DESIGN REPORT

WASTE STORAGE FACILITY
(LAYERS)

October 27, 2017

PREPARED FOR:

Daybreak Foods, Inc.
533 E Tyranena Park Road
Lake Mills, WI 53551

PREPARED BY:

Resource Engineering Associates, Inc.
3510 Parmenter St., Suite 100
Middleton, Wisconsin, 53562

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WISCONSIN PROFESSIONAL ENGINEER
ROBERT J. POFAHL
E-15298
MIDDLETON
WI

10-27-17

I, Robert J Pofahl, hereby certify that I am a registered professional engineer in the State of Wisconsin, registered in accordance with the requirements of ch. A-E, Wis. Adm. Code; that this document has and been prepared in accordance with the Rules of Professional Conduct in ch. A-E 8, Wis. Adm. Code; that to the best of my knowledge, all information contained in this document is correct.

Robert J. Pofahl P.E.

1. Project Contacts

Owner Contact

Keith Kulow
WI Regional Operations Manager
533 E Tyranena Park Road
Lake Mills, WI 53551
Phone: 920-648-2377 ext. 7412
Email: keith@daybreakfoods.com

Project Site Location

Jefferson County, Wisconsin
Town of Lake Mills (T7N, R13E)
SW ¼ SE ¼, Section 27

County Animal Waste Contact

Mark Watkins
Director, Land & Water Conservation Department
311 S Center Ave, Room 113
Jefferson, WI 53549-1701
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General Contractor

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Resource Engineering Associates, Inc. Contacts

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2. Purpose

The purpose of providing this report is to provide information on the design of the proposed structure and conformance with WI NRCS conservation practice standards and specifications.
Reviewable Structures Include:

Waste Storage Facility

Prior to construction, Wisconsin agencies with permit approval/design review include:

WDNR Water Resources Application for Project Permits (WRAPP)
WDNR WPDES Reviewable Structures Plan Approval
County Animal Waste Storage
County Animal Siting

3. Background

Daybreak Foods, Inc. is planning to build a new poultry layer facility at N5344 Crossman Road in Lake Mills, Wisconsin to replace an existing layer facility at N5505 Crossman Road in Lake Mills. The proposed site for the proposed facility is currently a crop field. A house, barn, shed, and concrete silo bases are also present on the proposed site. The existing structures are planned to be removed prior to construction, however the barn may be left intact.

4. Management Assessment

The management assessment was performed with the owner/operator to explore options and to determine the purpose of storage components, available resources, manure disposal schemes, and waste characteristics.

Waste Characterization

Calculations are based on animal waste from the proposed layer houses (5) housing approximately 2 million layers (400,000 each house). Manure generation rates of dry manure are estimated as 0.8 cubic feet (cf) per chicken per year. The animals are planned to be housed in cage-free, aviary system layer houses. Manure from the chickens is planned to be air-dried to 15-20-% moisture using the Big Dutchman *Optisec Manure Drying System*. The proposed waste storage facility provides approximately 1,740,200 cu. ft. of storage. A copy of the manure generation calculations is attached in **Appendix C**.

Animals	#	Manure (ft^3/chicken/year)	Total (ft^3/year)	Storage Days
Chicken (Layers)	2,000,000	0.8	1,600,000	397

Land base

Daybreak Foods, Inc. has a revolving contract with Midwestern Bio Ag to purchase and market all manure generated both on the current site and the future site.

Planned storage period

The designed storage period is approximately 397 days as shown on the calculation sheet attached in **Appendix C,** however, manure is not planned to be stored longer than 365 days.

Waste handling and transfer

The manure from under the layer house aviary system rows is transferred to the east end of the layer buildings using a multi belt system. A cross conveyor belt system over a 5-foot wide by 6-foot deep concrete lined maintenance channel is planned to be located inside the east end of each house. This conveyor belt will transfer the manure to the center of each building where it will be dropped onto another conveyor belt system which will transfer it back to the west into one of the Optisec Manure Drying Systems in the center of each building. Once the manure passes through the dryer system it will return to the east end of the buildings via a conveyor belt system to a final conveyor belt system that will transfer it into the waste storage facility. The moisture content of the dried manure will be approximately 15-20%.

The concrete lined maintenance channels underneath the conveyor belt systems at the east end of the houses and the final conveyor belt system into the waste storage facility are not believed to be reviewable structures. *NRCS 634, Waste Transfer, III. Conditions Where Practice Applies*, states, "This practice standard does not apply to conveyance systems using equipment or mechanisms such as gutters, barn cleaners, alley scrapers, or belts for moving manure in the housing facility to the manure transfer system." However, the channels are designed in accordance with *NRCS 522 – Pond Sealing or Lining – Concrete, Table 3* standards for liquid tight concrete with waterstop.

Facility waste removal methods

Waste from the proposed waste storage facility is planned to be loaded into trucks via wheel loaders. The waste removed from storage is sold to Midwestern Bio Ag. All contracted waste hauling trucks will follow all bio-security requirements and will be loaded inside the waste storage facility in the specifically designed drive-through loading lane. Truck tarps will be secured before trucks leave the waste storage facility.

Access needs

Access to the proposed facility will be provided by a proposed paved access drive off of Crossman Road. Truck drive thru access will be provided inside the manure building for the loading and removal of manure.

Safety needs

Warning signs, fall protection, and necessary PPE shall be utilized where deemed necessary where access to the waste storage facility is possible.

Labor and equipment needs

The farm currently has labor and manure handling equipment to distribute manure in the building and load trucks for transport by Midwestern Bio Ag.

Potential odor concerns

Odor will be limited as the manure drying systems will dry the manure to a moisture content as low as 15-20 percent. Manure is planned to be stored in an enclosed building which will also limit the potential for outside odor.

Facility expansion

Daybreak Foods, Inc. has no plans for future expansion at this site. Associated pullet facilities are planned at the existing facility at N5505 Crossman Road. The pullet facilities will be described in a separate report.

5. Site Assessment

The site assessment was performed to determine physical site characteristics that will influence the placement, construction, maintenance, and environmental integrity of proposed structures.

Topography

A site engineering survey was conducted to determine locations and elevations of buildings, roads, lanes, soil test excavations, setbacks, wells, surface waters, surface drains and drain tile.

The site engineering survey was completed by REA, Inc. personnel on October 4, 2017. The survey was done in Jefferson County Wisconsin Coordinate Reference System and NAVD88.

The site engineering survey can be found on the Existing Conditions page of the plan set.

An ALTA survey was performed by Land Tech Surveying, LLC personnel. The survey was done in Jefferson County Wisconsin Coordinate Reference System and NAVD88.

Soils Investigation

The soils investigation was completed on October 17, 2017 using a backhoe and logged by REA, Inc. personnel.

Eleven soil test excavations were advanced with a backhoe. TE-11 through TE-21 were advanced approximately 8-13 feet below existing site grade. The soils primarily consisted of lean clay (CL) or clayey sand (SC) soils underlain with sandy (SP) soils.

A Soil Survey map and soil logs can be found in **Appendix B**.

Bedrock

Bedrock was not encountered during the soil test excavations and is not expected to be encountered during excavation of the proposed waste facility. Soil test excavations extended from 8 to 28 feet below the planned top of the waste storage facility floor. Bedrock data as reported in the Ground Water Resources and Geology of Jefferson County, Wisconsin Report circular #33 Figure 5 by WG&NHS indicate the bedrock elevation is about 700'. This is greater than 100' below the proposed waste storage structure.

Saturation

Saturation was encountered during soil test excavation TE-19 six and one-half feet below existing site grade (839.6'). The saturation encountered is approximately 23.4' below the top of the proposed waste storage facility floor (863.0'). Saturation is not expected to be encountered during excavation of the proposed waste storage facility.

Borrow Areas

The manure building is planned to be constructed on fill material. Fill material is planned to come from an existing bean field approximately 800 feet southeast of the proposed facility. The fill material shall be placed and compacted in accordance with the *Geotechnical Report* (by others).

Wells

The site has one existing potable well approximately 850 feet west of the proposed waste storage facility, which is planned to be abandoned. Four proposed high capacity wells are planned to be located approximately 850 feet northwest of the proposed waste storage facility. A set back of 250 feet is required by NR 243.

Wetlands

The site was evaluated for wetlands by an assured wetland delineator (Stantec) and wetland boundaries were surveyed and shown in the *Assured Wetland Delineation Report*. A copy of the wetland delineation map from the assured wetland delineation report is presented in **Appendix E**. Based on review of the Wisconsin DNR Wetland Map in the Surface Water Data Viewer and the *Assured Wetland Delineation Report*, the proposed waste storage facility is not in mapped wetlands.

Floodplain

Based on review of the Wisconsin DNR Floodplain Map in the Surface Water Data Viewer, the proposed waste storage facility is not in a 100-year floodplain.

Drain tiles

Drain tiles are not proposed for this project.

Karst features

Daybreak Foods, Inc. advised they are not aware of springs or other karst features in the project area. The WG&NHS circular #33 identifies the bedrock surface as greater than 100 feet below grade and indicates the site is located in an end moraine area. The site is not believed to be in a karst prone area.

Cultural Resources

The proposed site was screened for cultural resources and the project footprint was identified as being immediately proximal to a reported archaeological site (Site JE-0565). Daybreak Foods, Inc. hired cultural resource management firm *Archaeological Research, Inc*. (David Keene) to evaluate the project's potential to adversely impact the site and better define the site limits and character relative to the area to be impacted by project-related activities. The Archaeology Report produced by *Archaeological Research, Inc*. indicated *"no historic or prehistoric archaeological remains were encountered during the course of this investigation. Field investigations were intensive and methods were appropriate for the particular conditions. If any unanticipated cultural resources or human remains are encountered during construction, construction activities will be halted in that location and appropriate authorities and specialists will be contacted immediately."* The archaeological report was submitted to and accepted by the Wisconsin Historical Society and the Wisconsin DNR.

Surface Water features

The closest body of surface water is an unnamed wetland approximately 130 feet east of the proposed facility.

Site maps are presented in **Appendix A**. Included are the following with site area shown:

- Site Vicinity Map (USGS Quad)
- Existing Conditions Map (Aerial)
- Wetlands Map (WDNR Surface Water Data Viewer)
- Floodplain Map (WDNR Surface Water Data Viewer)
- Designated Waters Map (WDNR Surface Water Data Viewer)

Potential Discharge Impacts

The waste storage facility is planned to store dry poultry manure at grade in a liquid-tight concrete facility.

6. Location Criteria

The top of floor elevation for the proposed waste storage facility is planned to be 863.0'. This elevation is based on the topographic survey by REA, Inc. personnel. The benchmark datum was set in Jefferson County Wisconsin Coordinate Reference System and NAVD88. The benchmark (BM#1) is described as a metal nail with pink tape under it and a pink triangle spray painted on Crossman Road. The nail is approximately 475' north of the existing driveway of N5344 Crossman Road. The benchmark location is Northing-571581.97' and Easting-818957.10' with an elevation of 863.5' MSL. Natural ground in the area of the proposed waste storage facility varies in elevation from approximately 845.0' to 863.0'.

Bedrock & Saturation Separation Criteria

Specific criteria outlined in *NRCS 522, Pond Sealing or Lining – Concrete* includes depth to bedrock, depth to saturated soil, and well and sinkhole separation distances as follows:

	Liquid Tight Concrete with Waterstop	Reduced Seepage Concrete with Waterstop PLUS Secondary Containment-Soil Liner	Reduced Seepage Concrete with Waterstop PLUS Secondary Liquid Containment-Geomembrane Liner Note 2	Reduced Seepage Concrete with Waterstop PLUS Secondary Liquid Containment-Foundry Sand Liner
Soils of the Secondary Liquid Containment				
Fines	---	40%	---	Foundry Sand
Plasticity Index (PI)	---	12	---	---
Thickness (bottom and sides)	---	1.5 feet	---	1.5 feet
Compaction of Placed Material	---	WI Spec 204	---	WI Spec 204
Separation Distances				
Sink Hole	250 feet	250 feet	250 feet	250 feet
Well	100 feet	100 feet	100 feet	100 feet
Subsurface Saturation Note 1	2 feet	4 feet	3 feet	4 feet
Bedrock Note 1	1.5 feet	3 feet	2 feet	3 feet
Impoundment				
Inside Side Slopes	2.5:1 or flatter	2.5:1 or flatter	2.5:1 or flatter	2.5:1 or flatter

Note 1 Separation distance assumes a concrete thickness of 6 inches. Increase separation distance when slab thickness is greater than 6 inches by an equal amount.

Note 2 Design geomembrane liner per *WI NRCS CPS 521, Pond Sealing or Lining – Geomembrane or Geosynthetic Clay Liner.*

A copy of WI-NRCS 522 is attached in this report in **Appendix D**. Liquid tight concrete with waterstop is proposed for the floor and walls of the proposed waste storage facility. The soil test excavations extended approximately 8 to 28 feet below the planned top of floor elevation of the waste storage facility.

7. Design – Waste Storage Facility

The proposed waste storage facility is planned to be constructed inside of the proposed pre-engineered metal building (PEMB). The PEMB overall dimensions are 670’ x 218’-6”. The proposed waste storage facility is planned to be 200’ x 565’ with 16’ high walls on 3 sides. The 16’ high walls are planned to be built 180’ long on the ends (north & south) of the waste storage facility and 565’ long on the east side of the waste storage facility. A 20’ wide opening for drive thru access and operations area is planned along the west side of the facility. A 6’ high wall is planned along the west side of the waste storage facility. Manure is planned to be stored in an area 180’ x 565’. An overview of the proposed waste storage facility and PEMB is presented in **Appendix C** and in the design plan.

The proposed waste storage facility is a cast in place design using USDA-NRCS design codes, criteria and construction specification standards. The codes and construction standards include:

- NRCS Code 313 – Waste Storage Facility
- NRCS Code 522 – Pond Sealing or Lining-Concrete
- WI Construction Specification 4, Concrete
- WI Construction Specification 004, WS Embedded or Expansive Waterstop
- Design loads are as summarized on the drawings. Loads are intended to meet or exceed criteria as specified in WI-NRCS Code 313 – Waste Storage Facility.

Structural details are presented on the attached plans and specifications.

Waste Storage Facility Floor Design

The waste storage facility floor is designed as liquid tight concrete with waterstop. The concrete floor shall be a minimum of 8 inches thick and include control joints with waterstop spaced in accordance with the attached plans and specifications. The floor is designed for an H-20 truck load and for an articulating loader.

Waste Storage Facility Wall Design

The waste storage facility walls are designed as liquid tight concrete with waterstop. The design manure load is based on 50 pounds per cubic foot. Available information as reported by Cornell University indicates dry chicken manure at a moisture of 13.4% has a bulk density of 14.2 pounds per cubic foot and has an angle of repose of 50°. The proposed design of 50 pounds per cubic foot has a factor of safety of over 3.

Days of Storage

Calculations indicate the proposed waste storage facility should provide the farm approximately 397 days of storage, however, manure is not planned to be stored longer than 365 days. Days of storage calculations are presented in **Appendix C**.

8. Erosion Control and Storm Water Drainage Management

Erosion Control Practices

The project boundary for the construction area is greater than 1 acre in size. Using this data, Daybreak Foods, Inc. has applied for and been granted approval for a Wisconsin DNR Water Resources Application for Project Permits (WRAPP) for construction site erosion control (*Permit No. WI-S067831-05*). Erosion control practices during construction are presented on Sheet C101 & C102 of the plan set and include:

- Stone tracking pad at entrances to project site off Crossman Road
- Temporary diversion berms/sediment traps to limit sediment from leaving the site
- Silt fencing to limit sediment from leaving project site
- Diversion berms/detention basin to limit sediment from leaving project site
- Temporary and permanent stone ditch checks in channel areas
- De-watering plan to remove accumulated rainfall from excavation (if necessary)
- Culvert outlet protection for culverts installed
- Inlet protection
- The area disturbed by construction will be asphalted, seeded and mulched and/or erosion matted to limit erosion once the area is final graded.

Storm Water Drainage

North: Storm water falling north of the proposed facility will overland flow north into adjacent crop land or east into the existing wetland.

East: Storm water falling east of the proposed facility will overland flow east down the embankment and then into the existing wetland.

South: Storm water falling south of the proposed facility is planned to overland flow south and then east into the proposed channel and storm water detention basin.

West: Storm water falling west of the proposed facility will overland flow west into manhole inlets and drain south via storm water pipes and then east into the storm water detention basin.

9. Operation and Maintenance Plan

The Operation and Maintenance Plan is presented in a separate report that is enclosed with this design report.

10. Construction Plans and Specifications

Construction drawings are enclosed with this design report. The drawings provide the layout and details of the proposed structure. Applicable NRCS Construction Specifications are referenced in the drawings and copies of the applicable specifications are included in the Construction Quality Assurance Plan.

11. Construction Schedule

Site work for the proposed waste storage facility is planned to begin in June 2018 upon approval of the plans. Construction of the waste storage facility is expected to be completed in the spring of 2019, unless inclement weather or contracting scheduling delays progress.

- Begin Construction – June 2018
- Complete Construction Activities – March 2019

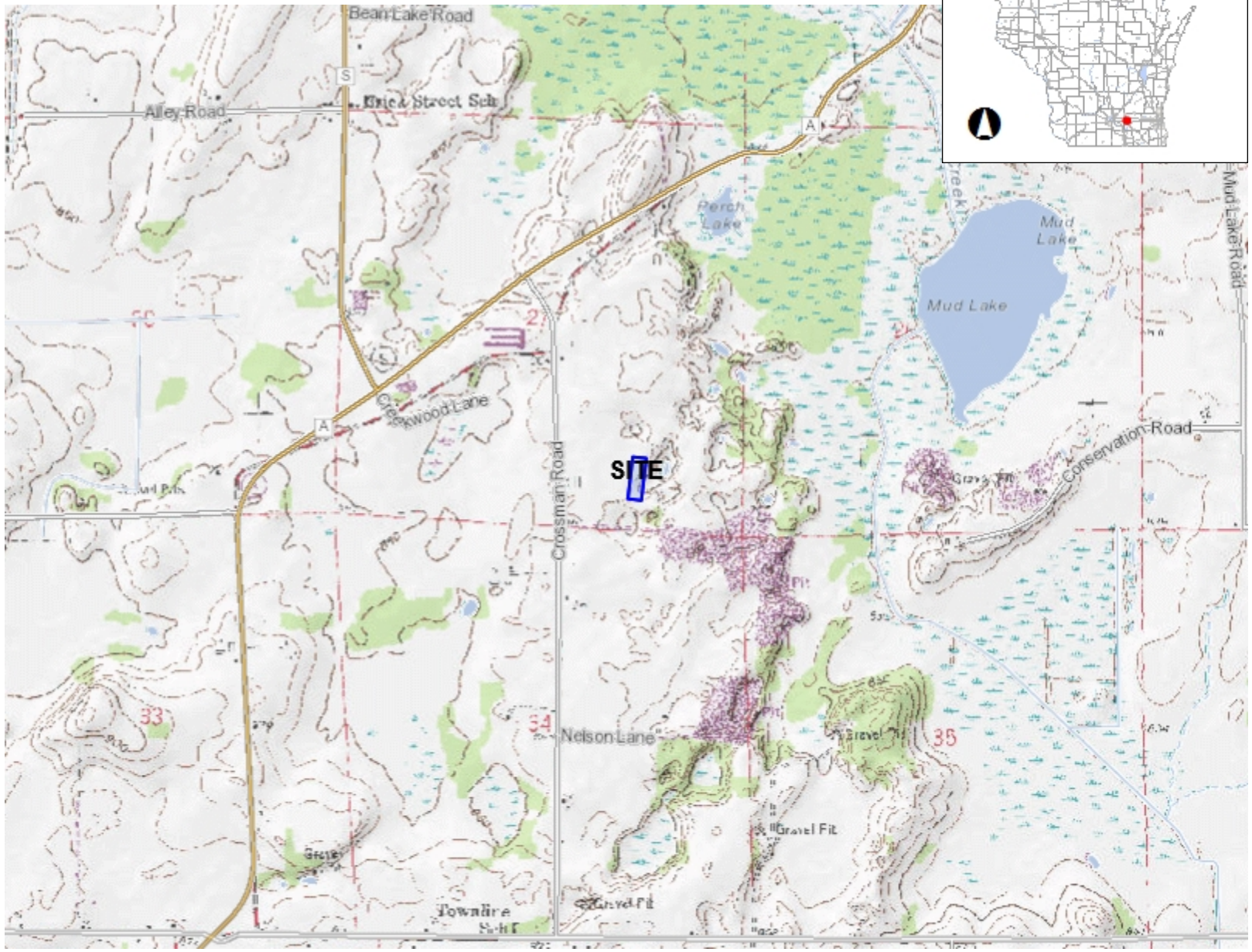
12. Construction Quality Assurance Plan

The Construction Quality Assurance Plan is presented in a separate report that is enclosed with this design report.

Appendix A

Site Maps

SITE VICINITY MAP



Legend

- Municipality
- State Boundaries
- County Boundaries
- Major Roads
  - Interstate Highway
  - State Highway
  - US Highway
- County and Local Roads
  - County HWY
  - Local Road
- Railroads
- Tribal Lands
- Rivers and Streams
- Intermittent Streams
- Lakes and Open water

0.8 0 0.38 0.8 Miles

NAD_1983_HARN_Wisconsin_TM

1: 23,760

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Notes

DAYBREAK FOODS, INC.

EXISTING SITE CONDITIONS MAP

Legend

- Municipality
- State Boundaries
- County Boundaries
- Major Roads
  - Interstate Highway
  - State Highway
  - US Highway
- County and Local Roads
  - County HWY
  - Local Road
- Railroads
- Tribal Lands
- Rivers and Streams
- Intermittent Streams
- Lakes and Open water
- Index to EN_Image_Basemap_Leaf_Off

0.1 0 0.06 0.1 Miles

NAD_1983_HARN_Wisconsin_TM

1: 3,960

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Notes

DAYBREAK FOODS, INC.

WETLANDS MAP

Legend

- Wetland Class Points
  - Dammed pond
  - Excavated pond
  - Filled excavated pond
  - Filled/drained wetland
  - Wetland too small to delineate
- Filled Points
- Wetland Class Areas
  - Wetland
  - Upland
- Filled Areas
- NRCS Wetspots
- Wetland Indicators
- Municipality
- State Boundaries
- County Boundaries
- Major Roads
  - Interstate Highway
  - State Highway
  - US Highway
- County and Local Roads
  - County HWY
  - Local Road
- Railroads
- Tribal Lands
- Rivers and Streams
- Intermittent Streams
- Lakes and Open water
- Index to EN_Image_Basemap_Leaf_Off

0.1 0 0.06 0.1 Miles

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Notes

DAYBREAK FOODS, INC.

FLOODPLAIN MAP

Legend

- Dams
  - Dams with FERC License
  - Dams
- Floodplain Analysis Lines
  - Other
  - Flood Insurance Study
  - Letter of Map Revision
  - Case By Case Analysis
  - Bridge
- Floodplain Analysis Points
  - Other
  - Flood Insurance Study
  - Letter of Map Revision
  - Case By Case Analysis
  - Bridge
- Statewide Non-digitzed FIRM Index
- Municipality
- State Boundaries
- County Boundaries
- Major Roads
  - Interstate Highway
  - State Highway
  - US Highway
- County and Local Roads
  - County HWY
  - Local Road
- Railroads
- Tribal Lands
- Rivers and Streams
- Intermittent Streams
- Lakes and Open water
- Index to EN_Image_Basemap_Leaf_Off

Notes

DAYBREAK FOODS, INC.

0.1 0 0.06 0.1 Miles

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1: 3,960

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DESIGNATED WATERS MAP

Legend

- PNW-ASNRI Sensitive Areas of Lakes
- PNW-ASNRI Wild and Scenic Rivers
- PNW-ASNRI Outstanding and Exceptional Streams
- PNW-ASNRI Trout Streams
- PNW-ASNRI Wild Rice Streams
- PNW-ASNRI Outstanding and Exceptional Lakes
- PNW-ASNRI Special Area Management Plan Streams
- PNW-ASNRI Special Wetlands Inventory Study Streams
- PNW-ASNRI Coastal Wisconsin Wetlands Streams
- PNW-ASNRI Special Area Management Plan Areas
- PNW-ASNRI Special Wetlands Inventory Study Areas
- PNW-ASNRI Coastal Wisconsin Wetlands Areas
- PNW-ASNRI Wild Rice Areas
- PNW-ASNRI Trout Spring Ponds
- PNW-ASNRI State Natural Areas
- PNW-PRF Other Public Rights Features
- PNW Musky Streams
- PNW Sturgeon Streams
- PNW Musky Areas
- PNW Sturgeon Areas
- PNW Walleye Areas

0.1 0 0.06 0.1 Miles

NAD_1983_HARN_Wisconsin_TM

1: 3,960

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Notes

DAYBREAK FOODS, INC.

Appendix B

Soils Information

Soil Map—Jefferson County, Wisconsin
(Daybreak Foods, Inc.)

Map Scale: 1:4,000 if printed on A landscape (11" x 8.5") sheet.

N

Meters: 0 50 100 200 300

Feet: 0 150 300 600 900

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 16N WGS84

MAP LEGEND

Area of Interest (AOI)

- Area of Interest (AOI)

Soils

- Soil Map Unit Polygons
- Soil Map Unit Lines
- Soil Map Unit Points

Special Point Features

- Blowout
- Borrow Pit
- Clay Spot
- Closed Depression
- Gravel Pit
- Gravelly Spot
- Landfill
- Lava Flow
- Marsh or swamp
- Mine or Quarry
- Miscellaneous Water
- Perennial Water
- Rock Outcrop
- Saline Spot
- Sandy Spot
- Severely Eroded Spot
- Sinkhole
- Slide or Slip
- Sodic Spot
- Spoil Area
- Stony Spot
- Very Stony Spot
- Wet Spot
- Other
- Special Line Features

Water Features

- Streams and Canals

Transportation

- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

Background

- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:15,800.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Jefferson County, Wisconsin
Survey Area Data: Version 15, Sep 27, 2016

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Apr 29, 2011—Sep 6, 2011

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
BpB	Boyer sandy loam, 2 to 6 percent slopes	0.1	0.1%
CaB2	Casco loam, 2 to 6 percent slopes, eroded	0.2	0.2%
CaC2	Casco loam, 6 to 12 percent slopes, eroded	24.4	37.7%
CrD2	Casco-Rodman complex, 12 to 20 percent slopes, eroded	0.4	0.6%
FsA	Fox silt loam, 0 to 2 percent slopes	39.2	60.7%
FsB	Fox silt loam, 2 to 6 percent slopes	0.5	0.8%
Totals for Area of Interest		**64.7**	**100.0%**

Project: **Daybreak Foods** Project Location: **533 E Tyranena Park Road Lake Mills, WI 53551** Project Number: **170020.1**	**Resource Engineering Associates, Inc.** 3510 Parmenter Street, STE 100 Middleton, WI 53562 (608) 831-5522	Log of Boring 11 **Sheet 1 of 1**

Date(s) Drilled **10/17/17**	Logged By **BP**	Checked By
Drilling Method **Trackhoe**	Drill Bit Size/Type	Total Depth of Borehole
Drill Rig Type	Drilling Contractor	Approximate Surface Elevation **857.9**
Groundwater Level and Date Measured	Sampling Method(s)	Hammer Data
Borehole Backfill	Location **Southeast building 1**	

Elevation (feet)	Depth (feet)	USCS Class	DESCRIPTION OF USCS PROPOERTIES Depth, USCS Name, Plasticity, Strength, Moisture & Color	Sample	COMMENTS & NOTES Saturation Type, Bedrock Type, Field Tests, & Other Comments/Notes
857.9	0	Grass	Topsoil, dark brown, few roots, moist, clay, little silt, little sand		
		CL	Clay, little silt, some sand, low plasticity, moist, 7.5 YR 4/4 brown		
		SP	Sand, medium to coarse, some 30% gravel, moist		
		SP	Sand, medium to fine, moist, trace silt, 10 YR 6/4 light yellow brown		
852.9	5				
					caves easy
847.9	10		Bottom of Boring @ 10'		
842.9	15				

C:\Users\adevaux\AppData\Local\Temp\borings_temp\tmpfile.bgs[15ft Depth.tpl]

Project: **Daybreak Foods** Project Location: **533 E Tyranena Park Road Lake Mills, WI 53551** Project Number: **170020.1**	**Resource Engineering Associates, Inc.** 3510 Parmenter Street, STE 100 Middleton, WI 53562 (608) 831-5522	Log of Boring 12 **Sheet 1 of 1**

Date(s) Drilled **10/17/17**	Logged By **BP**	Checked By
Drilling Method **Trackhoe**	Drill Bit Size/Type	Total Depth of Borehole
Drill Rig Type	Drilling Contractor	Approximate Surface Elevation **858.6**
Groundwater Level and Date Measured	Sampling Method(s)	Hammer Data
Borehole Backfill	Location **N # 11**	

Elevation (feet)	Depth (feet)	USCS Class	DESCRIPTION OF USCS PROPOERTIES Depth, USCS Name, Plasticity, Strength, Moisture & Color	Sample	COMMENTS & NOTES Saturation Type, Bedrock Type, Field Tests, & Other Comments/Notes
858.6	0	Grass	Topsoil, clay, some silt, some sand, moist, SAB dark brown		
853.6	5				
		SP	Sand, moist, medium grain, trace silt, 10 YR 5/4 yellowish brown		
					begins caving significantly
					pockets of small 0.25" gravel
848.6	10				
		SC	Sand, some clay, moist, low plasticity, 7.5 YR 4/4 brown		
			Bottom of Boring @ 13'		
843.6	15				

