Notice of Availability of an Environmental Assessment Worksheet (EAW)

Daley Farms of Lewiston, LLP – 2018 Dairy Expansion

Doc Type: Public Notice

Public comment information

EAW public comment period begins: October 1, 2018
EAW public comment period ends: 4:30 p.m. on October 31, 2018 EXTENDED to 4:30 p.m. on November 15, 2018
Notice published in the EQB Monitor: October 1, 2018

Permit public comment period begins: October 1, 2018
Permit public comment period ends: October 31, 2018 EXTENDED to 4:30 p.m. on November 15, 2018

Facility specific information

Facility name and location: Daley Farms of Lewiston, LLP
18774 Highway 14
Lewiston, MN  55952
Utica Township
Winona County

Facility contact:
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Daley Farms of Lewiston, LLP
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Phone: 507-251-2444
Email: BDaley7@hotmail.com

MPCA contact information

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Fax: 651-297-2343
Email: kim.grosenheider@state.mn.us

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Watershed Division
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Admin staff phone: 651-757-2100

General information

The Minnesota Pollution Control Agency (MPCA) is distributing this Environmental Assessment Worksheet (EAW) for a 30-day review and comment period pursuant to the Environmental Quality Board (EQB) rules. The MPCA uses the EAW and any comments received to evaluate the potential for significant environmental effects from the project and decide on the need for an Environmental Impact Statement (EIS).

An electronic version of the EAW is available on the MPCA Environmental Review webpage at https://www.pca.state.mn.us/eaw. If you would like a copy of the EAW or Permit or have any questions on the EAW or Permit, contact the appropriate person listed above.
Description of proposed project
Daley Farms of Lewiston, LLP currently owns and operates three dairy sites (LLP, LLP1, and LLP7) in Utica Township, Winona County. Daley intends to expand its existing dairy at the LLP site, close the LLP1 site and install open-lot runoff controls at the LLP7 site. The expansion at the LLP site will include a total confinement barn with 3,000 dairy cows, a rotary milking parlor, a manure storage basin, a feed storage pad, and stormwater runoff controls.

The MPCA will host a public informational meeting on October 16, 2018, with an open house from 6:00 to 6:30 pm, presentations from 6:30 to 7:00 pm, and questions from 7:00 to 8:00 pm, regarding the EAW and the Permit. The meeting will be at the Lewiston Community Center, 75 Rice Street, Lewiston, MN  55952.

To submit written comments on the EAW and Permit
Written comments on the EAW and the Permit must be received within the comment period listed above.

Submit comments online by clicking on this link:  http://survey.mn.gov/s.asp?k=153730433478

Or by U.S. mail to:
Kim Grosenheider
Minnesota Pollution Control Agency
520 Lafayette Road North
St. Paul, MN 55155

NOTE: All comment letters are public documents and will be part of the official public record for this project.

Need for an EIS
The MPCA Commissioner will make a final decision on the need for an EIS after the end of the comment period.
Alternative EAW Form for Animal Feedlots

ENVIRONMENTAL ASSESSMENT WORKSHEET

Note to preparers: This form is authorized for use only for the preparation of Environmental Assessment Worksheets (EAWs) for animal feedlots. Project proposers should consult the guidance Guidelines for Alternative EAW Form for Animal Feedlots (also available at the Minnesota Environmental Quality Board (EQB) website https://www.eqb.state.mn.us/content/environmental-review-guidance-practitioners-and-proposers, or by calling 651-296-6300) regarding how to supply information needed by the Responsible Government Unit to complete the worksheet form.

Note to reviewers: The Environmental Assessment Worksheet (EAW) provides information about a project that may have the potential for significant environmental effects. This EAW was prepared by the Minnesota Pollution Control Agency (MPCA), acting as the Responsible Governmental Unit (RGU), to determine whether an Environmental Impact Statement (EIS) should be prepared. The project proposer supplied reasonably accessible data for, but did not complete the final worksheet. Comments on the EAW must be submitted to the MPCA during the 30-day comment period which begins with notice of the availability of the EAW in the Minnesota Environmental Quality Board (EQB) Monitor. Comments on the EAW should address the accuracy and completeness of information, potential impacts that are reasonably expected to occur that warrant further investigation, and the need for an EIS. A copy of the EAW may be obtained from the MPCA by calling 651-757-2100. An electronic version of the completed EAW is available at the MPCA website www.pca.state.mn.us/eaw.

1. Basic Project Information.

A. Feedlot Name: Daley Farms of Lewiston, LLP – 2018 Dairy Expansion

B. Feedlot Proposer: Daley Farms of Lewiston, LLP

C. RGU: Minnesota Pollution Control Agency

<table>
<thead>
<tr>
<th>Technical Contact Person</th>
<th>Contact Person</th>
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<tbody>
<tr>
<td>Ben Daley</td>
<td>Kim Grosenheider</td>
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<th>and Title</th>
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<tr>
<td>Owner/Partner</td>
<td>Planner Principal</td>
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<td>18774 Highway 14, Lewiston, MN 55952</td>
<td>520 Lafayette Road North, St. Paul, Minnesota 55155-4194</td>
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<td>507-523-2273</td>
<td><a href="mailto:BDaley7@hotmail.com">BDaley7@hotmail.com</a></td>
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D. Reason for EAW Preparation: (check one)

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<th>EIS Scoping</th>
<th>Mandatory</th>
<th>Citizen Petition</th>
<th>RGU Discretion</th>
<th>Proposer Volunteered</th>
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<tr>
<td>X</td>
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Printed on recycled paper containing 30% fibers from paper recycled by consumers
If EAW or EIS is mandatory, give EQB rule category subpart number and name: Minn. R. 4410.4300, subp. 29(B)
Construction of an animal feedlot with the capacity of 500 animal units or more located in a sensitive location

E. Project Location: County Winona City/Twp Utica

NE 1/4 Section 16 Township 106N Range 9W
Watershed (name and 4-digit code):
Mississippi River – Winona (07040003) and Root River (07040008)

F. Attachments:
Attachment A – General Location Map
Attachment B – USGS Topographic Map
Attachment C – Project Site Map
Attachment D – Sites Covered under Daley Feedlot Permit
Attachment E – 1 Mile Radius Map
Attachment F – Manure Application Site Summary Map
Attachment G – Manure Application Site Individual Maps
Attachment H – Utica Drinking Water Supply Management Area
Attachment I – Lewiston Drinking Water Supply Management Area
Attachment J – Minnesota State Historic Preservation Office Correspondence
Attachment K – DNR Natural Heritage Review
Attachment L – U.S. Fish and Wildlife Service Wetland Map
Attachment M – Natural Resources Conservation Service Soils Report
Attachment N – Geotechnical Evaluation (Jan 9, 2017)
Attachment P – Nearby Wells Map
Attachment Q – Well Logs
Attachment R – DNR Preliminary Well Construction Assessment
Attachment S – Groundwater Sensitivity Map
Attachment T – Air Modeling Report
Attachment U – Cumulative Impacts Map
Attachment V – Regional Surface Water

The following documents are available upon request:
- Draft State of Minnesota Individual Animal Feedlot National Pollution Discharge Elimination System Permit MN0067652 (Feedlot Permit), also available for public comment from October 1, 2018 until October 31, 2018
- Manure Management Plan (MMP)
- Emergency Response Plan (ERP)

G. Project summary of 50 words or less to be published in the EQB Monitor.
Daley Farms of Lewiston, LLP (Daley) currently owns and operates three dairy sites (LLP, LLP1, and LLP7) in Utica Township, Winona County. Daley intends to expand its existing dairy at the LLP site, close the LLP1 site and install open-lot runoff controls at the LLP7 site. The expansion at the LLP site will include a total confinement barn with 3,000 dairy cows, a rotary milking parlor, a manure storage basin, a feed storage pad, and stormwater runoff controls.
H. Please check all boxes that apply and fill in requested data.

<table>
<thead>
<tr>
<th>Animal Type</th>
<th>Number Proposed</th>
<th>Type of Confinement</th>
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<tbody>
<tr>
<td>Finishing hogs</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sows</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nursery pigs</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dairy cows</td>
<td>3,000</td>
<td>cross-vented, total confinement, freestall barn</td>
</tr>
<tr>
<td>Beef cattle</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Turkeys</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Layer hens</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chickens</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pullets</td>
<td></td>
<td></td>
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<tr>
<td>Other (Please identify species)</td>
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</table>

I. Project magnitude data.

- Total acreage of farm: 2,381 acres (owned by Daley)
- Number of animal units proposed in this project: 4,200 AU
- Total animal unit capacity at this location after project construction: 5,968 AU
- Acreage required for manure application: 4,083 acres

J. Describe construction methods and timing.

Daley currently owns and operates three dairy sites (LLP, LLP1, and LLP7) in Section 16, Utica Township, Winona County (Project Site) under the current Feedlot Permit. These sites consist of:
- A 1,996.4 animal units (AU) total confinement barns with runoff control (LLP)
- A 140 AU partial confinement barn and concrete lot without runoff control (LLP1)
- A 138.8 AU partial confinement barn and concrete lot without runoff control (LLP7)

Daley intends to expand its existing dairy at the LLP site, close the LLP1 site, and install open-lot runoff controls at the LLP7 site (Project). The Project, shown in Attachments A-D, will include:

**LLP Site:**
- A cross-vented, total confinement freestall barn (proposed barn) with 3,000 dairy cows, or 4,200 AU\(^1\),
- Eliminating 525 dairy cows and adding 525 heifers to the existing barns (resulting in a decrease of 367.5 AU)
- Stormwater filtration basins to collect barn stormwater runoff (barn runoff basins),
- A rotary milking parlor with a holding area (parlor),
- A liquid manure storage area (manure basin),
- A sand processing and storage building (sand building),
- An animal mortality building (location to be determined),
- A feed storage pad (feed storage pad),
- A basin to collect feed storage pad stormwater runoff (feedpad runoff basin), and
- Installing two livestock wells.

\( ^1 \) An animal unit or AU is a unit of measure developed to compare the differences in the amount of manure produced by livestock species. The AU is standardized to the amount of manure produced on a regular basis by a slaughter steer or heifer, which also correlates to 1,000 pounds of body weight. The AU is used for administrative purposes by various governmental entities for permitting and record keeping.
LLP1 Site and LLP7 Site:

- Eliminating the LLP1 site is conditional upon approval of a variance from Winona County to construct the expansion of the LLP site (see discussion under item 2.B.). If the variance is approved, Daley will close the LLP1 site and will request termination of Feedlot Permit coverage for the LLP1 site. If the variance is not approved, Daley will not conduct the expansion at LLP and the LLP1 site will remain in operation with the addition of open-lot runoff controls, in accordance with the Feedlot Permit Schedule of Compliance. Open-lot runoff controls are required to eliminate runoff from animal lots in order to create zero discharge from the LLP1 site.

- Construct open-lot runoff controls at the LLP7 site, in accordance with the Feedlot Permit Schedule of Compliance. Open-lot runoff controls are required to eliminate runoff from animal lots in order to create zero discharge from the LLP7 site.

The type and number of animals and AUs in the existing Facility, proposed Project and total are outlined in the following table:

<table>
<thead>
<tr>
<th>Facility</th>
<th>Facility - Existing number of Animals</th>
<th>Proposed Project Animal increase/decrease</th>
<th>Totals after construction</th>
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<tbody>
<tr>
<td>LLP Dairy Cows/Heifer (Expansion)</td>
<td>1,426 cows 1996.4</td>
<td>+2,475 cows +525 heifers</td>
<td>3,901 cows 525 heifers</td>
</tr>
<tr>
<td>LLP1 Dairy Cows (Eliminate)</td>
<td>100 cows 140</td>
<td>-100 cows -140</td>
<td>82 cows 120 calves</td>
</tr>
<tr>
<td>LLP7 Dairy Cows and calves (Add runoff controls)</td>
<td>82 cows 120 calves</td>
<td>0 0</td>
<td>82 cows 120 calves</td>
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<tr>
<td>TOTAL AUs</td>
<td>2275.2</td>
<td>3692.5</td>
<td>5967.7</td>
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</table>

Timing
As weather conditions allow, Daley plans to begin construction once the environmental review process is completed and applicable permits issued, Daley expects construction to take approximately 9 months.

Construction Methods – LLP Site

**Barn**
To house the additional cows, Daley will construct an 836’ by 435’ barn using steel beams, roof, and sidewalls. The barn will be divided into 16 rows of 4’ by 8’ animal stalls. Daley will construct bedding stalls using sand over a clay base; scape alleys and five feed alleys using concrete, which will provide feed to the cattle from eight mangers. A concrete gutter at the north end of the barn will collect urine, water from the misters (used for keeping the cows cool in the summer), and dumpings from the drinkers, where it will be pumped to a manure basin. A bank of 4’ diameter fans on the east wall with air intake ports on the west wall will vent the barn. A continuous grade of 0.5% from the south to the north will provide drainage of floor moisture. Overhead doors on the west and east sides of the barn will provide access.

**Barn Runoff Basins**
Construction of the barn will create approximately 8.34 acres of new impervious surface, and therefore, a significant amount of stormwater runoff from the roofs and driveways. The Feedlot permit (containing construction stormwater requirements) requires Daley to permanently treat
stormwater runoff since more than 1 acre of new impervious surface is being added. To treat this runoff, Daley will install a series of permanent stormwater runoff basins around the barn to collect, filter, and discharge the runoff.

**Parlor**
To milk the dairy cows, Daley will construct a 110' by 110' building that will contain an 80' diameter rotary milking parlor and a 110' by 169' holding area with two 50' pens and a crowd gate to guide the dairy cows into the parlor. Additionally, Daley will construct a 50' by 60' utility room that will contain the milk handling and cooling equipment as well as system washing equipment.

**Manure Basin**
The Project Site currently contains four liquid manure storage areas (existing manure basins) with 22.0 million gallons (MG) of available storage. Daley will install one more manure basin, with 13.6 MG of available storage, as part of the Project. In total, the existing and proposed manure basins will have a storage capacity of 35.6 MG, enough for 281 days of operations at the LLP site.

Daley will construct the proposed 400' by 400' by 16' deep manure basin using 6” thick reinforced concrete bottom, extending 2’ up the 3:1 side slopes. The 60-millimeter thick High Density Polyethylene (HDPE) side slopes will connect to the reinforced concrete by an embedded HDPE “Poly-Lock” system, which is heat-fusion welded. Beneath the manure basin, Daley will install a compacted clay sub-liner, with a thickness of 2’ under the reinforced concrete and 3’ under the side slopes.

Daley will install a venting system under the side slopes to allow any gases that accumulate under the liner to release to the atmosphere through vents, installed at a minimum of every 100’ around the top perimeter. Additionally, Daley will install a drain tile system around the base of the manure basin to control fluctuations in seasonal saturation. Around the perimeter of the manure basin, Daley will install fencing and safety signs.

**Sand-laden manure Processing and Storage**
Daley intends to use sand over a clay base to bed the cows. Daley will regularly remove the sand-laden manure, using a vacuum truck, for processing in the existing sand building. Daley will clean the sand using screens, agitation and wash water and will discharge manure and wash water to the manure basins, connected via a pipe. Daley intends to construct a new sand building adjacent to the existing sand building, which will store new sand and recovered sand, transferred via a conveyor belt from the existing sand building.

**Feed Storage Pad**
To provide feed for the cows, Daley will construct a 440' by 590' asphalt feed storage pad. Daley will construct the feed storage pad to have a gradual 2% slope towards the northeast corner, with a perimeter berm to limit surface stormwater from entering the pad. Feed storage pad stormwater runoff will collect at the northeast corner, where a float trap will catch floating solids. The floating solids will be removed and disposed of in a manure basin. The remaining runoff will flow to the feedpad runoff basin.

**Feedpad Runoff Basin**
Daley will construct a 250' by 250', 14.5' deep, feedpad runoff basin to collect stormwater runoff from the feed storage pad. Daley will use the same construction methods described for the manure basin, such as reinforced concrete bottom, 60-millimeter HDPE side slopes, compacted clay sub-liner, with a venting and drain tile system, for the feedpad runoff basin. Around the perimeter of the feedpad runoff basin, Daley will install fencing and safety signs.
K. Past and future stages.

Is this project an expansion or addition to an existing feedlot? ☒ Yes  ☐ No

Are future expansions of this feedlot planned or likely? ☐ Yes  ☒ No

If either question is answered yes, briefly describe the existing feedlot (species, number of animals and animal units, and type of operation) and any past environmental review or the anticipated expansion.

The Daley family has been farming in the Lewiston area for over 100 years. In 1998, Daley completed an EAW to consolidate and modernize some of its dairy operations at the LLP site (Attachment D).

See Table in 1.J for type and number of existing, proposed and total animals. Daley does not anticipate expansion beyond the Project described in this EAW.

2. Land uses and noteworthy resources in proximity to the site.

A. Adjacent land uses. Describe the uses of adjacent lands and give the distances and directions to nearby residences, schools, daycare facilities, senior citizen housing, places of worship, and other places accessible to the public (including roads) within one mile of the feedlot and within or adjacent to the boundaries of the manure application sites.

Project Site

The Project Site is on land zoned for agricultural use and is rural in nature. The Project Site is approximately 3 miles to the east of Utica and 2 miles west of Lewiston. U.S. Highway 14 and Holstein Road borders the south and east sides of the Project Site. Approximately 1 mile to the north is Township Road 14, and ½ mile to the west is Cemetery Road.

There are 29 residences within 1 mile of the Project Site, the closest being approximately 1,150 feet south of the Project Site. Also, within 1 mile of the Project Site is Benson Farm Services, a cemetery, Lewiston County Club, and Dairyland Power Cooperative. The Lewiston Waste Water Treatment Plant is just over 1 mile south of the Project Site. Daley knows of no schools, daycare facilities, senior citizen housing or public places of worship within a 1-mile radius (Attachment E).

There are 13 feedlots within a 3 by 3 mile grid around the Project Site.

Manure Application Sites

The 42 manure application sites (Attachment F) are currently being cultivated for crop production and all are in Winona County. Daley owns 31 of the manure application sites. For the other 11 manure application sites, Daley has agreements (written or verbal) with the owners to accept manure from the Project. Individual land application site maps are given in Attachment G. Daley is unaware of any schools, daycare facilities, senior citizen housing or public places of worship within the manure application site boundaries, although several have residences. Many of the manure application sites have streams near or within the field. Additionally, some of the manure application sites are adjacent to housing developments. Manure application sites 37 and 38 border a housing development on the south side of Lewiston, and manure application site 16 is adjacent to the Lewiston Country Club. Manure application site 35 is adjacent to the north side of Lewiston, a mostly commercial and industrial area. Adjacent to Utica are manure application sites 33 and 34, which border housing, grain elevators and a baseball park.
B. Compatibility with plans and land use regulations. Is the project subject to any of the following adopted plans or ordinances? Check all that apply.

- [ ] local comprehensive plan
- [x] land use plan or ordinance
- [ ] shoreland zoning ordinance
- [ ] flood plain ordinance
- [ ] wild or scenic river land use district ordinance
- [ ] local wellhead protection plan

Is there anything about the proposed feedlot that is not consistent with any provision of any ordinance or plan checked? [ ] Yes  [ ] No.

If yes, describe the inconsistency and how it will be resolved.

Winona County Zoning Ordinance\(^2\) prohibits feedlot sites in excess of 1,500 AU. However, existing feedlots, such as the Daley’s, that contained more than 1,500 AU at the time the ordinance issuance were grandfathered in, and therefore may continue to operate at the size they were when the ordinance was issued. Because the Project will increase Daley’s operations from 2,275.2 AU to 5,967.7 AU, Daley must apply for and receive a zoning variance from Winona County for the Project. See additional discussion regarding the variance under item 1.J.

Are there any lands in proximity to the feedlot that are officially planned for or zoned for future uses that might be incompatible with a feedlot (such as residential development)? [ ] Yes  [ ] No

C. Nearby resources. Are any of the following resources on or in proximity to the feedlot, manure storage areas, or within or adjacent to the boundaries of the manure application sites?

- Drinking Water Supply Management Areas designated by the Minnesota Department of Health? [x] Yes  [ ] No
- Public water supply wells (within two miles)? [x] Yes  [ ] No
- Archaeological, historical or architectural resources? [ ] Yes  [x] No
- Designated public parks, recreation areas or trails? [x] Yes  [ ] No
- Lakes or Wildlife Management Areas? [ ] Yes  [x] No
- State-listed (endangered, threatened or special concern) species, rare plant communities or other sensitive ecological resources such as native prairie habitat, colonial waterbird nesting colonies or regionally rare plant communities? [x] Yes  [ ] No
- Scenic views and vistas? [x] Yes  [ ] No
- Other unique resources? [x] Yes  [ ] No

If yes, describe the resource and identify any project-related impacts on the resource. Describe any measures to minimize or avoid adverse impacts.

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Drinking Water Supply Management Areas and Public Water Supply Wells

Drinking Water Supply Management Areas\(^3\) (DWSMA) for Utica and Lewiston are near the Project Site and several manure application sites. Manure application sites 24, 29N, 29S, 30, 33 and 34 are within the Utica DWSMA. Additionally, within 2 miles of the manure application sites, there are public water supply wells for the cities of Lewiston and Utica.

Utica

The city of Utica extracts water from two wells constructed in different strata – the Prairie du Chien Group and the deeper Jordan Sandstone. The well accessing water from the Prairie du Chien Group has consistently shown concentrations of nitrate far exceeding the drinking water limit of 10 milligrams per liter (mg/L) over many years. For this reason, it is used only as an emergency back up and is pumped very infrequently. The deeper well accessing water from the Jordan Sandstone also has consistently shown elevated concentrations of nitrate but at levels below the drinking water limit of 10 mg/L. Drinking water is regularly tested under the federal Safe Drinking Water Act. Utica’s DWSMA is rated highly vulnerable to contamination (Attachment H). While the Project Site is not within Utica’s DWSMA, manure application sites 24, 29N, 29S, 30, 33, and 34 are. Farms that apply manure within the Utica DWSMA must follow best management practices (BMPs), such as applying at agronomical rates, and following all setback requirements from special features.

Lewiston

The city of Lewiston constructed a well in 2000 open to the Mt. Simon Sandstone aquifer and had an older well constructed to be open to the Jordan Sandstone and the Wonewoc Sandstone that cross-connected the two aquifers. The older well had shown consistent elevated nitrate concentrations. The Lewiston DWSMA was very large and included the Project Site because of this older well. Lewiston sealed this well in 2015 and replaced it with a new well constructed in the Wonewoc Sandstone aquifer. The new well and the well constructed in 2000 have not shown nitrate contamination. The Minnesota Department of Health (MDH) classified both of these wells to have a low vulnerability to contamination. In March 2018, the MDH delineated a new DWSMA for the city of Lewiston (Attachment I) based on the use of Lewiston’s new wells. The Project Site no longer falls within the DWSMA.

Recreational Areas

Within 1 mile of the Project Site and some manure applications sites, is the Lewiston County Club, a 9 hole public golf course with a driving range, bar and restaurant. At the Lewiston County Club, temporary odors will likely be noticeable during land application of manure. Daley expects no other impacts to the Lewiston County Club.

Archaeological, historical or architectural resources

The Minnesota State Historic Preservation Office identified no archaeological sites or historic structures near the Project Site (Attachment J).

Natural Heritage Review

The Minnesota Department of Natural Resources' (DNR) Minnesota Natural Heritage Review Specialist identified documentation of three rare species, timber rattlesnakes, Wilson’s phalaropes, and loggerhead shrikes near the Project Site (Attachment K). The DNR provided Daley information about the rare species and a reminder that state law and rules prohibit the destruction of threatened or endangered species, except under certain prescribed conditions.

\(^3\) A DWSMA is the area delineated using identifiable landmarks that reflects the scientifically calculated wellhead protection area boundaries as closely as possible. (Minn. R. 4720.5100, subp. 13) A wellhead protection area is the surface and subsurface area surrounding a well or well field that supplies a public water system, through which contaminants are likely to move toward and reach the well or well field. (Minn. Stat. § 103I.005, subd. 24)
• The timber rattlesnake is a state-listed threatened species; its ideal Minnesota habitat is forest bluffs, south-facing rock outcrops, and bluff prairies, particularly in the Mississippi River Valley. Daley has not observed the timber rattlesnake at the Project Site and none of these ideal habitats exists at the Project Site. However, to reduce possible impact to the timber rattlesnake, reptiles and amphibians, Daley will use erosion control blankets with biodegradable netting (instead of plastic netting, which may trap wildlife).

• The Wilson’s phalaropes, a state-listed threatened bird, nests on the ground in wet meadows, grassy marshes, and along edges of shallow inland waters. Daley has not observed the Wilson’s phalaropes at the Project Site; however, grassed waterways exist on the Project Site. Daley will minimize construction in the grassed waterways.

• The loggerhead shrike, a state-listed endangered bird, use grasslands that contain short grass and scattered perching sites such as hedgerows, shrubs, or small trees. The loggerhead shrike can be found in native prairie, pastures, shelterbelts, old fields or orchards, cemeteries, grassy road sides, and farmyards. Daley has not observed the loggerhead shrike at the Project Site; however, grassed waterways and farmyards may provide habitat for the loggerhead shrike. Daley will minimize construction in the grassed waterways.

Attachment L shows a U.S. Fish and Wildlife Service National Wetlands Inventory map. The map identifies four freshwater ponds at the Project Site, which are the existing manure basins; these do not act as wildlife habitat. The map also shows freshwater emergent wetlands on the very south part of the Project Site. South of State Highway 14 the map shows a freshwater pond and freshwater emergent wetlands. Daley will not alter these areas as part of the construction or operation of the Project. Daley will inform Project construction crews to stop and notify them if they observe any of the three species identified in the Natural Heritage Review. If Daley observes any of these three species, they will report it to the DNR.

3. Geologic and soil conditions.

A. Approximate depth (in feet) to:

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<tr>
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<th>Feedlot</th>
<th>Manure Storage Area</th>
<th>Manure Application Sites</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ground Water (minimum)</td>
<td>16</td>
<td>16</td>
<td>2</td>
</tr>
<tr>
<td>(average)</td>
<td>20</td>
<td>20</td>
<td>6.5</td>
</tr>
<tr>
<td>Bedrock (minimum)</td>
<td>42</td>
<td>42</td>
<td>&lt;10</td>
</tr>
<tr>
<td>(average)</td>
<td>43</td>
<td>42</td>
<td>unknown</td>
</tr>
</tbody>
</table>

B. NRCS Soil - Classifications

<table>
<thead>
<tr>
<th>Soil Description</th>
<th>Feedlot</th>
<th>Manure Storage Area</th>
<th>Manure Application Sites</th>
</tr>
</thead>
<tbody>
<tr>
<td>Port Byron silt loam (285B) – well drained silt loam soils, formed in silty loess material deposited over glacial deposits</td>
<td>5%</td>
<td>50%</td>
<td>63%</td>
</tr>
<tr>
<td>Lindstrom silt loam (301A) – well drained silt loam soils, formed in silty loess and alluvial materials deposited over glacial deposits</td>
<td>5%</td>
<td>50%</td>
<td>5%</td>
</tr>
<tr>
<td>Eitzen silt loam (1830) – well drained silt loam soils formed in silty alluvium in the waterways and swales</td>
<td>90%</td>
<td>--</td>
<td>10%</td>
</tr>
<tr>
<td>Mt. Carrol silt loam (401C) – well drained silt loam soils formed in deep loess over 80&quot; thick</td>
<td>--</td>
<td>--</td>
<td>11%</td>
</tr>
<tr>
<td>Littleton silt loam (301A) – somewhat poorly drained silt loam soils formed on concave slopes in silty alluvium</td>
<td>--</td>
<td>--</td>
<td>3%</td>
</tr>
</tbody>
</table>

See Attachment M for the Natural Resources Conservation Services Soils Report.
C. Indicate with a yes or no whether any of the following geologic site hazards to ground water are present at the feedlot, manure storage area, or manure application sites.

<table>
<thead>
<tr>
<th>Geologic Site Hazard</th>
<th>Feedlot</th>
<th>Manure Storage Area</th>
<th>Manure Application Sites</th>
</tr>
</thead>
<tbody>
<tr>
<td>Karst features (sinkhole, cave, resurgent spring, disappearing spring, karst window, blind valley, or dry valley)</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Exposed bedrock</td>
<td>No</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>Soils developed in bedrock (as shown on soils maps)</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
</tr>
</tbody>
</table>

For items answered yes (in C), describe the features, show them on a map, and discuss proposed design and mitigation measures to avoid or minimize potential impacts.

The southeastern part of Minnesota has karst geology and therefore contains sinkholes, caves, springs and other karst features.

The Project Site contains about 20’ to 25’ of silty and loamy alluvium sediments over about 5’ to 10’ of weathered limestone over limestone and sandstone bedrock. Daley has contracted several geotechnical evaluations, including soil borings, of its property (Attachments N and O).

No karst features were located at the existing or proposed feedlot or manure basin sites. Manure application site 5 borders the north and west sides of the Project Site and contains a mapped sinkhole (Attachment D). Minn. R. 7020.2005, subpart 1, prohibits construction of a new animal feedlot or a manure storage area within 300 feet of a sinkhole. MPCA technical staff verified that the proposed feedlot and manure basin are more than 300 feet from the mapped sinkhole, so the Proposer will be in compliance with these setback requirements.

Attachment F shows mapped karsts features in the area, including sinkholes within or near the following manure application sites: 1, 2, 5, 9N, 10, 11, 12, 23, 24, 27, 29N, 32, 33, 34, 35, 36, 39, 40, Lappier’s, and Matt’s (Attachment G). At these manure application sites, Daley will follow manure application practices and setbacks required in the Feedlot Permit or Minnesota rule4, as applicable.

The following manure application sites have soils developed in bedrock, described as shallow bedrock in soils: 3, 4, 5, 6, 8, 9N, 9S, 11, 12, 13, 19, 20, 21, 22, 24, 25, 26, 27, 28, 32, 34, 36, 39, 41, Lappier’s, Matt’s, and Orlies. Daley will use one or more of the following practices to reduce the likelihood of nitrates leaching to groundwater: delaying manure applications in the fall until soil temperature is below 50 degrees, planting cover crops when manure is applied early in the fall before soil temperatures are below 50 degrees and weather and field conditions are conducive for seeding a cover crop, or applying manure in the spring.

4 Water Use, Tiling and Drainage, and Physical Alterations.

A. Will the project involve installation or abandonment of any water wells, appropriation of any ground or surface water (including dewatering), or connection to any public water supply?

☐ Yes  ☐ No

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4 Minn. R. 7020.2225, subp. 8
If yes, as applicable, give location and purpose of any new wells; the source, duration, quantity and purpose of any appropriations or public supply connections; and unique well numbers and the Department of Natural Resources (DNR) appropriation permit numbers, if available. Identify any existing and new wells on the site map. If there are no wells known on-site, explain methodology used to determine that none are present.

Daley is not planning any surface water withdrawals or connections to public water supplies for the Project.

Daley has two existing water wells (MN Unique Well #00591916 and #00678949) at the Project Site that draw approximately 88,000 gallons per day or approximately 32 MG of water annually. These wells supply water to the Project Site for drinking water for livestock, cleaning, sprinkler systems for cooling the cows, restroom facilities, and potable water for employees. The Project will require two additional on-site wells for the same uses which they expect to utilize 165,000 gallons per day, or about 60 MG of water annually. In total, Daley estimates 92 MG of water annually. Attachment P shows the location of the existing and proposed wells, as well as nearby wells. Well logs for Daley’s existing wells and nearby wells are provided in Attachment Q.

Daley received DNR’s preliminary approval letter to construct the new wells for the Project on October 30, 2017 (Attachment R). The DNR has stated in the preliminary approval letter, that DNR has “determined that the proposed rate and volume may interfere with other water uses or have negative impacts on nearby lakes, streams or wetlands.”

Daley may use the DNR preliminary approval to decide whether to proceed in constructing the new livestock wells. The DNR’S preliminary approval to construct a well is not an approval to use or pump the well. To use the well, a proposer must apply for, and obtain a DNR water appropriation permit. In this case, Daley must apply for a modification to its existing DNR Water Appropriation Permit. State law requires the DNR water appropriation permit for users withdrawing more than 10,000 gallons of water daily, or 1 million gallons annually. The DNR Water Appropriation Permit ensures the well user manages water resources so adequate supply is available for long-range seasonal requirements for domestic, agriculture, fish and wildlife, recreation, power, navigation and water quality. State law establishes domestic use as the highest priority when water supplies are limited, and when well interference occurs, the DNR follows a standardized procedure of investigation.

If Daley drills the wells and applies for the modification to its DNR Water Appropriation Permit, Daley must conduct and submit a pump test with the application. At that point, DNR may require Daley to conduct additional testing to determine if the proposed wells can be permitted for use for additional amount needed for the Project, or potentially the amount of water needed for both the existing operations as well as the Project, or if the additional appropriation of water will be limited or prohibited.

Daley must register the wells with the MDH before construction, and wells must be constructed to meet current well code\(^5\).

B. Will the project involve installation of drain tiling, tile inlets or outlets?  ☒ Yes  ☐ No

If yes, describe.

Daley will install a drain tile system around the base of the manure basin and feedpad runoff basin to control fluctuations in seasonal saturation. The drain tile system will connect to an inspection port

\(^5\) Minn. R. 4725
with a dedicated sump. This inspection port will serve as a leak detection system. Daley will evaluate any accumulated liquids in the inspection port on a monthly basis for discoloration or odors, which may be signs that there is an issue with the liner of the manure basin or feedpad runoff basin, before discharging the liquid back to the manure basin or feedpad runoff basin. Daley must keep records and take action, including contacting the MPCA if there is an issue with the liner of the manure basin or feedpad runoff basin.

Daley will also install a venting system under the HDPE side slopes of the manure basin and feedpad runoff basin to release any gases that may accumulate beneath the liner to the atmosphere through vents, installed at a minimum of every 100' around the top perimeter of the manure basin or feedpad runoff basin.

C. Will the project involve the physical or hydrologic alteration — dredging, filling, stream diversion, outfall structure, diking, and impoundment — of any surface waters such as a lake, pond, wetland, stream or drainage ditch? ☐ Yes ☑ No

If yes, identify water resource affected and give the DNR Protected Waters Inventory number(s) if the water resources affected are on the PWI. Describe proposed mitigation measures to avoid or minimize impacts.

5. Manure management.

A. Check the box or boxes below which best describe the manure management system proposed for this feedlot.

☐ Stockpiling for land application
☐ Containment storage under barns for land application
☑ Containment storage outside of barns for land application
☐ Dry litter pack on barn floors for eventual land application
☐ Composting system
☐ Treatment of manure to remove solids and/or to recover energy
☐ Other (please describe)

B. Manure collection, handling, and storage.

Quantities of manure generated: total 46.2 MG per year of manure (including cows, barn wash wastewater, parlor wash wastewater, sand wash wastewater, and a portion of the feedpad runoff wastewater)

1.7 MG per year of feedpad runoff wastewater

Frequency and duration of manure removal:

number of days per cycle

2 times per year, over 10 days (manure)
1 time per year, over 5 days (feedpad runoff wastewater)

Total days per year 25 days per year
Give a brief description of how manures will be collected, handled (including methods of removal), and stored at this feedlot:

**Manure Quantity and Storage**

Daley will collect, handle and store manure from the Project in conjunction with the existing operations at the LLP and LLP7 sites. Daley estimates the total annual manure produced at the expanded LLP site and LLP7 site from the cows, barn wash wastewater, parlor wash wastewater, sand wash wastewater, and a portion of feedpad stormwater runoff will be 46.2 MG.

Daley proposes to add a 13.6 MG manure basin at the LLP site. This proposed manure basin, combined with the existing manure basins, will provide a total capacity of 35.6 MG. This means Daley will have 281 days of manure storage available, which exceeds the required 270-day storage capacity minimum.

The feedpad runoff basin will have 2.90 MG storage capacity, which will provide ample storage for any wintertime runoff as well as rainfall events throughout the year. The liquid level in the feed pad runoff basin will be managed so that sufficient storage is available at all times for the runoff volume generated by a 25-year 24-hour storm event (5.4 inches).

**Manure Handling**

Three times per day, Daley will use a vacuum truck to collect manure mixed with sand bedding from the barn, and transport it to the sand building to be processed in the sand bedding recovery unit. Ninety-five percent or more of the sand will be reused for animal bedding. For the waste, Daley will pump it to one of the manure basins. Manure and wastewater from the barn, milking parlor, and the holding area will drain by gravity or will be pumped into the manure basins.

Stormwater runoff from the feedpad storage will drain into the feedpad runoff basin.

C. **Manure utilization.**

Physical state of manure to be applied: ☒ liquid ☐ solid ☐ other - describe:

D. **Manure application.**

1. Describe application technology, technique, frequency, time of year and locations.

Daley will use verbal and signed agreements to transfer ownership of some of the manure, the rest will be land applied on Daley property. Daley will provide the manure recipient a description of the minimum state requirements for manure application as required by Minn. R. 7020.2225, subp. 1.D., and the most current manure nutrient analysis.

Attachment F gives a map of all manure application sites, and Attachment G gives individual manure application site maps.

Daley will hire a Commercial Animal Waste Technical (CAWT) licensed by the Minnesota Department of Agriculture for manure application to fields. The CAWT will land apply manure primarily in the fall after harvest and in the spring prior to planting. Typically, application takes 10 days each spring and 10 days each fall. The CAWT will apply the manure via direct injection. The CAWT will operate the manure tow hose/drag line and will calibrate the application system by using a flow meter and then adjusting the speed of the manure application equipment to achieve the planned rate of manure application. The CAWT will meet setbacks and specific practices when applying manure near sensitive areas.
features such as tile intakes, intermittent streams, wetlands, public well management areas, sinkholes, or wells.

Daley will apply the feedpad runoff wastewater, over a period of approximately 5 days, in summer when there is a cover crop present.

The CAWT will transport manure using accepted industry methods to prevent manure spilling onto public roadways. If spillage occurs, the CAWT must remove and properly dispose of the manure in accordance with Minn. R. 7020.2010, Transportation of Manure.

2. **Describe the agronomic rates of application (per acre) to be used and whether the rates are based on nitrogen or phosphorus. Will there be a nutrient management plan?**
   
   - Yes
   - No

   Daley submitted a Manure Management Plan (MMP) with the Feedlot Permit applications. The MPCA reviewed and approved the MMP/plans, which will become an enforceable condition of the Feedlot Permit upon issuance. Minn. R. 7020.2225 Land Application of Manure, outlines the requirements for appropriate manure testing, land application of manure, requirements, restrictions, prohibitions, recordkeeping, as well as what must be included in an MMP.

   Daley will determine agronomic rates using the University of Minnesota's recommendations for manure application based on: the previous crop harvested, the available nutrients, yield goals and the crop to be grown. The MMP also specifies the requirements to change from nitrogen to phosphorus-based application rates, if needed in the future.

   Nitrogen is the limiting nutrient in calculating the manure application rate. Daley is responsible for providing the cropland owner/operator with the requirements for soil testing, manure application rate limits, seasonal restrictions, manure application setbacks, manure application record keeping, and spill reporting. Cropland owner/operators are required to meet all manure application requirements per Minn. R. 7020.2225, Land Application of Manure, or local requirements, whichever is more stringent.

3. **Discuss the capacity of the sites to handle the volume and composition of manure. Identify any improvements necessary.**

   Daley estimates total manure generation will be approximately 46.2 MG annually. The storage volume of the proposed manure basin and the existing manure basins (at LLP site) is 35.6 MG. This equates to a manure storage capacity of 281 days at the Project Site. Daley's MMP estimates that land application of all the manure requires up to 4,083 acres of cropland. Daley has ensured there are a total of 4,179 acres of cropland available, meaning sufficient acreage is available for land application of manure.

4. **Describe any required setbacks for land application systems.**

   The Project is subject to setback requirements contained in the following regulations:
E. Other methods of manure utilization. If the project will utilize manure other than by land application, please describe the methods.

Daley intends to only utilize manure through land application.

6. Air/odor emissions.

A. Identify the major sources of air or odor emissions from this feedlot.

The Project will release air and odor emissions typically associated with a dairy farm. Major sources of air and odor emissions will include:

- Animals
- Barn and barn ventilation
- Animal carcasses
- Manure basin
- Land application of manure
- Sand bedding recovery and storage
- Feed storage
- Feedpad runoff basin
- Vehicle and equipment dust

B. Describe any proposed feedlot design features or air or odor emission mitigation measures to be implemented to avoid or minimize potential adverse impacts and discuss their anticipated effectiveness.

The Project has operational and design features to avoid and minimize adverse air and odor emissions.

Project design and operational measures to reduce air and odor emissions include:

- Daley will maintain clean, dry floors, eliminate manure buildup, and clean up any spilled feed.
- Daley will store animal mortalities in an enclosed and shaded structure, and contract a rendering service to pickup the animal mortalities within 48 hours.
- Daley will maintain general Project Site cleanliness to help minimize air and odor emissions.
- Daley will maintain an organic crusts on the manure basins to reduce odors.

Manure land application measures to reduce air and odor emissions include:

- Daley will only agitate the stored manure immediately before the manure is removed for land application.
- Daley will inject manure into the soil during manure land application.
- Daley will evaluate weather conditions, primarily wind speed/direction and humidity, before manure application to minimize impacts to neighbors and the public.

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6 Minn. R. 7020.225
• Daley will consult with the MPCA or County Feedlot Officer to identify changes to reduce odors in the event complaints are received.
• Daley will observe all required setbacks or specific practices from nearby residences and special features.

