



DAKOTA ENVIRONMENTAL, INC.

Engineers...Hydrogeologists...Geologists...Remedial Specialists

January 10, 2017

Robert Hill
Brookings County Zoning & Drainage Dept.
520 3rd Street, Suite 200
Brookings, SD 57006

Re: Proposed Animal Waste Management System
Parnell Dairy AWMS, Brookings County, SD
DEC Project No. 1611

Dear Mr. Hill:

Please find included with this letter information regarding the conditional use application for the above referenced facility. These materials are provided on behalf of the applicant with the intent of addressing the required items listed in Article 22.00 page 19 of the ordinance.

Appendix I includes the design calculations summarizing the volume of manure produced by the proposed population, as well as the storage capacity available in the proposed storage structures. Manure will be collected from the manure alleys in the barn by vacuum trucks, which will transport it to a solids separation system. The barn will utilize separated manure solids as bedding. With the exception of a small concrete pad for temporary storage of excess separated solids, all waste at the facility will be handled as a liquid. The storage volume available exceeds 365 days of manure and wastewater production for the proposed population. Additional volume is also provided in the ponds for residual volume, stormwater events, annual precipitation, and freeboard of two feet. Storage ponds 1 and 2 are intended to store manure liquids, while pond 3 is intended mainly to receive stormwater runoff from the feed storage area, though additional storage for manure is also available. A secondary containment berm is proposed on the east side of ponds 2 and 3 as shown.

Appendix II contains information regarding the intended method of Nutrient Management for the proposed facility. The applicant is in feasibility exploration with a third party development company to develop plans for a value added facility to process the manure from the proposed dairy and convert it to commercial products. This processing facility would be located in the south half of section 28, and would utilize processes of anaerobic digestion, additional liquid/solid separation, filtration, and treatment to produce commercial grade fertilizer products. Initiation of the permitting process for this facility would commence upon assurances that the proposed dairy can be constructed. General information regarding the type of facility is included for reference.

Appendix III contains the Operation and Maintenance Manual for the facility, which details the operational, upkeep, and inspection requirements for the facility, as well as best management practices for operation.

Appendix IV contains the Management Plan for Fly and Odor Control, which was developed to summarize best management practices for dealing with these issues, as well as disposal of mortalities. Any existing and proposed shelterbelts, which are recommended for odor reduction, are also shown on the site plan in Appendix VII.

Appendix V contains an aerial map showing the required setback of 2,640 feet from all nearby residences. A setback is indicated from the farmstead immediately south of the site, though it is currently unoccupied. Setbacks are also not shown from any other farmsteads in the south half of section 28, as these will be purchased by the applicant.

The included map also includes the required setback from all known nearby wells. To the best of our knowledge, an existing well at the farmstead in section 33 is the only well which falls within the required setback distance. It is unknown if the well is currently useable. The well was not located in DENR or DENR Water Rights databases. An entry in the US Geological Survey database was found for a well in the northwest quarter of section 33, but provided little detail other than the depth. The above entry is included.

A map is included indicating the requested variance distance from the unoccupied residence. A variance of 2,040 feet is requested, to allow construction of the confinement within 600 feet of the unoccupied residence.

A map is included indicating the requested variance distance from the well location. A variance of 1,640 feet is requested, to allow construction of the confinement within 1,000 feet of the well.

It is believed all other required setbacks are met, as we are unaware of any listed features being present within the prescribed distances. The required setbacks from property lines and rights of way are shown, and are also shown on the site plan. The proposed structures are also placed to be in accordance with all yard requirements for the agricultural district.

The boundary of the FEMA floodplain is also shown. No structures are proposed for construction within the boundary.

The sections of South Dakota law assigning beneficial uses to streams (ARSD 74:51:03) were reviewed in regard to the nearby unnamed tributary. The tables in this section do not assign the tributary a beneficial use as a fishery, therefore it is believed that a 500 foot setback is not required.

Appendix VI contains information regarding soils at the site, aquifers, wellhead protection zones, and flood zones.

A copy of the soils map from the Brookings County Soil Survey is included, which shows the predominant surface soil types at the proposed site. A summary page is included identifying the individual groups. The soils listed on these maps are surface soils, and are commonly not evaluated below a depth of five feet from the surface. Information is presented later in the Appendix regarding deeper soils which will represent the majority of proposed excavation at the site.

Maps from the study titled "Water Resources of Brookings and Kingsbury Counties" (US Geological Survey, 1989) are included showing the site location relative to the Big Sioux, Rutland, Howard, Altamont and Niobrara aquifers, which are the glacial aquifers potentially present in the surrounding area. The Big Sioux Aquifer is usually present at the surface or slightly below, and in this part of Brookings County consists of alluvial soils in creekbeds, such

as to the east of the site. The main body of the Big Sioux aquifer is not mapped as present beneath the site. No other shallow aquifers are mapped as present beneath the site.

The above corresponds with the map titled "First Occurrence of Aquifer Materials in Brookings County, South Dakota" (SD DENR, 2004), which indicates the site to be located in an area where no aquifers are encountered within 100 feet of the ground surface. The map titled "Brookings County Groundwater Protection Zones" delineates a narrow band of Zone B along the unnamed creek bed as it flows downstream from the area of the site. The southeastern edge of this mapped zone crosses the northwest boundary of the quarter containing the site. The Zone B area mapped nearby is not believed to represent the Big Sioux Aquifer, but instead the alluvial material associated with the creekbed. The boundary of this zone was digitized from this map and is shown on the site map in Appendix VII. Copies of the above maps are also included.

To provide additional information regarding the above, fifteen initial soil borings were performed on site. Information from these soil borings is included, consisting of a map showing the boring locations, the boring logs, laboratory testing of representative samples, and a copy of the United Soil Classification System chart.

The purpose of these borings was to delineate any boundary of large scale alluvial or waterbearing soils near the mapped Zone B boundary, as well as to confirm the presence of glacial till soils in the remainder of the site, as well as beneath any alluvium.

The borings generally encountered clay till soils over the majority of the explored site, with waterbearing alluvial (cleaner sands and gravels) in the northwest corner of the site. A thin layer of surficial alluvial soils was also encountered in borings along the northeast edge of the site, immediately above the creekbed, though these were not observed to be waterbearing. All borings encountering alluvium were advanced through this material into the underlying till, while certain borings were advanced deeper to confirm the required thickness of clay till. Boring #4 was advanced to a depth meeting the deep boring requirements of the DENR General Permit. Additional borings will be required before submittal of the General Permit application at the rate of one boring per acre of storage structures.

The information obtained from the borings, when considered with the included maps, leads us to conclude that the waterbearing alluvial soils are confined to the north edge of the site, and that the soils beneath these, as well as the rest of the site, consist of clay till. Till deposits often have good qualities for resisting the passage of water due to the high percentage of clay in the mixture. The till deposits in the area of the site are mapped to extend to the underlying bedrock. Laboratory testing of samples obtained from separate borings and elevations demonstrated very similar results, suggesting consistency across the site. Permeability testing performed on samples obtained from the clay in the elevation range of the pond bottoms was favorable for meeting the permeability requirements of the DENR General Permit, and therefore adequate for use as liner material.

The information obtained from the soil borings was utilized in arranging the proposed structures. All waste storage structures were placed to avoid any the area of waterbearing alluvium, instead utilizing the areas showing deep deposits of clay till. The feed area proposed north of the storage structures will be concrete surfaced, with all runoff reporting to the containment system.

A copy of the FEMA Flood Rate Insurance Map for the area is also included, which indicates the structures proposed on the site area not located within the mapped flood plain (Zone A).

Appendix VII includes the site plan for the proposed facility, as well as additional drawings showing details of the proposed construction.

We hope you will find the included information helpful as you evaluate this application. Based on our initial research and findings to date, it is our opinion that the proposed facility can be constructed to meet the requirements of Brookings County and the South Dakota DENR General Permit. Please feel free to contact me if there are any questions, or if further information is required.

Sincerely,

A handwritten signature in black ink, appearing to read "Brian Friedrichsen". The signature is fluid and cursive, with a large initial "B" and "F".

Brian Friedrichsen, PE
Senior Engineer

APPENDIX I
DESIGN CALCULATIONS



1/10/17

PARNELL DAIRY AWMS
MANURE VOLUME CALCULATIONS

Dairy Waste - Milking Herd

Number	Weight	Manure, cf/day/cow	Manure, total cf/day	Storage Period, days	Manure Volume over Storage Period
3,900	1,000	2.4	9,360	365	3,416,400

Dairy Washwater & Flushwater - Milking Herd

Number	Weight	Wash water, cf/day/1000#	Wash water, total cf/day	Storage Period, days	Wash water Volume over Storage Period
3,900	1,000	0.6	2,340	365	854,100

Annual Precipitation on Contributing Areas

Annual precipitation runoff from solids stockpiling area, cf:	6,144
Annual precipitation runoff from feed storage area, cf:	307,200

Total Volume of Manure, Wastewater, and Precipitation to Ponds, cubic feet **4,583,844**

Total Storage Pond Volume Available, cubic feet: **6,797,813**

1/10/17

PARNELL DAIRY AWMS
SOLIDS STORAGE AREA
VOLUME CALCULATIONS

SOLIDS STORAGE PAD RUNOFF VOLUME	
Length of stockpile area, ft	80
Width of stockpile area, ft	80
100 year/24 hour storm depth, ft	0.48
100 year24 hour storm volume, cubic ft	3,040
Annual precipitation, ft	1.92
Runoff - percent of mean annual precipitation, % @ CN 97	50.0%
Annual precipitation volume, cubic ft	6,144

1/10/17

PARNELL DAIRY AWMS
FEED STORAGE AREA
RUNOFF VOLUME CALCULATIONS

FEED STORAGE PAD RUNOFF VOLUME	
Length of feed area, ft	800
Width of feed area, ft	400
100 year/24 hour storm depth, ft	0.48
100 year/24 hour storm volume, cubic ft	152,000
Annual precipitation, ft	1.92
Runoff - percent of mean annual precipitation, % @ CN 97	50.0%
Annual precipitation volume, cubic ft	307,200

Dakota Environmental, Inc.

P.O. Box 636, 1122 21st Street SW Huron, SD 57350 Phone: (605) 352-5610 Fax: (605) 352-0951

1/10/17

PARNELL DAIRY AWMS
REQUIRED POND CAPACITY CALCULATIONS

Storage Pond Capacity Balance

100 year / 24 hour storm volumes reporting to Pond 1	Volume, cf
Solids storage pad and drainage area	3,040
100 year / 24 hour storm volumes reporting to Pond 3	Volume, cf
Feed storage pad and drainage area	152,000
Volumes reporting to ponds for storage	Volume, cf
Manure, washwater, and bedding volume from herd	4,270,500
Annual precipitation from solids storage pad and drainage area	6,144
Annual precipitation from feed storage pad and drainage area	307,200
Total, cubic feet	<u>4,583,844</u>

Storage Volumes Available	Volume, cf
Storage Pond 1	2,969,781
Storage Pond 2	2,969,781
Storage Pond 3	<u>858,250</u>
Total pond storage volume provided, cubic feet	6,797,813

Balance 2,213,969

PARNELL DAIRY AWMS
POND 1 VOLUME CALCULATIONS

POND DESIGN VOLUME AND ELEVATION SUMMARY

DESCRIPTION	EQN.		DEPTH (FT)	ELEV.	ACTUAL DESIGN USED
Existing Grade	G			1682.00	
Inside Top of Berm Width (ft)	W	450			
Inside Width Slope, horizontal feet per foot drop	SW	3			
Inside Top of Berm Length (ft)	L	450			
Inside Length Slope, horizontal feet per foot drop	SL	3			
Constructed Top of Berm, including settlement	E+S			1688.00	1688.0
Settlement, % of embankment height	S=%(E-G)	0%	0.00		
Reference Elevation, operational top of berm (acres & elev. - ft.)	E	4.65		1688.00	
Freeboard (in)	F	24	2.00		
Surface Area at Top of 100yr/24hr storm (acres/elev)	AS=E-F	4.40		1686.00	
100yr/24hr Rainfall (in)	R	5.7			
Surface Area at Inside Top of Berm (ac)	OB	4.65			
Volume of 100yr/24hr Rainfall (cf)	VR=R*OB	99,228			
Volume Provided for 100yr/24hr Rainfall (cf)	avg(AS,O)*(AS-O)	104,722	0.55		
Maximum Surface Area and Operating Level (acres/elev)	O=E-F-R	4.34		1685.45	1685.45
Mean Annual Rainfall (in)	MAR	23.04			
Direct Mean Annual Rainfall within berms (cf)	DM=OB*MAR	388,800			
Mean Annual Lake Evaporation (in)	ME	34			
Evaporation Midpoint (elev)				1674.73	
Surface Area at Evaporation Midpoint (ac)	ESA	3.15			
Net Evaporation at Midpoint (cf)	NE=ME*ESA	388,618			
Net Moisture used for design (evap[-] or rain[+]) (cf)	M	182	0.01		
Apparent Operation Level considering Net Moisture adj.	A=O-M	4.34		1685.44	
Volume Provided for Net Moisture (cf)	avg(O,A)*(O-A)	1,889			
Waste Storage Depth (ft) excluding residual depth	D	21.45			
Surface area at top of residual layer (acres/elev)	SS=O-D	2.15		1664.00	
Net Storage Depth provided	D-M	21.4	21.4		
Total Storage Volume from Net Storage Depth (cf)		2,969,781			
Residual Layer Depth (in)	SD	12	1.00		
Top of Liner, surface area, acres	SS-SD	2.07		1663.00	1663.0

PARNELL DAIRY AWMS
POND 2 VOLUME CALCULATIONS

POND DESIGN VOLUME AND ELEVATION SUMMARY

DESCRIPTION	EQN.		DEPTH (FT)	ELEV.	ACTUAL DESIGN USED
Existing Grade	G			1682.00	
Inside Top of Berm Width (ft)	W	450			
Inside Width Slope, horizontal feet per foot drop	SW	3			
Inside Top of Berm Length (ft)	L	450			
Inside Length Slope, horizontal feet per foot drop	SL	3			
Constructed Top of Berm, including settlement	E+S			1688.00	1688.0
Settlement, % of embankment height	S=%(E-G)	0%	0.00		
Reference Elevation, operational top of berm (acres & elev. - ft.)	E	4.65		1688.00	
Freeboard (in)	F	24	2.00		
Surface Area at Top of 100yr/24hr storm (acres/elev)	AS=E-F	4.40		1686.00	
100yr/24hr Rainfall (in)	R	5.7			
Surface Area at Inside Top of Berm (ac)	OB	4.65			
Volume of 100yr/24hr Rainfall (cf)	VR=R*OB	96.188			
Volume Provided for 100yr/24hr Rainfall (cf)	avg(AS,O)*(AS-O)	104.722	0.55		
Maximum Surface Area and Operating Level (acres/elev)	O=E-F-R	4.34		1685.45	1685.45
Mean Annual Rainfall (in)	MAR	23.04			
Direct Mean Annual Rainfall within berms (cf)	DM=OB*MAR	388.800			
Mean Annual Lake Evaporation (in)	ME	34			
Evaporation Midpoint (elev)				1674.73	
Surface Area at Evaporation Midpoint (ac)	ESA	3.15			
Net Evaporation at Midpoint (cf)	NE=ME*ESA	388.618			
Net Moisture used for design (evap[-] or rain[+]) (cf)	M	182	0.01		
Apparent Operation Level considering Net Moisture adj.	A=O-M	4.34		1685.44	
Volume Provided for Net Moisture (cf)	avg(O,A)*(O-A)	1.889			
Waste Storage Depth (ft) excluding residual depth	D	21.45			
Surface area at top of residual layer (acres/elev)	SS=O-D	2.15		1664.00	
Net Storage Depth provided	D-M	21.4	21.4		
Total Storage Volume from Net Storage Depth (cf)		2,969,781			
Residual Layer Depth (in)	SD	12	1.00		
Top of Liner, surface area, acres	SS-SD	2.07		1663.00	1663.0

PARNELL DAIRY AWMS
POND 3 VOLUME CALCULATIONS

POND DESIGN VOLUME AND ELEVATION SUMMARY

DESCRIPTION	EQN.		DEPTH (FT)	ELEV.	ACTUAL DESIGN USED
Existing Grade	G			1680.00	
Inside Top of Berm Width (ft)	W	150			
Inside Width Slope, horizontal feet per foot drop	SW	3			
Inside Top of Berm Length (ft)	L	850			
Inside Length Slope, horizontal feet per foot drop	SL	3			
Constructed Top of Berm, including settlement	E+S			1688.00	1688.0
Settlement, % of embankment height	S=%(E-G)	0%	0.00		
Reference Elevation, operational top of berm (acres & elev. - ft.)	E	2.93		1688.00	
Freeboard (in)	F	24	2.00		
Surface Area at Top of 100yr/24hr storm (acres/elev)	AS=E-F	2.65		1686.00	
100yr/24hr Rainfall (in)	R	5.7			
Surface Area at Inside Top of Berm (ac)	OB	2.93			
Volume of 100yr/24hr Rainfall (cf)	VR=R*OB	212,563			
Volume Provided for 100yr/24hr Rainfall (cf)	avg(AS,O)*(AS-O)	214,506	1.95		
Maximum Surface Area and Operating Level (acres/elev)	O=E-F-R	2.40		1684.05	1684.05
Mean Annual Rainfall (in)	MAR	23.04			
Direct Mean Annual Rainfall within berms (cf)	DM=OB*MAR	244,800			
Mean Annual Lake Evaporation (in)	ME	34			
Evaporation Midpoint (elev)				1676.53	
Surface Area at Evaporation Midpoint (ac)	ESA	1.46			
Net Evaporation at Midpoint (cf)	NE=ME*ESA	179,606			
Net Moisture used for design (evap[-] or rain[+]) (cf)	M	65,194	0.65		
Apparent Operation Level considering Net Moisture adj.	A=O-M	2.31		1683.40	
Volume Provided for Net Moisture (cf)	avg(O,A)*(O-A)	66,633			
Waste Storage Depth (ft) excluding residual depth	D	15.05			
Surface area at top of residual layer (acres/elev)	SS=O-D	0.61		1669.00	
Net Storage Depth provided	D-M	14.4	14.4		
Total Storage Volume from Net Storage Depth (cf)		858,250			
Residual Layer Depth (in)	SD	12	1.00		
Top of Liner, surface area, acres	SS-SD	0.50		1668.00	1668.0

APPENDIX II

NUTRIENT MANAGEMENT PLAN



December 21, 2016

Mr. Michael Crinion
46844 South Dakota Highway 28
Estelline, SD 57234

RE: Organic Fertilizer Plant Development

Dear Mr. Crinion,

This letter will memorialize the understandings and intentions of Dynamic Concepts LLC a Wisconsin based company with offices in Waukesha, Brown Deer WI and Houston, TX. This letter is intended solely as a basis for further discussion and is not intended to be and does not constitute a legally binding obligation.

Dynamic is in the business of designing, developing, operating and owning organic waste processing facilities. Dynamic specializes in agricultural based projects processing livestock waste utilizing anaerobic digestion.

Project Description: Anaerobic digestion is a waste treatment process which manages and treats animal wastes reducing pathogens and odor. The biogas produced by the digester can be used to create organic nitrogen fertilizer. By integrating additional technologies following the digester such as Nutrient Concentration systems that are technically capable of successfully "dewatering or removing water" from the waste stream through suspended solids separation, ultrafiltration, and reverse osmosis. The remaining clean water generated by the process can be re-used by the farming operations, irrigated on acres close to the farm, or discharged to surface waters. The solids from the separation process can be dried using biogas from the digester and pelleted for land application. Ultimately, the dairy becomes a mini organic fertilizer plant. When this implemented, this project will provide water quality protection, agricultural viability, and economic sustainability to the community.

As you know our preliminary feasibility study indicates that your project is economically viable. To move the project forward Dynamic is willing to be responsible for all development cost of the fertilizer plant. Dynamic would also provide one hundred percent (100%) of the capital required. Before project development and due diligence can continue you need to secure all property rights and permits necessary for construction and operation of the project. Once these requirements are met we will enter into good faith negotiations of definitive agreements.

Please keep us informed of your progress and feel free to contact us at any time.

Best regards,

A handwritten signature in black ink, appearing to read "Dimitry", written over a light grey horizontal line.

CEO Dynamic Concepts LLC

Dynamic Proven Track Record: Specializing in Complete Manure Management Systems

Dynamic is comprised of a team of professionals with over 75 years of combined experience in project development, engineering, project management, financial analysis. Members of Dynamic's team have successfully designed, engineered, constructed and operated over a dozen facilities in the United States. Dynamic's approach is technologically "agnostic" in its application of proven methods of processing organic waste into valuable revenue streams.

The state of Wisconsin is home to 37 dairy digesters, 2 of which are community based (source: <http://www.epa.gov/agstar>). The principals of Dynamic were responsible for the design, construction,

Biogas Feasibility Studies

- 70 Methane Recovery Feasibility Studies
- 21 Community Digester Projects

Nutrient Management Studies

- Dane County Community Nutrient Concentration
- 2,500 Cow Dairy Livestock Waste to Irrigation Water
- 8,000 Sow Farm Livestock Waste to Drinkable Water

Installation

- Installed 2 Community Digesters
- Installed 12 Single Digester Systems

Management & Operations

- GL Dairy Biogas
- Sunnyside Digester

and implementation of both these community systems. In the last 8 years, the principals of Dynamic have conducted technical evaluations and economic analysis of over 70 digester projects with 21 of those studies being community based systems.

The first Ag based community clean water project in the nation will be installed this year at GL Dairy Biogas LLC (GL) located in rural Middleton, WI

through a partnership with GL, Dane County, and the participating dairy farms. This effort is being led by Dynamic.

This project includes the installation of an anaerobic digester to process the manure and off farm organic waste and new separation equipment to remove the solids (fiber) from the dairy manure and organic waste allowing the liquid to be land applied by standard irrigation equipment or reused as drinking water.

The anaerobic digestion process works similar to an animal's natural digestive system, where enzymes break down organic matter in the absence of oxygen. Methane and ammonia are two primary by-products of the process. The methane biogas is used for renewable fuel, electricity or compressed natural gas. The nitrogen in the ammonia, along with the other macro and micro nutrients, is processed through a patented nutrient concentration system (NCS) creating organic fertilizer products. Bacteria and pathogens in manure are eliminated, so the resulting fertilizer is safe to handle and safe to use on food crops, OMRI certified for organic use with no restrictions. The anaerobic digestion process works well with organic feedstocks such as food waste. Clean water is also a product of the NCS, reducing water pollution in the surrounding ecosystem.

Anaerobic digesters generate renewable biogas energy and help with manure management by reducing odors and pathogens but digesters alone don't solve the volume or nutrient management problems. The objectives of installing NCS are to improve the economic efficiencies of manure handling, improve flexibility of the timing of manure

application, and reduce the adverse environmental impact of nutrient loading to ground and surface waters by making the redistribution of nutrients economically feasible. This is accomplished by decreasing volume of manure land applied by 50-60%. The NCS system will “dewater” the manure creating clean water for discharge, crop irrigation and organic fertilizer to be sold into the market place replacing commercial fertilizer.

Operations & Maintenance and Management of the Facilities

The digester plant will be managed and operated under a long-term management agreement by Dynamic Systems Management LLC (Dynamic). Members of Dynamic’s team have successfully designed, engineered, constructed, and operated over a dozen facilities in the United States. In addition, Dynamic personnel are currently operating the GL Dairy Biogas LLC in Middleton, WI (<http://www.gundersenenvision.org/environmental-photos/middleton-dairy-digester>), the Sunny Side Digester LLC in Sun Prairie, WI (<http://www.gundersenenvision.org/environmental-photos/sun-prairie-dairy-digester>), and provide consulting services to Waste No Energy LLC in Monticello, IN (<http://www.wastenoenergyllc.com>).

APPENDIX III

MANURE MANAGEMENT AND OPERATION PLAN

OPERATION AND MAINTENANCE MANUAL

for the
PARNELL DAIRY
ANIMAL WASTE MANAGEMENT SYSTEM

BROOKINGS COUNTY, SOUTH DAKOTA

January 10, 2017

DEC Project No. 1611

Producers: Killeskillen LLC
Address: 126 Pine Ridge Road
Brookings, SD 57006
Phone: (605) 691-1045
Project Location: SW ¼ of Section 28, T109N R48W, Brookings County, SD

The Owner acknowledges responsibility for the proper operation and maintenance of the animal waste management system. Although the design is based on the best available technical knowledge, it must be recognized that any system creates some risks, and therefore needs to be properly operated and maintained, including periodic inspection. In addition, maximum efficiency cannot be obtained unless the system is properly operated and maintained so that it will function safely in its intended manner. Recognizing this, this Manual has been prepared for operating and maintaining the system.

The following items list the anticipated major and uncommon items of Operation and Maintenance for this system. It is recommended that the following list be reviewed and be used as a checklist to ensure major elements of operation and maintenance are consistently being observed.

I. Operation

A. *Inspection:*

- ___ 1. Entire system weekly.
- ___ 2. Manure transfer pipes and inlet structures.
- ___ 3. Fences and safety signs.
- ___ 4. Depth of waste.
- ___ 5. Inspect all components for signs of damage or leakage.
- ___ 6. Inspect earthwork for signs of seepage, rodent damage, settlement, misalignment, excessive vegetative growth, or erosion.
- ___ 7. Document all inspections on the form included with this manual, including all pertinent information.
- ___ 8. If a discharge from the manure management system is found to have occurred, the producer must report the discharge as soon as possible, but no later than twenty-four hours after the discharge was discovered. The discharge must be reported to the State of South Dakota at (605) 773-3351, or (605) 773-3231 after normal business hours.

B. *Daily Operation:*

- ___ 1. All pond liner bottoms shall be kept submerged a minimum of one foot at all times. If there is less than one foot of water, additional water will need to be added to prevent the clay from shrinking and cracking. If cracking occurs, contact Dakota Environmental to evaluate the liner.
- ___ 2. Divert all stormwater and runoff not designated for collection from entering buildings, transfer structures, and the storage ponds.

- _____ 3. Confine travel of vehicles and livestock to designated areas to prevent erosion and enhance vegetation.
- _____ 4. Maintain grades around all components to assure positive surface drainage away from the structures in all directions. Fill any settled areas which may collect water.
- _____ 5. Piled feed should be kept covered to the maximum extent practical in order to minimize contact with stormwater. The open end of the piles should be kept as clean as possible so that no more material than absolutely necessary is exposed. Good housekeeping practices shall be employed at the loading face of any pile to prevent loose material from piling up around the open face of the covered pile and becoming exposed.
- _____ 6. Manure must be removed from the freestall barn alleys by suction truck as needed to maintain adequate containment. Transfer of collected manure to the separator pit shall be via the opening in the pit cover.
- _____ 7. Manure from the freestall barn alleys must be manually scraped to the separator pit opening if the suction truck is unavailable.
- _____ 8. Maintain adequate freeboard and storage capacity in the storage structures. The liquid levels are not to exceed the maximum operating depth markers. If the maximum operating level is exceeded, storage capacity must be restored within 14 days in accordance with statutes of the General Permit.
- _____ 9. The contents of the storage ponds should be agitated during removal of wastes to prevent buildup of solids and sludge.
- _____ 10. All provisions of the General Water Pollution Control Permit for Concentrated Animal Feeding Operations must be followed. The producer should be familiar with this permit in its entirety.
- _____ 11. For safety, cover all openings to pump pits and similar structures when not in use. Be certain the covers provide ventilation as explosive, poisonous, and suffocating gases are produced. This applies to all enclosed areas where manure is present.
- _____ 12. Extreme care must be exercised before entering any enclosure, such as pumping stations, for maintenance. This should include operations by experienced and knowledgeable workers **in pairs**, making use of appropriate safety equipment, such as a harness, forced ventilation, or the use of an oxygen mask. All operators should familiarize themselves with gas problems, special wiring needs and ventilation needs. "**NO SMOKING**" or similar signs to warn against ignition hazards should be posted to warn persons of explosion danger at any pump pits or other enclosed, poorly ventilated areas in which combustible gases may accumulate.