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Project: **Daybreak Foods** Project Location: **533 E Tyranena Park Road Lake Mills, WI 53551** Project Number: **170020.1**	**Resource Engineering Associates, Inc.** 3510 Parmenter Street, STE 100 Middleton, WI 53562 (608) 831-5522	Log of Boring 13 **Sheet 1 of 1**

Date(s) Drilled **10/17/17**	Logged By **BP**	Checked By
Drilling Method **Trackhoe**	Drill Bit Size/Type	Total Depth of Borehole
Drill Rig Type	Drilling Contractor	Approximate Surface Elevation **861.2**
Groundwater Level and Date Measured	Sampling Method(s)	Hammer Data
Borehole Backfill	Location **N # 12**	

Elevation (feet)	Depth (feet)	USCS Class	DESCRIPTION OF USCS PROPOERTIES Depth, USCS Name, Plasticity, Strength, Moisture & Color	Sample	COMMENTS & NOTES Saturation Type, Bedrock Type, Field Tests, & Other Comments/Notes
861.2	0	Grass	Topsoil, clay, some silt, trace fine sand, dark brown, moist		some roots
		CL	Clay, some sand, moist, medium plasticity, 7.5 YR 4/4 brown		
		SP	Sand, coarse, dry, some gravel 30% (0.25" to 2"), 10 YR 5/6 yellow brown		pockets of 60% gravel
856.2	5				
		SP	Sand, coarse to medium, trace small gravel, dry, 10 YR 5/6, yellow brown		caves easily at 9'
851.2	10				cave
			Bottom of Boring @ 12'		
846.2	15				

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Project: **Daybreak Foods** Project Location: **533 E Tyranena Park Road Lake Mills, WI 53551** Project Number: **170020.1**	**Resource Engineering Associates, Inc.** 3510 Parmenter Street, STE 100 Middleton, WI 53562 (608) 831-5522	Log of Boring 14 **Sheet 1 of 1**

Date(s) Drilled **10/17/17**	Logged By **BP**	Checked By
Drilling Method **Trackhoe**	Drill Bit Size/Type	Total Depth of Borehole
Drill Rig Type	Drilling Contractor	Approximate Surface Elevation **863.4**
Groundwater Level and Date Measured	Sampling Method(s)	Hammer Data
Borehole Backfill	Location **N # 13**	

Elevation (feet)	Depth (feet)	USCS Class	DESCRIPTION OF USCS PROPOERTIES Depth, USCS Name, Plasticity, Strength, Moisture & Color	Sample	COMMENTS & NOTES Saturation Type, Bedrock Type, Field Tests, & Other Comments/Notes
863.4	0	Grass	Topsoil, clay with silt, moist, trace sand, dark brown		
		CL	Clay, little silt, trace sand, medium plastic, moist, 7.5 YR 4/3 brown		
		SP	Sand, little silt (10%), moist, 2.5 YR 4/4 Reddish brown		
		SP	Sand, medium to fine moist, 10 YR 6/6 brownish yellow		
858.4	5				
					caves at 7'
					pockets with gravel
853.4	10	SP	little gravel ~ 10%		caves easily
			Bottom of Boring @ 12'		
848.4	15				

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Project: **Daybreak Foods** Project Location: **533 E Tyranena Park Road Lake Mills, WI 53551** Project Number: **170020.1**	**Resource Engineering Associates, Inc.** 3510 Parmenter Street, STE 100 Middleton, WI 53562 (608) 831-5522	Log of Boring 15 **Sheet 1 of 1**

Date(s) Drilled **10/17/17**	Logged By **BP**	Checked By
Drilling Method **Trackhoe**	Drill Bit Size/Type	Total Depth of Borehole
Drill Rig Type	Drilling Contractor	Approximate Surface Elevation **860.0**
Groundwater Level and Date Measured	Sampling Method(s)	Hammer Data
Borehole Backfill	Location **N # 14**	

Elevation (feet)	Depth (feet)	USCS Class	DESCRIPTION OF USCS PROPOERTIES Depth, USCS Name, Plasticity, Strength, Moisture & Color	Sample	COMMENTS & NOTES Saturation Type, Bedrock Type, Field Tests, & Other Comments/Notes
860	0	Grass	Topsoil, clay, some silt, moist, little fine sand, dark brown		
		SP	Sand, little silt, moist, 7.5 YR 3/4 dark brown		
		SP	Sand, medium trace gravel, 10 YR 6/3, pale brown		
		SP	Sand, medium to fine, dry, 10 YR 6/3 pale brown		
855	5				
					caves easily
850	10				
			Bottom of Boring @ 12'		
845	15				

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Project: **Daybreak Foods** Project Location: **533 E Tyranena Park Road Lake Mills, WI 53551** Project Number: **170020.1**	**Resource Engineering Associates, Inc.** 3510 Parmenter Street, STE 100 Middleton, WI 53562 (608) 831-5522	Log of Boring 16 **Sheet 1 of 1**

Date(s) Drilled **10/17/17**	Logged By **BP**	Checked By
Drilling Method **Trackhoe**	Drill Bit Size/Type	Total Depth of Borehole
Drill Rig Type	Drilling Contractor	Approximate Surface Elevation **862.4**
Groundwater Level and Date Measured	Sampling Method(s)	Hammer Data
Borehole Backfill	Location **N # 15**	

Elevation (feet)	Depth (feet)	USCS Class	DESCRIPTION OF USCS PROPOERTIES Depth, USCS Name, Plasticity, Strength, Moisture & Color	Sample	COMMENTS & NOTES Saturation Type, Bedrock Type, Field Tests, & Other Comments/Notes
862.4	0	Grass	Topsoil, few roots, dark brown, little moist clay, little silt, little sand		
		CL	Clay medium plasticity, some silt, little sand, 7.5 YR 3/3		
		SP	Sand, little clay, brownish red, trace silt, moist, 2.5 YR 4/6		
		SP	Sand few cobbles 15-20% cobbles, moist, trace silt		
		SP	Sand, little cobbles (5%), moist		
857.4	5				
		SP	Sand medium to fine, moist, 10 YR 6/6		
852.4	10				
			Bottom of Boring @ 13'		
847.4	15				

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Project: **Daybreak Foods** Project Location: **533 E Tyranena Park Road Lake Mills, WI 53551** Project Number: **170020.1**	**Resource Engineering Associates, Inc.** 3510 Parmenter Street, STE 100 Middleton, WI 53562 (608) 831-5522	Log of Boring 17 **Sheet 1 of 1**

Date(s) Drilled **10/17/17**	Logged By **BP**	Checked By
Drilling Method **Trackhoe**	Drill Bit Size/Type	Total Depth of Borehole
Drill Rig Type	Drilling Contractor	Approximate Surface Elevation **861.1**
Groundwater Level and Date Measured	Sampling Method(s)	Hammer Data
Borehole Backfill	Location **Near east end of manure storage**	

Elevation (feet)	Depth (feet)	USCS Class	DESCRIPTION OF USCS PROPOERTIES Depth, USCS Name, Plasticity, Strength, Moisture & Color	Sample	COMMENTS & NOTES Saturation Type, Bedrock Type, Field Tests, & Other Comments/Notes
861.1	0	Grass	Topsoil, clay, some silt, little sand, moist, dark brown		
		SP	Sand, little silt (10%), moist, 5 YR 4/4 reddish brown		
		SP	Some 25% gravel		
		SP	Sand, moist, 10 YR 6/4 yellow brown		
856.1	5				
			Bottom of Boring @ 8'		
851.1	10				
846.1	15				

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Project: **Daybreak Foods** Project Location: **533 E Tyranena Park Road Lake Mills, WI 53551** Project Number: **170020.1**	**Resource Engineering Associates, Inc.** 3510 Parmenter Street, STE 100 Middleton, WI 53562 (608) 831-5522	Log of Boring 18 **Sheet 1 of 1**

Date(s) Drilled **10/17/17**	Logged By **BP**	Checked By
Drilling Method **Trackhoe**	Drill Bit Size/Type	Total Depth of Borehole
Drill Rig Type	Drilling Contractor	Approximate Surface Elevation **854.8**
Groundwater Level and Date Measured	Sampling Method(s)	Hammer Data
Borehole Backfill	Location **S # 17**	

Elevation (feet)	Depth (feet)	USCS Class	DESCRIPTION OF USCS PROPOERTIES Depth, USCS Name, Plasticity, Strength, Moisture & Color	Sample	COMMENTS & NOTES Saturation Type, Bedrock Type, Field Tests, & Other Comments/Notes
854.8	0	Grass	Topsoil, clay, some silt, little sand, moist, dark brown		
		CL	Clay, brown, medium plasticity, 10 YR 3/4, moist		
		SP	Sand, little clay, reddish brown, 5 YR 4/6		
849.8	5	SP	Sand, trace silt, 10 YR 6/4		
			Bottom of Boring @ 6'		
844.8	10				
839.8	15				

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Project: **Daybreak Foods** Project Location: **533 E Tyranena Park Road Lake Mills, WI 53551** Project Number: **170020.1**	**Resource Engineering Associates, Inc.** 3510 Parmenter Street, STE 100 Middleton, WI 53562 (608) 831-5522	Log of Boring 19 **Sheet 1 of 1**

Date(s) Drilled **10/17/17**	Logged By **BP**	Checked By
Drilling Method **Trackhoe**	Drill Bit Size/Type	Total Depth of Borehole
Drill Rig Type	Drilling Contractor	Approximate Surface Elevation **846.1**
Groundwater Level and Date Measured	Sampling Method(s)	Hammer Data
Borehole Backfill	Location **S # 18**	

Elevation (feet)	Depth (feet)	USCS Class	DESCRIPTION OF USCS PROPOERTIES Depth, USCS Name, Plasticity, Strength, Moisture & Color	Sample	COMMENTS & NOTES Saturation Type, Bedrock Type, Field Tests, & Other Comments/Notes
846.1	0	Grass	Topsoil, clay, some silt, moist, trace sand		
		CL	Clay, some silt, moist SAB, 7.5 YR 2.5/2 very dark brown		
841.1	5	ML	Silt with organic plant material, some sand, moist, 7.5 YR 2.5/1 black		
		SM	Sand, little silt (20%) very moist, 7.5 YR 4/2 brown		saturated water seeping in through sides, bottom, water at 7' after 30 minutes
836.1	10				
			Bottom of Boring @ 11'		
831.1	15				

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Project: **Daybreak Foods** Project Location: **533 E Tyranena Park Road Lake Mills, WI 53551** Project Number: **170020.1**	**Resource Engineering Associates, Inc.** 3510 Parmenter Street, STE 100 Middleton, WI 53562 (608) 831-5522	Log of Boring 20 **Sheet 1 of 1**

Date(s) Drilled **10/17/17**	Logged By **BP**	Checked By
Drilling Method **Trackhoe**	Drill Bit Size/Type	Total Depth of Borehole
Drill Rig Type	Drilling Contractor	Approximate Surface Elevation **857.1**
Groundwater Level and Date Measured	Sampling Method(s)	Hammer Data
Borehole Backfill	Location **S # 19**	

Elevation (feet)	Depth (feet)	USCS Class	DESCRIPTION OF USCS PROPOERTIES Depth, USCS Name, Plasticity, Strength, Moisture & Color	Sample	COMMENTS & NOTES Saturation Type, Bedrock Type, Field Tests, & Other Comments/Notes
857.1	0	Grass	Topsoil, clay with silt, moist, very dark brown		
		CL	Clay, some silt, little sand, moist, 10 YR 2.5/3, very dark brown SAB		
		SP	Sand, medium, moist, some 30% gravel, 5 YR 4/4 Reddish brown		
		SP	Sand, medium, moist, 10 YR 6/4, light yellow brown		
		SP	Sand medium, moist, 10 YR 6/4		caves easily
852.1	5				
			Bottom of Boring @ 9'		
847.1	10				
842.1	15				

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Project: **Daybreak Foods** Project Location: **533 E Tyranena Park Road Lake Mills, WI 53551** Project Number: **170020.1**	**Resource Engineering Associates, Inc.** 3510 Parmenter Street, STE 100 Middleton, WI 53562 (608) 831-5522	Log of Boring 21 **Sheet 1 of 1**

Date(s) Drilled **10/17/17**	Logged By **BP**	Checked By
Drilling Method **Trackhoe**	Drill Bit Size/Type	Total Depth of Borehole
Drill Rig Type	Drilling Contractor	Approximate Surface Elevation **864.4**
Groundwater Level and Date Measured	Sampling Method(s)	Hammer Data
Borehole Backfill	Location **S # 20**	

Elevation (feet)	Depth (feet)	USCS Class	DESCRIPTION OF USCS PROPOERTIES Depth, USCS Name, Plasticity, Strength, Moisture & Color	Sample	COMMENTS & NOTES Saturation Type, Bedrock Type, Field Tests, & Other Comments/Notes
864.4	0	Grass	Topsoil, clay with silt, moist, trace sand, dark brown		
		CL	Clay, little silt, moist SAB, 7.5 3/3 dark brown		
		SP	Sand medium, trace fine sand, dry, 10 YR 7/3 very pale brown		
859.4	5				caves easily
854.4	10		Bottom of Boring @ 10'		
849.4	15				

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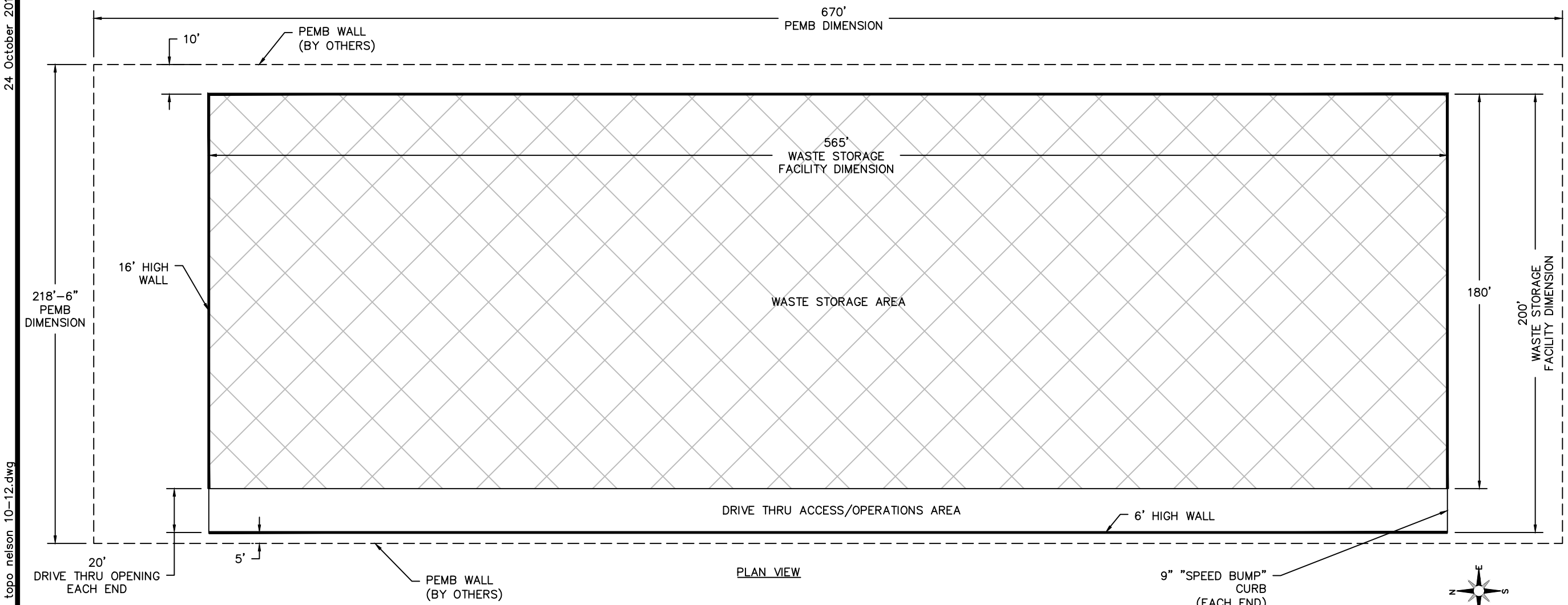
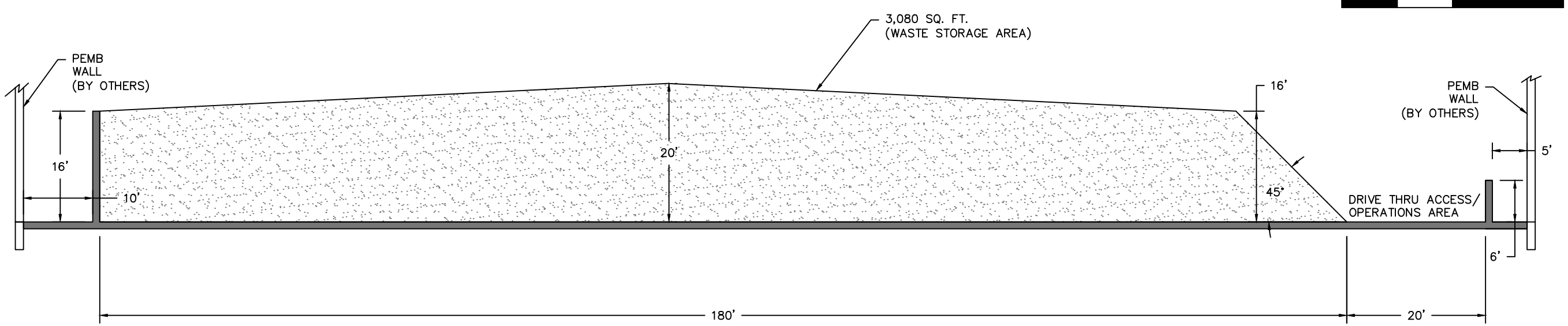
Appendix C

Manure Generation and Storage Calculations



PLAN VIEW



SECTION VIEW

0 16 32

2,000,000 BIRDS x 0.8 CU. FT MANURE/BIRD/YEAR = 1,600,000 CU. FT. MANURE/YEAR

3,080 SQ. FT x 565 FT. = 1,740,200 CU. FT. (STORAGE CAPACITY)

1,740,200 CU. FT. – 1,600,000 CU. FT. = 140,200 CU. FT.

140,200 CU. FT. / 4,384 CU. FT/DAY = 32 DAYS (397 DAYS OF STORAGE)

REVISIONS:
DATE
DATE
DATE
DATE

RESOURCE ENGINEERING ASSOCIATES, INC.
Resource Engineering Associates, Inc.
3510 Parmenter Street, Suite 100
Middleton, Wisconsin 53562-2507
Phone: 608-831-5522
Fax: 608-831-6564
Web: www.reaeng.com

MANURE STORAGE CALCULATION
POULTRY WASTE STORAGE FACILITY
DAYBREAK FOODS, INC.
533 E TYRANENA PARK ROAD
LAKE MILLS, WI 53551

DATE: OCT 2017
DRAWN: JWA
CHECKED: CTC
APPROVED: RJP
DRAWING NAME: 1720 topo nelson 10-12.dwg
PROJECT NUMBER: 170020.1

APP. C

24 October 2017
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Appendix D

WI NRCS Code 313 – Waste Storage Facility

&

WI NRCS Code 522 – Pond Sealing or Lining – Concrete

United States Department of Agriculture

NATURAL RESOURCES CONSERVATION SERVICE
CONSERVATION PRACTICE STANDARD

WASTE STORAGE FACILITY

CODE 313
(NO.)

DEFINITION

An agricultural waste storage impoundment or containment made by constructing an embankment, excavating a pit or dugout, or by fabricating a structure.

PURPOSE

To store manure, agricultural by-products, wastewater, manure processing derivatives, leachate, and contaminated runoff to provide the agricultural operation management flexibility for waste utilization.

CONDITIONS WHERE PRACTICE APPLIES

Use where regular storage is needed for wastes generated by agricultural production or processing, where soils, geology, and topography are suitable for construction of the facility, and where the construction, operation, and maintenance will protect the soil and water resources.

For structures and conduits used to transfer waste and other byproducts, use the Wisconsin NRCS Conservation Practice Standard (WI NRCS CPS) Waste Transfer (Code 634).

For liquid waste storage facilities implemented with an embankment, this practice applies only to low hazard facilities as defined in the NRCS National Engineering Manual (NEM), Part 520 subpart C with a maximum effective height of 25 feet.

This standard applies to:

- Waste storage impoundments or structures up to 30 million gallons in size. Multiple independent storage impoundments or structures, up to 30 million gallons each, may be constructed on the same site if all other conditions are met;
- Waste storage impoundment or structures up to 25 feet of impoundment depth; and
- Facilities that are part of a planned agriculture waste management system intended to meet the facility management goals, regulatory requirements, or nutrient management plans by providing storage of waste.

For the purposes of this standard, liquid waste is used to describe any waste that is too wet to stack. It includes both liquid and slurry waste.

This practice does not apply to the storage of human waste, routine animal mortality, the unstacked waste that accumulates in animal housing units (barns) or animal production areas not intended to store waste (animal confinement/feed areas).

Conservation practice standards are reviewed periodically and updated if needed. To obtain the current version of this standard, contact your Natural Resources Conservation Service (NRCS) State office or visit the Field Office Technical Guide.
USDA is an equal opportunity provider, employer, and lender.

CRITERIA

General Criteria Applicable to All Waste Storage Facilities.

The following criteria establish minimum allowable limits for design parameters, acceptable installation processes, or performance requirements for all waste storage facilities (impoundments and structures).

Laws and Regulations. Plan, design, and construct the waste storage facility to meet all Federal, State, and local laws and regulations. This standard does not contain the text of the federal, tribal, state, or local laws governing waste storage facilities. Regulatory approval may be needed prior to accepting off-site material(s) or adding chemicals to the waste storage facility. The operator is responsible for securing required permits.

Location. Locate and design the waste storage facility such that it is outside the 100-year floodplain unless site restrictions require locating it within the floodplain. Where waste storage facilities are located in flood prone areas, protect these facilities from inundation, structural damage, and instability. Design these facilities to accommodate any additional loading resulting from static water levels or saturated soils. The lowest point at which floodwater could potentially enter the waste storage facility must be 2 feet above the maximum flood elevation resulting from a 100-year, 24- hour rainfall event. Additionally, follow the policy found in the NRCS General Manual (GM) 190, Part 410.25, Flood Plain Management.

Management Assessment

Conduct, document, and incorporate a management assessment into the design. Perform the assessment with the owner/operator to explore options and to determine the purpose of storage components, available resources, manure disposal schemes, sand and manure solids separation methods, and waste characteristics.

The management assessment shall address the following as appropriate to the system being designed:

- Waste Characterization
  - » Sources, volumes, and consistency of manure, contaminated runoff, manure processing derivatives, leachate, wastewater, and other inputs to the waste storage facility
  - » Animal type, size, number and weight
  - » Bedding types and quantity
  - » Chemical characteristics which may impact facility design
- Land base available for utilization of waste
- Method of distribution of manure onto the land base
- Planned storage period
- Waste handling and transfer methods from the waste source to the storage facility
- Facility waste removal methods
- Storage facility liner possibilities and preferences
- Access needs and limitations
- Safety needs, including those to address the hazards of manure gases
- Labor and equipment needs
- Potential odor concerns
- Provisions for facility expansion

When the intent of the owner/operator is to process and/or treat the various waste streams within the animal production area, provide a narrative describing the system. The description will include the intent and purpose of the processing or treatment strategies relative to land spreading or waste distribution strategies, stabilization of organic by-products, separation of sand bedding, reducing pollutant loads, nutrient concentration, waste consistencies, odor control, energy production, and volume reduction.

Site Assessment

Conduct, document, and incorporate a site assessment into the design. Perform the assessment to determine physical site characteristics that will influence the placement, construction, maintenance, and environmental integrity of a proposed waste storage facility, liner(s) and transfer components. Include input from the owner/operator in the site assessment. The site assessment shall include:

- Locations and elevations of buildings, roads, lanes, soil investigations, property lines, setbacks, easements, wells, springs, floodplains, surface waters, surface drains, subsurface drains, utilities, overhead lines, cultural resources, and wetlands.
- The location of sinkholes and other karst features and conduits to groundwater within 1,000 feet of the facility. Features within 1,000 feet of the facility must be further analyzed per WI NRCS Engineering Field Handbook Supplement Chapter 4, Exhibit A (Chapter 4, Exhibit A) to determine if they pose a hazard to the facility or environment.
- Log subsurface investigations for all waste storage facilities sufficient in detail and analysis to support the design in accordance with Chapter 4, Exhibit A. Describe the soil material encountered, location of any seeps, depth to subsurface saturation, and depth to bedrock *(Note: Chapter 4, Exhibit A follows NRCS NEM Part 531, Geology, by utilizing ASTM D2488 procedures)*. Document the location of test pits or soil borings, soil test results, photos taken during the soils investigation, and a narrative describing the design parameters that have been derived from the soils data. *Note the bedrock type, if encountered, such as sandstone, limestone, dolomite, or granite*.
    - » Locate test pits and borings used to meet the criteria within the footprint or no more than 100 feet from the footprint. A minimum of one test pit or boring per 15,000 square feet of footprint, with a minimum of two per facility, is required. Extend these test pits/soil borings to bedrock, a free water surface, or to a minimum depth to ensure subsurface saturation and bedrock separation distances required in this standard or associated Pond Sealing or Lining standards are achieved.
    - » Complete soil tests for sub-soil or sub-liner soils in a laboratory on representative samples of soil beneath the proposed liner grade at a rate of 1 test per 15,000 square feet of facility footprint, with a minimum of two tests. The plasticity index (PI) shall be determined in accordance with ASTM D4318 and the percent fines (% fines) in accordance with ASTM D1140.
    - » Increase the number and distribution of test pits and soil borings needed to characterize the subsurface (soils, saturation, and bedrock) if there is inconsistency within or between test pits or borings.

- » Characterize soil for liners according to Chapter 4, Exhibit A. Include locations, dimensions and elevations, soil volumes, soil samples, testing results, and reclamation plans of any borrow areas. Complete liner soil characterization at a rate of one test per 15,000 square feet of facility footprint, with a minimum of two tests per area. Distribute the test pit or borings evenly across the borrow source. Soils for liners and sub-liners may be located within the footprint of the storage, on site, or off site and transported to the site for construction. Additional soils testing may be needed to meet the requirements of the selected liner type. See the appropriate Pond Sealing or Lining standards and Wisconsin construction specifications for additional criteria.

Separation from Subsurface Saturation or Bedrock. The separation is determined to be the closest distance from any point on the inside surface (bottom and sides) of the storage facility to the feature from which separation is required.

For the purposes of this standard, factors used to identify subsurface saturation shall include observed saturation, gleyed soil, gray redoximorphic features, and soil color in conjunction with nearby surface water features. The highest subsurface saturation elevation in a test pit/soil boring will be identified by any of the following soil properties:

- Free water or wet soil identified by glistening, due to the slow release of water
- Gleyed soil, that may extend uninterrupted from an observed free water surface.
- The presence of distinct gray redoximorphic features with a chroma of 2 or less based on Munsell color charts.
- Depleted matrices having a value of 4 or more and chroma 2 or less based on Munsell color charts. In some cases soil parent materials have a natural color of 2 chroma or less or gleyed color that is not due to saturation. In these cases other indicators may be used such as landscape position, relative elevation or soils in relation to nearby water features.

In soils not conducive to mottling, such as sand, establish the subsurface saturation elevation by evaluating the soil morphology of the soil profile. Other indicators that may be considered in making the determination are the position of the soil in the landscape, topography, nearby wetlands and well construction logs. In sites susceptible to groundwater contamination or complex hydrogeological sites, additional saturation verification methods may be required. Verification methods could include but are not limited to groundwater monitoring wells, piezometers, and soil test pits conducted during the wet season. Other information to consider includes historic precipitation and groundwater elevation records from nearby locations, which can indicate whether or not the area is experiencing a local high or low trend in groundwater elevation.

If the site assessment indicates artesian features, complete a hydrogeologic and geotechnical evaluation of the site to determine the site suitability for an in-ground waste storage facility. Include a piezometer monitoring well below the apparent confining layer and a water table observation monitoring well in the evaluation. Monitor the site through the wettest portion of the groundwater recharge cycle.

Construct and develop groundwater monitoring wells and piezometers according to WI NRCS CPS Monitoring Well (Code 353) or appropriate state monitoring well construction requirements.

Subsurface saturation, pockets of sand and gravel, or water-bearing materials, if encountered, shall not be removed or drained except for perched conditions. Include documentation to demonstrate that subsurface saturation is perched and of drainable extent or its effects otherwise eliminated.

Excavation of bedrock is permitted to achieve the required separation distance as specified in Table 5 or 6 of this standard and tables in associated Pond Sealing or Lining standards. Do not remove bedrock by blasting. Evaluate the exposed bedrock surface to ensure a structurally sound base for liner or other soil material. Treat fractures or voids to prevent migration of soil material. The entire surface of the excavated bedrock shall have a positive grade, minimum of 1 percent, under and away from the storage facility, as to prevent any significant ponding on the rock surface. If bedrock is excavated, the material placed between the liner and the bedrock shall meet the requirements of sub-liner soil in the appropriate Pond Sealing or Lining standards.

Perched Conditions. Pockets of sand and gravel, or other water-bearing materials may be removed or drained to achieve separation distances in Tables 1, 5 and 6 within this standard, or tables in associated Pond Sealing or Lining standards, and to relieve hydrostatic loads on the facility and its liner(s). All drainage systems shall drain to the ground surface or surface water by gravity. Evaluate the effect of temporary tailwater on the structure or liner and the effects of outletting to perennial and intermittent waterways. Locate a drainage system around the outside perimeter of the facility footprint and drain to a surface outlet. Protect outlets against erosion and undermining of the conduit, entry of vegetation, damaging periods of submergences, and entry of rodents or other animals into the subsurface drain. A drainage system may also be located around the outside perimeter of an impoundment floor within the facility footprint if the drainage system enters an observation and pumping port and then continues by gravity to a surface outlet. Design the port such that the outlet can be blocked and a pump can be utilized to remove the polluted liquids until the source is identified and repairs can be completed.

