

Project: Buckey Swine - Septic System Design

Location: SW 1/4, S19, T108N, R56W

SET #: 26228

SD DANR

26-1126

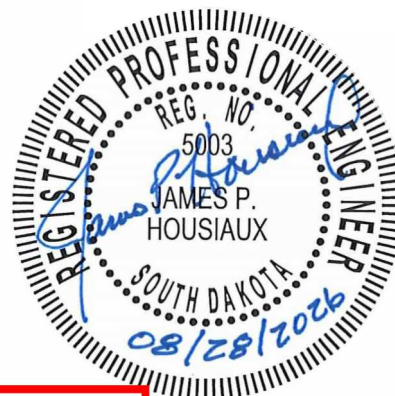
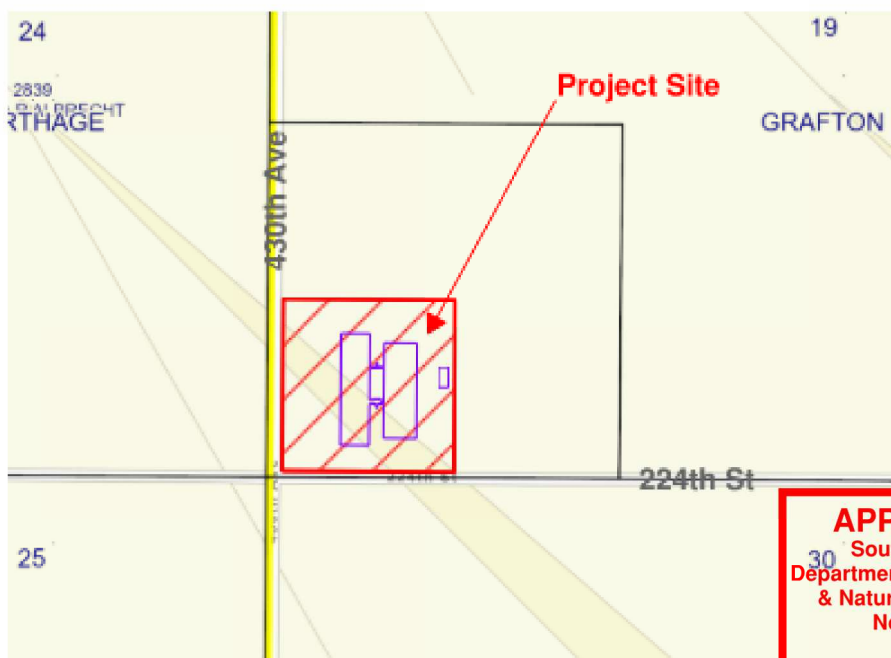


Project Description

In general, the project includes the design for a new domestic mound septic system near Carthage, South Dakota. The system will receive wastewater from staff restrooms, shower and a small laboratory. Wastewater will be collected and pumped to a conventional on-site wastewater system (septic tank and mound system.)

Facility Location/Layout

Address: SW 1/4, S19, T108N, R56W



DESIGN FLOWS

Table 1 - Average and Maximum Daily Flow Calculations

Wastewater Source	Number of Staff	Average Daily Flow, Gallons (Per Person)	Maximum Daily Flow, Gallons (Per Person)	Average Daily Flow, Gallons (Total)	Maximum Daily Flow, Gallons (Total)
Staff Restrooms	25	23.3	35	583	875
Shower	25	-	60	1000	1500
Total:				1583	2375

USE

2400

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74:52-01-20. Wastewater flow capacity requirements of residential and nonresidential establishments. All individual or small on-site wastewater treatment systems shall be designed to have a capacity at least equal to the anticipated maximum daily flow. For existing facilities where the average daily flow is measured, the anticipated maximum daily wastewater flow shall be assumed to be 150 percent of the average daily flow as the basis for the design of the system. In other cases, the anticipated maximum daily flow capacity shall be determined according to the type of facility as set forth in Table 2.