C. Provide a summary of the results of an air emissions modeling study designed to compare predicted emissions at the property boundaries with state standards, health risk values, or odor threshold concentrations. The modeling must incorporate an appropriate background concentration for hydrogen sulfide to account for potential cumulative air quality impacts.

Daley conducted air dispersion modeling to predict how the Project’s air emissions of hydrogen sulfide, ammonia, and odors would impact air quality at Daley’s property lines and at the nearest residences. The modeling was done using the American Meteorological Society/Environmental Protection Agency Regulatory Model (AERMOD). The modeling results are contained within a report (Attachment V) and summarized below.

Hydrogen sulfide (H2S)
• **Minnesota Ambient Air Quality Standard (MAAQS)**
  AERMOD predicted that the Project will not result in an exceedance of the 30 parts per billion (ppb) H2S MAAQS. The third exceedance of the MAAQS standard within any 5-day period is a violation. Modeled compliance is demonstrated when the high-third-high (H3H) H2S predicted concentration from the Project, when added to the existing background ambient air concentration for H2S (at each property-line receptor) is less than 30 ppb. AERMOD predicted that the Project emissions alone would result in a maximum H3H property-line H2S concentration of 7.7 ppb. The ambient air concentration for H2S in the area of the Project is estimated to be 17 ppb. The total (Project emissions plus existing background) H3H H2S concentration in the air is predicted to be 25 ppb at the Project’s property lines.

• **Sub-chronic Inhalation Health Risk Value (iHRV)**
  AERMOD predicted that the Project will not result in an exceedance of the 10 micrograms per cubic meter (µg/m³) subchronic (13-week time averaged) H2S iHRV at the nearest residences to the Project. An iHRV is the concentration of a chemical (or a defined mixture of chemicals) that is likely to pose little or no risk to human health. AERMOD predicted that the Project emissions alone would result in a maximum monthly H2S concentration at the neighboring residences of 0.42 micrograms per cubic meter (µg/m³). The background ambient air concentration for H2S in the area of the Project is estimated to be 1.0 µg/m³. The total (Project emissions plus existing background) H2S concentration in the air is predicted to be 1.4 µg/m³. Note that while the iHRV is for a 13-week period, AERMOD is not capable of averaging concentrations for this time. Instead, AERMOD uses a monthly averaging period, which produces a more conservative or protective prediction.

Ammonia (NH3)
• **Acute iHRV**
  AERMOD predicted that the Project will not result in an exceedance of the 3,200 µg/m³ acute (1-hour time averaged) NH3 iHRV at the nearest residences to the Project. AERMOD predicted that the Project emissions alone would result in a maximum hourly property-line concentration of NH3 of 814 µg/m³. The background ambient air concentration for NH3 in the area of the Project is estimated to be 148 µg/m³. The total (Project emissions plus existing background) NH3 concentration in the air is predicted to be 962 µg/m³.
- **Chronic iHRV**
  AERMOD predicted that the Project will not result in an exceedance of the 80 µg/m³ chronic (1-year time averaged) NH₃ iHRV at the nearest residences to the Project. AERMOD predicted that the Project emissions alone would result in a maximum 1-year time-averaged NH₃ concentration of 19.5 µg/m³. The background ambient air concentration for NH₃ in the Project area is estimated to be 5.72 µg/m³. The total (Project emissions plus existing background) maximum NH₃ concentration in the air is predicted to be 25.3 µg/m³.

**Odor**
- **At Project Property Line**
  AERMOD predicted that the Project will result in a maximum odor intensity of 238 odor units per cubic meter (OU/m³) at the Project’s North property line. This predicted odor intensity is considered “faint.”

- **At Nearest Residences**
  AERMOD predicted that the Project would result in a maximum odor intensity of 126 OU/m³ at a non-feedlot nearby residence. This predicted odor intensity is considered to be “faint.”

<table>
<thead>
<tr>
<th>Maximum Property Boundary AERMOD Air Quality Modeling Results</th>
<th>Modeled value</th>
<th>Background value</th>
<th>Modeled plus Background value</th>
<th>Threshold</th>
<th>Percent of Threshold</th>
</tr>
</thead>
<tbody>
<tr>
<td>1-hour H₂S H₃H</td>
<td>7.7 ppb</td>
<td>17 ppb</td>
<td>25 ppb</td>
<td>30 ppb</td>
<td>83%</td>
</tr>
<tr>
<td>1-hour NH₃</td>
<td>2814 µg/m³</td>
<td>148 µg/m³</td>
<td>962 µg/m³</td>
<td>3,200 µg/m³</td>
<td>30%</td>
</tr>
<tr>
<td>Maximum Hourly Odor Intensity</td>
<td>238 OU/m³</td>
<td>NA</td>
<td>238 OU/m³</td>
<td>83 OU/m³ (faint)</td>
<td>287%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Maximum Nearest Neighbor AERMOD Air Quality Modeling Results</th>
<th>Modeled value</th>
<th>Background value</th>
<th>Modeled plus Background value</th>
<th>Threshold</th>
<th>Percent of Threshold</th>
</tr>
</thead>
<tbody>
<tr>
<td>13-week H₂S</td>
<td>0.42 µg/m³</td>
<td>1.0 µg/m³</td>
<td>1.42 µg/m³</td>
<td>10 µg/m³</td>
<td>14%</td>
</tr>
<tr>
<td>Annual NH₃</td>
<td>19.5 µg/m³</td>
<td>5.72 µg/m³</td>
<td>25.3 µg/m³</td>
<td>80 µg/m³</td>
<td>32%</td>
</tr>
<tr>
<td>Maximum Hourly Odor Intensity</td>
<td>126 OU/m³</td>
<td>NA</td>
<td>126 OU/m³</td>
<td>83 OU/m³ (faint)</td>
<td>152%</td>
</tr>
</tbody>
</table>

Thus, the AERMOD modeling results for the Project suggest compliance with the hydrogen sulfide air quality standard, no exceedances of the subchronic hydrogen sulfide iHRV, no exceedances of the acute ammonia iHRV, and no exceedances of chronic ammonia iHRV.

**D. Describe any plans to notify neighbors of operational events (such as manure storage agitation and pumpout) that may result in higher-than-usual levels of air or odor emissions.**

Daley does not plan to notify neighbors of operational events such as manure agitation, pump out, or land application. Daley will try to avoid manure handling operation during planned social events or holidays.

Daley will adjust manure application, based on weather conditions in an attempt to minimize impacts on neighbors and the public. Additionally, Daley will work with county or MPCA staff to find a resolution if there are complaints.

**E. Noise and dust. Describe sources, characteristics, duration, quantities or intensity and any proposed measures to mitigate adverse impacts.**
Noise
Construction of the Project will create a temporary increase in noise, mostly due to construction equipment and delivery truck traffic, especially during earthwork operations. Typical construction noises, such as saws, pneumatic/electric power tools, and hand tools will also be present. Project construction noise will be limited to daylight hours as to minimize nuisances to neighboring properties.

Operation of the Project will create minor amounts of noise, not much more than what is already present at the Project. However, because of the Project, there will be additional traffic.

Dust
Construction of the Project will create a temporary increase in dust, mostly due to earth working activities and delivery truck traffic and construction equipment operating on unpaved surfaces. Daley estimates that Project construction will take approximately nine months. If necessary, Daley will apply water to dry surfaces to minimize dust. Once practical, open areas will be seeded in permanent vegetation, thus reducing operational dust.

7. Dead Animal Disposal.

Describe the quantities of dead animals anticipated, the method for storing and disposing of carcasses, and frequency of disposal.

The Feedlot Permit requires Daley to manage animal mortalities in compliance with the Minnesota Board of Animal Health rules.

Daley will remove animal mortalities from the barn upon discovery and contact a rendering service. Prior to pickup by a contracted rendering service, which typically occurs within 48 hours, Daley will store the animal mortality in an enclosed and shaded structure. The location of this structure on the LLP site has not yet been determined. Daley predicts a mortality rate of 2% for the Project.

In the event of a catastrophic loss, Daley will follow the state of Minnesota Emergency Response Plan.

8. Surface Water Runoff.

Compare the quantity and quality of site runoff before and after the project. Describe permanent controls to manage or treat runoff.

Project Site
Daley will construct the Project on land currently used for cropland. Stormwater runoff from the Project Site currently travels over cropland and drains in four directions, approximately 30% to the northeast, 30% to the east, 10% to the northwest and 30% to the south. Water leaving the Project Site to the northwest, northeast, and east drain to unnamed intermittent streambeds, then eventually to the Whitewater River, which is approximately 4.5 miles hydraulically downstream from the Project Site. Water leaving the Project Site to the south drain to an unnamed intermittent streambed, then eventually to Rush Creek, which is approximately 4 miles hydraulically downstream from the Project Site. The Project will not change the general direction of stormwater flow.

The Feedlot Permit regulates stormwater runoff from both the construction and the operation of the Project. The Feedlot Permit requires Daley to develop a Stormwater Pollution Prevention Plan (SWPPP). The SWPPP must propose erosion prevention and sediment control BMPs to prevent and control the discharge of sediment and other pollutants from the Project Site.
Daley has completed a SWPPP for the Project. To prevent erosion and minimize eroded sediment impacts to surface waters during construction Daley proposes to use perimeter silt fences, sediment lots in waterway channels, inlet protection for culverts and storm drains, pipe discharge riprap aprons and filtration basins. Daley will install BMPs at the earliest time practicable and before upslope soils are disturbed.

Further, the Project will create approximately 15 acres of new impervious surfaces in total from the construction of the feed storage pad, as well as buildings such as the barn, parlor and holding area, and sand processing and storage building. Because of the increase in new impervious surface is greater than 1 acre, in accordance with the CSW requirements contained in the Feedlot permit, Daley will construct permanent treatment to control 1” of volume runoff from the Project Site. Daley will use a variety of approaches to reduce and treat stormwater runoff at the Project Site, including filtration, culverts and grassed waterways.

Stormwater should not come into contact with the cows because the animals will be contained 100% indoors. Daley will install a feedpad runoff basin, which will meet the same design standards as the manure basin, to collect stormwater runoff from the feedpad storage area. The manure basin and feedpad runoff basin are designed to contain precipitation falling in the basins, and therefore no manure-contaminated runoff should occur.

Emergency Response Plan
Daley has drafted and submitted an Emergency Response Plan (ERP) to the MPCA with its Feedlot Permit application. Daley’s ERP includes procedures to address spills should these occur. In the event of a spill, Daley’s ERP requires Daley to stop the source of the liquid manure leak or spill immediately. The ERP also includes using the following measures where appropriate:

- Installation of bale checks
- Blockage of downstream culverts
- Plugging tile intakes
- Tilling ground ahead of the spill
- Use of absorptive materials

The MPCA reviewed and approved the ERP, which will become an enforceable condition of the Feedlot Permit upon issuance.

Manure Application Sites
All manure generated by the Project will be land applied, at agronomic rates, at the manure application sites (Attachments F and G). Daley will determine the agronomic rate using the University of Minnesota’s recommendations for manure application based on: the previous crop harvested, the available nutrients, yield goals and the crop to be grown. The CAWT will land apply manure in the fall, spring, or summer with cover crop. The CAWT will inject the manure directly into the soil when cover crop is not present. The CAWT must adhere to applicable manure application setbacks as outlined in question five of the EAW.

All Project manure application sites are within the Root River Watershed and the Mississippi River - Winona Watershed. Previous landowners have farmed land in the watersheds for several decades. Daley expects the stormwater runoff characteristics from the Project manure application sites to remain the same, and under certain circumstances, improve because of the land application activities regulated under the Feedlot Permit. The improvements occur through developing better soil tilth from organic fertilizer and the uniform practice of incorporating manure over the acres identified in the MMP. Daley expects no change in stormwater runoff characteristics (physically and chemically) from the Project manure application sites.

A. Estimate the number of heavy truck trips generated per week and describes their routing over local roads. Describe any road improvements to be made.

Truck and employee traffic use Highway 14 to access the Project Site. No road improvements are required for the Project.

Construction of Project
During the Project construction, traffic will temporarily increase due to construction vehicles and delivery truck traffic. Daley estimates that Project construction will take approximately 9 months and will require, on average, 12 vehicles per day.

Operation of Project
During operation of the Project, Daley expects an average of 269 vehicles per week. Traffic will peak during harvest time. Estimates include the following:

- 25 vehicles per day for employee transportation
- 2 trucks to deliver cows, twice per week
- 1 truck to take cows to the market twice per week
- 3 milk hauling trucks per day
- 400 trucks over 12 days for hay delivery
- 1,400 trucks over 10 days for corn silage delivery
- 520 trucks over 6 days for earlage delivery
- 8 trucks every other month for sand delivery
- 1 truck/day for rendering service to remove animal fatalities when needed
- 2 trucks/day for other miscellaneous deliveries

No alternative transit modes are available.

B. Will new or expanded utilities, roads, other infrastructure, or public services be required to serve the project? ☑ Yes ☐ No

If yes, please describe.

10. Permits and approvals required. Mark required permits and give status of application:

<table>
<thead>
<tr>
<th>Unit of government</th>
<th>Type of Application</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>☑ MPCA</td>
<td>State of Minnesota Individual Animal Feedlot National Pollutant Discharge Elimination System (NPDES) Permit (Feedlot Permit) MN0067652– including NPDES/State Disposal System General Construction Stormwater Permit requirements</td>
<td>Draft permit on public notice</td>
</tr>
<tr>
<td>☑ County</td>
<td>Animal Unit Cap Variance</td>
<td>To be applied for</td>
</tr>
<tr>
<td>☑ County</td>
<td>Conditional Use Permit</td>
<td>To be applied for</td>
</tr>
<tr>
<td>☑ DNR</td>
<td>Water Appropriation</td>
<td>To be applied for</td>
</tr>
<tr>
<td>☑ Utica</td>
<td>Town of Utica Building Permit</td>
<td>To be applied for</td>
</tr>
</tbody>
</table>
11. Other potential environmental impacts, including cumulative impacts. If the project may cause any adverse environmental impacts not addressed by items 1 to 10, identify and discuss them here, along with any proposed mitigation. This includes any cumulative impacts caused by the project in combination with other existing, proposed, and reasonably foreseeable future projects that may interact with the project described in this EAW in such a way as to cause cumulative impacts. Examples of cumulative impacts to consider include air quality, stormwater volume or quality, and surface water quality. *(Cumulative impacts may be discussed here or under the appropriate item(s) elsewhere on this form.)*

The MPCA must evaluate whether the Project, which may not individually have the potential to cause significant environmental effects, could have a significant effect when considered along with other projects, known as cumulative effects. To assess the Project’s "cumulative potential effects of related or anticipated future projects," the MPCA conducted an analysis that evaluated other operations and looked for the potential for other projects in the context to potential direct or indirect impacts of the Project that: (1) are already in existence or planned for the future; (2) are located in the surrounding area; and (3) might reasonably be expected to affect the same natural resources. The following is a review of the MPCA’s analysis.

The MPCA reviewed existing public data and identified 532 current feedlots in Winona County that are large enough to require registration, with Daley’s existing operation being the largest in the County. The Project is located at the edge of two sub-watersheds. Within the sub-watershed draining to the north, there are 23 feedlots with 4,270 AU total (including Daley’s existing operations). Within the sub-watershed draining to the south, there are 21 feedlots with 1,783 AU (this count does not include the Daley’s existing operations). See Attachment U.

In March 2017, the MPCA completed an EAW on a proposal from Holden Farms Inc. to expand two existing swine feedlots approximately 3.5 miles west and 7.5 miles northwest of the Daley Project Site. The MPCA issued a negative declaration on the need for an EIS on the proposed project. The Holden Farms Inc. and Daley Project have one manure application field in common, as identified in the EAWs. Manure application at this field must be done according to its MMP and cannot exceed agronomical rates; therefore, the MPCA does not expect cumulative impacts.

If the Project were constructed, it would result in an approximate 4% AU increase in Winona County. Winona County Feedlot Officer and Daley are unaware of any large feedlots planned near the Project Site. Daley does not plan to expand beyond the Project.

**Surface Water Quality**

The Project Site and the manure application sites are located within the Mississippi River – Winona Watershed (07040003) and the Root River Watershed (07040008), which all eventually drain to the Mississippi River. The Project Site is at the interface of these watersheds. Approximately half of the manure application sites are within three minor watersheds in the Mississippi River – Winona Watershed, and the other half are within three minor watersheds in the Root River Watershed.

The Federal Clean Water Act\(^8\) (CWA) requires that each state develop a plan to identify and restore any waterbody that is deemed impaired by state regulations. The U.S. Environmental Protection Agency requires states to develop a total maximum daily load (TMDL) for each pollutant causing an impairment. The TMDL establishes how much of the impairing pollutant may enter the waterbody and still allow that waterbody to meet water quality standards.

\(^8\) 33 U.S.C. § 303(d) (1972)
Within the Mississippi River – Winona Watershed, the Whitewater River South Fork (AUID 07040003-512), impaired for nitrate and total suspended solids (TSS), and Peterson Creek (AUID 07040003-529), impaired for *E. coli*, are the nearest impaired waters. Downstream reaches of Garvin Brook are also impaired. In 2016, the MPCA released the Mississippi River – Winona Watershed Pollutant Reduc...
Trout Streams
Trout streams are sensitive to land use practices related to agriculture and require special attention to ensure they remain healthy and productive. Row crop farming on uplands and pasturing near river bottoms contribute to land erosion and sedimentation to streambeds. Fine sediment covers the gravel runs and riffles that trout need to spawn and invertebrates need to survive. The clearing of shoreline trees takes away underwater root wads and fallen trees in which trout find cover from current and predators.

While the Project Site is more than 2.5 miles away from a trout stream, it is located in trout stream watersheds in an active karst area. Several of the manure application sites are near Peterson Creek and Unnamed Creek leading to Rush Creek, fishable trout streams (Attachment V). These manure application sites have been in cultivation for many years. The Project will not result in clearing trees or adding additional land into agriculture production. The CAWT will apply manure at agronomic rates on already existing fields and will observe setback distances from special features. If a spill or release were to occur, the CAWT and Daley will take immediate action, as required in its emergency response plan.

While overland runoff carries pollutants of concern to trout streams during storm events, groundwater with dissolved nitrates from row crop lands easily makes its way to trout streams in southeast Minnesota, including those in this project area – South Fork Whitewater and Rush Creek.

Groundwater Quality
Feedlot operations can adversely affect groundwater quality if not properly managed. One measure of an areas risk of groundwater pollution is from the DNR’s Pollution Sensitivity of Near-Surface Materials report14. The report uses a matrix for determining a sensitivity rating of the water table ranging from high to ultra-low based on aquifer material, recharge potential, soil materials, and vadose zone materials. However, no rating is given for special conditions such as regions prone to surface karst feature development.

Attachment S shows the manure application sites are located in a special condition area, karst. Karst allows a direct, very rapid exchange between surface water and groundwater, and significantly increases groundwater contamination risk from surface pollutants. Groundwater quality is especially important since residences around the Project site access drinking water from private and municipal wells. The Utica and Lewiston municipal wells are discussed in question 2.C. The leaching of nitrates is the greatest threat to groundwater quality in the Project area. The Mississippi River – Winona Watershed WRAPS15 states that “Nitrate reduction via reduction of input to and loss from corn/soy agricultural acres” is the top priority in a list of key watershed issues.

Daley will reduce impacts to groundwater by following the design, construction and operation requirements in Minnesota rules16. These rules protect groundwater from both cumulative and individual feedlot impacts. Additionally, Daley will use one or more of the following practices to reduce the likelihood of nitrates leaching to groundwater: delaying manure applications in the fall until soil temperature is below 50 degrees; planting cover crops when manure is applied early in the fall before soil temperatures are below 50 degrees and weather and field conditions are conducive for seeding a cover crop; or applying manure in the spring. Daley has submitted design plans and construction specifications for the manure basin and the MMP for the land application of manure. The MPCA reviewed and approved the MMP/plans, which will become an enforceable condition of the Feedlot Permit upon issuance.

16 Minn. R. 7020
Water Quality Protections Summary
The primary goal of the Feedlot Permit is to ensure that waters are not contaminated by the runoff or leachate from feedlots, manure storage or stockpiles, and cropland with improperly applied manure. Daley will implement BMPs through its MPCA-approved MMP, an enforceable part of the Feedlot Permit. Daley will take the following actions to minimize impacts to water quality:

- Test soil and apply manure at agronomic rates based on nitrogen.
- Test soil every 4 years for phosphorus to ensure it isn’t accumulating at unacceptable amounts.
- Comply with state and county required manure application setbacks.
- Immediately incorporating manure into soil. (Injecting or incorporating manure assimilates it into the soil profile and ties up a large portion of the nutrients in the organic portion of the soil, thereby decreasing mobilization of the nutrients by wind and/or water. Injection or incorporation of the manure also increases the organic matter in the soil, making it less likely to erode and add sediment to surface water.)
- If a manure spill occurs, comply with the ERP in its Feedlot Permit.
- Design and build the Project as a total confinement operation.
- Examine the manure basin and runoff basin drain tile inspection ports monthly for water flow and signs of discoloration or odor in any water in the drain tile. This will ensure that, if there are any manure basin leaks, they will be detected in a timely manner.

The surrounding area is primarily agriculture that receives nutrient applications from commercial fertilizer or manure. The nutrients in manure from the Project will replace the use of commercial fertilizers for the manure application sites. All manure application is required to take place at agronomical rates and in accordance with Minn. R. 7020 and the Feedlot Permit. This includes setbacks to sensitive features and management of phosphorus within the fields. This oversight of nutrient application is not required for use of commercial fertilizers. Furthermore, manure application provides enhanced soil tilth, a beneficial property of soil that helps retain moisture and reduce runoff form fields. Daley has adequate cropland to utilize the nutrients generated from the Project.

Groundwater Quantity and Appropriation
The surrounding area is primarily agriculture that receives nutrient applications from commercial fertilizer or manure. The nutrients in manure from the Project will replace the use of commercial fertilizers for the manure application sites. All manure application is required to take place at agronomical rates and in accordance with Minn. R. 7020 and the Feedlot Permit. This includes setbacks to sensitive features and management of phosphorus within the fields. This oversight of nutrient application is not required for use of commercial fertilizers. Furthermore, manure application provides enhanced soil tilth, a beneficial property of soil that helps retain moisture and reduce runoff form fields. Daley has adequate cropland to utilize the nutrients generated from the Project.

The DNR’s Water Appropriation Permit Program regulates groundwater appropriation. The program manages water resources so that adequate supply is provided for domestic, agricultural, fish and wildlife, recreational, power, navigational, and quality control. The program balances competing management objectives, including both development and the protection of water resources. Minn. Stat. § 103G.261 establishes domestic use as the highest priority when water supplies are limited, and, when well interference occurs, the DNR follows a standardized procedure of investigation. Daley will need to correct any problems a DNR investigation determines they are causing. The DNR has preliminarily approved the construction of Daley’s well (Attachment R). The preliminary approval does not constitute an authorization or guarantee of a Water Appropriation Permit approval by the DNR.

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https://www.pca.state.mn.us/sites/default/files/wq-f1-08.pdf (Retrieved June 2018)
Air Quality
Daley used the AERMOD dispersion model to predict potential emissions of hydrogen sulfide, ammonia, and selected odorous gases from the Project (Attachment T). The model estimated pollutant concentrations from the Project, along with an ambient hydrogen sulfide and ammonia background concentration to account for any nearby air emission sources. Based on the results of the modeling, the MPCA does not expect significant air quality impacts from the Project including adverse cumulative potential effects.

Traffic
Daley evaluated the cumulative potential effects of the direct contribution of new traffic through the development and operation of the Project in context to the existing traffic load, provided in Item 9.A. This information indicates the Project will result in a slight increase of traffic, an average of 269 vehicles per week. The MPCA does not expect the slight increase in traffic to contribute to an adverse cumulative potential effect.

Land Use
The Project Site and manure application sites are in existing agricultural production areas that have been used for agricultural purposes for decades. Daley does not expect the Project’s construction to cause the conversion of wildlife habitat, fallow or marginal cropland land into row crop production. The Project is consistent with nearby land use. As a result, the MPCA does not expect the Project to contribute to an adverse cumulative potential effect related to land use.

Wildlife Habitat
There are competing issues in rural landscapes to maintain a balance between agricultural demands and preserving natural resources. In this case, the Project is in areas currently used for agricultural production. Previous landowners have used all affected acres for agricultural purposes, including the proposed manure application fields. The Project will not displace or disrupt any wildlife habitat and as a result, will not contribute to any adverse cumulative potential effects related to habitat fragmentation and loss.

Row Crop Agriculture
The manure application sites will use existing row crop feedstock, rather than cultivate fallow or marginal land to meet crop use needs. As a result, Daley does not expect to create any additional or new impacts to environmental quality. The MPCA and Daley did not receive information that indicates any other projects in the area will convert fallow or marginal cropland into row crop production within the Project area. The Project will modify land use related to row crop agriculture.
12. Summary of issues. List any impacts and issues identified above that may require further investigation before the project is begun. Discuss any alternatives or mitigative measures that have been or may be considered for these impacts and issues, including those that have been or may be ordered as permit conditions.

No additional issues.

RGU CERTIFICATION.

I hereby certify that:

- The information contained in this document is accurate and complete to the best of my knowledge.
- The EAW describes the complete project; there are no other projects, stages or components other than those described in this document, which are related to the project as “phased actions,” pursuant to Minn. R. 4410.0200, subp. 60, 4410.1000, subp. 4, and 4410.4300, subp. 1.
- Copies of this EAW are being sent to the entire EQB distribution list.

Name and Title of Signer:  
Dan R. Card, P.E., Supervisor, Environmental Review Unit  
St. Paul Office  
Resource Management and Assistance Division

Date:  
9/20/18

The format for the alternative Environmental Assessment Worksheet form has been approved by the Chair of the Environmental Quality Board pursuant to Minn. R. 4410.1300 for use for animal feedlot projects. For additional information contact: Environmental Quality Board, 520 Lafayette Road, St. Paul, Minnesota, 55155-4194, 651-296-6300, or at their website https://www.eqb.state.mn.us/
Daley Feedlot Permit - Site Locations

Project Site / LLP
LLP1
LLP7
Sinkhole

Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
ATTACHMENT G

INDIVIDUAL MANURE APPLICATION SITES
Erions 1 Field Map
Utica 17, NW1/4

Winona County, MN

MANURE APPLICATION NOTES:
Winter application is NOT permitted within 300' Buffer or slopes greater than 6%.
Non-Winter application within 300' Buffer needs 100’ grass buffer on rivers and lakes, or 50’ grass buffer on all other
waterways. If insufficient buffer or within Tile Intake Buffer you must incorporate immediately.
There is NO application within 25’ of any waterway and within 100’ of all wells.
If soil tests exceed 21ppm Bray/16ppm Olsen in 300’ Buffer, Phosphorus must be applied at crop removal rates.

Legend

- Field Boundary
- Stream (Intermittent)
- Karst Feature
- Karst - No Applicatin Zone
- Karst Special Protection Area
- 300ftSetback

Soil Restrictions
- No Restriction
- CWI - Known Wells
- Well 300’ Buffer

Feet

Ex- tended Ag Services, Inc.
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West Farm 40 Field Map
Utica 8, SE1/4 of SW1/4

MANURE APPLICATION NOTES:
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Legend
- Field Boundary
- Stream (Intermittent)
- 300ft Setback
- Soil Restrictions
  - No Restriction
  - Shallow Bedrock
- CWI - Known Wells
- Well 300’ Buffer
MANURE APPLICATION NOTES:
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Legend
- Field Boundary
- CWI - Known Wells
- Stream (Intermittent)
- Well 300’ Buffer
- 300ft Setback

Soil Restrictions
- No Restriction
- Shallow Bedrock

Note: The diagram shows a map of a farm pasture in Utica 9, S1/2 of SW1/4, Winona County, MN, with various features and restrictions labeled.
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Legend
- **Field Boundary**
- Stream (Intermittent)
- **Karst Feature**
- **Karst - No Application Zone**
- **Karst Special Protection Area**
- **300ft Setback**

Soil Restrictions
- **No Restriction**
- **CWI - Known Wells**
- Well 300' Buffer
Hartke, Along Road 8 Field Map
Utica 9, SE1/4 of SE1/4

MANURE APPLICATION NOTES:
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Legend

- Field Boundary
- CWI - Known Wells
- Stream (Intermittent)
- No Restriction
- Shallow Bedrock

0 62.5 125 250 375 500 Feet
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Legend
- Field Boundary
- Stream (Intermittent)
- Karst - No Application Zone
- Karst Special Protection Area
- 300ft Setback

Soil Restrictions
- No Restriction
- Shallow Bedrock
- CWI - Known Wells
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Legend
- Field Boundary
- Stream (Intermittent)
- 300ft Setback
- No Restriction
- Shallow Bedrock

CWI - Known Wells
Hole Pasture 20 Field Map
Utica 22, SE1/4 of NW1/4

Winona County, MN

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Legend
- Field Boundary
- CWI - Known Wells
- Stream (Intermittent)
- Well 300’ Buffer
- 300ft Setback
- Soil Restrictions
  - No Restriction
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Legend
- Field Boundary
- Stream (Intermittent)
- Karst Feature
- Karst - No Application Zone
- Karst Special Protection Area
- 300ftSetback

Soil Restrictions
- No Restriction
- Shallow Bedrock
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- Well 300' Buffer
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- CWI - Known Wells
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Non-Winter application within 300' Buffer needs 100' grass buffer on rivers and lakes, or 50' grass buffer on all other waterways. If insufficient buffer or within Tile Intake Buffer you must incorporate immediately.
There is NO application within 25' of any waterway and within 100' of all wells.
If soil tests exceed 21ppm Bray/16ppm Olsen in 300' Buffer, Phosphorus must be applied at crop removal rates.
MANURE APPLICATION NOTES:
Winter application is NOT permitted within 300' Buffer or slopes greater than 6%.
Non-Winter application within 300' Buffer needs 100' grass buffer on rivers and lakes, or 50' grass buffer on all other waterways. If insufficient buffer or within Tile Intake Buffer you must incorporate immediately.
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Legend
- Field Boundary
- Stream (Intermittent)
- Wetland
- 300ft Buffer DNR Features
- Karst Feature
- Karst - No Application Zone
- 300ft Setback
- Soil Restrictions
  - No Restriction
  - CWI - Known Wells
  - Well 300' Buffer
MANURE APPLICATION NOTES:
Winter application is NOT permitted within 300' Buffer or slopes greater than 6%.
Non-Winter application within 300' Buffer needs 100' grass buffer on rivers and lakes, or 50’ grass buffer on all other waterways. If insufficient buffer or within Tile Intake Buffer you must incorporate immediately.
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Lappier's Field Map
Fremont 2 & 11

Winona County, MN
Daley Farms

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Legend
- Field Boundary
- Stream (Intermittent)
- Karst Feature
- Karst - No Application Zone
- Karst Special Protection Area

Soil Restrictions
- No Restriction
- Shallow Bedrock
- CWI - Known Wells
MANURE APPLICATION NOTES:
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Legend

- Field Boundary
- Soil Restrictions
  - No Restriction
  - CWI - Known Wells
  - Well 300' Buffer
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Legend
- Field Boundary
- Stream (Intermittent)
- Karst Feature
- Karst_No_Application
- Karst_Special_Protection_Area
- 300ftSetback

Soil Restrictions
- Shallow Bedrock
- CWI - Known Wells
- Well 300' Buffer
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Legend

- Field Boundary
- Stream (Intermittent)
- Karst Feature
- Karst_No_Application
- Karst_Special_Protection_Area
- 300ft Setback

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- Shallow Bedrock
- CWI - Known Wells
- Well 300' Buffer
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Transfer Field Map
St. Charles 13, NE1/4

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Legend
- Field Boundary
- CWI - Known Wells
- Stream (Intermittent)
- Well 300’ Buffer
- 300ft Setback
- Soil Restrictions
- Shallow Bedrock
Lewiston Drinking Water Supply Management Area

Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

Lewiston DWSMA
Manure Application Site
Subject: SHPO Review for site of dairy expansion
From: Thomas Cinadr <thomas.cinadr@mnhs.org>
Date: 10/9/2017 11:38 AM
To: "Michael J. Tiry" <mike@oakridgeeng.com>

Mike,

Submit the results of the search to the review staff for project clearance. Future requests should be sent to Jesse Kling as I am retiring at the end of this week.

Tom

On Monday, October 9, 2017, Michael J. Tiry <mike@oakridgeeng.com> wrote:

Hello Tom,

We hope to submit the plans and specifications for this project this week. This tag below says that "This email is not a project clearance." Does that mean that there is further work that is required before submittal of the project for MPCA review? Would you call me at 715-225-9292?

Thank you,

Mike Tiry

On 8/8/2017 7:59 AM, Thomas Cinadr wrote:

THIS EMAIL IS NOT A PROJECT CLEARANCE.

This message simply reports the results of the cultural resources database search you requested. The database search produced results for only previously known archaeological sites and historic properties. Please read the note below carefully.

No archaeological sites or historic structures were identified in a search of the Minnesota Archaeological Inventory and Historic Structures Inventory for the search area requested.

The result of this database search provides a listing of recorded archaeological sites and historic architectural properties that are included in the current SHPO databases. Because the majority of archaeological sites in the state and many historic architectural properties have not been recorded, important sites or structures may exist within the search area and may be affected by development projects within that area. Additional research, including field survey, may be necessary to adequately assess the area’s potential to contain historic properties.
If you require a comprehensive assessment of a project’s potential to impact archaeological sites or historic architectural properties, you may need to hire a qualified archaeologist and/or historian. If you need assistance with a project review, please contact Kelly Gragg-Johnson in Review and Compliance @ 651-259-3455 or by email at kelly.graggjohnson@mnhs.org.

The Minnesota SHPO Survey Manuals and Database Metadata and Contractor Lists can be found at http://www.mnhs.org/shpo/survey/inventories.htm

---

**Tom Cinadr**
Survey and Information Management Coordinator
Minnesota Historic Preservation Office
Minnesota Historical Society
345 Kellogg Blvd. West
St. Paul, MN 55102

651-259-3453

On Thu, Aug 3, 2017 at 10:32 AM, Michael J. Tiry <mike@oakridgeeng.com> wrote:

Hello Tom,

Thank you for taking my call today. The project that we are preparing an EAW for is located in Township 106N; R9W Section 16 Town of Utica; Winona County, Minnesota.

---

**Michael J. Tiry, PE, Principal Engineer**
Oakridge Engineering, Inc.
Mike@OakridgeEng.com | 715.723.6777:0 | www.OakridgeEng.com

---

**Tom Cinadr**
Survey and Information Management Coordinator
Minnesota Historic Preservation Office
Minnesota Historical Society
345 Kellogg Blvd. West
St. Paul, MN 55102

651-259-3453
Correspondence # ERDB 20180097

Mr. Michael Tiry
Oakridge Engineering, Inc.
PO Box 44
Chippewa Falls, WI  54729

RE: Natural Heritage Review of the proposed Daley Farms of Lewiston,

As requested, the Minnesota Natural Heritage Information System has been queried to determine if any rare species or other significant natural features are known to occur within an approximate one-mile radius of the proposed project. Based on this query, rare features have been documented within the search area (for details, please visit the Rare Species Guide at http://www.dnr.state.mn.us/rsg/index.html for more information on the biology, habitat use, and conservation measures of these rare species). Please note that the following rare features may be adversely affected by the proposed project:

**State-listed Species**

- Timber rattlesnakes (*Crotalus horridus*), a state-listed threatened species, have been documented in the vicinity the proposed project. In Minnesota, ideal habitat for this species is forested bluffs, south-facing rock outcrops, and bluff prairies, particularly in the Mississippi River Valley. Nearby forests, prairies, and agricultural lands are used as summer feeding grounds. Given the presence of these rare snakes, I recommend that the use of erosion control mesh, if any, be limited to wildlife-friendly materials (see enclosed fact sheet). Please remember that state law and rules prohibit the destruction of threatened or endangered species, except under certain prescribed conditions. As such, crews working in the area should be advised that if they encounter any snakes, the snakes should not be disturbed.

- Wilson’s phalaropes (*Phalaropus tricolor*), a state-listed threatened bird, have been documented during the breeding season in the vicinity of the proposed project. This wetland species nests on the ground in wet meadows, grassy marshes, and along edges of shallow inland waters. Limiting disturbance near wetlands from May through July will help to minimize any potential disturbance to this rare bird.
The loggerhead shrike (*Lanius ludovicianus*), a state-listed endangered bird, has been documented in the vicinity of the project site. Loggerhead shrikes use grasslands that contain short grass and scattered perching sites such as hedgerows, shrubs, or small trees. They can be found in native prairie, pastures, shelterbelts, old fields or orchards, cemeteries, grassy roadsides, and farmyards. Shrikes frequently shift territories between years so it is not unusual for a particular nesting area to be vacant for several years before it is used again. If the project boundary contains suitable habitat, then it is possible that these birds may breed in the area. Recommendations to minimize potential impacts include the following:

- Avoid or minimize tree and shrub removal within suitable habitat during the breeding season, typically April through July,
- If any tree or shrub removal will occur within suitable habitat during the breeding season, inspect the trees/shrubs for active nests prior to removal,
- Report any loggerhead shrike sightings to the DNR,
- Please reference the attached fact sheet and the DNR Rare Species Guide for additional recommendations.

*Environmental Review and Permitting*

- The Environmental Assessment Worksheet should address whether the proposed project has the potential to adversely affect the above rare features and, if so, it should identify specific measures that will be taken to avoid or minimize disturbance.

- Please include a copy of this letter in any state or local license or permit application. Please note that measures to avoid or minimize disturbance to the above rare features may be included as restrictions or conditions in any required permits or licenses.

The Natural Heritage Information System (NHIS), a collection of databases that contains information about Minnesota’s rare natural features, is maintained by the Division of Ecological and Water Resources, Department of Natural Resources. The NHIS is continually updated as new information becomes available, and is the most complete source of data on Minnesota's rare or otherwise significant species, native plant communities, and other natural features. However, the NHIS is not an exhaustive inventory and thus does not represent all of the occurrences of rare features within the state. Therefore, ecologically significant features for which we have no records may exist within the project area. If additional information becomes available regarding rare features in the vicinity of the project, further review may be necessary.

For environmental review purposes, the results of this Natural Heritage Review are valid for one year; the results are only valid for the project location (noted above) and the project description provided on the NHIS Data Request Form. Please contact me if project details change or for an updated review if construction has not occurred within one year.

The Natural Heritage Review does not constitute review or approval by the Department of Natural Resources as a whole. Instead, it identifies issues regarding known occurrences of rare features and potential effects to these rare features. If you have not done so already, please contact your DNR Regional Environmental Assessment Ecologist to determine whether there are other natural resource concerns associated with the proposed project.
Please be aware that additional site assessments or review may be required.

Thank you for consulting us on this matter, and for your interest in preserving Minnesota's rare natural resources. An invoice will be mailed to you under separate cover.

Sincerely,

Samantha Bump
Natural Heritage Review Specialist
Samantha.Bump@state.mn.us

Enc. Wildlife Friendly Erosion Control
Loggerhead Shrike Fact Sheet

Cc: Becky Horton
Leslie Parris
Preventing Entanglement by Erosion Control Blanket

Plastic mesh netting is a common component in erosion control blanket. It is utilized to hold loose fibrous materials in place (e.g., straw) until vegetation is established. Erosion control blanket is being utilized extensively and is effective for reducing soil erosion, benefitting both soil health and water quality. Unfortunately there is a negative aspect of the plastic mesh component: it is increasingly being documented that its interaction with reptiles and amphibians can be fatal (Barton and Kinkead, 2005; Kapfer and Paloski, 2011). Mowing machinery is also susceptible to damage due to the long lasting plastic mesh.

Potential Problems:
- Plastic netting remains a hazard long after other components have decomposed.
- Plastic mesh netting can result in entanglement and death of a variety of small animals. The most vulnerable group of animals are the reptiles and amphibians (snakes, frogs, toads, salamanders, turtles). Ducklings, small mammals, and fish have also been observed entangled in the netting.
- Road maintenance machinery can snag the plastic mesh and pull up long lengths into machinery, thus binding up machinery and causing damage and/or loss of time cleaning it out.

Suggested Alternatives:
- Do not use in known locations of reptiles or amphibians that are listed as Threatened or Endangered species.
- Limit use of blanket containing welded plastic mesh to areas away from where reptiles or amphibians are likely (near wetlands, lakes, watercourses, or rock outcrops) or habitat transition zones (prairie – woodland edges, rocky outcrop – woodland edges, steep rocky slopes, etc.)
- Select products with biodegradable netting (preferably made from natural fibers, though varieties of biodegradable polyesters also exist on the market). Biodegradable products will degrade under a variety of moisture and light conditions.
- DO NOT use products that require UV-light to degrade (also called “photodegradable”) as they do not degrade properly when shaded by vegetation.

Solution: Most categories of erosion control blanket and sediment control logs are available in natural net options.
- Specify ‘Natural Netting’ for rolled erosion control products, per MnDOT Spec 3885. See Table 3885-1.
- Specify ‘Natural Netting’ for sediment control logs, per MnDOT Spec 3897

The plastic mesh component of erosion control blanket becomes a net for entrapment.

Literature Referenced

Best Practices for Meeting DNR GP 2004-0001 (version 4, October 2014)
Loggerhead Shrikes

Loggerhead shrikes are in trouble – but you may be able to help. Throughout the United States, and particularly in the Midwest, loggerhead shrikes are disappearing at an alarming rate. So serious is the decline that the loggerhead shrike is one of six bird species considered threatened in Minnesota.