II. Maintenance

- ____ 1. Repair any earth work, or erosion thereof, to original grade. Grading must maintain a slope away from the buildings and storage pond in all directions to drain runoff.
- ____ 2. Repair and revegetate any areas of significant erosion.
- ____ 3. Repair any damaged system components.
- ____ 4. Seal any areas where seepage is noted. Cracks in concrete pit walls or floors must be sealed with a suitable high modulus sealant.
- ____ 5. Repair fences, covers, and safety signs, etc. to original specifications if damaged.
- ____ 6. Remove and dispose of trash and debris that will affect the aesthetics or functioning of the system.
- ____ 7. Remove any trees growing adjacent to pits, buildings, or ponds to prevent root damage to the structures.
- ____ 8. Apply herbicide as needed to retard growth of vegetation on the inside of the pond embankments so the integrity of the clay is not disturbed.

I have reviewed the above Operation and Maintenance Manual for my Waste Management System and agree to provide the necessary resources to properly implement its provisions.

Operator

Date

APPENDIX IV

MANAGEMENT PLAN FOR FLY AND ODOR CONTROL

MANAGEMENT PLAN FOR FLY AND ODOR CONTROL

for the
PARNELL DAIRY
ANIMAL WASTE MANAGEMENT SYSTEM

BROOKINGS COUNTY, SOUTH DAKOTA

January 10, 2017

DEC Project No. 1611

Producers: Killeskillen LLC
Address: 126 Pine Ridge Road
Brookings, SD 57006
Phone: (605) 691-1045
Project Location: SW ¼ of Section 28, T109N R48W, Brookings County, SD

This plan is provided to describe the Best Management Practices (BMPs) that are used to minimize any nuisance created by flies and odors from the proposed dairy facility. The BMPs described have been utilized at other facilities and have been reported to be useful for the confinement areas, manure storage areas, and the disposal of dead animals.

I. Manure Storage Areas

The majority of the waste produced on the site will be contained in earthen storage ponds, though a small amount of separated manure solids could be stored on a concrete storage pad near the ponds. The cattle will be housed in a freestall barn from which manure is transported to a reception pit and solids separator before being discharged to the ponds. The ponds are designed in accordance with state law to provide adequate storage capacity as well as minimize odors. The solids storage pad is designed to capture all runoff from precipitation falling on the area and drain it to the storage ponds. The storage ponds will likely form a semi-solid crust consisting of buoyant residues, which will serve to reduce odors by minimizing air contact with the raw manure.

The configuration of the buildings and manure collection reduce odors by removing manure from the housing areas as soon as possible. It is vital to the best interests of any dairy operation to keep the animals as clean and dry as possible, which is assurance that good housekeeping practices is maintained in the barn areas. A solids separator will be used to remove a percentage of the manure solids from the waste stream before it reports to the ponds. The solids will be dried and recycled as bedding. Washwater used in the process of cleaning the milking parlor and holding area also dilutes the raw manure, resulting in reduced odor as well.

The site is located with consideration to applicable zoning ordinances and permit requirements for confined animal feeding operations. These include specific separation distances from roads, residences, churches, schools, businesses, and municipalities. These distances were established to prevent any nuisance to surrounding features from facilities of this type. Good ventilation of the buildings will be provided, which is also in the best interests of the animal herd and operator.

Final disposal of the manure is anticipated to be processing by a proposed plant producing fertilizer products as a value added venture.

Since higher winds tend to disperse odors by agitating odors, windy days are when odors are usually noticed the least. On calm days, or days with light winds, odor is transported without being agitated. Therefore, trees, shrubs or other plantings will aid in the dispersion of airborne odors by agitation in either low or high wind conditions. Adequate space exists on the north, west, and south sides of the site for planting of shelterbelts.

Trees and vegetation also serve as habitat for species such as birds, which prey upon insects or insect larvae. For areas around the barns, pesticide, especially in powdered form, can also be used to control insects. The periodic use of professional pest control services which utilize sprays or fogging to eliminate insects is also a common practice in the dairy industry.

Rodent control is aided by the fact that the configuration of the buildings offers little shelter for these animals. Control of rodents is also in the best interests of the dairy for reasons of sanitation and biosecurity, which is thoroughly inspected on a regular basis by state officials. For areas around the building walls, solid poison can be used to control rodents and keep burrowing from occurring near the concrete. Professional control services are also available, and are commonly used in the industry.

II. Disposal of Dead Animals

Disposal of dead animal is not expected to be a major concern at this facility, since death loss is generally very low at dairy operations not raising their own calves. The herd is generally culled on a regular basis, with animals which are not producing as desired being sold and removed. In this way, death loss is minimized by removing animals which are past their prime before they become chronically ill. A rendering service will be utilized in the infrequent occurrences of mortality. This method is one of several approved by the State Animal Industry Board for removal of carcasses, and offers the most efficient option for the operator.

Summary

The Best Management Practices that have been described above are fully expected to minimize nuisances from odors and insects at this facility. While some production of odor is inevitable, it is possible through concerted effort and careful attention to keep both the intensity and frequency of odors and insects at a level where area residents are not inconvenienced.

APPENDIX V
SETBACK MAP

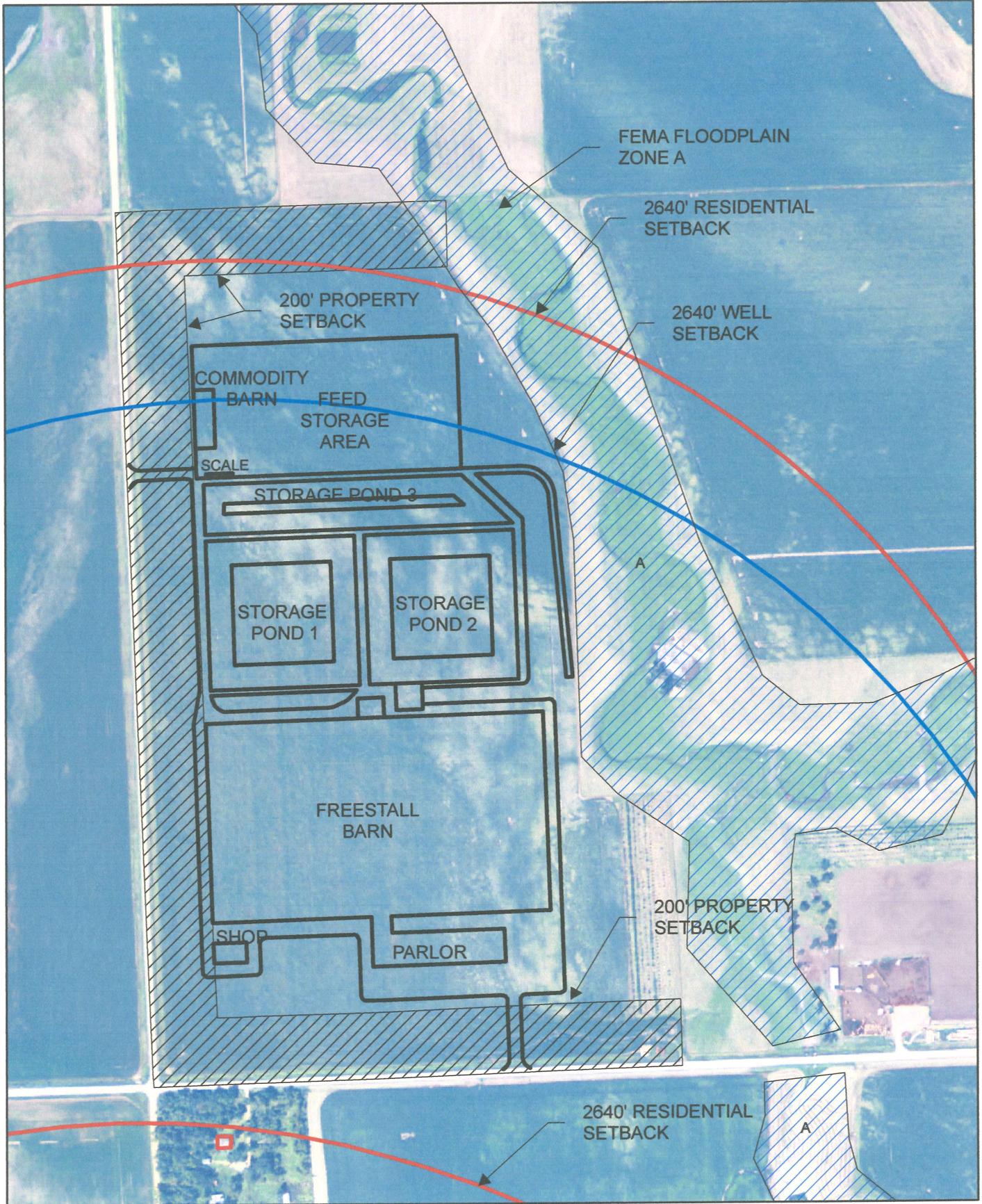
PARNELL DAIRY AWMS RESIDENTIAL SETBACK MAP



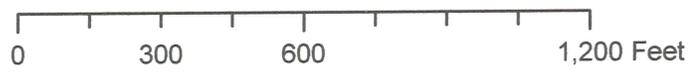
1 inch = 1,200 feet



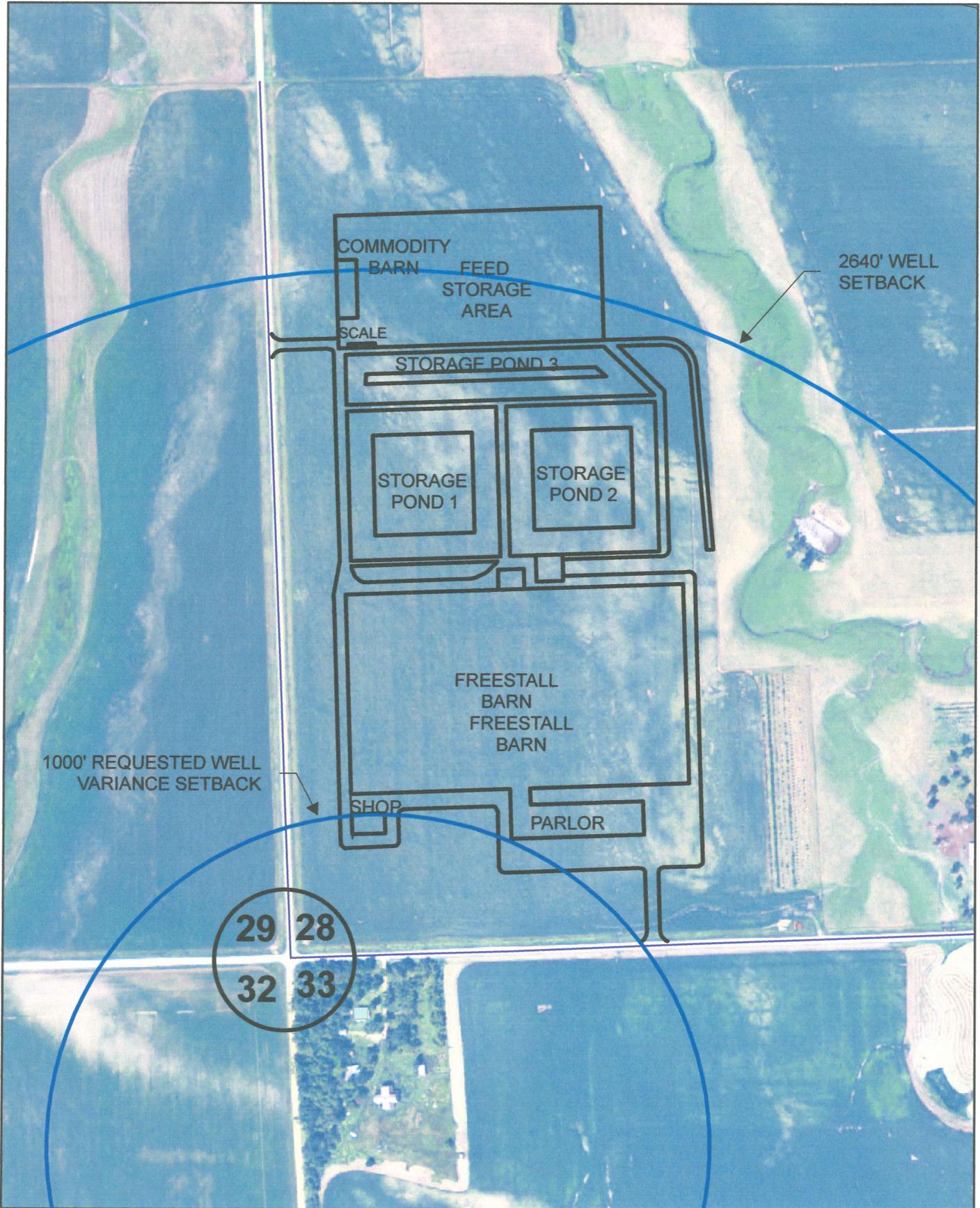
PARNELL DAIRY AWMS SETBACK MAP



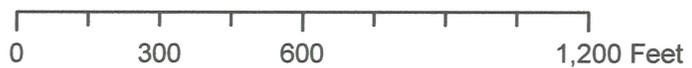
1 inch = 400 feet



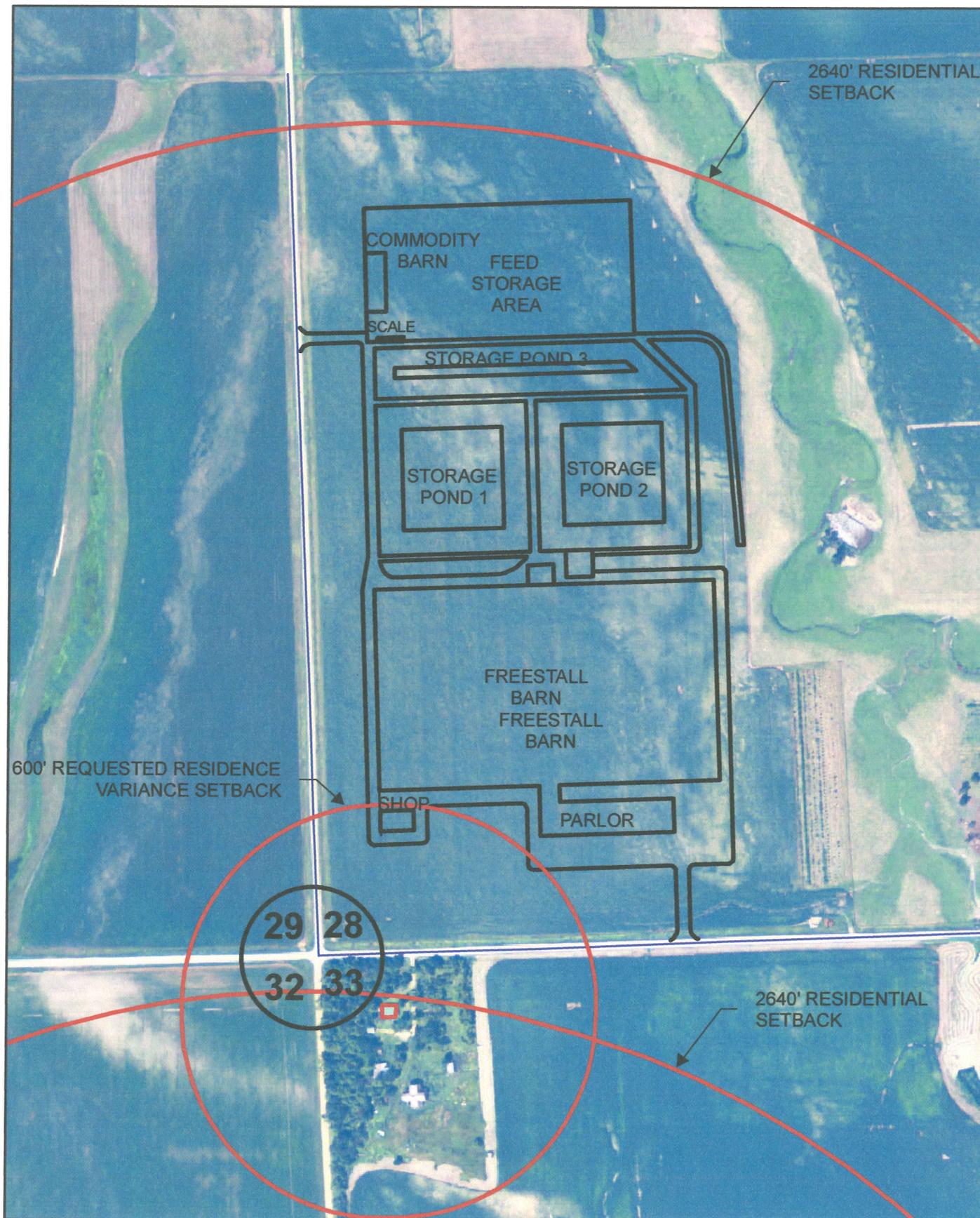
PARNELL DAIRY AWMS REQUESTED WELL VARIANCE MAP



1 inch = 400 feet



PARNELL DAIRY AWMS REQUESTED RESIDENCE VARIANCE MAP



1 inch = 400 feet

0 300 600 1,200 Feet

Well Site

DESCRIPTION:

Latitude 44°12'36", Longitude 96°36'35" NAD27
Brookings County, South Dakota , Hydrologic Unit 10170203
Well depth: 170 feet
Land surface altitude: 1,703 feet above NGVD29.

AVAILABLE DATA:

*****There are no data available online for this site.*****

Contact the state office (below) to inquire about the availability of other data for this site.

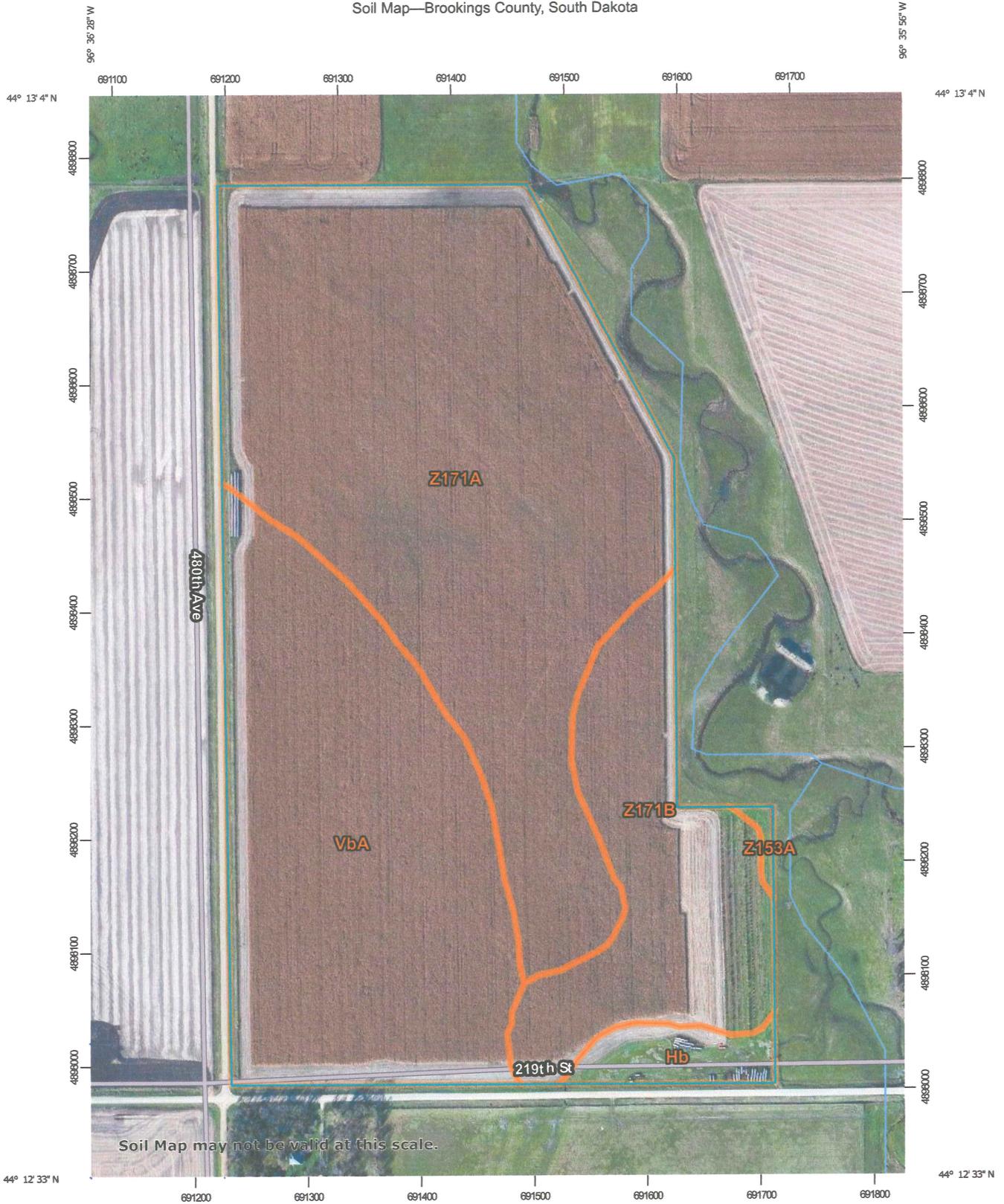
OPERATION:

Record for this site is maintained by the USGS South Dakota Water Science Center
Email questions about this site to [South Dakota Water Science Center Water-Data Inquiries](#)

APPENDIX VI

*SOILS, SHALLOW AQUIFERS, WELLHEAD PROTECTION,
& FLOODPLAIN INFORMATION*

Soil Map—Brookings County, South Dakota



Map Scale: 1:4,630 if printed on A portrait (8.5" x 11") sheet.

0 50 100 200 300 Meters

0 200 400 800 1200 Feet

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 14N WGS84



Natural Resources
Conservation Service

Web Soil Survey
National Cooperative Soil Survey

1/10/2017
Page 1 of 3

MAP LEGEND

 Area of Interest (AOI)	 Spoil Area
 Soil Map Unit Polygons	 Stony Spot
 Soil Map Unit Lines	 Very Stony Spot
 Soil Map Unit Points	 Wet Spot
 Special Point Features	 Other
 Blowout	 Special Line Features
 Borrow Pit	 Streams and Canals
 Clay Spot	 Railroads
 Closed Depression	 Interstate Highways
 Gravel Pit	 US Routes
 Gravelly Spot	 Major Roads
 Landfill	 Local Roads
 Lava Flow	 Aerial Photography
 Marsh or swamp	 Background
 Mine or Quarry	 Aerial Photography
 Miscellaneous Water	 Aerial Photography
 Perennial Water	 Aerial Photography
 Rock Outcrop	 Aerial Photography
 Saline Spot	 Aerial Photography
 Sandy Spot	 Aerial Photography
 Severely Eroded Spot	 Aerial Photography
 Sinkhole	 Aerial Photography
 Slide or Slip	 Aerial Photography
 Sodic Spot	 Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:24,000.

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:
 Coordinate System: Web Mercator (EPSG:3857)

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

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

Soil Survey Area: Brookings County, South Dakota
 Survey Area Data: Version 23, Sep 26, 2016

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

Date(s) aerial images were photographed: Aug 6, 2010—Oct 21, 2010

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

Brookings County, South Dakota (SD011)			
Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
Hb	Hamerly-Badger complex, 0 to 2 percent slopes	2.1	2.6%
VbA	Vienna-Brookings complex, 0 to 2 percent slopes	25.2	31.6%
Z153A	Lamoure-Rauville silty clay loams, channeled, 0 to 2 percent slopes, frequently flooded	0.3	0.3%
Z171A	Renshaw-Fordville loams, coteau, 0 to 2 percent slopes	39.9	50.0%
Z171B	Renshaw-Fordville loams, coteau, 2 to 6 percent slopes	12.2	15.4%
Totals for Area of Interest		79.7	100.0%