Sensitive Environmental Settings. Wisconsin Sensitive Environmental Settings are sites where one or more of the following conditions are met:

- Bedrock or subsurface saturation separation distances are less than those listed in Tables 1 or 5 of this standard, Table 1 of WI NRCS CPS Pond Sealing or Lining – Compacted Soil Treatment (Code 520), Tables 5 and 6 of WI NRCS CPS Pond Sealing or Lining –Geomembrane or Geosynthetic Clay Liner (Code 521), or Table 2 of WI NRCS CPS Pond Sealing or Lining – Concrete (Code 522);
- Sub-liner soils do not meet both the required thickness and percent fines listed Table 5 of this standard, Table 1 of WI NRCS CPS Pond Sealing or Lining – Compacted Soil Treatment (Code 520) , Tables 5 and 6 of WI NRCS CPS Pond Sealing or Lining –Geomembrane or Geosynthetic Clay Liner (Code 521), or Table 2 of WI NRCS CPS Pond Sealing or Lining – Concrete (Code 522);
- For facilities with one or more sloped sides or structures with vertical sides with the storage floor below existing ground surface, a sinkhole or other karst feature is present within 400 feet horizontally from the footprint of the proposed storage facility; or
- For above ground structures where the storage floor is entirely above existing ground surface, a sinkhole or other karst feature is present within 200 feet horizontally from the footprint of the proposed storage facility.

In-situ soils that do not meet both the sub-liner required thickness and percent fines listed in the applicable liner standard can be removed and replaced with compliant materials. When designed and constructed in this manner, the site is no longer classified as Wisconsin Sensitive Environmental Settings.

Where liquid-storage is to be provided in sensitive environmental settings, design according to WI NRCS CPS Pond Sealing or Lining – Concrete (Code 522), Sensitive Environmental Settings.

Storage Period. The storage period is the maximum length of time anticipated between emptying events. Base the minimum storage period on the timing required for environmentally safe waste utilization considering the climate, crops, soils, equipment, in accordance with the operations and maintenance plan, nutrient management plan and Federal, State, and local regulations.

Design Storage Volume. Calculate design storage volumes with the procedures and default values found in the Wisconsin supplement to Chapter 10 of the NRCS Agricultural Waste Management Field Handbook (AWMFH) or site-specific estimates and measurements documented in the design. Include the sum of the following during the storage period in the design volume:

- The maximum operating level (MOL) for liquid storage facilities is the level that provides the operational volume (Figure 1 contains a diagram of this information). This includes the following:
  - » Manure, wastewater, bedding, and all other wastes accumulated during the storage period.
  - » For liquid storage facilities, include normal precipitation (omit diverted roof runoff) less evaporation during the storage period.
  - » Normal runoff from the facility's drainage area during the storage period. Exclude clean water from the facility to the fullest extent practical except where including the runoff is advantageous to the operation of the agricultural waste management system.
  - » Additional storage when required to meet management goals or regulatory requirements.
- Emergency Volume (liquid storages only) includes the following:
  - » 25-year, 24-hour precipitation on the surface of the liquid storage facility at the maximum level of the required design storage.
  - » 25-year, 24-hour runoff from the facility's drainage area.

Remaining Waste. Add a minimum of two feet to storage depth for facilities with side slopes and one foot for vertical walled facilities for planned maximum remaining waste. The additional storage depth can be reduced if a sump is installed or other provisions to empty the facility have been made. The anticipated method for solids removal must be accommodated in design, particularly in determining the configuration of impoundments and the type of liner to be used and maintained.

Freeboard Volume. This volume applies to liquid waste storage exposed to precipitation. Add a minimum of one foot of depth to the design storage volume to reduce the risk of overtopping. This depth is not intended to add storage capacity.

Inlet. Design inlet to resist corrosion, plugging, freeze damage, and ultraviolet deterioration. Incorporate erosion protection for in-place earth (Table 1 of this standard), clay liner (WI NRCS CPS Pond Sealing or Lining – Compacted Soil Treatment (Code 520), Table 1), and geosynthetic clay liners (WI NRCS CPS Pond Sealing or Lining –Geomembrane or Geosynthetic Clay Liner (Code 521), Table 6).

Waste Removal. Provide components for removing waste such as gates, pipes, docks, wet wells, pumping platforms, retaining walls, or ramps. Incorporate features to protect against erosion, tampering, and accidental release of stored waste as necessary. Design ramp slopes to accommodate anticipated equipment and traction available. Use WI NRCS CPS Nutrient Management (Code 590) for land application of stored material or follow other disposal options outlined in a Comprehensive Nutrient Management Plan (CNMP).

Outlet. An outlet that can automatically release stored material is not permitted except for outlets leading to another storage facility with adequate capacity for releases due to accident or system component failure. Design a permanent outlet that will resist corrosion and plugging. Provide a backflow prevention measure for an outlet that pumps wastewater to secondary storage located at a higher elevations.

Staff Gauge. Place a staff gauge or other permanent marker that does not compromise the integrity of the liner in the liquid storage facility to clearly indicate the following elevations:

- Maximum operating level (top of the operational volume).
- Emergency level (top of the design storage volume).
- State or local codes may require additional markers.

For storages where the contents or staff gage are not visible, such as below a slatted floor, identify the method for the operator to measure the depth of stored waste.

Safety. Identify and minimize the hazards to animals and people in the safety design. In particular, waste storage facility designs may create confined spaces, which may pose significant hazards in terms of the inhalation of poisonous gases, asphyxiation, or explosion. At a minimum, the safety design shall include the following:

- Include appropriate safety features to minimize the hazards of the facility (refer to American Society of Agricultural and Biological Engineers (ASABE) Standard EP470, Manure Storage Safety for guidance, as needed). Design and operate confined spaces where human entry might occur in compliance with the provisions contained in ASABE EP470, Manure Storage Safety.
- Characterize and identify any combination of effluent and amendments currently in use that may have the potential to create hazardous conditions.
- Provide warning signs, fences, ladders, ropes, bars, rails, and other devices as appropriate, to ensure the safety of humans and livestock. Provide ventilation and warning signs for covered waste holding facilities, as necessary, to prevent explosion, poisoning, or asphyxiation.
- Install safety stops, gates, or both at push-off ramps and load-out areas of impoundments and structures to reduce the potential for accidental entry of machinery.
- Ensure equipment access ramps and embankment slopes are compatible with the equipment intended to be used.
- Design covers and grating over openings such that livestock or humans cannot accidentally displace them and fall into the facility.
- Design pipelines with a water-sealed trap and vent, or similar device, if there is a potential for gases from the pipe to accumulate in confined spaces.

- Place a fence around impoundments and uncovered tanks which have exposed walls less than 5 feet above ground surface. Use the WI NRCS CPS Fence (Code 382) for design of a fence that will restrict access to safety hazards by people and animals likely to be onsite. Post universal warning signs to prevent children and others from entering liquid waste storage facilities.
- Safety features should be added to the Operation and Maintenance Plan.

Roofs and Covers. Use WI NRCS CPS Roofs and Covers (Code 367) for design of waste storage facility covers or roofs, as needed.

Failure Analysis. Evaluate the overall functionality of the waste storage facility for possible malfunctions which could lead to sudden breach of embankment or accidental release of waste from the storage facility under normal operational conditions. Identified failure modes should be addressed in the design phase, the operation and maintenance plan, and the emergency action plan.

The Failure Analysis should include features, safeguards, and/or management measures to minimize the risk of failure or accidental release, or to mitigate impact of this type of failure when any of the features listed below might be significantly affected:

- Human safety
- Surface water bodies – perennial and intermittent streams, lakes, wetlands and estuaries
- Conduits to groundwater
- Artesian well features
- Critical habitat for threatened and endangered species
- Riparian areas
- Farmstead, or other areas of habitation
- Off-farm property
- Historical and archaeological sites or structures

Seeding and Mulching. Seed and mulch disturbed areas and embankments in accordance with WI NRCS CPS Critical Area Planting (Code 342).

Additional Criteria for Liquid Waste Storage Impoundments

The following criteria establish **additional** design parameters, acceptable installation processes, or performance requirements for waste storage impoundments.

Foundation. Locate the impoundment in soils with a permeability that meets all applicable regulations (Table 1 meets the specific discharge requirements specified in the National Engineering Handbook (NEH), Part 651, Agricultural Waste Management Field Handbook (AWMFH), Chapter 10, Appendix 10D). Alternately, line the impoundment with suitable material. If a liner is needed, use liners which meet or exceed WI NRCS CPS Pond Sealing or Lining – Compacted Soil Treatment (Code 520), Pond Sealing or Lining –Geomembrane or Geosynthetic Clay Liner (Code 521), or Pond Sealing or Lining – Concrete (Code 522). Construction shall not occur on or with organic soils.

A combination of liners is acceptable. Join the liners so as to preserve the performance and integrity of all liner types. Concrete walls used within impoundments shall maintain the integrity of any liner. Construct and maintain any penetration and overfall/outfalls of the liner to maintain the performance and integrity of the liner used.

Waste storage impoundments that store milkhouse waste or feed storage runoff may be subject to the requirements of Wisconsin Administrative Code, Chapter NR 213 (NR 213) if the operation is considered a CAFO or if compliance with NR 213 is required by other NRCS standards. NR 213 contains requirements not contained within this standard. If the waste storage impoundment is regulated under NR 213, the design must meet the requirements of both NR 213 and this standard.

Embankments. Minimum design requirements for in place earth storages are listed in Table 1. Minimum embankment top widths are shown in Table 2. Design the combined side slopes of the settled embankment to be equal to or flatter than 5 horizontal to 1 vertical. Interior side slopes must meet the design requirements listed in either Table 1 or the selected liner requirements, found in the pond liner standards (WI NRCS CPS Pond Sealing or Lining – Compacted Soil Treatment (Code 520), Pond Sealing or Lining –Geomembrane or Geosynthetic Clay Liner (Code 521), and Pond Sealing or Lining – Concrete (Code 522)). Exterior side slopes may be no steeper than 2 horizontal to 1 vertical.

The top of the embankment may be constructed to drain, either toward or away from the stored waste, as desired by the designer. Add additional material above the required top width to accommodate desired drainage.

Increase the constructed embankment height by at least 5 percent to allow for settlement. After settlement, the top of the embankment shall be greater than or equal to 1 foot above the surrounding grade. Stabilize all embankments to prevent erosion or deterioration. Compact according to WI FOTG Construction Specification 204, Earthfill for Waste Storage Facilities or Construction Specification 300, Clay Liner, as applicable. For an impoundment with greater than one acre of surface area and where wave action is a concern, increase the embankment height to account for calculated wave height.

Any diversion or waterway along the embankment shall have a capacity for 25-year, 24-hour storm plus 0.5 feet of freeboard, with a minimum depth of 1 foot.

Construct a core trench whenever the settled embankment fill height at the centerline is greater than or equal to 10 feet. Minimum dimensions of the core trench shall be 8-foot bottom width, 2-foot depth, and 1 horizontal to 1 vertical or flatter side slopes.

Spillway or Equivalent Protection. For a facility having an effective height greater than 20 feet, construct an auxiliary (emergency) spillway designed to handle the peak flow or routed peak flow from the 25-year, 24-hour precipitation event, as defined in the Design Storage Volume section of this standard. The crest of the spillway shall be sited above the design storage volume elevation.

Excavations. Design embankments and excavated side slopes to meet the requirements of the liner used; see WI NRCS CPS Pond Sealing or Lining – Compacted Soil Treatment (Code 520), Pond Sealing or Lining –Geomembrane or Geosynthetic Clay Liner (Code 521) and Pond Sealing or Lining – Concrete (Code 522), as applicable.

Table 1. In-Place Earth Criteria for Waste Storage Facility Impoundments 20 Feet Deep or Less [Note 1, 2]

Size		
Design Storage Volume	≤ 300,000 cu. feet	> 300,000 cu. feet
Manure Produced at Farm per Year	≤ 600,000 cu. feet	> 600,000 cu. feet
Waste Characteristics	≥ 4% manure solids in stored waste, ruminant animals only	All
Soils (In Place)		
% Fines	≥ 40%	≥ 40%
Plasticity Index (PI)	≥ 7	≥ 12
Total Thickness (measured perpendicular to storage surface, includes thickness of recompacted layer)	≥ 5 feet [Note 3]	≥ 5 feet [Note 3]
Thickness of Recompacted Surface Layer	≥ 1 foot	≥ 1 foot
WI FOTG Construction Specification for Recompacted Layer	204, Earthfill for Waste Storage Facilities	300, Clay Liner
Sub-Soil [Note 4]		
% Fines	≥ 20%	≥ 20%
Plasticity Index (PI)	—	—
Thickness (bottom and sides)	≥ 3 feet	≥ 3 feet
Separation Distances		
Well Distance [Note 5]	≥ 250 feet	≥ 250 feet
Sinkholes or Other Karst Features	≥ 800 feet	≥ 400 feet
Subsurface Saturation	≥ 8 feet	≥ 8 feet
Bedrock	≥ 8 feet	≥ 8 feet
Impoundment		
Inside Slope	2.5:1 or flatter	
Embankment	Construct with material meeting criteria in the Soils (In Place) rows of this table, to the total thickness and applicable compaction specification for the recompacted 1 foot surface layer. Place material complying with the sub-soil requirements listed in this table underneath the Soils (In Place) thickness, compacted to WI FOTG Spec 204.	

Other		
Scour Protection	Agitation and Pumping Locations	Minimum 20 feet wide x 30 feet long x 4 inches thick concrete pad or sump in bottom and 20 feet wide ramp or a 16-foot wide ramp with 12-inch high curbs to the top of the facility.
	Scraping and Other Mechanical Means of Removing Solids and Sand	Protect with hard surfacing designed for the expected conditions and loads, a minimum of 4 inches thick.
Existing Field Drain Tile	Additional site investigation shall be completed to determine the presence of existing subsurface drain or underground outlet within 100 feet of the footprint of the facility. Any tile found must be abandoned or removed.	

Note 1 The depth is measured from the bottom of the impoundment to the maximum operating level.
Note 2 Facilities in this table do not meet the requirements of NR 213.
Note 3 Thickness is calculated based on a maximum permeability of $1x10^{-7}$ cm/sec
Note 4 Sub-soils are located beneath the required in place soils and above subsurface saturation or bedrock. Sub-soils must be in situ materials.
Note 5 Community water system wells may require larger separation distances (see Wisconsin Administrative Code, Chapter NR 811 (NR 811)).

Table 2. Minimum Embankment Top Widths

Effective Height (feet)	Top width (feet)
< 15	8
15–19.9	10
20–25	12

Additional Criteria for Fabricated Structures

The following criteria establish **additional** design parameters, acceptable installation processes, or performance requirements for waste storage structures.

Foundation. Based on subsurface investigation, provide a foundation for fabricated waste storage structures to safely support all superimposed loads without excessive movement or settlement.

Total and Differential Settlement. Where a non-uniform foundation cannot be avoided or where applied loads may create highly variable foundation loads, calculate differential settlement based upon site-specific soil test data. Index tests (such as Atterberg limits, moisture content, etc.) of site soils may allow correlation with similar soils for which test data is available.

Bearing Capacity. If no site specific test data are available, presumptive bearing strength values for assessing actual bearing pressures obtained from Table 3 or another nationally recognized building code may be used. In using presumptive bearing values, provide adequate detailing and articulation to avoid distressing movements in the structure (i.e., settlement).

Structural Loadings. Design the waste storage structure to withstand all anticipated loads in accordance with the requirements in NRCS NEM, Part 536, Structural Design. Such loads should include internal and external loads, hydrostatic uplift pressure, concentrated surface and impact loads, and water pressure due to subsurface saturation, frost or ice. If a dense ice cover can be expected, account for the additional point load associated with an ice sheet against a vertical wall.

Calculate loading from lateral earth pressures using soil strength values determined from the results of appropriate soil tests and procedures described in NRCS Technical Release 210-74, Lateral Earth Pressures. Table 4 provides minimum lateral earth pressure values when soil strength tests are not available. If heavy equipment will operate near the wall, use an additional soil surcharge as indicated in footnote 4 in Table 4 in the wall analysis.

For the lateral load from stored waste not protected from precipitation, use a minimum 65 pounds/square foot/foot of depth as the design internal lateral pressure. Use a minimum value of 60 pounds/square foot/foot of depth for the lateral load from stored waste protected from precipitation and not likely to become saturated. Use a minimum internal lateral pressure of 72 pounds/square foot/foot of depth for sand-laden manure storage if the percentage of sand exceeds 20%. Designers may use lesser values if supported by measurement of actual pressures of the waste to be stored.

Design structures covers to withstand both dead and live loads. Use the minimum live load values for covers contained in ASABE EP378, Floor and Suspended Loads on Agricultural Structure Due to Use, and in ASABE EP393, Manure Storages. Use the actual axle load for tank wagons having more than a 2,000 gallon capacity.

If the facility is to have a roof, use WI NRCS CPS Roofs and Covers (Code 367) for design of waste storage facility covers or roofs, as needed. Use snow and wind loads specified in American Society of Civil Engineers (ASCE) SEI/ASCE 7-10 or newer version, Minimum Design Loads for Buildings and Other Structures. If the facility is to serve as part of a foundation or support for a building, consider the total load in the structural design.

Table 3. Presumptive Allowable Foundation and Lateral Pressure Note 1

Class of materials	Allowable foundation pressure (pounds per square foot)	Lateral bearing	Coefficient of friction	Cohesion (pounds per square foot)
Crystalline bedrock	12,000	1,200	0.70	-
Sedimentary and foliated rock	4,000	400	0.35	-
Sandy gravel or gravel (GW and GP)	3,000	200	0.35	-
Sand, silty sand, clayey sand, silty gravel, clayey gravel (SW, SP, SM, SC, GM and GC)	2,000	150	0.25	-
Clay, sandy clay, silty clay, clayey silt, silt and sandy silt (CL, ML, MH and CH)	1,500	100	-	130

Note 1 International Building Code (IBC), 2015, International Code Council (ICC)

Concrete Joints. Wall control joints with embedded waterstop – Cast-in-place cantilevered vertical walls shall have a control joint spacing less than 100 feet of running wall length, including around corners and bends. This criterion does not apply to hoop strength design or tanks with pin connections at both the top and bottom of the wall.

TABLE 4. LATERAL EARTH PRESSURE VALUES [Note 1]

Description of backfill material [Note 2]	Unified soil classification [Note 3]	Design lateral soil load (pounds/square foot/foot of depth) [Note 4]
Well-graded, clean gravels; gravel-sand mixes [Note 5]	GW	60
Poorly graded clean gravels; gravel-sand mixes	GP	60
Silty gravels, poorly graded gravel-sand mixes	GM	60
Clayey gravels, poorly graded gravel-sand mixes	GC	60
Well-graded, clean sands; gravely sand mixes	SW	60
Sand-silt clay mix with plastic fines	SP	60
Silty sands, poorly graded sand-silt mixes	SM	60
Sand-silt clay mix with plastic fines	SM-SC	100
Clayey sands, poorly graded sand-clay mixes	SC	100
Inorganic silts and clayey silts	ML	100
Mixture of inorganic silt and clay	CL-ML	100
Inorganic clays of low to medium plasticity	CL	100
Inorganic clayey silts, elastic silts	MH	Note 6
Inorganic clays of high plasticity	CH	Note 6

[Note 1] Table 1610.1, Lateral Soil Load, International Building Code (IBC), 2015, International Code Council (ICC). For lightly compacted soils (85% to 95% maximum standard density). Includes compaction by use of typical farm equipment.

[Note 2] Base the definition and classification of soil in accordance with ASTM D2487 and D2488.

[Note 3] All definitions and procedures in accordance with ASTM D2488 and D653.

[Note 4] Design loads based on moist conditions for the specified soils at optimum density. Include the weight of the buoyant soil plus hydrostatic pressure for submerged or saturated soil. Pressures are calculated for level backfill for a distance equal to the wall height. If backfill exceeds wall height at a distance equal to or less than the wall height, increase pressures accordingly. If equipment loads are expected or are possible to operate within a distance equal to the wall height behind the wall, use an additional live load soil surcharge equal to 2 feet of backfill for 5,000 pound wheel loads and more or less for other wheel loads, as appropriate.

[Note 5] Generally, only washed materials are in this category.

[Note 6] Not recommended. Requires special design if used.

Waterstop. Use embedded or expansive waterstop in accordance with WI Construction Specification 004-WS Embedded or Expansive Waterstop. The type of waterstop is based on the joint movement criterion indicated below.

Install an embedded waterstop at the wall to footing intersection if the joint is designed for movement. Install either an expansive or embedded waterstop at this joint if it is not designed for movement (fixed).

If there is no embedded waterstop at the wall base, cast the wall joint waterstop a minimum of 4 inches into the footing. If there is an embedded waterstop between the footing and the bottom of the wall, weld the wall joint waterstop to a factory fabricated intersection at the base of the wall.

Floor joints in vertical walled structures, if used, should be extended through the footing and continue to the top of the vertical wall. Joints and liner shall meet the criteria listed in WI NRCS CPS Pond Sealing or Lining – Concrete (Code 522).

Joints for pre-cast walls shall demonstrate evidence of equivalent performance to waterstop joints as determined by the NRCS State Conservation Engineer.

Make transitions from concrete wall footings to concrete slabs at a ratio of one inch of thickness change to one inch of run (1:1) or flatter.

Structural Design. Design structures with reinforced concrete, steel, wood, or masonry materials in accordance with NRCS-NEM, Part 536, Structural Engineering. Account for all items that will influence the performance of the structure, including loading assumptions, durability, serviceability, material properties, construction quality, waterstops, pipe penetration, channel penetrations, anchor plates, or other attachments to walls such as fence posts. Ensure that the material used for a fabricated structure is compatible with the waste product to be stored.

Indicate design assumptions and construction requirements on the construction plans. Construct any penetration of the structure to maintain the performance and integrity of the structure.

Tanks may be designed with or without a cover. Design covers, beams, or braces that are integral to structural performance accordingly and indicate their location and design requirements on the construction drawings. Design openings in a covered tank to accommodate equipment for loading, agitating, and emptying. Equip these openings with fencing, grills or secure covers for safety, and for odor and vector control as necessary.

Fabricated structures shall be designed according to the following criteria:

- Steel: "Manual of Steel Construction," American Institute of Steel Construction.
- Timber: "National Design Specifications for Wood Construction," American Forest and Paper Association.
- Concrete: "Building Code Requirements for Reinforced Concrete, American Concrete Institute (ACI) 318". Concrete design calculations shall use a minimum design compressive strength of 3,500 psi. or "Code Requirements of Environmental Engineering Concrete Structures, ACI 350.
- Concrete used as part of a structure: WI Construction Specification 4, Concrete.

Separation Distance. All fabricated structures must meet the separation distances listed in Table 5 below.

TABLE 5. WASTE STORAGE STRUCTURE SEPARATION DISTANCES

Feature	Separation Distance
Well Distance [Note 1]	≥ 100 feet
Sinkholes or Other Karst Features	
Storage floor above ground	≥ 200 feet
Storage floor below ground	≥ 400 feet
Subsurface Saturation, Bedrock	See WI CPS 522 Table 2 or 3
Sub-Liner Soil	See WI CPS 522 Table 2A

[Note 1] For operations subject to Wisconsin Administrative Code, Chapter NR 243 (NR 243), the private or non-community well separation distances is 250 feet, community water system wells may require larger separation distances (see NR 811).

Additional Criteria - Stacking Facilities

This criteria applies to stacking the following materials at the animal production area:

- Separated manure solids
- Compost
- Dewatered, recycled sand storage
- Poultry litter (turkey or broiler operations)
- Dry poultry layer manure
- Bedded manure (>50% solids)
- Waste feed

Criteria for stacking facilities are shown in Table 6. Solids stacking within the animal production area may be done in an impoundment, fabricated structure or stacking slab, when provisions are made to capture seepage and runoff for long term storage.

A stacking facility may be open, covered, or roofed and is used for wastes which behave primarily as solid. Determine the wall height using the anticipated stacking angle of the waste material. Construct a stacking facility of durable materials such as reinforced concrete, reinforced concrete block, or treated lumber. Design the stacking facility with adequate safety factors to prevent failure due to internal or external pressures, including hydrostatic uplift pressure and imposed surface loads such as equipment which may be used within, on, or adjacent to the structure.

TABLE 6. LINER CRITERIA FOR PERMANENT SOLIDS STACKING FACILITIES AT THE ANIMAL PRODUCTION AREA [Note 1]

	Roofed		Not Roofed	
	Work Surface [Note 2]	No Surface [Note 3]	Work Surface [Note 2]	No Surface [Note 3]
Soils In-Place Liner [Note 3]				
% Fines	≥ 30%	≥ 30%	≥ 40%	≥ 40%
Plasticity index (PI)	-	≥ 7	-	≥ 7
Thickness	≥ 2 feet	≥ 2.5 feet	≥ 3 feet	≥ 5 feet
Soils Compacted Liner [Note 3]				
% Fines	≥ 30%	≥ 40%	≥ 40%	≥ 40%
Plasticity index (PI)	≥ 5	≥ 7	≥ 7	≥ 7
Thickness	≥ 1.5 feet	≥ 2 feet	≥ 2 feet	≥ 3 feet
Compaction	WI Spec 204	WI Spec 204	WI Spec 204	WI Spec 204
Separation Distances				
Sinkholes	≥ 400 feet	≥ 400 feet	≥ 400 feet	≥ 400 feet
Well distance [Note 4]	≥ 100 feet	≥ 100 feet	≥ 100 feet	≥ 100 feet
Subsurface Saturation	≥ 3 feet	≥ 3 feet	≥ 5 feet	≥ 5 feet
Bedrock	≥ 3 feet	≥ 3 feet	≥ 5 feet	≥ 5 feet
Stacking Area	Stacking area not to exceed 7 acres for unroofed managed compost, 2 acres for sand, 2 acres for roofed facilities, or 1 acre for all other materials.			

[Note 1] Solids and sand stacking facilities, treatment areas and other production area structures and systems may be subject to surface water setbacks and other requirements under state and local rules. MOL requirements do not apply to this Table.

[Note 2] The work surface may be constructed of any of the following: minimum 3 in. for asphalt; minimum 4 in. for concrete; or minimum 8 in. for macadam, and designed for anticipated equipment loads. Refer to industry standard design criteria for each work surface material. The purpo--se of the work surface is to protect the liner material.

[Note 3] Facilities without a work surface must be operated to minimize rutting and removal of the soil liner. Ruts must be repaired and the soil liner thickness maintained after material handling. Stacking height is not to exceed 10 feet.

[Note 4] Additional separation distances to wells may be necessary on WDNR regulated farms.

Seepage. All facilities lacking permanent, engineered roofs are considered not roofed for the purposes of this standard. Tarps, plastic coverings, or other temporary measures are considered not roofed. Facilities that are not roofed must have floors sloped to control surface drainage and all leachate and runoff (up to the 25-year, 24-hour storm) must be managed. Prevent influent seepage in amounts that would infringe on designed storage capacity. Seepage control may not be necessary on sites that have a roof or waste material with little seepage potential.

Internal Drainage. Make provisions for drainage of leachate, and rainfall from the stacking areas without a roof. Collect leachate and runoff in a facility suitable for liquid containment (as defined within this standard) or transfer receptacle WI NRCS CPS Waste Transfer (Code 634), until land applied in accordance with WI NRCS CPS Nutrient Management (Code 590), or provide other acceptable treatment.

Poultry Litter Stacking Facility. To reduce the potential for spontaneous combustion damage to wood walled facilities, design the height of the litter stack not to exceed 7 feet, with litter to wood contact limited to 5 feet. Compost facilities should be designed and operated to meet the requirements of WI NRCS CPS Composting Facility (Code 317).

Design facilities to prevent run-on and runoff, and operate them to prevent ponding and significant hydrostatic head. Facilities may commonly be located near the ground surface, but may be above or below ground. Determine the wall height using the anticipated stacking angle of the waste material.

CONSIDERATIONS

Additional recommendations relating to design which may enhance the use of, or avoid problems with, this practice, but are not required to ensure its basic conservation function are as follows:

Consider using the companion documents located in Chapter 10 of the NRCS, Agriculture Waste Management Field Handbook (AWMFH).

Consider using the Waste Storage Design spreadsheet located in Chapter 10 of the NRCS AWMFH for design storage volume, liner thicknesses, and other calculations described in this standard.

This standard does not preclude the addition of other off farm organic materials not specifically prohibited by standard, pending approval by the appropriate regulatory authority. During planning, consider discussing the potential for off farm organic material storage with the landowner. Encourage the landowner to investigate the impact of accepting off farm organic material to waste consistency, toxic gas generation, nutrient management, and remaining volume prior to accepting any off farm waste. Incorporate any additional operation or maintenance requirements resulting from these discussions.

Consider implementing erosion control methods on the top half of the inside slopes of earthen impoundments.

Consider adding agitation locations on different sides of the storage facility, or different cardinal directions, allowing the location of agitation to be adjusted if wind directions change.

Consider adding curbs, structural or visual components, to all agitation and pumping locations, which may reduce the risk of accidental entry and damage to the liner during agitation.

When designing impoundment embankments, consider using flatter slopes on the outside embankment slope for better operation access and easier maintenance.

Consider adding an auxiliary spillway, additional embankment height, or both as needed to help protect the embankment, particularly for systems that store large volumes of runoff. Factors such as downstream hazards and receiving waters should be evaluated in this consideration.