TABLE 2

Maximum Daily Flow

Commercial

Airport (per passenger, without food service)	5
Airport (per public toilet room)	*500
Automobile Service Station (per toilet room)	*500
Automobile Service Station (per vehicle served)	*10
Bars and Cocktail Lounges (per patron)	2
Bars and Cocktail Lounges (per seat)	*20
Bus Stations (without food service)	5
Commercial Employees (except factory, plant, or office)	10
Factories and Plants (exclusive of industrial waste)	35
Laundries, Self Service (per washer)	*600
Offices (per employee)	15
Restaurants (kitchen wastes per patron)	3
Restaurants, on Interstate or Through Highways (per seat)	*180
Restaurants, (per seat)	*35
Restaurants (toilet and kitchen wastes per patron)	10
Restaurants (with paper service per patron)	1.5
Shopping Centers (per parking space)	2
Stores (per public toilet room)	*500
Theaters, Drive-in (not including food, per car space)	*10
Theaters, Movie, Auditorium Type (not including food, per seat)	*5
Work or Construction Camps (semipermanent, with flush toilets)	50
Work or Construction Camps (semipermanent, without flush toilets)	25



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SEPTIC TANK

Table 2 - Septic Tank Sizing

Requirements per 74:53:01:25 - Minimum Capacities for Septic Tanks	
Flow, Gallons/Day	Minimum Septic Tank Capacity, Gallons
< 750	1000
750 - 1,500	$1.5 * (\text{Wastewater Flow})$
> 1,500	$1,125 + 0.75 * (\text{Wastewater Flow})$
Project Calculations	
Wastewater Flow:	2400 Gallons/Day
Capacity Calculation:	$1,125 + 0.75 * (\text{Wastewater Flow})$
Calculated Capacity:	2925
Selected Capacity:	3000

74:53:01:25. Minimum capacities for septic tanks. The minimum capacities for septic tanks serving individual or small on-site systems shall be determined as follows:

(1) All septic tanks receiving wastewater flows of 750 gallons per day or less shall have a minimum capacity of at least 1,000 gallons of liquid before there will be an overflow into the septic tank outlet. When a housing unit or units served by a septic tank contains more than three bedrooms, each bedroom in excess of three shall require an additional 250-gallon increase in the capacity of the septic tank beyond the 1,000 gallons. If a septic tank receives wastes from a garbage disposal, the overall capacity of the tank shall be increased by an additional 20 percent;

(2) Septic tanks serving premises other than housing units or receiving wastewater flows of more than 750 gallons per day but equal to or less than 1,500 gallons per day shall have a minimum liquid volume capacity to permit retention of incoming sewage at 150 percent of the average daily flow;

(3) Septic tanks receiving wastewater flows greater than 1,500 gallons per day shall have a minimum liquid volume capacity (V) equal to at least 1,125 gallons plus 75 percent of the daily wastewater flow (Q), or $V = 1,125 + 0.75Q$; and

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PERCOLATION RATES

Average Percolation Rate: 139.3 min/inch

Selected Percolation Rate: 139.3 min/inch

Attached to this report is the percolation testing report developed by Foerster Testing. The testing report presents the results of the percolation tests performed in the identified area for the wastewater treatment system.

74:53:01:30. Manner for conducting percolation test. A soil percolation test shall be made in at least 3 test holes within 5 feet of where the proposed absorption system or shallow wastewater system is to be located. The holes shall be randomly located in soil representative of and similar in character to the rest of the area where the system will be placed. An additional test hole shall be made to a depth of 4 feet beneath the bottom of the proposed absorption system, unless groundwater or bedrock is encountered first, to determine the type and depth of absorption system.

The horizontal dimension or diameter of the percolation test hole shall be from 6 to 12 inches and the vertical sides shall extend to the maximum depth of the proposed absorption system or to a depth of at least 30 inches, whichever is greater.