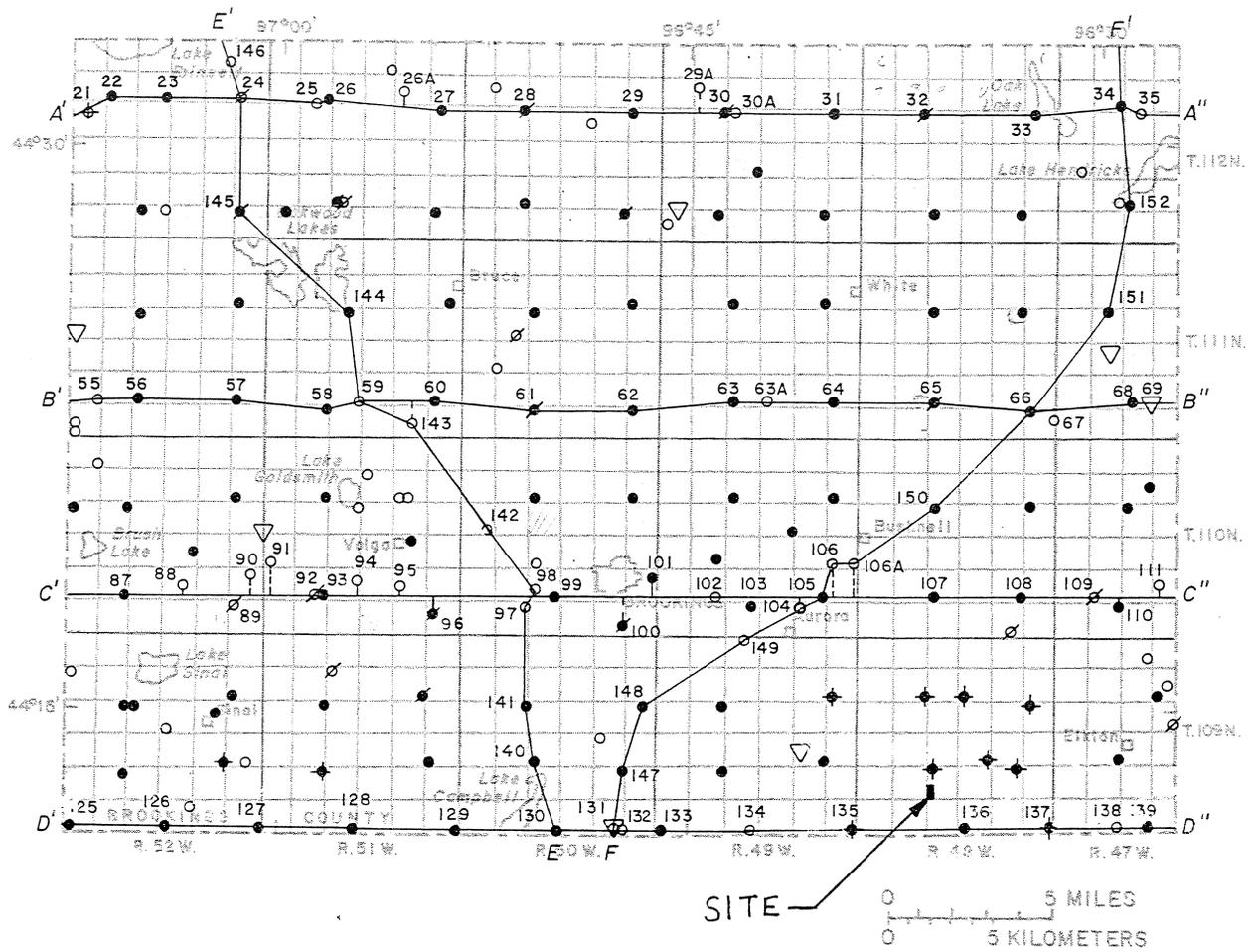
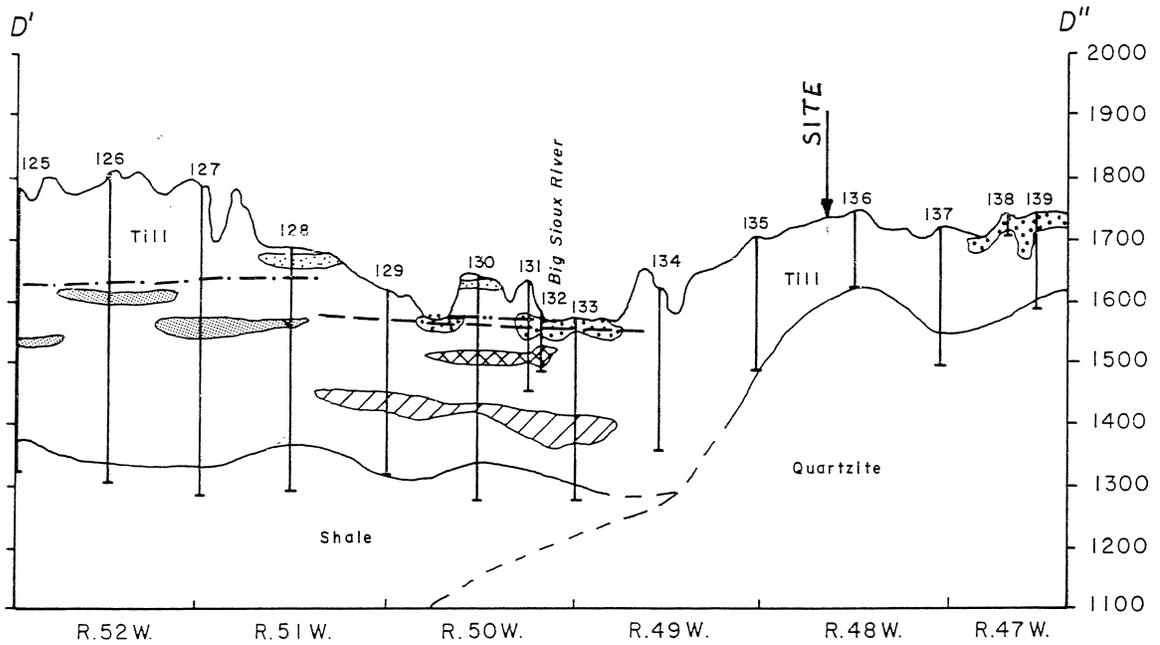
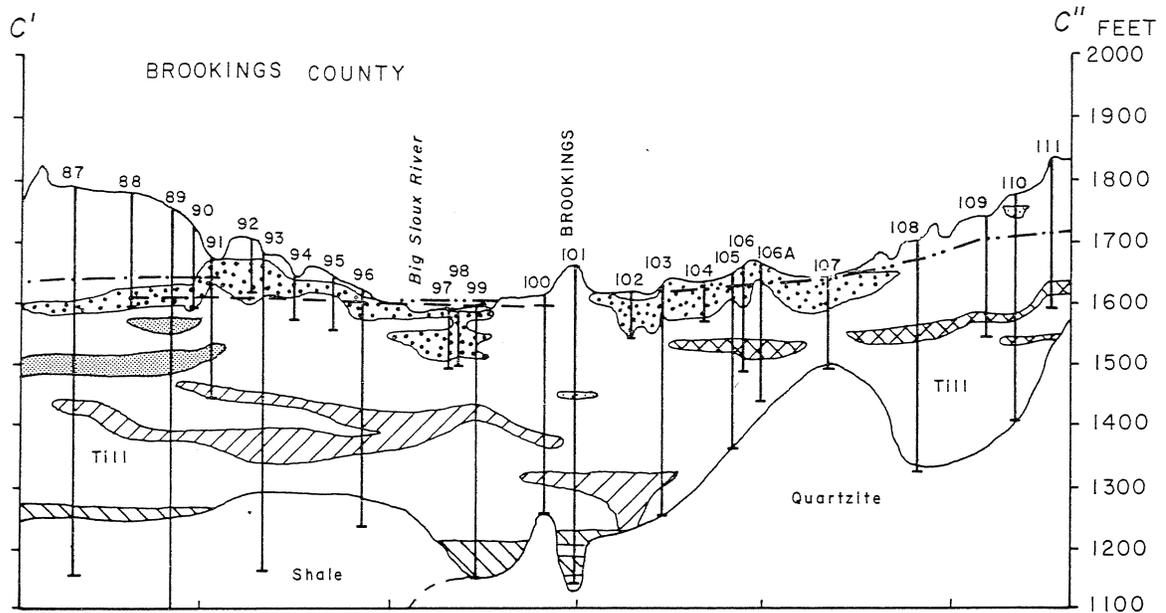


Figure 6.--Locations of hydrologic sections, test holes, and wells for which geologic, electric, or drillers' logs are available (excluding test holes in the Big Sioux aquifer).--Continued



VERTICAL SCALE IS GREATLY EXAGGERATED

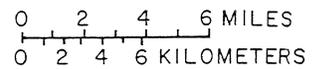


Figure 7.--Aquifers and potentiometric surfaces in glacial deposits.--Continued

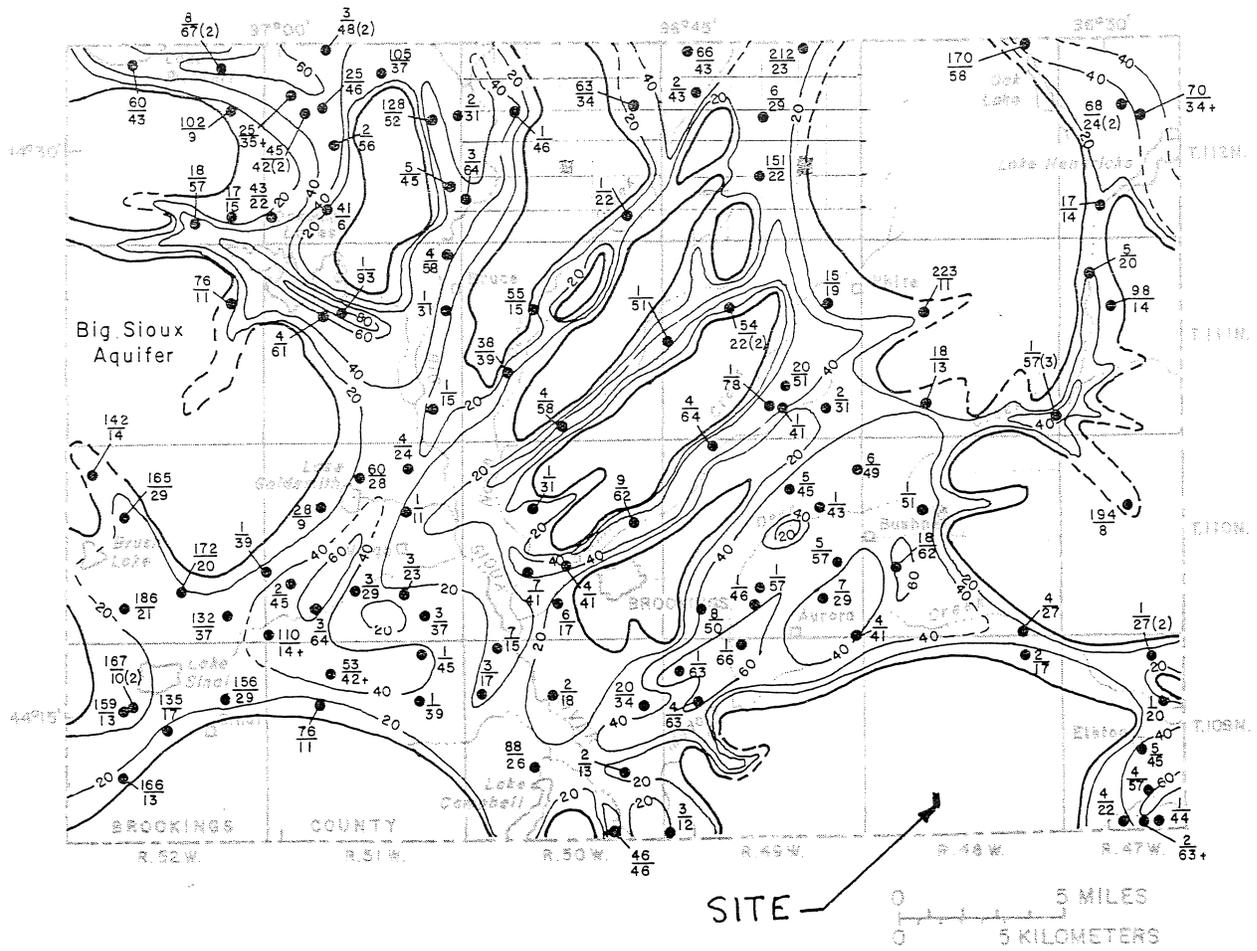


Figure 9.--Extent, depth, and thickness of the Big Sioux and Vermillion East Fork aquifers.--Continued

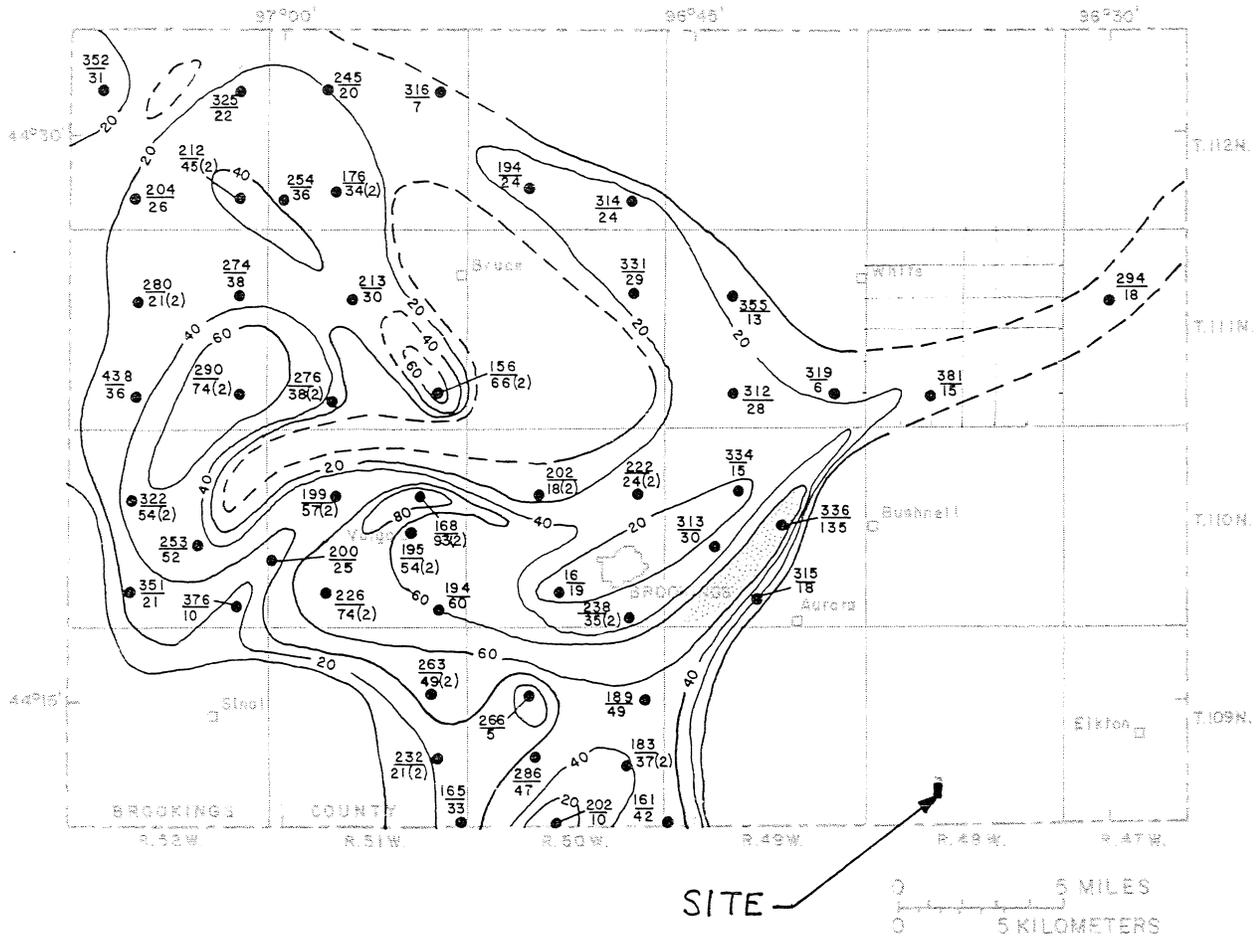


Figure 16.--Extent, depth, and thickness of the Howard aquifer.--Continued

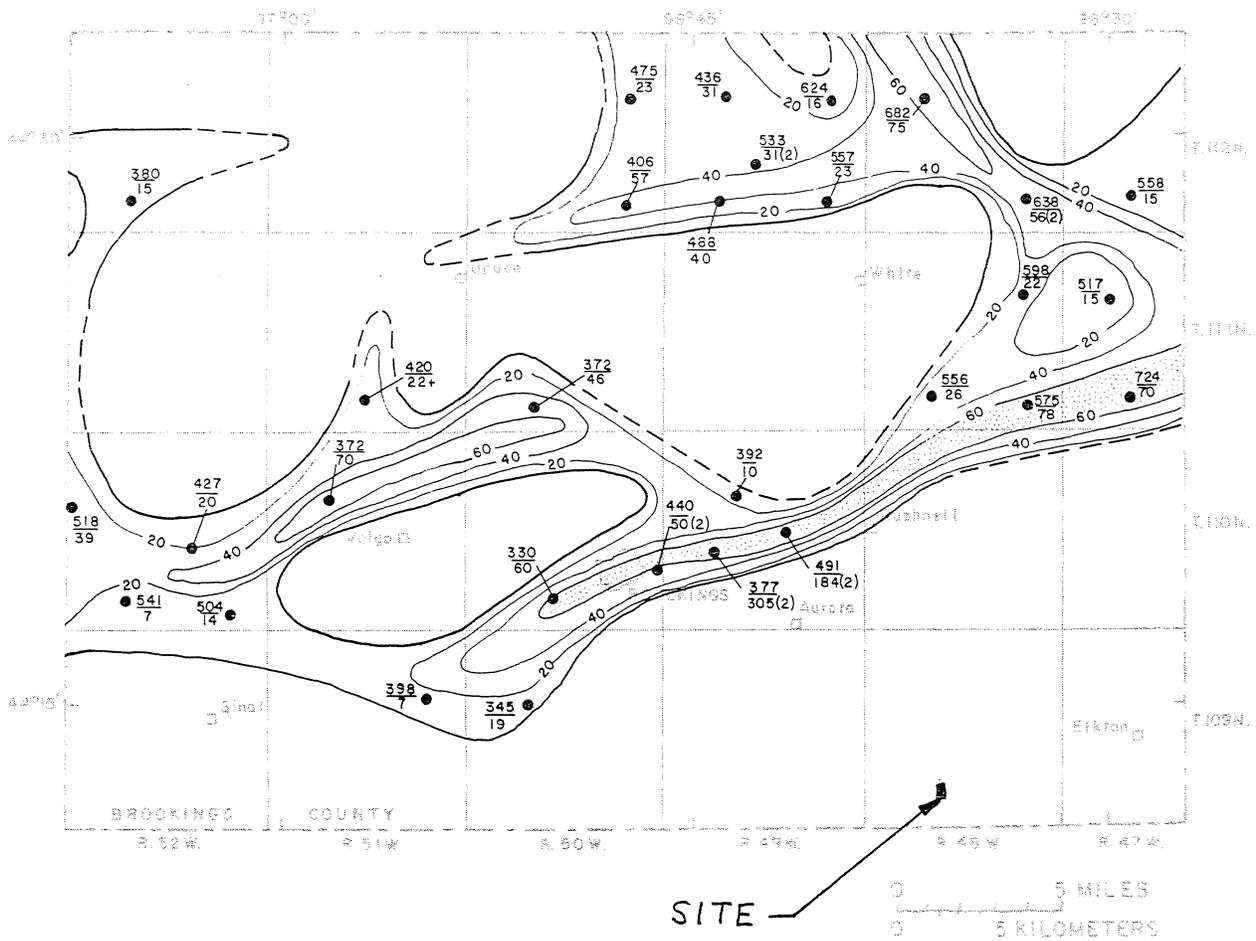


Figure 18.--Extent, depth, and thickness of the Altamont aquifer.--Continued

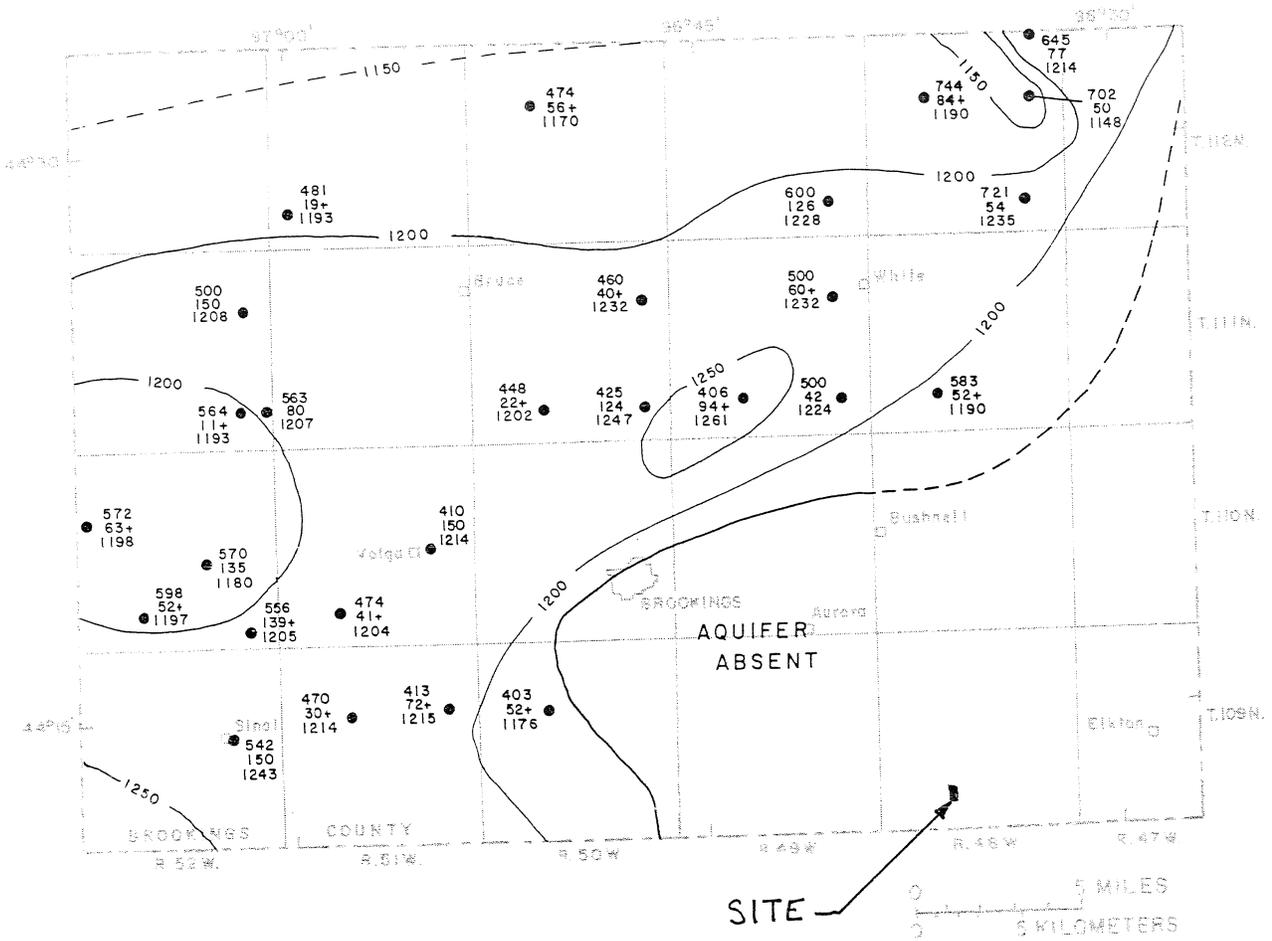
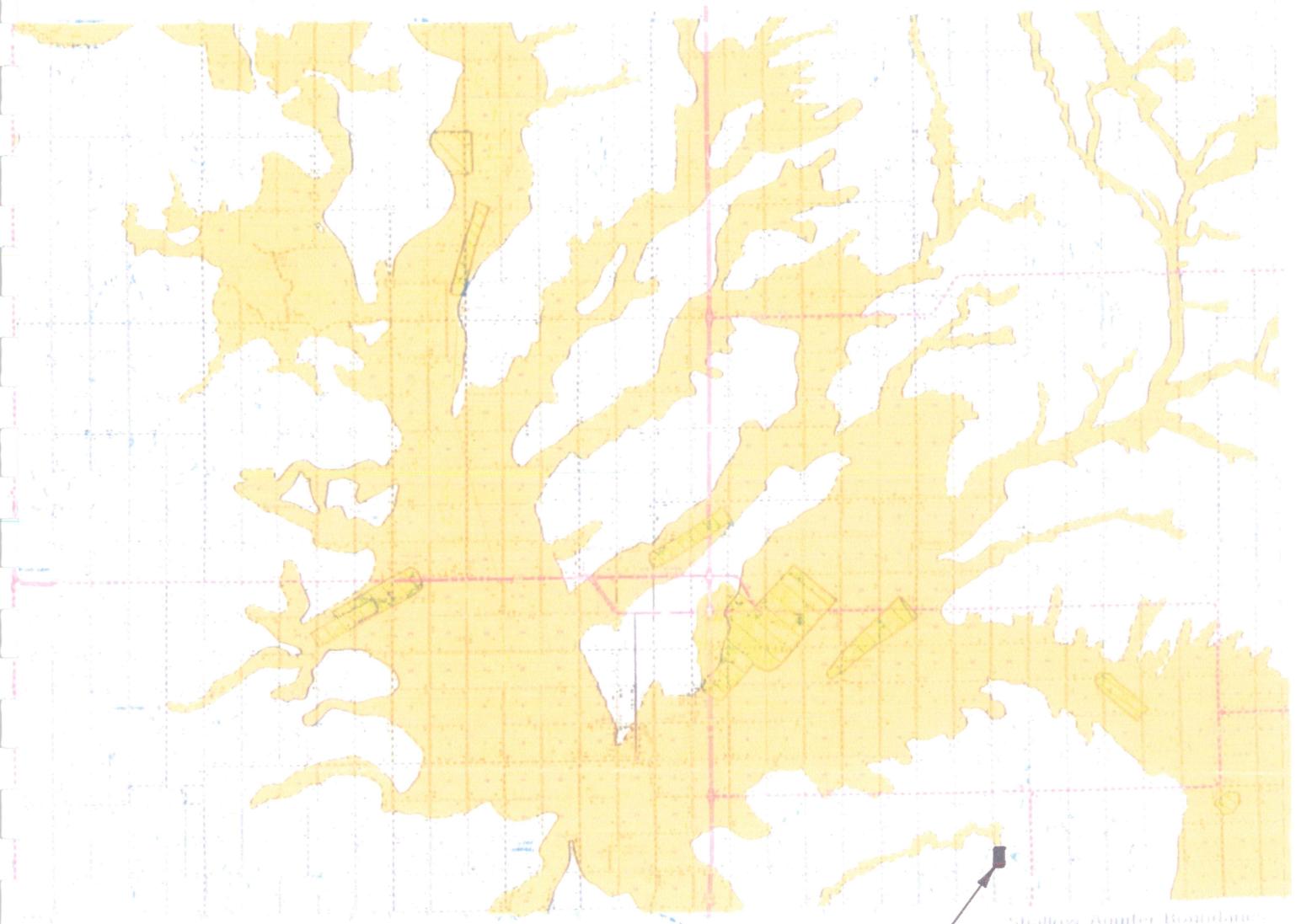


Figure 20.--Depth, thickness, and structure contours of the Niobrara aquifer.--Continued

Brookings County Groundwater Protection Zones

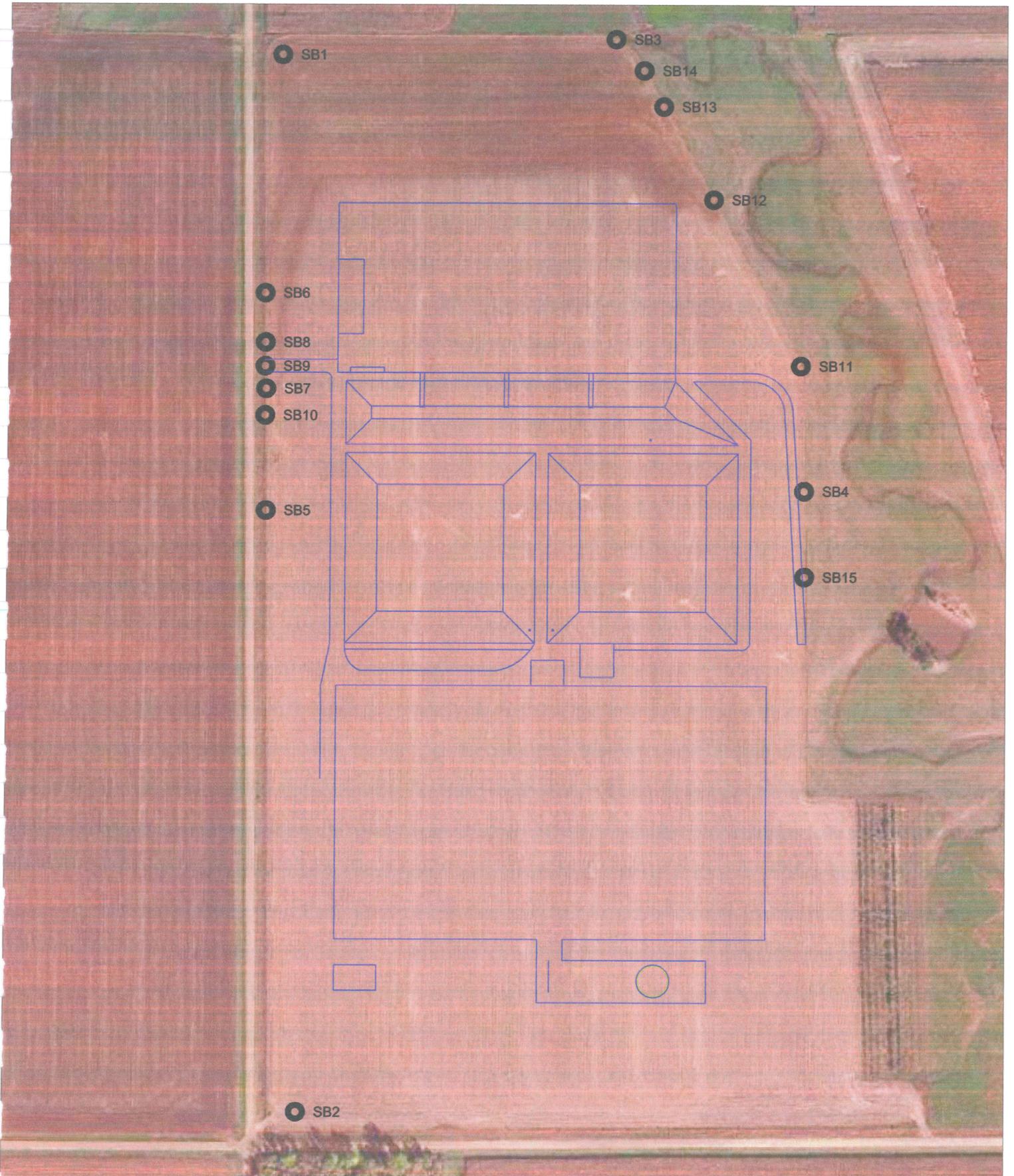


- Zone A Wellhead Protection Area
- Areas Contributing Drainage to Zone A
- Zone B Shallow Aquifer Boundaries