What is a loggerhead shrike?
Loggerhead shrikes are special birds – an interesting cross between songbird and hawk. They feed on large insects such as grasshoppers and beetles, mice, small birds, frogs and toads. Shrikes spend much of their time perched on powerlines, fences or the top-most branches of trees and shrubs, scouting for prey and then swooping down to catch it. Then the bird either eats its prey, impales it on a nearby thorn or barbed wire fence or wedges it into the fork of a branch. Because shrikes lack the strong, sharp claws and feet of hawks, impaling food holds it in place as the bird tears at it with its bill. Your first clue that loggerhead shrikes are on your property may be finding an animal impaled on a fence barb or a thorn. This habit has earned the loggerhead shrike the nickname “butcher bird.”

What do loggerhead shrikes look like?
The robin-sized loggerhead shrike has a slate-gray back with a light breast. The most distinguishing markings of this bird are the black mask, which extends across the eye, and the black and white wing and tail patches which flash when the bird flies. Males and females are similar in size and color.

In Minnesota, loggerhead shrikes are most easily confused with eastern kingbirds and northern shrikes. However, eastern kingbirds have no mask, their heads are entirely dark, and they do not have white patches on their wings. The northern shrike looks very similar to the loggerhead shrike, but occurs in Minnesota from October through April, whereas the loggerhead shrike is here from March to October. During the early spring and fall, when both shrikes are in the state, they can be told apart by the loggerhead shrike’s completely black bill and its mask which extends across the top of the bill.

Where do they live?
Loggerhead shrikes were once found throughout much of the unforested region of the state. Today, their numbers are very low. Recent surveys have located fewer than 30 nests in the state (Fig. 1). It is very important that we try to maintain habitat for the few shrikes that still breed in Minnesota.

Shrikes use grassy, open areas with scattered trees and shrubs such as pastures, prairie patches and grassy roadsides. A few trees and shrubs, along with fences and powerlines provide nesting sites and perches from

continued on back
which to hunt. Red cedar, hawthorn and plum trees are often used for nesting. A pair may range over 2.5 - 30 acres.

Loggerhead shrikes are early nesters, arriving in Minnesota from their wintering areas in the southern U.S. and Mexico in early spring. Shrikes lay 4-6 eggs that hatch after about 16 days. The young birds remain with their parents for about 4 weeks after leaving the nest. It is at this time that the birds are most conspicuous. Shrikes tend to nest in the same general areas from year to year, although they may be absent for a year or two and then return again, as long as the habitat remains.

**Why is the loggerhead shrike population declining?**

The decline of the loggerhead shrike is likely the result of a combination of factors, including loss of habitat resulting from the conversion of pasture and grasslands to houses or cropland and the encroachment of forest and brush on pastures and grasslands. In addition, changes in farming practices have resulted in larger fields and fewer trees, shrubs and fences scattered about. The increasing use of pesticides may also play a role in the decline of shrikes because these chemicals affect many animals that shrikes eat.

---

**WHAT CAN YOU DO TO HELP LOGGERHEAD SHRIKES?**

**If there are shrikes nesting on your property, congratulations!** You are one of a very few Minnesotans fortunate to share your property with such a unique bird. We hope you will want to help this bird continue its presence in your neighborhood. Obviously your land management practices and land use are already compatible if the birds have selected your land for nesting. While biologists continue to investigate the decline of the shrike there are things you can do on your property to encourage shrikes.

1. **Leave fences standing for shrikes to use for perching and impaling food.** If a fence must be removed, or if there are no fences near your grassland or pasture, you can create perch and impaling posts. To do this, wrap barbed wire near the top of a post. Place these posts along the edges of pastures and fields for shrikes to use. Your local nongame wildlife biologist can help you select the best locations for the posts.

2. **Keep brush from encroaching upon grasslands** by removal or burning, but only to the extent that the shrubs and trees don't dominate the grassland. A few scattered shrubs and trees are necessary to maintain the best shrike habitat.

3. **Pastures and grassland are more attractive to shrikes than are row crops.** Therefore, it is important to maintain existing pasture and grasslands. Investigate the Conservation Reserve Program (CRP) which pays farmers to retire highly erodible farmlands from production and to establish permanent grassland. Contact your local Natural Resources Conservation Service office (formerly the Soil Conservation Service) for more information about this program.

4. **Take advantage of financial incentives for maintaining compatible land uses.** In many counties, the Agricultural Preserve Program and/or the Green Acres Program provide tax adjustments and/or defferments to farmers to help them maintain their land for agricultural use. Contact your county assessor's office for more information about these programs.

5. **Minimize use of pesticides.** Pesticides can reduce the supply of large insects and other non-target animals that shrikes need. Also, because shrikes feed on animals at which pesticides are directed, these chemicals can build up in the birds and impair their ability to reproduce and reduce the survival of their young.

---

For more information about shrikes or to report loggerheads shrikes on your property please contact:

Nongame Wildlife Program
500 Lafayette Rd.,
St. Paul, MN  55155
(651) 297-3764
1-800 766-6000

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June 20, 2017

Wetlands

- Estuarine and Marine Deepwater
- Estuarine and Marine Wetland
- Freshwater Emergent Wetland
- Freshwater Forested/Shrub Wetland
- Freshwater Pond
- Lake
- Other
- Riverine

This map is for general reference only. The US Fish and Wildlife Service is not responsible for the accuracy or currentness of the base data shown on this map. All wetlands related data should be used in accordance with the layer metadata found on the Wetlands Mapper web site.
Custom Soil Resource Report for
Winona County, Minnesota
Daley Farms of Lewiston

November 6, 2017
Preface

Soil surveys contain information that affects land use planning in survey areas. They highlight soil limitations that affect various land uses and provide information about the properties of the soils in the survey areas. Soil surveys are designed for many different users, including farmers, ranchers, foresters, agronomists, urban planners, community officials, engineers, developers, builders, and home buyers. Also, conservationists, teachers, students, and specialists in recreation, waste disposal, and pollution control can use the surveys to help them understand, protect, or enhance the environment.

Various land use regulations of Federal, State, and local governments may impose special restrictions on land use or land treatment. Soil surveys identify soil properties that are used in making various land use or land treatment decisions. The information is intended to help the land users identify and reduce the effects of soil limitations on various land uses. The landowner or user is responsible for identifying and complying with existing laws and regulations.

Although soil survey information can be used for general farm, local, and wider area planning, onsite investigation is needed to supplement this information in some cases. Examples include soil quality assessments (http://www.nrcs.usda.gov/wps/portal/nrcs/main/soils/health/) and certain conservation and engineering applications. For more detailed information, contact your local USDA Service Center (https://offices.sc.egov.usda.gov/locator/app?agency=nrcs) or your NRCS State Soil Scientist (http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/contactus/?cid=nrcs142p2_053951).

Great differences in soil properties can occur within short distances. Some soils are seasonally wet or subject to flooding. Some are too unstable to be used as a foundation for buildings or roads. Clayey or wet soils are poorly suited to use as septic tank absorption fields. A high water table makes a soil poorly suited to basements or underground installations.

The National Cooperative Soil Survey is a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local agencies. The Natural Resources Conservation Service (NRCS) has leadership for the Federal part of the National Cooperative Soil Survey.

Information about soils is updated periodically. Updated information is available through the NRCS Web Soil Survey, the site for official soil survey information.

The U.S. Department of Agriculture (USDA) prohibits discrimination in all its programs and activities on the basis of race, color, national origin, age, disability, and where applicable, sex, marital status, familial status, parental status, religion, sexual orientation, genetic information, political beliefs, reprisal, or because all or a part of an individual's income is derived from any public assistance program. (Not all prohibited bases apply to all programs.) Persons with disabilities who require
alternative means for communication of program information (Braille, large print, audiotape, etc.) should contact USDA's TARGET Center at (202) 720-2600 (voice and TDD). To file a complaint of discrimination, write to USDA, Director, Office of Civil Rights, 1400 Independence Avenue, S.W., Washington, D.C. 20250-9410 or call (800) 795-3272 (voice) or (202) 720-6382 (TDD). USDA is an equal opportunity provider and employer.
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Soil Map

The soil map section includes the soil map for the defined area of interest, a list of soil map units on the map and extent of each map unit, and cartographic symbols displayed on the map. Also presented are various metadata about data used to produce the map, and a description of each soil map unit.
The soil surveys that comprise your AOI were mapped at 1:20,000.

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: 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: Winona County, Minnesota
Survey Area Data: Version 12, Oct 5, 2017

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

Date(s) aerial images were photographed: Jun 7, 2014—Mar 7, 2017

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

<table>
<thead>
<tr>
<th>Map Unit Symbol</th>
<th>Map Unit Name</th>
<th>Acres in AOI</th>
<th>Percent of AOI</th>
</tr>
</thead>
<tbody>
<tr>
<td>11D</td>
<td>Sogn silt loam, rocky, 6 to 30 percent slopes</td>
<td>1.4</td>
<td>0.5%</td>
</tr>
<tr>
<td>176</td>
<td>Garwin silt loam</td>
<td>1.5</td>
<td>0.5%</td>
</tr>
<tr>
<td>285B</td>
<td>Port Byron silt loam, 2 to 6 percent slopes</td>
<td>213.5</td>
<td>75.6%</td>
</tr>
<tr>
<td>285C</td>
<td>Port Byron silt loam, 6 to 12 percent slopes, moderately eroded</td>
<td>12.1</td>
<td>4.3%</td>
</tr>
<tr>
<td>301A</td>
<td>Lindstrom silt loam, 1 to 3 percent slopes</td>
<td>13.5</td>
<td>4.8%</td>
</tr>
<tr>
<td>401C</td>
<td>Mt. Carroll silt loam, 6 to 12 percent slopes, moderately eroded</td>
<td>1.6</td>
<td>0.6%</td>
</tr>
<tr>
<td>476D</td>
<td>Frankville silt loam, 12 to 18 percent slopes</td>
<td>0.8</td>
<td>0.3%</td>
</tr>
<tr>
<td>477</td>
<td>Littleton silt loam</td>
<td>2.6</td>
<td>0.9%</td>
</tr>
<tr>
<td>587D</td>
<td>Palsgrove silt loam, 12 to 20 percent slopes</td>
<td>0.0</td>
<td>0.0%</td>
</tr>
<tr>
<td>1830</td>
<td>Eitzen silt loam</td>
<td>33.6</td>
<td>11.9%</td>
</tr>
<tr>
<td>1857</td>
<td>Eitzen silt loam, channeled</td>
<td>1.7</td>
<td>0.6%</td>
</tr>
<tr>
<td><strong>Totals for Area of Interest</strong></td>
<td></td>
<td><strong>282.3</strong></td>
<td><strong>100.0%</strong></td>
</tr>
</tbody>
</table>

Map Unit Descriptions

The map units delineated on the detailed soil maps in a soil survey represent the soils or miscellaneous areas in the survey area. The map unit descriptions, along with the maps, can be used to determine the composition and properties of a unit.

A map unit delineation on a soil map represents an area dominated by one or more major kinds of soil or miscellaneous areas. A map unit is identified and named according to the taxonomic classification of the dominant soils. Within a taxonomic class there are precisely defined limits for the properties of the soils. On the landscape, however, the soils are natural phenomena, and they have the characteristic variability of all natural phenomena. Thus, the range of some observed properties may extend beyond the limits defined for a taxonomic class. Areas of soils of a single taxonomic class rarely, if ever, can be mapped without including areas of other taxonomic classes. Consequently, every map unit is made up of the soils or miscellaneous areas for which it is named and some minor components that belong to taxonomic classes other than those of the major soils.

Most minor soils have properties similar to those of the dominant soil or soils in the map unit, and thus they do not affect use and management. These are called noncontrasting, or similar, components. They may or may not be mentioned in a particular map unit description. Other minor components, however, have properties
and behavioral characteristics divergent enough to affect use or to require different management. These are called contrasting, or dissimilar, components. They generally are in small areas and could not be mapped separately because of the scale used. Some small areas of strongly contrasting soils or miscellaneous areas are identified by a special symbol on the maps. If included in the database for a given area, the contrasting minor components are identified in the map unit descriptions along with some characteristics of each. A few areas of minor components may not have been observed, and consequently they are not mentioned in the descriptions, especially where the pattern was so complex that it was impractical to make enough observations to identify all the soils and miscellaneous areas on the landscape.

The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The objective of mapping is not to delineate pure taxonomic classes but rather to separate the landscape into landforms or landform segments that have similar use and management requirements. The delineation of such segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, however, onsite investigation is needed to define and locate the soils and miscellaneous areas.

An identifying symbol precedes the map unit name in the map unit descriptions. Each description includes general facts about the unit and gives important soil properties and qualities.

Soils that have profiles that are almost alike make up a soil series. Except for differences in texture of the surface layer, all the soils of a series have major horizons that are similar in composition, thickness, and arrangement.

Soils of one series can differ in texture of the surface layer, slope, stoniness, salinity, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into soil phases. Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Alpha silt loam, 0 to 2 percent slopes, is a phase of the Alpha series.

Some map units are made up of two or more major soils or miscellaneous areas. These map units are complexes, associations, or undifferentiated groups.

A complex consists of two or more soils or miscellaneous areas in such an intricate pattern or in such small areas that they cannot be shown separately on the maps. The pattern and proportion of the soils or miscellaneous areas are somewhat similar in all areas. Alpha-Beta complex, 0 to 6 percent slopes, is an example.

An association is made up of two or more geographically associated soils or miscellaneous areas that are shown as one unit on the maps. Because of present or anticipated uses of the map units in the survey area, it was not considered practical or necessary to map the soils or miscellaneous areas separately. The pattern and relative proportion of the soils or miscellaneous areas are somewhat similar. Alpha-Beta association, 0 to 2 percent slopes, is an example.

An undifferentiated group is made up of two or more soils or miscellaneous areas that could be mapped individually but are mapped as one unit because similar interpretations can be made for use and management. The pattern and proportion of the soils or miscellaneous areas in a mapped area are not uniform. An area can be made up of only one of the major soils or miscellaneous areas, or it can be made up of all of them. Alpha and Beta soils, 0 to 2 percent slopes, is an example.
Some surveys include *miscellaneous areas*. Such areas have little or no soil material and support little or no vegetation. Rock outcrop is an example.
Winona County, Minnesota

11D—Sogn silt loam, rocky, 6 to 30 percent slopes

Map Unit Setting

National map unit symbol: gddf
Elevation: 1,000 to 1,500 feet
Mean annual precipitation: 30 to 38 inches
Mean annual air temperature: 43 to 50 degrees F
Frost-free period: 145 to 205 days
Farmland classification: Not prime farmland

Map Unit Composition

Sogn, rocky, and similar soils: 95 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Sogn, Rocky

Setting

Landform: Hills
Landform position (two-dimensional): Backslope, shoulder
Down-slope shape: Convex
Across-slope shape: Linear
Parent material: Residuum

Typical profile

Ap,A1,A2 - 0 to 15 inches: silt loam
2R - 15 to 19 inches: unweathered bedrock

Properties and qualities

Slope: 6 to 30 percent
Percent of area covered with surface fragments: 4.0 percent
Depth to restrictive feature: 4 to 20 inches to lithic bedrock
Natural drainage class: Somewhat excessively drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.57 to 1.98 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Very low (about 2.4 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 7s
Hydrologic Soil Group: D
Other vegetative classification: Rocky (G105XS019MN)
Hydric soil rating: No
176—Garwin silt loam

Map Unit Setting

National map unit symbol: gddj
Elevation: 700 to 1,400 feet
Mean annual precipitation: 30 to 38 inches
Mean annual air temperature: 43 to 50 degrees F
Frost-free period: 145 to 205 days
Farmland classification: Prime farmland if drained

Map Unit Composition

Garwin and similar soils: 95 percent
Estimates are based on observations, descriptions, and transects of the map unit.

Description of Garwin

Setting

Landform: Drainageways
Landform position (two-dimensional): Footslope, toeslope
Down-slope shape: Concave
Across-slope shape: Linear
Parent material: Loess

Typical profile

Ap - 0 to 9 inches: silt loam
A1,A2,A3,AB - 9 to 39 inches: silty clay loam
Bg,Cg - 39 to 60 inches: silt loam

Properties and qualities

Slope: 0 to 2 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Poorly drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.57 to 1.98 in/hr)
Depth to water table: About 0 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum in profile: 15 percent
Available water storage in profile: Very high (about 12.1 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 2w
Hydrologic Soil Group: B/D
Other vegetative classification: Level Swale, Neutral (G105XS001MN)
Hydric soil rating: Yes
285B—Port Byron silt loam, 2 to 6 percent slopes

**Map Unit Setting**
- **National map unit symbol:** 2wtrc
- **Elevation:** 560 to 1,740 feet
- **Mean annual precipitation:** 31 to 39 inches
- **Mean annual air temperature:** 41 to 50 degrees F
- **Frost-free period:** 120 to 190 days
- **Farmland classification:** All areas are prime farmland

**Map Unit Composition**
- **Port byron and similar soils:** 90 percent
- **Minor components:** 10 percent

Estimates are based on observations, descriptions, and transects of the map unit.

**Description of Port Byron**

**Setting**
- **Landform:** Ridges
- **Landform position (two-dimensional):** Summit, shoulder, backslope
- **Landform position (three-dimensional):** Interfluve, side slope
- **Down-slope shape:** Linear
- **Across-slope shape:** Concave, linear
- **Parent material:** Silty loess

**Typical profile**
- **Ap,A,AB - 0 to 15 inches:** silt loam
- **Bw - 15 to 43 inches:** silt loam
- **BC,C - 43 to 79 inches:** silt loam

**Properties and qualities**
- **Slope:** 2 to 6 percent
- **Depth to restrictive feature:** More than 80 inches
- **Natural drainage class:** Well drained
- **Capacity of the most limiting layer to transmit water (Ksat):** Moderately high to high (0.57 to 1.98 in/hr)
- **Depth to water table:** More than 80 inches
- **Frequency of flooding:** None
- **Frequency of ponding:** None
- **Available water storage in profile:** Very high (about 12.9 inches)

**Interpretive groups**
- **Land capability classification (irrigated):** None specified
- **Land capability classification (nonirrigated):** 2e
- **Hydrologic Soil Group:** B
- **Other vegetative classification:** Sloping Upland, Neutral (G105XS002MN)
- **Hydric soil rating:** No

**Minor Components**

**Biggsville**
- **Percent of map unit:** 5 percent
Landform: Ridges
Landform position (two-dimensional): Summit, shoulder
Landform position (three-dimensional): Interfluve, side slope
Down-slope shape: Linear
Across-slope shape: Concave
Other vegetative classification: Sloping Upland, Neutral (G105XS002MN)
Hydric soil rating: No

Dinsmore
Percent of map unit: 5 percent
Landform: Ridges
Landform position (two-dimensional): Summit, shoulder
Landform position (three-dimensional): Interfluve, side slope
Down-slope shape: Linear
Across-slope shape: Concave, convex
Other vegetative classification: Sloping Upland, Neutral (G105XS002MN)
Hydric soil rating: No

285C—Port Byron silt loam, 6 to 12 percent slopes, moderately eroded

Map Unit Setting
National map unit symbol: 2wtrd
Elevation: 560 to 1,740 feet
Mean annual precipitation: 31 to 39 inches
Mean annual air temperature: 41 to 50 degrees F
Frost-free period: 120 to 190 days
Farmland classification: Farmland of statewide importance

Map Unit Composition
Port byron, moderately eroded, and similar soils: 90 percent
Minor components: 10 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Port Byron, Moderately Eroded
Setting
Landform: Ridges
Landform position (two-dimensional): Shoulder, backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Linear
Across-slope shape: Concave, linear
Parent material: Silty loess

Typical profile
Ap,A,AB - 0 to 15 inches: silt loam
Bw - 15 to 43 inches: silt loam
BC,C - 43 to 79 inches: silt loam

Properties and qualities
Slope: 6 to 12 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.57 to 1.98 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Very high (about 12.9 inches)

Interpretive groups
Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 3e
Hydrologic Soil Group: B
Other vegetative classification: Sloping Upland, Neutral (G105XS002MN)
Hydric soil rating: No

Minor Components
Dinsmore
Percent of map unit: 5 percent
Landform: Ridges
Landform position (two-dimensional): Shoulder, backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Linear
Across-slope shape: Concave, convex
Other vegetative classification: Sloping Upland, Neutral (G105XS002MN)
Hydric soil rating: No

Biggsville
Percent of map unit: 5 percent
Landform: Ridges
Landform position (two-dimensional): Shoulder, backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Linear
Across-slope shape: Concave
Other vegetative classification: Sloping Upland, Neutral (G105XS002MN)
Hydric soil rating: No

301A—Lindstrom silt loam, 1 to 3 percent slopes

Map Unit Setting
National map unit symbol: gdfs
Mean annual precipitation: 30 to 38 inches
Mean annual air temperature: 43 to 50 degrees F
Frost-free period: 145 to 205 days
Farmland classification: All areas are prime farmland

Map Unit Composition
Lindstrom and similar soils: 95 percent
Estimates are based on observations, descriptions, and transects of the mapunit.
Description of Lindstrom

Setting
Landform: Hills
Landform position (two-dimensional): Footslope
Down-slope shape: Concave
Across-slope shape: Linear
Parent material: Loess and/or silty alluvium

Typical profile
Ap - 0 to 9 inches: silt loam
A1,A2 - 9 to 36 inches: silt loam
Bw1,Bw2 - 36 to 60 inches: silt loam

Properties and qualities
Slope: 1 to 3 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.57 to 1.98 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Very high (about 13.4 inches)

Interpretive groups
Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 1
Hydrologic Soil Group: B
Other vegetative classification: Sloping Upland, Neutral (G105XS002MN)
Hydric soil rating: No

401C—Mt. Carroll silt loam, 6 to 12 percent slopes, moderately eroded

Map Unit Setting
National map unit symbol: 2tc64
Elevation: 560 to 1,740 feet
Mean annual precipitation: 31 to 39 inches
Mean annual air temperature: 41 to 50 degrees F
Frost-free period: 120 to 190 days
Farmland classification: Farmland of statewide importance

Map Unit Composition
Mt. carroll, moderately eroded, and similar soils: 90 percent
Minor components: 10 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Mt. Carroll, Moderately Eroded
Setting
Landform: Ridges
Landform position (two-dimensional): Summit, shoulder
Landform position (three-dimensional): Side slope
Down-slope shape: Convex
Across-slope shape: Linear
Parent material: Loess

Typical profile
Ap - 0 to 8 inches: silt loam
Bt - 8 to 38 inches: silt loam
BC,C - 38 to 79 inches: silt loam

Properties and qualities
Slope: 6 to 12 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained
Runoff class: Medium
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.60 to 2.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Salinity, maximum in profile: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water storage in profile: Very high (about 12.7 inches)

Interpretive groups
Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 3e
Hydrologic Soil Group: B
Other vegetative classification: High AWC, adequately drained (G105XY008WI)
Hydric soil rating: No

Minor Components
Pepin, moderately eroded
Percent of map unit: 5 percent
Landform: Ridges
Landform position (two-dimensional): Summit, shoulder
Landform position (three-dimensional): Side slope
Down-slope shape: Convex
Across-slope shape: Linear
Other vegetative classification: High AWC, adequately drained (G105XY008WI)
Hydric soil rating: No

Seaton, moderately eroded
Percent of map unit: 5 percent
Landform: Ridges
Landform position (two-dimensional): Summit, shoulder
Landform position (three-dimensional): Side slope
Down-slope shape: Convex
Across-slope shape: Linear
Other vegetative classification: High AWC, adequately drained (G105XY008WI)
Hydric soil rating: No
476D—Frankville silt loam, 12 to 18 percent slopes

Map Unit Setting

National map unit symbol: gdgk
Elevation: 700 to 1,400 feet
Mean annual precipitation: 30 to 38 inches
Mean annual air temperature: 43 to 50 degrees F
Frost-free period: 145 to 205 days
Farmland classification: Not prime farmland

Map Unit Composition

Frankville and similar soils: 95 percent
Estimates are based on observations, descriptions, and transects of the map unit.

Description of Frankville

Setting

Landform: Hills
Landform position (two-dimensional): Backslope
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Loess over clayey residuum

Typical profile

Ap,Be - 0 to 7 inches: silt loam
Bt1,Bt2 - 7 to 25 inches: silt loam
2Bt3,2Bt4 - 25 to 35 inches: clay
2R - 35 to 45 inches: unweathered bedrock

Properties and qualities

Slope: 12 to 18 percent
Depth to restrictive feature: 20 to 40 inches to lithic bedrock
Natural drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately low (0.00 to 0.14 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Low (about 5.7 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 6e
Hydrologic Soil Group: C
Other vegetative classification: Sloping; Fine Texture (G105XS023MN)
Hydric soil rating: No
477—Littleton silt loam

Map Unit Setting
National map unit symbol: gdgl
Mean annual precipitation: 30 to 38 inches
Mean annual air temperature: 43 to 50 degrees F
Frost-free period: 145 to 205 days
Farmland classification: All areas are prime farmland

Map Unit Composition
Littleton and similar soils: 95 percent
Minor components: 2 percent
Estimates are based on observations, descriptions, and transects of the map unit.

Description of Littleton
Setting
Landform: Terraces
Landform position (two-dimensional): Footslope, toeslope
Down-slope shape: Concave
Across-slope shape: Linear
Parent material: Silty alluvium

Typical profile
Ap - 0 to 8 inches: silt loam
A - 8 to 35 inches: silt loam
Bw, C - 35 to 60 inches: silt loam

Properties and qualities
Slope: 0 to 2 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Somewhat poorly drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.57 to 1.98 in/hr)
Depth to water table: About 12 to 24 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Very high (about 13.2 inches)

Interpretive groups
Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 1
Hydrologic Soil Group: B/D
Other vegetative classification: Sloping Upland, Neutral (G105XS002MN)
Hydric soil rating: No

Minor Components
Garwin
Percent of map unit: 2 percent
Landform: Depressions
Hydric soil rating: Yes
587D—Palsgrove silt loam, 12 to 20 percent slopes

Map Unit Setting
National map unit symbol:  gdhb
Elevation:  650 to 1,350 feet
Mean annual precipitation:  30 to 38 inches
Mean annual air temperature:  43 to 50 degrees F
Frost-free period:  145 to 205 days
Farmland classification:  Not prime farmland

Map Unit Composition
Palsgrove and similar soils:  95 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Palsgrove

Setting
Landform:  Hills
Landform position (two-dimensional):  Backslope
Down-slope shape:  Linear
Across-slope shape:  Linear
Parent material:  Loess over residuum

Typical profile
Ap - 0 to 9 inches:  silt loam
Bt1,Bt2,Bt3 - 9 to 40 inches:  silty clay loam
2Bt4 - 40 to 48 inches:  clay
2R - 48 to 52 inches:  unweathered bedrock

Properties and qualities
Slope:  12 to 20 percent
Depth to restrictive feature:  40 to 60 inches to lithic bedrock
Natural drainage class:  Well drained
Capacity of the most limiting layer to transmit water (Ksat):  Very low to moderately low (0.00 to 0.14 in/hr)
Depth to water table:  More than 80 inches
Frequency of flooding:  None
Frequency of ponding:  None
Available water storage in profile:  Moderate (about 8.7 inches)

Interpretive groups
Land capability classification (irrigated):  None specified
Land capability classification (nonirrigated):  4e
Hydrologic Soil Group:  B
Other vegetative classification:  Sloping; Fine Texture (G105XS023MN)
Hydric soil rating:  No
1830—Eitzen silt loam

Map Unit Setting

- National map unit symbol: gddl
- Elevation: 700 to 1,340 feet
- Mean annual precipitation: 30 to 38 inches
- Mean annual air temperature: 43 to 50 degrees F
- Frost-free period: 145 to 205 days
- Farmland classification: All areas are prime farmland

Map Unit Composition

- Eitzen, occasionally flooded, and similar soils: 95 percent
- Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Eitzen, Occasionally Flooded

Setting

- Landform: Flood plains
- Down-slope shape: Linear
- Across-slope shape: Linear
- Parent material: Silty alluvium

Typical profile

- C - 0 to 28 inches: silt loam
- Ab - 28 to 47 inches: silt loam
- Bttb - 47 to 60 inches: silt loam

Properties and qualities

- Slope: 1 to 2 percent
- Depth to restrictive feature: More than 80 inches
- Natural drainage class: Well drained
- Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.57 to 1.98 in/hr)
- Depth to water table: About 24 to 36 inches
- Frequency of flooding: Occasional
- Frequency of ponding: None
- Available water storage in profile: Very high (about 12.9 inches)

Interpretive groups

- Land capability classification (irrigated): None specified
- Land capability classification (nonirrigated): 2w
- Hydrologic Soil Group: C
- Other vegetative classification: Sloping Upland, Acid (G105XS006MN)
- Hydric soil rating: No
1857—Eitzen silt loam, channeled

Map Unit Setting
National map unit symbol: gddm
Elevation: 700 to 1,340 feet
Mean annual precipitation: 30 to 38 inches
Mean annual air temperature: 43 to 50 degrees F
Frost-free period: 145 to 205 days
Farmland classification: Not prime farmland

Map Unit Composition
Eitzen, channeled, occasionally flooded, and similar soils: 95 percent
Estimates are based on observations, descriptions, and transects of the map unit.

Description of Eitzen, Channeled, Occasionally Flooded
Setting
Landform: Flood plains
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Silty alluvium

Typical profile
C - 0 to 28 inches: silt loam
Ab - 28 to 47 inches: silt loam
Btb - 47 to 60 inches: silt loam

Properties and qualities
Slope: 1 to 3 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.57 to 1.98 in/hr)
Depth to water table: About 24 to 36 inches
Frequency of flooding: Occasional
Frequency of ponding: None
Available water storage in profile: Very high (about 12.9 inches)

Interpretive groups
Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 5w
Hydrologic Soil Group: C
Other vegetative classification: Sloping Upland, Acid (G105XS006MN)
Hydric soil rating: No
References


Geotechnical Evaluation:

Proposed Liquid Manure Storage Structure
T106N R9W Section 16 NE ¼
Utica Township, Winona County, Minnesota

Prepared for:

Mr. Dennis Marquardt, Jr., PE
Tiry Engineering, Inc.

January 9, 2017
10091.16.MNR
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- Boring Location Sketch
- Log of Boring # 1-6
- Atterberg Limits
- Gradation Curves
- Standard Proctor Results
- Legend to Soil Description
Dear Mr. Marquardt,

As authorized, we performed soil borings at the site of the proposed earthen liquid manure storage area in Utica Township, Winona County, Minnesota. This brief report summarizes the results of our exploration.

A. Introduction

The intent of this report is to present our findings and describe the means used to collect the data. The data was collected for a specific purpose and may not be suitable for other purposes. We should be consulted before attempting to use the data for other uses. A complete and thorough review of the entire document, including its assumptions and its appendices, should be undertaken immediately upon receipt.

A.1. Scope

To provide data for analysis, a total of 6 penetration test borings were performed on site. The borings were drilled to depths of about 20 to 30 feet. Our scope included geotechnical recommendations for the proposed manure basin.

A.2. Boring Locations

The boring locations were indicated to Chosen Valley Testing by staking on site, provided by Tiry Engineering. The Boring Location Sketch in the Appendix shows the approximate locations as drilled. The ground surface elevations at the borings were also provided by Tiry Engineering.

A.3. Geologic Background

A geotechnical report is based on subsurface data collected for the specific structure or problem. Available geologic data from the region can help interpretation of the data and is briefly summarized in this section.

Geologic maps of the area indicate that the natural soils at the site are loessial (wind deposited) clays and silts overlying glacial till deposits of unsorted clay, silt, and sand mixtures. Bedrock is commonly within
50 feet of the surface and typically consists of dolomite with minor amounts of sandstone and shale of the Shakopee Formation.

**B. Exploration Results**

The borings were performed using penetration test procedures (Method of Test D1586 of the American Society for Testing and Materials). This procedure allows for the extraction of intact soil specimen from deep in the ground. With this method, a hollow-stem auger is drilled to the desired sampling depth. A 2-inch OD sampling tube is then screwed onto the end of a sampling rod, inserted through the hole in the auger’s tip, and then driven into the soil with a 140-pound hammer dropped repeatedly from a height of 30 inches above the sampling rod. The sampler is driven 18 inches into the soil, unless the material is too hard. The samples are generally taken at 2½ to 5-foot intervals. The core of soil obtained is classified and logged by the driller and a representative portion is then sealed and delivered to the soils engineer for review.

**B.1. Stratification**

At the surface, the borings encountered about 1½ feet of topsoil. The topsoil primarily consisted of slightly organic clay.

Beneath the topsoil, the borings came across loessial clay and silt to depths of about 10 to 14 feet, followed by glacial clays with 1 to 4-foot thick clayey/silty sand layers interbedded to termination depths around 21 to 31 feet below the surface.

The boring data has been summarized in the following cross-section. For more detailed information, please refer to the individual Log of Boring sheets in the Appendix.
B.2. Penetration and Laboratory Test Data

The number of blows needed for the hammer to advance the penetration test sampler is an indicator of soil characteristics. The number of blows to advance the sampler 1 foot is called the penetration resistance or “N”-value. The results tend to be more meaningful for natural mineral soils, than for fill soils. In fill soils, compaction tests are more meaningful.

Penetration resistance values ("N" Values) of 2 to 7 blows per foot (BPF) were recorded in the loessial clay and silt, indicating it was soft to medium, but was mostly soft to rather soft.

The glacial clays and clayey/silty sands returned values ranging from 6 BPF to 50 hammer blows for 2 inches of sampler advancement, indicating it was medium to hard or loose to very dense. These soils primarily became stiffer and denser with depth.

A key to the descriptors used to qualify the relative density of soil (such as soft, stiff, loose, and dense) can be found on the Legend to Soil Description in the Appendix.

A pocket penetrometer was used to provide additional data on the compressive strength of the cohesive soils. The loessial clays returned values of ¼ to 1 tons per square foot (tsf), while the loessial silt returned values of less than ¼ to ¼ tsf. The glacial clays returned values of 1 ¼ to greater than 4 ½ tsf.

B.3. Ground Water Data

Methods: During drilling, the drillers may note the presence of moisture on the sampler, in the cuttings, or in the borehole itself. These findings are reported on the boring logs. Because water levels vary with weather, time of year, and other factors, the presence or lack of water during exploration is subject to interpretation and is not always conclusive.

Water was observed in Borings B-1, B-2, B-3, B-4, and B-6 around 16 to 26 ½ feet below the surface during our exploration. The depths correspond near elevations 1180 to 1186 feet. The loessial clays found in the upper 14 feet were also mostly very wet. We would expect moisture to be capable of perching above the less permeable glacial clays. Due to the fine grained nature of the soils on site, long term water monitoring would be required with piezometers or wells to better determine groundwater levels on site. Water levels at the site are expected to fluctuate seasonally, similar to water levels in nearby creeks and rivers, as well as with local weather patterns.

The Winona County Soil Survey indicates that the Port Byron silt loam, 3 to 6 percent slopes is the dominant soil type at the site. The seasonally high water table for this soil is indicated as greater than 6½ feet below the surface.

C. Design Information

The proposed project consists of the construction of a liquid manure storage structure. We understand
the manure storage structure will be approximately 400-foot by 400-foot and 16 feet deep. It is assumed that the structure will have concrete as a primary liner and clay as a secondary liner. A provided site layout with general contours indicated that the bottom of the pit is planned near elevation 69.0 feet on the project datum, which is assumed to be near elevation 1191 feet.

D. Analysis of Data

D.1. Bedrock Considerations

According to the Minnesota Rules Chapter 7020, manure in a concrete lined pit must be kept at least 5 feet above soluble bedrock, with this rule further dependent on pit size, the use of additional liners, and other karst factors. Bedrock was not encountered within 21 to 31 feet below the surface or above elevations 1174 to 1178 feet.

The County Feedlot Officer or Minnesota Pollution Control Agency (MPCA) should be contacted to determine the type of preparations needed for this facility in consideration of the several factors involved.

D.2. Groundwater/De-Watering

Basin bottoms must be maintained above the water table or draintile should be installed to maintain water levels below the basin. Water was encountered in five of the six borings around elevations 1180 to 1186 feet. As a precaution, a draintile is recommended behind any concrete walls to prevent water problems and excess moisture from collecting behind below-grade walls.

D.3. Manure Storage Structure - Excavation

We recommend that the topsoil and any other organic materials be completely removed from below the basin bottom and berm areas prior to any mass grading. This is in an effort to prevent mixing of topsoil or organics with any on-site materials proposed to be used as fill. The topsoil and organic materials should not be used as structural fill below the manure pit or for the berms, but can be re-used as topsoil or as fill in green areas.

Grading plans were not provided but the provided layout indicated that berm tops are planned for elevation 85.0 feet on the project datum, which is assumed to be near elevation 1207 feet. It is assumed that cut and fill earthwork will take place on the site for grading. The loessial clays were very wet at the time of our exploration and will be very sensitive to disturbance if such conditions prevail at the time of construction. We recommend using a backhoe with a smooth-lipped bucket for excavating, in order to limit disturbance to the bearing soils, and to produce a smooth working surface. The backhoe should work from existing grades starting at one end of the site to the opposite end, in an effort to prevent tracking, rutting, or getting stuck in the supporting basin bottom soils which would require soil corrections.

It is recommended that geotechnical personnel from Chosen Valley Testing be retained to evaluate the
overall grading for conformance to the analyses and recommendations in this report. Subject to these observations, soil corrections or further recommendations may be deemed warranted.

D.4. Secondary Liner Recommendations

D.4.a. Clay Liner: The clays encountered on site are considered generally suitable for use as a secondary liner material, provided they are properly compacted and moisture conditioned.

Based on the data, the dominant materials available are expected to consist of loessial lean clay in the upper 6 ½ to 11 ½ feet on site and underlying glacial sandy clay, expected to be encountered on the south and possibly the east end of the site. The silty clay and silt do not meet MPCA Specifications for approved secondary liner material. The loessial clay and glacial sandy clay should be separated into stockpiles during excavation. This is intended, in part to prevent mixing of these materials if used as liner material. These two materials have very different compaction and stability characteristics, and mixing would create a material with highly variable compaction and permeability characteristics – which is not easily quantified and is more likely to result in a poor quality liner.

Clays present at basin bottom elevations must be excavated and recompressed to the full liner thickness to cut off any seams or zones of highly permeable soils (i.e. sands or gravels) while producing a uniform liner. Any over-sized material (cobbles and boulders) should also be removed from the liner zone and replaced with suitable material. We recommend clay liner material be moisture conditioned 1% to 5% above the optimum moisture level during compaction and should be compacted to about an average of 95% of the soils’ maximum standard Proctor density. As mentioned earlier, the loessial clays were very wet at the time of our exploration and will likely require drying to attain desired moisture and compaction levels. Compaction tests should be performed on the liner soils, to evaluate the moisture and compactive efforts. Moisture levels are far more critical than compaction, provided proper compactive effort is applied. We recommend obtaining samples after grading to confirm or evaluate the suitability of the completed liner.

After placement, the surface of the clay liner should not be allowed to dry to the point that fissures or cracks form as they would allow liquid to seep through the liner rapidly. Water trucks or other equipment may be required to keep the liner moisturized until it is covered. The liner should also be covered as soon as possible, to limit surface erosion due to run off.

D.5. Backfill and Earth Pressure Recommendations

D.5.a. Backfilling and Lateral Earth Pressure: The clays onsite are considered generally suitable for use as backfill behind walls, provided they are adequately compacted. To limit perimeter settlement as well as infiltration of water into the backfill, we recommend compacting all fill to 95% of its maximum standard Proctor density. The ground surface should be sloped away from the structure for drainage reasons and to prevent undue pressures on below-grade walls. If sands are used for backfilling, they should be capped with a layer of clay or pavement to discourage surface water from entering the backfill, and a perimeter draintile should be incorporated.
Earth pressures on the walls will depend on the material used, its compaction, drainage and slopes around the structure, along with the allowable deformation of the walls. Should the backfill behind below-grade walls consist of compacted clays, we suggest using an equivalent fluid pressure of 80 pcf for preliminary design. If sands are used as wall backfill, we recommend using an equivalent fluid pressure of 50 pcf. These values do not include a safety factor and would increase if they became saturated or water bearing.

The above values also assume that the backfill does not freeze. If the backfill can freeze, much higher pressures will result – particularly with regard to clayey and silty materials. This situation may be accommodated with a stiffer wall design, by insulation of the backfill (to prevent freezing), replacing the clay with non-frost-susceptible materials, or other measures.

**D.6. Construction Phase Testing**

The MPCA requires construction testing and inspection on all manure storage structures. Typical requirements would include:

- Evaluation of the natural soils after topsoil stripping and before placing any fill
- Compaction testing on fills used for embankments, subgrades, etc, and
- Review of the excavation for karst features.

Events of the last few years have intensified requirements for testing and inspection of the concrete slabs, footings, and walls of the manure storage structures. Testing of the concrete for air content and compressive strength are becoming normal requirements, as well as documentation of reinforcement, control joints, water stops, drain tile, etc. Although our firm provides such services, the necessity and extent of such services will need to be determined by consultation between the design consultant and the appropriate regulatory services.

**E. Level of Care**

The services provided for this project have been conducted in a manner consistent with that level of care and skill ordinarily exercised by members of the profession currently practicing in this area, under similar budget and time constraints. This is our professional responsibility. No other warranty, expressed or implied, is made.
F. Certification

I hereby certify that this report was prepared by me or under my direct supervision, and that I am a duly registered engineer under the laws of the State of Minnesota.