Test holes shall be located in unfrozen soil and shall be filled at least 50 percent full with water for at least 8 hours but not more than 16 hours before making the soil percolation test. Immediately before making the test, each hole shall be refilled with water to at least 50 percent of its volume. When the water reaches the lower 25 percent of the test hole, the test shall begin. The percolation rate of a test hole shall be expressed in the number of minutes it takes the water level to drop 1 inch. The percolation rate for the area where the subsurface infiltration system is desired is the average percolation rate of all the test holes. The percolation tests shall be conducted for 2 hours unless the percolation rate is slower than 45 minutes per inch, in which case the percolation tests shall be run for at least 4 hours.

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MOUND SYSTEM

Table 3 - Mound or Evapotranspiration System Sizing

Requirements per 74:53:01:37 - Requirements for a Mound or Evapotranspiration System		
Flow (Gallons/Day)	Percolation Rate (Minute/Inch)	Minimum Dispersal Area
< 1,500	3 - 60	(Gallons/Day)/(0.83 Square Feet)
< 1,500	60 - 120	(Gallons/Day)/(0.6 Square Feet)
> 1,500	-	Soil Percolation Rate + Seasonal Evapotranspiration Rate
Project Calculations		
Maximum Daily Flow:	2400 Gallons/Day	
Percolation Rate:	139.3 Minutes/Inch	
	Evapotranspiration	
Evapotranspiration Rate	0.12 inches/sq.ft.	
Soil Infiltration Rate	0 inches/sq.ft.	
Total Infiltration Rate	0.12 inches/sq.ft.	
Minimum Dispersal Area Calculation:	(Gallons/Day)/(0.12 Square Feet)	
Calculated Area:	20000 Square Feet	
Selected Area:	20000 Square Feet	

74:53:01:37. Requirements for a mound or evapotranspiration system. A mound or evapotranspiration system may be designed for gravity or pressure flows in accordance with the following criteria:

(5) The required bottom area of the bed shall be calculated on the basis of a recommended or design application rate with respect to the soil percolation rate. For mound systems receiving less than 1,500 gallons of wastewater per day, an application rate of 0.6 gallons per square foot per day shall be used when the percolation rate is from 60 to 120 minutes per inch and an application rate of 0.83 gallons per square foot per day shall be used when the percolation rate is 3 or more but less than 60 minutes per inch. For mound systems receiving 1,500 or more gallons of wastewater per day, the application design rate shall equal the soil percolation rate plus the seasonal evapotranspiration rate as shown in Table 6. For evapotranspiration systems, the application design rate is the seasonal evapotranspiration rate shown in Table 6 as follows:

TABLE 6

Evapotranspiration Rate

Season of Use

Year Around
Summer
Winter

0.12
0.20
0.06

Soil Infiltration Rate

Percolation Time, Minutes per inch

5 or more but less than 10
10 or more but less than 15
15 or more but less than 20
20 or more but less than 30
30 or more but less than 45
45 or more but less than 60
60 or more but less than 90
90 or more but less than 120
120

Gallons per square foot per day

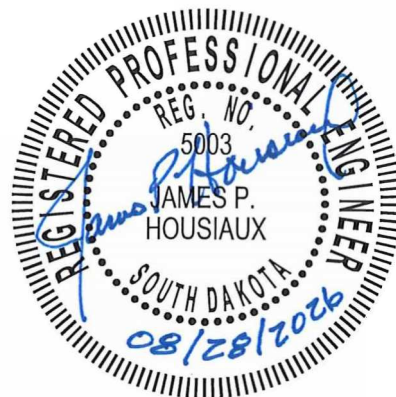
0.65
0.60
0.54
0.49
0.42
0.34
0.27
0.18
0.12

