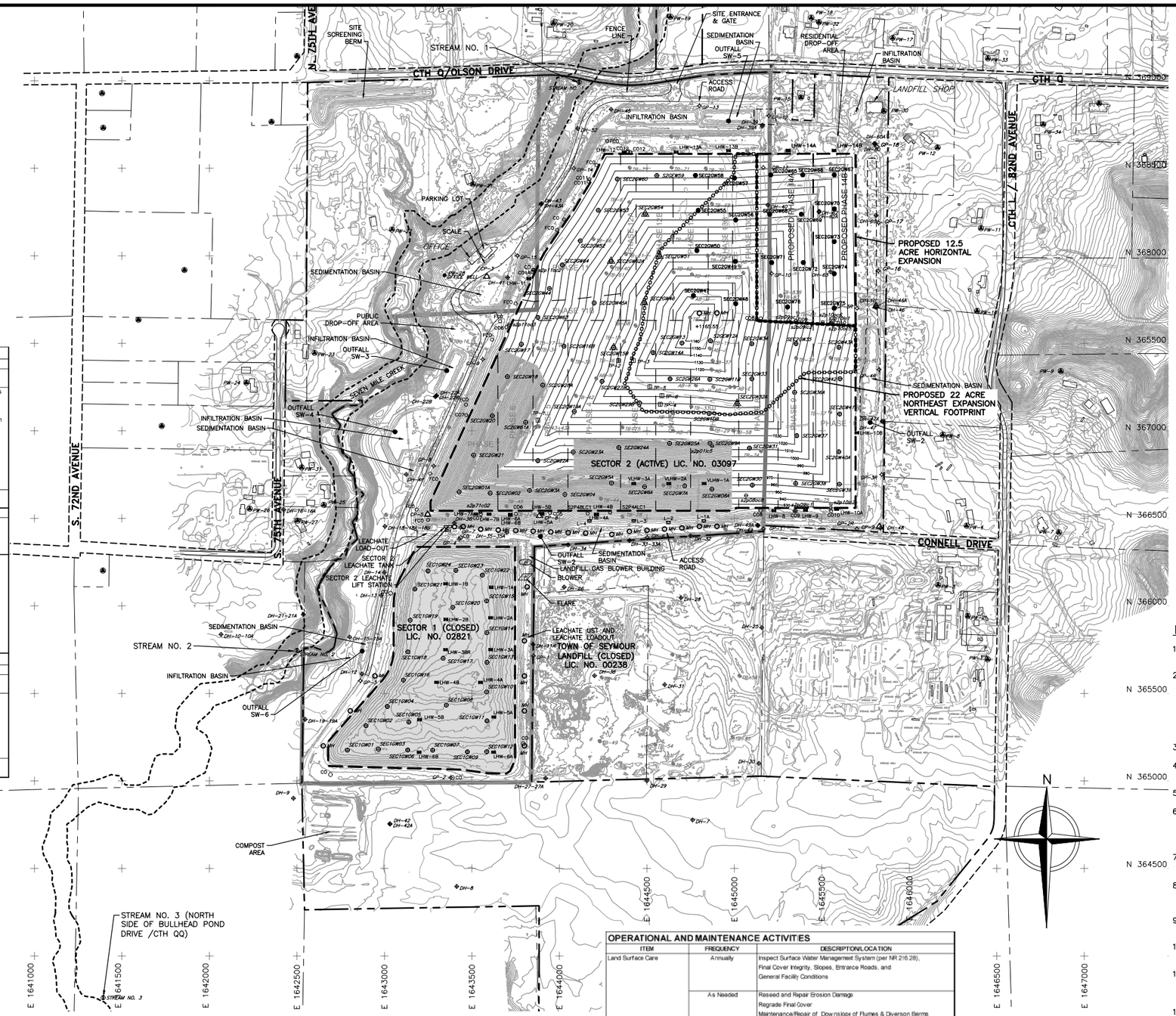
GAS SYSTEM

MONITORING POINT			FREQUENCY	PARAMETERS
Gas Probes				
GP-1	GP-7	GP-13	Quarterly (January, April, July, October)	Ground Conditions Ambient Air Temperature Methane Gas (volume %) Oxygen Gas (volume %) Barometric Pressure Barometric Pressure Trend
GP-2R	GP-8	GP-14		
GP-3R	GP-9	GP-15		
GP-4R	GP-10 (1)	GP-16 (2)		
GP-5R *	GP-11 (1)	GP-17 (2)		
GP-6	GP-12	GP-18 (2)		
(1) Probes to be abandoned during Phase 14A construction. (2) Probes to be installed during Phase 14A construction.				
Gas Wells				
SEC2GW01A	SC2GW27A	SEC2GW53	Monthly (submitted semiannually)	Wellhead pressure (inches) Gas Flow Rate (cfm) Valve Opening (% open) Gas Temperature (F) Methane (volume %) Oxygen (volume %) Carbon dioxide (volume %) Balance Gas (volume %)
SEC2GW02	SC2GW28A	SEC2GW54		
SEC2GW03A	SC2GW29B	SEC2GW55 (1)		
SEC2GW04	SEC2GW30	SEC2GW56 (1)		
SEC2GW05A	SEC2GW31	SEC2GW57 (1)		
SEC2GW06A	SEC2GW32A	SEC2GW58 (1)		
SEC2GW07A	SEC2GW33	SEC2GW59		
SEC2GW08A	SEC2GW34	SEC2GW60		
SEC2GW09A	SEC2GW35	SC2GW61A		
SC2GW10B	SC2GW36A	SC2GW62A		
SC2GW11B	SEC2GW37	SEC2GW63		
SC2DW12A	SEC2GW38	SEC2GW64		
SEC2GW13	SEC2GW39	SEC2GW65 (1)	Annual (October)	Leachate depth Leachate head elevation
SC2GW14A	SC2GW40A	SEC2GW66 (1)		
SC2GW15B	SEC2GW41	SEC2GW67 (1)		
SC2GW16B	SEC2GW42	SEC2GW68 (1)		
SEC2GW17	SC2GW43A	SEC2GW69 (1)		
SEC2GW18	SEC2GW44	SEC2GW70 (1)		
SEC2GW19A	SEC2GW45A	SEC2GW71 (1)		
SEC2GW20	SEC2GW46	SEC2GW72 (1)		
SEC2GW21	SEC2GW47	SEC2GW73 (1)		
SC2GW22A	SEC2GW48 (1)	SEC2GW74 (1)		
SC2GW23A	SEC2GW49 (1)	SEC2GW75 (1)		
SEZGW24A	SEC2GW50 (1)	SEC2GW76 (1)		
SEZGW25A	SEC2GW51			
SC2GW26A	SEC2GW52			
(1) Gas extraction wells to be installed. And any other wells installed as needed.				

Misc. Gas Monitoring		
Flare (DNR POINT ID 854)	Semi-monthly	Gas Flow Rate (cfm)
Blower Inlet (DNR POINT ID 850)	Semi-monthly	Header Pressure (inches)
Blower Outlet (DNR POINT ID 852)	Semi-monthly	Gas Volume Extracted (total monthly volume in 1000 cu. ft./month) Gas temperature (F) Header Pressure (inches) Gas Flow Rate (cfm) Carbon dioxide (volume %) Methane (volume %) Oxygen Gas (volume %) Balance Gas (volume %)
	Annual (October)	Total Sulfur Compounds VOCs per USEPA Method TO-15 or TO-14A
Note: data submitted semiannually		

SURFACE WATER

MONITORING POINT	FREQUENCY	PARAMETERS	
Stream No. 1 (upstream) Stream No. 2 (mid-upstream) Stream No. 3 (downstream) *Note: Surface water elevation not required at Stream No. 2.*	Semiannual (April, October)	Field Temperature	Total Alkalinity
		Field Conductivity	Total Chloride
		Field pH	Total Hardness
		Water Elevation	Nitrate (NO3 -N)
		Odor	Total Phosphorus
		Color	Total Iron
		Turbidity	Dissolved Oxygen



OPERATIONAL AND MAINTENANCE ACTIVITES

ITEM	FREQUENCY	DESCRIPTION/LOCATION
Land Surface Care	Annually	Inspect Surface Water Management System (per NR 216.28), Final Cover Integrity, Slopes, Entrance Roads, and General Facility Conditions
	As Needed	Reseed and Repair Erosion Damage Regrade Final Cover Maintenance/Repair of Downslope of Flumes & Diversion Berms Mow Vegetation Plow Snow
Sedimentation Water Basins	Annually (or as needed)	Remove Sediment from Storm Water Basins
Leachate Collection System	Monthly	Visually Inspect for Liquids in the Leachate Transfer Manholes, Perimeter Access Manholes, & Leachate Collection Tank Secondary Containment
	Annually	Jet Leachate Collection Lines Inspect Integrity of the Leachate Collection Tank Inspect the Leachate Collection Tank Inspect/Repair/Replace Pumps, Transducers, etc.
Settlement Monitoring	Annually	Measure elevations relative to mean sea level

LEGEND

- MUNICIPAL BOUNDARY
- PROPERTY BOUNDARY
- ROAD RIGHT-OF-WAY
- PERMITTED SOLID WASTE BOUNDARY
- PHASE BOUNDARY
- FINAL COVER (CLOSED)
- APPROXIMATE 100-YEAR FLOODPLAIN DELINEATION
- PROPOSED NORTHEAST EXPANSION VERTICAL FOOTPRINT
- PROPOSED NORTHEAST EXPANSION HORIZONTAL FOOTPRINT
- EXISTING EDGE OF WOODS/SHRUBS
- 1000 EXISTING 10' CONTOUR
- EXISTING 2' CONTOUR
- DH-33 EXISTING GROUNDWATER MONITORING WELL
- PW-8 EXISTING PRIVATE WELL
- GP-13 EXISTING GAS PROBE
- TB-68 EXISTING SOIL BORING LOCATION
- MH EXISTING MANHOLE
- LHW-1A EXISTING LEACHATE HEADWELL
- L-2 EXISTING LYSIMETER
- EXISTING STAFF GAUGE
- TP-4 EXISTING TEST PIT
- SEC2GW60 EXISTING LFG EXTRACTION WELL
- SEC2GW45 EXISTING CAISSON LFG EXTRACTION WELL
- S2P080C3 EXISTING SUPPLEMENTAL EXTRACTION WELL
- GP-16 PROPOSED GAS PROBE
- LHW-14B PROPOSED LEACHATE HEADWELL
- SEC2GW PROPOSED LFG EXTRACTION WELL
- PROPOSED SOLID WASTE BOUNDARY SETBACK
- PROPOSED STORM WATER BASIN
- PROPOSED ROAD

NOTES:

1. DRONE SURVEY PERFORMED BY CQM ON APRIL 9, 2019 AND SUPPLEMENTED BY TOPOGRAPHIC SURVEY PERFORMED BY SRMC ON APRIL 6, 2017.
2. PROPERTY BOUNDARIES AND ROAD RIGHT-OF-WAYS ARE FROM DRAWINGS CREATED BY AYRES ASSOCIATES WITH SUPPLEMENTAL DATA FROM EAU CLAIRE COUNTY'S GIS DEPARTMENT. CTH Q/OLSON ROAD OVER SEVEN MILE CREEK WAS REDESIGNED AND REBUILT IN LATE 2018. THE ROAD WAS STRAIGHTENED AND RAISED. UPDATES TO THE ROAD CONFIGURATION ON DRAWINGS WILL BE PROVIDED ONCE ADDITIONAL SURVEY INFORMATION AND/OR AERIAL PHOTOGRAPHY IS PROVIDED.
3. LOCATION OF EXISTING SECTOR 2 GAS WELLS, CLEANOUTS AND LEACHATE HEADWELLS ARE FROM CQM SURVEY (AUGUST 5, 2014).
4. LOCATION OF EXISTING SECTOR 1 GAS WELLS ARE FROM AYRES AND ASSOCIATES HORIZONTAL AND VERTICAL EXPANSION FEASIBILITY REPORT (NOVEMBER 2003).
5. LOCATION OF EXISTING GAS PROBES ARE FROM AYRES 2006 AND 2013 SURVEYS, AND CQM SURVEY (AUGUST 2014).
6. MONITORING WELL AND BORING LOCATIONS, EXCEPT FOR DH-40, DH-51, DH-22R, DH-52, DH-53, DH-60, DH-60A, DH-61, DH-62, DH-62A, DH-63, TB-81, TB-82, TB-83 AND TB-83B ARE FROM AYRES ASSOCIATES HORIZONTAL AND VERTICAL EXPANSION FEASIBILITY REPORT (NOVEMBER 2003).
7. MONITORING WELL (DH-40 AND DH-51) LOCATIONS ARE FROM AYRES ASSOCIATES SECTOR 2-PLAN OF OPERATION-PLAN MODIFICATION (AUGUST 2011).
8. MONITORING WELL (DH-52 AND DH-53) LOCATIONS ARE BASED ON AYRES ASSOCIATES WELL INFORMATION FORM DATED SEPTEMBER 2006. MONITORING WELL DH-22R LOCATION BASED ON AYRES ASSOCIATES WELL INFORMATION FORM DATED OCTOBER 2011.
9. BORINGS TB-81 THROUGH TB-83B AND WELLS DH-60 THROUGH DH-63 INSTALLED IN DECEMBER 2018 FOR THE NORTHEAST EXPANSION AND SURVEYED BY CQM, INC. ON JANUARY 8, 2019.
10. EXISTING TEST PIT LOCATIONS ARE FROM AYRES AND ASSOCIATES HORIZONTAL AND VERTICAL EXPANSION FEASIBILITY REPORT (NOVEMBER 2003).
11. MONITORING WELLS THAT HAVE BEEN REPLACED ARE DESIGNATED WITH THE LETTER "R" IN WELL NAME (DH-4R). PIEZOMETER LOCATIONS ARE DESIGNATED WITH THE LETTERS "A, B OR C" (DH-22A/DH-22B).
12. GAS EXTRACTION WELLS ARE LABELED PER ADVANCED DISPOSAL NAMING SCHEME IN WHICH THE NUMBERS CORRELATE TO THE WDNR NAMING SCHEME.
13. FINAL COVER GRADES SHOWN IN SECTOR 2 PROVIDED ON PLAN SHEET 29 OF JULY 2019 FEASIBILITY REPORT PREPARED BY CORNERSTONE, A TETRATECH COMPANY.
14. MONITORING POINTS WITHIN PHASE 13 ARE FROM THE APPROVED 2016 PLAN OF OPERATION.
15. MONITORING POINTS FOR PHASE 14 WILL BE FURTHER EVALUATED AS PART OF THE PLAN OF OPERATION.

REV	DATE	DESCRIPTION	DWN BY	DES BY	CHK BY	APP BY
1	11/14/19	ADDED PROPOSED MONITORING LOCATIONS	SSW	TD	JCO	MJT

DATE OF ISSUE 7/9/2019
DRAWN BY SSW/SRC
DESIGNED BY SSW
CHECKED BY DJR
APPROVED BY JCO

TETRA TECH

ALL PROFESSIONAL ENGINEERING WORK IS PERFORMED BY DULY LICENSED PROFESSIONAL ENGINEERS UNDER THE APPROPRIATE STATE REGISTERED PROFESSIONAL ENTITY.

ADVANCED DISPOSAL
SEVEN MILE CREEK LANDFILL
EAU CLAIRE, WISCONSIN

FEASIBILITY REPORT - ADDENDUM NO. 1
SECTOR 2-NORTHEAST EXPANSION
ENVIRONMENTAL MONITORING PLAN

SHEET NO. **30**
PROJECT NO. 180720

This drawing represents intellectual property of Tetra Tech. Any modification to the original by other than Tetra Tech personnel violates its original purpose and as such is rendered void. Tetra Tech will not be held liable for any changes made to this document without express written consent of the originator.

File: X:\PROJECTS\SEVEN MILE CREEK\180720 - NE EXPANSION FEASIBILITY REPORT_Plan Set\30-SECT2D-S-ENMON.dwg Layout: 30 User: SCOTT.WILSON Nov 14, 2019 - 10:23am

1" 1/2" 0" 1"

SEVEN MILE CREEK LANDFILL SECTOR 2 (WDNR LIC # 3097)
TABLE 1 - ENVIRONMENTAL MONITORING PROGRAM

GROUNDWATER WELLS

WELL ID	FREQUENCY	PARAMETERS
DH-4R, DH-36, DH-47 DH-18A, DH-38, DH-47A DH-18B, DH-39, DH-48 DH-22A, DH-39A, DH-49 DH-22B, DH-40 (1), DH-49A DH-32, DH-41, DH-52 DH-33, DH-43, DH-60	Semiannual (April, October)	Field Temperature Field Conductivity Field pH, Odor Groundwater Elevation, Color Chloride, Turbidity Hardness, Total, Dissolved Alkalinity, Total, Dissolved
DH-33A, DH-43A, DH-60A DH-34, DH-45, DH-61 DH-35A, DH-46A	Annual (April)	VOCs (8260 or 8021)
DH-62 (1), DH-62A (1), DH-63 (1)	Semiannual	Groundwater Elevation (until abandoned)
(Subtitle D Wells) DH-18 DH-22R DH-35 DH-46 (1) Wells to be abandoned during Phase 14A construction.	Semiannual (April, October)	Field Temperature, Turbidity Field Conductivity, Odor Field pH, Color Groundwater Elevation, Chloride Hardness, Total, Dissolved Alkalinity, Total, Dissolved, VOCs (8260 or 8021)

PRIVATE WELLS

WELL ID	FREQUENCY	PARAMETERS
Advanced Office Well (PW-28) Advanced Shop Well (PW-30) Thompson Dahlby Residence (PW-2) Lee Residence (PW-26)	Semiannual (April, October)	Field Temperature Field Conductivity Field pH Alkalinity, Total (unfiltered) Hardness, Total (unfiltered) Chloride, Total VOC (SWDA method 524.2)
Up to 8 Additional Wells per Local Agreement and designated by SMCL	Annual (October)	VOC (EPA 524.2 extended list)

SEVEN MILE CREEK LANDFILL SECTOR 2 (WDNR LIC # 3097)
TABLE 1 - ENVIRONMENTAL MONITORING PROGRAM (continued)

LEACHATE

MONITORING POINT	FREQUENCY	PARAMETERS	
Sector 2 Leachate Lift Station (DNR Point ID 430)	Monthly (reported semiannually)	Leachate Volume Pumped/Removed (in 1000s of gallons)	
Sector 2 Leachate Tank (DNR Point ID 425)	Semiannual (April and October)	Odor, Color, Turbidity	Total Suspended Solids
		Field Conductivity	Total Alkalinity
		Field pH	Total Hardness
		BOD5	Total Ammonia Nitrogen
		Total Sodium	Total Iron
		Total Kjeldahl Nitrogen	Total Lead
		Total Chloride	Total Manganese
		Total Mercury	Total Sulfate
		Total Cadmium	Field Temperature
		VOCs (8260 or 8021)	
		PCBs (See 40 CFR Part 761.358)	
	Annual (April)	SVOCs (See NR 507, Appendix IV)	
Monitoring requirements when leachate recirculation is active per NR 507.215			
Sector 2 Leachate Tank (DNR Point ID 425)	Quarterly (January, April, July, October)	BOD5	Total Alkaliniity
		COD	Total Hardness
		Total Ammonia Nitrogen	Field conductivity
		Field pH	Field Temperature
VLHW-1A LHW-6A LWH-10B VLHW-2A (1) LHW-6B LHW-11 VLHW-3A LHW-7A LHW-12 LHW-4A LHW-7B LHW-13A LHW-4B LHW-8 LHW-13B LHW-5A LHW-9 LHW-14A (2) LHW-5B LHW-10A LHW-14B (2) (1) Proposed for abandonment per 5/29/2019 Plan Modification. (2) To be installed during Phase construction.	Monthly (reported semiannually)	Leachate Head Elevation (feet MSL) Leachate Depth (in feet)	

LYSIMETERS

MONITORING POINT	FREQUENCY	PARAMETERS	
L-1A L-2 L-3 L-4	Monthly (reported semiannually)	Lysimeter Discharge (gallons) Depth to Liquid	
	Semiannual (April, October)	Field Conductivity	Total Kjeldahl Nitrogen
		Field pH	Total Sulfate
		Total Alkalinity	Elevation
		Total Hardness	Odor
		Total Sodium	Color
		Total Chloride	Turbidity
		Field Temperature	
	Annual (April)	VOCs (8260 or 8021)	

SEVEN MILE CREEK LANDFILL SECTOR 2 (WDNR LIC # 3097)
TABLE 1 - ENVIRONMENTAL MONITORING PROGRAM (continued)

GAS SYSTEM

MONITORING POINT	FREQUENCY	PARAMETERS
Gas Probes GP-1 GP-7 GP-13 GP-2R GP-8 GP-14 GP-3R GP-9 GP-15 GP-4R GP-10 (1) GP-16 (2) GP-5R * GP-11 (1) GP-17 (2) GP-6 GP-12 GP-18 (2) (1) Probes to be abandoned during Phase 14A construction. (2) Probes to be installed during Phase 14A construction.	Quarterly (January, April, July, October)	Ground Conditions Ambient Air Temperature Methane Gas (volume %) Oxygen Gas (volume %) Barometric Pressure Barometric Pressure Trend
Gas Wells SEC2GW01A SC2GW27A SEC2GW53 SEC2GW02 SC2GW28A SEC2GW54 SEC2GW3A SC2GW29B SEC2GW55 (1) SEC2GW04 SEC2GW30 SEC2GW56 (1) SEC2GW5A SEC2GW31 SEC2GW57 (1) SEC2GW6A SEC2GW32A SEC2GW58 (1) SEC2GW7A SEC2GW33 SEC2GW59 SEC2GW8A SEC2GW34 SEC2GW60 SEC2GW9A SEC2GW35 SC2GW61A SC2GW10B SC2GW36A SC2GW62A SC2GW11B SEC2GW37 SEC2GW63 S2GEW12A SEC2GW38 SEC2GW64 SEC2GW13 SEC2GW39 SEC2GW65 (1) SC2GW14A SC2GW40A SEC2GW66 (1) SC2GW15B SEC2GW41 SEC2GW67 (1) SC2GW16B SEC2GW42 SEC2GW68 (1) SEC2GW17 SC2GW43A SEC2GW69 (1) SEC2GW18 SEC2GW44 SEC2GW70 (1) SEC2GW19A SEC2GW45A SEC2GW71 (1) SEC2GW20 SEC2GW46 SEC2GW72 (1) SEC2GW21 SEC2GW47 SEC2GW73 (1) SC2GW22A SEC2GW48 (1) SEC2GW74 (1) SC2GW23A SEC2GW49 (1) SEC2GW75 (1) SE2GW24A SEC2GW50 (1) SEC2GW76 (1) SE2GW25A SEC2GW51 SC2GW26A SEC2GW52 (1) Gas extraction wells to be installed. And any other wells installed as needed.	Monthly (submitted semiannually)	Wellhead pressure (inches) Gas Flow Rate (cfm) Valve Opening (% open) Gas Temperature (F) Methane (volume %) Oxygen (volume %) Carbon dioxide (volume %) Balance Gas (volume %)
	Annual (October)	Leachate depth Leachate head elevation
Misc. Gas Monitoring Flare (DNR POINT ID 854)	Semi-monthly	Gas Flow Rate (cfm)
Blower Inlet (DNR POINT ID 850)	Semi-monthly	Header Pressure (inches)
Blower Outlet (DNR POINT ID 852)	Semi-monthly	Gas Volume Extracted (total monthly volume in 1000 cu. ft./month) Gas temperature (F) Header Pressure (inches) Gas Flow Rate (cfm) Carbon dioxide (volume %) Methane (volume %) Oxygen Gas (volume %) Balance Gas (volume %)
Note: data submited semiannually	Annual (October)	Total Sulfur Compounds VOCs per USEPA Method TO-15 or TO-14A

SEVEN MILE CREEK LANDFILL SECTOR 2 (WDNR LIC # 3097)
TABLE 1 - ENVIRONMENTAL MONITORING PROGRAM (continued)

SURFACE WATER			
MONITORING POINT	**FREQUENCY**	**PARAMETERS**	
Stream No. 1 (upstream)	Semiannual (April, October)	Field Temperature	Total Alkalinity
Stream No. 2 (mid-upstream)		Field Conductivity	Total Chloride
Stream No. 3 (downstream)		Field pH	Total Hardness
		Water Elevation	Nitrate (NO3 -N)
		Odor	Total Phosphorus
Note: Surface water elevation not required at Stream No. 2.		Color	Total Iron
		Turbidity	Dissolved Oxygen

SEVEN MILE CREEK LANDFILL SECTOR 2 (WDNR LIC # 3097)
TABLE 1 - ENVIRONMENTAL MONITORING PROGRAM (continued)

OPERATIONAL AND MAINTENANCE ACTIVITIES		
ITEM	**FREQUENCY**	**DESCRIPTION/LOCATION**
Land Surface Care	Annually	Inspect Surface Water Management System (per NR 216.28), Final Cover Integrity, Slopes, Entrance Roads, and General Facility Conditions
	As Needed	Reseed and Repair Erosion Damage Regrade Final Cover Maintenance/Repair of Downslope of Flumes & Diversion Berms Mow Vegetation Plow Snow
Sedimentation Water Basins	Annually (or as needed)	Remove Sediment from Storm Water Basins
Leachate Collection System	Monthly	Visually Inspect for Liquids in the Leachate Transfer Manholes, Perimeter Access Manholes, & Leachate Collection Tank Secondary Containment
	Annually	Jet Leachate Collection Lines Inspect Integrity of the Leachate Collection Tank
		Inspect the Leachate Collection Tank
		Inspect/Repair/Replace Pumps, Transducers, etc.
Settlement Monitoring	Annually	Measure elevations relative to mean sea level

Attachment 2
Manufacturer's Manual for YSI 556 Meter

YSI Environmental

YSI 556 Multiparameter System

Versatile, multiparameter handheld instrument

The 556 has multiple language capabilities and graphing!