Devin M. Ehler, PE
Geotechnical Engineer
Registration Number 52649
Date: January 9, 2017
Appendix

Boring Location Sketch
Log of Boring # 1-6
Atterberg Limits
Gradation Curves
Standard Proctor Results
Legend to Soil Description
Boring Location Sketch
Proposed Liquid Manure Storage Structure
T106N R9W Section 16 NE ¼
Utica Twp., Winona Co., Minnesota
10091.16.MNR
### LOG OF BORING

**PROJECT:** 10091.16.MNR  
Design Phase Geotechnical Evaluation  
Proposed Earthen Liquid Manure Storage Area  
T106N R9W Section 16 NE 1/4  
Utica Twp, Winona Co, Minnesota

**BORING:** B-1  
**LOCATION:** See attached sketch

**DATE:** 11/4/2016  
**SCALE:** 1" = 4'

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<tr>
<th>Elev.</th>
<th>Depth</th>
<th>USCS Symbol</th>
<th>Description of Materials (ASTM D 2487/2488)</th>
<th>BPF</th>
<th>WL</th>
<th>Tests and Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>1196.6</td>
<td>0.0</td>
<td>CL</td>
<td>Slightly Organic LEAN CLAY, black. (Topsoil)</td>
<td></td>
<td></td>
<td>Ground surface elevation provided by Tiry Engineering.</td>
</tr>
<tr>
<td>1195.1</td>
<td>1.5</td>
<td>OL</td>
<td>LEAN CLAY, brown, wet to very wet, soft to rather soft. (Loess)</td>
<td>3</td>
<td></td>
<td>PP = 1.0 tsf</td>
</tr>
<tr>
<td>1190.1</td>
<td>6.5</td>
<td>CL</td>
<td>SILTY CLAY, gray, very wet, soft to rather soft. (Loess)</td>
<td>3</td>
<td></td>
<td>PP = 0.25 tsf</td>
</tr>
<tr>
<td>1185.1</td>
<td>11.5</td>
<td>CL</td>
<td>SANDY LEAN CLAY, trace gravel, brown with slight light gray mottling, wet, medium to rather stiff. (Glacial Till)</td>
<td>7</td>
<td></td>
<td>PP = 1.5 tsf, MC = 15.8%</td>
</tr>
<tr>
<td>1181.1</td>
<td>15.5</td>
<td>SM</td>
<td>SILTY SAND, fine grained, brown, water bearing, medium dense. (Glacial Till)</td>
<td>10</td>
<td></td>
<td>Water encountered around 16 feet during drilling. PP = 1.5 tsf</td>
</tr>
<tr>
<td>1180.1</td>
<td>16.5</td>
<td>CL</td>
<td>LEAN CLAY, gray to light gray, wet, very stiff. (Glacial Till)</td>
<td>29</td>
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<td>PP = 3.0 tsf</td>
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<tr>
<td>1175.6</td>
<td>21.0</td>
<td></td>
<td>End of boring. Boring sealed upon completion.</td>
<td>24</td>
<td></td>
<td>PP = 4.0 tsf, MC = 20.3%</td>
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## LOG OF BORING

### CHOOSEN VALLEY TESTING

**PROJECT:** 10091.16.MNR  
Design Phase Geotechnical Evaluation  
Proposed Earthen Liquid Manure Storage Area  
T106N R9W Section 16 NE 1/4  
Utica Twp, Winona Co, Minnesota

**BORING:** B-2  
**LOCATION:** See attached sketch  
**DATE:** 11/4/2016  
**SCALE:** 1" = 4'

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<th>Tests and Notes</th>
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<tr>
<td>1207.4</td>
<td>0.0</td>
<td>CL OL</td>
<td>Slightly Organic LEAN CLAY black. (Topsoil)</td>
<td></td>
<td></td>
<td>Ground surface elevation provided by Tirry Engineering.</td>
</tr>
<tr>
<td>1205.9</td>
<td>1.5</td>
<td>CL</td>
<td>LEAN CLAY brown, wet, rather soft. (Loess)</td>
<td>4</td>
<td></td>
<td>PP = 0.75 tsf</td>
</tr>
<tr>
<td>1200.9</td>
<td>6.5</td>
<td>ML</td>
<td>SILT brown, very wet to saturated, soft. (Loess)</td>
<td>2</td>
<td></td>
<td>PP &lt; 0.25 tsf</td>
</tr>
<tr>
<td>1195.9</td>
<td>11.5</td>
<td>CL</td>
<td>SANDY LEAN CLAY brown, wet, medium to very stiff. (Glacial Till)</td>
<td>8</td>
<td></td>
<td>PP = 1.5 tsf</td>
</tr>
<tr>
<td>1186.9</td>
<td>20.5</td>
<td>CL</td>
<td>POORLY-GRADED SAND with SILT medium grained, brown, water bearing, dense. (Glacial Outwash)</td>
<td>38</td>
<td></td>
<td>PP = 3.5 tsf</td>
</tr>
<tr>
<td>1185.9</td>
<td>21.5</td>
<td>SP SM CL</td>
<td>SANDY LEAN CLAY trace seams of sand, brown with slight light gray mottling, wet, hard. (Glacial Till)</td>
<td>50</td>
<td></td>
<td>Water encountered around 21.5 feet during drilling. PP &gt; 4.5 tsf</td>
</tr>
<tr>
<td>1177.5</td>
<td>29.9</td>
<td></td>
<td>Dark gray to light gray below 27 feet.</td>
<td>69</td>
<td></td>
<td>PP &gt; 4.5 tsf</td>
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<tr>
<td></td>
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<td>End of boring. Boring sealed upon completion.</td>
<td></td>
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</tr>
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* 18/27/50 = 3", PP > 4.5 tsf  
* 50 = 5" (set), PP > 4.5 tsf
## Log of Boring

### Project: 10091.16.MNR

- **Design Phase Geotechnical Evaluation**
- **Proposed Earthen Liquid Manure Storage Area**
- **T106N R9W Section 16 NE 1/4**
- **Utica Twp, Winona Co, Minnesota**

### Boring: B-3

#### Location:
See attached sketch

#### Date: 11/4/2016

#### Scale: 1" = 4'

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<th>WL</th>
<th>Tests and Notes</th>
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</thead>
<tbody>
<tr>
<td>1203.5</td>
<td>0.0</td>
<td>CL OL</td>
<td>Slightly Organic LEAN CLAY black. (Topsoil)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1202.0</td>
<td>1.5</td>
<td>CL</td>
<td>LEAN CLAY brown, wet to very wet, soft to rather soft. (Loess)</td>
<td>3</td>
<td></td>
<td>PP = 0.75 tsf</td>
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<tr>
<td>1197.0</td>
<td>6.5</td>
<td>CL ML</td>
<td>SILTY CLAY gray, very wet, rather soft to medium. (Loess)</td>
<td>5</td>
<td></td>
<td>PP = 0.25 tsf, MC = 24.8%</td>
</tr>
<tr>
<td>1192.0</td>
<td>11.5</td>
<td>CL</td>
<td>SANDY LEAN CLAY trace gravel and seams of sand, brown, wet, stiff to hard. (Glacial Till)</td>
<td>14</td>
<td></td>
<td>PP = 2.0 tsf</td>
</tr>
<tr>
<td>1184.5</td>
<td>19.0</td>
<td>SM</td>
<td>SILTY SAND fine grained, grayish brown, water bearing, dense. (Glacial Till)</td>
<td>38</td>
<td></td>
<td>PP = 4.0 tsf, MC = 15.3%</td>
</tr>
<tr>
<td>1182.0</td>
<td>21.5</td>
<td>CL</td>
<td>LEAN CLAY dark gray, wet, hard. (Glacial Till)</td>
<td>73</td>
<td></td>
<td>PP &gt; 4.5 tsf, MC = 14.2%</td>
</tr>
<tr>
<td>1178.1</td>
<td>25.4</td>
<td>SC</td>
<td>CLAYEY SAND fine grained, gray, moist, very dense. (Glacial Till)</td>
<td></td>
<td></td>
<td>* 22/50 = 5&quot;</td>
</tr>
</tbody>
</table>

- Ground surface elevation provided by Tiry Engineering.
- Water encountered around 19.5 feet during drilling.
### LOG OF BORING

**PROJECT:** 10091.16.MNR  
Design Phase Geotechnical Evaluation  
Proposed Earthen Liquid Manure Storage Area  
T106N R9W Section 16 NE 1/4  
Utica Twp, Winona Co, Minnesota

**BORING:** B-4

**LOCATION:**  
See attached sketch

**DATE:** 11/4/2016  
**SCALE:** 1" = 4'

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<th>Description of Materials (ASTM D 2487/2488)</th>
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<th>WL</th>
<th>Tests and Notes</th>
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<tr>
<td>1204.8</td>
<td>0.0</td>
<td>CL OL</td>
<td>Slightly Organic LEAN CLAY black. (Topsoil)</td>
<td></td>
<td></td>
<td>Ground surface elevation provided by Tiry Engineering.</td>
</tr>
<tr>
<td>1203.3</td>
<td>1.5</td>
<td>CL</td>
<td>LEAN CLAY brown, wet, medium. (Loess)</td>
<td>6</td>
<td></td>
<td>PP = 1.0 tsf</td>
</tr>
<tr>
<td>1198.3</td>
<td>6.5</td>
<td>CL ML</td>
<td>SILTY CLAY grayish brown, very wet, rather soft to medium. (Loess)</td>
<td>6</td>
<td></td>
<td>PP = 1.0 tsf</td>
</tr>
<tr>
<td>1190.8</td>
<td>14.0</td>
<td>CL</td>
<td>SANDY LEAN CLAY brown, wet, rather stiff to stiff. (Glacial Till)</td>
<td>11</td>
<td></td>
<td>PP = 2.0 tsf</td>
</tr>
<tr>
<td>1186.3</td>
<td>18.5</td>
<td>SM</td>
<td>SILTY SAND fine to medium grained, brown, water bearing, medium dense. (Glacial Till)</td>
<td>27</td>
<td></td>
<td>Water encountered around 18.5 feet during drilling.</td>
</tr>
<tr>
<td>1183.3</td>
<td>21.5</td>
<td>CL</td>
<td>LEAN CLAY dark gray, wet, hard. (Glacial Till)</td>
<td>38</td>
<td></td>
<td>PP &gt; 4.5 tsf, MC = 20.5%</td>
</tr>
<tr>
<td>1177.8</td>
<td>27.0</td>
<td>SC</td>
<td>CLAYEY SAND fine grained, gray, moist, very dense. (Glacial Till)</td>
<td>78</td>
<td></td>
<td>* 10/18/50 = 5&quot;</td>
</tr>
</tbody>
</table>
| 1173.8 | 31.0  |             | End of boring.  
Boring sealed upon completion. |     |    |     |
### Log of Boring

**Project:** 10091.16.MNR  
**Location:**  
**Date:** 11/4/2016  
**Scale:** 1" = 4'

<table>
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<tr>
<th>Elev.</th>
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<tr>
<td>+199.6</td>
<td>1.5</td>
<td>CL OL</td>
<td><strong>Slightly Organic LEAN CLAY</strong> black. (Topsoil)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>+194.6</td>
<td>6.5</td>
<td>CL</td>
<td><strong>LEAN CLAY</strong> brown, very wet, soft. (Loess)</td>
<td>2</td>
<td></td>
<td>PP = 0.5 tsf</td>
</tr>
<tr>
<td></td>
<td></td>
<td>ML</td>
<td><strong>SILT</strong> brown with light gray mottling, very wet, rather soft. (Loess)</td>
<td>3</td>
<td></td>
<td>PP = 0.5 tsf</td>
</tr>
<tr>
<td>1191.1</td>
<td>10.0</td>
<td>CL</td>
<td><strong>SANDY LEAN CLAY</strong> brown with light gray mottling, wet, medium. (Glacial Till)</td>
<td>4</td>
<td></td>
<td>PP = 0.25 tsf</td>
</tr>
<tr>
<td></td>
<td></td>
<td>SC</td>
<td><strong>CLAYEY SAND</strong> fine grained, brown, moist to wet, loose. (Glacial Till)</td>
<td>8</td>
<td></td>
<td>PP = 1.5 tsf</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>14</td>
<td></td>
<td>PP = 2.0 tsf</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>34</td>
<td></td>
<td>PP &gt; 4.5 tsf</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>26</td>
<td></td>
<td>PP &gt; 4.5 tsf</td>
</tr>
<tr>
<td></td>
<td></td>
<td>SC</td>
<td><strong>CLAYEY SAND</strong> fine grained, gray, slight iron staining, moist, very dense. (Glacial Till)</td>
<td>*</td>
<td></td>
<td>* 50 = 6&quot; (set)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>*</td>
<td></td>
<td>* 50 = 2&quot; (set)</td>
</tr>
</tbody>
</table>

Ground surface elevation provided by Tiry Engineering.

*50 = 6" (set)  
*50 = 2" (set)  
End of boring. Boring sealed upon completion.
## Log of Boring

### Project: 10091.16.MNR
Design Phase Geotechnical Evaluation
Proposed Earthen Liquid Manure Storage Area
T106N R9W Section 16 NE 1/4
Utica Twp, Winona Co, Minnesota

### Boring: B-6

#### Location:
See attached sketch

#### Date: 11/4/2016

#### Scale: 1" = 4'

<table>
<thead>
<tr>
<th>Depth</th>
<th>Description of Materials (ASTM D 2487/2488)</th>
<th>BPF</th>
<th>WL</th>
<th>Tests and Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>1206.7</td>
<td>Slightly Organic LEAN CLAY black. (Topsoil)</td>
<td></td>
<td></td>
<td>Ground surface elevation provided by Tiry Engineering.</td>
</tr>
<tr>
<td>1205.2</td>
<td>LEAN CLAY brown, wet to very wet, soft to rather soft. (Loess)</td>
<td>2</td>
<td></td>
<td>PP = 0.5 tsf</td>
</tr>
<tr>
<td>1204.7</td>
<td>Grayish brown and very wet below 7 feet.</td>
<td>4</td>
<td></td>
<td>PP = 0.5 tsf</td>
</tr>
<tr>
<td>1205.2</td>
<td>CLAYEY SAND fine grained, gray, slight iron staining, water bearing, very dense. (Glacial Till)</td>
<td></td>
<td></td>
<td>PP &gt; 4.5 tsf, MC = 10.4%</td>
</tr>
<tr>
<td>1184.7</td>
<td>SANDY LEAN CLAY trace gravel, brown, wet, stiff to very stiff. (Glacial Till)</td>
<td>16</td>
<td></td>
<td>PP = 2.0 tsf</td>
</tr>
<tr>
<td>1180.2</td>
<td>Seam of sand around 17.5 feet.</td>
<td>17</td>
<td></td>
<td>PP = 2.0 tsf</td>
</tr>
</tbody>
</table>
| 1176.8 | End of boring. Boring sealed upon completion. | + |  | Water encountered around 26.5 feet during drilling. *
|  | * 50 = 6" (set) |  |  | PP > 4.5 tsf |
|  | * 50 = 5" (set) |  |  | MC = 9.8% |

---

*Note: PP = 0.5 tsf, PP = 4.5 tsf, PP = 2.0 tsf.*
**Atterberg Limits' Results**

<table>
<thead>
<tr>
<th>Specimen Identification</th>
<th>LL</th>
<th>PL</th>
<th>PI</th>
<th>Fines</th>
<th>Classification</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>B-2</strong></td>
<td>7.5</td>
<td>29</td>
<td>20</td>
<td>9</td>
<td>LEAN CLAY CL</td>
</tr>
<tr>
<td><strong>B-2</strong></td>
<td>12.5</td>
<td>25</td>
<td>13</td>
<td>12</td>
<td>CLAYEY SAND SC</td>
</tr>
<tr>
<td><strong>B-3</strong></td>
<td>2.5</td>
<td>37</td>
<td>21</td>
<td>16</td>
<td>LEAN CLAY CL</td>
</tr>
<tr>
<td><strong>B-3</strong></td>
<td>7.5</td>
<td>27</td>
<td>20</td>
<td>7</td>
<td>SILTY CLAY CL-ML</td>
</tr>
</tbody>
</table>

**Project Information**

- **Project**: Proposed Earthen Liquid Manure Storage Area - T106N R9W Section 16 NE 1/4
- **Job No.**: 10091.16.MNR
- **Date**: 1/9/17

**Atterberg Limits**

- **Liquid Limit (LL)**
- **Plasticity Index (PI)**
- **Fines Content**

**Graph**

- The graph shows the relationship between liquid limit and plasticity index for various soil samples.
- Different symbols represent different specimens with their respective characteristics.
<table>
<thead>
<tr>
<th>Specimen Identification</th>
<th>Classification</th>
<th>COBBLER</th>
<th>GRAVEL</th>
<th>SAND</th>
<th>SILT OR CLAY</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>coarse</td>
<td>fine</td>
<td>coarse</td>
<td>medium</td>
</tr>
<tr>
<td>B-2</td>
<td>LEAN CLAY CL</td>
<td>7.5</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>B-2</td>
<td>CLAYEY SAND SC</td>
<td>12.5</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>B-3</td>
<td>LEAN CLAY CL</td>
<td>2.5</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>B-3</td>
<td>SILTY CLAY CL-ML</td>
<td>7.5</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Specimen Identification</th>
<th>D100</th>
<th>D60</th>
<th>D30</th>
<th>D10</th>
<th>%Gravel</th>
<th>%Sand</th>
<th>%Silt</th>
<th>%Clay</th>
</tr>
</thead>
<tbody>
<tr>
<td>B-2</td>
<td>7.5</td>
<td>9.50</td>
<td>0.02</td>
<td>0.007</td>
<td>0.2</td>
<td>2.8</td>
<td>70.7</td>
<td>26.3</td>
</tr>
<tr>
<td>B-2</td>
<td>12.5</td>
<td>19.00</td>
<td>0.16</td>
<td>0.014</td>
<td>2.2</td>
<td>48.7</td>
<td>25.0</td>
<td>24.0</td>
</tr>
<tr>
<td>B-3</td>
<td>2.5</td>
<td>4.75</td>
<td>0.02</td>
<td>0.004</td>
<td>0.0</td>
<td>2.5</td>
<td>64.9</td>
<td>32.5</td>
</tr>
<tr>
<td>B-3</td>
<td>7.5</td>
<td>4.75</td>
<td>0.02</td>
<td>0.011</td>
<td>0.0</td>
<td>2.6</td>
<td>77.4</td>
<td>19.9</td>
</tr>
</tbody>
</table>

PROJECT: Proposed Earthen Liquid Manure Storage Area - T106N R9W Section 16 NE 1/4

JOB NO. 10091.16.MNR

DATE 1/9/17

GRADATION CURVES
Chosen Valley Testing, Inc.
Job Number: 10091.16.MNR
Project: Daley Farm Liquid Manure Storage Structure
Utica Twp, Winona County, MN

Sample Number: B-2, 12.5'
Source: On Site
Soil Classification: CL Sandy Lean Clay
Test Method: Standard Method A (ASTM D 698)

Test Results
Maximum Dry Density: 112.3 PCF
Optimum Moisture: 12.2%

Curves of 100% Saturation
2.80
2.70
2.60
Job Number: 10091.16.MNR
Project: Daley Farm Liquid Manure Storage Structure
Utica Twp, Winona Co, MN

Sample Number: B-3, 2.5'
Source: On Site
Soil Classification: CL Lean Clay
Test Method: Standard Method A (ASTM D 698)

Test Results
Maximum Dry Density: 106.7 PCF
Optimum Moisture: 16.4 %
## UNIFIED SOIL CLASSIFICATION (ASTM D-2487/2488)

### MATERIAL TYPES

<table>
<thead>
<tr>
<th>Type</th>
<th>Criteria for Assigning Soil Group Names</th>
<th>Group Symbol</th>
<th>Soil Group Names &amp; Legend</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gravels</td>
<td>Clean Gravels</td>
<td>GW</td>
<td>Well-Graded Gravel</td>
</tr>
<tr>
<td></td>
<td>Gravels With Fines</td>
<td>GM</td>
<td>Silty Gravel</td>
</tr>
<tr>
<td></td>
<td>Sands with Fines</td>
<td>GC</td>
<td>Clayey Gravel</td>
</tr>
<tr>
<td>Fine-Grained Soils</td>
<td>Inorganic</td>
<td>SM</td>
<td>Silty Sand</td>
</tr>
<tr>
<td></td>
<td>Organic</td>
<td>SC</td>
<td>Clayey Sand</td>
</tr>
<tr>
<td>Fine-Grained Soils</td>
<td>Organic + 5% Fines</td>
<td>OL</td>
<td>Organic Clay or Silt</td>
</tr>
<tr>
<td></td>
<td>Inorganic</td>
<td>OH</td>
<td>Organic Clay or Silt</td>
</tr>
<tr>
<td>Highly Organic Soils</td>
<td></td>
<td>PT</td>
<td>Peat</td>
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</table>

### Relative Proportions of Sand and Gravel

<table>
<thead>
<tr>
<th>Term</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Trace</td>
<td>&lt; 15</td>
</tr>
<tr>
<td>With</td>
<td>15 - 29</td>
</tr>
<tr>
<td>Modifier</td>
<td>&gt; 30</td>
</tr>
</tbody>
</table>

### Relative Proportions of Fines

<table>
<thead>
<tr>
<th>Term</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Trace</td>
<td>&lt; 5</td>
</tr>
<tr>
<td>With</td>
<td>5 - 12</td>
</tr>
<tr>
<td>Modifier</td>
<td>&gt; 12</td>
</tr>
</tbody>
</table>

### Grain Size Terminology

<table>
<thead>
<tr>
<th>Term</th>
<th>Size</th>
</tr>
</thead>
<tbody>
<tr>
<td>Boulder</td>
<td>&gt; 12 in.</td>
</tr>
<tr>
<td>Cobble</td>
<td>3 in. - 12 in.</td>
</tr>
<tr>
<td>Gravel</td>
<td>#4 sieve to 3 in.</td>
</tr>
<tr>
<td>Sand</td>
<td>#200 sieve to #4 sieve</td>
</tr>
<tr>
<td>Silt or Clay</td>
<td>Passing #200 sieve</td>
</tr>
</tbody>
</table>

### SAMPLE TYPES

- Hollow Stem
- Standard Penetration Test

### TEST SYMBOLS

- LL - Liquid Limit
- OC - Organic Content
- PI - Plasticity Index
- CN - Consolidation
- DD - Dry Density
- PP - Pocket Penetrometer
- RV - R-value
- SA - Sieve Analysis
- UU - Unconsolidated Undrained Triaxial

### Penetration Resistance

**Sand & Gravel**

<table>
<thead>
<tr>
<th>Relative Density</th>
<th>Consistency</th>
<th>BLOWS/FOOT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Very Loose</td>
<td></td>
<td>0 - 4</td>
</tr>
<tr>
<td>Loose</td>
<td></td>
<td>4 - 10</td>
</tr>
<tr>
<td>Medium Dense</td>
<td></td>
<td>10 - 30</td>
</tr>
<tr>
<td>Dense</td>
<td></td>
<td>30 - 50</td>
</tr>
<tr>
<td>Very Dense</td>
<td></td>
<td>Over 50</td>
</tr>
</tbody>
</table>

**Silt & Clay**

<table>
<thead>
<tr>
<th>Relative Density</th>
<th>Consistency</th>
<th>BLOWS/FOOT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Very Loose</td>
<td></td>
<td>0 - 1</td>
</tr>
<tr>
<td>Soft</td>
<td></td>
<td>1 - 2</td>
</tr>
<tr>
<td>Rather Soft</td>
<td></td>
<td>2 - 3</td>
</tr>
<tr>
<td>Medium</td>
<td></td>
<td>3 - 4</td>
</tr>
<tr>
<td>Rather stiff</td>
<td></td>
<td>4 - 5</td>
</tr>
<tr>
<td>Stiff</td>
<td></td>
<td>5 - 6</td>
</tr>
<tr>
<td>Very stiff</td>
<td></td>
<td>6 - 8</td>
</tr>
<tr>
<td>Hard</td>
<td></td>
<td>Over 8</td>
</tr>
</tbody>
</table>

**Compressive Strength (TSF)**

<table>
<thead>
<tr>
<th>Consistency</th>
<th>BLOWS/FOOT</th>
<th>COMPRESSIVE STRENGTH (TSF)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* Number of BLOWS of 140 lb hammer falling 30 inches to drive a 2 inch O.D. (1.28 inch [3.2 cm]) split-barrel sampler the last 12 inches of an 18-inch drive (ASTM-1586 Standard Penetration Test).

---

**Chosen Valley Testing, Inc.**

Job No. 10091.16.MNR

**Legend to Soil Descriptions**

- **CL** - VERY LOOSE
- **ML** - SOFT
- **CH** - MEDIUM DENSE
- **CL** - MEDIUM
- **CL** - DENSE
- **CL** - VERY DENSE
- **ML** - SOFT
- **CH** - MEDIUM DENSE
Geotechnical Evaluation:

Proposed Manure Pit, Feed Bunker, and Barn
T106N R9W Section 16 NE ¼
Utica Township, Winona County, Minnesota

Prepared for:

Daley Farms
c/o: Mr. Dennis Marquardt, Jr., PE
Oak Ridge Engineering, Inc.

August 4, 2017
11566.17.MNR
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Boring Location Sketch
Log of Boring #1-9
Legend to Soil Description
Chosen Valley Testing, Inc.

Geotechnical Engineering and Testing • 1410 7th St. NW • Rochester, MN 55901 • Telephone (507) 281-0968 • Fax (507) 286-2523

Mr. Dennis Marquardt, Jr, PE
Senior Engineer
Oak Ridge Engineering, Inc.
220 ½ North Bridge Street
PO Box 44
Chippewa Falls, WI 54729
dennis@oakridgeeng.com

August 4, 2017

Re: Geotechnical Evaluation
Proposed Manure Pit, Feed Bunker, and Barn
T106N R9W Section 16 NE ¾
Utica Twp., Winona Co., Minnesota
CVT Project Number: 11566.17.MNR

Dear Mr. Marquardt,

As authorized, we performed soil borings at the site of the proposed manure pit, feed bunker, and barn at the Daley Farm in Utica Township, Winona County, Minnesota. This brief report summarizes the results of our exploration.

A. Introduction

The intent of this report is to present our findings and describe the means used to collect the data. The data was collected for a specific purpose and may not be suitable for other purposes. We should be consulted before attempting to use the data for other uses. A complete and thorough review of the entire document, including its assumptions and its appendices, should be undertaken immediately upon receipt.

A.1. Scope

To provide data for analysis, a total of 9 penetration test borings were performed on site. The borings were drilled to depths of about 6 to 26 feet. Our scope included geotechnical recommendations for the proposed manure pit, feed bunker, and barn.

A.2. Boring Locations

The desired boring locations were indicated to Chosen Valley Testing on a site plan and by GPS coordinates, provided by the client. The borings were located in the field using a handheld GPS device. The Boring Location Sketch in the Appendix shows the approximate locations as drilled. The ground surface elevations at the borings were also provided by the Client.
A.3. Geologic Background

A geotechnical report is based on subsurface data collected for the specific structure or problem. Available geologic data from the region can help interpretation of the data and is briefly summarized in this section.

Geologic maps of the area indicate that the natural soils at the site are loessial (wind deposited) clays and silts overlying glacial till deposits of unsorted clay, silt, and sand mixtures. Bedrock is commonly within 50 feet of the surface and typically consists of dolomite with minor amounts of sandstone and shale of the Shakopee Formation.

B. Exploration Results

The borings were performed using penetration test procedures (Method of Test D1586 of the American Society for Testing and Materials). This procedure allows for the extraction of intact soil specimen from deep in the ground. With this method, a hollow-stem auger is drilled to the desired sampling depth. A 2-inch OD sampling tube is then screwed onto the end of a sampling rod, inserted through the hole in the auger's tip, and then driven into the soil with a 140-pound hammer dropped repeatedly from a height of 30 inches above the sampling rod. The sampler is driven 18 inches into the soil, unless the material is too hard. The samples are generally taken at 2½ to 5-foot intervals. The core of soil obtained is classified and logged by the driller and a representative portion is then sealed and delivered to the soils engineer for review.

B.1. Stratification

B.1.a. Manure Storage Area: At the surface, the borings for the proposed manure storage pit encountered about 1½ to 2 feet of topsoil. The topsoil primarily consisted of slightly organic clay.

Beneath the topsoil, the borings came across loessial clay and silt to depths of about 6½ to 12 feet. The loess was followed by clayey/silty sand in the northern borings to approximately 9 feet, while the southwestern boring met glacial clay to about 18 feet, over clayey/silty sand to around 21 feet.

At depth, the borings encountered weathered dolomite below 9, 12, and 21-foot depths, until terminating due to refusal of auger advancement around 9½ to 22½ feet below the surface at the locations explored.

The boring data has been summarized in the following cross-section on the next page and has been arranged by general location. For more detailed information, please refer to the individual Log of Boring sheets in the Appendix.
B.1.b. Feed Bunker Area: At the surface, the borings for the proposed feed storage bunker encountered about 1 to 1 ½ feet of topsoil. The topsoil primarily consisted of slightly organic clay.

Beneath the topsoil, the borings came across loessial clay and silt to termination depths around 8 ½ to 11 feet below the surface.

The boring data has been summarized in the following cross-section. For more detailed information, please refer to the individual Log of Boring sheets in the Appendix.
B.1.c. Barn Area: At the surface, the borings for the proposed free-stall parlor barn encountered about 1½ to 2 feet of topsoil. The topsoil primarily consisted of slightly organic clay.

Beneath the topsoil, the borings came across loessial clay and silt to depths of about 11½ to 14 feet, followed by glacial clay to approximately 21 to 21½ feet. A 2½-foot layer of clayey sand was met in the northern boring around 17½ feet and this boring also came across clean sand following the glacial clay to a termination depth around 26 feet.

The boring data has been summarized in the following cross-section. For more detailed information, please refer to the individual Log of Boring sheets in the Appendix.

![Barn Area Cross-Section Diagram]

**B.2. Penetration and Laboratory Test Data**

The number of blows needed for the hammer to advance the penetration test sampler is an indicator of soil characteristics. The number of blows to advance the sampler 1 foot is called the penetration resistance or "N"-value. The results tend to be more meaningful for natural mineral soils, than for fill soils. In fill soils, compaction tests are more meaningful.

Penetration resistance values ("N" Values) of 2 to 14 blows per foot (BPF) were recorded in the loessial clay and silt, indicating they were soft to stiff, but they were mostly soft to rather soft.

The clayey/silty sands returned values ranging from 15 to 37 BPF, indicating they were medium dense to dense. The glacial clays returned N-values of 10 to 75 BPF, indicating it was rather stiff to hard. Resistance values of 40 to 53 BPF were recorded in the clean sand, indicating it was dense to very dense.
The weathered dolomite returned 50 hammer blows for 1 to 4 inches of sampler advancement, indicating it was very dense.

A key to the descriptors used to qualify the relative density of soil (such as soft, stiff, loose, and dense) can be found on the Legend to Soil Description in the Appendix.

A pocket penetrometer was used to provide additional data on the compressive strength of the cohesive soils. The loessial clay and silt returned values of ¾ to 1 ¾ tons per square foot (tsf), while the glacial clays returned values of 1 to greater than 4 ½ tsf.

B.3. Groundwater Data

Methods: During drilling, the drillers may note the presence of moisture on the sampler, in the cuttings, or in the borehole itself. These findings are reported on the boring logs. Because water levels vary with weather, time of year, and other factors, the presence or lack of water during exploration is subject to interpretation and is not always conclusive.

Water was observed in Boring B-8 around 24 feet below the surface during our exploration. The depth correspond near elevations 1182 feet. The loessial soil samplers found in the upper 6 ½ to 14 feet were also mostly very wet. We would expect moisture to be capable of perching above the less permeable glacial clays and bedrock. Due to the dominant fine grained nature of the soils on site, long term water monitoring would be required with piezometers or wells to better determine groundwater levels on site. Water levels at the site are expected to fluctuate seasonally with local weather patterns and similar to water levels in nearby creeks and rivers.

The Winona County Soil Survey indicates that the Port Byron silt loam, 3 to 6 percent slopes, Lindstrom silt loam, 1 to 3 percent slopes, and Eitzen silt loam are the dominant soil types at the site. The seasonally high water tables for these soil are indicated as 2 ½ to greater than 6½ feet below the surface.

C. Design Information

The proposed project consists of the construction of a liquid manure storage structure, feed storage bunker, and free-stall parlor barn. We estimate the manure storage structure will be approximately 250-foot by 240-foot and 16 feet deep. It is assumed that the structure will have concrete as a primary liner and clay as a secondary liner. The bottom of the pit is understood to be planned for around elevation 1172 feet.

The feed storage bunker is understood to be planned to have an asphalt surface and is estimated to have dimensions of approximately 550-foot by 440-foot from the site layout. Surface grades are preliminarily planned for around 1210 feet on the southwest corner to about 1197 feet on the northeast corner.

The free-stall barn is understood the have dimensions of approximately 836 feet long by 435 feet wide. Final grades are understood to be planned near elevation 1207 feet on the south end and 1203 feet on the north end.
D. LMSA Recommendations

D.1. Bedrock Considerations

According to the Minnesota Rules Chapter 7020, manure in a concrete lined pit must be kept at least 5 feet above soluble bedrock, with this rule further dependent on pit size, the use of additional liners, and other karst factors. Weathered dolomite was encountered around 9 to 21 feet below the surface or near elevations 1169 ½ to 1175 feet.

With the boring data, weathered dolomite would be anticipated to be encountered at or within 5 feet of the proposed pit bottom elevation of 1172 feet. Therefore, the pit bottom would need to be raised to at least 1185 feet, with the number of animal units and other karst factors needing to be taken into account for required separation to bedrock.

The County Feedlot Officer or Minnesota Pollution Control Agency (MPCA) should be contacted to determine the type of preparations needed for this facility in consideration of the several factors involved.

D.2. Groundwater/De-Watering

Basin bottoms must be maintained above the water table or drain tile should be installed to maintain water levels below the basin. Free water was not encountered in the LMSA borings during our exploration, but the overlying loessial soils were very wet. The Fillmore County Soil Survey also indicates that the Eitzen Silt Loam along the waterways on the north and east edges of the site has a seasonally high water table around 2 ½ feet below the surface. Therefore, drain tile is recommended to prevent water problems and excess moisture from collecting behind below-grade walls and slabs.

D.3. Manure Storage Structure - Excavation

We recommend that the topsoil and any other organic materials be completely removed from below the basin bottom and berm areas prior to any mass grading. This is in an effort to prevent mixing of topsoil or organics with any on-site materials proposed for use as fill. The topsoil and organic materials should not be used as structural fill below the manure pit or for the berms, but can be re-used as topsoil or as fill in green areas.

Preliminary grading plans indicate that berm tops are planned to be about 16 feet above the proposed pit bottom. It is assumed that cut and fill earthwork will take place on the site for grading. As previously mentioned, the proposed pit bottom will be need to be raised to attained required separation to soluble bedrock. The loessial soils found near the surface on site were very wet at the time of our exploration and will be extremely sensitive to disturbance if such conditions prevail at the time of construction. We recommend using a backhoe with a smooth-lined bucket for excavating, in order to limit disturbance to the bearing soils, and to produce a smooth working surface. The backhoe should work from existing grades starting at one end of the site to the opposite end, in an effort to prevent tracking, rutting, or
getting stuck in the supporting basin bottom soils which would then require soil corrections if they were to become unstable.

It is recommended that geotechnical personnel from Chosen Valley Testing be retained to evaluate excavations and the overall grading for conformance to the analyses and recommendations in this report. Subject to these observations, soil corrections or further recommendations may be deemed warranted.

D.4. Secondary Liner Recommendations

D.4.a. Clay Liner: The clays encountered on site are considered generally suitable for use as a secondary liner material, provided they are properly compacted and moisture conditioned.

Based on the exploration data, the dominant materials available are expected to consist of loessial lean clay in the upper 6 ½ feet at the proposed pit location and possibly some glacial sandy clay, depending on excavation depth. The silt does not meet MPCA Specifications for approved secondary liner material. The loessial clay and glacial sandy clay should be separated into stockpiles during excavation. This is intended, in part to prevent mixing of these materials if used as liner material. These two materials have very different compaction and stability characteristics, and mixing would create a material with highly variable compaction and permeability characteristics – which is not easily quantified and is more likely to result in a poor quality liner.

Clays present at basin bottom elevations must still be excavated and recompacted to the full liner thickness to cut off any seams or zones of highly permeable soils (i.e. sand or gravels seams, lenses, or layers) while producing a uniform liner. Any over-sized material (cobbles and boulders) should be removed from the liner zone and replaced with suitable material. We recommend clay liner material be moisture conditioned 1% to 5% above the optimum moisture level during compaction and should be compacted to about an average of 95% of the material's maximum standard Proctor density. As mentioned earlier, the loessial clays were very wet at the time of our exploration and will likely require some drying to attain desired moisture and compaction levels. Compaction tests should be performed on the liner soils, to evaluate the moisture and compactive efforts. Moisture levels are far more critical than compaction, provided proper compactive effort is applied. We recommend obtaining samples after grading to confirm or evaluate the suitability of the completed liner.

After placement, the surface of the clay liner should not be allowed to dry to the point that fissures or cracks form as they would allow liquid to seep through the liner more readily. Water trucks or other equipment may be required to keep the liner moisturized until it is covered. The liner should also be covered as soon as possible, to limit surface erosion due to run off.

D.5. Backfill and Earth Pressure Recommendations

D.5.a. Backfilling and Lateral Earth Pressure: The clays onsite are considered generally suitable for use as backfill behind walls, provided they are adequately compacted. To limit perimeter settlement as well as infiltration of water into the backfill, we recommend compacting all fill to 95% of its maximum standard Proctor density. The ground surface should be sloped away from the structure for drainage
reasons and to prevent undue pressures on below-grade walls. If sands are used for backfilling, they should be capped with a layer of clayey topsoil or pavement to discourage surface water from entering the backfill, and a perimeter drain tile should be incorporated.

Earth pressures on the walls will depend on the material used, its compaction, drainage and slopes around the structure, along with the allowable deformation of the walls. Should the backfill behind below-grade walls consist of compacted clays, we suggest using an equivalent fluid pressure of 80 pounds per cubic foot (pcf) for preliminary design. If sands are used as wall backfill, we recommend using an equivalent fluid pressure of 50 pcf. These values do not include a safety factor and would increase if they became saturated or water bearing.

The above values also assume that the backfill does not freeze. If the backfill can freeze, much higher pressures will result – particularly with regard to clayey and silty materials. This situation may be accommodated with a stiffer wall design, by insulation of the backfill (to prevent freezing), replacing the clay with non-frost-susceptible materials, or other measures.

D.6. Construction Phase Testing

The MPCA requires construction testing and inspection on all manure storage structures. Typical requirements would include:

- Evaluation of the natural soils after topsoil stripping and before placing any fill
- Compaction testing on fills used for embankments, subgrades, etc., and
- Review of the excavation for karst features.

Events of the last few years have intensified requirements for testing and inspection of the concrete slabs, footings, and walls of the manure storage structures. Testing of the concrete for air content and compressive strength are becoming normal requirements, as well as documentation of reinforcement, control joints, water stops, drain tile, etc. Although our firm provides such services, the necessity and extent of such services will need to be determined by consultation between the design consultant and the appropriate regulatory services.

E. Feed Storage Bunker Recommendations

E.1. Stripping and Grading

We recommend stripping and removing the topsoil and any deeper organics or root zone from areas planned to receive fill and/or pavement. The topsoil was about 1 to 1½ feet thick at the locations explored for the proposed bunker.

After stripping, the near-surface soils are expected to consist primarily of loessial clay and silt. Subgrades should be scarified and compacted in order to even out any localized discontinuities in the subgrade soils and provide a more gradational transition between differing materials. It appears that on
the order of 10 feet of fill will be required on the northeast portion of the bunker. We assume that the onsite materials are desired to be used and fill.

The loessial clay and silt on site will be difficult to place and properly compact due to their extreme sensitivity to moisture. If these materials are overly wet at the time of grading, they will likely be very unstable, but if they are too dry at the time of compaction, they could also result in unusual long term settlement after the soils are naturally rehydrated. For ease of construction, clean sand or gravel could be imported for use as fill, but economically this is not anticipated to be feasible.

It is recommended that geotechnical personnel from Chosen Valley Testing be retained for full-time or frequent testing to assure the proper placement and compaction of the fill materials below planned pavements.

The surface of the soils directly below new pavements should be compacted to at least 95% of the soil’s standard Proctor density and should be capable of passing a test roll with a tandem axle truck. Soft areas revealed by the test roll will require stabilization. Again, loessial soils will be sensitive to disturbance if exposed to excessive moisture and heavy traffic during construction. Typical stabilization efforts consist of limited soil corrections, thicker pavement sections, and/or extra breaker run or geotextile fabric to strengthen the subgrade. More technical methods, such as fly ash or lime stabilization could also be considered but would likely be more costly.