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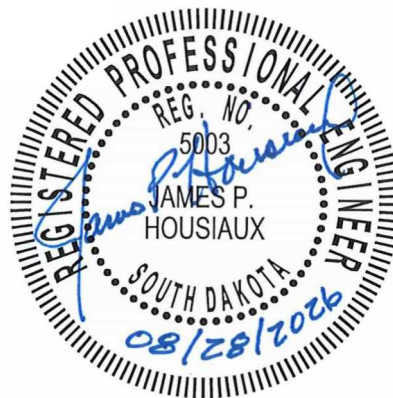
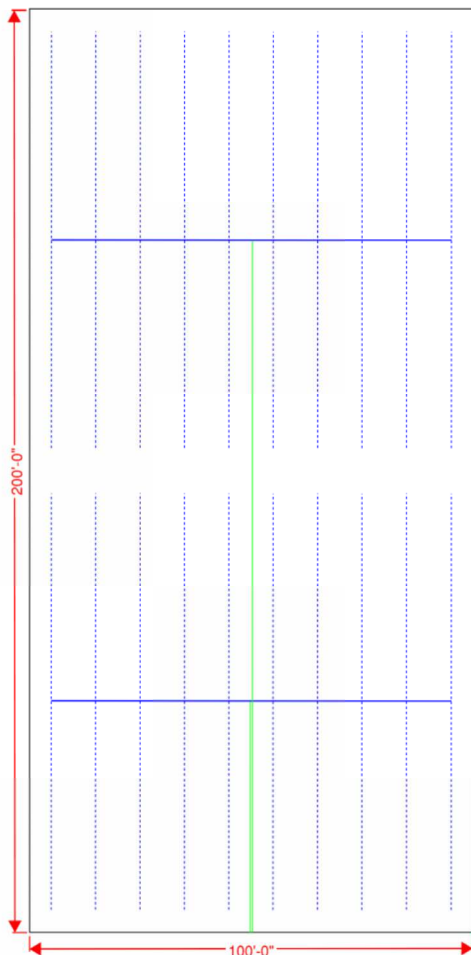
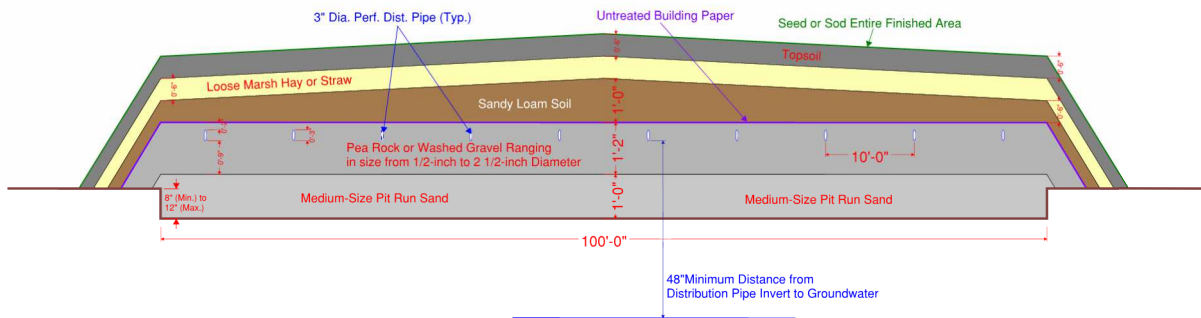
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SET #: 26228



Figure 1 Evapotranspiration System Profile

Subgrade:	Native Soil
Layer 1:	12" Sand
Layer 2:	9" Pea rock or washed gravel
Layer 3:	(Diameter of Distribution Pipe + 2)" Pea rock or washed gravel
Layer 5:	Untreated building paper
Layer 6:	6" - 12" Sandy loam soil
Layer 7:	6" Straw
Layer 8:	6" Grass Seeded Topsoil



Project: Buckeye Swine - Septic System Design

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SET #: 26228



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04/58:01:37. Requirements for a mound or evapotranspiration system. A mound or evapotranspiration system may be designed for gravity or pressure flows in accordance with the following criteria:

(1) Plans and specifications shall be submitted to the secretary by a registered professional engineer or licensed plumber for review and approval of any individual or small on-site mound or evapotranspiration system prior to construction;

(2) Mound and evapotranspiration systems shall not be constructed on sites located in a floodplain. Mound systems shall not be constructed on sites located on bedrock or on soils with percolation rates of 120 or more minutes per inch or 3 or fewer minutes per inch at a depth of 12 inches below the sand layer of the mound. Mound or evapotranspiration systems may not be located on natural slopes exceeding 12 percent under any soil percolation rate conditions. When a mound or evapotranspiration system is located on a slope, no buildings, driveways, other surface or subsurface obstructions, or future construction is permitted within 30 feet of the system on the down gradient side while the system is being used. The systems shall be located in open areas with maximum available sunshine. The area surrounding the systems shall be graded to provide for diversion of surface runoff water;