Rugged and reliable, the YSI 556 MPS (Multiprobe System) combines the versatility of an easy-to-use, easy-to-read handheld unit with all the functionality of a multiparameter system.

- **Simultaneously measures dissolved oxygen, pH, conductivity, temperature, and ORP**
- **Field-replaceable electrodes**
- **Compatible with EcoWatch® for Windows® data analysis software**
- **Stores over 49,000 data sets, time and date stamped, interval or manual logging**
- **Three-year warranty on the instrument; one-year on the probes**
- **GLP assisting, records calibration data in memory**
- **Available with 4, 10, and 20-m cable lengths**
- **IP-67, impact-resistant, waterproof case**
- **Easy-to-use, screw-on cap DO membranes**
- **RS-232 interface for PC connection**

Options to Fit Your Applications!

- **Battery Options – The unit is powered by alkaline batteries or an optional rechargeable battery pack with quick-charge feature.**
- **Optional Barometer – Internal barometer can be user-calibrated and displayed along with other data, used in dissolved oxygen calibrations, and logged to memory for tracking changes in barometric pressure. (Choose 556-02)**
- **Optional Flow Cell - The 5083 flow cell can be used for ground water applications or anytime water is pumped for sampling.**
- **Carrying Case – The instrument comes standard with YSI 5061, a soft-sided carrying case with enough space for the 556, a 20-meter cable, and calibrating supplies. An optional 5080 hard-sided carrying case is also available.**
- **Confidence Solution® - Quality assurance ensured. Quickly check conductivity, pH, and ORP readings with one solution.**

Pure Data for a Healthy Planet.®

A rugged, cost-effective multiparameter handheld system designed for the field!

+1 937 767 7241
800 897 4151 (US)
www.ysi.com

YSI Environmental
+1 937 767 7241
Fax +1 937 767 9353
environmental@ysi.com

YSI Integrated Systems
+1 508 748 0366
systems@ysi.com

SonTek/YSI
+1 858 546 8327
inquiry@sontek.com

YSI Gulf Coast
+1 225 753 2650
environmental@ysi.com

AMJ Environmental
+1 727 565 2201
amj@ysi.com

YSI Hydrodata (UK)
+44 1462 673 581
europe@ysi.com

YSI Middle East (Bahrain)
+973 1753 6222
halsalem@ysi.com

YSI (Hong Kong) Limited
+852 2891 8154
hongkong@ysi.com

YSI (China) Limited
+86 532 575 3636
beijing@ysi-china.com.

YSI Nanotech (Japan)
+81 44 222 0009
nanotech@ysi.com

YSI India
+91 989 122 0639
sham@ysi.com

YSI Australia
+61 7 390 17223
acorbett@ysi.com

ISO 9001
ISO 14001

EcoWatch, Pure Data for a Healthy Planet, Confidence Solution and Who's Minding the Planet? are registered trademarks of YSI Incorporated. Windows is a registered trademark of Microsoft.

©2009 YSI Incorporated
Printed in USA 0709 W11-06

YSI incorporated
Who's Minding the Planet?™

5563 MPS Sensor Specifications

Dissolved Oxygen (% saturation)	Sensor Type	Steady state polarographic
	Range	0 to 500% air saturation
	Accuracy	0 to 200% air saturation, ± 2% of the reading or ±2% air saturation, whichever is greater; 200 to 500% air saturation, ± 6% of the reading
	Resolution	0.1% air saturation
Dissolved Oxygen (mg/L)	Sensor Type	Steady state polarographic
	Range	0 to 50 mg/L
	Accuracy	0 to 20 mg/L, ± 2% of the reading or ±0.2 mg/L, whichever is greater; 20 to 50 mg/L, ± 6% of the reading
	Resolution	0.01 mg/L
Temperature	Sensor Type	YSI Temperature Precision™ thermistor
	Range	-5 to 45°C
	Accuracy	± 0.15°C
	Resolution	0.1°C
Conductivity	Sensor Type	4-electrode cell with autoranging
	Range	0 to 200 mS/cm
	Accuracy	± 0.5% of reading or ± 0.001 mS/cm; whichever is greater (4-meter cable) ± 1.0% of reading or ± 0.001 mS/cm; whichever is greater (20-meter cable)
	Resolution	0.001 mS/cm to 0.1 mS/cm (range-dependent)
Salinity	Sensor Type	Calculated from conductivity and temperature
	Range	0 to 70 ppt
	Accuracy	± 1.0% of reading or ±0.1 ppt, whichever is greater
	Resolution	0.01 ppt
pH (optional)	Sensor Type	Glass combination electrode
	Range	0 to 14 units
	Accuracy	±0.2 units
	Resolution	0.01 units
ORP (optional)	Sensor Type	Platinum button
	Range	-999 to +999 mV
	Accuracy	± 20 mV
	Resolution	0.1 mV
Total Dissolved Solids (TDS)	Sensor Type	Calculated from conductivity (variable constant, default 0.65)
	Range	0 to 100 g/L
	Resolution	4 digits
Barometer (optional)	Range	500 to 800 mm Hg
	Accuracy	± 3 mm Hg within ± 10°C temperature range from calibration point
	Resolution	0.1 mm Hg

YSI 556 Instrument Specifications

Size	11.9 cm width x 22.9 cm lenth (4.7 in. x 9 in.)
Weight with batteries	2.1 lbs. (916 grams)
Power	4 alkaline C-cells; optional rechargeable pack
Cables	4-, 10-, and 20-m (13.1, 32.8, 65.6 ft.) lengths
Warranty	3-year instrument; 1-year probes and cables
Communication Port	RS-232 Serial
Data Logger	49,000 data sets, date and time stamp, manual or logging, with user-selectable intervals

556 Ordering Information (Order all items separately)

556-01	Instrument (with 5061 large, soft-sided carrying case)
556-02	Instrument with barometer option (with 5061 carrying case)
5563-4	4-m cable and DO/temp/conductivity
5563-10	10-m cable and DO/temp/conductivity
5563-20	20-m cable and DO/temp/conductivity
5564	pH Probe for any 5563 cable
5565	pH/ORP Probe for any 5563 cable
6118	Rechargeable battery pack kit (includes battery, adapter, charger)
614	Ultra clamp, C-clamp mount
616	Charger, cigarette lighter
4654	Tripod (small tripod for instrument)
5060	Small carrying case, soft-sided (fits instrument and 4-m cable)
5065	Form-fitted carrrier with shoulder strap
5080	Small carrying case, hard-sided (fits instrument, 4-m cable, flow cell, batteries, membrane kit, calibration bottles)
5083	Flow cell
5085	Hands-free harness
5580	Confidence Solution® (insure probe accuracy with a simple field-check for conductivity, pH, and ORP)

The 5080 carrying case with 556, 5563-4 cable, and 5083 flow cell.

YSI **Environmental**

YSI 556 MPS

Multi Probe System

Operations Manual

Contents

1. Safety 1

1.1 General Information 1

2. General Information 6

2.1 Description 6
2.2 Unpacking the Instrument 7
2.3 Features of the YSI 556 Multi-Probe System 8
2.4 Batteries 9
2.5 Power On 14
2.6 Setting Display Contrast 14
2.7 Backlight 15
2.8 General Screen Features 15
2.9 Keypad Use 16
2.10 Instrument Reset 17
2.11 Menu Flowchart 18

3. Probe Module 18

3.1 Introduction 19
3.2 Unpacking the Probe Module 19
3.3 Features of the YSI 5563 Probe Module 20
3.4 Preparing the Probe Module 20
3.5 Transport/Calibration Cup 24
3.6 Instrument/Cable Connection 25

4. Sensors 26

5. Report 29

6. Calibrate 32

6.1 Getting Ready to Calibrate 32
6.2 Calibration Procedures 35
6.3 Return to Factory Settings. 52

7. Run 54

7.1 Real-Time Data 54

8. File 55

8.1 Accessing the File Screen 55
8.2 Directory 56
8.3 View File 58
8.4 Upload to PC 59
8.5 File Memory 63
8.6 Delete All Files 64

9. Logging 66
9.1 Accessing the Logging Setup Screen 66
9.2 Setting Logging Interval 67
9.3 Storing Barometer Readings 67
9.4 Creating a Site List 68
9.5 Editing a Site List 72
9.6 Logging Data Without a Site List 72
9.7 Logging Data with a Site List 75
9.8 Adding Data to Existing Files 77
10. System Setup 79
10.1 Accessing the System Setup Screen 79
10.2 Language Setting 80
10.3 Date and Time Setup 80
10.4 Data Filter 82
10.5 Shutoff Time 84
10.6 Comma Radix 85
10.7 ID 85
10.8 GLP Filename 85
10.9 TDS Constant 86
10.10 Barometer Units 87
10.11 Calibrate Barometer 88
11. Maintenance 90
11.1 Sensor Care and Maintenance 90
11.2 Upgrading YSI 556 MPS Software 96
12. Storage 99
12.1 General Recommendations for Short Term Storage 99
12.2 General Recommendations for Long Term Storage 99
13. Troubleshooting 102
14. Appendix A YSI 556 MPS Specifications 105
15. Appendix B Instrument Accessories 106
16. Appendix C Required Federal Communications Notice 107
17. Appendix D Health Safety 108
18. Appendix E Customer Service 111
18.1 Ordering and Technical Support 111
18.2 YSI Authorized Service Centers 111
18.3 Cleaning Instructions 111

18.4 Packing Procedure 112
18.5 Warranty 113

19. Appendix F Ferrite Bead Installation.....114

20. Appendix G EcoWatch.....116

20.1 Installing EcoWatch for Windows.....116
20.2 EcoWatch Tutorial.....116

21. Appendix H Calibration Record Information 127

21.1 Viewing the Calibration Record (.glp) File 127
21.2 Uploading the Calibration Record (.glp) File 127
21.3 Understanding the Calibration Record (.glp) File.....127

1. Safety

1.1 General Information

Read all safety information in this manual carefully before using the YSI 556 Multi-Probe System (MPS). Reagents that are used to calibrate and check this instrument may be hazardous to your health. Take a moment to review Appendix D Health and Safety.

⚠ **WARNING**

Warnings are used in this manual when misuse of the instrument could result in death or serious injury to a person.

⚠ **CAUTION**

Cautions are used in this manual when misuse of the instrument could result in mild or serious injury to a person and/or damage to equipment.

⚠ **IMPORTANT SAFETY INSTRUCTIONS!**

⚠ **SAVE THESE INSTRUCTIONS!**

⚠ In essence, the most important safety rule for use of the YSI 556 MPS is to utilize the instrument ONLY for purposes documented in this manual. This is particularly true of the YSI 6117 rechargeable battery pack that contains nickel metal hydride (NiMH) batteries. The user should be certain to read all of the safety precautions outlined below before using the instrument.

⚠ Batteries

⚠ This instrument is powered by alkaline or optional nickel-metal hydride batteries, which the user must remove and dispose of when the batteries no longer power the instrument. Disposal requirements vary by country and region, and users are expected to understand and follow the battery disposal requirements for their specific locale.

The circuit board in this instrument contains a manganese dioxide lithium "coin cell" battery that must be in place for continuity of power to memory devices on the board. This battery is not user serviceable or replaceable.

When appropriate, an authorized YSI service center will remove this battery and properly dispose of it, per service and repair policies.

⚠YSI Rechargeable Battery Pack Safety Information

⚠Restrictions on Usage

1. Never dispose of the battery pack in a fire.
2. Do not attempt to disassemble the YSI 6117 battery pack
3. Do not tamper with any of the electronic components or the batteries within the battery pack. Tampering with either the electronic circuitry or the batteries will result in the voiding of the warranty and the compromising of the system performance, but, more importantly, can cause safety hazards which result from overcharging such as overheating, venting of gas, and loss of corrosive electrolyte.
4. Do not charge the battery pack outside the 0–40°C temperature range.
5. Do not use or store the battery at high temperature, such as in strong direct sunlight, in cars during hot weather, or directly in front of heaters.
6. Do not expose the battery pack to water or allow the terminals to become damp.
7. Avoid striking or dropping the battery pack. If the pack appears to have sustained damage from these actions or malfunctions after an impact or drop, the user should not attempt to repair the unit. Instead, contact YSI Customer Service. Refer to *Appendix E Customer Service.*
8. If the battery pack is removed from the YSI 556 MPS, do not store it in pockets or packaging where metallic objects such as keys can short between the positive and negative terminals.

⚠Precautions for Users with Small Children.

Keep the battery pack out of reach of babies and small children.

⚠Danger Notifications – Misuse creates a STRONG possibility of death or serious injury.

FAILURE TO CAREFULLY OBSERVE THE FOLLOWING PROCEDURES AND PRECAUTIONS CAN RESULT IN LEAKAGE OF BATTERY FLUID, HEAT GENERATION, BURSTING, AND SERIOUS PERSONAL INJURY.

1. Never dispose of the battery pack in a fire or in heat.
2. Never allow the positive and negative terminals of the battery pack to become shorted or connected with electrically conductive materials. When the battery pack has been removed from the YSI 556 MPS, store it in a heavy plastic bag to prevent accidental shorting of the terminals.
3. Never disassemble the battery pack and do not tamper with any of the electronic components or the batteries within the battery pack. The battery pack is equipped with a variety of safety features. Accidental deactivation of any of these safety features can cause a serious hazard to the user.
4. The NiMH batteries in the battery pack contain a strong alkaline solution (electrolyte). The alkaline solution is extremely corrosive and will cause damage to skin or other tissues. If any fluid from the battery pack comes in contact with a user's eyes, immediately flush with clean water and consult a physician immediately. The alkaline solution can damage eyes and lead to permanent loss of eyesight.

⚠ Warning Notifications – Misuse creates a possibility of death or serious injury

1. Do not allow the battery pack to contact freshwater, seawater, or other oxidizing reagents that might cause rust and result in heat generation. If a battery becomes rusted, the gas release vent may no longer operate and this failure can result in bursting.
2. If electrolyte from the battery pack contacts the skin or clothing, thoroughly wash the area immediately with clean water. The battery fluid can irritate the skin.

⚠ Caution Notifications – Misuse creates a possibility of mild or serious injury or damage to the equipment.

1. Do not strike or drop the battery pack. If any impact damage to the battery pack is suspected, contact YSI Customer Service. Refer to *Appendix E Customer Service*.

2. Store the battery pack out of reach of babies and small children.
3. Store the battery pack between the temperatures of -20 and 30°C.
4. Before using the battery pack, be sure to read the operation manual and all precautions carefully. Then store this information carefully to use as a reference when the need arises.

⚠YSI 616 Cigarette Lighter Charger Safety Information

1. This section contains important safety and operating instructions for the YSI 556 MPS cigarette lighter battery charger (YSI 616; RadioShack Number 270-1533E). BE SURE TO SAVE THESE INSTRUCTIONS.
2. Before using the YSI 616 cigarette lighter charger, read all instructions and cautionary markings on battery charger, battery pack, and YSI 556 MPS.
3. Charge the YSI 6117 battery pack with the YSI 616 cigarette lighter charger ONLY when the YSI 6117 is installed in the YSI 556 MPS.
4. Do not expose charger to rain, moisture, or snow.
5. Use of an attachment not recommended or sold by the battery charger manufacturer may result in a risk of fire, electric shock, or injury to persons.
6. To reduce risk of damage to cigarette lighter and cord, pull by cigarette lighter rather than cord when disconnecting charger.
7. Make sure that the cord is located so that it will not be stepped on, tripped over, or otherwise subjected to damage or stress.
8. Do not operate charger with damaged cord or cigarette lighter connector – replace it immediately.
9. Do not operate charger if it has received a sharp blow, been dropped, or otherwise damaged in any way; contact YSI Customer Service. Refer to *Appendix E Customer Service*.
10. Do not disassemble charger other than to change the fuse as instructed. Replace the part or send it to YSI Product Service if repair is required (refer to *Appendix E Customer Service*). Incorrect reassembly may result in a risk of electric shock or fire.

11. To reduce risk of electric shock, unplug charger before attempting any maintenance or cleaning. Turning off controls will not reduce this risk.

⚠ YSI 556 MPS Water Leakage Safety Information

The YSI 556 MPS has been tested and shown to comply with IP67 criterion, i.e. submersion in 1 meter of water for 30 minutes with no leakage into either the battery compartment or the main case. However, if the instrument is submersed for periods of time in excess of 30 minutes, leakage may occur with subsequent damage to the batteries, the rechargeable battery pack circuitry, and/or the electronics in the main case.

If leakage into the battery compartment is observed when using alkaline C cells, remove batteries, dispose of batteries properly, and dry the battery compartment completely, ideally using compressed air. If corrosion is present on the battery terminals, contact YSI Customer Service for instructions. Refer to *Appendix E Customer Service*.

If leakage into the battery compartment is observed when using the YSI rechargeable battery pack, remove the battery assembly and set aside to dry. Return the battery pack to YSI Product Service for evaluation of possible damage. Finally dry the battery compartment completely, ideally using compressed air. If corrosion is present on the battery terminals, contact YSI Customer Service for instructions. Refer to *Appendix E Customer Service*.

⚠ **CAUTION:** If water has contacted the rechargeable battery pack, do not attempt to reuse it until it has been evaluated by YSI Product Service (refer to Appendix E Customer Service). Failure to follow this precaution can result in serious injury to the user.

If it is suspected that leakage into the main cavity of the case has occurred, remove the batteries immediately and return the instrument to YSI Product Service for damage assessment. Refer to *Appendix E Customer Service*.

⚠ **CAUTION:** Under no circumstances should the user attempt to open the main case.

2. General Information

2.1 Description

The rugged and reliable YSI 556 MPS (Multi-Probe System) combines the versatility of an easy-to-use, easy-to-read handheld unit with all the functionality of a multi-parameter system. Featuring a waterproof, impact-resistant case, the YSI 556 MPS simultaneously measures dissolved oxygen, conductivity, temperature, and optional pH and ORP. A simple cellular phone style keypad and large display make the instrument easy to use. The YSI 556 MPS is compatible with YSI EcoWatch™ for Windows™ software.

The YSI 556 MPS assists the user in conforming to Good Laboratory Practice (GLP) standards which help ensure that quality control/quality assurance methods are followed. Battery life is displayed with a fuel gauge, and the user can choose standard alkaline batteries or an optional rechargeable battery pack.

The 1.5 MB memory can store more than 49,000 data sets. Other options include a flow cell and barometer. The internal barometer can be user-calibrated and displayed along with other data, used in dissolved oxygen calibrations, and logged to memory for tracking changes in barometric pressure.

Features

- Waterproof -meets IP67 specifications
- Field-replaceable DO electrode module; pH and pH/ORP sensors
- Compatible with EcoWatch™ for Windows™ data analysis software
- Assists with Good Laboratory Practice Standards (GLP)
- Choice of DO membrane material for different applications
- Easy-to-use, screw-on cap DO membranes
- User-upgradeable software from YSI website
- Three-year warranty on the instrument; one-year on the probe modules
- Available with 4,10, and 20 m cable lengths
- Stores over 49,000 data sets, time and date stamped

- Auto temperature compensating display contrast
- Optional barometer
- Optional rechargeable battery pack or standard alkaline batteries

2.2 Unpacking the Instrument

1. Remove the instrument from the shipping box. Note that the probe module and sensors are shipped in a separate box and will be unpacked later in Section *3.2 Unpacking the Probe Module*

   NOTE: Do not discard any parts of supplies.

2. Use the packing list to ensure all items are present.

3. Visually inspect all components for damage.

   NOTE: If any parts are missing or damaged, contact your YSI Service Center immediately. Refer to Appendix E Customer Service or www.ysi.com.