### F.2. Pavement Design

As mentioned, loessial clay and silt dominated the areas planned for pavements. Based on this, we recommend designing pavements using support values with the following estimated parameters:

<table>
<thead>
<tr>
<th>Soil Type</th>
<th>AASHTO Classification</th>
<th>Frost Index</th>
<th>Design Group Index</th>
<th>K-Value</th>
<th>Soil Support Factor</th>
<th>Est. California Bearing Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>Clay and Silt</td>
<td>A-4/A-6</td>
<td>F-3</td>
<td>15</td>
<td>125</td>
<td>3.8</td>
<td>5 or less</td>
</tr>
</tbody>
</table>

### F. Free-stall Barn Recommendations

#### F.1. Discussion:

Based on the boring data from the free-stall barn area, the soils at footing grade are anticipated to consist of soft, very wet, and compressible loessial clay and silt. On the order of 5 feet of fill is also expected to be required to attain desired floor elevation in the east-central barn area. Load from the fill material and foundations bearing directly on the loessial soils are expected to result in settlement greater than normal desired structure movement limits.
In order to limit settlements, we recommend preloading the barn area by grading the site to final grades and then pausing construction for 2 to 3 weeks to allow consolidation and settlement to occur prior to the placement of foundations.

Settlement beyond the normal desired limits of 1 inch or less total settlement and ½ inch differential settlement is expected to occur in areas. However, if this free-stall barn is planned to be a pole type structure and no sheet rock or paneling is planned, then larger than normal settlement are likely more tolerable. Differential settlement is normally the controlling factor of foundation performance which is expected to be on the order of 2½ inches or less. Lambe and Whitman’s 1969 “Soil Mechanics” text provides empirical allowable maximum total settlement, tilting, and differential settlement in Table 14.1, which states allowable maximum total settlement for framed structures is about 2 to 4 inches, allowable tilting for drainage floors is about 1% to 2% of the length, and allowable differential settlement for reinforced-concrete building frame and curtain walls is about 0.25% to 0.4% of the length. Based on these values and our analyses, settlements are expected to be within allowable tolerance values stated above.

If the clays are overly wet and/or soft at the time of construction, a stabilizing layer of sand or gravel will likely be needed below footings. A 1 to 2-foot layer of sand or gravel would be expected to provide a firm base.

We recommend that personnel form Chosen Valley Testing be retained to observe and evaluate subgrades and excavation to confirm soils match our expectations in this report. During this evaluation it will be determined whether a stabilizing layer of sand or gravel is recommended.

F.2. Grading Recommendations

F.2.a. Stripping / Excavation: The topsoil is not considered suitable for support and should be completely removed from the building area, along with any other organics, deeper root zones, or otherwise deleterious materials that may be discovered during construction. The topsoil was about 1 ½ to 2 feet at the locations explored in the barn area.

F.2.b. Oversizing: Any corrective excavations should be oversized at least 1-foot beyond the edge of the foundations for each foot of fill needed below footing grade. This over-sizing can be reduced by up to 50% if rather precise staking is present during grading and the excavation limits can be rather precisely confirmed relative to the foundations. However, additional oversizing provides the Owner some protection against stakes getting moved or knocked down or slight repositioning of the building after soil corrections.

F.2.c. Filling and Compaction: All fill should be compacted to a minimum of 95% of its maximum standard Proctor density (ASTM D 698). For ease in compaction, we recommend using imported sand or gravel having less than 13% particles passing a number 200 sieve, as engineered structural fill. The onsite clay, aggregate base, limestone screenings, crushed sandstone, or similar materials could also be
considered for use as fill upon evaluation, but will require more stringent moisture control during compaction.

If floors will have coverings that are less permeable than concrete, the upper 4 to 6 inches of subgrade is recommended to have less than 5% particles passing a number 200 sieve.

F.3. Building Design

F.3.a. Foundation Depth: For frost protection, we recommend that foundations for unheated structures bear on soils at least 60 inches below the exposed ground surface. Exterior footings for heated structures should be placed at least 42 inches below the surface while interior footings for heated structures can be placed directly below slabs.

F.3.b. Bearing Capacity and Settlement: With assumed foundation loads, design data, and implementation of our earthwork recommendations, we are of the opinion that foundations may be designed to exert bearing pressures up to 1,500 pounds per square foot (psf). This allowable bearing capacity includes a safety factor of at least 3 against shear failure.

Based on the information above, total post-construction settlement of footings is expected to be on the order of 3 inch or less. Differential settlement is expected to be on the order of 2 ½ inches or less between similarly loaded footings.

F.3.c. Vapor Barrier and Drainage: If the slab will receive coverings that are less permeable than concrete, a vapor barrier should be placed below the slab. Some contractors prefer to place this barrier below sand, to limit the potential for curling.

F.3.d. Slab Design: If the completed slab subgrade consists of clay, we recommend using a modulus of subgrade reaction of up to 125 pounds per cubic inch (pci). If the subgrade consists of clean sand fill, a modulus of up to 200 pci may be used.

G. General Grading Recommendations

G.1. Excavation

The earthwork corrections can likely be accomplished with a variety of equipment provided the soils are dry. Standard tire vehicles would have difficulty traveling across the clayey/silty soils if they are overly wet. The loessial clay and silt found near the surface on site was very wet and soft at the time of our exploration. A backhoe with a smooth-lined bucket is recommended for excavations to prevent disturbance and instability of supporting soils while also providing a level working surface.

G.2. Dewatering

Water was encountered around 24 feet below the surface in the northern barn boring. Based on the
boring data, water is not expected to be encountered during construction. Any seepage or precipitation that may pond in excavations can likely be removed by sump pumps.

G.3. Sideslopes
The contractor will be required to slope or shore the excavations as needed to meet OSHA requirements for safety and to protect existing structures. The soft, wet clay and silt on site would likely classify as Type C soils as defined by OSHA. Sands would also likely classify as Type C soils. Firm clays would be expected to classify as Type B soils.

G.4. Cold Weather
If the excavation occurs during freezing temperatures, good winter construction practices should be used. Frozen fill should not be used nor should structural filling take place on frozen ground. Slab areas should be completely thawed before placing any concrete.

G.5. Construction Testing and Documentation
Excavations and grading should be evaluated and documented by geotechnical personnel to assess the soils at bearing depth. Fill placed below foundations, slabs, or pavements should be evaluated for conformance to the project gradation recommendations and should be tested for compaction. If the filling proceeds during periods of freezing weather, full-time testing should be considered to help confirm that imported fill is thawed prior to and during compaction, and that all snow has been removed before placement of the fill.

Although our firm offers testing services relating to civil and structural components of the structure (such as concrete testing, reinforcement observations, etc.), specification of such services are beyond our work scope and the designer should be consulted as to such requirements.

H. Level of Care
The services provided for this project have been conducted in a manner consistent with that level of care and skill ordinarily exercised by members of the profession currently practicing in this area, under similar budget and time constraints. This is our professional responsibility. No other warranty, expressed or implied, is made.
1. Certification

I hereby certify that this report was prepared by me or under my direct supervision, and that I am a duly registered engineer under the laws of the State of Minnesota.

Devin M. Ehler
Geotechnical Engineer
Registration Number 52649
Date: August 4, 2017
Appendix

Boring Location Sketch
Log of Boring # 1-9
Legend to Soil Description
**LOG OF BORING**

**CHOSEN VALLEY TESTING**

**PROJECT:** 11566.17.MNR
Design Phase Geotechnical Evaluation
Proposed Free Stall Barn, Feed Bunker, and Manure Pit
T106N R9W Section 16 NE 1/4
Utica Twp., Winona Co., Minnesota

**BORING:** B-1

**LOCATION:** See attached sketch

**DATE:** 5/30/2017  **SCALE:** 1" = 3'

<table>
<thead>
<tr>
<th>Elev.</th>
<th>Depth</th>
<th>USCS Symbol</th>
<th>Description of Materials (ASTM D 2487/2488)</th>
<th>BPF</th>
<th>WL.</th>
<th>Tests and Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>1183.8</td>
<td>0.6</td>
<td>OL</td>
<td>Slightly Organic LEAN CLAY black. (Topsoil)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1182.3</td>
<td>1.5</td>
<td>CL</td>
<td>LEAN CLAY brown, very wet, soft to rather soft. (Loess)</td>
<td></td>
<td></td>
<td>PP = 0.75 tsf</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>3</td>
<td></td>
<td>MC = 28.7%</td>
</tr>
<tr>
<td>1177.3</td>
<td>6.5</td>
<td>SM</td>
<td>SILTY SAND with GRAVEL fine grained, brown to light brown, moist, medium dense. (Residuum)</td>
<td></td>
<td>5</td>
<td>PP = 0.5 tsf</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>MC = 26.7%</td>
</tr>
<tr>
<td>1174.8</td>
<td>9.0</td>
<td></td>
<td>WEATHERED DOLOMITE light brown to tan, moist, very dense</td>
<td></td>
<td>15</td>
<td></td>
</tr>
<tr>
<td>1173.8</td>
<td>10.0</td>
<td></td>
<td></td>
<td>4</td>
<td></td>
<td>* 50 = 3&quot; (Set)</td>
</tr>
</tbody>
</table>

End of boring.
Boring terminated due to auger refusal around 10 feet, presumably on bedrock.
Boring sealed upon completion.
## LOG OF BORING

### CHOSEN VALLEY TESTING

<table>
<thead>
<tr>
<th>Elev.</th>
<th>Depth</th>
<th>USCS Symbol</th>
<th>Description of Materials (ASTM D 2487/2488)</th>
<th>BPF</th>
<th>WL</th>
<th>Tests and Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>1178.9</td>
<td>0.0</td>
<td>CL</td>
<td>Ground surface elevation provided by Tiry Engineering.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1176.9</td>
<td>2.0</td>
<td>OL</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
| 1172.4| 6.5   | CL          | Slightly Organic LEAN CLAY black. (Topsoil)                   | 4   |    | PP = 0.75 tsf
|       |       |             |                                                               |     |    | MC = 27.0%                                                                      |
| 1169.9| 9.0   | SC          | CLAYEY SAND to SILTY SAND fine grained, trace gravel, brown to light brown, moist, dense. (Residuum) | 5   |    | PP = 0.25 tsf
|       |       | SM          |                                                               |     |    | MC = 26.4%                                                                      |
| 1169.3| 9.6   | WEATHERED DOLOMITE | light brown to tan to light gray, moist, very dense.  | 32  |    | * 50 = 1" (Set)                                                                |

End of boring.
Boring terminated due to auger refusal around 9.5 feet, presumably on bedrock.
Boring sealed upon completion.
## LOG OF BORING

**PROJECT:** 11566.17.MNR  
**LOCATION:** See attached sketch  
**DATE:** 5/30/2017  
**SCALE:** 1" = 3'  

### Description of Materials (ASTM D 2487/2488)

<table>
<thead>
<tr>
<th>Elev.</th>
<th>Depth</th>
<th>USCS Symbol</th>
<th>Description of Materials</th>
<th>BPF</th>
<th>WL</th>
<th>Tests and Notes</th>
</tr>
</thead>
</table>
| 1181.4 | 0.0   | CL          | Black, slightly organic lean clay  
(Topsoil) |     |    | Ground surface elevation provided by Tiry Engineering. |
| 1179.9 | 1.5   | OL          | Lean clay, brown, very wet, rather soft.  
(Loess) |     |    | PP = 0.75 tsf  
MC = 27.2% |
| 1174.9 | 6.5   | CL          | Grayish brown, very wet, soft to medium.  
(Loess) |     |    | PP = 0.5 tsf  
MC = 30.1% |
| 1169.4 | 12.0  | ML          | Weathered dolomite, light brown to light gray, moist, very dense.  
End of boring.  
Boring terminated due to auger refusal around 12.5 feet, presumably on bedrock.  
Boring sealed upon completion.  
*50 = 4" (Set) |
<p>| 1168.9 | 12.5  |            |                           |     |    |                 |</p>
<table>
<thead>
<tr>
<th>Elev. (ft)</th>
<th>Depth (ft)</th>
<th>USCS Symbol</th>
<th>Description of Materials (ASTM D 2487/2488)</th>
<th>BPF</th>
<th>WL</th>
<th>Tests and Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>1193.1</td>
<td>0.0</td>
<td>CL OL</td>
<td>Slightly Organic LEAN CLAY black. (Topsoil)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1191.1</td>
<td>2.0</td>
<td>CL</td>
<td>LEAN CLAY brown, very wet, rather soft. (Loess)</td>
<td>4</td>
<td></td>
<td>PP = 0.75 tsf</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>MC = 25.4%</td>
</tr>
<tr>
<td>1186.6</td>
<td>6.5</td>
<td>ML</td>
<td>SILT brown, very wet, soft to rather soft. (Loess)</td>
<td>5</td>
<td></td>
<td>PP = 0.25 tsf</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>MC = 28.4%</td>
</tr>
<tr>
<td>1181.6</td>
<td>11.5</td>
<td>CL SC</td>
<td>SANDY LEAN CLAY to CLAYEY SAND fine grained, trace gravel, brown, wet, rather stiff to stiff. (Glacial Till)</td>
<td>12</td>
<td></td>
<td>PP = 0.75 tsf</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>MC = 24.7%</td>
</tr>
<tr>
<td>1175.1</td>
<td>18.0</td>
<td>SM</td>
<td>SILTY SAND with GRAVEL light brown, moist, dense. (Residuum)</td>
<td>33</td>
<td></td>
<td>PP = 1.0 tsf</td>
</tr>
<tr>
<td>1172.1</td>
<td>21.0</td>
<td></td>
<td></td>
<td>37</td>
<td></td>
<td></td>
</tr>
<tr>
<td>-1170.8</td>
<td>22.3</td>
<td></td>
<td>WEATHERED DOLOMITE light brown to light gray, moist, very dense.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>*</td>
<td>50</td>
<td>* 50 = 3&quot; (Set)</td>
</tr>
</tbody>
</table>

End of boring. Boring terminated due to auger refusal around 22 feet, presumably on bedrock. Boring sealed upon completion.
<table>
<thead>
<tr>
<th>Elev.</th>
<th>Depth</th>
<th>USCS Symbol</th>
<th>Description of Materials (ASTM D 2487/2488)</th>
<th>BPF</th>
<th>WL</th>
<th>Tests and Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>1188.6</td>
<td>0.0</td>
<td>CL</td>
<td>Slightly Organic LEAN CLAY black. (Topsoil)</td>
<td></td>
<td></td>
<td>Ground surface elevation provided by Tiry Engineering.</td>
</tr>
<tr>
<td>1187.1</td>
<td>1.5</td>
<td>OL</td>
<td>LEAN CLAY brown, very wet, rather soft. (Loess)</td>
<td>4</td>
<td>4</td>
<td>PP = 0.75 tsf</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>MC = 26.6%</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>PP = 0.25 tsf</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>MC = 26.7%</td>
</tr>
<tr>
<td>1182.1</td>
<td>6.5</td>
<td>CL</td>
<td>Very wet around 5 feet</td>
<td>4</td>
<td>4</td>
<td>MC = 25.3%</td>
</tr>
<tr>
<td>1180.1</td>
<td>8.5</td>
<td>ML</td>
<td>SILT brown, very wet, rather soft. (Loess)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>End of boring. Boring sealed upon completion.</td>
</tr>
<tr>
<td>Elev. 1205.8</td>
<td>Depth 1.0</td>
<td>USCS Symbol</td>
<td>Description of Materials (ASTM D 2487/2488)</td>
<td>BPF</td>
<td>WL</td>
<td>Tests and Notes</td>
</tr>
<tr>
<td>------------</td>
<td>---------</td>
<td>-------------</td>
<td>---------------------------------------------</td>
<td>-----</td>
<td>----</td>
<td>----------------</td>
</tr>
<tr>
<td>CL OL ML</td>
<td></td>
<td>Slightly Organic LEAN CLAY black. (Topsoil)</td>
<td></td>
<td></td>
<td></td>
<td>Ground surface elevation provided by Tiry Engineering.</td>
</tr>
<tr>
<td></td>
<td>1195.8</td>
<td>SILT brown, wet, stiff to medium. (Loess)</td>
<td></td>
<td>13</td>
<td></td>
<td>MC = 19.9%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>With light gray mottling below 7 feet.</td>
<td></td>
<td>6</td>
<td></td>
<td>MC = 23.4%</td>
</tr>
<tr>
<td></td>
<td>1195.8</td>
<td>Sand in tip of sampler around 11 feet.</td>
<td></td>
<td>7</td>
<td></td>
<td>End of boring. Boring sealed upon completion.</td>
</tr>
</tbody>
</table>
**LOG OF BORING**

**PROJECT:** 11566.17.MNR  
Design Phase Geotechnical Evaluation  
Proposed Free Stall Barn, Feed Bunker, and Manure Pit  
T106N R9W Section 16 NE 1/4  
Utica Twp., Winona Co., Minnesota

**BORING:** B-7

**LOCATION:**  
See attached sketch

**DATE:** 5/30/2017  
**SCALE:** 1" = 3'

<table>
<thead>
<tr>
<th>Elev.</th>
<th>Depth</th>
<th>USCS Symbol</th>
<th>Description of Materials (ASTM D 2487/2488)</th>
<th>BPF</th>
<th>WL</th>
<th>Tests and Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>1205.3</td>
<td>0.0</td>
<td>CL Ol</td>
<td>Slightly Organic LEAN CLAY black. (Topsoil)</td>
<td></td>
<td></td>
<td>Ground surface elevation provided by Tiry Engineering.</td>
</tr>
</tbody>
</table>
| 1203.8| 1.5   | CL           | LEAN CLAY brown, very wet, soft to rather soft. (Loess) | 2   |    | PP = 0.75 tsf  
MC = 27.1% |
|       |       |              |                                             | 2   |    | PP = 0.25 tsf  |
| 1196.3| 9.0   | ML           | SILT light gray, very wet, rather soft. (Loess) | 4   |    | PP = 0.75 tsf  
MC = 25.2% |
|       |       |              |                                             | 4   |    | PP = 0.25 tsf  |
| 1191.3| 14.0  | CL           | SANDY LEAN CLAY light grey, slightly iron stained, wet, rather stiff to very stiff. (Glacial Till) | 5   |    | PP = 0.25 tsf  |
|       |       |              |                                             | 10  |  | PP = 2.0 tsf  
MC = 17.4% |
|       |       |              |                                             | 10  |    | PP = 2.25 tsf  |
| 1184.3| 21.0  |              | End of boring. Boring sealed upon completion. | 27  |    | PP > 4.5 tsf  |
**LOG OF BORING**

**CHOSEN VALLEY TESTING**

**PROJECT:** 11566.17.MNR
Design Phase Geotechnical Evaluation
Proposed Free Stall Barn, Feed Bunker, and Manure Pit
T106N R9W Section 16 NE 1/4
Utica Twp., Winona Co., Minnesota

**BORING:** B-8

**LOCATION:**
See attached sketch

**DATE:** 5/30/2017
**SCALE:** 1" = 3'

<table>
<thead>
<tr>
<th>Elev.</th>
<th>Depth</th>
<th>USCS Symbol</th>
<th>Description of Materials (ASTM D 2487/2488)</th>
<th>BPI</th>
<th>WL</th>
<th>Tests and Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>1206.2</td>
<td>0.0</td>
<td>CL Ol.</td>
<td>Slightly Organic LEAN CLAY black. (Topsoil)</td>
<td></td>
<td></td>
<td>Ground surface elevation provided by Tiry Engineering.</td>
</tr>
<tr>
<td>1204.2</td>
<td>2.0</td>
<td>CL</td>
<td>LEAN CLAY brown, very wet, soft. (Loess)</td>
<td>2</td>
<td></td>
<td>MC = 25.1%</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Light gray around 10 feet.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1199.7</td>
<td>6.5</td>
<td>ML</td>
<td>SILT brown, very wet, rather soft to medium. (Loess)</td>
<td>5</td>
<td></td>
<td>MC = 24.6%</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Light gray around 10 feet.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1194.7</td>
<td>11.5</td>
<td>CL</td>
<td>SANDY LEAN CLAY brown, wet, medium to rather stiff. (Glacial Till)</td>
<td>11</td>
<td></td>
<td>MC = 13.5%</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Trace gravel around 15 feet.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1189.7</td>
<td>16.5</td>
<td>SC</td>
<td>CLAYEY SAND fine grained, trace gravel, brown, moist, dense. (Glacial Till)</td>
<td>30</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1187.2</td>
<td>19.0</td>
<td>CL</td>
<td>SANDY LEAN CLAY trace gravel, brown, wet, hard. (Glacial Till)</td>
<td>75</td>
<td></td>
<td>PP &gt; 4.5 tsf</td>
</tr>
<tr>
<td>1184.7</td>
<td>21.5</td>
<td>SP</td>
<td>POORELY GRADED SAND fine to medium grained, trace gravel, brown, water bearing, dense to very dense. (Glacial Outwash)</td>
<td>53</td>
<td></td>
<td>Water encountered around 24 feet during drilling.</td>
</tr>
<tr>
<td>1180.2</td>
<td>26.0</td>
<td></td>
<td>End of boring. Boring sealed upon completion.</td>
<td>40</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Elev.</td>
<td>Depth</td>
<td>USCS Symbol</td>
<td>Description of Materials (ASTM D 2487/2488)</td>
<td>BPF</td>
<td>WL</td>
<td>Tests and Notes</td>
</tr>
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<td>-------</td>
<td>-------</td>
<td>-------------</td>
<td>---------------------------------------------</td>
<td>-----</td>
<td>----</td>
<td>-----------------</td>
</tr>
<tr>
<td>1205.9</td>
<td>0.0</td>
<td>CL OL</td>
<td>Slightly Organic LEAN CLAY black. (Topsoil)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1204.4</td>
<td>1.5</td>
<td>CL</td>
<td>LEAN CLAY brown, very wet, soft to rather soft. (Loess)</td>
<td>3</td>
<td></td>
<td>PP = 1.25 tsf</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>MC = 26.5%</td>
</tr>
<tr>
<td>1199.9</td>
<td>6.0</td>
<td></td>
<td></td>
<td>4</td>
<td></td>
<td>MC = 28.5%</td>
</tr>
</tbody>
</table>

End of boring.
Boring sealed upon completion.
### UNIFIED SOIL CLASSIFICATION (ASTM D-2487/2488)

<table>
<thead>
<tr>
<th>Material Types</th>
<th>Criteria for Assigning Soil Group Names</th>
<th>Group Symbol</th>
<th>Soil Group Names &amp; Legend</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gravels &gt;50% of Coarse Fraction Retained on No. 4 Sieve</td>
<td>Clean Gravels &lt;5% Fines, Gravels with Fines &gt;12% Fines, Sands and Fines &gt;12% Fines</td>
<td>Cu-4 and 1&lt; Co&lt;3, Fines classify as ML or CL, Fines classify as CL or CH</td>
<td>GW, WELL-GRADED GRAVEL, GP, POORLY-GRADED GRAVEL, GM, SILTY GRAVEL, GC, CLAYEY GRAVEL, SW, WELL-GRADED SAND, SP, POORLY-GRADED SAND, SM, SILTY SAND, SC, CLAYEY SAND</td>
</tr>
<tr>
<td>Sands &gt;50% of Coarse Fraction Retains on No. 4 Sieve</td>
<td>Clean Sands &lt;5% Fines, Sands and Fines &gt;12% Fines</td>
<td>Cu-6 and 1&lt; Co&lt;3, Fines classify as ML or CL, Fines classify as CL or CH</td>
<td>CL, LEAN CLAY, ML, SILT, ORGANIC CLAY OR SILT, CH, FAT CLAY, MH, ELASTIC SILT, OH, ORGANIC CLAY OR SILT</td>
</tr>
<tr>
<td>Silts and Clays Liquid Limit &lt;50, Inorganic</td>
<td>Pi-2 and Pilots = A Line</td>
<td>CL, LEAN CLAY, ML, SILT</td>
<td></td>
</tr>
<tr>
<td>Silts and Clays Liquid Limit &gt;50, Organic</td>
<td>Pi-4 and Pilots = A Line</td>
<td>LL, ORGANIC CLAY OR SILT</td>
<td></td>
</tr>
<tr>
<td>Organic</td>
<td>LL, ORGANIC CLAY OR SILT</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Highly Organic Soils
- Primarily organic matter, dark in color, and having an odor
- PT, FEAT

### Relative Proportions of Sand and Gravel

<table>
<thead>
<tr>
<th>Term</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Trace</td>
<td>5-12</td>
</tr>
<tr>
<td>Wash</td>
<td>0.1-2</td>
</tr>
<tr>
<td>Moderator</td>
<td>1-2</td>
</tr>
</tbody>
</table>

### Relative Proportions of Fines

<table>
<thead>
<tr>
<th>Term</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Trace</td>
<td>&lt;5</td>
</tr>
<tr>
<td>Wash</td>
<td>1-5</td>
</tr>
<tr>
<td>Moderator</td>
<td>1-2</td>
</tr>
</tbody>
</table>

### Grain Size Terminology

<table>
<thead>
<tr>
<th>Term</th>
<th>Size</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bolton</td>
<td>&lt;12 k</td>
</tr>
<tr>
<td>Carbon</td>
<td>24 k - 12 k</td>
</tr>
<tr>
<td>Sand</td>
<td>48 k - 24 k</td>
</tr>
<tr>
<td>Silt or Clay</td>
<td>Passing 200 sieve</td>
</tr>
</tbody>
</table>

### Plasticity Chart

#### Sample Types
- **CL:** Follow Soil
- **ML:** Standard Penetration Test

#### Test Symbols
- **LC:** Moisture Content
- **OC:** Organic Content
- **CN:** Consolidation
- **DD:** Dry Density
- **PP:** Pocket Penetrometer
- **RV:** R-Value
- **SA:** Sieve Analysis
- **F20:** % Passing #200 Sieve

#### Water Level (with or without measurement)

### Penetration Resistance (Recorded as Blows / 10 ft)

#### Sand & Gravel

<table>
<thead>
<tr>
<th>Relative Density</th>
<th>Blow/foot*</th>
<th>Consistency</th>
<th>Blow/foot*</th>
<th>Compresive Strength (PSI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Very Loose</td>
<td>0.4</td>
<td>10-30</td>
<td>0.5</td>
<td>1200-2000</td>
</tr>
<tr>
<td>Loose</td>
<td>1.10</td>
<td>30-50</td>
<td>1.20</td>
<td>2000-3000</td>
</tr>
<tr>
<td>Medium Dense</td>
<td>1.20</td>
<td>50-70</td>
<td>1.30</td>
<td>3000-4500</td>
</tr>
<tr>
<td>Dense</td>
<td>1.50</td>
<td>70-90</td>
<td>1.50</td>
<td>5000-6000</td>
</tr>
<tr>
<td>Very Dense</td>
<td>OVER 10000</td>
<td>OVER 10000</td>
<td>OVER 10000</td>
<td>OVER 10000</td>
</tr>
</tbody>
</table>

#### Clay

*Number of blows of a 14 lb hammer falling 30 inches to drive a 2 inch o.d. (1.96 inch o.d.) IPFPR (penetrometer) sampler the last 12 inches of an 18 inch drive (ASTM 1056 standard penetration test).
1 MILE PERIMETER FROM PROPOSED WELLS

WELL #3 & #4
PROJECT ACTIVITY

WELL #8 (NO. 70993)
WELL #9 (NO. 546893)
WELL #10 (NO. 1000014063)
WELL #11 (NO. 1000014045)
WELL #12 (NO. 464600)
WELL #13 (NO. 1000014056)
WELL #14 (NO. 1000014062)

WELL #5 & #6
EXISTING WELLS ON PROJECT SITE

WELL #5 (NO. 506807)
WELL #6 (NO. 506808)
WELL #1 (NO. 591916)
WELL #2 (NO. 678949)
WELL #16 (NO. 187629)
WELL #15 (NO. 1000014069)
WELL #14 (NO. 1000014062)
WELL #13 (NO. 1000014074)
WELL #11 (NO. 1000014045)
WELL #10 (NO.1000014063)
WELL #9 (NO. 70993)
WELL #8 (NO. 70993)
WELL #7 (NO. 512469)
WELL #6 (NO. 512469)
WELL #5 (NO. 512469)
WELL #4 (NO. 512469)
WELL #3 (NO. 512469)
WELL #2 (NO. 512469)
WELL #1 (NO. 512469)

WELL #1 (NO. 591916)
EXISTING WELLS ON PROJECT SITE

WELL #2 (NO. 678949)
EXISTING WELLS ON PROJECT SITE

WELL #12 (NO. 464600)
WELL #16 (NO. 187629)
WELL #10 (NO.1000014063)
WELL #9 (NO. 70993)
WELL #8 (NO. 70993)
WELL #7 (NO. 512469)
WELL #6 (NO. 512469)
WELL #5 (NO. 512469)
WELL #4 (NO. 512469)
WELL #3 (NO. 512469)
WELL #2 (NO. 512469)
WELL #1 (NO. 512469)
Status of the Source Water Protection Plan:

The water supply system is not formally preparing a wellhead protection plan as defined under Minnesota Rules Chapter 4720.

Source Water Assessment Area:

No - A Source Water Assessment Area has yet to be designated for this well.

Description of the source water - The water supply for Daley Farm of Lewiston LLC is obtained from 2 primary wells. Well depth (in feet), well status, aquifer(s) used, and sensitivity of the source(s) of drinking water are listed in the following table.

<table>
<thead>
<tr>
<th>Unique Well No</th>
<th>Well ID</th>
<th>Depth</th>
<th>Well Use</th>
<th>Aquifer</th>
<th>Aquifer Sensitivity</th>
<th>*Well Sensitivity</th>
<th>SWPA</th>
</tr>
</thead>
<tbody>
<tr>
<td>00591916</td>
<td>Well #1</td>
<td>715</td>
<td>Primary</td>
<td>Bedrock</td>
<td>Low</td>
<td>See (2)</td>
<td>No</td>
</tr>
<tr>
<td>00678949</td>
<td>Well #2</td>
<td>720</td>
<td>Primary</td>
<td>Bedrock</td>
<td>Low</td>
<td>See (2)</td>
<td>No</td>
</tr>
</tbody>
</table>

Well construction assessment - The water wells used by the Daley Farm of Lewiston LLC meet current standards for construction and maintenance. These factors do not contribute to the susceptibility of the source water to contamination.

Well Sensitivity - Well sensitivity refers to the integrity of the well due to its construction and maintenance. It is based on the results of the well construction assessment. It can be one of the following:

1. The well is susceptible to contamination because it does not meet current construction standards or no information about well construction is available, regardless of aquifer sensitivity.
2. The well is not susceptible because it meets well construction standards and does not present a pathway for contamination to readily enter the water supply.

Aquifer Sensitivity - Aquifer sensitivity refers to the degree of geological protection afforded the aquifer(s) used by the public water supply.

Low - The bedrock aquifer is covered by one or more layers of fine-grained material that probably protect it from potential sources of contamination.

Source Water Susceptibility - Source water susceptibility refers to the likelihood that a contaminant will reach the source of drinking water. It reflects the results of assessing well sensitivity, aquifer sensitivity, and water quality data.

Low - The source of drinking water is covered by one or more layers of fine-grained material that probably protect it from potential sources of contamination.

Contaminants of concern - The following statement summarizes the potential contaminants for which a source of drinking water may be at risk:

None of the contaminants regulated under the federal Safe Drinking Water Act for this type public water system have been detected in the source water during required monitoring. A list of regulated contaminants can be found at http://www.epa.gov/safewater (http://www.epa.gov/safewater)

651-201-5000 Phone
888-345-0823 Toll-free

Information on this website is available in alternative formats to individuals with disabilities upon request.

Updated
**MINNESOTA DEPARTMENT OF HEALTH**

**WELL AND BORING RECORD**

**MINNESOTA UNIQUE WELL NO.**

**591916**

---

**PROPERTY OWNER’S NAME**

**Steve & Mike Daley**

Property owner's mailing address different than well location address indicated above.

Rt. #2 Box 33
Lewiston, MN 55952

---

**WELL OWNER’S NAME**

**Same**

Well owner's mailing address different than property owner's address indicated above.

---

### GEOLOGICAL MATERIALS

<table>
<thead>
<tr>
<th>Material</th>
<th>Color</th>
<th>Hardness</th>
<th>From</th>
<th>To</th>
</tr>
</thead>
<tbody>
<tr>
<td>Drift</td>
<td>Brown</td>
<td>Med</td>
<td>0</td>
<td>44</td>
</tr>
<tr>
<td>Limestone</td>
<td>Gray</td>
<td>Med</td>
<td>44</td>
<td>64</td>
</tr>
<tr>
<td>Sandstone</td>
<td>Brown</td>
<td>Med</td>
<td>64</td>
<td>100</td>
</tr>
<tr>
<td>Limestone</td>
<td>Gray</td>
<td>Med</td>
<td>100</td>
<td>300</td>
</tr>
<tr>
<td>Sandstone</td>
<td>Gray</td>
<td>Med</td>
<td>300</td>
<td>400</td>
</tr>
<tr>
<td>Limestone</td>
<td>Blue</td>
<td>Med</td>
<td>400</td>
<td>450</td>
</tr>
<tr>
<td>Sandstone Shale</td>
<td>Green</td>
<td>Med</td>
<td>450</td>
<td>587</td>
</tr>
<tr>
<td>Sandstone</td>
<td>Gray</td>
<td>Med</td>
<td>587</td>
<td>715</td>
</tr>
</tbody>
</table>

---

**REMARKS, ELEVATION, SOURCE OF DATA, etc.**

**Revised 2-25-98 by Roger Kurth**

**Minn. Dept. of Health Copy 591916**
**Well Location**

**Well Name:** Daley Farms

**Well Location:** Rt. #2 Box 33, Lewiston, MN 55952

**Well Number:** 16-UT-04

**Well Depth (completed):** 715 ft

**Date Work Completed:** 2-8-98

**Drilling Method:**
- Cable Tool
- Driven
- Auger
- Rotary

**Drilling Fluid:**
- Foam

**Well Use:**
- Domestic
- Irrigation
- Noncommunity PWS
- Community PWS
- Irrigation PWS
- Test Well
- Drinking Water
- Industrial
- Commercial
- Other Dairy Farm

**Casing Diameter:**
- 6 in. to 614 ft
- 6 in. to 614 ft
- 6 in. to 715 ft

**Screen:**
- From 614 ft to 715 ft

**Static Water Level:**
- 350 ft below

**Pumping Level (below land surface):**
- 6-23-97

**Pumping Level after:**
- 4 hours, pumping 60 gpm

**Wells Head Completion:**
- Whitewater: 6" x 6" buried

**Grouting Information:**
- Well grouted: Yes
- No

**Nearest Known Source of Contamination:**
- 50 feet any direction

**Wells Disinfected upon Completion:**
- Yes
- No

**Pump:**
- Model: Aeromotor 6
- HP: 15
- Volts: 460
- S.p.m.

**Abandoned Wells:**
- Does property have any not in use and not sealed wells? Yes
- No

**Variance:**
- Was a variance granted from the MNDH for this well? Yes
- No

**Well Contractor Certification:**
- This well was drilled under my supervision and in accordance with Minnesota Rules, Chapter 4725. The information contained in this report is true to the best of my knowledge.

**Received by:**
- Roger Kurth
- Name of Order Date

**License Refreshed Date:** 2-20-98

**License Information:**
- License Number: 55079
- Lic. or Reg. No.: 2-20-98

**Remarks, Elevation, Source of Data, etc.:**

**Geological Materials:**

<table>
<thead>
<tr>
<th>Geological Materials</th>
<th>Color</th>
<th>Hardness of Material</th>
<th>From</th>
<th>To</th>
</tr>
</thead>
<tbody>
<tr>
<td>Drift</td>
<td>Brown</td>
<td>Med</td>
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<td>100</td>
<td>300</td>
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<td>Brown</td>
<td>300</td>
<td>400</td>
</tr>
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<td>587</td>
</tr>
<tr>
<td>Sandstone</td>
<td>Gray</td>
<td>Med</td>
<td>587</td>
<td>715</td>
</tr>
</tbody>
</table>

**Additional Data Added: APR 23, 1999**

**Data Received:**
- From: By:

**Additional Notes:**
- Use a second sheet, if needed

**MINN. DEPT. OF HEALTH COPY:**
- 591916
**MINNESOTA DEPARTMENT OF HEALTH**  
**WELL AND BORING RECORD**

**Well Name:** DALEY/MIKE & STEVE  
**County:** Wacona  
**Quad:** 106  
**Quadrant:** 9  
**Section:** 18  
**Subsection:** AC28D  
**Well Number:** 591916  
**Mineral Statutes Chapter 103**  
**Entry Date:** 09/16/1999  
**Update Date:** 08/10/2014  
**Recieved Date:**

<table>
<thead>
<tr>
<th>Township</th>
<th>Range</th>
<th>Dir</th>
<th>Section</th>
<th>Subsections</th>
<th>Elevation</th>
<th>Well Depth</th>
<th>Depth Completed</th>
<th>Data Well Completed</th>
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<tbody>
<tr>
<td>RR 2 BOX 35</td>
<td>106</td>
<td>9</td>
<td>W</td>
<td>18</td>
<td>1202 ft.</td>
<td>715 ft</td>
<td>715 ft</td>
<td>02/06/1998</td>
</tr>
</tbody>
</table>

**Drilling Method:** Air Rotary

**Color** | **Hardness** | **From** | **To**
---|---|---|---
BROWN | MEDIUM | 44 | 0
GRAY | MEDIUM | 100 | 64
GRAY | MEDIUM | 300 | 10
GRAY | MEDIUM | 450 | 600
GRAY | MEDIUM | 500 | 450
GRAY | MEDIUM | 715 | 507

**Depth Completed:**
- 715 ft

**Drilling Fluid:**
- Foam
- Hydrofractured: Yes
- Not Hydrofractured: No

**Use Domestic:**
- Yes
- No

**Casing Diameter:**
- 10 in. to 47 ft.
- 6 in. to 614 ft.

**Weight:**
- lbs./ft.

**Hole Diameter:**
- lbs./ft.

**Open Hole:** from 614 ft. to 715 ft.

**Screen NO:**
- None

**Well Head Completion:**
- Pressure: 20 psi

**Wells Contractor Certification:**
- License: 5697
- Name: KURTZ R.

**Remarks:**
- Well for Dairy Farm
- Located by: Minnesota Department of Health
- Input Date: 08/07/2013
- Unique Number Verification: InfoGPS from data source
- System: UTM - NAD83, Zone 15, Meters

---

**Grounding Information:**
- Well Grouted: Yes
- Not Grouted: No
- Not Specified

**Grounding Material:**
- Grout Material: 0 ft. to 100 ft.

**Nearest Known Source of Contamination:**
- 10 feet
- Direction: Right
- Well Disaffected upon completion: Yes
- No

**Abandoned Wells:**
- Does property have any abandoned wells? Yes
- No

**Well Water Certification:**
- Printed: 10/23/2014
- m50:01205:07
<table>
<thead>
<tr>
<th>GEOLOGICAL MATERIALS</th>
<th>COLOR</th>
<th>HARDNESS OF MATERIAL</th>
<th>FROM</th>
<th>TO</th>
</tr>
</thead>
<tbody>
<tr>
<td>Drift</td>
<td>Soft</td>
<td>Brown</td>
<td>0</td>
<td>40</td>
</tr>
<tr>
<td>Limestone</td>
<td>Med</td>
<td>Yellow</td>
<td>40</td>
<td>63</td>
</tr>
<tr>
<td>Sandstone</td>
<td>Soft</td>
<td>Brown</td>
<td>63</td>
<td>100</td>
</tr>
<tr>
<td>Cave</td>
<td></td>
<td></td>
<td>100</td>
<td>108</td>
</tr>
<tr>
<td>Limestone</td>
<td>Hard</td>
<td>Tan</td>
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<td>294</td>
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<tr>
<td>Sandstone</td>
<td>Soft</td>
<td>Yellow</td>
<td>294</td>
<td>395</td>
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<tr>
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<td>580</td>
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<tr>
<td>Sandstone</td>
<td>Soft</td>
<td>Gray</td>
<td>580</td>
<td>720</td>
</tr>
</tbody>
</table>

**Remarks, Elevation, Source of Data, etc.**

*Received by: 09-23-04*  
*Winona County Environmental Services*  
*Minn. DEPT. OF HEALTH COPY 678949*
**MINNESOTA DEPARTMENT OF HEALTH**  
**WELL AND BORING RECORD**

**Winona**

**MINNESOTA UNIQUE WELL NO.**  
678949

**WELL LOCATION**

- **County Name:** Winona
- **Township Name:** Utica
- **Township No:** 106
- **Range No:** 9
- **Section No:** 16
- **Field SW:** SE SE NE

**Show exact location of well in section grid with "X"**

**18762 Hwy 14, Lewiston**

**WELL DEPTH (completed):** 720

**Date Work Completed:** 9-17-04

**DRILLING METHOD:**
- **Cable Tool:**
- **Auger:**
- **Reamer:**
- **Jacked:**

**DRILLING FLUID:**
- **Foam-Water:**
- **WELL HYDROFRACURATED:** Yes

**Foam-Water**

- **Use:** Domestic
- **Depth:** 18-97
- **Type:** Bore Hole
- **Hole Diameter:** 6.6 in
- **Volume:** 658 gal
- **Drill Depth:** 720 ft

**Casing Diameter**

- **Make:**
- **Weight:** 12 lb
- **Perforation Depth:**
- **Fitting:**

**Statistical Water Level**

- **Screen:**
- **Height:** 330 ft
- **Gauging Point:**
- **Depth:**

**Cut-off Date:**

- **Well Head Completion:**
- ** fracking:**
- ** Water Protection:**

**Groundwater Protection:**

- **Type:**
- **Distance:**
- **Emplacement:**
- **Type:**

**Nearest Known Source of Contamination**

- **Distance:**
- **Type:**
- **Well Disconnected:** Yes

**Pump**

- **Manufacturer:**
- **Model Number:**
- **Capacity:**
- **Volume:**

**Abandoned Wells**

- **Does Property have any in use and not sealed well(s):** Yes

**Variance**

- **Was Variance granted from the MDH for this well:** Yes

**Well Contractor Certification**

- **This well was drilled by the contractor in accordance with Minnesota Rules.**

**Received by:**

- **09-23-04**
- **Winona County Environmental Services**

**MINN. DEPT. OF HEALTH COPY** 673349
<table>
<thead>
<tr>
<th>Township</th>
<th>Range</th>
<th>Sec</th>
<th>Subsections</th>
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<th>Date Well Completed</th>
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<td>105</td>
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<td>16</td>
<td>ACACCD</td>
<td>1204 ft.</td>
<td>720 ft.</td>
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**Drilling Method:** Non-specified Rotary

**Geological Material**

<table>
<thead>
<tr>
<th>Color</th>
<th>Hardness</th>
<th>From</th>
<th>To</th>
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</thead>
<tbody>
<tr>
<td>DRIFT</td>
<td>BROWN</td>
<td>0</td>
<td>40</td>
</tr>
<tr>
<td>LIMESTONE</td>
<td>YELLOW</td>
<td>40</td>
<td>63</td>
</tr>
<tr>
<td>SANDSTONE</td>
<td>BROWN</td>
<td>63</td>
<td>100</td>
</tr>
<tr>
<td>CAVE</td>
<td>TAN</td>
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<td>LIMESTONE</td>
<td>HARD</td>
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<td>294</td>
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<td>395</td>
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<tr>
<td>LIMESTONE</td>
<td>GRAY</td>
<td>395</td>
<td>445</td>
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<tr>
<td>SANDSTONE</td>
<td>GREEN</td>
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<td>560</td>
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<tr>
<td>SANDSTONE</td>
<td>GRAY</td>
<td>560</td>
<td>720</td>
</tr>
</tbody>
</table>

**Static Water Level:**

- 330 ft. from land surface (Date Measured: 09/17/2004)

**Pumping Level (below land surface):**

- 40 ft. after 2 hrs pumping 75 gpm.