Consider adding or including steel reinforcement in slabs that will be scraped; this may prevent vertical displacement at crack locations.

Consider placing a permanent marker to designate the empty level. This consideration is particularly important for operations considering future herd expansion to WPDES permit size (see Figure 1).

Monitoring and leakage collection systems should be considered for larger waste storage facilities, especially where the site assessment indicates the area is sensitive for groundwater impacts. This is particularly important for operations considering future expansion to WPDES permit size. Components of a designed system may include secondary containment (soil or synthetic), leachate collection, leachate recirculation, monitoring sumps, and/or monitoring wells. See Wisconsin Administrative Code, Chapter NR 141 (NR 141) for regulations concerning monitoring wells.

For exposed liners utilizing HDPE or similar materials that are slippery when wet, consider the use of textured liners or addition of features such as tire ladders that would allow for escape from the waste storage facility.

Consider solid/liquid separation of runoff or wastewater entering impoundments to minimize the frequency of accumulated solids removal and to facilitate pumping and application of the stored waste.

Due consideration should be given to environmental concerns, economics, the overall waste management system plan, and safety and health factors.

Since the economics and risks associated with waste storage facilities are quite high, consider providing the operator with the cost to close the facility. Cost should include removal of the planned sludge accumulation volume and the waste stored at the maximum operating volume.

Consider using well construction logs within ½ mile of the proposed facility, available from the Wisconsin Geologic and Natural History Survey and/or the Wisconsin Department of Natural Resources, which promote understanding of water supply aquifers in the area along with area hydrogeology.

Considerations for Improving Air Quality

Liquid manure storage may result in emissions of volatile organic compounds, ammonia, hydrogen sulfide, methane, nitrous oxide, and carbon dioxide. Solid manure storage may result in emissions of particulate matter, volatile organic compounds, ammonia, carbon dioxide, and nitrous oxide.

To reduce emissions of greenhouse gases, ammonia, volatile organic compounds, particulate matter and odor, other WI NRCS CPSs such as Anaerobic Digester (Code 366), Roofs and Covers (Code 367), Waste Treatment (Code 629), Amendments for Treatment of Agricultural Waste (Code 591), and Composting Facility (Code 317) can be added to the waste management system. Additionally, consider adding the following components: siting of livestock housing or feedlots, manure storage, and land application; biofilters; feed ration additives and adjustments; manure additives, disinfectants, or aeration; incorporation of manure when land-applied; moisture and dust control within livestock housing areas; and dead animal disposal plans.

For additional information on odor abatement, see ASABE EP379.54 April 2012, Management of Manure Odors.

Adjusting pH below 7 may reduce ammonia emissions from the waste storage facility but may increase odor when waste is surface applied - see WI NRCS CPS Nutrient Management (Code 590).

Some fabric and organic covers have been shown to be effective in reducing odors.

Maintain appropriate manure moisture content for solid manure storage facilities. Excessive moisture will increase the potential for air emissions of volatile organic compounds, ammonia, and nitrous oxide, and may lead to anaerobic conditions, which will increase the potential for emissions of methane and hydrogen sulfide. Too little moisture will increase the potential for particulate matter emissions.

PLANS AND SPECIFICATIONS

Prepare plans and specifications that describe the requirements for applying the practice to achieve its intended use. As a minimum, include the following in the engineering plans and specifications:

- Plan view of system layout.
- Minimum of two cross sections, perpendicular to each other, for each waste storage facility.
- Structural details of all components, including reinforcing steel, type of materials, thickness, anchorage requirements, and lift thickness, sufficient to clearly show the construction requirements.
- Locations, sizes, and type of pipelines and appurtenances including a profile of the waste transfer system.
- Requirements for foundation and preparation and treatment, including bedrock treatment.
- Surface Drainage/Grading plan.
- Subsurface drainage details.
- Location of soil test pits within 100 feet of the facility footprint on the plan view, and a summary of soil logs plotted on the cross sections or profile, with subsurface saturation and bedrock elevations marked, if encountered.
- Safety features, roof covers, fencing, ladders, and safety signs.
- Construction site erosion control practices.
- Specifications for materials and installation.
- Vegetative requirements.
- Quantity of materials.
- Approximate location of utilities and notification requirements.
- Other site-specific information necessary to construct the waste storage facility.
- Applicable Wisconsin Construction Specifications.
- Signature of the person responsible for the design, their engineering stamp, NRCS Job Approval or WDATCP Agricultural Engineering Practitioner Certification level, the date, and a statement attesting the plans meet the requirements of the this standard and appropriate liner standard.

The following information should be included only if applicable to the project:

- Details for joining different liner types or new liners to existing liners.
- Waterstop joint layout for slabs and walls.
- References to components supplied by others (pumps, etc.).
- Identification of borrow source location(s).
- Reclamation plans for borrow area.

Engineering Design Documentation. Prepare engineering design documentation in compliance with the Design Deliverables in the WI NRCS Statement of Work for the WI NRCS CPS Waste Storage Facility (Code 313), and demonstrate that the criteria in the NRCS practice standard have been met. Include all substantiating data, assumptions, computations and analyses in design documentation. The design documentation shall include:

- Management assessment,
- Site assessment,
- Operation and maintenance plan,
- Construction plan,
- Construction Quality Assurance Plan,
- Engineering computations, such as runoff, structural (unless using NRCS Standard Drawings), earthwork quantities, and volumetric computations for sizing of waste storage facility.

Construction Quality Assurance Plan

A construction quality assurance plan is required that describes the type and frequency of testing, items requiring observation, and the documentation required. The plan shall be approved by a person with NRCS Job Approval, WDATCP Agricultural Engineering Practitioner Certification, a Wisconsin registered professional engineer, or staff under the direction and control of the person holding the aforementioned credentials. The construction quality assurance plan shall address all the following items:

- Contact information and responsibilities of key parties (including owner, designer, construction observer, and contractor).
- Pre-construction meeting agenda items (including quality assurance plan, construction plans and specifications, design change procedures, and critical project-specific items).
- Observation and construction verification (including items to be verified, sequencing, layout/staking, notification requirements, and onsite materials testing documentation).
- Items to be noted on as-built plans, job diary, and other certification (attesting) documentation.

OPERATION AND MAINTENANCE

Develop an operation and maintenance plan that is consistent with the purposes of the practice, its intended life, safety requirements, and the criteria for its design. At a minimum, the plan will contain where appropriate:

Include a narrative describing the purpose of the system or structure and how it is intended to operate. This narrative should include design criteria such as number and type of animals, type of waste, type of bedding, days of storage, method for emptying, vehicle sizes intended to operate within or near the system and other pertinent operational information. Include the operational requirements for emptying the storage facility, including the expected storage period. .Also include the requirement that waste be removed from storage and utilized at locations, times, rates, and volume in accordance with the overall waste management system plan and WI NRCS CPS Nutrient Management (Code 590).

Manage the stored waste such that it remains below the maximum operating level during normal operating conditions. Include a contingency plan, which shall be implemented when the maximum operating level is reached. The contingency plan shall include how to handle unexpected volumes of wastewater and/or runoff that could cause the system to overflow or negatively impact the liner before scheduled emptying can occur. The contingency plan shall provide for the safe disposition of waste. Include requirements for location and methods of waste removal and emergency disposal.

For impoundments and other liquid storages include an explanation of the staff gauge or other permanent marker to indicate the maximum operating level. For storages where the contents are not visible and a staff gauge would not be visible, such as below a slatted floor, identify the method for the operator to measure the depth of accumulated waste. Include requirements for monitoring the waste level relative to the permanent maximum operating level markers or indicators.

Include a provision for emergency removal and disposition of liquid waste in the event of an unusual storm event that may cause the waste storage facility to fill to capacity prematurely.

If an observation and pumping port is installed, monitor the discharge in the port for flow depth and pollutants. If pollutants are identified, block the gravity outlet and utilize a pump to remove the polluted liquids until the source is identified and repairs can be completed. Pump pollutants to an appropriate location (e.g. pumped back to the structure or spread per a nutrient management plan).

Describe safety issues and procedures/requirements connected with waste storage facilities, including confined spaces. Include additional measures needed to address the fatal or serious inhalation hazards of gases including, but not limited to, hydrogen sulfide (H2S), carbon dioxide (CO_2), methane (CH_4), and ammonia (NH3), which may or may not exist where manure gases are generated through the handling of liquid or semi-solid manure through activities such as pumping, mixing, agitating, spreading, or cleaning-out. Agitating open-air manure storage facilities can be especially hazardous when high humidity and low winds may cause hydrogen sulfide gas to reside near the storage.

Include instructions as needed for ventilating confined spaces according to ASABE Standard S607, Venting Manure Storages to Reduce Entry Risk.

Develop an emergency action plan for waste storage facilities where there is a potential for significant impact from breach or accidental release. Include site-specific provisions for emergency actions that will minimize these impacts.

Include a requirement to contact the appropriate regulatory authority for approval prior to storing any off-farm waste material in a waste storage facility that has been constructed using the criteria in this standard.

Include a description of the routine maintenance needed for each component of the facility. Also include provisions for maintenance that may be needed as a result of waste removal or material deterioration and requirements for inspecting and maintaining the structural components and mechanical systems.

Maintain appropriate manure moisture content for solid manure storage facilities. Excessive moisture will increase the potential for air emissions of volatile organic compounds, ammonia, and nitrous oxide, and may lead to anaerobic conditions, which will increase the potential for emissions of methane and hydrogen sulfide. Too little moisture will increase the potential for particulate matter emissions.

REFERENCES

American Society for Testing and Materials. Annual Book of ASTM Standards. Standards D 653, D 698, D 1140, D 1760, D 2487, D 2488, D5084. ASTM, Philadelphia, PA.

American Society of Civil Engineers (ASCE), Minimum Design Loads for Buildings and Other Structures, SEI/ASCE 7-10 or newer version.

American Society of Agricultural and Biological Engineers (ASABE), Standards EP378, EP393, EP379, and EP470.

Manual of Steel Construction, American Institute of Steel Construction.

National Design Specifications for Wood Construction, American Forest and Paper Association.

USDA NRCS. 1992. Agricultural Waste Management Field Handbook. USDA-NRCS, Washington, DC.

USDA NRCS. General Manual. USDA-NRCS, Washington, DC.

USDA NRCS. National Engineering Manual. USDA-NRCS, Washington, DC.

USDA NRCS. National Handbook of Conservation Practices.

USDA NRCS Wisconsin Field Office Technical Guide (FOTG), Section IV, Practice Standards and Specifications.

USDA Soil Conservation Service. 1989. Technical Release Number 74, Lateral Earth Pressures, USDA-SCS, Washington, DC.

Wisconsin Administrative Code, Department of Natural Resources, Chapters NR 141, NR 213, NR 243 and NR 811.

DEFINITIONS

Animal Production Area – Means any part of the livestock operation that is used for the feeding and housing of livestock. This includes the entire animal confinement and feeding area, and any adjacent manure storage areas, raw materials storage areas, and waste containment areas. This does not include pasture and cropland.

Bedrock – The solid or consolidated rock formation typically underlying loose surficial material such as soil, alluvium or glacial drift. Bedrock includes but is not limited to limestone, dolomite, sandstone, shale and igneous and metamorphic rock.

> *Note: Although solid or consolidated bedrock can sometimes be removed with typical excavation equipment, these materials are included in the above definition.*

Clean Water – Water that has not been mixed with manure, wastewater or other contaminants

Conduits to Groundwater – Sinkholes, swallets, fractured bedrock at the surface, mine shafts, non-metallic mines, tile inlets discharging to groundwater, quarries, or depressional groundwater recharge areas over shallow fractured bedrock. Wells were intentionally left out of this NR 151 list.

Confined Space – Confined Space is a space that 1) contains or has the potential to contain a hazardous atmosphere; 2) is large enough and so configured that a person can bodily enter; 3) has limited or restricted means for entry or exit; and 4) is not designed for continuous human occupancy.

Contaminated Runoff – Runoff that has come through or across a barnyard or animal lot or feed storage area. It generally includes the runoff and any manure, sediment, feed, or other material carried in the runoff. It contains lower concentrations of contaminants than leachate from feed or manure.

Control Joints – Control joints, often called contraction joints, are used to control the location of cracks caused by concrete shrinkage during setting and thermal changes. Steel reinforcement is interrupted in control joints with embedded waterstop.

Cultural Resources – Cultural resources are the traces of any past activities and accomplishments of people. They include tangible traces such as historic districts, sites, buildings, structures, historical

documents and cemeteries. They also include traces of less tangible objects such as dance forms, aspects of folk-life, cultural or religious practices, and some landscapes and vistas.

Drainage System – Water conveyance measures of specified capacity, location, and material that insure the removal of water to a free outlet.

Effective Height – The difference in elevation between the auxiliary (emergency) spillway crest or the settled top of the embankment if there is no auxiliary spillway and the lowest point in the cross section taken along the centerline of the embankment at existing ground surface.

Environmental Structure - Any structure intended for conveying, storing, or treating water, wastewater, or other liquids and nonhazardous materials, such as solid waste, and for secondary containment of hazardous liquids or solid waste and designed to be liquid-tight, with minimal leakage under normal service conditions.

Flood Prone Areas – These include areas delineated as floodplains on Federal Emergency Management Agency (FEMA) maps, or local floodplain maps as well as areas along perennial streams (blue lines) shown on the United States Geologic Survey quadrangle sheets that may be subject to out of bank flows.

Footprint – This is the horizontal area within the perimeter of a facility liner, or the perimeter of a work surface that may cover a liner. For a liquid or solids containment facility, the footprint is the maximum horizontal extent of containment. For a liquid impoundment facility or pond, the footprint is normally defined by the inside top of the embankment. For a solids storage facility, the footprint is normally defined by the edge of the pad, the curb on a pad, or the inside surface of bunker walls.

Gleyed Soil – A soil condition resulting from prolonged soil saturation, which is manifested by the presence of grayish, bluish or greenish colors through the soil matrix. Gleying occurs under reducing conditions, by which iron is reduced predominantly to the ferrous state.

Hydraulic structure - any structure subjected to hydrostatic or hydrodynamic pressures, either externally or internally.

Impoundment – A waste storage facility constructed of earthen embankments and/or excavations for the purpose of storing waste. An impoundment may be lined or unlined.

Impoundment depth – Depth is the distance from the bottom of the impoundment up to the maximum operating level (M.O.L.).

In-Place Earth – A waste storage facility impoundment where the entire bottom surface is sited where in situ soils have sufficiently low hydraulic conductivity to provide waste storage without a constructed liner. The bottom is excavated a minimum depth of one foot into the situ soils as measured from the planned floor elevation.

Karst features – Refers to areas of land underlain by carbonate bedrock (limestone or dolomite). Typical land features in karst areas include sinkholes, network of interconnected fissures, fractures, disappearing streams, closed depressions, blind valleys, caves, and springs. See the companion document in Chapter 10 of the AWMFH for additional discussion of karst features.

Leachate – Concentrated liquid waste which has percolated through or drained by gravity from a pile of manure, manure processing derivative, or animal feed. It contains much higher concentrations of contaminants than Contaminated Runoff.

Liquid Waste Storage Impoundment – A facility where the stored material does not consistently stack and is either a manmade excavation, or diked area formed primarily of earthen materials, such as soil (although the unit may be lined with earthen or manmade materials) .

Manure Processing Derivatives – The by-products and waste components that are produced as a result of treatment and processing practices. These include, but are not limited to, the following waste components: separated sand, separated manure solids, precipitated manure sludges, supernatants, digested liquids, composted biosolids, process waters.

Nutrient Management Plans – A planning document that outlines the requirements for managing the amount, form, placement, and timing of applications of plant nutrients to cropland.

Perched Conditions – A soil moisture condition, usually of limited area, where wet soil, reduced redoximorphic features or depleted, gleyed, or reduced matrixes are maintained above the normal free water elevation. This condition is located above a barrier to downward flow that is dry or moist.

Percent Fines (% Fines) – Percentage of given sample of soil which passes through a #200 sieve.

Permeability – The coefficient of permeability (K) is a measure of the ability of soil to transmit liquids. It is used to compute the flow rate of liquid through a soil liner for specific conditions of soil thickness and fluid head (e.g., $1x10^{-7}$ cm/s).

Plasticity Index (PI) – A soil property indicating moldability. Measured by ASTM D4318.

Sinkholes – Closed, usually circular depressions which form in karst areas. Sinkholes are formed by the downward migration of unconsolidated deposits into solutionally enlarged openings in the top of bedrock.

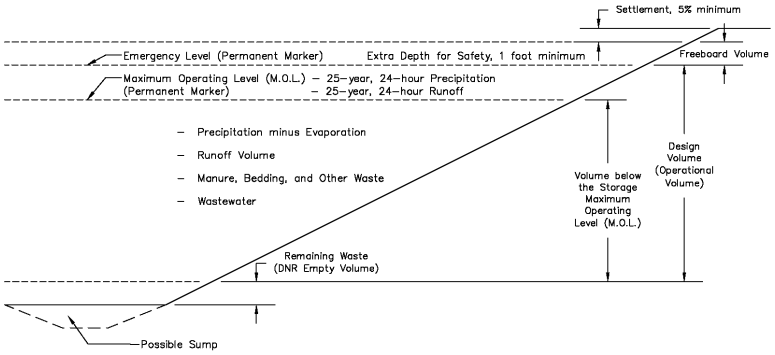
Structure – A waste storage facility consisting of constructed surfaces, tanks, or walls for the purpose of storing waste above or below the ground surface. Structures may be constructed of concrete, steel, wood or other construction materials.

Sub-Liner Soil – The soil directly below the bottom of the liner. This may be placed or in situ material.

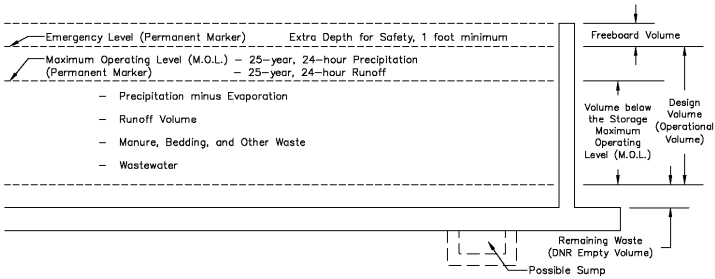
Sub-Soil – The soil directly below the bottom of the liner. This must be in situ material.

Wastewater – Milking center waste, flush water, leachate from feed holding areas, and similar waste materials generated at the animal production area.

Figure 1
Design Storage Volume



IMPOUNDMENT



STRUCTURE

USDA United States Department of Agriculture

NATURAL RESOURCES CONSERVATION SERVICE
CONSERVATION PRACTICE STANDARD

POND SEALING OR LINING – CONCRETE

CODE 522
(FT.^{2})

DEFINITION

A liner for an impoundment constructed using reinforced or non-reinforced concrete.

PURPOSE

This practice is installed to reduce seepage losses from impoundments constructed for water conservation and environmental protection.

CONDITIONS WHERE PRACTICE APPLIES

This practice applies where:

- In-place natural soils have excessive seepage rates.
- Construction of a compacted soil liner is not feasible with available soils.
- Use of impoundment requires concrete both as a liner and a protective subgrade cover.

CRITERIA

General Criteria Applicable to All Concrete Liners

Select the concrete liner design for either 'reduced seepage' or 'liquid tight' criteria, depending on the site conditions and management needs.

Liquid Tight. Where liquid tightness is required to provide an additional level of protection for sensitive environmental settings (SES), geologic concerns, groundwater resources and risk factors as described in the Agricultural Waste Management Field Handbook (AWMFH), Chapter 10, building code requirements must be one of the following:

- Structural Engineering, NRCS National Engineering Manual (NEM) Part 536, Structural Engineering.
- Requirements for Environmental Concrete Structures, Slabs-on-Soil, American Concrete Institute (ACI) 350 Appendix H.
- This liner is required for Wisconsin SES. See Table 3 for design requirements for this liner.

Reduced Seepage. Where liquid tightness is not required, building code requirements must be one of the following:

- ACI 318, Building Code Requirements for Reinforced Concrete.
- ACI 330R, Guide for the Design and Construction of Concrete Parking Lots.

Conservation practice standards are reviewed periodically and updated if needed. To obtain the current version of this standard, contact your Natural Resources Conservation Service (NRCS) State office or visit the Field Office Technical Guide.
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- ACI 360R, Guide to Design of Slabs-on-Ground.
- This liner may be used in all settings not deemed SES. See Table 1, 2, and 2A for design requirements for this liner.

Joints. Design construction joints and isolation joints to meet the appropriate ACI code specified above. Protrusions through the liner, such as pipes, must be properly sealed.

Side Slopes. Design side slopes of the pond or impoundment to be stable during construction. Design liners to withstand all anticipated internal and external loads, and resist agitation scouring, as specified in Table 2 or 3. Proportion the concrete mixture for a sufficiently stiff mix that can be installed on the slope without slumping or bulging.

Foundation and Liner Protection. Design floors and slabs used as a liner for anticipated loads including crack control and joint treatments stated below. Design slabs on ground that will be subject to heavy truck or heavy equipment loads in accordance with ACI 360, Guide to Design of Slabs-on-Ground and Concrete Floors on Ground, Chapter 5, Portland Cement Association (PCA).

Concrete with waterstop – Include distributed reinforcing steel within the concrete, and include embedded waterstop in all joints in accordance with Wisconsin FOTG Construction Specification 004-WS, Waterstop.

Include temperature and shrinkage reinforcing steel equal to or greater than shown in Table 1 in floors and slabs. Place steel in the top ½ of the slab thickness with a minimum clear distance from the top of the slab of 1.5 inches.

Table 1. Reinforcing Steel Size (Grade 60) and Spacing for Temperature and Shrinkage Control

Concrete Thickness	Joint			
	< 100 feet	< 125 feet	< 150 feet	< 175 feet
< 5"	#4 @ 18"	#4 @ 15"	#4 @ 15"	#5 @ 18"
< 6"	#4 @ 18"	#4 @ 12"	#5 @ 18"	#5 @ 15"
< 7"	#4 @ 15"	#5 @ 18"	#5 @ 15"	#5 @ 12"
< 8"	#5 @ 18"	#5 @ 15"	#5 @ 15"	#5 @ 12"

Include a waterstop joint plan in the construction plans and include the following: location of joints; cross-section details of joint(s); waterstop materials including factory fabricated corners, intersections, and transitions; and installation specifications.

Plan additional waterstop control joints where stresses can be predicted to exceed the reinforcing steel's ability to restrain cracking and minimize leakage.

All waterstop joints in areas subject to equipment traffic shall be designed with a dowel system to transfer the load across the joint. Slab thickness changes at these joints shall be made with a minimum transition ratio of one inch of thickness change over ten inches of run (10:1).

Concrete used as part of a liner is required to meet WI Construction Specification 4, Concrete.

Reduced seepage concrete soil composite (Table 2) – Determine the plasticity index (PI) in accordance with ASTM D4318 and the percent fines in accordance with ASTM D1140. Place the concrete in intimate contact with the foundation soil. Design floors and slabs to be a minimum of 5 inches thick with reinforcing consisting of #4 bars spaced at 18 inches on center each way. No control or expansion joints are required. Maintain continuous reinforcing steel through all construction joints. Drain tile and/or drain fill material may not be installed within the soil liner component of the composite liner.

Additional Criteria for Waste Storage Facilities (WI NRCS CPS 313).

For waste storage facilities, design foundation conditions for concrete liners in accordance with Tables 2, 2A and 3. All waste storage facilities shall also meet the requirements of WI NRCS Conservation Practice Standard (WI NRCS CPS) Waste Storage Facility (Code 313). Use WI NRCS CPS Waste Storage (Code 313) criteria to determine subsurface saturation and bedrock depth.

Table 2. Concrete Liner (ACI-318, ACI-330R, ACI 360R) Criteria for Waste Storage Facility Structure Floors and Impoundments [Note 1]

	Reduced Seepage Concrete with Waterstop	Reduced Seepage Concrete – Soil Composite			
Soil Liner Component					
% Fines	N/A Concrete Liner Only	≥ 20%	≥ 20%	≥ 40%	Foundry Sand [Note 2]
Plasticity Index (PI)		≥ 7	—	≥ 12	—
Thickness (bottom and sides)		≥ 1.5 feet	≥ 3 feet	≥ 8 inches	≥ 1.5 feet
Compaction of Placed Material		WI Spec 204	WI Spec 204	WI Spec 300	WI Spec 204
Sub-Liner Soils (Soil Directly Below Liner) See Table 2A for Options					
Separation Distances [Note 3]					
Sinkholes Or Other Karst Features					
Impoundment or Structure below ground	≥ 400 feet	≥ 400 feet	≥ 400 feet	≥ 400 feet	≥ 400 feet
Structure above ground	≥ 200 feet	≥ 200 feet	≥ 200 feet	≥ 200 feet	≥ 200 feet
Well Distance [Notes 4]	≥ 100 feet	≥ 100 feet	≥ 100 feet	≥ 100 feet	≥ 100 feet
Subsurface Saturation	≥ 2.5 feet (1.5 feet for sump)	≥ 4.0 feet (3.0 feet for sump)	≥ 5.5 feet (4.5 feet for sump)	≥ 3.5 feet (2.5 feet for sump)	≥ 4.0 feet (3.0 feet for sump)
Bedrock	≥ 2.5 feet (1.5 feet for sump)	≥ 4.0 feet (3.0 feet for sump)	≥ 5.5 feet (4.5 feet for sump)	≥ 3.5 feet (2.5 feet for sump)	≥ 4.0 feet (3.0 feet for sump)
Impoundment					
Inside Side Slopes	2.5:1 or flatter	2:1 or flatter			

[Note 1] This liner may be used to meet the requirements of Wisconsin Administrative Code, Chapter NR 213 (NR 213), with additional restrictions (e.g. soils investigations, separation distances, liner properties, maintenance requirements). See NR 213 and WI AWMFH 313 companion document.

[Note 2] The foundry sand must be ferrous foundry sand with only minimal concentrations of hazardous constituents, cores and other over-size materials crushed or removed, and at least 5% bentonite content. A site specific WDNR approval is required under NR 538 that may specify greater separation distances and parameters not addressed by this standard. An NR 538 Category I or II ferrous foundry sand may be appropriate.

[Note 3] Lesser separation distances shown for sumps apply only when the total sump area is less than 15% of the floor footprint area of the waste storage facility.

[Note 4] Community water system wells may require larger separation distances (see NR 811). For operations subject to NR 243, the private or non-community Well Separation Distance is 250 feet

Sub-Liner Soils. Sub-liner soil requirements are listed in Table 2A. These soils can be placed or in situ materials. There is no compaction requirement for in situ materials. Sub-liner soil is required under the footprint of all waste storage facilities. For structures, the sub-liner soil must be wrapped around to the top of the footing to provide continuous protection. Determine the PI in accordance with ASTM D4318 and the percent fines in accordance with ASTM D1140.

Sand or gravel is allowed between the concrete with waterstop liner or structure and the sub-liner soil. However, the sub-liner soil thickness must be present below the sand or gravel.

Sub-liner soil thickness is in addition to any concrete- soil composite thickness requirement.

Table 2A. Sub-Liner Soil Requirements for Waste Storage Facility Impoundments

	Minimum Soil Requirements			
% Fines	≥ 20%	≥ 20%	≥ 40%	Foundry Sand [Note 1]
Plasticity Index (PI)	≥ 7	—	≥ 12	—
Thickness (bottom and sides)	≥ 1.5 feet	≥ 2	≥ 8 inches	≥ 1.5 feet
Compaction of Placed Material	WI Spec 204	WI Spec 204	WI Spec 300	WI Spec 204

[Note 1] The foundry sand must be ferrous foundry sand with only minimal concentrations of hazardous constituents, cores and other over-size materials crushed or removed, and at least 5% bentonite content. A site specific WDNR approval is required under NR 538 that may specify greater separation distances and parameters not addressed by this standard. An NR 538 Category I or II ferrous foundry sand may be appropriate.

Sensitive Environmental Settings. Table 3 contains the criteria for constructing liquid waste storage facilities in Wisconsin's sensitive environmental settings, as defined in WI NRCS CPS Waste Storage (Code 313).

Design the storage facility as a reinforced concrete hydraulic or environmental structure according to NRCS NEM, Part 536, Structural Design with liquid tight concrete (concrete with waterstop ACI 350 or 350 Appendix H).

Alternatively, construct a facility with reduced seepage concrete and secondary liquid containment. Three components must be present for this system, a concrete liner, a drainage layer, and a secondary liquid containment liner. Design the concrete liner to meet the reduced seepage liner requirements contained within this standard. The drainage layer will consist of a minimum of twelve (12) inches of clean stone, with a drainage system that enters into an observation and pumping port with gravity outlet discharging to the surface. This port must be monitored for discharge for flow depth and pollutants. If pollutants are identified, the gravity outlet must be blocked and the port pumped until the source is identified and repairs can be completed. Determine the PI in accordance with ASTM D4318 and the percent fines in accordance with ASTM D1140.

Table 3. Structural Concrete and Concrete Liners with Secondary Liquid Containment for Waste Storage Facilities in Sensitive Environmental Settings

	Liquid Tight Concrete with waterstop	Reduced Seepage Concrete with waterstop PLUS Secondary Liquid Containment-Soil Liner	Reduced Seepage Concrete with waterstop PLUS Secondary Liquid Containment-Geomembrane Liner [Note 2]	Reduced Seepage Concrete with waterstop PLUS Secondary Liquid Containment-Foundry Sand Liner
Soils of the Secondary Liquid Containment				
Fines	—	40%	—	Foundry sand
Plasticity Index (PI)	—	12	—	—
Thickness (bottom and sides)	—	1.5 feet	—	1.5 feet
Compaction of Placed Material	—	WI Spec 204	—	WI Spec 204
Separation Distances				
Sink hole	250 feet	250 feet	250 feet	250 feet
Well	100 feet	100 feet	100 feet	100 feet
Subsurface Saturation [Note 1]	2.0 feet	4 feet	3 feet	4 feet
Bedrock [Note 1]	1.5 feet	3 feet	2 feet	3 feet
Impoundment				
Inside Side Slopes	2.5:1 or flatter	2.5:1 or flatter	2.5:1 or flatter	2.5:1 or flatter

[Note 1] Separation distance assumes a concrete thickness of 6 inches. Increase separation distance when slab thickness is greater than 6 inches by an equal amount.