SITE

- Shallow Aquifer Boundaries:
 - 300 ft. accuracy
 - 1600 ft. accuracy
- Areas Contributing Drainage to Zone A

PARNELL DAIRY SOIL BORING LOCATIONS MAP



1 INCH = 300 FEET



SOIL BORING LOG
Dakota Environmental Consultants, Inc. P.O. Box 636 Huron, SD 57350 (605) 352-5610

Boring #
SB 1

Soil Description	WL	Depth	Geo.	Elevation	Sample ID	USCS
Topsoil		0.0	Topsoil	1672.0	SB1 0'-4"	OL
Sandy lean clay, brown, moist, soft		0.5		1671.5	SB1 4"-2'	CL
		1.0		1671.0		
Well graded sand with gravel, light brown, moist to wet		1.5		1670.5	SB1 2'-6.5'	SW
		2.0		1670.0		
		2.5		1669.5		
		3.0	Mixed Alluvium	1669.0		
		3.5 (TOB)		1668.5		
		4.0		1668.0		
		4.5		1667.5		
		5.0		1667.0		
		5.5		1666.5		
		6.0		1666.0		
Clay with sand, brown, moist, soft to medium stiff		6.5		1665.5	SB1 6.5' 20'	CL
		7.0		1665.0		
		7.5		1664.5		
		8.0		1664.0		
		8.5		1663.5		
		9.0		1663.0		
		9.5		1662.5		
		10.0		1662.0		
		10.5		1661.5		
		11.0		1661.0		
		11.5		1660.5		
		12.0		1660.0		
		12.5		1659.5		
		13.0	Weathered Till	1659.0		
		13.5		1658.5		
	14.0		1658.0			
	14.5		1657.5			
	15.0		1657.0			
	15.5		1656.5			
	16.0		1656.0			
	16.5		1655.5			
	17.0		1655.0			
	17.5		1654.5			
	18.0		1654.0			
	18.5		1653.5			
	19.0		1653.0			
	19.5		1652.5			
END OF BORING		20.0		1652.0		
		20.5		1651.5		
		21.0		1651.0		
		21.5		1650.5		
		22.0		1650.0		
		22.5		1649.5		
		23.0		1649.0		
		23.5		1648.5		
		24.0		1648.0		
		24.5		1647.5		
	25.0		1647.0			
	25.5		1646.5			

NOTE: Water level at time of boring: 3.5'	Water Level:	3.5' @ TOB	DEC #	Date of Boring:	6/23/2016	
	Method:	Split Spoon	1611	Page:	1 of 1	
	Driller:	TB	Chkd by:	BF	Elevation:	1672
	Sampler:	RR	Project:			
	Recorded By:	RR	Parnell Dairy AWMS			
	Entered By/Date:	RR 6/27/16				



SOIL BORING LOG
Dakota Environmental Consultants, Inc. P.O. Box 636 Huron, SD 57350 (605) 352-5610

Boring #
SB 2

Soil Description	WL	Depth	Geo.	Elevation	Sample ID	USCS
Topsoil		0.0	Topsoil	1697.8	SB2 0'-4"	OL
Lean clay with sand, brown, moist, medium stiff		0.5		1697.3	SB2 4"-2'	
		1.0		1696.8		
Clay with sand, brown, moist, medium stiff to stiff		1.5		1696.3	SB2 2'-30'	CL
		2.0		1695.8		
		2.5		1695.3		
		3.0		1694.8		
		3.5		1694.3		
		4.0		1693.8		
		4.5		1693.3		
		5.0		1692.8		
		5.5		1692.3		
		6.0		1691.8		
		6.5		1691.3		
		7.0		1690.8		
		7.5		1690.3		
		8.0		1689.8		
		8.5		1689.3		
		9.0		1688.8		
		9.5		1688.3		
		10.0		1687.8		
		10.5		1687.3		
		11.0		1686.8		
		11.5		1686.3		
		12.0		1685.8		
		12.5	Weathered Till	1685.3		
		13.0		1684.8		
	13.5		1684.3			
	14.0		1683.8			
	14.5		1683.3			
	15.0		1682.8			
	15.5		1682.3			
	16.0		1681.8			
	16.5		1681.3			
	17.0		1680.8			
	17.5		1680.3			
	18.0		1679.8			
	18.5		1679.3			
	19.0		1678.8			
	19.5		1678.3			
	20.0		1677.8			
	20.5		1677.3			
	21.0		1676.8			
	21.5		1676.3			
	22.0		1675.8			
	22.5		1675.3			
	23.0		1674.8			
	23.5		1674.3			
	24.0		1673.8			
	24.5		1673.3			
	25.0		1672.8			
	25.5		1672.3			

NOTE: Water level at time of boring: None	Water Level: None @ TOB	DEC #	Date of Boring: 6/23/2016
	Method: Split Spoon	1611	Page: 1 of 2
	Driller: TB	Chkd by: BF	Elevation: 1697.8
	Sampler: RR	Project:	
	Recorded By: RR	Parnell Dairy AWMS	
	Entered By/Date: RR 6/27/16		



SOIL BORING LOG

Dakota Environmental Consultants, Inc. P.O. Box 636 Huron, SD 57350 (605) 352-5610

Boring #

SB 2

Soil Description	WL	Depth	Geo.	Elevation	Sample ID	USCS
Clay with sand, brown, moist, medium stiff to stiff		26.0		1671.8	SB2 2'-30'	CL
		26.5		1671.3		
		27.0		1670.8		
		27.5		1670.3		
		28.0	Weathered Till	1669.8		
		28.5		1669.3		
		29.0		1668.8		
		29.5		1668.3		
END OF BORING		30.0		1667.8		
		30.5		1667.3		
		31.0		1666.8		
		31.5		1666.3		
		32.0		1665.8		
		32.5		1665.3		
		33.0		1664.8		
		33.5		1664.3		
		34.0		1663.8		
		34.5		1663.3		
		35.0		1662.8		
		35.5		1662.3		
		36.0		1661.8		
		36.5		1661.3		
		37.0		1660.8		
		37.5		1660.3		
		38.0		1659.8		
		38.5		1659.3		
		39.0		1658.8		
		39.5		1658.3		
		40.0		1657.8		
		40.5		1657.3		
		41.0		1656.8		
		41.5		1656.3		
		42.0		1655.8		
		42.5		1655.3		
		43.0		1654.8		
		43.5		1654.3		
	44.0		1653.8			
	44.5		1653.3			
	45.0		1652.8			
	45.5		1652.3			
	46.0		1651.8			
	46.5		1651.3			
	47.0		1650.8			
	47.5		1650.3			
	48.0		1649.8			
	48.5		1649.3			
	49.0		1648.8			
	49.5		1648.3			
	50.0		1647.8			
	50.5		1647.3			
	51.0		1646.8			
	51.5		1646.3			

NOTE: Water level at time of boring: None	Water Level: None @ TOB	DEC # 1611	Date of Boring: 6/23/2016
	Method: Split Spoon		Page: 2 of 2
	Driller: TB	Chkd by: BF	Elevation: 1697.8
	Sampler: RR	Project: Parnell Dairy AWMS	
	Recorded By: RR		
	Entered By/Date: RR 6/27/16		



SOIL BORING LOG
Dakota Environmental Consultants, Inc. P.O. Box 636 Huron, SD 57350 (605) 352-5610

Boring #
SB 3

Soil Description	WL	Depth	Geo.	Elevation	Sample ID	USCS
Topsoil		0.0	Topsoil	1672.8	SB3 0'-4"	OL
Well graded gravel, brown, moist, medium stiff		0.5	Mixed Alluvium	1672.3	SB3 4"-2'	GW
		1.0		1671.8		
		1.5		1671.3		
		2.0		1670.8		
		2.5		1670.3		
Lean sandy clay, brown, moist, medium stiff		3.0	Mixed Alluvium	1669.8	SB3 2'-4'	CL
		3.5		1669.3		
		4.0		1668.8		
		4.5		1668.3		
		5.0		1667.8		
Poorly graded fine silty sand, light brown, moist		5.5	Mixed Alluvium	1667.3	SB3 4'-7.5'	SP
		6.0		1666.8		
		6.5		1666.3		
		7.0		1665.8		
		7.5		1665.3		
Well graded sand, brown, wet	(TOB)	8.0	Mixed Alluvium	1664.8	SB3 7.5'-8'	SW
Sandy clay, brown, moist, medium stiff		8.5		1664.3	SB3 8'-10'	CL
		9.0		1663.8		
		9.5		1663.3		
		10.0		1662.8		
		10.5	1662.3			
Well graded sand and gravel, brown, moist, wet		11.0	Weathered Till	1661.8	SB3 10'-11'	SW
Clay with sand, brown, moist, medium stiff to stiff		11.5		1661.3		
		12.0		1660.8		
		12.5		1660.3		
		13.0		1659.8		
		13.5		1659.3		
		14.0		1658.8		
		14.5		1658.3		
		15.0		1657.8		
		15.5		1657.3		
		16.0		1656.8		
		16.5		1656.3		
		17.0		1655.8		
		17.5		1655.3		
		18.0		1654.8		
		18.5	1654.3			
	19.0	1653.8				
	19.5	1653.3				
END OF BORING		20.0		1652.8		
		20.5		1652.3		
		21.0		1651.8		
		21.5		1651.3		
		22.0		1650.8		
		22.5		1650.3		
		23.0		1649.8		
		23.5		1649.3		
		24.0		1648.8		
		24.5		1648.3		
	25.0	1647.8				
	25.5	1647.3				

NOTES: Water level 7.5' at time of boring.	Water Level: 7.5' @ TOB	DEC #	Date of Boring: 6/23/2016
	Method: Split Spoon	1611	Page: 1 of 1
	Driller: TB	Chkd by: BF	Elevation: 1672.8
	Sampler: RR	Project:	
	Recorded By: RR	Parnell Dairy AWMS	
	Entered By/Date: RR 6/27/16		



SOIL BORING LOG
Dakota Environmental Consultants, Inc. P.O. Box 636 Huron, SD 57350 (605) 352-5610

Boring #

SB 4

Soil Description	WL	Depth	Geo.	Elevation	Sample ID	USCS
Topsoil		0.0	Topsoil	1677.5	SB4 0'-3"	OL
Well graded sand with gravel, brown, moist		0.5		1677.0	SB4 3"-2'	SW
		1.0		1676.5		
		1.5		1676.0		
		2.0		1675.5		
		2.5		1675.0		
		3.0		1674.5		
		3.5		1674.0		
		4.0		1673.5		
		4.5		1673.0		
		5.0		1672.5		
		5.5		1672.0		
		6.0		1671.5		
		6.5		1671.0		
		7.0		1670.5		
		7.5		1670.0		
		8.0		1669.5		
		8.5		1669.0		
		9.0		1668.5		
	Clay with sand, brown, moist, medium stiff to stiff		9.5			
		10.0		1667.5		
		10.5		1667.0		
		11.0	Weathered Till	1666.5		
		11.5		1666.0		
		12.0		1665.5		
		12.5		1665.0		
		13.0		1664.5		
		13.5		1664.0		
		14.0		1663.5		
		14.5		1663.0		
Clay with sand, brown/olive, stiff		15.0		1662.5	SB4 20'-35'	CL
		15.5		1662.0		
		16.0		1661.5		
		16.5		1661.0		
		17.0		1660.5		
		17.5		1660.0		
		18.0		1659.5		
		18.5		1659.0		
		19.0		1658.5		
		19.5		1658.0		
		20.0		1657.5		
	20.5		1657.0			
	21.0		1656.5			
	21.5		1656.0			
	22.0		1655.5			
	22.5		1655.0			
	23.0		1654.5			
	23.5		1654.0			
	24.0		1653.5			
	24.5		1653.0			
	25.0		1652.5			
	25.5		1652.0			

NOTES: Water level at time of boring: 42'	Water Level: 42' @ TOB	DEC #	Date of Boring: 6/23/2016
	Method: Split Spoon	1611	Page: 1 of 2
	Driller: TB	Chkd by: BF	Elevation: 1677.5
	Sampler: RR	Project: Parnell Dairy AWMS	
	Recorded By: RR		
Entered By/Date: RR 6/27/16			



SOIL BORING LOG
Dakota Environmental Consultants, Inc. P.O. Box 636 Huron, SD 57350 (605) 352-5610

Boring #

SB 4

Soil Description	WL	Depth	Geo.	Elevation	Sample ID	USCS	
Clay with sand. brown/olive. stiff		26.0		1651.5	SB4 20'-35'	CL	
		26.5		1651.0			
		27.0		1650.5			
		27.5		1650.0			
		28.0		1649.5			
		28.5		1649.0			
		29.0		1648.5			
		29.5		1648.0			
		30.0		1647.5			
		30.5		1647.0			
		31.0		1646.5			
		31.5		1646.0			
		32.0		1645.5			
		32.5		1645.0			
		33.0		1644.5			
		33.5		1644.0			
	Sandy clay, gray/olive, moist, stiff		34.0	Weathered Till			1643.5
		34.5			1643.0		
		35.0			1642.5		
		35.5			1642.0		
		36.0			1641.5		
		36.5			1641.0		
		37.0			1640.5		
		37.5			1640.0		
		38.0			1639.5		
		38.5			1639.0		
		39.0			1638.5		
		39.5			1638.0		
Clay with sand. gray. slight weathering. moist. stiff			40.0			1637.5	SB4 45'-50'
		40.5		1637.0			
		41.0		1636.5			
		41.5		1636.0			
		42.0		1635.5			
		42.5		1635.0			
		43.0		1634.5			
		43.5		1634.0			
		44.0		1633.5			
		44.5		1633.0			
		45.0		1632.5			
		45.5		1632.0			
		46.0		1631.5			
	46.5		1631.0				
	47.0		1630.5				
	47.5		1630.0				
	48.0		1629.5				
	48.5		1629.0				
	49.0		1628.5				
	49.5		1628.0				
END OF BORING		50.0		1627.5			
		50.5		1627.0			
		51.0		1626.5			
		51.5		1626.0			
NOTES: Water level at time of boring: 42'	Water Level:	42' @ TOB		DEC #	Date of Boring: 6/23/2016		
	Method:	Split Spoon		1611	Page: 2 of 2		
	Driller:	TB		Chkd by: BF	Elevation: 1677.5		
	Sampler:	RR		Project:			
	Recorded By:	RR		Parnell Dairy AWMS			
	Entered By/Date:	RR 6/27/16					



SOIL BORING LOG
Dakota Environmental Consultants, Inc. P.O. Box 636 Huron, SD 57350 (605) 352-5610

Boring #

SB 5

Soil Description	WL	Depth	Geo.	Elevation	Sample ID	USCS
Topsoil		0.0		1680.7	SB5 0-1.5'	OL
		0.5	Topsoil	1680.2		
Sandy clay, light brown, moist		1.0		1679.7	SB5 1.5'-10'	CL
		1.5		1679.2		
		2.0		1678.7		
		2.5		1678.2		
		3.0		1677.7		
		3.5		1677.2		
		4.0		1676.7		
		4.5		1676.2		
		5.0		1675.7		
		5.5	Weathered Till	1675.2		
		6.0		1674.7		
		6.5		1674.2		
		7.0		1673.7		
		7.5		1673.2		
		8.0		1672.7		
		8.5		1672.2		
		9.0		1671.7		
	9.5		1671.2			
END OF BORING		10.0		1670.7		
		10.5		1670.2		
		11.0		1669.7		
		11.5		1669.2		
		12.0		1668.7		
		12.5		1668.2		
		13.0		1667.7		
		13.5		1667.2		
		14.0		1666.7		
		14.5		1666.2		
		15.0		1665.7		
		15.5		1665.2		
		16.0		1664.7		
		16.5		1664.2		
		17.0		1663.7		
		17.5		1663.2		
		18.0		1662.7		
	18.5		1662.2			
	19.0		1661.7			
	19.5		1661.2			
	20.0		1660.7			
	20.5		1660.2			
	21.0		1659.7			
	21.5		1659.2			
	22.0		1658.7			
	22.5		1658.2			
	23.0		1657.7			
	23.5		1657.2			
	24.0		1656.7			
	24.5		1656.2			
	25.0		1655.7			
	25.5		1655.2			
NOTES: Water level at time of boring:	Water Level:	None @ TOB	DEC #	Date of Boring: 7/5/2016		
	Method:	Split Spoon	1611	Page: 1 of 1		
	Driller:	TB	Chkd by: BF	Elevation: 1680.7		
	Sampler:	AU	Project:	Parnell Dairy AWMS		
	Recorded By:	RR				
	Entered By/Date:	RR 7/11/16				



SOIL BORING LOG
Dakota Environmental Consultants, Inc. P.O. Box 636 Huron, SD 57350 (605) 352-5610

Boring #
SB 6

Soil Description	WL	Depth	Geo.	Elevation	Sample ID	USCS	
Topsoil		0.0	Topsoil	1676.9	SB6 0'-1'	OL	
		0.5		1676.4			
Well graded sand & gravel, light brown, moist		1.0	Mixed Alluvium	1675.9	SB6 1'-8.5'	GW	
		1.5		1675.4			
		2.0		1674.9			
		2.5		1674.4			
		3.0		1673.9			
		3.5		1673.4			
		4.0		1672.9			
		4.5		1672.4			
		5.0		1671.9			
		5.5		1671.4			
		6.0		1670.9			
	Clay with sand, light brown, moist			6.5			Weathered Till
		7.0	1669.9				
		7.5	1669.4				
		8.0	1668.9				
		8.5	1668.4				
END OF BORING		9.0		1667.9			
		9.5		1667.4			
		10.0			1666.9		
		10.5			1666.4		
		11.0			1665.9		
		11.5			1665.4		
		12.0			1664.9		
		12.5			1664.4		
		13.0			1663.9		
		13.5			1663.4		
		14.0			1662.9		
		14.5			1662.4		
		15.0			1661.9		
		15.5			1661.4		
		16.0			1660.9		
		16.5			1660.4		
		17.0			1659.9		
		17.5			1659.4		
	18.0			1658.9			
	18.5			1658.4			
	19.0			1657.9			
	19.5			1657.4			
	20.0			1656.9			
	20.5			1656.4			
	21.0			1655.9			
	21.5			1655.4			
	22.0			1654.9			
	22.5			1654.4			
	23.0			1653.9			
	23.5			1653.4			
	24.0			1652.9			
	24.5			1652.4			
	25.0			1651.9			
	25.5			1651.4			

NOTES: Water level at time of boring: 6'	Water Level:	6' @ TOB	DEC #	Date of Boring:	7/5/2016
	Method:	Split Spoon	1611	Page:	1 of 1
	Driller:	TB	Chkd by: BF	Elevation:	1676.9
	Sampler:	AU	Project:		
	Recorded By:	TB	Parnell Dairy AWMS		
	Entered By/Date:	RR 7/11/16			



SOIL BORING LOG

Dakota Environmental Consultants, Inc. P.O. Box 636 Huron, SD 57350 (605) 352-5610

Boring #

SB 7

Soil Description	WL	Depth	Geo.	Elevation	Sample ID	USCS	
Topsoil		0.0		1678.5	SB7 0-1.5'	OL	
		0.5	Topsoil	1678.0			
		1.0		1677.5			
Sandy clay, light brown, moist		1.5	Weathered Till	1677.0	SB7 1.5'-2.5'	CL	
		2.0		1676.5			
		2.5		1676.0			
Clayey sand, light brown, moist		3.0			1675.5	SB7 2.5'-3.5'	SC
		3.5			1675.0		
		4.0			1674.5		
Sandy clay, light brown, moist		4.5		1674.0	SB7 3.5'-10'	CL	
		5.0		1673.5			
		5.5		1673.0			
		6.0		1672.5			
		6.5		1672.0			
		7.0		1671.5			
		7.5		1671.0			
		8.0		1670.5			
		8.5		1670.0			
		9.0		1669.5			
		9.5		1669.0			
	END OF BORING		10.0				1668.5
		10.5		1668.0			
		11.0		1667.5			
		11.5		1667.0			
		12.0		1666.5			
		12.5		1666.0			
		13.0		1665.5			
		13.5		1665.0			
		14.0		1664.5			
		14.5		1664.0			
		15.0		1663.5			
		15.5		1663.0			
		16.0		1662.5			
		16.5		1662.0			
		17.0		1661.5			
		17.5		1661.0			
		18.0		1660.5			
		18.5		1660.0			
	19.0		1659.5				
	19.5		1659.0				
	20.0		1658.5				
	20.5		1658.0				
	21.0		1657.5				
	21.5		1657.0				
	22.0		1656.5				
	22.5		1656.0				
	23.0		1655.5				
	23.5		1655.0				
	24.0		1654.5				
	24.5		1654.0				
	25.0		1653.5				
	25.5		1653.0				
NOTES: Water level at time of boring: None	Water Level:	None @ TOB		DEC #	Date of Boring: 7/5/2016		
	Method:	Split Spoon		1611	Page: 1 of 1		
	Driller:	TB		Chkd by: BF	Elevation: 1678.5		
	Sampler:	AU		Project: Parnell Dairy AWMS			
	Recorded By:	TB					
	Entered By/Date:	RR 7/11/16					



SOIL BORING LOG
Dakota Environmental Consultants, Inc. P.O. Box 636 Huron, SD 57350 (605) 352-5610

Boring #
SB8

Soil Description	WL	Depth	Geo.	Elevation	Sample ID	USCS	
Topsoil		0.0	Topsoil	1677.7	SB8 0-1.5'	OL	
		0.5		1677.2			
		1.0		1676.7			
Sandy clay, light brown, moist		1.5	Mixed Alluvium	1676.2	SB8 1.5'-2.5'	CL	
		2.0		1675.7			
		2.5		1675.2			
Well graded sand and gravel, light brown, dry		3.0		Mixed Alluvium	1674.7	SB8 2.5'-3.5'	SW
		3.5			1674.2		
		4.0			1673.7		
Sandy clay, light brown, moist		4.5	Mixed Alluvium		1673.2	SB8 3.5'-5.5'	CL
		5.0			1672.7		
		5.5			1672.2		
Well graded sand, brown, wet	(TOB)	6.0		Mixed Alluvium	1671.7	SB8 5.5'-8.5'	SW
		6.5			1671.2		
		7.0			1670.7		
		7.5	1670.2				
		8.0	1669.7				
		8.5	1669.2				
Sandy clay, light brown, moist		9.0	Weathered Till	1668.7	SB8 8.5'-10'	CL	
		9.5		1668.2			
		10.0		1667.7			
END OF BORING		10.5		1667.2			
		11.0		1666.7			
		11.5		1666.2			
		12.0		1665.7			
		12.5		1665.2			
		13.0		1664.7			
		13.5		1664.2			
		14.0		1663.7			
		14.5		1663.2			
		15.0		1662.7			
		15.5		1662.2			
		16.0		1661.7			
		16.5		1661.2			
		17.0		1660.7			
		17.5		1660.2			
		18.0		1659.7			
		18.5		1659.2			
		19.0		1658.7			
		19.5		1658.2			
		20.0		1657.7			
20.5	1657.2						
21.0	1656.7						
21.5	1656.2						
22.0	1655.7						
22.5	1655.2						
23.0	1654.7						
23.5	1654.2						
24.0	1653.7						
24.5	1653.2						
25.0	1652.7						
25.5	1652.2						

NOTES: Water level at time of boring: 5.5'	Water Level: 5.5' @ TOB	DEC #	Date of Boring: 7/5/2016
	Method: Split Spoon	1611	Page: 1 of 1
	Driller: TB	Chkd by: BF	Elevation: 1677.7
	Sampler: AU	Project:	
	Recorded By: TB	Parnell Dairy AWMS	
	Entered By/Date: RR 7/11/16		



SOIL BORING LOG

Dakota Environmental Consultants, Inc. P.O. Box 636 Huron, SD 57350 (605) 352-5610

Boring #

SB9

Soil Description	WL	Depth	Geo.	Elevation	Sample ID	USCS
Topsoil		0.0	Topsoil	1678.5	SB9 0'-1'	OL
Sandy clay, light brown, moist		0.5		1678.0	SB9 1'-5.5'	CL
		1.0		1677.5		
		1.5		1677.0		
		2.0		1676.5		
		2.5		1676.0		
		3.0		1675.5		
		3.5		1675.0		
		4.0		1674.5		
		4.5		1674.0		
		5.0		1673.5		
Well graded clayey sand, brown, wet	(TOB)	5.5		1673.0	SB9 5.5'-7'	SC
		6.0		1672.5		
Clay with sand, light brown, moist		6.5		1672.0	SB9 7'-20'	CL
		7.0		1671.5		
		7.5		1671.0		
		8.0		1670.5		
		8.5	Weathered Till	1670.0		
		9.0		1669.5		
		9.5		1669.0		
		10.0		1668.5		
		10.5		1668.0		
		11.0		1667.5		
		11.5		1667.0		
		12.0		1666.5		
		12.5		1666.0		
		13.0		1665.5		
		13.5		1665.0		
		14.0		1664.5		
		14.5		1664.0		
		15.0		1663.5		
	15.5		1663.0			
	16.0		1662.5			
	16.5		1662.0			
	17.0		1661.5			
	17.5		1661.0			
	18.0		1660.5			
	18.5		1660.0			
	19.0		1659.5			
	19.5		1659.0			
END OF BORING		20.0		1658.5		
		20.5		1658.0		
		21.0		1657.5		
		21.5		1657.0		
		22.0		1656.5		
		22.5		1656.0		
		23.0		1655.5		
		23.5		1655.0		
		24.0		1654.5		
		24.5		1654.0		
	25.0		1653.5			
	25.5		1653.0			

NOTES: Water level at time of boring: 5.5'	Water Level: 5.5' @ TOB	DEC #	Date of Boring: 7/5/2016
	Method: Split Spoon	1611	Page: 1 of 1
	Driller: TB	Chkd by: BF	Elevation: 1678.5
	Sampler: AU	Project: Parnell Dairy AWMS	
	Recorded By: TB		
	Entered By/Date: RR 7/11/16		



SOIL BORING LOG
Dakota Environmental Consultants, Inc. P.O. Box 636 Huron, SD 57350 (605) 352-5610

Boring #
SB 10

Soil Description	WL	Depth	Geo.	Elevation	Sample ID	USCS
Topsoil		0.0	Topsoil	1678.8	SB10 0'-1'	OL
		0.5		1678.3		
Clay with sand, light brown, moist		1.0	Weathered Till	1677.8	SB10 1'-10'	CL
		1.5		1677.3		
		2.0		1676.8		
		2.5		1676.3		
		3.0		1675.8		
		3.5		1675.3		
		4.0		1674.8		
		4.5		1674.3		
		5.0		1673.8		
		5.5		1673.3		
		6.0		1672.8		
		6.5		1672.3		
		7.0		1671.8		
		7.5		1671.3		
		8.0		1670.8		
		8.5		1670.3		
		9.0		1669.8		
	9.5	1669.3				
END OF BORING		10.0		1668.8		
		10.5		1668.3		
		11.0		1667.8		
		11.5		1667.3		
		12.0		1666.8		
		12.5		1666.3		
		13.0		1665.8		
		13.5		1665.3		
		14.0		1664.8		
		14.5		1664.3		
		15.0		1663.8		
		15.5		1663.3		
		16.0		1662.8		
		16.5		1662.3		
		17.0		1661.8		
		17.5		1661.3		
		18.0		1660.8		
	18.5		1660.3			
	19.0		1659.8			
	19.5		1659.3			
	20.0		1658.8			
	20.5		1658.3			
	21.0		1657.8			
	21.5		1657.3			
	22.0		1656.8			
	22.5		1656.3			
	23.0		1655.8			
	23.5		1655.3			
	24.0		1654.8			
	24.5		1654.3			
	25.0		1653.8			
	25.5		1653.3			