2.3 Features of the YSI 556 Multi-Probe System

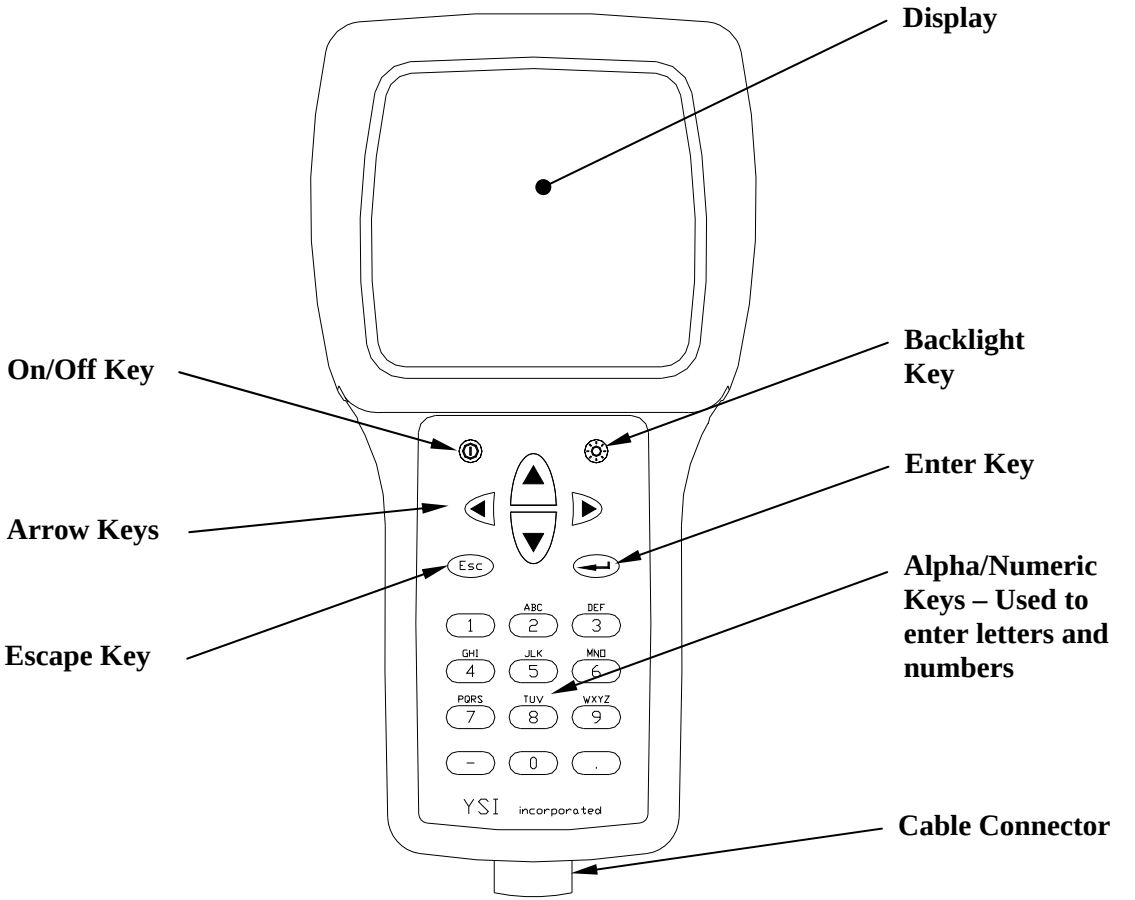


Figure 2.1 Front View of YSI 556 MPS

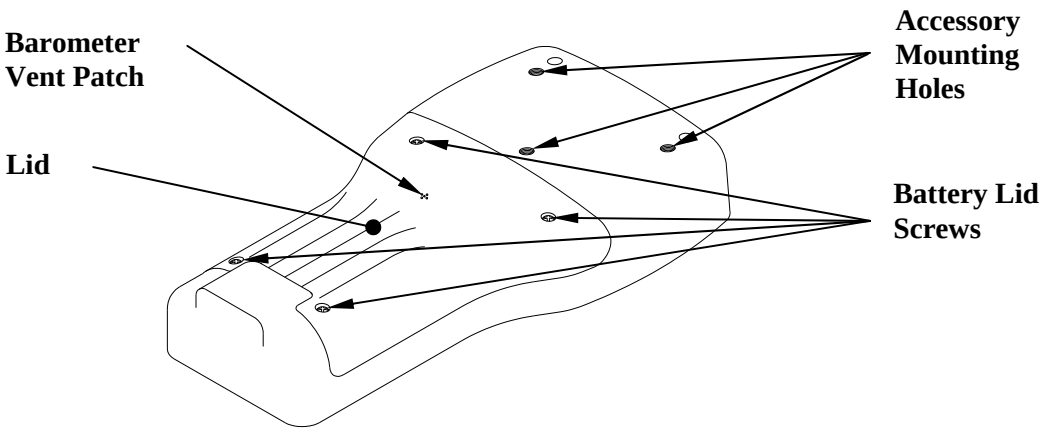


Figure 2.2 Back View of YSI 556 MPS

2.4 Batteries

2.4.1 Battery Life

Standard Alkaline Batteries

With the standard battery configuration of 4 alkaline C cells, the YSI 556 MPS will operate continuously for approximately 180 hours. Assuming a standard usage pattern when sampling of 3 hours of “on time” in a typical day, the alkaline cells will last approximately 60 days.

Optional Rechargeable Battery Pack

When fully charged, the optional rechargeable battery pack will provide approximately 50 hours of battery life.

2.4.2 Inserting 4 C Batteries

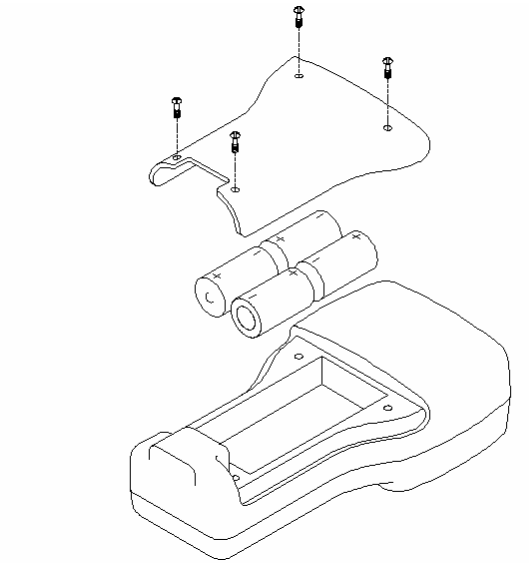


Figure 2.1 Inserting C Cells

⚠ **CAUTION: Install batteries properly to avoid damage to the instrument**.

1. Loosen the four screws in the battery lid on the back of the instrument using any screwdriver.
2. Remove the battery lid.
3. Insert four C batteries between the clips following the polarity (+ and -) labels on the bottom of the battery compartment.
4. Check gasket for proper placement on the battery lid.
5. Replace the battery lid and tighten the 4 screws securely and evenly.

NOTE: Do not over-tighten the screws.

2.4.3 Inserting Optional Rechargeable Battery Pack

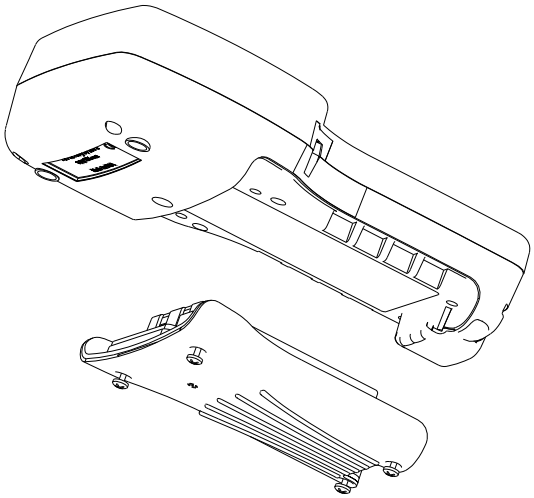


Figure 2.2 Inserting Battery Pack

⚠ **CAUTION: Read all cautions and warning that come with the battery pack before using the battery pack.**

1. Loosen the four screws in the battery lid on the back of the instrument using any screwdriver.

2. Remove the C battery lid and store for future use. Remove C batteries, if installed.

3. Install the rechargeable battery pack and lid and tighten the 4 screws securely and evenly.

NOTE: Do not over tighten the screws.

2.4.4 Charging the Optional Rechargeable Battery Pack

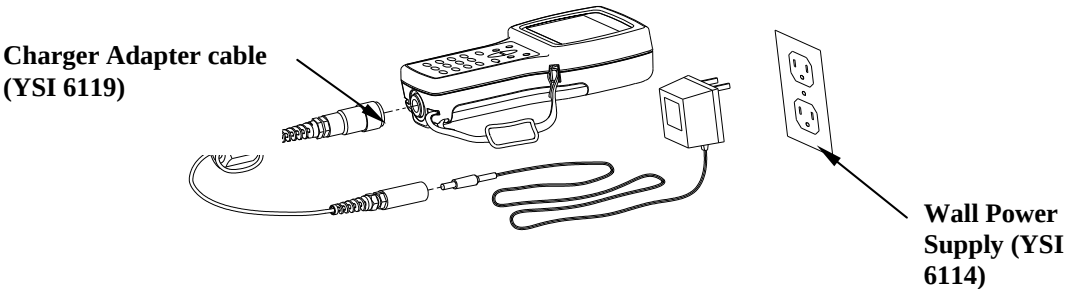


Figure 2.3 Charging the Battery Pack

⚠ **CAUTION: Do not use or store the battery pack at extreme temperatures such as in strong direct sunlight, in cars during hot weather or close to heaters.**

1. Install the rechargeable battery pack into the instrument as described in Section *2.4.3 Inserting Optional Rechargeable Battery Pack*.

2. Attach the charger adapter cable (YSI 6119) to the instrument.

NOTE: Wall power supplies for use in countries outside the US and Canada can be found in *Appendix B Instrument Accessories.*

3. Insert the barrel connector of the wall power supply into the barrel of the adapter cable.

⚠ **CAUTION: Do not charge the battery pack continuously for more than 48 hours.**

⚠ **CAUTION: Do not drop or expose to water.**

⚠ **CAUTION: Do no charge the battery pack at temperatures below 0°C or above 40°C.**

4. Plug the wall power supply into an AC power outlet for approximately 2 hours to obtain an 80% to 90% charge for 6 hours to get a full charge.

NOTE: The battery pack can be recharged whether the instrument is on or off.

2.4.5 Storing the Battery Pack

Remove the battery pack from the instrument when the instrument will not be used for extended periods of time to prevent over discharge of the battery pack.

Store the battery pack in a heavy plastic bag to prevent accidental shorting of the terminals. Store between –20 and 30°C.

2.4.6 Optional Cigarette Lighter Charger

⚠ **CAUTION: Read all warnings and cautions that come with the charger before using the charger.**

⚠ **CAUTION: Only use cigarette lighter charger when rechargeable battery pack is inserted into instrument.**

⚠ **CAUTION: Do not mishandle cigarette lighter charger. Do not expose to moisture.**

1. Plug the barrel connector of the cigarette lighter charger into the mating end of the YSI 6119 Charger Adapter Cable.

2. Attach the MS-19 end of the YSI 6119 Charger Adapter Cable to the instrument.

3. Make one of the following modifications to the other end of the charger:

Slide the adapter ring off the plug to use the device with an American or Japanese vehicle.

.

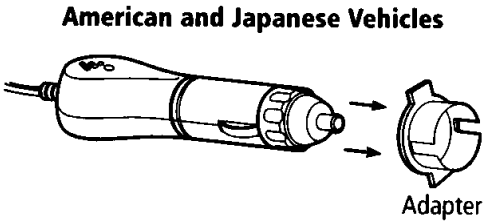


Figure 2.1 Charger Plug Adapter Use

Leave the adapter ring on the plug and position it so that the slots on the adapter ring line up with the plug's spring clips to use the device on a European vehicle.

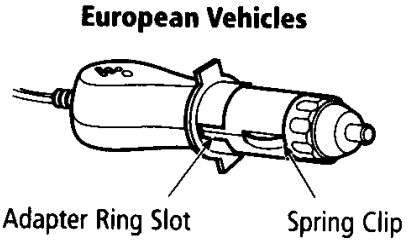


Figure 2.2 European Charger Plug Adapter Use

NOTE: If the charger stops working properly, refer to Section 13 *Troubleshooting.*

2.5 Power On

Press and release the on/off button in the upper left corner of the instrument keypad to turn the instrument on or off. See Figure2.1 Front View of YSI 556 MPS.

2.6 Setting Display Contrast

The display contrast automatically compensates for temperature changes. However, under extreme temperature conditions you may wish to optimize the display by manual adjustment as follows:

1. Press and *hold down* the backlight key in the upper right corner of the keypad and press the “up” arrow to increase (darken) the contrast.

2. Press and *hold down* the backlight key in the upper right corner of the keypad and press the “down” arrow to decrease (lighten) the contrast.

2.7 Backlight

Press and *release* the backlight key in the upper right corner of the keypad to turn the backlight on or off. See Figure 2.1 Front View of YSI 556 MPS.

NOTE: The backlight turns off automatically after two minutes of non-use.

2.8 General Screen Features

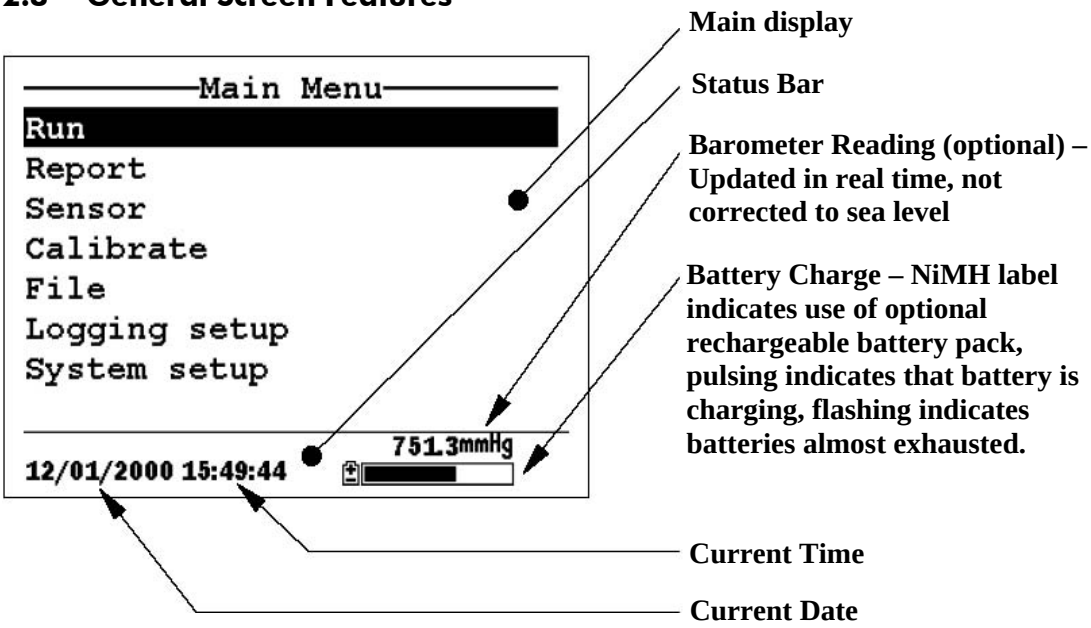


Figure 2.4 Main Screen Menu

2.9 Keypad Use

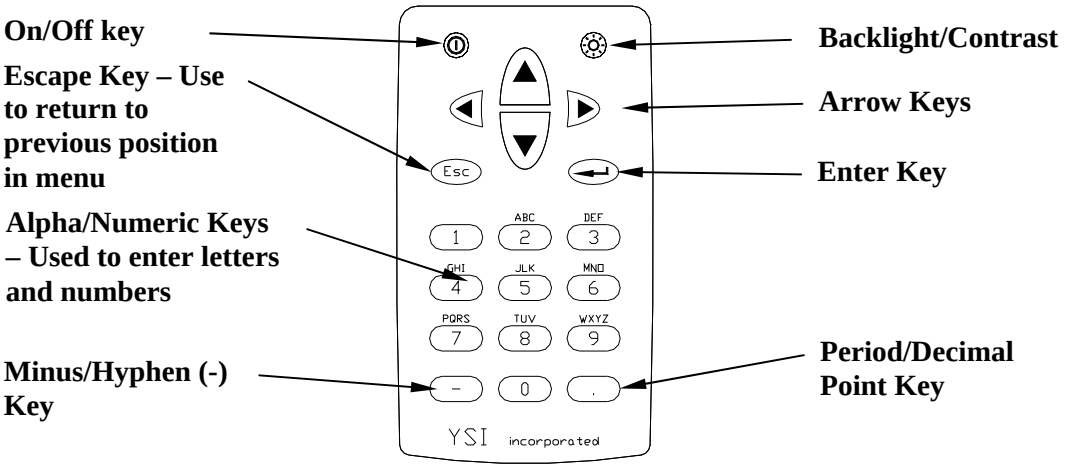


Figure 2.5 Keypad Features

KEY	LETTER/NUMBER
1	1
2	ABC2abc3
3	DEF3def3
4	GHI4ghi4
5	JKL5jkl5
6	MNO6mno6
7	PQRS7pqrs7
8	TUV8tuv8
9	WXYZ9wxyz9
0	0

Figure 2.6 Keypad Features

1. See Figure 2.10 Keypad Letters & Numbers and press the appropriate key repeatedly until letter or number desired appears in display.

NOTE: Press the key repeatedly in rapid succession to get to the desired letter or number. If you pause for more than a second, the cursor automatically scrolls to the right to prepare for the next input.

EXAMPLE 1: Press the **6** key *once* and *release* to display an uppercase “M”.

EXAMPLE 2: Press the **6** key *four times* and *release* to display the number “6”.

EXAMPLE 3: Press the **6** key *five times* and *stop* to display a lowercase “m”.

2. Press the left arrow key to go back and reenter a number or setter that needs to be changed.

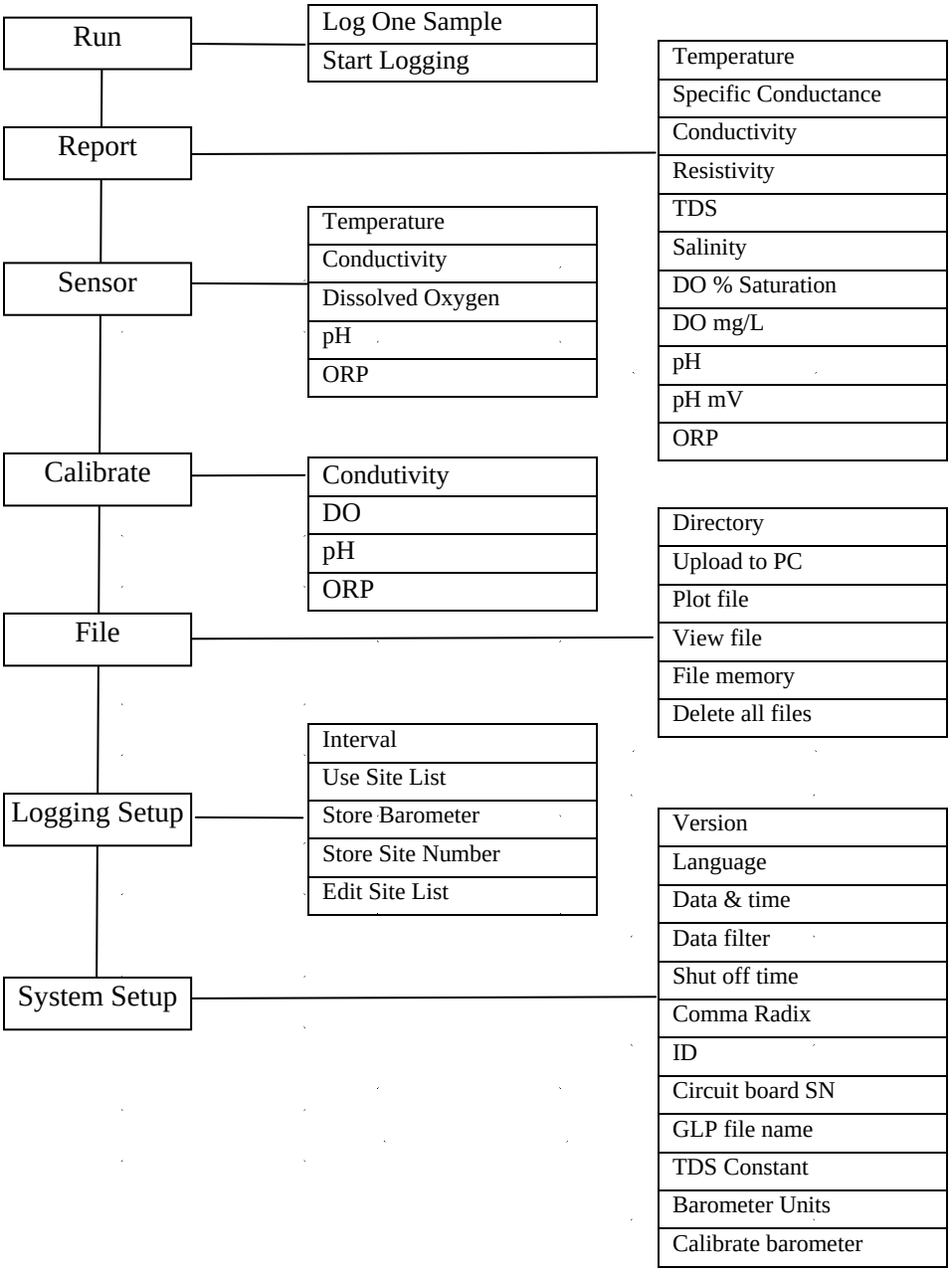
   Press the **Enter** key when your entry is complete.

   NOTE: The instrument software permits only numeric entries in many instances, such as when setting the clock or entering calibration parameters.

2.10 Instrument Reset

The YSI 556 MPS is characterized by sophisticated software that should provide trouble-free operation. However, as with all high-capability software packages, it is always possible that the user will encounter circumstances in which the instrument does not respond to keypad entry. If this occurs, the instrument function can easily be restored by removing and then reapplying battery power. Simply remove either your C-cells or rechargeable battery pack from the battery compartment, wait 30 seconds and then replace the batteries. See Section *2.4 Batteries* for battery removal/reinstallation instructions.

2.11 Menu Flowchart



3. Probe Module

3.1 Introduction

The YSI 5563 Probe module is used for measuring dissolved oxygen, temperature, conductivity, and optional pH and ORP. The probe module is rugged, with the sensors enclosed in a heavy duty probe sensor guard with attached sinking weight. A 4, 10 or 20 meter cable is directly connected to the probe module body making it waterproof. An MS-19 connector at the end of the cable makes the YSI 5563 fully compatible with the YSI 556 Multi-Probe System.

3.2 Unpacking the Probe Module

1. Remove the YSI 5563 Probe Module from the shipping boxes.

   NOTE: Do not discard any parts or supplies.

2. Use the packing list to ensure all items are present.

3. Visually inspect all components for damage.

NOTE: If any parts are missing or damaged, contact a YSI representative immediately. Refer to: *Appendix E Customer Service* o visit www.ysi.com.

3.3 Features of the YSI 5563 Probe Module

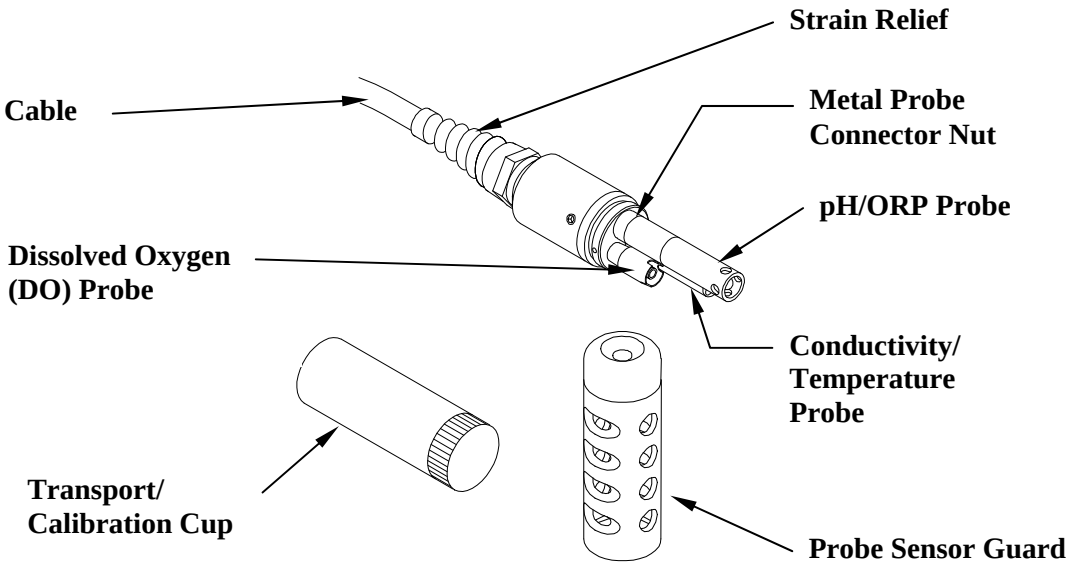


Figure 3.1 Probe Module

3.4 Preparing the Probe Module

To prepare the probe module for calibration and operation, you need to install the sensors into the connectors on the probe module bulkhead. In addition to sensor installation, you need to install a new DO membrane cap.