(3) The mound or evapotranspiration system may be constructed only upon undisturbed naturally occurring soils. The bottom of the system bed shall be excavated to a depth from 8 to 12 inches below the ground surface and shall be completely level. The system may be round or rectangular;

(4) The mound system shall be constructed so that the minimum distance between the seasonal high groundwater table and the invert elevation of the distribution system is 4 feet;

(6) The fill material for the interior portion of a mound or evapotranspiration system shall consist of sandy loam soil, medium-size pit run sand, and pea rock or washed gravel ranging in size from 1/2-inch to 2 1/2-inch diameter. The first layer of fill material placed on the excavated bed bottom shall be a minimum of 12 inches of sand. The next layer of fill material shall consist of at least 9 inches of the pea rock or washed gravel placed in the immediate area on which the distribution pipe system will be placed. After placement of the distribution pipe system, additional pea rock or washed gravel shall be added until there are at least 2 inches of cover over and around the entire pipe system. The rock or gravel layer shall be covered with untreated building paper. The finish fill shall consist of sandy loam soil placed on the untreated building paper to a depth of 1 foot in the center of the mound and to a depth of 6 inches at the sides tapered out onto the side of the sand filled layer;

(7) The exterior portion of mound shall consist of at least a 6-inch layer of loose marsh hay or straw over the sandy loam soil, covered with at least 6 inches of topsoil. Flax straw may not be used. The outside slopes may not be steeper than 3 feet horizontally to 1 foot vertically (3:1). Where the terrain slopes more than 7 percent, the downward slopes may not be steeper than 5 feet horizontally to 1 foot vertically (5:1). The entire system shall be seeded, sodded, or otherwise provided with a grass cover. No shrubs, trees, or other woody vegetation may be planted on the top of the system;

(9) Livestock and heavy equipment shall not be allowed on the bed.



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Table 4. Distribution Pipe Layout

05/03/2025

Requirements per 74:53:01:27 - Dosing or pressure systems required when absorption systems are large.									
Dispersal Area, Square Feet				Number of Dispersal Sections					
< 1,800				1					
> 1,800				2					
Project Calculations									
Total Dispersal Area:				20000		Square Feet			
Number of Dispersal Sections				2					
Dispersal Section Area:				10000		Square Feet			
Dimensions, Feet (L = W):				Length:	100.0	Width:		100.0	
Dimensions, Feet (L = 3*W):				Length:	145.0	Width:		69.0	
Dimensions, Feet (L = 4*W):				Length:	173.2	Width:		57.7	
Selected Dimensions, Ft:				Length:	100	Width:		100.0	
Adjusted Dispersal Section Area:				10000		Square Feet			
Number of Distribution Pipes/Section:				10					
Length of Distribution Pipe/Section:				900					
Total Length of Distribution Pipe:				1800					



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SET #: 26228



74:53:01:27. Dosing or pressure systems required when absorption systems are large. A dosing chamber shall be installed with a siphon or a pump when the total length of absorption lines exceeds 750 feet, the area of the absorption system exceeds 1,200 square feet, the topography and location is such that any absorption line will exceed 100 feet in length, or it is necessary to elevate the wastewater effluent from the septic tank for discharge into a mound or absorption field. The dosing chamber shall be equipped with an automatic siphon or pump with level control switches and an alarm system. All electrical components in the dosing chamber shall be waterproof and corrosion-resistant. The alarm and electrical panel shall be located outside of the dosing chamber and shall be weatherproof. The total storage volume of the dosing chamber shall be such that the wastewater is discharged once every three to four hours. The dosing chamber shall be at least 30 inches in diameter and have a net capacity to dose 60 to 75 percent of the total volume of the absorption lines at one time. The siphon or pump for the dosing chamber shall be capable of maintaining a pressure of at least one pound per square inch at the outer ends of the absorption lines. The dosing chamber shall be vented but watertight and designed for ease of maintenance. Absorption fields exceeding 1,000 feet in total length or 1,800 square feet in area shall be divided into at least two equal sections with each section dosed alternately.