**Well Head Completion**

- Field ascertain manufacturer: MONITOR Model: 12 in. above grade

**Wells Completion:**

- No Remarks

**Grounding Information:**

- Well Grouted?: Yes
- Grout Material: N/A

**Nearest Known Source of Contamination:**

- None

**Well Contractor Certification:**

- Peterson, J.W. 00338

**County Well Index Online Report:**

- 678949
## MINNESOTA DEPARTMENT OF HEALTH
### WELL AND BORING REPORT
**Minnesota Statutes Chapter 1031**

### 506807

<table>
<thead>
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<th>Township</th>
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<th>Dir Section</th>
<th>Subsection</th>
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<tr>
<td>MUSSEL</td>
<td>106</td>
<td>9</td>
<td>W 9</td>
<td>BCDBAC</td>
</tr>
</tbody>
</table>

### Elevation
- **1145**
- **7.5 minute topographic map (+/- 5 feet)**

### Address
- **Contact**: RR 1 BOX 22 UTICA MN 55979

### Stratigraphy Information

<table>
<thead>
<tr>
<th>Geological Material</th>
<th>From (ft.)</th>
<th>To (ft.)</th>
<th>Color</th>
<th>Hardness</th>
</tr>
</thead>
<tbody>
<tr>
<td>DRIFT</td>
<td>0</td>
<td>9</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PLATTEVILLE</td>
<td>9</td>
<td>27</td>
<td>BROWN</td>
<td>MEDIUM</td>
</tr>
<tr>
<td>ST. PETER</td>
<td>27</td>
<td>52</td>
<td>BROWN</td>
<td>SOFT</td>
</tr>
<tr>
<td>SHAKOPEE/ONEOTA</td>
<td>52</td>
<td>237</td>
<td>BROWN</td>
<td>MEDIUM</td>
</tr>
<tr>
<td>JORDAN</td>
<td>237</td>
<td>340</td>
<td>BRN/GY</td>
<td>SOFT</td>
</tr>
<tr>
<td>ST. LAWRENCE</td>
<td>340</td>
<td>385</td>
<td>GRAY</td>
<td>MEDIUM</td>
</tr>
<tr>
<td>FRANCONIA</td>
<td>385</td>
<td>560</td>
<td>BRN/WHT</td>
<td>SFT-MED</td>
</tr>
</tbody>
</table>

### Well Depth
- **Well Depth Completed**: 560 ft.
- **Date Well Completed**: 08/30/1989

### Drill Method
- **Drill Method**: Non-specified Rotary
- **Drill Fluid**:

### Use
- **domestic**

### Status
- **Active**

### Well Hydrofractured
- **Yes**

### Casing Type
- **Step down**

### Drive Shoe
- **Yes**

### Joint
- **Welded**

<table>
<thead>
<tr>
<th>Casing Diameter</th>
<th>Weight</th>
<th>Hole Diameter</th>
</tr>
</thead>
<tbody>
<tr>
<td>4 in. To</td>
<td>141 ft.</td>
<td>8 in. To</td>
</tr>
<tr>
<td>10.7 lbs./ft.</td>
<td></td>
<td>560 ft.</td>
</tr>
</tbody>
</table>

### Open Hole

<table>
<thead>
<tr>
<th>Screen?</th>
<th>From (ft.)</th>
<th>To (ft.)</th>
<th>Make</th>
</tr>
</thead>
</table>

### Static Water Level
- **184 ft. land surface**

### Pumping Level (below land surface)
- **194 ft. 1 hrs. Pumping at 50 g.p.m.**

### Wellhead Completion
- **Pitless adapter manufacturer Model**

### Grouting Information
- **Well Grouted? Yes**

### Nearest Known Source of Contamination
- **50 feet**

### Pump
- **Model Number**
- **Length of drop pipe ft**
- **Capacity g.p. Typ**

### Abandoned
- **Does property have any not in use and not sealed well(s)? Yes**

### Variances
- **Was a variance granted from the MDH for this well? Yes**

### Miscellaneous
- **First Bedrock**
- **Last Strat**
- **Located by**

### Well Contractor
- **Thein Well Co.**
- **55079**
- **BOISEN, J.**

### Licensee Business
- **Lic. or Reg. No.**
- **Name of Driller**
## Minnesota Department of Health
### Well and Boring Record

**Location:** Winona, Altura, 47C**

<table>
<thead>
<tr>
<th>Well Name</th>
<th>Township</th>
<th>Range</th>
<th>Dir</th>
<th>Section</th>
<th>Subsection</th>
<th>Use</th>
<th>Status</th>
<th>Well Depth</th>
<th>Depth Completed</th>
<th>Date Well Completed</th>
<th>Lie/Reg. No.</th>
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<tbody>
<tr>
<td>MUSSEL, MARVIN</td>
<td>106</td>
<td>9</td>
<td>W</td>
<td>9</td>
<td>BCDBAC</td>
<td>domestic</td>
<td>A</td>
<td>560 ft</td>
<td>560 ft</td>
<td>08/30/1989</td>
<td>55079</td>
</tr>
</tbody>
</table>

**Elevation:** 1145 ft  7.5 minute topographic map (+/- 5 feet)

**Aquifer:** Tunnel City/Lone

**Depth to Bedrock:** 9 ft  Open Hole 414 ft - 560 ft

**Elev. Method:** Digitization (Screen) - Map (1:24,000)

**Field Located By:** Winona State University

**Unique No. Verified:** Name on mailbox

**Geological Interpretation:** John Mossler

**Input Source:** Minnesota Geological Survey

**Input Date:** 03/19/2002

**Universal Transverse Mercator (UTM) - NAD83 - Zone 15 -**
- UTM Easting (X): 586938
- UTM Northing (Y): 487244

**Interpretation Method:** Geologic study 1:24k to 1:100k

### Geological Material

<table>
<thead>
<tr>
<th>Depth (ft.)</th>
<th>Elevation (ft.)</th>
<th>Stratigraphy</th>
<th>Primary Lithology</th>
<th>Secondary</th>
<th>Minor Lithology</th>
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<tbody>
<tr>
<td>DRIFT</td>
<td>0 - 9</td>
<td>1145 - 1136</td>
<td>Quaternary deposit</td>
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<tr>
<td>PLATTEVILLE</td>
<td>9 - 27</td>
<td>1136 - 1118</td>
<td>Shakopee/Willow</td>
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<tr>
<td>ST. PETER</td>
<td>27 - 52</td>
<td>1118 - 1093</td>
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<td>1093 - 908</td>
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<td>dolomite</td>
<td></td>
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<tr>
<td>JORDAN</td>
<td>237 - 340</td>
<td>908 - 805</td>
<td>Jordan Sandstone</td>
<td>sandstone</td>
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<tr>
<td>ST. LAWRENCE</td>
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<td>805 - 760</td>
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<td>silstone</td>
<td>dolomite</td>
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<td>385 - 560</td>
<td>760 - 585</td>
<td>Tunnel City/Lone</td>
<td>sandstone</td>
<td>shale</td>
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</table>

The report indicates the geological stratigraphy and lithology of the well, providing a detailed account of the materials encountered during the drilling process.
**Well Name**
- Township: BROWN, PAT
- Range: 106
- Dir Section: 9
- Subsection: W 9 BDACBC

**Elevation**
- 1160
- Elev. Method: 7.5 minute topographic map (\( \pm \) 5 feet)

**Address**
- C/W: RR 2 LEWISTON MN 55952

**Stratigraphy Information**

<table>
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<tr>
<th>Geological Material</th>
<th>From</th>
<th>To (ft.)</th>
<th>Color</th>
<th>Hardness</th>
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</thead>
<tbody>
<tr>
<td>ST. PETER</td>
<td>0</td>
<td>70</td>
<td>YELLOW</td>
<td>MEDIUM</td>
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<td>SHAKOPEE</td>
<td>70</td>
<td>315</td>
<td>GRAY</td>
<td>HARD</td>
</tr>
<tr>
<td>JORDAN</td>
<td>315</td>
<td>380</td>
<td>WHITE</td>
<td>HARD</td>
</tr>
</tbody>
</table>

**Well Depth**
- Depth: 380 ft.
- Depth Completed: 380 ft.
- Date Well Completed: 07/21/1977

**Drill Method**
- Non-specified Rotary

**Drill Fluid**
- Use: domestic

**Well Hydrofractured?**
- Yes [ ]
- No [ ]
- From [ ]
- To [ ]

**Casing Type**
- Single casing

**Fitting**
- Yes [X]

**Drive Shoe?**
- No [ ]

**Casing Diameter**
- Weight: 10.7 lbs./ft.
- Hole Diameter: 8 in. To 336 ft.
- 4 in. To 380 ft.

**Open Hole**
- From: 337 ft.
- To: 380 ft.

**Screen?**
- Type: Make

**Static Water Level**
- Measure: 07/21/1977
- 129 ft. land surface

**Pumping Level (below land surface)**
- 129 ft.
- 2 hrs. Pumping at 30 g.p.m.

**Wellhead Completion**
- Fitting adapter manufacturer
- Casing Protection [X] 12 in. above grade
- At-grade (Environmental Wells and Boring s ONLY)

**Grouting Information**
- Well Grouted? [X]
- Material: cement
- Amount: 7 cubic yards
- From: 6 ft.
- To: 336 ft.

**Nearest Known Source of Contamination**
- 150 feet
- Direction: West
- Barnyard: Type

**Pump**
- Manufacturer's name
- Model Number
- HP: 0
- Capacity: ft
- Volt: gp
- Typ: 

**Abandoned**
- Does property have any not in use and not sealed well(s)?
- Yes [ ]
- No [ ]

**Variances**
- Was a variance granted from the MDH for this well?
- Yes [ ]
- No [ ]

**Miscellaneous**
- First Bedrock: Prairie Du Chien Group
- Last Strata: Jordan-St.
- Depth to Bedrock: 0 ft
- Located by: Minnesota Geological Survey
- Locate Method: Digitized - scale 1:24,000 or larger (Digitizing Table)
- System: UTM - NAD83, Zone 15, Meters
- Unique Number Verification:
- 587275
- 487256

**Angled Drill Hole**

**Well Contractor**
- Christenson Well 20065
- CHRISTENSON D

**Licensee Business**
- Lic. or Reg. No.
- Name of Driller
<table>
<thead>
<tr>
<th>Well Name</th>
<th>Township</th>
<th>Range</th>
<th>Dir</th>
<th>Section</th>
<th>Subsection</th>
<th>Use</th>
<th>Status</th>
<th>Well Depth</th>
<th>Depth Completed</th>
<th>Date Well Completed</th>
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</thead>
<tbody>
<tr>
<td>BROWN, PAT</td>
<td>106</td>
<td>9</td>
<td>W</td>
<td>9</td>
<td>BDACBC</td>
<td>domestic</td>
<td>A</td>
<td>380 ft.</td>
<td>380 ft.</td>
<td>07/21/1977</td>
</tr>
</tbody>
</table>

Elevation: 1160 ft. Elev. Method: 7.5 minute topographic map (1/4-5 feet)
Aquifer: Jordan-St.Lawrence
Depth to Bedrock: 0 ft
Open Hole: 337 - 380 ft
Static Water Level: 129 ft

Field Located By: Minnesota Geological Survey
Unique No. Verified: Information from owner
Geological Interpretation: Julia Steenberg
Locate Method: Digitized - scale 1:24,000 or larger (Digitizing Minnesota Geological Survey)
Input Source: 01/01/1990
Input Date: Universal Transverse Mercator (UTM) - NAD83 - Zone 15 -

<table>
<thead>
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<th>Geological Material</th>
<th>Color</th>
<th>Hardness</th>
<th>From</th>
<th>To</th>
<th>Thickness</th>
<th>From</th>
<th>To</th>
<th>Stratigraphy</th>
<th>Primary Lithology</th>
<th>Secondary Lithology</th>
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<tbody>
<tr>
<td>St. Peter</td>
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<td>MEDIUM</td>
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<td>70</td>
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<td>Shakopee</td>
<td>GRAY</td>
<td>HARD</td>
<td>70</td>
<td>315</td>
<td>245</td>
<td>1090</td>
<td>845</td>
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</table>

Minnesota Well Index - Stratigraphy Report

Printed on 10/16/2017
### Stratigraphy Information

<table>
<thead>
<tr>
<th>Geological Material</th>
<th>From (ft.)</th>
<th>To (ft.)</th>
<th>Color</th>
<th>Hardness</th>
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<tr>
<td>DRIFT</td>
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<tr>
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<td>BROWN</td>
<td>SOFT</td>
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<tr>
<td>SHAKOPEE/ONEOTA</td>
<td>22</td>
<td>209</td>
<td>BROWN</td>
<td>SOFT</td>
</tr>
<tr>
<td>JORDAN</td>
<td>209</td>
<td>342</td>
<td>BRN/GRY</td>
<td>SOFT</td>
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<td>MEDIUM</td>
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<td>DRESBACH</td>
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### Well Information

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<tr>
<th>Well Depth</th>
<th>Depth Completed</th>
<th>Date Well Completed</th>
</tr>
</thead>
<tbody>
<tr>
<td>625 ft.</td>
<td>625 ft.</td>
<td>09/06/1989</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Drill Method</th>
<th>Drill Fluid</th>
</tr>
</thead>
<tbody>
<tr>
<td>Non-specified Rotary</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Use</th>
<th>Status</th>
<th>Active</th>
</tr>
</thead>
<tbody>
<tr>
<td>domestic</td>
<td></td>
<td></td>
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### Casing Information

<table>
<thead>
<tr>
<th>Casing Diameter</th>
<th>Weight</th>
<th>Casing Diameter</th>
<th>Weight</th>
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<tbody>
<tr>
<td>4 in. To</td>
<td>574</td>
<td>ft.</td>
<td>10.7 lbs./ft.</td>
</tr>
<tr>
<td>8 in. To</td>
<td>24</td>
<td>ft.</td>
<td>1 lbs./ft.</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Open Hole</th>
<th>From</th>
<th>To</th>
</tr>
</thead>
<tbody>
<tr>
<td>574 ft.</td>
<td></td>
<td>625 ft.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Screen?</th>
<th>Type</th>
<th>Make</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Static Water Level

- 271 ft. land surface
- Measure 09/06/1989

### Pumping Level (below land surface)

- 281 ft. 1 hrs. Pumping at 50 g.p.m.

### Wellhead Completion

- Pilotless adapter manufacturer
- Model
- Casing Protection: x 12 in. above grade
- At-grade (Environmental Wells and Borings ONLY)

### Grouting Information

<table>
<thead>
<tr>
<th>Well Grouted?</th>
<th>Material</th>
<th>Amount</th>
<th>From</th>
<th>To</th>
</tr>
</thead>
<tbody>
<tr>
<td>x Yes</td>
<td>11 Cubic yards</td>
<td>10 ft.</td>
<td>574 ft.</td>
<td></td>
</tr>
</tbody>
</table>

### Nearest Known Source of Contamination

- 50 feet Direction
- Septic tank/drain field Type: 
  - Well disinfected upon completion: x Yes

### Pump

- Manufacturer's name
- Model Number
- Length of drop pipe ft. Capacity g.p. Typ
- HP

### Abandoned

- Does property have any not in use and not sealed well(s)?
  - Yes x No

### Variance

- Was a variance granted from the MDH for this well?
  - Yes No

### Miscellaneous

- First Bedrock: Shakopee/New Richmond
- Aquifer: Wionewoc
- Last Strat: Wionewoc Sandstone
- Depth to Bedrock: 7 ft
- Located by: Minnesota Geological Survey
- Locate Method: Digitization (Screen) - Map (1:24,000)
- System: UTM - NAD83, Zone 15, Meters X 587449 Y 4872646
- Unique Number Verification Information from Input Date: 03/19/2002

### Angled Drill Hole

- Well Contractor: Thein Well Co.
- Licensee Business
- Lic. or Reg. No. 55079
- Name of Driller: BOISEN, J.
### Minnesota Well Index - Stratigraphy Report

**506808**

<table>
<thead>
<tr>
<th>Depth (ft.)</th>
<th>Elevation (ft.)</th>
<th>Stratigraphy</th>
<th>Primary Lithology</th>
<th>Secondary</th>
<th>Minor Lithology</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>DRIFT</strong></td>
<td></td>
<td></td>
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<tr>
<td>BRN/GRY</td>
<td>209</td>
<td>342</td>
<td>133</td>
<td>942</td>
<td>809</td>
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<tr>
<td>GRAY</td>
<td>342</td>
<td>400</td>
<td>58</td>
<td>809</td>
<td>751</td>
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<td>GREEN</td>
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<td>550</td>
<td>150</td>
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<td>WHITE</td>
<td>550</td>
<td>625</td>
<td>75</td>
<td>601</td>
<td>526</td>
</tr>
</tbody>
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**Field Located By**
- County Environmental &/or Information from owner
- John Mrossler

**Locate Method**
- Digitization (Screen) - Map (1:24,000)

**Input Source**
- Minnesota Geological Survey

**Input Date**
- 03/19/2002

**Geological Material**
- Color
- Hardness
- From
- To
- Thickness

**Geological Interpretation**
- Universal Transverse Mercator (UTM) - NAD83 - Zone 15 -
  - UTM Easting (X): 587449
  - UTM Northing (Y): 487264

**Interpretation Method**
- Geologic study 1:24k to 1:100k

**Well Name**
- REGRE, GARY &

**Township**
- 106

**Range**
- 9

**Dir Section**
- W 9

**Subsection**
- BDAAAD

**Use**
- Domestic

**Status**
- A

**Well Depth**
- 625 ft.

**Depth Completed**
- 625 ft.

**Date Well Completed**
- 09/06/1989

**Lic/Reg. No.**
- 55079

**County**
- Winona

**Quad**
- Altura

**Quad ID**
- 47C

**Elevation**
- 1151 ft.

**Elev. Method**
- 7.5 minute topographic map (+/- 5 feet)
MINNESOTA DEPARTMENT OF HEALTH
WELL AND BORING REPORT
Minnesota Statutes Chapter 1031

Entry Date: 08/18/2014
Update Date: 02/09/2005

Well Name: LUEHMANN
Township: 106
Range: 9
Dir Section: W 9
Subsection: ADDACC
Elevation: 1181
Elev. Method: CALC FROM 2-FOOT COUNTY DEM

Address:
C/W 23421 HOLSTEIN RD LEWISTON MN 55952

Well Depth: 640 ft.
Depth Completed: 640 ft.
Date Well Completed: 01/07/2005

Drill Method: Non-specified Rotary
Drill Fluid: Foam

Use: Domestic
Status: Active

Well Hydrofractured?: No
From: To
Casing Type: Step down
Joint: Welded
Drive Shoe?: Yes

Casing Diameter: 6 in. To 552 ft. lbs./ft.
Weight: 14 in. To 60 ft.

Hole Diameter: 10 in. To 60 ft. lbs./ft.

Open Hole: 6 in. To 640 ft.

Screen?: No
Type: Make

Static Water Level:
320 ft. land surface Measure: 01/07/2005

Pumping Level (below land surface):
330 ft. 2 hrs. Pumping at: 15 g.p.m.

Wellhead Completion:
Pitless adapter manufacturer
Model

Casing Protection: Yes
12 in. above grade
At-grade (Environmental Wells and Boringcs ONLY)

Grouting Information:
Well Grouted?: Yes
Not Specified

Material: neat cement
Amount: 0.13 Cubic yards From
To:
60 ft.

neat cement: 7 Cubic yards
552 ft.

pearock: 5 Cubic yards
212 ft.

Nearest Known Source of Contamination:
50 feet Direction Type
Well disinfected upon completion?: Yes
No

Pump:
Manufacturer's name
Model Number
Length of drop pipe ft
Capacity g.p.
Typ

Abandoned:
Does property have any not in use and not sealed well(s)?
Not Installed Date Installed

Variance:
Was a variance granted from the MDH for this well?
Yes No

Miscellaneous:
First Bedrock
Last Strat
Located by
Locate Method
System
Unique Number Verification

Angled Drill Hole

Well Contractor:
Thein Well Co.
Licensee Business: SANDERS, T
Lic. or Reg. No.
Name of Driller

Remarks:
OLD WELL TO BE SEALED AT A LATER DATE

Minnesota Well Index Report
719931
Printed on 10/16/2017
HE-01205-15
## Minnesota Unique Well No.

**719931**

### County
Winona

### Quad
Utica

### Quad ID
2681

## MINNESOTA DEPARTMENT OF HEALTH

### WELL AND BORING RECORD

*Minnesota Statutes Chapter 1031*

<table>
<thead>
<tr>
<th>Well Name</th>
<th>Township</th>
<th>Range</th>
<th>Dir</th>
<th>Section</th>
<th>Subsection ADDAACC</th>
<th>Use</th>
<th>Status</th>
<th>Well Depth</th>
<th>Depth Completed</th>
<th>Date Well Completed</th>
<th>Lie/Reg. No.</th>
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<tbody>
<tr>
<td>LUEHMANN</td>
<td>106</td>
<td>9</td>
<td>W</td>
<td>9</td>
<td>A</td>
<td>domestic</td>
<td>A</td>
<td>640 ft</td>
<td>640 ft</td>
<td>01/07/2005</td>
<td>55079</td>
</tr>
</tbody>
</table>

### Elevation
1181 ft, Elev. Method: CALC FROM 2-FOOT COUNTY DEM

### Field Located By
County Environmental &/or Tax Records

### Unique No. Verified
GPS SA Off (averaged)

### Geological Interpretation
Julia Steenberg

### Locate Method
Minnesota Geological Survey

### Input Source
04/07/2011

### Input Date

### Depth to Bedrock
10 ft, Open Hole: 552 - 640 ft

### Static Water Level
320 ft

### Geological Material

<table>
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<tr>
<th>Color</th>
<th>Hardness</th>
<th>From</th>
<th>To</th>
<th>Thickness</th>
<th>From</th>
<th>To</th>
<th>Stratigraphy</th>
<th>Primary Lithology</th>
<th>Secondary</th>
<th>Minor Lithology</th>
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</thead>
<tbody>
<tr>
<td>DRIFT</td>
<td>BROWN</td>
<td>SOFT</td>
<td>0</td>
<td>10</td>
<td>10</td>
<td>1171</td>
<td>Quat. deposit-brown</td>
<td>drift</td>
<td></td>
<td></td>
</tr>
<tr>
<td>BROKEN SANDSTONE</td>
<td>SOFT</td>
<td>10</td>
<td>60</td>
<td>50</td>
<td>1171</td>
<td>1121</td>
<td>Prairie Du Chien</td>
<td>dolomite</td>
<td>crevice</td>
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<tr>
<td>LIMESTONE</td>
<td>GRAY</td>
<td>MEDIUM</td>
<td>60</td>
<td>212</td>
<td>1121</td>
<td>969</td>
<td>Prairie Du</td>
<td>dolomite</td>
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<td></td>
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<tr>
<td>SANDSTONE</td>
<td>BROWN</td>
<td>SOFT</td>
<td>212</td>
<td>332</td>
<td>969</td>
<td>849</td>
<td>Jordan Sandstone</td>
<td>sandstone</td>
<td></td>
<td></td>
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<tr>
<td>LIMESTONE</td>
<td>GRAY</td>
<td>MEDIUM</td>
<td>332</td>
<td>392</td>
<td>849</td>
<td>789</td>
<td>St.Lawrence</td>
<td>dolomite</td>
<td>siltstone</td>
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<tr>
<td>SHALE</td>
<td>GREEN</td>
<td>392</td>
<td>580</td>
<td>188</td>
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<td>601</td>
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<td>Wonenwoc Sandstone</td>
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</table>

## Minnesota Well Index - Stratigraphy Report

**719931**

*Printed on 10/16/2017*
<table>
<thead>
<tr>
<th>Well Name</th>
<th>Township</th>
<th>Range</th>
<th>Dir Section</th>
<th>Subsection</th>
<th>Depth</th>
<th>Depth Completed</th>
<th>Date Well Completed</th>
<th>Drill Method</th>
<th>Drill Fluid</th>
<th>Use</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>DALEY</td>
<td>106</td>
<td>9</td>
<td>W 9</td>
<td>CCCBAA</td>
<td>578 ft.</td>
<td>578 ft.</td>
<td>06/01/1994</td>
<td>Air Rotary</td>
<td></td>
<td></td>
<td>Active</td>
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</tbody>
</table>

**Address**
C/W RR 2 BOX 33 LEWISTON MN 55952

**Stratigraphy Information**
<table>
<thead>
<tr>
<th>Geological Material</th>
<th>From</th>
<th>To (ft.)</th>
<th>Color</th>
<th>Hardness</th>
</tr>
</thead>
<tbody>
<tr>
<td>DRIFT</td>
<td>0</td>
<td>56</td>
<td>BLK/BRN</td>
<td></td>
</tr>
<tr>
<td>PLATTEVILLE</td>
<td>56</td>
<td>75</td>
<td>BROWN</td>
<td>MEDIUM</td>
</tr>
<tr>
<td>SANDSTONE</td>
<td>75</td>
<td>105</td>
<td>BROWN</td>
<td>MEDIUM</td>
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<tr>
<td>LIMESTONE</td>
<td>105</td>
<td>295</td>
<td>BROWN</td>
<td>MEDIUM</td>
</tr>
<tr>
<td>SANDSTONE</td>
<td>295</td>
<td>395</td>
<td>BROWN</td>
<td>MEDIUM</td>
</tr>
<tr>
<td>LIMESTONE</td>
<td>395</td>
<td>445</td>
<td>BLUE</td>
<td>MEDIUM</td>
</tr>
<tr>
<td>SANDSTONE &amp; SHALE</td>
<td>445</td>
<td>578</td>
<td>GREEN</td>
<td>MEDIUM</td>
</tr>
</tbody>
</table>

**Well Hydrofractured?**
- Yes [ ]
- No [ ]
- From [ ]
- To [ ]

**Casing Type**
- Step down [ ]
- Joint [ ]

**Casing Diameter**
- 5 in. To 462 ft. [ ] lbs./ft.
- 10 in. To 578 ft. [ ] lbs./ft.

**Open Hole**
- From 462 ft. To 578 ft.

**Screen?**
- [ ]

**Static Water Level**
- 178 ft. land surface [ ]

**Pumping Level (below land surface)**
- 195 ft. 1 hrs. Pumping at 20 g.p.m.

**Wellhead Completion**
- Fitless adapter manufacturer [ ]
- Casing Protection [ ]
- 12 in. above grade [ ]
- At-grade (Environmental Wells and Borings ONLY) [ ]

**Grouting Information**
- Well Grouted? [X]
- [ ] Yes
- [ ] No
- Not Specified [ ]
- Material [ ]
- Amount [ ]
- From [ ]
- To [ ]
- neat cement [ ]
- 14 Cubic yards [ ]
- 0 ft. [ ]
- 462 ft. [ ]

**Nearest Known Source of Contamination**
- feet [ ]
- Direction [ ]

**Well disinfected upon completion?**
- [X] Yes
- [ ] No

**Pump**
- Manufacturer's name [ ]
- HP [ ]
- Capacity [ ]
- g.p. [ ]
- Typ [ ]
- Not Installed [ ]
- Date Installed [ ]

**Abandoned**
- Does property have any not in use and not sealed well(s)?
- [ ] Yes
- [ ] No

**Variance**
- Was a variance granted from the MDH for this well?
- [ ] Yes
- [ ] No

**Miscellaneous**
- First Bedrock Shakopee/Willow River Aquifer Tunnel City/Lone
- Last Strat Tunnel City/Lone Rock Fm Depth to Bedrock 56 ft
- Located by Minnesota Geological Survey
- Locate Method Digitization (Screen) - Map (1:24,000)
- System UTM - NAD83, Zone 15, Meters [X] 586746 Y 4871687
- Unique Number Verification Address verification Input Date 05/25/2000

**Angled Drill Hole**
- [ ]

**Well Contractor**
- Their Well Co. 55079 VAN HOUTEN, D
- Licensee Business Lic. or Reg. No. Name of Driller

---

**Remarks**
<table>
<thead>
<tr>
<th>Well Name</th>
<th>Township</th>
<th>Range</th>
<th>Dir Section</th>
<th>Subsection</th>
<th>Use</th>
<th>Status</th>
<th>Well Depth</th>
<th>Depth Completed</th>
<th>Date Well Completed</th>
<th>Lic/Reg. No.</th>
</tr>
</thead>
<tbody>
<tr>
<td>DALEY, MICHAEL</td>
<td>106</td>
<td>9</td>
<td>W 9</td>
<td>CCCBAA</td>
<td>domestic</td>
<td>A</td>
<td>578 ft</td>
<td>578 ft</td>
<td>06/01/1994</td>
<td>55079</td>
</tr>
</tbody>
</table>

**Elevation** 1203 ft.  
**Elev. Method** 7.5 minute topographic map (+/- 5 feet)  
**Aquifer** Tunnel City/Lone  
**Depth to Bedrock** 56 ft.  
**Open Hole** 462 - 578 ft.  
**Static Water Level** 178 ft.  

**Field Located By** Winona State University  
**Unique No. Verified** Address verification  
**Geological Interpretation** John Mossler  
**Locate Method** Digitization (Screen) - Map (1:24,000)  
**Input Source** Minnesota Geological Survey  
**Input Date** 05/25/2000  
**Universal Transverse Mercator (UTM)** - NAD83 - Zone 15 -  
**UTM Easting (X)** 586746  
**UTM Northing (Y)** 487168  
**Interpretation Method** Geologic study 1:24k to 1:100k

<table>
<thead>
<tr>
<th>Geological Material</th>
<th>Color</th>
<th>Hardness</th>
<th>From</th>
<th>To</th>
<th>Thickness</th>
<th>From</th>
<th>To</th>
<th>Stratigraphy</th>
<th>Primary Lithology</th>
<th>Secondary</th>
<th>Minor Lithology</th>
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<tbody>
<tr>
<td>DRIFT</td>
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<td>56</td>
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<td>1128</td>
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<td>1128</td>
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<tr>
<td>LIMESTONE</td>
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<td>MEDIUM</td>
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<td>295</td>
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<td>908</td>
<td>Prairie Du Chien</td>
<td>dolomite</td>
<td></td>
<td></td>
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<tr>
<td>SANDBSTONE</td>
<td>BROWN</td>
<td>MEDIUM</td>
<td>295</td>
<td>395</td>
<td>100</td>
<td>908</td>
<td>808</td>
<td>Jordan Sandstone</td>
<td>sandstone</td>
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<td>MEDIUM</td>
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<td>445</td>
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<td>758</td>
<td>St.Lawrence</td>
<td>dolomite</td>
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<td>siltstone</td>
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<td>SANDBONE &amp; SHALE</td>
<td>GREEN</td>
<td>MEDIUM</td>
<td>445</td>
<td>578</td>
<td>133</td>
<td>758</td>
<td>625</td>
<td>Tunnel City/Lone</td>
<td>sandstone</td>
<td>shale</td>
<td>dolomite</td>
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</table>

**Minnesota Well Index - Stratigraphy Report**  
546893  
Printed on 10/16/2017
MINNESOTA DEPARTMENT OF HEALTH
WELL AND BORING REPORT
Minnesota Statutes Chapter 1031

Well Name: TIMM, JOHN
Township: 106
Range: 9
Dir Section: W 17
Subsection: DBBB
Elevation: 1200
Elev. Method: 7.5 minute topographic map (+/- 5 feet)

Well Depth: 300 ft.
Depth Completed: 300 ft.
Date Well Completed: 
Drill Method: 
Drill Fluid: 

Use: 
Status: Active

Well Hydrofractured?: Yes [ ] No [ ] From [ ] To [ ]
Casing Type: 
Joint: 
Drive Shoe?: Yes [ ] No [ ] Above/Below [ ]

Open Hole: From [ ] ft. To [ ] ft.
Screen?: [ ] Type: 
Make: 

Static Water Level: 
Pumping Level (below land surface): 

Wellhead Completion:

Casing Protection: [ ] 12 in. above grade
At-grade (Environmental Wells and Borings ONLY): [ ]

Grouting Information:
Well Grouted?: Yes [ ] No [ ] [X] Not Specified

Nearest Known Source of Contamination:
feet: 
Direction: 
Well disinfected upon completion?: Yes [ ] No [ ]

Pump:
Manufacturer's name: 
Model: 
Model Number: 
HP: 
Volt: 
Length of drop pipe: ft. 
Capacity: g.p. 
Typ: 

Abandoned:
Does property have any not in use and not sealed well(s)? Yes [ ] No [ ]

Variance:
Was a variance granted from the MDH for this well? Yes [ ] No [ ]

Miscellaneous:
First Bedrock: 
Last Strat: 
Located by: Minnesota Geological Survey
Locate Method: Digitized - scale 1:24,000 or larger (Digitizing Table)
System: UTM - NAD83, Zone 15, Meters
X: 583897
Y: 4870644
Unique Number Verification: 
Input Date: 01/01/1990

Angled Drill Hole:

Well Contractor:
Licensee Business: 
Lic. or Reg. No: 
Name of Driller: 

Minnesota Well Index Report
1000014063

Printed on 10/16/2017
HE-01205-15
**MINNESOTA DEPARTMENT OF HEALTH**  
**WELL AND BORING REPORT**  
*Minnesota Statutes Chapter 1031*

<table>
<thead>
<tr>
<th>Well Name</th>
<th>Township</th>
<th>Range</th>
<th>Dir Section</th>
<th>Subsection</th>
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</thead>
<tbody>
<tr>
<td>PETERSON</td>
<td>106</td>
<td>9</td>
<td>W 17</td>
<td>DAAA</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Elevation</th>
<th>Elev. Method</th>
<th>7.5 minute topographic map (+/- 5 feet)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1200</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Address**

**Stratigraphy Information**

<table>
<thead>
<tr>
<th>Well Depth</th>
<th>Depth Completed</th>
<th>Date Well Completed</th>
</tr>
</thead>
<tbody>
<tr>
<td>270 ft.</td>
<td>270 ft.</td>
<td></td>
</tr>
</tbody>
</table>

**Drill Method**

<table>
<thead>
<tr>
<th>Use</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Active</td>
</tr>
</tbody>
</table>

**Hydrofractured?**

<table>
<thead>
<tr>
<th>Yes</th>
<th>No</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Casing Type**

<table>
<thead>
<tr>
<th>Joint</th>
</tr>
</thead>
</table>

**Drive Shoe?**

<table>
<thead>
<tr>
<th>Yes</th>
<th>No</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Above/Below**

**Open Hole**

<table>
<thead>
<tr>
<th>From</th>
<th>To</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Screen?**

<table>
<thead>
<tr>
<th>Yes</th>
<th>No</th>
<th>X</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Type**

<table>
<thead>
<tr>
<th>Make</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
</tr>
</tbody>
</table>

**Static Water Level**

<table>
<thead>
<tr>
<th>100 ft.</th>
<th>land surface</th>
</tr>
</thead>
</table>

**Measure**

<table>
<thead>
<tr>
<th>null</th>
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</thead>
</table>

**Pumping Level (below land surface)**

<table>
<thead>
<tr>
<th>Wellhead Completion</th>
</tr>
</thead>
</table>

**Pitless adapter manufacturer**

<table>
<thead>
<tr>
<th>Model</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
</tr>
</tbody>
</table>

**12 in. above grade**

**At-grade (Environmental Wells and Borings ONLY)**

**Grouting Information**

<table>
<thead>
<tr>
<th>Well Grouted?</th>
<th>Yes</th>
<th>No</th>
<th>X</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Nearest Known Source of Contamination**

<table>
<thead>
<tr>
<th>feet</th>
<th>Direction</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Well disinfected upon completion?**

<table>
<thead>
<tr>
<th>Yes</th>
<th>No</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Pump**

<table>
<thead>
<tr>
<th>Manufacturer's name</th>
</tr>
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<tbody>
<tr>
<td></td>
</tr>
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</table>

<table>
<thead>
<tr>
<th>Model Number</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>HP</th>
<th>Volt</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Length of drop pipe</th>
<th>Capacity</th>
</tr>
</thead>
<tbody>
<tr>
<td>ft.</td>
<td>g.p.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Abandoned</th>
</tr>
</thead>
<tbody>
<tr>
<td>Does property have any not in use and not sealed well(s)?</td>
</tr>
<tr>
<td></td>
</tr>
</tbody>
</table>

**Variance**

<table>
<thead>
<tr>
<th>Was a variance granted from the MDH for this well?</th>
<th>Yes</th>
<th>No</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Miscellaneous**

<table>
<thead>
<tr>
<th>Aquifer</th>
<th>Prairie Du Chien-</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Depth to Bedrock</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Located by</th>
<th>Minnesota Geological Survey</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Locate Method</th>
<th>Digitized - scale 1:24,000 or larger (Digitizing Table)</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>System</th>
<th>UTM - NAD83, Zone 15, Meters</th>
</tr>
</thead>
<tbody>
<tr>
<td>X 586605</td>
<td>Y 4870667</td>
</tr>
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</table>

<table>
<thead>
<tr>
<th>Unique Number Verification</th>
<th>Input Date</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>01/01/1990</td>
</tr>
</tbody>
</table>

**Angled Drill Hole**

**Well Contractor**

<table>
<thead>
<tr>
<th>Licensee Business</th>
<th>Lic. or Reg. No.</th>
<th>Name of Driller</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Remarks**

**Minnesota Well Index Report 1000014045**

Printed on 10/16/2017

HE-01205-15
Well Name: Peterson, Iles 106
Well Depth: 560 ft.
Depth Completed: 560 ft.
Date Well Completed: 10/04/1990

Elevation: 1202
Elev. Method: 7.5 minute topographic map (+/- 5 feet)

C/W: RR 1 Box 19 Utica MN

Stratigraphy Information

<table>
<thead>
<tr>
<th>Geological Material</th>
<th>From ft.</th>
<th>To ft.</th>
<th>Color</th>
<th>Hardness</th>
</tr>
</thead>
<tbody>
<tr>
<td>DRIFT</td>
<td>0</td>
<td>30</td>
<td></td>
<td></td>
</tr>
<tr>
<td>DRIFT</td>
<td>30</td>
<td>40</td>
<td></td>
<td></td>
</tr>
<tr>
<td>LIMEROCK</td>
<td>40</td>
<td>90</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SANDROCK</td>
<td>90</td>
<td>130</td>
<td>BROWN</td>
<td></td>
</tr>
<tr>
<td>ROCK</td>
<td>130</td>
<td>200</td>
<td>BROWN</td>
<td></td>
</tr>
<tr>
<td>ROCK</td>
<td>200</td>
<td>270</td>
<td>WHITE</td>
<td></td>
</tr>
<tr>
<td>ROCK</td>
<td>270</td>
<td>300</td>
<td>GRAY</td>
<td></td>
</tr>
<tr>
<td>SANDROCK</td>
<td>300</td>
<td>326</td>
<td>BROWN</td>
<td></td>
</tr>
<tr>
<td>SANDROCK</td>
<td>326</td>
<td>410</td>
<td>BROWN</td>
<td></td>
</tr>
<tr>
<td>ROCK</td>
<td>410</td>
<td>428</td>
<td>BLUE</td>
<td></td>
</tr>
<tr>
<td>ROCK</td>
<td>428</td>
<td>470</td>
<td>BLUE</td>
<td></td>
</tr>
<tr>
<td>FRANCONIA</td>
<td>470</td>
<td>491</td>
<td></td>
<td></td>
</tr>
<tr>
<td>FRANCONIA</td>
<td>491</td>
<td>560</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Well Hydrofractured: No

Casing Type: Step down
Joint: Welded
Use: Domestic
Status: Active

Casing Diameter: 10 in. To 26 ft.
Weight: lbs./ft.
Hole Diameter: 10 in. To 26 ft.