3.4.1 Sensor Installation

Whenever you install, remove or replace a sensor, it is extremely important that the entire probe module and all sensors be thoroughly dried prior to the removal of a sensor or a sensor port plug. This will prevent water from entering the port. Once you remove a sensor or plug, examine the connector inside the probe module sensor port. If any moisture is present, use compressed air to completely dry the connector. If the connector is corroded, return the probe module to your YSI Distributor or directly to YSI Customer Service. Refer to *Appendix E Customer Service*.

Conductivity/Temperature and pH, pH/ORP Sensor Installation

1. Unscrew and remove the probe sensor guard.

2. Using the sensor installation tool supplied in the YSI 5511 maintenance kit, unscrew and remove the sensor port plugs.

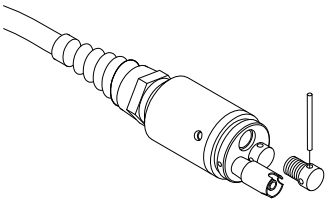


Figure 3.2 Port Plug Removal

3. Locate the port with the connector that corresponds to the sensor that is to be installed.

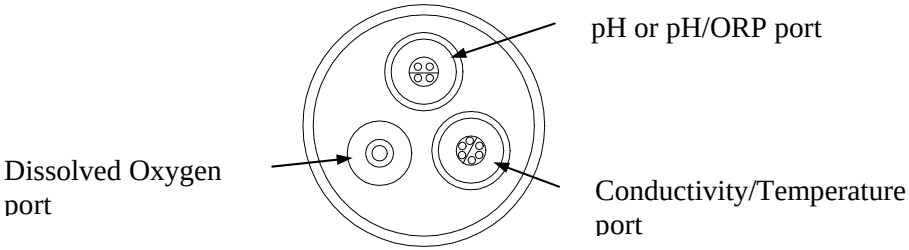


Figure 3.3 Sensor Port Identification

4. Apply a thin coat of o-ring lubricant (supplied in the YSI 5511 maintenance kit) to the o-rings on the connector side of the sensor (see Figure 3.4 O-ring Lubrication).

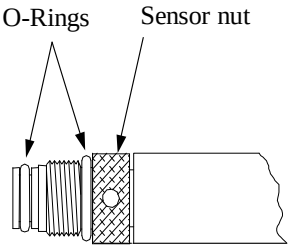


Figure 3.4 O-ring Lubrication

⚠ **CAUTION:** Make sure that there are NO contaminants between the o-ring and the sensor. Contaminants that are present under the o-ring may cause the o-ring to leak.

5. Be sure the probe module sensor port is free of moisture and then insert the sensor into the correct port. Gently rotate the sensor until the two connectors align.

6. With the connectors aligned, screw down the sensor nut using the sensor installation tool.

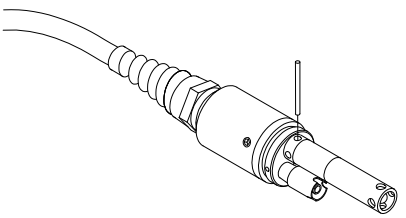


Figure 3.5 Sensor Installation

⚠ **CAUTION:** Do not cross thread the sensor nut. Tighten the nut until it is flush with the face of the probe module bulkhead. Do not over tighten.

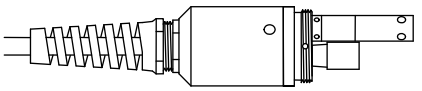


Figure 3.6 Bulkhead Seating

7. Repeat steps 3-6 for any other sensors.

8. Replace the probe sensor guard.

Dissolved Oxygen Sensor Installation

The YSI 5563 comes with the DO sensor already installed. Refer to Section *11.1.2 DO Sensor Replacement* for instructions on installing the YSI 559 Replaceable DO Module Kit.

3.4.2 Membrane Cap Selection

The YSI 5563 is shipped with a YSI 5909 kit that contains membrane caps made with 2 mil polyethylene (PE), a material which should be ideal for most field applications of the 556. However, YSI also offers membrane caps made with two other materials (1 mil polyethylene and 1 mil Teflon) which some users may also prefer. All membranes available for the 556/5563 system provide comparable accuracy if used properly. The difference between the two thicknesses of PE is found in the trade-off of flow dependence and response time as described below. Teflon is offered because some users may prefer to continue using the traditional membrane material used by YSI. To avoid confusion, the membrane caps are color coded as described below and can be ordered in kits as noted:

1 mil Teflon – Black Caps (Kit = YSI 5906)
1 mil Polyethylene (PE) – Yellow Caps (Kit = YSI 5908)
2 mil Polyethylene (PE) – Blue Caps (Kit = YSI 5909)

The 1 mil Teflon caps will offer traditional, reliable performance for most dissolved oxygen applications. The 1 mil PE caps will provide a significantly faster dissolved oxygen response (as long as your 556 Data Filter is set correctly as described below in Sections 10.2 and 10.3.1) while also giving readings which are significantly less flow dependent than the 1 mil Teflon caps. Finally, 2 mil PE caps will show a large reduction in flow dependence over 1 mil Teflon while not significantly increasing the response time. Generally, one of the PE caps is likely to provide better performance for your application.

IMPORTANT: No matter which type of membrane cap you select, you will have to confirm your selection in the 556 software from the Sensor menu as described in Section *4 Sensors*.

3.4.3 Membrane Cap Installation

NOTE: The YSI 5563 DO sensor (already installed in the probe module) was shipped dry. A shipping membrane was installed to protect the electrode. **A new membrane cap must be installed before the first use.**

1. Unscrew and remove the probe sensor guard.
2. Unscrew, remove, and discard the old membrane cap.
3. Thoroughly rinse the sensor tip with distilled water.
4. Prepare the electrolyte according to the directions on the electrolyte solution bottle.
5. Hold the new membrane cap and fill it at least ½ full with the electrolyte solution.
6. Screw the membrane cap onto the sensor moderately tight. A small amount of electrolyte should overflow.

⚠ **Caution:** Do not touch the membrane surface.

7. Screw the probe sensor guard on moderately tight.

3.5 Transport/Calibration Cup

The YSI 5563 Probe module has been supplied with a convenient transport/calibration cup. This cup is an ideal container for calibration of the different sensors, minimizing the amount of solution needed. Refer to Section *6 Calibrate*.

3.5.1 Transport/Calibration Cup Installation

1. Remove probe sensor guard, if already installed.

2. Ensure that an o-ring is installed in the o-ring groove on the threaded end of the probe module body.

3. Screw the transport/calibration cup on the threaded end of the probe module and securely tighten.

   NOTE: Do not over tighten as this could cause damage to the threaded portions.

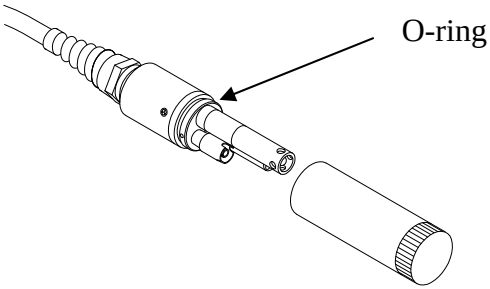


Figure 3.7 Transport/Calibration Cup Installation

3.6 Instrument/Cable Connection

Attach the cable to the instrument as follows:

1. Line up the pins and guides on the cable with the holes and indentations on the cable connector at the bottom of the YSI 556 instrument. See Figure 2.1 Front View of YSI 556 MPS.

2. Holding the cable firmly against the cable connector, turn the locking mechanism clockwise until it snaps into place.

Remove the cable from the instrument by turning the cable connector counterclockwise until the cable disengages from the instrument.

4. Sensors

The Sensors screen allows the user to enable or disable each of the sensors and select which membrane material will be used for the dissolved oxygen sensor. Disabled sensors will not be displayed on the screen in real time or logged to files.

1. Press the **On/off** key to display the run screen.

2. Press the **Escape** key to display the main menu screen.

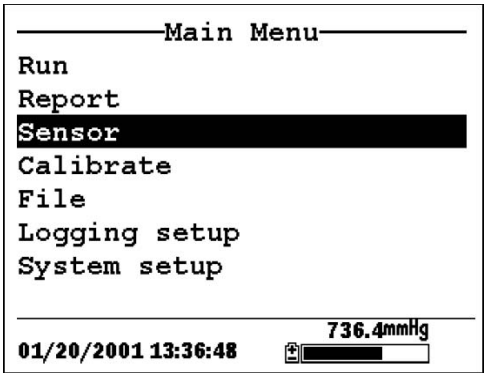


Figure 4.1 Main Menu Screen

3. Use the arrow keys to highlight the **Sensor** selection.

4. Press the **Enter** key to display the sensors enabled screen.

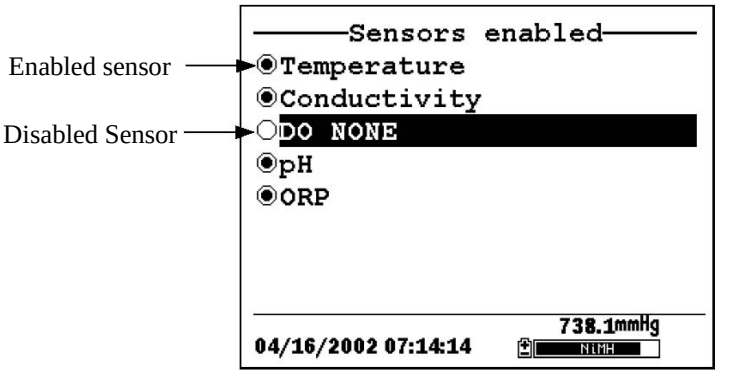


Figure 4.2 Sensors Enabled Screen Before DO Membrane Selection

A black dot to the left of a sensor indicates that sensor is enabled. Sensors with an empty circle are disabled.

Highlight the “DO None” entry as shown above and press **Enter** to display the membrane choice screen. Consult Section *3.4.2 Membrane Cap Selection* for information on the advantages of each type of membrane material. Blue membrane caps using 2 mil polyethylene (PE) were shipped with your YSI 5563 and are likely to be the best choice for most 556 field applications.

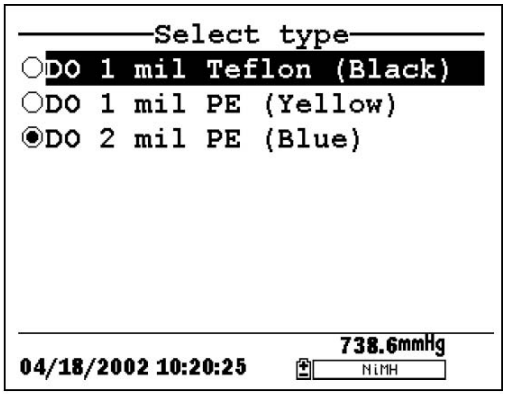


Figure 4.3 Membrane Selection Screen

Highlight the desired membrane choice – in this case, 2 mil PE - and press Enter to activate your selection with a dot to the left of the screen. Then press **Escape** to return to the Sensor menu that now shows your DO membrane selection.

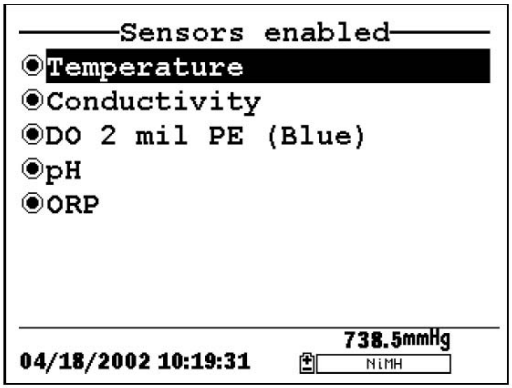


Figure 4.4 Sensors Enabled Screen After DO Membrane Selection

NOTE: The Temperature sensor cannot be disabled. Most other sensors require temperature compensation for accurate readings. In addition, the conductivity sensor must be activated in order to obtain accurate dissolved oxygen mg/L readings.

5. Use the arrow keys to highlight the sensor you want to change, then press the Enter key to enable or disable it.

6. Repeat step 5 for each sensor you want to change.

7. Press the Escape key to return to the main menu screen.

5. Report

The Report Setup screen allows the user to select which sample parameters and units the YSI 556 MPS will display on the screen. It does NOT determine which parameters are logged to memory. Refer to Section *4 Sensors.*

1. Press the **On/off** key to display the run screen.

2. Press the **Escape** key to display the main menu screen.

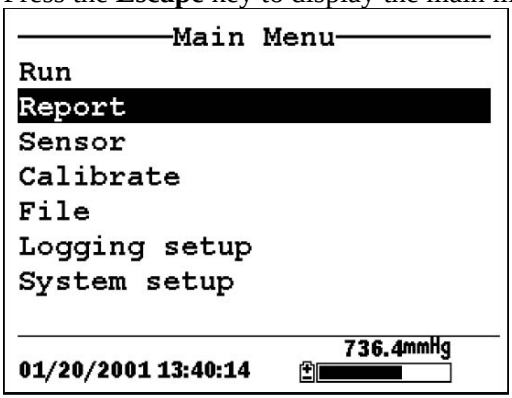


Figure 5.1 Main Menu

3. Use the arrow keys to highlight the **Report** selection.

4. Press the **Enter** key to display the report setup screen.

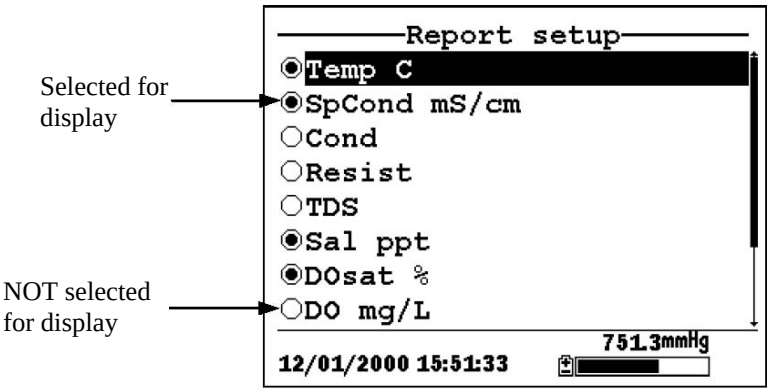


Figure 5.2 Report Setup Screen

NOTE: A black dot to the left of a parameter indicates that parameter is selected for display. Parameters with an empty circle will not be displayed.

NOTE: You may have to scroll down past the bottom of the screen to see all the parameters.

5. Use the arrow keys to highlight the parameter you want to change, then press the **Enter** key. If you can't find the parameter you want, even after scrolling down past the bottom of the screen, the sensor used for that parameter is disabled. Refer to Section *4 Sensors*.

6. If you selected Temperature, Specific Conductivity, Conductivity, Resistance or Total Dissolved Solids, the Units screen will appear.

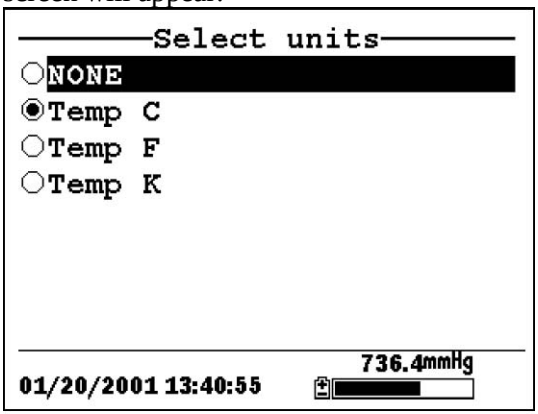


Figure 5.3 Units Screen

7. Use the arrow keys to select the units desired, then press the **Enter** key to return to the report setup screen.

8. Repeat steps 5 and 6 for each parameter you want to change.

NOTE: Specific Conductance (temperature compensated conductivity) is notated on the Run screen with a small ‘c’ after the units of measure.

All parameters may be enabled at the same time.

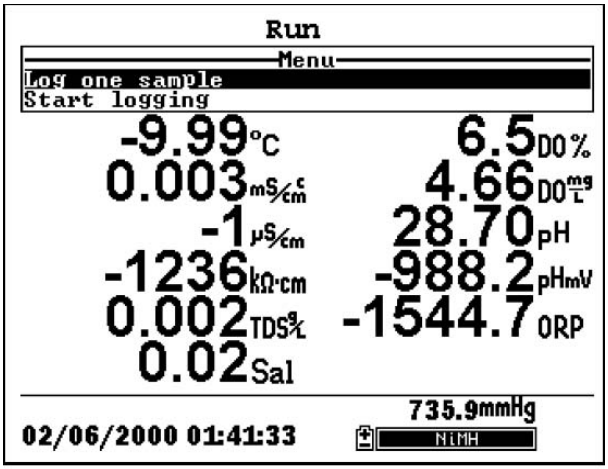


Figure 5.4 All Parameters Displayed

9. Press the **Escape** key to return to the Main menu screen.

6. Calibrate

All of the sensors, except temperature, require periodic calibration to assure high performance. You will find specific calibration procedures for all sensors that require calibration in the following sections. If a sensor listed is not installed in your probe module, skip that section and proceed to the next sensor until the calibration is complete.

⚠ **CAUTION:** Reagents that are used to calibrate and check this instrument may be hazardous to your health. Take a moment to review *Appendix D Health and Safety*. Some calibration standard solutions may require special handling.

6.1 Getting Ready to Calibrate

6.1.1 Containers Needed to Calibrate the Probe Module

The transport/calibration cup that comes with your probe module serves as a calibration chamber for all calibrations and minimizes the volume of calibration reagents required.

Instead of the transport/calibration cup, you may use laboratory glassware to perform calibrations. If you do not use the transport/calibration cup that is designed for the probe module, you are cautioned to do the following:

- ✓ Perform all calibrations with the Probe Sensor Guard installed. This protects the sensors from possible physical damage.
- ✓ Use a ring stand and clamp to secure the probe module body to prevent the module from falling over. Most laboratory glassware has convex bottoms.
- ✓ Ensure that all sensors are immersed in calibration solutions. Many of the calibrations factor in readings from other sensors (e.g., temperature sensor). The top vent hole of the conductivity sensor must also be immersed during some calibrations.

6.1.2 Calibration Tips

1. If you use the Transport/Calibration Cup for dissolved oxygen (DO) calibration, make certain to loosen the seal to allow pressure equilibration before calibration. The DO calibration is a water-saturated air calibration.

2. When calibrating pH, always calibrate with buffer 7 first, regardless if performing a 1, 2, or 3 point calibration

3. The key to successful calibration is to ensure that the sensors are completely submersed when calibration values are entered. Use recommended volumes when performing calibrations.

4. For maximum accuracy, use a small amount of previously used calibration solution to pre-rinse the probe module. You may wish to save old calibration standards for this purpose.

5. Fill a bucket with ambient temperature water to rinse the probe module between calibration solutions.

6. Have several clean, absorbent paper towels or cotton cloths available to dry the probe module between rinses and calibration solutions. Shake the excess rinse water off of the probe module, especially when the probe sensor guard is installed. Dry off the outside of the probe module and probe sensor guard. Making sure that the probe module is dry reduces carry-over contamination of calibrator solutions and increases the accuracy of the calibration.

7. If you are using laboratory glassware for calibration, you do not need to remove the probe sensor guard to rinse and dry the sensors between calibration solutions. The inaccuracy resulting from simply rinsing the sensor compartment and drying the outside of the guard is minimal.

8. If you are using laboratory glassware, remove the stainless steel weight from the bottom of the probe sensor guard by turning the weight counterclockwise. When the weight is removed, the calibration solutions have access to the sensors

without displacing a lot of fluid. This also reduces the amount of liquid that is carried between calibrations.

9. Make certain that port plugs are installed in all ports where sensors are not installed. It is extremely important to keep these electrical connectors dry.

6.1.3 Recommended Volumes

Follow these instructions to use the transport/calibration cup for calibration procedures.

- ✓ Ensure that an o-ring is installed in the o-ring groove of the transport/calibration cup bottom cap, and that the bottom cap is securely tightened.

  NOTE: Do not over-tighten as this could cause damage to the threaded portions.

- ✓ Remove the probe sensor guard, if it is installed.
- ✓ Remove the o-ring, if installed, from the probe module and inspect the installed o-ring on the probe module for obvious defects and, if necessary, replace it with the extra o-ring supplied.
- ✓ Some calibrations can be accomplished with the probe module upright or upside down. A separate clamp and stand, such as a ring stand, is required to support the probe module in the upside down position.
- ✓ To calibrate, follow the procedures in the next section, Calibration Procedures. The approximate volumes of the reagents are specified below for both the upright and upside down orientations.
- ✓ When using the Transport/Calibration Cup for dissolved oxygen % saturation calibration, make certain that the vessel is vented to the atmosphere by loosening the bottom cap or cup assembly and that approximately 1/8 inch (3 cm) of water is present in the cup.

Sensor to Calibrate	Upright	Upside Down
Conductivity	55ml	55ml
pH/ORP	30ml	60ml

Table 6.1 Calibration Volumes

6.2 Calibration Procedures

6.2.1 Accessing the Calibrate Screen

1. Press the **On/off** key to display the run screen.
2. Press the **Escape** key to display the main menu screen.
3. Use the arrow keys to highlight the **Calibrate** selection.

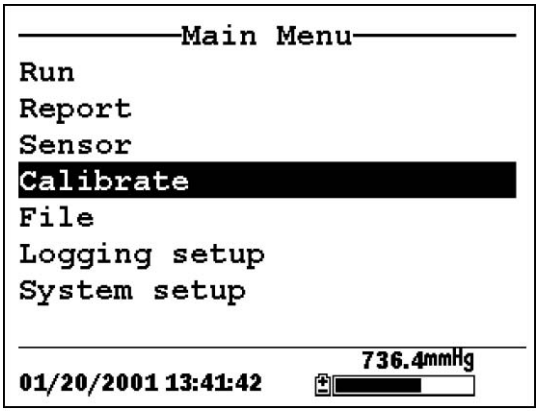


Figure 6.1 Main Menu

4. Press the **Enter** key. The Calibrate screen will be displayed.

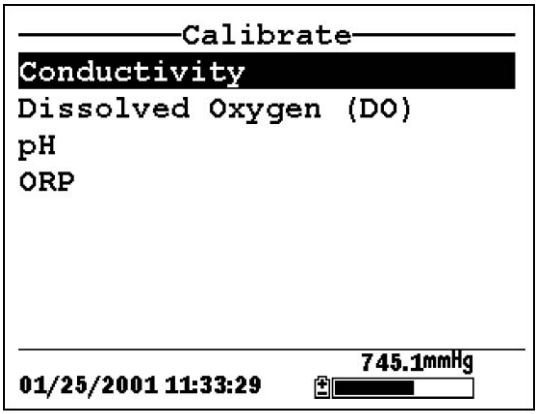


Figure 6.2 Calibrate Screen

6.2.2 Conductivity Calibration

This procedure calibrates specific conductance (recommended), conductivity and salinity. Calibrating any one option automatically calibrates the other two.