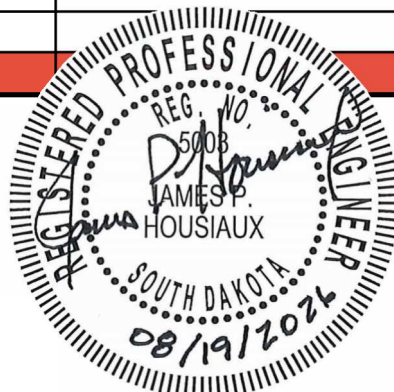
74:53:01:36. Requirements for an absorption bed. Seepage beds may not be constructed where the soil percolation rate is 30 or more minutes per inch. An absorption bed may be designed and constructed for gravity or pressure flows in accordance with the following criteria:

(2) A pressurized absorption bed system may exceed the length and width requirements in subdivision 74:53:01:36(1) but must not be more than 3 feet in depth. The bed bottom shall be level. Each distribution line shall be installed within the perimeter limits of the bed and spaced not greater than 10 feet on center across the bed. The bed shall be center-fed by a manifold pipe. The outermost distribution lines may not be closer than 5 feet to the bed wall perimeter. The distribution system shall be closed -loop or have all ends capped;

DOSING CHAMBER

Table 5 - Dosing Chamber Sizing

Requirements per 74:53:01:27 - Dosing or pressure systems required when absorption systems are large.									
Dosing Chamber Size:			30" Diameter, Minimum						
Dosing Chamber Working Volume:			60% - 70% of the total absorption line volume						
Dosage Frequency:			3 - 4 Hours						
Project Calculations									
Distribution Pipe Length:			900		Feet				
Distribution Pipe Diameter:			3		Inches				
Distribution Pipe Cross Sectional Area:			0.05		Square Feet				
Distribution Pipe Total Volume:			44.2		Cubic Feet				
Distribution Pipe Volume/Section:			22.1		Cubic Feet				
Distribution Pipe Volume/Section:			165.2		Gallons				
Distribution Pipe Volume/Section (60%):			99.1		Gallons				
Distribution Pipe Volume/Section (75%):			123.9		Gallons				
Dosing Chamber Dimensions:									
Diameter:			48 Inches						
Area:			12.6		Square Feet				
Depth (60%):			1.1		Feet				
Depth (75%):			1.3		Feet				
Selected Depth:			1.3 Feet						



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SET #: 026228



Table 5 - Dosing Chamber Sizing (Continued)

Dosing Frequency:		
Dosage Volume:	16.3	Cubic Feet
Dosage Volume:	122.2	Gallons
Maximum Daily Flow/bed:	1200	Gallons/Day
Number of Doses/Day:	10	Doses
Number of Doses/Day/bed:	5	Doses
Dosage Interval:	4.9	Hours

74:53:01:27. Dosing or pressure systems required when absorption systems are large. A dosing chamber shall be installed with a siphon or a pump when the total length of absorption lines exceeds 750 feet, the area of the absorption system exceeds 1,200 square feet, the topography and location is such that any absorption line would exceed 150 feet in length, or it is necessary to elevate the wastewater effluent from the septic tank for discharge into a mound or absorption field. The dosing chamber shall be equipped with an automatic siphon or pump with level control switches and an alarm system. All electrical components in the dosing chamber shall be waterproof and corrosion-resistant. The alarm and electrical panel shall be located outside of the dosing chamber and shall be weatherproof. The total storage volume of the dosing chamber shall be such that the wastewater is discharged once every three to four hours. The dosing chamber shall be at least 30 inches in diameter and have a net capacity to dose 60 to 75 percent of the total volume of the absorption lines at one time. The siphon or pump for the dosing chamber shall be capable of maintaining a pressure of at least one pound per square inch at the outer ends of the absorption lines. The dosing chamber shall be vented but watertight and designed for ease of maintenance. Absorption fields exceeding 1,000 feet in total length or 1,800 square feet in area shall be divided into at least two equal sections with each section dosed alternately.