NOTES: Water level at time of boring: None	Water Level: None @ TOB	DEC #	Date of Boring: 7/5/2016
	Method: Split Spoon	1611	Page: 1 of 1
	Driller: TB	Chkd by: BF	Elevation: 1678.8
	Sampler: AU	Project: Parnell Dairy AWMS	
	Recorded By: TB		
	Entered By/Date: RR 7/11/16		



SOIL BORING LOG

Dakota Environmental Consultants, Inc. P.O. Box 636 Huron, SD 57350 (605) 352-5610

Boring #

SB11

Soil Description	WL	Depth	Geo.	Elevation	Sample ID	USCS	
Topsoil		0.0		1675.6	SB11 0-1.5'	OL	
		0.5	Topsoil	1675.1			
		1.0		1674.6			
Poorly graded sand with clay, light brown, moist		1.5		1674.1	SB11 1.5'-4'	SP-SC	
		2.0	Mixed Alluvium	1673.6			
		2.5		1673.1			
		3.0		1672.6			
		3.5		1672.1			
		4.0		1671.6			
		4.5		1671.1			
Clay with sand, light brown, moist		5.0		Weathered Till	1670.6	SB11 4'-10'	CL
		5.5	1670.1				
		6.0	1669.6				
		6.5	1669.1				
		7.0	1668.6				
		7.5	1668.1				
		8.0	1667.6				
		8.5	1667.1				
		9.0	1666.6				
		9.5	1666.1				
	END OF BORING		10.0				
		10.5		1665.1			
		11.0		1664.6			
		11.5		1664.1			
		12.0		1663.6			
		12.5		1663.1			
		13.0		1662.6			
		13.5		1662.1			
		14.0		1661.6			
		14.5		1661.1			
		15.0		1660.6			
		15.5		1660.1			
		16.0		1659.6			
		16.5		1659.1			
		17.0		1658.6			
		17.5		1658.1			
		18.0		1657.6			
	18.5		1657.1				
	19.0		1656.6				
	19.5		1656.1				
	20.0		1655.6				
	20.5		1655.1				
	21.0		1654.6				
	21.5		1654.1				
	22.0		1653.6				
	22.5		1653.1				
	23.0		1652.6				
	23.5		1652.1				
	24.0		1651.6				
	24.5		1651.1				
	25.0		1650.6				
	25.5		1650.1				
NOTES: Water level at time of boring: None	Water Level:	None @ TOB		DEC #	Date of Boring: 7/5/2016		
	Method:	Split Spoon		1611	Page: 1 of 1		
	Driller:	TB		Chkd by: BF	Elevation: 1675.6		
	Sampler:	AU		Project: Parnell Dairy AWMS			
	Recorded By:	TB					
	Entered By/Date:	RR 7/11/16					



SOIL BORING LOG
Dakota Environmental Consultants, Inc. P.O. Box 636 Huron, SD 57350 (605) 352-5610

Boring #
SB12

Soil Description	WL	Depth	Geo.	Elevation	Sample ID	USCS	
Topsoil		0.0	Topsoil	1674.3	SB12 0'-0.5'	OL	
Poorly graded clayey sand, light brown, moist		0.5		1673.8	SB12 0.5'-1'	SC	
Well graded sand and gravel, light brown, moist		1.0	Mixed Alluvium	1673.3	SB12 1'-3'	SW	
		1.5		1672.8			
		2.0		1672.3			
		2.5		1671.8			
		3.0		1671.3			
	Clay with sand, light brown, moist		3.5	Weathered Till	1670.8	SB12 3'-15'	CL
			4.0		1670.3		
			4.5		1669.8		
			5.0		1669.3		
			5.5		1668.8		
		6.0	1668.3				
		6.5	1667.8				
		7.0	1667.3				
		7.5	1666.8				
		8.0	1666.3				
		8.5	1665.8				
		9.0	1665.3				
		9.5	1664.8				
		10.0	1664.3				
		10.5	1663.8				
	11.0	1663.3					
	11.5	1662.8					
	12.0	1662.3					
	12.5	1661.8					
	13.0	1661.3					
	13.5	1660.8					
	14.0	1660.3					
	14.5	1659.8					
END OF BORING		15.0		1659.3			
		15.5		1658.8			
		16.0		1658.3			
		16.5		1657.8			
		17.0		1657.3			
		17.5		1656.8			
		18.0		1656.3			
		18.5		1655.8			
		19.0		1655.3			
		19.5		1654.8			
		20.0		1654.3			
		20.5		1653.8			
		21.0		1653.3			
		21.5		1652.8			
		22.0		1652.3			
	22.5		1651.8				
	23.0		1651.3				
	23.5		1650.8				
	24.0		1650.3				
	24.5		1649.8				
	25.0		1649.3				
	25.5		1648.8				

NOTES: Water level at time of boring: None	Water Level: None @ TOB	DEC #	Date of Boring: 7/5/2016
	Method: Split Spoon	1611	Page: 1 of 1
	Driller: TB	Chkd by: BF	Elevation: 1674.3
	Sampler: AU	Project:	
	Recorded By: TB	Parnell Dairy AWMS	
	Entered By/Date: RR 7/11/16		



SOIL BORING LOG

Dakota Environmental Consultants, Inc. P.O. Box 636 Huron, SD 57350 (605) 352-5610

Boring #

SB13

Soil Description	WL	Depth	Geo.	Elevation	Sample ID	USCS	
Topsoil		0.0	Topsoil	1673.3	SB13 0'-0.5'	OL	
Poorly graded clayey sand, light brown, moist		0.5		1672.8	SB13 0.5'-1'	SC	
Well graded sand and gravel, light brown, moist		1.0		1672.3	SB13 1'-3'	SW	
		1.5	Mixed	1671.8			
		2.0	Alluvium	1671.3			
		2.5		1670.8			
		3.0		1670.3			
Clay with sand, light brown, moist		3.5		1669.8	SB13 3'-11'	CL	
		4.0		1669.3			
		4.5		1668.8			
		5.0		1668.3			
		5.5		1667.8			
		6.0		1667.3			
		6.5	Weathered	1666.8			
		7.0	Till	1666.3			
		7.5		1665.8			
		8.0		1665.3			
		8.5		1664.8			
		9.0		1664.3			
		9.5		1663.8			
		10.0		1663.3			
		10.5		1662.8			
END OF BORING		11.0		1662.3			
		11.5		1661.8			
		12.0		1661.3			
		12.5		1660.8			
		13.0		1660.3			
		13.5		1659.8			
		14.0		1659.3			
		14.5		1658.8			
		15.0		1658.3			
		15.5		1657.8			
		16.0		1657.3			
		16.5		1656.8			
		17.0		1656.3			
		17.5		1655.8			
		18.0		1655.3			
		18.5		1654.8			
		19.0		1654.3			
		19.5		1653.8			
		20.0		1653.3			
		20.5		1652.8			
	21.0		1652.3				
	21.5		1651.8				
	22.0		1651.3				
	22.5		1650.8				
	23.0		1650.3				
	23.5		1649.8				
	24.0		1649.3				
	24.5		1648.8				
	25.0		1648.3				
	25.5		1647.8				
NOTES: Water level at time of boring: None	Water Level:	None @ TOB		DEC #	Date of Boring: 7/5/2016		
	Method:	Split Spoon		1611	Page: 1 of 1		
	Driller:	TB		Chkd by: BF	Elevation: 1673.3		
	Sampler:	AU		Project:			
	Recorded By:	TB		Parnell Dairy AWMS			
	Entered By/Date:	RR 7/11/16					



SOIL BORING LOG
Dakota Environmental Consultants, Inc. P.O. Box 636 Huron, SD 57350 (605) 352-5610

Boring #
SB14

Soil Description	WL	Depth	Geo.	Elevation	Sample ID	USCS
Topsoil		0.0	Topsoil	1673.2	SB14 0'-0.5'	OL
Sandy clay, light brown, moist		0.5		1672.7	SB14 0.5'-1'	CL
Well graded sand and gravel, light brown, moist		1.0		1672.2	SB14 1'-3'	SW
		1.5	Mixed	1671.7		
		2.0	Alluvium	1671.2		
		2.5		1670.7		
		3.0		1670.2		
		3.5		1669.7		
		4.0		1669.2		
Clay with sand, light brown, moist		4.5		1668.7	SB14 3'-11'	CL
		5.0		1668.2		
		5.5		1667.7		
		6.0		1667.2		
		6.5	Weathered	1666.7		
		7.0	Till	1666.2		
		7.5		1665.7		
		8.0		1665.2		
		8.5		1664.7		
		9.0		1664.2		
		9.5		1663.7		
		10.0		1663.2		
		10.5		1662.7		
END OF BORING		11.0		1662.2		
		11.5		1661.7		
		12.0		1661.2		
		12.5		1660.7		
		13.0		1660.2		
		13.5		1659.7		
		14.0		1659.2		
		14.5		1658.7		
		15.0		1658.2		
		15.5		1657.7		
		16.0		1657.2		
		16.5		1656.7		
		17.0		1656.2		
		17.5		1655.7		
		18.0		1655.2		
		18.5		1654.7		
		19.0		1654.2		
		19.5		1653.7		
		20.0		1653.2		
		20.5		1652.7		
	21.0		1652.2			
	21.5		1651.7			
	22.0		1651.2			
	22.5		1650.7			
	23.0		1650.2			
	23.5		1649.7			
	24.0		1649.2			
	24.5		1648.7			
	25.0		1648.2			
	25.5		1647.7			

NOTES: Water level at time of boring: None	Water Level: None @ TOB	DEC #	Date of Boring: 7/5/2016
	Method: Split Spoon	1611	Page: 1 of 1
	Driller: TB	Chkd by: BF	Elevation: 1673.2
	Sampler: AU	Project:	
	Recorded By: TB	Parnell Dairy AWMS	
	Entered By/Date: RR 7/11/16		



SOIL BORING LOG
Dakota Environmental Consultants, Inc. P.O. Box 636 Huron, SD 57350 (605) 352-5610

Boring #
SB15

Soil Description	WL	Depth	Geo.	Elevation	Sample ID	USCS			
Topsoil		0.0	Topsoil	1680.0	SB15 0'-0.5'	OL			
Sandy clay, light brown, moist		0.5		1679.5	SB15 0.5'-1'	CL			
Well graded sand and gravel, light brown, moist		1.0	Mixed Alluvium	1679.0	SB15 1'-3'	SW			
		1.5		1678.5					
		2.0		1678.0					
		2.5		1677.5					
		3.0		1677.0					
Well graded clayey sand/sandy clay, brown, moist		3.5	Weathered Till	1676.5	SB15 3'-5.5'	SC/CL			
		4.0		1676.0					
		4.5		1675.5					
		5.0		1675.0					
		5.5		1674.5					
Clay with sand, light brown, moist		6.0		1674.0	SB15 5.5'-10'	CL			
		6.5		1673.5					
		7.0		1673.0					
		7.5		1672.5					
		8.0		1672.0					
		8.5	1671.5						
		9.0	1671.0						
		9.5	1670.5						
	END OF BORING		10.0				1670.0		
			10.5				1669.5		
		11.0		1669.0					
		11.5		1668.5					
		12.0		1668.0					
		12.5		1667.5					
		13.0		1667.0					
		13.5		1666.5					
		14.0		1666.0					
		14.5		1665.5					
		15.0		1665.0					
		15.5		1664.5					
		16.0		1664.0					
		16.5		1663.5					
		17.0		1663.0					
		17.5		1662.5					
		18.0		1662.0					
		18.5		1661.5					
		19.0		1661.0					
		19.5		1660.5					
		20.0		1660.0					
	20.5		1659.5						
	21.0		1659.0						
	21.5		1658.5						
	22.0		1658.0						
	22.5		1657.5						
	23.0		1657.0						
	23.5		1656.5						
	24.0		1656.0						
	24.5		1655.5						
	25.0		1655.0						
	25.5		1654.5						

NOTES: Water level at time of boring: None	Water Level: None @ TOB	DEC #	Date of Boring: 7/5/2016
	Method: Split Spoon	1611	Page: 1 of 1
	Driller: TB	Chkd by: BF	Elevation: 1680
	Sampler: AU	Parnell Dairy AWMS	
	Recorded By: TB		
	Entered By/Date: RR 7/11/16		



ATTERBERG LIMITS

Dakota Environmental Inc. P.O. Box 636 Huron, SD 57350 (605) 352-5610

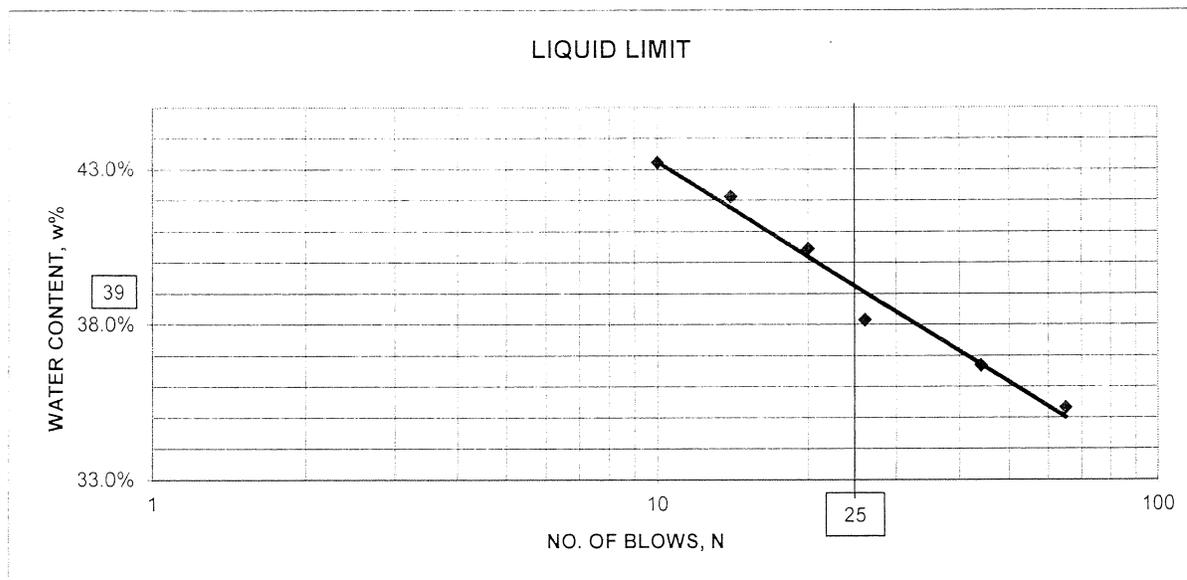
Project Parnell Dairy AWMS Job No. 1611

Location of Project W1/2 of SW1/4 Section 28, T109N R48W Test No. 1611-PL-1

Description of Soil Clay with sand, brown (CL) SB2 16-20 Test Method ASTM: D4318, Multipoint

Tested By RR Test Date 12/28/2016 Reviewed by BF

Can no.	E	JJ	M	D	Y	N
Mass of wet soil + can	21.67	19.77	20.57	20.29	20.63	21.15
Mass of dry soil + can	20.14	18.50	19.12	18.87	19.05	19.36
Mass of can	15.81	15.04	15.32	15.36	15.30	15.22
Mass of dry soil	4.33	3.46	3.80	3.51	3.75	4.14
Mass of moisture	1.53	1.27	1.45	1.42	1.58	1.79
Water Content, w%	35.3%	36.7%	38.2%	40.5%	42.1%	43.2%
No of Blows, N	65	44	26	20	14	10



Plastic Limit Data

Can no.	AA	HH	Average
Mass of wet soil & can	19.42	19.59	
Mass of dry soil & can	18.71	18.88	
Mass of can	15.38	15.48	
Mass of dry soil	3.33	3.40	
Mass of Moisture	0.71	0.71	
Water Content, w% = wp	21.3%	20.9%	21.1%

Liquid limit 39
 Plastic limit 21
 Plasticity Index 18

% retained on #200 sieve 21.7%



ATTERBERG LIMITS

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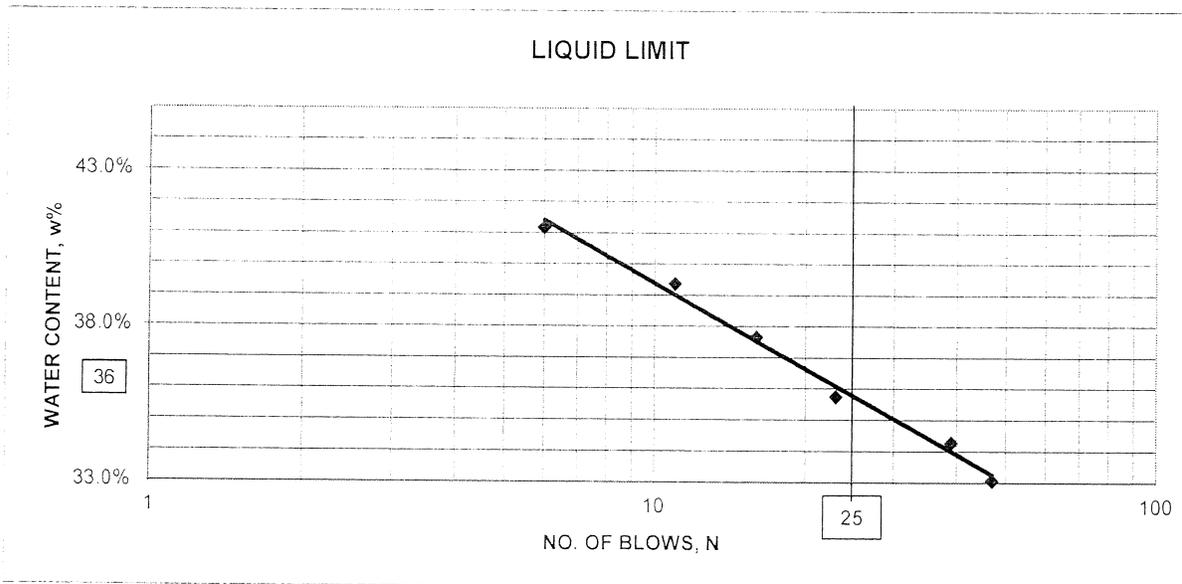
Project Parnell Dairy AWMS Job No. 1611

Location of Project W1/2 of SW1/4 Section 28, T109N R48W Test No. 1611-PL-3

Description of Soil Clay with sand, brown (CL) SB10 7.5-10 Test Method ASTM: D4318, Multipoint

Tested By RR Test Date 12/28/2016 Reviewed by BF

Can no.	F	EE	B	K	O	J
Mass of wet soil + can	20.87	20.46	20.73	20.20	21.59	18.89
Mass of dry soil + can	19.61	19.12	19.25	18.81	19.94	17.77
Mass of can	15.80	15.21	15.11	15.12	15.75	15.05
Mass of dry soil	3.81	3.91	4.14	3.69	4.19	2.72
Mass of moisture	1.26	1.34	1.48	1.39	1.65	1.12
Water Content, w%	33.1%	34.3%	35.7%	37.7%	39.4%	41.2%
No of Blows, N	47	39	23	16	11	6



Plastic Limit Data

Can no.	U	P	
Mass of wet soil & can	18.84	19.26	Liquid limit 36
Mass of dry soil & can	18.29	18.73	Plastic limit 18
Mass of can	15.30	15.82	Plasticity Index 17
Mass of dry soil	2.99	2.91	
Mass of Moisture	0.55	0.53	Average
Water Content, w% = wp	18.4%	18.2%	18.3%

% retained on #200 sieve 27.3%



ATTERBERG LIMITS

Dakota Environmental Inc. P.O. Box 636 Huron, SD 57350 (605) 352-5610

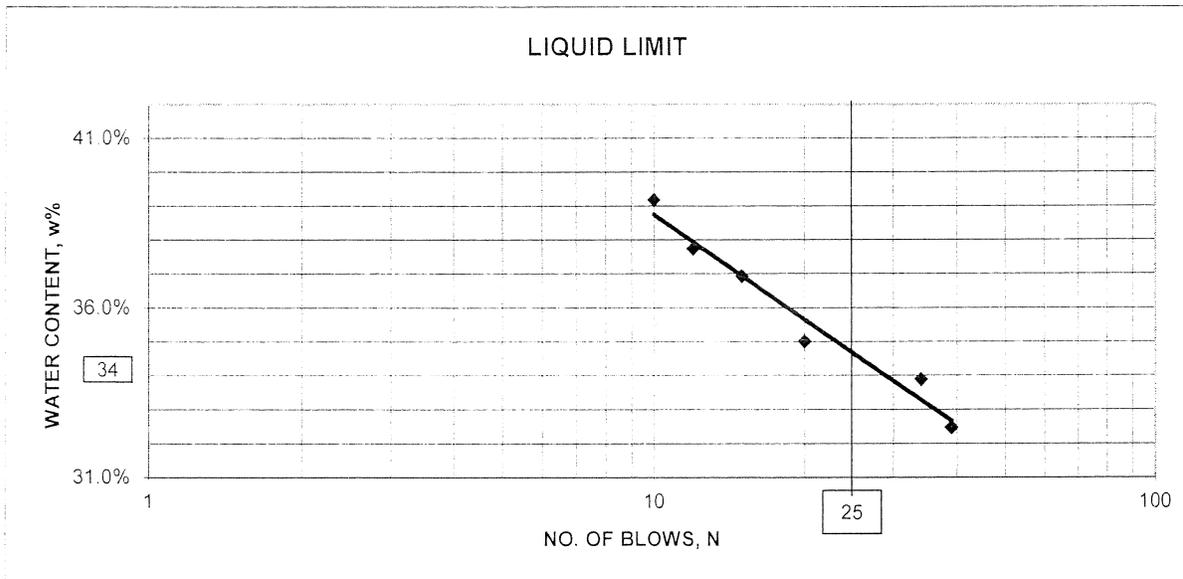
Project Parnell Dairy AWMS Job No. 1611

Location of Project W1/2 of SW1/4 Section 28, T109N R48W Test No. 1611-PL-2

Description of Soil Clay with sand, brown (CL) SB4 20-22' Test Method ASTM: D4318, Multipoint

Tested By RR Test Date 12/28/2016 Reviewed by BF

Can no.	Q	II	GG	X	G	R
Mass of wet soil + can	20.28	19.97	20.41	19.80	19.32	19.21
Mass of dry soil + can	19.01	18.78	19.09	18.57	18.15	18.05
Mass of can	15.10	15.27	15.32	15.24	15.05	15.09
Mass of dry soil	3.91	3.51	3.77	3.33	3.10	2.96
Mass of moisture	1.27	1.19	1.32	1.23	1.17	1.16
Water Content, w%	32.5%	33.9%	35.0%	36.9%	37.7%	39.2%
No of Blows, N	39	34	20	15	12	10



Plastic Limit Data

Can no.	CC	Z	
Mass of wet soil & can	18.34	18.06	Liquid limit 35
Mass of dry soil & can	17.86	17.63	Plastic limit 19
Mass of can	15.35	15.37	Plasticity Index 16
Mass of dry soil	2.51	2.26	
Mass of Moisture	0.48	0.43	Average
Water Content, w% = wp	19.1%	19.0%	19.1%

% retained on #200 sieve 24.0%

TUBE



PERMEABILITY TEST

Dakota Environmental Inc. P.O. Box 636 Huron, SD 57350 (605) 352-5610

Project Parnell Dairy AWMS Project No. 1611
 Location of Project W1/2 of SW1/4 of Section 8, T109N R48W Test No. 1611-PM-1
 Origin of Soil SB4 20-22'
 Description of Soil Clay with sand, brown (CL) Determined by Practice, ASTM D2488
 Test Method Increasing tailwater Preparation Method In situ
 Method of Compaction In situ Permeant Tap water

SPECIMEN DATA

Max. Proctor Density N/A Proctor Chart No. N/A
 Dry Unit Weight 113.2 Moisture Content 14.7%
 Diameter (cm) 6.35 Length (in) 2.06
 Cross Sect. Area (cm²) 31.67

RESULTS

Hydraulic Gradient 23.47 to 25.65
 Average Hydraulic Conductivity (k) 7.55E-09 cm/sec at NA of Max. Proctor Density
 Tested By TB Date 1/10/2017

NOTES: Sample was obtained by pushing a thin wall tube into the native soils.