[Note 2] Design geomembrane liner per WI NRCS CPS 521- Pond Sealing or Lining- Geomembrane or Geosynthetic Clay Liner

CONSIDERATIONS

Consider texturing concrete surfaces to provide traction for rubber-tired equipment. Texturing may not compromise the integrity of the liner.

PLANS AND SPECIFICATIONS

Prepare plans and specifications for a concrete liner for a pond or a waste storage impoundment that describe the requirements for applying the practice to achieve its intended purpose. As a minimum, include:

- Soils investigation, including subgrade.
- Concrete and reinforcing requirements.
- Quantities of concrete and reinforcement as specified.
- Subgrade preparation, materials and compaction.
- Construction and material specifications.

- Safety requirements.
- Applicable Wisconsin Construction Specifications

OPERATION AND MAINTENANCE

Maintenance activities required for this practice consist of those operations necessary to prevent and/or repair damage to the concrete liner. This includes, but is not limited to:

- Visually inspecting liner annually.
- Excluding animals.
- Repairing damage to concrete liner, as necessary. Repairing liner to its original condition.
- Preventing damage from roots of tree and large shrubs by removing such vegetation at first appearance.
- Preventing and/or repairing rodent damage to concrete subgrade.

REFERENCES

American Concrete Institute (ACI), Farmington Hills, MI

ACI 318, Building Code Requirements for Reinforced Concrete

ACI 330R, Guide for the Design and Construction of Concrete Parking Lots

ACI 350, Appendix H, Requirements for Environmental Concrete Structures, Slab-on-Soil

ACI 360, Design of Slabs on Grade

DEFINITIONS

Bedrock – The solid or consolidated rock formation typically underlying loose surficial material such as soil, alluvium or glacial drift. Bedrock includes but is not limited to limestone, dolomite, sandstone, shale and igneous and metamorphic rock. Although solid or consolidated bedrock can sometimes be removed with typical excavation equipment, these materials are included in this definition of bedrock.

Note: Although solid or consolidated bedrock can sometimes be removed with typical excavation equipment, these materials are included in the above definition.

Construction Joint – These joints are used where a fresh pour of concrete abuts an existing recent pour. Construction joints where the steel is continuous through the joint are considered to be monolithic and liquid tight, if constructed properly.

Control Joints – Control joints, often called contraction joints, are used to control the location of cracks caused by concrete shrinkage during setting and thermal changes. Steel reinforcement is interrupted in control joints with embedded waterstop.

Expansion Joints – These joints are used to prevent crushing of abutting concrete or other structural units due to compressive forces developed during expansion caused by high temperature.

Impoundment – A waste storage facility constructed of earthen embankments and/or excavations for the purpose of storing waste. An impoundment may be lined or unlined.

Intimate Contact – Direct contact between liner materials (concrete, GCL, and geomembrane) and soil.

Isolation Joint- Joint installed to separate one section of concrete from another. Isolation joints prevent transfer of loading from one section to another, and allow movement to occur between a concrete slab and adjoining columns or walls. They also separate new concrete from existing or adjacent construction which might expand, contract, or settle at different rates.

Karst features – Refers to areas of land underlain by carbonate bedrock (limestone or dolomite). Typical land features in karst areas include sinkholes, network of interconnected fissures, fractures, disappearing streams, closed depressions, blind valleys, caves, and springs. See the companion document in Chapter 10 of the AWMFH for additional discussion of karst features.

Sinkholes – Closed, usually circular depressions which form in karst areas. Sinkholes are formed by the downward migration of unconsolidated deposits into solutionally enlarged openings in the top of bedrock.

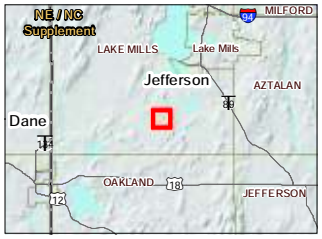
Structure – A waste storage facility consisting of constructed surfaces, tanks, or walls for the purpose of storing waste above or below the ground surface. Structures may be constructed of concrete, steel, wood or other construction materials.

Sub-Liner Soil – The soil directly below the bottom of the liner. This may be placed or in situ material.

Appendix E

Assured Wetland Delineation Map

V:\193705272\03 data\gis cad\gis\mxds\nelson\fig5 fcd 193705272.mxd Revised: 2017-07-28 By: jmarty



Notes
1. Coordinate System: NAD 1983 StatePlane Wisconsin South FIPS 4803 Feet
2. Data Sources Include: Stantec, WDOT, WDNR
3. Orthophotography: NAIP 2015

Disclaimer: Stantec assumes no responsibility for data supplied in electronic format. The recipient accepts full responsibility for verifying the accuracy and completeness of the data. The recipient releases Stantec, its officers, employees, consultants and agents, from any and all claims arising in any way from the content or provision of the data.

Legend

- Approximate Project Boundary
- 2ft Elevation Contour
- Sample Point
- Field Delineated Wetland

DNR 24k Hydrography
- Perennial Stream
- Intermittent Stream
- Waterbody

Figure No.
5

Title
Field Collected Data

Client/Project
Daybreak Foods, Inc.
Nelson Site
Wetland Delineation

Project Location
T7N, R13E, S27,
T. of Lake Mills,
Jefferson Co., WI

193705272
Prepared by JM on 2017-07-05
Technical Review by BT on 2017-07-05
Independent Review by KR on 2017-07-27

0 200 400 Feet
1:4,800 (at original document size of 8.5x11)

Stantec

CONSTRUCTION QUALITY ASSURANCE PLAN

WASTE STORAGE FACILITY
(LAYERS)

October 27, 2017

PREPARED FOR:

Daybreak Foods, Inc.
533 E Tyranena Park Road
Lake Mills, WI 53551

PREPARED BY:

Resource Engineering Associates, Inc.
3510 Parmenter St., Suite 100
Middleton, Wisconsin, 53562

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5. Documentation 6
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8. Material Alternatives 9
9. NRCS Wisconsin Construction Specifications 9

Appendix A – Forms
Appendix B – NRCS Wisconsin Construction Specifications

1. Project Contacts

Owner Contact

Keith Kulow
WI Regional Operations Manager
533 E Tyranena Park Road
Lake Mills, WI 53551
Phone: 920-648-2377 ext. 7412
Email: keith@daybreakfoods.com

DNR or NRCS Regional Contact

Terry Donovan
Water Resources Engineer
PO Box 7921
Madison, WI 53707-7921
Phone: 608-267-2340
Email: terry.donovan@wisconsin.gov

DNR CAFO Permit #: 0056308

County Animal Waste Contact

Mark Watkins
Director, Land & Water Conservation Department
311 S Center Ave, Room 113
Jefferson, WI 53549-1701
Phone: 920-674-7111
Email: markw@jeffersoncountywi.gov

General Contractor

Henning Companies, LLC
5800 Merle Hay Road, Suite 14
P.O. Box 394
Johnston, Iowa 50131
Contact: Kevin Lex
Phone: 515-253-0943 ext. 162
Email: klex@webild.com

Resource Engineering Associates, Inc. Contacts

Robert Pofahl
3510 Parmenter Street
Suite 100
Middleton, WI 53562
Phone: 608-831-5522
bob@reaeng.com
www.reaeng.com

2. Purpose

The purpose of providing this report is to identify specific construction features which should be documented to support conformance to the plans and specifications.

The Contractor is responsible for means and methods to accomplish construction in accordance with the plans and specifications. Construction observation by the Engineer is not intended to be an exhaustive check or a detailed inspection of the Contractor's work but rather to allow the Engineer to become generally familiar with the work in progress and to determine, in general, if the work is proceeding in accordance with the engineering plans.

Once construction is complete, record drawings shall be submitted, by a Professional Engineer, to verify that the system was installed substantially, in accordance with the plans and applicable standards.

3. Responsibilities of Parties

The purpose of this section is to identify key parties, their responsibilities and authorities for the project.

Owner

The Owner is responsible for selecting and authorizing the Contractor of choice to install the structures of the proposed plan. The Owner is responsible for awarding the project, coordinating project communications, scheduling and work for the project. Resolution of construction quality assurance issues shall be brought to the attention of the Owner and the Owner shall require the Contractor to install the structures in accordance with the approved plans and specifications. Contractors are responsible to the Owner.

Owner is responsible to coordinate construction observation with Engineer.

Construction Contractor

The Contractor(s) are to install structures as per the approved plans and specifications. A contractor may hire a sub-contractor to complete the work with the Owner's permission, but is responsible for their workmanship and compliance with the approved plans and specifications. No changes to the plans and specifications shall be made or accepted unless submitted in writing and approved by the Engineer.

Engineer

The Engineer is responsible for the project design and specifications. If modifications to the project are needed, the Engineer shall discuss with the Owner to determine a resolution. If evidence indicates the project is not constructed in accordance with the approved plans and specifications or approved modifications the Engineer shall not certify the construction as being in accordance with the plans.

Construction Observation Personnel

Construction observations shall be performed by REA, Inc. personnel under the direction of the project's Engineer and direction from the Owner. Construction Observation Personnel are responsible for documenting structures being installed in accordance with the approved plans and specifications. Items requiring observation are detailed in the Observation and Verification section.

Observation Personnel shall notify the Owner, Engineer, and Contractor of deficiencies that are observed. The Contractor must correct these deficiencies to the satisfaction of the Observation Personnel for the construction to be certified by the Engineer upon project completion.

Testing Firm

The Testing Firm(s) is responsible for providing soil, concrete and liner material testing as required by the plans and specifications. The Testing Firm shall be retained by the Owner or Construction Contractor based on the awarding of the project. The Testing Firm shall be an independent entity not associated with the Owner, Engineer, or Construction Contractor. Test results shall be supplied to the Owner and Engineer for review. Deficiencies shall be discussed between the Engineer and Owner and a resolution brought to the Contractor.

4. Qualifications for Construction Observer

Construction Observation Personnel shall be under the supervision of Robert Pofahl, P.E., unless otherwise specified by the Owner.

Engineer personnel should obtain readily available construction material manufacturers tags, take photographs of materials listed, and collect data from contractors.

The purpose of providing documentation of these materials is to show the facility was installed according to the approved plan design.

REA staff expected to be assigned for construction documentation activities at project are:

- Robert Pofahl, PE
- Carl Chenoweth, PE
- Darrin Sherstad, PE
- Dan Wierzba
- Jon Ardelt
- Ryan Nehls
- Alex Devaux

5. Documentation

Construction Observation Personnel should obtain readily available construction material manufacturers tags, take photographs of materials listed, and collect data from Contractors or Testing Firms.

The purpose of providing documentation of these materials is to show the project was installed according to the approved plan and specifications.

The Construction Observation Personnel shall prepare an Engineer's Field Report summarizing observations made during each site visit. The Field Report shall contain the following at a minimum.

- Project name, date, weather conditions, and time on site.
- Personnel on site and work being completed.
- Items observed, deficiencies, and resolutions.
- Communications with Owner, Contractor or Testing Firm.

An Engineer's Field Report form is in **Appendix A**.

Once construction is complete, a record documentation report and drawings shall be submitted, by a Professional Engineer, to verify that the system was installed substantially, in accordance with the plans, specifications, and applicable standards.

6. Pre-Construction Meeting

A meeting shall be scheduled before construction to discuss construction schedules, plan details, construction specifications, and known site limitations. The meeting should include the following:

	NAME	INVITED	ATTENDED	NOT ATTENDED
OWNER (representatives)	Keith Kulow Rick Roedl			
DNR	Terry Donovan			
COUNTY LCD	Mark Watkins			
ENGINEER	Robert Pofahl, P.E.			
EXCAVATOR	TBD			
CONCRETE CONTRACTOR	TBD			
BUILDING CONTRACTOR	Jeff Henning			
TESTING FIRM	TBD			
OTHER				

Items of discussion should include:

- ☐ Roles and responsibilities of parties
- ☐ Construction observation requirements and notification
- ☐ Continuous inspection during placement of concrete around embedded water-stop
- ☐ Testing requirements
- ☐ Modifications and alternatives procedures
- ☐ Review plans & specifications
- ☐ Locate and observe benchmark
- ☐ Determine who and how construction staking will take place
- ☐ Project Schedule
- ☐ Coordination of Work
- ☐ Procedure for certification of construction
- ☐ Discuss construction observation and which party is responsible for what structure(s)
- ☐ Discuss construction practices

Other items discussed:

- ☐ Site security and bio-security

7. Observation & Construction Verification

Items to be observed and documented include the following: (Initial and date individual items as performed).

Grading/Drainage

- ☐ Document post construction surface drainage for conformance to the plan.
- ☐ Document storm water pipe sizes, dimensions, and elevations for conformance to the plans.

Concrete Waste Storage Facility

Excavation

- ☐ Document separation to bedrock or saturation if needed.
- ☐ Document elevations and dimensions of the Waste Storage Facility.

Concrete

- ☐ Document concrete mix meets specifications (Contractor to supply at least seven days prior to concrete being placed).
- ☐ Concrete Contractor is to provide at least two days' notice prior to concrete being placed.
- ☐ Concrete shall be tested for slump, air, temperature and strength as required by specifications and drawings.
- ☐ Batch tickets shall be provided for concrete delivered to the site and provide information as required by specifications.
- ☐ Document control joint location and dimensions for conformance with the plans.
- ☐ Document concrete dimensions of slabs, footings, walls, etc. for conformance with the plans.
- ☐ Document concrete placement is in accordance with specifications.
- ☐ Document concrete curing is in accordance with specifications.
- ☐ Document form removal and backfilling is in accordance with plans and specifications.

Reinforcing Steel

- ☐ Document reinforcing steel size, grade, and that it is free of loose rust, oil, or other debris.
- ☐ Document reinforcing steel placement, spacing, splice lengths and clearances.

Waterstop

- ☐ Document waterstop size, material type, and factory joints.
- ☐ Document waterstop placement, splices and clearances.
- ☐ Document waterstop is secured per manufacturer recommendation (No cold sticking is allowed).
- ☐ Document waterstop is free of concrete, dirt, mud or other debris prior to concrete placement.
- ☐ Document concrete around waterstop is vibrated.
- ☐ Continuous inspection during placement of concrete around embedded water-stop

Safety and Markers

- ☐ Document warning signs are installed.

Storm Water Piping

- ☐ Document storm water piping materials, dimensions, and elevations for conformance to the plans and specifications.
- ☐ Document pipe bedding and cover is in accordance with the plans and specifications.

8. Material Alternatives

Contractors wishing to use materials that differ from the approved plans and specifications shall supply a written request of the alternative with material information to the Engineer for approval prior to its use. The request must describe the alternative material and its intended location or installation of use. Approval of use shall be submitted at least one week prior to use or installation. The Engineer shall review and comment on the approval of the material information within one week of request. Some alternatives may not be allowed.

9. NRCS Wisconsin Construction Specifications

Applicable NRCS Wisconsin Construction Specifications include:

1	Clearing	5/12
2	Excavation	5/12
3	Earthfill	5/12
4	Concrete	10/17
004	WS Embedded or Expansive Waterstop	10/17
9	Rock Riprap	11/11
10	Fences	3/15
13	Geotextiles	12/16
15	Plastic Pipe Conduits	12/16
26	Topsoiling	5/12
204	Earthfill for Waste Storage Facilities	10/12

Appendix A – Forms

Engineer's Field Report			
Project Name:		**Date:**	
Project #:		**Arrival/Departure:**	
Owner/Client:		**Weather:**	
Present on Site:			

The Following Was Noted:

Items to Be Addressed with Owner or Contractor:

RESOURCE ENGINEERING ASSOCIATES, INC.

Observer Signature:

Distribution: **Date:** **Sheet:** **of:**

RESOURCE ENGINEERING ASSOCIATES, INC.
3510 Parmenter Street
Suite 100
Middleton, WI 53562
Phone: 608-831-5522
Fax: 608-831-6564
Web: www.reaeng.com

WATERSTOP INSTALLATION VERIFICATION AND DOCUMENTATION

Project Name:

Project Location:

Item	Observed By	Date
Water stop size and material Notes:		
Factory joints used Notes:		
Water stop placement, splices, and clearances Notes:		
Water stop secured per manufacturer's recommendation Notes:		
Water stop free of concrete, dirt, mud or other debris Notes:		
Concrete around water stop was vibrated under continuous observation Notes:		

Water stop was installed in accordance with *WI NRCS 313 – Waste Storage Facility* and *WI NRCS Construction Specification 004, WS Embedded or Expansive Waterstop* specifications.

_____ _____

Contractor Foreman/Supervisor Date

Appendix B – NRCS Wisconsin Construction Specifications

WISCONSIN CONSTRUCTION SPECIFICATION

1. Clearing

1. SCOPE

The work shall consist of the clearing and disposal of trees, snags, logs, brush, shrubs, stumps, and rubbish from the designated areas.

2. MARKING

The limits of the areas to be cleared will be marked by means of stakes, flags, tree markings, or other suitable methods. Trees to be left standing and uninjured will be designated by special markings placed on the trunks at a height of about 6 feet above the ground surface.

3. PROTECTION OF EXISTING VEGETATION

Trees and other woody vegetation designated to remain undisturbed shall be protected from damage throughout the entire construction period. Any damage resulting from the Contractor's operations or neglect shall be repaired by the Contractor.

Earthfill, stockpiling of materials, vehicular parking, and excessive foot or vehicular traffic shall not be allowed within the dripline of vegetation designated to remain in place. Vegetation damaged by any of these or similar actions shall be replaced with viable vegetation of the same species.

Any cuts, skins, scrapes, or bruises to the bark of the vegetation shall be carefully trimmed and local nursery accepted procedures used to seal damaged bark.

Any limbs or branches 0.5-inch or larger in diameter that are broken, severed, or otherwise seriously damaged during construction shall be cut off at the base of the damaged limb or branch flush with the adjacent limb or tree trunk.

All roots 1 inch or larger in diameter that are cut, broken, or otherwise severed during construction operations shall have the end smoothly cut perpendicular to the root. Roots exposed during excavation or other operations shall be covered with moist earth and/or backfilled as soon as possible to prevent them from drying.

4. CLEARING

Trees, brush, shrubs, stumps, and other woody growth shall be cleared to a height not exceeding 12 inches above the ground surface. Such growth may be cleared by cutting, pulling, grubbing, or other approved methods.

Trees shall be felled in such a manner as to avoid damage to trees that are to be left standing, existing structures, utilities, and with regard for the safety of persons.

When the designated areas to be cleared include borrow areas and/or areas upon which improvements are to be constructed, the required grubbing of stumps, roots, and other objectionable material in these areas shall be a part of this specification. The grubbing shall consist of the removal of all stumps,

roots of 1 inch in diameter or larger, buried logs, and other objectionable material to a minimum depth of 2 feet below a structure subgrade and 1 foot below an embankment foundation.

5. SITE EROSION CONTROL

Measures shall be installed, or the work performed in a manner that will minimize site erosion, and the production of sediment. Protective measures shall include but are not limited to diversions, waterways, seeding, mulching, sediment basins, and silt fences.

6. DISPOSAL

All materials cleared from the designated areas shall be burned or buried at approved locations or otherwise removed from the site. Buried materials shall be covered with a minimum of 2 feet of earthfill (including any topsoil added for seeding).

The Contractor is responsible for complying with all rules and regulations for disposal at locations away from the construction site or for the burning of cleared materials.

WISCONSIN CONSTRUCTION SPECIFICATION

2. Excavation

1. SCOPE

The work shall consist of the excavation of all materials necessary for the construction of the work.

2. USE OF EXCAVATED MATERIALS

To the extent that they are needed, all suitable materials removed from the specified excavations shall be used in the construction of the required earthfill. The suitability of materials for specific purposes will be determined by the Technician. The Contractor shall not waste or otherwise dispose of suitable excavated materials.

3. DISPOSAL OF WASTE MATERIALS

All surplus or unsuitable excavated materials will be designated as waste and shall be disposed of at the locations shown on the drawings or as approved by the Technician. Waste materials shall not be placed in wetlands.

Material placed in designated waste disposal areas shall be left in a neat and sightly condition and sloped to provide positive drainage. Compaction of the waste materials will not be required unless specified by the construction plans.

Waste material excavated from channels may be deposited in leveled spoilbanks or areas adjacent to the channel work (if permissible). The shape and slopes of the spoilbanks shall be indicated on the drawings or as approved by the Technician. Spoil piles shall be located a minimum of 12 feet from the top of the channel side slope.

Spoil piles or disposal areas shall be protected to minimize site erosion and the production of sediment. Protective measures may include but are not limited to diversions, seeding, mulching, sediment basins, and silt fences.

4. SPECIAL REQUIREMENTS FOR STRUCTURE AND TRENCH EXCAVATION

The required dimensions and side slopes of all structure and trench excavations shall be as shown on the drawings.

Excavation beyond the limits of the specified lines and grades shall be corrected by filling the resulting voids with approved compacted materials.

Excavation for the installation of pipes shall follow the practices contained in the Occupational Safety and Health Administration (OSHA) Subpart P, Excavation, of 29 CFR 1926.650, .651 and .652.

Side slopes shall be excavated or braced to safeguard the work and workers. When bracing or supporting is required, the width of the excavation shall be adjusted to allow for the space occupied by the sheeting, bracing, or other supporting installations. The Contractor shall furnish, place, and subsequently remove such supporting installations.

5. REMOVAL OF WATER

The Contractor shall construct and maintain all necessary cofferdams, channels, flumes, pumping equipment, and/or other temporary diversion and protective work for dewatering the various parts of the work. Foundations, cutoff trenches, and other parts of the work shall be maintained free from water as required for constructing each part of the work. After having served their purpose, all cofferdams and other temporary protective works shall be removed, or leveled to give a sightly appearance and so as not to interfere in any way with the operation, usefulness, or stability of the permanent structure.

6. BORROW EXCAVATION

When the quantities of suitable materials obtained from specified excavations are insufficient to construct the specified fill portions of the permanent works, additional materials shall be obtained from the designated borrow areas.

When shown on the drawings, sediment basins, terraces, diversions, or other measures shall be constructed to protect the borrow areas from erosion and retain sediment within the borrow area.

The upper six (6) inches shall be stripped from all borrow areas. This stripping shall be performed immediately prior to use of the borrow material to reduce the time the area is exposed to erosion. For large borrow areas, only a portion of the area should be stripped at a time. This material shall be redistributed over the area from which it came after borrow excavation is completed.

The extent of excavation and the selection of materials from the borrow area shall be as directed by the Technician. On completion of excavation, all borrow pits shall be left in a neat and sightly condition. All borrow areas shall be graded to blend with existing topography and sloped to prevent ponding and provide positive drainage.

WISCONSIN CONSTRUCTION SPECIFICATION

3. Earthfill

1. SCOPE

The work shall consist of placing the earthfill required by the drawings. This specification does not apply to the earthfill required for waste storage facilities.

2. MATERIALS

All fill materials shall be obtained from required excavations and designated borrow areas. The selection, blending, routing, and disposition of materials in the various fills shall be subject to approval by Technician.

Fill materials shall contain no sod, brush, roots, frozen soil, or other perishable materials. Stones larger than two-thirds of the uncompacted layer thickness shall be removed from the materials prior to compaction of the fill.

3. FOUNDATION PREPARATION

The foundation area shall be cleared of trees, stumps, roots, brush, rubbish, and stones having a maximum dimension greater than six (6) inches. Foundations shall be stripped to remove vegetation and other unsuitable materials or to the depth shown on the drawings, whichever is greater. Topsoil shall be stripped from the foundation area and stockpiled for use as a top dressing for vegetation establishment unless otherwise shown on the drawings.

Earth foundations shall be graded to remove surface irregularities and slopes steeper than 1:1.

The foundation surfaces shall be scarified parallel to the centerline of the fill to a minimum depth of 2 inches. The moisture content of the scarified materials shall be maintained as specified for the earthfill. The surface materials of the foundation shall be compacted and bonded with the first layer of earthfill as specified for subsequent layers of earthfill.

4. PLACEMENT

Fill shall not be placed until the required excavation and preparation of the underlying foundation is completed and inspected and approved by the Technician. No fill shall be placed upon a frozen surface nor shall snow, ice, or frozen material be incorporated in the fill.

Fill shall be placed in approximately horizontal layers beginning at the lowest elevation of the foundation. The thickness of each layer of fill prior to compaction shall be as specified in Table 1. Materials placed by dumping in piles or windrows shall be spread uniformly to not more than the specified layer thickness prior to compaction.

Adjacent to structures, earthfill shall be placed in 4-inch lifts (prior to compaction) in a manner adequate to prevent damage to the structure and to allow the structure to gradually and uniformly assume the backfill loads.

The height of the fill shall be increased at approximately the same rate on all sides of the structure.

Placement of fill adjacent to concrete structures may begin after the concrete has cured for the minimum time specified.

Earthfill in dams, levees, and other structures designed to impound water shall be placed to meet the following additional requirements:

a. The distribution of materials throughout each zone shall be essentially uniform, and the fill shall be free from lenses, pockets, streaks, or layers of material differing substantially in texture, moisture content, or gradation from the surrounding material.

b. The embankment top shall be maintained approximately level during construction except for sectional construction as described in Section 7.

c. Dam embankments shall be constructed in continuous layers from abutment to abutment, except where openings to facilitate construction or to allow passage of stream flow during construction are specified.

d. If the surface of any layer becomes too hard and smooth to achieve a suitable bond with the succeeding layer, it shall be scarified parallel to the axis of the fill to a depth of not less than 2 inches before the next layer is placed.

5. CONTROL OF MOISTURE CONTENT

Fill materials shall have a moisture content sufficient to insure the required compaction. When kneaded in the hand, the soil will form a ball which does not readily separate and will not extrude out of the hand when squeezed tightly. The adequacy of the moisture content will be determined by the Technician.

Fill material or the top surface of the preceding layer of compacted fill that becomes too dry to permit suitable bond shall either be removed or scarified and wetted by sprinkling to an acceptable moisture content prior to placement of the next layer of fill.

Fill material that is too wet when deposited or the top surface of the preceding layer of compacted fill that becomes too wet shall be either removed or allowed to dry to an acceptable moisture content before compaction or placing additional layers of fill.

6. COMPACTION

The Contractor shall furnish and operate the types and kinds of equipment necessary to compact the fill materials.

Unless otherwise specified on the plans or approved by the Technician, compaction requirements for each layer of fill material are as shown in Table 1.

Each pass shall consist of at least one complete coverage by the wheel, track, or roller over the entire surface of the fill layer in a direction parallel to the main axis of the fill.

Adjacent to structures or in confined areas, compaction of the fill shall be accomplished by means of manually directed power tampers or plate vibrators or hand tamping, unless otherwise specified. The Technician shall determine if adequate compaction is being achieved. Heavy equipment shall not be

operated within 2 feet of any structure. Compaction by means of drop weights operating from a crane or hoist of any type will not be permitted.

7. SPECIAL REQUIREMENTS FOR SECTIONAL CONSTRUCTION OF EMBANKMENTS

When sectional (or phase) construction of embankments is authorized, the work shall be accomplished in the following manner:

Each section of the embankment that is constructed in the first phase shall be so placed that a slope not steeper than 3 feet horizontal to 1 foot vertical is maintained at the end of the embankment section adjacent to the gap in construction or closure section.

Prior to placement of the closure sections, the surfaces of completed fills and excavations that will be in contact with the closure shall be stripped of all loose material, scarified, moistened, and recompacted as necessary.

Table 1 - Equipment Compaction Requirements

Equipment Type		Applicable Soils[1]	Maximum Fill Height[2] (feet)	Layer Thickness[3] (inches)	Minimum Passes[4]
Sheepsfoot roller (10,000 lb. min. operating weight)		ML, MH, CL, CH or SM, SC, GM, GC with >20% fines	None	9	1
Vibratory tamping roller (9,000 lb. min. operating weight)		SM, SC, GM, GC	None	9	2
Rubber-tired scraper (fully loaded)		GM, GC, SM, SC, ML, MH, CL, CH	20	9	1
Rubber-tired front end loader (fully loaded)		GM, GC, SM, SC, ML, MH, CL, CH	20	6	1
Track-type crawler (standard tracks)	30,000 lb. min.	GM, GC, SM, SC, ML, CL	10**	6	2
		SP, SW, GP, GW	6**	12	4
		CL, ML, SC, SM	15[##]	3	2
	less than 30,000 lb.	GM, GC, GP, GW, SM, SC, SP, SW, ML, CL	6**	6	2
Farm tractor (2,400 lb. min.)		GM, GC, SM, SC, ML, MH, CL, CH	15	6	2
Steel drum vibratory roller (10,000 lb. min.)		SP, SW, GP, GW	None**	12	2

[1] Unified Soil Classification System.

[2] Measured from the top of the fill to the lowest point along the centerline of the fill.

[3] Prior to Compaction.

[4] The Technician shall determine if adequate compaction is being achieved. Additional passes may be required.

** The fill shall not have a permanent body of water stored against it.

[##] This method may only be used for embankments that will not have the potential for a permanent body of water stored against it that is greater than 1/4 acre in surface area or more than 6 feet deep.