1. Go to the calibrate screen as described in Section *6.2.1Accessing the Calibrate Screen.*.

2. Use the arrow keys to highlight the **Conductivity** selection. See Figure 6.2 Calibrate Screen.

3. Press **Enter**. The Conductivity Calibration Screen is displayed.

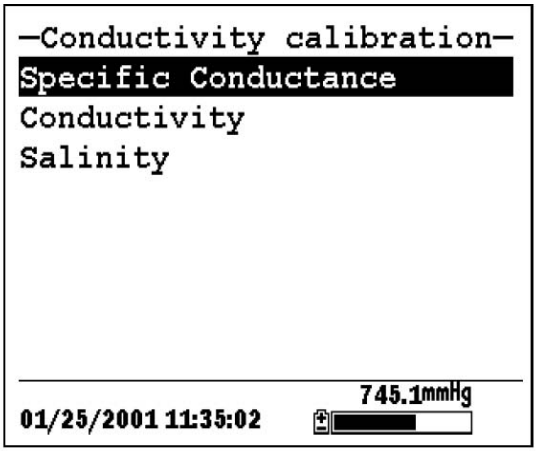


Figure 6.3 Conductivity Calibration Selection Screen

4. Use the arrow keys to highlight the Specific Conductance selection.

5. Press **Enter**. The Conductivity Calibration Entry Screen is displayed.

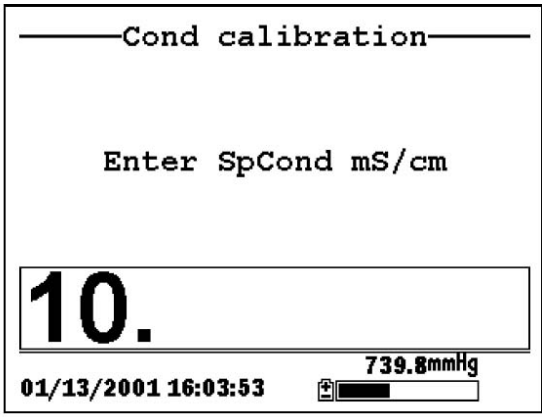


Figure 6.4 Conductivity Calibration Selection Screen

6. Place the correct amount of conductivity standard (see Table 6.1 Calibration Volumes) into a clean, dry or pre-rinsed transport/calibration cup.

⚠ **WARNING**: Calibration reagents may be hazardous to your health. See *Appendix D Health and Safety* for more information.

NOTE: For maximum accuracy, the conductivity standard you choose should be within the same conductivity range as the samples you are preparing to measure. However, we do not recommend using standards less than 1 mS/cm. For example:

- ✓ For fresh water use a 1 mS/cm conductivity standard.
- ✓ For brackish water use a 10 mS/cm conductivity standard.
- ✓ For seawater use a 50 mS/cm conductivity standard.

NOTE: Before proceeding, ensure that the sensor is as dry as possible. Ideally, rinse the conductivity sensor with a small amount of standard that can be discarded. Be certain that you avoid cross-contamination of solutions. Make certain that there are no salt deposits around the oxygen and pH/ORP sensors, particularly if you are employing standards of low conductivity.

7. Carefully immerse the sensor end of the probe module into the solution.

8. Gently rotate and/or move the probe module up and down to remove any bubbles from the conductivity cell.

NOTE: The sensor must be completely immersed past its vent hole. Using the recommended volumes from Table 6.1 Calibration Volumes, should ensure that the vent hole is covered.

9. Screw the transport/calibration cup on the threaded end of the probe module and securely tighten.

NOTE: Do not over tighten as this could cause damage to the threaded portions.

10. Use the keypad to enter the calibration value of the standard you are using.

NOTE: Be sure to enter the value in **mS/cm at 25°C**.

11. Press **Enter**. The Conductivity Calibration Screen is displayed.

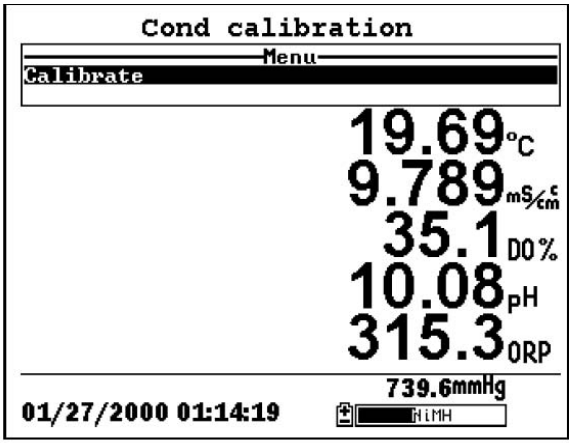


Figure 6.5 Conductivity Calibration Screen

12. Allow at least one minute for temperature equilibration before proceeding. The current values of all enabled sensors will appear on the screen and will change with time as they stabilize.

13. Observe the reading under Specific Conductance. When the reading shows no significant change for approximately 30 seconds, press **Enter**. The screen will indicate that the calibration has been accepted and prompt you to press **Enter** again to Continue.

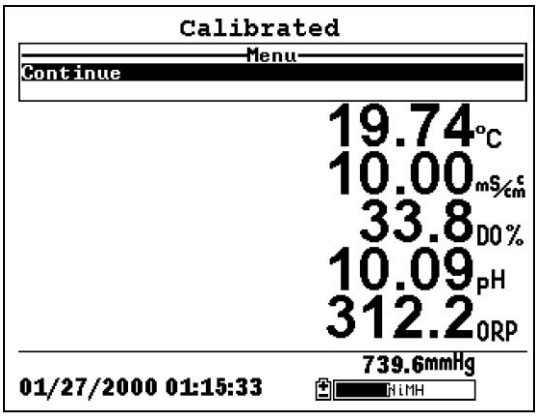


Figure 6.6 Calibrated

14. Press **Enter**. This returns you to the Conductivity Calibrate Selection Screen, See Figure 6.3 Conductivity Calibration Selection Screen..

15. Press **Escape** to return to the calibrate menu. See Figure 6.2 Calibrate Screen .

16. Rinse the probe module and sensors in tap or purified water and dry.

6.2.3 Dissolved Oxygen Calibration

This procedure calibrates dissolved oxygen. Calibrating any one option (% or mg/L) automatically calibrates the other.

1. Go to the calibrate screen as described in Section *6.2.1 Accessing the Calibrate Screen*.

NOTE: The instrument must be on for at least 10 - 15 minutes to polarize the DO sensor before calibrating.

2. Use the arrow keys to highlight the **Dissolved Oxygen** selection. See Figure 6.2 Calibrate Screen.

3. Press **Enter**. The dissolved oxygen calibration screen is displayed.

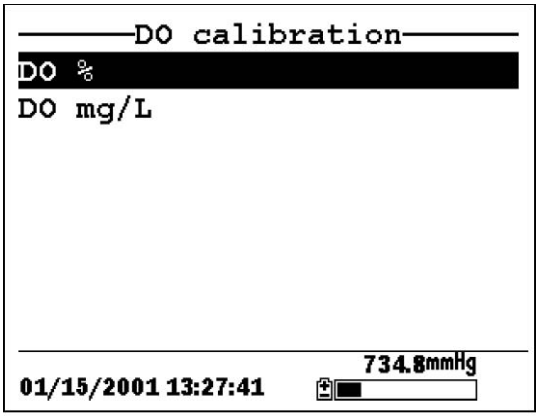


Figure 6.7 DO Calibration Screen

DO Calibration in % Saturation

1. Use the arrow keys to highlight the DO% selection.

2. Press **Enter**. The DO Barometric Pressure Entry Screen is displayed.

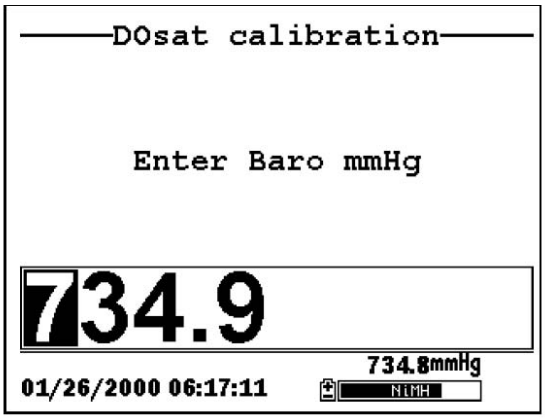


Figure 6.8 DO Barometric Pressure Entry Screen

3. Place approximately 3 mm (1/8 inch) of water in the bottom of the transport/calibration cup.

4. Place the probe module into the transport/calibration cup.

NOTE: Make sure that the DO and temperature sensors are **not** immersed in the water.

5. Engage only 1 or 2 threads of the transport/calibration cup to ensure the DO sensor is vented to the atmosphere.

6. Use the keypad to enter the current local barometric pressure.

NOTE: If the unit has the optional barometer, no entry is required.

NOTE: Barometer readings that appear in meteorological reports are generally corrected to sea level and must be uncorrected before use (refer to Section *10.10 Calibrate Barometer, Step 2*).

7. Press **Enter**. The DO% saturation calibration screen is displayed.

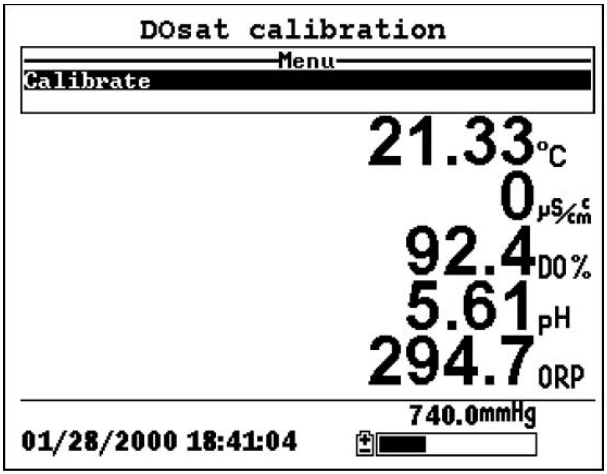


Figure 6.9 DO Sat Calibration Screen

8. Allow approximately ten minutes for the air in the transport/calibration cup to become water saturated and for the temperature to equilibrate before proceeding.

9. Observe the reading under DO %. When the reading shows no significant change for approximately 30 seconds, press **Enter**. The screen will indicate that the calibration has been accepted and prompt you to press **Enter** again to Continue. See Figure 6.6 Calibrated.

10. Press **Enter**. This returns you to the DO calibration screen, See Figure 6.7 DO Calibration Screen.

11. Press **Escape** to return to the calibrate menu. See Figure 6.2 Calibrate Screen.

12. Rinse the probe module and sensors in tap or purified water and dry.

DO Calibration in mg/L

DO calibration in mg/L is carried out in a water sample which has a known concentration of dissolved oxygen (usually determined by a Winkler titration).

1. Go to the DO calibrate screen as described in Section *6.2.3 Dissolved Oxygen Calibration*, steps 1 through 3.

2. Use the arrow keys to highlight the **DO mg/L** selection.

3. Press **Enter**. The DO mg/L Entry Screen is displayed.

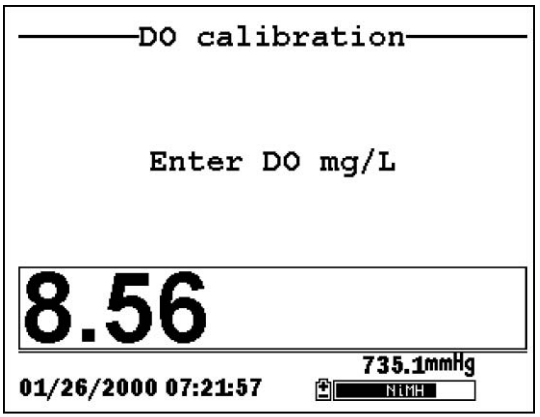


Figure 6.10 DO mg/L Entry Screen

4. Place the probe module in water with a known DO concentration.

NOTE: Be sure to completely immerse all the sensors.

5. Use the keypad to enter the known DO concentration of the water.

6. Press **Enter**. The Dissolved Oxygen mg/L Calibration Screen is displayed.

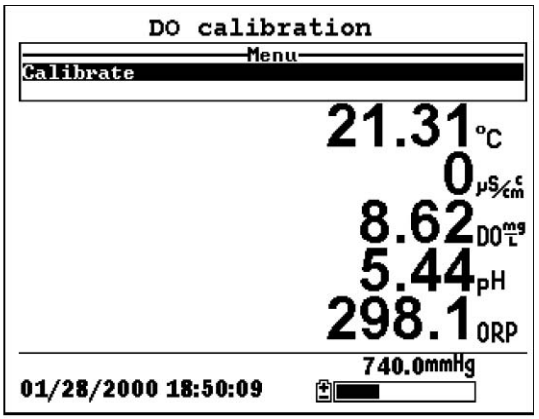


Figure 6.11 DO mg/L Calibration Screen

7. Stir the water with a stir bar, or by rapidly moving the probe module, to provide fresh sample to the DO sensor.

8. Allow at least one minute for temperature equilibration before proceeding. The current values of all enabled sensors will appear on the screen and will change with time as they stabilize.

9. Observe the DO mg/L reading, when the reading is stable (shows no significant change for approximately 30 seconds), press **Enter**. The screen will indicate that the calibration has been accepted and prompt you to press **Enter** again to Continue.

10. Press **Enter**. This returns you to the DO calibration screen. See Figure 6.7 DO Calibration Screen.

11. Press **Escape** to return to the calibrate menu. See Figure 6.2 Calibrate Screen.

12. Rinse the probe module and sensors in tap or purified water and dry.

6.2.4 pH Calibration

1. Go to the calibrate screen as described in *Section 6.2.1 Accessing the Calibrate Screen*.

2. Use the arrow keys to highlight the **pH** selection. See Figure 6.2 Calibrate Screen.

3. Press **Enter**. The pH calibration screen is displayed.

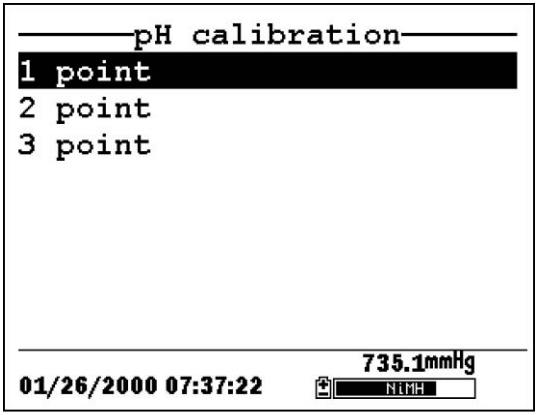


Figure 6.12 pH Calibration Screen

- Select the **1-point** option only if you are adjusting a previous calibration. If a 2-point or 3-point calibration has been performed previously, you can adjust the calibration by carrying out a one point calibration. The procedure for this calibration is the same as for a 2-point calibration, but the software will prompt you to select only one pH buffer.
- Select the **2-point** option to calibrate the pH sensor using only two calibration standards. Use this option if the media being monitored is known to be either basic or acidic. For example, if the pH of a pond is known to vary between 5.5 and 7, a two-point calibration with pH 7 and pH 4 buffers is sufficient. A three point calibration with an additional pH 10 buffer will not increase the accuracy of this measurement since the pH is not within this higher range.
- Select the **3-point** option to calibrate the pH sensor using three calibration solutions. In this procedure, the pH sensor is calibrated with a pH 7 buffer and two additional buffers. The 3-point calibration method assures maximum accuracy when the pH of the media to be monitored cannot be anticipated. The procedure for this calibration is the same as for a 2-point calibration, but the software will prompt you to select a third pH buffer.

4. Use the arrow keys to highlight the **2-point** selection.

5. Press **Enter**. The pH Entry Screen is displayed.

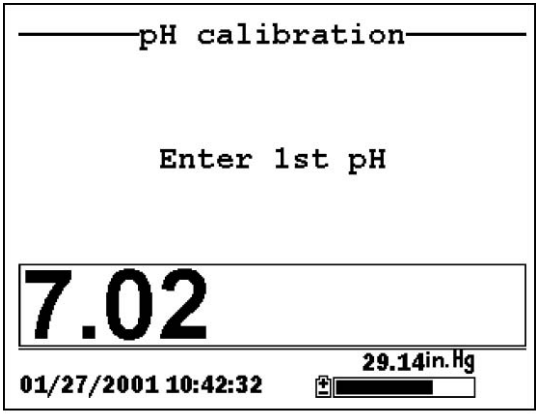


Figure 6.13 pH Entry Screen

6. Place the correct amount (see Table 6.1 Calibration Volumes) of pH buffer into a clean, dry or pre-rinsed transport/calibration cup.

NOTE: Always calibrate with buffer 7 first, regardless if performing a 1, 2, or 3 point calibration.

⚠ **WARNING**: Calibration reagents may be hazardous to your health. See *Appendix D Health and Safety* for more information.

NOTE: For maximum accuracy, the pH buffers you choose should be within the same pH range as the water you are preparing to sample.

NOTE: Before proceeding, ensure that the sensor is as dry as possible. Ideally, rinse the pH sensor with a small amount of buffer that can be discarded. Be certain that you avoid cross-contamination of buffers with other solutions.

7. Carefully immerse the sensor end of the probe module into the solution.

8. Gently rotate and/or move the probe module up and down to remove any bubbles from the pH sensor.

NOTE: The sensor must be completely immersed. Using the recommended volumes from Table 6.1 Calibration Volumes, should ensure that the sensor is covered.

9. Screw the transport/calibration cup on the threaded end of the probe module and securely tighten

NOTE: Do not over tighten as this could cause damage to the threaded portions.

10. Use the keypad to enter the calibration value of the buffer you are using **at the current temperature**.

NOTE: pH vs. temperature values are printed on the labels of all YSI pH buffers.

11. Press **Enter**. The pH calibration screen is displayed.

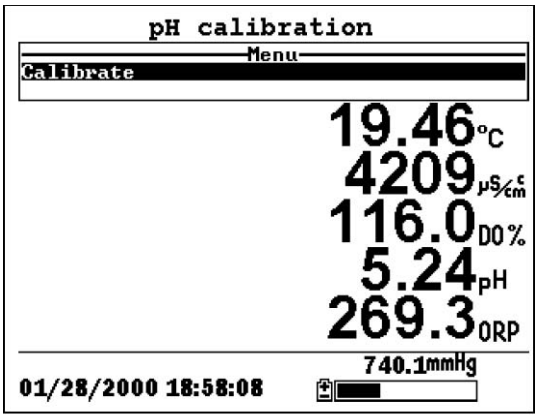


Figure 6.14 pH Calibration Screen

12. Allow at least one minute for temperature equilibration before proceeding. The current values of all enabled sensors will appear on the screen and will change with time as they stabilize.

13. Observe the reading under pH, when the reading shows no significant change for approximately 30 seconds, press **Enter**.

The screen will indicate that the calibration has been accepted and prompt you to press **Enter** again to Continue.

14. Press **Enter**. This returns you to the specified pH Calibration Screen, See Figure 6.13 pH Entry Screen.

15. Rinse the probe module, transport/calibration cup and sensors in tap or purified water and dry.

16. Repeat steps 6 through 13 above using a second pH buffer.

17. Press **Enter**. This returns you to the pH Calibration Screen, See Figure 6.12 pH Calibration Screen.

18. Press **Escape** to return to the calibrate menu. See Figure 6.2 Calibrate Screen.

19. Rinse the probe module and sensors in tap or purified water and dry.

6.2.5 ORP Calibration

1. Go to the calibrate screen as described in Section *6.2.1 Accessing the Calibrate Screen*.

2. Use the arrow keys to highlight the **ORP** selection. See Figure 6.2 Calibrate Screen..

3. Press **Enter**. The ORP calibration screen is displayed.

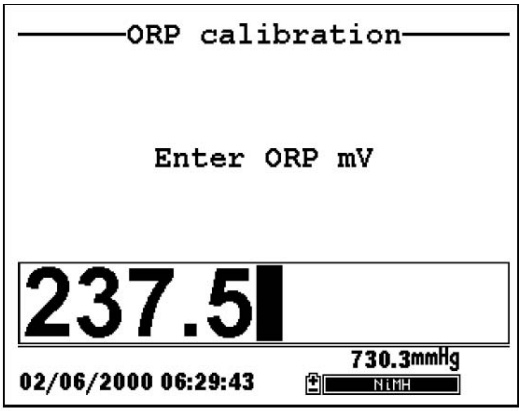


Figure 6.15 Specified ORP Calibration Screen

4. Place the correct amount (see Table 6.1 Calibration Volumes) of a known ORP solution (we recommend Zobell solution) into a clean, dry or pre-rinsed transport/calibration cup.

⚠ **WARNING**: Calibration reagents may be hazardous to your health. See *Appendix D Health and Safety* for more information.

NOTE: Before proceeding, ensure that the sensor is as dry as possible. Ideally, rinse the ORP sensor with a small amount of solution that can be discarded. Be certain that you avoid cross-contamination with other solutions.

5. Carefully immerse the sensor end of the probe module into the solution.

6. Gently rotate and/or move the probe module up and down to remove any bubbles from the ORP sensor.

NOTE: The sensor must be completely immersed. Using the recommended volumes from Table 6.1 Calibration Volumes should ensure that the sensor is covered.

7. Screw the transport/calibration cup on the threaded end of the probe module and securely tighten.

NOTE: Do not over tighten as this could cause damage to the threaded portions.

8. Use the keypad to enter the correct value of the calibration solution you are using at the current temperature. Refer to Table 6.2 Zobell Solution Values.

Temperature °C	Zobell Solution Value, mV
-5	270.0
0	263.5
5	257.0
10	250.5
15	244.0
20	237.5
25	231.0
30	224.5
35	218.0
40	211.5
45	205.0
50	198.5

Table 6.2 Zobell Solution Values

9. Press **Enter**. The ORP calibration screen is displayed.

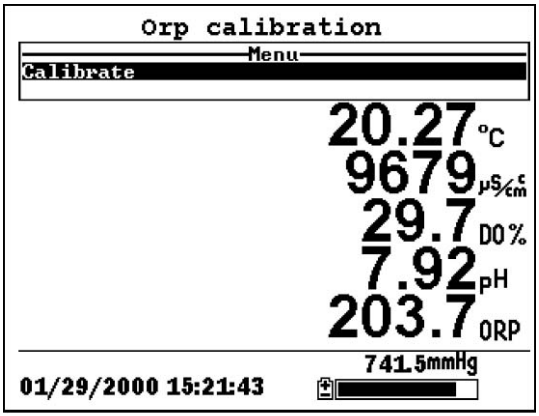


Figure 6.16 DO Cal Screen

10. Allow at least one minute for temperature equilibration before proceeding. The current values of all enabled sensors will appear on the screen and will change with time as they stabilize.

NOTE: Verify that the temperature reading matches the value you used in Table 6.2 Zobell Solution Values.

11. Observe the reading under ORP, when the reading shows no significant change for approximately 30 seconds, press **Enter**. The screen will indicate that the calibration has been accepted and prompt you to press **Enter** again to Continue.

12. Press **Enter**. This returns you to the Calibrate Screen. See Figure 6.2 Calibrate Screen.

13. Rinse the probe module and sensors in tap or purified water and dry.

6.3 Return to Factory Settings.

1. Go to the calibrate screen as described in Section *6.2.1 Accessing the Calibrate Screen*.

2. Use the arrow keys to highlight the **Conductivity** selection. See Figure 6.2 Calibrate Screen.

   NOTE: We will use the Conductivity sensor as an example; however, this process will work for any sensor.

3. Press **Enter.** The Conductivity Calibration Selection Screen is displayed. See Figure 6.3 Conductivity Calibration Selection Screen.