UNIFIED SOIL CLASSIFICATION INCLUDING IDENTIFICATION AND DESCRIPTION

FIELD IDENTIFICATION PROCEDURES		GROUP SYMBOLS	TYPICAL NAMES	INFORMATION REQUIRED FOR DESCRIBING SOILS	LABORATORY CLASSIFICATION CRITERIA
COARSE GRAINED SOILS More than half of material is larger than No. 200 sieve size 12. (Excluding particles larger than 3 inches and bag fractions on estimated weights)	SANDS More than half of coarse fraction is larger than No. 4 sieve size. For visual classification, the $\frac{1}{2}$ size may be used as equivalent to the No. 4 sieve size.)	GW, GP, GM, GC	Well graded gravels, gravel-sand mixtures, little or no fines. Poorly graded gravels, gravel-sand mixtures, little or no fines. Silty gravels, poorly graded gravel-sand-silt mixtures.	Give typical name, indicate approximate percentage of sand and gravel, max. size, angularity, surface condition, local or geologic name and other pertinent descriptive information, and symbol in parentheses. For undisturbed soils add information on stratification, degree of compaction, cementation, moisture conditions and drainage characteristics.	$C_u = \frac{D_{60}}{D_{30}}$ Greater than 4 $C_c = \frac{D_{30}^2}{D_{60} \times D_{10}}$ Between one and 3 Not meeting all gradation requirements for GW Atterberg limits below "X" line, or PI less than 4 Atterberg limits above "X" line with PI greater than 7 $C_u = \frac{D_{60}}{D_{30}}$ Greater than 6 $C_c = \frac{D_{30}^2}{D_{60} \times D_{10}}$ Between one and 3 Not meeting all gradation requirements for SW Atterberg limits below "X" line or PI less than 4 Atterberg limits above "X" line with PI greater than 7
	SANDS WITH FINES (Amount of fines) (L, little or no fines) CLEAN SANDS (Amount of fines) (S, some intermediate sizes missing) SANDS WITH FINES (Amount of fines) (SP, predominantly one size or a range of sizes with some intermediate sizes missing) SANDS WITH FINES (Amount of fines) (SM, non-plastic fines for identification procedures see ML below) SANDS WITH FINES (Amount of fines) (SC, plastic fines for identification procedures see CL below)	SP, SM, SC	Poorly graded sands, gravelly sands, little or no fines. Silty sands, poorly graded sand-silt mixtures. Clayey sands, poorly graded sand-clay mixtures.	EXAMPLE:- Silty sand, gravelly; about 20% hard, angular gravel particles 1/4-in. maximum size, rounded and subangular sand grains coarse to fine, about 10% non-plastic fines with low dry strength; well compacted and moist in place; alluvial sand; (SM) Give typical name, indicate degree and character of plasticity, amount and maximum size of silt or clay, local or in wet condition, odor if any, local or geologic name and other pertinent descriptive information, and symbol in parentheses. For undisturbed soils add information on structure, stratification, consistency in undisturbed and remolded states, moisture and drainage conditions.	Determine percentages of gravel and sand from grain size curve. Depending on percentage of fines (fraction smaller than No. 200 sieve size) coarse grained soils are classified as follows:- Less than 5% 5 to 12% More than 12% 6M, 6G, 6A, 6C, 6U, 6S, 6M, 6C, 6U, 6S, 6M, 6C, 6U, 6S
FINE GRAINED SOILS More than half of material is smaller than No. 200 sieve size. (The No. 200 sieve size is about the smallest particle visible to the naked eye)	IDENTIFICATION PROCEDURES ON FRACTION SMALLER THAN NO. 40 SIEVE SIZE	ML, CL, OL, MH, CH, OH, PT	Inorganic silts and very fine sands, rock flour, silty or clayey fine sands with slight plasticity. Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays. Organic silts and organic silt-clays of low plasticity. Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, elastic silts. Inorganic clays of high plasticity, fat clays. Organic clays of medium to high plasticity. Peat and other highly organic soils.	Give typical name, indicate degree and character of plasticity, amount and maximum size of silt or clay, local or in wet condition, odor if any, local or geologic name and other pertinent descriptive information, and symbol in parentheses. For undisturbed soils add information on structure, stratification, consistency in undisturbed and remolded states, moisture and drainage conditions. EXAMPLE:- Clayey silt, brown, slightly plastic; small percentage of fine sand; no odor; vertical root holes; firm and dry in place; (ML)	Use grain size curve in identifying the fractions as given under field identification
HIGHLY ORGANIC SOILS Readily identified by color, odor, spongy feel and frequently by fibrous texture.	DRY STRENGTH CHARACTERISTICS DILATANCY REACTION TO SHAKING TOUGHNESS (ICR PLASTIC LIMIT)				

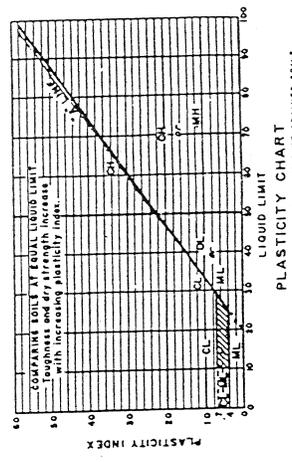
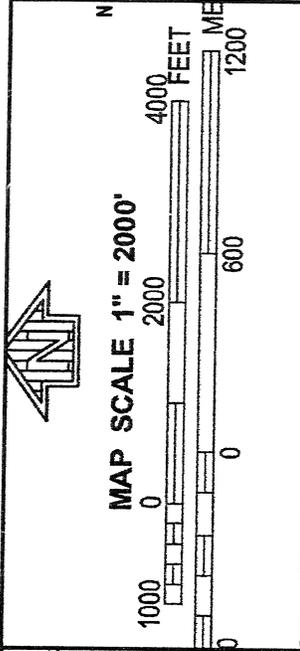


Figure 36. Unified Soil Classification Chart. (Sheet 1 of 2) From drawing no. 103-D-347.

a Boundary Classification: Soils possessing characteristics of two groups are designated by combinations of group symbols. For example GW-GC, well graded gravel-sand mixture with clay binder.
b All sieve sizes on this chart are U.S. Standard
SOURCE: A.S.T.M. COMMITTEE ON SOILS AND BUREAU OF RECLAMATION - JANUARY 1952



NATIONAL FLOOD INSURANCE PROGRAM

PANEL 0675C

FIRM
FLOOD INSURANCE RATE MAP
BROOKINGS COUNTY,
SOUTH DAKOTA
AND INCORPORATED AREAS

PANEL 675 OF 700
 (SEE MAP INDEX FOR FIRM PANEL LAYOUT)
CONTAINS:
COMMUNITY: 460253
NUMBER: 0875
PANEL SUFFIX: C

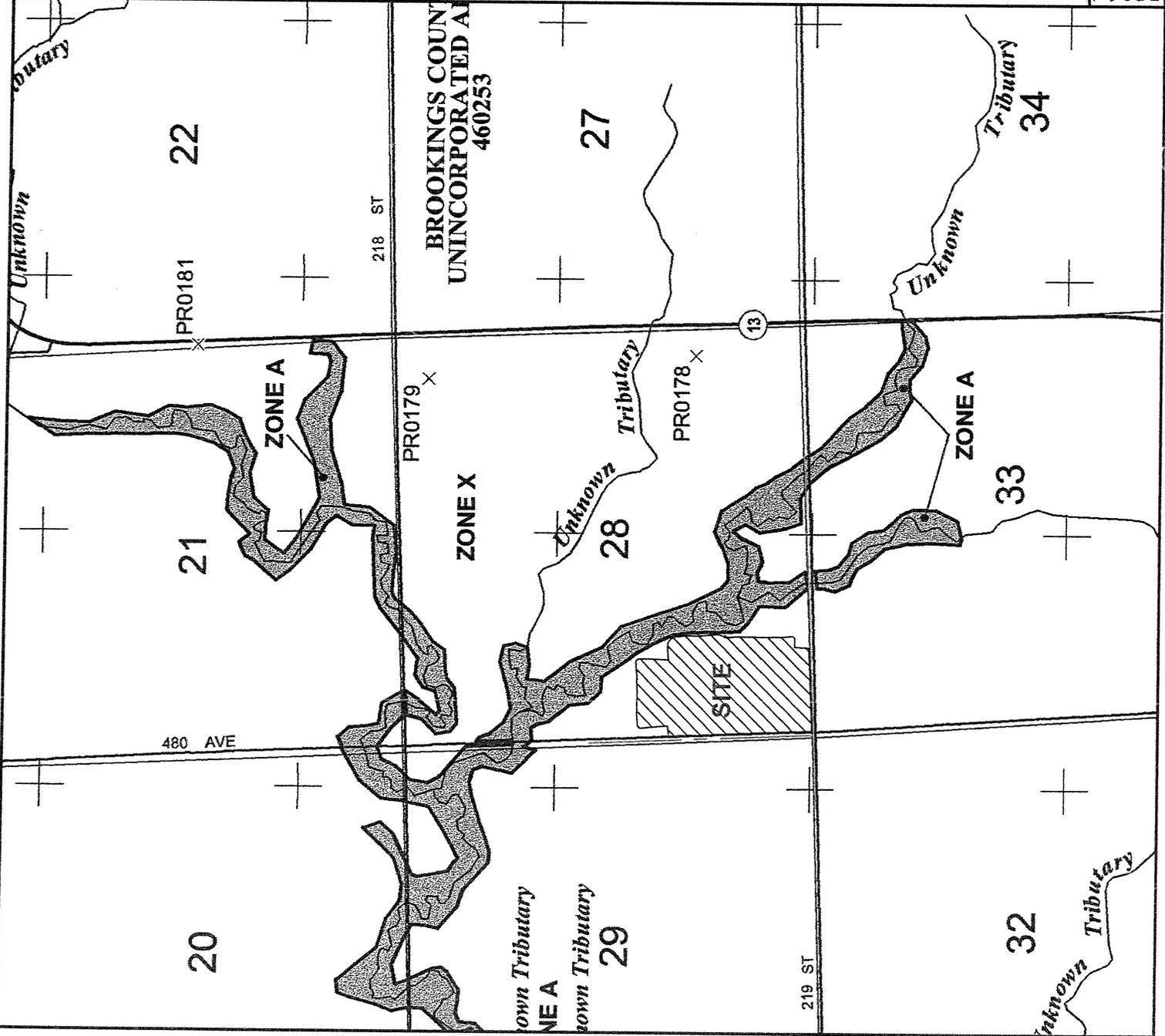
Notice to User: The Map Number shown below should be used when placing map orders; the Community Number shown above should be used on insurance applications for the subject community.



MAP NUMBER
46011C0675C
EFFECTIVE DATE
JULY 16, 2008

Federal Emergency Management Agency

This is an official copy of a portion of the above referenced flood map. It was extracted using F-MIT On-Line. This map does not reflect changes or amendments which may have been made subsequent to the date on the title block. For the latest product information about National Flood Insurance Program flood maps check the FEMA Flood Map Store at www.msc.fema.gov



APPENDIX VII

SITE PLAN / PLANS AND SPECIFICATIONS

PARNELL DAIRY AWMS ANIMAL WASTE MANAGEMENT SYSTEM PLANS AND SPECIFICATIONS ISSUED 1/10/17

PRODUCER: KILLESKILLEN LLC
 ADDRESS: 126 PINE RIDGE ROAD
 BROOKINGS, SD 57006
 PHONE: (605) 691-1045
 SITE LOCATION: W 1/2 OF SW 1/4 of Section 28, T109N R48W
 COUNTY: BROOKINGS

LEGEND

<ul style="list-style-type: none"> CONCRETE ROCK SELECT GRANULAR FILL EXISTING EARTH COMPACTED FILL TOPSOIL WETLAND CLEANOUT DEPTH MARKER LOCATION SPLASH PAD RESIDENCE 	<ul style="list-style-type: none"> CULVERT MONITORING WELL POWER POLE PROPERTY LINE DRAINAGE SWALE EXISTING CONTOUR LINE PROPOSED CONTOUR LINE BM BENCHMARK OR CONTROL POINT X 1270.00 NEW SPOT ELEVATION SBx SOIL BORING ELEVATION FENCE 	<ul style="list-style-type: none"> SECTION TAKEN FROM DRAWING NO. SECTION LOCATED ON DRAWING NO.
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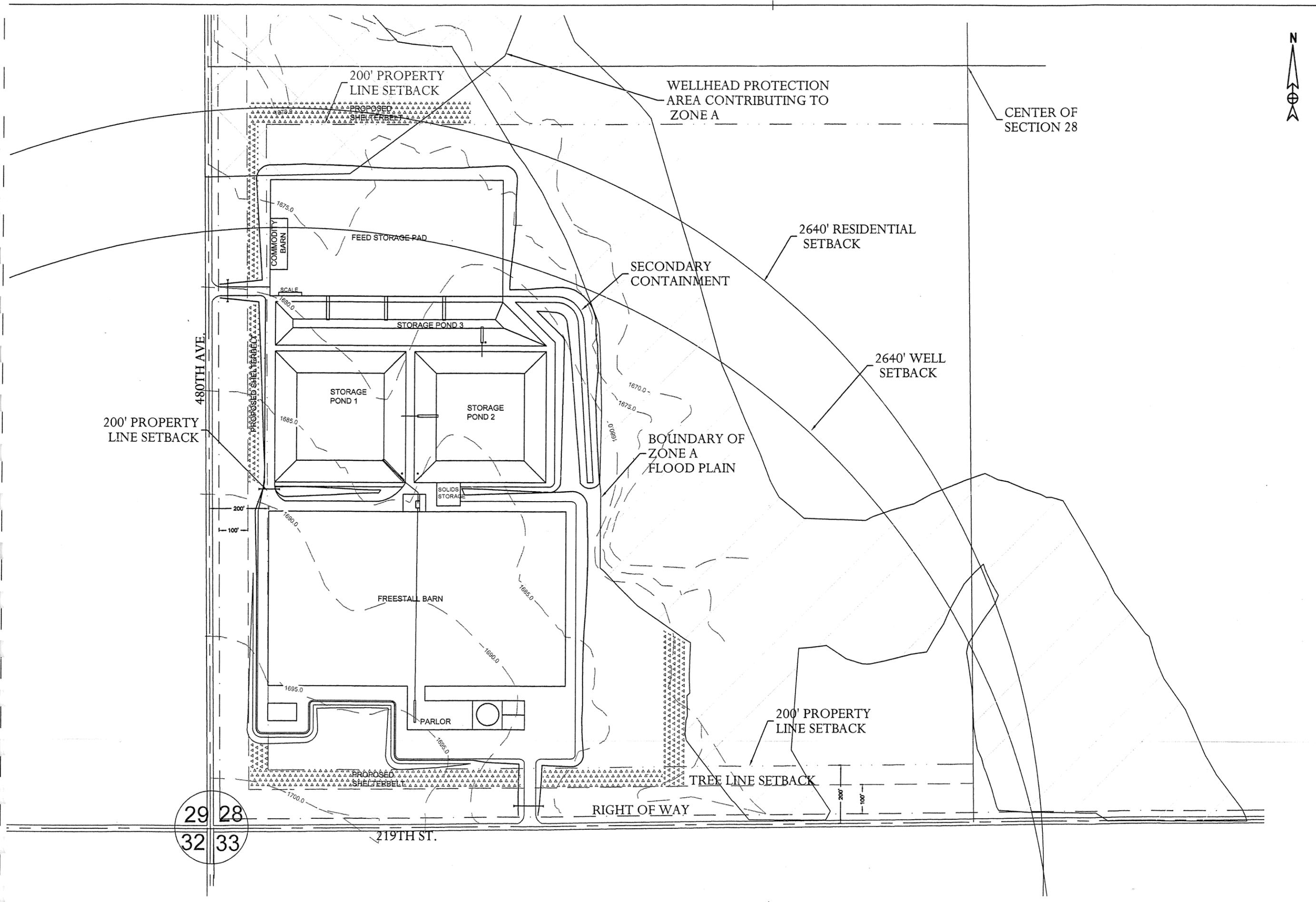
SHEET INDEX	
DWG. NO.	DESCRIPTION
1	TITLE PAGE
2	SITE PLAN
3	BUILDING PLAN
4	POND PLAN
5	POND DETAILS
6	FREESTALL BARN SECTION
7	COLLECTION PIT DETAILS
8	SEPARATOR BUILDING PLAN
9	SEPARATOR BUILDING SECTION
10	SEPARATOR DETAILS
11	GENERAL NOTES & SPECIFICATIONS
12	CONCRETE NOTES



Brian H. Friedrichsen, P.E.

I hereby certify that these plans were prepared by me, or prepared under my direct supervision; and that I am a duly Registered Professional Engineer under the Laws of the State of South Dakota.

REV.	DATE	DESCRIPTION	BY	CHKD	
	1/10/17	DRAWN: TB		CHECKED: BF	
TITLE PAGE PARNELL DAIRY AWMS DAKOTA ENVIRONMENTAL CONSULTANTS INCORPORATED					P.O. BOX 636 HURON, SD 57350 605-352-5610
					JOB NO:
					1611
					SCALE:
					NTS
					DWG:
					1



SITE PLAN		REV.	DATE	DESCRIPTION	BY	CHKD
PARNELL DAIRY AWMS			1/10/17		TB	BF
DAKOTA ENVIRONMENTAL CONSULTANTS INCORPORATED		P.O. BOX 636 HURON, SD 57350		605-352-5610		
		JOB NO:		1611		
		SCALE:		1"=300'		
		DWG:		2		

29 28
32 33

219TH ST.

RIGHT OF WAY

200' PROPERTY LINE SETBACK

TREE LINE SETBACK

200' PROPERTY LINE SETBACK

480TH AVE.

CENTER OF SECTION 28

WELLHEAD PROTECTION AREA CONTRIBUTING TO ZONE A

200' PROPERTY LINE SETBACK

2640' RESIDENTIAL SETBACK

SECONDARY CONTAINMENT

2640' WELL SETBACK

BOUNDARY OF ZONE A FLOOD PLAIN

FREESTALL BARN

STORAGE POND 1

STORAGE POND 2

STORAGE POND 3

FEED STORAGE PAD

COMMODITY BARN

SOLIDS STORAGE

PARLOR

SCALE

200'
100'

200'
100'

1700.0

1695.0

1690.0

1685.0

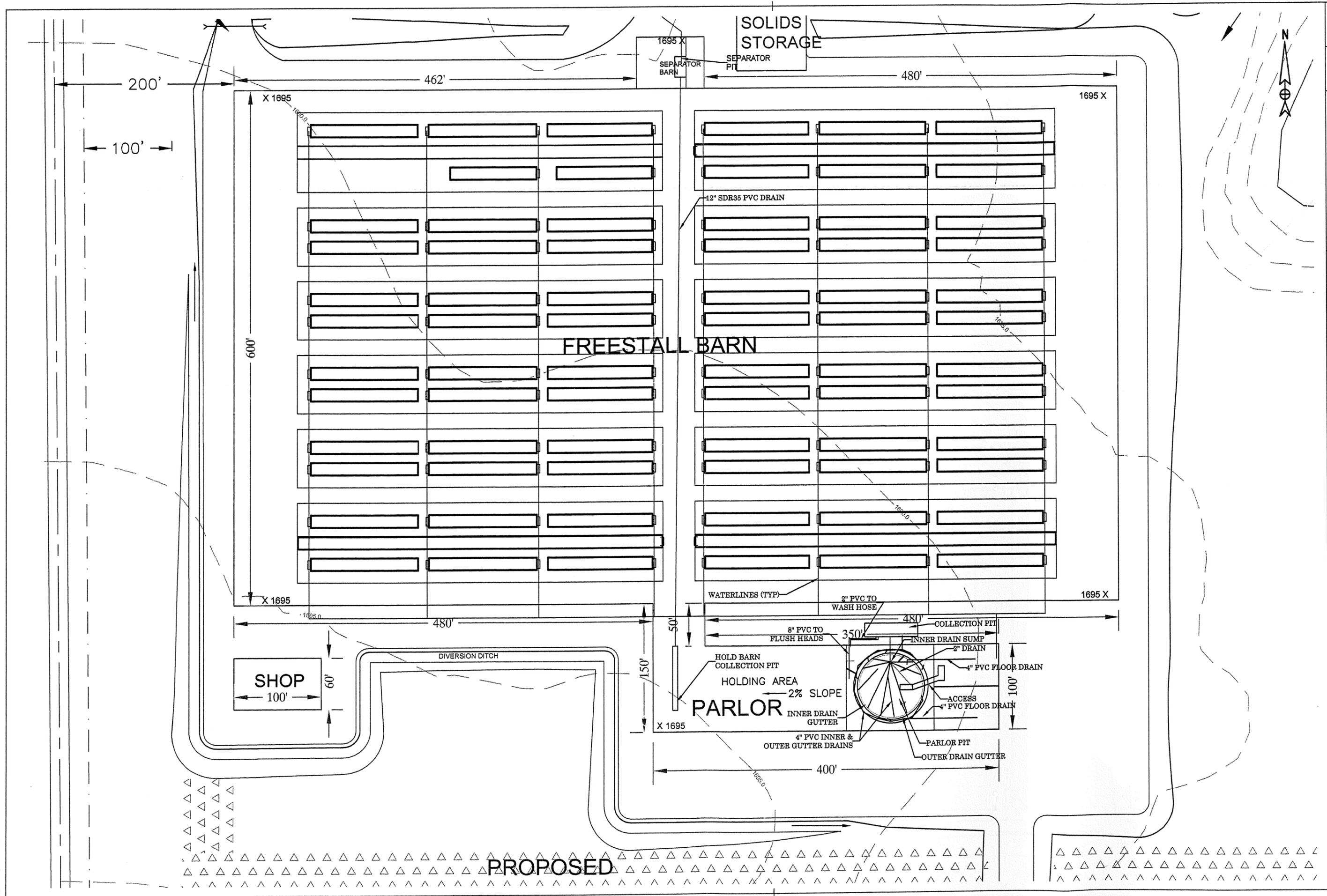
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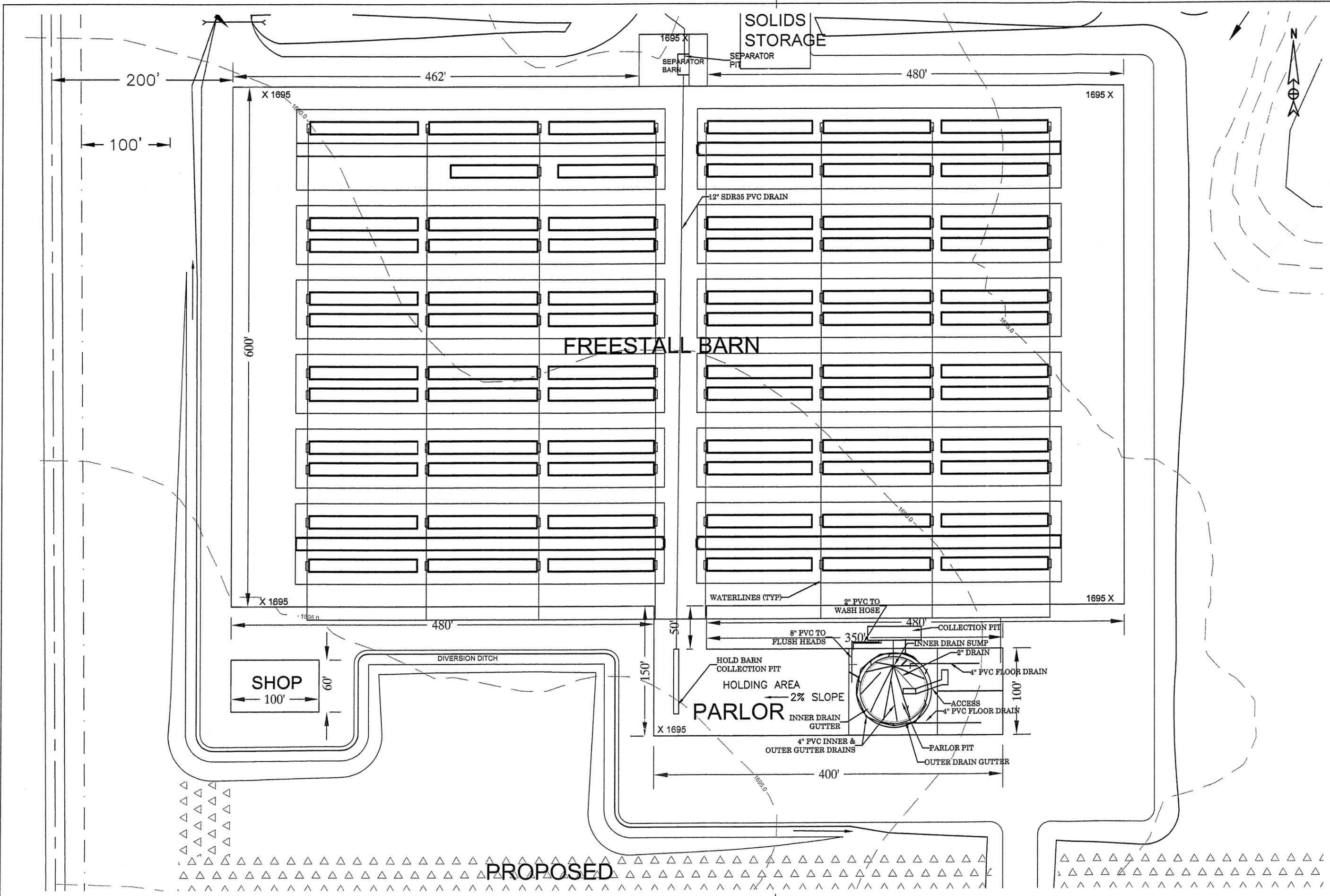
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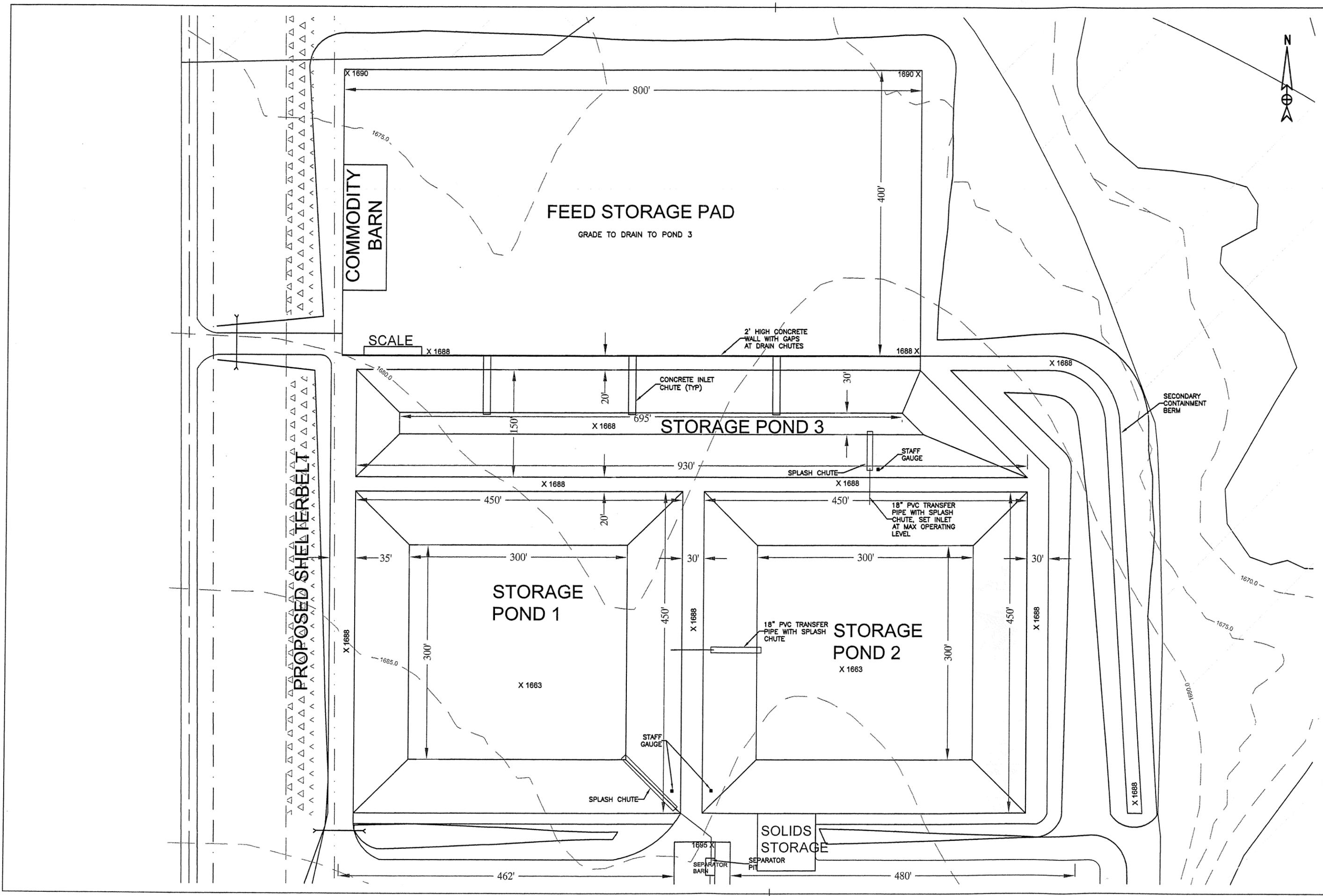
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PARNELL DAIRY AWMS		DATE: 1/10/17	DRAWN: TB	CHECKED: BF	BF
DAKOTA ENVIRONMENTAL CONSULTANTS INCORPORATED					
JOB NO: 1611					
SCALE: 1"=100'					
DWG: 3					
P.O. BOX 636 HURON, SD 57350 605-352-5610					



BUILDING PLAN		REV.	DATE	DESCRIPTION	BY	CHKD
PARNELL DAIRY AWMS			1/10/17		TB	BF
DAKOTA ENVIRONMENTAL CONSULTANTS INCORPORATED						
JOB NO:		1611				
SCALE:		1"=100'				
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P.O. BOX 636 HURON, SD 57350		605-352-5610				