WISCONSIN CONSTRUCTION SPECIFICATION

4. CONCRETE

1. SCOPE

The work shall consist of furnishing, forming, placing, consolidating, finishing, and curing Portland cement concrete and the furnishing and placing of steel reinforcement or other appurtenances as required on the construction drawings. All materials, test procedures, and admixtures shall meet the requirements of the latest edition of the applicable ASTM designation.

Failure to meet any requirements contained in this specification may be cause for rejection of the concrete or delay of placement.

2. DEFINITIONS

The following definitions are provided for the purpose of this specification. The words that are defined in this section are italicized the first time that they are used in the text.

Batch delivery ticket refers to the form showing the total weights of all the ingredients used to mix the contents of the rotating drum mixer (total weights of all ingredients on the load) and other job pertinent information.

Consolidating refers to the process of reducing the volume of entrapped air in a fresh cementitious mixture, usually accomplished by inputting mechanical energy.

Construction joints are those joints where two successive placements of concrete meet, through which reinforcement is continuous and bond is required between the two pours.

Finishing refers to the process of treating surfaces of fresh or recently placed concrete or mortar to produce desired appearance and service.

Firm refers to the condition of the subgrade where it is not significantly displaced or deformed by foot traffic during construction, and is able to properly support reinforcement chairs.

Flatwork refers to concrete slabs poured on slopes flatter than 5:1 (Horizontal:Vertical).

Form release agent refers to commercially manufactured formwork release agents that prevent formwork absorption of moisture, prevent bond with concrete, and do not stain the concrete surfaces.

Formed surfaces are those that require a temporary structure or mold for the support of concrete while it is setting and gaining sufficient strength to be self-supporting, such as walls or poured-inplace tank lids.

Hand tamping refers to the operation of consolidating freshly placed concrete by hand-held implements.

Honeycomb refers to voids left in concrete due to failure of the mortar to effectively fill the spaces among coarse aggregate particles.

Jitterbug refers to a grate tamper for pushing coarse aggregate slightly below the surface of a slab to facilitate finishing.

Liquid-tight concrete refers to applications using specific placement and finishing techniques, and design features to minimize the loss of liquids.

Manufacturer refers to the producer/supplier of the ready-mixed concrete.

Mesh roller refers to a finishing tool consisting of a rolling drum attached to a handle, of which the surface of the drum is made of mesh, sometimes used for rolling over the surface of fresh concrete to embed coarse aggregate

Rock pocket refers to a porous, mortar-deficient portion of hardened concrete consisting primarily of coarse aggregate and open voids; caused by leakage of mortar from the form, separation (segregation) during placement, or insufficient consolidation.

Sloped slabs refers to concrete slabs poured on slopes of 5:1 (Horizontal:Vertical) or steeper.

Technician refers to an individual trained in specific technical processes, and may include an engineer, government agency representative, private sector technical service provider, qualified independent third party quality assurance inspector, or a similar person that is primarily responsible for the project quality assurance.

Ternary mix is a mixture using three cementitious materials, such as Portland cement, fly ash, and ground granulated blast-furnace slag (slag).

Top bars are horizontal reinforcements placed such that more than 12 inches of fresh concrete is cast below the reinforcing bar (such as horizontal wall bars).

Vibration refers to mechanical energetic agitation of freshly mixed concrete during placement by mechanical devices, either pneumatic or electric, that create vibratory impulses of moderately high frequency to assist in consolidating the concrete.

- Internal vibration employs one or more vibrating elements that can be inserted into the fresh concrete at selected locations.
- Surface vibration employs a portable horizontal platform on which a vibrating element is mounted.

Water-cement ratio (w/c) is the ratio of the weight of free water (excluding that absorbed by the aggregates) to the weight of Portland cement in a concrete mix expressed as a decimal.

Water-cementitious material ratio (w/cm) is the ratio of the weight of free water (excluding that absorbed by the aggregates) to the weight of cementitious material (fly ash, Portland cement, and slag) in a concrete mix expressed as a decimal.

3. MATERIALS

The Contractor shall provide test data, independent laboratory reports, or other evidence from the concrete manufacturer showing that all materials meet the requirements of this specification. All materials proposed for use shall be approved by the Technician.

1. Portland cement shall conform to ASTM C 150 and shall be Type I, II, or III.
2. Fine aggregate shall conform to ASTM C 33 and be composed of clean, uncoated grains of material. Refer to the fine aggregate gradation table in Section 4 of this specification.

3. Coarse aggregates shall be gravel or crushed stone conforming to ASTM C 33 and be clean, hard, durable, and free from clay or coating of any character. Refer to the coarse aggregate gradation table in Section 4 of this specification.
4. Water shall be clean and free from injurious amounts of oil, salt, acid, alkali, organic matter, or other deleterious substances.
5. Air entraining agent shall conform to ASTM C 260.
6. Pozzolan (fly ash) shall conform to ASTM C 618, Class C or F. The loss of ignition shall not exceed 2 percent for Class C and 6 percent for Class F.
7. Ground granulated blast furnace (GGBF) slag shall conform to ASTM C 989.
8. Chemical admixtures shall be used in strict compliance with the manufacturer's recommendations, conform to ASTM C 494, and may be the following types:
   1. Type A - Water-reducing admixtures.
   2. Type B - Retarding admixtures.
   3. Type C - Accelerating admixtures.
   4. Type D - Water-reducing and retarding admixtures.
   5. Type E – Water-reducing and accelerating admixtures.
   6. Type F - Water-reducing, high range admixtures (superplasticizers).
   7. Type G - Water-reducing, high range, and retarding admixtures (superplasticizers) .
   8. Type S—Specific performance admixtures

   If Type C or E is used, the manufacturer shall provide the Technician a product data sheet verifying that the product is a non-chloride accelerator.

   If Type S is used the manufacturer shall provide the Technician a report stating the specific performance characteristic(s) of the admixture and data to substantiate the performance characteristic(s).

   Calcium chloride or admixtures containing chloride ions other than from impurities in admixture ingredients shall not be used.
9. Deformed reinforcing bars shall be free from loose rust, oil, grease, paint, or other deleterious matter. Steel bars for concrete reinforcement shall meet the requirements of ASTM A 615. The steel shall be deformed Grade 40 or Grade 60 billet-steel bars as noted on the plans.
10. Deformed welded wire reinforcement (WWR) shall conform to the requirements of ASTM A 1064 and shall be furnished in flat sheets, and shall be size D4 or larger as indicated on the plans. This material may only be used for non-structural elements such as slabs on grade. Spacing of welded intersections shall not exceed 16 inches.
11. Curing compound shall be a liquid membrane-forming compound suitable for spraying on the concrete surface. The curing compound shall meet the requirements of ASTM C 309, Type 2 (white pigmented).

4. Design of the Concrete Mix

No less than seven (7) days prior to the start of concrete placement the Contractor is responsible for submitting documentation of the proposed design mix to the Technician. The Contractor is responsible for providing a mix with the minimum required 28-day compressive strength in the construction plan and meet the following:

- The water-cement (w/c) or the water-cementitious material (w/cm) ratio shall not exceed 0.45 for all concrete construction.
- The cementitious material required shall be 564 pounds per cubic yard of concrete.
  - » The cementitious material may include a maximum of 25 percent (by weight) of fly ash or a maximum of 30 percent (by weight) of ground granulated blast-furnace (GGBF) slag. The remaining cementitious materials shall be Portland cement.
  - » Mixes containing both fly ash and GGBF slag shall not exceed 30 percent in combination (ternary mix) and no more than 25 percent shall be fly ash. The remaining cementitious materials shall be Portland cement.
- The air content (by volume) shall be 6 percent of the volume of the concrete.
- The maximum (not to exceed) slump, with the use of water reducers, shall be 5 inches.
- The maximum (not to exceed) slump, with the use of superplasticizers, shall be 8 inches.

The fine aggregate oven dry weight shall be 30-45 percent of the total oven dry weight of the combined coarse and fine aggregates. The well-graded fine aggregate shall conform to the following ASTM C 33 or Wisconsin DOT gradation requirements shown below:

Fine Aggregate Gradation

Sieve Size	Percent Passing By Weight	
	ASTM C 33	WI DOT
⅜" (9.5 mm)	100	100
No. 4 (4.75 mm)	95-100	90-100
No. 8 (2.36 mm)	80-100	---
No. 16 (1.18 mm)	50-85	45-85
No. 30 (600 µm)	25-60	---
No. 50 (300 µm)	5-30	5-30
No. 100 (150 µm)	0-10	0-10
No. 200 (75 µm)	0-5	0-3.5

The well graded coarse aggregate shall conform to the following ASTM C 33 gradation requirements for size number 67 aggregate shown below:

Coarse Aggregate Gradation

Sieve Size	Percent Passing By Weight
1" (25.0 mm)	100
¾" (19.0 mm)	90-100
⅜" (9.5 mm)	20-55
No. 4 (4.75 mm)	0-10
No. 8 (2.36 mm)	0-5
No. 200 (µm)	0-1.5

5. Mixing

Ready-mixed concrete shall be in accordance with ASTM C 94 for ordering (OPTION C, Minimum Cement Content), batching, mixing, and transporting.

Batching Tolerances (maximum w/c or w/cm ratio shall not exceed 0.45):

1. Cementitious Material: The weight of the cementitious material shall be within plus or minus 1 percent (+/- 1%) of the required weight of the cementitious material.
2. Aggregate: The weight of the fine and coarse aggregate shall be within plus or minus 2 percent (+/- 2%) of the required weight.
3. Mixing Water: The water added to the batch, including free water on the aggregates, shall be measured by weight or volume to an accuracy of 1 percent of the required total mixing water. Added ice shall be measured by weight.
4. Admixtures: The admixtures shall be within plus or minus 3 percent (+/- 3%) of the required weight or volume for each specific admixture.
5. Air: The air content (by volume) shall be 6 ± 1.5 percent of the volume of the concrete at the location and time of placement.

Concrete shall be uniform and thoroughly mixed when delivered to the forms.

The water-cement (w/c) ratio or water-cementitious material (w/cm) shall not exceed 0.45 at any time, including the addition of water at the site.

The concrete shall be batched and mixed such that the temperature of the concrete at time of placement shall not be less than 55 degrees Fahrenheit or, at no time during its production or transportation more than 90 degrees Fahrenheit.

6. Batch Delivery Ticket Information

The Contractor shall obtain from the manufacturer a batch delivery ticket for each load of concrete before unloading at the site. Any concrete load delivered without a batch delivery ticket containing all the following information shall not be allowed to be discharged in any part of the construction project covered under this specification.

The following minimum information shall be included on the batch delivery ticket.

1. Job-pertinent information
   - Name of concrete manufacturer and batch plant
   - Name of purchaser and job location
   - Date of delivery
   - Truck number
   - Amount of concrete delivered
   - Time loaded or time of first mixing of cement and aggregates
2. Ingredients used to mix the batch
   - Mixing water in the load added as free water
   - Percent moisture content, or weight of free water contained in the aggregates
   - Percent moisture content, or weight of free water absorbed by the aggregates
   - Type and amount of cementitious materials
   - Type and amount of admixtures
   - Weights of fine and coarse aggregates
3. The Contractor is responsible for adding the following information
   - Volume of water added by the receiver of the concrete
   - Time the concrete arrived at the site
   - Time the concrete was completely unloaded

Upon completion of the concrete placement, copies of all batch delivery tickets shall be provided to the Technician.

7. Placement of Subgrade, Forms, and Reinforcing Steel

A. Subgrade

The site shall be graded to the dimensions and elevations as specified in the construction plans.

All surfaces shall be firm and damp prior to placing concrete. Concrete shall not be placed on mud, dried earth, uncompacted fill, frozen subgrade, or in standing water. The use of plastic sheeting to isolate the concrete from unsuitable foundations shall not be permitted.

B. Forms

The forms and associated bracing shall be substantial, unyielding and constructed so that the finished concrete will conform to the specified dimensions and contours. Forms shall be mortar tight. Forms shall be coated with a form release agent before being set into place. Form release agent shall not come in contact with the steel reinforcement, waterstop, or with hardened concrete against which fresh concrete is to be placed.

For structures which are to be liquid-tight, form ties shall be used that permit their removal to a depth of at least ½ inch.

Concrete joints shall be placed at locations and be of the type shown on the construction drawings.

C. Reinforcing Steel

Reinforcement shall be accurately placed as shown on the drawings and secured in position in a manner that will prevent its displacement during the placement of concrete.

1. Tolerances - The following tolerances will be allowed in the placement of reinforcement:
   - Where 1½ inches clear distance is shown between reinforcing steel and forms, or embedded objects, allowable clear distance is 1⅛ to 1½ inches.
   - Where 2 inches clear distance is shown between reinforcing steel and forms, allowable
   - clear distance is 1⅝ to 2 inches.
   - Where 3 inches clear distance is shown between reinforcing steel and earth or forms, allowable clear distance is 2½ to 3 inches. Over-excavation backfilled with concrete shall not be considered as clear distance.
   - The maximum variation from the reinforcing steel spacing shown, shall be 1/12 of the spacing, without a reduction in the amount of reinforcing steel specified.
   - The ends of all reinforcing steel shall be covered with at least 1½ inches of concrete, with an allowable minimum distance of 1⅛ inches.
2. Reinforcement Support - Holding steel reinforcement in position with temporary supports is not permitted. Tack welding of bars is not permitted. Metal chairs, metal hangers, metal spacers, plastic chairs, or concrete chairs shall be used to support the reinforcement. Precast concrete chairs shall be manufactured from concrete equal in compressive strength to the concrete being placed. Reinforcement shall be supported at a minimum as follows:
   a. Deformed reinforcing bars for flatwork and sloped slabs shall be supported by a minimum of 1 support chair every 4 feet in each direction. Reinforcement shall not deflect or sag between supports. Deformed reinforcing bars shall be tied at every other rebar intersection or as approved by the Technician.
   b. Deformed welded wire reinforcement (WWR) shall be supported no further than as indicated in the table below.

c. When two layers of deformed reinforcing bars or deformed welded wire reinforcement are used for wall footings, flatwork and sloped slabs, the bottom layer may be supported by precast concrete chairs. The upper layer must be supported by metal chairs, metal spacers, plastic spacers, or rebar with legs tied to the lower mat and supporting the upper layer of reinforcing bars.

WWR Support

Welded Wire Reinforced Size(1)	Welded Wire Spacing	Maximum Support Spacing in Each Direction(2), feet
D9 or larger	12 inches or more	4 to 6 feet
D5 to D8	12 inches or more	3 to 4 feet
D9 or larger	Less than 12 inches	3 to 4 feet
D4 to D8	Less than 12 inches	2 to 3 feet

Notes:
(1) "D" is the standard designation for deformed wire.
(2) Support spacing shall be adequate to support all loads, including construction personnel and equipment. If excessive deflections occur, closer support spacing is required.

Flatwork reinforcement may be driven on prior to placement of supports if both of the following conditions are met:

- The subgrade is firm so that minimal displacement is made by equipment. If significant displacement occurs, the steel shall be removed, the subgrade regraded and compacted before steel and concrete placement.
- The reinforcing steel is not deformed by the equipment. If the steel is deformed, it shall be replaced before concrete placement.

Steel tying to protruding steel from a previous pour or form construction for new concrete that will be in contact with previously poured concrete shall not be started until the previously poured concrete has cured a minimum of 12 hours.

3. Reinforcement Splice Lengths and Bend diameters:

a. Deformed reinforcing bars

Bend diameter: 6 bar diameters for #3 through #8 bar sizes and 8 bar diameters for larger bars. Reinforcing bars shall not be heated to facilitate bending.

Splice Length: The minimum splice lengths in the table below are for concrete designed with a 28-day compressive strength of 3,500 psi. (NRCS standard wall designs) Other higher concrete design strengths and reinforcement grades require different splice lengths (typically shorter) in accordance with ACI 318. Deformed reinforcing bars shall not be spliced by welding. All lap splices shall be adequately tied together to firmly hold the reinforcement in position to maintain the proper splice length.

Minimum Splice Lengths Note 1

	Grade 40	Grade 60
#3 through #6 bars		
Top bars	27 bar diameters	41 bar diameters
all other bars	21 bar diameters	32 bar diameters
#7 and larger bars		
Top bars	34 bar diameters	51 bar diameters
all other bars	26 bar diameters	40 bar diameters

Note 1: Splice lengths shall be the greater of that indicated in the Table or 12-inches.

b. Deformed welded wire reinforcement (WWR) - Splice length shall be in accordance with the requirements of ACI 318-08 or ACI 318-11 Part 12.18. Deformed welded wire reinforcement shall not be spliced by welding. All lap splices shall be tied to firmly hold the reinforcement in position to maintain the proper splice length.

8. Placing, Consolidating, and Finishing Concrete

The Contractor shall notify the Technician of the proposed method of placement, consolidation, and finishing of the concrete at least seven (7) days prior to the start of concrete placement. The Contractor shall furnish the Technician a record of daily data including:

- Ambient temperature
- Relative humidity
- Wind velocity

A. General

Prior to placement of concrete, the forms and subgrade shall be free of chips, sawdust, debris, water, ice, snow, extraneous oil, mortar, or other harmful substances or coatings. Any oil on the reinforcing steel or other surfaces required to be bonded to the concrete shall be removed. Concrete shall not be placed until the subgrade, forms, waterstop, and steel reinforcement have been inspected and accepted by the Technician. Any deficiencies shall be corrected before the concrete is delivered for placement. Forms, reinforcing steel, and subgrade shall be moistened prior to placing concrete.

B. Delivery

Concrete shall be delivered to the site and discharged into the forms within 1½ hours after the introduction of the mixing water to the cement and aggregates, or when a superplasticizer is used, the manufacturer's recommended time limit for discharge after addition shall apply. The 1½ hour time may be extended if the concrete is of a slump that it can be placed, consolidated, and finished without the addition of water to the batch. Upon arrival at the job site, addition of water will be allowed to adjust the slump, provided such addition does not exceed the water-cement (w/c) ratio or water-cementitious material ratio (w/cm). Final placement of the batch shall begin immediately after mixing of the added water is completed.

Additional superplasticizer shall not be added to the concrete mix after discharge of the concrete at the job site has commenced.

C. Placement

The slump of the placed concrete shall not exceed the maximum slump of 5 inches with the use of water reducers.

The slump of the placed concrete shall not exceed the maximum slump of 8 inches with the use of superplacticizers.

Concrete shall be deposited as closely as possible to its final position. Concrete shall be worked into the corners and angles of the forms and around all reinforcement and embedded items in a manner to prevent segregation of aggregates. All placement shall be done in a manner that prevents incorporation of subgrade material into the concrete.

Methods for placing concrete on sloped slabs shall only include chutes, pumps, conveyors, wheelbarrows, or similar means of directly depositing concrete as near as possible to its final position. Placement of concrete by other methods where concrete is deposited upslope and flows to its final position downslope (commonly called "lava flow", "glacial pours", etc.) shall not be permitted.

Concrete shall not be dropped more than 6 feet vertically unless suitable equipment is used to prevent segregation. Concrete containing superplasticizer shall not be dropped more than 12 feet vertically and shall not be placed in lifts exceeding 6 feet in depth. Non-superplasticized concrete shall be placed in forms in horizontal layers not more than 24 inches deep. Each layer shall be thoroughly consolidated before the next is placed, at a rate such that previously placed concrete has not yet set when the next layer of concrete is placed upon it.

D. Consolidation

All concrete required to be consolidated with internal type mechanical vibrator shall be capable of transmitting vibration to the concrete at frequencies not less than 8,000 impulses per minute, unless otherwise specified or approved before placement.

Vibration shall be supplemented by spading, rodding, and hand tamping as necessary to ensure smooth and dense concrete along the form surface, in corners, and around embedded items. The contractor shall provide a sufficient number of vibrators to properly consolidate the concrete immediately after it is placed. Placement rate will be restricted if an inadequate number of vibrators are available.

Vibration shall compact the concrete and bring it into intimate contact with the forms, reinforcing steel, and other embedded items while removing voids and pockets of entrapped air. The location, insertion, duration, and removal of the vibrators shall be such that maximum consolidation of the concrete is achieved without causing segregation of the mortar and coarse aggregate or causing water or cement paste to flush to the surface.

The use of vibrators to transport concrete in the forms, slabs or conveying equipment will not be permitted.

1. *Formed Surfaces*

All concrete walls shall be vibrated.

Immediately after the concrete is placed in the forms, it shall be consolidated by internal vibration or hand tamping as necessary to insure dense concrete. Vibration shall be applied to the freshly deposited concrete by rapidly inserting the vibrator and slowly, in an up and down motion, removing the vibrator at points uniformly spaced at not more than 1.5 times the radius of the area visibly effected by vibration. Generally, this is at 5 to 10 seconds per foot on 14-inch spacings or less. The area visibly effected by the vibrator shall overlap the adjacent, just vibrated area. The vibrator shall extend vertically into the previously placed layer of fresh concrete by at least 6 inches at all points. Concrete supplied with superplasticizer shall be placed with a minimum amount of vibrating and finishing effort. Vibration shall not be applied directly to the reinforcement steel or the forms, nor to concrete which has hardened to the degree that it does not become plastic when vibrated. Each pour shall be consolidated to insure a monolithic bond with the preceding pour.

2. Slabs and footings

Immediately after the concrete is placed, it shall be consolidated by hand or mechanical methods as necessary to insure dense concrete.

- Surface vibrators may be used to consolidate slabs 8 inches and less in thickness. In thin slabs the internal vibrator(s) should be sloped toward the horizontal to allow operations in a fully embedded position, but shall not contact the subgrade.
- Slabs and footings more than 8 inches thick shall be consolidated with internal vibration and may be augmented through use of a surface vibrator.

Surface vibrators include vibrating screeds, plate or grid vibratory tampers, or vibratory roller screeds. (Mesh rollers, jitterbugs, and grate tampers are finishing tools and not consolidation tools.) When the concrete slab is to be consolidated using surface vibration methods, the contractor shall detail how this work is to be performed in writing to the technician for review and approval. This report must be submitted no less than 7 calendar days before placing concrete by this method. It includes equipment selection and specifications.

E. Finishing

All screed support devices shall be removed from the concrete or driven down flush with the subgrade prior to finishing.

1. Formed Surfaces: All formed concrete surfaces shall be true and even, and shall be free of depressions, holes, projections, bulges, or other defects in the specified surface finish or alignment. All surface defects shall be repaired as stated in the "Form Removal" section of this specification.

2. Slabs: All flatwork and sloped slabs shall be worked to a uniform grade, maintaining the specified thickness. Concrete shall be worked to minimize segregation and in a manner that does not adversely affect the structural integrity, durability or function of the structure. Surfaces shall be free from rock pockets, or honeycomb areas or other harmful irregularities or defects.

Water shall not be sprinkled or added to the surface of the concrete to facilitate finishing. An additional finish shall be applied if specified in the construction plans.

The proposed finished texture (broom, float, mesh roller, trowel, non-slip, etc.) of the concrete surface shall be approved by the Technician.

Evaporation reducer may be used during the finishing operation if approved by the Technician. Curing of the concrete is still required as per Section 11, Curing.

If a protective concrete coating is specified on the drawings, the coating manufacturer's recommendations for curing and surface preparation shall be followed.

F. Construction Joints

If the concrete sets during placement to the degree that it will not flow and merge with the succeeding pour when tamped or vibrated, the Contractor shall discontinue placing concrete and install a formed construction joint. The Contractor shall be prepared to install unplanned construction joints in the event that there is an interruption of the pour, equipment breakdown, or other problem which makes it necessary to stop placement of concrete at locations other than those previously planned. The reinforcement shall pass through the joint, unless otherwise indicated on the construction plan. Prior to the succeeding pour, the joint surface shall be cleaned to remove all unsatisfactory concrete, laitance, coatings, stains, or debris by one of the following methods:

1. The joint surface shall be cleaned to expose the fine aggregate and sound surface mortar, but not so deep as to undercut the edges of coarse aggregate. Cleaning shall be by wire brush, sandblasting, or high pressure air-water cutting after the concrete has gained sufficient strength to prevent displacement of the coarse aggregate. The joint surface shall be washed to remove all loose material after cutting.

2. According to methods specified by the person approving the construction plans.

   The surfaces of all construction joints shall be wetted and standing water removed immediately prior to placement of the new concrete. The new concrete shall be placed directly on the cleaned and washed surface. New concrete shall not be placed until the hardened concrete has cured at least 12 hours. The newly placed concrete shall be consolidated to achieve a good bond with the previously hardened concrete.

9. FORM REMOVAL AND CONCRETE REPAIR

A. Form Removal

Forms shall be removed without damage to the concrete. Supports shall be removed in a manner that permits the concrete to take the stresses due to its own weight uniformly and gradually. The minimum period from completion of the concrete placement to the removal of the forms shall be based on either strength tests or cumulative times.

1. Strength Tests: The strength of the in-place concrete is determined by testing concrete cylinders specifically cast for this purpose and cured adjacent to the member in accordance with the ASTM C 31 methods for determining removal time. Unless otherwise specified, forms supporting the weight of the concrete member may be removed after the concrete strength is 70 percent of that specified for the 28-day compressive strength.

2. Cumulative Time: The total accumulated time, not necessarily continuous, that the air adjacent to the concrete is above 50 degrees Fahrenheit will be determined by the Contractor and accepted by the Technician. The forms may be removed after the total accumulated time shown in the following table:

Form Removal

Forms		Time
Sides of slabs or beams without waterstop		12 hours
Sides of slabs or beams with waterstop		16 hours
Undersides of slabs or beams	Clear Span < 10 feet	4 days
	10-20 feet	7 days
	> 20 feet	14 days
Sides of walls or columns	Height of forms < 20 feet	24 hours
	> 20 feet	72 hours

For structures which are not required to be liquid-tight, form ties shall be removed flush with or below the concrete surface. For structures which are to be liquid-tight, form ties shall be removed to a minimum depth of ½ inch. All cavities or depressions resulting from form tie removal shall be patched in accordance with Part C of this Section.

Forms shall be removed and the concrete inspected by the Technician before walls are backfilled. Concrete loading shall be in accordance with Section 13, Loading New Reinforced Concrete Structures.

B. Repair of Surface Defects (other than tie holes)

Immediately after removal of the forms, concrete which is honeycombed, damaged or otherwise defective as identified by the Technician shall be repaired or replaced by the Contractor. All repairs of surface defects shall be completed prior to the application of curing compound. Repair of surface defects such as honeycombed or otherwise defective concrete shall be made using bonding grout and site mixed Portland cement mortar or other products specifically intended to repair surface defects that are applied in accordance with the manufacturer's recommendations.

1. Bonding grout and site mixed Portland cement mortar:

   a. Outline the honeycombed or otherwise defective concrete with a ½ to ¾ inch deep saw cut and remove such concrete down to sound concrete. When chipping is necessary, leave chipped edges perpendicular to the surface or slightly undercut. Do not feather edges.

   b. Dampen the area to be patched plus another 6 inches around the patch area perimeter.

   c. Prepare bonding grout by mixing approximately one part Portland cement and one part fine sand with water to the consistency of thick cream.

   d. Thoroughly brush the bonding grout into the surface. When the bond coat begins to lose water sheen, apply repair mortar. Repair mortar is made by mixing 1 part Portland cement to 2½ parts fine sand (approximately finer than the No. 16 sieve size) by damp loose volume. The mortar shall be at a stiff consistency with no more mixing water than

is necessary for handling and placing. Mix the repair mortar and manipulate the mortar frequently with a trowel without adding water.

e. Thoroughly consolidate the mortar into place and strike off, leaving the patch slightly higher than the surrounding surface to compensate for shrinkage. Leave the patch undisturbed for 1 hour before finishing. The repair shall be cured as specified Section 10, Curing.

2. Repair materials other than site mixed Portland cement:

a. Portland cement mortar modified with a latex bonding agent conforming to ASTM C 1059, Type II.

b. Epoxy mortars and epoxy compounds that are moisture-insensitive during application and after curing and that embody an epoxy binder conforming to ASTM C 881. The type, grade, and class shall be appropriate for the application as specified in ASTM C 881.

c. Nonshrink Portland cement grout conforming to ASTM C 1107.

d. Packaged dry concrete repair materials conforming to ASTM C 928.

e. Other products specifically intended to repair surface defects that are applied and cured in accordance with the manufacturer's recommendations.

C. Repair of Form Tie Holes

Liquid-Tight Concrete Structures – Repair tie holes immediately after formwork removal and prior to the application of curing compound. All cavities or depressions resulting from form tie removal shall be patched with commercially available patching products or site mixed Portland cement repair mortar.

1. Site-mixed Portland cement repair mortar

Repair mortar is made by mixing 1-part cement to 2.5-parts fine sand (approximately finer than the No. 16 sieve size) by damp loose volume. Mortar shall be at a stiff consistency with no more mixing water than is necessary for handling and placing. Mix the repair mortar and manipulate the mortar frequently with a trowel without adding water. Clean and dampen tie holes before applying the mortar. Cure in accordance with Section 10, Curing.

2. Repair materials other than site mixed Portland cement:

a. All those materials listed in Section 9.B.2.a-d.

b. Other products specifically intended to fill form tie holes for liquid-tight applications that are applied and cured in accordance with the manufacturer's recommendations.

10. CURING

Concrete shall be cured for a period of at least 7 consecutive days (curing period) after it is placed, except as stated in Section 12. Exposed concrete surfaces shall be kept continually wet during the entire curing period or until curing compound is applied.

Curing compound shall be applied at the rate and with the proper equipment recommended by the manufacturer. It shall form a uniform, continuous, adherent film that shall not check, crack, or peel and shall be free from pinholes or other imperfections.

Curing compound shall not be used at construction joints or other areas that are to be bonded to additional concrete. Surfaces subjected to heavy rainfall or running water within 3 hours after the application of curing compound, or surfaces damaged by subsequent construction operations during the curing period, shall be recoated in the same manner as the original application.