4. Use the arrow keys to highlight the **Specific Conductance** selection.

5. Press **Enter.** The Conductivity Calibration Entry Screen is displayed. See Figure 6.4 Conductivity Calibration Entry Screen.

6. Press and hold the **Enter** key down and press the **Escape** key.

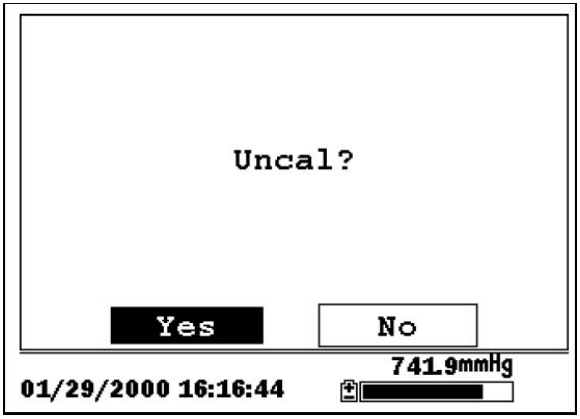


Figure 6.17 ORP Calibration Screen

7. Use the arrow keys to highlight the **YES** selection.

CAUTION: This returns a sensor to the factory settings. For example, in selecting to return specific conductance to the factory setting, salinity and conductivity will automatically return to their factory settings.

8. Press **Enter**. This returns you to the Conductivity Calibrate Selection Screen, See Figure 6.3 Conductivity Calibration Selection Screen. .

9. Press **Escape** to return to the calibrate menu. See Figure 6.2 Calibrate Screen.

7. Run

The Run screen displays data from the sensors in real-time and allows the user to log sample data to memory for later analysis. Refer to Section *9 Logging* for details on logging sample data.

7.1 Real-Time Data

NOTE: Before measuring samples you must prepare the probe module (refer to Section *3.4 Preparing the Probe Module*), attach the probe module to the instrument (refer to Section *3.6 Instrument/Cable Connection*) and calibrate the sensors (refer to Section *6 Calibrate*).

1. Press the On/off key.

OR select Run from the main menu to display the run screen.

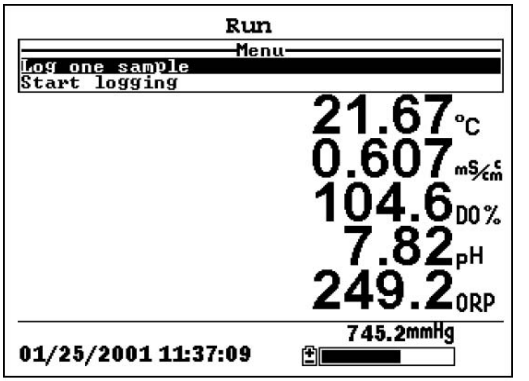


Figure 7.1 Run Screen

2. Make sure the probe sensor guard is installed.

3. Place the probe module in the sample. Be sure to completely immerse all the sensors.

4. Rapidly move the probe module through the sample to provide fresh sample to the DO sensor.

5. Watch the readings on the display until they are stable.

6. Refer to Section *9 Logging* for instructions on logging sample data.

8. File

The File menu allows the user to view, upload or delete sample data and calibration record files stored in the YSI 556 MPS.

8.1 Accessing the File Screen

1. Press the **On/off** key to display the run screen.

2. Press the **Escape** key to display the main menu screen.

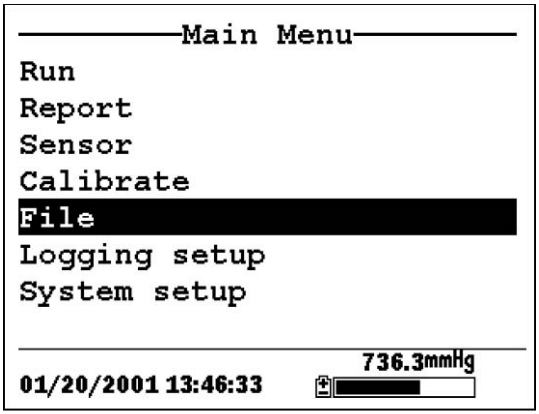


Figure 8.1 Main Menu Screen

3. Use the arrow keys to highlight the **File** selection.

4. Press the **Enter** key. The file screen is displayed.

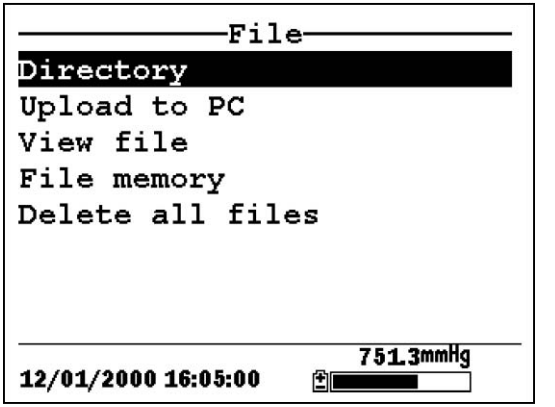


Figure 8.2 File Screen

8.2 Directory

1. Go to the file screen as described in Section *8.1 Accessing the File Screen*.

2. Use the arrow keys to highlight the **Directory** selection. See Figure 8.2 File Screen.

3. Press the **Enter** key. The file list screen is displayed.

NOTE: Files are listed in the order in which they are logged to memory. Sample Data files have the file extension **.dat**, while Calibration Record files have the file extension **.glp**.

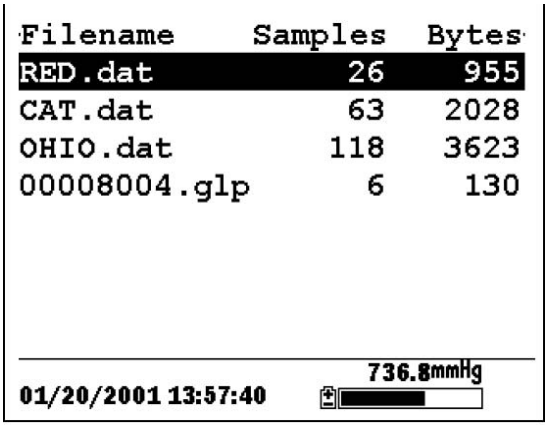


Figure 8.3 File List Screen

4. Use the arrow keys to highlight a file.

5. Press the **Enter** key. The file details screen is displayed.

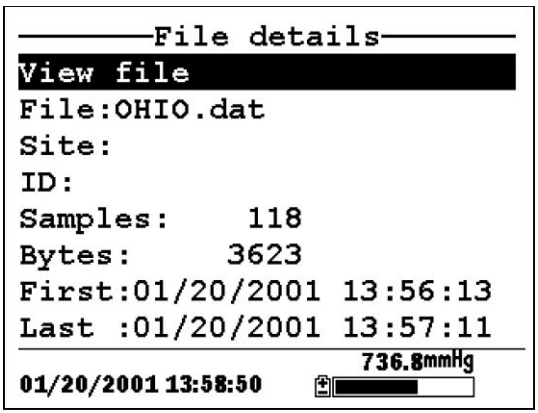


Figure 8.4 File Details Screen

6. Press the **Enter** key to view the file data. Refer to Section *8.3 View File* for details.

7. Press the **Escape** key repeatedly to return to the main menu screen.

8.3 View File

1. Go to the file screen as described in Section *8.1 Accessing the File Screen*. See Figure 8.2 File Screen.

2. Use the arrow keys to highlight the **View file** selection.

3. Press the **Enter** key. A list of files is displayed. See Figure 8.3 File List Screen.

4. Use the arrow keys to highlight an individual file.

   NOTE: You may have to scroll down to see all the files.

5. Press the **Enter** key. The file data is displayed with the file name at t8e top of the display.

   NOTE: If no file name was specified, the data is stored under the default name NONAME1.dat.

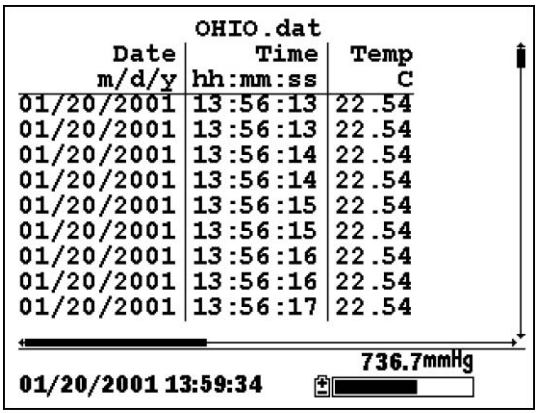


Figure 8.5 File Data Screen

6. Use the arrow keys to scroll horizontally and/or vertically to view all the data.

7. Press the **Escape** key repeatedly to return to the main menu screen.

8.4 Upload to PC

EcoWatch™ for Windows™ must be used as the PC software interface to the YSI 556 MPS. Refer to *Appendix G EcoWatch* for more information. EcoWatch for Windows® is available at no cost via a download from the YSI Web Site (www.ysi.com) or by contacting YSI Customer Support. Refer to *Appendix E Customer Service.*

8.4.1 Upload Setup

1. Disconnect the YSI 5563 Probe Module from the YSI 556 MPS instrument.

2. Connect the YSI 556 MPS to a serial (Comm) port of your computer via the 655173 PC Interface cable as shown in the following diagram:

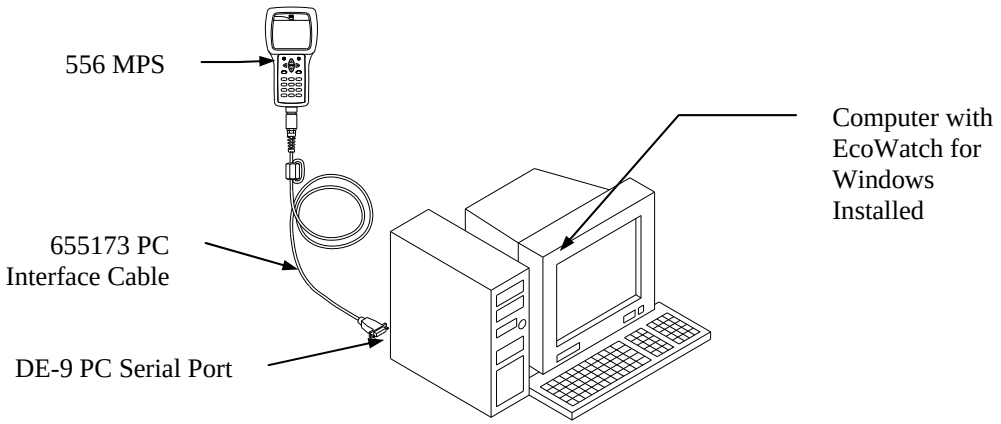


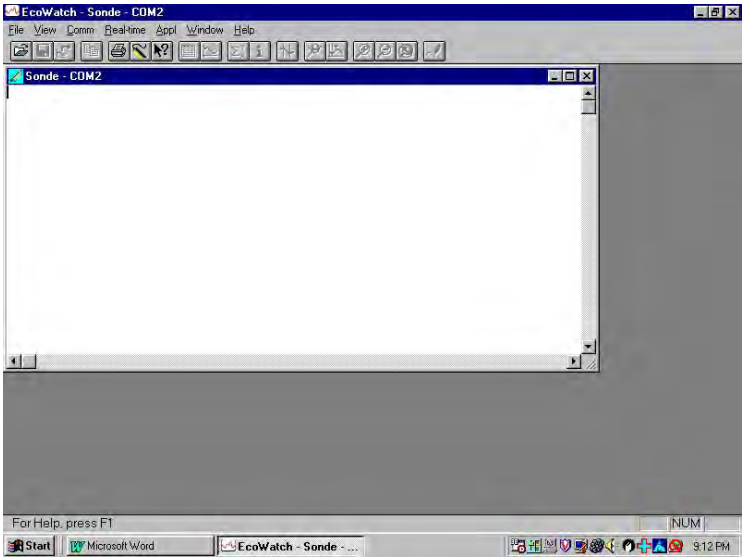
Figure 8.2 Computer/Instrument Interface

3. Open EcoWatch for Windows on your computer.

   NOTE: See *Appendix G EcoWatch* for installation instructions.

4. Click on the sonde/probe icon in the upper toolbar.

5. Set the Comm port number to match the port the YSI 556 MPS is connected to. After this setup procedure, the following screen will be present on your PC monitor:



8.4.2 Uploading a .DAT File

1. Setup the instrument as described in Section *8.4.1 Upload Setup*.

2. Go to the YSI 556 MPS file screen as described in Section *8.1 Accessing the File Screen.*

3. Use the arrow keys to highlight the **Upload to PC** selection. See Figure 8.2 File Screen.

4. Press the **Enter** key. The file list screen is displayed. See Figure 8.3 File List Screen.

5. Use the arrow keys to highlight the DAT file that you wish to transfer and press **Enter**, both the YSI 556 MPS and PC displays show the progress of the file transfer.

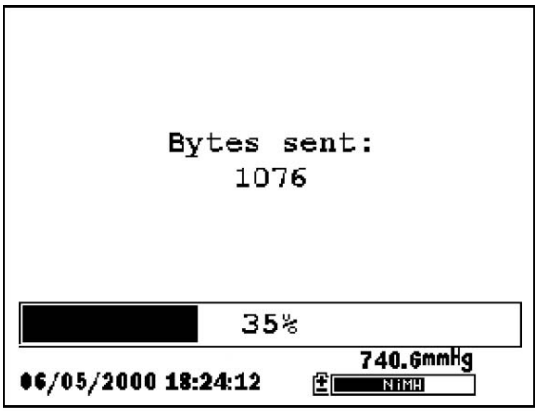
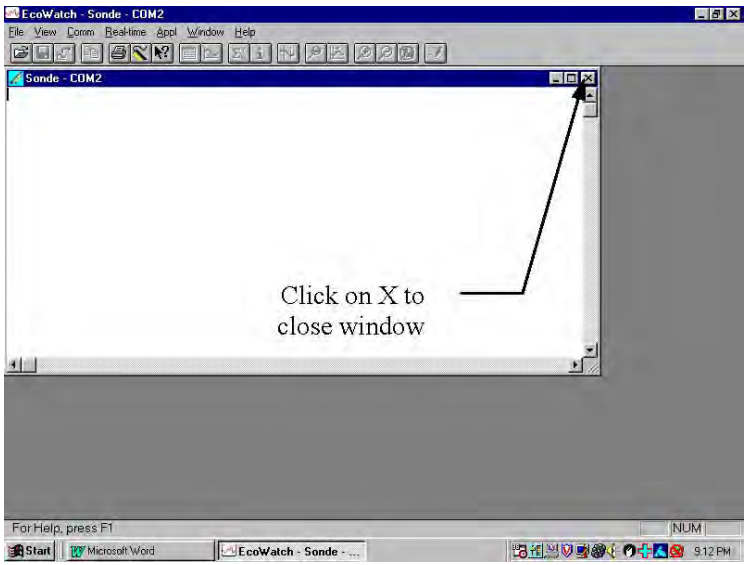


Figure 8.3 File Transfer Progress Screen

NOTE: After transfer, the file will be located in the C:\ECOWWIN\DATA folder of your PC, designated with a .DAT extension.

6. After the file transfer is complete, close the terminal window (small window on the PC) by clicking on the "X" at its upper right corner.



7. Press the **Escape** key on the YSI 556 MPS repeatedly to return

to the main menu screen.

8.4.3 Uploading a Calibration Record (.glp) File

For more information on the calibration record, refer to *Appendix H Calibration Record Information*.

1. Setup up the instrument as described in Section *8.4.1 Upload Setup*.

2. Go to the YSI 556 MPS file screen as described in Section

3. Use the arrow keys to highlight the Upload to PC selection. See Figure 8.2 File Screen.

4. Press the **Enter** key. The file list screen is displayed. See Figure 8.3 File List Screen.

5. Use the arrow keys to highlight the calibration record file that you wish to transfer and press **Enter.**

6. You will then be given a choice of uploading the file in three formats; **Binary, Comma & “” Delimited, and ASCII Text**.

   NOTE: The binary format is reserved for future YSI software packages.

7. Choose an option and press Enter, both the YSI 556 and PC displays show the progress of the file transfer.

   NOTE: After transfer, the file will be located in the C:\ECOWWIN\DATA folder of your PC, designated with the appropriate file extension.

   NOTE: To view the Calibration Record data after upload, simply open the .txt file in a general text editor such as Wordpad or Notepad.

8. After the file transfer is complete, close the terminal window (small window on the PC) by clicking on the “X” at its upper right corner.

9. Press the **Escape** key repeatedly to return to the main menu screen.

8.5 File Memory

1. Go to the file screen as described in Section *8.1 Accessing the File Screen*.

2. Use the arrow keys to highlight the **File memory** selection. See Figure 8.2 File Screen.

3. Press the **Enter** key. The file bytes used screen is displayed.

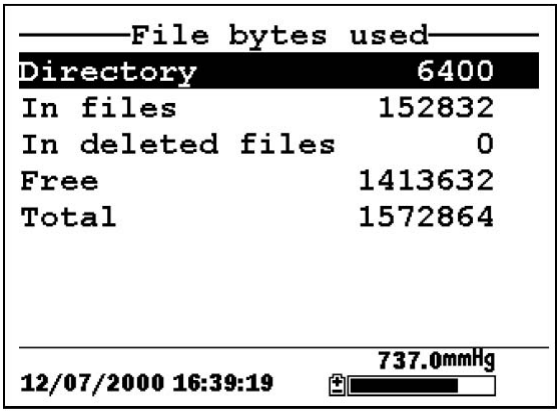


Figure 8.4 File Bytes Used Screen

4. The amount of free memory is listed in line 4 of the file bytes used screen.

   NOTE: If the amount of free memory is low, it may be time to delete all files (after first uploading all data to a PC). Refer to Section *8.6 Delete All Files*.

5. Press the **Escape** key repeatedly to return to the main menu screen.

8.6 Delete All Files

NOTE: It is not possible to delete individual files in order to free up memory. The only way to free up memory is to delete ALL files present. Take care to transfer all files to your computer (refer to Section 8.4 Upload to PC) before deleting them.

1. Go to the file screen as described in Section *8.1 Accessing the File Screen*.

2. Use the arrow keys to highlight the **Delete all files** selection. See Figure 8.2 File Screen.

3. Press the **Enter** key. The Delete all Files screen is displayed.

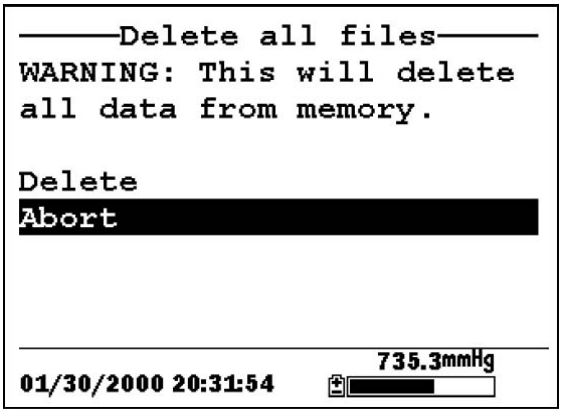


Figure 8.5 Delete All Files Screen

4. Use the arrow keys to highlight the **Delete** selection.

5. Press the **Enter** key.

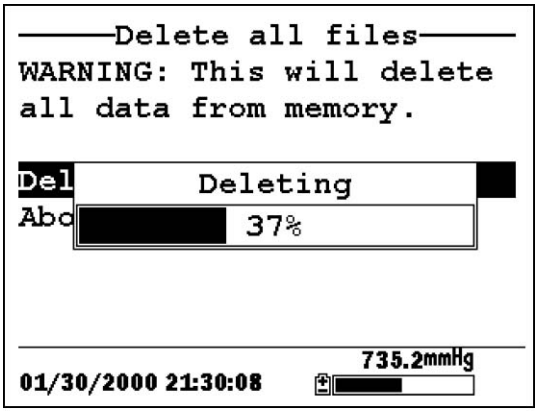


Figure 8.10 Deleting

The progress of file deletion is displayed in bar graph format.

NOTE: Deleting all files in the directory will not change any information in the site list.

6. Press the Escape key repeatedly to return to the main menu screen.

9. Logging

9.1 Accessing the Logging Setup Screen

1. Press the **On/off** key to display the run screen.

2. Press the **Escape** key to display the main menu screen.

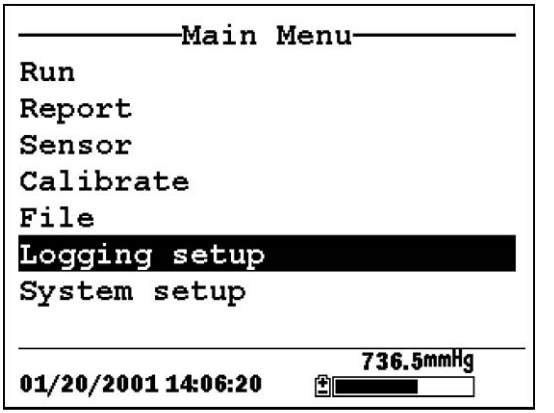


Figure 9.1 Main Menu

3. Use the arrow keys to highlight the **Logging setup** selection.

4. Press the **Enter** key. The logging setup screen is displayed.

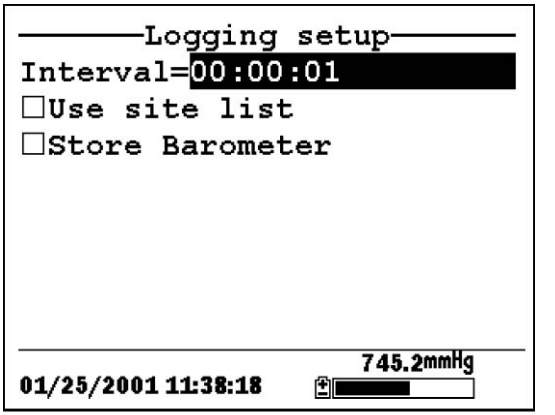


Figure 9.2 Setup Screen

9.2 Setting Logging Interval

Follow steps below to set the interval for logging a data stream.

NOTE: If you do not specify an interval, the instrument will use a default interval setting of 1 second.

NOTE: It is not necessary to set a logging interval when logging a single sample.

1. Go to the logging setup screen as described in Section *9.1 Accessing the Logging Setup Screen*.

2. Use the keypad to enter an interval between 1 second and 15 minutes. Refer to Section *2.9 Keypad Use*.

   NOTE: The interval field has hour, minute and second entry fields. Any entry over 1 hour will change automatically to a 15-minute setting.

3. Press the **Enter** key. The data stream interval is set.

4. Press the **Escape** key repeatedly to return to the main menu screen.

9.3 Storing Barometer Readings

NOTE: The **Store barometer** option is only available on instruments that are equipped with the optional barometer.

1. Go to the logging setup screen as described in Section *9.1 Accessing the Logging Setup Screen*.

2. Use the arrow keys to highlight the **Store barometer** selection. See Figure 9.2 Logging Setup Screen.

3. Press the **Enter** key until a check mark is entered in the box next to the store barometer selection if you want to log barometric readings.

OR press the **Enter** key until the box next to the barometer selection is empty if you do not want to log barometric readings.