Open Hole: 26 ft. To 560 ft.

Static Water Level: 200 ft. land surface
Measure: 10/04/1990

Pumping Level (below land surface): 320 ft.
Pumping at: 0 g.p.m.

Wellhead Completion

Well Drilled by: Monitor
Model: 6PS67BS
Casing Protection: 12 in. above grade
At-grade: Environmental Wells and Boreholes Only

Grouting Information

Well Grouted: Yes
Material: peacock
Amount: 4 Cubic yards
From: ft.
To: ft.
neat cement
Amount: 12 Cubic yards
From: ft.
To: ft.

Nearest Known Source of Contamination

75 feet Southwest
Silver Lake

Well Disinfected upon completion: Yes

Pump
Manufacturer's name: X
Model: X
Not Installed
Date Installed: X

Abandoned
Does property have any not in use and not sealed well(s)? Yes

Variance
Was a variance granted from the MDH for this well? Yes

Miscellaneous
First Bedrock: Prairie Du Chien Group
Last Strat: Tunnel City/Lone Rock Fm
Located by: Minnesota Geological Survey
Locate Method: Digitization (Screen) - Map (1:24,000)
System: UTM - NAD83, Zone 15, Meters
Unique Number Verification Information from Input Date: 10/19/2000

Angled Drill Hole

Well Contractor: Larson Well Co.
Licensee Business LIC
g Reg. No.: 23150
Name of Driller: RAAEN, D.
## Minnesota Department of Health
### Well and Boring Record

**Well Name:** PETERSON, ILES

**County:** Winona

**Quad ID:** 26B

**Well No.:** 464600

**Entry Date:** 01/28/1992

**Update:**

**Received Date:** 08/18/2014

**Lic/Reg. No.:** 23150

### Field Located By
- **Minnesota Geological Survey**

### Unique No. Verified
- **Information from owner**

### Geological Interpretation
- **John Mossier**

### Locate Method
- **Digitization (Screen) - Map (1:24,000)**

### Input Source
- **Minnesota Geological Survey**

### Input Date
- **10/19/2000**

### Aquifer
- St. Lawrence-Tunnel

### Depth to Bedrock
- **30 ft**

### Open Hole
- **26 - 560 ft**

### Static Water Level
- **200 ft**

### Well and Boring Details

<table>
<thead>
<tr>
<th>Geological Material</th>
<th>Color</th>
<th>Hardness</th>
<th>Depth (ft)</th>
<th>Elevation (ft)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>From</td>
<td>To</td>
<td>From to</td>
</tr>
<tr>
<td>DRIFT</td>
<td></td>
<td>0</td>
<td>30</td>
<td>1202 to 1172</td>
</tr>
<tr>
<td>DRIFT</td>
<td></td>
<td>30</td>
<td>40</td>
<td>1172 to 1162</td>
</tr>
<tr>
<td>LIMEROCK</td>
<td></td>
<td>40</td>
<td>90</td>
<td>1162 to 1112</td>
</tr>
<tr>
<td>SANDROCK</td>
<td>BROWN</td>
<td>90</td>
<td>130</td>
<td>1112 to 1072</td>
</tr>
<tr>
<td>ROCK</td>
<td>BROWN</td>
<td>130</td>
<td>200</td>
<td>1072 to 1002</td>
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<td>ROCK</td>
<td>WHITE</td>
<td>200</td>
<td>270</td>
<td>1002 to 932</td>
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<td>ROCK</td>
<td>GRAY</td>
<td>270</td>
<td>300</td>
<td>932 to 902</td>
</tr>
<tr>
<td>SANDROCK</td>
<td>BROWN</td>
<td>300</td>
<td>326</td>
<td>902 to 876</td>
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<td>SANDROCK</td>
<td>BROWN</td>
<td>326</td>
<td>410</td>
<td>876 to 792</td>
</tr>
<tr>
<td>ROCK</td>
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<td>410</td>
<td>428</td>
<td>792 to 774</td>
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<tr>
<td>ROCK</td>
<td>BLUE</td>
<td>428</td>
<td>470</td>
<td>774 to 732</td>
</tr>
<tr>
<td>FRANCONIA</td>
<td></td>
<td>470</td>
<td>491</td>
<td>732 to 711</td>
</tr>
<tr>
<td>FRANCONIA</td>
<td></td>
<td>491</td>
<td>560</td>
<td>711 to 642</td>
</tr>
</tbody>
</table>

---

**Minnesota Well Index - Stratigraphy Report**

**Well No.:** 464600

**Printed on:** 10/16/2017
### MINNESOTA DEPARTMENT OF HEALTH
### WELL AND BORING REPORT

#### Address:

**Well Name**
- BEYER, WAYNE

**Township**
- 106

**Range**
- 9

**Dir Section**
- W 16

**Subsection**
- CABD

**Elevation**
- 1200

**Elev. Method**
- 7.5 minute topographic map (+/- 5 feet)

---

### Stratigraphy Information:

<table>
<thead>
<tr>
<th>Well Depth</th>
<th>Depth Completed</th>
<th>Date Well Completed</th>
</tr>
</thead>
<tbody>
<tr>
<td>300 ft.</td>
<td>300 ft.</td>
<td></td>
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<table>
<thead>
<tr>
<th>Drill Method</th>
<th>Drill Fluid</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Use</th>
<th>Status</th>
<th>Active</th>
</tr>
</thead>
</table>

- **Well Hydrofractured?**
  - Yes [ ]
  - No [ ]
  - Not Specified [X]

- **Casing Type**
  - Joint [ ]

- **Drive Shoe?**
  - Yes [ ]
  - No [ ]

<table>
<thead>
<tr>
<th>Open Hole</th>
<th>From</th>
<th>To</th>
</tr>
</thead>
<tbody>
<tr>
<td>Screen?</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- **Static Water Level**
  - 0 ft. land surface

- **Pumping Level (below land surface)**

<table>
<thead>
<tr>
<th>Wellhead Completion</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fitless adapter manufacturer</td>
</tr>
<tr>
<td>Casing Protection</td>
</tr>
<tr>
<td>At-grade (Environmental Wells and Boreholes ONLY)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Grouting Information</th>
</tr>
</thead>
</table>
| Well Grouted? | Yes [ ]
| No [ ]
| Not Specified [X] |

<table>
<thead>
<tr>
<th>Nearest Known Source of Contamination</th>
</tr>
</thead>
<tbody>
<tr>
<td>feet</td>
</tr>
</tbody>
</table>

- **Well disinfected upon completion?**
  - Yes [ ]
  - No [ ]

- **Pump**
  - Manufacturer's name

<table>
<thead>
<tr>
<th>Model Number</th>
<th>HP</th>
<th>Volt</th>
<th>Length of drop pipe</th>
<th>ft</th>
<th>Capacity</th>
<th>g.p.</th>
<th>Typ</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Abandoned</th>
</tr>
</thead>
</table>
| Does property have any not in use and not sealed well(s)? | Yes [ ]
| No [ ] |

<table>
<thead>
<tr>
<th>Variance</th>
</tr>
</thead>
</table>
| Was a variance granted from the MDH for this well? | Yes [ ]
| No [ ] |

<table>
<thead>
<tr>
<th>Miscellaneous</th>
</tr>
</thead>
<tbody>
<tr>
<td>First Bedrock</td>
</tr>
<tr>
<td>Last Strat</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Located by</th>
</tr>
</thead>
<tbody>
<tr>
<td>Minnesota Geological Survey</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Locate Method</th>
</tr>
</thead>
<tbody>
<tr>
<td>Digitized - scale 1:24,000 or larger (Digitizing Table)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>System</th>
</tr>
</thead>
<tbody>
<tr>
<td>UTM - NAD83, Zone 15, Meters X 587345 Y 4870661</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Unique Number Verification</th>
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</thead>
<tbody>
<tr>
<td>Input Date</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Angled Drill Hole</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Well Contractor</th>
</tr>
</thead>
<tbody>
<tr>
<td>Licensee Business</td>
</tr>
</tbody>
</table>

---

**Remarks**

---

**County**
- Winona

**Quad**
- Utica

**Quad ID**
- 26B

**Entry Date**
- 04/17/1988

**Update Date**
- 08/18/2016

**Received Date**
- 

**Minnesota Well Index Report**

---

**1000014074**

Printed on 10/16/2017

HE-01205-15
MINNESOTA DEPARTMENT OF HEALTH
WELL AND BORING REPORT
Minnesota Statutes Chapter 1031

Well Name: ROHRER, 106 9 W 16 CAB
Elevation: 1200

Well Depth: 270 ft.
Depth Completed: 270 ft.
Date Well Completed: 

Drill Method: 
Drill Fluid: 

Use: Status: Active
Well Hydrofractured? Yes No From To
Casing Type: Joint
Drive Shoe? Yes No Above/Below

Open Hole From ft. To ft.
Screen? Type Make

Static Water Level

Pumping Level (below land surface)

Wellhead Completion
Fitless adapter manufacturer: Model
Casing Protection 12 in. above grade
At-grade (Environmental Wells and Borings ONLY)

Grouting Information
Well Grouted? Yes No Not Specified

Nearest Known Source of Contamination
feet Direction Type
Well disinfected upon completion? Yes No

Pump
Manufacturer's name
Model Number
Length of drop pipe ft Capacity g.p. Typ

Abandoned
Does property have any not in use and not sealed well(s)? Yes No

Variance
Was a variance granted from the MDH for this well? Yes No

Miscellaneous
First Bedrock Aquifer
Last Strat Depth to Bedrock ft
Located by Minnesota Geological Survey
Locate Method Digitized - scale 1:24,000 or larger (Digitizing Table)
System UTM - NAD83, Zone 15, Meters X 587369 Y 4870564
Unique Number Verification Input Date 01/01/1990

Angled Drill Hole

Well Contractor
Licensee Business Lic. or Reg. No. Name of Driller

Remarks
**WELL AND BORING REPORT**

**Minnesota Statutes Chapter 1031**

<table>
<thead>
<tr>
<th>Well Name</th>
<th>Township</th>
<th>Range</th>
<th>Dir Section</th>
<th>Subsection</th>
<th>Elevation</th>
<th>Elev. Method</th>
</tr>
</thead>
<tbody>
<tr>
<td>LUEHMANN,</td>
<td>106</td>
<td>9</td>
<td>W 15</td>
<td>CABA</td>
<td>1195</td>
<td>7.5 minute topographic map (± 5 feet)</td>
</tr>
</tbody>
</table>

**Address**

**Stratigraphy Information**

**Well Depth**
- Depth Completed: 200 ft.
- Date Well Completed: 200 ft.

**Drill Method**
- Drill Fluid

**Use**
- Status: Active
- Well Hydrofractured?: Yes [ ] No [ ] From [ ] To [ ]

**Casing Type**
- Joint

**Drive Shoe?**
- Yes [ ] No [ ] Above/Below [ ]

**Open Hole**
- From [ ft. ] To [ ft. ]
- Screen? [ ] Type [ ] Make [ ]

**Static Water Level**
- [ ft. ] land surface
- Measure [ ] null

**Pumping Level (below land surface)**

**Wellhead Completion**
- Model
- Casing Protection [ ] 12 in. above grade [ ] At-grade (Environmental Wells and Borings ONLY) [ ]

**Grouting Information**
- Well Grouted? [ ] Yes [ ] No [ ] Not Specified

**Nearest Known Source of Contamination**
- Feet [ ] Direction
- Well disinfected upon completion? [ ] Yes [ ] No [ ]

**Pump**
- Not Installed [ ] Date Installed [ ]
- Manufacturer's name
- Model Number
- HP
- Capacity g.p.
- Typ
- Length of drop pipe [ ft. ]

**Abandoned**
- Does property have any not in use and not sealed well(s)? [ ] Yes [ ] No [ ]

**Variance**
- Was a variance granted from the MDH for this well? [ ] Yes [ ] No [ ]

**Miscellaneous**
- First Bedrock
- Last Strat
- Locate Method: Minnesota Geological Survey
- Locate Method: Digitized - scale 1:24,000 or larger (Digitizing Table)
- System: UTM - NAD83, Zone 15, Meters
- Unique Number Verification: Input Date 01/01/1990

**Angled Drill Hole**

**Well Contractor**
- Licensee Business
- Lic. or Reg. No.
- Name of Driller

Printed on 10/16/2017
HE-01205-15
**WELL AND BORING REPORT**

**MINNESOTA DEPARTMENT OF HEALTH**

**County:** Winona  
**Quad:** Utica  
**Quad ID:** 26B

**Entry Date:** 04/17/1988  
**Update Date:** 09/09/2014  
**Received Date:**

---

**Well Name:** PITCOCK, TONY  
**Township:** 106  
**Range:** 9  
**Dir Section:** W 15  
**Subsection:** DBBAAB  
**Elevation:** 1195  
**Elev. Method:** 7.5 minute topographic map (+/- 5 feet)

---

**Stratigraphy Information**

<table>
<thead>
<tr>
<th>Geological Material</th>
<th>From</th>
<th>To</th>
<th>Color</th>
<th>Hardness</th>
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<tbody>
<tr>
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<tr>
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<td>312</td>
<td>360</td>
<td>BROWN</td>
<td>MEDIUM</td>
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</tbody>
</table>

---

**Well Depth**  
**Depth Completed:** 360 ft.  
**Date Well Completed:** 06/29/1983

**Drill Method:** Non-specified Rotary  
**Drill Fluid:**

---

**Use:** domestic  
**Status:** Active

**Well Hydrofractured?**  
| Yes | No | From | To |

**Casing Type**  
**Step down**  
**Joint**  
**Welded**

**Drive Shoe?**  
| Yes | No | Above/Below |

**Casing Diameter**  
3 in. To 319 ft. lbs./ft.  
8 in. To 43 ft. lbs./ft.

---

**Open Hole**  
**From**  
**To**

**Screen?**  
**Type**  
**Make**

---

**Static Water Level**  
116 ft. land surface  
**Measure**  
06/30/1983

---

**Pumping Level (below land surface)**

---

**Wellhead Completion**

| Casing Protection | 12 in. above grade | At-grade (Environmental Wells and Boreholes ONLY) |

**Grouting Information**

<table>
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<tr>
<th>Well Grouted?</th>
<th>Yes</th>
<th>No</th>
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<tr>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Amount</td>
<td>9.5</td>
<td>Cubic yards</td>
<td></td>
</tr>
<tr>
<td>From</td>
<td></td>
<td>ft.</td>
<td></td>
</tr>
<tr>
<td>To</td>
<td></td>
<td>ft.</td>
<td></td>
</tr>
</tbody>
</table>

---

**Nearest Known Source of Contamination**

**feet**

**Well disinfected upon completion?**  
| Yes | No |

---

**Pump**

<table>
<thead>
<tr>
<th>Manufacturer's name</th>
<th>Model Number</th>
<th>HP</th>
<th>Volts</th>
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<tbody>
<tr>
<td></td>
<td></td>
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</tbody>
</table>

**Length of drop pipe**

**ft**

---

**Abandoned**

**Does property have any not in use and not sealed well(s)?**  
| Yes | No |

---

**Variance**

**Was a variance granted from the MDH for this well?**  
| Yes | No |

---

**Miscellaneous**

**First Bedrock**

**Last Strat**

**Located by**

**Locate Method**

**System**

**Unique Number Verification**

**Name on mailbox**

**Input Date**

01/01/1990

---

**Angled Drill Hole**

---

**Well Contractor**

**Thein Well Co.**

**VAN HOUTEN, D.**

**Licensee Business**

**Lic. or Reg. No.**

**Name of Driller**

---

**Remarks**

5.9 NITRATE IS FROM SOFTENED WATER PUMP INSTALLED BY OTHERS.
## MINNESOTA DEPARTMENT OF HEALTH
### WELL AND BORING RECORD
**Minnesota Statutes Chapter 1031**

**Well Name:** PITCOCK, TONY

<table>
<thead>
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<th>Range</th>
<th>Sec</th>
<th>Dir</th>
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<th>Date Well Completed</th>
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<tr>
<td>106</td>
<td>9</td>
<td>15</td>
<td>W</td>
<td>A</td>
<td>360 ft</td>
<td>360 ft.</td>
<td>06/29/1983</td>
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**Elevation:** 1195 ft.  
**Elev. Method:** 7.5 minute topographic map (+/- 5 feet)

**Aquifer:** Jordan  
**Depth to Bedrock:** 42 ft.  
**Open Hole:** - ft.  
**Static Water Level:** 116 ft.

**Field Located By:** Minnesota Geological Survey  
**Unique No. Verified:** Name on mailbox  
**Geological Interpretation Agency:** John Mossler  
**Input Source:** Minnesota Geological Survey  
**Input Date:** 01/01/1990  
**Locate Method:** Digitized - scale 1:24,000 or larger (Digitizing)

**Universal Transverse Mercator (UTM)**: NAD83 - Zone 15-
**UTM Easting (X):** 589257  
**UTM Northing (Y):** 487070  
**Interpretation Method:** Geologic study 1:24k to 1:100k

### Geological Material

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</table>

**Minnesota Well Index - Stratigraphy Report**

187629

Printed on 10/16/2017
October 30, 2017

Re: DNR Well Construction Preliminary Assessment; Tracking No. 2017-4001; T106N-R9W-S16 SENW; Winona County.

Daley Farm of Lewiston LLP
18942 County Road 18
Lewiston, MN 55952

Dear Daley Farm of Lewiston LLP:

This is your preliminary approval to construct a well. We have reviewed your well drilling proposal and determined that the proposed rate and volume may interfere with other water users or have negative impacts on nearby lakes, streams or wetlands.

**Basis for recommendation:**
State law¹ requires that use of water not cause harm to ecosystems, degrade water quality, or significantly reduce the public water supply. We found that your proposed well has the following potential concerns:

- An unnamed trout stream tributary to the Whitewater River is located within 1.8 miles of the proposed wells.

  Rush Creek, a DNR designated trout stream, is 2.2 miles from the proposed wells.

- Non-DNR Protected Streams are located .22, .24 and .34 miles from the proposed well site.

- Wilsons' Phalarope, a State Species of Concern, was documented 1.9 miles from the site of the proposed wells.

- A 300 foot deep domestic (home water supply) well is located .26 miles from the site of the proposed wells.

- The City of Lewiston Wellhead Protection Area is located .30 miles from the site of the proposed wells.

- An active Minnesota Pollution Control Agency pollution site exists in the City of Lewiston, 2.5 miles from the site of the proposed wells.

---

¹ Minnesota Statute 103G.287
² Minnesota Statute 103I
The attached assessment checklist contains further information about our analysis.

**If you choose to drill this well:**
The well contractor or property owner needs to notify the MN Department of Health² before the well is constructed.

**Then:**
The landowner needs to apply for a DNR water appropriation permit before the well is pumped for production. A permit from the DNR is required for water use above 10,000 gallons per day or 1 million gallons per year. The easiest method to apply for a water use permit is through the Minnesota DNR Permitting and Reporting System (MPARS) at www.mndnr.gov/mpars/signin. Instructions at this website will assist you, step-by-step, through the application process.

To more completely understand the risk to other wells or lakes, streams or wetlands, you may be asked for additional information and testing or monitoring, at your expense. We will use this information to determine how much water can be appropriated.

**Please note:**
This preliminary approval to construct a well is information you can use to decide whether to proceed in constructing a well and is based largely on information you provided. It is not notification to the MN Department of Health, and is not a DNR water use permit.

Thank you for your attention. We anticipate this process will save money for landowners with water needs near sensitive or limited water resources, and will help avoid water shortages. If you have any questions, please contact me at 651-259-5877 or joe.richter@state.mn.us.

Sincerely,

Joe Richter
Hydrologist

Enclosures
Re: DNR Well Construction Preliminary Assessment; Tracking No. 2017-4001; T106N-R9W-S16
SENW; Winona County.

This well construction preliminary assessment is not an appropriation permit. State law requires you
to obtain preliminary approval to drill a well that is required to have a DNR water appropriation permit. A
water appropriation permit from the DNR is required for all users withdrawing more than 10,000 gallons of
water per day or 1 million gallons per year. DNR Staff have evaluated your project to determine whether the
proposed appropriation is likely to meet statutory requirements in Minnesota Statute section 103G.287.

The factors checked below are those that we believe may be impacted by your proposed water use:

☐ Calcareous fens
☑ Designated trout streams
☑ Lakes and rivers, wetlands
☑ Rare Species (Threatened, Endangered, Special Concern), Native Plant Communities (S1-3)
☐ Minnesota Biological Survey Sites of Biodiversity Significance (High, Outstanding)
☐ Known well interference problems
☑ Existing water appropriation permits with higher priority as defined in Statute 103G.261
☐ Publicly owned lands such as DNR Wildlife Management Areas
☑ Municipal Wellhead Protection Areas, Drinking Water Source Management Areas, Source Water
  Protection Areas
☑ Known groundwater contamination
☐ Groundwater management areas or areas with declining water levels
☐ MDH Special Well and Boring Construction Areas

If any of the factors above are marked with a checkmark, you may be required to install monitoring well(s),
perform aquifer test(s), or provide other information to ascertain anticipated impacts to these features. This
information will be used to evaluate and make a decision on your water appropriation request. Your water
appropriation request may be modified, reduced, or denied based upon site specific information.
Daley Well Construction Assessment.

-------- Forwarded Message --------
Subject: [MPARS] Well Assessment 2017-4001 Assessment Complete
Date: Mon, 30 Oct 2017 11:00:22 -0500
From: NOREPLY.MPARS.dnr@state.mn.us
To: charissa@oakridgeeng.com

The DNR has completed review of a well drilling proposal in Winona County. Please see the attached assessment letter and checklist for the determination. If you are not the applicant, you are receiving this notification as a courtesy.

This assessment is based on the best information available. As time passes, it is likely that we will learn more about the water resources in this area. We encourage you to request a new assessment if you do not drill your proposed well this year, your proposal changes (e.g. well depth, location, pumping rate), and/or there is a significant change in water use in your area.

You may sign-in to the MNDNR Permitting and Reporting System (MPARS) using the link below anytime you wish to view this assessment. If you are using MPARS for the first time, you will need to create an account.

https://webapps11.dnr.state.mn.us/mpars/public/permits

If you have any questions about the well assessment, please contact Joe Richter at joe.richter@state.mn.us, 651-259-5877.

*** DO NOT REPLY TO THIS EMAIL ***

--
Charissa Tiry, Technician
Oakridge Engineering, Inc.
Charissa@OakridgeEng.com | 715.723.6777:0 | www.OakridgeEng.com
Well Construction Assessment Form

<table>
<thead>
<tr>
<th>Date Submitted to DNR:</th>
<th>October 17, 2017 at 1:53 PM</th>
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<table>
<thead>
<tr>
<th>DNR Lead Hydrologist:</th>
<th>Joe Richter</th>
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<tbody>
<tr>
<td>Area:</td>
<td>Lake City</td>
</tr>
<tr>
<td>Email:</td>
<td><a href="mailto:joe.richter@state.mn.us">joe.richter@state.mn.us</a></td>
</tr>
<tr>
<td>Phone:</td>
<td>651-259-5877</td>
</tr>
<tr>
<td>DNR Region:</td>
<td>Central Region 3</td>
</tr>
<tr>
<td>Address:</td>
<td>Minnesota Department of Natural Resources</td>
</tr>
<tr>
<td></td>
<td>1200 Warner Road</td>
</tr>
<tr>
<td></td>
<td>St. Paul, MN 55106</td>
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<table>
<thead>
<tr>
<th>Parties (Individuals and Organizations associated with the assessment)</th>
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<tbody>
<tr>
<td>Daley Farm of Lewiston LLP - Landowner or Government Unit</td>
</tr>
<tr>
<td>Address: 18942 County Road 18, Lewiston, MN 55952</td>
</tr>
<tr>
<td>Phone: 507-523-3687</td>
</tr>
<tr>
<td>Charissa Tiry - Contact (representing Oakridge Engineering, Inc.)</td>
</tr>
<tr>
<td>Address: 220 1/2 North Bridge Street, PO Box 44, Chippewa Falls, WI 54729</td>
</tr>
<tr>
<td>Phone: 715-723-6777</td>
</tr>
<tr>
<td>Email: <a href="mailto:charissa@oakridgeengineering.com">charissa@oakridgeengineering.com</a></td>
</tr>
<tr>
<td>Ben Daley - Contact (representing Daley Farm of Lewiston LLP)</td>
</tr>
<tr>
<td>Address: 19317 Highway 14, Lewiston, MN 55952</td>
</tr>
<tr>
<td>Phone: 507-257-2444</td>
</tr>
<tr>
<td>Email: <a href="mailto:bdaley7@hotmail.com">bdaley7@hotmail.com</a></td>
</tr>
<tr>
<td>Oakridge Engineering, Inc. - Agent</td>
</tr>
<tr>
<td>Address: 220 1/2 North Bridge Street, PO Box 44, Chippewa Falls, WI 54729</td>
</tr>
<tr>
<td>Phone: 715-723-6777</td>
</tr>
</tbody>
</table>

Proposed Activity

Private Water Supply
### Location and Water Resources

**Installation Name:** Installation #1  
**Counties:** Winona  
**Watersheds:** Mississippi River - Winona, Root River  
**PLS:** T106N-R9W-S16 NENW, T106N-R9W-S16 SENW  
**UTM:** X:587271 Y:4871079  
**Water Resources:** Groundwater

**Installation Name:** Installation #2  
**Counties:** Winona  
**Watersheds:** Mississippi River - Winona, Root River  
**PLS:** T106N-R9W-S16 NENW, T106N-R9W-S16 SENW  
**UTM:** X:587192 Y:4871080  
**Water Resources:** Groundwater

### Well Construction Assessment Overview

<p>| | | |</p>
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<tr>
<th></th>
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<tbody>
<tr>
<td>1</td>
<td>What is the main type of work you are proposing to do?</td>
<td>Well assessment</td>
</tr>
<tr>
<td>2</td>
<td>If drilled, would this well(s) be connected to an existing system that is already covered by a DNR water appropriation permit?</td>
<td>No</td>
</tr>
<tr>
<td>3</td>
<td>Which of the following most accurately describes what you are proposing?</td>
<td>Drilling two or more new wells that will be connected together</td>
</tr>
<tr>
<td>4</td>
<td>How many individual wells are you planning to drill at this time?</td>
<td>2</td>
</tr>
<tr>
<td>5</td>
<td>What is the maximum desired pumping rate for the entire system (in gpm)?</td>
<td>115</td>
</tr>
<tr>
<td>6</td>
<td>What is the maximum volume of water you think you will need per year (in million gallons), if known? (For example, enter 2,500,000 gallons as 2.5)</td>
<td>60 million gallons per year</td>
</tr>
</tbody>
</table>
| 7 | If you are not the well driller, please provide their name, phone number, and email address. (if known) | Thein Well Rochester, Inc. 7025 Highway 63 N., Rochester, MN, 55906 507-288-5554  
TheinWell1@aol.com Contact: Mark Thein 507-696-7188  
TheinBomb@aol.com |
| 8 | What is the county property parcel ID# for the land where the well(s) are proposed to be drilled (enter multiple if applicable)? (if known) | 150001320 |

### Activity Detail

**Activity:** Private Water Supply
Activity Detail (Continued)

I don't know how much water I need N/A

Will your water supply system serve fewer than 25 people? No

Installations (2)

**Installation #1 Name:** Installation #1 (Well)

1. What is the estimated proposed depth (in feet) of the well? (if known) 700 feet
2. What is the maximum desired pumping rate (in gpm) for this well? 58 gallons per minute
3. What is the water source formation? Deeper bedrock unit
4. What is the aquifer name? (if known) Jordan, St. Lawrence, and Tunnel City
5. Counties Winona
6. Watersheds Mississippi River - Winona, Root River
7. PLS T106N-R9W-S16 NENW, T106N-R9W-S16 SENW
8. UTMXY X:587271 Y:4871079
9. Water resources Groundwater

**Installation #2 Name:** Installation #2 (Well)

1. What is the estimated proposed depth (in feet) of the well? (if known) 700 feet
2. What is the aquifer name? (if known) Jordan, St. Lawrence, and Tunnel City
3. What is the maximum desired pumping rate (in gpm) for this well? 58 gallons per minute
4. What is the water source formation? Deeper bedrock unit
5. Counties Winona
6. Watersheds Mississippi River - Winona, Root River
7. PLS T106N-R9W-S16 NENW, T106N-R9W-S16 SENW
8. UTMXY X:587192 Y:4871080
9. Water resources Groundwater

Acknowledgment (By the party who submitted the well assessment)

☑ I attest that:
   - I own or control (by lease, license, or other permission) the land from which groundwater or surface water will be appropriated, AND
   - There are no easements or other restrictions on the land that would prohibit the proposed activities from being authorized under a permit, AND
   - I possess the authority to undertake the work described, or I am acting as a duly authorized agent, AND
   - The information submitted and the statements made concerning this application are true and correct to the best of my knowledge, AND
   - If I drill the proposed well, I will apply for and receive a DNR water use permit prior to pumping.

PRINTED: 10/17/2017 at 1:53 PM

NOTICE: THIS IS NOT A PERMIT. All information provided on this application form is considered to be public information in accordance with the Minnesota Data Practices Act (Minnesota Statutes, Chapter 13).
Winona County - Groundwater Sensitivity

Project Site
- Manure Application Sites
- Karst
- Water
- Bedrock at or near surface
- High
- Moderate
- Low
- Very low
Air Quality Modeling Report
Daley Farm of Lewiston, LLP
Proposed Dairy Expansion

Winona County
Utica Township
N ½ Section 16

Prepared by
Barr Engineering Company
4300 MarketPointe Drive, Suite 200
Minneapolis, Minnesota  55435

September 2016
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Introduction

Daley Farm of Lewiston, LLP (Daley) proposes to expand its dairy by adding a 3,000-head freestall barn, a second holding barn, and a fifth manure storage basin.

Based on a protocol approved by the Minnesota Pollution Control Agency (MPCA) on May 6, 2016, air quality modeling calculated the hydrogen sulfide concentrations, ammonia concentrations, and odor intensities at the property lines for the expanded Daley dairy and at the locations for 42 of the expanded dairy’s nearest neighbors.

The modeled emission sources for the expanded feedlot consisted of the following:

• one 836-ft by 436-ft freestall barn (proposed),
• four 290-ft by 120-ft dairy barns (existing),
• one 145-ft by 66-ft dairy barn (existing),
• one 150-ft by 60-ft dairy barn (existing),
• one 135-ft by 75-ft holding barn (existing),
• one 180-ft by 68-ft holding barn (proposed),
• one 150-ft by 65-ft sand separation building (existing),
• one 136-ft by 95-ft open lot (existing),
• one 465-ft by 265-ft manure basin (existing),
• one 250-ft by 220-ft manure basin (existing),
• two 220-ft by 210-ft manure basins (existing), and
• one 400-ft by 400-ft manure basin (proposed).

In addition to the expanded Daley dairy, the air quality modeling also included the gaseous emissions from thirteen neighboring feedlots. The locations of the expanded dairy, the thirteen neighboring feedlots, and the 42 neighboring residences are provided in Figure 1.

The following atmospheric concentrations were calculated:

1. the maximum hourly hydrogen sulfide concentration at the property lines for the expanded Daley dairy to assess the potential to comply with Minnesota’s ambient air quality standard for hydrogen sulfide of 30 parts per billion (ppb);
2. the maximum monthly hydrogen sulfide concentration at 42 of the expanded dairy’s nearest neighbors to assess the potential to exceed Minnesota’s subchronic (13-week) inhalation Health Risk Value (iHRV) for hydrogen sulfide of 10 micrograms per cubic meter ($\mu g/m^3$);
3. the maximum hourly ammonia concentration at the property lines for the expanded Daley dairy to assess the potential to exceed Minnesota’s acute iHRV for ammonia of 3,200 $\mu g/m^3$;
4. the maximum annual ammonia concentration at 42 of the expanded dairy’s nearest neighbors to assess the potential to exceed Minnesota’s chronic iHRV for ammonia of 80 $\mu g/m^3$; and
5. the maximum hourly odor intensities at the property lines for the expanded Daley dairy and at 42 of the dairy’s nearest neighbors to access the potential for off-site odor episodes.

The above concentrations were calculated using the AERMOD air quality model, based on 5 years of historical weather data.
Figure 1. Modeled locations of the Daley dairy, the thirteen neighboring feedlots, and the 42 neighboring residences (not labeled).
The modeling results suggest that the expanded Daley dairy will comply with the Minnesota ambient air quality standard for hydrogen sulfide. The standard regards the third exceedance of 30 ppb within any 5-day period as a violation. Compliance is demonstrated when the high-third-high (H3H) concentration (with background) for any 5-day period at each property-line receptor is less than 30 ppb. AERMOD calculated a maximum H3H hydrogen sulfide concentration of 7.72 ppb at the expanded dairy’s property lines.

When a background concentration of 17 ppb is added to the AERMOD-calculated concentration, the H3H hydrogen sulfide concentration is 24.72 ppb, which is below the ambient standard of 30 ppb. Thus, no violation of the 30-ppb ambient hydrogen sulfide standard was modeled for the expanded Daley dairy.

The modeling approach assumed that the expanded Daley dairy and the thirteen neighboring feedlots are the only significant and quantifiable emission sources within a 3-mile by 3-mile grid. The air quality impacts associated with the fourteen feedlots were explicitly modeled. The air quality impacts associated with any other sources in the modeled 3-mile by 3-mile grid were considered implicitly as contributors to the background concentrations that are added to the modeling results. Hence, the background concentrations of hydrogen sulfide and ammonia include the impacts associated with sources such as small feedlots, septic tank vents, fertilizer and manure application to cropland, and wetlands.

The AERMOD results indicate that the expanded Daley dairy and the thirteen neighboring feedlots will not create exceedances of the chronic ammonia iHRV at the neighboring residences. The calculated maximum one-year time-averaged ammonia concentration for the neighbors is 19.54 µg/m³. When a background ammonia concentration of 5.72 µg/m³ is added to the AERMOD concentration, the maximum annual ammonia concentration for a neighboring residence is 25.26 µg/m³, which is below the chronic ammonia iHRV of 80 µg/m³.

Thus, the AERMOD modeling results for the expanded Daley dairy suggest compliance with the hydrogen sulfide air quality standard, no exceedances of the subchronic hydrogen sulfide iHRV, no exceedances of the acute ammonia iHRV, and no exceedances of chronic ammonia iHRV.

General Modeling Approach

The modeling approach assumed that the expanded Daley dairy and the thirteen neighboring feedlots are the only significant and quantifiable emission sources within a 3-mile by 3-mile grid. The air quality impacts associated with the fourteen feedlots were explicitly modeled. The air quality impacts associated with any other sources in the modeled 3-mile by 3-mile grid were considered implicitly as contributors to the background concentrations that are added to the modeling results. Hence, the background concentrations of hydrogen sulfide and ammonia include the impacts associated with sources such as small feedlots, septic tank vents, fertilizer and manure application to cropland, and wetlands.
The AERMOD (version 15181) air quality model\(^1\) was used to calculate the property-line and nearest-neighbor odorous gas concentrations. The calculated concentrations were based on historical wind speeds, wind directions, atmospheric stabilities, and rural mixing heights. The historical weather data consisted of five years (2009-2013) of surface meteorological data for the National Weather Service (NWS) station in Rochester, MN and of upper air weather data for the NWS station in Chanhassen, MN. The Rochester surface weather data represents a location surrounded by flat terrain and row crops. Similar conditions immediately surround the expanded Daley dairy site. The surface and upper air weather data files were combined into an AERMET (version 14134) meteorological file by the MPCA.\(^1\)\(^2\)\(^3\)

Maximum one-hour, monthly, and annual average concentrations were calculated. The modeling assumed no decay of any modeled gas due to chemical reactions. A complex terrain was considered. Source and receptor elevations were determined by AERMAP (version 11103)\(^6\)\(^7\) using National Elevation Dataset (NED) files obtained from the Multi-Resolution Land Characteristics Consortium (MRLC) website.\(^8\) The modeled receptor height was ground level. All modeled property-line and nearest-neighbor receptors were defined as discrete receptors. Property-line receptors were less than or equal to 25 meters apart. An arbitrary Cartesian coordinate system \((x, y)\) was used with the southwest corner of Section 16, Utica Township, Winona County as the origin \((0, 0)\). Positive values of \(x\) represent distance east of the origin. Positive values of \(y\) represent distance north of the origin.

**Impact Thresholds and Background Values**

To assess the potential for environmental impacts, the concentrations of hydrogen sulfide and ammonia generated by the air quality modeling were compared to air quality standards and inhalation Health Risk Values (iHRVs). The AERMOD-generated odor intensities were compared to an odor classification system based on detection-threshold odor numbers.

The direct comparison of model-generated concentrations to these environmental threshold concentrations does not consider the impact of different averaging times. EPA guidelines do not allow concentrations to be time averaged for time

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\(^8\) [http://www.mrlc.gov/viewerjs](http://www.mrlc.gov/viewerjs)
periods less than an hour. This is important because the Minnesota ambient air quality standards for hydrogen sulfide are based on average concentrations over a 30-minute time period and because the published odor intensity correlations are often based on instantaneous measurements. For example, an hourly model-generated hydrogen sulfide concentration of 29 ppb may contain a half-hour average concentration that exceeds the 30 ppb standard. Also, an odor intensity that an odor panelist may find to be merely detectable in a short-term field measurement could be annoying if present for an hour or longer.

The background concentrations of hydrogen sulfide and ammonia provided in Table 1 were added to the AERMOD-calculated concentrations as described in EPA guidelines. The listed background concentrations are for rural Minnesota. The listed 17-ppb background hydrogen sulfide concentration is appropriate when assessing a feedlot’s potential to comply with the 30-ppb standard. A background concentration of 18 ppb should be used when assessing the potential to comply with the 50-ppb hydrogen sulfide standard.

The background concentrations listed in Table 1 are not the time-averaged concentrations obtained from monitoring. Instead, the listed concentrations reflect the monitored data expressed in the terms of the “exceedance or violation condition” for the corresponding iHRV guideline or ambient standard. For example, the background 208-ppb ammonia concentration for the acute ammonia iHRV represents the maximum hourly concentration that occurred within the entire length of monitoring. This is the appropriate interpretation of background for the acute ammonia iHRV, because the guidance is concerned with any potential exceedance of the iHRV. Also, the 17-ppb hydrogen sulfide background represents the third highest 30-minute concentration that occurred within any 5-day period (i.e., the high-third-high or H3H). This is appropriate, because the ambient hydrogen sulfide standard defines a violation as the third exceedance of 30-ppb within any 5-day period.

To assess the potential for odor episodes, the estimated atmospheric concentrations of hydrogen sulfide and ammonia were compared to each gas’s reported odor threshold concentration. The odor

<table>
<thead>
<tr>
<th>Pollutant</th>
<th>Hourly Background Concentration</th>
<th>13-Week Background Concentration</th>
<th>Annual Background Concentration</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hydrogen Sulfide</td>
<td>17 ppb (v/v) (24.3 µg/m³)</td>
<td>0.70 ppb (v/v) (1.00 µg/m³)</td>
<td>Not Required</td>
</tr>
<tr>
<td>Ammonia</td>
<td>208 ppb (v/v) (148 µg/m³)</td>
<td>Not Required</td>
<td>8.07 ppb (v/v) (5.72 µg/m³)</td>
</tr>
</tbody>
</table>


threshold concentration is defined as the gas-phase concentration at which 50 percent of the population can detect the gas’s odor. For this presentation, odor number is defined as the ratio of the estimated atmospheric concentration for a specific odorous gas divided by its odor threshold concentration. An odor number equal to 1 suggests that 50 percent of the population can detect the estimated atmospheric concentration for a specific gas. An odor number greater than 1 suggests that more than 50 percent of the population can detect the gas, while a value less than 1 indicates that less than 50 percent of the population can detect the gas. Typically, an odor number below about 0.1 suggests that less than 1 percent of the population can detect the gas. The odor threshold concentrations used in this assessment are presented in Table 2.

<table>
<thead>
<tr>
<th>Odorous Gas</th>
<th>Odor Threshold Concentration (ppb, v/v)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hydrogen Sulfide</td>
<td>9.4</td>
</tr>
<tr>
<td>Ammonia</td>
<td>5,800</td>
</tr>
</tbody>
</table>

As a second means of assessing potential odor impacts, the AERMOD-calculated odor intensities (expressed as detection-threshold odor units) were compared to the reference odor intensities provided in Table 3. An odor intensity of 83 detection-threshold odor units (OU) is defined as a faint odor and is the odor intensity that “an average person might detect if attention is called to the odor, but the odor would not otherwise be noticed.”


Table 3. Odor intensity classification.15

<table>
<thead>
<tr>
<th>Odor Intensity Number</th>
<th>Odor Strength</th>
<th>n-Butanol Reference Solution (ppm)</th>
<th>Detection-Threshold Odor Units (OU, D/T)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>no odor</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>1</td>
<td>very faint</td>
<td>250</td>
<td>28</td>
</tr>
<tr>
<td>2</td>
<td>faint</td>
<td>750</td>
<td>83</td>
</tr>
<tr>
<td>3</td>
<td>moderate</td>
<td>2,250</td>
<td>244</td>
</tr>
<tr>
<td>4</td>
<td>strong</td>
<td>6,750</td>
<td>723</td>
</tr>
<tr>
<td>5</td>
<td>very strong</td>
<td>20,250</td>
<td>2,140</td>
</tr>
</tbody>
</table>

Source Characterizations

The livestock barns at the expanded Daley dairy and at the neighboring feedlots were characterized as either line sources or volume sources using the approaches described in EPA air quality modeling documentation.16, 17 A barn with a length greater than twice its width (aspect ratio greater than 2) was represented as a line source, i.e., a line of separated square volume subsources. A barn with an aspect ratio less than or equal to 2 was modeled as a square volume source.