Concrete shall be allowed to cure for a minimum of 28 days before storing material that will produce leachate.

11. CONCRETE PLACEMENT IN HOT WEATHER

Hot weather conditions exist at the time of proposed placement when:

1. The rate of evaporation greater than 0.10 lb. /sq. ft. /hr. OR

2. Two or more of the following factors are exceeded:

1. Ambient temperature is greater than 80 degrees Fahrenheit

2. Relative humidity is less than 60 percent

3. Wind velocity (average) is greater than 10 mph

Concrete surfaces shall not be allowed to dry after placement and during the curing period.

Measures to reduce surface moisture loss and rate of cement hydration must be taken to immediately protect and cure the concrete due to rapid drying conditions.

- Plan placement to early morning, late afternoon or evening.
- Use a set-retarding admixture meeting the requirements in Section 3 of WCS-4 when the time between the introduction of the mixing water to the cement and aggregates and discharge exceeds 45 minutes. The 45 minute time may be extended if the concrete is of a slump that it can be placed, consolidated, and finished without the addition of water to the batch.
- Use a fog spray to raise the relative humidity of the ambient air.
- Moist cure the concrete surface as soon as the surfaces are finished and continue for at least 24 hours.
- Use a monomolecular film, or evaporation retarder in accordance with the manufacturers printed instructions.

Concrete placement shall be suspended when:

1. The rate of evaporation is greater than 0.25 lb./sq. ft./hr. OR

2. When all of the following factors, as measured at the time of concrete placement are exceeded:

1. The ambient temperature is greater than 80 degrees Fahrenheit,

2. Relative humidity is less than 40 percent, and

3. Wind velocity (average) is greater than 15 mph

$$E = (Tc^{2.5} - R * Ta^{2.5})\ (1+0.4V) \times 10^{-6}$$

where:

E = evaporation rate, lb. /sq. ft. /hr.
Tc = concrete temperature, °F
Ta = air temperature, °F

R = percent relative humidity /100 (decimal form 20% = 0.20) V = wind velocity, mph

Wind speeds at reporting station are taken above the ground surface, so V = average reported wind speeds x 0.66).

12. CONCRETING IN COLD WEATHER

The following provisions shall apply when the minimum air temperature at the local job site is less than 35 degrees Fahrenheit (the forecasted temperature, which shall be verified with a maximum/ minimum thermometer at the start of the morning job shift).

A. No concrete shall be placed without the required thermometers at the job site.

B. The Contractor shall furnish the Technician a record of daily temperature data including:
   - Outside air maximum and minimum temperatures at the local job site, and
   - Temperatures, of the air adjacent to the surface of the concrete, at several points along the concrete surface for all concrete curing periods.

C. When the cement is initially added to the mix, the temperature of the mixing water shall not exceed 100 degrees Fahrenheit nor shall the temperature of the aggregate exceed 100 degrees Fahrenheit.

D. The temperature of the concrete at the time of placement shall be not less than 55 degrees

E. Fahrenheit or at no time during its production or transport more than 90 degrees Fahrenheit.

F. Placed concrete may be protected by covering, housing, insulating or heating concrete structures.

G. The minimum air temperature adjacent to the surface of the concrete shall be maintained above

H. 40 degrees Fahrenheit for a period of at least 7 accumulated days. These 7 days must occur during the first 10 days after the concrete is placed. At no time, during the first 10 days after concrete is placed, shall the minimum air temperature adjacent to the surface of the concrete be less than 32 degrees Fahrenheit unless Type III cement or an approved accelerating admixture is used (see Item G below).

I. The curing period may be reduced from 7 cumulative days to 3 consecutive days when Type III cement or an approved accelerating admixture is used. The accelerating admixture shall be used at the proportions recommended by the manufacturer. The minimum air temperature adjacent to the surface of the concrete shall be maintained above 40 degrees Fahrenheit for the 3 day curing period.

J. Combustion heaters shall have exhaust flue gases vented out of the concrete protection enclosure. The heat from heaters and ducts shall be directed in such a manner as to not overheat or dry the concrete in localized areas or to dry the exposed concrete surface.

   At the end of the curing period, the concrete shall be allowed to cool gradually. The maximum temperature decrease at the concrete surface in a 24-hour period shall not exceed 40 degrees.

13. LOADING NEW REINFORCED CONCRETE STRUCTURES

Backfill material shall be the type indicated on the drawings and shall be free of large stones or debris.

Compaction within 3 feet of the new structure wall will be by means of small manually directed tamping or vibrating equipment.

The age of concrete shall be at least 7 days before any load (including backfill) is applied other than the weight of the wall, forms, or scaffolds for succeeding lifts or light equipment. The 7-days may be reduced to 3 days when Type III cement or an approved accelerating admixture is used. Loads may also be applied to new concrete less than 7 days after placement when 75 percent of the design strength has been attained through compressive strength testing on cylinders that have been cured onsite under field conditions.

14. 14. INSPECTION AND TESTING

The inspection and testing details of this section shall apply when specific concrete tests are required in the construction drawings or quality assurance plan. This testing does not relieve the Contractor of the responsibility to perform the work according to this specification. The Technician shall have free access to the work **site and batching** to obtain samples.

When testing is conducted, the following methods shall be used:

Type of Test	Test Method (ASTM Designation)
Sampling	C 172
Slump	C 143
Air Content	C 231 or C 173
Making and Curing Specimens in the Field	C 31
Obtaining and Testing Drilled Cores	C 42
Compressive Strength	C 39
Density (Unit Weight)	C 138
Temperature	C 1064

The contractor is responsible for determining who is responsible for testing, and providing results to all parties.

Compressive strength of the concrete shall be considered satisfactory if test results equal or exceed the 28-day design strength. For each ASTM C 39 strength test, three test specimens shall be made. The test result shall be the average of the compressive strength tests of any two of the three test specimens. If one test specimen shows evidence of improper sampling, molding, or testing, it shall be discarded and the remaining specimens tested. The strengths of the remaining two specimens shall be averaged, and the result shall then be considered the compressive strength of the concrete. If more than one specimen shows such defects, the test is not valid and the remaining specimen shall be discarded.

If test results are invalid due to specimen defects, or the in-place concrete that is in question was not sampled, the in-place concrete may be sampled by coring in accordance with ASTM C 42. For core tests, at least three representative cores shall be taken from each area of the concrete in question. If one or more of the cores shows signs of being damaged before testing, it shall be replaced by a new one.

WISCONSIN CONSTRUCTION SPECIFICATION
004-WS EMBEDDED OR EXPANSIVE WATERSTOP

1. Scope

The work shall consist of furnishing, welding, placing and installation of embedded waterstop base seal waterstop, or expansive waterstop as required on the construction drawings. All material shall meet the requirements of the latest edition of the applicable ASTM designation.

2. Quality Control and Quality Assurance During Concrete Placement

The contractor shall provide the technician a construction quality control plan at the pre-construction conference.

The plan shall detail the requirements for waterstop installation, including as a minimum:

- Waterstop placement and welding methods that will be utilized during construction,
- Name, contact information and responsibilities of a quality control (QC) individual providing continuous quality control during concrete placement around the embedded waterstop to ensure proper placement and consolidation.
  - » The quality control person may be an employee of the contractor or the owner of the project, without other duties during concrete placement.
- Name, contact information and responsibilities of an individual performing continuous quality assurance (QA) during concrete placement around the embedded waterstop to ensure proper placement and consolidation.
  - » The quality assurance individual shall be a person under the direction and control of the individual responsible for approving the as-built construction plan.

    OR
  - » A qualified consultant hired by the owner to assure and document the installation complies with the manufacturer's recommendations and procedures and this specification. The third party consultant shall provide documentation to the owner and the Technician.

3. Materials

The Contractor shall provide evidence from the manufacturer showing that the waterstop materials meet the requirements of this specification. All materials proposed for use shall be approved by the Technician.

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Preformed expansion joint filler shall be commercially available products made of sponge rubber, closed cell foam, or boards containing bituminous materials. The joint filler shall have a minimum thickness of ½ inch and a width equal to the full cross sectional width of the concrete at the joint.

Embedded waterstops shall be made of polyvinyl chloride (PVC), thermoplastic elastomeric rubber (TPE-R), or polyethylene (PE or VLDPE). The minimum width of waterstop shall be 6 inches, or the width and material shown on an NRCS approved Wisconsin Standard Drawing. The waterstop web thickness shall be a minimum of 3/8 inches throughout the entire cross section of the waterstop. The maximum bulb size shall not exceed 1 inch. Waterstops shall be the type intended for placement entirely within the concrete cross section, or as shown on an NRCS approved Wisconsin Standard Drawing or other drawings as approved by the NRCS State Conservation Engineer. Waterstops shall have ribbed or "dumb-bell" type anchor flanges and a hollow tubular center bulb. Split flange waterstops are prohibited.

Base seal waterstops shall be made of polyvinyl chloride (PVC), thermoplastic elastomeric rubber (TPE-R), or polyethylene (PE or VLDPE). The minimum width of waterstop shall be 9 Inches. This waterstop shape is limited to NRCS approved Wisconsin Standard drawing for feed storage facilities and pre-engineered waste storage structures approved by the Wisconsin State Conservation Engineer (SCE).

Expansive waterstops shall consist of preformed strips or mastic (caulk) made of hydrophilic materials that expand when subjected to moisture and shall not contain bentonite. Use shall be limited to non-movement joints (fixed joints).

4. Welding of Waterstop

Manufacturers' fabricated waterstop intersections shall be provided.

Only straight butt joint splices are allowed for field fabrication. Splices in waterstops shall be welded as recommended by the manufacturer. The specific splicing iron and the temperature of the iron shall be in accordance with the manufactures instructions for the type of waterstop being spliced.

Manufacturer-certified contractors may fabricate waterstop intersections in a controlled environment with the proper manufacturer's equipment. Prior to the time of delivery of the fabricated intersections, documentation of certification must be presented to the Technician.

5. Placement and Installation of Waterstop

Embedded Waterstop

Joints with embedded waterstops shall not be placed horizontally across sloped slabs.

Embedded waterstops shall be located as shown on the drawings and secured in position so that displacement does not occur during concrete placement. Vertical applications (footing to wall joints and wall to wall joints) shall be secured to reinforcement using wire or "hog ring" type fasteners or factory installed grommets at the outermost rib at the spacing as recommended by the waterstop manufacturer (usually 12 inches on center). Hog rings shall be factory installed, if the manufacturer has that option available. Each waterstop shall be placed and secured with the hollow bulb aligned in the center of the planned joint.

Waterstop clearance shall be a minimum of 1½ inches from reinforcement and one half the waterstop's width to the face of the concrete (3 inches for 6 inch wide waterstop).

Internal vibration is required along the entire length of all joints that contain embedded waterstops for both formed surfaces and slabs and shall be performed in the presence of the QC and QA individuals.

Continuous placement of concrete through a waterstop joint is not allowed, except for control joints in formed walls where preformed joint control formers are used in conjunction with the waterstops, or in control joints as shown on an NRCS approved Wisconsin Standard Drawing or other drawings as approved by the NRCS SCE.

Expansive Waterstop

Expansive waterstop shall be placed at the locations shown on the drawings in accordance with the manufacturer's instructions.

Preformed strips may require adhesive or other forms of mechanical fastening to existing concrete based on the manufacturer's instructions. The adhesive for preformed expansive waterstop and the mastic for caulk type expansive waterstop shall be allowed to cure for the duration as indicated by the manufacturer prior to placing concrete over the waterstop.

Mastic (caulk) type expansive waterstops shall be placed to the bead size as recommended by the manufacturer based on the amount of concrete cover provided.

Colder temperatures will require longer curing periods prior to concrete placement. Do not allow the expansive waterstop to become wet prior to placing concrete over the waterstop.

6. Repair protocol

Waterstop which does not comply with this specification, damaged or otherwise defective shall be repaired or replaced by the Contractor in accordance with the manufacturer's recommendations or a repair plan developed by the contractor and approved by the Technician. All repairs shall be completed prior to additional work on the waterstop joint.

WISCONSIN CONSTRUCTION SPECIFICATION

9. ROCK RIPRAP

1. SCOPE

The work shall consist of testing, furnishing, transporting, and placing rock riprap, including filter, bedding or geotextile materials where specified, in the construction of loose rock riprap revetments, blankets, rock toes, crossings, rock chutes, channel linings and other similar structures.

2. QUALITY OF MATERIALS

The rock shall be obtained from tested sources unless exempted below. Rock sources used for streambank protection, lined waterways, rock chutes, or other similar major projects (Job Class II and above) shall be tested prior to use. A test is required a minimum of every ten (10) years. The Technician may require a more current test.

Rock riprap from igneous or metamorphic origins such as granite, basalt, and quartzite may be used without testing. Dolomite from quarries within the map legend units shown in Figure 1 may also be used without testing:

- Dolomite (Sd) - all counties.
- Sinnipee Group (Os) and Prairie du Chien (Opc) exempt only in the following counties: Marinette, Oconto, Shawano, Brown, Outagamie, Calumet, Winnebago, Green Lake, and Fond du Lac.

The Technician shall inspect and approve sources of these rock types prior to use and determine if testing is required.

Rock for equipment or cattle channel crossings, access roads, heavy use area protection or similar minor structures need not be tested.

Individual rock fragments shall be dense, sound and free from cracks, seams and other defects conducive to accelerated weathering. The rock fragments shall be angular to subrounded in shape. The least dimension of each individual rock fragment shall be not less than one-third the greatest dimension of the fragment. It should also be free from dirt, clay, sand, rock fines and other materials not meeting the gradation limits. Rock shall be excavated, selected and handled as necessary to meet the grading requirements stated in the construction plans.

Representative samples of rock requiring testing shall conform to the following requirements:

Bulk Specific Gravity (saturated surface-dry basis). Not less than 2.50 when tested in accordance with ASTM Specification C 127 on samples prepared as described for soundness testing.

Absorption. Not more than four (4.0) percent when tested in accordance with ASTM C 127 on samples prepared as described for soundness testing.

Soundness. The weight loss in five cycles shall not be more than 28 percent when tested by the sodium sulfate soundness test method in the modified ASTM C 88. Losses in excess of 20 percent are acceptable only when the design D_{50} rock size has been increased by 10 percent for a loss of 20-23.9 percent or 20 percent for a loss of 24-28 percent.

3. METHODS OF TESTING

Bulk Specific Gravity and Absorption shall be determined by ASTM C 127 on samples prepared as described for rock cube soundness testing.

Rock Cube Soundness. Soundness testing shall be performed by ASTM C 88 for coarse aggregate modified as follows.

The sodium sulfate soundness test shall be performed on a test sample of 5000 ± 300 grams of rock fragments, reasonably uniform in size and cubical in shape and weighing, after sampling, approximately 100 grams each. The test sample shall be obtained from rock samples that are representative of the total rock mass, as noted in ASTM Specification D 4992, and that have been sawed into slabs as described in ASTM Specification D 5121. The samples shall be further reduced in size by sawing the slabs into cubic blocks. The thickness of the slabs and the size of the sawed blocks shall be determined by the size of the available test apparatus and as necessary to provide, after sawing, the approximate 100 gram samples.

Due to internal defects, some of the cubes may break during the sawing process or during the initial soaking period. Cubes that break during this preparatory process shall not be tested. Such breakage, including an approximation of the percentage of cubes that break, shall be noted in the test report.

After the sample has been dried, following completion of the final test cycle and washing to remove the sodium sulfate, the loss of weight shall be determined by subtracting from the original weight of the sample the final weight of all fragments which have not broken into three or more fragments. (Samples that break into three or more large fragments during testing will be assigned a final weight of 0.0.) The test report shall show the percentage loss of the weight. Photographic documentation of all samples before and after testing shall be part of the test report.

Equivalent AASHTO testing specifications may be substituted for ASTM testing specifications.

A rock source may be rejected if the rock from that source deteriorates in less than 5 years under similar use and exposure conditions expected for the rock to be installed under this specification, even though it meets the testing requirements stated above.

Deterioration is defined as the visual loss of more than one-quarter of the original rock volume, or severe cracking that would cause a rock to split.

4. GRADATION

The gradation of the rock riprap and filter or bedding material shall be as shown in the construction plans.

Rock used for streambank protection, lined waterways, rock chutes, or other similar major projects (Job Class II and above) shall have a gradation verification be done by one of the following methods.

Method A
Measurement of a random truck load of stone (reference sample) according to the procedure outlined in EFH-17, Procedure for Determining Rock Weights, Sizes, and Gradations; or ASTM D5519, Standard Test Methods for Particle Size Analysis of Natural and Man-Made Riprap Materials (Test Method A).

Method B
Creation of reference samples of rock of at least 0.5 tons, made according to the procedure outlined in EFH-17 (Tables 1 - 5), creating the envelope limits of the gradation specified.

Control of project gradation will be by visual inspection comparing rock delivered to the reference samples.

The reference sample(s) may be used as part of the finished riprap or remain at the quarry.

Any difference of opinion between the Technician and the Contractor shall be resolved by dumping and checking (by measurement) the gradation of a random truck load of stone by Method A. Mechanical equipment, a sorting site, and labor needed to assist in checking gradation shall be provided by the Contractor at no additional cost.

5. SUBGRADE PREPARATION

The subgrade surfaces on which the riprap, filter or bedding material is to be placed shall be cut or filled and graded to the lines and grades as shown on the drawings or as directed by the Technician. When fill to subgrade lines is required, it shall consist of approved materials and shall be compacted as specified in Wisconsin Construction Specification 3, Earthfill. Riprap, filter, bedding or geotextile shall not be placed until the foundation preparation is completed, and approved by the Technician.

6. FILTER AND BEDDING

Filter or bedding material, when required, shall be spread uniformly on the prepared subgrade surfaces to the depth shown on the drawings. The surfaces of the layers shall be finished reasonably free of mounds, dips or windrows and shall meet the gradation shown on the plans or as specified in Wisconsin Construction Specification 8.

Geotextile, when required, shall meet the requirements shown on the drawings and as specified in Wisconsin Construction Specification 13, Geotextiles.

7. PLACING ROCK RIPRAP

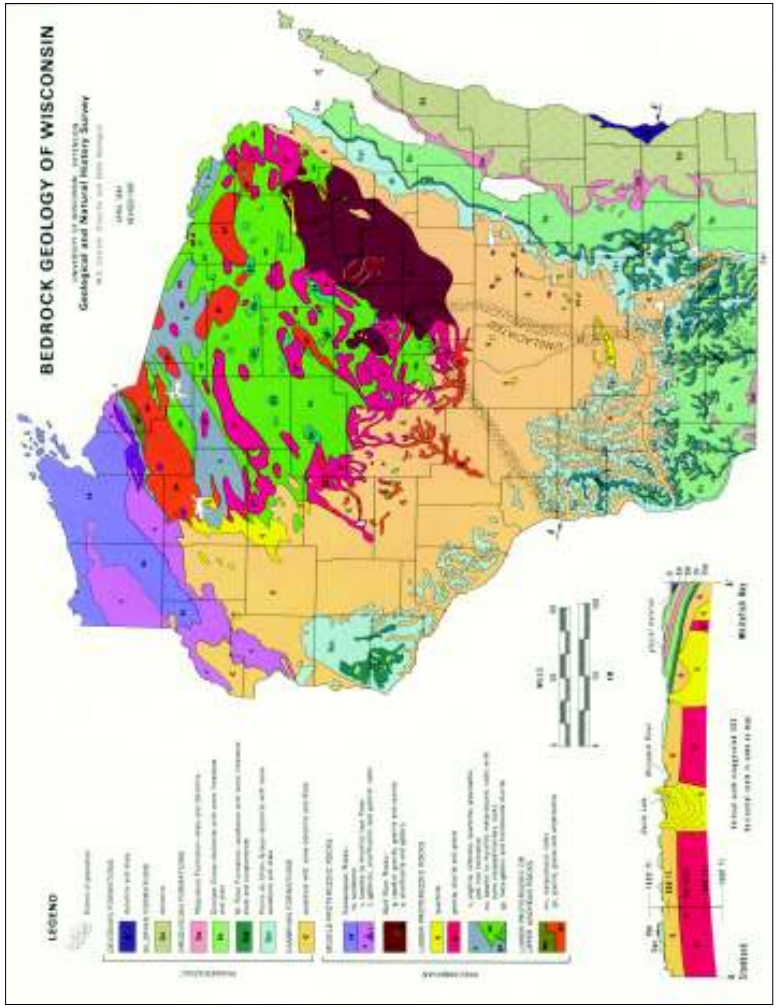
The rock riprap shall be placed by equipment on the surfaces and to the depths specified. The rock riprap shall be installed to the full course thickness in one operation and in such a manner as to avoid displacement of underlying materials. The rock for riprap shall be delivered and placed in a manner that will ensure that the riprap in-place shall be reasonably homogeneous with the larger rocks uniformly distributed and firmly in contact one to another with the smaller rocks and spalls filling the voids between the larger rocks. Some hand placing may be required to provide a neat and uniform surface or to prevent damage to structures.

8. VEGETATED ROCK RIPRAP

If the rock riprap is to be vegetated, topsoil shall be placed by equipment in the riprap voids (surface) and on the surface of the rock to the depth specified. The topsoil placement shall not take place before the placement of the rock riprap is approved by the Technician. Topsoil shall be placed in such a manner as to avoid displacement of the underlying rock.

The topsoil may extend from the top of the riprap down to the bankfull elevation (OHWM) or as shown on the drawings. Care shall be taken so topsoil is retained on the rock and is not allowed into the water body. The area shall be seeded and mulched within 12 hours following topsoil placement.

Figure 1



WISCONSIN CONSTRUCTION SPECIFICATION

13. GEOTEXTILES

1. SCOPE

This work shall consist of furnishing all materials, equipment, and labor necessary for the installation of geotextiles.

2. MATERIALS

The class and type of geotextile shall be as shown on the drawings.

Geotextiles shall be manufactured from synthetic long chain or continuous polymeric filaments or yarns composed of at least 95 percent by weight of polypropylene, polyethylene, polyester, polyamide, or polyvinylidene-chloride. Fibers shall contain stabilizers and/or inhibitors to enhance its resistance to ultraviolet light. The geotextile shall be formed into a stable network of filaments or yarns that retain dimensional stability relative to each other, including selvages. The geotextile shall be free of any chemical treatment or coating that might significantly reduce its permeability and shall have no flaws or defects that significantly alter its physical properties.

Thread used for factory or field sewing shall be of a contrasting color to the fabric and made of polypropylene, polyester, or polyamide thread. The sewing thread shall have a minimum breaking strength of 28 pounds when tested in accordance to ASTM D 2256. The thread shall be as resistant to ultraviolet light as the geotextile being sewn.

Additional requirements for geotextile materials are as follows:

a. Slit Tape Geotextile

Slit tape geotextile shall conform to the physical properties listed in Table 1. The slit tape geotextile shall be manufactured from a filament that is woven. The edges of the material shall be selvaged or otherwise finished to prevent the outer filament from unraveling.

b. Woven Geotextile

Woven geotextile shall conform to the physical properties listed in TABLE 1. The woven geotextile shall be manufactured from monofilament yarn that is woven into a uniform pattern with distinct and measurable openings. The fabric shall be manufactured so that the yarns will retain their relative position with regard to each other. The edges of the material shall be selvaged or otherwise finished to prevent the outer yarn from unraveling.

c. Nonwoven Geotextile

Nonwoven geotextile shall conform to the physical properties listed in TABLE 2. Nonwoven geotextile shall be manufactured from randomly oriented fibers that have been bonded together by needle-punching.

3. SHIPPING AND STORAGE

Geotextiles labeling, shipment, and storage shall follow ASTM D 4873. Product labels shall clearly show the manufacturer or supplier name, style name, and roll number. Each geotextile roll shall be wrapped with a material that will protect the geotextile, including the ends of the roll, from damage due to shipment, water, sunlight, and contaminants. The protective wrapping shall be maintained during periods of shipment and storage.

Prior to use, the geotextile shall be inspected and approved by the Technician, then stored in a clean, dry, place, out of direct sunlight, not subject to temperature extremes, and with the manufacturer's protective cover in place.

4. SURFACE PREPARATION

The surface on which the geotextile is to be placed shall be graded to the neat lines and grades as shown on the drawings. The surface shall be reasonably smooth and free of holes, vegetation, excessive mud, and projections. The surface preparation will be inspected and approved by the Technician prior to placing the geotextile.

5. PLACEMENT

a. General

The geotextile shall be placed on the approved, prepared surface at the locations and in accordance with the details shown on the drawings. The geotextile shall be unrolled along the placement area and loosely laid (not stretched) in such a manner that it will conform to the surface irregularities when the stone or other material is placed on or against it. The geotextile may be folded and overlapped to permit proper placement in the designated area.

No cuts, punctures, tears, or gaps in sewn or overlapped joints will be permitted in the geotextile.

The panel length shall be placed parallel to the direction of water flow, except as stated below in paragraph b. Slope Protection and d. Road Stabilization.

The geotextile panels may be joined by overlapping the roll ends 36 inches and sides a minimum of 18 inches and securing the overlap against the underlying foundation materials. The fabric shall be restrained as needed to prevent lifting and displacement during construction. Allowable restrainment methods include backfilled trenches, stitching, sandbags, rocks, and securing pins that are approved and provided by the geotextile manufacturer. The upstream or up-slope geotextile shall overlap the abutting down-slope geotextile.

The geotextile panels may be joined by machine sewing using thread described under 2. Materials. The seam shall conform to Federal Standard SSa-2, SSn-2 or SSd-2.The sewing shall consist of two parallel stitched rows spaced approximately 1 inch apart. Each row of stitching shall be located a minimum of 2 inches from the geotextile edge. The seam type and sewing machine to be used shall produce a seam strength, in the specified geotextile, that provides a minimum of 90 percent of the tensile strength in the weakest principal direction of the geotextile being used, when tested in accordance with ASTM D 4884. The seams may be factory or field sewn. All seaming and stitching of woven geotextiles shall be in the selvage.

Non-woven geotextiles shall be sewn a minimum of ½ inch from the edge. Geotextile shall be installed with the sewn seams pointing up.

The geotextile shall be restrained as needed during placement of overlying materials to prevent slippage, folding, or other movements of the geotextile.

Prior to covering, the geotextile shall be inspected by the Technician to ensure that the geotextile has not been damaged during construction. Backfill shall be placed by end dumping onto the geotextile from the edge of the geotextile or over previously placed backfill. Vehicles shall not be allowed directly on the geotextile. Materials shall be placed on the geotextile without causing tears, punctures, or separations of overlaps or sewn joints. Should such damage occur, the backfill around the damaged or displaced area will be removed and the subgrade restored to the original approved condition. Repair of the area shall consist of a patch of the same type of geotextile overlaying the existing geotextile. The patch shall extend a minimum of 2 feet from the edge of any damaged area.

b. Slope Protection

The geotextile shall not be placed until it can be anchored and protected with the intended covering within 48 hours. Temporary cover, for protection from ultraviolet light, may be used if the 48-hour limit will be exceeded. Material will not be dropped from a height of more than 3 feet on to uncovered geotextile. In lakeshore applications, the geotextile may be unrolled parallel or perpendicular to the bank. The geotextile shall be joined by machine sewing if the panel length is placed perpendicular to the direction of water flow (wave runup).

c. Subsurface Drains

The geotextile shall not be placed until drainfill or other material can be used to cover it within the same working day. Material will not be dropped from a height of more than 5 feet on to the geotextile and sharp, angular aggregates will not be used unless the drawing details state otherwise.

d. Road Stabilization

The geotextile shall be unrolled in a direction parallel to the roadway centerline in a loose manner permitting it to conform to surface irregularities when the roadway fill material is placed on it. Overlap shall be in the direction of construction. The minimum overlap of geotextile panels joined without sewing shall be 24 inches. The geotextile may be temporarily secured with pins recommended by the manufacturer. They shall be removed prior to placement of the covering material. Slit tape geotextile shall not be used in a wet location. Material will not be dropped from a height of more than 5 feet on to uncovered geotextile.

Table 1. Requirements for Woven Geotextiles by Use

Property	Test Method	Slope Protection		Road Stabilization	
		Unprotected (Class I)	Protected (Class II)	(Class IV)	Slit Tape
Tensile Strength (lbs.)[1]	ASTM D 4632 Grab Test	≥ 250 in any principal direction	≥ 120 in any principal direction	≥ 180 in any principal direction	≥ 200 in any principal direction
Elongation at failure (Percent)[1]	ASTM D 4632 Grab Test	≤ 20	≤ 35	≤ 35	≤ 10
Puncture (lbs.)[1]	ASTM D 6241	≥ 900	≥ 350	≥ 350	≥ 700
Ultraviolet Light (percent residual tensile strength)	ASTM D 4355 150 hours exposure	70 minimum	70 minimum	70 minimum	70 minimum
Apparent Opening Size (AOS)	ASTM D 4751	≥ #100 (.150 mm) and ≤ #70 (.212 mm)[3]	≥ #100 (.150 mm) and ≤ #70 (.212 mm)[3]	≥ #100 (.150 mm) and ≤ #70 (.212 mm)[3]	As specified or a min. size > #50[3]
Percent Open Area (POA)	CW-02215[2]	4.0 min.	4.0 min.	1.0 min.	N/A
Permittivity (1/seconds)	ASTM D 4491	0.20 minimum	0.10 minimum	0.10 minimum	0.05 minimum
Water Flow (gal/sq. ft./minute)	ASTM D 4491	15 minimum	7.5 minimum	7.5 minimum	3.8 minimum

[1]Minimum average roll values (MARV); calculated as the mean minus two standard deviations, yielding a 95 percent confidence level that the table value will be equaled or exceeded.