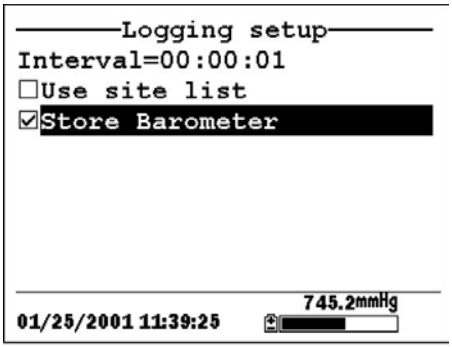


Figure 9.3 Store Barometer

4. Press the **Escape** key repeatedly to return to the main menu screen.

9.4 Creating a Site List

The site list option allows you to define file and site descriptions in the office or laboratory before moving to field logging studies. This is usually more convenient than entering the information at the site and is particularly valuable if you are visiting certain sites on a regular basis. The following section describes how to set up site lists which contain entries designated “Site Descriptions” that will be instantly available to the user in the field to facilitate the logging of data with pre-established naming of files and sites. There are two kinds of **Site Descriptions** available for use in Site lists:

• **Site Descriptions** associated with applications where data from a single site is always logged to a single file. This type is referred to as a “Single-Site Description” and is characterized by two parameters – a file name and a site name. Files logged to YSI 556 MPS memory under a **Single-Site Description** will be characterized primarily by the file name, but will also have the Site name attached, so that it is viewable in either the YSI 556 MPS **File directory** or in EcoWatch for Windows after upload to a PC

• **Site Descriptions** associated with applications where data from multiple sites are logged to a single file. This type is referred to as a “Multi-site Description” and is characterized by three parameters – a file name, a site name, and a site number. Files logged to YSI 556 MPS memory under a

Multi-site Description are characterized by a file name, but not a site name, since multiple sites are involved. However, each data point has a Site Number attached to it so that the user can easily determine the sampling site when viewing the data from the YSI 556 MPS **File** menu or processing the data in EcoWatch for Windows after upload to a PC.

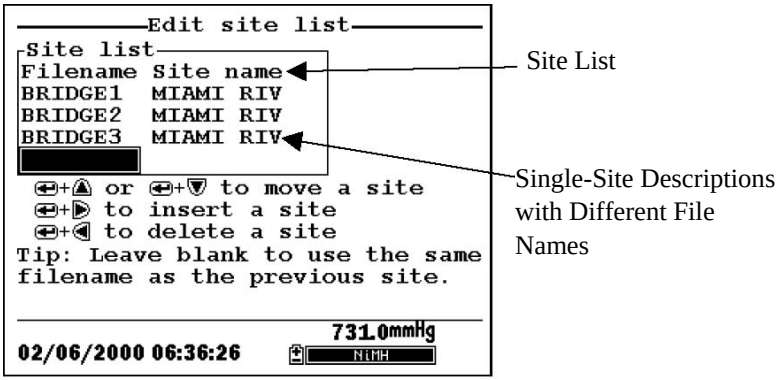


Figure 9.4 Single-Site Descriptions

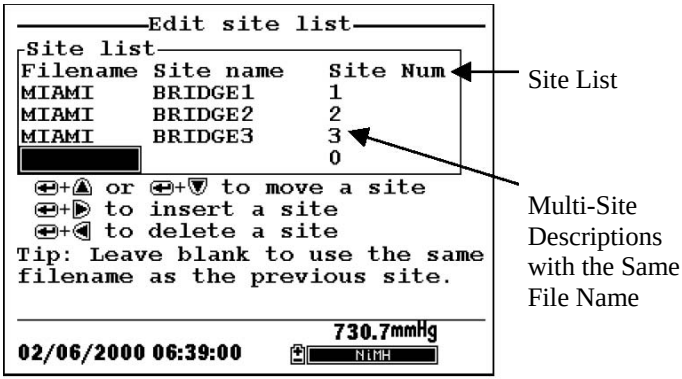


Figure 9.5 Multiple-Site Descriptions

NOTE: Site lists containing Single Site Descriptions are usually input with the designation **Store Site Number** INACTIVE in the YSI 556 MPS **Logging setup** menu. Thus, no site numbers appear in the first **Site list** example. Conversely, **Site lists** containing **Multi-Site Descriptions** MUST be input with the **Store Site Number** selection ACTIVE as shown in the second example.

To create a site list:

1. Go to the logging setup screen as described in Section *9.1 Accessing the Logging Setup Screen*.

2. Use the arrow keys to highlight the **Use site list** selection.

3. Press the **Enter** key. A check mark is entered in the box next to the use site list selection *and* two new entries appear on the logging setup screen. See Figure 9.6 Logging Setup Screen.

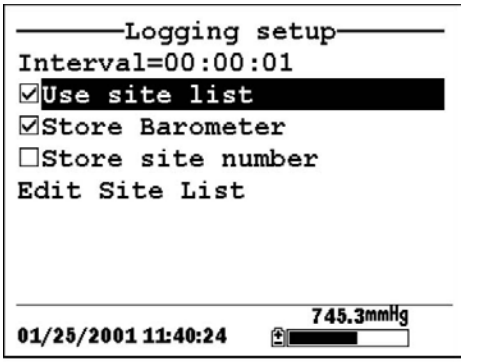


Figure 9.6 Logging Setup Screen

4. Use the arrow keys to highlight the **Store site number** selection.

5. If you are creating Multi-Site Descriptions (which require that the site **number** be stored in your data files), press the **Enter** key until a check mark appears in the box next to the store site number selection.

OR Press the **Enter** key until the box next to the store site number selection is empty, to create Single-Site Descriptions. The site **name** will be stored in the header of your data files.

6. Use the arrow keys to highlight the **Edit site list** selection.

7. Press the **Enter** key. The edit site list screen is displayed. See Figure 9.7 Edit Site List Screen. The **Filename** field is ready for input.

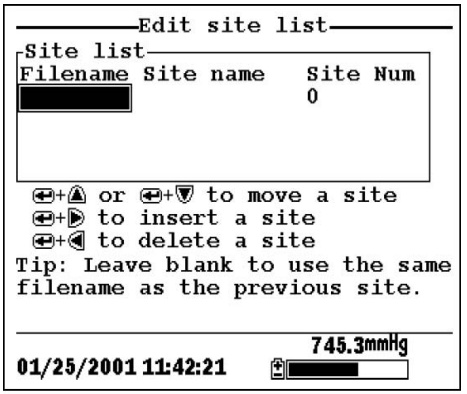


Figure 9.7 Edit Site List Screen

8. Use the keypad to enter a filename up to 8 characters in length. Refer to Section *2.9 Keypad Use*.

9. Press the **Enter** key. The cursor moves to the right for the entry of a **Site name**.

10. Use the keypad to enter a site name up to 11 characters in length. Refer to Section *2.9 Keypad Use*.

NOTE: If the store site number selection is *not* checked, skip to Step 13.

11. Press the **Enter** key. The cursor moves to the site number entry position.

12. Use the keypad to enter a site number up to 7 characters in length. Refer to Section *2.9 Keypad Use*.

13. Press **Enter**. The cursor moves to the next filename entry position.

14. Repeat Steps 8 to 13 until all filenames and sites have been entered.

15. Press **Escape** repeatedly to return to the main menu screen.

9.5 Editing a Site List

1. Go to the logging setup screen as described in Section *9.1 Accessing the Logging Setup Screen*.

2. Use the arrow keys to highlight the **Edit Site List** selection. See Figure 9.6 Logging Setup Screen.

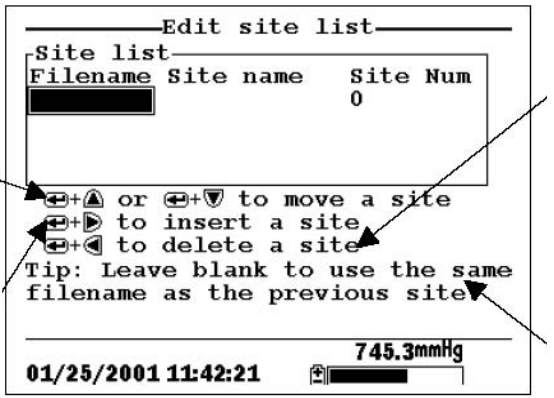
3. Press the **Enter** key. The edit site list screen is displayed.

4. Edit the site list using the keystrokes described below.

NOTE: Editing the site list will not have any effect on files stored in the instrument memory.

To MOVE a site:
Use the arrow keys to highlight a site. Press the Up or Down arrow key while holding down the Enter key.

To INSERT a site above another site:
Use the arrow keys to highlight the site. Press the Right arrow key while holding down the Enter key. Use keypad to input letters. Refer to Section 2.9 *Keypad Use.*



To DELETE a site:
Use the arrow keys to highlight a site. Press the Left arrow key while holding down the Enter key.

To use the same file name as the previous site: **Leave the filename blank**

Figure 9.1 Keystrokes for Editing Site List

9.6 Logging Data Without a Site List

1. Follow Steps 1 through 5 in Section 7.1 Real-Time Data.

2. Use the arrow keys to highlight the **Log one sample** selection on the run screen if only a single sample is being logged.

OR Use the arrow keys to highlight the **Start logging** selection on the run screen if a data stream is being logged.

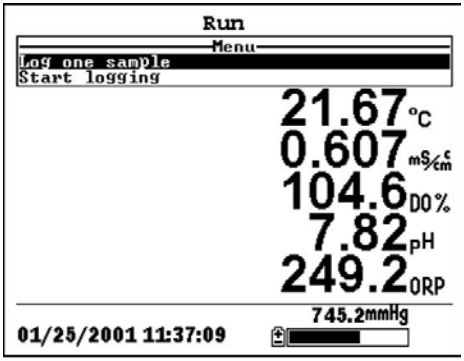


Figure 9.9 Run Screen

3. Press the **Enter** key. The Enter information screen is displayed.

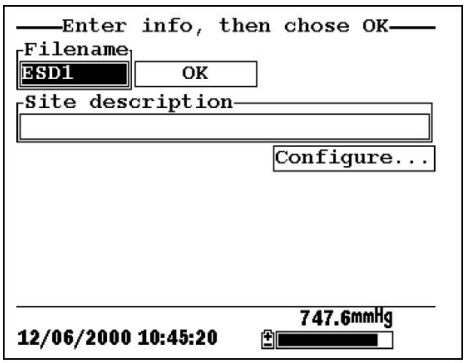


Figure 9.10 Enter Information Screen

NOTE: The last filename used will be displayed.

4. Use the keypad to enter a file name. Refer to Section *2.9 Keypad Use*.

NOTE: The instrument will assign a default file name of NONAME if no file name is specified.

5. Press the **Enter** key to input the file name.

6. Use the arrow keys to highlight the **Site description** field in the enter information screen.

   NOTE: Entering a Site Description is optional. You may leave the Site Description blank and skip to Step 9.

7. Use the keypad to enter a site description name. Refer to Section *2.9 Keypad Use*.

8. Press the **Enter** key to input the site description.

   NOTE: If you want to change the logging setup, such as sampling interval or storing the barometer reading, use the arrow keys to highlight the **Configure** field, press the **Enter** key, then refer to Section *9.2 Setting Logging Interval* or *9.3 Storing Barometer Readings* for details.

9. Use the arrow keys to highlight the **OK** field in the center of the information screen.

10. Press the **Enter** key to start logging.

    NOTE: If the parameter mismatch screen is displayed, refer to Section *9.8 Adding Data to Existing Files*.

11. If a single point is being logged, the header on the run screen changes momentarily from **Menu** to **Sample logged** to confirm that the point was successfully logged. Skip to Step

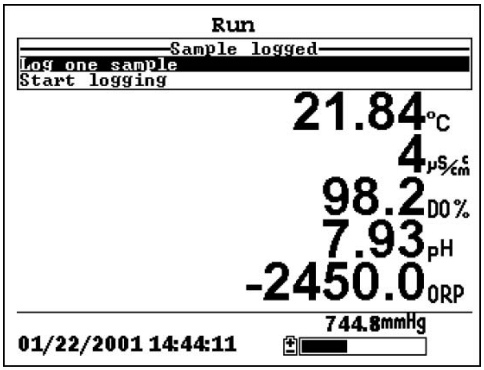


Figure 9.11 Sample Logged Screen

If a continuous stream of points is being logged, the start logging entry in the run screen changes from **Start logging** to **Stop logging**.

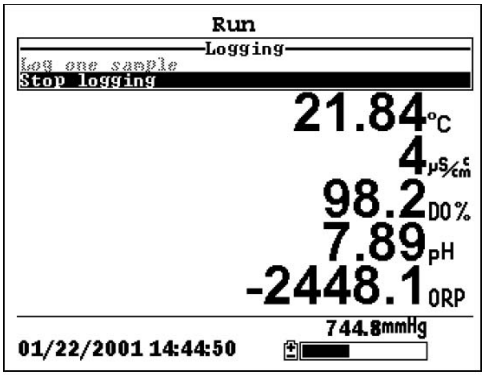


Figure 9.12 Logging Screen

12. At the end of the logging interval, press **Enter** to stop logging.

13. Refer to Section *8.3 View File* to view the data on the instrument display.

9.7 Logging Data with a Site List

1. If you have not already created a site list, refer to Section *9.4 Creating a Site List*.

2. Follow Steps 1 through 5 in Section 7.1 Real-Time Data.

3. Use the arrow keys to highlight the **Log one sample** selection on the run screen if only a single sample is being logged.

OR Use the arrow keys to highlight the **Start logging** selection on the run screen if a data stream is being logged. See Figure 9.9 Run Screen.

4. Press the **Enter** key. The Pick a site screen is displayed.

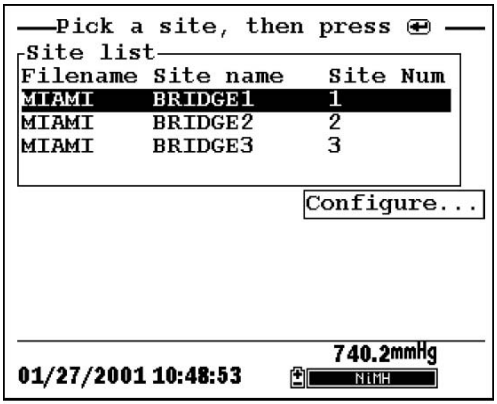


Figure 9.13 Pick a Site Screen

5. Use the arrow keys to highlight the **site** of your choice.

   NOTE: If the site of your choice is grayed out in the site list, refer to Section *9.8 Adding Data to Existing Files*.

   NOTE: Refer to Section *9.5 Editing a Site List* if you want to edit the site list.

6. Press the **Enter** key to start logging.

   NOTE: If the parameter mismatch screen is displayed, refer to Section 9.8 Adding Data to Existing Files.

7. If a single point is being logged, the header on the run screen changes momentarily from **Menu** to **Sample logged** to confirm that the point was successfully logged. See Figure 9.11 Sample Logged Screen. Skip to Step 9.

   If a continuous stream of points is being logged, the start logging entry in the run screen changes from **Start logging** to **Stop logging**. See Figure 9.12 Logging Screen.

8. At the end of the logging interval, press **Enter** to stop logging.

9. Refer to Section *8.3 View File* to view the data on the instrument display.

9.8 Adding Data to Existing Files

In order to add new data to an existing file, the current logging and sensor setup must be *exactly* the same as when the file was created. The following settings must be the same:

- **Sensors enabled** (refer to Section *4 Sensors*)
- **Store Barometer** (refer to Section *9.3 Storing Barometer Readings*)
- **Store Site Number** (refer to Section *9.4 Creating a Site List*)

If the current logging setup is not exactly the same as when the file was created, a parameter mismatch screen is displayed.

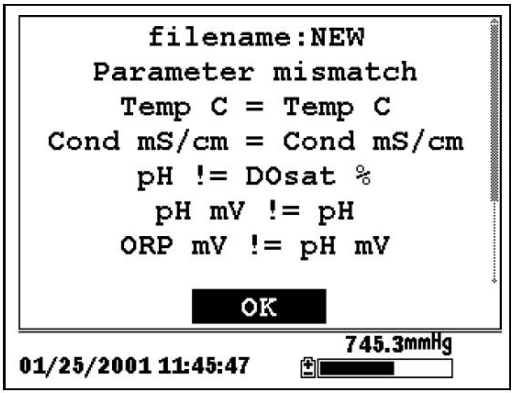


Figure 9.14 Parameter Mismatch Screen

NOTE: The right column shows parameters used when the file was created. The left column shows current parameters.

1. Press the **Down Arrow** key to scroll down and find the mismatch(es).

2. Use the following chart to resolve the mismatch(es).

Mismatch	Action	Reference
Sensor(s) missing from left column	Enable the missing sensor(s)	Section *4 Sensors*
Extra sensor(s) listed in left column	Disable the extra sensor(s)	Section *4 Sensors*
Barometer missing from left column, but present in right column	Enable the Store Barometer setting	Section *9.3 Storing Barometer Readings*
Barometer present in left column, but missing from right column	Disable the Store Barometer setting	Section *9.3 Storing Barometer Readings*
Store Site Number missing from left column, but present in right column	Enable the Store Site Number setting	Section *9.4 Creating a Site List*
Store Site Number present in left column, but missing from right column	Disable the Store Site Number setting	Section *9.4 Creating a Site List*

3. Return to Section *9.6 Logging Data without a Site List* or *9.7 Logging Data with a Site List*.

10. System Setup

The YSI 556 MPS has a number of features that are user-selectable or can be configured to meet the user's preferences. Most of these choices are found in the **System setup** menu.

10.1 Accessing the System Setup Screen

1. Press the **On/off** key to display the run screen. See Figure Front View of YSI 556 MPS.

2. Press the **Escape** key to display the main menu screen.

3. Use the arrow keys to highlight the **System setup** selection.

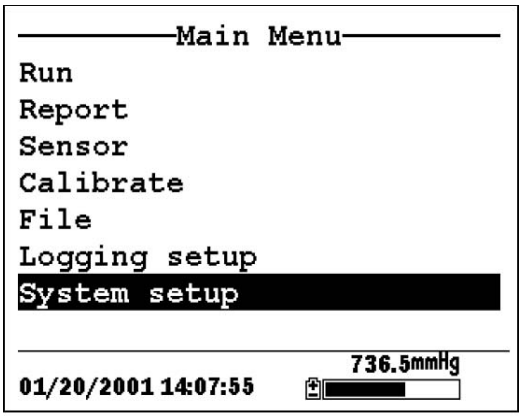


Figure 10.1 Main Menu

4. Press the **Enter** key. The system setup screen is displayed.

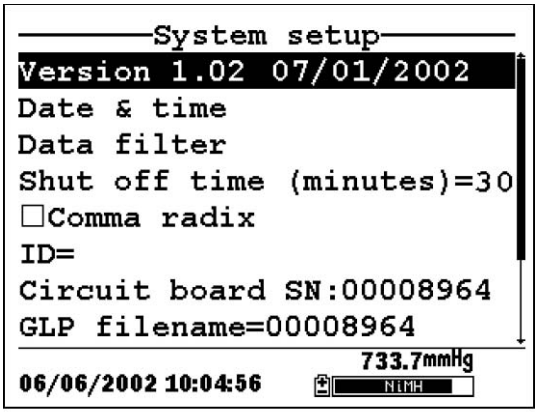


Figure 10.2 System Setup Screen

NOTE: The first line of the **System setup** menu shows the current software version of your YSI 556 MPS. As software enhancements are introduced, you will be able to upgrade your YSI 556 MPS from the YSI Web site. Refer to Section *11.2 Upgrading YSI 556 MPS* Software for details.

10.2 Language Setting

1. Go to the System Setup screen as described in Section *10.1 Accessing the System Setup Screen*.

2. Use the arrow keys to highlight **Language** on the System Setup screen. Press **Enter** to open the Language screen. .

3. Use the arrow keys to highlight your desired **Language**. Press **Enter**.

4. Press the Escape key repeatedly to return to the Main men

10.3 Date and Time Setup

1. Go to the system setup screen as described in Section *10.1 Accessing the System Setup Screen*.

2. Use the arrow keys to highlight the **Date & time** selection on the system setup screen. See Figure 10.2 System Setup Screen.

3. Press **Enter**. The date and time setup screen is displayed.

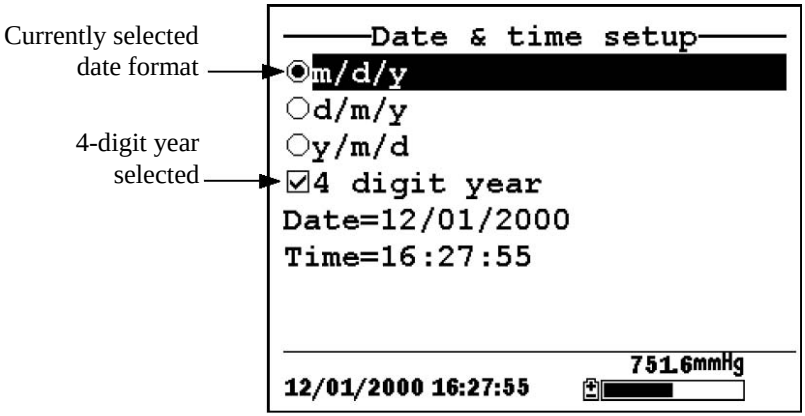


Figure 10.3 Date Setup Screen

NOTE: A black dot to the left of a date format indicates that format is selected.

4. Use the arrow keys to highlight your desired date format.

5. Press **Enter**.

6. Use the arrow keys to highlight the 4-digit year selection.

7. Press **Enter**. A check mark appears in the check box next to the 4-digit year selection.

   NOTE: If unchecked, a 2-digit year is used.

8. Use the arrow keys to highlight the **Date** selection.

9. Press **Enter**. A cursor appears over the first number in the date.

10. Enter the proper number from the keypad for the highlighted date digit. The cursor moves automatically to the next date digit. Refer to Section *2.9 Keypad Use* for more keypad information.

11. Repeat Step 10 until all date digits are correct.

12. Press **Enter** to input the specified date.

13. Use the arrow keys to highlight the **Time** selection.

14. Press **Enter**. A cursor appears over the first number in the time selection.

15. Enter the proper number from the keypad for the highlighted time digit. The cursor moves automatically to the next time digit.

    NOTE: Use military format when entering time. For example, 2:00 PM is entered as 14:00.

16. Repeat Step 15 until all time digits are correct.

17. Press **Enter** to input the correct time.

18. Press the **Escape** key repeatedly to return to the Main menu screen.

10.4 Data Filter

The Data Filter is a software filter that eliminates sensor noise and provides more stable readings.

NOTE: YSI recommends using the default values for the data filter for most field applications.

However, users who are primarily interested in a fast response from their dissolved oxygen sensor should consider a change of the default time constant setting of 8 seconds to one of 2 seconds. This change can be made according to the instructions in Section *10.3.1 Changing the Data Filter Settings* below. The disadvantage of lowering the time constant is that field pH readings may appear somewhat noisy if the cable is in motion.

10.4.1 Changing the Data Filter Settings

1. Go to the system setup screen as described in Section *10.1 Accessing the System Setup Screen*.

2. Use the arrow keys to highlight the **Data filter** selection. See Figure 10.1 Main Menu.

3. Press the **Enter** key. The Data filter setup screen is displayed.

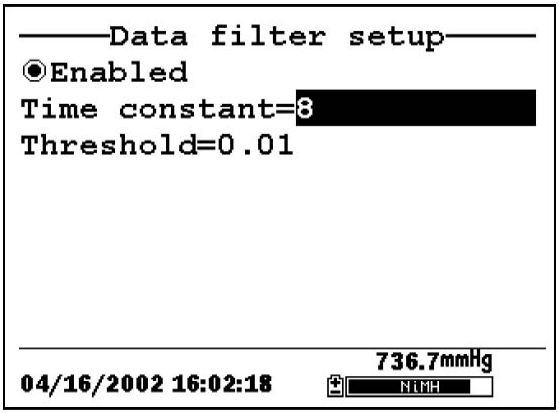


Figure 10.4 Data Filter Screen

4. With Enabled highlighted, press the **Enter** key to Enable or Disable the data filter. A black dot to the left of the selection indicates the data filter is enabled.