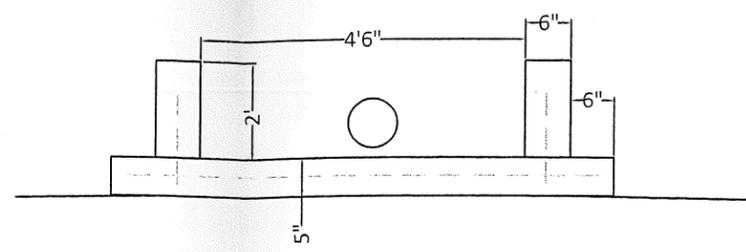


PROPOSED

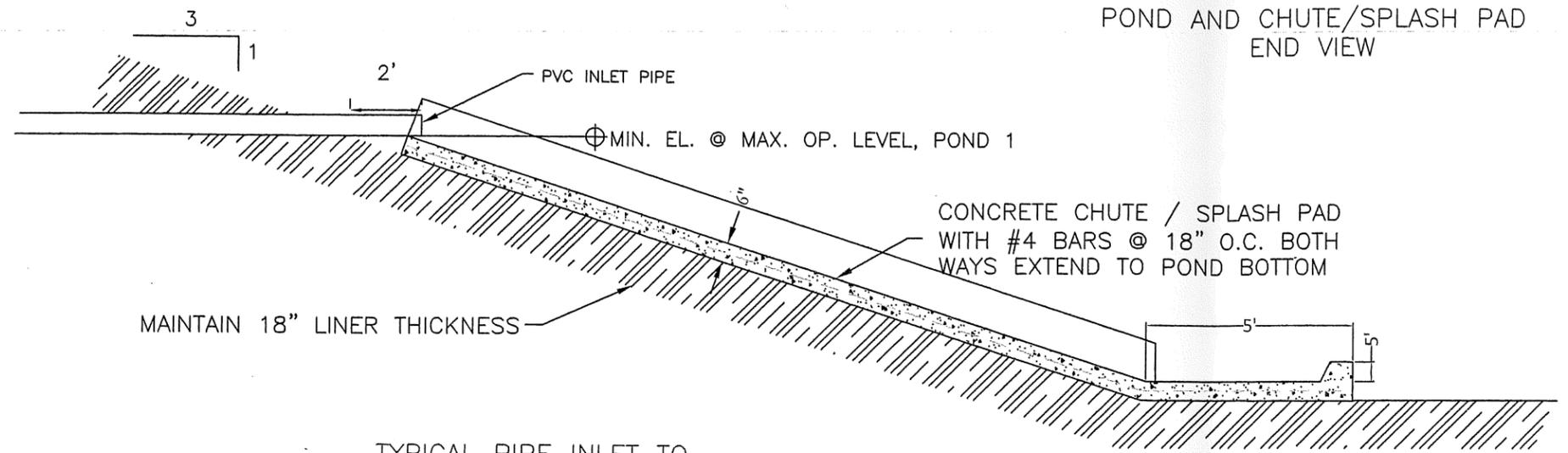


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SCALE:		1" = 120'				
DWG:		4				
P.O. BOX 636 HURON, SD 57350		605-352-5610				

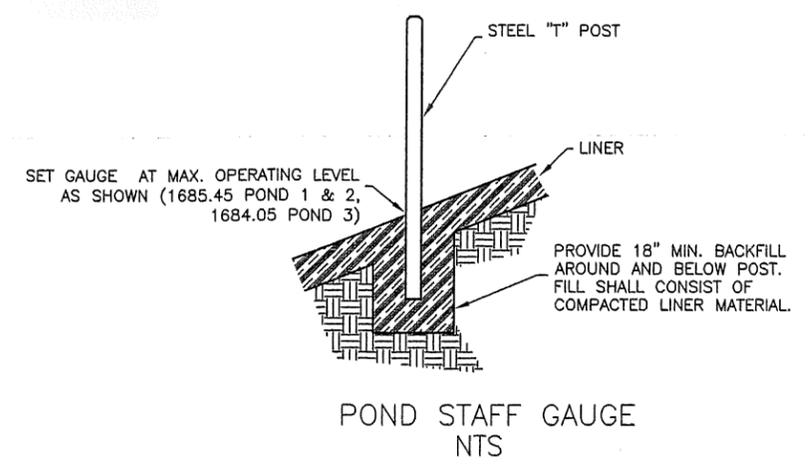




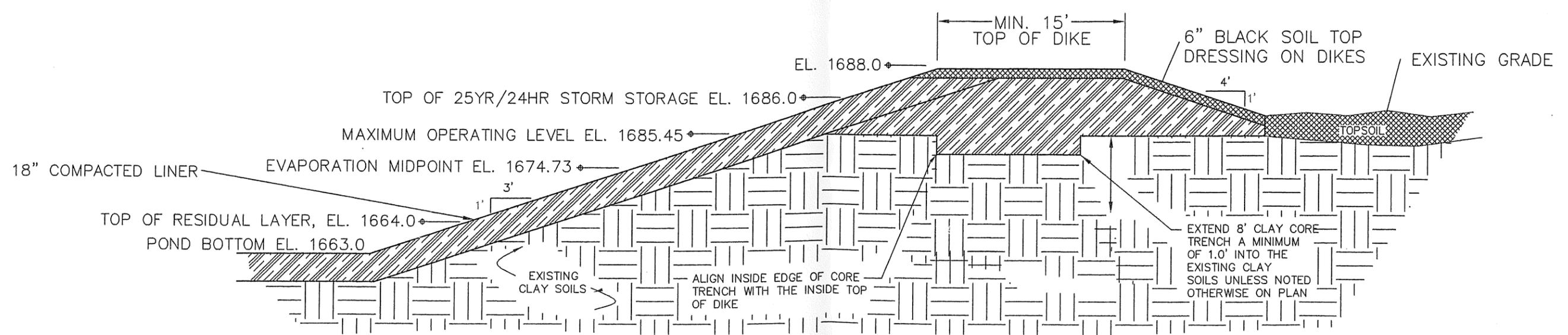
TYPICAL PIPE INLET TO POND AND CHUTE/SPLASH PAD END VIEW



TYPICAL PIPE INLET TO POND AND CHUTE/SPLASH PAD SIDE VIEW

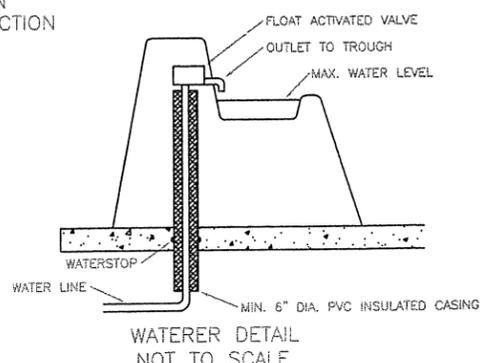
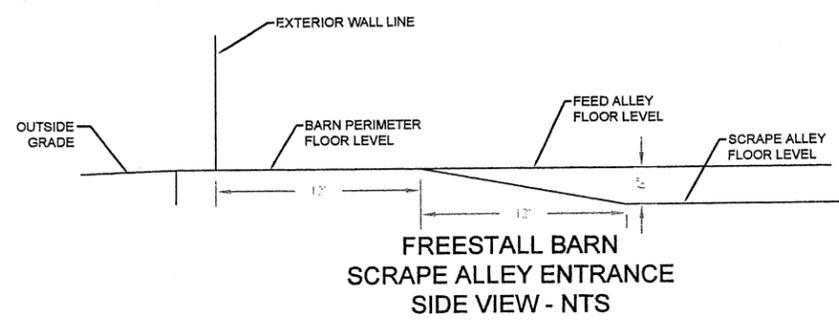
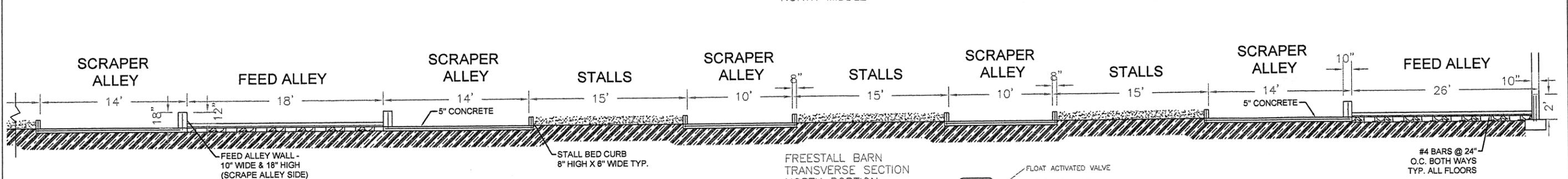
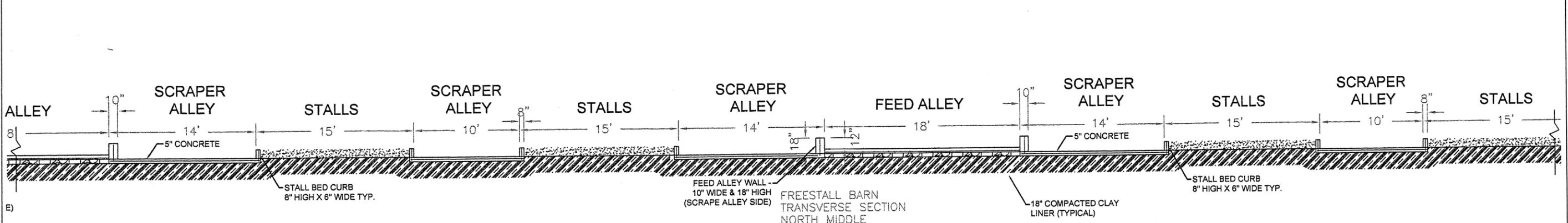
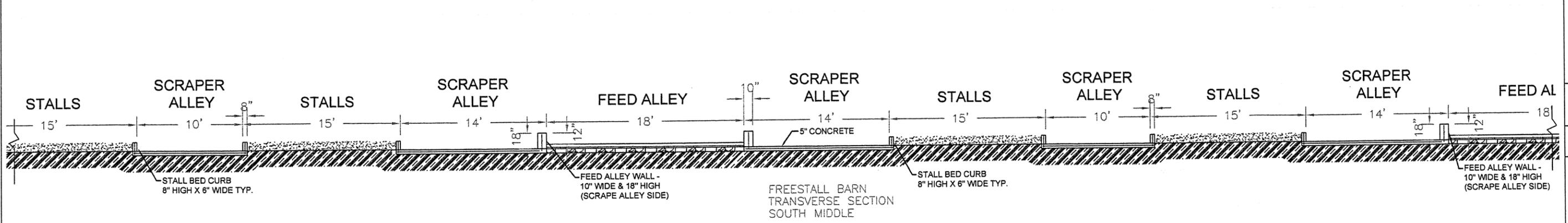
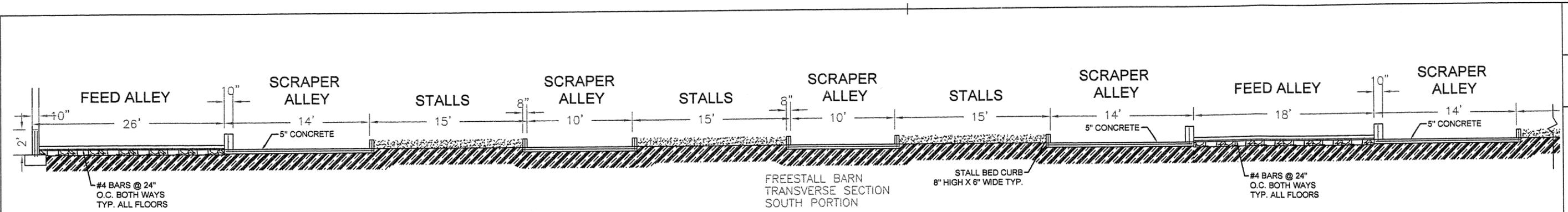


POND STAFF GAUGE NTS

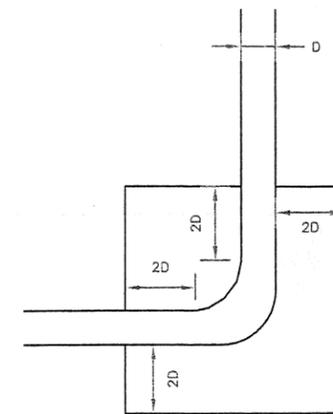
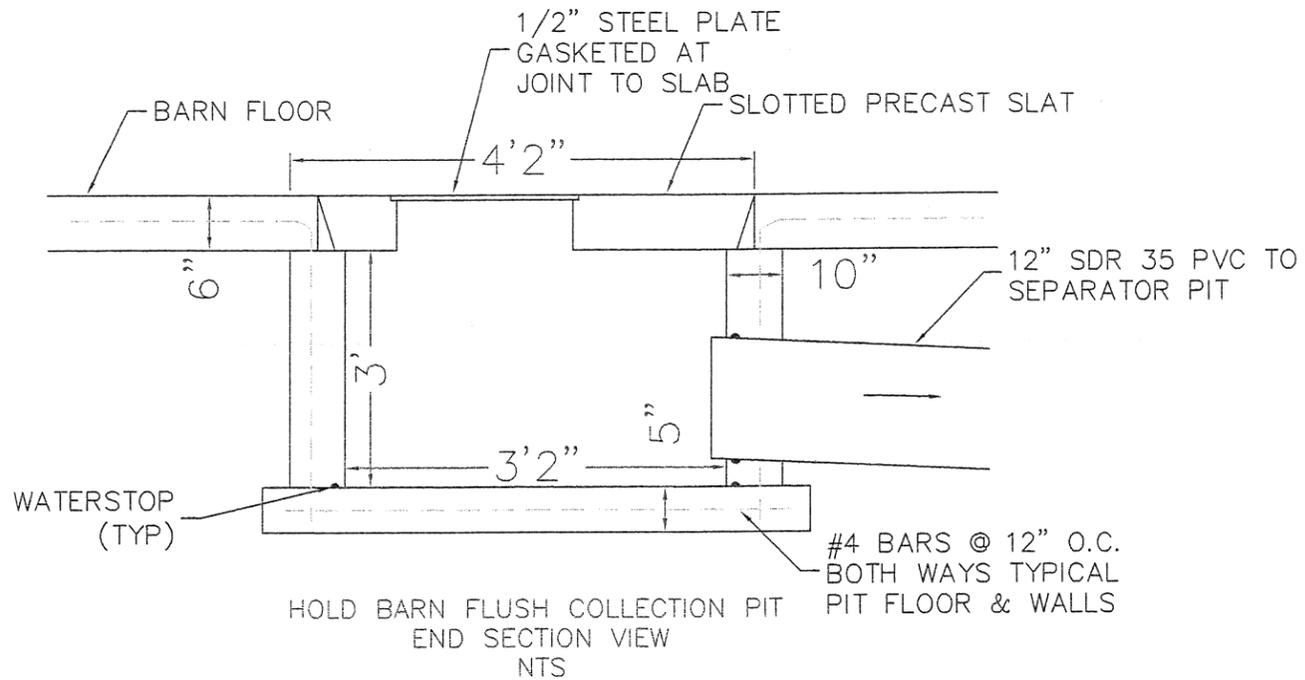


TYPICAL POND DIKE CROSS SECTION POND 1 ELEVATIONS SHOWN NTS

POND DETAILS	REV.	DATE	DESCRIPTION	BY	CHKD
		1/10/17		TB	BF
PARNELL DAIRY AWMS					
DAKOTA ENVIRONMENTAL CONSULTANTS INCORPORATED					
					
JOB NO: 1611					
SCALE: NTS					
DWG: 5					
P.O. BOX 636 HURON, SD 57350 605-352-5610					

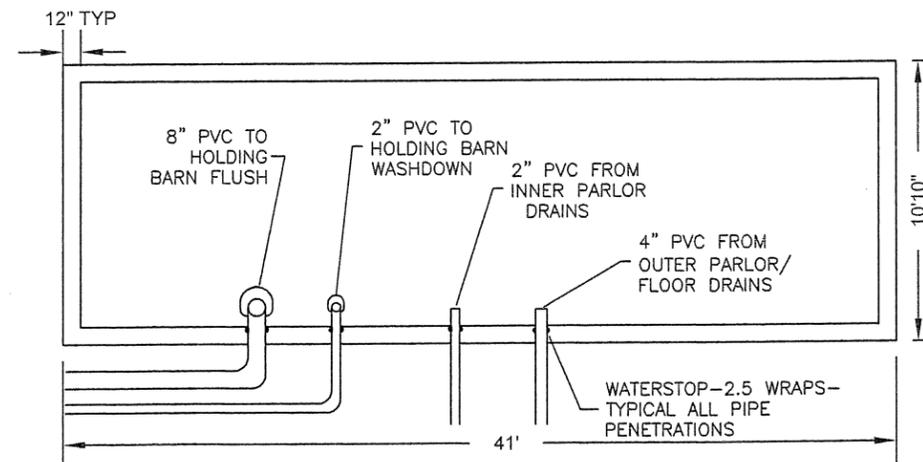
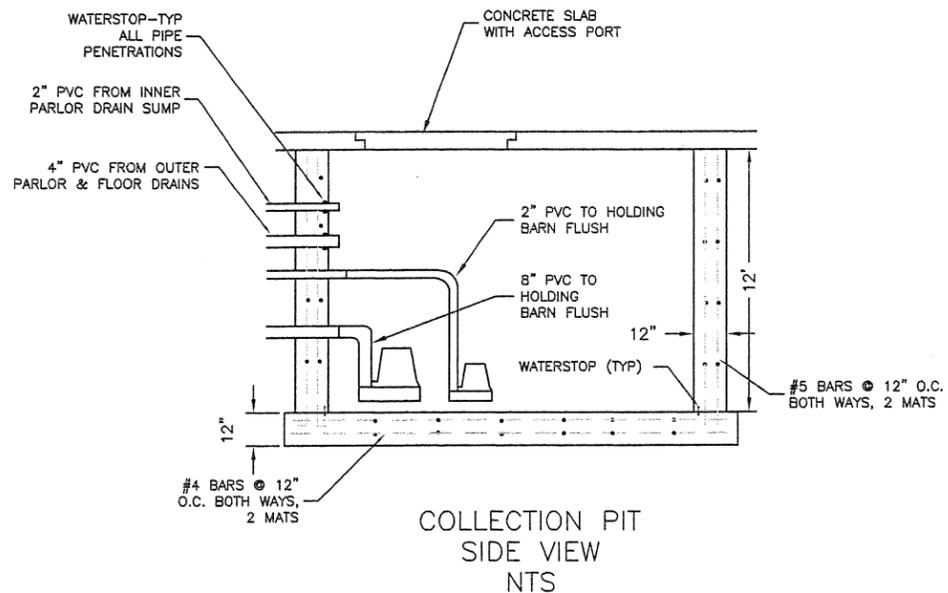


CHKD	BY	DESCRIPTION	DRAWN	DATE	REV.
		FREESTALL BARN SECTIONS	TB	1/10/17	
BF	BF	PARNELL DAIRY AWMS			
DAKOTA ENVIRONMENTAL CONSULTANTS INCORPORATED					
P.O. BOX 636 HURON, SD 57350 605-352-5610					
JOB NO: 1611					
SCALE: NTS					
DWG: 6					

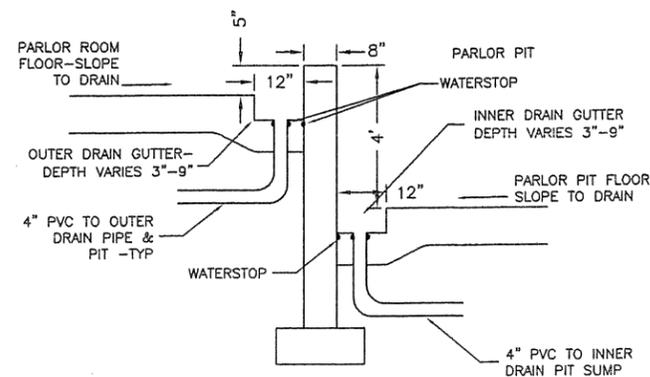


- NOTES:
1. PROVIDE ENCASEMENT MIN 2 PIPE DIAMETERS BEFORE TO AFTER ANY BEND IN FORCEMAIN
 2. PROVIDE ENCASEMENT MIN 2 PIPE DIAMETERS AROUND PERIMETER OF FORCEMAIN AT ANY BEND.

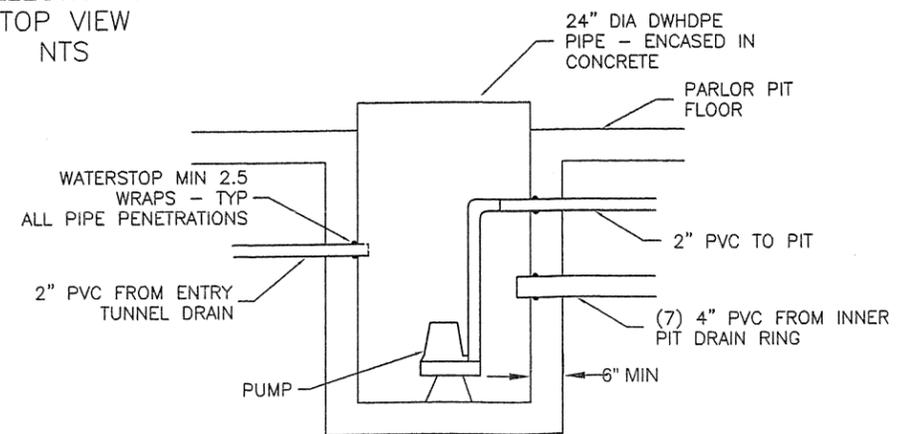
TYPICAL THRUST BLOCK
NOT TO SCALE



COLLECTION PIT
TOP VIEW
NTS



PARLOR ROOM & PIT
DRAINS - SIDE VIEW
NTS



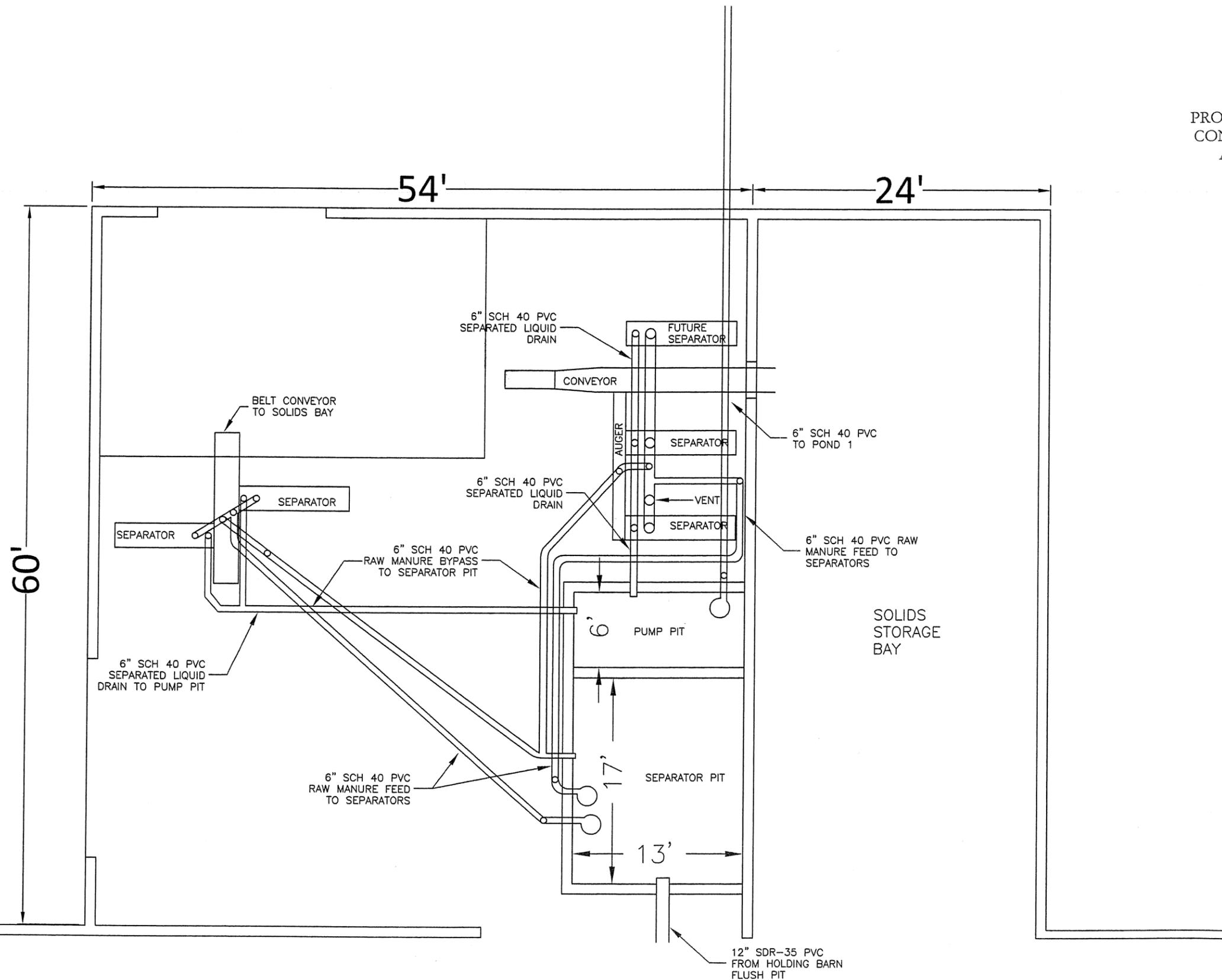
INNER PARLOR PIT DRAIN
COLLECTION SUMP -
SIDE VIEW - NTS

REV.	DATE	DESCRIPTION	BY	CHKD
	1/10/17		TB	BF

COLLECTION PIT DETAILS
 PARNELL DAIRY AWMS
 DAKOTA ENVIRONMENTAL CONSULTANTS INCORPORATED
 P.O. BOX 636 HURON, SD 57350 605-352-5610