[2]Test Methods prepared by U. S. Army Corps of Engineers

[3]U. S. Standard Sieve Size

Table 2. Requirements for Nonwoven Geotextiles by Use

Property	Test Method	Slope Protection		Subsurface Drainage	Road Stabilization
		Unprotected (Class I)	Protected (Class II)	(Class III)	(Class IV)[3]
Tensile Strength (lbs.)[1]	ASTM D 4632 Grab Test	≥ 180	≥ 120	≥ 90	≥ 180
Elongation At failure (percent)[1]	ASTM D 4632 Grab Test	≥ 50	≥ 50	≥ 50	≥ 50
Puncture (lbs.)[1]	ASTM D 6241	≥ 350	≥ 250	≥ 200	≥ 200
Ultra-Violet Light (percent residual tensile strength)	ASTM D 4355 150 hours exposure	70 minimum	70 minimum	70 minimum	70 minimum
Apparent Opening Size (AOS)	ASTM D 4751	As specified or max. #40[2]	As specified or max. #40[2]	As specified or max. #40[2]	As specified or max. #40[2]
Permittivity (1/seconds)	ASTM D 4491	0.70 minimum	0.70 minimum	0.70 minimum	0.10 minimum
Water Flow (gal/sq. ft./ minute)	ASTM D 4491	52.5 minimum	52.5 minimum	52.5 minimum	7.5 minimum

[1]minimum average roll values (MARV); calculated as the mean minus two standard deviations, yielding a 95 percent confidence level that the table value will be equaled or exceeded.

[2]U. S. Standard Sieve Size.

[3]Heat-bonded or resin-bonded geotextile may be used.

WISCONSIN CONSTRUCTION SPECIFICATION

15. Plastic Pipe Conduits

1. SCOPE

The work shall consist of furnishing and installing polyvinyl chloride (PVC), acrylonitrile-butadienestyrene (ABS), and polyethylene (PE) plastic pipe and the necessary fittings as shown on the drawings. **This specification does not apply to corrugated polyethylene tubing used for subsurface drainage systems.**

2. MATERIALS

Polyvinyl chloride (PVC) pipe and fittings shall conform to the requirements of the following ASTM and AWWA specifications unless otherwise stated on the drawings.

Pressure Rated:

a. ASTM D-1785 PVC Plastic Pipe, Schedules 40, 80, and 120.
b. ASTM D-2241 PVC Pressure-Rated Pipe (SDR Series).
c. ASTM D-2464 Threaded PVC Plastic Pipe Fittings, Schedule 80.
d. ASTM D-2466 PVC Plastic Pipe Fittings, Schedule 40.
e. ASTM D-2467 Socket-Type PVC Plastic Pipe Fittings, Schedule 80.
f. ASTM D-2855 Two-Step (Primer and Solvent Cement) Method of Joining Poly (Vinyl Chloride) (PVC) or Chlorinated Poly (Vinyl Chloride) (CPVC) Pipe and Piping Components with Tapered Sockets.
g. ASTM D-3139 Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals.
h. AWWA C 900 Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings, 4 in. through 12 in.

Non-Pressure Rated:

i. ASTM D-2729 PVC Sewer Pipe and Fittings.
j. ASTM D-2855 Two-Step (Primer and Solvent Cement) Method of Joining Poly (Vinyl Chloride) (PVC) or Chlorinated Poly (Vinyl Chloride) (CPVC) Pipe and Piping Components with Tapered Sockets.
k. ASTM D-3034 Type PSM PVC Sewer Pipe and Fittings.
l. ASTM D-3212 Joints for Drain and Sewer Plastic Pipes using Flexible Elastomeric Seals.
m. ASTM F-679 PVC Large-Diameter Plastic Gravity Sewer Pipe and Fittings.
n. ASTM F-794 PVC Profile Gravity Sewer Pipe and Fittings, Based on Controlled Inside Diameter.
o. ASTM F-949 PVC Corrugated Sewer Pipe with a Smooth Interior and Fittings.
p. ASTM F-1760 Coextruded Poly (Vinyl Chloride) (PVC) Non-Pressure Plastic Pipe having Reprocessed-Recycled Content.

Acrylonitrile-butadiene-styrene (ABS) plastic pipe and fittings shall conform to the requirements of the following ASTM specifications unless otherwise stated on the drawings.

Non-Pressure Rated:

a. ASTM D-2661 Acrylonitrile-Butadiene-Styrene (ABS) Schedule 40 Plastic Drain, Waste, and Vent Pipe and Fittings.

Polyethylene (PE) plastic pipe and fittings shall conform to the requirements of the following ASTM specifications unless otherwise stated on the drawings.

Pressure Rated:

a. ASTM D-2239 PE Plastic Pipe (SIDR-PR) Based on Controlled Inside Diameter.
b. ASTM D-2683 Socket-Type Polyethylene Fittings for Outside Diameter-Controlled Polyethylene Pipe and Tubing.
c. ASTM D-3035 PE Plastic Pipe (SDR-PR) Based on Controlled Outside Diameter.
d. ASTM D-3261 Butt Heat Fusion Polyethylene (PE) Plastic Fittings for Polyethylene (PE) Plastic Pipe and Tubing.
e. ASTM F-714 Polyethylene (PE) Plastic Pipe (SDR-PR) Based on Outside Diameter.
f. ASTM F-2620 Heat Fusion Joining of Polyethylene Pipe and Fittings.

Non-Pressure Rated:

g. ASTM F-667 Large Diameter Corrugated PE Tubing and Fittings.
h. ASTM F-2306 PE Plastic Pipe and Fittings - Annular Corrugated Profile Walled - Based on Inside Diameter

The pipe shall be homogeneous throughout and free from visible cracks, holes, foreign matter, or other defects. The pipe shall be as uniform in color, opacity, density, and other physical properties as is commercially practicable.

3. JOINTS AND FITTINGS

Joints and fittings shall be of the same or similar materials as the pipe and equal to or exceeding that specified for the pipe to which it is attached.
Joints may be bell and spigot type with elastomeric gaskets, coupling type with elastomeric gaskets on each end or solvent cemented. The joints shall be installed according to the manufacturer's recommendations unless otherwise specified.

When a lubricant is required to facilitate joint assembly, it shall be a type having no detrimental effect on the gasket or pipe material.

4. HANDLING AND STORAGE

Pipe shall be delivered to the job site and handled by means which provide adequate support to the pipe and does not subject it to undue stresses or damage. When handling and placing plastic pipe, care shall be taken to prevent impact blows, abrasion damage, and gouging or cutting. All special handling requirements of the manufacturer shall be strictly observed. Special care shall be taken to avoid impact when the pipe must be handled at temperatures of 40°F or less.

Pipe shall be stored on a relatively flat surface so that the barrels are evenly supported. Unless the pipe is specifically coated to withstand exposure to ultraviolet radiation, it shall be covered with an opaque material when stored outdoors for a period of 15 days or longer.

5. LAYING AND BEDDING THE PIPE

The pipe shall be laid to the lines and grades as shown on the drawings and specified herein. The pipe shall be laid so that there is no reversal of grade between joints, unless otherwise shown on the drawings. The pipe shall not be dropped or dumped on the bedding or into the pipe trench. The ground surface near the pipe trench shall be free of loose rocks and stones greater than 1 inch in diameter. This ensures that rock will not be displaced and impact the pipe.

Just before placement, each pipe section shall be inspected to ensure that all foreign material is removed from inside the pipe. The pipe ends and the couplings shall be free of foreign material when assembled. At the completion of a work shift, all open ends of the pipeline shall be temporarily closed off using a suitable cover or plug.

Care shall be taken to prevent distortion and damage during unusually hot (over 90°F) or cold weather (under 40°F). After the pipe has been assembled in the trench, it shall be allowed to reach ground temperature before backfilling to prevent pull out of joints due to thermal contraction.

Bell and spigot pipe shall be laid with the bell pointed upstream. The pipe ends and couplings shall be free of foreign material when assembled.

Perforated pipe shall be laid with the perforations down and oriented symmetrically about the vertical centerline. Perforations shall be clear of any obstructions when the pipe is laid and before the pipe is approved for backfill.

The pipe shall be firmly and uniformly bedded throughout its entire length. The bedding depth and materials to be used will be as shown on the drawings. For pipe with bell joints, the bedding material shall be excavated at the locations of the bells to prevent the pipe from being supported by the bells.

6. PIPE EMBEDMENT

Earth bedding – The pipe shall be firmly and uniformly placed on compacted earthfill bedding or an in-place earth material bedding of ample bearing strength to support the pipe without noticeable settlement. The earth material on which the pipe is placed shall be of uniform density to prevent differential settlement.

Unless otherwise specified, a groove that closely conforms to the outside surface of the pipe shall be formed in the bedding. The depth of the groove shall be equal to or greater than 0.3 of the pipe diameter.

Earth bedding shall be compacted to a density not less than adjacent undisturbed in-place earth material or be compacted earth backfill. Earthfill material used for compacted earth bedding shall be free of rocks or stones greater than 1 inch in diameter and earth clods greater than 2 inches in diameter. The pipe shall be loaded sufficiently during the compaction of bedding under the haunches and around the sides of the pipe to prevent displacement from its final approved placement.

Sand, gravel, or crushed rock bedding – When sand, gravel, or crushed rock bedding is specified, the pipe shall be firmly and uniformly placed on the bedding material. Material for bedding shall not exceed 1 inch in diameter. Unless otherwise shown on the drawings, the coarse-grained bedding material shall be carefully placed and compacted to a depth equal to or greater than 0.3 of the

diameter of the pipe above the bottom of the pipe. The pipe shall be loaded sufficiently during backfilling and compaction around the sides to prevent displacement of the pipe from its final approved placement.

Pipe encased in drainfill – The pipe shall be firmly and uniformly placed on bedding of specified drainfill. Drainfill shall be placed and compacted as specified in Wisconsin Construction Specification 8, Drainfill or as shown on the drawings. The pipe shall be loaded sufficiently during backfilling around the sides and during compaction to prevent displacement of the pipe.

Pipe encased in concrete – Concrete encasement shall be carefully placed to form a continuous uniform support around the entire circumference of the pipe or as shown on the drawings. Pipes encased in concrete shall be securely anchored to prevent movement of the pipe during concrete placement. A clear distance of 1.5 inches shall be maintained between the pipe and any reinforcing steel.

7. BACKFILL

Initial backfill – Unless otherwise specified or shown on the drawings, initial backfill to 6 inches above the top of the conduit is required. Earth haunching and initial backfill material shall consist of soil material that is free of rocks, stones, or hard clods more than 1 inch in diameter. Coarse backfill material shall be the specified sand, gravel, crushed rock, or drainfill material.

Initial backfill shall be placed in two stages. In the first stage (haunching), backfill is placed to the pipe spring line (center of pipe). In the second stage, it is placed to 6 inches above the top of the pipe.

The first stage material shall be worked carefully under the haunches of the pipe to provide continuous support throughout the entire pipe length. The haunching backfill material shall be placed in layers that have a maximum thickness of about 6 inches and are compacted as shown on the drawings or as stated in the Wisconsin Construction Specification appropriate for the backfill material. During compaction operations, care shall be taken to ensure that the tamping or vibratory equipment does not come in contact with the pipe and the pipe is not deformed or displaced.

Final backfill – Final backfill shall consist of placing the remaining material required to complete the backfill from the top of the initial backfill to the ground surface, including mounding at the top of the trench. Final backfill material within 2 feet of the top of the pipe shall be free of debris or rocks larger than 3 inches nominal diameter. Coarse backfill material shall be the specified sand, gravel, crushed rock, or drainfill. Final backfill shall be placed in approximately uniform, compacted layers. Final backfill compaction and layer thickness requirements shall be as shown on the drawings or as stated in the Wisconsin Construction Specification appropriate for the backfill material.

WISCONSIN CONSTRUCTION SPECIFICATION

26. Topsoiling

1. SCOPE

The work consists of furnishing and spreading topsoil to specified depths at locations shown on the drawings. This specification does not apply to any other earthfill.

2. MATERIALS

Topsoil shall consist of naturally occurring friable surface soil reasonably free of grass, roots, weeds, sticks, rocks, other unsuitable material, herbicides, or other compounds whose presence would prevent establishment of grass and/or legume sod cover.

Topsoil shall be obtained from soil surfaces containing USDA soil textural classifications of loam, sandy loam, silt loam, silty clay loam, sandy clay loam, or clay loam soils shown on the drawings or acceptable to the Technician.

Topsoil shall:

- be salvaged from designated areas that will be disturbed by construction activities or be furnished from an offsite source designated by the Contractor. The Technician shall be granted access to the source for inspection and acceptance before delivery to the site.
- meet the following requirements (when testing is required):
  - 100% passing the ¾-inch sieve.
  - minimum 95% passing the #10 sieve.
  - minimum 25% passing the #200 sieve.
  - 3% - 15% organic material.
  - non-positive herbicide carryover (UW Extension Publication A3819, Herbicide Persistence and Carryover).

3. TESTING

The Technician will determine the need for testing the topsoil for gradation, percent organic matter content, and herbicide carryover effect. The testing will be at the expense of the Contractor.

4. FOUNDATION PREPARATION AND PLACEMENT

The surfaces designated to receive a topsoil application shall be cleared of all objectionable materials including trees, stumps, roots, brush, rubbish, and stones having a maximum dimension greater than 6 inches. The surfaces shall be lightly scarified just before the spreading operation. Topsoil shall not be placed until the required excavation, fill and preparation of the surfaces is complete and approved by the Technician.

Spreading shall not be conducted when the ground or topsoil is frozen, excessively wet, or otherwise in a condition detrimental to uniform spreading operations. Snow, ice, or frozen material shall not be incorporated in the topsoil.

Topsoil shall be placed in approximately horizontal layers no greater than 8 inches thick.

Placement of topsoil adjacent to concrete structures may begin after the concrete has cured for the minimum time specified. Heavy equipment shall not be operated within 2 feet of any structure.

Following the spreading operation, the topsoil surface shall be left reasonably smooth and without ruts or surface irregularities that could contribute to concentrated waterflow downslope.

5. MOISTURE CONTENT

Topsoil shall have a moisture content sufficient to insure the spreading of the material to the required thickness. When kneaded in the hand the soil will form a ball which does not readily separate and will not extrude out of the hand when squeezed tightly. The adequacy of the moisture content will be determined by the Technician.

6. COMPACTION

The Contractor shall furnish and operate the types and kinds of equipment necessary to compact the topsoil material when specified. The Technician shall determine if adequate compaction is being achieved.

Adequate compaction is defined as a firm surface able to support the growth of vegetation. Methods for compaction may include back-blading or a single pass from a rubber tire, track, or roller. A pass shall consist of complete coverage by the rubber tire, track, or roller over the entire surface of the topsoil. Care must be taken to avoid excessive compaction of topsoil.

Adjacent to structures or in confined areas, compaction of topsoil shall be accomplished by means of manually directed power tampers of plate vibrators or hand tamping, unless otherwise specified.

Where compacted earthfill is designated to be topsoiled, the topsoil shall be placed concurrently with the earthfill and shall be bonded to the compacted fill with the compacting equipment.

WISCONSIN CONSTRUCTION SPECIFICATION

204. EARTHFILL FOR WASTE STORAGE FACILITIES

1. SCOPE

The work shall consist of all operations necessary to place the earthfill required by the drawings or directed by the Technician.

2 MATERIALS

All fill materials shall be obtained from required excavations and designated borrow areas. The selection, blending, routing, and disposition of materials in the various fills shall be subject to approval by the Technician.

Fill materials shall contain no sod, brush, roots, frozen soil, or other perishable materials. Stones larger than two-thirds of the uncompacted layer thickness shall be removed from the materials prior to compaction of the fill.

3. GENERAL

Construction operations shall be carried out in such a manner and sequence that erosion and air and water pollution will be minimized. The completed job shall present a professional appearance and shall conform to the lines, grades, and elevations as shown on the drawings or as staked in the field. All operations shall be carried out in a safe and skillful manner. Safety and health regulations shall be observed and appropriate safety measures used.

4. FOUNDATION PREPARATION

The foundation area shall be cleared of trees, stumps, roots, brush, rubbish, frozen soil, and stones having a maximum dimension greater than 6 inches. Foundations shall be stripped to remove vegetation and other unsuitable materials to a minimum depth of 6 inches or to a greater depth if so shown on the drawings. Topsoil shall be stripped from the foundation area and stockpiled for use as a top dressing for vegetation establishment unless otherwise shown on the drawings.

The moisture content of the scarified foundation materials shall be maintained as specified for the earthfill in Section 7. The surface materials of the foundation shall be compacted and bonded with the first layer of earthfill as specified for subsequent layers of earthfill.

5. EXCAVATION

The required excavations shall conform to the lines, grades, and elevations as shown on the drawings. Excavation beyond specified limits shall be corrected by filling with approved compacted materials.

The required dimensions and side slopes of all structure and trench excavations shall be as shown on the drawings. Trenches deeper than 4 feet shall have side slopes above the 4-foot depth excavated at 0.5:1 or flatter depending on the materials being excavated or the trench shall be braced to safeguard the work and workers. When backfilling pipe trenches in the waste storage facility embankment, the trench slopes shall be cut back to 1:1 from 12 inches above the top of the pipe. The backfill material and compaction shall be equivalent to the surrounding embankment.

To the extent that they are needed, all suitable materials removed from the specified excavations shall be used in the construction of the required earthfill. The suitability of materials for specific purposes will be determined by the Technician.

All surplus or unsuitable excavated materials shall be disposed of at the locations shown on the drawings or as approved by the Technician. Surplus materials shall not be placed in wetlands.

6. BORROW AREAS

When the quantities of suitable materials obtained from specified excavations are insufficient to construct the specified fill portions of the permanent works, additional materials shall be obtained from the designated borrow areas. The borrow area shall be stripped to remove vegetation or other unsuitable materials to a minimum depth of 6 inches or to the depth shown on the drawings. This stripping shall be performed immediately prior to use of the borrow material to reduce the time the area is exposed to erosion. For large borrow areas, only a portion of the area should be stripped at a time.

7. FILL MOISTURE CONTENT

Fill materials shall have a moisture content sufficient to insure the required compaction. When kneaded in the hand, the soil will form a ball which does not readily separate and will not extrude out of the hand when squeezed tightly. The adequacy of the moisture content will be determined by the Technician.

If the top surface of compacted fill is too dry to permit suitable bond, it shall either be removed or scarified and wetted by sprinkling to an acceptable moisture content prior to placement of the next layer of fill. The applied water must be allowed time to be absorbed by the fill or disked into the dry layer.

Fill material that is too wet shall be allowed to dry to an acceptable moisture content before placement. If the top surface of compacted fill is too wet, it shall be either removed or allowed to dry to an acceptable moisture content before compaction or placing additional layers of fill.

8. FILL PLACEMENT

Fill shall not be placed until the required excavation and preparation of the underlying foundation is completed and approved by the Technician. Fill shall be placed beginning at the lowest elevation of the foundation. No fill shall be placed on a frozen surface.

If the surface of any layer becomes too hard and smooth for proper bond with the succeeding layer, it shall be scarified parallel to the axis of the fill to a depth of not less than 2 inches before the next layer is placed.

Available topsoil shall be placed on the top and the exposed outside slopes of the waste storage facility embankment, the borrow areas, and any other area where the topsoil was removed during construction and where vegetation will be established.

The pre-compacted thickness of each layer of fill and compaction requirements shall be as stated below unless otherwise specified in the construction plans. Materials placed by dumping in piles or windrows shall be spread uniformly to not more than the specified layer thickness prior to

compaction. The Technician shall determine if adequate compaction is being achieved and may require more than the minimum specified passes of the compaction equipment.

(a) Embankments. The fill shall be placed in horizontal layers extending the entire length and width of the embankment. Unless otherwise specified in the construction plans, compaction requirements shall be as shown in Table 1. Each layer shall be compacted by a minimum of one pass over the entire surface of the fill by the compaction equipment.

(b) Adjacent to Structures and Pipes. Adjacent to structures or pipes, earthfill shall be placed in 4-inch lifts (prior to compaction) in a manner adequate to prevent damage to the structure and to allow the structure or pipe to gradually and uniformly assume the backfill loads. Compaction shall be accomplished by means of manually directed power tampers or plate vibrators or hand tamping unless otherwise specified. Heavy equipment shall not be operated within 2 feet of any structure or pipe. Compaction by means of drop weights operating from a crane or hoist of any type will not be permitted.

All intrusions into or penetrations of a clay or other soil liner will be backfilled with equivalent material and compacted to maintain its integrity. Pipe trenches into a storage facility will be backfilled with the same soils and compaction required for the storage facility for the distance shown on the drawings.

(c) Clay Liners. A clay liner shall be installed as designated on the drawings. This work shall consist of constructing an impermeable earthliner for the inside slopes and the bottom of the earthen basin to the thickness shown on the drawings. It also includes the liner material placed in conjunction with other liner materials to form a composite liner as shown on the drawings. Only soils approved by the Technician will be used.

The liner fill shall be placed in layers with a maximum thickness of 6 inches prior to compaction. The liner material shall be disked or worked in such a manner as to obtain a maximum clod size of 4 inches prior to compaction. Each layer shall be compacted by a minimum of one pass over the entire surface of the fill by a fully-loaded rubber-tired front end loader or scraper or a sheepsfoot or tamping roller. Smooth drum rollers are not suitable for compaction of clay liners. Operation of the compaction equipment will be continuous over the entire area during fill operations. Any liner area disturbed by subsequent construction operations will be scarified and recompacted as specified.

(d) Small Areas of Unsuitable Materials. Lenses or pockets of soil not meeting the criteria requirements in NRCS Standard 313 shall be removed and replaced with specified materials. The extent of removal and the quality of replacement materials will be as shown on the drawings or approved by the Technician. Excavated slopes shall be 1:1 or flatter. Replacement soil material placement, layer thickness, and compaction will be as stated for clay liners. Manually directed power tampers may be used for compaction and the soil shall be placed in 4-inch lifts prior to compaction.

Table 1 - Embankment Compaction Requirements

Equipment Type	Applicable Soils[1]	Maximum Fill Height[2] (feet)	Layer Thickness[3] (inches)
Sheepsfoot or tamping roller 10,000 lb. min. operating weight	ML, MH, CL, CH SM, SC, GM, GC	None	9
Vibratory tamping roller 9,000 lb. min. operating weight	SM, SC, GM, GC	None	6
Smooth drum vibratory roller 10,000 lb. min.	SP, SW, GP GW	20	6
Rubber-tired scraper (fully loaded)	ML, MH, CL, CH SM, SC, GM, GC	None	9
Rubber-tired front end loader (fully loaded)	ML, MH, CL, CH SM, SC, GM, GC	20	6
Track-type crawler standard tracks 30,000 lb. min.	SM, SC, GM, GC, ML, CL SP, SW, GP, GW	10	6
Farm tractor 2,400 lb. min.	ML, MH, CL, CH, SM, SC, GM, GC	15	6

[1] Unified Soil Classification System.

[2] Measured from the top of the fill to the lowest point along the centerline of the fill.

[3] Prior to compaction.

OPERATION AND MAINTENANCE PLAN

WASTE STORAGE FACILITY
(LAYERS)

October 27, 2017

PREPARED FOR:

Daybreak Foods, Inc.
533 E Tyranena Park Road
Lake Mills, WI 53551

PREPARED BY:

Resource Engineering Associates, Inc.
3510 Parmenter St., Suite 100
Middleton, Wisconsin, 53562

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1. Project Contacts

Owner Contact

Keith Kulow
WI Regional Operations Manager
533 E Tyranena Park Road
Lake Mills, WI 53551
Phone: 920-648-2377 ext. 7412
Email: keith@daybreakfoods.com

DNR or NRCS Regional Contact

Terry Donovan
Water Resources Engineer
PO Box 7921
Madison, WI 53707-7921
Phone: 608-267-2340
Email: terry.donovan@wisconsin.gov
DNR CAFO Permit #: 0056308

County Animal Waste Contact

Mark Watkins
Director, Land & Water Conservation Department
311 S Center Ave, Room 113
Jefferson, WI 53549-1701
Phone: 920-674-7111
Email: markw@jeffersoncountywi.gov

General Contractor

Henning Companies, LLC
5800 Merle Hay Road, Suite 14
P.O. Box 394
Johnston, Iowa 50131
Contact: Kevin Lex
Phone: 515-253-0943 ext. 162
Email: klex@webild.com

Resource Engineering Associates, Inc. Contacts

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3510 Parmenter Street
Suite 100
Middleton, WI 53562
Phone: 608-831-5522
bob@reaeng.com
www.reaeng.com

2. Purpose

This Operation and Maintenance (O&M) Plan has been developed for the proposed structures being constructed at the Daybreak Foods Inc. poultry layer facility in Jefferson County, WI. The purpose of providing this report is to provide information on the operation and maintenance of the following structures:

Waste Storage Facility.

Proper operation and maintenance is required for a structure to function as intended and to extend the useful life of that structure. Standard Wisconsin O & M documents have been reviewed and incorporated into this plan. The owner is responsible for implementing the O & M plan. The O & M plans may be required to be modified to accommodate unforeseen circumstances or conditions.

3. Waste Storage Facility

The proposed poultry layer houses (5) are planned to house approximately 2,000,000 layers (400,000 in each house). The manure from under the layer house aviary system rows is transferred to the east end of the layer buildings using a multi belt system. A cross conveyor belt system over a 5-foot wide by 6-foot deep concrete lined maintenance channel is planned to be located inside the east end of each house. This conveyor belt will transfer the manure to the center of each building where it will be dropped onto another conveyor belt system which will transfer it back to the west into one of the Optisec Manure Drying Systems in the center of each building. Once the manure passes through the dryer system it will return to the east end of the buildings via a conveyor belt system to a final conveyor belt system that will transfer it into the waste storage facility. The moisture content of the dried manure will be approximately 15-20%.

The proposed waste storage facility is planned to be constructed inside of the proposed pre-engineered metal building (PEMB). The PEMB overall dimensions are 670' x 218'-6". The proposed waste storage facility is planned to be 200' x 565' with 16' high walls on 3 sides. The 16' high walls are planned to be built 180' long on the ends (north & south) of the waste storage facility and 565' long on the east side of the waste storage facility. A 20' wide opening for drive thru access and operations area is planned along the west side of the facility. A 6' high wall is planned along the west side of the waste storage facility. Manure is planned to be stored in an area 180' x 565'.

The waste storage facility should provide approximately 397 days of storage; however, manure is not planned to be stored longer than 365 days.

Waste Utilization

Wastes removed from the waste storage facility is sold to Midwestern Bio Ag.

Emptying

Immediately remove foreign debris within the structure that may cause damage to the structure or equipment. Waste from the proposed waste storage facility is planned to be loaded into trucks via wheel loaders. The waste removed from storage is sold to Midwestern Bio Ag. All contracted waste hauling trucks will follow all bio-security requirements and will be loaded inside the waste storage facility in the specifically designed drive-through loading lane. Truck tarps will be secured before trucks leave the waste storage facility.

Inspections

1. The waste storage facility should be observed for overall performance in containing manure residue in the facility and protecting against operational losses. Areas damaged by equipment should be repaired by grouting or caulking as appropriate. Displacement or other indications of differential movement of the structure should be reported to the Engineer or WDNR for direction on action which may be needed.

2. Vegetative cover should be maintained on earth embankments. If the vegetative cover is damaged, embankments should be re-vegetated as soon as possible. Keep machinery away from steep side slopes. Keep equipment operators informed of all potential hazards.

3. Maintain necessary safety features including warning signs and similar items to provide warning and/or prevent unauthorized human or livestock entry.

4. Waste Utilization

Waste removed from structure is sold to Midwestern Bio Ag.

5. Emergency Response Plan

Farm Name: *Daybreak Foods, Inc. – Creekwood Farm*

Operator: *Keith Kulow*

Farm Address: *N5344 Crossman Road*
Lake Mills, WI 53551
Legal Description: *Lake Mills Township (T7N, R13E) SW ¼ SE ¼, Section 27*

Directions to Farm from Fire Department: *Start out going east on Veterans Ln toward WI-89. Turn right on S Main St/WI-89. Turn slight right onto Topel St/County Hwy A. Turn left onto Crossman Road. The farm is on the left.*

EMERGENCY RESPONSE PLAN – Manure Spill/ Structure Overflowing

- Stop the flow
- Access the situation and make appropriate calls
- Notify the DNR spill hotline 1-800-943-0003
- Begin Clean up
- If necessary, call manure hauler to bring solids manure handling equipment as needed, call for front end loader/backhoe
- Construct a temporary dike below manure flow from earthfill or other available material if manure is flowing towards a drainage outlet.
- If spill is in a field area, use tillage equipment to slow the flow
- Land apply manure on fields approved for manure application in the nutrient management plan of Midwestern Bio Ag. Apply at established rates.
- Collect contaminated soil from the impacted area and land apply materials on fields approved for manure application in the nutrient management plan.
- Document and review actions taken to contain or minimize the spill
- Contact Engineer to assess manure storage facility and repair if necessary.

FARM CONTACTS	NAME	TELEPHONE
Fire/Rescue	Lake Mills Fire Department	911 920-648-5117 Non-Emergency
Police	Jefferson County Sheriff	911 920-674-7310 Non-Emergency
Veterinarian	Daybreak Foods, Inc. (Rosemary Marusak)	715-781-3018
Manure Hauler	Midwestern Bio Ag	800-327-6012
Excavation Contractor	Trumpf Excavating (Craig Trumpf)	920-988-1469
Nutrient Management Planner	Phillips Crop Care (Phillip Laatsch)	920-296-6044
Mortality Contractor	Daybreak Foods, Inc. (Keith Kulow)	920-648-8341