For the open dairy and cattle lots at the expanded Daley dairy and at the neighboring feedlots, the OPENLOTFLUX algorithms calculated the hourly hydrogen sulfide, ammonia, and odor emission flux rates based on the wind speed, cloud cover, solar radiation, air


temperature, and surface soil temperature. OPENLOTFLUX uses mass transfer algorithms obtained from the agricultural and micro-meteorological literature. OPENLOTFLUX uses the average effective hydrogen sulfide and ammonia concentrations at the surface of the manure pack obtained from cattle feedlot monitoring data. An average effective odor surface concentration was obtained from the flux chamber measurements of Duysen et al. (2003) and the ratio of ammonia fluxes measured with flux chambers and micro-meteorological techniques reported by Beak et al. (2006). The impact of manure pack temperature on hydrogen sulfide and ammonia flux rates was calculated using the correlations of Koziel et al. (2005). Manure pack temperatures were calculated from the historical soil temperatures at 4-inch below the surface near Lamberton, MN. Monthly scalars were used to address temperature impacts on odor emission flux rates.

The dairy and cattle manure storage basins were characterized as non-buoyant area sources. The BASINODOR algorithms calculated hourly hydrogen sulfide and ammonia emission rates based on the water-phase concentration of the modeled gas, the estimated water temperature, and the recorded wind speed. BASINODOR uses EPA-recommended mass-transfer algorithms to estimate emission rates. The liquid-phase mass transfer coefficients in the BASINODOR algorithms are defined by modified Mackay-Yeun correlations.

The overall mass transfer coefficients for the crust-covered manure basins were adjusted to...
account for the presence of a crust. The dry crust is assumed to be 1-inch thick and to prevent the wind-induced mixing of the liquid surface. While the crust is assumed to reduce the gas-phase mass transfer coefficient, no chemical or biological reactions are assumed to occur within the crust. The modeled effectiveness of a 1-inch thick dry crust in reducing emissions is provided in Figure 2.

Hourly water temperatures within the manure storage basins were estimated by the heat balance approach described in Thomann and Mueller (1987). The approach assumes that the basin is completely-mixed vertically and that the sky is free of clouds. The EPA’s PCRAMMET algorithms were used to estimate the hourly variation in solar radiation based on day of the year, hour of the day, site latitude, and site longitude. Basin depth was assumed constant and equal to maximum design capacity depth. When the water temperature algorithms predict water temperatures less than or equal to 0°C (32°F), the emission algorithms assumed that the basin was ice covered and that no gas emissions were emitted into the atmosphere.

Figure 2. Modeled percent reduction in emission rates from a crust-covered basin compared to a crust-free basin. The gas-specific responses to wind speed are due to differences in the Henry’s Law coefficients and diffusion coefficients for the three gases. A uniform temperature of 20°C (68°F) is assumed.

**Neighboring Residences**

The air quality modeling calculated the odorous gas concentrations at the 42 neighboring residences shown in Figure 3.

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Figure 3. Modeled locations of the Daley dairy, the thirteen neighboring feedlots (not labeled), and the 42 neighboring residences.


**Site Descriptions**

**Expanded Daley Dairy**

The expanded Daley dairy will consist of seven dairy barns, two holding barns, one sand separation building, one open dairy lot, and five crust-covered manure storage basins. The modeled locations of the barns, lot, and basins are provided in Figure 4. The setback distances to the property lines range from 464 to 1,285 feet.

The physical characteristics of the dairy barns, holding barns, and the sand separation building are provided in Table 4. Two barns, Dairy #5 and Dairy #6, no longer house livestock, but were modeled as active dairy barns. The proposed freestall barn (Dairy #7) and the existing holding barn (Holding #1) were modeled as volume sources. The remaining barns and buildings were modeling as line sources.

The following crust-covered manure storage basins were modeled as non-buoyant area sources:

- 465-ft by 265-ft manure basin (Basin #1),
- 250-ft by 220-ft manure basin (Basin #2),
- 220-ft by 210-ft manure basin (Basin #3),
- 220-ft by 210-ft manure basin (Basin #4), and
- 400-ft by 400-ft manure basin (Basin #5).

The 136-ft by 95-ft open dairy lot (Lot #1) was modeled as a non-buoyant area source.

![Figure 4. Modeled locations of the buildings, lot, and basins for the expanded Daley dairy.](image)
Table 4. Dimensions and capacities of the barns and buildings at the expanded Daley dairy.

<table>
<thead>
<tr>
<th>Dairy Barn</th>
<th>Barn Length (feet)</th>
<th>Barn Width (feet)</th>
<th>Barn Height (feet)</th>
<th>Number of Housed Animals</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dairy #1</td>
<td>290</td>
<td>120</td>
<td>28</td>
<td>400 cows</td>
</tr>
<tr>
<td>Dairy #2</td>
<td>290</td>
<td>120</td>
<td>28</td>
<td>150 heifers, 150 cows</td>
</tr>
<tr>
<td>Dairy #3</td>
<td>290</td>
<td>120</td>
<td>28</td>
<td>400 heifers</td>
</tr>
<tr>
<td>Dairy #4</td>
<td>290</td>
<td>120</td>
<td>28</td>
<td>400 cows</td>
</tr>
<tr>
<td>Dairy #5</td>
<td>145</td>
<td>66</td>
<td>21</td>
<td>none</td>
</tr>
<tr>
<td>Dairy #6</td>
<td>150</td>
<td>60</td>
<td>21</td>
<td>none</td>
</tr>
<tr>
<td>Dairy #7</td>
<td>836</td>
<td>436</td>
<td>30</td>
<td>3,000 cows</td>
</tr>
<tr>
<td>Holding #1</td>
<td>135</td>
<td>75</td>
<td>22</td>
<td>varies</td>
</tr>
<tr>
<td>Holding #2</td>
<td>180</td>
<td>68</td>
<td>21</td>
<td>varies</td>
</tr>
<tr>
<td>Sand #1</td>
<td>150</td>
<td>65</td>
<td>21</td>
<td>none</td>
</tr>
</tbody>
</table>

Feedlot #1

Feedlot #1 is a dairy heifer and dairy calf feedlot. The feedlot consists of one dairy barn and one open dairy lot. The modeled locations of the barn and lot are provided in Figure 5.

The physical characteristics of the dairy barn are provided in Table 5. Dairy #1 was modeled as a line source.

The 200-ft by 148-ft lot (Lot #1) was modeled as a non-buoyant area source.

Figure 5. Modeled locations of the dairy barn and open lot at Feedlot #1.
Table 5. Dimensions of the dairy barn at Feedlot #1.

<table>
<thead>
<tr>
<th>Dairy Barn</th>
<th>Barn Length (feet)</th>
<th>Barn Width (feet)</th>
<th>Barn Height (feet)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dairy #1</td>
<td>240</td>
<td>76</td>
<td>22</td>
</tr>
</tbody>
</table>

Feedlot #2

Feedlot #2 consists of one dairy heifer barn and one crust-covered manure storage basin. The modeled locations of the barn and basin are provided in Figure 6.

The physical characteristics of the dairy barn are provided in Table 6. Dairy #1 was modeled as a line source.

The 140-ft by 120-ft crust-covered basin (Basin #1) was modeled as a non-buoyant area source.

![Figure 6. Modeled locations of the dairy barn and manure basin at Feedlot #2.](image)

Table 6. Dimensions of the dairy barn at Feedlot #2.

<table>
<thead>
<tr>
<th>Dairy Barn</th>
<th>Barn Length (feet)</th>
<th>Barn Width (feet)</th>
<th>Barn Height (feet)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dairy #1</td>
<td>110</td>
<td>40</td>
<td>17</td>
</tr>
</tbody>
</table>
**Feedlot #3**

Feedlot #3 is a dairy heifer feedlot consisting of one barn and one open lot (Figure 7).

The barn dimensions are provided in Table 7. Dairy #1 was modeled as a line source.

The 315-ft by 280-ft lot (Lot #1) was modeled as a non-buoyant area source.

![Figure 7. Modeled locations of the barn and open lot at Feedlot #3.](image)

**Table 7. Dimensions of the dairy barn at Feedlot #3.**

<table>
<thead>
<tr>
<th>Dairy Barn</th>
<th>Barn Length (feet)</th>
<th>Barn Width (feet)</th>
<th>Barn Height (feet)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dairy #1</td>
<td>235</td>
<td>40</td>
<td>17</td>
</tr>
</tbody>
</table>

**Feedlot #4**

Feedlot #4 is dairy feedlot. The feedlot consists of three dairy barns and one manure basin. The modeled locations of the barns and basin are provided in Figure 8.

The physical characteristics of the dairy barns are provided in Table 8. Dairy #1 and Dairy #2 were modeled as volume sources. Dairy #3 was modeled as a line source.

The 130-ft by 110-ft crust-covered manure basin (Basin #1) was modeled as a non-buoyant area source.

![Figure 8. Modeled locations of the dairy barns and manure basin at Feedlot #4.](image)
Feedlot #5

Feedlot #5 is an apparent dairy feedlot consisting of two dairy barns and one manure basin. The modeled locations of the barns and basin are provided in Figure 9.

The physical characteristics of the dairy barns are provided in Table 9. Dairy #1 and Dairy #2 were modeled as line sources.

The 130-ft by 130-ft crust-covered manure basin (Basin #1) was modeled as a non-buoyant area source.

Table 8. Dimensions of the dairy barns at Feedlot #4.

<table>
<thead>
<tr>
<th>Dairy Barn</th>
<th>Barn Length (feet)</th>
<th>Barn Width (feet)</th>
<th>Barn Height (feet)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dairy #1</td>
<td>96</td>
<td>66</td>
<td>20</td>
</tr>
<tr>
<td>Dairy #2</td>
<td>90</td>
<td>46</td>
<td>18</td>
</tr>
<tr>
<td>Dairy #3</td>
<td>325</td>
<td>60</td>
<td>20</td>
</tr>
</tbody>
</table>

Table 9. Dimensions of the dairy barns at Feedlot #5.

<table>
<thead>
<tr>
<th>Dairy Barn</th>
<th>Barn Length (feet)</th>
<th>Barn Width (feet)</th>
<th>Barn Height (feet)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dairy #1</td>
<td>124</td>
<td>60</td>
<td>20</td>
</tr>
<tr>
<td>Dairy #2</td>
<td>375</td>
<td>105</td>
<td>25</td>
</tr>
</tbody>
</table>
Feedlot #6

Feedlot #6 is a 225-head dairy heifer feedlot consisting of two open lots (Figure 10).

Both the 115-ft by 72-ft lot (Lot #1) and the 245-ft by 62-ft lot (Lot #2) were modeled as non-buoyant area sources.

Feedlot #7

Feedlot #7 is a dairy feedlot with one barn and one open lot. The modeled locations of the barn and lot are provided in Figure 11.

The physical characteristics of the dairy barn are provided in Table 10. Dairy #1 was modeled as a line source.

The 208-ft by 190-ft lot (Lot #1) was modeled as a non-buoyant area source.

Table 10. Dimensions of the dairy barn at Feedlot #7.

<table>
<thead>
<tr>
<th>Dairy Barn</th>
<th>Barn Length (feet)</th>
<th>Barn Width (feet)</th>
<th>Barn Height (feet)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dairy #1</td>
<td>122</td>
<td>55</td>
<td>19</td>
</tr>
</tbody>
</table>
**Feedlot #8**

Feedlot #8 is a cattle feedlot consisting of two barns and two open lots. The modeled locations of the barns and lots are provided in Figure 12.

The physical characteristics of the cattle barns are provided in Table 11. Both barns were modeled as line sources.

Both the 164-ft by 44-ft lot (Lot #1) and the 241-ft by 50-ft lot (Lot #2) were modeled as non-buoyant area sources.

![Figure 12. Modeled locations of the cattle barns and open cattle lots at Feedlot #8.](image)

**Table 11. Dimensions of the cattle barns at Feedlot #8.**

<table>
<thead>
<tr>
<th>Cattle Barn</th>
<th>Barn Length (feet)</th>
<th>Barn Width (feet)</th>
<th>Barn Height (feet)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cattle #1</td>
<td>132</td>
<td>49</td>
<td>18</td>
</tr>
<tr>
<td>Cattle #2</td>
<td>241</td>
<td>35</td>
<td>16</td>
</tr>
</tbody>
</table>

**Feedlot #9**

Feedlot #9 is an inactive dairy heifer feedlot consisting of one barn and one open lot (Figure 13).

The barn dimensions are provided in Table 12. Dairy #1 was modeled as a volume source.

The 170-ft by 70-ft lot (Lot #1) was modeled as a non-buoyant area source.

![Figure 13. Modeled locations of the barn and open lot at Feedlot #9.](image)
Feedlot #10

Feedlot #10 is an inactive dairy heifer feedlot consisting of two dairy barns and one open lot. The modeled locations of the barns and lot are provided in Figure 14.

The physical characteristics of the dairy barns are provided in Table 13. Dairy #1 was modeled as a volume source and Dairy #2 was modeled as a line source.

The 225-ft by 100-ft lot (Lot #1) was modeled as a non-buoyant area source.

**Figure 14. Modeled locations of the dairy barns and open lot at Feedlot #10.**

**Table 12. Dimensions of the dairy barn at Feedlot #9.**

<table>
<thead>
<tr>
<th>Dairy Barn</th>
<th>Barn Length (feet)</th>
<th>Barn Width (feet)</th>
<th>Barn Height (feet)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dairy #1</td>
<td>72</td>
<td>38</td>
<td>17</td>
</tr>
</tbody>
</table>

**Table 13. Dimensions of the dairy barns at Feedlot #10.**

<table>
<thead>
<tr>
<th>Dairy Barn</th>
<th>Barn Length (feet)</th>
<th>Barn Width (feet)</th>
<th>Barn Height (feet)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dairy #1</td>
<td>64</td>
<td>54</td>
<td>19</td>
</tr>
<tr>
<td>Dairy #2</td>
<td>140</td>
<td>42</td>
<td>17</td>
</tr>
</tbody>
</table>
**Feedlot #11**

Feedlot #11 is a cattle feedlot consisting of three cattle barns, two open lots, and one crust-covered manure basin. The modeled locations of the barns, lots, and basin are provided in Figure 15.

The physical characteristics of the cattle barns are provided in Table 14. Cattle #1 was modeled as a line source. Cattle #2 and Cattle #3 were modeled as volume sources.

The 80-ft by 75-ft lot (Lot #1), the 120-ft by 55-ft lot (Lot #2), and the 115-ft by 110-ft crust-covered manure basin (Basin #1) were modeled as non-buoyant area sources.

![Figure 15. Modeled locations of the cattle barns, open cattle lot, and manure basin at Feedlot #11.](image)

**Table 14. Dimensions of the cattle barns at Feedlot #11.**

<table>
<thead>
<tr>
<th>Cattle Barn</th>
<th>Barn Length (feet)</th>
<th>Barn Width (feet)</th>
<th>Barn Height (feet)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cattle #1</td>
<td>80</td>
<td>24</td>
<td>15</td>
</tr>
<tr>
<td>Cattle #2</td>
<td>40</td>
<td>24</td>
<td>15</td>
</tr>
<tr>
<td>Cattle #3</td>
<td>120</td>
<td>64</td>
<td>20</td>
</tr>
</tbody>
</table>
Feedlot #12

Feedlot #12 is an inactive cattle feedlot consisting of one barn and one open lot (Figure 16).

The barn dimensions are provided in Table 15. The barn was modeled as a line source.

The 140-ft by 55-ft lot (Lot #1) was modeled as a non-buoyant area source.

Table 15. Dimensions of the cattle barn at Feedlot #12.

<table>
<thead>
<tr>
<th>Cattle Barn</th>
<th>Barn Length (feet)</th>
<th>Barn Width (feet)</th>
<th>Barn Height (feet)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cattle #1</td>
<td>95</td>
<td>45</td>
<td>18</td>
</tr>
</tbody>
</table>

Feedlot #13

Feedlot #13 is a dairy calf feedlot consisting of two barns and two open lots. The modeled locations of the barns and lots are provided in Figure 17.

The physical characteristics of the dairy barns are provided in Table 16. Dairy #1 was modeled as a volume source and Dairy #2 was modeled as a line source.

Both the 300-ft by 250-ft lot (Lot #1) and the 145-ft by 63-ft lot (Lot #2) were modeled as non-buoyant area sources.

Figure 16. Modeled locations of the cattle barn and open cattle lot at Feedlot #12.

Figure 17. Modeled locations of the dairy barns and open lots at Feedlot #13.
Table 16. Dimensions of the dairy barns at Feedlot #13.

<table>
<thead>
<tr>
<th>Dairy Barn</th>
<th>Barn Length (feet)</th>
<th>Barn Width (feet)</th>
<th>Barn Height (feet)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dairy #1</td>
<td>204</td>
<td>112</td>
<td>26</td>
</tr>
<tr>
<td>Dairy #2</td>
<td>140</td>
<td>60</td>
<td>20</td>
</tr>
</tbody>
</table>

**Gas Emission Rates**

**Dairy and Cattle Barns**

The dairy barns, cattle barns, and associated buildings at the expanded Daley dairy and at the thirteen neighboring feedlots were modeled as sources of hydrogen sulfide, ammonia, and odor. The barn emission rates were based on following constant emission fluxes:

- $0.55 \text{µg} \text{H}_2\text{S}/(\text{m}^2\text{sec})^{33}$
- $33.5 \text{µg} \text{NH}_3/(\text{m}^2\text{sec})^{34}$
- $1.34 \text{OU}\cdot\text{m}^3/(\text{m}^2\text{sec})^{35}$

**Open Dairy and Cattle Lots**

The open dairy and cattle lots at the expanded Daley dairy and at the neighboring feedlots were modeled as sources of hydrogen sulfide, ammonia, and odor. Emission rates were equal to the surface area times the calculated emission flux rate. The modeled hydrogen sulfide, ammonia, and odor emission flux rates from the manure pack of the open lot varied hourly. The **OPENLOTFLUX** algorithms calculated the hourly emission flux rates, based on the wind speed, manure pack temperature, and effective surface concentrations. Temperature effects on hydrogen sulfide and ammonia flux rates were calculated using the correlations of Koziel *et al.* (2005).^{36} The impact of temperature on odor emission flux rates was addressed by the monthly scalars listed in Table 17.

To illustrate the range and variability in the hourly emissions, the estimated 2009 noon-hour emission flux rates for hydrogen sulfide are provided in Figure 18.

---


^{34} *Ibid.*


Table 17. Odor emission scalars for lots.\textsuperscript{37}

<table>
<thead>
<tr>
<th>Month</th>
<th>Odor Emission Scalar</th>
</tr>
</thead>
<tbody>
<tr>
<td>January</td>
<td>0.38</td>
</tr>
<tr>
<td>February</td>
<td>0.38</td>
</tr>
<tr>
<td>March</td>
<td>0.38</td>
</tr>
<tr>
<td>April</td>
<td>1.00</td>
</tr>
<tr>
<td>May</td>
<td>1.00</td>
</tr>
<tr>
<td>June</td>
<td>0.67</td>
</tr>
<tr>
<td>July</td>
<td>0.67</td>
</tr>
<tr>
<td>August</td>
<td>0.64</td>
</tr>
<tr>
<td>September</td>
<td>0.38</td>
</tr>
<tr>
<td>October</td>
<td>0.38</td>
</tr>
<tr>
<td>November</td>
<td>0.38</td>
</tr>
<tr>
<td>December</td>
<td>0.38</td>
</tr>
</tbody>
</table>

Dairy and Cattle Manure Storage Basins

The dairy and cattle manure storage basins at expanded Daley dairy and at the neighboring feedlots were modeled as sources of odor, hydrogen sulfide, and ammonia. The basins were assumed to have a 1-inch thick crust floating on the manure surface. The BASINODOR algorithms calculated the hourly hydrogen sulfide and ammonia emissions from the basins based on the manure chemistry provided in Table 18. To illustrate the range and variability in the hourly emissions, the estimated 2009 noon-hour emission flux rates for hydrogen sulfide and ammonia are provided in Figures 19 and 20, respectively.

Table 18. Chemical characteristics of stored dairy manure.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Units</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>pH</td>
<td>-log(_{10}[H^+])</td>
<td>7.8</td>
</tr>
<tr>
<td>Sulfide</td>
<td>mg S/L</td>
<td>1.3</td>
</tr>
<tr>
<td>Ammonia</td>
<td>mg N/L</td>
<td>856</td>
</tr>
</tbody>
</table>

The calculated odor emission rates for the dairy and cattle manure basins varied hourly based on a linear correlation between odor flux and basin temperature. As shown in Figure 21, correlated odor fluxes ranged from 0 OU/(m\(^2\)•sec) at 5°C up to 8.8 OU/(m\(^2\)•sec) at 25°C. Hourly basin temperatures were calculated by the BASINODOR algorithms.

Figure 19. Estimated 2009 noon-hour hydrogen sulfide flux rates for a crust-covered dairy manure storage basin.

Figure 20. Estimated 2009 noon-hour ammonia flux rates for a crust-covered dairy manure storage basin.

Figure 21. Linear correlation between basin temperature and odor emission flux for dairy manure basins.\textsuperscript{38}

Hydrogen Sulfide at Property Lines and Neighbors

The AERMOD results suggest that the expanded Daley dairy will comply with the Minnesota ambient air quality standard for hydrogen sulfide (H$_2$S). The calculated high-third-high (H3H) concentrations at the expanded dairy’s property lines are provided in Table 19. When a background concentration of 17 ppb is added to the AERMOD-calculated concentrations, the maximum H3H hydrogen sulfide concentration is 24.72 ppb, which does not exceed the standard of 30 ppb. Thus, no violations of the hydrogen sulfide standard were modeled.

Table 19. High-third-high hourly property-line hydrogen sulfide concentrations for the expanded Daley dairy.

<table>
<thead>
<tr>
<th>Dairy Property Line</th>
<th>High-Third-High H$_2$S Concentration Without Background (ppb, v/v)</th>
<th>High-Third-High H$_2$S Concentration With a 17 ppb Background (ppb, v/v)</th>
</tr>
</thead>
<tbody>
<tr>
<td>North</td>
<td>7.28</td>
<td>24.28</td>
</tr>
<tr>
<td>East</td>
<td>3.68</td>
<td>20.68</td>
</tr>
<tr>
<td>South</td>
<td>4.66</td>
<td>21.66</td>
</tr>
<tr>
<td>West</td>
<td>7.72</td>
<td>24.72</td>
</tr>
</tbody>
</table>

The maximum AERMOD-calculated hourly hydrogen sulfide concentrations (without background) are plotted in Figure 22. The plotted 10-ppb concentration isopleth is assumed to represent the the maximum extent of detectable hydrogen sulfide odors. This assumption slightly underestimates the extent of detectable odors, because the reported odor threshold concentration for hydrogen sulfide is 9.4 ppb (Table 2). The 10-ppb isopleth in Figure 22 suggests that any detectable concentrations of hydrogen sulfide will be largely confined to dairy site.

The AERMOD results also suggest that the expanded Daley dairy and the thirteen neighboring feedlots will not create exceedances of the subchronic (13-week) hydrogen sulfide iHRV at the neighboring residences. As provided in Table 20, when a background concentration of 1.00 µg/m$^3$ is added to the AERMOD-calculated concentrations, the maximum monthly hydrogen sulfide concentration for a neighboring residence is 1.42 µg/m$^3$, which is below the subchronic iHRV for hydrogen sulfide of 10 µg/m$^3$. 
Figure 22. Maximum AERMOD-calculated hourly hydrogen sulfide concentrations in ppb for the expanded Daley dairy and the thirteen neighboring feedlots. The contour lines represent 5, 10, and 15 ppb of hydrogen sulfide. The plotted concentrations do not include the 17-ppb background hydrogen sulfide concentration.
Table 20. Maximum monthly H$_2$S concentrations for neighboring residences. (* = feedlot residence)

<table>
<thead>
<tr>
<th>Neighbor</th>
<th>H$_2$S Concentration Without Background (µg/m$^3$)</th>
<th>H$_2$S Concentration With a 1 µg/m$^3$ Background (µg/m$^3$)</th>
</tr>
</thead>
<tbody>
<tr>
<td>A1</td>
<td>0.02</td>
<td>1.02</td>
</tr>
<tr>
<td>A2</td>
<td>0.03</td>
<td>1.03</td>
</tr>
<tr>
<td>A3</td>
<td>0.03</td>
<td>1.03</td>
</tr>
<tr>
<td>A4</td>
<td>0.08</td>
<td>1.08</td>
</tr>
<tr>
<td>B1*</td>
<td>0.19</td>
<td>1.19</td>
</tr>
<tr>
<td>B2</td>
<td>0.10</td>
<td>1.10</td>
</tr>
<tr>
<td>B3</td>
<td>0.07</td>
<td>1.07</td>
</tr>
<tr>
<td>B4</td>
<td>0.08</td>
<td>1.08</td>
</tr>
<tr>
<td>B5</td>
<td>0.06</td>
<td>1.06</td>
</tr>
<tr>
<td>B6</td>
<td>0.06</td>
<td>1.06</td>
</tr>
<tr>
<td>B7</td>
<td>0.04</td>
<td>1.04</td>
</tr>
<tr>
<td>B8*</td>
<td>0.12</td>
<td>1.12</td>
</tr>
<tr>
<td>C1*</td>
<td>0.20</td>
<td>1.20</td>
</tr>
<tr>
<td>C2*</td>
<td>0.18</td>
<td>1.18</td>
</tr>
<tr>
<td>C3*</td>
<td>0.40</td>
<td>1.40</td>
</tr>
<tr>
<td>D1</td>
<td>0.04</td>
<td>1.04</td>
</tr>
<tr>
<td>D2</td>
<td>0.04</td>
<td>1.04</td>
</tr>
<tr>
<td>D3</td>
<td>0.04</td>
<td>1.04</td>
</tr>
<tr>
<td>D4</td>
<td>0.05</td>
<td>1.05</td>
</tr>
<tr>
<td>D5</td>
<td>0.09</td>
<td>1.09</td>
</tr>
<tr>
<td>D6</td>
<td>0.10</td>
<td>1.10</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Neighbor</th>
<th>H$_2$S Concentration Without Background (µg/m$^3$)</th>
<th>H$_2$S Concentration With a 1 µg/m$^3$ Background (µg/m$^3$)</th>
</tr>
</thead>
<tbody>
<tr>
<td>D7*</td>
<td>0.11</td>
<td>1.11</td>
</tr>
<tr>
<td>D8</td>
<td>0.13</td>
<td>1.13</td>
</tr>
<tr>
<td>E1*</td>
<td>0.42</td>
<td>1.42</td>
</tr>
<tr>
<td>E2</td>
<td>0.27</td>
<td>1.27</td>
</tr>
<tr>
<td>E3</td>
<td>0.17</td>
<td>1.17</td>
</tr>
<tr>
<td>E4*</td>
<td>0.28</td>
<td>1.28</td>
</tr>
<tr>
<td>F1</td>
<td>0.14</td>
<td>1.14</td>
</tr>
<tr>
<td>F2</td>
<td>0.05</td>
<td>1.05</td>
</tr>
<tr>
<td>F3</td>
<td>0.04</td>
<td>1.04</td>
</tr>
<tr>
<td>F4</td>
<td>0.02</td>
<td>1.02</td>
</tr>
<tr>
<td>G1*</td>
<td>0.29</td>
<td>1.29</td>
</tr>
<tr>
<td>G2*</td>
<td>0.04</td>
<td>1.04</td>
</tr>
<tr>
<td>G3*</td>
<td>0.17</td>
<td>1.17</td>
</tr>
<tr>
<td>G4*</td>
<td>0.04</td>
<td>1.04</td>
</tr>
<tr>
<td>G5</td>
<td>0.02</td>
<td>1.02</td>
</tr>
<tr>
<td>H1</td>
<td>0.02</td>
<td>1.02</td>
</tr>
<tr>
<td>H2</td>
<td>0.02</td>
<td>1.02</td>
</tr>
<tr>
<td>H3*</td>
<td>0.18</td>
<td>1.18</td>
</tr>
<tr>
<td>I1</td>
<td>0.02</td>
<td>1.02</td>
</tr>
<tr>
<td>I2</td>
<td>0.02</td>
<td>1.02</td>
</tr>
<tr>
<td>I3</td>
<td>0.03</td>
<td>1.03</td>
</tr>
</tbody>
</table>
Ammonia at Property Lines and Neighbors

The AERMOD-calculated maximum hourly ammonia (NH₃) concentrations at the expanded Daley dairy’s property lines are provided in Table 21. The highest calculated property-line concentration with a background concentration of 148 μg/m³ is 962 μg/m³, which is below the acute iHRV for ammonia of 3,200 μg/m³. Thus, no exceedances of the acute ammonia iHRV were modeled.

Table 21. Maximum hourly property-line ammonia concentrations for the expanded Daley dairy.

<table>
<thead>
<tr>
<th>Dairy Property Line</th>
<th>NH₃ Concentration Without Background (μg/m³)</th>
<th>NH₃ Concentration With a 148 μg/m³ Background (μg/m³)</th>
</tr>
</thead>
<tbody>
<tr>
<td>North</td>
<td>802</td>
<td>950</td>
</tr>
<tr>
<td>East</td>
<td>507</td>
<td>655</td>
</tr>
<tr>
<td>South</td>
<td>592</td>
<td>740</td>
</tr>
<tr>
<td>West</td>
<td>814</td>
<td>962</td>
</tr>
</tbody>
</table>

The maximum AERMOD-calculated hourly ammonia concentrations (without background) are plotted in Figure 23. The reported odor threshold concentration for ammonia is 4,125 μg/m³ or 5,800 ppb (Table 2). Because all plotted ammonia concentrations are less than 4,125 μg/m³, Figure 23 suggests that the expanded Daley dairy and the thirteen neighboring feedlots will not generate detectable off-site concentrations of ammonia.

The AERMOD results also suggest that the ammonia emissions from the expanded Daley dairy and the thirteen neighboring feedlots will not cause exceedances of the chronic ammonia iHRV at the nearest neighbors. As provided in Table 22, the highest annual ammonia concentration for a neighbor with a background concentration of 5.72 μg/m³ is 25.26 μg/m³, which is below the chronic ammonia iHRV of 80 μg/m³.
Figure 23. Maximum AERMOD-calculated hourly ammonia concentration in µg/m³ for the expanded Daley dairy and the thirteen neighboring feedlots. The contour lines represent 300, 600, and 900 µg/m³ of ammonia. The plotted concentrations do not include the 148 µg/m³ background ammonia concentration.
Table 22. Maximum annual NH₃ concentrations for neighbors residences. (* = feedlot residence)

<table>
<thead>
<tr>
<th>Neighbor</th>
<th>NH₃ Concentration Without Background (µg/m³)</th>
<th>NH₃ Concentration With a 5.72 µg/m³ Background (µg/m³)</th>
</tr>
</thead>
<tbody>
<tr>
<td>A1</td>
<td>0.43</td>
<td>6.15</td>
</tr>
<tr>
<td>A2</td>
<td>0.61</td>
<td>6.33</td>
</tr>
<tr>
<td>A3</td>
<td>0.78</td>
<td>6.50</td>
</tr>
<tr>
<td>A4</td>
<td>1.65</td>
<td>7.37</td>
</tr>
<tr>
<td>B1*</td>
<td>7.50</td>
<td>13.22</td>
</tr>
<tr>
<td>B2</td>
<td>1.82</td>
<td>7.54</td>
</tr>
<tr>
<td>B3</td>
<td>1.35</td>
<td>7.07</td>
</tr>
<tr>
<td>B4</td>
<td>1.78</td>
<td>7.50</td>
</tr>
<tr>
<td>B5</td>
<td>1.48</td>
<td>7.20</td>
</tr>
<tr>
<td>B6</td>
<td>1.64</td>
<td>7.36</td>
</tr>
<tr>
<td>B7</td>
<td>1.28</td>
<td>7.00</td>
</tr>
<tr>
<td>B8*</td>
<td>4.15</td>
<td>9.87</td>
</tr>
<tr>
<td>C1*</td>
<td>8.18</td>
<td>13.90</td>
</tr>
<tr>
<td>C2*</td>
<td>5.54</td>
<td>11.26</td>
</tr>
<tr>
<td>C3*</td>
<td>12.21</td>
<td>17.93</td>
</tr>
<tr>
<td>D1</td>
<td>1.03</td>
<td>6.75</td>
</tr>
<tr>
<td>D2</td>
<td>1.17</td>
<td>6.89</td>
</tr>
<tr>
<td>D3</td>
<td>1.42</td>
<td>7.14</td>
</tr>
<tr>
<td>D4</td>
<td>1.47</td>
<td>7.19</td>
</tr>
<tr>
<td>D5</td>
<td>3.76</td>
<td>9.48</td>
</tr>
<tr>
<td>D6</td>
<td>3.46</td>
<td>9.18</td>
</tr>
</tbody>
</table>

Table 22. Maximum annual NH₃ concentrations for neighbors residences. (* = feedlot residence) (continued)

<table>
<thead>
<tr>
<th>Neighbor</th>
<th>NH₃ Concentration Without Background (µg/m³)</th>
<th>NH₃ Concentration With a 5.72 µg/m³ Background (µg/m³)</th>
</tr>
</thead>
<tbody>
<tr>
<td>D7*</td>
<td>4.70</td>
<td>10.42</td>
</tr>
<tr>
<td>D8</td>
<td>3.73</td>
<td>9.45</td>
</tr>
<tr>
<td>E1*</td>
<td>19.54</td>
<td>25.26</td>
</tr>
<tr>
<td>E2</td>
<td>8.09</td>
<td>13.81</td>
</tr>
<tr>
<td>E3</td>
<td>4.52</td>
<td>10.24</td>
</tr>
<tr>
<td>E4*</td>
<td>6.63</td>
<td>12.35</td>
</tr>
<tr>
<td>F1</td>
<td>1.94</td>
<td>7.66</td>
</tr>
<tr>
<td>F2</td>
<td>0.93</td>
<td>6.65</td>
</tr>
<tr>
<td>F3</td>
<td>0.80</td>
<td>6.52</td>
</tr>
<tr>
<td>F4</td>
<td>0.55</td>
<td>6.27</td>
</tr>
<tr>
<td>G1*</td>
<td>11.58</td>
<td>17.30</td>
</tr>
<tr>
<td>G2*</td>
<td>2.07</td>
<td>7.79</td>
</tr>
<tr>
<td>G3*</td>
<td>5.54</td>
<td>11.26</td>
</tr>
<tr>
<td>G4*</td>
<td>1.94</td>
<td>7.66</td>
</tr>
<tr>
<td>G5</td>
<td>0.49</td>
<td>6.21</td>
</tr>
<tr>
<td>H1</td>
<td>0.49</td>
<td>6.21</td>
</tr>
<tr>
<td>H2</td>
<td>0.58</td>
<td>6.30</td>
</tr>
<tr>
<td>H3*</td>
<td>5.07</td>
<td>10.79</td>
</tr>
<tr>
<td>I1</td>
<td>0.97</td>
<td>6.69</td>
</tr>
<tr>
<td>I2</td>
<td>0.73</td>
<td>6.45</td>
</tr>
<tr>
<td>I3</td>
<td>0.75</td>
<td>6.47</td>
</tr>
</tbody>
</table>
Odorous Gas Concentrations

AERMOD calculated the ground-level atmospheric concentrations of hydrogen sulfide and ammonia at the property lines for the expanded Daley dairy and at the neighboring residences. The calculated maximum property-line concentrations are 1,140 ppb for ammonia (without background) and 14.58 ppb for hydrogen sulfide (without background). The corresponding odor numbers for the maximum property-line concentrations are 1.6 for hydrogen sulfide and 0.2 for ammonia. Population response curves suggest that 74 percent of the population could detect the calculated maximum property-line hydrogen sulfide concentration and 2 percent the ammonia concentration.

The calculated maximum hourly concentrations for the neighboring residences are 768 ppb for ammonia (without background), and 7.66 ppb for hydrogen sulfide (without background). The corresponding odor numbers for the maximum neighbor concentrations are 0.8 for hydrogen sulfide and 0.1 for ammonia. Population response curves suggest that 38 percent of the population could detect the calculated maximum neighbor hydrogen sulfide concentration and 1 percent the ammonia concentration. The population response curves assume the presence of individual gases.

Odor Intensities at Property Lines and Neighbors

AERMOD calculated the ground-level odor intensities at the property lines for the expanded Daley dairy and at 42 of the dairy’s neighboring residences. As indicated in Table 23, the maximum hourly odor intensity at the expanded dairy’s property lines is 238 odor units (OU), which is below the “moderate” odor threshold of 244 OU and above the “faint” odor threshold of 83 OU (Table 3). The calculated frequency at which the faint odor threshold of 83 OU was exceeded at any property-line receptor was less than or equal to 0.07 percent of the time (Table 23). Thus, for at least 99.93 percent of the time, the calculated hourly odor intensity at any property-line receptor was less than or equal to 83 OU.

Table 23. Maximum hourly property-line odor intensities and the maximum frequency at which the “faint” odor threshold of 83 OU is equaled or exceeded for the expanded Daley dairy.

<table>
<thead>
<tr>
<th>Dairy Property Line</th>
<th>Maximum Hourly Odor Intensity (OU, d/t)</th>
<th>Maximum Frequency at Which the “Faint” Odor Threshold is Exceeded (percent)</th>
</tr>
</thead>
<tbody>
<tr>
<td>North</td>
<td>238</td>
<td>0.07</td>
</tr>
<tr>
<td>East</td>
<td>126</td>
<td>0.02</td>
</tr>
<tr>
<td>South</td>
<td>162</td>
<td>0.03</td>
</tr>
<tr>
<td>West</td>
<td>163</td>
<td>0.07</td>
</tr>
</tbody>
</table>

Figure 24 suggests that any “moderate” or stronger odors generated by the expanded Daley dairy will be confined to within the boundaries of the dairy site.

The AERMOD-calculated ground-level odor intensities at the 42 neighboring residences are provided in Table 24. The estimated maximum odor intensity for a non-feedlot neighboring residence is 126 OU at Neighbor E2, which is above the 83-OU threshold for “faint” odors and below the 244-OU threshold for “moderate” odors. For 5-years of weather data, the calculated hourly odor intensities at Neighbor E2 exceeded the 83-OU threshold for 7 hours, i.e., the threshold for “faint” odors was exceeded for less than 0.02 percent of the time.
Figure 24. Maximum AERMOD-calculated hourly odor intensities for the expanded Daley dairy and the thirteen neighboring feedlots. The threshold for “faint” odors is 83 OU and for “moderate” odors is 244 OU (Table 3).
<table>
<thead>
<tr>
<th>Neighbor</th>
<th>Maximum Hourly Odor Intensity (OU, d/t)</th>
<th>Frequency at Which the “Faint” Odor Threshold is Exceeded (percent)</th>
</tr>
</thead>
<tbody>
<tr>
<td>A1</td>
<td>17</td>
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<tr>
<td>A2</td>
<td>25</td>
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</tr>
<tr>
<td>A3</td>
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<td>A4</td>
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</tr>
<tr>
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<td>62</td>
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</tr>
<tr>
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</tr>
<tr>
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</tr>
<tr>
<td>B4</td>
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<tr>
<td>B5</td>
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</tr>
<tr>
<td>B6</td>
<td>35</td>
<td>0.00</td>
</tr>
<tr>
<td>B7</td>
<td>23</td>
<td>0.00</td>
</tr>
<tr>
<td>B8*</td>
<td>32</td>
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</tr>
<tr>
<td>C1*</td>
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</tr>
<tr>
<td>C2*</td>
<td>75</td>
<td>0.00</td>
</tr>
<tr>
<td>C3*</td>
<td>55</td>
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</tr>
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<td>D6</td>
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</table>

<table>
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<tr>
<th>Neighbor</th>
<th>Maximum Hourly Odor Intensity (OU, d/t)</th>
<th>Frequency at Which the “Faint” Odor Threshold is Exceeded (percent)</th>
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</thead>
<tbody>
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<td>D7*</td>
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<tr>
<td>H2</td>
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<tr>
<td>H3*</td>
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<td>0.00</td>
</tr>
<tr>
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</tr>
<tr>
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</tr>
<tr>
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<td>18</td>
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</tr>
</tbody>
</table>
Summary

The AERMOD modeling results suggest that the expanded Daley dairy will comply with the ambient air quality standard for hydrogen sulfide at the dairy’s property lines. The results also suggest that the expanded dairy will not create exceedances of the acute ammonia iHRV at its property lines.

The modeling results suggest that the expanded Daley dairy and the thirteen neighboring feedlots will not create exceedances of the subchronic iHRV for hydrogen sulfide and of the chronic iHRV for ammonia at the neighboring residences.

The calculated maximum property-line odor intensity for the expanded Daley dairy was less the 244-OU threshold for “moderate” odors. The calculated property-line receptor odor intensities were less than the 83-OU threshold for “faint” odors at least 99.93 percent of the time. The maximum number of hours at which the calculated odor intensities for a non-feedlot neighboring residence exceeded the 83-OU threshold for “faint” odors was 7 hours for 5 years of weather data, which is less than 0.02 percent of the time.
For detailed information on trout angling regulations see the Minnesota Fishing Regulations booklet and observe signs posted on the stream.