Dosing Pump

Table 6 - Dosing Pump Sizing

Formula:	$(Q/\text{dose}) / (\text{Pump Run Time}/\text{dose})$	
Flow per dose	123.9	Gallons
Pump Time per dose	3	Minutes
Pump Discharge Rate:	41.31	Gallons/Minute/Hole
Distribution Pipe:		
Pipe Size	3	Inches
Hole Spacing:	4	Feet
Pipe Length/Section:	900	Feet
Total Holes:	225.0	Holes
Pump Flow:	41.3	Gallons/Minute

Parameter	Pump Discharge
Pipe Dia., in.	2.5
Pipe Length, ft.	600
Pipe Area, sq.ft.	0.034
Chw	130
K	6.1

Parameter	Pump Discharge
Flow, GPM	41.3
Flow, CFS	0.09
Vel., FPS	2.70
H _{static}	11.5
H _{minor}	0.7
H _{friction}	8.6
H _{total}	20.8



41.31 gpm @ 21 Ft. TDH

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On-site Wastewater Component Setbacks

Setback Requirements per 74:53:01:28 have been met.

74:53:01:19. Distance between on-site wastewater system components and pertinent ground features. All on-site wastewater system components shall be located and maintained in accordance with minimum distance requirements from pertinent ground and terrain features on or near the site of the system. The minimum required horizontal distances, in feet, between system components and pertinent ground features are shown in Table 1 as follows:

TABLE 1

Wastewater System Components	Ground and Terrain Features						
	(A)	(B)	(C)	(D)	(E)	(F)	(G)
Septic tank, aerobic system, or holding tank	50	75	50	50	25	10	10
Absorption field, mound, evapotranspiration, seepage pit, or graywater system	100	150	100	100	25	20	10
Sewer lines of tightly-jointed tile or equivalent material	50	75	50	50	10	0	0
Sewer lines—materials, construction, and testing comply with AWWA standards for water mains	30	30	25	3	10	0	0
Unconventional systems	50	75	50	50	25	0	10

(A) = Wells over 100 feet deep

(B) = Wells less than 100 feet deep, springs, or water suction lines

(C) = Cisterns or reservoirs

(D) = High-water line of lakes, streams, or impoundments (meandered or ordinary, whichever is higher)

(E) = Pressurized water lines

(F) = Dwelling or occupied building

(G) = Property line - all sides

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1511 Doral Drive Brookings, SD 57006

Attn: Tad Woelber

Re: Percolation Test Results
Buckeye
Carthage, SD

Dear: Tad Woelber

Please find below the percolation test data for tests performed August 5, 2026. The percolation test was performed to South Dakota Rule 74:53:01:30 standards. Test holes were filled to a minimum 50 percent of their total volume for 12hrs before the percolation tests were performed. The test holes then were filled back to 50 percent volume with water. Then the percolation test was started when the lower 25 percent was reached. The percolation tests were performed for 2 hours unless the rate is slower than 45 minutes per inch, in which case the test was ran for 4 hours. Test holes were drilled to a minimum depth of 30" with a diameter of 6". Borings soils consisted mainly of a dark gray/brown clay loam. The percolation rate Average was **139.3mpi** (Minutes Per Inch).

Location: Carthage, SD
Depth: 32"
Diameter: 6"

Boring	#1	#2	#3	#4
Total Time (hrs)	4	4	4	2
Cumulative Infiltration (in)	1.0	3.0	1.125	5.0
Percolation Rate (mpi)	240	80	213.3	24
Average Perc. Rate (mpi)				139.3

We appreciate the opportunity to be of service to you on this project. If you have any questions concerning this report, or if we may be of further service to you in any way, please do not hesitate to contact us.

Sincerely,
Foerster Testing

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Livestock
Services Program
08/28/2026