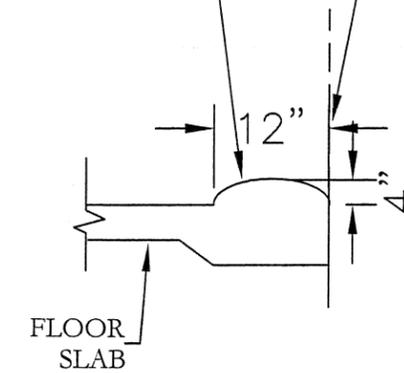


JOB NO:	1611
SCALE:	NTS
DWG:	7



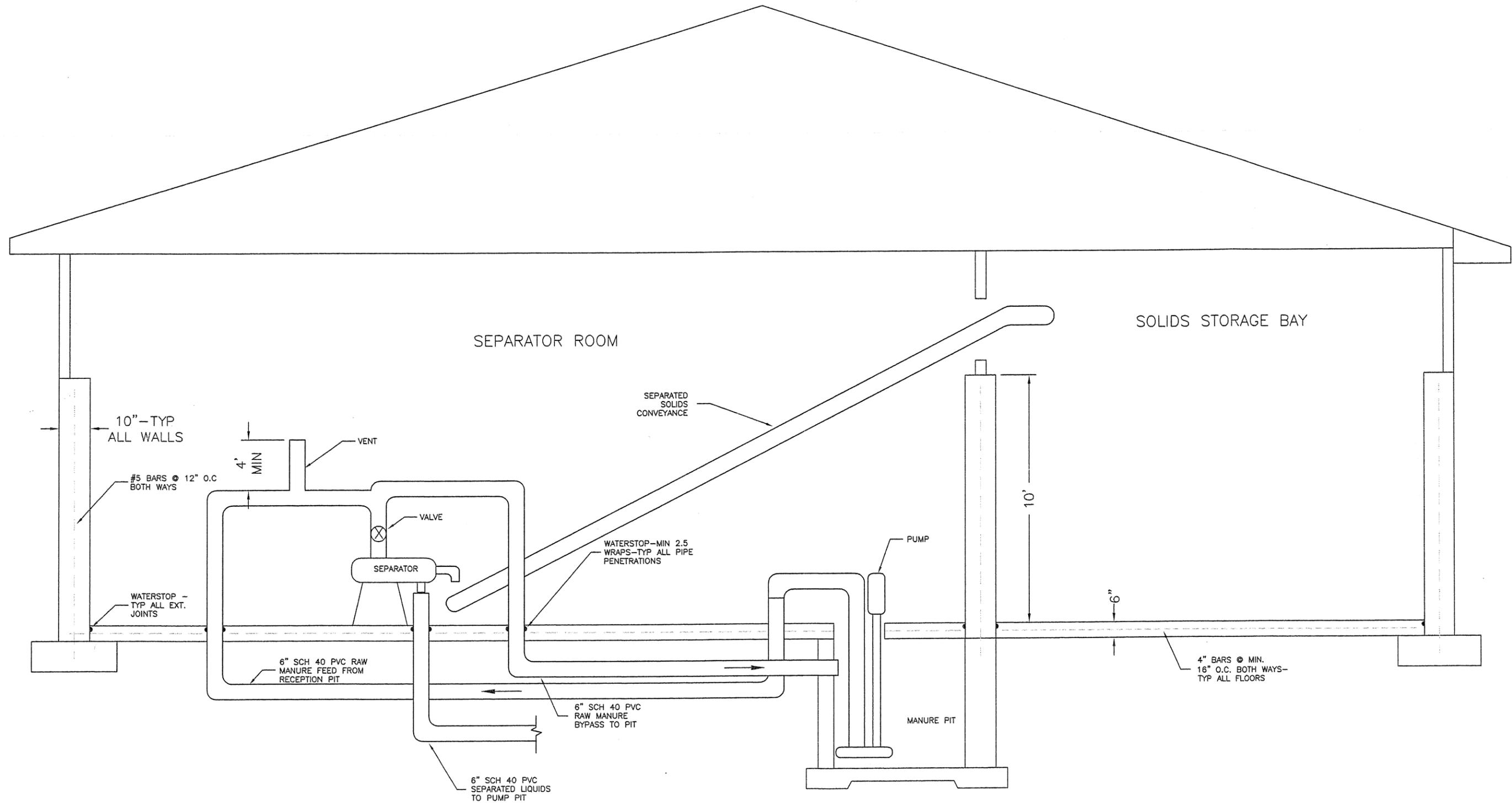
PROVIDE FORMED
CONCRETE LIP AT
ALL ENTRANCES

EXTERIOR
WALL
LINE OF
BUILDING



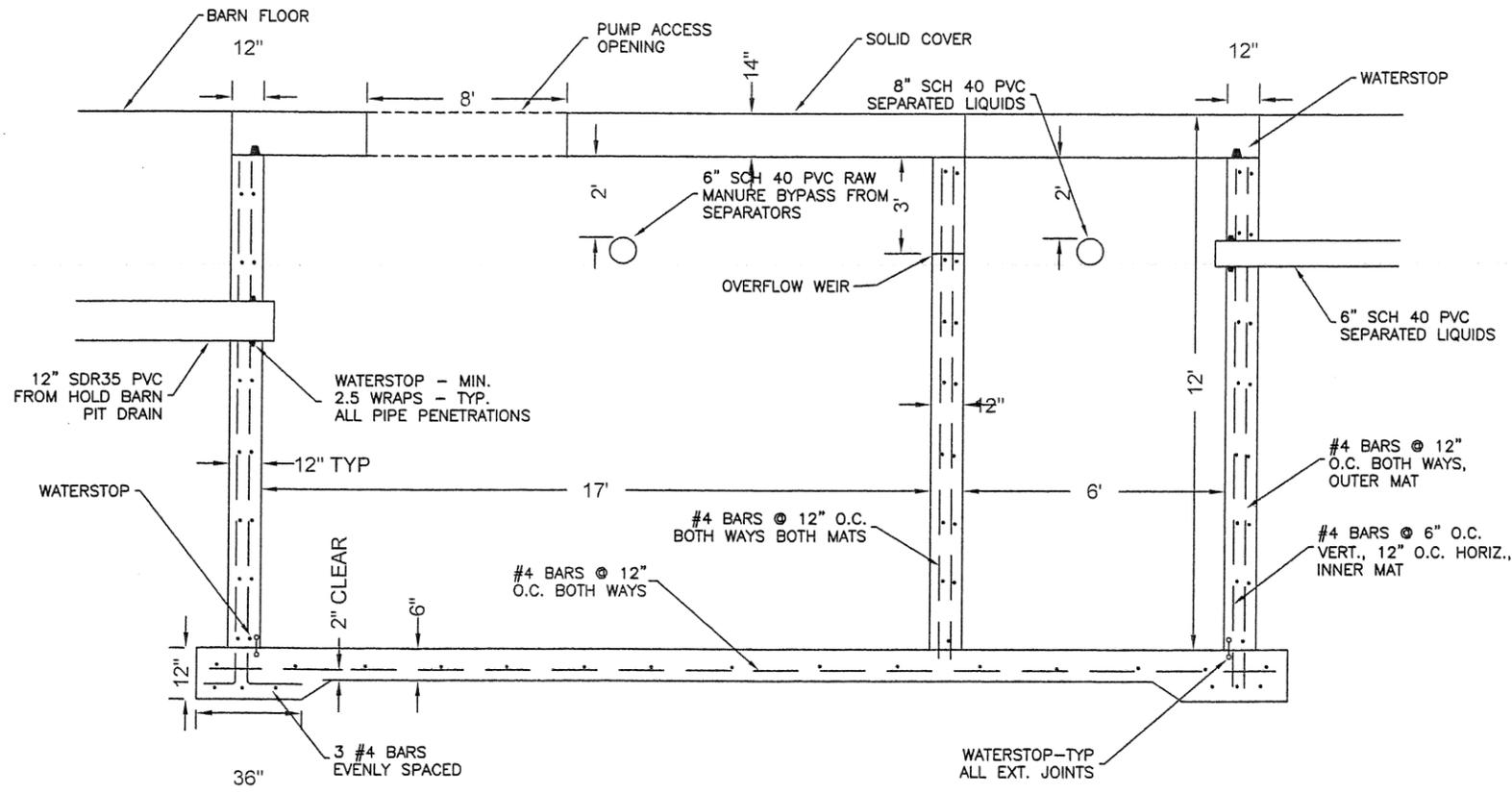
FLOOR DETAIL
AT DOOR OPENINGS

REV. DATE	DESCRIPTION	BY	CHKD
DATE: 1/10/17	DRAWN: TB	CHECKED: BF	
SEPARATOR BUILDING PLAN PARNELL DAIRY AWMS DAKOTA ENVIRONMENTAL CONSULTANTS INCORPORATED			
			
JOB NO: 1611			
SCALE: NTS			
DWG: 08			
P.O. BOX 636 HURON, SD 57350 605-352-5610			

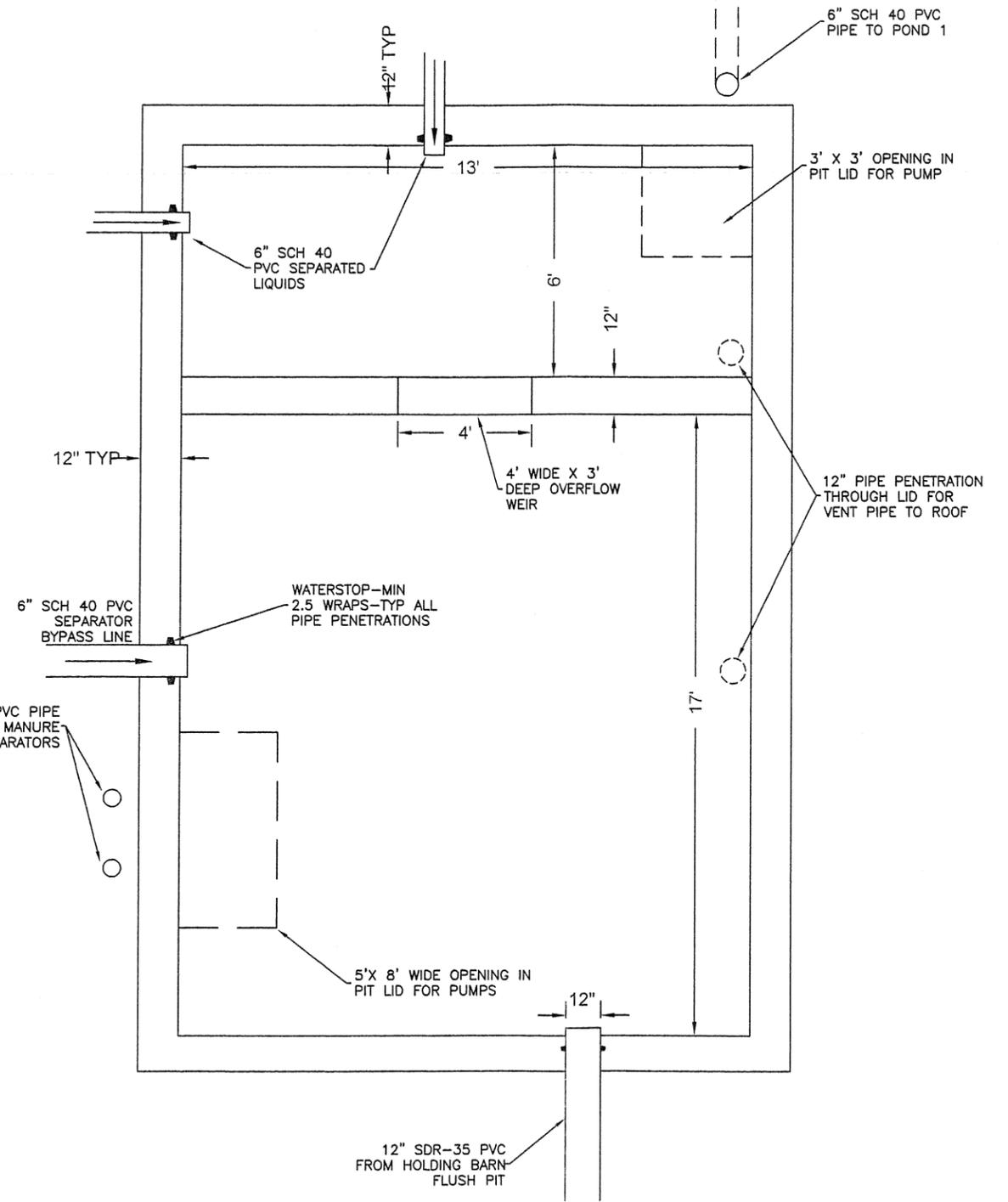


SEPARATOR BARN &
GENERAL SEPARATOR
SCHEMATIC-NTS

SEPARATOR BUILDING SECTION		REV.	DATE	DESCRIPTION	BY	CHKD.
THOMPSON DAIRY AWMS		DATE:	1/10/17	DRAWN:	TB	BF
DAKOTA ENVIRONMENTAL CONSULTANTS INCORPORATED		P.O. BOX 636 HURON, SD 57350 605-352-5610				
		JOB NO:				
		1611				
		SCALE:				
		NTS				
		DWG:				
		9				



SEPARATOR PIT
SIDE VIEW



SEPARATOR PIT
PLAN VIEW

REV.	DATE	DESCRIPTION	BY	CHKD
	1/10/17		TB	BF
DATE:		DRAWN:		

SEPARATOR DETAILS
 PARNELL DAIRY AWMS
 DAKOTA ENVIRONMENTAL CONSULTANTS INCORPORATED
 P.O. BOX 636 HURON, SD 57350 605-352-5610



JOB NO:	1611
SCALE:	NTS
DWG:	10

GENERAL NOTES/SPECIFICATIONS

1. **NO VARIATION FROM THESE PLANS IS AUTHORIZED WITHOUT PRIOR APPROVAL OF ENGINEER. THE BUILDER IS TO ADVISE ENGINEER IMMEDIATELY UPON DISCOVERY OF ANY INCONSISTENCY OR DISCREPANCY IN THESE PLANS WITH FIELD CONDITIONS OR PLANS PROVIDED BY OTHERS.**
2. Any new water supply wells placed on the site must be a minimum of 150 feet from the closest point of any waste holding structure including manure pits. Any new well must be a minimum of 50 feet from the closest point of a sewer line.
3. Strip topsoil and vegetation from all areas under structures and embankments. Stripping excavation shall extend to a depth sufficient to expose subsoil reasonably free of roots and other perishable material. Excavated earth material determined to be satisfactory by the Engineer shall be used for earth fill or topsoil. Stripped material suitable for topsoil shall be stockpiled and spread, as specified in these specifications.
4. Stripping excavation for foundations shall extend to consolidated subsoil and shall be left as reasonably smooth surfaces free of unconsolidated or loose soil. Because of the fact that imposed structural loads are distributed laterally with depth, when replacing poor soils with compacted fill it is necessary to oversize the excavation to a certain extent. In most soils we recommend that at least a 1:1 lateral oversize be maintained in excavating below footing grade. In soft clay and swamp deposits we generally recommend a 2:1 or even 3:1 lateral oversize.
5. Excavated soils consisting of loams and clay shall be deemed satisfactory for earth fill to the extent needed. Sandy soil shall be blended to provide for earth fills, or be wasted as directed by the Engineer. The selection, blending, routing, and disposition of material shall be the responsibility of the Builder and subject to approval by the Engineer. Fill materials shall contain no frozen material, ice, snow, sod, brush, roots or other perishable materials, or rocks larger than four inches in diameter. No fill shall be placed on a frozen surface.
6. Prior to placement of fill, the entire area to receive fill shall be rolled with heavy equipment (such as a loaded end-dump) and inspected to identify any unsuitable soils that require removal. Unsuitable materials shall be overexcavated to a depth of 2 feet. After stripping or overexcavating, the foundation shall be loosened thoroughly by scarifying or discing to a minimum depth 6 inches. The entire foundation area shall then be compacted to the density and at the moisture specified for the fill.
7. All foundation excavation and/or preparation shall be completed before placing fill. The fill shall be placed such that the distribution of materials is essentially uniform throughout the entire fill and is free from lenses, pockets, streaks, or layers of material differing substantially from surrounding material.
8. Fill shall be placed within specified moisture contents. When material deposited on the fill is too dry, water may be added to the fill material in the borrow area, or after material has been brought onto the fill. If moisture is added to the fill, uniform moisture distribution shall be obtained by discing, blading or other approved methods.
9. Density and moisture content of the fill will be tested during the course of the work following the methods described in ASTM D2216, ASTM D1556, or equivalent. The engineer shall be notified two days prior to the need for performance of compaction tests. Testing shall be performed at the following rates:
 - a) Earthen liners: A minimum of 4 per lift for areas up to two (2) acres. Provide an additional 2 tests per lift for each additional acre.

b) Earthfill: A minimum of one compaction test for every 5000 cu. yd.

If a compaction test fails to meet the required level of compaction, the Builder shall be responsible for the cost of re-testing after the area has been recompacted.

10. In lieu of conducting density tests on the completed liner, there shall be a minimum of two permeability tests conducted on the completed liner. For ponds larger than two acres, one permeability test shall be conducted for each acre of liner. The locations of the tests must be random and equally distributed over the liner bottom and inside embankments. All liner tests shall demonstrate an in-place permeability not to exceed 1.0×10^{-7} cm/sec.
11. Builder is responsible to manage the routing and stockpiling of material for the clay liner. It is anticipated the native clay soils below the topsoil will be suitable for use as liner material, though certain soils encountered may contain excessive sand or silt and are not suitable. As early as possible during excavation, field evaluation of the quality of the native clay soil in the vicinity of the bottom liner should be performed with the engineer to verify its adequacy. The contractor shall stockpile choice clay materials during the progress of excavation to ensure the availability of a suitable volume and quality of liner material.
12. When in-place native soils are used as for compacted liner, excavate beyond the design bottom an additional twelve inches. The next six inch layer shall be scarified and recompacted. Additional six inch lifts of select material will be placed and compacted to reach the specified liner thickness. When imported clay material is used for a liner, overexcavate beyond the design bottom by the liner thickness. The entire liner subgrade area shall be rolled to identify any unsuitable soils that require removal. Following overexcavation, six inch lifts of select material will be placed and compacted to reach the specified liner thickness.
13. Pipe trench bottoms shall be uniform so that the pipe will lay on the bottom without bridging. Clods, rocks, and uneven spots which could damage or cause non-uniform support to the pipe shall be removed. Where rocks, boulders or any other material which might damage pipe are encountered, the trench bottom shall be undercut a minimum of 4 inches below final compacted fine-grained soils. Provisions shall be made to insure safe working conditions where unstable soil, trench depth, or other conditions are such as to impose a safety hazard to personnel working in the trench.
14. Pipe shall be installed in accordance with these plans, the manufacturer's recommendations, and ASTM D2321. Pipe shall be fully supported its entire length by hand excavation or other suitable means. Initial pipe backfill shall be of selected material free from sharp edged rocks, stones or clods. Care shall be taken to avoid deformation or displacement of the pipe during initial backfill operation. The remainder of the backfill shall be placed and spread in approximately uniform layers in such a manner as to completely fill the trench so that there will be no unfilled spaces in the backfill. Mound the backfill soil to replace the soil removed from the trench.
15. All piping shall be installed so a minimum of 5 feet of cover is present between the surface and the crown of the pipe if additional insulation is not provided.
16. Gravity sewer and drainage pipes shall be constructed using SDR 35 or heavier PVC pipe laid at the grades shown on the drawings. Pressure pipe (force main) shall be constructed using SDR-26 PVC pipe or heavier. On pressure pipe systems, provide concrete thrust blocks, with at least 4 square feet of bearing on undisturbed, firm soil, at all bends, valves, tees, fittings or reducers. Where water supply pipes cross under or within 18 inches of any sewer piping, encase the water line in concrete (minimum of 6" surrounding the pipe) for at least 10 feet either side of the crossing.
18. All sewer pipes shall be pressure tested. Contractor shall provide written certification of pressure testing results to the engineer prior to application for payment. The contractor shall provide all labor and materials for pressure testing.

19. Pressure tests of gravity sewers shall be performed as follows: A test plug shall be inserted at the point of discharge into the pond. The sewer shall then be filled with water to the top of the inlet pipe. The water level at the top of the inlet shall not drop for at least fifteen minutes.

20. Pressure tests of pressurized sewers shall be performed as follows:

- a) Fill the service line and bleed to remove all air.
- b) Isolate service line from main and raise pressure to 50% above the design operating pressure.
- c) Maintain pressure within 1 psi for a minimum of 30 minutes.
- d) Line will pass the test if leakage is no more than the following:
 $L = (N \times D \times P) / 1850$

Where:
 L = Allowable leakage, in gallons per hour.
 N = Number of pipe joints.
 D = Nominal pipe diameter, in inches
 P = Average test pressure during test, in psig.

21. Unless otherwise specified on the plans, the fill shall be compacted to the following specifications. Maximum density shall be determined by ATSM-D-698, Standard Proctor Test.

	% maximum dry density	moisture range about optimum %	max. lift thickness	total liner thickness
Embankment	90%	-2 to +2	12"	-
Structural fill beneath slabs and pipe	97%	-3 to +3	8"	-
Pond liner	95%	-2 to +2	6"	18"

22. In locations where existing embankments or liners are disturbed to install, remove, or modify piping or appurtenances, the disturbed embankments shall be recompacted to the above specified densities using the procedure described above. The disturbed liner shall be replaced and recompacted to the above specifications. Rammer or plate compactors are considered to be acceptable if larger compacting equipment is not practical for these locations.

23. Seed disturbed and topsoiled areas using Fairway Crested Wheatgrass at 15#/acre, or Smooth Bromegrass at 20#/acre. Apply seed when soil is not wet, using a grass drill at a depth of 1/4 to 3/4 inch, or with other approved types of equipment that will ensure a uniform distribution of the seed. Areas with slopes steeper than 4:1 shall be mulched with straw or hay and anchored by use of a mulching machine or netting.

	CHKD				
	BY	CHECKED:	DATE:	DRAWN:	TB
			1/10/17		
GENERAL NOTES & SPECIFICATIONS					
PARNELL DAIRY AWMS					
DAKOTA ENVIRONMENTAL CONSULTANTS INCORPORATED					
					
JOB NO:					
1611					
SCALE:					
NTS					
DWG:					
11					
P.O. BOX 636 HURON, SD 57350 605-352-5610					

CONCRETE CONSTRUCTION NOTES

1. **BUILDER SHALL NOTIFY THE ENGINEER OF CONSTRUCTION SCHEDULE TO PERMIT SCHEDULING OF PRE-CONSTRUCTION MEETING AND CONSTRUCTION OBSERVATION.**
2. **NO VARIATION FROM THESE PLANS IS AUTHORIZED WITHOUT PRIOR APPROVAL OF THE ENGINEER.**
3. **BUILDER IS RESPONSIBLE TO ADVISE ENGINEER IMMEDIATELY UPON DISCOVERY OF ANY INCONSISTENCY OR DISCREPANCY IN THESE PLANS WITH FIELD CONDITIONS OR PLANS PROVIDED BY OTHERS.**
4. Any required grounding of building components including concrete reinforcement shall be installed in accordance with the provisions of the National Electric Code and regulations.
5. No excavation shall begin without first having locations of all present utilities identified. Builder is responsible for contacting South Dakota One-Call at 1-800-781-7474.
6. All concrete work shall conform to the American Concrete Institute's "Building Code Requirements for Structural Concrete" (ACI 318).
7. **Concrete Materials and Testing:**
 - a) All concrete shall have 3/4 inch maximum aggregate size. Provide a mix with a slump of 4 inches +/- 1 inch. Do not exceed a water/cementitious materials ratio of 0.45. Water reducing admixtures may be used at the discretion of the contractor.
 - b) Concrete shall use Type II cement and be furnished with proper admixture to obtain 5% +/- 1% air entrainment.
 - c) Concrete shall develop a minimum 28 day strength of 4000 psi.
 - d) Provide quality assurance testing in accordance with the following requirements. Submit the results of all tests to the Engineer. **Testing will be wholly the contractor's responsibility.**
 - e) Collect concrete test cylinders in accordance with ASTM C31. Test cylinders may be taken either at the batch plant (assure materials are thoroughly mixed, at least 1½ minutes after all water and cementitious materials have been introduced), or in the field. Test cylinders shall be made in sets of two. At least one set of two cylinders shall be taken each day concrete may be placed, however, procurement of test cylinders may be waived with the concurrence of the engineer or when less than 40 cubic yards is placed in a given day.
 Obtain at least the following numbers of test cylinders:
 One set of 2 cylinders for each 3000 square feet of flatwork;
 one set of 2 cylinders for each 500 linear feet of exterior walls;
 and one set of 2 cylinders each for floors and walls of any individual pit.
 Test all cylinders in accordance with ASTM C39 at 28 days.
8. During hot weather (80° F and above), comply with ACI 305 "Hot Weather Concreting". During cold weather (40° F and below), comply with ACI 306 "Cold Weather Concreting."
9. Calcium Chloride accelerators will not be allowed.
10. Steel reinforcing shall comply with the following:
 - a) Steel for walls shall be ASTM A615, Grade 60.

b) Reinforcing steel for floors shall be ASTM A615, Grade 40 or Grade 60.

11. All steel shall be lapped 36 bar diameters at splices unless noted otherwise. Splices shall be staggered at least 3 feet. Splices occurring at the same location shall be at least 6 bars apart.
12. Standard concrete cover of bars shall be as follows, unless noted otherwise:
 - a) Where earth formed 3 inches
 - b) Where exposed to earth or weather 2 inches
13. Walls and slabs shall bear on soil capable of safely supporting 2400 psf. Pier bearing elevations are to be at least 4.5 feet below finished grade.
14. For backfill provide granular or low plasticity soil such as silt and clay mixtures, sandy clay, or clean sand and gravel. All backfill materials are subject to approval of the engineer. Compact all fill and backfill in maximum 12-inch layers (loose thickness) to at least 95% of the maximum density as determined by Standard Proctor test (ASTM D698).
15. Excavate the area to the required lines and grades. The entire area shall be rolled as needed to compact any loosened materials. The subgrade shall be trimmed and compacted to provide a uniform surface that does not vary in depth more than 2" in 10 feet from the grades shown on the plan. Fill below footings and slabs, if needed due to unsuitable soils or uneven surface grading, shall consist of clean granular material (sand with less than 12% passing a #200 US sieve) compacted as specified for backfill in note #14, above. Constructed thickness of slabs shall not be less than the dimension given on the drawings.
16. If necessary, wall penetrations shall avoid interruption of steel reinforcement, where possible. Where interruption by piping is required, additional reinforcement around the openings shall be as shown on plans.
17. If groundwater conditions or any soft or potentially unstable materials are encountered during excavation, the Engineer shall be notified immediately.
18. Provide suitable chairs, spacers, or bolsters to support all reinforcing. Accessories shall be as specified in the latest edition of "Concrete Reinforcing Steel Institute Handbook." Maximum spacing of accessories shall be 5'-0". All accessories shall have galvanized or plastic feet. For slabs on grade, use supports with sand plates or horizontal runners if needed. No aluminum items shall be embedded.
19. Install all construction or control (contraction) joints as called for on the drawings or as approved by the floor engineer.
20. Concrete construction shall be planned to minimize the number of construction joints. Except at corners, the location of all construction joints in walls and floor slabs, and the layout of slab control (contraction) joints, shall be reviewed with and approved by the engineer prior to construction.
21. All construction joints in and between floor slabs and exterior walls shall be provided with waterstop. Provide Waterstop RX 102, as manufactured by American Colloid Corp., or polyvinyl chloride waterstop, style #703 as manufactured by Greenstreak or approved equal. Install waterstop in accordance with manufacturer's recommendations on the manure side of reinforcing steel, near the middle of the of the wall or slab section, and as shown on the detail

drawings. Maintain specified concrete cover over waterstop and reinforcing steel.

22. All pipe penetrations shall be provided with suitable waterstops.
23. Contractor/builder shall notify the Engineer approximately 48 hours prior to the following activities to permit inspections:
 - a) after subbase preparation, including compaction of granular cushion, and prior to drilling of piers.
 - b) during installation of wall forms and reinforcement, prior to casting concrete.
 - c) after form removal and prior to backfill to permit visual inspection of finished work.
24. Any imperfections or damage to concrete surfaces below the waterline shall be repaired as approved by the Engineer.
25. Compaction of fill adjacent to new concrete shall not be started until at least seven days after placement of the concrete and after all walls are laterally braced.
26. These plans are intended to provide details relevant to the animal waste management system and are a supplement to the building plans supplied by others. The builder is responsible for confirmation of all work to be coordinated with others. Anchorage requirements, embedded items, dimensions of slats, openings for doors or fans, etc. shall be confirmed prior to erection of forms and concrete placement.
27. Any new water supply wells placed on the site must be a minimum of 150 feet from the closest point of any waste holding structure including manure pits (1,000 feet if the well will be used for human consumption). Any new well must be a minimum of 50 feet from the closest point of a sewer line.
28. All buried water service lines shall be installed to maintain a minimum of 3 feet of separation from any manure containment or storage structure.
29. Seed disturbed and topsoiled areas as directed by the project engineer.

	CHKD		BY		CHECKED:	BF
		DESCRIPTION			DRAWN:	TB
				DATE		1/10/17
				REV. DATE:		
CONCRETE NOTES PARNELL DAIRY AWMS DAKOTA ENVIRONMENTAL CONSULTANTS INCORPORATED						
						
JOB NO:						
1611						
SCALE:						
NTS						
DWG:						
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