5. Use the arrow keys to highlight the **Time constant** field.

   NOTE: This value is the time constant in seconds for the software data filter. Increasing the time constant will result in greater filtering of the data, but will also slow down the apparent response of the sensors.

6. Use the keypad to enter a value. The default value is 8 and this value is ideal for most 556 field applications. As described in Section *10.3 Data Filter* above, users who wish to decrease the response time of the DO readings at the expense of some noise for the pH readings determined

concurrently, should change the Time Constant to a value of 2.

7. Press the **Enter** key to enter the time constant.

8. Use the arrow keys to highlight the **Threshold** field.

   NOTE: This value determines when the software data filter will engage/disengage, speeding the response to large changes in a reading. When the difference between two consecutive readings is larger than the threshold, then the reading is displayed unfiltered. When the difference between two consecutive readings drops below the threshold, readings will be filtered again.

9. Use the keypad to enter a value. The default value is 0.01.

10. Press the **Enter** key to enter the threshold.

11. Press the **Escape** key repeatedly to return to the Main menu screen.

10.5 Shutoff Time

The YSI 556 MPS shuts off automatically after 30 minutes of inactivity. The shut off time may be changed as described below.

1. Go to the system setup screen as described in Section *10.1 Accessing the System Setup Screen*.

2. Use the arrow keys to highlight the **Shutoff time** selection on the system setup screen. See Figure 10.2 System Setup Screen.

3. Use the keypad to enter a value from 0 to 60 minutes. The default value is 30.

   NOTE: To disable the automatic shutoff feature, enter a zero (0).

4. Press the **Enter** key to enter the correct shutoff time.

5. Press the **Escape** key repeatedly to return to the main menu screen.

10.6 Comma Radix

The user can toggle between a period (default) and comma for the radix mark by selecting this item and pressing the **Enter** key as follows:

1. Go to the system setup screen as described in Section *10.1 Accessing the System Setup Screen*.

2. Use the arrow keys to highlight the **Comma radix** selection on the system setup screen. See Figure 10.2 System Setup Screen.

3. Press the **Enter** key. A check mark appears in the check box next to the comma radix selection indicating that the radix mark is a comma.

10.7 ID

This selection allows you to enter an identification name/number for your YSI 556 MPS. This ID name/number is logged in the header of each file.

1. Go to the system setup screen as described in Section *10.1 Accessing the System Setup Screen*.

2. Use the arrow keys to highlight the **ID** selection. See Figure 10.1 Main Menu.

3. Use the keypad to enter an alphanumeric ID up to 15 characters in length. Refer to Section *2.9 Keypad Use*.

4. Press the **Enter** key to enter the ID.

5. Press the **Escape** key repeatedly to return to the main menu screen.

10.8 GLP Filename

This selection allows you to enter a different filename for the YSI 556 MPS Calibration Record file.

NOTE: The default filename is the “556 PC board Serial Number.glp.”

1. Go to the system setup screen as described in Section *10.1 Accessing the System Setup Screen*.
2. Use the arrow keys to highlight the **GLP Filename** selection. See Figure 10.1 Main Menu.
3. Use the keypad to enter a filename up to 8 characters in length. Refer to Section *2.9 Keypad Use*.
4. Press the **Enter** key to enter the new filename.
5. Press the **Escape** key repeatedly to return to the main menu screen.

10.9 TDS Constant

This selection allows you to set the constant used to calculate Total Dissolved Solids (TDS). TDS in g/L is calculated by multiplying this constant times the specific conductance in mS/cm.

10.9.1 Changing the TDS Constant

1. Go to the system setup screen as described in Section *10.1 Accessing the System Setup Screen*.
2. Use the arrow keys to highlight the **TDS Constant** selection. See Figure 10.1 Main Menu.
3. Use the keypad to enter a value. Refer to Section *2.9 Keypad Use*. The default value is 0.65.
4. Press the **Enter** key to enter the correct TDS constant.
5. Press the **Escape** key repeatedly to return to the main menu screen.

10.10 Barometer Units

The following information is only for instruments with the barometer option.

1. Go to the system setup screen as described in Section *10.1 Accessing the System Setup Screen*.

2. Use the arrow keys to highlight the **Barometer units** selection on the system setup screen. See Figure 10.2 System Setup Screen.

3. Press the **Enter** key. The Barometer units screen will appear.

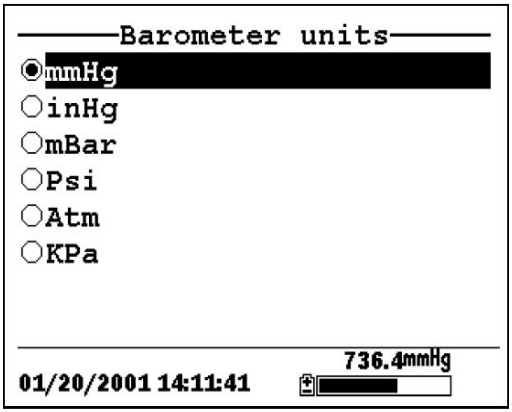


Figure 10.5 Data Filter Screen

A black dot indicates the currently selected units.

4. Use the arrow keys to highlight your desired barometric unit.

5. Press the **Enter** key to select your choice. A black dot will appear in the circle next to your selected units.

6. Press the **Escape** key repeatedly to return to the main menu screen.

10.11 Calibrate Barometer

The optional barometer has been factory calibrated to provide accurate readings. However, some sensor drift may occur over time, requiring occasional calibration by the user, as follows:

1. Determine your local barometric pressure from an independent laboratory barometer or from your local weather service.

2. If the barometric pressure (BP) reading is from your local weather station, reverse the equation that corrects it to sea level.

   NOTE: For this equation to be accurate, the barometric pressure units must be in mmHg.

   True BP = (Corrected BP) – [2.5 * (Local Altitude/100)]

3. Go to the system setup screen as described in Section *10.1 Accessing the System Setup Screen*.

4. Use the arrow keys to highlight the **Calibrate barometer** selection on the system setup screen. See Figure 10.2 System Setup Screen.

5. Press the **Enter** key. The Calibrate Barometer screen is displayed.

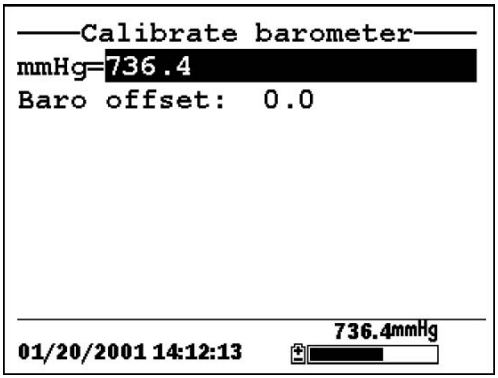


Figure 10.6 Barometer Calibration Screen

6. Use the keypad to input the known barometric pressure value as determined in Step 2.

7. Press the **Enter** key. The new barometer reading is displayed as well as the approximate offset from the factory reading.

   NOTE: To return the sensor to the factory setting, subtract the offset amount from the current setting and repeat Steps 5 to 7.

8. Press the **Escape** key repeatedly to return to the main menu screen.

11. Maintenance

11.1 Sensor Care and Maintenance

Once the sensors have been properly installed, remember that periodic cleaning and DO membrane changes are required.

11.1.1 DO Sensor

For best results, we recommend that the KCl solution and the membrane cap be changed at least once every 30 days.

1. It is important to recognize that oxygen dissolved in the sample is consumed during sensor operation. It is therefore essential that the sample be continuously stirred at the sensor tip. If stagnation occurs, your readings will be artificially low. Stirring may be accomplished by mechanically moving the sample around the sensor tip, or by rapidly moving the sensor through the sample. The rate of stirring should be at least 1 foot per second.

2. Membrane life depends on usage. Membranes will last a long time if installed properly and treated with care. Erratic readings are a result of loose, wrinkled, damaged, or fouled membranes, or from large (more than 1/8" diameter) bubbles in the electrolyte reservoir. If erratic readings or evidence of membrane damage occurs, you should replace the membrane and the electrolyte solution. The average replacement interval is two to four weeks.

3. If the membrane is coated with oxygen consuming (e.g. bacteria) or oxygen producing organisms (e.g. algae), erroneous readings may occur.

4. Chlorine, sulfur dioxide, nitric oxide, and nitrous oxide can affect readings by behaving like oxygen at the sensor. If you suspect erroneous readings, it may be necessary to determine if these gases are the cause.

5. Avoid any environment that contains substances that may attack the probe module and sensor materials. Some of these substances are concentrated acids, caustics, and strong solvents. The sensor materials that come in contact

with the sample include FEP Teflon, acrylic plastic, EPR rubber, stainless steel, epoxy, polyetherimide and the PVC cable covering.

6. It is possible for the silver anode, which is the entire silver body of the sensor, to become contaminated. This will prevent successful calibration. To restore the anode, refer to Section *11.1.1 DO Sensor, Silver Anode Cleaning.*

7. For correct sensor operation, the gold cathode must always be bright. If it is tarnished (which can result from contact with certain gases), or plated with silver (which can result from extended use with a loose or wrinkled membrane), the gold surface must be restored. To restore the cathode, refer to Section *11.1.1 DO Sensor, Gold Cathode Cleaning.*

8. To keep the electrolyte from drying out, store the sensor in the transport/calibration cup with at least 1/8″ of water.

Silver Anode Cleaning

After extended use, a thick layer of AgCl builds up on the silver anode reducing the sensitivity of the sensor. The anode must be cleaned to remove this layer and restore proper performance. The cleaning can be chemical or mechanical:

Chemical Cleaning: Remove the membrane cap and soak the entire anode section in a 14% ammonium hydroxide solution for 2 to 3 minutes, followed by a thorough rinsing with distilled or deionized water. The anode should then be thoroughly wiped with a wet paper towel to remove the residual layer from the anode.

Mechanical Cleaning: Sand off the dark layer from the silver anode with 400 grit wet/dry sandpaper. Wrap the sandpaper around the anode and twist the sensor. Rinse the anode with clean water after sanding, followed by wiping thoroughly with a wet paper towel.

NOTE: After cleaning, a new membrane cap must be installed. Refer to Section *3.4.3 Membrane Cap Installation***.**

Turn the instrument on and allow the system to stabilize for at least 30 minutes. If, after several hours, you are still unable to calibrate, contact your dealer or YSI Customer Service. Refer to *Appendix E Customer Service*.

Gold Cathode Cleaning

For correct sensor operation, the gold cathode must be textured properly. It can become tarnished or plated with silver after extended use. The gold cathode can be cleaned by using the adhesive backed sanding disc and tool provided in the YSI 5238 Probe Reconditioning Kit.

Using the sanding paper provided in the YSI 5238 Probe Reconditioning Kit, wet sand the gold with a twisting motion about 3 times or until all silver deposits are removed and the gold appears to have a matte finish. Rinse the cathode with clean water after sanding, followed by wiping thoroughly with a wet paper towel. If the cathode remains tarnished, contact your dealer or YSI Customer Service. Refer to *Appendix E Customer Service*.

NOTE: After cleaning, a new membrane cap must be installed. Refer to Section *3.4.3 Membrane Cap Installation***.**

11.1.2 DO Sensor Replacement

1. Remove the probe sensor guard.

⚠ **CAUTION:** Thoroughly dry the sensor so that no water enters the probe module sensor port when the sensor is removed.

2. Insert the long end of the hex key wrench into the small hole in the side of the probe module bulkhead. Turn the wrench counterclockwise and remove the screw. (You do not have to remove the screw all the way to release the sensor.)

3. Pull the old DO sensor module straight out of the probe module body.

   NOTE: The DO sensor is not threaded, it is keyed, so it cannot be removed by twisting.

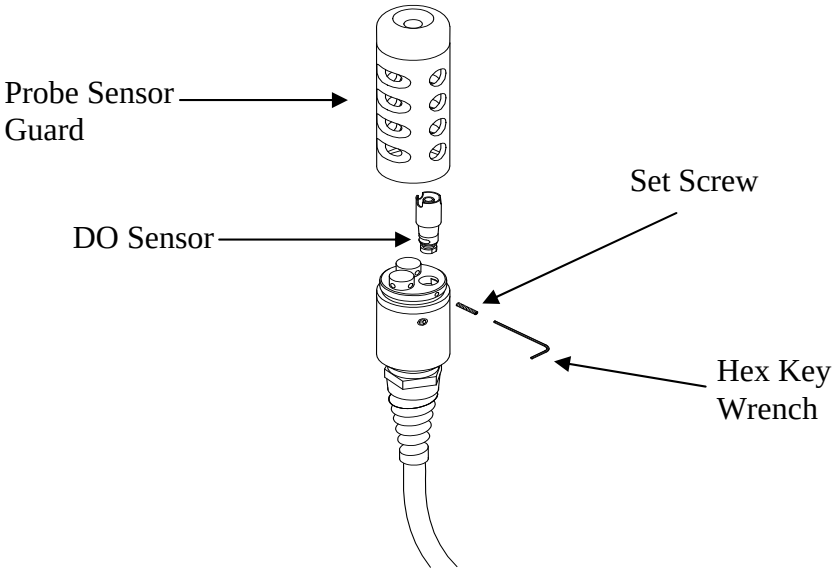


Figure 11.1 DO Sensor Replacement

4. Insert the new DO sensor module. Make sure that the inside of the probe module sensor port and the o-ring on the sensor are clean, with no contaminants, such as grease, dirt, or hair. The DO sensor is keyed, or has a flat side, so that it cannot be aligned improperly.

NOTE: Make sure the DO sensor bottoms out before the set screw is inserted.

5. Insert the set screw into the small hole in the side of the probe module bulkhead, and turn clockwise to rethread.

⚠ **CAUTION**: Make sure that you do not cross-thread the set screw. Use the hex key wrench to tighten the screw in properly, making sure that the screw does not stick out of the side of the probe module bulkhead. The probe sensor guard will not thread on properly and damage may result if the screw is allowed to stick out.

NOTE: The YSI 5563 DO sensor is shipped dry. A shipping membrane was installed to protect the electrode. A new membrane cap must be installed before the first use. Refer to Section 3.4.1 Sensor Installation.

11.1.3 YSI 5564 pH and 5565 Combination pH/ORP Sensor Cleaning

Cleaning is required whenever deposits or contaminants appear on the glass and/or platinum surfaces of these sensors or when the response of the sensor becomes slow.

1. Remove the sensor from the probe module.

2. Initially, simply use clean water and a soft clean cloth, lens cleaning tissue, or cotton swab to remove all foreign material from the glass bulb (YSI 5564 and YSI 5565) and platinum button (YSI 5565). Then use a moistened cotton swab to carefully remove any material that may be blocking the reference electrode junction of the sensor.

⚠ **CAUTION:** When using a cotton swab with the YSI 5564 or YSI 5565, be careful NOT to wedge the swab tip between the guard and the glass sensor. If necessary, remove cotton from the swab tip, so that the cotton can reach all parts of the sensor tip without stress.

NOTE: If good pH and/or ORP response is not restored by the above procedure, perform the following additional procedure:

1. Soak the sensor for 10-15 minutes in clean water containing a few drops of commercial dishwashing liquid.

2. GENTLY clean the glass bulb and platinum button by rubbing with a cotton swab soaked in the cleaning solution.

3. Rinse the sensor in clean water, wipe with a cotton swab saturated with clean water, and then re-rinse with clean water.

   NOTE: If good pH and/or ORP response is still not restored by the above procedure, perform the following additional procedure:

1. Soak the sensor for 30-60 minutes in one molar (1 M) hydrochloric acid (HCl). This reagent can be purchased from most distributors. Be sure to follow the safety instructions included with the acid.

2. GENTLY clean the glass bulb and platinum button by rubbing with a cotton swab soaked in the acid.

3. Rinse the sensor in clean water, wipe with a cotton swab saturated with clean water, and then re-rinse with clean water. To be certain that all traces of the acid are removed from the sensor crevices, soak the sensor in clean water for about an hour with occasional stirring.

   NOTE: If biological contamination of the reference junction is suspected or if good response is not restored by the above procedures, perform the following additional cleaning step:

1. Soak the sensor for approximately 1 hour in a 1 to 1 dilution of commercially available chlorine bleach.

2. Rinse the sensor with clean water and then soak for at least 1 hour in clean water with occasional stirring to remove residual bleach from the junction. (If possible, soak the sensor for period of time longer than 1 hour in order to be certain that all traces of chlorine bleach are removed.) Then re-rinse the sensor with clean water and retest.`

11.1.4 Temperature/Conductivity Sensor Cleaning

The single most important requirement for accurate and reproducible results in conductivity measurement is a clean cell. A dirty cell will change the conductivity of a solution by contaminating it. The small cleaning brush included in the YSI 5511 Maintenance Kit is ideal for this purpose.

To clean the conductivity cell:

1. Dip the brush in clean water and insert it into each hole 1520 times.

2. Rinse the cell thoroughly in deionized or clean tap water.

NOTE: In the event that deposits have formed on the electrodes, perform the following additional procedure:

1. Use a mild detergent solution in combination with the brush. Dip the brush in the solution and insert it into each hole 1520 times.

2. Rinse the cell thoroughly in deionized or clean tap water.

   NOTE: After cleaning, check the response and accuracy of the conductivity cell with a calibration standard.

   NOTE: If this procedure is unsuccessful, or if sensor performance is impaired, it may be necessary to return the sensor to a YSI authorized service center for service, Refer to *Appendix E Customer Service*.

   The temperature portion of the sensor requires no maintenance.

11.2 Upgrading YSI 556 MPS Software

1. Access the YSI Environmental Software Downloads page as described in *Appendix G EcoWatch* Step 1 through 3.

2. Click on the **YSI Instruments Software Updates** link (or scroll down until you see YSI 556 MPS).

3. Click on the file icon to the right of the **YSI 556 MPS** listing and save the file to a temporary directory on your computer.

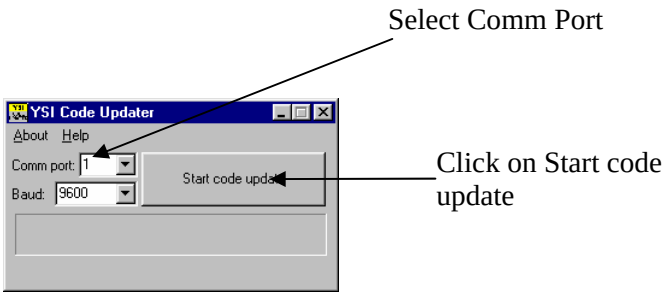
4. After the download is complete, run the file (that you just downloaded) and follow the on screen instructions to install the YSI Code Updater on your computer. If you encounter difficulties, contact YSI customer service for advice. Refer to *Appendix E Customer Service*.

5. If necessary, disconnect the YSI 5563 Probe Module from the YSI 556 MPS instrument.

6. Connect the YSI 556 MPS to a serial port of your computer via the 655173 PC interface cable. See Figure 8.6 Computer/Instrument Interface.

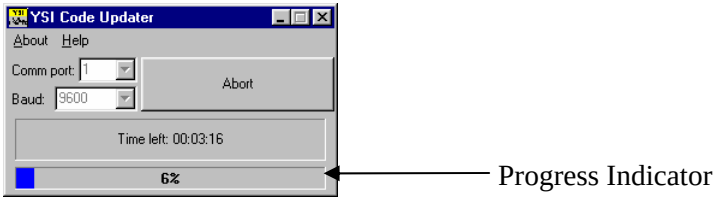
7. Press the **On/off** key on the YSI 556 MPS to display the run screen.

8. Run the YSI Code Updater software that you just installed on your computer. The following window will be displayed:



9. Set the Comm port number to match the port that you connected the 655173 PC Interface Cable to, then click on the Start Code Update button.

The YSI 556 MPS screen will blank out and a progress indicator will be displayed on the PC.



When the update is finished (indicated on the PC screen), the YSI 556 MPS will return to the Run screen. See Figure 7.1 Run Screen.

10. Close the YSI Code Updater window (on the PC) by clicking on the "X" in the upper right corner of the window.

11. Disconnect the YSI 556 MPS from the 655173 PC interface cable and reconnect it to the YSI 5563 Probe Module. Refer to Section *3.6 Instrument/Cable Connection*.

12. Storage

Proper storage between periods of usage will not only extend the life of the sensors, but will also ensure that the unit will be ready to use as quickly as possible in your next application.

12.1 General Recommendations for Short Term Storage

No matter what sensors are installed in the instrument, it is important to keep them moist without actually immersing them in liquid. Immersing them could cause some of them to drift or result in a shorter lifetime.

YSI recommends that short term storage of all multi-parameter instruments be done by placing approximately 1/2 inch of tap water in the transport/calibration cup that was supplied with the instrument, and by placing the probe module with all of the sensors installed into the cup. The use of a moist sponge instead of a 1/2 inch of tap water is also acceptable, as long as its presence does not compromise the attachment of the cup to the probe module. The transport/calibration cup should be sealed to prevent evaporation.

NOTE: Ensure that an o-ring is installed in the o-ring groove on the threaded end of the probe module body. See Figure 3.7 Transport/Calibration Cup Installation.

⚠ **CAUTION**: The water level has to be low enough so that none of the sensors are actually under water. Check the transport/calibration cup periodically to make certain that the water is still present or the sponge is still moist.

NOTE: If the storage water (tap water) is accidentally lost during field use, environmental water can be used.

12.2 General Recommendations for Long Term Storage

12.2.1 Probe Module Storage

1. Remove the pH or pH/ORP sensor from the probe module and store according to the individual sensor storage instructions found in Section *12.2.2 Sensor Storage*.

2. Seal the empty port with the provided port plug.

   NOTE: Leave the conductivity/temperature sensor and

dissolved oxygen sensor, with membrane cap still on, in the probe module.

3. Place 1/2″ of water, deionized, distilled or tap, in the transport/calibration cup.

⚠ **CAUTION:** The water level has to be low enough so that none of the sensors are actually under water. Check the transport/calibration cup periodically to make certain that the water is still present or the sponge is still moist.

4. Insert the probe module into the cup.

   NOTE: Ensure that an o-ring is installed in the o-ring groove on the threaded end of the probe module body. See Figure 3.7 Transport/Calibration Cup Installation.

12.2.2 Sensor Storage

Temperature/Conductivity Sensor

No special precautions are required. Sensor can be stored dry or wet, as long as solutions in contact with the thermistor and conductivity electrodes are not corrosive (for example, chlorine bleach). However, it is recommended that the sensor be cleaned with the provided brush prior to long term storage. Refer to Section *11.1.4 Temperature/Conductivity Sensor Cleaning.*

pH and Combination pH/ORP Sensor

The key to sensor storage is to make certain that the reference electrode junction does not dry out. Junctions which have been allowed to dry out due to improper storage procedures can usually be rehydrated by soaking the sensor for several hours (overnight is recommended) in a solution which is 2 molar in potassium chloride. If potassium chloride solution is not available, soaking the sensor in tap water or commercial pH buffers may restore sensor function. However in some cases the sensor may have been irreparably damaged by the dehydration and will require replacement.

⚠ **CAUTION:** Do not store the sensor in distilled or deionized water as the glass sensor may be damaged by exposure to this medium.

1. Remove the pH or pH/ORP sensor from the probe module.